Unidrive M700

Frequency inverter for manufactoring automation

Parameter Reference Guide

RFC-S Mode

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About Parameter Reference Guide

Parameter mm.000

Parameter mm.000 (mm.000) is one parameter that can be accessed from every drive menu so that the user can initiate various actions by setting a value in this parameter and then performing a drive reset. If the action is completed successfully parameter mm.000 is cleared when the action is complete. If the action is not started because the value does not correspond to an action, or because the action is not allowed (i.e. an attempt is made to load defaults and the drive is enabled), parameter mm.000 is not cleared. If the action is started and then fails a trip is produced and parameter mm.000 is not cleared.

There could be some conflict between the actions of *Parameter mm.000* (mm.000) and *Parameter Cloning* (11.042) when the drive is reset. If *Parameter Cloning* (11.042) has a value of 1 or 2 and a valid action is required from the value of parameter mm.000 then only the action required by parameter mm.000 is performed, but on successful completion of the action both parameters are cleared. If *Parameter Cloning* (11.042) has any other value it is not affected.

The table below shows the possible actions that can be initiated with *Parameter mm.000* (mm.000).

Parameter mm.000 (mm.000) value	Action	Possible failures
1000	Save drive user save parameters to non-volatile memory. Power-down save parameters are saved when the drive enters the under voltage state.	No action if the drive is in the under voltage state (i.e. *Under Voltage Active* (10.016)), or *Low Under Voltage Threshold Select* (06.067) =1 or *Backup Supply Mode Enable* (06.068) = 1 or *User Supply Select* (06.072).
1001	Save drive parameters to non-volatile memory. It should be noted that power-down save parameters are also saved which will result in one background task scan being extended to 100ms.	
1070	Reset all option modules	
1233	Load 50Hz defaults	No action if the drive is enabled
1234	Load 50Hz defaults to all menus except option module menus (i.e 15 to 20 and 24 to 28)	No action if the drive is enabled
1244	Load 60Hz defaults	No action if the drive is enabled
1245	Load 60Hz defaults to all menus except option module menus (i.e 15 to 20 and 24 to 28)	No action if the drive is enabled
1253	Change drive mode and load 50Hz defaults	No action if the drive is enabled
1254	Change drive mode and load 60Hz defaults	No action if the drive is enabled
1255	Change drive mode and load 50Hz defaults except for menus 15 to 20 and 24 to 28	No action if the drive is enabled
1256	Change drive mode and load 60Hz defaults except for menus 15 to 20 and 24 to 28	No action if the drive is enabled
1299	Reset *Stored HF* trip.	
2001	Create a boot file on a non-volatile media card based on the present drive parameters including all Menu 20 parameters	Non-volatile media card trips
4xxx	NV media card: Transfer the drive parameters to parameter file xxx	Non-volatile media card trips
5xxx	NV media card: Transfer the onboard user program to onboard user program file xxx	Non-volatile media card trips
6xxx	NV media card: Load the drive parameters from parameter file xxx or the onboard user program from onboard user program file xxx	No action if the drive is enabled Non-volatile media card trips
7xxx	NV media card: Erase file xxx	Non-volatile media card trips
8xxx	NV Media card: Compare the data in the drive with file xxx	Non-volatile media card trips
9555	NV media card: Clear the warning suppression flag	Non-volatile media card trips
9666	NV media card: Set the warning suppression flag	Non-volatile media card trips
9777	NV media card: Clear the read-only flag	Non-volatile media card trips
9888	NV media card: Set the read-only flag	Non-volatile media card trips
9999	NV media card: Erase and format the NV media card	Non-volatile media card trips
110SI	Transfer electronic nameplate data from an encoder into drive parameters. I is the interface: 1=P1 position feedback interface, 2=P2 position feedback interface. S is the source: 0=drive, 1=Option Slot 1, ... 4=Option Slot 4.	If a drive interface is selected (i.e. S = 0): • If a suitable feedback device is not available then parameter zero will remain at the value set and no action will be taken. • If the device does not respond, or there is a comms error or the CRC of the nameplate data is incorrect then a trip is initated. If an option module interface is selected (i.e. S = 1, 2, 3 or 4): • If the selected option module is not present or does not support the electronic nameplate function then the system will time out and initiate a trip. • If the device does not respond, or there is a comms error or the CRC of the nameplate data is incorrect then a trip is initated. See *Name Plate* for more details on the trips.
12000	Only display parameters that are different from their default value. This action does not require a drive reset.	
12001	Only display parameters that are used to set-up destinations (i.e. DE format bit is 1). This action does not require a drive reset.	
59999	Deletes an onboard user program if a program is present. Note: Any parameter changes that have not been saved will be lost during this action.	No action if the drive is enabled. No action if there is no program present. No action if the user program is enabled (i.e. *Onboard User Program: Enable* (11.047) = 1)
40xxx	If xxx is between 001 and 999 the system is cloned on to an SD card if fitted. This system has been partially implemented, so initiating this process creates the back-up structure on the SD card but does not copy any drive or option module data. Future development is required to complete this function.	No action if the drive is enabled. The drive will trip if the requested back-up data already exists or an option module deos respond correctly during the process.

	If xxx is between 001 and 999 the system is cloned from an SD card if fitted. This system has not been implemented, but parameter mm.000 is reset if a value between 60001 and 60999 is entered and the drive is reset. Future development is required to complete this function.	No action if the drive is enabled.
60xxx		

Parameter mm.000 (mm.000) values from 1 to 14 are equivalent to other values as shown in the table below to allow easy access to some commonly used functions. For 0 and each of these values the keypad provides a string as shown.

Value	String	Equivalent value	Action
0	[No Action]	0	
1	[Save parameters]	1001	Save drive parameters to non-volatile memory
2	[Load file 1]	6001	Load the data from file 1 on a non-volatile media card into the drive provided it is a parameter file
3	[Save to file 1]	4001	Store the drive parameters in file 1 on a non-volatile media card
4	[Load file 2]	6002	Load the data from file 2 on a non-volatile media card into the drive provided it is a parameter file
5	[Save to file 2]	4002	Store the drive parameters in file 2 on a non-volatile media card
6	[Load file 3]	6003	Load the data from file 3 on a non-volatile media card into the drive provided it is a parameter file
7	[Save to file 3]	4003	Store the drive parameters in file 3 on a non-volatile media card
8	[Show non-default]	12000	Only display parameters that are different from their default value
9	[Destinations]	12001	Only display parameters that are used to set-up destinations
10	[Reset 50Hz defs]	1233	Load 50Hz defaults
11	[Reset 60Hz defs]	1244	Load 60Hz defaults
12	[Reset modules]	1070	Reset all option modules
13	[Read Enc. NP P1]	11001	Encoder electronic nameplate transfer from the encoder connected to drive P1 interface to the drive.
14	[Read Enc. NP P2]	11051	Encoder electronic nameplate transfer from the encoder connected to drive P2 interface to the drive.

Saving drive parameters

User-save and power-down save drive parameters are stored in non-volatile memory within the drive. Any values that have changed are copied to this memory under the following conditions.

Parameter type	Conditions for copy to non-volatile memory
User-save parameter not visible in menu 0	Drive reset with 1000 in *Parameter mm.000* (mm.000) if the drive is not in the under voltage state and the standard under voltage threshold is being used (i.e. *Low Under Voltage Threshold Select* (06.067) = 0). OR A drive reset with 1001 in *Parameter mm.000* (mm.000). OR After parameters are transferred from a non-volatile media card. OR After the drive mode is changed. OR After default parameters are loaded. OR After parameters are transferred from an electronic nameplate.
User save parameter visible in menu 0	Under the conditions given above for user save parameters not visible in Menu 0. OR If the keypad is in edit mode for a user-save parameter in Menu 0, the parameter is saved when the keypad mode is changed from edit mode.
Power-down save parameter	A drive reset with 1000 in *Parameter mm.000* (mm.000) if the drive is not in the under voltage state and the standard under voltage threshold is being used (i.e. *Low Under Voltage Threshold Select* (06.067) = 0). OR A drive reset with 1001 in *Parameter mm.000* (mm.000). OR On the transition into the under voltage state when the standard under voltage threshold is being used (i.e. *Low Under Voltage Threshold Select* (06.067) is zero). OR After the drive mode is changed. OR After parameters are transferred from a non-volatile media card which results in the drive mode changing.

It can take some time for parameter data to be copied to non-volatile memory, especially if there are a large number of differences between the parameter values in the drive and the values stored in the memory. Saving Power-down save parameters takes a maximum of 300ms, but saving user-save parameters can take several seconds. If the drive is powered from a 24V control supply, or from a low voltage supply, the power down time of the control system can be very short and there is a risk that either the stored values of the power-down save or user-save parameters could be corrupted. This would result in an *EEPROM Fail* trip at the next power-up. To reduce this risk, the power-down save and user-save parameters are each stored in two banks. The banks are alternated each time a save is performed and the bank pointer is only updated once the save is complete. If the new bank is

corrupted a *User Save* or *Power Down Save* is initiated at the next power-up indicating an error in the user-save or power-down save data respectively, and the data from the old bank is used. The following points should be noted:

1. If a *User Save* or *Power Down Save* trip occur at power-up then parameter changes made before power down will be lost. To clear these trips a parameter save must be performed. If both the user-save and power-down save data is corrupted then a *Power Down Save* trip is produced.
2. When a Menu 0 parameter is changed its value is saved immediately to the active bank and the bank pointer is not changed. Therefore changes made via Menu 0 are not lost if a *User Save* trip occurs at power-up.
3. When the drive mode changes all the data in both banks in the non-volatile memory is cleared and the default parameters are saved in both banks. Therefore there is an extended parameter saving period immediately after a drive mode change.
4. Two banks are not provided in non-volatile media cards therefore the card could be corrupted if the power is removed when the drive is writing data to the card.

Loading defaults

A drive reset with 1233 in *Parameter mm.000* (mm.000) loads the defaults defined for each parameter. If defaults are loaded with 1244 in *Parameter mm.000* (mm.000) then the parameters in the table below have different defaults that are intended for the 60Hz regions.

Parameter	Default	Drive modes	Drive voltage rating
Maximum reference clamp (01.006)	60.0Hz	Open-loop	All
Maximum reference clamp (01.006)	1800rpm	RFC-A	All
Standard Ramp Voltage (02.008)	775V	Open-loop, RFC-A, RFC-S	400V
Rated Frequency (05.006)	60.0Hz	Open-loop, RFC-A	All
Rated Load rpm (05.008)	1800rpm	Open-loop	All
Rated Load rpm (05.008)	1770rpm	RFC-A	All
Rated Voltage (05.009)	460V	Open-loop, RFC-A, RFC-S	400V
M2 Maximum Reference Clamp (21.001)	60.0Hz	Open-loop	All
M2 Maximum Reference Clamp (21.001)	1800rpm	RFC-A	All
M2 Rated Frequency (21.006)	60.0Hz	Open-loop, RFC-A	All
M2 Rated Load rpm (21.008)	1800rpm	Open-loop	All
M2 Rated Load rpm (21.008)	1770rpm	RFC-A	All
M2 Rated Voltage (21.009)	460V	Open-loop, RFC-A, RFC-S	All

Non-volatile media card data transfer

Details of the data that can be stored on a non-volatile media card and the methods to transfer/access this data are given in Menu 11.

Stored HF trips

When the drive is subsequently powered up a *Stored HF* trip is initiated where the sub-trip number is the number of the HF trip that last occurred. This trip will occur at every power-up until it is reset. The trip can only be reset by first entering 1299 into *Parameter mm.000* (mm.000). If the drive is powered up and a *Stored HF* trip occurs, *Onboard User Program: Enable* (Pr 11.047) is reset to zero to prevent the on-board user program from running. This ensures that the user program can be changed or erased in case it causes an HF trip at every power-up. Once the *Stored HF* is cleared, it is necessary to power cycle the drive or to re-download the user program to allow the program to restart.

Electronic nameplate

The electronic nameplate is stored in an encoder as a table of bytes as shown in the example below which contains 7 parameter objects.

N1	N0		CRC3	CRC2	CRC1	CRC0	FLG1	FLG0	0xFF	0xFF	0xFF	0xFF	0xFF	0xFF	0xFF	0xFF
M	P		V3	V2	V1	V0	M	P	V3	V2	V1	V0	M	P	V3	V2
V1	V0		M	P	V3	V2	V1	V0	M	P	V3	V2	V1	V0	M	P
V3	V2		V1	V0	M	P	V3	V2	V1	V0						

N1(MS byte) and N0(LS byte) gives the number of parameter objects stored in the nameplate. In this example N1=0x00 and N0=0x07.

CRC3 (MS byte) to CRC0 (LS byte) is a 32 bit CRC applied to all bytes in the nameplate except for the number of parameter objects and the CRC. The CRC is generated with a reverse polynomial 0xEDB88320.

FLG1 (MS byte) and FLG0 (LS byte) are assigned for bit flags. At present none of these flags are used, and so these bytes are always zero.

Each parameter object consists of 6 bytes:
M is the menu number between 1 and 41.
P is the parameter number between 0 and 255.
V3 (MS byte) to V0 (LS byte) give a signed 32 bit parameter value. This is equivalent to the largest parameter size used by the drive, and so it can be used to hold the maximum or minimum value of any parameter.

The total size of the nameplate in bytes is the 16 header bytes plus 6 x number of parameter objects.

In an EnDat encoder the namplate begins at the start of MRS area 0xAB and finishes at the end of MRS area 0xAD. Although not guaranteed, these areas normally both consist of 256 words giving a total size of 1024 bytes. Therefore a nameplate can hold up to (1024 - 16 (header)) / 6 = 168 parameter objects. The time to read the nameplate is approximately 60ms per parameter object when *P1 Device Type* (03.038) is SC.EnDat, and 120ms per parameter when *P1 Device Type* (03.038) is EnDat.

In a Hiperface encoder the nameplate can be stored in up to 8 datafields starting at the begining of datafield 0. The size of datafields can be between 16 and 128 bytes. It is recommended that 128 byte datafields are used, and so the maximum size of the nameplate is 1024 bytes. Therefore a nameplate can hold up to (1024 - 16 (header)) / 6 = 168 parameter objects. The time to read the nameplate is approximately 100ms per parameter object.

The nameplate can hold any parameters stored in drive menus (i.e. 0 to 41). If the menu and parameter number correspond to a parameter that does not exist or is read-only then the parameter is simply not written and no trip is initiated. If the value of the parameter is out of range for the parameter then the parameter is not written and a no trip is initiated.

Current Ratings

The tables below give the maximum output current ratings, peak current ratings and power ratings for all drive sizes and voltage ratings.

200V Rated Drives

Model	Heavy Duty					Normal Duty				Kc
	Rated Current	Motor Shaft Power		Peak Current Open Loop	Peak Current RFC	Rated Current	Motor Shaft Power		Peak Current	
	A	kW	hp	A	A	A	kW	hp	A	A
03200050	5	0.75	1	7.5	10	6.6	1.1	1.5	7.26	11.111
03200066	6.6	1.1	1.5	9.9	13.2	8	1.5	2	8.8	14.667
03200080	8	1.5	2	12	16	11	2.2	3	12.1	17.778
03200106	10.6	2.2	3	15.9	21.2	12.7	3	3	13.97	23.556
04200137	13.7	3	3	20.55	27.4	18	4	5	19.8	30.444
04200185	18.5	4	5	27.75	37	25	5.5	7.5	27.5	41.111
05200250	25	5.5	7.5	37.5	50	30	7.5	10	33	55.556
06200330	33	7.5	10	49.5	66	50	11	15	55	73.333
06200440	44	11	15	66	88	58	15	20	63.8	97.778
07200610	61	15	20	91.5	122	75	18.5	25	82.5	135.556
07200750	75	18.5	25	112.5	150	94	22	30	103.4	166.667
07200830	83	22	30	124.5	166	117	30	40	128.7	184.444
08201160	116	30	40	174	232	149	37	50	163.9	257.778
08201320	132	37	50	198	264	180	45	60	198	293.333
09201760	176	45	60	264	308	216	55	75	237.6	342.222
09202190	219	55	75	328.5	383.25	266	75	100	292.6	425.833
10202830	283	75	100	424.5	495.25	325	90	125	357.5	550.278
10203000	300	90	125	450	525	360	110	150	396	583.333

400V Rated Drives

Model	Heavy Duty					Normal Duty				Kc
	Rated Current	Motor Shaft Power		Peak Current Open Loop	Peak Current RFC	Rated Current	Motor Shaft Power		Peak Current	
	A	kW	hp	A	A	A	kW	hp	A	A
03400025	2.5	0.75	1	3.75	5	3.4	1.1	1.5	3.74	5.556
03400031	3.1	1.1	1.5	4.65	6.2	4.5	1.5	2	4.95	6.889
03400045	4.5	1.5	2	6.75	9	6.2	2.2	3	6.82	10
03400062	6.2	2.2	3	9.3	12.4	7.7	3	5	8.47	13.778
03400078	7.8	3	5	11.7	15.6	10.4	4	5	11.44	17.333
03400100	10	4	5	15	20	12.3	5.5	7.5	13.53	22.222
04400150	15	5.5	10	22.5	30	18.5	7.5	10	20.35	33.333
04400172	17.2	7.5	10	25.8	34.4	24	11	15	26.4	38.222
05400270	27	11	20	40.5	54	30	15	20	33	60
05400300	30	15	20	45	60	31	15	20	34.1	66.667
06400350	35	15	25	52.5	70	38	18.5	25	41.8	77.778
06400420	42	18.5	30	63	84	48	22	30	52.8	93.333
06400470	47	22	30	70.5	94	63	30	40	69.3	104.444
07400660	66	30	50	99	132	79	37	50	86.9	146.667
07400770	77	37	60	115.5	154	94	45	60	103.4	171.111
07401000	100	45	75	150	200	112	55	75	123.2	222.222
08401340	134	55	100	201	268	155	75	100	170.5	297.778
08401570	157	75	125	235.5	314	184	90	125	202.4	348.889
09402000	200	90	150	300	350	221	110	150	243.1	388.889
09402240	224	110	150	336	392	266	132	200	292.6	435.556
10402700	270	132	200	405	472.5	320	160	250	352	525
10403200	320	160	250	480	560	361	200	300	397.1	622.222
11403770	377	185	300	565.5	659.75	437	225	350	480.7	733.056
11404170	417	200	350	625.5	729.75	487	250	400	535.7	810.833
11404640	464	250	400	696	812	507	315	450	557.7	902.222

575V Rated Drives

Model	Heavy Duty					Normal Duty				Kc
	Rated Current	Motor Shaft Power		Peak Current Open Loop	Peak Current RFC	Rated Current	Motor Shaft Power		Peak Current	
	A	kW	hp	A	A	A	kW	hp	A	A
05500030	3	1.5	2	4.5	6	3.9	2.2	3	4.29	6.667
05500040	4	2.2	3	6	8	6.1	4	5	6.71	8.889
05500069	6.9	4	5	10.35	13.8	10	5.5	7.5	11	15.333
06500100	10	5.5	7.5	15	20	12	7.5	10	13.2	22.222
06500150	15	7.5	10	22.5	30	17	11	15	18.7	33.333
06500190	19	11	15	28.5	38	22	15	20	24.2	42.222
06500230	23	15	20	34.5	46	27	18.5	25	29.7	51.111
06500290	29	18.5	25	43.5	58	34	22	30	37.4	64.444
06500350	35	22	30	52.5	70	43	30	40	47.3	77.778
07500440	44	30	40	66	88	53	45	50	58.3	97.778
07500550	55	37	50	82.5	110	73	55	60	80.3	122.222
08500630	63	45	60	94.5	126	86	75	75	94.6	140
08500860	86	55	75	129	172	108	90	100	118.8	191.111
09501040	104	75	100	156	182	125	110	125	137.5	202.222
09501310	131	90	125	196.5	229.25	150	110	150	165	254.722
10501520	152	110	150	228	266	200	130	200	220	295.556
10501900	190	132	200	285	332.5	200	150	200	220	369.444
11502000	200	150	200	300	350	248	175	250	272.8	388.889
11502540	254	185	250	381	444.5	288	225	300	316.8	493.889
11502850	285	225	300	427.5	498.75	315	250	350	346.5	554.167

690V Rated Drives

Model	Heavy Duty					Normal Duty				Kc
	Rated Current	Motor Shaft Power		Peak Current Open Loop	Peak Current RFC	Rated Current	Motor Shaft Power		Peak Current	
	A	kW	hp	A	A	A	kW	hp	A	A
07600190	19	15	20	28.5	38	23	18.5	25	25.3	42.222
07600240	24	18.5	25	36	48	30	22	30	33	53.333
07600290	29	22	30	43.5	58	36	30	40	39.6	64.444
07600380	38	30	40	57	76	46	37	50	50.6	84.444
07600440	44	37	50	66	88	52	45	60	57.2	97.778
07600540	54	45	60	81	108	73	55	75	80.3	120
08600630	63	55	75	94.5	126	86	75	100	94.6	140
08600860	86	75	100	129	172	108	90	125	118.8	191.111
09601040	104	90	125	156	182	125	110	150	137.5	202.222
09601310	131	110	150	196.5	229.25	155	132	175	170.5	254.722
10601500	150	132	175	225	262.5	172	160	200	189.2	291.667
10601780	178	160	200	267	311.5	197	185	250	216.7	346.111
11602100	210	185	250	315	367.5	225	200	250	247.5	408.333
11602380	238	200	250	357	416.5	275	250	300	302.5	462.778
11602630	263	250	300	394.5	460.25	305	315	400	335.5	511.389

Variable Minimum / Maximum Pairs

The descriptions below define the variable minimum/maximum pairs that can be used with parameters when the VM format bit is set. The variable minimum and maximum themselves can be dependent on other parameters, or the drive rating or other conditions as defined. The variable minimum and the variable maximum have a limited range and this is defined for each minimum/maximum pair.

Identifier	VM_AC_VOLTAGE
Description	Range applied to parameters showing a.c. voltage
Units	V
Range of [MIN]	0
Range of [MAX]	0 to 930

VM_AC_VOLTAGE[MAX] in drive voltage rating dependent. See the table below.

Voltage level	200V	400V	575V	690V
VM_AC_VOLTAGE[MAX]	325	650	780	930

VM_AC_VOLTAGE[MIN] = 0

Identifier	VM_AC_VOLTAGE_SET
Description	Range applied to a.c. voltage set-up parameters
Units	V
Range of [MIN]	0
Range of [MAX]	0 to 765

VM_AC_VOLTAGE_SET[MAX] is drive voltage rating dependent. See the table below.

Voltage level	200V	400V	575V	690V
VM_AC_VOLTAGE_SET[MAX]	265	530	635	765

VM_AC_VOLTAGE_SET[MIN] = 0

Identifier	VM_ACCEL_RATE
Description	Maximum applied to the ramp rate parameters
Units	s/100Hz, s/1000rpm, s/1000mm/s
Range of [MIN]	Open-loop: 0.0 RFC-A, RFC-S: 0.000
Range of [MAX]	Open-loop: 0.0 to 3200.0 RFC-A, RFC-S: 0.000 to 3200.000

A maximum needs to be applied to the ramp rate parameters because the units are a time for a change of speed from zero to a defined level or to maximum speed. The defined level is 100Hz for Open-loop mode and 1000rpm or 1000mm/s for RFC-A and RFC-S modes. If the change of speed is to the maximum speed then changing the maximum speed changes the actual ramp rate for a given ramp rate parameter value. The variable maximum calculation ensures that longest ramp rate (parameter at its maximum value) is not slower than the rate with the defined level, i.e. 3200.00 s / Hz for Open-loop mode, and 3200.000 s / 1000rpm or 3200.000 s / 1000mm/s for RFC-A and RFC-S modes.

The maximum frequency/speed is taken from *Maximum Reference Clamp* (01.006) if *Select Motor 2 Parameters* (11.045) = 0, or *M2 Maximum Reference Clamp* (21.001) if *Select Motor 2 Parameters* (11.045) = 1.

Open-loop mode
VM_ACCEL_RATE[MIN] = 0.0

If *Ramp Rate Units* (02.039) = 0:
VM_ACCEL_RATE[MAX] = 3200.0
Otherwise:
VM_ACCEL_RATE[MAX] = 3200.0 x Maximum frequency / 100.0

RFC-A, RFC-S modes
VM_ACCEL_RATE[MIN] = 0.000

If *Ramp Rate Units* (02.039) = 0:
VM_ACCEL_RATE[MAX] = 3200.000
Otherwise:
VM_ACCEL_RATE[MAX] = 3200.000 x Maximum speed / 1000.0

Identifier	VM_AMC_JERK_UNIPOLAR
Description	Range applied to the parameters showing the AMC jerk
Units	User units / ms / ms / ms
Range of [MIN]	0
Range of [MAX]	107374.1823

VM_AMC_JERK_UNIPOLAR[MAX] = 107374.1823 / *AMC Auto Resolution Scaling* (31.016)

VM_AMC_JERK_UNIPOLAR[MIN] = 0

Identifier	VM_AMC_POSITION
Description	Range applied to the parameters showing the AMC position
Units	User units
Range of [MIN]	-2147483648
Range of [MAX]	2147483647

VM_AMC_POSITION is modified by *AMC Auto Resolution Scaling* (31.016) and *AMC Roll Over Limit* (31.010). See the table below.

AMC Roll Over Limit (31.010)	= 0	> 0
VM_AMC_POSITION[MAX]	2147483647 / *AMC Auto Resolution Scaling* (31.016)	*AMC Roll Over Limit* (31.010) - 1
VM_AMC_POSITION[MIN]	-2147483648 / *AMC Auto Resolution Scaling* (31.016)	0

Identifier	VM_AMC_POSITION_CAM
Description	Range applied to the parameters showing the AMC cam position
Units	User units
Range of [MIN]	-1073741824
Range of [MAX]	1073741823

VM_AMC_POSITION_CAM is modified by *AMC Auto Resolution Scaling* (31.016) and *AMC Roll Over Limit* (31.010). See the table below.

AMC Roll Over Limit (31.010)	= 0	> 0
VM_AMC_POSITION_CAM[MAX]	1073741823 / *AMC Auto Resolution Scaling* (31.016)	*AMC Roll Over Limit* (31.010) - 1
VM_AMC_POSITION_CAM[MIN]	-1073741824 / *AMC Auto Resolution Scaling* (31.016)	-*AMC Roll Over Limit* (31.010) + 1

Identifier	VM_AMC_POSITION_CAM_UNIPOLAR
Description	Unipolar version of VM_AMC_POSITION_CAM
Units	User units
Range of [MIN]	0
Range of [MAX]	1073741823

VM_AMC_POSITION_CAM_UNIPOLAR is modified by *AMC Auto Resolution Scaling* (31.016) and *AMC Roll Over Limit* (31.010). See the table below.

AMC Roll Over Limit (31.010)	= 0	> 0
VM_AMC_POSITION_CAM_UNIPOLAR[MAX]	1073741823 / *AMC Auto Resolution Scaling* (31.016)	*AMC Roll Over Limit* (31.010) - 1
VM_AMC_POSITION_CAM_UNIPOLAR[MIN]	0	0

Identifier	VM_AMC_POSITION_REF
Description	Range applied to the AMC position reference
Units	User units
Range of [MIN]	-2147483648
Range of [MAX]	2147483647

VM_AMC_POSITION_REF is modified by *AMC Auto Resolution Scaling* (31.016), *AMC Roll Over Limit* (31.010) and *AMC Rotary Mode* (34.005). See the table below.

AMC Roll Over Limit (31.010)	= 0	> 0	> 0
AMC Rotary Mode (34.005)	Not active	< 4	= 4
VM_AMC_POSITION_REF[MAX]	2147483647 / *AMC Auto Resolution Scaling* (31.016)	*AMC Roll Over Limit* (31.010) - 1	1073741823 / *AMC Auto Resolution Scaling* (31.016)
VM_AMC_POSITION_REF[MIN]	-2147483648 / *AMC Auto Resolution Scaling* (31.016)	0	-1073741824 / *AMC Auto Resolution Scaling* (31.016)

Identifier	VM_AMC_POSITION_UNIPOLAR
Description	Unipolar version of VM_AMC_POSITION
Units	User units
Range of [MIN]	0
Range of [MAX]	2147483647

VM_AMC_POSITION_UNIPOLAR is modified by *AMC Auto Resolution Scaling* (31.016) and *AMC Roll Over Limit* (31.010). See the table below.

AMC Roll Over Limit (31.010)	= 0	> 0
VM_AMC_POSITION_UNIPOLAR[MAX]	2147483647 / *AMC Auto Resolution Scaling* (31.016)	*AMC Roll Over Limit* (31.010) - 1
VM_AMC_POSITION_UNIPOLAR[MIN]	0	0

Identifier	VM_AMC_RATE
Description	Range applied to the parameters showing the AMC acceleration
Units	User units / ms / ms
Range of [MIN]	1073742.824
Range of [MAX]	1073741.823

VM_AMC_RATE_UNIPOLAR[MAX] = 1073741.823 / *AMC Auto Resolution Scaling* (31.016)

VM_AMC_RATE_UNIPOLAR[MIN] = -1073741.824 / *AMC Auto Resolution Scaling* (31.016)

Identifier	VM_AMC_RATE_UNIPOLAR
Description	Unipolar version of VM_AMC_RATE
Units	User units / ms / ms
Range of [MIN]	0
Range of [MAX]	1073741.823

VM_AMC_RATE_UNIPOLAR[MAX] = 1073741.823 / *AMC Auto Resolution Scaling* (31.016)

VM_AMC_RATE_UNIPOLAR[MIN] = 0

Identifier	VM_AMC_ROLLOVER
Description	Maximum applied to the AMC Rollover parameter
Units	User units
Range of [MIN]	0
Range of [MAX]	1073741823

VM_AMC_ROLLOVER[MAX] = 1073741823 / *AMC Auto Resolution Scaling* (31.016)

VM_AMC_ROLLOVER[MIN] = 0

Identifier	VM_AMC_SPEED
Description	Range applied to the parameters showing the AMC speed
Units	User units / ms
Range of [MIN]	-21474836.48
Range of [MAX]	21474836.47

VM_AMC_SPEED[MAX] = 21474836.47 / *AMC Auto Resolution Scaling* (31.016)

VM_AMC_SPEED[MIN] = -21474836.48 / *AMC Auto Resolution Scaling* (31.016)

Identifier	VM_AMC_SPEED_UNIPOLAR
Description	Unipolar version of VM_AMC_SPEED
Units	User units / ms
Range of [MIN]	0
Range of [MAX]	21474836.47

VM_SPEED_UNIPOLAR[MAX] = 21474836.47 / *AMC Auto Resolution Scaling* (31.016)

VM_SPEED_UNIPOLAR[MIN] = 0

Identifier	VM_DC_VOLTAGE
Description	Range applied to d.c. voltage reference parameters
Units	V
Range of [MIN]	0
Range of [MAX]	0 to 1190

VM_DC_VOLTAGE[MAX] is the full scale d.c. link voltage feedback (over voltage trip level) for the drive. This level is drive voltage rating dependent. See the table below.

Voltage level	200V	400V	575V	690V
VM_DC_VOLTAGE[MAX]	415	830	990	1190

VM_DC_VOLTAGE[MIN] = 0

Identifier	VM_DC_VOLTAGE_SET
Description	Range applied to d.c. voltage reference parameters
Units	V
Range of [MIN]	0
Range of [MAX]	0.0 to 1150.0

VM_DC_VOLTAGE_SET[MAX] is drive voltage rating dependent. All values are shown in the table below.

Voltage level	200V	400V	575V	690V
VM_DC_VOLTAGE_SET[MAX]	400	800	955	1150

VM_DC_VOLTAGE_SET[MIN] = 0

Identifier	VM_DRIVE_CURRENT
Description	Range applied to parameters showing current in A
Units	A
Range of [MIN]	-99999.999 to 0.000
Range of [MAX]	0.000 to 99999.999

VM_DRIVE_CURRENT[MAX] is equivalent to the full scale (over current trip level) for the drive and is given by *Full Scale Current Kc* (11.061).

VM_DRIVE_CURRENT[MIN] = - VM_DRIVE_CURRENT[MAX]

Identifier	VM_DRIVE_CURRENT_UNIPOLAR
Description	Unipolar version of VM_DRIVE_CURRENT
Units	A
Range of [MIN]	0.000
Range of [MAX]	0.000 to 99999.999

VM_DRIVE_CURRENT_UNIPOLAR[MAX] = VM_DRIVE_CURRENT[MAX]

VM_DRIVE_CURRENT_UNIPOLAR[MIN] = 0.000

Identifier	VM_HIGH_DC_VOLTAGE
Description	Range applied to the parameters showing high d.c. voltage
Units	V
Range of [MIN]	0
Range of [MAX]	0 to 1500

VM_HIGH_DC_VOLTAGE[MAX] = 1500. This is the full scale d.c. link voltage feedback for the high d.c. link voltage measurement which can measure the voltage if it goes above the normal full scale value.

VM_HIGH_DC_VOLTAGE[MIN] = 0

Identifier	VM_LOW_UNDER_VOLTS
Description	Range applied to the low under voltage threshold
Units	V
Range of [MIN]	24
Range of [MAX]	24 to 1150

If *Back-up Mode Enable* (06.068) = 0
VM_LOW_UNDER_VOLTS[MAX] = VM_STD_UNDER_VOLTS[MIN]

Otherwise
VM_LOW_UNDER_VOLTS[MAX] = VM_STD_UNDER_VOLTS[MIN] / 1.1.

VM_LOW_UNDER_VOLTS[MIN] = 0.

Identifier	VM_MIN_SWITCHING_FREQUENCY
Description	Range applied to the minimum switching frequency parameter
Units	User units
Range of [MIN]	0
Range of [MAX]	0 to 6

VM_MIN_SWITCHING_FREQUENCY[MAX] = *Maximum Switching Frequency* (05.018)

VM_MIN_SWITCHING_FREQUENCY[MIN] = 0 for motor control modes, or 1 for Regen mode (subject to the maximum)

Identifier	VM_MOTOR1_CURRENT_LIMIT
Description	Range applied to current limit parameters (motor 1)
Units	%
Range of [MIN]	0.0
Range of [MAX]	0.0 to 1000.0

VM_MOTOR1_CURRENT_LIMIT[MAX] is dependent on the drive rating and motor set-up parameters.

VM_MOTOR1_CURRENT_LIMIT[MIN] = 0.00

Identifier	VM_MOTOR2_CURRENT_LIMIT
Description	Range applied to current limit parameters (motor 2)
Units	%
Range of [MIN]	0.0
Range of [MAX]	0.0 to 1000.0

VM_MOTOR2_CURRENT_LIMIT[MAX] is dependent on the drive rating and motor set-up parameters.

VM_MOTOR2_CURRENT_LIMIT[MIN] = 0.0

Identifier	VM_NEGATIVE_REF_CLAMP1
Description	Limits applied to the negative frequency or speed clamp (motor 1)
Units	Open-loop: Hz RFC-A, RFC-S: rpm or mm/s
Range of [MIN]	Open-loop: -599.0 to 0.0 RFC-A, RFC-S: -550 x 60 / Motor pole pairs to 0.0
Range of [MAX]	Open-loop: 0.0 to 599.0 RFC-A, RFC-S: 0.0 to 550 x 60 / Motor pole pairs

This variable maximum/minimum defines the range of the negative frequency or speed clamp associated with motor map 1 (*Minimum Reference Clamp* (01.007)). The minimum and maximum are affected by the settings of the *Negative Reference Clamp Enable* (01.008), *Bipolar Reference Enable* (01.010) and *Maximum Reference Clamp* (01.006) as shown in the table below.

Negative Reference Clamp Enable (01.008)	*Bipolar Reference Enable (01.010)*	VM_NEGATIVE_REF_CLAMP1[MIN]	VM_NEGATIVE_REF_CLAMP1[MAX]
0	0	0.0	Pr 01.006
0	1	0.0	0.0
1	X	-VM_POSITIVE_REF_CLAMP[MAX]	0.0

Identifier	VM_NEGATIVE_REF_CLAMP2
Description	Limits applied to the negative frequency or speed clamp (motor 2)
Units	Open-loop: Hz RFC-A, RFC-S: rpm or mm/s
Range of [MIN]	Open-loop: -599.0 to 0.0 RFC-A, RFC-S: -550 x 60 / Motor pole pairs to 0.0
Range of [MAX]	Open-loop: 0.0 to 599.0 RFC-A, RFC-S: 0.0 to 550 x 60 / Motor pole pairs

This variable maximum/minimum defines the range of the negative frequency or speed clamp associated with motor map 2 (*M2 Minimum Reference Clamp* (21.002)). It is defined in the same way as VM_NEGATIVE_REF_CLAMP1 except that the *M2 Maximum Reference Clamp* (21.001) is used instead of *Maximum Reference Clamp* (01.006).

Identifier	VM_POSITIVE_REF_CLAMP1
Description	Limits applied to the positive frequency or speed reference clamp
Units	Open-loop: Hz RFC-A, RFC-S: rpm or mm/s
Range of [MIN]	Open-loop: 0.0 RFC-A, RFC-S: 0.0
Range of [MAX]	Open-loop: 0.0 to 599.0 RFC-A, RFC-S: 0.0 to 550 x 60 / Motor pole pairs

VM_POSITIVE_REF_CLAMP1[MAX] defines the range of the positive reference clamp, *Maximum Reference Clamp* (01.006), which in turn limit the references. In RFC-A and RFC-S modes an additional limit is applied so that the position feedback does not exceed the speed where the drive can no longer interpret the feedback signal correctly as given in the table below. The limit is based on the position feedback device selected with *Motor Control Feedback Select* (03.026). It is possible to disable this additional limit if the *RFC Feedback Mode* (03.024) ≥ 1, so that the motor can be operated at a speed above the level where the drive can interpret the feedback in sensorless mode. It should be noted that the position feedback device itself may have a maximum speed limit that is lower than those given in the table. Care should be taken not to exceed a speed that would cause damage to the position feedback device.

Feedback device	VM_POSITIVE_REF_CLAMP1[MAX]
AB, AB Servo	(500kHz x 60 / rotary lines per revolution) rpm (500kHz x linear line pitch in mm) mm/s
FD, FR, FD Servo, FR Servo	(500kHz x 60 / rotary lines per revolution)/2 rpm (500kHz x linear line pitch in mm)/2 mm/s
SC, SC Hiper, SC EnDat, SC SSI, SC Servo	(500kHz x 60 / sine waves per revolution) rpm (500kHz x linear line pitch in mm) mm/s
Resolver	30000 rpm* (250Hz x pole pitch in mm) mm/s
Any other device	50000.0 rpm or mm/s*

*Note that even though these are shown as fixed values they are subject to the maximum of 550 x 60 / Motor Pole Pairs, as are all the other values in this table.

The limit ensures that the frequency of incremental digital or sine wave signals from the encoder do not exceed 500kHz and the modulation frequency for a resolver does not exceed 1kHz, neglecting any speed controller overshoot. The position feedback resolution remains fixed over the whole frequency for digital signals, but reduces with increased frequency or reduced voltage with sine wave signals. The position resolution with sine wave signals is given by the equations below.

Position resolution for a rotary device = K x sine waves per revolution

Position resolution for a linear device = K x sine waves per pole pitch

The value of K varies with the frequency and magnitude of the sine wave signals. The nominal value of K is 1024, and the drive interface provides at least this resolution with 1.0Vp-p sine waves up to a frequency of 50kHz. The table below shows the variation of K with sine wave peak to peak voltage and frequency.

	1kHz	5kHz	50kHz	100kHz	200kHz	500kHz
1.2Vp-p	2048	2048	1024	1024	512	512
1.0Vp-p	2048	2048	1024	512	512	128
0.8Vp-p	1024	1024	1024	512	256	128
0.6Vp-p	1024	1024	512	512	256	128
0.4Vp-p	512	512	512	256	128	64

VM_POSITIVE_REF_CLAMP1[MIN] = 0.0

VM_POSITIVE_REF_CLAMP2[MAX] defines the range of the positive reference clamp, *M2 Maximum Reference Clamp* (21.001), which in turn limit the references. See VM_POSITIVE_REF_CLAMP1 for more details.

Identifier	VM_POWER
Description	Range applied to parameters that either set or display power
Units	kW
Range of [MIN]	-99999.999 to 0.000
Range of [MAX]	0.000 to 99999.999

VM_POWER[MAX] is rating dependent and is chosen to allow for the maximum power that can be output by the drive with maximum a.c. output voltage, at maximum controlled current and unity power factor.

VM_POWER[MAX] = √3 x VM_AC_VOLTAGE[MAX] x VM_DRIVE_CURRENT[MAX] / 1000

VM_POWER[MIN] = -VM_POWER[MAX]

Identifier	VM_RATED_CURRENT
Description	Range applied to rated current parameters
Units	A
Range of [MIN]	0.000
Range of [MAX]	0.000 to 99999.999

VM_RATED_CURRENT [MAX] = *Maximum Rated Current* (11.060) and is dependent on the drive rating.

VM_RATED_CURRENT [MIN] = 0.000

Identifier	VM_REGEN_REACTIVE
Description	Range applied to the reactive current reference in Regen mode
Units	%
Range of [MIN]	-1000.0 to 0.0
Range of [MAX]	0.0 to 1000.0

VM_REGEN_REACTIVE[MAX] applies a limit to the reactive current reference in Regen mode so that the total current reference does not exceed its maximum allowed level.

VM_REGEN_REACTIVE[MIN] = - VM_REGEN_REACTIVE[MAX]

Identifier	VM_SPEED
Description	Range applied to parameters showing speed
Units	Open-loop, RFC-A, RFC-S: rpm or mm/s
Range of [MIN]	Open-loop, RFC-A, RFC-S: -50000.0 to 0.0
Range of [MAX]	Open-loop, RFC-A, RFC-S: 0.0 to 50000.0

This variable minimum/maximum defines the range of speed monitoring parameters. To allow headroom for overshoot the range is set to twice the range of the speed references.

VM_SPEED[MIN] = 2 x VM_SPEED_FREQ_REF[MIN]

VM_SPEED[MAX] = 2 x VM_SPEED_FREQ_REF[MAX]

Identifier	VM_SPEED_FREQ_KEYPAD_REF
Description	Range applied to the keypad reference
Units	Open-loop: Hz RFC-A, RFC-S: rpm or mm/s
Range of [MIN]	Open-loop: -599.0 to 599.0 RFC-A, RFC-S: -550 x 60 / Motor pole pairs to 550 x 60 / Motor pole pairs
Range of [MAX]	Open-loop: 0.0 to 5990.0 RFC-A, RFC-S: 0.0 to 550 x 60 / Motor pole pairs

This variable maximum is applied to *Keypad Control Mode Reference* (01.017). The maximum applied to these parameters is the same as other frequency reference parameters.

VM_SPEED_FREQ_USER_REFS [MAX] = VM_SPEED_FREQ_REF[MAX]

However the minimum is dependent on *Negative Reference Clamp Enable* (01.008) and *Bipolar Reference Enable* (01.010).

Negative Reference Clamp Enable (01.008)	Bipolar Reference Enable (01.010)	VM_SPEED_FREQ_USER_REFS[MIN]
0	0	If *Select Motor 2 Parameters* (11.045) = 0 *Minimum Reference Clamp* (01.007), otherwise *M2 Minimum Reference Clamp* (21.002)
0	1	-VM_SPEED_FREQ_REF[MAX]
1	0	0.0
1	1	-VM_SPEED_FREQ_REF[MAX]

Identifier	VM_SPEED_FREQ_REF
Description	Range applied to the frequency or speed reference parameters
Units	Open-loop: Hz RFC-A, RFC-S: rpm or mm/s
Range of [MIN]	Open-loop: -599.0 to 0.0 RFC-A, RFC-S: -550 x 60 / Motor pole pairs to 0.0
Range of [MAX]	Open-loop: 0.0 to 599.0 RFC-A, RFC-S: 0.0 to 550 x 60 / Motor pole pairs

This variable minimum/maximum is applied throughout the frequency and speed reference system so that the references can vary in the range from the minimum to maximum clamps.

Negative Reference Clamp Enable (01.008)	VM_SPEED_FREQ_REF[MAX] if *Select Motor 2 Parameters* (11.045) = 0	VM_SPEED_FREQ_REF[MAX] if *Select Motor 2 Parameters* (11.045) = 1
0	*Maximum Reference Clamp* (01.006)	*M2 Maximum Reference Clamp* (21.001)
1	*Maximum Reference Clamp* (01.006) or |*Minimum Reference Clamp* (01.007)| whichever the larger	*M2 Maximum Reference Clamp* (21.001) or |M2 *Minimum Reference Clamp* (21.002)| whichever the larger

VM_SPEED_FREQ_REF[MIN] = -VM_SPEED_FREQ_REF[MAX].

Identifier	VM_SPEED_FREQ_REF_UNIPOLAR
Description	Unipolar version of VM_SPEED_FREQ_REF
Units	Open-loop: Hz RFC-A, RFC-S: rpm or mm/s
Range of [MIN]	Open-loop: 0.0 RFC-A, RFC-S: 0.0
Range of [MAX]	Open-loop: 0.0 to 599.0 RFC-A, RFC-S: 0.0 to 550 x 60 / Motor pole pairs

VM_SPEED_FREQ_REF_UNIPOLAR[MAX] = VM_SPEED_FREQ_REF[MAX]

VM_SPEED_FREQ_REF_UNIPOLAR[MIN] = 0.0

Identifier	VM_SPEED_FREQ_USER_REFS
Description	Range applied to analogue reference parameters
Units	Open-loop: Hz RFC-A, RFC-S: rpm or mm/s
Range of [MIN]	Open-loop: -599.00 to 599.00 RFC-A, RFC-S: -550 x 60 / Motor pole pairs to 550 x 60 / Motor pole pairs
Range of [MAX]	Open-loop: 0.0 to 599.00 RFC-A, RFC-S: 0.0 to 550 x 60 / Motor pole pairs

This variable maximum is applied to *Analogue Reference 1* (01.036) and *Analogue Reference 2* (01.037). It should be noted that in Open-loop mode the analogue reference parameters have two decimal places.

The maximum applied to these parameters is the same as other frequency reference parameters.

VM_SPEED_FREQ_USER_REFS [MAX] = VM_SPEED_FREQ_REF[MAX]

However the minimum is dependent on *Negative Reference Clamp Enable* (01.008) and *Bipolar Reference Enable* (01.010).

Negative Reference Clamp Enable (01.008)	Bipolar Reference Enable (01.010)	VM_SPEED_FREQ_USER_REFS[MIN]
0	0	If *Select Motor 2 Parameters* (11.045) = 0 *Minimum Reference Clamp* (01.007), otherwise *M2 Minimum Reference Clamp* (21.002)
0	1	-VM_SPEED_FREQ_REF[MAX]
1	0	0.0
1	1	-VM_SPEED_FREQ_REF[MAX]

Identifier	VM_STD_UNDER_VOLTS
Description	Range applied to the standard under voltage threshold
Units	V
Range of [MIN]	0 to 1150
Range of [MAX]	0 to 1150

VM_STD_UNDER_VOLTS[MAX] = VM_DC_VOLTAGE_SET / 1.1

VM_STD_UNDER_VOLTS[MIN] is voltage rating dependent. See the table below.

Voltage level	200V	400V	575V	690V
VM_STD_UNDER_VOLTS[MIN]	175	330	435	435

Identifier	VM_SUPPLY_LOSS_LEVEL
Description	Range applied to the supply loss threshold
Units	V
Range of [MIN]	0 to 1150
Range of [MAX]	0 to 1150

VM_SUPPLY_LOSS_LEVEL[MAX] = VM_DC_VOLTAGE_SET[MAX]

VM_SUPPLY_LOSS_LEVEL[MIN] is drive voltage rating dependent. See the table below.

Voltage level	200V	400V	575V	690V
VM_SUPPLY_LOSS_LEVEL[MIN]	205	410	540	540

Identifier	VM_SWITCHING_FREQUENCY
Description	Range applied to the maximum switching frequency parameters
Units	User units
Range of [MIN]	0
Range of [MAX]	0 to 6

VM_SWITCHING_FREQUENCY[MAX] = Power stage dependent

VM_SWITCHING_FREQUENCY[MIN] = 0 for motor control modes, or 1 for Regen mode (subject to the maximum)

Identifier	VM_TORQUE_CURRENT
Description	Range applied to torque and torque producing current parameters. (Where this is used in Regen mode it refers to the active current.)
Units	%
Range of [MIN]	-1000.0 to 0.0
Range of [MAX]	0.0 to 1000.0

Select Motor 2 Parameters (11.045)	VM_TORQUE_CURRENT[MAX]
0	VM_MOTOR1_CURRENT_LIMIT[MAX]
1	VM_MOTOR2_CURRENT_LIMIT[MAX]

VM_TORQUE_CURRENT[MIN] = -VM_TORQUE_CURRENT[MAX]

Identifier	VM_TORQUE_CURRENT_UNIPOLAR
Description	Unipolar version of VM_TORQUE_CURRENT
Units	%
Range of [MIN]	0.0
Range of [MAX]	0.0 to 1000.0

VM_TORQUE_CURRENT_UNIPOLAR[MAX] = VM_TORQUE_CURRENT[MAX]

VM_TORQUE_CURRENT_UNIPOLAR[MIN] =0.0

Identifier	VM_USER_CURRENT
Description	Range applied to torque reference and percentage load parameters with one decimal place
Units	%
Range of [MIN]	-1000.0 to 0.0
Range of [MAX]	0.0 to 1000.0

VM_USER_CURRENT[MAX] = *User Current Maximum Scaling* (04.024)

VM_USER_CURRENT[MIN] = -VM_USER_CURRENT[MAX]

Identifier	VM_USER_CURRENT_HIGH_RES
Description	Range applied to torque reference and percentage load parameters with two decimal places
Units	%
Range of [MIN]	-1000.00 to 0.00
Range of [MAX]	0.00 to 1000.00

VM_USER_CURRENT_HIGH_RES[MAX] = *User Current Maximum Scaling* (04.024) with an additional decimal place

VM_USER_CURRENT_HIGH_RES[MIN] = -VM_USER_CURRENT_HIGH_RES[MAX]
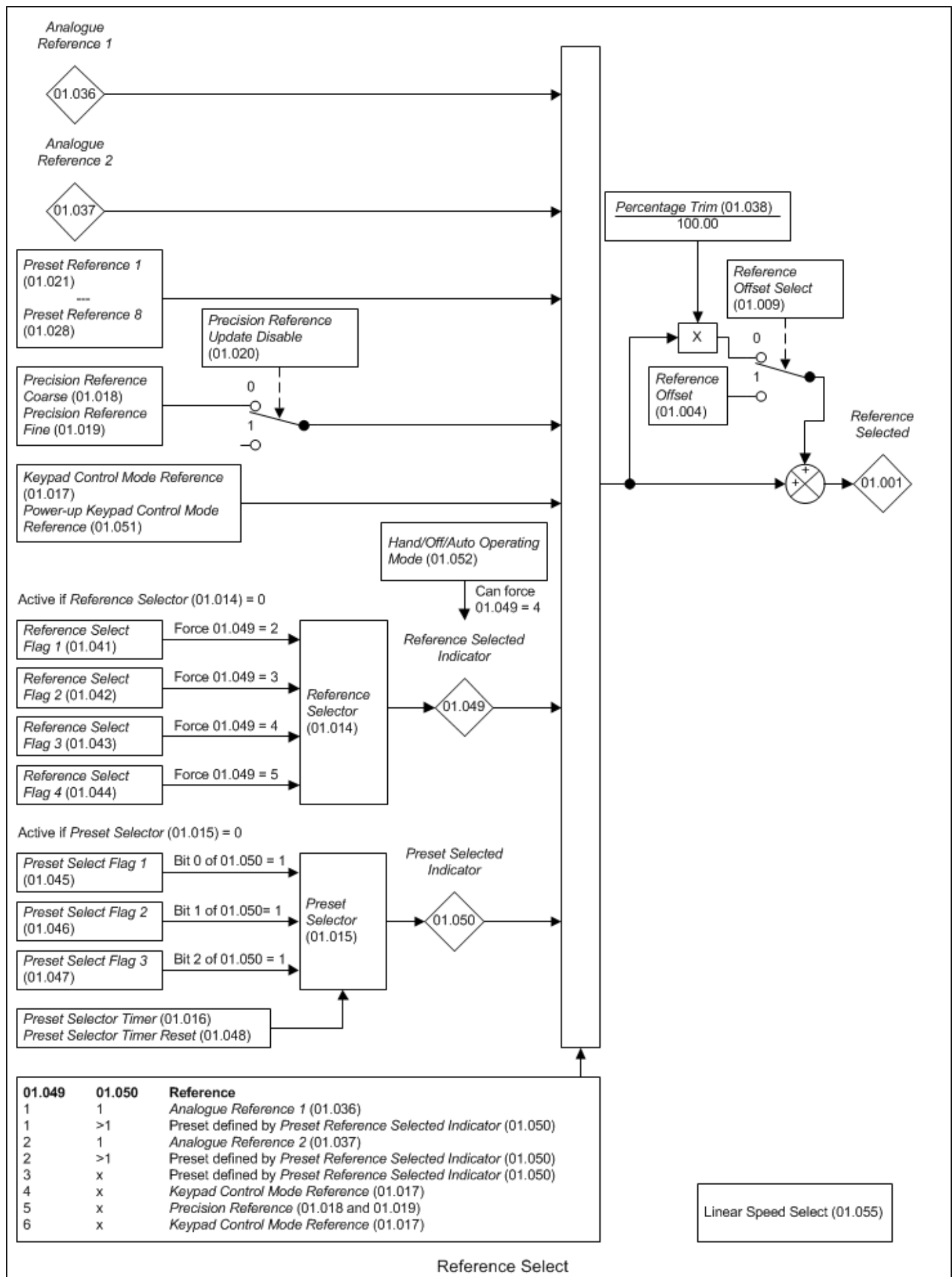
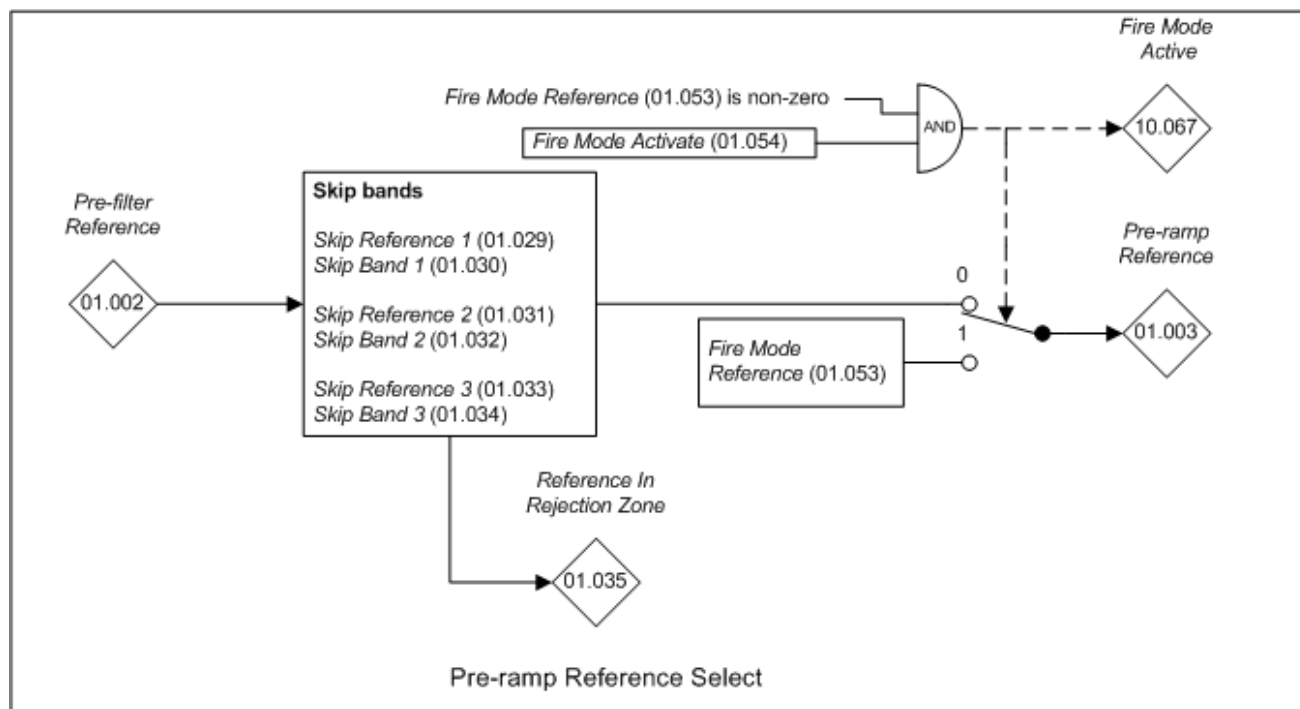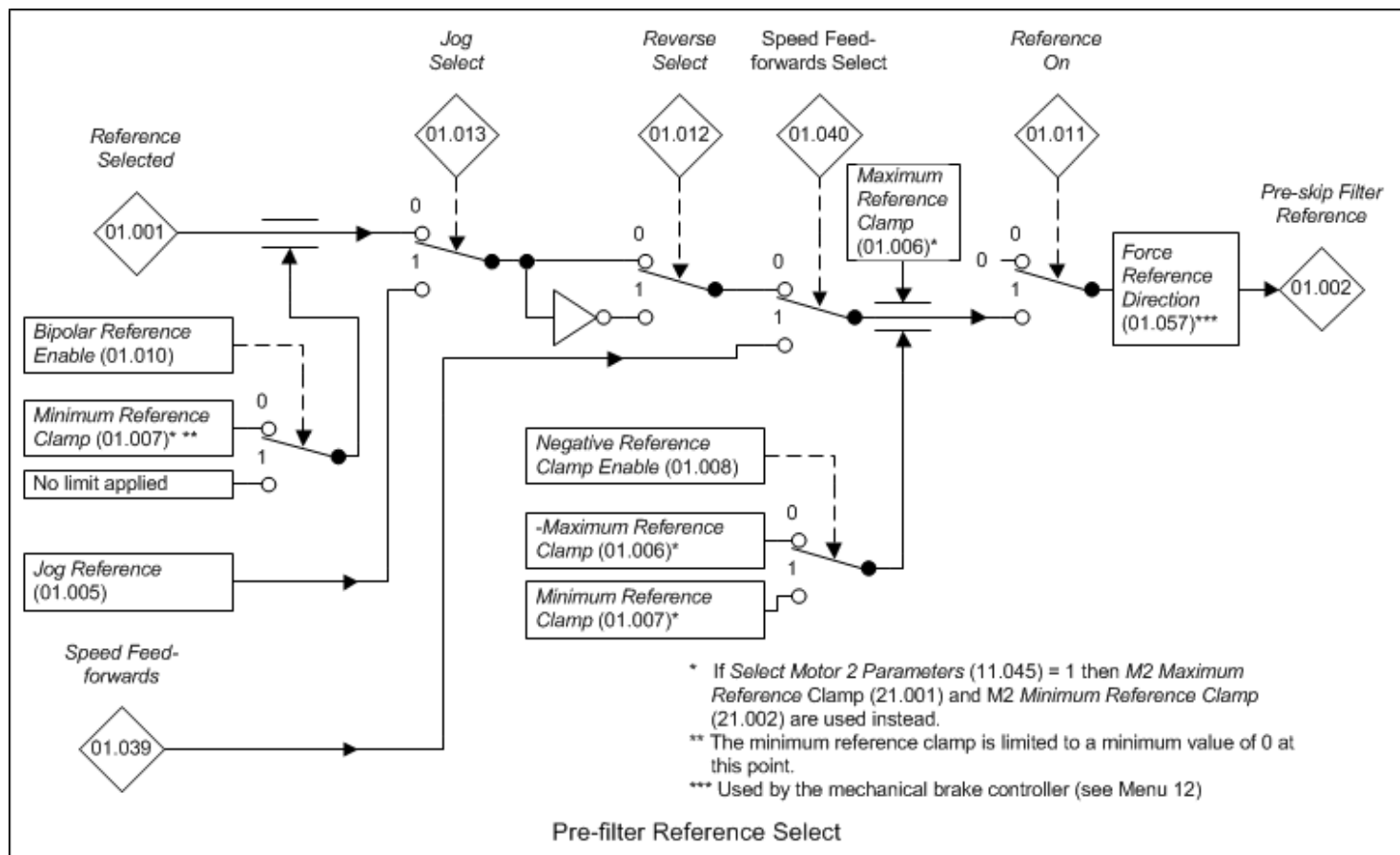# Menu 1 Single Line Descriptions − *Speed References*

Mode: RFC‑S

Parameter		Range	Default	Type					
01.001	Reference Selected	±VM_SPEED_FREQ_REF		RO	Num	ND	NC	PT	
01.002	Pre‑skip Filter Reference	±VM_SPEED_FREQ_REF		RO	Num	ND	NC	PT	
01.003	Pre‑ramp Reference	±VM_SPEED_FREQ_REF		RO	Num	ND	NC	PT	
01.004	Reference Offset	±VM_SPEED_FREQ_REF	0.0	RW	Num				US
01.005	Jog Reference	0.0 to 4000.0	0.0	RW	Num				US
01.006	Maximum Reference Clamp	±VM_POSITIVE_REF_CLAMP1	3000.0	RW	Num				US
01.007	Minimum Reference Clamp	±VM_NEGATIVE_REF_CLAMP1	0.0	RW	Num				US
01.008	Negative Reference Clamp Enable	Off (0) or On (1)	Off (0)	RW	Bit				US
01.009	Reference Offset Select	Off (0) or On (1)	Off (0)	RW	Bit				US
01.010	Bipolar Reference Enable	Off (0) or On (1)	Off (0)	RW	Bit				US
01.011	Reference On	Off (0) or On (1)		RO	Bit	ND	NC	PT	
01.012	Reverse Select	Off (0) or On (1)		RO	Bit	ND	NC	PT	
01.013	Jog Select	Off (0) or On (1)		RO	Bit	ND	NC	PT	
01.014	Reference Selector	A1 A2 (0), A1 Preset (1), A2 Preset (2), Preset (3), Keypad (4), Precision (5), Keypad Ref (6)	A1 A2 (0)	RW	Txt				US
01.015	Preset Selector	0 to 9	0	RW	Num				US
01.016	Preset Selector Timer	0.0 to 400.0 s	10.0 s	RW	Num				US
01.017	Keypad Control Mode Reference	±VM_SPEED_FREQ_KEYPAD_REF	0.0	RO	Num		NC	PT	PS
01.018	Precision Reference Coarse	±VM_SPEED_FREQ_REF	0.0	RW	Num				US
01.019	Precision Reference Fine	0.000 to 0.099	0.000	RW	Num				US
01.020	Precision Reference Update Disable	Off (0) or On (1)	Off (0)	RW	Bit		NC		
01.021	Preset Reference 1	±VM_SPEED_FREQ_REF	0.0	RW	Num				US
01.022	Preset Reference 2	±VM_SPEED_FREQ_REF	0.0	RW	Num				US
01.023	Preset Reference 3	±VM_SPEED_FREQ_REF	0.0	RW	Num				US
01.024	Preset Reference 4	±VM_SPEED_FREQ_REF	0.0	RW	Num				US
01.025	Preset Reference 5	±VM_SPEED_FREQ_REF	0.0	RW	Num				US
01.026	Preset Reference 6	±VM_SPEED_FREQ_REF	0.0	RW	Num				US
01.027	Preset Reference 7	±VM_SPEED_FREQ_REF	0.0	RW	Num				US
01.028	Preset Reference 8	±VM_SPEED_FREQ_REF	0.0	RW	Num				US
01.029	Skip Reference 1	0 to 33000	0	RW	Num				US
01.030	Skip Reference Band 1	0 to 250	0	RW	Num				US
01.031	Skip Reference 2	0 to 33000	0	RW	Num				US
01.032	Skip Reference Band 2	0 to 250	0	RW	Num				US
01.033	Skip Reference 3	0 to 33000	0	RW	Num				US
01.034	Skip Reference Band 3	0 to 250	0	RW	Num				US
01.035	Reference In Rejection Zone	Off (0) or On (1)		RO	Bit	ND	NC	PT	
01.036	Analog Reference 1	±VM_SPEED_FREQ_USER_REFS	0.0	RO	Num		NC		
01.037	Analog Reference 2	±VM_SPEED_FREQ_USER_REFS	0.0	RO	Num		NC		
01.038	Percentage Trim	±100.00 %	0.00 %	RW	Num		NC		
01.039	Speed Feed‑forwards	±VM_SPEED_FREQ_REF		RO	Num	ND	NC	PT	
01.040	Speed Feed‑forwards Select	Off (0) or On (1)		RO	Bit	ND	NC	PT	
01.041	Reference Select Flag 1	Off (0) or On (1)	Off (0)	RW	Bit		NC		
01.042	Reference Select Flag 2	Off (0) or On (1)	Off (0)	RW	Bit		NC		
01.043	Reference Select Flag 3	Off (0) or On (1)	Off (0)	RW	Bit		NC		
01.044	Reference Select Flag 4	Off (0) or On (1)	Off (0)	RW	Bit		NC		
01.045	Preset Select Flag 1	Off (0) or On (1)	Off (0)	RW	Bit		NC		
01.046	Preset Select Flag 2	Off (0) or On (1)	Off (0)	RW	Bit		NC		
01.047	Preset Select Flag 3	Off (0) or On (1)	Off (0)	RW	Bit		NC		
01.048	Preset Selector Timer Reset	Off (0) or On (1)	Off (0)	RW	Bit		NC		
01.049	Reference Selected Indicator	1 to 6		RO	Num	ND	NC	PT	
01.050	Preset Selected Indicator	1 to 8		RO	Num	ND	NC	PT	
01.051	Power‑up Keypad Control Mode Reference	Reset (0), Last (1), Preset (2)	Reset (0)	RW	Txt				US
01.052	Hand/Off/Auto Operating Mode	0 to 3	0	RW	Num				US
01.053	Fire Mode Reference	±VM_SPEED_FREQ_REF	0.0	RW	Num				US
01.054	Fire Mode Activate	Off (0) or On (1)	Off (0)	RO	Bit		NC		
01.055	Linear Speed Select	Off (0) or On (1)	Off (0)	RW	Bit				US
01.056	Linear Speed Selected	Off (0) or On (1)		RO	Bit	ND	NC	PT	
01.057	Force Reference Direction	None (0), Forward (1), Reverse (2)	None (0)	RW	Txt				

RW	Read / Write	RO	Read-only	Bit	Bit parameter	Txt	Text string	Date	Date parameter	Time	Time parameter
Chr	Character parameter	Bin	Binary parameter	IP	IP address	Mac	MAC address	Ver	Version number	SMP	Slot, menu, parameter
Num	Number parameter	DE	Destination	ND	No default value	RA	Rating dependent	NC	Non-copyable	PT	Protected
FI	Filtered	US	User save	PS	Power-down save						

Menu 1 − *Speed References*

Mode: RFC‑S

Analogue Reference 1

⟨01.036⟩

Analogue Reference 2

⟨01.037⟩

Preset Reference 1 (01.021)

Preset Reference 8 (01.028)

Precision Reference Update Disable (01.020)

Precision Reference Coarse (01.018)
Precision Reference Fine (01.019)

0
1

Keypad Control Mode Reference (01.017)
Power-up Keypad Control Mode Reference (01.051)

Percentage Trim (01.038) / 100.00

Reference Offset Select (01.009)

X   0
     1

Reference Offset (01.004)

Reference Selected

⟨01.001⟩

Hand/Off/Auto Operating Mode (01.052)

Can force 01.049 = 4

Active if Reference Selector (01.014) = 0

Reference Select Flag 1 (01.041)   Force 01.049 = 2
Reference Select Flag 2 (01.042)   Force 01.049 = 3
Reference Select Flag 3 (01.043)   Force 01.049 = 4
Reference Select Flag 4 (01.044)   Force 01.049 = 5

Reference Selector (01.014)

Reference Selected Indicator

⟨01.049⟩

Active if Preset Selector (01.015) = 0

Preset Select Flag 1 (01.045)   Bit 0 of 01.050 = 1
Preset Select Flag 2 (01.046)   Bit 1 of 01.050 = 1
Preset Select Flag 3 (01.047)   Bit 2 of 01.050 = 1

Preset Selector (01.015)

Preset Selected Indicator

⟨01.050⟩

Preset Selector Timer (01.016)
Preset Selector Timer Reset (01.048)

01.049	01.050	Reference
1	1	Analogue Reference 1 (01.036)
1	>1	Preset defined by Preset Reference Selected Indicator (01.050)
2	1	Analogue Reference 2 (01.037)
2	>1	Preset defined by Preset Reference Selected Indicator (01.050)
3	x	Preset defined by Preset Reference Selected Indicator (01.050)
4	x	Keypad Control Mode Reference (01.017)
5	x	Precision Reference (01.018 and 01.019)
6	x	Keypad Control Mode Reference (01.017)

Linear Speed Select (01.055)

Reference Select

Pre-filter Reference Select

Pre-ramp Reference Select

Parameter	01.001 *Reference Selected*		
Short description	Displays the basic reference selected from the available sources		
Mode	RFC-S		
Minimum	−VM_SPEED_FREQ_REF	Maximum	VM_SPEED_FREQ_REF
Default		Units	
Type	32 Bit Volatile	Update Rate	4ms write
Display Format	Standard	Decimal Places	1
Coding	RO, VM, ND, NC, PT		

Reference Selected (01.001) is the basic reference selected from the available sources including the effect of the reference offset.

Parameter	01.002 *Pre-skip Filter Reference*		
Short description	Displays the level of the reference after the reference clamps		
Mode	RFC-S		
Minimum	−VM_SPEED_FREQ_REF	Maximum	VM_SPEED_FREQ_REF
Default		Units	
Type	32 Bit Volatile	Update Rate	4ms write
Display Format	Standard	Decimal Places	1
Coding	RO, VM, ND, NC, PT		

Pre-skip Filter Reference (01.002) is the level of the reference after the reference clamps but before the skip filters.

Parameter	01.003 *Pre-ramp Reference*		
Short description	Displays the final output from the Menu 1 reference system		
Mode	RFC-S		
Minimum	−VM_SPEED_FREQ_REF	Maximum	VM_SPEED_FREQ_REF
Default		Units	
Type	32 Bit Volatile	Update Rate	4ms write
Display Format	Standard	Decimal Places	1
Coding	RO, VM, ND, NC, PT		

The *Pre-ramp Reference* (01.003) is the final output from the Menu 1 reference system that is fed into the Menu 2 ramp system.

Parameter	01.004 *Reference Offset*		
Short description	Defines the the offset applied to the reference		
Mode	RFC-S		
Minimum	−VM_SPEED_FREQ_REF	Maximum	VM_SPEED_FREQ_REF
Default	0.0	Units	
Type	32 Bit User Save	Update Rate	4ms read
Display Format	Standard	Decimal Places	1
Coding	RW, VM		

If *Reference Offset Select* (01.009) = 0 then *Reference Selected* (01.001) is the selected reference multiplied by [1 + (*Percentage Trim* (01.038) / 100.00)].
If *Reference Offset Select* (01.009) = 1 then the *Reference Offset* (01.004) is added to the selected reference to give *Reference Selected* (01.001).

Parameter	01.005 *Jog Reference*		
Short description	Defines the reference when jog is enabled		
Mode	RFC-S		
Minimum	0.0	Maximum	4000.0
Default	0.0	Units	
Type	16 Bit User Save	Update Rate	4ms read
Display Format	Standard	Decimal Places	1
Coding	RW, BU		

The *Jog Reference* (01.005) is selected when *Jog Select* (01.013) = 1. *Jog Select* (01.013) is controlled by the drive sequencer (see Menu 6).

Parameter	01.006 *Maximum Reference Clamp*		
Short description	Defines the maximum value for the reference		
Mode	RFC-S		
Minimum	−VM_POSITIVE_REF_CLAMP1	Maximum	VM_POSITIVE_REF_CLAMP1
Default	3000.0	Units	
Type	32 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	1
Coding	RW, VM		

Maximum Reference Clamp (01.006) provides a limit on the maximum frequency or speed. (If *Select Motor 2 Parameters* (11.045) = 1 then *M2 Maximum Reference Clamp* (21.001) is used instead.)

Parameter	01.007 *Minimum Reference Clamp*		
Short description	Defines the minimum value for the reference		
Mode	RFC-S		
Minimum	−VM_NEGATIVE_REF_CLAMP1	Maximum	VM_NEGATIVE_REF_CLAMP1
Default	0.0	Units	
Type	32 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	1
Coding	RW, VM		

If *Negative Reference Clamp Enable* (01.008) = 1 then *Minimum Reference Clamp* (01.007) is forced to be a negative value and is applied to the final reference as the negative limit. If *Negative Reference Clamp Enable* (01.008) = 0 then -*Maximum Reference Clamp* (01.006) is applied to the final reference as the negative limit. (If *Select Motor 2 Parameters* (11.045) = 1 then *M2 Minimum Reference Clamp* (21.002) is used instead.)

The minimum reference clamp is also used to provide the minimum speed limit for uni-polar mode (i.e. *Bipolar Reference Enable* (01.010) = 0) after the *Reference Selected* (01.001).

Parameter	01.008 *Negative Reference Clamp Enable*		
Short description	Set to 1 to allow the minimum reference clamp value to be negative		
Mode	RFC‑S		
Minimum	0	Maximum	1
Default	0	Units	
Type	1 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW		

See *Minimum Reference Clamp* (01.007).

Parameter	01.009 *Reference Offset Select*		
Short description	Enables the use of the reference offset		
Mode	RFC‑S		
Minimum	0	Maximum	1
Default	0	Units	
Type	1 Bit User Save	Update Rate	4ms read
Display Format	Standard	Decimal Places	0
Coding	RW		

See *Reference Offset* (01.004).

Parameter	01.010 *Bipolar Reference Enable*		
Short description	Enables the minimum value of the reference to be negative		
Mode	RFC‑S		
Minimum	0	Maximum	1
Default	0	Units	
Type	1 Bit User Save	Update Rate	4ms read
Display Format	Standard	Decimal Places	0
Coding	RW		

See *Minimum Reference Clamp* (01.007).

Parameter	01.011 *Reference On*		
Short description	Indicates that the reference from the reference system is active		
Mode	RFC‑S		
Minimum	0	Maximum	1
Default		Units	
Type	1 Bit Volatile	Update Rate	2ms write
Display Format	Standard	Decimal Places	0
Coding	RO, ND, NC, PT		

Reference On (01.011), which is controlled by the drive sequencer (see Menu 6) indicates that the reference from the reference system is active. Note that *Reference On* (01.011) is also used in RFC-A and RFC-S modes to enable and disable the *Hard Speed Reference* (03.022).

Parameter	01.012 *Reverse Select*		
Short description	Indicates when the reverse function is active		
Mode	RFC‑S		
Minimum	0	Maximum	1
Default		Units	
Type	1 Bit Volatile	Update Rate	2ms write
Display Format	Standard	Decimal Places	0
Coding	RO, ND, NC, PT		

Reverse Select (01.012), which is controlled by the drive sequencer (see Menu 6), is used to invert *Reference Selected* (01.001) or the *Jog Reference* (01.005).

Parameter	01.013 *Jog Select*		
Short description	Indicates when the jog function is active		
Mode	RFC‑S		
Minimum	0	Maximum	1
Default		Units	
Type	1 Bit Volatile	Update Rate	2ms write
Display Format	Standard	Decimal Places	0
Coding	RO, ND, NC, PT		

Jog Select (01.013), which is controlled by the drive sequencer (see Menu 6), is used to select the *Jog Reference* (01.005).

Parameter	01.014 *Reference Selector*		
Short description	Defines the source for the references		
Mode	RFC‑S		
Minimum	0	Maximum	6
Default	0	Units	
Type	8 Bit User Save	Update Rate	4ms read
Display Format	Standard	Decimal Places	0
Coding	RW, TE		

Value	*Text*
0	A1 A2
1	A1 Preset
2	A2 Preset
3	Preset
4	Keypad
5	Precision
6	Keypad Ref

Reference Selector (01.014) defines how *Reference Selected Indicator* (01.049) is derived. If *Reference Selector* (01.014) is not 0 then *Reference Selected Indicator* (01.049) is equal to *Reference Selector* (01.014). If *Reference Selector* (01.014) = 0 then *Reference Selected Indicator* (01.049) is controlled by the reference select flags as shown below. The higher numbered flags have priority over the lower numbered flags.

Reference select flag states	*Reference Selected Indicator* (01.049)
All reference select flags equal to 0	1
Reference Select Flag 1 (01.041) = 1	2
Reference Select Flag 2 (01.042) = 1	3
Reference Select Flag 3 (01.043) = 1	4
Reference Select Flag 4 (01.044) = 1	5

Preset Selector (01.015) defines how *Preset Selected Indicator* (01.050) is derived as shown below.

Preset Selector (01.015)	*Preset Selected Indicator* (01.050)
0	Controlled by the preset select flags (01.045 to 01.047)
1	1
2	2
3	3
4	4
5	5
6	6
7	7
8	8
9	Controlled by the preset reference selector timer (see *Preset Selector Timer* (01.016))

When *Preset Selector* (01.015) = 0 then *Preset Selected Indicator* (01.050) is defined by the preset select flags as shown below.

Preset Select Flag 3 (01.047)	*Preset Select Flag 2* (01.046)	*Preset Select Flag 1* (01.045)	*Preset Selected Indicator* (01.050)
0	0	0	1
0	0	1	2
0	1	0	3
0	1	1	4
1	0	0	5
1	0	1	6
1	1	0	7
1	1	1	8

Reference Selected Indicator (01.049) and *Preset Selected Indicator* (01.050) then define the reference to be used as shown below.

Reference Selected Indicator (01.049)	Preset Selected Indicator (01.050)	Reference
1	1	*Analog Reference 1* (01.036)
1	>1	Preset reference defined by the value of *Preset Selected Indicator* (01.050)
2	1	*Analog Reference 2* (01.037)
2	>1	Preset reference defined by the value of *Preset Selected Indicator* (01.050)
3	x	Preset reference defined by the value of *Preset Selected Indicator* (01.050)
4	x	*Keypad Control Mode Reference* (01.017)
5	x	*Precision Reference Coarse* (01.018) and *Precision Reference Fine* (01.019)
6	x	*Keypad Control Mode Reference* (01.017)

If *Reference Selected Indicator* (01.049) = 4 the *Keypad Control Mode Reference* (01.017) is used and the sequencer operates in keypad mode where the start, stop and optionally the reverse selection functions are provided from the drive keypad. *Jog Select* (01.013) and *Speed Feed-forwards Select* (01.040) are always 0 when keypad mode is active.

If *Reference Selected Indicator* (01.049) = 6 the *Keypad Control Mode Reference* (01.017) is used, but keypad control mode is not active.

Parameter	01.015 *Preset Selector*		
Short description	Defines which preset is used for the reference		
Mode	RFC‑S		
Minimum	0	Maximum	9
Default	0	Units	
Type	8 Bit User Save	Update Rate	4ms read
Display Format	Standard	Decimal Places	0
Coding	RW		

See *Reference Selector* (01.014).

Parameter	01.016 *Preset Selector Timer*		
Short description	Defines the time between changes of preset selector		
Mode	RFC‑S		
Minimum	0.0	Maximum	400.0
Default	10.0	Units	s
Type	16 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	1
Coding	RW		

If *Preset Selector* (01.015) = 9 then *Preset Selected Indicator* (01.050) is incremented by one at intervals defined by *Preset Selector Timer* (01.016). When *Preset Selected Indicator* (01.050) has a value of 8 and is incremented it rolls over to 1. If *Preset Selector Timer Reset* (01.048) = 1 and *Preset Selector* (01.015) = 9, then *Preset Selected Indicator* (01.050) is held at 1.

Parameter	01.017 *Keypad Control Mode Reference*		
Short description	Defines the value of the keypad reference		
Mode	RFC‑S		
Minimum	−VM_SPEED_FREQ_KEYPAD_REF	Maximum	VM_SPEED_FREQ_KEYPAD_REF
Default	0.0	Units	
Type	32 Bit Power Down Save	Update Rate	4ms read
Display Format	Standard	Decimal Places	1
Coding	RO, VM, NC, PT		

Keypad control mode is active if the *Reference Selected Indicator* (01.049) is 4 or 6. The value of this parameter is controlled by the reference selector system and whether Hand/Off/Auto mode is selected (see *Hand/Off/Auto Operating Mode* (01.052)). If keypad control is selected the frequency/speed reference is defined by *Keypad Control Mode Reference* (01.017) which is a read-only parameter. The parameter can only be adjusted by pressing the Up or Down keys when the keypad is in Status Mode and only when keypad control mode is active. Holding the Up or down keys auto-increments or decrements *Keypad Control Mode Reference* (01.017), and the rate of adjustment increases the longer the key is held. *Keypad Control Mode Reference* (01.017) can be adjusted whether the drive is enabled or not, and can be retained at power-down if required (see *Power-up Keypad Control Mode Reference* (01.051)).

If the *Reference Selected Indicator* (01.049) is 6 then the normal drive sequencer is used and the run commands are derived from the sequencer control bit parameters. If *Reference Selected Indicator* (01.049) is 4 then the keypad control sequencer is used and the drive run commands are derived using keys on the keypad. If the keypad control sequencer is active the Stop and Run keys automatically become active and the Auxilliary key may be optionally enabled as the reverse key with *Enable Auxiliary Key* (06.013).

Parameter	01.018 *Precision Reference Coarse*		
Short description	Defines the value of the coarse precision reference		
Mode	RFC‑S		
Minimum	−VM_SPEED_FREQ_REF	Maximum	VM_SPEED_FREQ_REF
Default	0.0	Units	
Type	32 Bit User Save	Update Rate	4ms read
Display Format	Standard	Decimal Places	1
Coding	RW, VM		

The *Precision Reference Coarse* (01.018) and *Precision Reference Fine* (01.019) can be combined to provide a reference with a precision of 3 decimal places. The precision reference value is given by *Precision Reference Coarse* (01.018) + *Precision Reference Fine* (01.019), therefore *Precision Reference Fine* (01.019) increases positive values of *Precision Reference Coarse* (01.018) away from zero, and negative values of *Precision Reference Coarse* (01.018) towards zero.

If *Precision Reference Update Disable* (01.020) = 0 then any changes to *Precision Reference Coarse* (01.018) or *Precision Reference Fine* (01.019) have an effect immediately. When *Precision Reference Update Disable* (01.020) is changed to 1 then *Precision Reference Coarse* (01.018) and *Precision Reference Fine* (01.019) are stored in memory and used to provide the precision reference until *Precision Reference Update Disable* (01.020) is changed back to 0. This allows the component values of the precision reference to be changed without giving an unwanted intermediate value due to data skew.

Parameter	01.019 *Precision Reference Fine*		
Short description	Defines the value of the fine precision reference		
Mode	RFC‑S		
Minimum	0.000	Maximum	0.099
Default	0.000	Units	
Type	8 Bit User Save	Update Rate	4ms read
Display Format	Standard	Decimal Places	3
Coding	RW		

See *Precision Reference Coarse* (01.018).

Parameter	01.020 *Precision Reference Update Disable*		
Short description	Set to 1 to prevent immediate update to the reference from the precision reference		
Mode	RFC‑S		
Minimum	0	Maximum	1
Default	0	Units	
Type	1 Bit Volatile	Update Rate	4ms read
Display Format	Standard	Decimal Places	0
Coding	RW, NC		

See *Precision Reference Coarse* (01.018).

Parameter	01.021 *Preset Reference 1*		
Short description	Defines the value for preset reference 1		
Mode	RFC‑S		
Minimum	−VM_SPEED_FREQ_REF	Maximum	VM_SPEED_FREQ_REF
Default	0.0	Units	
Type	32 Bit User Save	Update Rate	4ms read
Display Format	Standard	Decimal Places	1
Coding	RW, VM		

See *Reference Selector* (01.014).

Parameter	01.022 *Preset Reference 2*		
Short description	Defines the value for preset reference 2		
Mode	RFC‑S		
Minimum	−VM_SPEED_FREQ_REF	Maximum	VM_SPEED_FREQ_REF
Default	0.0	Units	
Type	32 Bit User Save	Update Rate	4ms read
Display Format	Standard	Decimal Places	1
Coding	RW, VM		

See *Reference Selector* (01.014).

Parameter	01.023 *Preset Reference 3*		
Short description	Defines the value for preset reference 3		
Mode	RFC‑S		
Minimum	−VM_SPEED_FREQ_REF	Maximum	VM_SPEED_FREQ_REF
Default	0.0	Units	
Type	32 Bit User Save	Update Rate	4ms read
Display Format	Standard	Decimal Places	1
Coding	RW, VM		

See *Reference Selector* (01.014).

Parameter	01.024 *Preset Reference 4*		
Short description	Defines the value for preset reference 4		
Mode	RFC-S		
Minimum	−VM_SPEED_FREQ_REF	Maximum	VM_SPEED_FREQ_REF
Default	0.0	Units	
Type	32 Bit User Save	Update Rate	4ms read
Display Format	Standard	Decimal Places	1
Coding	RW, VM		

See *Reference Selector* (01.014).

Parameter	01.025 *Preset Reference 5*		
Short description	Defines the value for preset reference 5		
Mode	RFC-S		
Minimum	−VM_SPEED_FREQ_REF	Maximum	VM_SPEED_FREQ_REF
Default	0.0	Units	
Type	32 Bit User Save	Update Rate	4ms read
Display Format	Standard	Decimal Places	1
Coding	RW, VM		

See *Reference Selector* (01.014).

Parameter	01.026 *Preset Reference 6*		
Short description	Defines the value for preset reference 6		
Mode	RFC-S		
Minimum	−VM_SPEED_FREQ_REF	Maximum	VM_SPEED_FREQ_REF
Default	0.0	Units	
Type	32 Bit User Save	Update Rate	4ms read
Display Format	Standard	Decimal Places	1
Coding	RW, VM		

See *Reference Selector* (01.014).

Parameter	01.027 *Preset Reference 7*		
Short description	Defines the value for preset reference 8		
Mode	RFC-S		
Minimum	−VM_SPEED_FREQ_REF	Maximum	VM_SPEED_FREQ_REF
Default	0.0	Units	
Type	32 Bit User Save	Update Rate	4ms read
Display Format	Standard	Decimal Places	1
Coding	RW, VM		

See *Reference Selector* (01.014).

Parameter	01.028 *Preset Reference 8*		
Short description	Defines the value for preset reference 8		
Mode	RFC-S		
Minimum	−VM_SPEED_FREQ_REF	Maximum	VM_SPEED_FREQ_REF
Default	0.0	Units	
Type	32 Bit User Save	Update Rate	4ms read
Display Format	Standard	Decimal Places	1
Coding	RW, VM		

See *Reference Selector* (01.014).

Parameter	01.029 *Skip Reference 1*		
Short description	Defines the 1st reference point to skip		
Mode	RFC-S		
Minimum	0	Maximum	33000
Default	0	Units	
Type	16 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW, BU		

The skip references functions are available to prevent continuous operation within a specified speed range (i.e. where mechanical resonance may occur). When *Skip Reference 1* (01.029) = 0 Filter 1 is disabled. *Skip Reference Band 1* (01.030) defines the range either side of *Skip Reference 1* (01.029) over which references are rejected in either direction. The actual rejection band is therefore twice that defined by *Skip Reference Band 1* (01.030) with *Skip Reference 1* (01.029) as the centre of the band. When the selected reference is within the rejection band the lower limit of the band is passed through the filter so that reference is always less than demanded.

Filter 2 (*Skip Reference 2* (01.031), *Skip Reference Band 2* (01.032)) and Filter 3 (*Skip Reference 3* (01.033), *Skip Reference Band 3* (01.034)) operate in the same ways as Filter 1.

If any of the filters are active (i.e. the reference is within their rejection band) *Reference In Rejection Zone* (01.035) is set to 1, otherwise it is 0.

Parameter	01.030 *Skip Reference Band 1*		
Short description	Defines the range either side of skip reference 1 to be implemented		
Mode	RFC‑S		
Minimum	0	Maximum	250
Default	0	Units	
Type	8 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW, BU		

See *Skip Reference 1* (01.029).

Parameter	01.031 *Skip Reference 2*		
Short description	Defines the 2nd reference point to skip		
Mode	RFC‑S		
Minimum	0	Maximum	33000
Default	0	Units	
Type	16 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW, BU		

See *Skip Reference 1* (01.029).

Parameter	01.032 *Skip Reference Band 2*		
Short description	Defines the range either side of skip reference 2 to be implemented		
Mode	RFC‑S		
Minimum	0	Maximum	250
Default	0	Units	
Type	8 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW, BU		

See *Skip Reference 1* (01.029).

Parameter	01.033 *Skip Reference 3*		
Short description	Defines the 3rdreference point to skip		
Mode	RFC‑S		
Minimum	0	Maximum	33000
Default	0	Units	
Type	16 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW, BU		

See *Skip Reference 1* (01.029).

Parameter	01.034 *Skip Reference Band 3*		
Short description	Defines the range either side of skip reference 3 to be implemented		
Mode	RFC‑S		
Minimum	0	Maximum	250
Default	0	Units	
Type	8 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW, BU		

See *Skip Reference 1* (01.029).

Parameter	01.035 *Reference In Rejection Zone*		
Short description	Displays when the reference is in 1 of the pre-defined rejection zones		
Mode	RFC‑S		
Minimum	0	Maximum	1
Default		Units	
Type	1 Bit Volatile	Update Rate	4ms write
Display Format	Standard	Decimal Places	0
Coding	RO, ND, NC, PT		

See *Skip Reference 1* (01.029).

Parameter	01.036 *Analog Reference 1*		
Short description	Defines the relationship between the final value from analog 1 input and the frequency or speed reference		
Mode	RFC-S		
Minimum	−VM_SPEED_FREQ_USER_REFS	Maximum	VM_SPEED_FREQ_USER_REFS
Default	0.0	Units	
Type	32 Bit Volatile	Update Rate	4ms read*
Display Format	Standard	Decimal Places	1
Coding	RO, VM, NC		

* A faster update rate of 250µs is possible for the speed reference from an analog input. See Menu 7 for details. Note that this parameter has higher resolution than other frequency parameters in Open-loop mode as this prevents loss of resolution when an analogue input is routed to this parameter with a typical drive output frequency range.

Analog Reference 1 (01.036) or *Analog Reference 2* (01.037) should be used as the destinations for drive analog inputs when these provide the frequency or speed reference. The variable maximum/minimum applied to *Analog Reference 1* (01.036) or *Analog Reference 2* (01.037) gives the relationship shown below between the final value from the analog input and the frequency or speed reference.

Reference from an analog input
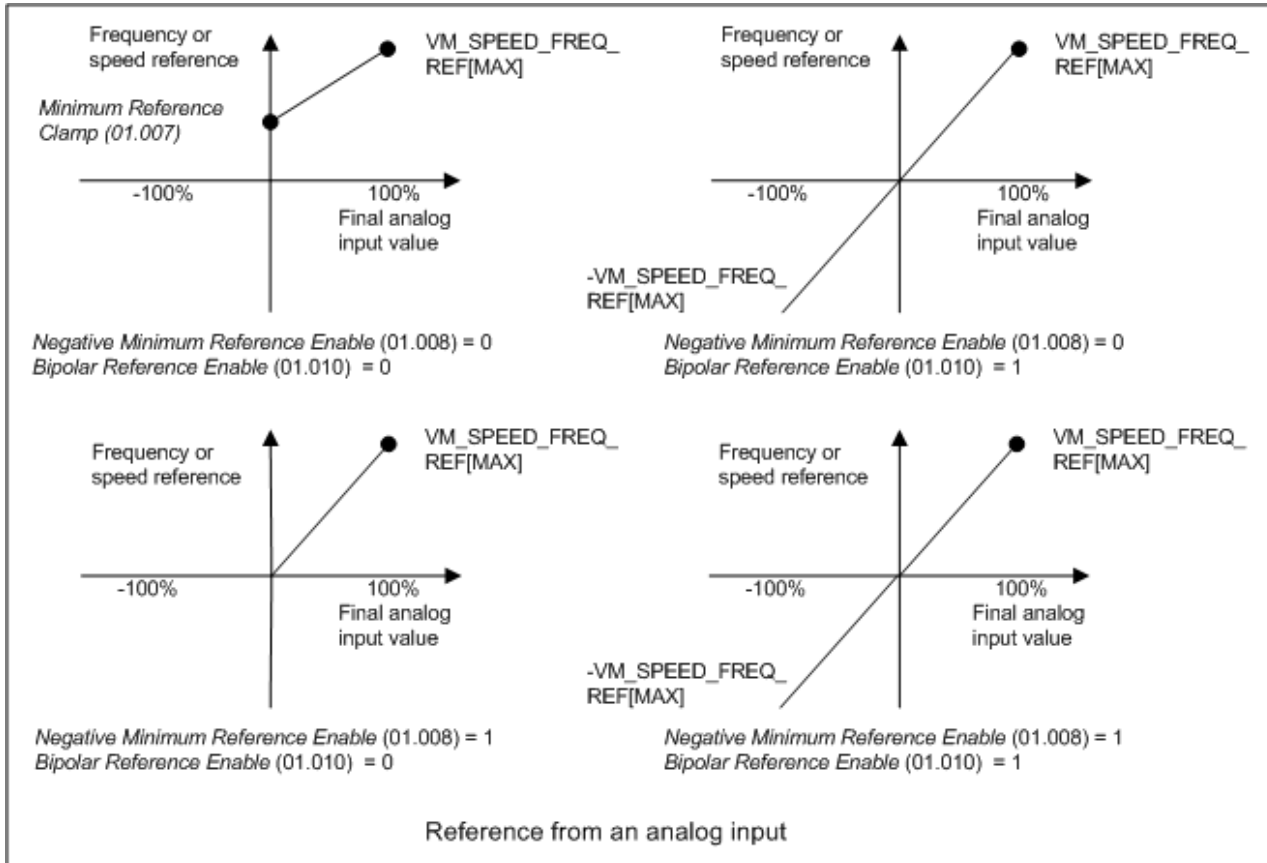
Parameter	01.037 *Analog Reference 2*		
Short description	Defines the relationship between the final value from analog input 2 and the frequency or speed reference		
Mode	RFC-S		
Minimum	−VM_SPEED_FREQ_USER_REFS	Maximum	VM_SPEED_FREQ_USER_REFS
Default	0.0	Units	
Type	32 Bit Volatile	Update Rate	4ms read*
Display Format	Standard	Decimal Places	1
Coding	RO, VM, NC		

* A faster update rate of 250µs is possible for the speed reference from an analog input. See Menu 7 for details. Note that this parameter has higher resolution than other frequency parameters in Open-loop mode as this prevents loss of resolution when an analogue input is routed to this parameter with a typical drive output frequency range.

See *Analog Reference 1* (01.036).

Parameter	01.038 *Percentage Trim*		
Short description	Defines the value of the reference trim as a percentage		
Mode	RFC-S		
Minimum	-100.00	Maximum	100.00
Default	0.00	Units	%
Type	16 Bit Volatile	Update Rate	4ms read
Display Format	Standard	Decimal Places	2
Coding	RW, NC		

See *Reference Offset Select* (01.009).

Parameter	01.039 *Speed Feed-forwards*		
Short description	Displays the value of the speed feed-forwards used by the standard motion controller		
Mode	RFC‑S		
Minimum	−VM_SPEED_FREQ_REF	Maximum	VM_SPEED_FREQ_REF
Default		Units	
Type	32 Bit Volatile	Update Rate	4ms write
Display Format	Standard	Decimal Places	1
Coding	RO, VM, ND, NC, PT		

Speed Feed-forwards (01.039) can be used by the Standard Motion Controller (Menu 13) to provide a speed feed-forwards term which uses the drive ramp system (Menu 2) to provide a speed profile. The speed feed-forwards is enabled with *Speed Feed-forwards Select* (01.040), which is controlled directly by the Standard Motion Controller.

Parameter	01.040 *Speed Feed-forwards Select*		
Short description	Indicates if the speed feed-forwards is being used by the standard motion controller		
Mode	RFC‑S		
Minimum	0	Maximum	1
Default		Units	
Type	1 Bit Volatile	Update Rate	Background write
Display Format	Standard	Decimal Places	0
Coding	RO, ND, NC, PT		

See *Speed Feed-forwards* (01.039).

Parameter	01.041 *Reference Select Flag 1*		
Short description	Defines which reference is selected by the drive		
Mode	RFC‑S		
Minimum	0	Maximum	1
Default	0	Units	
Type	1 Bit Volatile	Update Rate	4ms read
Display Format	Standard	Decimal Places	0
Coding	RW, NC		

See *Reference Selector* (01.014).

Parameter	01.042 *Reference Select Flag 2*		
Short description	Defines which reference is selected by the drive		
Mode	RFC‑S		
Minimum	0	Maximum	1
Default	0	Units	
Type	1 Bit Volatile	Update Rate	4ms read
Display Format	Standard	Decimal Places	0
Coding	RW, NC		

See *Reference Selector* (01.014).

Parameter	01.043 *Reference Select Flag 3*		
Short description	Defines which reference is selected by the drive		
Mode	RFC‑S		
Minimum	0	Maximum	1
Default	0	Units	
Type	1 Bit Volatile	Update Rate	4ms read
Display Format	Standard	Decimal Places	0
Coding	RW, NC		

See *Reference Selector* (01.014).

Parameter	01.044 *Reference Select Flag 4*		
Short description	Defines which reference is selected by the drive		
Mode	RFC‑S		
Minimum	0	Maximum	1
Default	0	Units	
Type	1 Bit Volatile	Update Rate	4ms read
Display Format	Standard	Decimal Places	0
Coding	RW, NC		

See *Reference Selector* (01.014).

Parameter	01.045 *Preset Select Flag 1*		
Short description	Defines which preset is selected by the drive		
Mode	RFC-S		
Minimum	0	Maximum	1
Default	0	Units	
Type	1 Bit Volatile	Update Rate	4ms read
Display Format	Standard	Decimal Places	0
Coding	RW, NC		

See *Reference Selector* (01.014).

Parameter	01.046 *Preset Select Flag 2*		
Short description	Defines which preset is selected by the drive		
Mode	RFC-S		
Minimum	0	Maximum	1
Default	0	Units	
Type	1 Bit Volatile	Update Rate	4ms read
Display Format	Standard	Decimal Places	0
Coding	RW, NC		

See *Reference Selector* (01.014).

Parameter	01.047 *Preset Select Flag 3*		
Short description	Defines which preset is selected by the drive		
Mode	RFC-S		
Minimum	0	Maximum	1
Default	0	Units	
Type	1 Bit Volatile	Update Rate	4ms read
Display Format	Standard	Decimal Places	0
Coding	RW, NC		

See *Reference Selector* (01.014).

Parameter	01.048 *Preset Selector Timer Reset*		
Short description	Set to 1 to hold the preset selected indicator at 1		
Mode	RFC-S		
Minimum	0	Maximum	1
Default	0	Units	
Type	1 Bit Volatile	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW, NC		

See *Preset Selector Timer* (01.016).

Parameter	01.049 *Reference Selected Indicator*		
Short description	Displays which reference is currently selected		
Mode	RFC-S		
Minimum	1	Maximum	6
Default		Units	
Type	8 Bit Volatile	Update Rate	4ms write
Display Format	Standard	Decimal Places	0
Coding	RO, ND, NC, PT		

See *Reference Selector* (01.014).

Parameter	01.050 *Preset Selected Indicator*		
Short description	Displays which preset is currently selected		
Mode	RFC-S		
Minimum	1	Maximum	8
Default		Units	
Type	8 Bit Volatile	Update Rate	4ms write
Display Format	Standard	Decimal Places	0
Coding	RO, ND, NC, PT		

See *Reference Selector* (01.014).

Parameter	01.051 *Power-up Keypad Control Mode Reference*		
Short description	Defines which value of keypad control mode reference is displayed at power-up		
Mode	RFC‑S		
Minimum	0	Maximum	2
Default	0	Units	
Type	8 Bit User Save	Update Rate	Power-up read
Display Format	Standard	Decimal Places	0
Coding	RW, TE		

Value	*Text*
0	Reset
1	Last
2	Preset

Power-up Keypad Control Mode Reference (01.051) defines the value written to *Keypad Control Mode Reference* (01.017) at power-up as given below.

Power-up Keypad Control Mode Reference (01.051)	**Value written to *Keypad Control Mode Reference* (01.017) at power-up**
0	0.0
1	The value in *Keypad Control Mode Reference* (01.017) at the previous power-down
2	The value saved in *Preset Reference 1* (01.021)

Parameter	01.052 *Hand/Off/Auto Operating Mode*		
Short description	Defines the hand/off/auto operating mode of the drive		
Mode	RFC‑S		
Minimum	0	Maximum	3
Default	0	Units	
Type	8 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW		

*Hand/Off/Auto Operating Mode* (01.052) defines the operating mode for this system as given in below.

Hand/Off/Auto Operating Mode (01.052)	**Operating mode**
0	Hand/Off/Auto system disabled
1	Hand/Off/Auto system enabled Auto state at power-up
2	Hand/Off/Auto system enabled Off state at power-up
3	Hand/Off/Auto system enabled Off state at power-up if off or hand state at previous power-down Auto state if auto state at previous power-down

Hand/Off/Auto mode is an additional state machine that directly controls *Reference Selected Indicator* (01.049) and *Keypad Control Mode Reference* (01.017). When Hand/Off/Auto mode is active the drive state and keypad keys are defined as shown in the tables below.

Hand/Off/Auto state	**Equivalent normal state**
Off	Ready with *Reference Selected Indicator* (01.049) = 4
Hand	Run with *Reference Selected Indicator* (01.049) = 4
Auto	*Reference Selected Indicator* (01.049) defined by the reference selector system

Hand/Off/Auto key	**Equivalent normal key**
Off	Stop
Hand	Run
Auto	Auxilliary (the reverse key does not function normally, and so the system behaves as though *Enable Auxiliary Key* (06.013) = 0)

The state diagram below shows how the system moves between states when the keypad keys are pressed and *Hand/Off/Auto Operating Mode* (01.052) is adjusted.
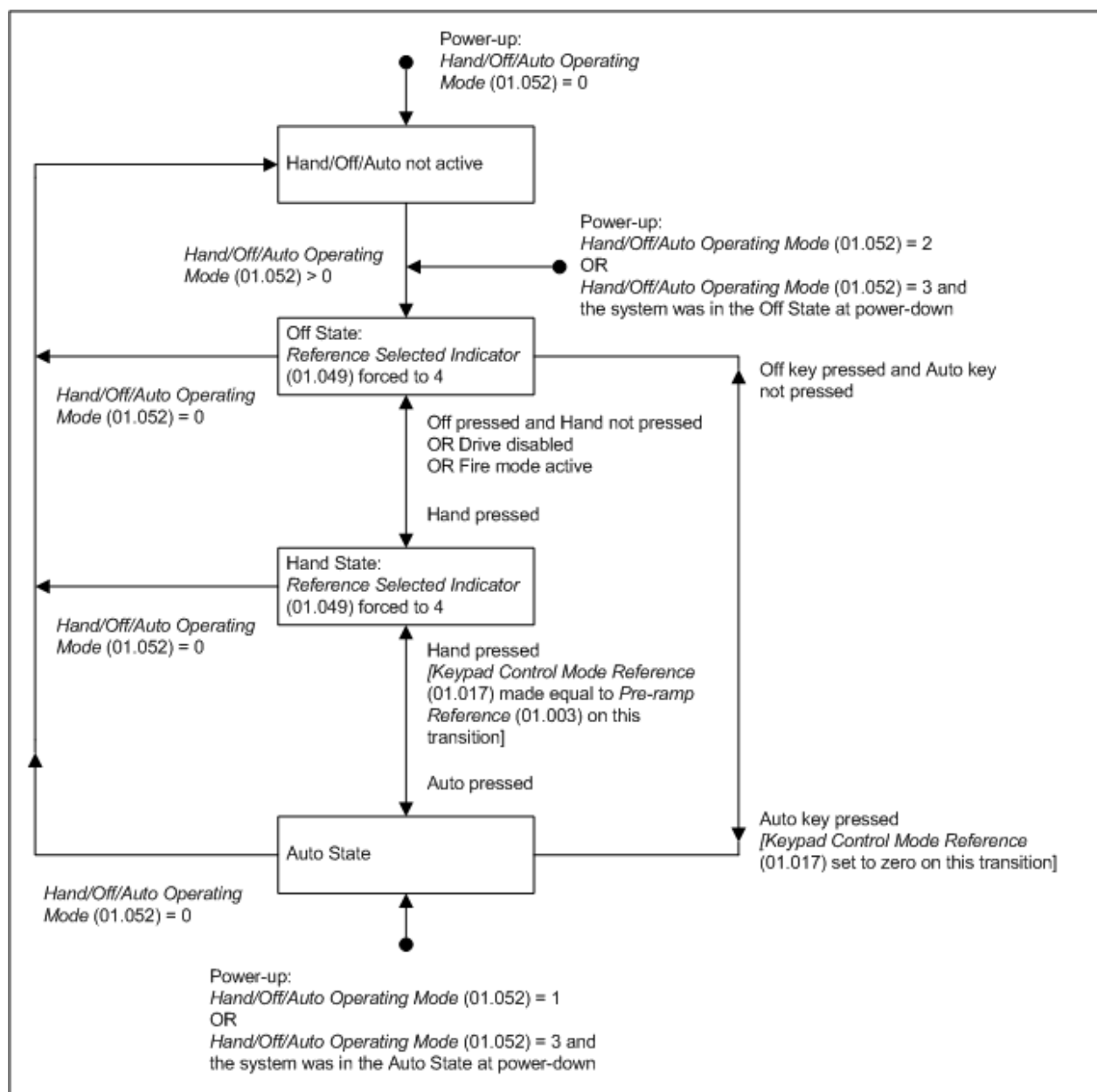
Parameter	01.053 *Fire Mode Reference*		
Short description	Defines the reference value when fire mode is activated		
Mode	RFC‑S		
Minimum	−VM_SPEED_FREQ_REF	Maximum	VM_SPEED_FREQ_REF
Default	0.0	Units	
Type	32 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	1
Coding	RW, VM		

See *Fire Mode Activate* (01.054).

Parameter	01.054 *Fire Mode Activate*		
Short description	Route a digital input to this parameter to activate fire mode		
Mode	RFC‑S		
Minimum	0	Maximum	1
Default	0	Units	
Type	1 Bit Volatile	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RO, NC		

Fire Mode Activate (01.054) cannot be written directly, but it can be controlled from a digital input. This prevents fire mode from being enabled from the keypad, comms or an option module.

Fire mode is intended for purging air from a ventilation system in the event of a fire. All trips are either disabled or are automatically reset after 1s. The use of fire mode can result in damage to the drive, and so if fire mode is enabled and any trip is initiated an indication that cannot be reset by the user is stored in *Potential Drive Damage Conditions* (10.106). For Open-loop, RFC-A or RFC-S modes fire mode is activated and if *Fire Mode Reference* (01.053) has a non-zero value and *Fire Mode Activate* (01.054) = 1. When fire mode is activated normal drive operation is overridden as follows.

1. *Pre-ramp Reference* (01.003) is forced to the value in *Fire Mode Reference* (01.053).
2. The Final drive enable is forced to be active provided the safe torque off hardware input will allow the drive to be enabled. The Final drive run is forced to be active.
3. *Forward Limit Switch* (06.035) and *Reverse Limit Switch* (06.036) are disabled.
4. *Hard Speed Reference* (03.022) is forced to 0 (RFC-A and RFC-S modes). The hard speed reference should not be used when fire mode can be activated as this could cause an abrupt change in speed.
5. The hand/off/auto system is disabled. If this system is in the hand state when fire mode is activated it will be forced to the off state, so that hand state is not active when fire mode is de-activated.
6. Keypad control mode is disabled.
7. All latched states in the sequencer (Menu 6) are reset.

For Regen mode fire mode is activated if *Fire Mode Activate* (01.054) = 1. When fire mode is activated the Final drive enable is forced to be active provided the safe torque off hardware input will allow the drive to be enabled.

If the drive is in the tripped state when fire mode is activated the trip is reset and then only the trips listed in the table below can be initiated whilst fire mode is active. If any of the trips shown as resettable occur, the drive will attempt to automatically reset the trip after 1s.

Trip number	Trip	Resettable
2	*Over Volts*	Yes
3	*OI ac*	Yes
4	*OI Brake*	Yes
5	*PSU*	Yes
9	*PSU 24V*	Yes
21	*OHt Inverter*	Yes
31	*EEPROM Fail*	No
36	*User Save*	No
37	*Power Down Save*	No
109	*OI dc*	Yes
200	*Slot1 HF*	No
205	*Slot2 HF*	No
210	*Slot3 HF*	No
217-249		No
250	*Slot4 HF*	No

Parameter	01.055 *Linear Speed Select*		
Short description	Set to 1 to enable linear speed units		
Mode	RFC‑S		
Minimum	0	Maximum	1
Default	0	Units	
Type	1 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW		

Normally the units for speed parameters are rpm for both rotary and linear applications. For a linear application one revolution corresponds to one motor pole. If the position feedback device that is selected for motor control with *Motor Control Feedback Select* (03.026) is a linear device then if *Linear Speed Select* (01.055) = 1 the units for speed parameters are mm/s with the following exceptions:

1. All speed parameters are displayed in rpm if sensorless mode is active, i.e. *Sensorless Mode Active* (03.078) = 1.
2. Speed feedback parameters associated with each feedback interface, i.e. *P1 Speed Feedback* (03.027) for position feedback interface P1, etc., are always displayed in rpm for a rotary device.

Linear Speed Selected (01.056) shows whether rotary of linear speed is being used. If *Linear Speed Selected* (01.056) = 0 then rotary speed is being used otherwise if it is 1 then linear speed is being used.

To enable the use of linear speed units, *P1 Linear Feedback Select* (03.051) must also be set to 1 to allow *Linear Speed Selected* (01.056) to be set to 1.

Parameter	01.056 *Linear Speed Selected*		
Short description	Indicates if linear speed units are being used		
Mode	RFC‑S		
Minimum	0	Maximum	1
Default		Units	
Type	1 Bit Volatile	Update Rate	Background write
Display Format	Standard	Decimal Places	0
Coding	RO, ND, NC, PT		

See *Linear Speed Select* (01.055).

Parameter	01.057 *Force Reference Direction*		
Short description	Defines the direction of the reference		
Mode	RFC‑S		
Minimum	0	Maximum	2
Default	0	Units	
Type	8 Bit Volatile	Update Rate	4ms read
Display Format	Standard	Decimal Places	0
Coding	RW, TE		

Value	*Text*
0	None
1	Forward
2	Reverse

If *Force Reference Direction* (01.057) = 0 then it has no effect. If *Force Reference Direction* (01.057) is non-zero then the modulus of the reference is used and the sign is defined by the value of *Force Reference Direction* (01.057). If *Force Reference Direction* (01.057) = 1 then *Pre-skip Filter Reference* (01.002) is always positive, and if *Force Reference Direction* (01.057) = 2 then *Pre-skip Filter Reference* (01.002) is always zero or negative.

# Menu 2 Single Line Descriptions − *Speed Ramps*

Mode: RFC‑S

Parameter		Range	Default	Type				
02.001	Post Ramp Reference	±VM_SPEED_FREQ_REF		RO	Num	ND	NC	PT
02.002	Ramp Enable	Off (0) or On (1)	On (1)	RW	Bit			US
02.003	Ramp Hold	Off (0) or On (1)	Off (0)	RW	Bit			US
02.004	Ramp Mode	Fast (0), Standard (1)	Standard (1)	RW	Txt			US
02.005	Disable Ramp Output	Off (0) or On (1)	Off (0)	RW	Bit			US
02.006	S Ramp Enable	Off (0) or On (1)	Off (0)	RW	Bit			US
02.007	Maximum Rate Of Change Of Acceleration	0.000 to 100.000	0.030	RW	Num			US
02.008	Standard Ramp Voltage	±VM_DC_VOLTAGE_SET V	200V drive: 375 V 400V drive 50Hz: 750 V 400V drive 60Hz: 775 V 575V drive: 895 V 690V drive: 1075 V	RW	Num		RA	US
02.009	Deceleration Fail Detection Disable	Off (0) or On (1)	Off (0)	RW	Bit			US
02.010	Acceleration Rate Selector	0 to 9	0	RW	Num			US
02.011	Acceleration Rate 1	±VM_ACCEL_RATE s	0.200 s	RW	Num			US
02.012	Acceleration Rate 2	±VM_ACCEL_RATE s	0.200 s	RW	Num			US
02.013	Acceleration Rate 3	±VM_ACCEL_RATE s	0.200 s	RW	Num			US
02.014	Acceleration Rate 4	±VM_ACCEL_RATE s	0.200 s	RW	Num			US
02.015	Acceleration Rate 5	±VM_ACCEL_RATE s	0.200 s	RW	Num			US
02.016	Acceleration Rate 6	±VM_ACCEL_RATE s	0.200 s	RW	Num			US
02.017	Acceleration Rate 7	±VM_ACCEL_RATE s	0.200 s	RW	Num			US
02.018	Acceleration Rate 8	±VM_ACCEL_RATE s	0.200 s	RW	Num			US
02.019	Jog Acceleration Rate	±VM_ACCEL_RATE s	0.000 s	RW	Num			US
02.020	Deceleration Rate Selector	0 to 9	0	RW	Num			US
02.021	Deceleration Rate 1	±VM_ACCEL_RATE s	0.200 s	RW	Num			US
02.022	Deceleration Rate 2	±VM_ACCEL_RATE s	0.200 s	RW	Num			US
02.023	Deceleration Rate 3	±VM_ACCEL_RATE s	0.200 s	RW	Num			US
02.024	Deceleration Rate 4	±VM_ACCEL_RATE s	0.200 s	RW	Num			US
02.025	Deceleration Rate 5	±VM_ACCEL_RATE s	0.200 s	RW	Num			US
02.026	Deceleration Rate 6	±VM_ACCEL_RATE s	0.200 s	RW	Num			US
02.027	Deceleration Rate 7	±VM_ACCEL_RATE s	0.200 s	RW	Num			US
02.028	Deceleration Rate 8	±VM_ACCEL_RATE s	0.200 s	RW	Num			US
02.029	Jog Deceleration Rate	±VM_ACCEL_RATE s	0.000 s	RW	Num			US
02.030	Acceleration Rate Selected	0 to 8		RO	Num	ND	NC	PT
02.031	Deceleration Rate Selected	0 to 8		RO	Num	ND	NC	PT
02.032	Acceleration Rate Select Bit 0	Off (0) or On (1)	Off (0)	RW	Bit		NC	
02.033	Acceleration Rate Select Bit 1	Off (0) or On (1)	Off (0)	RW	Bit		NC	
02.034	Acceleration Rate Select Bit 2	Off (0) or On (1)	Off (0)	RW	Bit		NC	
02.035	Deceleration Rate Select Bit 0	Off (0) or On (1)	Off (0)	RW	Bit		NC	
02.036	Deceleration Rate Select Bit 1	Off (0) or On (1)	Off (0)	RW	Bit		NC	
02.037	Deceleration Rate Select Bit 2	Off (0) or On (1)	Off (0)	RW	Bit		NC	
02.038	Inertia Compensation Torque	±1000.0 %		RO	Num	ND	NC	PT
02.039	Ramp Rate Units	Off (0) or On (1)	Off (0)	RW	Bit			US
02.040	S Ramp Percentage	0.0 to 50.0 %	0.0 %	RW	Num			US
02.041	S Ramp Set‑up Mode	Single (0), Percentage (1), Independent (2)	Single (0)	RW	Txt			US
02.042	Maximum Rate Of Change Of Acceleration 1	0.000 to 100.000	0.000	RW	Num			US
02.043	Maximum Rate Of Change Of Acceleration 2	0.000 to 100.000	0.000	RW	Num			US
02.044	Maximum Rate Of Change Of Acceleration 3	0.000 to 100.000	0.000	RW	Num			US
02.045	Maximum Rate Of Change Of Acceleration 4	0.000 to 100.000	0.000	RW	Num			US

RW	Read / Write	RO	Read-only	Bit	Bit parameter	Txt	Text string	Date	Date parameter	Time	Time parameter
Chr	Character parameter	Bin	Binary parameter	IP	IP address	Mac	MAC address	Ver	Version number	SMP	Slot, menu, parameter
Num	Number parameter	DE	Destination	ND	No default value	RA	Rating dependent	NC	Non-copyable	PT	Protected
FI	Filtered	US	User save	PS	Power-down save						

Menu 2 − *Speed Ramps*

Mode: RFC‑S

Acceleration and deceleration rate selection

RFC-A and RFC-S ramp system
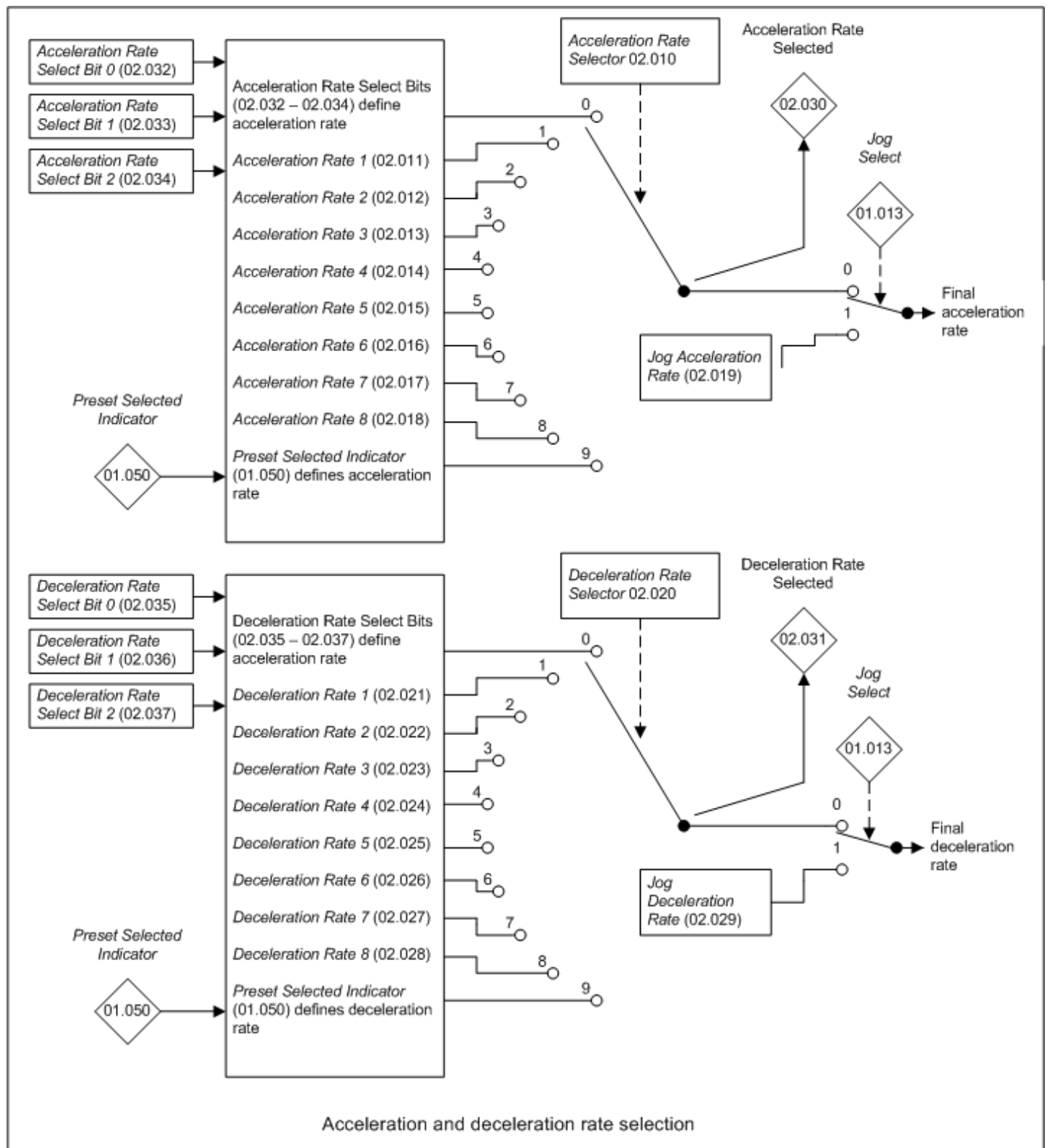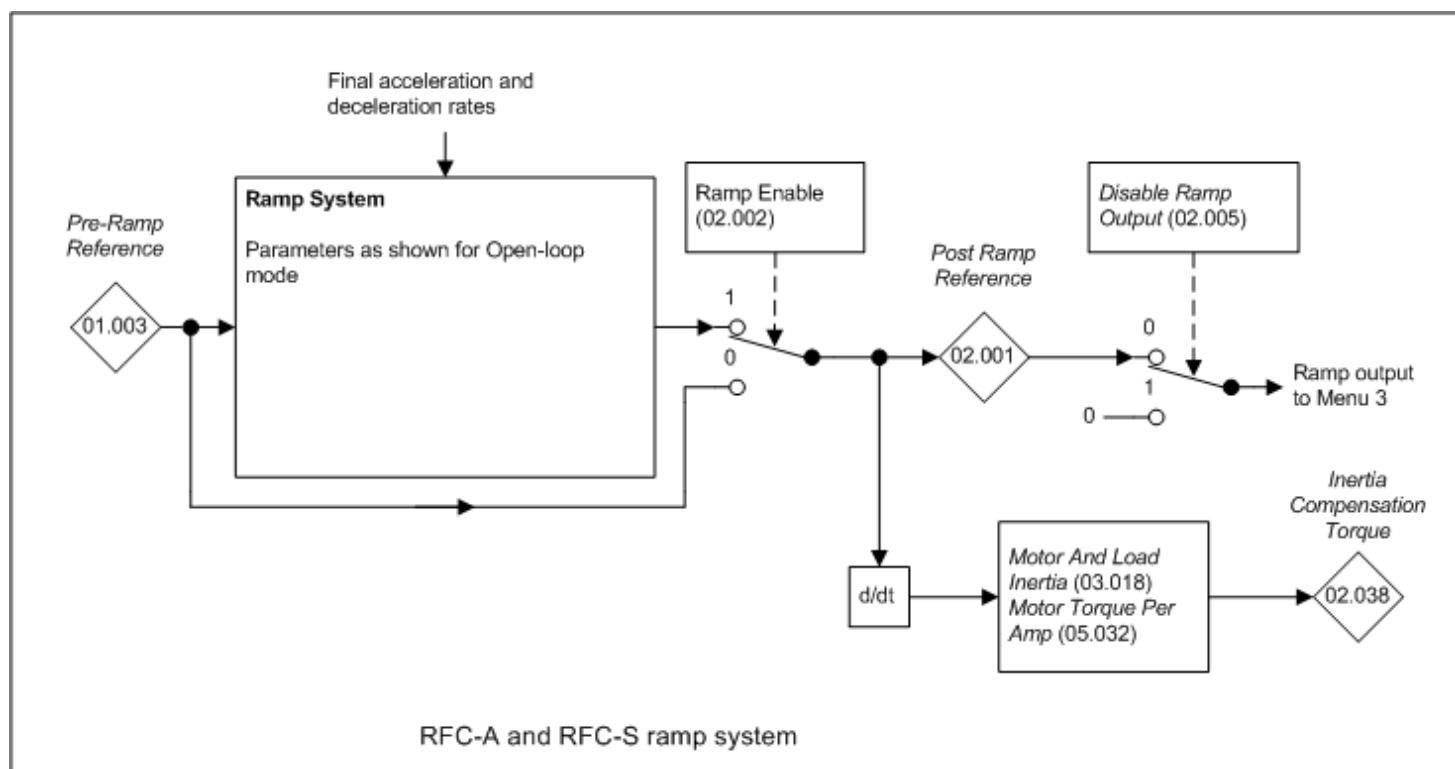
Parameter	02.001 *Post Ramp Reference*		
Short description	Displays the output of the ramp system		
Mode	RFC‑S		
Minimum	−VM_SPEED_FREQ_REF	Maximum	VM_SPEED_FREQ_REF
Default		Units	
Type	32 Bit Volatile	Update Rate	4ms write
Display Format	Standard	Decimal Places	1
Coding	RO, VM, ND, NC, PT		

The *Post Ramp Reference* (02.001) can be combined with the *Hard Speed Reference* (03.022) to give the final speed reference at the input to the speed controller (see Menu 3). If the *Hard Speed Reference* (03.022) is used alone to give the final speed reference, and the ramp output is not required, then the ramp output can be disconnected by setting *Disable Ramp Output* (02.005) = 1. This ensures that the reference and ramp systems do not affect the final speed reference.

It should be noted that the ramps are applied during starting and stopping (i.e. when *Reference On* (01.011) changes from 0 to 1 and vice versa) even when the hard speed reference is being used. This is achieved on starting by making the ramp output equal to *Speed Feedback* (03.002) - *Hard Speed Reference* (03.022). (See *Catch A Spinning Motor* (06.009) for more details.) For example, if the motor is stationary then the initial value of the ramp output is equal to -*Hard Speed Reference* (03.022). On stopping the ramp output is made equal to *Final Speed Reference* (03.001) and the setting of *Disable Ramp Output* (02.005) is ignored and so the ramp is always used, but just while the drive is in the deceleration state. If the hard speed reference is being used alone and ramps are not required on starting the ramps should be disabled. If ramps are not required on stopping then stopping without ramps should be used (i.e. *Stop Mode* (06.001) should be set for no ramp stop). The same feature is applied when stopping when the supply is lost, so that if *Supply Loss Mode* (06.003) is set to select a ramped stop, the speed will be ramped to standstill even if the hard speed reference is being used.

If the Advanced Motion Controller is being used, ramped stopping is selected and the run is deactivated (i.e. *Reference On* (01.011) changes from 1 to 0), but the drive enable ramains active, the AMC will be disabled and the speed will be ramped to zero using the ramp rate selected with Menu 2. If ramped stop on supply loss is selected then on supply loss the AMC is disabled and the ramp selected via Menu 2 will be used to stop the motor. It should be noted that orientation stop cannot be used when the run is deactivated if the AMC is selected (i.e. *AMC Select* (31.001) = 1).

Parameter	02.002 *Ramp Enable*		
Short description	Set to 1 to enable the ramp system		
Mode	RFC‑S		
Minimum	0	Maximum	1
Default	1	Units	
Type	1 Bit User Save	Update Rate	4ms read
Display Format	Standard	Decimal Places	0
Coding	RW, BU		

If *Ramp Enable* (02.002) = 1 then the ramp system is present between the *Pre-ramp Reference* (01.003) and the *Post Ramp Reference* (02.001). If *Ramp Enable* (02.002) = 0 then any changes in the *Pre-ramp Reference* (01.003) are reflected immediately in the *Post Ramp Reference* (02.001).

Parameter	02.003 *Ramp Hold*		
Short description	Set to 1 to hold the ramp system at its present value		
Mode	RFC-S		
Minimum	0	Maximum	1
Default	0	Units	
Type	1 Bit User Save	Update Rate	250µs read
Display Format	Standard	Decimal Places	0
Coding	RW		

If *Ramp Hold* (02.003) = 0 the ramp system functions normally. If *Ramp Hold* (02.003) is set to 1 and *S Ramp Enable* (02.006) = 0 the ramp system output is held at its current level. If *Ramp Hold* (02.003) is subsequently set to 0 the ramp system output is released and continues to operate normally. If *S Ramp Enable* (02.006) = 1 when *Ramp Hold* (02.003) is set to 1 the acceleration will ramp towards zero and the frequency or speed will change in an S curve towards a constant speed. If a drive stop is requested (i.e. *Reference On* (01.011) = 0) the ramp hold function is disabled.

Parameter	02.004 *Ramp Mode*		
Short description	Defines the mode used by the ramp system		
Mode	RFC-S		
Minimum	0	Maximum	1
Default	1	Units	
Type	8 Bit User Save	Update Rate	4ms read
Display Format	Standard	Decimal Places	0
Coding	RW, TE		

| *Value*	*Text*
0	Fast
1	Standard

Acceleration is defined as a positive (forward) or negative (reverse) frequency or speed change away from zero, and deceleration is defined as a change towards zero. *Ramp Mode* (02.004) defines the ramp mode used for deceleration. During acceleration the frequency or speed changes are based on the final acceleration rate only.

0: Fast ramp
During deceleration the frequency or speed changes are based on the final deceleration rate.

1: Standard ramp
If the d.c. bus voltage rises to the level defined by *Standard Ramp Voltage* (02.008) the regenerative current limit is modified to prevent the voltage from rising any higher. This form of control applies to speed or torque control and during supply loss. If the *Standard Ramp Voltage* (02.008) is set to a level that is below the nominal d.c. bus voltage level the motor is likely to accelerate with a low level of torque. The waveforms below show the behaviour of the system when the speed reference is set to zero and standard ramp control becomes active. In the first example the speed reference (ramp output) reaches zero before the actual speed reaches zero because the deceleration is being controlled to limit the d.c. link voltage. Then when standard ramp control becomes inactive the ramp output is set to the actual speed, so that the required ramp rate is used to decelerate to stop. In the second example the reference is reapplied before the speed reaches zero. Because the speed reference has fallen faster than the actual speed, there is a recovery time before the speed reference rises to meet the actual speed.
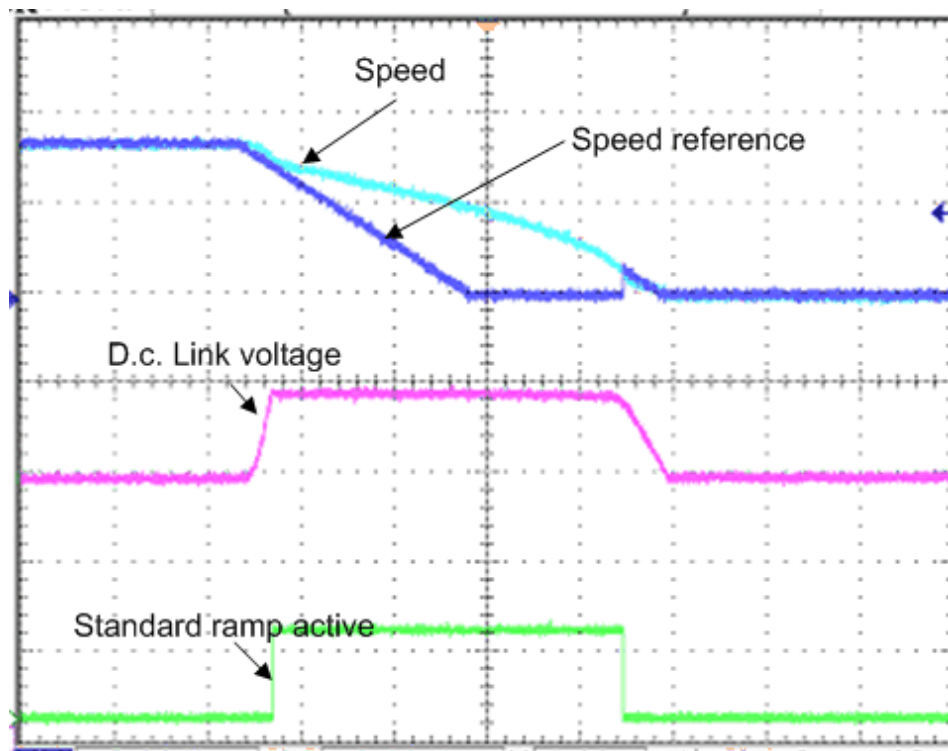
Deceleration to stop
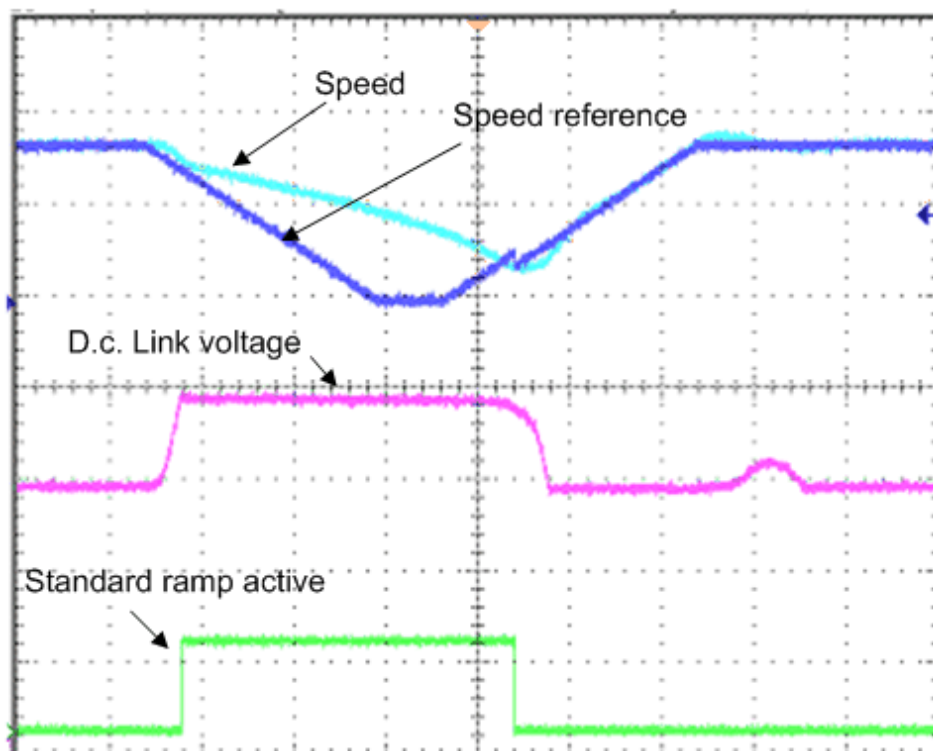
Deceleration and then acceleration before stop

Parameter	02.005 *Disable Ramp Output*		
Short description	Set to 1 to disable the ramp system		
Mode	RFC‑S		
Minimum	0	Maximum	1
Default	0	Units	
Type	1 Bit User Save	Update Rate	4ms read
Display Format	Standard	Decimal Places	0
Coding	RW		

See *Post Ramp Reference* (02.001).

Parameter	02.006 *S Ramp Enable*		
Short description	Set to 1 to enable the use of S ramps		
Mode	RFC-S		
Minimum	0	Maximum	1
Default	0	Units	
Type	1 Bit User Save	Update Rate	4ms read
Display Format	Standard	Decimal Places	0
Coding	RW		

If *S Ramp Enable* (02.006) = 0 linear ramps are used, but if *S Ramp Enable* (02.006) = 1 an acceleration limit is applied to give S ramps. See *Maximum Rate Of Change Of Acceleration* (02.007) for more details of S ramps.

Parameter	02.007 *Maximum Rate Of Change Of Acceleration*		
Short description	Defines the maximum rate of change of acceleration used by the ramp system		
Mode	RFC-S		
Minimum	0.000	Maximum	100.000
Default	0.030	Units	
Type	32 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	3
Coding	RW		

A rate of change of acceleration ramp (S ramp) can be applied by different methods depending on the value of *S Ramp Set-up Mode* (02.041). If *S Ramp Set-up Mode* (02.041) = 0 then the maximum rate of change of acceleration in both directions, accelerating away from or towards zero, is defined by *Maximum Rate Of Change Of Acceleration* (02.007).

The general equations are given below for a linear ramp and S ramp where
Δw is the required change of frequency or speed
a_{Max} is the maximum allowed acceleration in units of frequency/s or speed/s

J_{Max} is the maximum rate of change of acceleration (i.e. jerk) in units of frequency/s^2 or speed/s^2

The time for a linear ramp to give a change of frequency or speed Δw is

$T_{Linear} = \Delta w / a_{Max}$

If an S ramp is used w_B is the change of frequency or speed as the acceleration changes from zero to aMax, i.e. the S shaped part of the frequency or speed change.

$w_B = a_{Max}^2 / 2J_{Max}$

If the required frequency or speed change is less than 2wB, i.e. $\Delta w < 2wB$, then the acceleration never reaches its limit and the ramp does not contain a linear ramp section and the time for the ramp is given by

$T_{SRamp1} = 2 \sqrt{(\Delta w / J_{Max})}$

Otherwise

$T_{SRamp2} = (\Delta w / a_{Max}) + (a_{Max} / J_{Max})$

The following is an example based on the default parameter values for Open-loop mode. The diagram below shows a change of frequency from 0Hz to 50Hz with the ramp rate set to 5.0s/100Hz and *Maximum Rate Of Change Of Acceleration* (02.007) set to its default value of 3.1s^2/100Hz.

Linear and S ramps
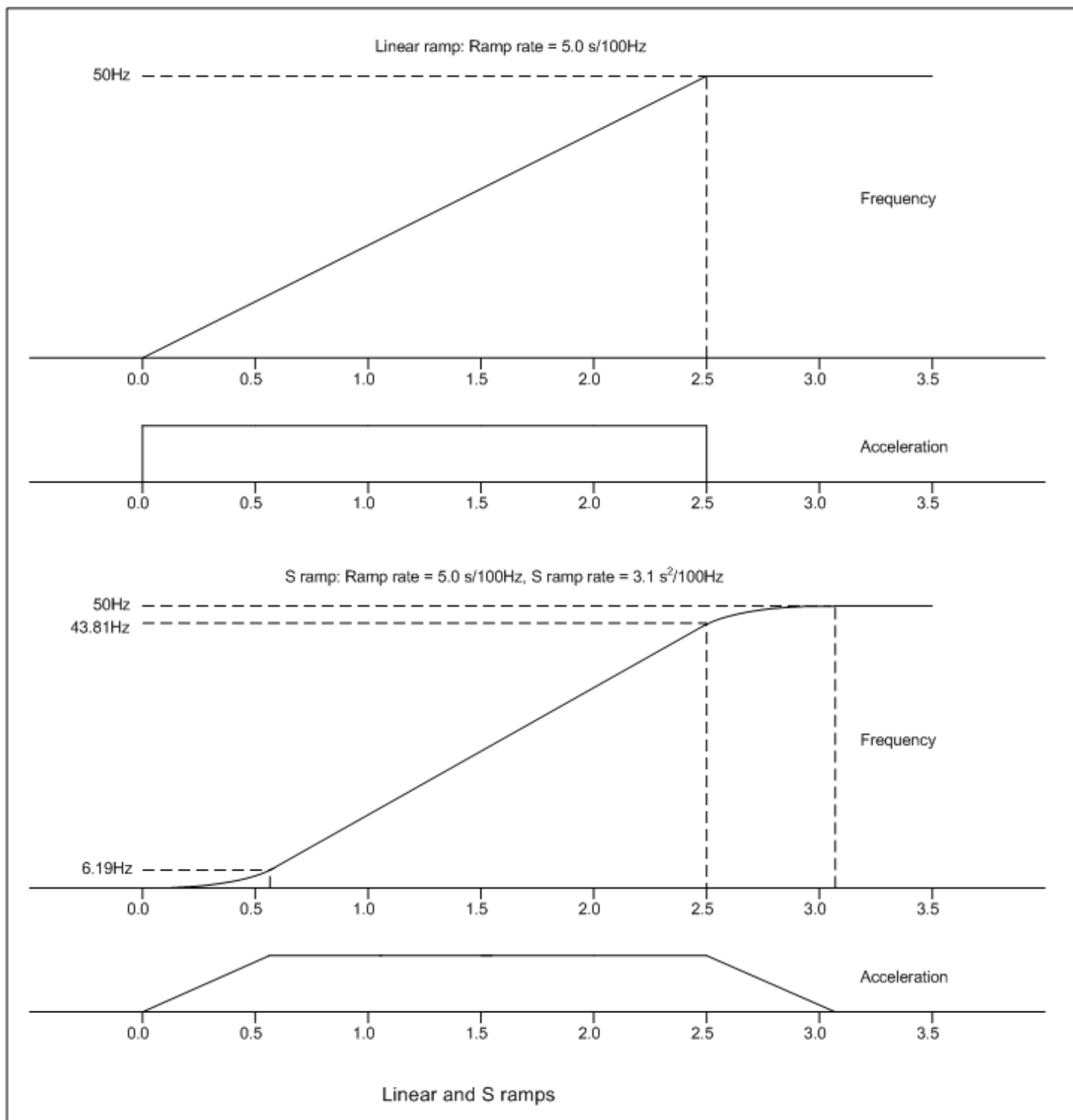
The required change of frequency $\Delta w = 50\text{Hz}$. The acceleration and jerk are converted from the parameter values as follows:

$a_{Max} = 100$ / ramp rate $= 20.0\text{Hz/s}$

$J_{Max} = 100$ / *Maximum Rate Of Change Of Acceleration* (02.007) $= 32.3\text{Hz/s}^2$

The linear ramp time $T_{Linear} = \Delta w \times a_{Max} = 50.0 / 20.0 = 2.5\text{s}$

The frequency change for the acceleration to reach its limit $w_B = a_{Max}^2 / 2J_{Max} = 20.0^2 / (2 \times 32.3) = 6.19\text{Hz}$

The required frequency change for $\Delta w = 50\text{Hz}$ and this is greater than $2w_B$, i.e. $\Delta w > 2 \times 6.19\text{Hz}$. Therefore the time for the ramp

$T_{SRamp2} = (\Delta w / a_{Max}) + (a_{Max} / J_{Max}) = (50.0 / 20.0) + (20.0 / 32.3) = 2.5 + 0.62 = 3.12\text{s}$

Note that the default value of *Maximum Rate Of Change Of Acceleration* (02.007) has been chosen so that when it is combined with the default acceleration rate, each of the S sections of the ramp is 20% of the overall time for the frequency change, i.e. $0.62/3.12 \times 100\% = 20\%$. This is the same as if *S Ramp Set-up Mode* (02.041) = 2 and *S Ramp Percentage* (02.040) = 20%.

If the required change of frequency had been 5.0Hz, i.e. less than $2 \times w_B$, then the alternative equation should be used:

$T_{SRamp1} = 2 \sqrt{(\Delta w / J_{Max})} = 2 \sqrt{(5.0 / 32.3)} = 0.78\text{s}$

For RFC-A and RFC-S modes the general equations are used in the same way as for Open-loop mode. The required values are calculated as follows:
Δw = 1000 / ramp rate
a_{Max} = 1000 / ramp rate
J_{Max} = 1000 / *Maximum Rate Of Change Of Acceleration* (02.007)

Parameter	02.008 *Standard Ramp Voltage*		
Short description	Defines the standard ramp voltage used by the ramp system		
Mode	RFC‑S		
Minimum	−VM_DC_VOLTAGE_SET	Maximum	VM_DC_VOLTAGE_SET
Default	See exceptions below	Units	V
Type	16 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW, VM, RA		

Voltage	*Region*	*Default Value*
200V	All	375
400V	50Hz	750
400V	60Hz	775
575V	All	895
690V	All	1075

See *Ramp Mode* (02.004).

Parameter	02.009 *Deceleration Fail Detection Disable*		
Short description	Set to 1 to disable the deceleration fal detection function		
Mode	RFC‑S		
Minimum	0	Maximum	1
Default	0	Units	
Type	1 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW		

In the following circumstances it is possible that the motor may not decelerated or even accelerate.

1. When standard ramp is selected with a high inductance supply it is possible for the d.c. bus voltage to rise as the motor speed approaches zero, and so the motor will continue to rotate slowly and not stop.
2. An overhauling load can cause the motor to accelerate.

It can be a problem if the drive state is changed to the "Decelerating" state and the motor does not stop. If *Deceleration Fail Detection Disable* (02.009) is at its default value of 0, the motor frequency or speed is monitored in the "Decelerating" state, and if this does not fall over a period of 10s the ramp output is forced to zero and the drive state is changed to "Stop" or "Inhibit" as appropriate.

If *Deceleration Fail Detection Disable* (02.009) = 1 this feature is disabled. This can be used in the following circumstances to prevent the system state from changing from the "Decelerating" state before the motor has stopped:

1. If S ramps are being used with long ramp rates, and the motor is still accelerating when the drive is changed to the "Decelerating" state because the run command is removed, then the ramp output may increase further before falling again towards zero.
2. In RFC-A or RFC-S modes the speed may appear not to reduce when very long ramp rates are used.

Parameter	02.010 *Acceleration Rate Selector*		
Short description	Defines which acceleration rate is used by the ramp system		
Mode	RFC‑S		
Minimum	0	Maximum	9
Default	0	Units	
Type	8 Bit User Save	Update Rate	4ms read
Display Format	Standard	Decimal Places	0
Coding	RW		

The *Acceleration Rate Selector* (02.010) is used to either select an acceleration rate directly or to define the method used to select an acceleration rate. If 1 ≤ *Acceleration Rate Selector* (02.010) ≤ 8 the acceleration rate is selected directly, i.e. 1 selects *Acceleration Rate 1* (02.011), 2 selects *Acceleration Rate 2* (02.012), etc. If *Acceleration Rate Selector* (02.010) = 0 the acceleration rate is selected with the acceleration rate select bits as shown in the table below.

Acceleration Rate Select Bit 2 (02.034)	Acceleration Rate Select Bit 1 (02.033)	Acceleration Rate Select Bit 0 (02.032)	Acceleration rate selected
0	0	0	Acceleration Rate 1 (02.011)
0	0	1	Acceleration Rate 2 (02.012)
0	1	0	Acceleration Rate 3 (02.013)
0	1	1	Acceleration Rate 4 (02.014)
1	0	0	Acceleration Rate 5 (02.015)
1	0	1	Acceleration Rate 6 (02.016)
1	1	0	Acceleration Rate 7 (02.017)
1	1	1	Acceleration Rate 8 (02.018)

If *Acceleration Rate Selector* (02.010) = 9 the acceleration rate is selected based on the value of *Preset Selected Indicator* (01.050), i.e. 1 selects *Acceleration Rate 1* (02.011), 2 selects *Acceleration Rate 2* (02.012), etc.

Parameter	02.011 *Acceleration Rate 1*		
Short description	Defines the acceleration rate present in acceleration rate 1		
Mode	RFC‑S		
Minimum	−VM_ACCEL_RATE	Maximum	VM_ACCEL_RATE
Default	0.200	Units	s
Type	32 Bit User Save	Update Rate	4ms read
Display Format	Standard	Decimal Places	3
Coding	RW, VM		

Acceleration Rate 1 (02.011) to *Acceleration Rate 8* (02.018) can be selected to define the linear ramp rate. The acceleration rate applies when the frequency/speed is changing away from zero.

Selecting a ramp rate that has been set to zero in Open-loop mode disables the ramp system so that the *Post Ramp Reference* (02.001) follows the *Pre-ramp Reference* (01.003) without any delay for acceleration or deceleration. It should be noted that this also disables the standard ramp d.c. link voltage controller and the frequency based current limits.

The units of *Acceleration Rate 1* (02.011) to *Acceleration Rate 8* (02.018) are s / Ramp rate frequency or s / Ramp rate speed. See *Ramp Rate Units* (02.039) for the definition of Ramp rate frequency and Ramp rate speed.

Parameter	02.012 *Acceleration Rate 2*		
Short description	Defines the acceleration rate present in acceleration rate 2		
Mode	RFC‑S		
Minimum	−VM_ACCEL_RATE	Maximum	VM_ACCEL_RATE
Default	0.200	Units	s
Type	32 Bit User Save	Update Rate	4ms read
Display Format	Standard	Decimal Places	3
Coding	RW, VM		

See *Acceleration Rate 1* (02.011).

Parameter	02.013 *Acceleration Rate 3*		
Short description	Defines the acceleration rate present in acceleration rate 3		
Mode	RFC‑S		
Minimum	−VM_ACCEL_RATE	Maximum	VM_ACCEL_RATE
Default	0.200	Units	s
Type	32 Bit User Save	Update Rate	4ms read
Display Format	Standard	Decimal Places	3
Coding	RW, VM		

See *Acceleration Rate 1* (02.011).

Parameter	02.014 *Acceleration Rate 4*		
Short description	Defines the acceleration rate present in acceleration rate 4		
Mode	RFC‑S		
Minimum	−VM_ACCEL_RATE	Maximum	VM_ACCEL_RATE
Default	0.200	Units	s
Type	32 Bit User Save	Update Rate	4ms read
Display Format	Standard	Decimal Places	3
Coding	RW, VM		

See *Acceleration Rate 1* (02.011).

Parameter	02.015 *Acceleration Rate 5*		
Short description	Defines the acceleration rate present in acceleration rate 5		
Mode	RFC‑S		
Minimum	−VM_ACCEL_RATE	Maximum	VM_ACCEL_RATE
Default	0.200	Units	s
Type	32 Bit User Save	Update Rate	4ms read
Display Format	Standard	Decimal Places	3
Coding	RW, VM		

See *Acceleration Rate 1* (02.011).

Parameter	02.016 *Acceleration Rate 6*		
Short description	Defines the acceleration rate present in acceleration rate 6		
Mode	RFC‑S		
Minimum	−VM_ACCEL_RATE	Maximum	VM_ACCEL_RATE
Default	0.200	Units	s
Type	32 Bit User Save	Update Rate	4ms read
Display Format	Standard	Decimal Places	3
Coding	RW, VM		

See *Acceleration Rate 1* (02.011).

Parameter	02.017 *Acceleration Rate 7*		
Short description	Defines the acceleration rate present in acceleration rate 7		
Mode	RFC‑S		
Minimum	−VM_ACCEL_RATE	Maximum	VM_ACCEL_RATE
Default	0.200	Units	s
Type	32 Bit User Save	Update Rate	4ms read
Display Format	Standard	Decimal Places	3
Coding	RW, VM		

See *Acceleration Rate 1* (02.011).

Parameter	02.018 *Acceleration Rate 8*		
Short description	Defines the acceleration rate present in acceleration rate 8		
Mode	RFC‑S		
Minimum	−VM_ACCEL_RATE	Maximum	VM_ACCEL_RATE
Default	0.200	Units	s
Type	32 Bit User Save	Update Rate	4ms read
Display Format	Standard	Decimal Places	3
Coding	RW, VM		

See *Acceleration Rate 1* (02.011).

Parameter	02.019 *Jog Acceleration Rate*		
Short description	Defines the acceleration rate present when the jog function is selected		
Mode	RFC‑S		
Minimum	−VM_ACCEL_RATE	Maximum	VM_ACCEL_RATE
Default	0.000	Units	s
Type	32 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	3
Coding	RW, VM		

The *Jog Acceleration Rate* (02.019) is selected when *Jog Select* (01.013) is active and when the frequency/speed is changing away from zero in either direction. The units of *Jog Acceleration Rate* (02.019) are s / Ramp rate frequency or s / Ramp rate speed. See *Ramp Rate Units* (02.039) for the definition of Ramp rate frequency and Ramp rate speed.

Parameter	02.020 *Deceleration Rate Selector*		
Short description	Defines which deceleration rate is used by the ramp system		
Mode	RFC‑S		
Minimum	0	Maximum	9
Default	0	Units	
Type	8 Bit User Save	Update Rate	4ms read
Display Format	Standard	Decimal Places	0
Coding	RW		

The *Deceleration Rate Selector* (02.020) operates in the same way as the *Acceleration Rate Selector* (02.010). If *Deceleration Rate Selector* (02.020) = 0 the deceleration rate is selected with the deceleration rate select bits as shown in the table below.

Deceleration Rate Select Bit 2 (02.037)	Deceleration Rate Select Bit 1 (02.036)	Deceleration Rate Select Bit 0 (02.035)	Deceleration rate selected
0	0	0	Deceleration Rate 1 (02.021)
0	0	1	Deceleration Rate 2 (02.022)
0	1	0	Deceleration Rate 3 (02.023)
0	1	1	Deceleration Rate 4 (02.024)
1	0	0	Deceleration Rate 5 (02.025)
1	0	1	Deceleration Rate 6 (02.026)
1	1	0	Deceleration Rate 7 (02.027)
1	1	1	Deceleration Rate 8 (02.028)

Parameter	02.021 *Deceleration Rate 1*		
Short description	Defines the deceleration rate present in deceleration rate 1		
Mode	RFC‑S		
Minimum	−VM_ACCEL_RATE	Maximum	VM_ACCEL_RATE
Default	0.200	Units	s
Type	32 Bit User Save	Update Rate	4ms read
Display Format	Standard	Decimal Places	3
Coding	RW, VM		

Deceleration Rate 1 (02.021) to *Deceleration Rate 8* (02.028) can be selected to define the linear ramp rate. The deceleration rate applies when the frequency/speed is changing towards zero.

Selecting a ramp rate that has been set to zero in Open-loop mode disables the ramp system so that the *Post Ramp Reference* (02.001) follows the *Pre-ramp Reference* (01.003) without any delay for acceleration or deceleration. It should be noted that this also disables the standard ramp d.c. link voltage controller and the frequency based current limits.

The units of *Deceleration Rate 1* (02.021) to *Deceleration Rate 8* (02.028) are s / Ramp rate frequency or s / Ramp rate speed. See *Ramp Rate Units* (02.039) for the definition of Ramp rate frequency and Ramp rate speed.

Parameter	02.022 *Deceleration Rate 2*		
Short description	Defines the deceleration rate present in deceleration rate 2		
Mode	RFC‑S		
Minimum	−VM_ACCEL_RATE	Maximum	VM_ACCEL_RATE
Default	0.200	Units	s
Type	32 Bit User Save	Update Rate	4ms read
Display Format	Standard	Decimal Places	3
Coding	RW, VM		

See *Deceleration Rate 1* (02.021).

Parameter	02.023 *Deceleration Rate 3*		
Short description	Defines the deceleration rate present in deceleration rate 3		
Mode	RFC‑S		
Minimum	−VM_ACCEL_RATE	Maximum	VM_ACCEL_RATE
Default	0.200	Units	s
Type	32 Bit User Save	Update Rate	4ms read
Display Format	Standard	Decimal Places	3
Coding	RW, VM		

See *Deceleration Rate 1* (02.021).

Parameter	02.024 *Deceleration Rate 4*		
Short description	Defines the deceleration rate present in deceleration rate 4		
Mode	RFC‑S		
Minimum	−VM_ACCEL_RATE	Maximum	VM_ACCEL_RATE
Default	0.200	Units	s
Type	32 Bit User Save	Update Rate	4ms read
Display Format	Standard	Decimal Places	3
Coding	RW, VM		

See *Deceleration Rate 1* (02.021).

Parameter	02.025 *Deceleration Rate 5*		
Short description	Defines the deceleration rate present in deceleration rate 5		
Mode	RFC‑S		
Minimum	−VM_ACCEL_RATE	Maximum	VM_ACCEL_RATE
Default	0.200	Units	s
Type	32 Bit User Save	Update Rate	4ms read
Display Format	Standard	Decimal Places	3
Coding	RW, VM		

See *Deceleration Rate 1* (02.021).

Parameter	02.026 *Deceleration Rate 6*		
Short description	Defines the deceleration rate present in deceleration rate 6		
Mode	RFC‑S		
Minimum	−VM_ACCEL_RATE	Maximum	VM_ACCEL_RATE
Default	0.200	Units	s
Type	32 Bit User Save	Update Rate	4ms read
Display Format	Standard	Decimal Places	3
Coding	RW, VM		

See *Deceleration Rate 1* (02.021).

Parameter	02.027 *Deceleration Rate 7*		
Short description	Defines the deceleration rate present in deceleration rate 7		
Mode	RFC‑S		
Minimum	−VM_ACCEL_RATE	Maximum	VM_ACCEL_RATE
Default	0.200	Units	s
Type	32 Bit User Save	Update Rate	4ms read
Display Format	Standard	Decimal Places	3
Coding	RW, VM		

See *Deceleration Rate 1* (02.021).

Parameter	02.028 *Deceleration Rate 8*		
Short description	Defines the deceleration rate present in deceleration rate 8		
Mode	RFC‑S		
Minimum	−VM_ACCEL_RATE	Maximum	VM_ACCEL_RATE
Default	0.200	Units	s
Type	32 Bit User Save	Update Rate	4ms read
Display Format	Standard	Decimal Places	3
Coding	RW, VM		

See *Deceleration Rate 1* (02.021).

Parameter	02.029 *Jog Deceleration Rate*		
Short description	Defines the deceleration rate present when the jog function is selected		
Mode	RFC‑S		
Minimum	−VM_ACCEL_RATE	Maximum	VM_ACCEL_RATE
Default	0.000	Units	s
Type	32 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	3
Coding	RW, VM		

The *Jog Deceleration Rate* (02.029) is selected when *Jog Select* (01.013) is active and when the frequency/speed is changing towards zero in either direction. It should be noted that when jog is selected and the drive run is de-activated *Jog Deceleration Rate* (02.029) is used to decelerate the motor to stop. The units of *Jog Deceleration Rate* (02.029) are s / Ramp rate frequency or s / Ramp rate speed. See *Ramp Rate Units* (02.039) for the definition of Ramp rate frequency and Ramp rate speed.

Parameter	02.030 *Acceleration Rate Selected*		
Short description	Indicates which acceleration rate is selected		
Mode	RFC‑S		
Minimum	0	Maximum	8
Default		Units	
Type	8 Bit Volatile	Update Rate	4ms write
Display Format	Standard	Decimal Places	0
Coding	RO, ND, NC, PT		

Acceleration Rate Selected (02.030) shows a value between 1 and 8 that corresponds to parameters 02.011 to 02.018 indicating which of these acceleration rates is actually being used.

Parameter	02.031 *Deceleration Rate Selected*		
Short description	Indicates which deceleration rate is selected		
Mode	RFC‑S		
Minimum	0	Maximum	8
Default		Units	
Type	8 Bit Volatile	Update Rate	4ms write
Display Format	Standard	Decimal Places	0
Coding	RO, ND, NC, PT		

Deceleration Rate Selected (02.031) shows a value between 1 and 8 that corresponds to parameters 02.021 to 02.028 indicating which of these deceleration rates is actually being used.

Parameter	02.032 *Acceleration Rate Select Bit 0*		
Short description	Defines which acceleration rate is used if acceleration rate selector = 0		
Mode	RFC‑S		
Minimum	0	Maximum	1
Default	0	Units	
Type	1 Bit Volatile	Update Rate	4ms read
Display Format	Standard	Decimal Places	0
Coding	RW, NC		

See *Acceleration Rate Selector* (02.010).

Parameter	02.033 *Acceleration Rate Select Bit 1*		
Short description	Defines which acceleration rate is used if acceleration rate selector = 0		
Mode	RFC‑S		
Minimum	0	Maximum	1
Default	0	Units	
Type	1 Bit Volatile	Update Rate	4ms read
Display Format	Standard	Decimal Places	0
Coding	RW, NC		

See *Acceleration Rate Selector* (02.010).

Parameter	02.034 *Acceleration Rate Select Bit 2*		
Short description	Defines which acceleration rate is used if acceleration rate selector = 0		
Mode	RFC‑S		
Minimum	0	Maximum	1
Default	0	Units	
Type	1 Bit Volatile	Update Rate	4ms read
Display Format	Standard	Decimal Places	0
Coding	RW, NC		

See *Acceleration Rate Selector* (02.010).

Parameter	02.035 *Deceleration Rate Select Bit 0*		
Short description	Defines which deceleration rate is used if deceleration rate selector = 0		
Mode	RFC‑S		
Minimum	0	Maximum	1
Default	0	Units	
Type	1 Bit Volatile	Update Rate	4ms read
Display Format	Standard	Decimal Places	0
Coding	RW, NC		

See *Deceleration Rate Selector* (02.020).

Parameter	02.036 *Deceleration Rate Select Bit 1*		
Short description	Defines which deceleration rate is used if deceleration rate selector = 0		
Mode	RFC‑S		
Minimum	0	Maximum	1
Default	0	Units	
Type	1 Bit Volatile	Update Rate	4ms read
Display Format	Standard	Decimal Places	0
Coding	RW, NC		

See *Deceleration Rate Selector* (02.020).

Parameter	02.037 *Deceleration Rate Select Bit 2*		
Short description	Defines which deceleration rate is used if deceleration rate selector = 0		
Mode	RFC‑S		
Minimum	0	Maximum	1
Default	0	Units	
Type	1 Bit Volatile	Update Rate	4ms read
Display Format	Standard	Decimal Places	0
Coding	RW, NC		

See *Deceleration Rate Selector* (02.020).

Parameter	02.038 *Inertia Compensation Torque*		
Short description	Displays the torque as a percentage of rated torque		
Mode	RFC‑S		
Minimum	-1000.0	Maximum	1000.0
Default		Units	%
Type	16 Bit Volatile	Update Rate	4ms write
Display Format	Standard	Decimal Places	1
Coding	RO, ND, NC, PT		

The *Motor And Load Inertia* (03.018), *Torque Per Amp* (05.032) and the rate of change of the *Post Ramp Reference* (02.001) are used to produce a torque feed-forwards value that should accelerate and decelerate the load at the required rate. This value can be used as a feed-forwards term that is added to the speed controller output if *Inertia Compensation Enable* (04.022) = 1. *Inertia Compensation Torque* (02.038) gives the torque as a percentage of rated torque.

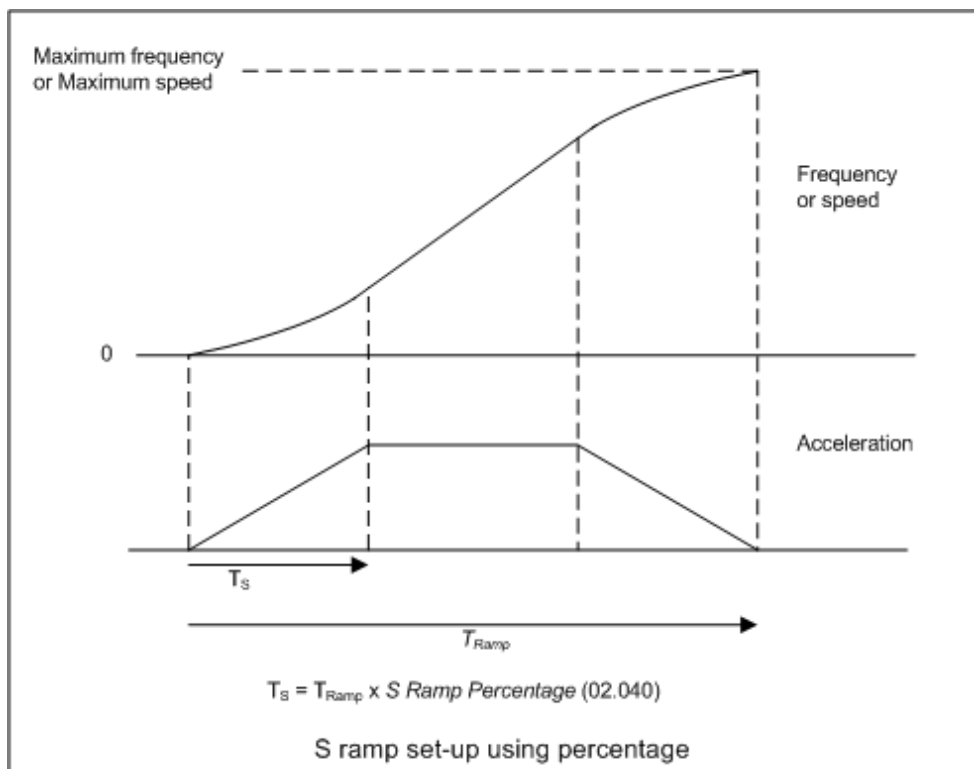| Parameter	02.039 *Ramp Rate Units*		
Short description	Defines the units used by the ramp system		
Mode	RFC‑S		
Minimum	0	Maximum	1
Default	0	Units	
Type	1 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW		

The ramp rate parameters (*Acceleration Rate 1* (02.011) to *Acceleration Rate 8* (02.018), *Jog Acceleration Rate* (02.019), *Deceleration Rate 1* (02.021) to *Deceleration Rate 8* (02.028) and *Jog Deceleration Rate* (02.029)) are specified in s / Ramp rate frequency for Open-loop mode and s / Ramp rate speed for RFC-A and RFC-S modes. Ramp rate frequency and Ramp rate speed are selected with *Ramp Rate Units* (02.039) as defined in the table below.

Ramp Rate Units (02.039)	Open-loop Ramp rate frequency	RFC-A and RFC-S mode Ramp rate speed
0	100Hz	1000rpm ot 1000mm/s
1	Maximum frequency	Maximum speed

Maximum frequency and Maximum speed are defined by *Maximum Reference Clamp* (01.006) if *Select Motor 2 Parameters* (11.045) = 0, or *M2 Maximum Reference Clamp* (21.001) if *Select Motor 2 Parameters* (11.045) = 1.

Parameter	02.040 *S Ramp Percentage*		
Short description	Defines the profile of the S ramp system as a percentage		
Mode	RFC‑S		
Minimum	0.0	Maximum	50.0
Default	0.0	Units	%
Type	16 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	1
Coding	RW		

If *S Ramp Set-up Mode* (02.041) = 1 the percentage of the ramp to Maximum frequency or Maximum speed that includes half the S ramp profile can be specified with *S Ramp Percentage* (02.040) as shown in the diagram below. If motor map one is active (i.e. *Select Motor 2 Parameters* (11.045) = 0), the acceleration or deceleration times are defined by *Acceleration Rate 1* (02.011) and *Deceleration Rate 1* (02.021) respectively irrespective of which ramps rates are selected. The maximum frequency/speed is defined by *Maximum Reference Clamp* (01.006). The time for the frequency/speed change remains constant at the time defined by the acceleration or deceleration rate, and so as the percentage S ramp is changed the maximum acceleration is modified automatically. If motor map 2 is selected then *M2 Maximum Reference Clamp* (21.001), *M2 Acceleration Rate 1* (21.004) and *M2 Deceleration Rate 1* (21.005) are used to define the ramp profile.

$$T_S = T_{Ramp} \times \text{S Ramp Percentage (02.040)}$$

S ramp set-up using percentage

Parameter	02.041 *S Ramp Set-up Mode*		
Short description	Defines the mode used by the S ramp system		
Mode	RFC-S		
Minimum	0	Maximum	2
Default	0	Units	
Type	8 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW, TE		

Value	*Text*
0	Single
1	Percentage
2	Independent

S Ramp Set-up Mode (02.041) defines the method used to set up the S ramp function.

0: Single maximum rate of change of acceleration
The maximum rate of change of acceleration in either direction, when the frequency/speed is changing away from or towards zero, is defined by *Maximum Rate Of Change Of Acceleration* (02.007).

1: Percentage
A single maximum rate of change of acceleration is used in either direction, when the frequency/speed is changing away from or towards zero, but this is specified as the percentage of the ramp from zero to Maximum frequency or Maximum speed which is covered by the S shaped profile.
See *S Ramp Percentage* (02.040).

2: Independent maximum rate of change of acceleration values
The maximum rate of change of acceleration can be specified as four independent values. See *Maximum Rate Of Change Of Acceleration 1* (02.042).

Parameter	02.042 *Maximum Rate Of Change Of Acceleration 1*		
Short description	Defines the 1st maximum rate of change of acceleration used by the S ramp system		
Mode	RFC-S		
Minimum	0.000	Maximum	100.000
Default	0.000	Units	
Type	32 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	3
Coding	RW		

If *S Ramp Set-up Mode* (02.041) = 2 it is possible to set up four independent maximum rate of change of acceleration values as shown in the diagram below. The values from 1 to 4 correspond to *Maximum Rate Of Change Of Acceleration 1* (02.042) to *Maximum Rate Of Change Of Acceleration 4* (02.045) respectively.

S ramp set-up with four maximum rate of change of acceleration values
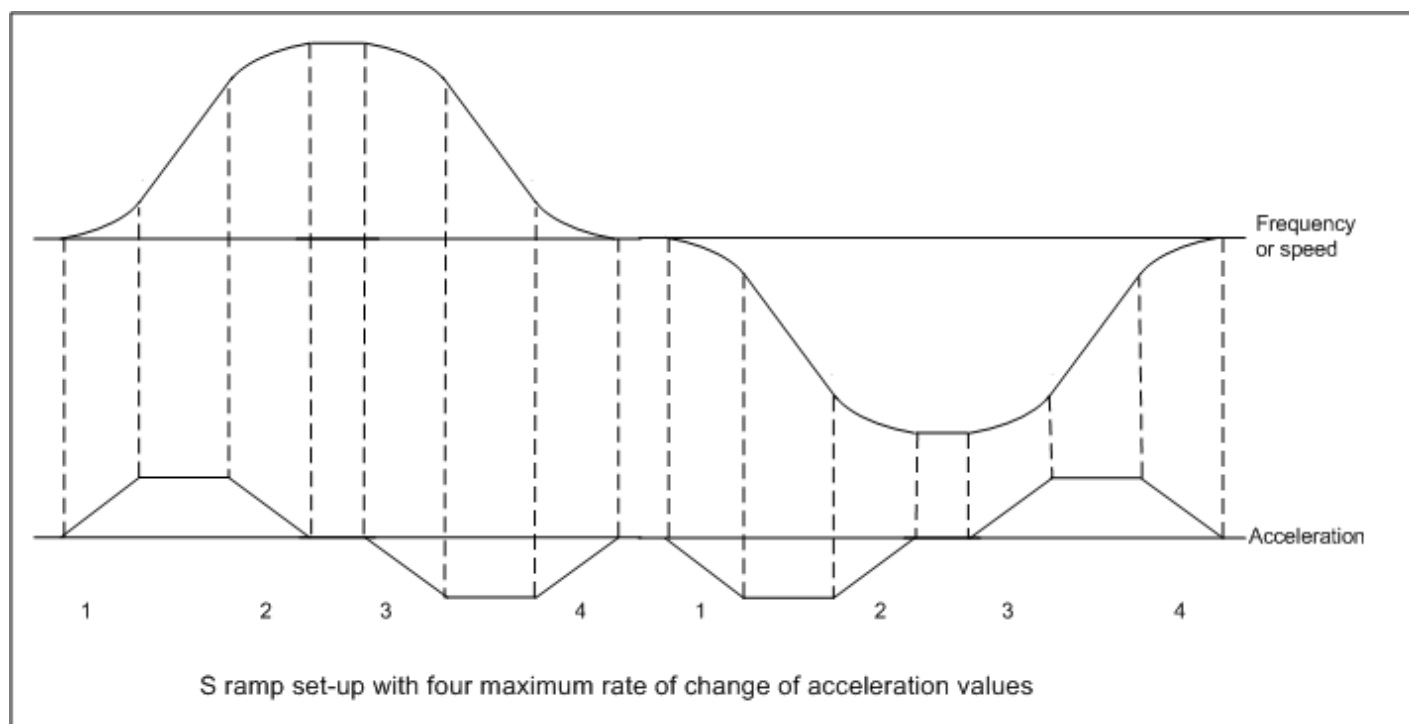
Parameter	02.043 *Maximum Rate Of Change Of Acceleration 2*		
Short description	Defines the 2nd maximum rate of change of acceleration used by the S ramp system		
Mode	RFC‑S		
Minimum	0.000	Maximum	100.000
Default	0.000	Units	
Type	32 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	3
Coding	RW		

See *Maximum Rate Of Change Of Acceleration 1* (02.042).

Parameter	02.044 *Maximum Rate Of Change Of Acceleration 3*		
Short description	Defines the 3rd maximum rate of change of acceleration used by the S ramp system		
Mode	RFC‑S		
Minimum	0.000	Maximum	100.000
Default	0.000	Units	
Type	32 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	3
Coding	RW		

See *Maximum Rate Of Change Of Acceleration 1* (02.042).

Parameter	02.045 *Maximum Rate Of Change Of Acceleration 4*		
Short description	Defines the 4th maximum rate of change of acceleration used by the S ramp system		
Mode	RFC‑S		
Minimum	0.000	Maximum	100.000
Default	0.000	Units	
Type	32 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	3
Coding	RW		

See *Maximum Rate Of Change Of Acceleration 1* (02.042).

Menu 3 Single Line Descriptions − *Speed Control and Position Feedback*

Mode: RFC‑S

Parameter		Range	Default	Type					
03.001	Final Speed Reference	±VM_SPEED		RO	Num	ND	NC	PT	FI
03.002	Speed Feedback	±VM_SPEED		RO	Num	ND	NC	PT	FI
03.003	Speed Error	±VM_SPEED		RO	Num	ND	NC	PT	FI
03.004	Speed Controller Output	±VM_TORQUE_CURRENT %		RO	Num	ND	NC	PT	FI
03.005	Zero Speed Threshold	0 to 200	5	RW	Num				US
03.006	At Speed Lower Limit	0 to 33000	5	RW	Num				US
03.007	At Speed Upper Limit	0 to 33000	5	RW	Num				US
03.008	Over Speed Threshold	0 to 33000	0	RW	Num				US
03.009	Absolute At Speed Select	Off (0) or On (1)	Off (0)	RW	Bit				US
03.010	Speed Controller Proportional Gain Kp1	0.0000 to 200.0000 s/rad	0.0100 s/rad	RW	Num				US
03.011	Speed Controller Integral Gain Ki1	0.00 to 655.35 s²/rad	1.00 s²/rad	RW	Num				US
03.012	Speed Controller Differential Feedback Gain Kd1	0.00000 to 0.65535 1/rad	0.00000 1/rad	RW	Num				US
03.013	Speed Controller Proportional Gain Kp2	0.0000 to 200.0000 s/rad	0.0100 s/rad	RW	Num				US
03.014	Speed Controller Integral Gain Ki2	0.00 to 655.35 s²/rad	1.00 s²/rad	RW	Num				US
03.015	Speed Controller Differential Feedback Gain Kd2	0.00000 to 0.65535 1/rad	0.00000 1/rad	RW	Num				US
03.016	Speed Controller Gain Select	Off (0) or On (1)	Off (0)	RW	Bit				US
03.017	Speed Controller Set-up Method	Disabled (0), Bandwidth (1), Comp Angle (2), Kp Gain Times 16 (3), Low Performance (4), Std Performance (5), High Performance (6), First Order (7)	Disabled (0)	RW	Txt				US
03.018	Motor And Load Inertia	0.00000 to 1000.00000 kgm²	0.00000 kgm²	RW	Num				US
03.019	Compliance Angle	0.0 to 360.0 °	4.0 °	RW	Num				US
03.020	Bandwidth	1 to 1000 Hz	10 Hz	RW	Num				US
03.021	Damping Factor	0.0 to 10.0	1.0	RW	Num				US
03.022	Hard Speed Reference	±VM_SPEED_FREQ_REF	0.0	RW	Num				US
03.023	Hard Speed Reference Select	Off (0) or On (1)	Off (0)	RW	Bit				US
03.024	RFC Feedback Mode	Feedback (0), Sensorless (1), Feedback NoMax (2), Sensorless NoMax (3)	Feedback (0)	RW	Txt				US
03.025	Position Feedback Phase Angle	0.0 to 359.9 °		RW	Num	ND			US
03.026	Motor Control Feedback Select	P1 Drive (0), P2 Drive (1), P1 Slot1 (2), P2 Slot1 (3), P1 Slot2 (4), P2 Slot2 (5), P1 Slot3 (6), P2 Slot3 (7)	P1 Drive (0)	RW	Txt				US
03.027	P1 Speed Feedback	±VM_SPEED		RO	Num	ND	NC	PT	FI
03.028	P1 Revolution/Pole Pitch Counter	0 to 65535		RO	Num	ND	NC	PT	PS
03.029	P1 Position	0 to 65535		RO	Num	ND	NC	PT	PS
03.030	P1 Fine Position	0 to 65535		RO	Num	ND	NC	PT	
03.031	P1 Marker Mode	0000 to 1111	0100	RW	Bin				US
03.032	P1 Marker Flag	Off (0) or On (1)	Off (0)	RW	Bit		NC		
03.033	P1 Rotary Turns Bits	0 to 16	16	RW	Num				US
03.034	P1 Rotary Lines Per Revolution	1 to 100000	4096	RW	Num				US
03.035	P1 Comms Bits	0 to 48	0	RW	Num				US
03.036	P1 Supply Voltage	5V (0), 8V (1), 15V (2)	5V (0)	RW	Txt				US
03.037	P1 Comms Baud Rate	100k (0), 200k (1), 300k (2), 400k (3), 500k (4), 1M (5), 1.5M (6), 2M (7), 4M (8) Baud	300k (2) Baud	RW	Txt				US
03.038	P1 Device Type	AB (0), FD (1), FR (2), AB Servo (3), FD Servo (4), FR Servo (5), SC (6), SC Hiperface (7), EnDat (8), SC EnDat (9), SSI (10), SC SSI (11), SC Servo (12), BiSS (13), Resolver (14), SC SC (15), Commutation Only (16), SC BiSS (17), Option Slot 1 (18), Option Slot 2 (19), Option Slot 3 (20), Option Slot 4 (21)	AB Servo (3)	RW	Txt				US
03.039	P1 Termination Select	0 to 2	1	RW	Num				US
03.040	P1 Error Detection Level	00000000 to 11111111	00000001	RW	Bin				US
03.041	P1 Auto-configuration Select	Disabled (0), Enabled (1)	Enabled (1)	RW	Txt				US
03.042	P1 Feedback Filter	Disabled (0), 1ms (1), 2ms (2), 4ms (3), 8ms (4), 16ms (5)	Disabled (0)	RW	Txt				US
03.043	P1 Maximum Reference	0 to 33000	3000	RW	Num				US
03.044	P1 Reference Scaling	0.000 to 4.000	1.000	RW	Num				US

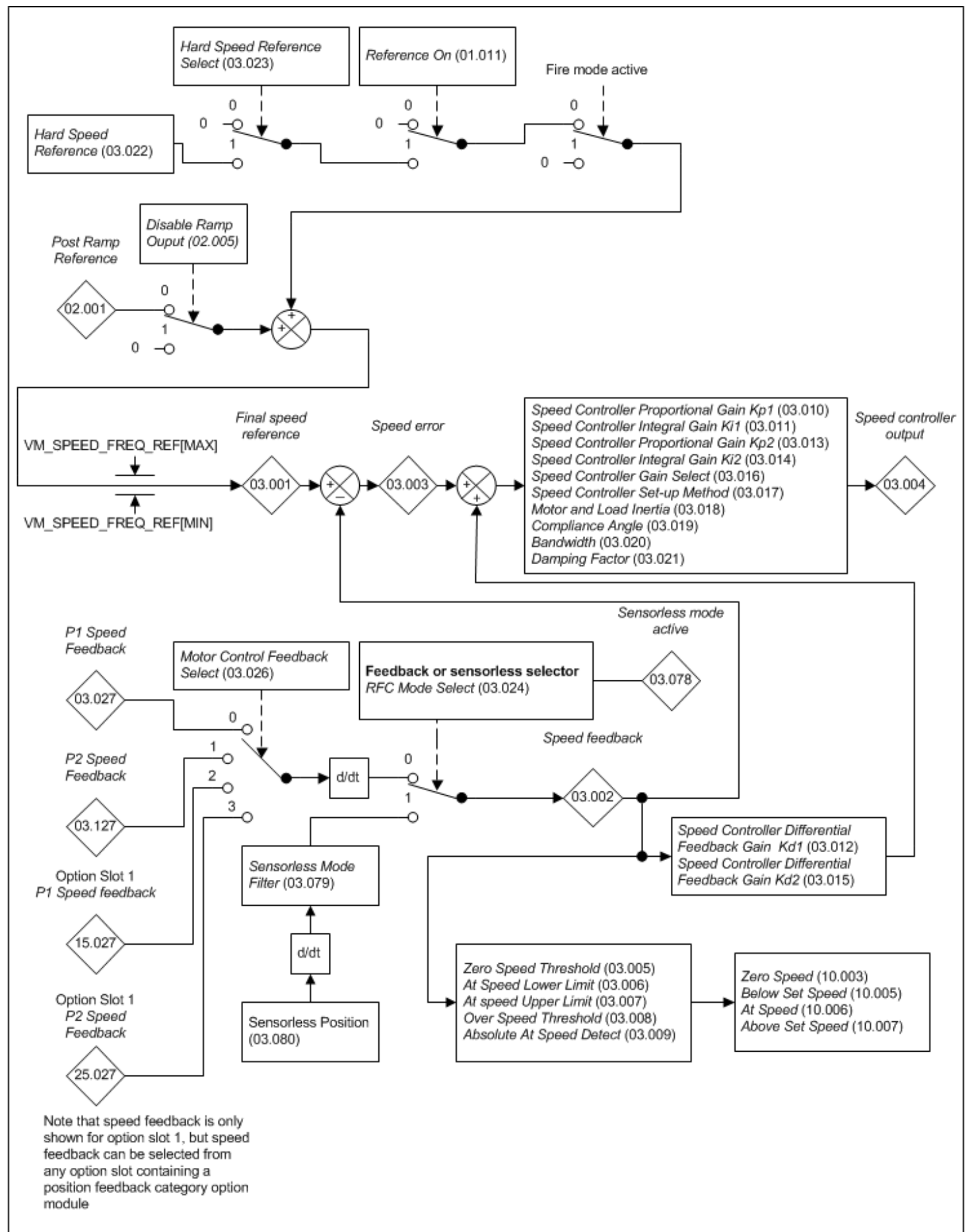| 03.045	P1 Reference	±100.0 %			RO	Num	ND	NC	PT	FI
03.046	P1 Reference destination	0.000 to 59.999	0.000		RW	Num	DE		PT	US
03.047	P1 SSI Incremental Mode	Off (0) or On (1)	Off (0)		RW	Bit				US
03.048	P1 SSI Binary Mode	Off (0) or On (1)	Off (0)		RW	Bit				US
03.049	P1 Additional Power-up Delay	0.0 to 25.0 s	0.0 s		RW	Num				US
03.050	P1 Feedback Lock	Off (0) or On (1)	Off (0)		RW	Bit				US
03.051	P1 Linear Feedback Select	Off (0) or On (1)	Off (0)		RW	Bit				US
03.052	P1 Linear Comms Pitch	0.001 to 100.000	0.001		RW	Num				US
03.053	P1 Linear Line Pitch	0.001 to 100.000	0.001		RW	Num				US
03.054	P1 Linear Comms And Line Pitch Units	millimetres (0), micrometres (1)	millimetres (0)		RW	Txt				US
03.055	P1 Pole Pitch	0.01 to 1000.00 mm	10.00 mm		RW	Num				US
03.056	P1 Feedback Reverse	Off (0) or On (1)	Off (0)		RW	Bit				US
03.057	P1 Normalisation Turns	0 to 16	16		RW	Num				US
03.058	P1 Normalised Position	-2147483648 to 2147483647			RO	Num	ND	NC	PT	
03.059	P1 Normalised Marker Position	-2147483648 to 2147483647			RO	Num	ND	NC	PT	
03.060	P1 Calculation Time	0 to 20 µs	5 µs		RW	Num				US
03.061	P1 Recovery Time	4 to 100 µs	30 µs		RW	Num				US
03.062	P1 Line Delay Time	0 to 5000 ns			RO	Num	ND	NC	PT	US
03.063	P1 Low Speed Update Rate Active	Off (0) or On (1)			RO	Bit	ND	NC	PT	
03.064	P1 Encoder Protocol Detected	None (0), Hiperface (1), EnDat2.1 (2), EnDat2.2 (3), BiSS (4)			RO	Txt	ND	NC	PT	
03.065	P1 Resolver Poles	2 (1) to 20 (10) Poles	2 (1) Poles		RW	Txt				US
03.066	P1 Resolver Excitation	6kHz 3V (0), 8kHz 3V (1), 6kHz 2V (2), 8kHz 2V (3), 6kHz 3V Fast (4), 8kHz 3V Fast (5), 6kHz 2V Fast (6), 8kHz 2V Fast (7)	6kHz 3V Fast (4)		RW	Txt				US
03.067	P1 User Comms Enable	0 to 1	0		RW	Num		NC	PT	
03.068	P1 User Comms Transmit Register	0 to 65535	0		RW	Num		NC	PT	
03.069	P1 User Comms Receive Register	0 to 65535	0		RW	Num		NC	PT	
03.070	P1 Position Feedback Signals	000000 to 111111			RO	Bin	ND	NC	PT	
03.071	P1 Error Detected	Off (0) or On (1)			RO	Bit	ND	NC	PT	
03.073	P1 Absolute Turns Recovery Enable	Off (0) or On (1)	Off (0)		RW	Bit				US
03.074	P1 Additional Configuration	0 to 511116116	0		RW	Num				US
03.075	Initialise Position Feedback	Off (0) or On (1)	Off (0)		RW	Bit		NC		
03.076	Position Feedback Initialized	0000000000 to 1111111111	0000000000		RO	Bin		NC	PT	
03.078	Sensorless Mode Active	Off (0) or On (1)			RO	Bit	ND	NC	PT	
03.079	Sensorless Mode Filter	4 (0), 8 (1), 16 (2), 32 (3), 64 (4) ms	64 (4) ms		RW	Txt				US
03.080	Sensorless Position	-2147483648 to 2147483647			RO	Num	ND	NC	PT	
03.085	Encoder Simulation Source	0.000 to 59.999	0.000		RW	Num			PT	US
03.086	Encoder Simulation Status	None (0), Full (1), No Marker Pulse (2)			RO	Txt	ND	NC	PT	
03.087	Encoder Simulation Sample Period	0.25 (0), 1 (1), 4 (2), 16 (3) ms	0.25 (0) ms		RW	Txt				US
03.088	Encoder Simulation Mode	Hardware (0), Lines Per Rev (1), Ratio (2), SSI (3)	Hardware (0)		RW	Txt				US
03.089	Encoder Simulation Hardware Divider	0 to 7	0		RW	Num				US
03.090	Encoder Simulation Hardware Marker Lock	Off (0) or On (1)	Off (0)		RW	Bit				US
03.091	Encoder Simulation Incremental Mode Select	Off (0) or On (1)	Off (0)		RW	Bit				US
03.092	Encoder Simulation Output Lines Per Revolution	1 to 16384	4096		RW	Num				US
03.093	Encoder Simulation Numerator	1 to 65536	65536		RW	Num				US
03.094	Encoder Simulation Denominator	1 to 65536	65536		RW	Num				US
03.095	Encoder Simulation Output Roll-over Limit	1 to 65535	65535		RW	Num				US
03.096	Encoder Simulation SSI Turns Bits	0 to 16	16		RW	Num				US
03.097	Encoder Simulation SSI Comms Bits	2 to 48	33		RW	Num				US
03.098	Encoder Simulation Output Mode	AB/Gray (0), FD/Binary (1), FR/Binary (2)	AB/Gray (0)		RW	Txt				US
03.100	F1 Freeze Trigger Source	Digital Input 4 (0), Digital Input 5 (1), P1 Marker (2), P2 Marker (3), Common (4), P1 Zero (5), P2 Zero (6)	Digital Input 4 (0)		RW	Txt				US
03.101	F1 Freeze Mode	Rising 1st (0), Falling 1st (1), Rising all (2), Falling all (3)	Rising 1st (0)		RW	Txt				US
03.102	F1 Freeze Position Source	P1 (0), P2 (1), Time (2)	P1 (0)		RW	Txt				US
03.103	F1 Normalised Freeze Position	-2147483648 to 2147483647			RO	Num	ND	NC	PT	
03.104	F1 Freeze Flag	Off (0) or On (1)			RW	Bit	ND	NC	PT	

03.105	F2 Freeze Trigger Source	Digital Input 4 (0), Digital Input 5 (1), P1 Marker (2), P2 Marker (3), Common (4), P1 Zero (5), P2 Zero (6)	Digital Input 4 (0)	RW	Txt				US
03.106	F2 Freeze Mode	Rising 1st (0), Falling 1st (1), Rising all (2), Falling all (3)	Rising 1st (0)	RW	Txt				US
03.107	F2 Freeze Position Source	P1 (0), P2 (1), Time (2)	P1 (0)	RW	Txt				US
03.108	F2 Normalised Freeze Position	-2147483648 to 2147483647		RO	Num	ND	NC	PT	
03.109	F2 Freeze Flag	Off (0) or On (1)		RW	Bit	ND	NC	PT	
03.110	Common Freeze Source 1	Digital Input 4 (0), Digital Input 5 (1), P1 Marker (2), P2 Marker (3), Disabled (4)	Digital Input 4 (0)	RW	Txt				US
03.111	Common Freeze Source 2	Digital Input 4 (0), Digital Input 5 (1), P1 Marker (2), P2 Marker (3), Disabled (4)	Digital Input 4 (0)	RW	Txt				US
03.112	Common Freeze Mode	0000 to 1111	0000	RW	Bin				US
03.113	Freeze Input States	00 to 11		RO	Bin	ND	NC	PT	
03.118	P1 Thermistor Type	DIN44082 (0), KTY84 (1), 0.8mA (2), Encoder (3)	DIN44082 (0)	RW	Txt				US
03.119	P1 Thermistor Feedback	0 to 5000 Ω		RO	Num	ND	NC	PT	
03.120	P1 Thermistor Trip Threshold	0 to 5000 Ω	3300 Ω	RW	Num				US
03.121	P1 Thermistor Reset Threshold	0 to 5000 Ω	1800 Ω	RW	Num				US
03.122	P1 Thermistor Temperature	-50 to 300 °C		RO	Num	ND	NC	PT	
03.123	P1 Thermistor Fault Detection	None (0), Temperature (1), Temp or Short (2)	Temperature (1)	RW	Txt				US
03.127	P2 Speed Feedback	±VM_SPEED		RO	Num	ND	NC	PT	FI
03.128	P2 Revolution/Pole Pitch Counter	0 to 65535		RO	Num	ND	NC	PT	PS
03.129	P2 Position	0 to 65535		RO	Num	ND	NC	PT	PS
03.130	P2 Fine Position	0 to 65535		RO	Num	ND	NC	PT	
03.131	P2 Marker Mode	0000 to 1111	0100	RW	Bin				US
03.132	P2 Marker Flag	Off (0) or On (1)	Off (0)	RW	Bit		NC		
03.133	P2 Rotary Turns Bits	0 to 16	16	RW	Num				US
03.134	P2 Rotary Lines Per Revolution	0 to 100000	4096	RW	Num				US
03.135	P2 Comms Bits	0 to 48	0	RW	Num				US
03.137	P2 Comms Baud Rate	100k (0), 200k (1), 300k (2), 400k (3), 500k (4), 1M (5), 1.5M (6), 2M (7), 4M (8) Baud	300k (2) Baud	RW	Txt				US
03.138	P2 Device type	None (0), AB (1), FD (2), FR (3), EnDat (4), SSI (5), BiSS (6)	None (0)	RW	Txt				US
03.140	P2 Error Detection Level	00000 to 11111	00001	RW	Bin				US
03.141	P2 Auto‑configuration Select	Disabled (0), Enabled (1)	Enabled (1)	RW	Txt				US
03.142	P2 Feedback Filter	Disabled (0), 1ms (1), 2ms (2), 4ms (3), 8ms (4), 16ms (5)	Disabled (0)	RW	Txt				US
03.143	P2 Maximum Reference	0 to 33000	3000	RW	Num				US
03.144	P2 Reference Scaling	0.000 to 4.000	1.000	RW	Num				US
03.145	P2 Reference	±100.0 %		RO	Num	ND	NC	PT	FI
03.146	P2 Reference Destination	0.000 to 59.999	0.000	RW	Num	DE		PT	US
03.147	P2 SSI Incremental Mode	Off (0) or On (1)	Off (0)	RW	Bit				US
03.148	P2 SSI Binary Mode	Off (0) or On (1)	Off (0)	RW	Bit				US
03.149	P2 Additional Power‑up Delay	0.0 to 25.0 s	0.0 s	RW	Num				US
03.150	P2 Feedback Lock	Off (0) or On (1)	Off (0)	RW	Bit				US
03.151	P2 Linear Feedback Select	Off (0) or On (1)	Off (0)	RW	Bit				US
03.152	P2 Linear Comms Pitch	0.001 to 100.000	0.001	RW	Num				US
03.153	P2 Linear Line Pitch	0.001 to 100.000	0.001	RW	Num				US
03.154	P2 Linear Comms And Line Pitch Units	millimetres (0), micrometres (1)	millimetres (0)	RW	Txt				US
03.155	P2 Pole Pitch	0.01 to 1000.00 mm	10.00 mm	RW	Num				US
03.156	P2 Feedback Reverse	Off (0) or On (1)	Off (0)	RW	Bit				US
03.157	P2 Normalisation Turns	0 to 16	16	RW	Num				US
03.158	P2 Normalised Position	-2147483648 to 2147483647		RO	Num	ND	NC	PT	
03.159	P2 Normalised Marker Position	-2147483648 to 2147483647		RO	Num	ND	NC	PT	
03.160	P2 Calculation Time	0 to 20 µs	5 µs	RW	Num				US
03.161	P2 Recovery Time	4 to 100 µs	30 µs	RW	Num				US
03.162	P2 Line Delay Time	0 to 5000 ns		RO	Num	ND	NC	PT	US
03.163	P2 Low Speed Update Rate Active	Off (0) or On (1)		RO	Bit	ND	NC	PT	
03.164	P2 Encoder Protocol Detected	None (0), Hiperface (1), EnDat2.1 (2), EnDat2.2 (3), BiSS (4)		RO	Txt	ND	NC	PT	
03.167	P2 User Comms Enable	0 to 1	0	RW	Num		NC	PT	
03.168	P2 User Comms Transmit Register	0 to 65535	0	RW	Num		NC	PT	

03.169	P2 User Comms Receive Register	0 to 65535	0	RW	Num			NC	PT	
03.171	P2 Error Detected	Off (0) or On (1)		RO	Bit	ND	NC	PT	
03.172	P2 Status	None (0), AB (1), FD (2), FR (3), EnDat (4), SSI (5), BiSS (6), EnDat Alt (7), SSI Alt (8), BiSS Alt (9)		RO	Txt	ND	NC	PT	
03.173	P2 Absolute Turns Recovery Enable	Off (0) or On (1)	Off (0)	RW	Bit				US
03.174	P2 Additional Configuration	0 to 511116116	0	RW	Num				US

RW	Read / Write	RO	Read-only	Bit	Bit parameter	Txt	Text string	Date	Date parameter	Time	Time parameter
Chr	Character parameter	Bin	Binary parameter	IP	IP address	Mac	MAC address	Ver	Version number	SMP	Slot, menu, parameter
Num	Number parameter	DE	Destination	ND	No default value	RA	Rating dependent	NC	Non-copyable	PT	Protected
FI	Filtered	US	User save	PS	Power-down save						

Menu 3 − *Speed Control and Position Feedback*

Mode: RFC‑S

Note that speed feedback is only
shown for option slot 1, but speed
feedback can be selected from
any option slot containing a
position feedback category option
module

Normally the units for speed parameters are rpm for both rotary and linear applications. For a linear application one revolution corresponds to one motor

pole. If the position feedback device that is selected for motor control with *Motor Control Feedback Select* (03.026) is a linear device then if *Linear Speed Select* (01.055) is set to 1 the units for speed parameters are mm/s with the following exceptions:

1. All speed parameters are displayed in rpm if sensorless mode is active, i.e. *Sensorless Mode Active* (03.078) = 1.
2. Speed feedback parameters associated with each feedback interface, i.e. *P1 Speed Feedback* (03.027) for position feedback interface P1, etc., are always displayed in rpm for a rotary device.

Position feedback interfaces

Two position feedback interfaces with associated freeze system are provided. Access to both these interfaces and the encoder simulation output are provided via one 15 way high density connector. There are limitations on the functions that can be provided simultaneously as shown in the table below along with the connections required for each combination of functions.

Functions			Connections							
P1 Position feedback interface	**P2 Position feedback interface**	**Encoder Simulation Output**	**1/2**	**3/4**	**5/6**	**7/8**	**9/10**	**11/12**	**13/14**	**15**
AB Servo FD Servo FR Servo			A1	B1	Z1	U1	V1	W1	PS1	Th
SC Servo			Cos1	Sin1	Z1	U1	V1	W1	PS1	Th
AB, FD, FR	AB, FD, FR		A1	B1	Z1	A2	B2	Z2	PS1	Th
AB, FD, FR	EnDat, BiSS, SSI		A1	B1	Z1	D2	Clk2	Z2	PS1	Th
AB, FD, FR		Full	A1	B1	Z1	AOut	BOut	ZOut	PS1	Th
SC	AB, FD, FR		Cos1	Sin1	Z1	A2	B2	Z2	PS1	Th
SC	EnDat, BiSS, SSI		Cos1	Sin1	Z1	D2	Clk2	Z2	PS1	Th
SC		Full	Cos1	Sin1	Z1	AOut	BOut	ZOut	PS1	Th
Resolver	AB, FD, FR		Cos1	Sin1	Ref1	A2	B2	Z2	PS1	Th
Resolver	EnDat, BiSS, SSI		Cos1	Sin1	Ref1	D2	Clk2	Z2	PS1	Th
Resolver		Full	Cos1	Sin1	Ref1	AOut	BOut	ZOut	PS1	Th
SC Hiperface	AB, FD, FR		Cos1	Sin1	D1	A2	B2	Z2	PS1	Th
SC Hiperface	EnDat, BiSS, SSI		Cos1	Sin1	D1	D2	Clk2	Z2	PS1	Th
SC Hiperface		Full	Cos1	Sin1	D1	AOut	BOut	ZOut	PS1	Th
SC EnDat, SC SSI, SC BiSS	AB, FD, FR No Z marker pulse		Cos1	Sin1	D1	A2	B2	Clk1	PS1	Th
SC EnDat, SC SSI, SC BiSS	EnDat, BiSS, SSI		Cos1	Sin1	D1	D2	Clk2	Clk1	PS1	Th
SC EnDat, SC SSI, SC BiSS		No Z marker pulse	Cos1	Sin1	D1	AOut	BOut	Clk1	PS1	Th
EnDat, BiSS, SSI	AB, FD, FR		D1	Clk1	Z1	A2	B2	Z2	PS1	Th
EnDat, BiSS, SSI	EnDat, BiSS, SSI		D1	Clk1	Z1	D2	Clk2	Z2	PS1	Th
EnDat, BiSS, SSI		Full	D1	Clk1	Z1	AOut	BOut	ZOut	PS1	Th
EnDat, BiSS, SSI	EnDat, BiSS, SSI	No Z marker pulse	D1	Clk1	D2	AOut	BOut	Clk2	PS1	Th
SC SC			Cos1	Sin1	Z1	SCs1	SSn1	Z2	PS1	Th
Commutation Only						U1	V1	W1	PS1	Th

The marker inputs can be used without their associated position feedback as freeze trigger inputs, therefore these are present where possible even if the associated incremental or SINCOS position feedback is not possible. The table below gives the connection functions associated with the codes used.

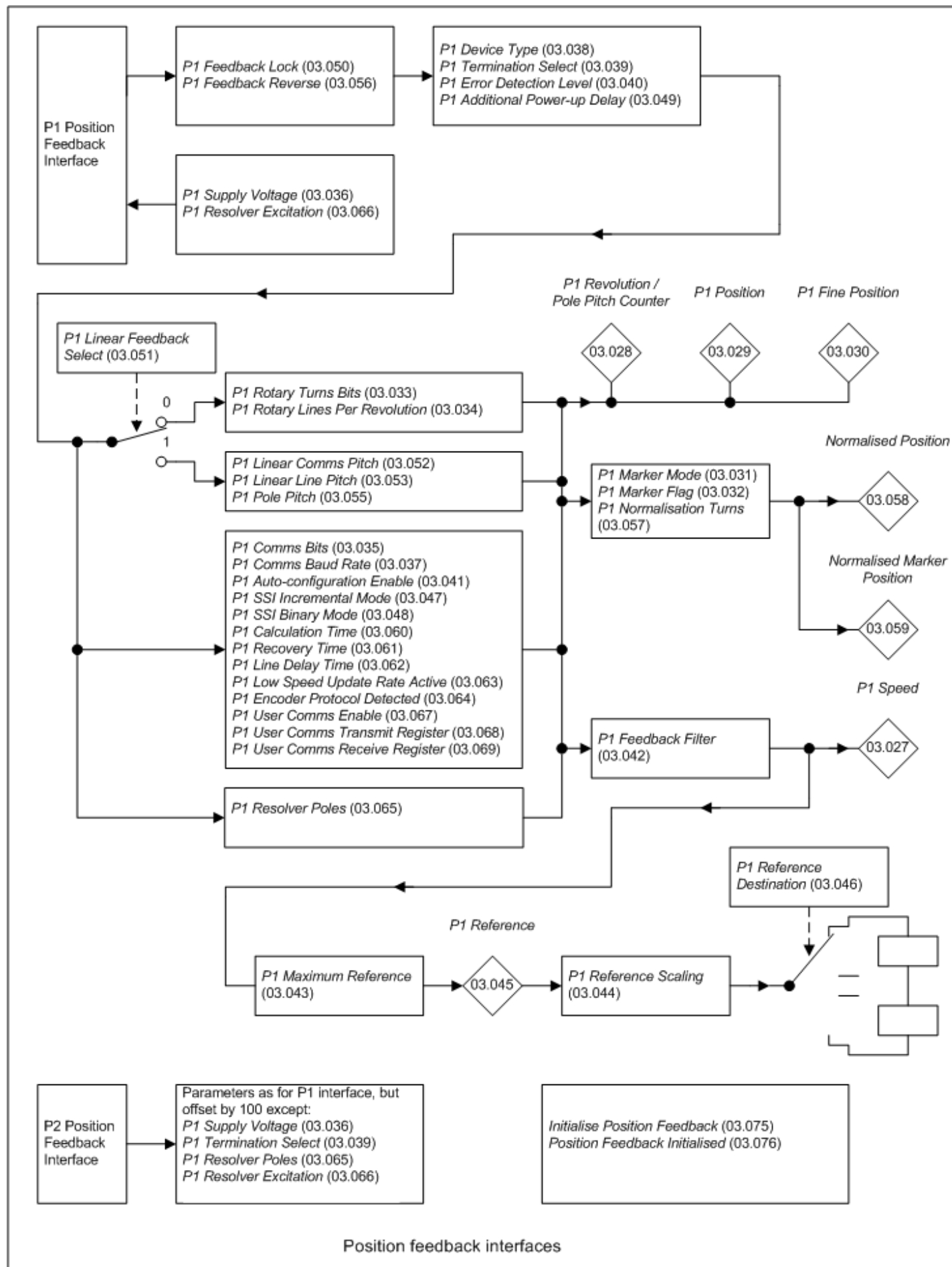| Connection Function	Connection Definition
Position Interface inputs	
A	A input for AB, or AB Servo encoders F input for FD, FD Servo, FR or FR Servo encoders
B	B input for AB, or AB Servo encoders D input for FD or FD Servo encoders R input for FR or FR Servo encoders
Z	Z input for AB, AB Servo, FD, FD Servo, FR, FR Servo, SC encoders Freeze input
U, V, W	Commutation signals for AB Servo, FD Servo, FR Servo, SC Servo or Commutation Only encoders
Cos, Sin	Cosine and Sine inputs for SC, SC EnDat, SC Hiperface, SC SSI or SC Servo encoders Cosine and Sine inputs for resolvers
Ref	Reference output for resolvers
D	Data input/output for SC EnDat, SC Hiperface, SC BiSS, EnDat or BiSS encoders Data input for SC SSI, SSI encoders
Clk	Clock output for SC EnDat, SC BiSS, SC SSI, EnDat, BiSS or SSI encoders
SCs, SSn	Single turn Cosine and Sine signals used to determine the absolute position within one turn
Encoder Simulation Output	
AOut	A output for AB or AB Lock modes F output for FD, FD Lock or FR modes Data output for SSI Gray or SSI Binary modes
BOut	B output for AB or AB Lock modes D output for FD, FD Lock or FR modes Clock input for SSI Gray or SSI Binary modes
Zout	Z output for AB, AB Lock, FD, FD Lock or FR modes
Power Supply and Temperature Measurement	
PS1	Power supply output (13 = Supply, 14 = 0V)
Th	Temperature measurement input

Position and speed measurement timing

The position information is normally taken at a datum point at the start of each current controller task. The current controller sample period varies with switching frequency (see *Auto-tune* (05.012)). At each of these datum points the position of the motor within one revolution is required. This information is used for basic motor control. The speed controller sample period is 250μs for 2, 3, 4, 6 and 12kHz switching and 125μs for 8 and 16kHz switching. At the datum corresponding to each of the speed controller tasks the full encoder position is required and all position feedback calculations and functions are completed. The diagram below shows examples of the datum points for switching frequencies of 12kHz and 16kHz.

Speed and current control task timing
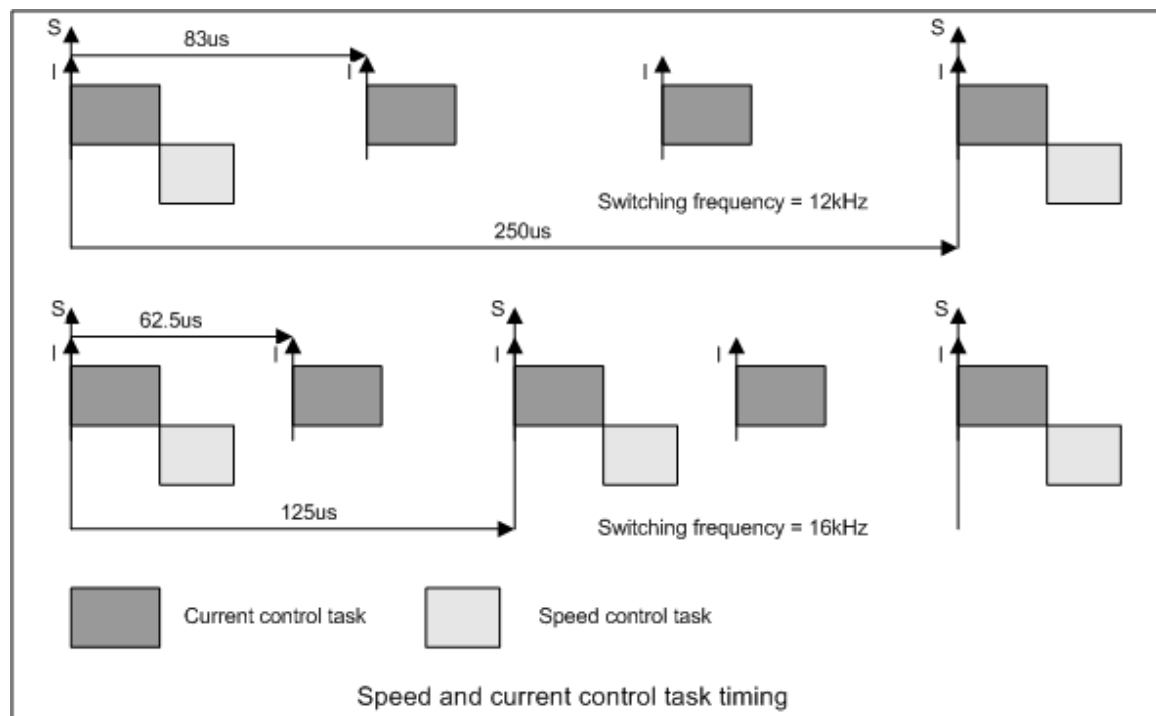
The datum points indicated with "I" are at the start of the current controller tasks and the datum points marked "S" correspond to speed controller tasks. The internal "I" datum points are not visible outside the drive control system. The "S" datum points are used to synchronise with option modules.

P1 Position feedback interface

P1 Revolution / Pole Pitch Counter — 03.028
P1 Position — 03.029
P1 Fine Position — 03.030

P1 Position Feedback Interface

P1 Feedback Lock (03.050)
P1 Feedback Reverse (03.056)

P1 Device Type (03.038)
P1 Termination Select (03.039)
P1 Error Detection Level (03.040)
P1 Additional Power-up Delay (03.049)

P1 Supply Voltage (03.036)
P1 Resolver Excitation (03.066)

P1 Linear Feedback Select (03.051)

P1 Rotary Turns Bits (03.033)
P1 Rotary Lines Per Revolution (03.034)

P1 Linear Comms Pitch (03.052)
P1 Linear Line Pitch (03.053)
P1 Pole Pitch (03.055)

P1 Comms Bits (03.035)
P1 Comms Baud Rate (03.037)
P1 Auto-configuration Enable (03.041)
P1 SSI Incremental Mode (03.047)
P1 SSI Binary Mode (03.048)
P1 Calculation Time (03.060)
P1 Recovery Time (03.061)
P1 Line Delay Time (03.062)
P1 Low Speed Update Rate Active (03.063)
P1 Encoder Protocol Detected (03.064)
P1 User Comms Enable (03.067)
P1 User Comms Transmit Register (03.068)
P1 User Comms Receive Register (03.069)

P1 Marker Mode (03.031)
P1 Marker Flag (03.032)
P1 Normalisation Turns (03.057)

Normalised Position — 03.058

Normalised Marker Position — 03.059

P1 Resolver Poles (03.065)

P1 Feedback Filter (03.042)

P1 Speed — 03.027

P1 Reference Destination (03.046)

P1 Reference

P1 Maximum Reference (03.043)

03.045

P1 Reference Scaling (03.044)

P2 Position Feedback Interface

Parameters as for P1 interface, but offset by 100 except:
P1 Supply Voltage (03.036)
P1 Termination Select (03.039)
P1 Resolver Poles (03.065)
P1 Resolver Excitation (03.066)

Initialise Position Feedback (03.075)
Position Feedback Initialised (03.076)

Position feedback interfaces

P2 Position feedback interface

The P2 position feedback interface duplicates most of the parameter structure and functions of the P1 feedback interface. The P2 interface parameters (03.127 to 03.169) have the same functions as the P1 interface parameters (03.027 to 03.069) except that parameters 03.136, 03.139, 03.162 and 03.163 are not included because the P2 interface does not have its own position feedback power supply, does not support resolvers, and the termination resistors are not selectable and are always enabled. Also *P2 Device type* (03.138) has less possible settings because the P2 interface does not support all the devices supported by the P1 interface.

Priority of the 15-way D-type is assigned in the following order from the highest priority to the lowest.

1. P1 position interface
2. Encoder simulation output
3. P2 position interface

The availability of the P2 position interface on the 15-way D-type on the drive is dependent on type of feedback device selected in *P1 Device Type* (03.038) and the encoder simulation mode selected in *Encoder Simulation Mode* (03.088). *P2 Status* (03.172) shows the status of the P2 position interface depending on the settings in *P2 Device type* (03.138), *P1 Device Type* (03.038), and *Encoder Simulation Mode* (03.088).

Position feedback initialisation

Some position feedback devices need to be initialised before they can provide position feedback information. For details of the initialisation required for each type of device see *Position Feedback Initialized* (03.076). The user can force all position feedback devices connected directly to the drive or to an option module to be initialised (see *Initialise Position Feedback* (03.075)). The drive also automatically initialises all position feedback devices connected to the drive position feedback interfaces immediately after power-up. An attempt is made to initialise any position feedback device that needs to be initialised when a drive reset occurs. This would happen inherently if the drive is tripped and the drive is reset to clear the trip.

It should be noted that the initialised bit for any position feedback interface in *Position Feedback Initialized* (03.076) is set to zero and an *Encoder 7* trip is initiated if any of the parameters given below or the number of poles of the active motor are changed.

P1 Position feedback interface	P2 Position feedback interface
P1 Rotary Turns Bits (03.033)	*P2 Rotary Turns Bits* (03.133)
P1 Rotary Lines Per Revolution (03.034)	*P2 Rotary Lines Per Revolution* (03.134)
P1 Comms Bits (03.035)	*P2 Comms Bits* (03.135)
P1 Comms Baud Rate (03.037)	*P2 Comms Baud Rate* (03.137)
P1 Device Type (03.038)	
P1 Auto-configuration Select (03.041)	*P2 Auto-configuration Select* (03.141)
P1 SSI Incremental Mode (03.047)	*P2 SSI Incremental Mode* (03.147)
P1 SSI Binary Mode (03.048)	*P2 SSI Binary Mode* (03.148)
P1 Linear Feedback Select (03.051)	*P2 Linear Feedback Select* (03.151)
P1 Linear Comms Pitch (03.052)	*P2 Linear Comms Pitch* (03.152)
P1 Linear Line Pitch (03.053)	*P2 Linear Line Pitch* (03.153)
P1 Linear Comms And Line Pitch Units (03.054)	*P2 Linear Comms And Line Pitch Units* (03.154)
P1 Pole Pitch (03.055)	*P2 Pole Pitch* (03.155)
P1 Feedback Reverse (03.056)	*P2 Feedback Reverse* (03.156)
P1 Calculation Time (03.060)	*P2 Calculation Time* (03.160)
P1 Recovery Time (03.061)	*P2 Recovery Time* (03.161)
P1 Resolver Poles (03.065)	
P1 Resolver Excitation (03.066) (Except changing bit 2 only)	
P1 Additional Configuration (03.074)	*P2 Additional Configuration* (03.174)
	P2 Status (03.172)
Motor pole pairs for the currently active motor	Motor pole pairs for the currently active motor

Encoder Simulation Output


Encoder Simulation
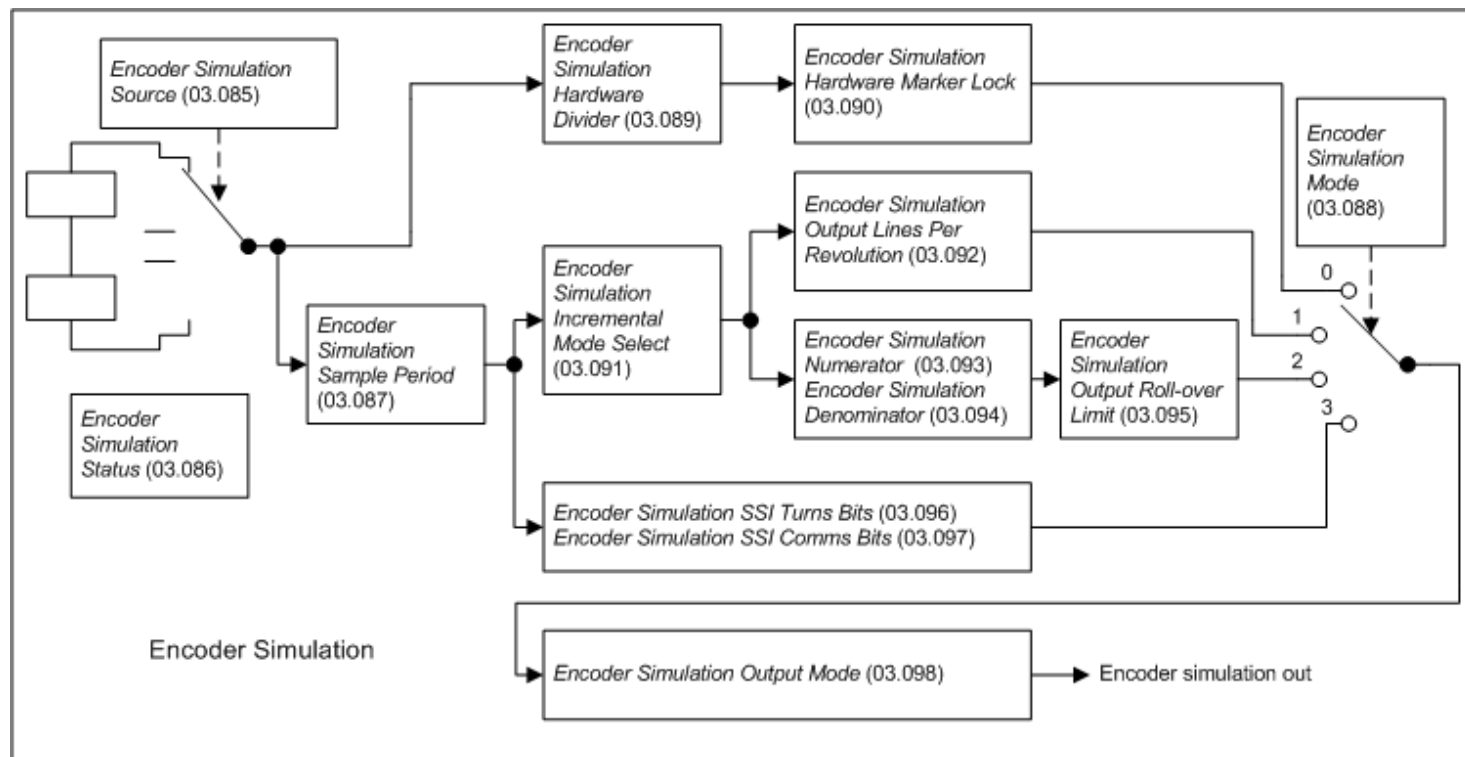
Freeze System

The drive has two freeze functions that can capture the position from either the P1 or P2 position interface in the drive when a freeze trigger event occurs. A common freeze logic system is also provided, so that the freeze trigger events can be combined either to trigger the freeze system in the drive or to generate a freeze trigger for option modules. The freeze system is shown in the diagram below.

Freeze System

Position feedback interface thermistor input
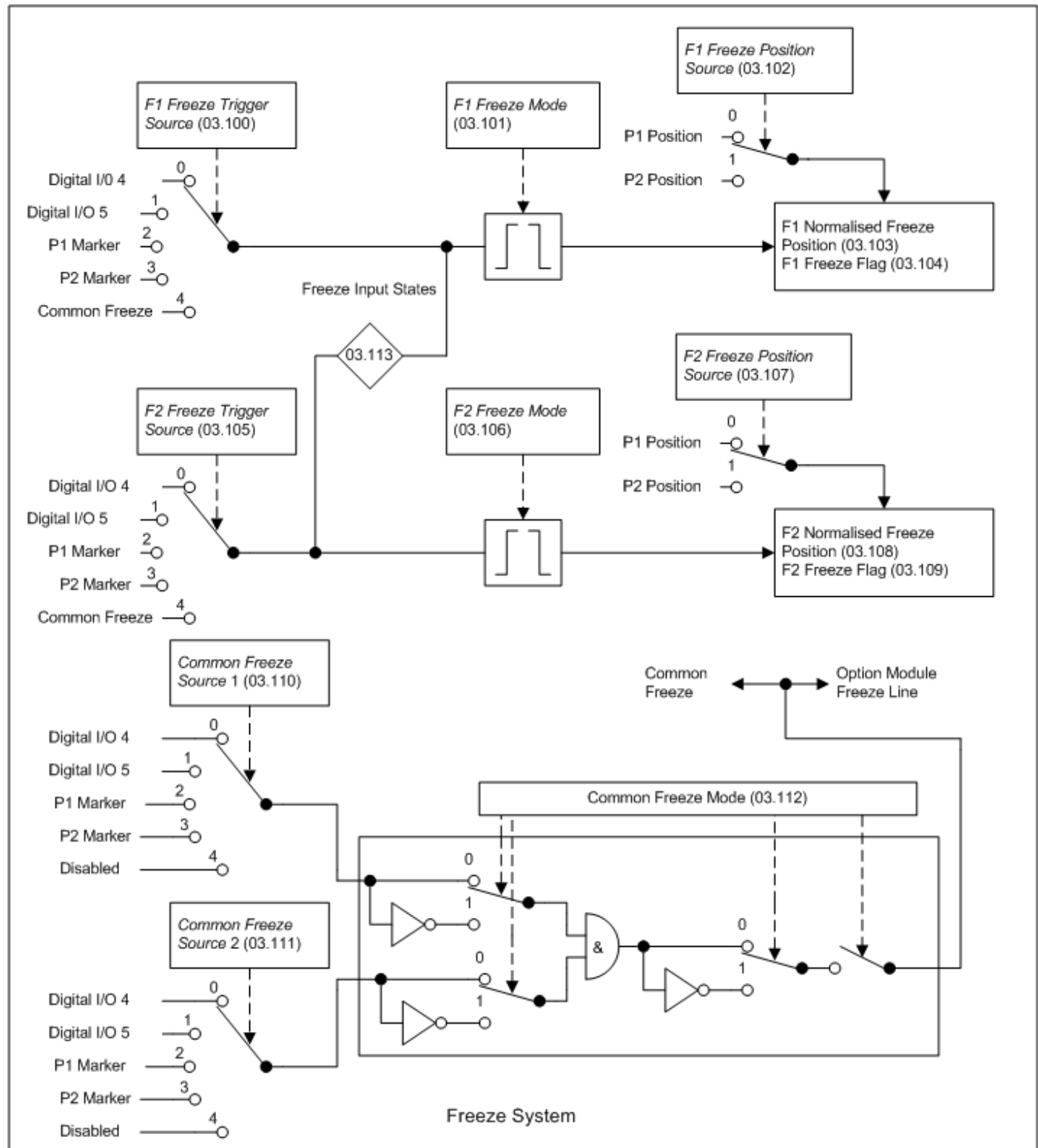
P1 Position feedback interface thermistor input
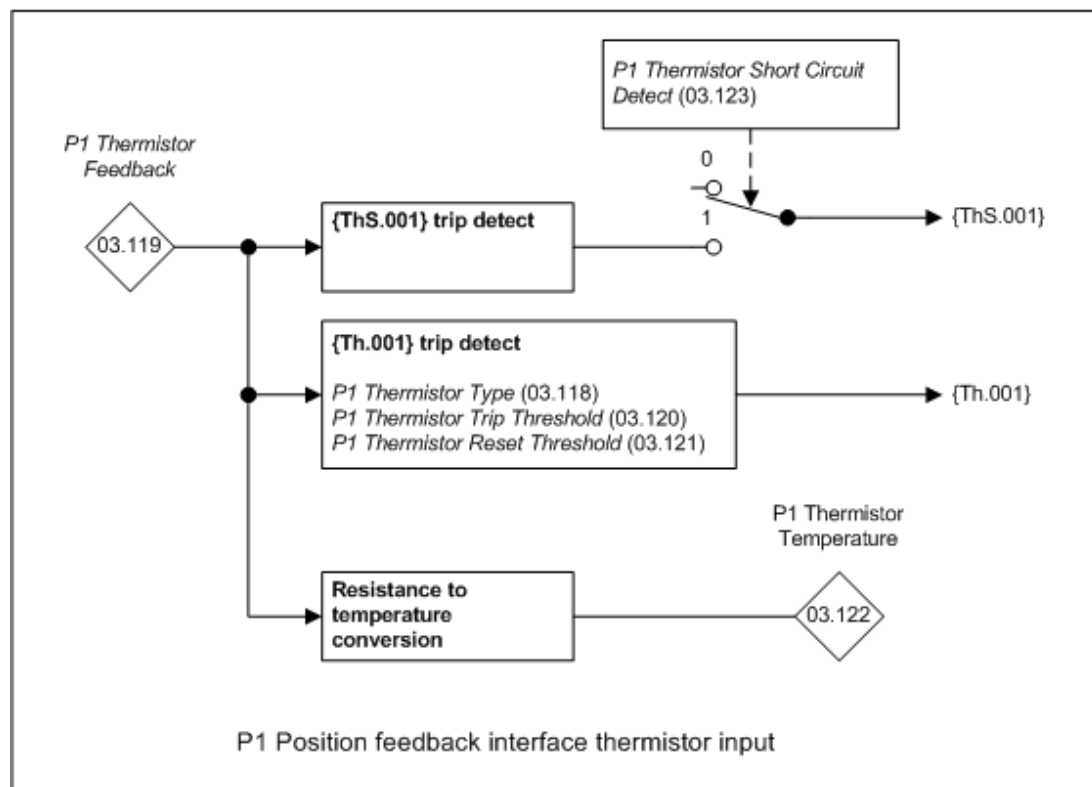
Parameter	03.001 *Final Speed Reference*		
Short description	Shows the reference at the input to the speed controller		
Mode	RFC‑S		
Minimum	−VM_SPEED	Maximum	VM_SPEED
Default		Units	
Type	32 Bit Volatile	Update Rate	4ms write
Display Format	Standard	Decimal Places	1
Coding	RO, FI, VM, ND, NC, PT		

Final Speed Reference (03.001) shows the reference at the input to the speed controller, which is the sum of the *Post Ramp Reference* (02.001) if the ramp output is not disabled and the hard speed reference (if enabled).

Parameter	03.002 *Speed Feedback*		
Short description	Displays the speed feedback from the selected feedback source		
Mode	RFC‑S		
Minimum	−VM_SPEED	Maximum	VM_SPEED
Default		Units	
Type	32 Bit Volatile	Update Rate	4ms write
Display Format	Standard	Decimal Places	1
Coding	RO, FI, VM, ND, NC, PT		

The speed feedback can be selected with *Motor Control Feedback Select* (03.026) to be taken from either of the drive position feedback interfaces or from a position feedback interface in a position feedback category option module. It is also possible to selected sensorless speed feedback with *RFC Feedback Mode* (03.024). *Speed Feedback* (03.002) shows the level of the speed feedback selected for the speed controller.

The FI attribute is set for this parameter, so display filtering is active when this parameter is viewed with one of the drive keypads. The value held in the drive parameter (accessible via comms or an option module) does not include this filter, but is a value that is obtained over a sliding 16ms period to limit the ripple. The speed feedback includes quantisation ripple given by the following equation in rpm:
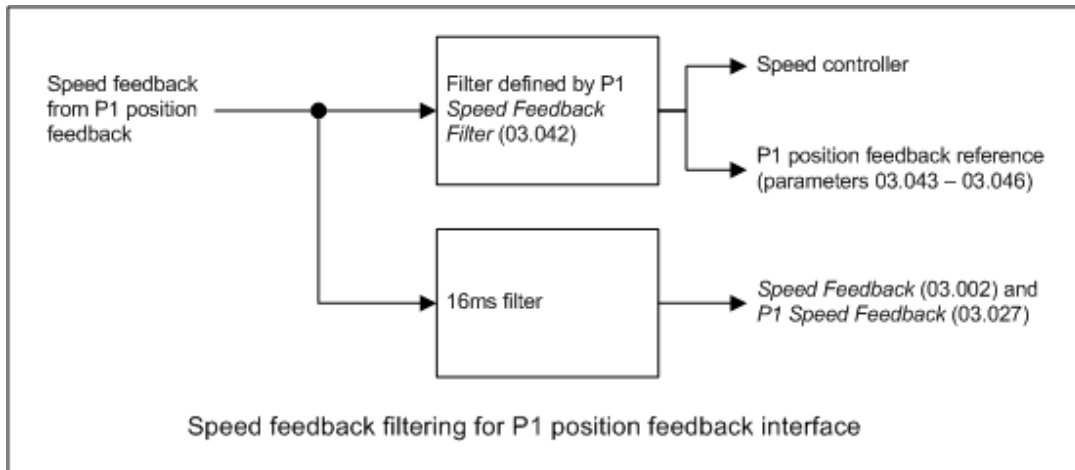
Ripple in *Speed Feedback* (03.002) = 60 / 16ms / Position resolution

The ripple for a linear system is given by the following equation in mm/s:

Ripple in *Speed Feedback* (03.002) = Pole pitch in mm / 16ms / Position resolution

The position resolution for each type of feedback device is defined in the table below.

Position feedback device	Position resolution
AB, AB Servo	4 x lines per revolution or pole pitch
FD, FR, FD Servo, FR Servo	2 x lines per revolution or pole pitch
SC, SC Hiperface, SC EnDat, SC SSI, SC Servo	1024 x sine waves per revolution or pole pitch
EnDat, SSI, BiSS	Comms bits per revolution or pole pitch
Resolver	See *P1 Resolver Excitation* (03.066)

For example the ripple in *Speed Feedback* (03.002) when a 4096 line AB type encoder is used is 0.23rpm. **It should be noted that no filtering is applied to the speed feedback used by the speed controller or for the position feedback reference system unless the feedback filter for that particular interface is activated by putting a non-zero value in the appropriate set up parameter (i.e. *P1 Feedback Filter* (03.042) for the P1 drive position feedback interface).** The diagram below shows the filtering applied to the speed feedback when this is taken from the P1 drive position feedback interface.

Speed feedback filtering for P1 position feedback interface

The speed feedback ripple seen by the speed controller and the position feedback reference is given by the following equations when the filter set up value *P1 Feedback Filter* (03.042) = 0.

Ripple for a rotary system in rpm = 60 / Speed controller sample time / Position resolution

Ripple for a linear system in mm/s = Pole pitch in mm / Speed controller sample time / Position resolution

The speed controller sample time is 250µs. If the filter set up value is non-zero the ripple is given by:

Ripple for a rotary system in rpm = 60 / Filter time / Position resolution

Ripple for a linear system in mm/s = Pole pitch in mm / Filter time / Position resolution

The description so far covers the P1 drive position feedback interface. Similar filtering is provided with the P2 drive position feedback interface and with position feedback interfaces in position feedback category option modules.

It is not advisable to use the speed feedback filter unless it is specifically required for high inertia applications with high controller gains, or if commutation signals alone are used for feedback, because the filter has a non-linear transfer function. It is preferable to use the current demand filters (*Current Reference Filter 1 Time Constant* (04.012) or *Current Reference Filter 2 Time Constant* (04.023)) as these are linear first order filters that provide filtering on noise generated from both the speed reference and the speed feedback. It should be noted that any filtering included within the speed controller feedback loop, either on the speed feedback or the current demand, introduces a delay and limits the maximum bandwidth of the controller for stable operation.

The speed ripple seen by the speed controller can be quite high in some cases, for example with a 4096 line encoder the speed ripple is 14.6rpm with a sample time of 250µs. This causes high frequency torque ripple and acoustic motor noise. These effects increase with the level of speed feedback ripple and with the gains used in the speed controller. Therefore high speed feedback ripple usually limits the maximum possible gain settings for the speed controller, and so a position feedback device with high position resolution is usually required for a system with high dynamic performance or stiffness. **It should be noted that the ripple caused by feedback quantisation and does not define speed feedback resolution. The speed controller accumulates all pulses from the position feedback, and so the speed controller resolution is not limited by the feedback, but by the resolution of the speed reference.**

Parameter	03.003 *Speed Error*		
Short description	Displays the difference betweent the Final Speed Reference and the Speed Feedback		
Mode	RFC‑S		
Minimum	−VM_SPEED	Maximum	VM_SPEED
Default		Units	
Type	32 Bit Volatile	Update Rate	4ms write
Display Format	Standard	Decimal Places	1
Coding	RO, FI, VM, ND, NC, PT		

The speed error is the difference between the final *Final Speed Reference* (03.001) and the *Speed Feedback* (03.002), and does not include the effect of the differential term in the speed controller feedback branch.

Parameter	03.004 *Speed Controller Output*		
Short description	Displays the output from the speed controller		
Mode	RFC‑S		
Minimum	−VM_TORQUE_CURRENT	Maximum	VM_TORQUE_CURRENT
Default		Units	%
Type	16 Bit Volatile	Update Rate	4ms write
Display Format	Standard	Decimal Places	1
Coding	RO, FI, VM, ND, NC, PT		

The output of the speed regulator is a torque demand given as a percentage of rated motor torque. It should be noted that this will be modified to take into account in the level of motor flux if field weakening is active before it is converted into the *Final Current Reference* (04.004).

Parameter	03.005 *Zero Speed Threshold*		
Short description	Set to the required zero speed threshold		
Mode	RFC‑S		
Minimum	0	Maximum	200
Default	5	Units	
Type	8 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW, BU		

If the *Speed Feedback* (03.002) is at or below the level defined by this parameter in either direction *Zero Speed* (10.003) = 1, otherwise *Zero Speed* (10.003) = 0.

Parameter	03.006 *At Speed Lower Limit*		
Short description	Set to the required minimum at speed threshold		
Mode	RFC‑S		
Minimum	0	Maximum	33000
Default	5	Units	
Type	16 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW, BU		

At Speed (10.006) is set if the *Speed Feedback* (03.002) is on the boundaries or within the at speed window. *Above Set Speed* (10.007) and *Below Set Speed* (10.005) are set if the feedback is above or below the window respectively.

If *Absolute At Speed Select* (03.009) = 0 reference window mode is used.
The "at speed" condition is true if,

> (|*Pre-ramp Reference* (01.003)| - *At Speed Lower Limit* (03.006)) ≤ |*Speed Feedback* (03.002)| ≤ (|*Pre-ramp Reference* (01.003)| + *At Speed Upper Limit* (03.007))

(If the lower limit is less than zero then zero is used as the lower limit.)

If *Absolute At Speed Select* (03.009) = 1 absolute window mode is used.
The "at speed" condition is true if,

> *At Speed Lower Limit* (03.006) ≤ |*Speed Feedback* (03.002)| ≤ *At Speed Upper Limit* (03.007)

Parameter	03.007 *At Speed Upper Limit*		
Short description	Set to the required maximum at speed threshold		
Mode	RFC‑S		
Minimum	0	Maximum	33000
Default	5	Units	
Type	16 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW, BU		

See *At Speed Lower Limit* (03.006).

Parameter	03.008 *Over Speed Threshold*		
Short description	Set to the required over speed threshold		
Mode	RFC‑S		
Minimum	0	Maximum	33000
Default	0	Units	
Type	16 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW, BU		

If *Over Speed Threshold* (03.008) is set to a non-zero value it defines the over speed threshold. If the *Speed Feedback* (03.002) exceeds this threshold in either direction an *Over Speed* trip is produced. If *Over Speed Threshold* (03.008) is set to 0.0 the threshold is based on the variable minimum/maximum for the references and is equal to 1.2 x VM_SPEED_FREQ_REF[MAX]. As the over-speed trip provides the ultimate protection against against the motor

operating beyond the maximum allowable speed, the trip function is time deterministic and will disable the drive within 4ms of the over-speed condition being detected.

The motor speed and the motor voltage can be monitored to detect if the motor is accelerating in an uncontrolled way because position feedback is being used and the *Position Feedback Phase Angle* (03.025) has not been set up correctly. If the *Over Speed Threshold* (03.008) = 0 then position feedback phase angle error monitoring is enabled and a *Phasing Error* trip is initiated if a failure is detected. If the *Over Speed Threshold* (03.008) is not equal to 0 this feature is disabled, and the over-speed trip is the only protection against high motor speed due to an incorrect value of *Position Feedback Phase Angle* (03.025). It should be noted that phase angle error monitoring is not possible with high saliency motors, and so if *Active Saliency Torque Mode* (05.066) = 1 then phase angle error detection is suppressed and the over-speed trip must be used to provide protection.

If sensorless control is being used, a *Phasing Error* trip is also initiated if loss of control is detected. This trip is also suppressed if *Over Speed Threshold* (03.008) is set to a non-zero value.

Parameter	03.009 *Absolute At Speed Select*		
Short description	Indicates when the motor is running at speed		
Mode	RFC-S		
Minimum	0	Maximum	1
Default	0	Units	
Type	1 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW		

See *At Speed Lower Limit* (03.006).

Parameter	03.010 *Speed Controller Proportional Gain Kp1*		
Short description	Defines the proportional gain for the speed controller		
Mode	RFC-S		
Minimum	0.0000	Maximum	200.0000
Default	0.0100	Units	s/rad
Type	32 Bit User Save	Update Rate	4ms read
Display Format	Standard	Decimal Places	4
Coding	RW		

The diagram below shows a generalised representation of the speed controller. The controller includes a feed forward proportional gain (Kp), a feed forward integral gain (Ki), and a differential feedback gain (Kd). The description here refers to the first set of gains for motor map 1 (*Speed Controller Proportional Gain Kp1* (03.010), *Speed Controller Integral Gain Ki1* (03.011) and *Speed Controller Differential Feedback Gain Kd1* (03.012)). See *Speed Controller Gain Select* (03.016) on how to select a different set of gains.
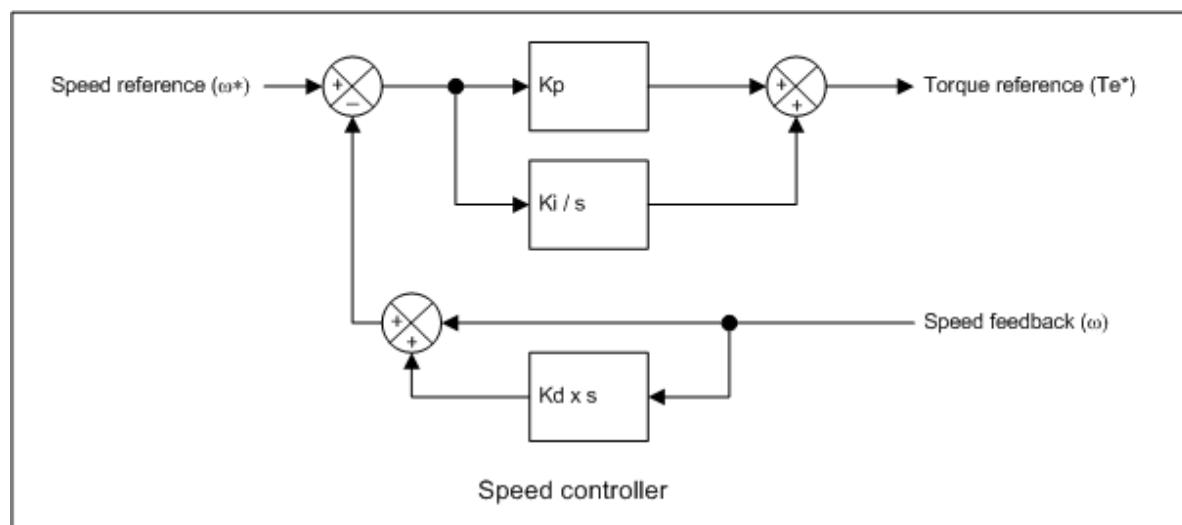
Speed controller

Proportional gain (Kp) - *Speed Controller Proportional Gain Kp1* (03.010)
If Kp is non-zero and Ki is zero the controller will only have a proportional term, and there must be a speed error to produce a torque reference. Therefore, as the motor load increases there will be a difference between the reference and actual speeds. This effect, called regulation, depends on the level of the proportional gain, the higher the gain the smaller the speed error for a given load. If the proportional gain is too high either the acoustic noise produced due to speed feedback quantisation becomes unacceptable, or the closed-loop stability limit is reached.

Integral gain (Ki) - *Speed Controller Integral Gain Ki1* (03.011)
The integral gain is provided to prevent speed regulation. The error is accumulated over a period of time and used to produce the necessary torque reference without any speed error. Increasing the integral gain reduces the time taken for the speed to reach the correct level and increases the stiffness of the system, i.e. it reduces the positional displacement produced by applying a load torque to the motor. Unfortunately increasing the integral gain also reduces the system damping giving overshoot after a transient. For a given integral gain the damping can be improved by increasing the proportional gain. A compromise must be reached where the system response, stiffness and damping are all adequate for the application. The integral term is implemented in the form of ∑(Ki x error), and so the integral gain can be changed when the controller is active without causing large transients on the torque reference.

Differential gain (Kd) - *Speed Controller Differential Feedback Gain Kd1* (03.012)
The differential gain is provided in the feedback of the speed controller to give additional damping. The differential term is implemented in a way that does not introduce excessive noise normally associated with this type of function. Increasing the differential term reduces the overshoot produced by under-damping, however for most applications the proportional and integral gains alone are sufficient. It should be noted that the differential term is limited internally so that it is ineffective if speed in rpm x Kd x Ki is greater than 170.

To analyse the performance of the speed controller it may be represented as an s-domain model as shown below.

Speed controller (s domain)
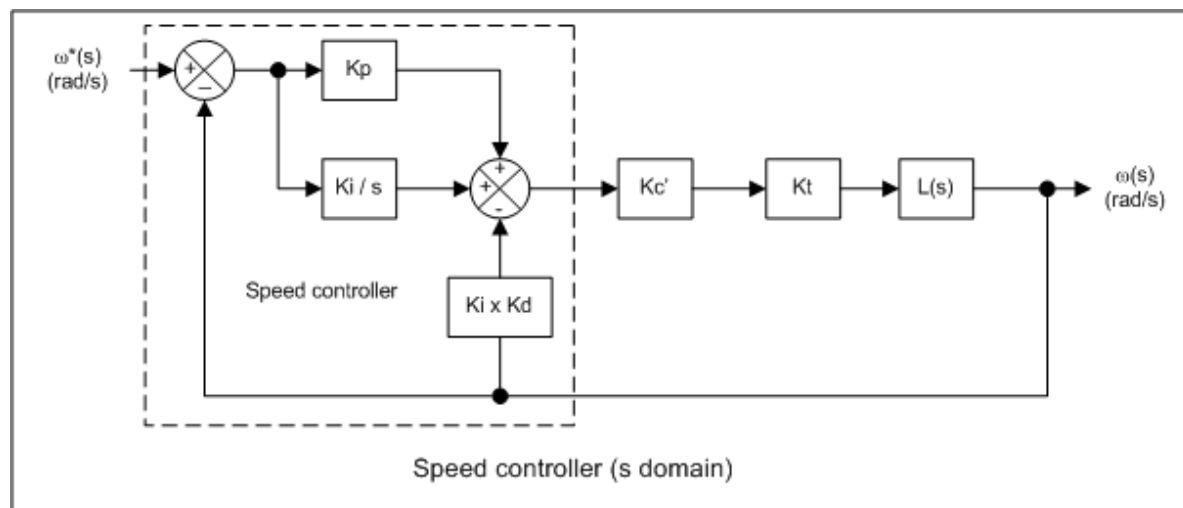
Kc' is the conversion between the speed controller output and the torque producing current reference. A value of unity at the output of the speed controller gives a torque producing current equal to Kc'. The drive automatically compensates the torque producing current reference for flux variations in field weakening, and so Kc' can be assumed to have a constant value even in field weakening. Kc' = *Full Scale Current Kc* (11.061) x 0.45.

Kt is the torque constant of the motor (i.e. torque in Nm per amp of torque producing current). This value is normally available from the manufacturer for a permanent magnet motor, however, for induction motors the value must be calculated from the motor parameters. In RFC-A mode this calculation is performed by the drive and the result is stored in *Torque Per Amp* (05.032)

L(s) is the transfer function of the load.

The speed controller calculations are provided for a rotary application. However, for a linear application it is possible to set *Torque Per Amp* (05.032) to the force per amp and the *Motor And Load Inertia* (03.018) to the mass, and all the rotary system equations still apply.

It should be noted that the gain levels are compatible with those in Unidrive SP. The internal resolution of the intergral gain parameter is twice that of Unidrive SP. In most applications this makes no difference to the performance, however, with Unidrive SP the internal value is zero (the integral term disabled) if the user parameter is less than 0.05. In Unidrive M the internal integral gain would be zero if *Speed Controller Integral Gain Ki1* (03.011) is less than 0.03. However, if *Speed Controller Integral Gain Ki1* (03.011) is non-zero and less than 0.03 (i.e. 0.01 or 0.02) the internal value is one, so that the integral term remains active, unless the user deliberately disables this term by setting *Speed Controller Integral Gain Ki1* (03.011) to zero.

Parameter	03.011 *Speed Controller Integral Gain Ki1*		
Short description	Defines the integral gain for the speed controller		
Mode	RFC‑S		
Minimum	0.00	Maximum	655.35
Default	1.00	Units	s²/rad
Type	16 Bit User Save	Update Rate	4ms read
Display Format	Standard	Decimal Places	2
Coding	RW, BU		

See *Speed Controller Proportional Gain Kp1* (03.010).

Parameter	03.012 *Speed Controller Differential Feedback Gain Kd1*		
Short description	Defines the differential gain for the speed controller		
Mode	RFC‑S		
Minimum	0.00000	Maximum	0.65535
Default	0.00000	Units	1/rad
Type	16 Bit User Save	Update Rate	4ms read
Display Format	Standard	Decimal Places	5
Coding	RW, BU		

See *Speed Controller Proportional Gain Kp1* (03.010).

Parameter	03.013 *Speed Controller Proportional Gain Kp2*		
Short description	Defines a 2nd proportional gain for the speed controller		
Mode	RFC‑S		
Minimum	0.0000	Maximum	200.0000
Default	0.0100	Units	s/rad
Type	32 Bit User Save	Update Rate	4ms read
Display Format	Standard	Decimal Places	4
Coding	RW		

See *Speed Controller Proportional Gain Kp1* (03.010).

Parameter	03.014 *Speed Controller Integral Gain Ki2*		
Short description	Defines a 2nd integral gain for the speed controller		
Mode	RFC‑S		
Minimum	0.00	Maximum	655.35
Default	1.00	Units	s²/rad
Type	16 Bit User Save	Update Rate	4ms read
Display Format	Standard	Decimal Places	2
Coding	RW, BU		

See *Speed Controller Proportional Gain Kp1* (03.010).

Parameter	03.015 *Speed Controller Differential Feedback Gain Kd2*		
Short description	Defines a 2nd differential gain for the speed controller		
Mode	RFC‑S		
Minimum	0.00000	Maximum	0.65535
Default	0.00000	Units	1/rad
Type	16 Bit User Save	Update Rate	4ms read
Display Format	Standard	Decimal Places	5
Coding	RW, BU		

See *Speed Controller Proportional Gain Kp1* (03.010).

Parameter	03.016 *Speed Controller Gain Select*		
Short description	Set to 1 to enable the 2nd set of speed controller proportional, integral and differential gains		
Mode	RFC‑S		
Minimum	0	Maximum	1
Default	0	Units	
Type	1 Bit User Save	Update Rate	4ms read
Display Format	Standard	Decimal Places	0
Coding	RW		

If *Speed Controller Gain Select* (03.016) = 0 then Kp1, Ki1 and Kd1 are used as the speed controller gains. These gains are given by
Speed Controller Proportional Gain Kp1 (03.010), *Speed Controller Integral Gain Ki1* (03.011) and *Speed Controller Differential Feedback Gain Kd1*
(03.012) if motor map 1 is selected (i.e. *Select Motor 2 Parameters* (11.045) = 0), or *M2 Speed Controller Proportional Gain Kp1* (21.017),
M2 Speed Controller Integral Gain Ki1 (21.018) and *M2 Speed Controller Differential Feedback Gain Kd1* (21.019) if motor map 2 is selected (i.e.
Select Motor 2 Parameters (11.045) = 1). If *Speed Controller Gain Select* (03.016) = 1 then Kp2, Ki2 and Kd2 are used as the speed controller gains.
These gains are given by *Speed Controller Proportional Gain Kp2* (03.013), *Speed Controller Integral Gain Ki2* (03.014) and
Speed Controller Differential Feedback Gain Kd2 (03.015). When *Speed Controller Gain Select* (03.016) is changed the gains are changed smoothly
between the old and new values over a period of 250ms. This allows the system gains to be switched between two different sets of values without causing
significant torque transients.

Parameter	03.017 *Speed Controller Set-up Method*		
Short description	Defines how the speed controller is set up		
Mode	RFC‑S		
Minimum	0	Maximum	7
Default	0	Units	
Type	8 Bit User Save	Update Rate	1s read
Display Format	Standard	Decimal Places	0
Coding	RW, TE		

Value	*Text*
0	Disabled
1	Bandwidth
2	Comp Angle
3	Kp Gain Times 16
4	Low Performance
5	Std Performance
6	High Performance
7	First Order

0: Disabled
When *Speed Controller Set-up Method* (03.017) is at its default value of 0, its functions are disabled and it has no effect.

1: Bandwidth set-up
If the load is predominantly a constant inertia and constant torque, the drive can calculate the required speed loop gain values, provided
the *Motor And Load Inertia* (03.018) and the *Torque Per Amp* (05.032) are set-up correctly. If *Speed Controller Set-up Method* (03.017) = 1 the gain
values are calculated to give the required *Bandwidth* (03.020) and *Damping Factor* (03.021). The calculated values for Kp and Ki are written
to *Speed Controller Proportional Gain Kp1* (03.010) and *Speed Controller Integral Gain Ki1* (03.011) once per second.
The *Speed Controller Differential Feedback Gain Kd1* (03.012) is not affected. The gains are calculated from a linear model assuming a pure inertia load,
not including unwanted delays in the speed and current controllers. The following equations are used by the drive to calculate the gains.

$$Ki = J / (Kc' \times Kt) \times (2\pi \times \omega bw / Kbw)^2$$

$$Kp = 2 \; \xi \; \sqrt{[\; (Ki \times J) / (Kc' \times Kt) \;]}$$

where:
Kc' = *Full Scale Current Kc* (11.061) x 0.45
J = *Motor And Load Inertia* (03.018)
Kt = *Torque Per Amp* (05.032)
ωbw = *Bandwidth* (03.020)
ξ = *Damping Factor* (03.021)
$Kwb = \sqrt{[\; (2\xi^2 + 1) + \sqrt{(\; (2\xi^2 + 1)^2 + 1) \;}\;]}$

2: Compliance angle set-up

If *Speed Controller Set-up Method* (03.017) = 2 the speed controller gains are set up based on the required *Compliance Angle* (03.019) and *Damping Factor* (03.021)
 based on the following equations.

$$Ki = 1 / \alpha comp(rs^{-1})$$

$$Kp = 2 \; \xi \; \sqrt{[\; (Ki \times J) / (Kc' \times Kt) \;]}$$

where:
Kc' = *Full Scale Current Kc* (11.061) x 0.45
J = *Motor And Load Inertia* (03.018)
Kt = *Torque Per Amp* (05.032)
αcomp = *Compliance Angle* (03.019)
ξ = *Damping Factor* (03.021)

3: Kp gain times 16

If *Speed Controller Set-up Method* (03.017) = 3 the selected proportional gain used by the drive is multiplied by 16. This feature was provided in Unidrive SP because the range of the proportional gain parameters was limited. The range has now been increased to allow higher gains to be selected, and so this feature is no longer necessary, but is provided for compatibility with Unidrive SP. It should be noted that if this feature is used the value of gain used by the speed controller (i.e. *Speed Controller Proportional Gain Kp1* (03.010) x 16) is limited internally to the maximum for *Speed Controller Proportional Gain Kp1* (03.010).

4-6: Low, Standard or High performance

If *Speed Controller Set-up Method* (03.017) is set to a value from 4 to 6 the *Speed Controller Proportional Gain Kp1* (03.010) and *Speed Controller Integral Gain Ki1* (03.011) are automatically set up to give the bandwidths given in the table below and a damping factor of unity. These settings give low, standard or high performance.

Speed Controller Set-up Method (03.017)	Performance	Bandwidth
4	Low	5Hz
5	Standard	25Hz
6	High	100Hz

7: First order characteristic

If *Speed Controller Set-up Method* (03.017) = 7 then *Speed Controller Proportional Gain Kp1* (03.010), *Speed Controller Integral Gain Ki1* (03.011) and *Speed Controller Differential Feedback Gain Kd1* (03.012) are set up to give a closed-loop speed controller response that approximates to a first order system with a transfer function of 1 / (sτ + 1), where τ = 1/ωbw and ωbw = 2π x *Bandwidth* (03.020). In this case the damping factor is meaningless, and *Damping Factor* (03.021) and *Compliance Angle* (03.019) have no effect. The following equations are used by the drive to calculate the gains.

$$Ki = J / (Kc' \times Kt) \times (2\pi \times \omega bw / 2)^2$$

$$Kp = 2 \sqrt{[\; (Ki \times J) / (Kc' \times Kt) \;]}$$

$$Kd = Kp / 4Ki$$

where:
Kc' = *Full Scale Current Kc* (11.061) x 0.45
J = *Motor And Load Inertia* (03.018)
Kt = *Torque Per Amp* (05.032)
ωbw = *Bandwidth* (03.020)

Parameter	03.018 *Motor And Load Inertia*		
Short description	Defines the inertia of the motor and the load for use in calculating the speed controller gains		
Mode	RFC‑S		
Minimum	0.00000	Maximum	1000.00000
Default	0.00000	Units	kgm²
Type	32 Bit User Save	Update Rate	1s read
Display Format	Standard	Decimal Places	5
Coding	RW		

The *Motor And Load Inertia* (03.018) represents the total inertia driven by the motor. This is used to set the speed controller gains (see *Speed Controller Set-up Method* (03.017)) and to provide torque feed forwards during acceleration when required (see *Torque Mode Selector* (04.011)).

It is possible to measure the inertia as part of the auto-tune process (see *Auto-tune* (05.012)).

Parameter	03.019 *Compliance Angle*		
Short description	Defines the required angular displacement when the drive delivers a torque producing current equivalent to drive rated current		
Mode	RFC‑S		
Minimum	0.0	Maximum	360.0
Default	4.0	Units	°
Type	16 Bit User Save	Update Rate	1s read
Display Format	Standard	Decimal Places	1
Coding	RW		

The *Compliance Angle* (03.019) is the required angular displacement when the drive delivers a torque producing current equivalent to Kc',
i.e. *Full Scale Current Kc* (11.061) x 0.45, with no field weakening. The value of this parameter is used to automatically determine the speed controller gains if required. See *Speed Controller Set-up Method* (03.017).

Parameter	03.020 *Bandwidth*		
Short description	Defines the theoretical 3dB point on the closed-loop gain characteristic of the speed controller as a second order system		
Mode	RFC‑S		
Minimum	1	Maximum	1000
Default	10	Units	Hz
Type	16 Bit User Save	Update Rate	1s read
Display Format	Standard	Decimal Places	0
Coding	RW		

The *Bandwidth* (03.020) is defined as the theoretical 3dB point on the closed-loop gain characteristic of the speed controller as a second order system. At this point the phase shift is approximately 60°. The value of *Bandwidth* (03.020) is used to automatically determine the speed controller gains if required. See *Speed Controller Set-up Method* (03.017).

Parameter	03.021 *Damping Factor*		
Short description	Defines the factor for the response of the system to a torque transient		
Mode	RFC‑S		
Minimum	0.0	Maximum	10.0
Default	1.0	Units	
Type	8 Bit User Save	Update Rate	1s read
Display Format	Standard	Decimal Places	1
Coding	RW		

Damping Factor (03.021) defines this factor for the response of the system to a torque transient, and so if the *Damping Factor* (03.021) is unity, the response to a load torque transient is critically damped. The closed-loop step response of the speed controller gives approximately 10% overshoot with unity damping factor. *Damping Factor* (03.021) is used to automatically determine the speed controller gains if required. See *Speed Controller Set-up Method* (03.017).

Parameter	03.022 *Hard Speed Reference*		
Short description	Defines a speed reference value which does not pass through the ramp system		
Mode	RFC‑S		
Minimum	−VM_SPEED_FREQ_REF	Maximum	VM_SPEED_FREQ_REF
Default	0.0	Units	
Type	32 Bit User Save	Update Rate	250µs read
Display Format	Standard	Decimal Places	1
Coding	RW, VM		

The *Hard Speed Reference* (03.022) is a reference value which does not pass through the ramp system, but is added directly to the *Post Ramp Reference* (02.001).The *Hard Speed Reference* (03.022) is only added when selected by the *Hard Speed Reference Select* (03.023) and the *Reference On* (01.011) is active.

Parameter	03.023 *Hard Speed Reference Select*		
Short description	Set to 1 to enable the use of the hard speed reference		
Mode	RFC‑S		
Minimum	0	Maximum	1
Default	0	Units	
Type	1 Bit User Save	Update Rate	4ms read
Display Format	Standard	Decimal Places	0
Coding	RW		

See *Hard Speed Reference* (03.022).

Parameter	03.024 *RFC Feedback Mode*		
Short description	Defines the method of feedback used for the speed controller		
Mode	RFC‑S		
Minimum	0	Maximum	3
Default	0	Units	
Type	8 Bit User Save	Update Rate	4ms read
Display Format	Standard	Decimal Places	0
Coding	RW, TE		

Value	*Text*
0	Feedback
1	Sensorless
2	Feedback NoMax
3	Sensorless NoMax

RFC Feedback Mode (03.024), which can be changed even when the motor is running, selects the feedback method used to provide position feedback to control the motor. The actual feedback method being used at any time is given by *Sensorless Mode Active* (03.078). When sensorless mode is used, a filter with a 4ms time constant is automatically included in the speed feedback as this is required for this system to operate correctly. The possible speed controller bandwidth will be reduced by a factor of approximately 10 compared with the bandwidth possible with a position feedback device. The maximum and minimum for the speed references are limited by the VM_POSITIVE_REF_CLAMP variable minimum/maximum which prevents the speed from exceeding the level where the position feedback cannot be interpreted correctly. This limit is disabled if *RFC Feedback Mode* (03.024) is 2 or 3, so that it is possible to change between operation with or without position feedback if the speed range needs to be extended beyond the limit of the position feedback device. Care should be taken not to exceed a speed that would damage the position feedback device.

0: Position feedback
RFC mode is active using the position feedback selected *Motor Control Feedback Select* (03.026) to control the motor.

1: Sensorless
RFC mode using a sensorless algorithm to provide position feedback, is used to control the motor.

2: Position feedback with no maximum speed limit
RFC mode with position feedback selected with *Motor Control Feedback Select* (03.026)) is used to control the motor. The maximum reference limit is disabled.

3: Sensorless with no maximum speed limit
RFC mode using a sensorless algorithm to provide position feedback, is used to control the motor. The maximum reference limit is disabled.

It should be noted for sensorless mode to operate correctly using the injection method (*RFC Low Speed Mode* (05.064)) there is a mimum difference required between Ld and Lq in the motor otherwise a trip is initated. See *Inductance* for details.

| Parameter	03.025 *Position Feedback Phase Angle*		
Short description	Defines the phase angle between the rotor flux and the feedback position and must be set up correctly for the drive to control the motor correctly		
Mode	RFC‑S		
Minimum	0.0	Maximum	359.9
Default		Units	°
Type	16 Bit User Save	Update Rate	4ms read
Display Format	Standard	Decimal Places	1
Coding	RW, ND		

The phase angle between the rotor flux and the feedback position must be set up correctly for the drive to control the motor correctly. If the phase angle is known it can be set in *Position Feedback Phase Angle* (03.025) by the user. Alternatively the drive can automatically measure the phase angle by performing a phasing test (see *Auto-tune* (05.012)). When the test is complete the new value is automatically written to *Position Feedback Phase Angle* (03.025). *Position Feedback Phase Angle* (03.025) can be modified at any time and becomes effective immediately. *Position Feedback Phase Angle* (03.025) has a factory default value of 0.0, but is not affected when defaults are loaded by the user.

The alignment required for zero position feedback phase angle (i.e. *Position Feedback Phase Angle* (03.025) = 0.0) is given below for different feedback devices. Forward rotation of the motor is produced when Vu leads Vv leads Vw. Although it is not essential, forward rotation of a motor is normally defined as clockwise when looking at the motor shaft end. When the motor is rotating forwards the motor speed is shown as positive and the position increases.

AB Servo, FD Servo, FR Servo, SC Servo
The alignment required between the no-load motor voltages and the commutation signals for *Position Feedback Phase Angle* (03.025) = 0.0 is shown in the diagram below. It should be noted that if the encoder is advanced (i.e. the UVW signals are moved to the right with respect to the voltages) the angle in *Position Feedback Phase Angle* (03.025) is increased from zero. If the encoder is retarded the angle changes to 359.9 and then reduces towards zero.

Vu   Vv   Vw

Vuv   Vvw   Vwu

Encoder commutation
signals

U

V

W

Position feedback phase angle alignment with commutation signals
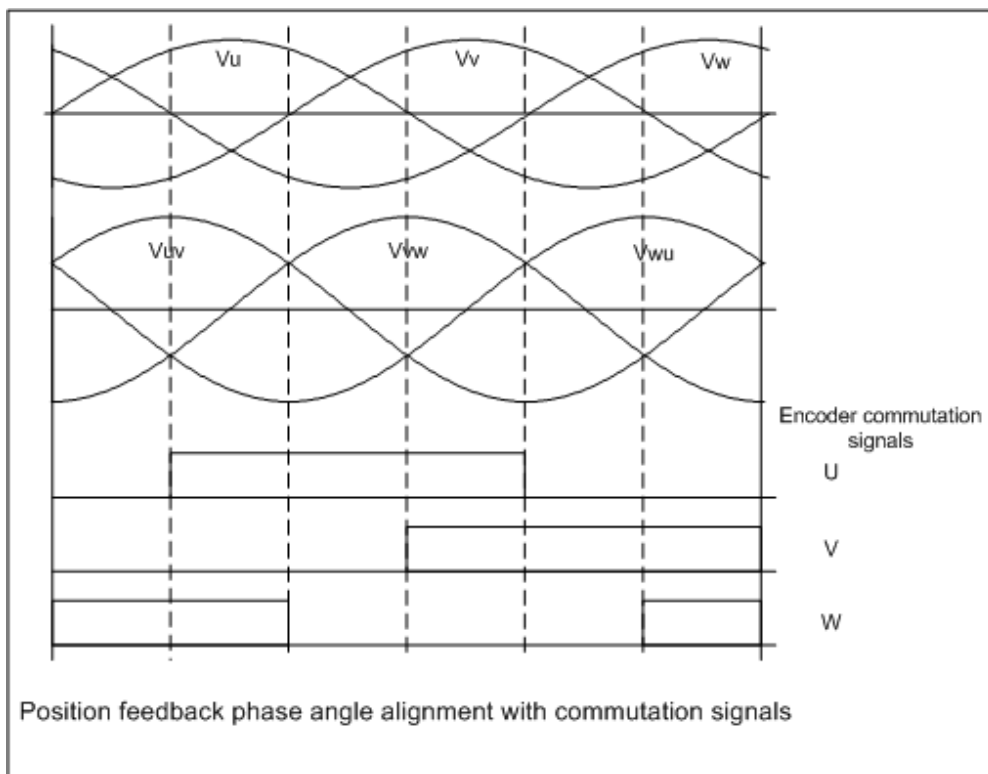
The encoder can be aligned statically by connecting the motor to a d.c. power supply as shown.
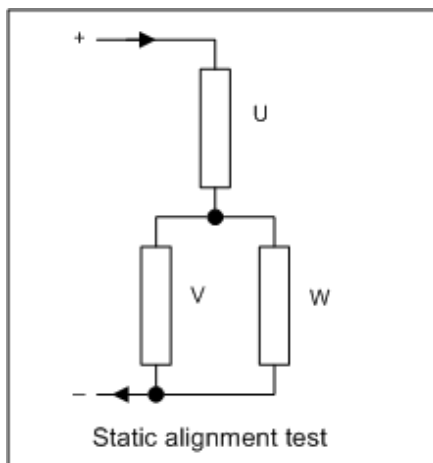
+

U

V   W

−

Static alignment test

The motor will move to one of a number of positions defined by the number of motor pole pairs (i.e. 3 positions for a six pole motor, etc.). The encoder should be adjusted so that the U commutation signal is high, W is low and V is toggling in one of these positions.

Any other feedback device
The alignment required between the no-load motor voltages and the position feedback (i.e. *P1 Position* (03.029) for the drive P1 position feedback interface) with *Position Feedback Phase Angle* (03.025) = 0.0 is shown in the diagram below for a 2 or 4 pole motor. For higher numbers of poles the zero position should still be aligned as shown, but the one electrical cycle shown corresponds to 360° / (Number of poles / 2). It should be noted that if the position feedback device is advanced (i.e. the zero position is moved to the right with respect to the voltages) *Position Feedback Phase Angle* (03.025) is increased from zero. If the position feedback is retarded *Position Feedback Phase Angle* (03.025) changes to 359.9 and then reduces towards zero.

Position feedback phase angle alignment
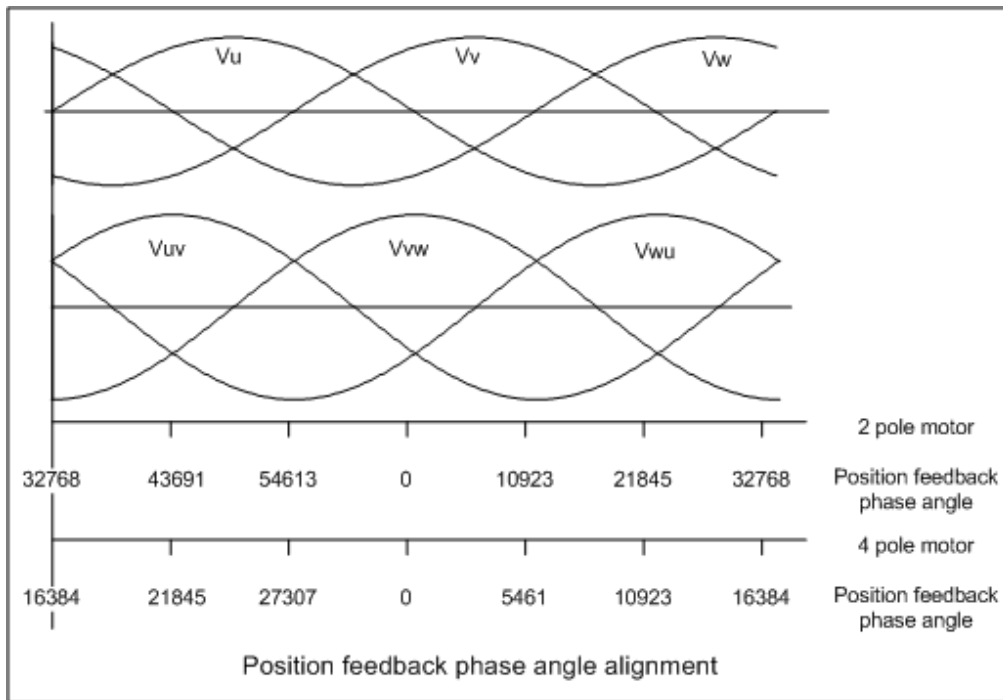
The position feedback device can be aligned statically by connecting the motor to a d.c. power supply as already shown. The motor will move to one of a number of positions defined by the number of motor poles (i.e. 3 positions for a six pole motor, etc.). The position feedback device should be adjusted so that the position displayed by the drive is (n x 65536) / (Number of poles / 2), where n = 0, 1, etc..

Parameter	03.026 *Motor Control Feedback Select*		
Short description	Defines the source of position feedback		
Mode	RFC‑S		
Minimum	0	Maximum	7
Default	0	Units	
Type	8 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW, TE		

Value	Text
0	P1 Drive
1	P2 Drive
2	P1 Slot1
3	P2 Slot1
4	P1 Slot2
5	P2 Slot2
6	P1 Slot3
7	P2 Slot3

Motor Control Feedback Select (03.026) should be used to select the position feedback interface for motor control. If the feedback interface does not exist then the drive will produce an *Encoder 9* trip if it is enabled. Note that if *RFC Feedback Mode* (03.024) is set to 1 or 3 to select sensorless control then this trip is suppressed.

Parameter	03.027 *P1 Speed Feedback*		
Short description	Displays the speed feedback from device P1		
Mode	RFC‑S		
Minimum	−VM_SPEED	Maximum	VM_SPEED
Default		Units	
Type	32 Bit Volatile	Update Rate	4ms write
Display Format	Standard	Decimal Places	1
Coding	RO, FI, VM, ND, NC, PT		

Provided the set-up parameters for the position feedback device connected to the drive P1 position interface are correct *P1 Speed Feedback* (03.027) shows the speed derived from the feedback. The speed is given in mm/s if *P1 Linear Feedback Select* (03.051) = 1 and *Linear Speed Select* (01.055) = 1, otherwise it is given in rpm. The value shown is measured over a 16ms sliding window period, and so the ripple in this value is as defined for *Speed Feedback* (03.002).

Parameter	03.028 *P1 Revolution/Pole Pitch Counter*		
Short description	Displays the revolution/pole pitch counter from device P1		
Mode	RFC‑S		
Minimum	0	Maximum	65535
Default		Units	
Type	16 Bit Power Down Save	Update Rate	4ms write
Display Format	Standard	Decimal Places	0
Coding	RO, ND, NC, PT, BU		

P1 Revolution/Pole Pitch Counter (03.028), *P1 Position* (03.029) and *P1 Fine Position* (03.030) combined give the encoder position with a resolution of $1/2^{32}$ of a revolution/pole pitch as a 48 bit number. If a rotary position feedback device is being used (*P1 Linear Feedback Select* (03.051) = 0) then these quantities relate directly to the rotary position of the feedback device. If a linear feedback device is used then one revolution or pole pitch relates to the distance given by *P1 Pole Pitch* (03.055).

Provided the position feedback interface set-up parameters are correct, the position is always converted to units of $1/2^{32}$ of a revolution/pole pitch, but some parts of the value may not be relevant depending on the resolution of the feedback device. For example a 1024 line digital encoder produces 4096 counts per revolution, and so the position is represented by the bits in the shaded area only.

When the position feedback moves by more than one revolution or pole pitch the *P1 Revolution/Pole Pitch Counter* (03.028) increments or decrements in the form of a sixteen bit roll-over counter. If an absolute position feedback device (except AB Servo, FD Servo, FR Servo, SC Servo) is used the position is initialised at power-up and each time the encoder is subsequently initialised with the absolute position including the revolution count if a multi-turn absolute rotary encoder is used, or the pole pitch count if an absolute linear encoder is used. To avoid showing turns values that are outside the range of the encoder any bits beyond the turns information are normally masked. For example, if the encoder provides 12 bits of turns information, then the most significant 4 bits of the revolutions are always zero. If a single turn encoder is used all the bits of the revolutions are zero. To remove this masking *P1 Absolute Turns Recovery Enable* (03.073) should be set to one. In addition to removing the mask, the extended turns value is retained on power-down and will be recovered on power-up. See *P1 Absolute Turns Recovery Enable* (03.073) for more details.

The position interface parameter descriptions cover rotary and linear applications, but the revolutions or pole pitches are always referred to as turns.

Parameter	03.029 *P1 Position*		
Short description	Displays the position feedback from device P1		
Mode	RFC‑S		
Minimum	0	Maximum	65535
Default		Units	
Type	16 Bit Power Down Save	Update Rate	4ms write
Display Format	Standard	Decimal Places	0
Coding	RO, ND, NC, PT, BU		

See *P1 Revolution/Pole Pitch Counter* (03.028).

Parameter	03.030 *P1 Fine Position*		
Short description	Displays the fine position feedback from device P1		
Mode	RFC‑S		
Minimum	0	Maximum	65535
Default		Units	
Type	16 Bit Volatile	Update Rate	4ms write
Display Format	Standard	Decimal Places	0
Coding	RO, ND, NC, PT, BU		

See *P1 Revolution/Pole Pitch Counter* (03.028).

Parameter	03.031 *P1 Marker Mode*		
Short description	Defines the marker mode for device P1		
Mode	RFC‑S		
Minimum	0 (Display: 0000)	Maximum	15 (Display: 1111)
Default	4 (Display: 0100)	Units	
Type	8 Bit User Save	Update Rate	Background read
Display Format	Binary	Decimal Places	0
Coding	RW		

P1 Device Type (03.038): AB, FD, FR, AB Servo, FD Servo, FR Servo
Each position feedback device produces incremental signals which are counted in hardware. If *P1 Marker Mode* (03.031) = 0 the following occurs when a marker event is produced by the Z1 input:

   1. *P1 Position* (03.029) and *P1 Fine Position* (03.030) are reset to zero.

2. The bits in *P1 Normalised Position* (03.058) related to *P1 Position* (03.029) and *P1 Fine Position* (03.030) are reset to zero
3. *P1 Marker Flag* (03.032) is set to one.

The marker is a hardware function, and so the position appears as though it is reset at the marker event time even if this is between control system sample points. It should be noted that the marker event occurs on the rising edge of the marker pulse if the position change over the last sample was positive or on the falling edge if the position change over the last sample was negative. This ensures that the marker event occurs at the same physical location for either direction of rotation.

The action taken when a marker event occurs can be modified by setting the bits of *P1 Marker Mode* (03.031) as described in the table below.

Bit	Effect of setting bit to one
0	No action is taken unless the marker flag is zero before the marker event occurs
1	*P1 Revolution/Pole Pitch Counter* (03.028) and the whole of *P1 Normalised Position* (03.058) are also set to zero on a marker event
2	*P1 Revolution/Pole Pitch Counter* (03.028), *P1 Position* (03.029), *P1 Fine Position* (03.030) and the related part of *P1 Normalised Position* (03.058) are not reset. (This overrides bit 1.) *P1 Normalised Position* (03.058) is transferred to *P1 Normalised Marker Position* (03.059) and *P1 Marker Flag* (03.032) is set to one.
3	If this bit is 0 the state of the marker is only undefined when the differential input is in the range from -200mV to 200mV. The marker pulse is only guaranteed to be recognised if it is at least 500ns wide. This setting is used for most encoders with standard level marker pulses. If this bit is set to 1 the undefined state region is reduced to the range from -30mV to 30mV. The marker pulse is only guaranteed to be recognised if it is at least 10us wide. The smaller undefined region is required for position feedback devices that produce a small marker pulse, such as the Heidenhain ERN1387 encoder. Note that the reduced undefined region is only provided for position feedback interface P1 and that this bit in *P2 Marker Mode* (03.131) has not effect.

The marker input can be used for a standard type marker function or alternatively it can be used as an additional freeze input for the P1 position feedback interface.

P1 Device Type (03.038): SC, SC Servo, SC SC
The marker function operates in the same way as for the digital incremental encoders. The resolution of the marker actions is only as accurate as the zero crossings of the sine waves. The marker is used with an SC SC type device to trim the absolute position derived from the single sine wave per turn channels once after initialisation. Until this is done (i.e. the marker has been active once after initialisation) marker events will not be registered.

P1 Device Type (03.038): Any other device type
The marker function cannot be used and *P1 Marker Mode* (03.031) has no effect.

Parameter	03.032 *P1 Marker Flag*		
Short description	Indicates when a marker event occurs		
Mode	RFC‑S		
Minimum	0	Maximum	1
Default	0	Units	
Type	1 Bit Volatile	Update Rate	250µs write
Display Format	Standard	Decimal Places	0
Coding	RW, NC		

P1 Marker Flag (03.032) is set to one when a marker event occurs. The flag must be cleared by the user.

Parameter	03.033 *P1 Rotary Turns Bits*		
Short description	Defines the number of rotary turns bits for device P1		
Mode	RFC‑S		
Minimum	0	Maximum	16
Default	16	Units	
Type	8 Bit User Save	Update Rate	Background read, auto-configuration write
Display Format	Standard	Decimal Places	0
Coding	RW		

P1 Rotary Turns Bits (03.033) normally only has any effect if the position feedback interface is being used with a rotary device
(i.e. *P1 Linear Feedback Select* (03.051) = 0).

P1 Device Type (03.038): SC Hiperface, SC EnDat, SC SSI, EnDat, BISS, SSI, SC BiSS
P1 Rotary Turns Bits (03.033) is used to determine the number of bits within the comms messages from the position feedback device that represent turns. For a single turn encoder *P1 Rotary Turns Bits* (03.033) must be set to zero. The most significant bits in *P1 Revolution/Pole Pitch Counter* (03.028) that are not included in the turns information provided by the encoder comms are held at zero. If *P1 Rotary Turns Bits* (03.033) = 0 (single turn encoder) the whole of *P1 Revolution/Pole Pitch Counter* (03.028) is held at zero. The number of bits of position information within one revolution for a rotary device are calculated from *P1 Rotary Turns Bits* (03.033) and *P1 Comms Bits* (03.035). If the resulting value is greater than 32 it is limited to 32.

Some SSI encoders include leading zeros before the turns information and in this case the number of turns bits should include the leading zeros. Some BiSS encoders include zero padding either before or after the turns information (see *P1 Additional Configuration* (03.074)). *P1 Rotary Turns Bits* (03.033) should include the actual turns bits and the additional padding.

P1 Device Type (03.038): Option Slot 1, Option Slot 2, Option Slot 3, Option Slot 4
Whatever the setting for *P1 Linear Feedback Select* (03.051) the number of rotary turns bits should be set up to indicate how many turns bits there are in the position provided by an option module. See *P1 Device Type* (03.038) for more details.

P1 Device Type (03.038): Any other device type
It is sometimes desirable to mask off the most significant bits of *P1 Revolution/Pole Pitch Counter* (03.028), but this does not have to be done for the drive to function correctly. If *P1 Rotary Turns Bits* (03.033) = 0 the whole of *P1 Revolution/Pole Pitch Counter* (03.028) is held at zero. If *P1 Rotary Turns Bits* (03.033) has any other value it indicates the number of bits in *P1 Revolution/Pole Pitch Counter* (03.028) that are not held at zero. For example, if *P1 Rotary Turns Bits* (03.033) = 5, then *P1 Revolution/Pole Pitch Counter* (03.028) counts up to 31 before being reset.

The description above is for normal operation when *P1 Absolute Turns Recovery Enable* (03.073) = 0. If *P1 Absolute Turns Recovery Enable* (03.073) = 1 no masking is applied to *P1 Rotary Turns Bits* (03.033), and so a 16 bit value is always shown.

Parameter	03.034 *P1 Rotary Lines Per Revolution*		
Short description	Defines the number of rotary lines per revolution for device P1		
Mode	RFC‑S		
Minimum	1	Maximum	100000
Default	4096	Units	
Type	32 Bit User Save	Update Rate	Background read, auto-configuration write
Display Format	Standard	Decimal Places	0
Coding	RW		

P1 Rotary Lines Per Revolution (03.034) only has any effect if the position feedback interface is being used with a rotary device (i.e. *P1 Linear Feedback Select* (03.051) = 0).

P1 Device Type (03.038): AB, AB Servo
P1 Rotary Lines Per Revolution (03.034) should be set to the number of lines per revolution for the encoder connected to the P1 position feedback interface.

P1 Device Type (03.038): FD, FR, FD Servo, FR Servo
P1 Rotary Lines Per Revolution (03.034) should be set to the number of lines per revolution for the encoder connected to the P1 position feedback interface divided by 2.

P1 Device Type (03.038): SC, SC Servo, SC Hiperface, SC EnDat, SC SSI, SC SC, SC BiSS
P1 Rotary Lines Per Revolution (03.034) should be set to the number of sine waves per revolution for the encoder connected to the P1 position feedback interface.

P1 Device Type (03.038): Any other device type
P1 Rotary Lines Per Revolution (03.034) has no effect.

Parameter	03.035 *P1 Comms Bits*		
Short description	Defines the total number of bits of position information in the comms message from the encoder for device P1		
Mode	RFC‑S		
Minimum	0	Maximum	48
Default	0	Units	
Type	8 Bit User Save	Update Rate	Background read, auto-configuration write
Display Format	Standard	Decimal Places	0
Coding	RW		

P1 Device Type (03.038): SC Hiperface, EnDat, SC EnDat
Total number of bits of position information in the comms message from the encoder.

P1 Device Type (03.038): SSI, SC.SSI
Total number of bits of position information in the comms message from the encoder including any leading or trailing zeros and the power supply alarm bit if present.

P1 Device Type (03.038): BiSS, SC BiSS
Total number of bits of position information in the comms message from the encoder excluding the warning and error bits. It is always assumed there is one warning bit and one error bit. The length of the position information includes any zero padding that is included by the encoder.
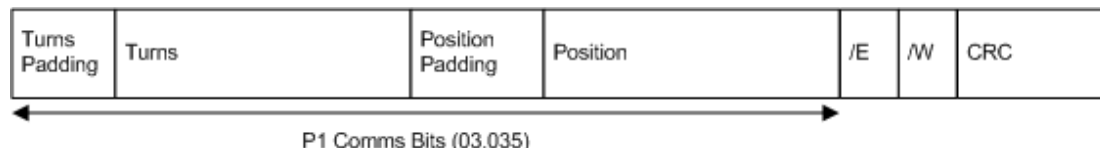
P1 Comms Bits (03.035)

P1 Device Type (03.038): Any other device type
P1 Comms Bits (03.035) has no effect.

Parameter	03.036 *P1 Supply Voltage*		
Short description	Defines the supply voltage output for device P1		
Mode	RFC‑S		
Minimum	0	Maximum	2
Default	0	Units	
Type	8 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW, TE		

Value	*Text*
0	5V
1	8V
2	15V

P1 Supply Voltage (03.036) sets the level for the supply voltage output. To ensure that the maximum voltage for the position feedback device is not accidentally exceeded, the device should be disconnected from the drive when the level is being adjusted.

Parameter	03.037 *P1 Comms Baud Rate*		
Short description	Defines the baud rate used for encoder communications		
Mode	RFC‑S		
Minimum	0	Maximum	8
Default	2	Units	Baud
Type	8 Bit User Save	Update Rate	Background read, Auto-configuration write
Display Format	Standard	Decimal Places	0
Coding	RW, TE		

Value	*Text*
0	100k
1	200k
2	300k
3	400k
4	500k
5	1M
6	1.5M
7	2M
8	4M

P1 Comms Baud Rate (03.037) defines the baud rate used for encoder communications. Restrictions are applied to the baud rate for different feedback devices, and so the baud rate may be different to the parameter value.

P1 Device Type (03.038): SC.Hiperface
A fixed baud rate of 9600 baud is always used with this type of encoder so *P1 Comms Baud Rate* (03.037) has no effect.

P1 Device Type (03.038): SC.SSI, SC EnDat, SC BiSS
Any baud rate that is within the range specified for the encoder may be used. The data from the encoder is not used for time critical functions, and so it is recommended that the default value of 300K baud is used unless this needs to be reduced because of a limitation imposed by the encoder.

P1 Device Type (03.038): EnDat, BiSS, SSI
Any baud rate that is within the range specified for the encoder may be used. The line delay is measured during initialisation, and used to compensate this delay during communications with the encoder. Therefore there is no timing based restriction on the length of the cable between the position feedback interface and the encoder. However, care should be taken to ensure that the wiring arrangement and the type of cable used are suitable for the selected baud rate and the distance between the position interface and the encoder. See *P1 Low Speed Update Rate Active* (03.063) for more details on timing restrictions related to the drive sample times.

P1 Device Type (03.038): Any other device
P1 Comms Baud Rate (03.037) has no effect.

Parameter	03.038 *P1 Device Type*		
Short description	Defines the device type connected to the drive P1 position feedback interface		
Mode	RFC‑S		
Minimum	0	Maximum	21
Default	3	Units	
Type	8 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW, TE		

Value	Text
0	AB
1	FD
2	FR
3	AB Servo
4	FD Servo
5	FR Servo
6	SC
7	SC Hiperface
8	EnDat
9	SC EnDat
10	SSI
11	SC SSI
12	SC Servo
13	BiSS
14	Resolver
15	SC SC
16	Commutation Only
17	SC BiSS
18	Option Slot 1
19	Option Slot 2
20	Option Slot 3
21	Option Slot 4

P1 Device Type (03.038) should be set up to match the device connected to the drive P1 position feedback interface. The table below gives the position feedback types supported by the P1 position feedback interface.

P1 Device Type (03.038)	Signals	Position feedback type	Communications
0: AB	Quadrature	Incremental	None
1: FD	Frequency and direction	Incremental	None
2: FR	Forward and reverse	Incremental	None
3: AB Servo	Quadrature and commutation	Absolute commutation signals with incremental	None
4: FD Servo	Frequency and direction, and commutation	Absolute commutation signals with incremental	None
5: FR Servo	Forward and reverse, and commutation	Absolute commutation signals with incremental	None
6: SC	SINCOS	Incremental SINCOS	None
7: SC Hiperface	SINCOS and Hiperface comms	Absolute comms with incremental SINCOS	Hiperface
8: EnDat	EnDat comms	Absolute comms	EnDat 2.1 EnDat 2.2
9: SC EnDat	SINCOS and EnDat comms	Absolute comms with incremental SINCOS	EnDat 2.1
10: SSI	SSI comms	Absolute comms	SSI
11: SC SSI	SINCOS and SSI comms	Absolute comms with incremental SINCOS	SSI
12: SC Servo	SINCOS and commutation	Absolute commutation signals with incremental	None
13: BiSS	BiSS comms	Absolute comms	BiSS
14: Resolver	Resolver	Resolver	None
15: SC SC	SINCOS and single sine and cosine signals per revolution	SINCOS with absolute position from single sine and cosine signals	None
16: Commutation Only	Commutation only	Absolute commutation signals only	None
17: SC BiSS	BiSS comms	Absolute comms with incremental SINCOS	BiSS
18: Option Slot 1	None	Provided by option module	None
19: Option Slot 2	None	Provided by option module	None
20: Option Slot 3	None	Provided by option module	None
21 Option Slot 4	None	Provided by option module	None

Position feedback type:

Incremental
Position devices that provide incremental feedback do not give absolute position feedback. The position is zero at power-up and accumulates the change of position from that point on. These devices are suitable for motor control in RFC-A mode. They can also be used for RFC-S mode, but some form of phasing auto-tune is required each time the position feedback is initialised.

Absolute commutation signals with incremental
Position devices with commutations signals are intended to provide absolute position feedback for motor control in RFC-S mode. If one of these devices is used for RFC-A mode the commutation signals are ignored. The position information given in *P1 Revolution/Pole Pitch Counter* (03.028), *P1 Position*

(03.029) and *P1 Fine Position* (03.030) appears as though the position feedback device is an incremental type in that it is initialised to zero at power-up and then accumulates the change of position from that point on. The commutation signals are used directly by the motor control algorithms in RFC-S mode to determine the motor position after position feedback initialisation. There must be one period of the commutation signals for each pole pair for a rotary motor (i.e. 3 commutation signal periods per revolution for a 6 pole motor), or one period of the commutation signals must be equal to the motor pole pitch for a linear motor. It should be noted that for a movement of up to 1/3 of the commutation signal period after position feedback initialisation the maximum motor torque is limited to 0.866 of the maximum possible torque.

Absolute commutation signals only
Position devices with commutations signals are intended to provide absolute position feedback for motor control in RFC-S mode but can also be used to provide position feedback for motor control in RFC-A mode. The position is derived from the commutation signals alone. A phase locked loop is used to smooth the feedback, but this introduces a delay and there is significant ripple in the position and speed feedback at low speeds. If this method is used for motor control then low speed loop gains should be used and *P1 Feedback Filter* (03.042) should be used to filter the feedback.

Incremental SINCOS
An incremental SINCOS encoder can be used in the same way as an AB incremental encoder, except that the position resolution is increased with interpolation. These devices are suitable for motor control in RFC-A mode. They can also be used for RFC-S mode, but some form of phasing auto-tune is required each time the position feedback is initialised. The increase in resolution due to interpolation depends on the magnitude and frequency of the sine wave signals at the position feedback interface inputs on the drive. The sine wave inputs take balanced signals each with a nominal 1V peak to peak level. (This means that the difference measured between the two signals for one sine wave input would be 2V peak to peak or 1V peak.) If interpolation is not used the position feedback would have a resolution related to the number of sine waves per revolution (i.e. 512 sine waves per revolution would give position feedback resolution equivalent to a 512 line incremental encoder, which gives 2048 discernible positions per revolution). With the nominal signal level and an input frequency below 5kHz the interpolation using sine waves instead of digital incremental signals increases the resolution by a factor of 1800. For a 512 sine wave encoder this would give a resolution of 512 x 4 x 1800 = 3686400 discernible positions per revolution. This is equivalent to a digital incremental encoder with 921600 lines per revolution.The increased resolution due to interpolation is directly proportional to the sine wave signal voltage levels, and also reduces with sine wave signal frequency. The resolution is given by

Resolution = *P1 Rotary Lines Per Revolution* (03.034) x 4 x 1800 x Vpeak to peak of the sine wave signals x Frequency Factor

where the frequency factor is given below.

1kHz	5kHz	50kHz	100kHz	200kHz	500kHz
1.00	1.00	0.86	0.66	0.39	0.14

Increasing the sine wave signal level above 1V peak to peak will increase the resolution, but the level should not be increased above 1.5V or else the input will saturate and the sine waves will be distorted.

Absolute comms with incremental SINCOS
The absolute position is obtained after position feedback initialisation via the comms interface and then after that point by tracking the incremental change from the sine wave signals. Interpolation is used to increase the position resolution. The comms interface can be used to check the position derived from the sine waves. It can also be used for bi-direction transfer of data between the drive and encoder (except SSI comms). These devices can be used for motor control in RFC-A or RFC-S modes.

Absolute comms
The absolute position is obtained at all times via the encoder comms. The comms interface can also be used for bi-directional transfer of data between the drive and the encoder (except SSI mode). These devices can be used for motor control in RFC-A or RFC-S modes.

Resolver
A resolver can be used to provide absolute position feedback within the range covered by one electrical revolution of the resolver (i.e. 360° mechanical for a 2 pole device, 180° mechanical for a 4 pole device, etc.). An angle of 0 degrees corresponds to the position where the cosine input is at its maximum and in phase with the excitation and the sine input zero. A resolver can be used for motor control in RFC-A mode or RFC-S mode. In RFC-S mode a 2 pole resolver can be used with a motor with any number of motor poles, but with any other number of poles there must be an integer number of motor poles for each resolver pole. In RFC-A mode this restriction does not apply. Standard or high speed sampling can be selected with *P1 Resolver Excitation* (03.066). If standard sampling is selected and the position feedback used for motor control the maximum operating speed is limited before the control perforomance starts to deteriorate. See *P1 Resolver Excitation* (03.066) for more details.

SINCOS with absolute position from sine and cosine signals
This type of device, which is not recommended for new applications, is intended to provide absolute position feedback for motor control in RFC-S mode. If one of these devices is used for RFC-A mode the additional sine wave signals and the Z1 marker signal do not affect the motor control position feedback. The position information given in *P1 Position* (03.029) and *P1 Fine Position* (03.030) is initialised to the position within one turn and *P1 Revolution/Pole Pitch Counter* (03.028) is set to zero when the device is initialised based on the once per turn sine and cosine signals. This gives a moderately accurate absolute position. When a marker event occurs it is used to give a more accurate absolute position. Care should be taken to ensure that the position feedback device is connected correctly. For example a Heidenhain ERN1387 device should be connected as follows: 1/2=A+/A-(Cosine), 3/4=B+/B-(Sine), 5/6=R+/R-(Marker), 7/8=C+/C-(Single turn cosine), 9/10=D+/D-(Single turn sine). It is assumed that the marker occurs at the positive zero crossing of the single turn cosine signal when operating in the forwards direction (i.e. compatible with the ERN1387). To ensure the drive can correctly detect the reference marker pulse with a Heidenhain ERN1387 encoder it is recommended that bit 3 of *P1 Marker Mode* (03.031) is set to 1.

Provided by Option Module
Position feedback information can be provided via the P1 interface from an option module. This is intended to be used by option modules that are not position feedback category modules. If this type of device is selected, and the module in the selected slot supports this feature, the position provided by the P1 interface will be written by the module and the interface will become initialised. If the option does not support this feature then the position will remain at zero and the interface will not become initialised. It should be noted that the system allows 1.3s after power-up, or feedback interface re-initialisation, for the option module to indicate that it is providing feedback before a *Encoder 4* trip will be initiated. If the option module takes longer than this to indicate that position feedback is available the power up delay should be extended with *P1 Additional Power-up Delay* (03.049).

The option module will provide the postion as a 32 bit value separated into turns and position within a turn as shown below.

Turns	Position

The number of turns bits should be set up in *P1 Rotary Turns Bits* (03.033) and the position value should be left justified. For example, if the information being provided contains 8 turns bits and 16 position bits then *P1 Rotary Turns Bits* (03.033) should be set to 8 and the information should be written as shown below.

8 turns bits	16 position bits	8 zeros

For a linear device *P1 Rotary Turns Bits* (03.033) should be used in the same way to partition the data from the module where one turn corresponds to one pole of the motor.

To avoid discontinuities when the whole position rolls over the maximum number of turns boundary, the drive calculates the change of position between the values provided by the option module at each sample and then accumulates the result. It is important that the change of position provide by the option module between samples is less than half the range of the position value. For example, if 16 position bits are being used the change must be less than 32767. This only applies when the position feedback interface is in the initialised state. If it is not initialised then larger changes can be applied.

Communications:

Hiperface
Hiperface is an asynchronous bi-direction communications protocol that is only used with incremental sine waves. Therefore it can be used to check the position derived from the sine waves or for bi-direction transfer of data between the drive and encoder. A checksum is provided for error checking.

EnDat 2.1
EnDat 2.1 is a synchronous bi-direction communications protocol that is intended to be used with incremental sine waves. Therefore it can be used to check the position derived from the sine waves or for bi-direction transfer of data between the drive and encoder. It can be used as an absolute comms only type position feedback interface, but the resolution of the position feedback using this method may be limited. If it is used in this way it is not possible to use the position feedback via comms at the same time as communicating with the encoder for data transfer. A CRC is provided for error checking.

EnDat 2.2 and BiSS C Mode
EnDat 2.2 and BiSS are synchronous bi-direction communications protocols that are intended to be used alone. It is possible to obtain position feedback at the same time as communicating with the encoder for data transfer. A CRC is provided for error checking.

SSI
SSI is a uni-directional communications protocol that is intended to be used alone. It is only possible to obtain the position information from the encoder and it is not possible to transfer data between the drive and the encoder. No error checking is provided by the SSI protocol, and so encoders based on this interface are not recommended for new applications.

Parameter	03.039 *P1 Termination Select*		
Short description	Used to enable or disable the terminations on the position feedback interface inputs		
Mode	RFC‑S		
Minimum	0	Maximum	2
Default	1	Units	
Type	8 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW		

P1 Termination Select (03.039) is used to enable or disable the terminations on the position feedback interface inputs. The function of *P1 Termination Select* (03.039) depends on the position feedback device type selected in *P1 Device Type* (03.038) as shown below.

Terminals 5/6 have selectable pull-apart resistors which follow the same state as the termination resistors for terminals 5/6, unless described differently below.

P1 Device Type **(03.038): AB, FD, FR, AB Servo, FD Servo, FR Servo**

Terminal	Input	03.039 = 0	03.039 = 1	03.039 = 2
1/2 & 3/4	A1 & B1	Disabled	Enabled	Enabled
5/6	Z1	Disabled	Disabled	Enabled

U1, V1 & W1 terminations (terminals 7/8, 9/10 & 11/12) are always enabled for AB Servo, FD Servo and FR Servo encoders.

P1 Device Type **(03.038): SC, SC Servo, SC SC**

Terminal	Input	03.039 = 0	03.039 = 1	03.039 = 2
1/2 & 3/4	Cos1 & Sin1	Disabled	Enabled	Enabled
5/6	Z1	Disabled	Disabled	Enabled

U1, V1 & W1 (terminals 7/8, 9/10 & 11/12) terminations are always enabled for SC Servo encoders. SCs1 and SSn1 (terminals 7/8 & 9/10) terminations are always enabled for SC SC encoders.

P1 Device Type **(03.038): SC Hiperface, SC EnDat, SC SSI, SC BiSS**

Terminal	Input	03.039 = 0	03.039 = 1	03.039 = 2
1/2 & 3/4	Cos1 & Sin1	Disabled	Enabled	Enabled
5/6	D1	Enabled	Enabled	Enabled

For SC EnDat and SC SSI encoder the pull-apart resistors on the D1 input/output (terminals 5/6) are always disabled, and for SC Hiperface encoders the pull-apart resistors on the D1 input/output (terminals 5/6) are always enabled.

P1 Device Type **(03.038): EnDat, BiSS, SSI**

Terminal	Input	03.039 = 0	03.039 = 1	03.039 = 2
1/2 & 3/4	D1/CLK1	Enabled	Enabled	Enabled
5/6	Z1	Disabled	Disabled	Enabled

If the *P2 Device type* (03.138) is set to EnDat, BiSS or SSI and the encoder simulation output is enabled, then the Z1 input becomes the data (D2) input for the P2 position interface and termination resistors are always enabled and pull-apart resistors are always disabled.

P1 Device Type **(03.038): Resolver**
P1 Termination Select (03.039) has no effect as terminations are always disabled.

P1 Device Type **(03.038): Commutation Only**
P1 Termination Select (03.039) has no effect as terminations are always enabled.

Parameter	03.040 *P1 Error Detection Level*		
Short description	Used to enable or disable position feedback trip functions		
Mode	RFC‑S		
Minimum	0 (Display: 00000000)	Maximum	255 (Display: 11111111)
Default	1 (Display: 00000001)	Units	
Type	8 Bit User Save	Update Rate	Background read
Display Format	Binary	Decimal Places	0
Coding	RW, BU		

This parameter can be used to enable or disable position feedback trip functions as follows:

Bit	Function	Trip(s)	Comments
0	Enable wire break detection.	*Encoder 2*	Bits 5 and 6 have no effect if this bit is set to zero.
1	Enable phase error detection.	*Encoder 3*	
2	Enable SSI power supply alarm bit monitor.	*Encoder 6*	
3	Disable indicated trips.	*Encoder 1* to *Encoder 6*	Trips related to bits 0, 1, 2, 5 and 6 do not occur if this bit is set to one. See note below about the position feedback device becoming uninitialised.
4	Disable indicated trip.	*Encoder 7*.	
5	Enable wire break detection for sine wave commutation signals for SC SC type encoders.	*Encoder 2*	
6	Enable wire break detection for the marker with SC SC type encoders with Heidenhain ERN1387 type marker signals.	*Encoder 2*	
7	Enable more sensitive resolver wire break detection.	*Encoder 2*	The standard wire break detection is only likely to detect a break in the excitation signal, or both the sine and cosine signals together. The more sensitive system will detect a break in any signal provided the motor is rotating. If the motor is stationary, there are positions where wire break will not be detected. The standard system uses 10% of the expected 1Vrms feedback signals as the detection threshold, but the more sensitive system uses 80%. If the resolver ratio is significantly less than 3:1 with 3V excitation, or 2:1 with 2V excitation, then the more sensitive detection system should not be used.

Bits 3 and 4 do not prevent the device from becoming un-initialised. The trip is suppressed, but the device is still un-initialised and this is indicated by the appropriate bit for the position feedback interface in *Position Feedback Initialized* (03.076).

Encoder trips
The following table shows trips that can be initiated that are related to the position feedback interface P1. The sub-trip number is 1 for the drive P1 position feedback interface.

Drive trip	Encoders	Reason for error
Encoder 1	All	Power supply short circuit
Encoder 2	AB, FD, FR, AB Servo, FD Servo, FR Servo	Hardware wire-break detect on A1, B1 and Z1 inputs [1]. (Note that there is no wire break detection on the U1, V1 and W1 commutation inputs.)
	SC, SC Servo, SC Hiperface, SC EnDat, SC SSI, Resolver, SC SC, SC BiSS	Software wire break detection on sine wave signals. Marker and single turn sine wave commutation signals for SC SC device[5]. (Note that there is no wire break detection on the U1, V1 and W1 commutation inputs.)
Encoder 3	AB Servo, FD Servo, FR Servo, SC Servo	Phase error [2]
	SC Hiperface, SC EnDat, SC SSI, SC BiSS	Sine/cosine phase error [3]
Encoder 4	SC Hiperface, SC EnDat, EnDat, BISS, SC BiSS	Comms timeout
	Option Slot 1, Option Slot 2, Option Slot 3, Option Slot 4	The option module in the selected option slot has not indicated that it is providing position feedback.
Encoder 5	SC Hiperface, SC EnDat, EnDat, BISS, SC BiSS	Checksum/CRC error
	SC SSI, SSI	Not ready at start of position transfer (i.e. data input not one)
Encoder 6	SC Hiperface, SC EnDat, EnDat, BiSS, SC BiSS	The encoder has indicated an error
	SSI, SC SSI	Power supply alarm bit active
Encoder 7	All	A set-up parameter for the device or the number of pole pairs for the currently selected motor have been changed.
Encoder 8	EnDat, SSI, BiSS	*P1 Device Type* (03.038), *P1 Comms Bits* (03.035), *P1 Comms Baud Rate* (03.037), *P1 Calculation Time* (03.060), *P1 Recovery Time* (03.061), *P1 Line Delay Time* (03.062) and *P1 User Comms Enable* (03.067) are used to determine the time taken for the communications exchange with the encoder. If this time exceeds 250µs an *Encoder 8* trip is initiated.
Encoder 9	All	Speed feedback selected from an option slot that does not have a position feedback category option module fitted
Phasing Error	All	Incorrect encoder phasing [4]
Encoder 12	SC Hiperface, BiSS	The encoder could not be identified during auto-configuration
Encoder 13	SC Hiperface, SC EnDat, EnDat, BiSS, SC BiSS	Data read from the position feedback device during auto-configuration is out of range
Encoder 14	BiSS, SC BiSS	The turns or position padding values in parameter *P1 Additional Configuration* (03.074) are out of range.

1. If the terminations are not enabled on the A1, B1 or Z1 inputs the wire break system will not operate. (Note that as default the Z1 input terminations are disabled to disable wire break detection on this input.)
2. Phase error detection for AB Servo, FD Servo, FR Servo or SC Servo encoders monitors the relationship between the position from the incremental signals and the commutation signals to ensure that the incremental pulses have been counted correctly. The error is detected if the incremental position moves outside the position range defined by the UVW commutation signals by 10º. The trip is initiated if the error is detected for 10 consecutive samples. This system should not be used unless one encoder line (AB Servo), or two lines (FD Servo, FR Servo), are less than 10° electrical or else spurious *Encoder 3* trips will occur.
3. Phase error detection for SINCOS encoders with comms monitors the relationship between the position derived from the sine waves with the position derived via comms. The encoder is interrogated via comms and the comparison is made once per second. If the error is greater than 10° electrical for 10 consecutive samples the trip is initiated. This system should not be used unless one sine wave is less than 10° electrical or else spurious *Encoder 3* trips will occur.
4. Incorrect encoder phasing is detected if the motor reaches half of the speed defined by VM_SPEED_FREQ_REF[MAX] and the phasing error is large enough for the motor to accelerate uncontrollably.
5. Detection of wire break on the sine wave commutation signals or marker of an SC SC device may require the encoder to rotate by several mechanical turns before the fault is detected, i.e. up to 2 turns for the sine wave commutation signals and up to 3 turns for the marker).

Wire-break detection
It may be important to detect a break in the connections between the drive and the position feedback device. This feature is provided for most position feedback devices either directly or indirectly as listed below.

Device	Detection method	Trip produced
AB, FD, FR, AB Servo, FD Servo, FR Servo	Hardware detectors on the A1, B1 and Z1 signal detect a wire break.	*Encoder 2*
SC, SC Servo, SC Hiperface, SC EnData, SC SSI, SC SC, SC BiSS	The magnitudes of the sine wave signals are monitored as the magnitude of a vector which is calculated as $\sqrt{(Sine^2+Cosine^2)}$. If this is less than the value produced by two valid waveforms with a peak to peak magnitude of 0.25V (i.e. 0.25 of the nominal level of 1V peak to peak) then a trip is initiated. This always detects wire break in the sine and cosine connections if the position feedback is changing. If the position feedback is stationary this may not detect wire break until the position feedback moves, e.g. if the sine connection is broken, but the cosine is at it's maximum then wirebreak will not be detected. Additional monitoring is provided for SC SC encoders to give software wire break detection for the single turn sine wave commutation signals and the marker. If the device is a Heidenhain ERN1387 the marker is too small for hardware wire break detection, and so the additional software detection is required to detect wire break on the marker.	*Encoder 2*
Resolver	The magnitudes of the sine and cosine input signals are monitored in a similar way to SINCOS signals where the peak of the sine and cosine waveforms are used to calculate the vector magnitude. If the caclulated value is less than the value produced by two valid waveforms with a differential peak to peak magnitude of 0.4V then a trip is initiated. This detects wire break in the sine and cosine connections. If the position feedback is stationary this may not detect wire break until the position feedback moves, e.g. if the sine connection is broken, but the cosine is at it's maximum then wirebreak will not be detected.	*Encoder 2*
SC Hiperface, SC EnDat, EnDat, BiSS, SC BiSS	Wire break in the comms link is detected by a CRC or timeout error.	*Encoder 4, Encoder 5*
SSI, SC SSI	Wire break detection in the comms is difficult with these devices. However, if power supply alarm bit monitoring is enabled the drive will be looking for a one at the start of the message and a zero to indicate that the power supply is okay. If the clock stops or the data line is disconnected the data input to the drive may stay in one state or the other and cause a trip.	*Encoder 5, Encoder 6*

Position feedback power supply trips
The position feedback power supply from the drive can be switched off by the drive either because the power supply is overloaded (*Encoder 1* trip) or because the internal 24V supply within the drive is overloaded (*PSU 24V* trip). The internal 24V supply provides power for the position feedback power supply, user 24V output, digital I/O, option modules etc. To ensure that an *Encoder 1* trip is not initiated when the internal 24V is overloaded, and subsequently switched off by the drive, there is a delay of 40ms in the detection of *Encoder 1* trip. It is possible for other position feedback trips, such as wire break detection (i.e. *Encoder 2*), to occur when the power supply is removed from the position feedback device. Therefore overloading the internal 24V supply or the position feedback supply could result in an immediate *Encoder 2* trip. To ensure that the correct reason for the trip is given *PSU 24V* and *Encoder 1* trips override an existing *Encoder 2* to *Encoder 6* trip. This means that both the original trip (*Encoder 2* to *Encoder 6*) and then the new trip (*PSU 24V* or *Encoder 1*) are stored in the trip log.

Parameter	03.041 *P1 Auto-configuration Select*		
Short description	Set to 1 to enable interrogation of the encoder to determine the set up required		
Mode	RFC‑S		
Minimum	0	Maximum	1
Default	1	Units	
Type	8 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW, TE		

Value	*Text*
0	Disabled
1	Enabled

P1 Device Type **(03.038): SC Hiperface, SC EnDat, EnDat, BiSS, SC BiSS**
If auto-configuration has not been disabled (i.e. *P1 Auto-configuration Select* (03.041) is not 0) then during position feedback initialisation the encoder is interrogated to determine whether the encoder is a rotary or linear encoder and *P1 Linear Feedback Select* (03.051) is set up appropriately. Then the following parameters are set up based on information from the encoder:

Rotary	Linear
P1 Rotary Turns Bits (03.033)	*P1 Linear Comms Pitch* (03.052)
P1 Rotary Lines Per Revolution (03.034)	*P1 Linear Line Pitch* (03.053)
P1 Comms Bits (03.035)	*P1 Comms Bits* (03.035)
P1 Additional Configuration (03.074)	*P1 Linear Comms And Line Pitch Units* (03.054)

The following actions are also taken to set up the timing for the encoder.

Comms Protocol	Actions taken
EnDat 2.1	*P1 Calculation Time* (03.060) = From the encoder *P1 Recovery Time* (03.061) = 30µs Line delay measured and result written to *P1 Line Delay Time* (03.062)
EnDat 2.2	*P1 Calculation Time* (03.060) = From the encoder *P1 Recovery Time* (03.061) is set to 4µs (and the encoder itself is set up to use its short recovery time of 3.75µs) if the *P1 Comms Baud Rate* (03.037) is 1M or more. Line delay measured and result written to *P1 Line Delay Time* (03.062)
BiSS	*P1 Absolute Turns Recovery Enable* (03.073) = 5µs *P1 Recovery Time* (03.061) = 13µs Line delay measured and result written to *P1 Line Delay Time* (03.062)

Once these parameters have been set up it should be possible for the drive to operate correctly with the encoder. Auto-configuration occurs as part of the position interface initialisation if selected, and so if the auto-configuration fails (i.e. communications cannot be established) then initialisation will not be completed. If initialisation has not been completed successfully the drive cannot be enabled (see *Enable Conditions* (06.010)). For SC Hiperface and BiSS encoders the drive must identify the encoder model number to perform auto-configuration. If communications is established, but the drive cannot recognise the encoder model, an *Encoder 12* trip is produced immediately.

If auto-configuration is disabled ((i.e. *P1 Auto-configuration Select* (03.041) = 0) then none of the above actions are carried out except for the line delay measurement.

P1 Device Type (03.038): All other device types
P1 Auto-configuration Select (03.041) has no effect.

Parameter	03.042 *P1 Feedback Filter*		
Short description	Defines the time period for a sliding window filter that may be applied to the feedback taken from the drive P1 position feedback interface		
Mode	RFC‑S		
Minimum	0	Maximum	5
Default	0	Units	
Type	8 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW, TE		

Value	Text
0	Disabled
1	1ms
2	2ms
3	4ms
4	8ms
5	16ms

P1 Feedback Filter (03.042) defines the time period for a sliding window filter that may be applied to the feedback taken from the drive P1 position feedback interface. This is particularly useful in applications where the drive encoder is used to give speed feedback for the speed controller and where the load includes a high inertia, and so the speed controller gains are very high. Under these conditions, without a filter on the feedback, it is possible for the speed loop output to change constantly from one current limit to the other and lock the integral term of the speed controller. In Unidrive SP this filter was applied to the output of the sensorless speed feedback, however, a separate filter is now provided (see *Sensorless Mode Filter* (03.079)).

Parameter	03.043 *P1 Maximum Reference*		
Short description	Defines the maximum speed reference from device P1		
Mode	RFC‑S		
Minimum	0	Maximum	33000
Default	3000	Units	
Type	16 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW, BU		

The speed feedback from the drive P1 position feedback interface can be used as a source to control a parameter. The speed feedback is scaled to give a value as a percentage of *P1 Maximum Reference* (03.043) in 0.1% units which is displayed in *P1 Reference* (03.045). The value is then scaled by the *P1 Reference Scaling* (03.044) and then routed to the destination defined by *P1 Reference destination* (03.046).

Normally the destination is updated every 4ms, but if the destination is the *Hard Speed Reference* (03.022), *P1 Maximum Reference* (03.043) = VM_SPEED_FREQ_REF[MAX] and *P1 Reference Scaling* (03.044) = 1.000 it is updated every 250µs. Although the hard speed reference is updated every 250µs internally a value in rpm or mm/s is written to *Hard Speed Reference* (03.022) every 4ms for indication only. It should be noted that if the fast update method is used the resolution of the speed feedback devived from the position feedback device defines the resolution of the hard speed reference and that any ripple on the feedback will be present on the hard speed reference (see *Speed Feedback* (03.002)).

Parameter	03.044 *P1 Reference Scaling*		
Short description	Defines the scaling applied to P1 reference		
Mode	RFC‑S		
Minimum	0.000	Maximum	4.000
Default	1.000	Units	
Type	16 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	3
Coding	RW		

See *P1 Maximum Reference* (03.043).

Parameter	03.045 *P1 Reference*		
Short description	Displays the value in P1 reference		
Mode	RFC‑S		
Minimum	-100.0	Maximum	100.0
Default		Units	%
Type	16 Bit Volatile	Update Rate	4ms write
Display Format	Standard	Decimal Places	1
Coding	RO, FI, ND, NC, PT		

See *P1 Maximum Reference* (03.043).

Parameter	03.046 *P1 Reference destination*		
Short description	Defines the destination parameter for P1 reference		
Mode	RFC‑S		
Minimum	0.000	Maximum	59.999
Default	0.000	Units	
Type	16 Bit User Save	Update Rate	Drive reset read
Display Format	Standard	Decimal Places	3
Coding	RW, DE, PT, BU		

See *P1 Maximum Reference* (03.043).

Parameter	03.047 *P1 SSI Incremental Mode*		
Short description	Set to 1 to enable SSI incremental mode		
Mode	RFC‑S		
Minimum	0	Maximum	1
Default	0	Units	
Type	1 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW		

P1 Device Type **(03.038): EnDat, BISS**
P1 SSI Incremental Mode (03.047) has no effect and these comms modes can only operate in incremental mode, i.e. the absolute position is taken during encoder initialisation and then incremental positions are accumulated from that point on, to determine the position. If there is an error in the position read from the encoder this will be detected from the CRC check, and the position data will be ignored until correct data is available or the drive trips after a number of consecutive errors. This prevents large spurious changes in position due to data errors, and so absolute mode is not required.

P1 Device Type **(03.038): SSI**
If *P1 SSI Incremental Mode* (03.047) = 0 the complete absolute position is read at each sample. Care should be taken when using this mode as some unwanted effects can occur when the encoder passes through the boundary between its maximum position and zero. In this mode the encoder can be used for motor control provided at least 6 bits of turns information are provided by the encoder otherwise an over speed trip will be produced as the position passes over the maximum position to zero boundary. *P1 Normalised Position* (03.058) can be used for position control over this boundary provided the normalised turns bits are set up so that the normalised positions do not contain turns information that is not available from the encoder. As the SSI format does not include any error checking it is not possible to detect if the position data has been corrupted by noise. The benefit of using the absolute position directly from an SSI encoder is that even if the encoder communications are disturbed by noise and position errors occur, the position will always recover the correct position after the disturbance has ended.

If *P1 SSI Incremental Mode* (03.047) = 1 the absolute position is only taken from the encoder during initialisation. The change of position over each sample is then accumulated to determine the position. This method always gives 16 bits of turns information that can always be used without jumps in position whatever value is used as the turns bits for normalisation. If noise corrupts the data from an SSI encoder it is possible to have apparent large change of position, and this can result in the turns information becoming and remaining corrupted until the encoder is re-initialised.

If an SSI encoder is used, but is not powered from the drive, and the encoder is powered up after the drive, it is possible that the first change of position detected could be large enough to cause the problems described above. This can be avoided if the encoder interface is initialised with *Initialise Position Feedback* (03.075) after the encoder has powered up. If the encoder includes a power supply alarm bit, the power supply monitor should be enabled. This will ensure that the drive remains tripped until the encoder is powered up and the action of resetting the trip will reinitialise the encoder interface.

P1 Device Type **(03.038): All other device types**
P1 SSI Incremental Mode (03.047) has no effect.

Parameter	03.048 *P1 SSI Binary Mode*		
Short description	Set to 1 to enable SSI binary mode		
Mode	RFC‑S		
Minimum	0	Maximum	1
Default	0	Units	
Type	1 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW		

P1 Device Type **(03.038): SC SSI, SSI**
SSI encoders normally use Gray code data format. However, some encoders use binary format which may be selected by setting *P1 SSI Binary Mode* (03.048) to one.

P1 Device Type **(03.038): All other device types**
P1 SSI Binary Mode (03.048) has no effect.

Parameter	03.049 *P1 Additional Power-up Delay*		
Short description	Defines an additional delay for when any attempt is made to communicate to the device P1		
Mode	RFC‑S		
Minimum	0.0	Maximum	25.0
Default	0.0	Units	s
Type	8 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	1
Coding	RW, BU		

When the position feedback is initialised, at power-up or at any other time, a delay is included before the information from the feedback device is used or any attempt is made to communicate with the device. The minimum delays are shown in the table below. *P1 Additional Power-up Delay* (03.049) defines an additional delay that is added to the minimum delay.

P1 Device Type (03.038)	Minimum delay
AB, FD, FR AB Servo, FD Servo, FR Servo SC, SC Servo Resolver, SC SC	100ms
SC Hiperface	150ms
EnDat, SC EnDat SSI, SC SSI BISS, SC BiSS Option Slot 1, Option Slot 2, Option Slot 3, Option Slot 4	1.3s

Parameter	03.050 *P1 Feedback Lock*		
Short description	Set to 1 to prevent the position feedback paramters for P1 being updated		
Mode	RFC‑S		
Minimum	0	Maximum	1
Default	0	Units	
Type	1 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW		

If *P1 Feedback Lock* (03.050) = 1 then *P1 Revolution/Pole Pitch Counter* (03.028), *P1 Position* (03.029) and *P1 Fine Position* (03.030) are not updated.
If *P1 Feedback Lock* (03.050) = 0 then these parameters are updated normally.

Parameter	03.051 *P1 Linear Feedback Select*		
Short description	Set to 1 to configure the P1 interface to operate with a linear position feedback device		
Mode	RFC‑S		
Minimum	0	Maximum	1
Default	0	Units	
Type	1 Bit User Save	Update Rate	Background read, Auto-configuration write
Display Format	Standard	Decimal Places	0
Coding	RW		

If *P1 Linear Feedback Select* (03.051) = 0 then the drive P1 position feedback interface is configured to operate with a rotary position feedback device. *P1 Rotary Turns Bits* (03.033) and *P1 Rotary Lines Per Revolution* (03.034) should be used to set up the position feedback interface.

If *P1 Linear Feedback Select* (03.051) = 1 then the position feedback interface is configured to operate with a linear position feedback device. *P1 Linear Comms Pitch* (03.052) and *P1 Linear Line Pitch* (03.053) should be used to set up the position feedback interface.

Parameter	03.052 *P1 Linear Comms Pitch*		
Short description	Defines the distance covered by the least significant bit of the position information in a comms message from a linear encoder		
Mode	RFC‑S		
Minimum	0.001	Maximum	100.000
Default	0.001	Units	
Type	32 Bit User Save	Update Rate	Background read, auto-configuration write
Display Format	Standard	Decimal Places	3
Coding	RW		

P1 Device Type (03.038): SC Hiperface, EnDat, SC EnDat, SSI, SC SSI, BiSS, SC BiSS
P1 Linear Comms Pitch (03.052) is used to define the distance covered by the least significant bit of the position information in a comms message from a linear encoder. The units used by this parameter are defined by *P1 Linear Comms And Line Pitch Units* (03.054).

P1 Device Type (03.038): Any other device
P1 Linear Comms Pitch (03.052) has no effect.

Parameter	03.053 *P1 Linear Line Pitch*		
Short description	Defines the linear line pitch for device P1		
Mode	RFC‑S		
Minimum	0.001	Maximum	100.000
Default	0.001	Units	
Type	32 Bit User Save	Update Rate	Background read, auto-configuration write
Display Format	Standard	Decimal Places	3
Coding	RW		

P1 Linear Line Pitch (03.053) only has any effect if the position feedback interface is being used with a linear device (i.e. *P1 Linear Feedback Select* (03.051) = 1) and should be used to define the distances listed below for each type of device. The units used by this parameter are defined by *P1 Linear Comms And Line Pitch Units* (03.054).

P1 Device Type (03.038): AB, AB Servo
P1 Linear Line Pitch (03.053) should be set to the distance covered by one line period on the encoder.

P1 Device Type (03.038): FD, FR, FD Servo, FR Servo
P1 Linear Line Pitch (03.053) should be set to the distance covered by two line periods on the encoder.

P1 Device Type (03.038): SC, SC Hiperface, SC EnDat, SC SSI, SC Servo, SC SC, SC BiSS
P1 Linear Line Pitch (03.053) should be set to the distance covered by one sine wave period on the encoder.

P1 Device Type (03.038): Resolver
P1 Linear Line Pitch (03.053) should be set to the distance covered by one pole of the resolver divided by 2^{14}.

P1 Device Type (03.038): Any other device
P1 Linear Line Pitch (03.053) has no effect.

Parameter	03.054 *P1 Linear Comms And Line Pitch Units*		
Short description	Defines the linear units in either millimetres or micrometres		
Mode	RFC‑S		
Minimum	0	Maximum	1
Default	0	Units	
Type	8 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW, TE		

Value	*Text*
0	millimetres
1	micrometres

P1 Linear Comms And Line Pitch Units (03.054) defines the units used by *P1 Linear Comms Pitch* (03.052) and *P1 Linear Line Pitch* (03.053) in either millimetres or micrometres.

Parameter	03.055 *P1 Pole Pitch*		
Short description	Defines the distance equivalent to one pole for linear position feedback devices		
Mode	RFC‑S		
Minimum	0.01	Maximum	1000.00
Default	10.00	Units	mm
Type	32 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	2
Coding	RW		

P1 Pole Pitch (03.055) is used to define the distance equivalent to one pole for linear position feedback devices. If the linear position feedback device is being used with a linear motor, then *P1 Pole Pitch* (03.055) should be set to the pole pitch of the motor.

Parameter	03.056 *P1 Feedback Reverse*		
Short description	Set to 1 to reverse the direction of the position feedback		
Mode	RFC‑S		
Minimum	0	Maximum	1
Default	0	Units	
Type	1 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW		

If *P1 Feedback Reverse* (03.056) = 1 the position feedback is negated. This can be used to reverse the direction of the position feedback. It should be noted that the position and the turns are negated, so for example if *P1 Revolution/Pole Pitch Counter* (03.028) = 0 and *P1 Position* (03.029) = 1000 with *P1 Feedback Reverse* (03.056) = 0, then if *P1 Feedback Reverse* (03.056) is set to one then *P1 Revolution/Pole Pitch Counter* (03.028) = 65535 (-1) and *P1 Position* (03.029) = 64536 (65536 - 1000). This will have an effect on the initial position for example, for a resolver which is a single turn absolute device, where the initial *P1 Revolution/Pole Pitch Counter* (03.028) = 0 with *P1 Feedback Reverse* (03.056) = 0 or 65535 (-1) with *P1 Feedback Reverse* (03.056) = 1.

Reversing the position feedback will not compensate for the following situations:

1. The direction of the incremental signals and the direction of the digital commutation signals are different for encoders which have digital commutation signals (i.e. AB Servo)
2. The direction of the SINCOS signals are incorrect for a SINCOS encoder with comms.

Parameter	03.057 *P1 Normalisation Turns*		
Short description	Defines the number of turns bits included in the normalisation parameters		
Mode	RFC‑S		
Minimum	0	Maximum	16
Default	16	Units	
Type	8 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW		

The combination of *P1 Revolution/Pole Pitch Counter* (03.028), *P1 Position* (03.029) and *P1 Fine Position* (03.030) give the position feedback as a 48 bit value. This position cannot be read atomically without locking the position feedback (*P1 Feedback Lock* (03.050) = 1) and it cannot be used directly by the Advanced Motion Controller (see Menu 31). It is useful to be able to create 32 bit position values that can be held by a single parameter as this value can be accessed atomically and can be used directly by the Advanced Motion Controller. *P1 Normalisation Turns* (03.057) defines the number of turns bits included in the following parameters.

P1 Normalised Position (03.058)
P1 Normalised Marker Position (03.059)
F1 Normalised Freeze Position (03.103) if P1 is the source position for freeze function F1
F2 Normalised Freeze Position (03.108) if P1 is the source position for freeze function F2

Parameter	03.058 *P1 Normalised Position*		
Short description	Displays the position taken from the position feedback device including the effect of the marker function		
Mode	RFC‑S		
Minimum	-2147483648	Maximum	2147483647
Default		Units	
Type	32 Bit Volatile	Update Rate	250µs write
Display Format	Standard	Decimal Places	0
Coding	RO, ND, NC, PT		

P1 Normalised Position (03.058) is the position taken from the position feedback device including the effect of the marker function.
See *P1 Normalisation Turns* (03.057) for details of the format.

Parameter	03.059 *P1 Normalised Marker Position*		
Short description	Displays the normalised position at the last marker event		
Mode	RFC‑S		
Minimum	-2147483648	Maximum	2147483647
Default		Units	
Type	32 Bit Volatile	Update Rate	250µs write
Display Format	Standard	Decimal Places	0
Coding	RO, ND, NC, PT		

P1 Normalised Marker Position (03.059) is the value *P1 Normalised Position* (03.058) at the last marker event provided bit 2 of *P1 Marker Mode* (03.031) is set to 1. See *P1 Marker Mode* (03.031) for more details.

Parameter	03.060 *P1 Calculation Time*		
Short description	Defines the time from the first edge of the clock signal from the position feedback interface until the encoder has calculated the position and is ready to return this information		
Mode	RFC‑S		
Minimum	0	Maximum	20
Default	5	Units	µs
Type	8 Bit User Save	Update Rate	Background read, auto-configuration write
Display Format	Standard	Decimal Places	0
Coding	RW		

***P1 Device Type* (03.038): EnDat, BiSS**
P1 Calculation Time (03.060) is the time from the first edge of the clock signal from the position feedback interface until the encoder has calculated the position and is ready to return this information. This is used to calculate the overall time for a message interchange with the encoder.
See *P1 Low Speed Update Rate Active* (03.063) for more details.

***P1 Device Type* (03.038): Any other type of device**
P1 Calculation Time (03.060) has no effect.

Parameter	03.061 *P1 Recovery Time*		
Short description	Defines the time that must be allowed after each message interchange before a new message begins		
Mode	RFC‑S		
Minimum	4	Maximum	100
Default	30	Units	µs
Type	8 Bit User Save	Update Rate	Background read, auto-configuration write
Display Format	Standard	Decimal Places	0
Coding	RW		

***P1 Device Type* (03.038): EnDat, SSI, BiSS**
P1 Recovery Time (03.061) is the time that must be allowed after each message interchange before a new message begins.

***P1 Device Type* (03.038): Any other type of device**
P1 Recovery Time (03.061) has no effect.

Parameter	03.062 *P1 Line Delay Time*		
Short description	Displays the transmission delay between the position feedback interface and the encoder and back again		
Mode	RFC‑S		
Minimum	0	Maximum	5000
Default		Units	ns
Type	16 Bit User Save	Update Rate	Background read, position feedback initialisation write
Display Format	Standard	Decimal Places	0
Coding	RO, ND, NC, PT		

***P1 Device Type* (03.038): EnDat, SC EnDat, BiSS, SC BiSS**
During position feedback initialisation the transmission delay between the position feedback interface and the encoder and back again is measured and stored in *P1 Line Delay Time* (03.062). This value is then used to compensate for this delay so that the clock/data skew does not prevent the data from the encoder from being read. This means that longer line lengths can be used with these feedback devices provided the correct cable and connection arrangements are used.

***P1 Device Type* (03.038): Any other type of device**
P1 Line Delay Time (03.062) is always zero.

Parameter	03.063 *P1 Low Speed Update Rate Active*		
Short description	Indicates when the low speed update rate is active		
Mode	RFC‑S		
Minimum	0	Maximum	1
Default		Units	
Type	1 Bit Volatile	Update Rate	Background write
Display Format	Standard	Decimal Places	0
Coding	RO, ND, NC, PT		

***P1 Device Type* (03.038): EnDat, SSI, BISS**
There is a delay when the position information is obtained via a communications interface from an encoder. It is assumed that the position information is taken from all types of encoder at a fixed datum point during each sample period. The drive initiates the comms transfer at a suitable point in advance of the datum to ensure that the position information is available when required. A correction is then applied to the position information based on the change of position over the previous sample and the advance time so that the position appears to have been sampled at the datum. If the communications exchange, including allowing the encoder a recovery time (*P1 Recovery Time* (03.061)), is completed in 60µs and the time required to obtain the full position is completed in 40µs then the position is sampled at each current controller task and *P1 Low Speed Update Rate Active* (03.063) = 0. Otherwise if the communication exchange is completed in 230µs the position is sampled every 250µs and *P1 Low Speed Update Rate Active* (03.063) = 1. If the complete exchange takes any longer an *Encoder 8* trip is initiated. The following table shows the calculations used by the drive to determine the necessary time to obtain the required data.

Protocol	Time for full position	Time for complete data exchange
Endat 2.1 encoder	$t_{ST} + t_D + 10T + 2T + NtT + 5T$ where $tcal \leq t_{ST} + t_D/2 + 10T$ $t_{ST} + t_D + t_{cal} + 2T + NtT + 5T$ where $t_{cal} > t_{ST} + t_D/2 + 10T$	Time for full position + t_m
EnDat 2.2 encoder	$t_{ST} + t_D + 10T + 3T + NtT + 5T + t_{Add}$ where $tcal \leq t_{ST} + t_D/2 + 10T$ $t_{ST} + t_D + t_{cal} + 3T + NtT + 5T + t_{Add}$ where $t_{cal} > t_{ST} + t_D/2 + 10T$	Time for full position + t_m
BiSS	$t_D + t_{cal} + 2T + NtT + 2T + (CRCBits \times T)$	Time for full position + t_m
SSI	$t_D + T + NtT$ (t_D cannot be measured, and so a value of 1.25µs is used)	Time for full position + t_m

where

Value	Description	Source
t_{ST}	EnDat start time	For 100K baud = 5us, 200K baud = 2.5us, for all other baud rates = 2µs
t_D	Transmission delay from the drive to the encoder and back	*P1 Line Delay Time* (03.062)
T	1 / baud rate	*P1 Comms Baud Rate* (03.037)
t_{cal}	Position calculation time	*P1 Calculation Time* (03.060)
Nt	Total number of position information bits	*P1 Comms Bits* (03.035)
tm	Encoder recovery time	*P1 Recovery Time* (03.061)
t_{Add}	Time for additional information	$t_{Add1} = 31T + t_{ST} + 30T$
CRCBits	The number of bits in the CRC applied to the position	*P1 Additional Configuration* (03.074)

P1 Device Type (03.038): Option Slot 1, Option Slot 2, Option Slot 3, Option Slot 4
It is intended that position information is provided by an option module with an upate rate of 250us. It is assumed that the position that is provided is sampled 230us before the position datum point. *P1 Low Speed Update Rate Active* (03.063) is always one to indicate that a sample rate of 250us is being used.

P1 Device Type (03.038): Any other type of device
P1 Low Speed Update Rate Active (03.063) is always zero.

Parameter	03.064 *P1 Encoder Protocol Detected*		
Short description	Defines which protocol is used with the device P1		
Mode	RFC‑S		
Minimum	0	Maximum	4
Default		Units	
Type	8 Bit Volatile	Update Rate	Background write
Display Format	Standard	Decimal Places	0
Coding	RO, TE, ND, NC, PT		

Value	Text
0	None
1	Hiperface
2	EnDat2.1
3	EnDat2.2
4	BiSS

P1 Encoder Protocol Detected (03.064) shows the encoder comms protocol detected during position feedback initialisation. If *P1 Device Type* (03.038) is set to SC Hiperface or BiSS then *P1 Encoder Protocol Detected* (03.064) is set to the appropriate value after successful communication with the encoder

during initialisation. If *P1 Device Type* (03.038) is set to EnDat or SC EnDat then *P1 Encoder Protocol Detected* (03.064) is set to the appropriate EnDat protocol after successful communication with the encoder during initialisation. If communications is not successful during initialisation then *P1 Encoder Protocol Detected* (03.064) is set to 0.

Parameter	03.065 *P1 Resolver Poles*		
Short description	Defines the number of poles for the resolver connected to P1		
Mode	RFC‑S		
Minimum	1	Maximum	10
Default	1	Units	PolePairs
Type	8 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW		

P1 Device Type (03.038): Resolver

P1 Resolver Poles (03.065) should be set to the number pole pairs for the resolver connected to the P1 position feedback interface. If the resolver is being used for motor control then a 2 pole resolver can be used with any motor, but if the number of resolver poles is greater than 2, it can only be used when motor poles / resolver poles is an integer (i.e. a 4 pole resolver can be used with an 8 pole motor). Note that this value is only used if *P1 Linear Feedback Select* (03.051) = 0. If not then the position feedback must be set up using *P1 Linear Line Pitch* (03.053) and *P1 Pole Pitch* (03.055).

P1 Device Type (03.038): Any other type of device
P1 Resolver Poles (03.065) has no effect.

Parameter	03.066 *P1 Resolver Excitation*		
Short description	Defines the excitation of the resolver when connected to P1		
Mode	RFC‑S		
Minimum	0	Maximum	7
Default	4	Units	
Type	8 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW, TE		

Value	Text
0	6kHz 3V
1	8kHz 3V
2	6kHz 2V
3	8kHz 2V
4	6kHz 3V Fast
5	8kHz 3V Fast
6	6kHz 2V Fast
7	8kHz 2V Fast

P1 Device Type (03.038): Resolver

P1 Resolver Excitation (03.066) defines the excitation voltage and frequency. A level of 3V r.m.s. should be used with 3:1 resolvers and 2V r.m.s. with 2:1 resolvers. These give a nominal level of 1V r.m.s. feedback into the position feedback interface. Other ratios can be used, but if the feedback is increased above the expected levels the feedback seen by the drive will be distorted. The resolution of the position feedback will be reduced if the feedback is less than 1V r.m.s. With a 2 pole resolver the nominal resolution is equivalent to 1600 line encoder. If the number of resolver poles are increased then the resolution increases, for example a 4 pole resolver gives a resolution equivalent to a 3200 line encoder, etc. The position feedback system allows for a delay from the excitation to the feedback from the resolver of up to 45° and will compensate for this lag during the position feedback initialisation process. (It should be noted that the excitation voltage given is the nominal level, but this can slightly higher than the nominal level.)

The resolver interface offers two sampling rates: standard and fast. With standard sampling (*P1 Resolver Excitation* (03.066) < 4) any switching frequency can be used with any resolver excitation frequency and the switching frequency can be changed when the position feedback is being used without any transient effects. There is a 250us sampling delay with this system and if the resolver feedback is used for motor control the system can become unstable at high speeds. It is recommended that the motor speed is limited to 9000rpm / Motor Pole Pairs. With fast sampling (*P1 Resolver Excitation* (03.066) ≥ 4) the sample delay is significantly reduced and resolver feedback can be used up to the maximum limit of 30000rpm, but the feedback is much noisier and the acoustic noise produced by the motor is increased. It is possible to switch between standard and fast sampling while the drive is enabled and controlling a motor, so for example standard sampling can be used at low speeds, and then fast sampling can be used at higher speeds. Normally when *P1 Resolver Excitation* (03.066) is changed an *Encoder 7* is initiated because the position feedback set-up has been changed and the position feedback interface needs to be re-initialised. However, if the new value of *P1 Resolver Excitation* (03.066) is the old value plus or minus 4 (i.e. 0 to 4, or 5 to 1, etc.) then a trip is not initiated and the interface does not need to be initialised.

The following restrictions apply if fast sampling is selected:

1. 2, 4, 8 or 16kHz switching frequencies should be used with 8kHz excitation. 3, 6 or 12kHz switching frequencies should be used with 6kHz excitation. If these conditions are not met the system will automatically operate with standard sampling.
2. If the switching frequency is changed by one step, i.e. from 2 to 3kHz, there will be a transient in the position feedback. To ensure that this does not happen as the drive alters the switching frequency because it has become too hot *Auto-switching Frequency Step Size* (05.036) should be left at its default value, so that all changes are made in steps of 2.
3. If the resolver feedback is not being used as the feedback for motor control then its sample rate is automatically reduced and the position feedback will automatically operate with standard sampling.
4. If a linear mode is selected (i.e. *P1 Linear Feedback Select* (03.051) = 1) then the system will operate with standard sampling.

P1 Device Type (03.038): Any other type of device
P1 Resolver Excitation (03.066) has no effect

Parameter	03.067 *P1 User Comms Enable*		
Short description	Enables the use of the user comms paramters to communicate to the encoder connected to P1		
Mode	RFC‑S		
Minimum	0	Maximum	1
Default	0	Units	
Type	8 Bit Volatile	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW, NC, PT		

If *P1 User Comms Enable* (03.067) set to one it is possible to use *P1 User Comms Transmit Register* (03.068) and *P1 User Comms Receive Register* (03.069) to communicate with an encoder that has a Hiperface, EnDat 2.1, EnDat2.2 or BiSS interface. A description of how to use these registers is given below.

P1 Device Type (03.038): SC Hiperface, SC EnDat
Hiperface or EnDat 2.1 communications are used as appropriate if *P1 User Comms Enable* (03.067) is set to one.

P1 Device Type (03.038): EnDat
Communication is enabled when *P1 User Comms Enable* (03.067) is set to one. If the encoder supports EnDat 2.2 it is possible to enable user communications at any time even if the drive is enabled. Otherwise if the encoder only supports EnDat 2.1 communication with the encoder is not possible.

P1 Device Type (03.038): BISS, SC BiSS
If *P1 User Comms Enable* (03.067) is set to one it is possible to enable user communications at any time even if the drive is enabled.

Encoder communications
A communication channel is provided to allow the user to communicate with an encoder connected to one of the communications interfaces. It should be noted that the communications channel is disabled under the following conditions:

1. If auto-configuration is active.
2. During the transfer of electronic nameplate data.
3. If the position feedback device is not initialised.
4. The channel is being used by an option module with safety functions.

To send a message to the encoder the required message must be written to the transmit register. To read the response from the encoder the data is read from the receive register. The data is written one byte at a time and is stored in a 16 byte buffer before being sent to the encoder. The data should only be written to the transmit register when it has been cleared to zero by the drive. Bits 13 to 15 are used to control the interface.

Bit	Function
15	This bit should be set to one each time data is written to the transmit register. This indicates that data has been written. This bit will be cleared when the LS byte of the data has been transferred into the comms buffer.
14	This bit should be set when the last byte of the message is written to the transmit register. The data will be read and transferred to the comms buffer and then the message will be sent to the encoder.
13	This bit should be set when the first byte of the message is written to the transmit register. Setting this bit will reset the pointer to the start of the comms buffer.

Data can be read from the receive register at any time. If there is data in the buffer bit 15 will be set. Once the data has been read the register should be cleared and the drive will transfer the next byte of data to the register.

Bit	Function
15	Indicates that data from the last transfer can be read from the receive register.
14	Indicates that the last byte from the receive message is in the register.
13	There is no data in the receive buffer and the LS byte of the receive register is the comms system status. If there was an error in the received message one of the status error bits will also be set until the comms is used again by this system or by the drive.

The status flags are defined as follows:

Bit	Meaning
0	The number of bytes put into the transmit buffer is not consistent with the expected message length. (Hiperface only)
1	The number of bytes written to the transmit buffer, or the expected length of the store data transmit message, or the expected length of a read data message have exceed the length of the buffer. (Hiperface only)
2	The command code is not supported.
3	A valid response was not received from the encoder.

The following sequence should be followed when transmitting and receiving data to ensure that the received data is always read correctly.

1. Check that *P1 User Comms Receive Register* (03.069) is not zero.
2. Check that *P1 User Comms Transmit Register* (03.068) is zero.
3. Write each word of the transmit message to *P1 User Comms Transmit Register* (03.068) in turn, waiting each time for the drive to return *P1 User Comms Transmit Register* (03.068) back to zero before writing the next word.
4. Write zero to *P1 User Comms Receive Register* (03.069).
5. Read *P1 User Comms Receive Register* (03.069) and when it is not zero the drive has updated it with a receive word.
6. Read each receive word in turn writing zero to *P1 User Comms Receive Register* (03.069) after reading the word.

If the above sequence is not followed correctly, it is possible that data from the transmit message will be seen in the first read of the receive message. It is not essential that any or all of the receive message is read before sending a new transmit message, and so steps 4 to 6 can be omitted if required provided step 1 is not ignored.

Hiperface
Up to 15 bytes of data can be written to the buffer. The first byte should be the encoder address. The checksum will be calculated by the drive and added to the end of the message before the message is transmitted to the encoder. The drive checks the checksum of the received message. If successfully received, the receive message can be read via the receive register including the address and the checksum received from the encoder. It should be noted that the encoder must be set up for 9600 baud, 1 start bit, 1 stop bit and even parity (default set-up) for the encoder comms to operate with the drive. Also the data block security should not be enabled in the encoder if the drive encoder nameplate system is to operate correctly. See Hiperface specification for more details of the comms message format.

The following commands are supported:

Code	Command
0x42	Read position
0x43	Set position
0x44	Read analog value
0x46	Read counter
0x47	Increment counter
0x49	Clear counter
0x4a	Read data (maximum of 10 bytes)
0x4b	Store data (maximum of 9 bytes)
0x4c	Data field status
0x4d	Create a data field
0x4e	Available memory
0x50	Read encoder status
0x52	Read type
0x53	Reset encoder

SC EnDat
Up to 4 bytes can be written to the buffer in the following format.

Byte 0			
Command	Address	Data (MSB)	Data (LSB)

The following commands are supported.

Code	Command	Address	Data (MSB)	Data (LSB)
0x07	Encoder to send position value	Any	Any	Any
0x0E	Selection of memory area	MRS code	Any	Any
0x1C	Encoder to receive parameter	Address	Data (MSB)	Data (LSB)
0x23	Encoder to send parameter	Address	Any	Any
0x2A	Encoder to receive reset	Any	Any	Any

The message from the encoder contains a CRC which is checked. If there are no errors in the message, then the message is put into the comms buffer. The position is retrieved from the drive buffer most significant byte first (Byte 0) and least significant byte last (Byte 7). An example is shown below where a 48 bit value has been read from the encoder which contains an error bit (Bit 0) and 47 bits of position data (Bits 1 to 47) where Bit 1 is the least signficant bit of the position. If there are less position bits the position is right justified with leading zeros.

Byte 0							Byte 7
0	0	Bits47-40	Bits 39-32	Bits 31-24	Bits 23-16	Bits 15-8	Bits 7-0

If any other command is sent the response is shown below. The response is available when the encoder has responded, but for "Encoder to recieve parameter" and "Encoder to receive reset" commands there is an additional delay of 12ms and 20ms respectively to allow the encoder to be ready again.

Byte 0		Byte 2
Address	Data (MSB)	Data (LSB)

EnDat
Up to 4 bytes can be written to the buffer in the same format as for EnDat 2.1. The following commands are supported.

Code	Command	Address	Data (MSB)	Data (LSB)
0x09	Encoder to send position value with additional information and select memory area	MRS code	0x00	Block address
0x1B	Encoder to send position value with additional information and receive parameters	Address	Data (MSB)	Data (LSB)
0x24	Encoder to send position value with additional information and send parameters	Address	Any	Any
0x2D	Encoder to send position value with additional information and receive error reset	Any	Any	Any
0x36	Encoder to send position values and receive test command	Any	Any	Any

The message from the encoder contains a CRC which is checked. If there are no errors in the message the message is put into the comms buffer.

Byte 0		Byte 2
Additional information 1 Byte 0 (B7) WRN (B6) RM (B5) Busy (B4) I4 (B3) I3 (B2) I2 (B1) I1 (B0) I0	Additional Information 1 Byte 1	Additional Information 1 Byte 2

It should be noted that the encoder is set up automatically so that it always returns Additional Information 1 with no data contents. An MRS is sent to the encoder to select which data contents should be included in Additional Information 1. An MRS code can also be used to select Additional Information 1, Additional Information 2 or no Additional Information to be sent from the encoder, but these commands must not be used. Although the contents of Additional Information 1 can be changed the encoder should always be in the state where it transmits only Additional Information 1.

BiSS, SC BiSS
It is possible to read or write to 8 bit registers in a BiSS device. The addressing range is 0 to 127 giving access to 128 registers. Two bytes should be written to the buffer for both read or write operations. Byte 0 contains the command in bit 7 (0 = read, 1= write) and the register address in bit 6 to bit 0. For reading Byte 1 can contain any value, for writing it should contain the data to be written.

Byte 0	Byte 1
Command + Address	Data

The response is always two bytes as shown below. Byte 0 is the same as Byte 0 in the request sent to the drive. For reading Byte 1 is the value read from the register and for writing it is always zero.

Byte 0	Byte 1
Command + Address	Data

Parameter	03.068 *P1 User Comms Transmit Register*		
Short description	Defines the value present in the user comms transmit register		
Mode	RFC‑S		
Minimum	0	Maximum	65535
Default	0	Units	
Type	16 Bit Volatile	Update Rate	Background read/write
Display Format	Standard	Decimal Places	0
Coding	RW, NC, PT, BU		

See *P1 User Comms Enable* (03.067).

Parameter	03.069 *P1 User Comms Receive Register*		
Short description	Defines the value present in the user comms receive register		
Mode	RFC‑S		
Minimum	0	Maximum	65535
Default	0	Units	
Type	16 Bit Volatile	Update Rate	Background read/write
Display Format	Standard	Decimal Places	0
Coding	RW, NC, PT, BU		

See *P1 User Comms Enable* (03.067).

Parameter	03.070 *P1 Position Feedback Signals*		
Short description	Shows the state of the signals from the position feedback device		
Mode	RFC‑S		
Minimum	0 (Display: 000000)	Maximum	63 (Display: 111111)
Default		Units	
Type	16 Bit Volatile	Update Rate	Background write
Display Format	Binary	Decimal Places	0
Coding	RO, ND, NC, PT		

P1 Position Feedback Signals (03.070) shows the state of the signals from the position feedback device as given in the table below where the signals are relevant for the type of device. *P1 Position Feedback Signals* (03.070) is only intended as a debugging aid.

P1 Position Feedback Signals (03.070) bits	Signals
0	A or F or Cos
1	B or D or R or Sin
2	Z
3	U
4	V
5	W

For Cos and Sin signals the relevant bits of *P1 Position Feedback Signals* (03.070) will be set when the signals are positive and cleared when the signals are negative.

Parameter	03.071 *P1 Error Detected*		
Short description	Indicates if an error has been detected with the position feedback device connected to the P1 position interface		
Mode	RFC‑S		
Minimum	0	Maximum	1
Default		Units	
Type	1 Bit Volatile	Update Rate	Background write
Display Format	Standard	Decimal Places	0
Coding	RO, ND, NC, PT		

P1 Error Detected (03.071) is set if an error has been detected with the position feedback device connected to the P1 position interface. This parameter is useful if encoder trips have been disabled by setting bit 3 of *P1 Error Detection Level* (03.040). It should be noted that this bit is not set if specific trips are disabled with bits 0 to 2 of *P1 Error Detection Level* (03.040).

Parameter	03.073 *P1 Absolute Turns Recovery Enable*		
Short description	Set to 1 to allow turns information beyond the number of turns bits provided by the position feedback device connected to P1 to be stored on power-down and recovered at next power-up		
Mode	RFC‑S		
Minimum	0	Maximum	1
Default	0	Units	
Type	1 Bit User Save	Update Rate	Background Read
Display Format	Standard	Decimal Places	0
Coding	RW		

P1 Absolute Turns Recovery Enable (03.073) can be used to remove the masking applied to *P1 Revolution/Pole Pitch Counter* (03.028) for any type of position feedback device. If *P1 Device Type* (03.038) is set to EnDat, SC.EnDat, SC.Hiperface, SSI, SC.SSI, BiSS, Option Slot 1, Option Slot 2, Option Slot 3 or Option Slot 4 then this parameter has an additional feature which allows turns bits beyond the number of turns bits provided by the position feedback device to be stored on power-down and then recovered on the next power-up. *P1 Revolution/Pole Pitch Counter* (03.028) is saved as a power-down save parameter. If *P1 Absolute Turns Recovery Enable* (03.073) = 0 the value saved at power-down is ignored on the next power-up and *P1 Revolution/Pole Pitch Counter* (03.028) is set up based on the information provided by the position feedback device. For example a device with 12 turns bits can define the position with up to 4096 turns. If *P1 Absolute Turns Recovery Enable* (03.073) = 1 the turns beyond those provide by the position feedback device are simulated from the saved value. This means that 65536 turns can be generated from a position feedback device with any number of turns bits. The following should be noted:

1. If the position feedback device moves by more than +/-1/4 of the range of the most significant turns bit while powered down the turns at power-up will not be correct. For example a device with 12 turns bits must not move by more than the range defined by 10 turns bits, or a device with no turns bits must not move by more than 1/4 of a turn.
2. This feature is not applicable to linear position feedback devices.
3. If an SSI based device is being used then *P1 SSI Incremental Mode* (03.047) must be set to one.
4. The recovered turns bits are stored in *P1 Revolution/Pole Pitch Counter* (03.028). To reset the additional bits *P1 Absolute Turns Recovery Enable* (03.073) should be set to zero to remove the recovered turns bits. A parameter save should then be initiated using a value of 1 or 1001 in parameter mm.000 to save the contents of *P1 Revolution/Pole Pitch Counter* (03.028). Absolute turns recovery can then be selected again by setting *P1 Absolute Turns Recovery Enable* (03.073) to one.
5. Absolute turns recovery is not possible when *Low Under Voltage Threshold Select* (06.067) = 1 or *Backup Supply Mode Enable* (06.068) = 1 or *User Supply Select* (06.072) = 1. If absolute turns recovery is required when one of these modes is enabled then a user save (*Parameter mm.000* (mm.000) = 1 or 1001) should be performed before the drive is powered down.

Parameter	03.074 *P1 Additional Configuration*		
Short description	Provides additional configuration information for the position feedback device not included in the other set-up parameters.		
Mode	RFC‑S		
Minimum	0	Maximum	511116116
Default	0	Units	
Type	32 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW		

P1 Additional Configuration (03.074) provides configuration information, not covered by the other set-up parameters, for the position feedback device connected to the P1 position feedback interface and is specific to the type of device being used.

P1 Device Type (03.038): BiSS, SC BiSS

This parameter is split into 3 fields as shown below.

Decimal Digits	9-6	5-3	2-0
	CRC polynomial	Rotary Turns Padding	Rotary Position Padding
Default	0067	000	000

CRC polynomial
The CRC polynomial is a bit representation of the terms of a polynomial used to generate the CRC applied to the position and the additional data transferred to/from the encoder via the BiSS communications channel. The standard value is 0067 which in hexadecimal is 0x0043, or in binary form is 0000 0000 0100 0011. The bits that are set to one show which terms exist in the polynomial. The standard value has bits 6, 1 and 0 set to one and gives the polynomial normally used with BiSS encoders which is X^6+X^1+1. If the encoder uses a different polynomial then this can be selected with the four digits (9-6). The maximum value is 511 (0x01FF), and so a polynomial up to degree 10 can be set up.

Rotary Turns Padding and Rotary Position Padding
The turns, and position within a turn, provided by a rotary encoder may not completely fill the number of bits provided. The unfilled bits will be padded with zeros. The total number of bits provided for the turns including zero padding is given by *P1 Rotary Turns Bits* (03.033). The zero padding is given by decimal digits 5 to 3 of *P1 Additional Configuration* (03.074). Digits 4 and 3 give the number of bits and digit 5 specifies whether the padding is on the left (0) or on the right (1). For example a value of 104 would specify 4 padding bits on the right of the turns data. The default value of 000 specifies no padding. If the padding value is outside the range +/-16 then an *Encoder 14* is initiated. The total number of bits provided for position within a turn is given by *P1 Comms Bits* (03.035) - *P1 Rotary Turns Bits* (03.033). The zero padding is given by decimal digits 2 to 0 of *P1 Additional Configuration* (03.074) in the same manner as is used for the turns padding. It is not possible to specify zero padding for linear encoders.

P1 Device Type (03.038): Any other device type
This parameter has no effect.

Parameter	03.075 *Initialise Position Feedback*		
Short description	Set to 1 to re-initialise any position feedback device connected		
Mode	RFC‑S		
Minimum	0	Maximum	1
Default	0	Units	
Type	1 Bit Volatile	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW, NC		

If *Initialise Position Feedback* (03.075) is set to one any position feedback devices connected to the drive position feedback interfaces or any position feedback category option modules will be re-initialised.

Parameter	03.076 *Position Feedback Initialized*		
Short description	Indicates the initialisation state of position feedback devices connected		
Mode	RFC‑S		
Minimum	0 (Display: 0000000000)	Maximum	1023 (Display: 1111111111)
Default	0 (Display: 0000000000)	Units	
Type	16 Bit Volatile	Update Rate	Background write
Display Format	Binary	Decimal Places	0
Coding	RO, NC, PT		

Position Feedback Initialized (03.076) contains flags that represent the initialisation state of position feedback devices connected to the drive position feedback interfaces or position feedback interfaces on position feedback category option modules. One indicates that the interface is initialised and zero indicates that the interface is not initialised. The flags are assigned as shown below.

Bit	Position feedback interface
0	P1 Drive
1	P2 Drive
2	P1 Option slot 1
3	P2 Option slot 1
4	P1 Option slot 2
5	P2 Option slot 2
6	P1 Option slot 3
7	P2 Option slot 3
8	P1 Option slot 4
9	P2 Option slot 4

If no option module, or an option module other than a position feedback category module, is fitted in an option slot then the relevant flag is always set to one. If an attempt is made to enable the drive when any of the flags are zero the drive initiates an *Encoder 7* trip. If a drive reset is initiated, the bits in *Position Feedback Initialized* (03.076) are checked, and if any position feedback devices are not initialised an attempt is made to initialise them.

The table below shows the initialisation process for different position feedback devices that can be connected to the drive.

Encoder types	Initialisation process
AB, FD, FR Resolver	None. Initialisation is immediate and is always successful. The position feedback is set to zero on initialisation.
AB Servo FD Servo FR Servo SC Servo	The absolute position used to control a motor can only be defined accurately after two different changes of state of the UVW commutation signals. Initialisation resets the system that ensures that the UVW signals alone will be used to define the motor position until the encoder has moved through two valid commutation signal state changes. Initialisation is immediate and is always successful. The position feedback is set to zero on initialisation.
SC	The SINCOS interpolation system must be initialised. Initialisation is immediate and is always successful. The position feedback is set to zero on initialisation.
SC Hiperface SC EnDat SC SSI	Auto-configuration if required except SC SSI. The absolute position must be obtained via comms. This may cause a large change in position feedback. The SINCOS interpolation system must be initialised. This may have a small effect on the position feedback.
EnDat BiSS SSI	Auto-configuration if required except SSI. The absolute position must be obtained via comms. This may cause a large change in position feedback.
SC SC	The absolute position used to control a motor is obtained from the sine and cosine signals provided for one revolution until the marker pulse occurs. The position obtained from the marker pulse is assumed to be a position of zero. Once a marker has occurred the incremental position is used and the single turn sine wave signals are ignored. When the position feedback device is initialised the single turn sine wave signals are used again until another marker event occurs. No part of the initialisation process affects the position feedback seen in parameters, except that the SINCOS interpolation system must be initialised which may have a small effect on the position feedback. Initialisation is immediate and is always successful.

Parameter	03.078 *Sensorless Mode Active*		
Short description	Indicates that sensorless mode is active		
Mode	RFC‑S		
Minimum	0	Maximum	1
Default		Units	
Type	1 Bit Volatile	Update Rate	4ms write
Display Format	Standard	Decimal Places	0
Coding	RO, ND, NC, PT		

If *Sensorless Mode Active* (03.078) = 0 it indicates that the position feedback selected with *Motor Control Feedback Select* (03.026) is being used for motor control. If Sensorless *Sensorless Mode Active* (03.078) = 1 it indicates that the sensorless algorithm is being used instead.
See *RFC Feedback Mode* (03.024) for more information.

Parameter	03.079 *Sensorless Mode Filter*		
Short description	Defines the filter for the estimated motor speed when sensorless mode is active		
Mode	RFC‑S		
Minimum	0	Maximum	4
Default	4	Units	ms
Type	8 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW, TE		

Value	Text
0	4
1	8
2	16
3	32
4	64

When sensorless mode is active the estimated motor speed can include some unwanted noise. Some motors have concentrated windings which results is flux distortion when the motor is loaded, which in turn causes ripple in the motor currents and additional unwanted components in the calculated speed feedback. This usually has a more significant effect if the motor is running at high speed when the voltage controller may be active to limit the motor voltage. A filter is applied to the speed feedback with a time constant defined by *Sensorless Mode Filter* (03.079). The default value for this parameter gives the maximum amount of filtering, so that motors which introduce unwanted feedback noise will operate correctly. If the motor does not introduce this type of noise it is possible to reduce the filter time constant to give better dynamic performance when speed control is required.

Parameter	03.080 *Sensorless Position*		
Short description	Displays the motor position when sensorless mode is active		
Mode	RFC‑S		
Minimum	-2147483648	Maximum	2147483647
Default		Units	
Type	32 Bit Volatile	Update Rate	4ms write
Display Format	Standard	Decimal Places	0
Coding	RO, ND, NC, PT		

When the drive is operating without position feedback *Sensorless Position* (03.080) gives the motor position where the least significant 16 bits represent a movement equivalent to one pole of the motor. The most significant 16 bits represent turns where one turn is the movement associate with one pole. For example in a rotary application with a 4 pole motor, the movement associated with one pole is a mechanical movement of 180°. In RFC-A mode *Sensorless Position* (03.080) is aligned with the motor flux and voltages, but this has no fixed relationship to the mechanical position of the rotor.

Parameter	03.085 *Encoder Simulation Source*		
Short description	Defines the source parameter used for the encoder simulation		
Mode	RFC‑S		
Minimum	0.000	Maximum	59.999
Default	0.000	Units	
Type	16 Bit User Save	Update Rate	Reset read
Display Format	Standard	Decimal Places	3
Coding	RW, PT, BU		

Encoder Simulation Source (03.085) is used to select a parameter as the input to the encoder simulation system. If *Encoder Simulation Source* (03.085) is zero then no source is selected and the encoder simulation system is disabled. The encoder simulation output connections are shared with the P1 and P2 position feedback interfaces, and so encoder simulation may be disabled because the connections are not available. See *Encoder Simulation Status* (03.086) for details.

Any parameter can be selected as the source, but it is assumed that the input is a 16 bit value with a range from 0 to 65535 or from -32768 to 32767. The source parameter is treated differently depending on the value of *Encoder Simulation Mode* (03.088) as given in the table below.

Encoder Simulation Mode (03.088)	
Hardware (0)	*Encoder Simulation Source* (03.085) must be set to 3.029 for the output to be enabled and the position from the P1 position feedback interface is used and *P1 Position* (03.029) is the source.
Lines Per Rev (1) or Ratio (2)	If *Encoder Simulation Source* (03.085) = 3.029 (i.e. *P1 Position* (03.029) is the source) then *P1 Position* (03.029) and *P1 Fine Position* (03.030) are combined as a 16 bit value with 16 bit fractional part as the input to the encoder simulation system, which gives additional output resolution if encoder simulation ratio is greater than unity.
	The encoder simulation system is intended to be used with a 16 bit source parameter. If the source of the encoder simulation system is not a 16 bit parameter then the drive uses the source parameter as follows. • 1 bit parameter: Zero extended • 8 bit parameter: Sign extended if BU attribute is zero (signed), otherwise zero extended (unsigned) • 32 bit parameter: Only the least significant word is used.
SSI (3)	For SSI output mode the number of bits included in the output can be selected (see *Encoder Simulation Mode* (03.088) for details).

Although *Encoder Simulation Source* (03.085) is not a standard source parameter in common with other sources the actual source is only changed on drive reset.

Parameter	03.086 *Encoder Simulation Status*		
Short description	Displays the status of the encoder simulation		
Mode	RFC‑S		
Minimum	0	Maximum	2
Default		Units	
Type	8 Bit Volatile	Update Rate	Background write
Display Format	Standard	Decimal Places	0
Coding	RO, TE, ND, NC, PT		

Value	Text
0	None
1	Full
2	No Marker Pulse

The availability of the encoder simulation output on the 15 way connector on the drive is dependent on the type of feedback device selected with *P1 Device Type* (03.038). Priority is as follows from highest to lowest priority:

1. P1 position feedback interface
2. Encoder simulation output
3. P2 position feedback interface

Encoder Simulation Status (03.086) shows the status of the encoder simulation output.

0: None
The encoder simulation output is not enabled or is not available.

1: Full
Full encoder simulation with marker output is available.

2: No Marker
Encoder simulation without marker output is available.

Parameter	03.087 *Encoder Simulation Sample Period*		
Short description	Defines the sample period of the encoder simulation		
Mode	RFC‑S		
Minimum	0	Maximum	3
Default	0	Units	ms
Type	8 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW, TE		

Value	Text
0	0.25
1	1
2	4
3	16

The update rate of the encoder simulation system is nominally 250µs, i.e. default value of *Encoder Simulation Sample Period* (03.087), but if the update rate of the source parameter is different, the encoder simulation output will consist of bursts of pulses at the update rate of the parameter. To prevent this and to give a smooth output, the update rate can be adjusted with *Encoder Simulation Sample Period* (03.087). *Encoder Simulation Sample Period* (03.087) has no effect if hardware mode is selected, i.e. *Encoder Simulation Mode* (03.088) = 0.

Parameter	03.088 *Encoder Simulation Mode*		
Short description	Defines the mode of the encoder simulation		
Mode	RFC‑S		
Minimum	0	Maximum	3
Default	0	Units	
Type	8 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW, TE		

Value	Text
0	Hardware
1	Lines Per Rev
2	Ratio
3	SSI

Encoder Simulation Mode (03.088) defines the encoder simulation output as incremental signals (AB, FD or FR) derived directly via hardware, incremental signals generated via software or SSI data generated via software.

0: Hardware
The encoder simulation output is derived directly in hardware from the P1 position feedback interface in the drive and the output is derived from the input with negligible delay. The ratio between the input at the P1 interface and the output is either unity or a limited number of binary divider ratios (see *Encoder Simulation Hardware Divider* (03.089)). Hardware mode only produces an output with AB, FD, FR, SC, SC Hiperface, SC EnDat or SC SSI

type devices. It should be noted that with a SINCOS source device the output is based on the zero crossings of the sine wave inputs and does not include interpolation. If *Encoder Simulation Hardware Marker Lock* (03.090) = 0 the marker output is derived directly from the marker input. If *Encoder Simulation Hardware Marker Lock* (03.090) = 1 the incremental output signals are adjusted on each marker event so that the A and B are high with an AB type output, or F is high with an FD or FR type output. Marker locking is not recommended if the number of lines per revolution of the encoder simulation source combined with the ratio does not give an encoder simulation output with a multiple of 4 counts per revolution (i.e. between each output marker event) for AB signals, or a multiple of 2 counts for FD or FR signals, because this causes a count error in the system receiving these signals. The input marker pulse width is not adjusted to take account of the divider ratio, but is simply routed from the input to the output. Therefore the output marker pulse becomes shorter with respect to the output incremental signals as the divider ratio is increased.

1: Lines Per Rev

The encoder simulation output is derived via software from the selected source with a resolution defined
by *Encoder Simulation Output Lines Per Revolution* (03.092) with a minimum delay of 250µs which may be extended
if *Encoder Simulation Sample Period* (03.087) is set up for a longer sample period. Note that the number of output lines per revolution apply to a quadrature (AB) type device, and that if FD or FR mode are selected the number of lines per revolution are 2 x
Encoder Simulation Output Lines Per Revolution (03.092). The output is derived by applying a ratio and output counter roll-over limit defined by *Encoder Simulation Output Lines Per Revolution* (03.092) as shown below. The output marker is produced when the output counter is zero.
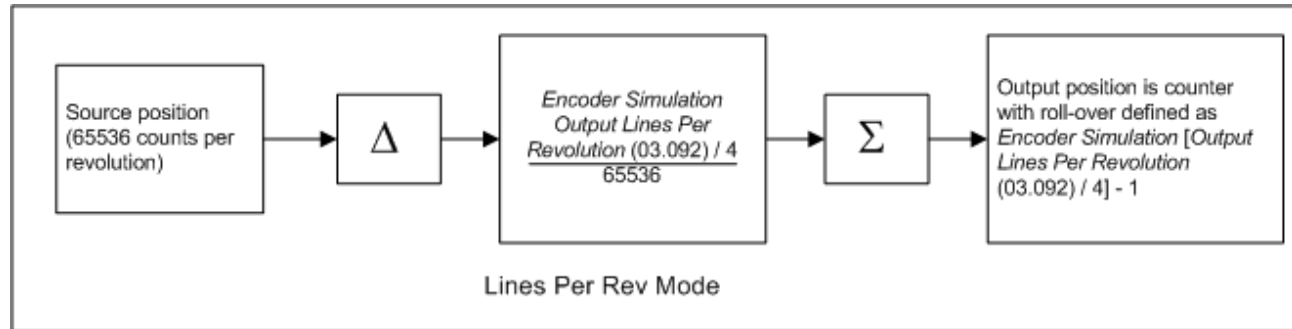
Lines Per Rev Mode

If *P1 Position* (03.029) is selected as the source and *Encoder Simulation Incremental Mode Select* (03.091) = 0 then the input and output counters are synchronised at power-up and when the P1 position feedback interface becomes initialised, so that the output marker is synchronised with zero position for the P1 position feedback interface. For devices that support a marker, the effect of the marker on the position can be selected using *P1 Marker Mode* (03.031). At power-up and on device initialisation there will be a step change in position from zero to the actual position from the device and the pulses necessary to make this change are produced at the encoder simulation output. If a marker event occurs that causes a step change in position, again the necessary pulses will be produced for this change of position. Where large sudden changes occur the maximum output frequency is limited to 500kHz, and so it may take some time for the output position to reach the input position. This mode of operation gives an initial position change from zero position and then follows all changes of position from that point onwards, and may be used to follow the absolute position of the device connected to the P1 position feedback interface.

If *P1 Position* (03.029) is selected as the source and *Encoder Simulation Incremental Mode Select* (03.091) = 1 then the encoder simulation output only follows the changes of source position. At power-up, on device initialisation and a marker event no additional pulses are produced to give the absolute position of the device related to zero position. The encoder simulation output markers is not synchronised to the source marker.

If a source other than *P1 Position* (03.029) is selected *Encoder Simulation Incremental Mode Select* (03.091) has no effect and the encoder simulation system always operates in absolute mode.

2: Ratio

The encoder simulation is derived in the same way as described previously for *Encoder Simulation Mode* (03.088) = 1 (i.e. lines per rev mode), except that different parameters are used to set up the system giving more flexibility as shown below.

Ratio Mode
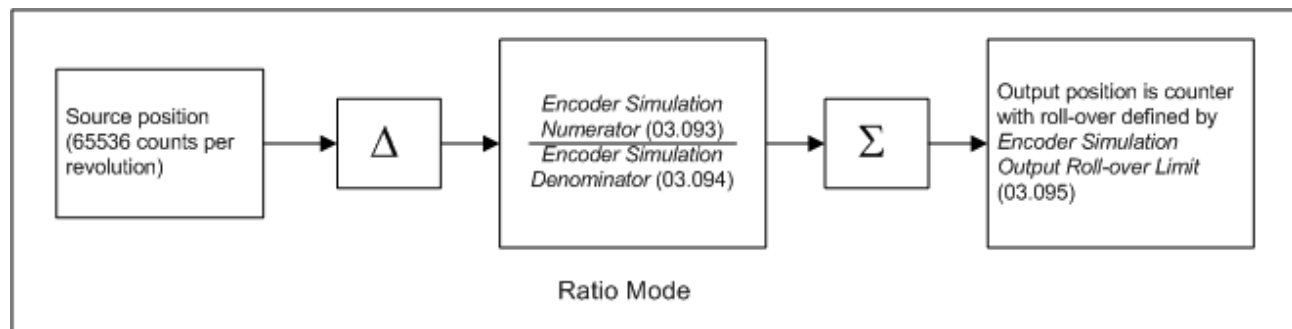
With the default settings (*Encoder Simulation Numerator* (03.093) = 65536, *Encoder Simulation Denominator* (03.094) = 65536
and *Encoder Simulation Output Roll-over Limit* (03.095) = 65535) the output produces a state change each time the source parameter changes by one. The numerator and denominator can be changed to provide a different ratio between the source and the output. Output markers are produced each time the output counter is zero and the counters are synchronised in the same way as for lines per rev mode. It is possible to control the roll-over limit of the output counter and hence the rate at which output markers are produced using *Encoder Simulation Output Roll-over Limit* (03.095). For example if the ratio is set to 1024/ 65536 and the roll-over limit is 1023 then one output marker is produced for every 1024 lines of output incremental signals. If the roll-over limit is changed to 512, then two output markers are produced for every 1024 lines of output incremental signals.

3: SSI

In this mode the B output becomes the clock input and the A output is the data output. If the source position is the P1 position feedback interface the data from the position feedback interface is transferred to the SSI output register once per sample period defined by *Encoder Simulation Sample Period* (03.087). An example is given below which shows how the data is aligned.

Example of SSI data set-up from P1 position feedback interface
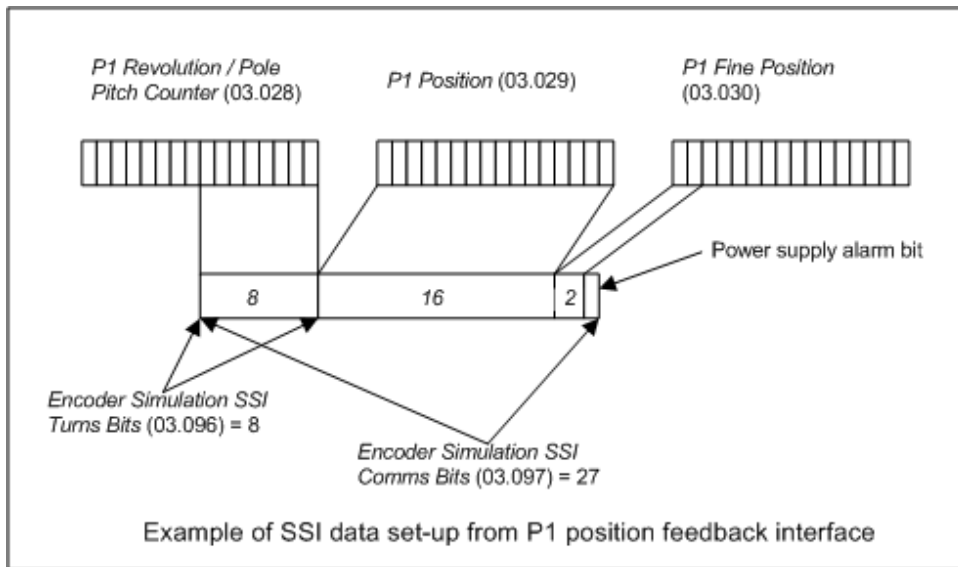
The SSI output is then clocked out from the register as shown in another example below which includes 15 bits of data.

SSI encoder simulation output
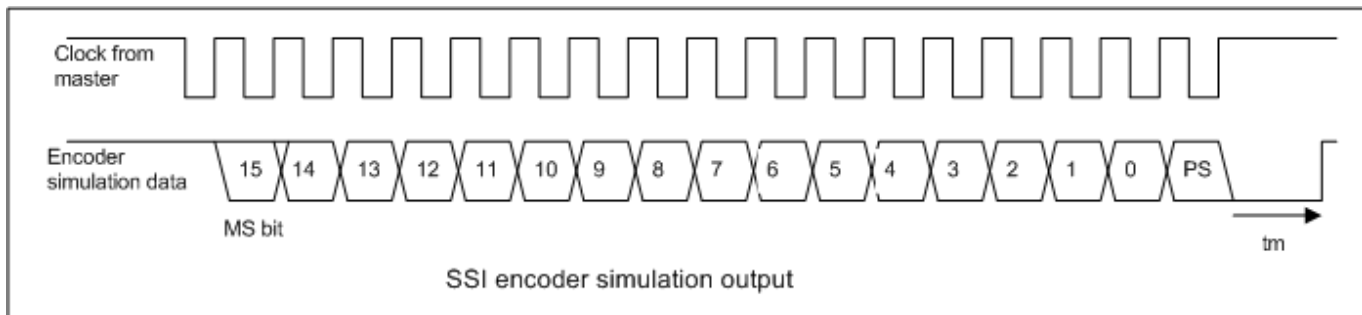
It should be noted that the data is shifted out by a clock that is produced by the SSI master connected to the encoder simulation interface as the interface is emulating an SSI encoder. However, unlike an SSI encoder the position data is not sampled on the first edge of the clock, but is updated by the drive at the rate defined by *Encoder Simulation Sample Period* (03.087). If the P1 position interface is being used as the source the power supply alarm bit (PS) is the inverse of the initialised flag in *Position Feedback Initialized* (03.076) related to this interface. The master can clock out as many bits of data as required, but once the power supply alarm bit has been produced the output will remain low. The SSI interface reset time (tm) of 20μs is required so that the interface can detect the end of the transmission and reset itself so that the output data begins again at the most significant bit. During this period the master should hold the clock line high. The master should not use a clock frequency of less than 50kHz or else spurious reset periods may be detected.

If any other parameter is used as the source the most significant M bits of the source parameter are used, where M = *Encoder Simulation SSI Comms Bits* (03.097) - 1. If the source parameter has less than M bits then trailing zeros are added. The power supply alarm bit is always zero in this mode.

Parameter	03.089 *Encoder Simulation Hardware Divider*		
Short description	Defines the divider ratio between the device connected to the P1 interface and the encoder simulation output when hardware simulation mode is used		
Mode	RFC‑S		
Minimum	0	Maximum	7
Default	0	Units	
Type	8 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW		

If hardware mode is selected (i.e. *Encoder Simulation Mode* (03.088) = 0) then *Encoder Simulation Hardware Divider* (03.089) defines the divider ratio between the device connected to the P1 position feedback interface and the output as $1/2^{Encoder\ Simulation\ Hardware\ Divider\ (03.089)}$. The maximum allowed input frequency is 500kHz, and so the maximum output frequency with the highest ratio of unity is 500kHz.

Parameter	03.090 *Encoder Simulation Hardware Marker Lock*		
Short description	Defines if the marker output is derived directly from the marker input		
Mode	RFC‑S		
Minimum	0	Maximum	1
Default	0	Units	
Type	1 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW		

See *Encoder Simulation Mode* (03.088).

Parameter	03.091 *Encoder Simulation Incremental Mode Select*		
Short description	Set to 1 to select incremental mode for the encoder simulation		
Mode	RFC‑S		
Minimum	0	Maximum	1
Default	0	Units	
Type	1 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW		

See *Encoder Simulation Mode* (03.088).

Parameter	03.092 *Encoder Simulation Output Lines Per Revolution*		
Short description	Defines the required lines per revolution when using the encoder simulation mode of Lines Per Rev		
Mode	RFC‑S		
Minimum	1	Maximum	16384
Default	4096	Units	
Type	32 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW		

See *Encoder Simulation Mode* (03.088).

Parameter	03.093 *Encoder Simulation Numerator*		
Short description	Defines the numerator when using the encoder simulation mode of Ratio		
Mode	RFC‑S		
Minimum	1	Maximum	65536
Default	65536	Units	
Type	32 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW		

See *Encoder Simulation Mode* (03.088).

Parameter	03.094 *Encoder Simulation Denominator*		
Short description	Defines the denominator when using the encoder simulation mode of Ratio		
Mode	RFC‑S		
Minimum	1	Maximum	65536
Default	65536	Units	
Type	32 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW		

See *Encoder Simulation Mode* (03.088).

Parameter	03.095 *Encoder Simulation Output Roll-over Limit*		
Short description	Defines the roll-over limit of the output counter and hence the rate at which output markers are produced when using the encoder simulation mode of Ratio		
Mode	RFC‑S		
Minimum	1	Maximum	65535
Default	65535	Units	
Type	16 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW, BU		

See *Encoder Simulation Mode* (03.088).

Parameter	03.096 *Encoder Simulation SSI Turns Bits*		
Short description	Defines the number of bits of the outputted SSI data that are used to represent turns information		
Mode	RFC‑S		
Minimum	0	Maximum	16
Default	16	Units	
Type	8 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW		

See *Encoder Simulation Mode* (03.088).

Parameter	03.097 *Encoder Simulation SSI Comms Bits*		
Short description	Defines the total number of bits of SSI data to be outputted		
Mode	RFC‑S		
Minimum	2	Maximum	48
Default	33	Units	
Type	8 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW		

See *Encoder Simulation Mode* (03.088).

Parameter	03.098 *Encoder Simulation Output Mode*		
Short description	Defines the format of the encoder simulation output		
Mode	RFC‑S		
Minimum	0	Maximum	2
Default	0	Units	
Type	8 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW, TE		

Value	*Text*
0	AB/Gray
1	FD/Binary
2	FR/Binary

Encoder Simulation Output Mode (03.098) is used to select the format of the encoder simulation output as given in the table below.

Encoder Simulation Mode (03.088)	*Encoder Simulation Output Mode* (03.098)	Format
Hardware (0), Lines Per Rev (1), Ratio (2)	AB/Gray	AB quadrature signals
Hardware (0), Lines Per Rev (1), Ratio (2)	FD/Binary	Frequency and direction signals
Hardware (0), Lines Per Rev (1), Ratio (2)	FR/Binary	Forward and reverse signals
SSI (3)	AB/Gray	The position data is in Gray code format. This does not include the "power supply" bit if present.
SSI (3)	FD/Binary, FR/Binary	The position data is in binary format

Parameter	03.100 *F1 Freeze Trigger Source*		
Short description	Used to select the source that generates trigger events for the F1 system		
Mode	RFC‑S		
Minimum	0	Maximum	6
Default	0	Units	
Type	8 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW, TE		

Value	*Text*
0	Digital Input 4
1	Digital Input 5
2	P1 Marker
3	P2 Marker
4	Common
5	P1 Zero
6	P2 Zero

F1 Freeze Trigger Source (03.100) is used to select the source that generates trigger events for the F1 system.

0, 1: Dig I/O 4, Dig I/O 5
Digital I/O 4 or Digital I/O 5 on the drive can be used as trigger sources. If the digital I/O is set up as an input, then trigger events will be produced on the relevant edge of the input signal. If the digital I/O is set up as an output, then trigger events will be produced on the relevant edge of the output signal.

2, 3: Z1, Z2
Z1 selects the P1 position feedback interface marker input as the trigger source and Z2 selects the P2 position feedback interface marker input as the trigger source. No trigger events will be produced unless the selected maker input is available.

4: Common
The output of the common freeze line is selected. If the output of the drive common freeze system is enabled (Bit 3 of *Common Freeze Mode* (03.112) = 1) then the drive common freeze system provides the freeze event triggers. If the output of the drive common freeze system is disabled the option module freeze line provides the freeze event triggers.

5, 6: P1 Zero, P2 Zero
A freeze event is triggered when the turns for the respective position feedback interface change (i.e. the feedback position passes through zero in either direction). The freeze position stored in *F1 Normalised Freeze Position* (03.103) or *F2 Normalised Freeze Position* (03.108) will include the turns associated with the zero position whichever direction the position changes. For example if the turns change from 4 to 5 or 5 to 4 the turns value stored is 5. This mode can be used as a substitute for a physical marker, with a position device that does not have one, to trigger an event to occur at the zero position of the feeback device. For example, it can be used with the AMC to start a CAM at the zero position of the feedback device. It should be noted that if P1 Zero is selected as the trigger source then *F1 Freeze Position Source* (03.102) has no effect and P1 is always used as the freeze position source. If P2 Zero is selected as the trigger source then *F1 Freeze Position Source* (03.102) has no effect and P2 is always used as the freeze position source. This is because these freeze trigger sources are only intended to capture the zero position of the device being used to give the zero position trigger event.

Parameter	03.101 *F1 Freeze Mode*		
Short description	Sets the mode used for the F1 freeze system		
Mode	RFC-S		
Minimum	0	Maximum	3
Default	0	Units	
Type	8 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW, TE		

Value	Text
0	Rising 1st
1	Falling 1st
2	Rising all
3	Falling all

0: Rising 1st
Freeze events are produced on the rising edge of the freeze trigger source. If the *F1 Freeze Flag* (03.104) is 0 then the first suitable edge produced by the trigger source causes the freeze position to be stored and the *F1 Freeze Flag* (03.104) to be set to 1. No further freeze events are possible until the *F1 Freeze Flag* (03.104) has been cleared by the user.

1: Falling 1st
As for Rising 1st, but the falling edge is used to trigger freeze events.

2: Rising All
Freeze events are produced on the rising edge of the freeze trigger source. If the *F1 Freeze Flag* (03.104) is 0 then the first suitable edge produced by the trigger source causes the freeze position to be stored and the *F1 Freeze Flag* (03.104) to be set to 1. If further suitable edges are produced by the trigger source the freeze position is updated with the current position.

3: Falling All
As for Rising All, but the falling edge is used to trigger freeze events.

Parameter	03.102 *F1 Freeze Position Source*		
Short description	Defines the source position for the F1 freeze system		
Mode	RFC-S		
Minimum	0	Maximum	2
Default	0	Units	
Type	8 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW, TE		

Value	Text
0	P1
1	P2
2	Time

F1 Freeze Position Source (03.102) defines the source for the F1 freeze system as follows:

P1 or P2
When a freeze event occurs, the position from the relevant position feedback interface within the drive (i.e. P1 or P2), including the effect of the marker (see *P1 Marker Mode* (03.031)), is stored and can be accessed as a 32 bit normalised value in *F1 Normalised Freeze Position* (03.103). For a digital incremental source (AB, FD, FR, AB Servo, FD Servo or FR Servo) the position is captured at the freeze event using a hardware system. For a resolver the freeze position is the position at the last 250us sample point. For all other position feedback devices the time of the freeze event is captured with hardware and then interpolation, based on the change of position during the previous nominal 250us period, is used to estimate the position at the freeze event.

Time
The time of the freeze event is stored with respect to the last datum used by the position feedback system and option modules fitted to the drive. These datum events occur at a nominal rate of 250us, but if the drive timing is being synchronised by the comms system in an option module then the actual timing may vary slightly depending on the accuracy of the clock providing the sysnchronisation. The time stored in *F1 Normalised Freeze Position* (03.103) is given as a proportion of the nominal 250us time period where 65536 corresponds to one nomial 250us time period. Note that the value may be positive or negative. Positive values give the time of an event that occured after the last datum, but before the freeze information is processed. Negative values give the time of an event that occurred before the datum, but after the previous time when the freeze information was processed. The time of the freeze event could be used, for example, to determine the value of a virtual position being generated within an option module at the freeze event. The calculated value would only be meaningful if the freeze information is used during the period between the position datum before and after the freeze event, because the time is related to the datum before the freeze information is made available.

Parameter	03.103 *F1 Normalised Freeze Position*		
Short description	Displays the normalised position from the F1 freeze system		
Mode	RFC‑S		
Minimum	-2147483648	Maximum	2147483647
Default		Units	
Type	32 Bit Volatile	Update Rate	250µs write
Display Format	Standard	Decimal Places	0
Coding	RO, ND, NC, PT		

See *F1 Freeze Position Source* (03.102).

Parameter	03.104 *F1 Freeze Flag*		
Short description	Displays when a freeze event occurs from the F1 freeze system		
Mode	RFC‑S		
Minimum	0	Maximum	1
Default		Units	
Type	1 Bit Volatile	Update Rate	250µs write
Display Format	Standard	Decimal Places	0
Coding	RW, ND, NC, PT		

The freeze flag is set when a freeze event occurs. If 0 is written to *F1 Freeze Flag* (03.104) the freeze flag is cleared.

Parameter	03.105 *F2 Freeze Trigger Source*		
Short description	User to select the source that generates trigger events for the F2 freeze system		
Mode	RFC‑S		
Minimum	0	Maximum	6
Default	0	Units	
Type	8 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW, TE		

Value	Text
0	Digital Input 4
1	Digital Input 5
2	P1 Marker
3	P2 Marker
4	Common
5	P1 Zero
6	P2 Zero

F2 Freeze Trigger Source (03.105) is used to select the source that generates trigger events for the F2 freeze system.

0, 1: Dig I/O 4, Dig I/O 5
Digital I/O 4 or Digital I/O 5 on the drive can be used as trigger sources. If the digital I/O is set up as an input, then trigger events will be produced on the relevant edge of the input signal. If the digital I/O is set up as an output, then trigger events will be produced on the relevant edge of the output signal.

2, 3: Z1, Z2
Z1 selects the P1 position feedback interface marker input as the trigger source and Z2 selects the P2 position feedback interface marker input as the trigger source. No trigger events will be produced unless the selected maker input is available.

4: Common
The output of the common freeze line is selected. If the output of the drive common freeze system is enabled (Bit 3 of *Common Freeze Mode* (03.112) = 1) then the drive common freeze system provides the freeze event triggers. If the output of the drive common freeze system is disabled the option module freeze line provides the freeze event triggers.

5, 6: P1 Zero, P2 Zero
A freeze event is triggered when the turns for the respective position feedback interface change (i.e. the feedback position passes through zero in either direction). The freeze position stored in *F1 Normalised Freeze Position* (03.103) or *F2 Normalised Freeze Position* (03.108) will include the turns associated with the zero position whichever direction the position changes. For example if the turns change from 4 to 5 or 5 to 4 the turns value stored is 5. This mode can be used as a substitute for a physical marker with a position device that does not have one to trigger an event to occur at the zero position of the feeback device. For example, it can be used with the AMC to start a CAM at the zero position of the feedback device. It should be noted that if P1 Zero is selected as the trigger source then *F1 Freeze Position Source* (03.102) has no effect and P1 is always used as the freeze position source. If P2 Zero is selected as the trigger source then *F1 Freeze Position Source* (03.102) has no effect and P2 is always used as the freeze position source. This is because these freeze trigger sources are only intended to capture the zero position of the device being used to give the zero position trigger event.

Parameter	03.106 *F2 Freeze Mode*		
Short description	Defines the mode for the F2 freeze system		
Mode	RFC‑S		
Minimum	0	Maximum	3
Default	0	Units	
Type	8 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW, TE		

Value	Text
0	Rising 1st
1	Falling 1st
2	Rising all
3	Falling all

0: Rising 1st
Freeze events are produced on the rising edge of the freeze trigger source. If the *F2 Freeze Flag* (03.109) is 0 then the first suitable edge produced by the trigger source causes the freeze position to be stored and the *F2 Freeze Flag* (03.109) to be set to 1. No further freeze events are possible until the *F2 Freeze Flag* (03.109) has been cleared by the user.

1: Falling 1st
As for Rising 1st, but the falling edge is used to trigger freeze events.

2: Rising All
Freeze events are produced on the rising edge of the freeze trigger source. If the *F2 Freeze Flag* (03.109) is 0 then the first suitable edge produced by the trigger source causes the freeze position to be stored and the *F2 Freeze Flag* (03.109) to be set to 1. If further suitable edges are produced by the trigger source the freeze position is updated with the current position.

3: Falling All
As for Rising All, but the falling edge is used to trigger freeze events.

Parameter	03.107 *F2 Freeze Position Source*		
Short description	Defines the source position for the F2 freeze system		
Mode	RFC‑S		
Minimum	0	Maximum	2
Default	0	Units	
Type	8 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW, TE		

Value	Text
0	P1
1	P2
2	Time

F2 Freeze Position Source (03.107) defines the source for the F1 freeze system as follows:

P1 or P2
When a freeze event occurs, the position from the relevant position feedback interface within the drive (i.e. P1 or P2), including the effect of the marker (see *P1 Marker Mode* (03.031)), is stored and can be accessed as a 32 bit normalised value in *F2 Normalised Freeze Position* (03.108). For a digital incremental source (AB, FD, FR, AB Servo, FD Servo or FR Servo) the position is captured at the freeze event using a hardware system. For a resolver the freeze position is the position at the last 250us sample point. For all other position feedback devices the time of the freeze event is captured with hardware and then interpolation, based on the change of position during the previous nominal 250us period, is used to estimate the position at the freeze event.

Time
The time of the freeze event is stored with respect to the last datum used by the position feedback system and option modules fitted to the drive. These datum events occur at a nominal rate of 250us, but if the drive timing is being synchronised by the comms system in an option module then the actual timing may vary slightly depending on the accuracy of the clock providing the sysnchronisation. The time stored in *F2 Normalised Freeze Position* (03.108) is given as a proportion of the nominal 250us time period where 65536 corresponds to one nomial 250us time period. Note that the value may be positive or negative. Positive values give the time of an event that occured after the last datum, but before the freeze information is processed. Negative values give the time of an event that occurred before the datum, but after the previous time when the freeze information was processed. The time of the freeze event could be used, for example, to determine the value of a virtual position being generated within an option module at the freeze event. The calculated value would only be meaningful if the freeze information is used during the period between the position datum before and after the freeze event, because the time is related to the datum before the freeze information is made available.

Parameter	03.108 *F2 Normalised Freeze Position*		
Short description	Displays the normalised position from the F2 freeze system		
Mode	RFC‑S		
Minimum	-2147483648	Maximum	2147483647
Default		Units	
Type	32 Bit Volatile	Update Rate	250µs write
Display Format	Standard	Decimal Places	0
Coding	RO, ND, NC, PT		

See *F2 Freeze Position Source* (03.107).

Parameter	03.109 *F2 Freeze Flag*		
Short description	Displays when a freeze event occurs from the F2 freeze system		
Mode	RFC‑S		
Minimum	0	Maximum	1
Default		Units	
Type	1 Bit Volatile	Update Rate	250µs write
Display Format	Standard	Decimal Places	0
Coding	RW, ND, NC, PT		

The freeze flag is set when a freeze event occurs. If 0 is written to *F2 Freeze Flag* (03.109) the freeze flag is cleared.

Parameter	03.110 *Common Freeze Source 1*		
Short description	Defines source 1 for the common freeze system		
Mode	RFC‑S		
Minimum	0	Maximum	4
Default	0	Units	
Type	8 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW, TE		

Value	*Text*
0	Digital Input 4
1	Digital Input 5
2	P1 Marker
3	P2 Marker
4	Disabled

See *F1 Freeze Trigger Source* (03.100) or *F2 Freeze Trigger Source* (03.105). It should be noted that if the Disabled option is selected then the input is set to a one.

Parameter	03.111 *Common Freeze Source 2*		
Short description	Defines source 2 for the common freeze system		
Mode	RFC‑S		
Minimum	0	Maximum	4
Default	0	Units	
Type	8 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW, TE		

Value	*Text*
0	Digital Input 4
1	Digital Input 5
2	P1 Marker
3	P2 Marker
4	Disabled

See *F1 Freeze Trigger Source* (03.100) or *F2 Freeze Trigger Source* (03.105). It should be noted that if the Disabled option is selected then the input is set to a one.

Parameter	03.112 *Common Freeze Mode*		
Short description	Defines the mode used for the common freeze system		
Mode	RFC‑S		
Minimum	0 (Display: 0000)	Maximum	15 (Display: 1111)
Default	0 (Display: 0000)	Units	
Type	8 Bit User Save	Update Rate	Background read
Display Format	Binary	Decimal Places	0
Coding	RW		

The common freeze system can be used to logically combine two freeze trigger sources. The switches in the common freeze system are controlled by the bits in *Common Freeze Mode* (03.112) as defined in the table below.

Bit	Function
0	Source 1 input invert 1
1	Source 2 input invert
2	Output invert
3	Output enable

Therefore the value defined bits 2 to 0 can be used to generate various logic functions as given in the table below.

Bits 2 to 0	Function
0	Source1 AND Source2
1	NOT(Source1) AND Source2
2	Source1 AND NOT(Source2)
3	Source1 NOR Source2
4	Source1 NAND Source2
5	NOT(Source1) NAND Source2
6	Source1 NAND NOT(Source2)
7	Source1 OR Source2

Parameter	03.113 *Freeze Input States*		
Short description	Displays the level of the selected freeze inputs		
Mode	RFC‑S		
Minimum	0 (Display: 00)	Maximum	3 (Display: 11)
Default		Units	
Type	8 Bit Volatile	Update Rate	4ms write
Display Format	Binary	Decimal Places	0
Coding	RO, ND, NC, PT		

The bits in *Freeze Input States* (03.113) show the level of the selected freeze trigger inputs. Bit 0 corresponds to F1 freeze input and bit 1 corresponds to F2 freeze input. It should be noted that if the trigger option is P1Zero or P2Zero there is no hardware trigger input, and so the relevant bit is always zero.

Parameter	03.118 *P1 Thermistor Type*		
Short description	Defines the thermistor type for the P1 interface		
Mode	RFC‑S		
Minimum	0	Maximum	3
Default	0	Units	
Type	8 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW, TE		

Value	Text
0	DIN44082
1	KTY84
2	0.8mA
3	Encoder

P1 Thermistor Type (03.118) defines the operating mode of the P1 thermistor input.

P1 Thermistor Type (03.118)	Compatible devices
0: DIN44082	Three thermistors in series as specified in DIN44082 standard
1: KTY84	KTY84 PTC thermistor
2: 0.8mA	Any device
3: Encoder	EnDat 2.2 encoder

All except 3(Encoder)
If a device is connected between the pin 15 of the encoder interface and 0V a current source will pass 0.8mA through the device with a maximum voltage of approximately 3.8V (i.e. maximum resistance of approximately 4750 Ohms). The resistance of the device is calculated and displayed in *P1 Thermistor Feedback* (03.119). If *P1 Thermistor Type* (03.118) is set to select KTY84 the temperature is also calculated and written to *P1 Thermistor Temperature* (03.122). Note that DIN44082 mode and 0.8mA mode operate in exactly the same way.

3 (Encoder)
If an EnDat 2.2 encoder which supports external temperature feedback is connected to the P1 position feedback interface then it is possible to obtain the measured temperature from the encoder if *P1 Thermistor Type* (03.118) is set to 3. The temperature is displayed in *P1 Thermistor Temperature* (03.122) and a resistance equivalent to that for a KTY84 device is displayed in *P1 Thermistor Feedback* (03.119). The drive does not check if an external device is connected, but short circuit protection can be selected to detect if the device is not connected because the resistance will appear as zero.

Parameter	03.119 *P1 Thermistor Feedback*		
Short description	Displays the resistance of the thermistor on the P1 interface		
Mode	RFC‑S		
Minimum	0	Maximum	5000
Default		Units	Ω
Type	16 Bit Volatile	Update Rate	Background write
Display Format	Standard	Decimal Places	0
Coding	RO, ND, NC, PT		

See *P1 Thermistor Type* (03.118).

Parameter	03.120 *P1 Thermistor Trip Threshold*		
Short description	Defines the thermistor trip threshold for the P1 interface		
Mode	RFC‑S		
Minimum	0	Maximum	5000
Default	3300	Units	Ω
Type	16 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW		

See *P1 Thermistor Fault Detection* (03.123).

Parameter	03.121 *P1 Thermistor Reset Threshold*		
Short description	Defines the thermistor reset threshold for the P1 interface		
Mode	RFC‑S		
Minimum	0	Maximum	5000
Default	1800	Units	Ω
Type	16 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW		

See *P1 Thermistor Fault Detection* (03.123).

Parameter	03.122 *P1 Thermistor Temperature*		
Short description	Displays the temperature of the device based on the resistance to temperature characteristic for the specified device		
Mode	RFC‑S		
Minimum	-50	Maximum	300
Default		Units	°C
Type	16 Bit Volatile	Update Rate	Background write
Display Format	Standard	Decimal Places	0
Coding	RO, ND, NC, PT		

See *P1 Thermistor Type* (03.118).

Parameter	03.123 *P1 Thermistor Fault Detection*		
Short description	Defines the fault detection for the P1 thermsitor input		
Mode	RFC‑S		
Minimum	0	Maximum	2
Default	1	Units	
Type	8 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW, TE		

Value	*Text*
0	None
1	Temperature
2	Temp or Short

Defines the fault detection for the P1 thermsitor input:

P1 Thermistor Fault Detection (03.123)	**Fault detection**
0: None	No detection active
1: Temperature	Over temperature detection
2: Temp and short	Over temperature and short circuit detection

If over temperature detection is enabled a *Thermistor*.001 trip is initiated if *P1 Thermistor Feedback* (03.119) is above the level defined by *P1 Thermistor Trip Threshold* (03.120). The trip cannot be reset until *P1 Thermistor Feedback* (03.119) is below *P1 Thermistor Reset Threshold* (03.121).

If short circuit detection is enabled then a *Th Short Circuit*.001 is initiated if *P1 Thermistor Feedback* (03.119) is below 50 Ohms.

Parameter	03.127 *P2 Speed Feedback*		
Short description	Displays the speed feedback from the P2 interface		
Mode	RFC‑S		
Minimum	−VM_SPEED	Maximum	VM_SPEED
Default		Units	
Type	32 Bit Volatile	Update Rate	4ms write
Display Format	Standard	Decimal Places	1
Coding	RO, FI, VM, ND, NC, PT		

Provided the set-up parameters for the position feedback device connected to the drive P2 position interface are correct *P2 Speed Feedback* (03.127) shows the speed derived from the feedback. The speed is given in mm/s if *P2 Linear Feedback Select* (03.151) = 1 and *Linear Speed Select* (01.055) = 1, otherwise it is given in rpm. The value shown is measured over a 16ms sliding window period, and so the ripple in this value is as defined for *Speed Feedback* (03.002).

Parameter	03.128 *P2 Revolution/Pole Pitch Counter*		
Short description	Displays the revolution/pole pitch counter from the P2 interface		
Mode	RFC‑S		
Minimum	0	Maximum	65535
Default		Units	
Type	16 Bit Power Down Save	Update Rate	4ms write
Display Format	Standard	Decimal Places	0
Coding	RO, ND, NC, PT, BU		

P2 Revolution/Pole Pitch Counter (03.128), *P2 Position* (03.129) and *P2 Fine Position* (03.130) combined give the encoder position with a resolution of $1/2^{32}$ of a revolution/pole pitch as a 48 bit number. If a rotary position feedback device is being used (*P2 Linear Feedback Select* (03.151) = 0) then these quantities relate directly to the rotary position of the feedback device. If a linear feedback device is used then one revolution or pole pitch relates to the distance given by *P2 Pole Pitch* (03.155).

See *P1 Revolution/Pole Pitch Counter* (03.028) for more information.

Parameter	03.129 *P2 Position*		
Short description	Displays the position feedback from the P2 interface		
Mode	RFC‑S		
Minimum	0	Maximum	65535
Default		Units	
Type	16 Bit Power Down Save	Update Rate	4ms write
Display Format	Standard	Decimal Places	0
Coding	RO, ND, NC, PT, BU		

See *P2 Revolution/Pole Pitch Counter* (03.128).

Parameter	03.130 *P2 Fine Position*		
Short description	Displays the fine position from the P2 interface		
Mode	RFC‑S		
Minimum	0	Maximum	65535
Default		Units	
Type	16 Bit Volatile	Update Rate	4ms write
Display Format	Standard	Decimal Places	0
Coding	RO, ND, NC, PT, BU		

See *P2 Revolution/Pole Pitch Counter* (03.128).

Parameter	03.131 *P2 Marker Mode*		
Short description	Defines the marker mode for the P2 interface		
Mode	RFC‑S		
Minimum	0 (Display: 0000)	Maximum	15 (Display: 1111)
Default	4 (Display: 0100)	Units	
Type	8 Bit User Save	Update Rate	Background read
Display Format	Binary	Decimal Places	0
Coding	RW		

P2 Device type (03.138): AB, FD, FR
Each position feedback device produces incremental signals which are counted in hardware. If *P2 Marker Mode* (03.131) = 0 the following occurs when a marker event is produced by the Z1 input:

1. *P2 Position* (03.129) and *P2 Fine Position* (03.130) are reset to zero.
2. The bits in *P2 Normalised Position* (03.158) related to *P2 Position* (03.129) and *P2 Fine Position* (03.130) are reset to zero
3. *P2 Marker Flag* (03.132) is set to one.

The marker is a hardware function, and so the position appears as though it is reset at the marker event time even if this is between control system sample points. It should be noted that the marker event occurs on the rising edge of the marker pulse if the position change over the last sample was positive or on the falling edge if the position change over the last sample was negative. This ensures that the marker event occurs at the same physical location for either direction of rotation.

The action taken when a marker event occurs can be modified by setting the bits of *P2 Marker Mode* (03.131) as described in the table below.

Bit	Effect of setting bit to one
0	No action is taken unless the marker flag is zero before the marker event occurs
1	*P2 Revolution/Pole Pitch Counter* (03.128) and the whole of *P2 Normalised Position* (03.158) are also set to zero on a marker event
2	*P2 Revolution/Pole Pitch Counter* (03.128), *P2 Position* (03.129), *P2 Fine Position* (03.130) and the related part of *P2 Normalised Position* (03.158) are not reset. (This overrides bit 1.) *P2 Normalised Position* (03.158) is transferred to *P2 Normalised Marker Position* (03.159) and *P2 Marker Flag* (03.132) is set to one.
3	This bit in has not effect.

The marker input can be used for a standard type marker function or alternatively it can be used as an additional freeze input for the P1 position feedback interface.

P2 Device type **(03.138): Any other device type**
The marker function cannot be used and *P2 Marker Mode* (03.131) has no effect.

Parameter	03.132 *P2 Marker Flag*		
Short description	Indicates when a marker event occurs		
Mode	RFC‑S		
Minimum	0	Maximum	1
Default	0	Units	
Type	1 Bit Volatile	Update Rate	250µs write
Display Format	Standard	Decimal Places	0
Coding	RW, NC		

P2 Marker Flag (03.132) is set to one when a marker event occurs. The flag must be cleared by the user.

Parameter	03.133 *P2 Rotary Turns Bits*		
Short description	Defines the number of rotary turns bit for the P2 interface		
Mode	RFC‑S		
Minimum	0	Maximum	16
Default	16	Units	
Type	8 Bit User Save	Update Rate	Background read, auto-configuration write
Display Format	Standard	Decimal Places	0
Coding	RW		

P2 Rotary Turns Bits (03.133) only has any effect if the position feedback interface is being used with a rotary device (i.e. *P2 Linear Feedback Select* (03.151) = 0).

P2 Device type **(03.138): EnDat, BISS, SSI**
P2 Rotary Turns Bits (03.133) is used to determine the number of bits within the comms messages from the position feedback device that represent turns. For a single turn encoder *P2 Rotary Turns Bits* (03.133) must be set to zero. It should be noted that some SSI encoders include leading zeros before the turns information and in this case the number of turns bits should include the leading zeros. The most significant bits in *P1 Revolution/Pole Pitch Counter* (03.028) that are not included in the turns information provided by the encoder comms are held at zero. If *P2 Rotary Turns Bits* (03.133) = 0 (single turn encoder) the whole of *P2 Revolution/Pole Pitch Counter* (03.128) is held at zero.

P2 Device type **(03.138): Any other device type**
It is sometimes desirable to mask off the most significant bits of *P2 Revolution/Pole Pitch Counter* (03.128), but this does not have to be done for the drive to function correctly. If *P2 Rotary Turns Bits* (03.133) = 0 the whole of *P2 Revolution/Pole Pitch Counter* (03.128) is held at zero. If *P2 Rotary Turns Bits* (03.133) has any other value it indicates the number of bits in *P2 Revolution/Pole Pitch Counter* (03.128) that are not held at zero. For example, if *P2 Rotary Turns Bits* (03.133) = 5, then *P2 Revolution/Pole Pitch Counter* (03.128) counts up to 31 before being reset.

Parameter	03.134 *P2 Rotary Lines Per Revolution*		
Short description	Defines the number of rotary lines per revolution for the P2 interface		
Mode	RFC‑S		
Minimum	0	Maximum	100000
Default	4096	Units	
Type	32 Bit User Save	Update Rate	Background read, auto-configuration write
Display Format	Standard	Decimal Places	0
Coding	RW		

P2 Rotary Lines Per Revolution (03.134) only has any effect if the position feedback interface is being used with a rotary device (i.e. *P2 Linear Feedback Select* (03.151) = 0).

P2 Device type **(03.138): AB**
P2 Rotary Lines Per Revolution (03.134) should be set to the number of lines per revolution for the encoder connected to the P1 position feedback interface.

P2 Device type **(03.138): FD, FR**

P2 Rotary Lines Per Revolution (03.134) should be set to the number of lines per revolution for the encoder connected to the P1 position feedback interface multiplied by 2.

P2 Device type (03.138): Any other device type
P2 Rotary Lines Per Revolution (03.134) has no effect.

Parameter	03.135 *P2 Comms Bits*		
Short description	Defines the total number of bits of position information in the comms message from the encoder on the P2 interface		
Mode	RFC‑S		
Minimum	0	Maximum	48
Default	0	Units	
Type	8 Bit User Save	Update Rate	Background read, auto-configuration write
Display Format	Standard	Decimal Places	0
Coding	RW		

P2 Device type (03.138): EnDat, SSI, BiSS
P2 Comms Bits (03.135) should be set to the total number of bits of position information in the comms message from the encoder. If SSI communications is being used this should include any leading or trailing zeros and the power supply alarm bit if present.

P2 Device type (03.138): Any other device type
P2 Comms Bits (03.135) has no effect.

Parameter	03.137 *P2 Comms Baud Rate*		
Short description	Defines the baud rate used for encoder communications		
Mode	RFC‑S		
Minimum	0	Maximum	8
Default	2	Units	Baud
Type	8 Bit User Save	Update Rate	Background read, auto-configuration write
Display Format	Standard	Decimal Places	0
Coding	RW, TE		

Value	Text
0	100k
1	200k
2	300k
3	400k
4	500k
5	1M
6	1.5M
7	2M
8	4M

P2 Comms Baud Rate (03.137) defines the baud rate used for encoder communications. Restrictions are applied to the baud rate for different feedback devices, and so the baud rate may be different to the parameter value.

P2 Device type (03.138): EnDat, BiSS, SSI
Any baud rate that is within the range specified for the encoder may be used. The line delay is measured during initialisation, and used to compensate this delay during communications with the encoder. Therefore there is no timing based restriction on the length of the cable between the position feedback interface and the encoder. However, care should be taken to ensure that the wiring arrangement and the type of cable used are suitable for the selected baud rate and the distance between the position interface and the encoder. See *P2 Low Speed Update Rate Active* (03.163) for more details on timing restrictions related to the drive sample times.

P2 Device type (03.138): Any other device
P2 Comms Baud Rate (03.137) has no effect.

Parameter	03.138 *P2 Device type*		
Short description	Set this to the feedback device type connected to the P2 position interface		
Mode	RFC‑S		
Minimum	0	Maximum	6
Default	0	Units	
Type	8 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW, TE		

Value	Text
0	None
1	AB
2	FD
3	FR
4	EnDat
5	SSI
6	BiSS

If *P2 Device type* (03.138) = Disabled, the P2 position feedback interface is disabled and does not provide any position feedback.

See *P1 Device Type* (03.038) for more information on the different position feedback device types.

Parameter	03.140 *P2 Error Detection Level*		
Short description	Used to enable or disable position feedback trip functions		
Mode	RFC‑S		
Minimum	0 (Display: 00000)	Maximum	31 (Display: 11111)
Default	1 (Display: 00001)	Units	
Type	8 Bit User Save	Update Rate	Background read
Display Format	Binary	Decimal Places	0
Coding	RW		

This parameter can be used to enable or disable position feedback trip functions as follows:

Bit	Function
0	Not used with the P2 position interface.
1	Not used with the P2 position interface.
2	Enable SSI power supply alarm bit monitor (indicated by trip *Encoder 6*).
3	Disable trips *Encoder 1* to *Encoder 6*.
4	Disable trip *Encoder 7*.

Bits 3 and 4 do not prevent the device from becoming un-initialised. The trip is suppressed, but the device is still un-initialised and this is indicated by the appropriate bit for the position feedback interface in *Position Feedback Initialized* (03.076).

Encoder trips
The following table shows trips that can be initiated that are related to the position feedback interface P2. The sub-trip number is 2 for the drive P2 position feedback interface.

Drive trip	Encoders	Reason for error
Encoder 4	EnDat, BISS	Comms timeout
Encoder 5	EnDat, BISS	Checksum/CRC error
	SSI	Not ready at start of position transfer (i.e. data input not one)
Encoder 6	EnDat, BiSS	The encoder has indicated an error
	SSI	Power supply alarm bit active
Encoder 7	EnDat, BiSS, SSI	An attempt has been made to enable the drive, but a position feedback device is not initialised
Encoder 8	EnDat, SSI, BiSS	*Maximum Switching Frequency* (05.018), *P2 Device type* (03.138), *P2 Comms Bits* (03.135), *P2 Comms Baud Rate* (03.137), *P2 Calculation Time* (03.160), *P2 Recovery Time* (03.161), *P2 Line Delay Time* (03.162) and *P2 User Comms Enable* (03.167) are used to determine the time taken for the communications exchange with the encoder. If this time exceeds 250µs an *Encoder 8* trip is initiated.
Encoder 9	All	Speed feedback selected from an option slot that does not have a position feedback category option module fitted
Phasing Error	All	Incorrect encoder phasing [1]
Encoder 12	BiSS	The encoder could not be identified during auto-configuration

1. Incorrect encoder phasing is detected if the motor reaches half of the speed defined by VM_SPEED_FREQ_REF[MAX] and the phasing error is large enough for the motor to accelerate uncontrollably.

Wire-break detection
It may be important to detect a break in the connections between the drive and the position feedback device. This feature is provided for most position feedback devices either directly or indirectly as listed below.

Device	Detection method	Trip produced
AB, FD, FR	There is no wire break detection of the A2, B2, and Z2 signals on the P2 position interface.	None
EnDat, BiSS	Wire break in the comms link is detected by a CRC or timeout error.	*Encoder 4, Encoder 5*
SSI	Wire break detection in the comms is difficult with these devices. However, if power supply alaram bit monitoring is enabled the drive will be looking for a one at the start of the message and a zero to indicate that the power supply is okay. If the clock stops or the data line is disconnected the data input to the drive may stay in one state or the other and cause a trip.	*Encoder 5, Encoder 6*

Parameter	03.141 *P2 Auto-configuration Select*		
Short description	Set this parameter to enable auto-configuration of EnDat and BiSS feedback devices		
Mode	RFC‑S		
Minimum	0	Maximum	1
Default	1	Units	
Type	8 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW, TE		

Value	*Text*
0	Disabled
1	Enabled

P2 Device type **(03.138): EnDat, BiSS**
If auto-configuration has not been disabled (i.e. *P2 Auto-configuration Select* (03.141) = 0) then during position feedback initialisation the encoder is interrogated to determine whether the encoder is a rotary or linear encoder and *P2 Linear Feedback Select* (03.151) is set up appropriately. Then the following parameters are set up based on information from the encoder:

Rotary	Linear
P2 Rotary Turns Bits (03.133)	*P2 Linear Comms Pitch* (03.152)
P2 Rotary Lines Per Revolution (03.134)	*P2 Linear Line Pitch* (03.153)
P2 Comms Bits (03.135)	*P2 Comms Bits* (03.135)
	P2 Linear Comms And Line Pitch Units (03.154)

The following actions are also taken to set up the timing for the encoder.

Comms Protocol	Actions taken
EnDat 2.1	*P2 Calculation Time* (03.160) = From the encoder *P2 Recovery Time* (03.161) = 30µs Line delay measured and result written to *P2 Line Delay Time* (03.162)
EnDat 2.2	*P2 Calculation Time* (03.160) = From the encoder *P2 Recovery Time* (03.161) = 4µs and the recovery time within the encoder is set up to the shortest value of 3.75µs if the *P2 Comms Baud Rate* (03.137) is 1M or more.Line delay measured and result written to *P2 Line Delay Time* (03.162)
BiSS	*P2 Recovery Time* (03.161) = 12µs Line delay measured and result written to *P2 Line Delay Time* (03.162)
SSI	Line delay measured and result written to *P2 Line Delay Time* (03.162)

If *P2 Auto-configuration Select* (03.141) = 1 then *P2 Comms Baud Rate* (03.137) is set to the minimum value that will give a total message transfer time of less than 62µs, so that the transfer will occur at the fast update rate with the minimum baud rate. It should be noted that the value of *P2 User Comms Enable* (03.167) is taken into account as this may affect the message time.

Once these parameters have been set up it should be possible for the drive to operate correctly with the encoder. The drive repeatedly attempts to initialise the encoder, including auto-configuration which is part of this process, until it is successful. Therefore if auto-configuration has not been successful by the time the drive is enabled because the drive cannot establish communications an *Encoder 7* trip occurs. For BiSS encoders the drive must identify the encoder model number to perform auto-configuration. If communications is established, but the drive cannot recognise the encoder model an *Encoder 12* trip is produced immediately.

If auto-configuration is disabled (i.e. *P2 Auto-configuration Select* (03.141) = 1) then none of the above actions are carried out except for the line delay measurement.

P2 Device type **(03.138): All other device types**
P2 Auto-configuration Select (03.141) has no effect.

Parameter	03.142 *P2 Feedback Filter*		
Short description	Defines the time period for a sliding window filter that may be applied to the feedback taken from the P2 interface		
Mode	RFC‑S		
Minimum	0	Maximum	5
Default	0	Units	
Type	8 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW, TE		

Value	*Text*
0	Disabled
1	1ms
2	2ms
3	4ms
4	8ms
5	16ms

P2 Feedback Filter (03.142) defines the time period for a sliding window filter that may be applied to the feedback taken from the drive P2 position feedback interface. This is particularly useful in applications where the drive encoder is used to give speed feedback for the speed controller and where the load includes a high inertia, and so the speed controller gains are very high. Under these conditions, without a filter on the feedback, it is possible for the speed loop output to change constantly from one current limit to the other and lock the integral term of the speed controller.

Parameter	03.143 *P2 Maximum Reference*		
Short description	Defines the maximum speed reference from the P2 interface		
Mode	RFC‑S		
Minimum	0	Maximum	33000
Default	3000	Units	
Type	16 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW, BU		

The speed feedback from the drive P1 position feedback interface can be used as a source to control a parameter. The speed feedback is scaled to give a value as a percentage of *P2 Maximum Reference* (03.143) in 0.1% units which is displayed in *P2 Reference* (03.145). The value is then scaled by the *P2 Reference Scaling* (03.144) and then routed to the destination defined by *P2 Reference Destination* (03.146).

Normally the destination is updated every 4ms, but if the destination is the *Hard Speed Reference* (03.022), *P2 Maximum Reference* (03.143) = VM_SPEED_FREQ_REF[MAX] and *P2 Reference Scaling* (03.144) = 1.000 it is updated every 250μs. Although the hard speed reference is updated every 250μs internally a value in rpm or mm/s is written to *Hard Speed Reference* (03.022) every 4ms for indication only. It should be noted that if the fast update method is used the resolution of the speed feedback devived from the position feedback device defines the resolution of the hard speed reference and that any ripple on the feedback will be present on the hard speed reference (see *Speed Feedback* (03.002)).

Parameter	03.144 *P2 Reference Scaling*		
Short description	Defines the scaling applied to the P2 reference		
Mode	RFC‑S		
Minimum	0.000	Maximum	4.000
Default	1.000	Units	
Type	16 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	3
Coding	RW		

See *P2 Maximum Reference* (03.143).

Parameter	03.145 *P2 Reference*		
Short description	Displays the value in P2 reference		
Mode	RFC‑S		
Minimum	-100.0	Maximum	100.0
Default		Units	%
Type	16 Bit Volatile	Update Rate	4ms write
Display Format	Standard	Decimal Places	1
Coding	RO, FI, ND, NC, PT		

See *P2 Maximum Reference* (03.143).

Parameter	03.146 *P2 Reference Destination*		
Short description	Defines the destination parameter for P2 reference		
Mode	RFC‑S		
Minimum	0.000	Maximum	59.999
Default	0.000	Units	
Type	16 Bit User Save	Update Rate	Drive reset read
Display Format	Standard	Decimal Places	3
Coding	RW, DE, PT, BU		

See *P2 Maximum Reference* (03.143).

Parameter	03.147 *P2 SSI Incremental Mode*		
Short description	Set to 1 to enable SSI incremental mode		
Mode	RFC‑S		
Minimum	0	Maximum	1
Default	0	Units	
Type	1 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW		

P2 Device type **(03.138): SSI**
If *P2 SSI Incremental Mode* (03.147) = 0 the complete absolute position is read at each sample. Care should be taken when using this mode as some unwanted effects can occur when the encoder passes through the boundary between its maximum position and zero. In this mode the encoder can be used for motor control provided at least 6 bits of turns information are provided by the encoder otherwise an over speed trip will be produced as the position passes over the maximum position to zero boundary. *P2 Normalised Position* (03.158) can be used for position control over this boundary provided the normalised turns bits are set up so that the normalised positions do not contain turns information that is not available from the encoder. As the SSI format does not include any error checking it is not possible to detect if the position data has been corrupted by noise. The benefit of using the absolute position directly from an SSI encoder is that even if the encoder communications are disturbed by noise and position errors occur, the position will always recover the correct position after the disturbance has ended.

If *P2 SSI Incremental Mode* (03.147) = 1 the absolute position is only taken from the encoder during initialisation. The change of position over each sample is then accumulated to determine the position. This method always gives 16 bits of turns information that can always be used without jumps in position whatever value is used as the turns bits for normalisation. If noise corrupts the data from an SSI encoder it is possible to have apparent large change of position, and this can result in the turns information becoming and remaining corrupted until the encoder is re-initialised.

If an SSI encoder is used, but is not powered from the drive, and the encoder is powered up after the drive, it is possible that the first change of position detected could be large enough to cause the problems described above. This can be avoided if the encoder interface is initialised with *Initialise Position Feedback* (03.075) after the encoder has powered up. If the encoder includes a power supply alarm bit, the power supply monitor should be enabled. This will ensure that the drive remains tripped until the encoder is powered up and the action of resetting the trip will reinitialise the encoder interface.

P2 Device type **(03.138): All other device types**
P2 SSI Incremental Mode (03.147) has no effect.

Parameter	03.148 *P2 SSI Binary Mode*		
Short description	Set to 1 to enable SSI binary mode		
Mode	RFC‑S		
Minimum	0	Maximum	1
Default	0	Units	
Type	1 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW		

P2 Device type **(03.138): SSI**
SSI encoders normally use Gray code data format. However, some encoders use binary format which may be selected by setting *P2 SSI Binary Mode* (03.148) to one.

P2 Device type **(03.138): All other device types**
P2 SSI Binary Mode (03.148) has no effect.

Parameter	03.149 *P2 Additional Power-up Delay*		
Short description	Defines an additional delay for when any attempt is made to communicate to the device P2		
Mode	RFC‑S		
Minimum	0.0	Maximum	25.0
Default	0.0	Units	s
Type	8 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	1
Coding	RW, BU		

When the position feedback is initialised, at power-up or at any other time, a delay is included before the information from the feedback device is used or any attempt is made to communicate with the device. *P2 Additional Power-up Delay* (03.149) defines an additional delay that is added to the minimum delay. See *P1 Additional Power-up Delay* (03.049) for the minimum delays for the different position feedback device types.

Parameter	03.150 *P2 Feedback Lock*		
Short description	Set to 1 to prevent the position feedback paramters for P2 being updated		
Mode	RFC‑S		
Minimum	0	Maximum	1
Default	0	Units	
Type	1 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW		

If *P2 Feedback Lock* (03.150) = 1 then *P2 Revolution/Pole Pitch Counter* (03.128), *P2 Position* (03.129) and *P2 Fine Position* (03.130) are not updated.
If *P2 Feedback Lock* (03.150) = 0 then these parameters are updated normally.

Parameter	03.151 *P2 Linear Feedback Select*		
Short description	Set to 1 to configure the P2 interface to operate with a linear position feedback device		
Mode	RFC‑S		
Minimum	0	Maximum	1
Default	0	Units	
Type	1 Bit User Save	Update Rate	Background read, auto-configuration write
Display Format	Standard	Decimal Places	0
Coding	RW		

If *P2 Linear Feedback Select* (03.151) = 0 then the drive P1 position feedback interface is configured to operate with a rotary position feedback device.
P2 Rotary Turns Bits (03.133) and *P2 Rotary Lines Per Revolution* (03.134) should be used to set up the position feedback interface.

If *P2 Linear Feedback Select* (03.151) = 1 then the position feedback interface is configured to operate with a linear position feedback device.
P2 Linear Comms Pitch (03.152) and *P2 Linear Line Pitch* (03.153) should be used to set up the position feedback interface.

Parameter	03.152 *P2 Linear Comms Pitch*		
Short description	Defines the distance covered by the least significant bit of the position information in a comms message from a linear encoder		
Mode	RFC‑S		
Minimum	0.001	Maximum	100.000
Default	0.001	Units	
Type	32 Bit User Save	Update Rate	Background read, auto-configuration write
Display Format	Standard	Decimal Places	3
Coding	RW		

***P2 Device type* (03.138): EnDat, SSI, BiSS**
P2 Linear Comms Pitch (03.152) is used to define the distance covered by the least significant bit of the position information in a comms message from a linear encoder. The units used by this parameter are defined by *P2 Linear Comms And Line Pitch Units* (03.154).

***P2 Device type* (03.138): Any other device**
P2 Linear Comms Pitch (03.152) has no effect.

Parameter	03.153 *P2 Linear Line Pitch*		
Short description	Defines the linear line pitch for device P2		
Mode	RFC‑S		
Minimum	0.001	Maximum	100.000
Default	0.001	Units	
Type	32 Bit User Save	Update Rate	Background read, auto-configuration write
Display Format	Standard	Decimal Places	3
Coding	RW		

P2 Linear Line Pitch (03.153) only has any effect if the position feedback interface is being used with a linear device (i.e. *P2 Linear Feedback Select* (03.151) = 1) and should be used to define the distances listed below for each type of device. The units used by this parameter are defined by *P2 Linear Comms And Line Pitch Units* (03.154).

***P2 Device type* (03.138): AB**
P2 Linear Line Pitch (03.153) should be set to the distance covered by one line period on the encoder.

***P2 Device type* (03.138): FD, FR**
P2 Linear Line Pitch (03.153) should be set to the distance covered by two line periods on the encoder.

***P2 Device type* (03.138): Any other device**
P2 Linear Line Pitch (03.153) has no effect.

Parameter	03.154 *P2 Linear Comms And Line Pitch Units*		
Short description	Defines the linear units in either millimetres or micrometres		
Mode	RFC‑S		
Minimum	0	Maximum	1
Default	0	Units	
Type	8 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW, TE		

Value	*Text*
0	millimetres
1	micrometres

P2 Linear Comms And Line Pitch Units (03.154) defines the units used by *P2 Linear Comms Pitch* (03.152) and *P2 Linear Line Pitch* (03.153) in millimetres or micrometres.

Parameter	03.155 *P2 Pole Pitch*		
Short description	Defines the distance equivalent to one pole for linear position feedback devices		
Mode	RFC‑S		
Minimum	0.01	Maximum	1000.00
Default	10.00	Units	mm
Type	32 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	2
Coding	RW		

P2 Pole Pitch (03.155) is used to define the distance equivalent to one pole for linear position feedback devices. If the linear position feedback device is being used with a linear motor, then *P2 Pole Pitch* (03.155) should be set to the pole pitch of the motor.

Parameter	03.156 *P2 Feedback Reverse*		
Short description	Set to 1 to reverse the direction of the position feedback		
Mode	RFC‑S		
Minimum	0	Maximum	1
Default	0	Units	
Type	1 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW		

If *P2 Feedback Reverse* (03.156) = 1 the position feedback is negated. This can be used to reverse the direction of the position feedback.

Parameter	03.157 *P2 Normalisation Turns*		
Short description	Defines the number of turns bits included in the normalisation parameters		
Mode	RFC‑S		
Minimum	0	Maximum	16
Default	16	Units	
Type	8 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW		

P2 Normalisation Turns (03.157) defines the number of turns bits included in the following parameters. See *P1 Normalisation Turns* (03.057) for more information.

P2 Normalised Position (03.158)
P2 Normalised Marker Position (03.159)
F1 Normalised Freeze Position (03.103) if P2 is the source position for freeze function F1
F2 Normalised Freeze Position (03.108) if P2 is the source position for freeze function F2

Parameter	03.158 *P2 Normalised Position*		
Short description	Displays the position taken from the position feedback device including the effect of the marker function		
Mode	RFC‑S		
Minimum	-2147483648	Maximum	2147483647
Default		Units	
Type	32 Bit Volatile	Update Rate	250µs write
Display Format	Standard	Decimal Places	0
Coding	RO, ND, NC, PT		

P2 Normalised Position (03.158) is the position taken from the position feedback device including the effect of the marker function.
See *P2 Normalisation Turns* (03.157) for details of the format.

Parameter	03.159 *P2 Normalised Marker Position*		
Short description	Displays the normalised position at the last marker event		
Mode	RFC‑S		
Minimum	-2147483648	Maximum	2147483647
Default		Units	
Type	32 Bit Volatile	Update Rate	250µs write
Display Format	Standard	Decimal Places	0
Coding	RO, ND, NC, PT		

P2 Normalised Marker Position (03.159) is the value *P2 Normalised Position* (03.158) at the last marker event provided bit 2 of *P2 Marker Mode* (03.131) is set to 1. See *P2 Marker Mode* (03.131) for more details.

Parameter	03.160 *P2 Calculation Time*		
Short description	Defines the time from the first edge of the clock signal from the position feedback interface until the encoder has calculated the position and is ready to return this information		
Mode	RFC‑S		
Minimum	0	Maximum	20
Default	5	Units	µs
Type	8 Bit User Save	Update Rate	Background read, auto-configuration write
Display Format	Standard	Decimal Places	0
Coding	RW		

P2 Device type (03.138): EnDat
P2 Calculation Time (03.160) is the time from the first edge of the clock signal from the position feedback interface until the encoder has calculated the position and is ready to return this information. This is used to calculate the overall time for a message interchange with the encoder. See *P2 Low Speed Update Rate Active* (03.163) for more details.

P2 Device type (03.138): Any other type of device
P2 Calculation Time (03.160) has no effect.

Parameter	03.161 *P2 Recovery Time*		
Short description	Defines the time that must be allowed after each message interchange before a new message begins		
Mode	RFC‑S		
Minimum	4	Maximum	100
Default	30	Units	µs
Type	8 Bit User Save	Update Rate	Background read, auto-configuration write
Display Format	Standard	Decimal Places	0
Coding	RW		

P2 Device type (03.138): EnDat, SSI, BiSS
P2 Recovery Time (03.161) is the time that must be allowed after each message interchange before a new message begins.

P2 Device type (03.138): Any other type of device
P2 Recovery Time (03.161) has no effect.

Parameter	03.162 *P2 Line Delay Time*		
Short description	Displays the transmission delay between the position feedback interface and the encoder and back again		
Mode	RFC‑S		
Minimum	0	Maximum	5000
Default		Units	ns
Type	16 Bit User Save	Update Rate	Background read, position feedback initialisation write
Display Format	Standard	Decimal Places	0
Coding	RO, ND, NC, PT		

P2 Device type (03.138): EnDat, SSI, BiSS
During position feedback initialisation the transmission delay between the position feedback interface and the encoder and back again is measured and stored in *P2 Line Delay Time* (03.162). This value is then used to compensate for this delay so that the clock/data skew does not prevent the data from the encoder from being read. This means that longer line lengths can be used with these feedback devices provided the correct cable and connection arrangements are used.

P2 Device type (03.138): Any other type of device
P2 Line Delay Time (03.162) is always zero.

Parameter	03.163 *P2 Low Speed Update Rate Active*		
Short description	Indicates when the low speed update rate is active		
Mode	RFC‑S		
Minimum	0	Maximum	1
Default		Units	
Type	1 Bit Volatile	Update Rate	Background write
Display Format	Standard	Decimal Places	0
Coding	RO, ND, NC, PT		

P2 Device type **(03.138): EnDat, SSI, BISS**
If the position can be sampled in 60µs *P2 Low Speed Update Rate Active* (03.163) = 0, otherwise *P2 Low Speed Update Rate Active* (03.163) = 1.

The following parameters are used by the drive to determine the necessary time to obtain the required data from the position feedback device.

P2 Rotary Turns Bits (03.133)
P2 Comms Bits (03.135)
P2 Comms Baud Rate (03.137)
P2 Calculation Time (03.160)
P2 Recovery Time (03.161)
P2 Line Delay Time (03.162)
P2 User Comms Enable (03.167)

See *P1 Low Speed Update Rate Active* (03.063) for more information on how this time is calculated.

P2 Device type **(03.138): Any other type of device**
P2 Low Speed Update Rate Active (03.163) is always zero.

Parameter	03.164 *P2 Encoder Protocol Detected*		
Short description	Defines which protocol is used with the device P2		
Mode	RFC‑S		
Minimum	0	Maximum	4
Default		Units	
Type	8 Bit Volatile	Update Rate	Background write
Display Format	Standard	Decimal Places	0
Coding	RO, TE, ND, NC, PT		

Value	*Text*
0	None
1	Hiperface
2	EnDat2.1
3	EnDat2.2
4	BiSS

P2 Encoder Protocol Detected (03.164) shows the encoder comms protocol detected during position feedback initialisation. If *P2 Device type* (03.138) is set to BiSS then *P2 Encoder Protocol Detected* (03.164) is set to the appropriate value after successful communication with the encoder during initialisation. If *P2 Device type* (03.138) is set to EnDat then *P2 Encoder Protocol Detected* (03.164) is set to the appropriate EnDat protocol after successful communication with the encoder during initialisation. If communications is not successful during initialisation then
P2 Encoder Protocol Detected (03.164) is set to 0 (*None*).

Parameter	03.167 *P2 User Comms Enable*		
Short description	Enables the use of the user comms paramters to communicate to the encoder connected to P2		
Mode	RFC‑S		
Minimum	0	Maximum	1
Default	0	Units	
Type	8 Bit Volatile	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW, NC, PT		

If *P2 User Comms Enable* (03.167) set to a non-zero value it is possible to use *P2 User Comms Transmit Register* (03.168) and
P2 User Comms Receive Register (03.169) to communicate with an encoder that has a Hiperface, EnDat 2.1, EnDat2.2 or BiSS interface. See
P1 User Comms Enable (03.067) for a description of how to use these registers.

Parameter	03.168 *P2 User Comms Transmit Register*		
Short description	Defines the value present in the user comms transmit register		
Mode	RFC‑S		
Minimum	0	Maximum	65535
Default	0	Units	
Type	16 Bit Volatile	Update Rate	Background read/write
Display Format	Standard	Decimal Places	0
Coding	RW, NC, PT, BU		

See *P2 User Comms Enable* (03.167).

Parameter	03.169 *P2 User Comms Receive Register*		
Short description	Defines the value present in the user comms receive register		
Mode	RFC‑S		
Minimum	0	Maximum	65535
Default	0	Units	
Type	16 Bit Volatile	Update Rate	Background read/write
Display Format	Standard	Decimal Places	0
Coding	RW, NC, PT, BU		

See *P2 User Comms Enable* (03.167).

Parameter	03.171 *P2 Error Detected*		
Short description	Indicates if an error has been detected with the position feedback device connected to the P1 position interface		
Mode	RFC‑S		
Minimum	0	Maximum	1
Default		Units	
Type	1 Bit Volatile	Update Rate	Background write
Display Format	Standard	Decimal Places	0
Coding	RO, ND, NC, PT		

P2 Error Detected (03.171) is set if an error has been detected with the position feedback device connected to the P2 position interface. This parameter is useful if encoder trips have been disabled with *P2 Error Detection Level* (03.140).

Parameter	03.172 *P2 Status*		
Short description	Displays the status of the P2 position interface		
Mode	RFC‑S		
Minimum	0	Maximum	9
Default		Units	
Type	8 Bit Volatile	Update Rate	Background write
Display Format	Standard	Decimal Places	0
Coding	RO, TE, ND, NC, PT		

Value	*Text*
0	None
1	AB
2	FD
3	FR
4	EnDat
5	SSI
6	BiSS
7	EnDat Alt
8	SSI Alt
9	BiSS Alt

Priority of the 15-way D-type is assigned in the following order from the highest priority to the lowest.

1. P1 position interface
2. Encoder simulation output
3. P2 position interface

The availability of the P2 position interface on the 15-way D-type on the drive is dependent on type of feedback device selected in *P1 Device Type* (03.038) and the encoder simulation mode selected in *Encoder Simulation Mode* (03.088). *P2 Status* (03.172) shows the status of the P2 position interface depending on the settings in *P2 Device type* (03.138), *P1 Device Type* (03.038), and *Encoder Simulation Mode* (03.088).

0: None
The P2 position interface is not available.

1: AB
2: FD
3: FR
4: EnDat
5: SSI
6: BiSS
The P2 position interface is available. The connections for the P2 position interface are shown below.

P2 Status (03.172)	15-way D-type connections					
	1/2	3/4	5/6	7/8	9/10	11/12
AB				A2	B2	Z2
FD				F2	D2	Z2
FR				F2	R2	Z2
EnDat				D2	Clk2	Z2
SSI				D2	Clk2	Z2
BiSS				D2	Clk2	Z2

7: EnDat Alt
8: SSI Alt
9: BiSS Alt
The P2 position interface is available but uses alternative connections as shown below as connection 7/8 and 9/10 are used by the encoder simulation output.

P2 Status (03.172)	15-way D-type connections					
	1/2	3/4	5/6	7/8	9/10	11/12
EnDat Alt			D2	AOut	BOut	Clk2
SSI Alt			D2	AOut	BOut	Clk2
BiSS Alt			D2	AOut	BOut	Clk2

See the introduction to this menu for more information on the position feedback interfaces.

Parameter	03.173 *P2 Absolute Turns Recovery Enable*		
Short description	Set to 1 to allow turns information beyond the number of turns bits provided by the position feedback device connected to P2 to be stored on power-down and recovered at next power-up		
Mode	RFC‑S		
Minimum	0	Maximum	1
Default	0	Units	
Type	1 Bit User Save	Update Rate	Background Read
Display Format	Standard	Decimal Places	0
Coding	RW		

See *P1 Absolute Turns Recovery Enable* (03.073).

Parameter	03.174 *P2 Additional Configuration*		
Short description	Provides additional configuration information for the position feedback device not included in the other set-up parameters.		
Mode	RFC‑S		
Minimum	0	Maximum	511116116
Default	0	Units	
Type	32 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW		

See *P1 Additional Configuration* (03.074).

Menu 4 Single Line Descriptions − *Torque and current control*

Mode: RFC‑S

Parameter	Range	Default	Type				
04.001 Current Magnitude	±VM_DRIVE_CURRENT_UNIPOLAR A		RO	Num	ND	NC	PT	FI
04.002 Iq	±VM_DRIVE_CURRENT A		RO	Num	ND	NC	PT	FI
04.003 Final Torque Reference	±VM_TORQUE_CURRENT %		RO	Num	ND	NC	PT	FI
04.004 Final Current Reference	±VM_TORQUE_CURRENT %		RO	Num	ND	NC	PT	FI
04.005 Motoring Current Limit	±VM_MOTOR1_CURRENT_LIMIT %	0.0 %	RW	Num		RA		US
04.006 Regenerating Current Limit	±VM_MOTOR1_CURRENT_LIMIT %	0.0 %	RW	Num		RA		US
04.007 Symmetrical Current Limit	±VM_MOTOR1_CURRENT_LIMIT %	0.0 %	RW	Num		RA		US
04.008 Torque Reference	±VM_USER_CURRENT_HIGH_RES %	0.00 %	RW	Num				US
04.009 Torque Offset	±VM_USER_CURRENT %	0.0 %	RW	Num				US
04.010 Torque Offset Select	Off (0) or On (1)	Off (0)	RW	Bit				US
04.011 Torque Mode Selector	0 to 5	0	RW	Num				US
04.012 Current Reference Filter 1 Time Constant	0.0 to 25.0 ms	0.0 ms	RW	Num				US
04.013 Current Controller Kp Gain	0 to 30000	150	RW	Num				US
04.014 Current Controller Ki Gain	0 to 30000	2000	RW	Num				US
04.015 Motor Thermal Time Constant 1	1.0 to 3000.0 s	89.0 s	RW	Num				US
04.016 Thermal Protection Mode	Motor Trip (0), Motor Limit (1), Drive Limit (2), Both Limit (3), Disabled (4)	Motor Trip (0)	RW	Txt				US
04.017 Id	±VM_DRIVE_CURRENT A		RO	Num	ND	NC	PT	FI
04.018 Final Current Limit	±VM_TORQUE_CURRENT %		RO	Num	ND	NC	PT	
04.019 Motor Protection Accumulator	0.0 to 200.0 %		RO	Num	ND	NC	PT	PS
04.020 Percentage Load	±VM_USER_CURRENT %		RO	Num	ND	NC	PT	FI
04.021 Current Feedback Filter Disable	Off (0) or On (1)	Off (0)	RW	Bit				US
04.022 Inertia Compensation Enable	Off (0) or On (1)	Off (0)	RW	Bit				US
04.023 Current Reference Filter 2 Time Constant	0.0 to 25.0 ms	0.0 ms	RW	Num				US
04.024 User Current Maximum Scaling	±VM_TORQUE_CURRENT_UNIPOLAR %	175.0 %	RW	Num		RA		US
04.025 Low Speed Thermal Protection Mode	0 to 1	0	RW	Num				US
04.026 Percentage Torque	±VM_USER_CURRENT %		RO	Num	ND	NC	PT	FI
04.027 Low Load Detection Level	0.0 to 100.0 %	0.0 %	RW	Num				US
04.028 Low Load Detection Speed/Frequency Threshold	±VM_SPEED_FREQ_REF_UNIPOLAR	0.0	RW	Num				US
04.029 Enable Trip On Low Load	Off (0) or On (1)	Off (0)	RW	Bit				US
04.030 Current Controller Mode	Off (0) or On (1)	Off (0)	RW	Bit				US
04.031 Notch Filter Centre Frequency	50 to 1200 Hz	100 Hz	RW	Num				US
04.032 Notch Filter Bandwidth	0 to 500 Hz	0 Hz	RW	Num				US
04.033 Inertia Times 1000	Off (0) or On (1)	Off (0)	RW	Bit				US
04.036 Motor Protection Accumulator Power‑up Value	Power down (0), Zero (1), Real time (2)	Power down (0)	RW	Txt				US
04.037 Motor Thermal Time Constant 2	1.0 to 3000.0 s	89.0 s	RW	Num				US
04.038 Motor Thermal Time Constant 2 Scaling	0 to 100 %	0 %	RW	Num				US
04.039 Rated Iron Losses As Percentage Of Losses	0 to 100 %	0 %	RW	Num				US
04.041 Rated Torque	0.00 to 50000.00 Nm	0.00 Nm	RW	Num				US
04.042 Torque Estimation Minimum Frequency	0 to 100 %	5 %	RW	Num				US
04.043 Torque Correction Time Constant	0.00 to 10.00 s	0.00 s	RW	Num				US
04.044 Torque Correction Maximum	0 to 100 %	20 %	RW	Num				US
04.045 No‑load Core Loss	0.000 to 99999.999 kW	0.000 kW	RW	Num				US
04.046 Rated Core Loss	0.000 to 99999.999 kW	0.000 kW	RW	Num				US
04.049 Magnetising Current Limit	0.0 to 100.0 %	100.0 %	RW	Num				US

RW	Read / Write	RO	Read-only	Bit	Bit parameter	Txt	Text string	Date	Date parameter	Time	Time parameter
Chr	Character parameter	Bin	Binary parameter	IP	IP address	Mac	MAC address	Ver	Version number	SMP	Slot, menu, parameter
Num	Number parameter	DE	Destination	ND	No default value	RA	Rating dependent	NC	Non-copyable	PT	Protected
FI	Filtered	US	User save	PS	Power-down save						

Menu 4 − *Torque and current control*

Mode: RFC‑S

RFC-A and RFC-S modes

The diagram below is common between RFC-A and RFC-S modes.
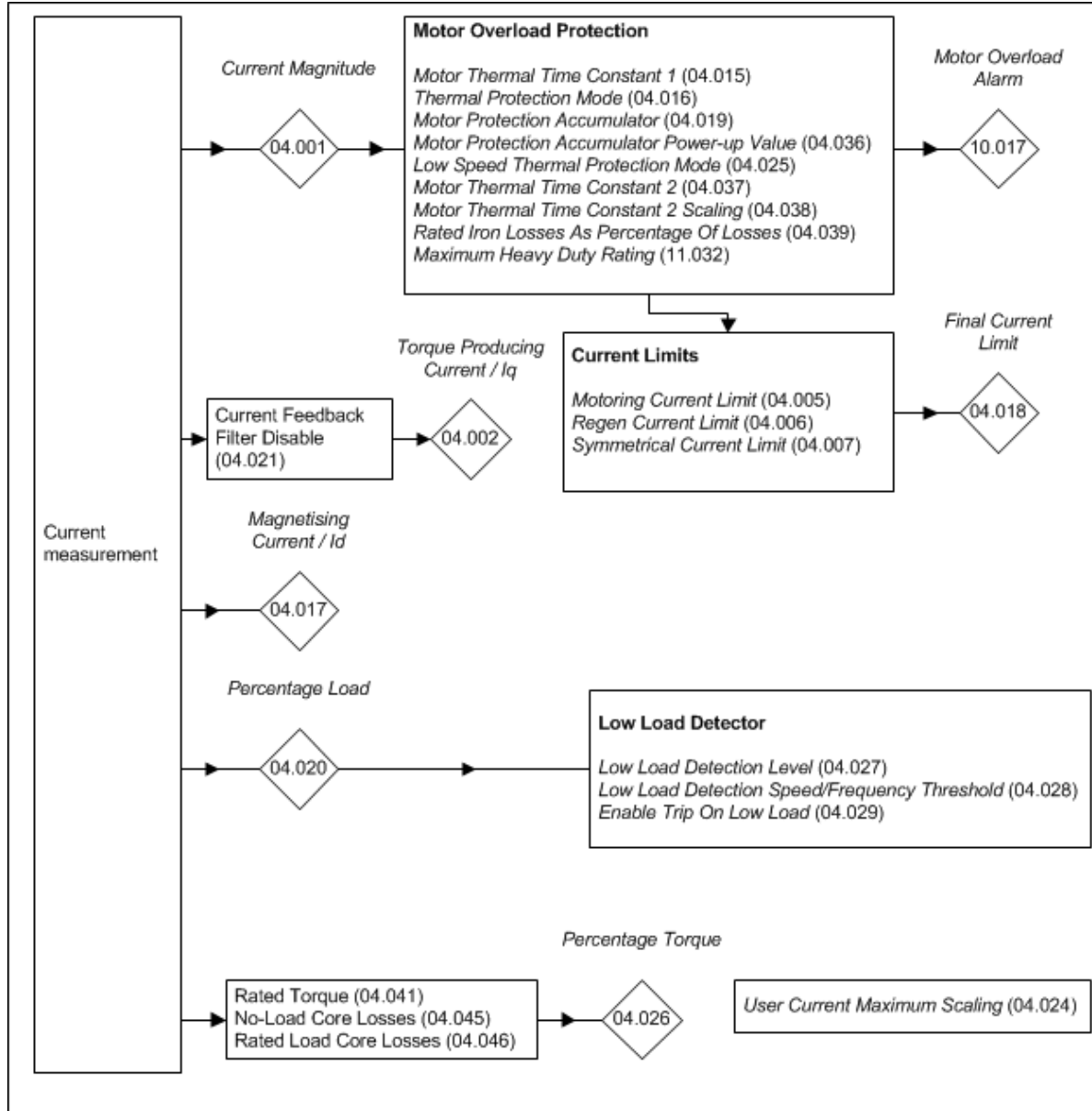
Throughout this section *Rated Current* (05.007) and other parameters related to motor 1 are used. It should be noted that this applies if *Select Motor 2 Parameters* (11.045) = 0. If *Select Motor 2 Parameters* (11.045) = 1 then *M2 Rated Current* (21.007) and other parameter associated with motor 2 should be used instead.

The full scale current is the maximum current that the drive can measure and if the current exceeds this level the drive may produce an over current trip. Kc is the current scaling for the drive and is used in determining the control performance of the drive. This is given in *Full Scale Current Kc* (11.061) and Kc is equal the full scale current in r.m.s. Amps. (Note that this is a change from Unidrive SP which used the full scale current multiplied by 0.45 for Kc.)

The maximum current reference is the highest magnitude of the current reference vector in the drive under any circumstances. The area between the maximum current reference and the full scale current provides headroom to allow for overshoot in the current controllers without tripping the drive. The current limits can be adjusted so that the maximum current reference vector (I_{MaxRef}) is equal to 0.9 x Kc provided *Rated Current* (05.007) is set to the *Maximum Heavy Duty Rating* (11.032) or less. If *Rated Current* (05.007) is set to a higher level then the current limits can be adjusted so that the maximum current reference vector (I_{MaxRef}) is equal to 1.1 x *Maximum Rated Current* (11.060) or 0.9 x Kc whichever is lower.

The drive can have a heavy duty rating intended for applications where high overload current may be required under transient conditions, or it can have a normal duty rating where a lower level of overload current is required. The duty rating is selected automatically by the drive based on the setting of *Rated Current* (05.007). The *Maximum Heavy Duty Rating* (11.032) and *Maximum Rated Current* (11.060) are fixed for each drive size and the table below shows the possible duty ratings that can be selected depending on the levels of these parameters.

Conditions	Possible duty ratings
Maximum Heavy Duty Rating (11.032) = 0.00	Normal duty operation only
Maximum Heavy Duty Rating (11.032) < *Maximum Rated Current* (11.060)	Heavy duty operation if rated current > MAX, otherwise normal duty operation
Maximum Heavy Duty Rating (11.032) = *Maximum Rated Current* (11.060)	Heavy duty operation only

The different duty ratings modify the motor protection characteristic (see *Motor Thermal Time Constant 1* (04.015)). The different duty ratings can also change the level of I_{MaxRef} as described previously.

In a drive that contains multiple power modules *Full Scale Current Kc* (11.061) is the full scale current of an individual module multiplied by the number of modules. *Maximum Heavy Duty Rating* (11.032) and *Maximum Rated Current* (11.060) are the value for an individual module multiplied by the number of modules.

RFC-A mode
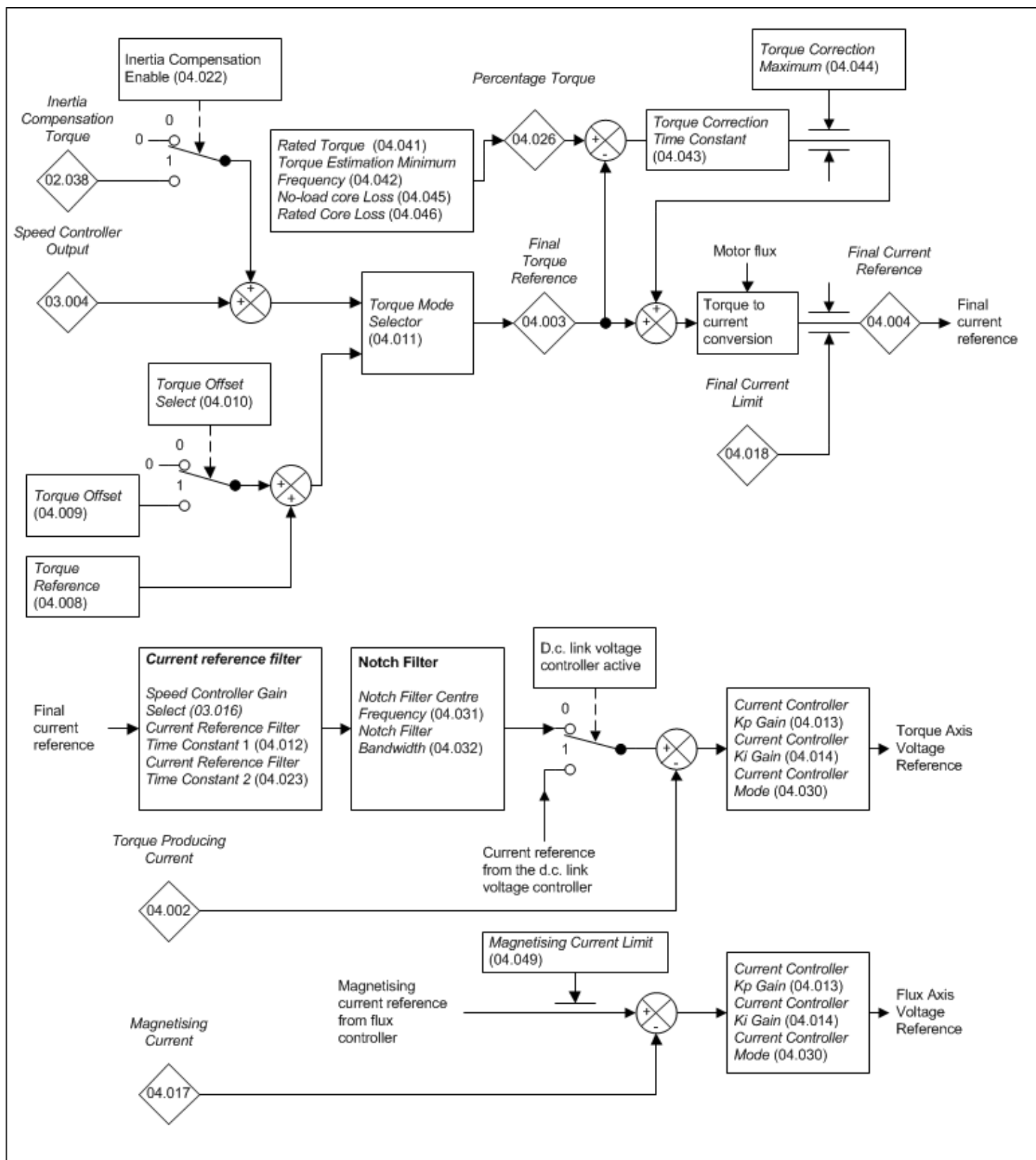
The torque reference is normally provided by the speed controller, or from the torque reference, or as a combination of both depending on the value of the *Torque Mode Selector* (04.011). During supply loss or when standard ramp mode is selected and the motor is regenerating it is possible that the torque producing current reference may be provided by the d.c. bus voltage controller as shown above. The torque reference becomes the torque producing current reference.

Variable Maximums applied to the current limits

The variable maximums applied to the current limit parameters are VM_MOTOR1_CURRENT_LIMIT for motor map 1 and VM_MOTOR2_CURRENT_LIMIT for motor map 2. The calculations given below are used in each drive mode to define VM_MOTOR1_CURRENT_LIMIT. Similar calculations based on the equivalent motor map 2 parameters are be used to define VM_MOTOR2_CURRENT_LIMIT.
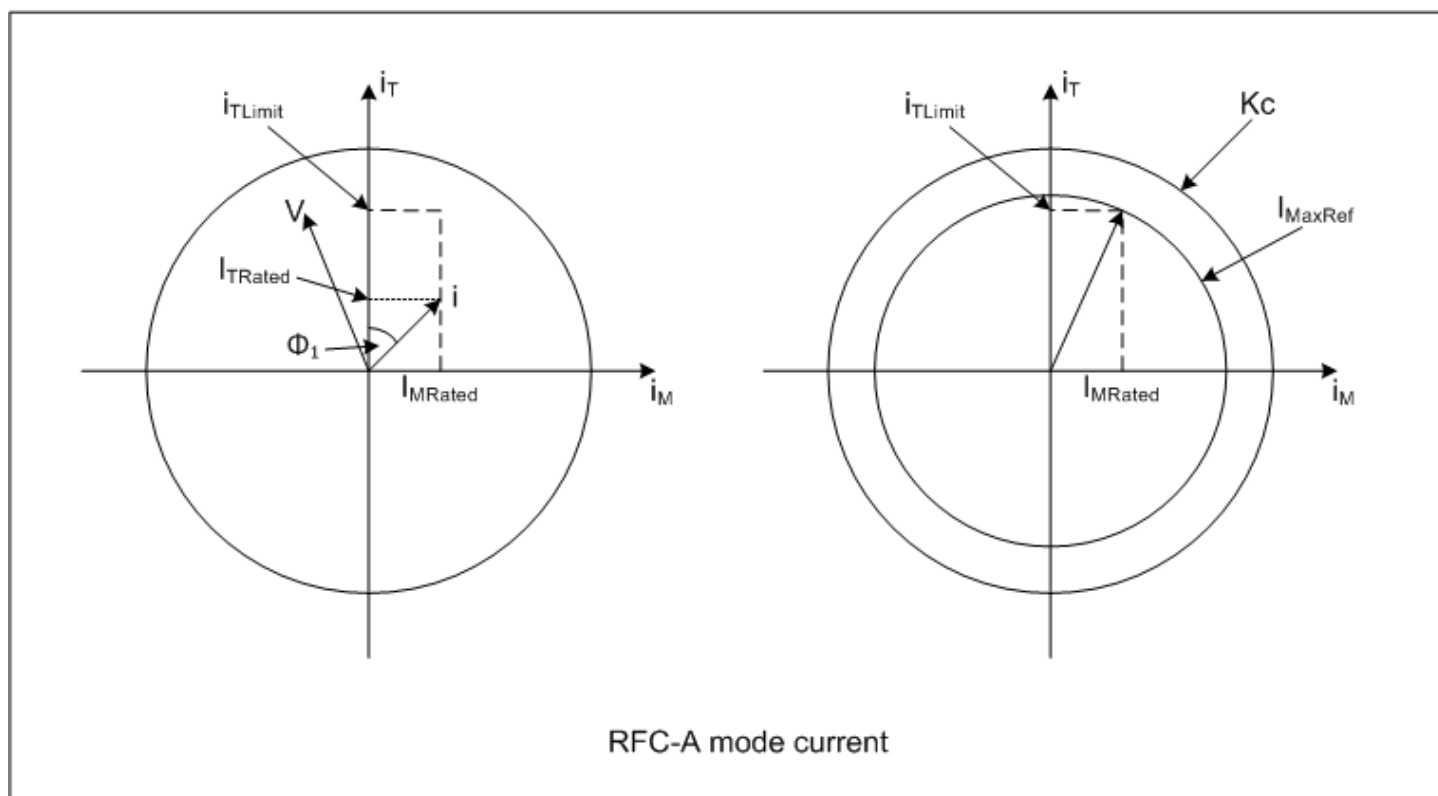
RFC-A mode current

The diagram shows a motor operating with *Rated Current* (05.007) and at I_{MaxRef}. RFC-A mode uses rotor oriented flux control, and so the magnetising current does not vary with load. The magnetising and torque producing motor currents are defined for rated conditions as follows.

With rotor flux oriented control there is a significant difference between the angle from the total current vector to the torque producing current (cos φ_1) and the power factor. The diagram below shows the voltages and currents in the motor represented as vectors.

RFC-A mode voltage and current vectors
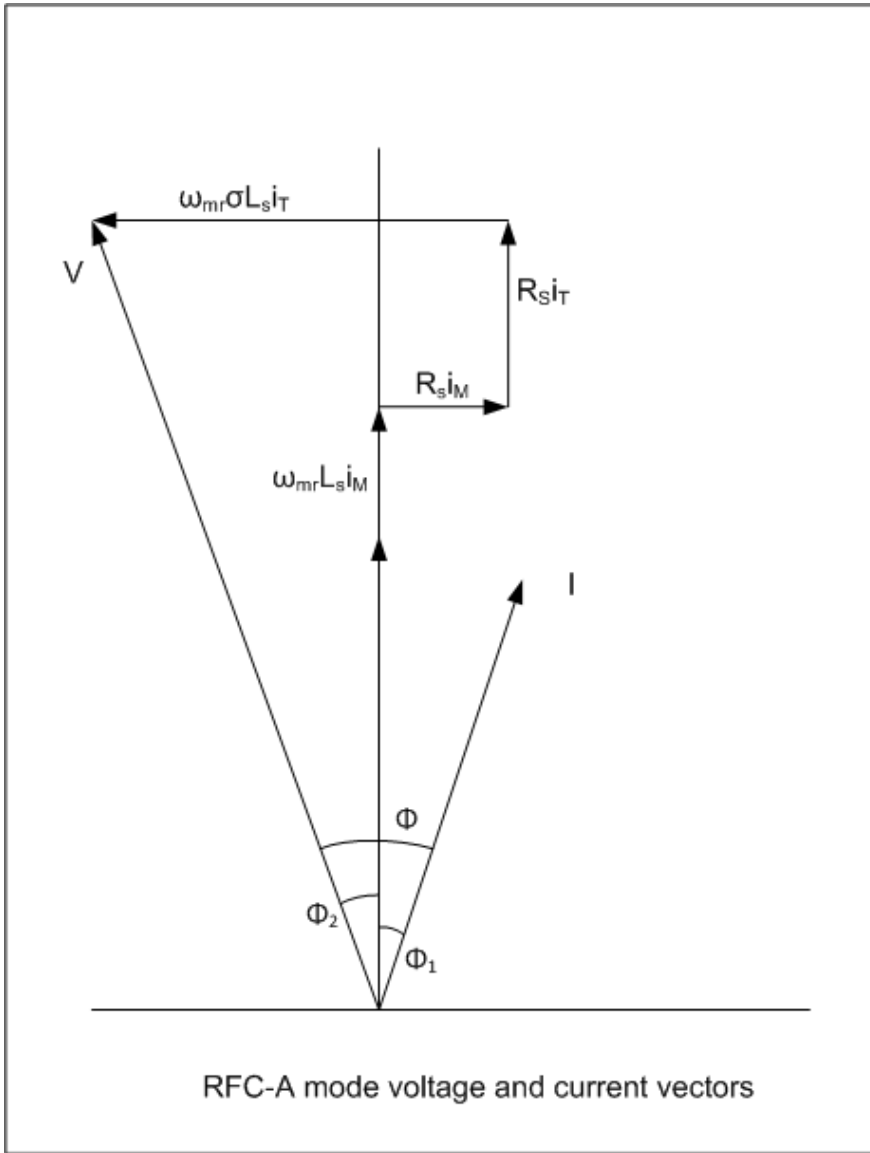
I_{Rated} = *Rated Current* (05.007)

I_{Trated} and I_{Mrated} are the torque producing current and magnetising current under rated conditions. An initial approximation to these can be used in order to calculate $\cos \varphi_1$ which in turn will be used to provide a more accurate estimate of I_{Trated} and I_{Mrated}.

$\cos \varphi$ = *Rated Power Factor* (05.010)

Initial estimates for the rated magnetising and torque producing currents are:

$I_{Mrated}{}' = I_{Rated} \times \sin \varphi$

$I_{Trated}{}' = I_{Rated} \times \cos \varphi$

$\cos \varphi_1$ can then be calculated from the power factor ($\cos \varphi$) and φ_2 as shown in the diagram above. It can be seen that under rated conditions:

$\varphi_2 = \sin^{-1}((R_s I_{MRated}{}' - 2\pi F_{Rated} \, \sigma L_s \, I_{Trated}{}') / V_{Rated})$

where

R_s is the *Stator Resistance* (05.017)

F_{Rated} is the *Rated Frequency* (05.006)

σL_s is the *Transient Inductance* (05.024)

V_{Rated} is the *Rated Voltage* (05.009)

And

$\varphi_1 = \varphi + \varphi_2$

Note that in most cases φ_2 is negative, and so φ_1 is smaller than φ. φ_1 can then be used to give more accurate values of the current components in the rotor flux reference frame.

$I_{Mrated} = I_{Rated} \sin \varphi_1$

$I_{Trated} = I_{Rated} \cos \varphi_1$

At the maximum current limit the torque producing current is given by:

$I_{Tlimit} = I_{MaxRef} \times \cos(\sin^{-1}(I_{Mrated} / I_{MaxRef}))$

The maximum required current limit setting is given by:

VM_MOTOR1_CURRENT_LIMIT = $(I_{Tlimit} / I_{Trated}) \times 100\%$

The above assumes that the user provides the *Rated Power Factor* (05.010). However, the user may provide the *Stator Inductance* (05.025) or this may be obtained by auto-tuning. If this case a more accurate value for φ_1 is calculated using *Stator Inductance* (05.025) as follows:

$I_{Mrated}' = V_{Rated} / 2\pi F_{Rated} L_s$

The magnetising current would give V_{Rated} as the terminal voltage under no load conditions, however this should be V_{Rated} under rated conditions. Therefore the rated magnetising current is adjusted assuming that the difference in terminal voltage between no load and rated load is dominated by the stator resistance drop. An estimate of φ_1 is produced as φ_1'.

$\varphi_1' = \sin^{-1}(I_{MRated}' / I_{Rated})$

The magnetising currrent is then rescaled by a factor K so that $I_{MRated} = K\, I_{MRated}'$.

$K = (V_{Rated} - R_s\, I_{TRated}') / V_{Rated}$

where $I_{TRated}' = I_{Rated} \cos \varphi_1'$

An accurate value for φ_1 can now be obtained from

$\varphi_1 = \cos^{-1}(I_{MRated} / I_{Rated})$

φ_2 can then be calculated in the same way as before and the result used with the calculated value of φ_1 to give the power factor which is written to the *Rated Power Factor* (05.010) as an indication of the motor power factor.

RFC-S mode
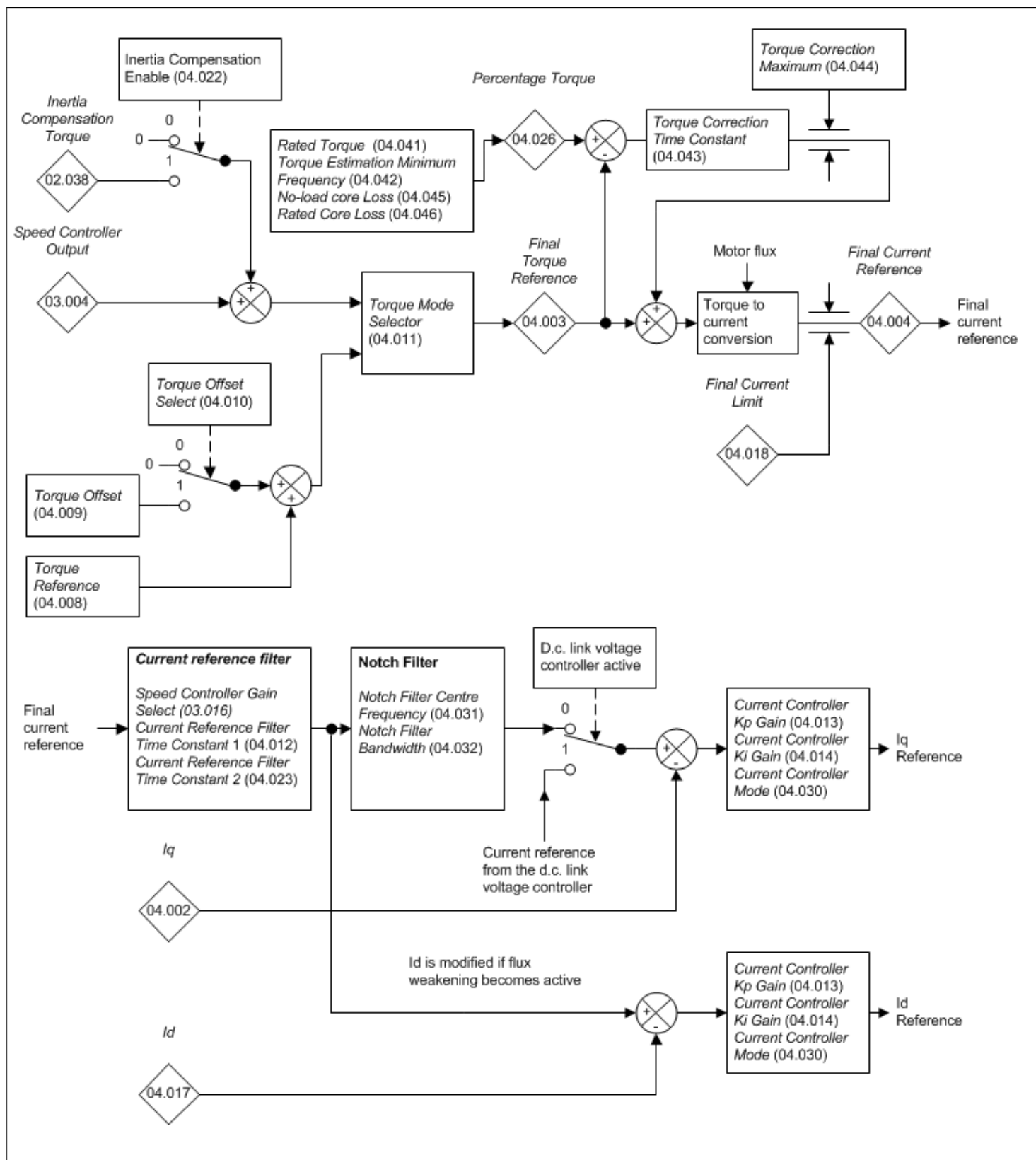
The torque reference is normally provided by the speed controller, or from the torque reference, or as a combination of both depending on the value of the *Torque Mode Selector* (04.011). During supply loss or when standard ramp mode is selected and the motor is regenerating it is possible that the torque producing current reference may be provided by the d.c. bus voltage controller as shown above. The torque reference becomes the final current reference after the current limits.Whether saliency torque is exploited or not (i.e. whatever the value of *Saliency Torque Control Select* (05.065)) a combination of d and q axis current is applied to the motor where the magnitude of the resulting current vector is approximately proportional to the *Final Current Reference* (04.004) when flux weakening is not active.

Variable Maximums applied to the current limits

The variable maximums applied to the current limit parameters are VM_MOTOR1_CURRENT_LIMIT for motor map 1 and VM_MOTOR2_CURRENT_LIMIT for motor map 2. The calculations given below are used in each drive mode to define VM_MOTOR1_CURRENT_LIMIT. Similar calculations based on the equivalent motor map 2 parameters are be used to define VM_MOTOR2_CURRENT_LIMIT.

VM_MOTOR1_CURRENT_LIMIT = (I_{MaxRef} / *Rated Current* (05.007)) x 100%

Parameter	04.001 *Current Magnitude*	
Short description	Shows the instantaneous drive output current	
Mode	RFC‑S	
Minimum	−VM_DRIVE_CURRENT_UNIPOLAR	Maximum	VM_DRIVE_CURRENT_UNIPOLAR
Default		Units	A
Type	32 Bit Volatile	Update Rate	4ms write
Display Format	Standard	Decimal Places	3
Coding	RO, FI, VM, ND, NC, PT	

Current Magnitude (04.001) is the instantaneous drive output current scaled so that it represents the r.m.s. phase current in Amps under steady state conditions.

Parameter	04.002 *Iq*	
Short description	Shows the instantaneous level of q axis current	
Mode	RFC‑S	
Minimum	−VM_DRIVE_CURRENT	Maximum	VM_DRIVE_CURRENT
Default		Units	A
Type	32 Bit Volatile	Update Rate	250us Write
Display Format	Standard	Decimal Places	3
Coding	RO, FI, VM, ND, NC, PT	

The current in the motor is separated into d and q axis current where d axis current is aligned with the flux from the magnets and the q axis current is aligned with an axis at right angles to the flux. If motor saliency is not being exploited (i.e. *Saliency Torque Control Select* (05.065) = 0) then there will only be q axis current, and no d axis current, if flux weakening is not active. If saliency torque is not being exploited then *Iq, Torque Producing Current* (04.002) is always proprotional to the torque produced by the motor. If saliency torque is being exploited (i.e. *Saliency Torque Control Select* (05.065) is non-zero) then the torque is produced by a combination of q axis current and negative d axis current. In this case *Iq, Torque Producing Current* (04.002) is not directly proportional to torque. The sign of *Iq, Torque Producing Current* (04.002) is defined in the table below.

Sign of *Iq, Torque Producing Current* (04.002)	Sign of frequency or speed	Direction of motor torque
+	+	Accelerating
-	+	Decelerating
+	-	Decelerating
-	-	Accelerating

Parameter	04.003 *Final Torque Reference*	
Short description	Shows the final torque reference	
Mode	RFC‑S	
Minimum	−VM_TORQUE_CURRENT	Maximum	VM_TORQUE_CURRENT
Default		Units	%
Type	16 Bit Volatile	Update Rate	250µs write
Display Format	Standard	Decimal Places	1
Coding	RO, FI, VM, ND, NC, PT	

The *Speed Controller Output* (03.004) can include a feed forward torque that will provide the torque necessary to accelerate the load inertia. This can be combined with the *Torque Reference* (04.008) and the *Torque Offset* (04.009) as defined by the *Torque Mode Selector* (04.011) to give the *Final Torque Reference* (04.003) as a percentage of rated motor torque.

Parameter	04.004 *Final Current Reference*	
Short description	Shows the final current reference after the current limits	
Mode	RFC‑S	
Minimum	−VM_TORQUE_CURRENT	Maximum	VM_TORQUE_CURRENT
Default		Units	%
Type	16 Bit Volatile	Update Rate	4ms write
Display Format	Standard	Decimal Places	1
Coding	RO, FI, VM, ND, NC, PT	

The *Final Torque Reference* (04.003) is converted into the *Final Current Reference* (04.004) using rotor temperature compensation if required (see *Rotor Temperature Coefficient* (05.054)) and applying the current limits.

Parameter	04.005 *Motoring Current Limit*	
Short description	Defines the current limit used when the motor is being accelerated away from standstill	
Mode	RFC‑S	
Minimum	−VM_MOTOR1_CURRENT_LIMIT	Maximum	VM_MOTOR1_CURRENT_LIMIT
Default	0.0	Units	%
Type	16 Bit User Save	Update Rate	4ms read
Display Format	Standard	Decimal Places	1
Coding	RW, VM, RA	

The *Motoring Current Limit* (04.005) limits the current when the motor is being accelerated away from standstill. The *Regenerating Current Limit* (04.006) limits the current when the motor is being decelerated towards standstill. If the *Symmetrical Current Limit* (04.007) is below the *Motoring Current Limit* (04.005) then it is used instead of the *Motoring Current Limit* (04.005). If the *Symmetrical Current Limit* (04.007) is below the *Regenerating Current Limit* (04.006) then it is

used instead of the *Regenerating Current Limit* (04.006).

The maximum possible current limit (VM_MOTOR1_CURRENT_LIMIT [MAX]) varies between drive sizes with default parameters loaded. For some drive sizes the default value may be reduced below the value given by the parameter range limiting.

Parameter	04.006 *Regenerating Current Limit*		
Short description	Defines the current limit used when the motor is being decelerated towards standstill		
Mode	RFC‑S		
Minimum	−VM_MOTOR1_CURRENT_LIMIT	Maximum	VM_MOTOR1_CURRENT_LIMIT
Default	0.0	Units	%
Type	16 Bit User Save	Update Rate	4ms read
Display Format	Standard	Decimal Places	1
Coding	RW, VM, RA		

See *Motoring Current Limit* (04.005).

Parameter	04.007 *Symmetrical Current Limit*		
Short description	Defines the symmetrical current limit		
Mode	RFC‑S		
Minimum	−VM_MOTOR1_CURRENT_LIMIT	Maximum	VM_MOTOR1_CURRENT_LIMIT
Default	0.0	Units	%
Type	16 Bit User Save	Update Rate	4ms read
Display Format	Standard	Decimal Places	1
Coding	RW, VM, RA		

See *Motoring Current Limit* (04.005).

Parameter	04.008 *Torque Reference*		
Short description	Defines the torque reference		
Mode	RFC‑S		
Minimum	−VM_USER_CURRENT_HIGH_RES	Maximum	VM_USER_CURRENT_HIGH_RES
Default	0.00	Units	%
Type	32 Bit User Save	Update Rate	250µs read
Display Format	Standard	Decimal Places	2
Coding	RW, VM		

Gives the required torque reference as a percentage of rated motor torque.

Parameter	04.009 *Torque Offset*		
Short description	Defines the torque offset to be added to the torque reference		
Mode	RFC‑S		
Minimum	−VM_USER_CURRENT	Maximum	VM_USER_CURRENT
Default	0.0	Units	%
Type	16 Bit User Save	Update Rate	4ms read
Display Format	Standard	Decimal Places	1
Coding	RW, VM		

The torque offset added to *Torque Reference* (04.008) if *Torque Offset Select* (04.010) = 1.

Parameter	04.010 *Torque Offset Select*		
Short description	Set to add the torque offset to the torque reference		
Mode	RFC‑S		
Minimum	0	Maximum	1
Default	0	Units	
Type	1 Bit User Save	Update Rate	4ms read
Display Format	Standard	Decimal Places	0
Coding	RW		

See *Torque Reference* (04.008).

Parameter	04.011 *Torque Mode Selector*		
Short description	Defines the torque mode used by the drive		
Mode	RFC‑S		
Minimum	0	Maximum	5
Default	0	Units	
Type	8 Bit User Save	Update Rate	4ms read
Display Format	Standard	Decimal Places	0
Coding	RW		

The value of the *Torque Mode Selector* (04.011) defines how the *Final Torque Reference* (04.003) is produced. The inputs to the torque mode selector system are referred to below as the Speed control torque reference and the User torque reference. The Speed control torque reference is the *Speed Controller Output* (03.004), combined with the *Inertia Compensation Torque* (02.038) if this is enabled. The User torque reference is the *Torque Reference* (04.008), combined with the *Torque Offset* (04.009) if this is enabled. Each of the modes is described below.

Mode 0 and Mode 4 use speed control with the combined output of the ramp system and the hard speed reference as the reference. The other modes are torque control modes (although the speed controller may be active). In these modes the ramp system output is not used, but the output of the ramp system (*Post Ramp Reference* (02.001)) is constantly preset with *Speed Feedback* (03.002) − *Hard Speed Reference* (03.022). This prevents a transient if the mode is changed to 0 or 4 while the drive is active, or the drive run is removed and the motor is stopped under ramp control, i.e. *Stop Mode* (06.001) is 1 or 2.

0: Speed control mode
The *Final Torque Reference* (04.003) is the Speed controller torque reference.

1: Torque control
The *Final Torque Reference* (04.003) is the User torque reference. The speed is not limited by the drive but, the drive will trip at the over-speed threshold if runaway occurs.

2: Torque control with speed override
The drive effectively operates in speed control and *Final Torque Reference* (04.003) is controlled by the Speed controller torque reference, however this is limited between 0 and the User torque reference. The effect is to produce an operating area as shown below if the Speed controller torque reference and the User torque reference are both positive. The speed controller will attempt to accelerate the motor to the *Final Speed Reference* (03.001) with a torque equivalent to the User torque reference. However, the speed cannot be forced above the *Final Speed Reference* (03.001) by the drive because the required torque would be negative, and so it would be clamped to zero.

Torque control with speed override
(*Positive Final Speed Reference* (03.001) and User torque reference)
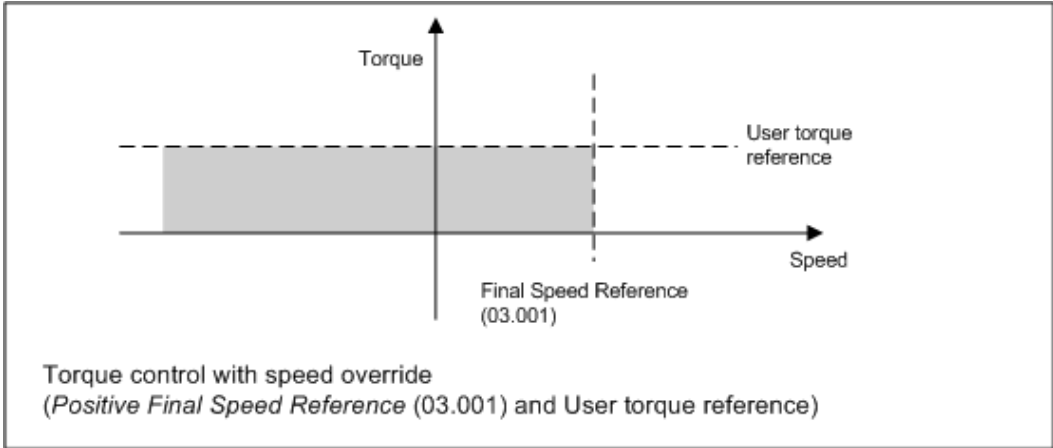
Depending on the sign of the *Final Speed Reference* (03.001) and the User torque reference there are four possible areas of operation as shown below.

Torque control with speed override
(Four possible areas of control)
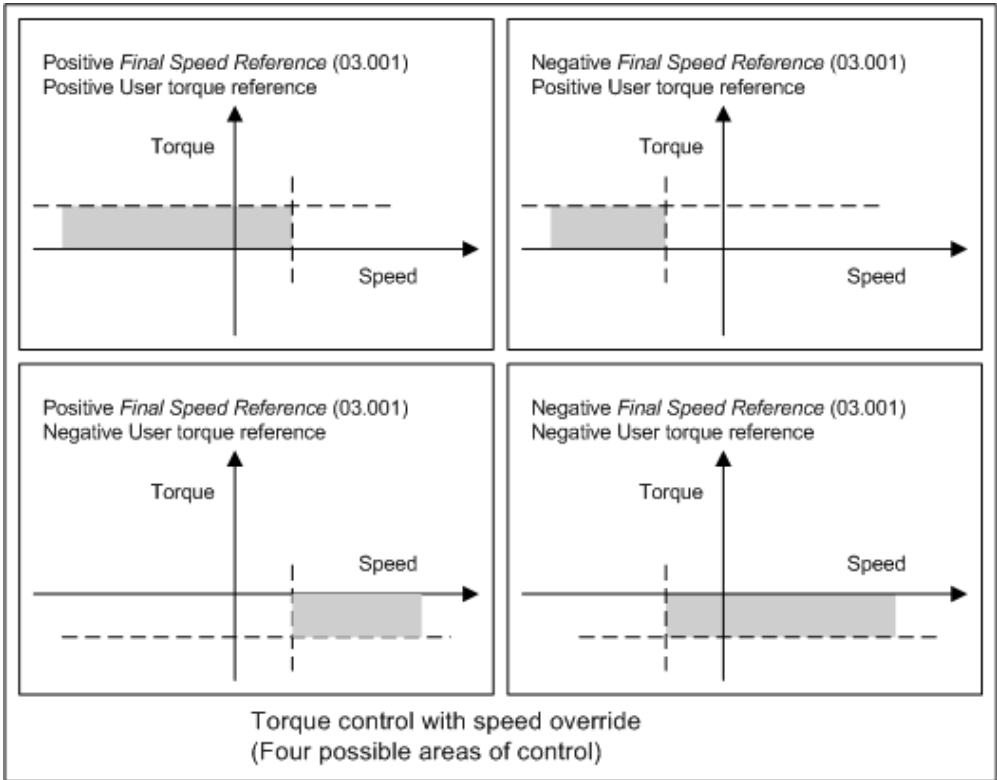
3: Coiler/uncoiler mode
Positive *Final Speed Reference* (03.001): Positive User torque reference gives torque control with a positive speed limit defined by the *Final Speed Reference* (03.001). A negative User torque reference gives torque control with a negative speed limit of -5rpm.

Negative *Final Speed Reference* (03.001): Negative User torque reference gives torque control with a negative speed limit defined by the *Final Speed Reference* (03.001). A positive User torque reference gives torque control with a positive speed limit of +5rpm.

Example of coiler operation:
This is an example of a coiler operating in the positive direction. The *Final Speed Reference* (03.001) is set to a positive value just above the coiler reference speed. If the User torque reference is positive the coiler operates with a limited speed, so that if the material breaks the speed does not exceed a level just above the reference. It is also possible to decelerate the coiler with a negative User torque reference. The coiler will decelerate down to -5rpm until a stop is applied. The operating area is shown below:

Coiler operation (figure)

Torque
Final Speed Reference (03.001)
Area for operating as a coiler
Area for decelerating
Speed
-5rpm
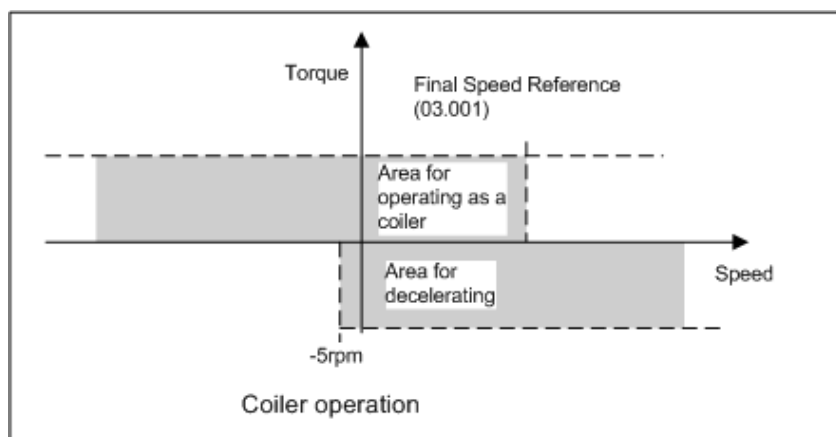
Coiler operation

Example of uncoiler operation:
This is an example for an uncoiler operating in the positive direction. The *Final Speed Reference* (03.001) should be set to a level just above the maximum normal speed. When the User torque reference is negative the uncoiler will apply tension and try and rotate at 5rpm in reverse, and so take up any slack. The uncoiler can operate at any positive speed applying tension. If it is necessary to accelerate the uncoiler a positive User torque reference is used. The speed will be limited to the *Final Speed Reference* (03.001). The operating area is the same as that for the coiler and is shown below:

Uncoiler operation (figure)

Torque
Final Speed Reference (03.001)
Area for accelerating
Area for operating as an uncoiler
Speed
-5rpm

Uncoiler operation
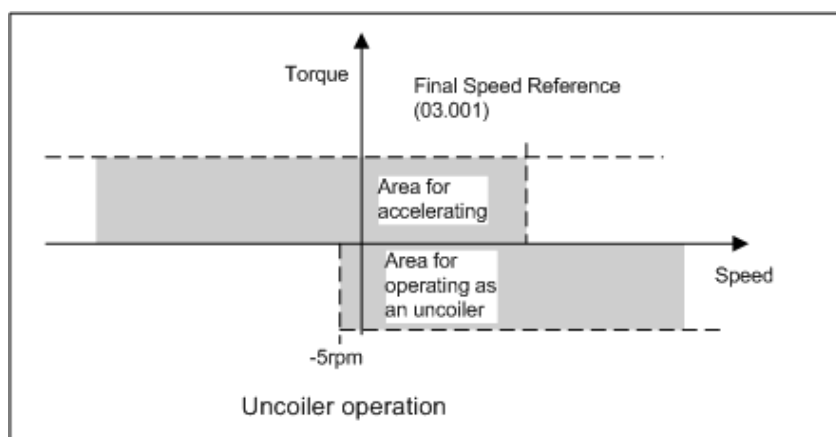
4: Speed control with torque feed-forward
The Speed control torque reference and User torque reference are summed so that the drive operates under speed control, but a torque value may be added to the output of the speed controller. This can be used to improve the regulation of systems where the speed controller gains need to be low for stability.

5: Bi-directional torque control with speed override
The drive effectively operates in speed control and *Final Torque Reference* (04.003) is controlled by the Speed controller torque reference. If the User torque reference is positive then the speed reference is *Final Speed Reference* (03.001) and the torque is limited to the User torque reference. Therefore for any negative speed and any positive speed up to *Final Speed Reference* (03.001) the motor will produce the required positive torque. If the speed exceeds *Final Speed Reference* (03.001) no torque will be produced. The system works in the same way for a negative User torque reference, but with a speed limit of -*Final Speed Reference* (03.001). This system can be used for torque control in either direction with a safe speed limit in either direction if the load torque is less than the applied torque (i.e. the load is removed). The diagram below shows the possible regions of operation.

Bi-directional torque control with speed override (figure)

Torque
|Final Speed Reference (03.001)|
Speed
|Final Speed Reference (03.001)|

Bi-directional torque control with speed override
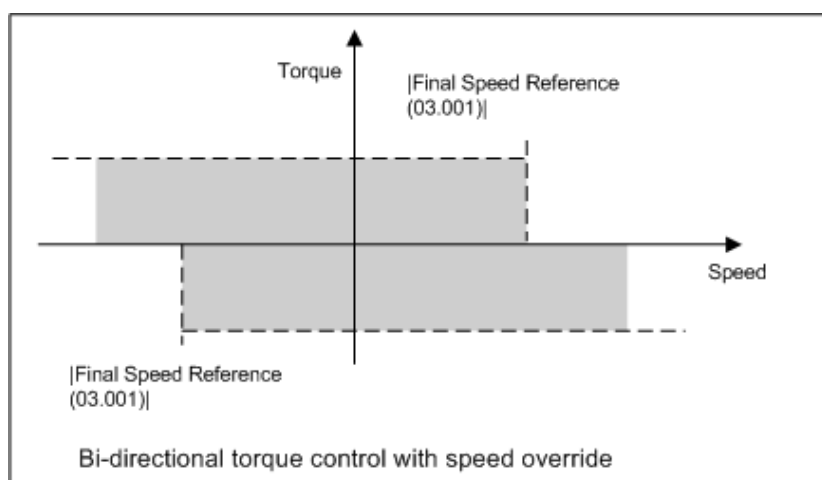
Parameter	04.012 *Current Reference Filter 1 Time Constant*		
Short description	Defines the time constant of a first order filter that can be applied to the final current reference		
Mode	RFC-S		
Minimum	0.0	Maximum	25.0
Default	0.0	Units	ms
Type	8 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	1
Coding	RW, BU		

Current Reference Filter 1 Time Constant (04.012) defines the time constant of a first order filter that can be applied to the *Final Current Reference* (04.004). The filter is provided to reduce acoustic noise and vibration produced as a result of position feedback quantisation. The filter introduces a lag in the speed controller loop, and so the speed controller gains may need to be reduced to maintain stability as the filter time constant is increased. The time constant used is dependent on *Speed Controller Gain Select* (03.016) so that different time constants can be used with different gains.
Current Reference Filter 1 Time Constant (04.012) is used if *Speed Controller Gain Select* (03.016) = 0, and *Current Reference Filter 2 Time Constant* (04.023) is used if *Speed Controller Gain Select* (03.016) = 1.

Parameter	04.013 *Current Controller Kp Gain*		
Short description	Defines the current loop controller proportional gain		
Mode	RFC-S		
Minimum	0	Maximum	30000
Default	150	Units	
Type	16 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW		

Current Controller Kp Gain (04.013) and *Current Controller Ki Gain* (04.014) are the proportional and integral gains of the current controllers. It is possible to use the current controller in standard mode (*Current Controller Mode* (04.030) = 0) or high performance mode (*Current Controller Mode* (04.030) = 1). The set up method for the current controller gains is described separately for each of these modes below. It should be noted that when an auto-tune is performed that measures the *Ld* (05.024) and *Stator Resistance* (05.017) the *Current Controller Kp Gain* (04.013) and *Current Controller Ki Gain* (04.014) are automatically set to the levels defined in the description for standard mode even if high performance mode is selected. These gains will give good performance in standard mode and produce moderate acoustic noise due to position feedback quantisation with a standard incremental encoder. These represent the maximum levels that are likely to be used with this mode in most applications. For high performance mode it is recommended that a high resolution position feedback device is used or else the acoustic noise due to position feedback quantisation is likely to be excessive. In high performance mode the proportional gain can be increased to a higher level as given in the description of this mode.

Standard mode
Standard mode can be used to give good current control dynamic performance and is compatible with the performance of Unidrive SP. The current controller gains can either be set using auto-tuning (see *Auto-tune* (05.012)) or the values can be set up manually by the user. The calculations given below are those used by the auto-tuning system and should give good performance without excessive overshoot.

The proportional gain, *Current Controller Kp Gain* (04.013), is the most critical value in controlling the performance of the current controllers. The required value can be calculated as

Current Controller Kp Gain (04.013) = $(L / T) \times (I_{fs} / V_{fs}) \times (256 / 5)$

where:

T is the sample time of the current controllers. The drive compensates for any change of sample time, and so it should be assumed that the sample time is equivalent to the base value of 167µs.

L is the motor inductance. For a servo motor this is half the phase to phase inductance that is normally specified by the manufacturer. For an induction motor this is the per phase transient inductance (σLs). The inductance for either of these motors can be taken from the manufacturers data or it can be obtained from the value stored in the *Ld* (05.024) after auto-tuning.

I_{fs} is the peak full scale current feedback, i.e. full scale current x $\sqrt{2}$. The r.m.s. full scale current is given by *Full Scale Current Kc* (11.061), and so I_{fs} = *Full Scale Current Kc* (11.061) x $\sqrt{2}$.

V_{fs} is the maximum d.c. bus voltage.

Therefore:

Current Controller Kp Gain (04.013) = $(L / 167µs) \times (Kc \times \sqrt{2} / V_{fs}) \times (256 / 5) = K \times L \times Kc$

Where K = $[\sqrt{2} / (V_{fs} \times 167µs)] \times (256 / 5)$

There is one value of the scaling factor K for each drive voltage rating as shown in the table below.

Drive Rated Voltage (11.033)	Vfs	K
200V	415V	1045
400V	830V	522
575V	990V	438
690V	1190V	364

The integral gain, *Current Controller Ki Gain* (04.014), is less critical. A suggested value which matches the zero with the pole caused by the electrical time constant of the motor and ensures that the integral term does not contribute to current overshoot is given by

Current Controller Ki Gain (04.014) = *Current Controller Kp Gain* (04.013) x 256 x T / τ_m

Where τ_m is the motor time constant (L / R). R is the per phase stator resistance of the motor (i.e. half the resistance measured between two phases).

Therefore:

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Current Controller Ki Gain (04.014) = (K x L x Kc) x 256 x 167µs x R / L = 0.0427 x K x R x Kc

The above equations give the gain values that should give a good response with minimal overshoot. If required the gains can be adjusted to modify the performance as follows:

1. *Current Controller Ki Gain* (04.014) can be increased to improve the performance of the current controllers by reducing the effects of inverter non-linearity. These effects become more significant with higher switching frequency. These effects will be more significant for drives with higher current ratings and higher voltage ratings. If *Current Controller Ki Gain* (04.014) is increased by a factor of 4 it is possible to get up to 10% overshoot in response to a step change of current reference. For high performance applications, it is recommended that *Current Controller Ki Gain* (04.014) is increased by a factor of 4 from the auto-tuned values. As the inverter non-linearity is worse with higher switching frequencies it is may be necessary to increase *Current Controller Ki Gain* (04.014) by a factor of 8 for operation with 16kHz switching frequency.
2. It is possible to increase *Current Controller Kp Gain* (04.013) to reduce the response time of the current controllers. If *Current Controller Kp Gain* (04.013) is increased by a factor of 1.5 then the response to a step change of reference will give 12.5% overshoot. It is recommended that *Current Controller Ki Gain* (04.014) is increased in preference to *Current Controller Kp Gain* (04.013).

As already stated, the drive compensates for changes of switching frequency and the sampling method used by the controller. The table below shows the adjustment applied to the proportional and integral gains.

Switching Frequency (05.037)	Current controller sample time Current	*Current Controller Kp Gain* (04.013) adjustment	*Current Controller Ki Gain* (04.014) adjustment
2kHz	250µs	x 167 / 250 = 0.7	x 1.0
3kHz	167µs	x 167 / 167 = 1.0	x 1.0
4kHz	125µs	x 167 / 125 = 1.3	x 1.0
6kHz	83µs	x 167 / 83 = 2.0	x 1.0
8kHz	62.5µs	x 167 / 62.5 = 2.7	x 1.0
12kHz	83µs	x (167 / 83) x (4 / 3) = 2.7	x 4 / 3 = 1.3
16kHz	62.5µs	x (167 / 62.5) x (4 / 3) = 3.6	x 4 / 3 = 1.3

The amount of acoustic noise produced in the motor from position feedback quantisation is related to the resolution of the position feedback and the product of the speed controller and current controller proportional gains. The values in this table can be used in conjunction with the speed controller loop proportional gain to assess the amount of acoustic noise that is likely to be produced.

High performance mode
High performance mode gives fast closed-loop dynamic performance as though the proportional gain has been set to the maximum value defined below. This is the maximum value that should be used to prevent excessive over-shoot or instability. It should be noted that this is 5 times the maximum value used for standard mode.

Current Controller Kp Gain (04.013) = (L / T) x (I$_{fs}$ / V$_{fs}$) x 256 = K x L x Kc x 5

The closed-loop dynamic performance defines the response of the current controllers to a change of current reference. This response cannot be changed by modifying *Current Controller Kp Gain* (04.013), however the ability of the current controllers to reject voltage disturbances is affected by *Current Controller Kp Gain* (04.013). Normally the auto-tuned value (which is one fifth of of the maximum recommended value) will give good rejection of voltage disturbances, but the proportional gain can be increased up to the maximum value to improve this. It should be noted that the higher closed-loop response of the controllers means that encoder position quantisation will cause significant acoustic noise in the motor unless a high resolution encoder is used. Increasing *Current Controller Kp Gain* (04.013) also increases acoustic noise due to noise on the current feedback. High performance mode uses the measured motor resistance and inductance, and so it is recommended that these are obtained with auto-tuning using test 1 or 2.

The integral gain provides a trim on the currents, and generally the auto-tuned value should be sufficient, however, this may be increased if required.

The drive compensates for changes of switching frequency used by the controller. The table below shows the adjustment applied to the proportional and integral gains.

Switching Frequency (05.037)	Current controller sample time Current	*Current Controller Kp Gain* (04.013) adjustment	*Current Controller Ki Gain* (04.014) adjustment
2kHz	500us	x 167 / 500 = 0.3	x 1.0
3kHz	333us	x 167 / 333 = 0.5	x 1.0
4kHz	250us	x 167 / 250 = 0.7	x 1.0
6kHz	167µs	x 167 / 167 = 1.0	x 1.0
8kHz	125µs	x 167 / 125 = 1.3	x 1.0
12kHz	83µs	x 167 / 83 = 2.0	x 1.0
16kHz	62.5µs	x 167 / 62.5 = 2.7	x 1.0

Parameter	04.014 *Current Controller Ki Gain*		
Short description	Defines the current loop controller integral gain		
Mode	RFC-S		
Minimum	0	Maximum	30000
Default	2000	Units	
Type	16 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW		

See *Current Controller Kp Gain* (04.013).

Parameter	04.015 *Motor Thermal Time Constant 1*		
Short description	Set to the thermal time constant for the motor		
Mode	RFC-S		
Minimum	1.0	Maximum	3000.0
Default	89.0	Units	s
Type	16 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	1
Coding	RW		

A dual time constant thermal model is provided that can be used to estimate the motor temperature as a percentage of its maximum allowed temperature. The input to the model is the *Current Magnitude* (04.001). Throughout the following discussion *Rated Current* (05.007) is used in the model assuming *Select Motor 2 Parameters* (11.045) = 0. If *Select Motor 2 Parameters* (11.045) = 1 then *M2 Rated Current* (21.007) is used instead. It should be noted that if the parameters that have been added in addition to those in Unidrive SP are left at their default values the model is a simple single time constant model as provided in Unidrive SP.

Percentage Losses
The losses in the motor are calculated as a percentage value.

Percentage Losses = 100% x [Load Related Losses + Iron Losses]

where:
Load Related Losses = $(1 - K_{fe})$ x $(I / (K_1 \times I_{Rated}))^2$
Iron Losses = K_{fe} x $(w / w_{Rated})^{1.6}$

where:
I = *Current Magnitude* (04.001)
I_{Rated} = *Rated Current* (05.007)
K_{fe} = *Rated Iron Losses As Percentage Of Losses* (04.039) / 100%

The iron losses are relatively low in motors that have a rated frequency of 60Hz or less, and so the motor could be modelled based on load related losses alone. This can be done by setting K_{fe} to zero. In motors where iron losses are significant, K_{fe} defines the proportion of losses that are iron losses under rated conditions (i.e. rated current and rated frequency). For example if the iron losses are 30% of losses and other losses are 70% of losses under rated conditions *Rated Iron Losses As Percentage Of Losses* (04.039) should be set to 30%.

The value of K_1 defines the continuous allowable motor overload as a proportion of the *Rated Current* (05.007) before the *Motor Protection Accumulator* (04.019) reaches 100%. The value of K_1 can be used to model reduced cooling at low speeds and to allow the motor to operate under rated conditions with a small margin to prevent spurious trips. K_1 is defined in more detail later.

Motor Protection Accumulator
So far the steady state motor losses have been defined, but the motor model must estimate the temperature within the motor under dynamically changing conditions, and so the *Motor Protection Accumulator* (04.019) is given by the following equation.

T = Percentage Losses x $[(1 - K_2)(1 - e^{-t/\tau1}) + K_2(1 - e^{-t/\tau2})]$

where
T = *Motor Protection Accumulator* (04.019)
K_2 = *Motor Thermal Time Constant 2 Scaling* (04.038) / 100%
τ1 = *Motor Thermal Time Constant 1* (04.015)
τ2 = *Motor Thermal Time Constant 2* (04.037)

$[(1 - K_2)(1 - e^{-t/\tau1}) + K_2(1 - e^{-t/\tau2})]$ gives the effects of the thermal time constants in the motor. K_2 defines the ratio of the contribution to the *Motor Protection Accumulator* (04.019) value from each of the time constants. If K_2 is set to its default value of 0 then only *Motor Thermal Time Constant 1* (04.015) is included and the model will give the temperature of the main mass of the motor body. To give better protection to the motor, the model can be used to model a particular point in the motor, for example the stator windings. This can be done by including an additional shorter time constant representing the thermal impedance between the windings and the main mass of the motor body which can be modelled with *Motor Thermal Time Constant 2* (04.037).

Reduced cooling with lower speed
If *Rated Current* (05.007) ≤ *Maximum Heavy Duty Rating* (11.032) then K_1 is defined as shown below. If *Low Speed Thermal Protection Mode* (04.025) = 0 the characteristic is intended for a motor which can operate at rated current over the whole speed range. Induction motors with this type of characteristic normally have forced cooling. If *Low Speed Thermal Protection Mode* (04.025) = 1 the characteristic is intended for motors where the cooling effect of motor fan reduces with reduced motor speed below half of rated speed. The maximum value for K_1 is 1.05, so that above the knee of the characteristics the motor can operate continuously up to 105% of rated current.

K_1 when *Motor Rated Current* (05.007) ≤ *Maximum Heavy Duty Rating* (11.032)
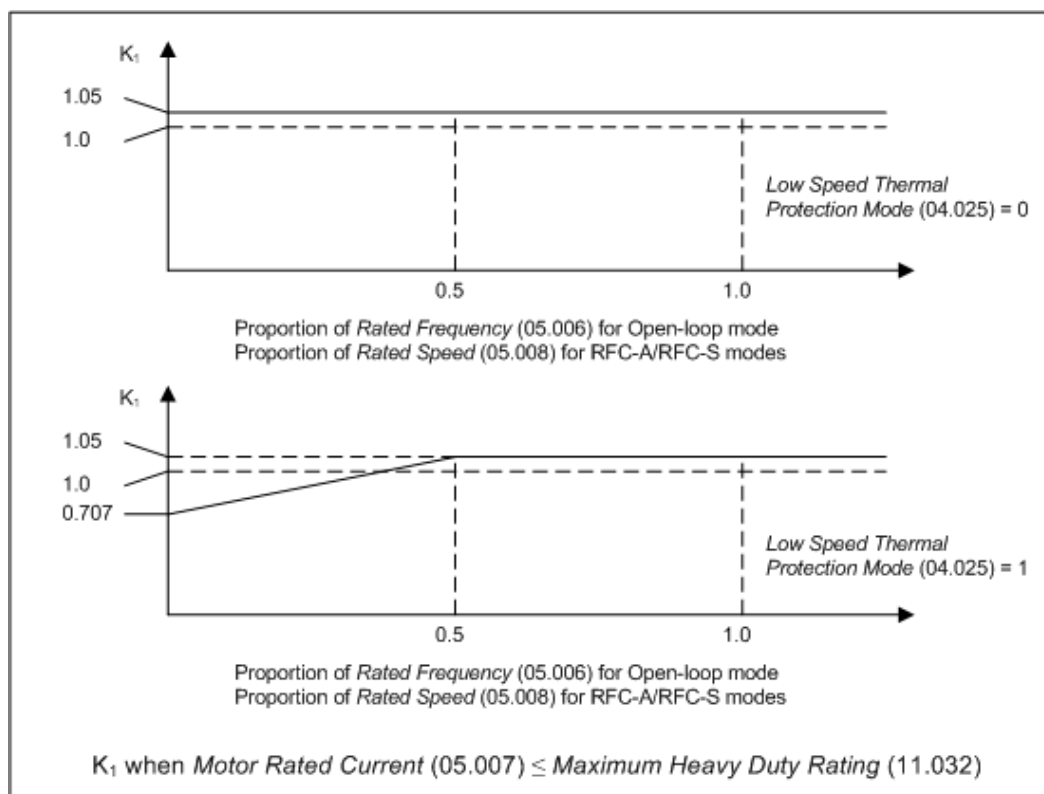
If *Rated Current* (05.007) > *Maximum Heavy Duty Rating* (11.032) then K_1 is defined as shown below. Two different characteristics are provided, but in both cases the motor performance is limited at lower speeds and the permissible overload is reduced from 105% to 101%.

K_1 when *Motor Rated Current* (05.007) > *Maximum Heavy Duty Rating* (11.032)
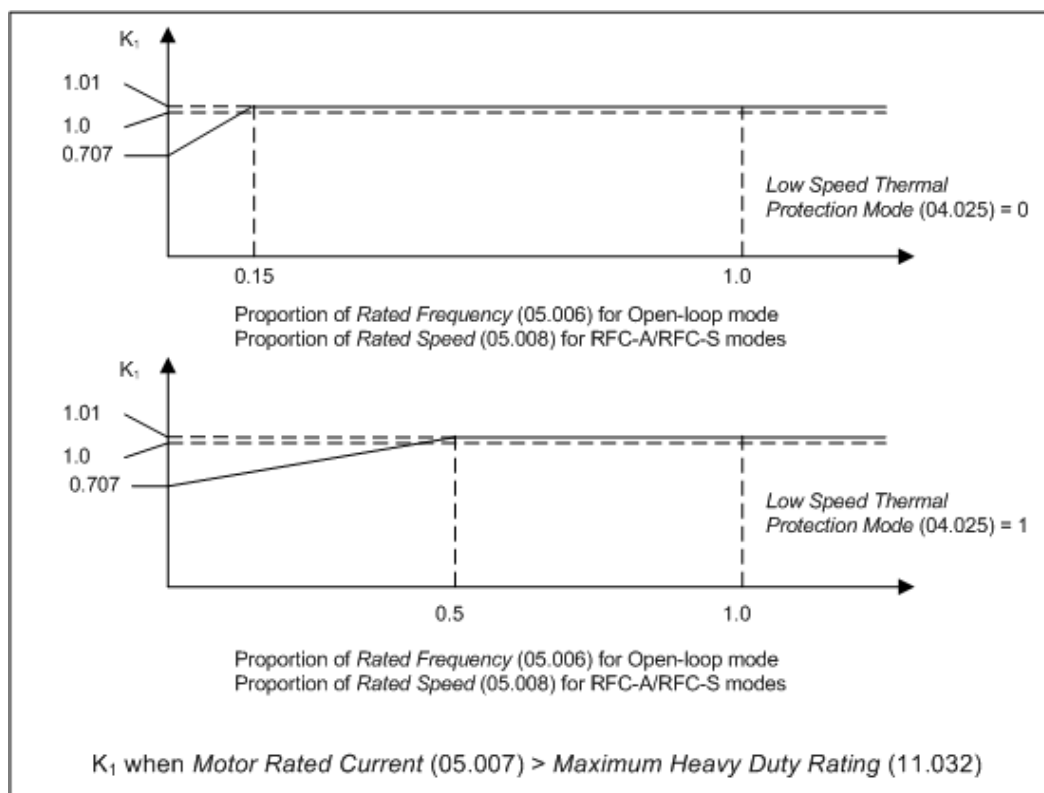
Time for Motor Protection Accumulator to reach 100%
Assuming a single time constant model is being used (i.e. *Motor Thermal Time Constant 2 Scaling* (04.038), the time for the *Motor Protection Accumulator* (04.019) to change from its initial value to 100% is given by the following equation:

Time to reach 100.0% = $-\tau 1 \times \ln[(1 - C_1) / (C_0 - C_1)]$

C_0 represents the conditions that have persisted for long enough for the *Motor Protection Accumulator* (04.019) to reach a steady state value. If the motor current and speed are I_0 and w_0 then,

$C_0 = [(1 - K_{fe}) \times (I_0 / (K_1 \times I_{Rated}))^2] + [K_{fe} \times (w_0 / w_{Rated})^{1.6}]$

C_1 represents the conditions that begin at the start of the time being calculated. If the motor current and speed are by I_1 and w_1 then,

$C_1 = [(1 - K_{fe}) \times (I_1 / (K_1 \times I_{Rated}))^2] + [K_{fe} \times (w_1 / w_{Rated})^{1.6}]$

Example 1: The effect of iron losses are not modelled (K_{fe} = 0), *Motor Thermal Time Constant 1* (04.015) = 89s, the initial current is zero, *Rated Current* (05.007) ≤ *Maximum Heavy Duty Rating* (11.032) and the new level of current is 1.5 x *Rated Current* (05.007).

C_0 = 0
C_1 = $[1.5 / (1.05 \times 1.0)]^2$ = 2.041

Time to reach 100.0% = $-89 \times \ln(1 - 1/C_1)$ = $-89 \times \ln(1 - 1/2.041)$ = 60s

This is the default setting for Open-loop and RFC-A modes allowing an induction motor to run at 150% rated current for 60s from cold.

Example 2: The effect of iron losses are not modelled (K_{fe} = 0), *Motor Thermal Time Constant 1* (04.015) = 89s, the initial current is *Rated Current* (05.007), *Rated Current* (05.007) ≤ *Maximum Heavy Duty Rating* (11.032) and the new level of current is 1.5 x *Rated Current* (05.007).

$C0$ = $[1.0 / (1.05 \times 1.0)]^2$ = 0.907
$C1$ = $[1.5 / (1.05 \times 1.0)]^2$ = 2.041

Time to reach 100.0% = $-89 \times \ln((1 - C1) / (C0 - C1))$ = $-89 \times \ln[(1 - 2.041) / (0.907 - 2.041)]$ = 7.6s

This is the default setting for Open-loop and RFC-A modes allowing an induction motor to run at 150% rated current for 7.6s after running under rated conditions for a significant period of time.

Motor Protection Accumulator Reset
The initial value in the *Motor Protection Accumulator* (04.019) at power-up is defined by *Motor Protection Accumulator Power-up Value* (04.036) as given in the table below.

Motor Protection Accumulator Power-up Value (04.036)	*Motor Protection Accumulator* (04.019) at power-up
Power Down	The value is saved at power-down and is used as the initial value at power-up.
Zero	The value is set to zero
Real Time	If a real-time clock is present and if *Date/Time Selector* (06.019) is set up to select the real-time clock then the value saved at power-down is modified to include the effect of the motor thermal protection time constants over the time between power-down and power-up. This modified value is then used as the initial value at power-up. If no real time clock is present then and this option is selected then the value saved at power-down is used as the initial value.

The *Motor Protection Accumulator* (04.019) is reset under the following conditions:

1. *Motor Thermal Time Constant 1* (04.015) is set to 0.0. Note that this is not possible in the standard product as the minimum parameter value is 1.0.
2. *Select Motor 2 Parameters* (11.045) is modified.
3. *Rated Current* (05.007) is modified when *Select Motor 2 Parameters* (11.045) = 0, or *M2 Rated Current* (21.007) is modified when *Select Motor 2 Parameters* (11.045) = 1.
4. *Thermal Protection Mode* (04.016) is modified.

Motor Protection Accumulator Warning
If Percentage Losses > 100% then eventually the *Motor Protection Accumulator* (04.019) will reach 100% causing the drive to trip or the current limits to be reduced. If this is the case and *Motor Protection Accumulator* (04.019) > 75.0% then [Motor Overload] alarm indication is given and *Motor Overload Alarm* (10.017) is set to one.

Parameter	04.016 *Thermal Protection Mode*		
Short description	Set to the require thermal protection mode		
Mode	RFC-S		
Minimum	0	Maximum	4
Default	0	Units	
Type	8 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW, TE		

Value	Text
0	Motor Trip
1	Motor Limit
2	Drive Limit
3	Both Limit
4	Disabled

Thermal Protection Mode (04.016) defines the action taken by the drive when *Motor Protection Accumulator* (04.019) reaches 100% and/or *Percentage Of Drive Thermal Trip Level* (07.036) exceeds 90%. The actions for each mode are given in the table below.

Thermal Protection Mode (04.016)	Actions
Motor Trip (0)	*Motor Too Hot* trip is initiated when *Motor Protection Accumulator* (04.019) reaches 100%. No current limiting. *Motor Protection Accumulator* (04.019) is limited to 100.0%.
Motor Current Limit (1)	*Motor Too Hot* trip is disabled. Current limiting on motor overload as described below. *Motor Protection Accumulator* (04.019) is limited to 100.0%.
Drive Current Limit (2)	*Motor Too Hot* trip is initiated when *Motor Protection Accumulator* (04.019) reaches 100%. Current limiting on drive thermal monitoring as described below. *Motor Protection Accumulator* (04.019) is limited to 100.0%.
Motor and Drive Current Limit (3)	*Motor Too Hot* trip is disabled. Current limiting on motor overload and drive thermal monitoring as described below. *Motor Protection Accumulator* (04.019) is limited to 100.0%.
Disabled (4)	*Motor Too Hot* trip is disabled and *Motor Overload* alarm is disabled. No current limiting. *Motor Protection Accumulator* (04.019) is limited to 200.0%.

The current limit is derived from the current limit parameters (i.e. *Motoring Current Limit* (04.005), etc.) depending on the set-up and conditions. The current limit can be further limited by current limit on motor overload and/or drive temperature monitoring as shown below to give the *Final Current Limit* (04.018).

Current limit modification
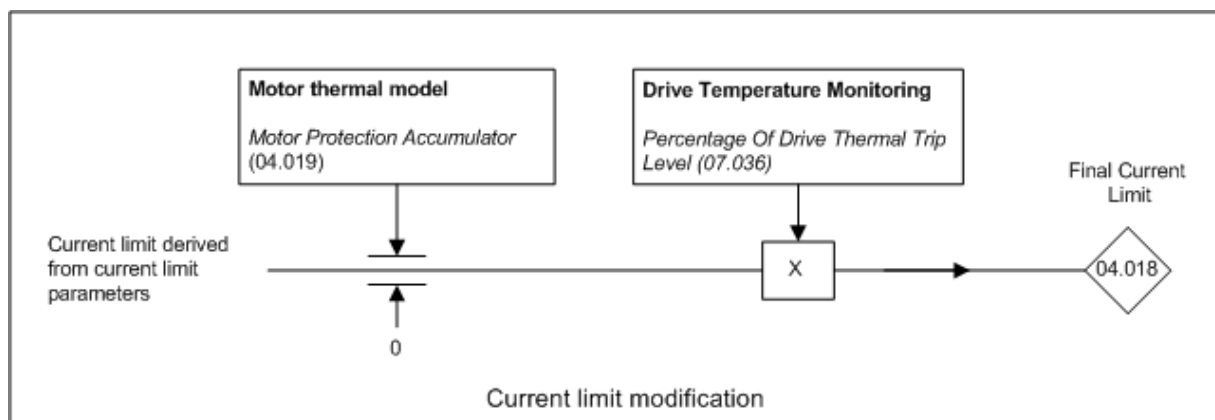
Current limiting on motor overload
When the *Motor Protection Accumulator* (04.019) reaches 100.0% the current limit is limited to $(K_1 - 0.05)$ x 100.0%. This limitation is removed when the *Motor Protection Accumulator* (04.019) falls below 95.0%. (K_1 is defined in the description of *Motor Thermal Time Constant 1* (04.015).)

Drive thermal monitoring current limiting
If *Percentage Of Drive Thermal Trip Level* (07.036) exceeds 90% the current limit is modified as follows:

Final Current Limit (04.018) = Current limit x (100% - *Percentage Of Drive Thermal Trip Level* (07.036)) / 10%

If both of the above attempt to reduce the final current limit the lowest calculated value of current limit is used.

This system has the effect of reducing the current limit to zero at the point where the drive should be tripped because its thermal monitoring has reached a trip threshold. This is intended to limit the load on the drive to prevent it from tripping when supplying a load that increases with speed and does not include rapid transients.

Parameter	04.017 *Id*		
Short description	Shows the instantaneous level of d axis current		
Mode	RFC-S		
Minimum	−VM_DRIVE_CURRENT	Maximum	VM_DRIVE_CURRENT
Default		Units	A
Type	32 Bit Volatile	Update Rate	250us Write
Display Format	Standard	Decimal Places	3
Coding	RO, FI, VM, ND, NC, PT		

Id, Magnetising Current (04.017) is the instantaneous level of d axis current scaled so that it represents the r.m.s. level of d axis current under steady state conditions.

Parameter	04.018 *Final Current Limit*		
Short description	Shows the final current limit that is applied to the torque producing current		
Mode	RFC-S		
Minimum	−VM_TORQUE_CURRENT	Maximum	VM_TORQUE_CURRENT
Default		Units	%
Type	16 Bit Volatile	Update Rate	4ms write
Display Format	Standard	Decimal Places	1
Coding	RO, VM, ND, NC, PT		

Final Current Limit (04.018) is the current limit level that is applied to give the *Final Current Reference* (04.004).

Parameter	04.019 *Motor Protection Accumulator*		
Short description	Shows the level of the motor protection accumulator		
Mode	RFC‑S		
Minimum	0.0	Maximum	200.0
Default		Units	%
Type	16 Bit Power Down Save	Update Rate	Background write
Display Format	Standard	Decimal Places	1
Coding	RO, ND, NC, PT		

See *Motor Thermal Time Constant 1* (04.015).

Parameter	04.020 *Percentage Load*		
Short description	Shows the level of Iq as a percentage of rated Iq for the motor		
Mode	RFC‑S		
Minimum	−VM_USER_CURRENT	Maximum	VM_USER_CURRENT
Default		Units	%
Type	16 Bit Volatile	Update Rate	Background write
Display Format	Standard	Decimal Places	1
Coding	RO, FI, VM, ND, NC, PT		

Percentage Load (04.020) gives the *Iq, Torque Producing Current* (04.002) as a percentage of the rated Iq for the motor. Positive values indicate motoring and negative values represent regenerating. It should be noted that if *Active Saliency Torque Mode* (05.066) = 1 indicating that the high saliency motor control system is being used in RFC-S mode that compensation is provided to give a linear relationship between the torque reference and the actual motor torque. This has the effect of making *Percentage Load* (04.020) higher than the torque reference between zero and rated torque reference.

Parameter	04.021 *Current Feedback Filter Disable*		
Short description	Disables the 4ms filter applied to current feedback parameters		
Mode	RFC‑S		
Minimum	0	Maximum	1
Default	0	Units	
Type	1 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW		

If *Current Feedback Filter Disable* (04.021) = 0 a 4ms filter is applied to the current feedback components measured by the drive to be used in *Iq, Torque Producing Current* (04.002) and *Id, Magnetising Current* (04.017). This filter removes ripple components associated with the PWM switching. If *Current Feedback Filter Disable* (04.021) = 1, the filter is disabled and the user parameters are based on the current components sampled every 250us.

Parameter	04.022 *Inertia Compensation Enable*		
Short description	Set to enable inertia compensation		
Mode	RFC‑S		
Minimum	0	Maximum	1
Default	0	Units	
Type	1 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW		

If *Inertia Compensation Enable* (04.022) is set to one the *Inertia Compensation Torque* (02.038) is added to the output of the speed controller. The *Inertia Compensation Torque* (02.038) is calculated based on a value of load inertia supplied by the user (*Motor And Load Inertia* (03.018)) and the rate of change of the speed reference. This can be used in speed or torque controller applications to provide the torque necessary to accelerate or decelerate the load.

Parameter	04.023 *Current Reference Filter 2 Time Constant*		
Short description	Defines the time constant of an alternative first order filter that can be applied to the final current reference		
Mode	RFC‑S		
Minimum	0.0	Maximum	25.0
Default	0.0	Units	ms
Type	8 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	1
Coding	RW, BU		

See *Current Reference Filter 1 Time Constant* (04.012).

Parameter	04.024 *User Current Maximum Scaling*		
Short description	Defines the maximum for the torque reference and percentage load parameters		
Mode	RFC‑S		
Minimum	−VM_TORQUE_CURRENT_UNIPOLAR	Maximum	VM_TORQUE_CURRENT_UNIPOLAR
Default	175.0	Units	%
Type	16 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	1
Coding	RW, VM, RA		

User Current Maximum Scaling (04.024) defines the variable maximum/minimums VM_USER_CURRENT and VM_USER_CURRENT_HIGH_RES which are

applied to *Percentage Load* (04.020), *Torque Reference* (04.008) and *Torque Offset* (04.009). This is useful when routing these parameters to an analog output as it allows the full scale output value to be defined by the user.

The maximum value (VM_TORQUE_CURRENT_UNIPOLAR [MAX]) varies between drive sizes with default parameters loaded. For some drive sizes the default value may be reduced below the value given by the parameter range limiting.

Parameter	04.025 *Low Speed Thermal Protection Mode*		
Short description	Set to enable low speed thermal protection mode		
Mode	RFC‑S		
Minimum	0	Maximum	1
Default	0	Units	
Type	8 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW		

See *Motor Thermal Time Constant 1* (04.015).

Parameter	04.026 *Percentage Torque*		
Short description	Shows the calculated torque as a percentage of rated torque		
Mode	RFC‑S		
Minimum	−VM_USER_CURRENT	Maximum	VM_USER_CURRENT
Default		Units	%
Type	16 Bit Volatile	Update Rate	4ms write
Display Format	Standard	Decimal Places	1
Coding	RO, FI, VM, ND, NC, PT		

The shaft torque of the motor is estimated by the drive and *Percentage Torque* (04.026) gives this torque as a percentage of the expected torque defined by *Rated Torque* (04.041). The default value for *Rated Torque* (04.041) is zero which disables this feature so that *Percentage Torque* (04.026) is always zero. To enable the torque estimation system *Rated Torque* (04.041) should be set to the expected torque from the motor under rated conditions. For accurate torque estimation, and consistent results for both motoring and regenerating conditions, it is necessary to provide the drive with the core losses under no-load and rated load conditions at rated speed (i.e. *No-load Core Loss* (04.045) and *Rated Core Loss* (04.046) respectively). The drive will then include the core power loss in the torque calculation as

PCoreLoss = *No-load Core Loss* (04.045) + (*Rated Core Loss* (04.046) - *No-load Core Loss* (04.045)) x (Torque Producing Current / Rated Torque Producing Current)

If *Rated Core Loss* (04.046) ≤ *No-load Core Loss* (04.045) then only the no load value is used and PCoreLoss = *No-load Core Loss* (04.045). This provides some compensation for core losses, but not the load dependent component. The core loss power values can be difficult to obtain except by experimental measurement because the loss mechanisms within the motor are complex and are affected by the PWM frequencies applied to the motor by the drive. It is possible to obtain an estimate for *No-load Core Loss* (04.045) during auto-tuning for RFC-A mode, but not RFC-S mode. As the auto-tuning algorithm cannot measure *Rated Core Loss* (04.046) this is set to zero, so that it is not used. If power dependent core losses are to be included *Rated Core Loss* (04.046) must be set by the user.

Parameter	04.027 *Low Load Detection Level*		
Short description	Defines the low load detection level		
Mode	RFC‑S		
Minimum	0.0	Maximum	100.0
Default	0.0	Units	%
Type	16 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	1
Coding	RW		

If *Low Load Detection Level* (04.027) is set to 0.0 the low load detection system is disabled, otherwise the low load detection system is enabled. The low load detection system is provided so that loss of load can be detected and action taken. So that the detector can be used with fan and pump type loads, where the load is relatively light at low motor speed, the detector is only active when the output frequency or speed is above the level defined by *Low Load Detection Speed/Frequency Threshold* (04.028). The detector is also only enabled when the motor is at the required speed (i.e. not accelerating or decelerating), and so it is only active when *At Speed* (10.006) = 1. Once the detector is active, the low load condition is detected when the *Percentage Load* (04.020) falls below the threshold defined by *Low Load Detection Level* (04.027). Therefore the condition for detecting low load is given by,

At Speed (10.006) = 1 AND |*Speed Feedback* (03.002)| > *Low Load Detection Speed/Frequency Threshold* (04.028) AND *Percentage Load* (04.020) *Low Load Detection Level* (04.027)

The diagram below shows a typical fan type load and the shaded areas define where low load is detected.
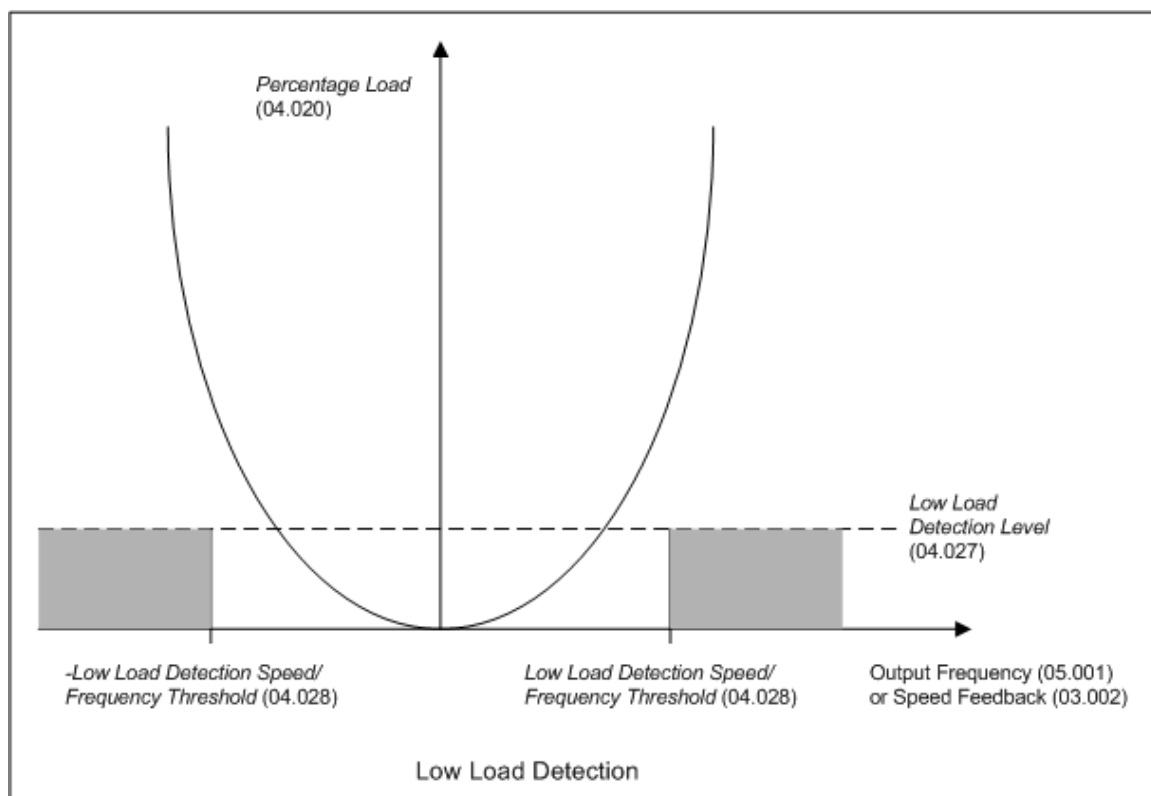
Low Load Detection

Enable Trip On Low Load (04.029) defines the action taken when low load is detected. If *Enable Trip On Low Load* (04.029) = 0 a Low Load warning is displayed and *Low Load Detected Alarm* (10.062) is set to one. If *Enable Trip On Low Load* (04.029) = 1 no warning is given, but a *Low Load* trip is initiated.

Parameter	04.028 *Low Load Detection Speed/Frequency Threshold*		
Short description	Defines the low load detection speed/frequency threshold		
Mode	RFC‑S		
Minimum	−VM_SPEED_FREQ_REF_UNIPOLAR	Maximum	VM_SPEED_FREQ_REF_UNIPOLAR
Default	0.0	Units	
Type	32 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	1
Coding	RW, VM		

See *Low Load Detection Level* (04.027).

Parameter	04.029 *Enable Trip On Low Load*		
Short description	Defines the action taken when low load is detected		
Mode	RFC‑S		
Minimum	0	Maximum	1
Default	0	Units	
Type	1 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW		

See *Low Load Detection Level* (04.027).

Parameter	04.030 *Current Controller Mode*		
Short description	Set to enable high performance current controller mode		
Mode	RFC‑S		
Minimum	0	Maximum	1
Default	0	Units	
Type	1 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW		

See *Current Controller Kp Gain* (04.013).

Parameter	04.031 *Notch Filter Centre Frequency*		
Short description	Defines the centre frequency for a notch filter to cancel a mechanical resonance		
Mode	RFC-S		
Minimum	50	Maximum	1200
Default	100	Units	Hz
Type	16 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW		

A notch filter can be inserted be applied to the *Final Current Reference* (04.004) to remove the effect of a mechanical resonance in the system. *Notch Filter Centre Frequency* (04.031) defines the centre frequency (f_0) in Hertz and *Notch Filter Bandwidth* (04.032) defines the bandwidth (f_{BW}) which is the frequency difference between the 3dB points of the notch filter in Hertz. The Q of the filter is given by $Q = f_0 / f_{BW}$. If *Notch Filter Bandwidth* (04.032) is at its default value of zero then the notch filter is disabled. It should be noted that although it is possible to set a bandwidth that is higher than half the centre frequency, the bandwidth of the filter is limited to half the centre frequency.

Parameter	04.032 *Notch Filter Bandwidth*		
Short description	Defines the bandwidth for a notch filter to cancel mechanical resonance		
Mode	RFC-S		
Minimum	0	Maximum	500
Default	0	Units	Hz
Type	16 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW		

See *Notch Filter Centre Frequency* (04.031).

Parameter	04.033 *Inertia Times 1000*		
Short description	Inertia is in 1000kgm2 units		
Mode	RFC-S		
Minimum	0	Maximum	1
Default	0	Units	
Type	1 Bit User Save	Update Rate	Background Read
Display Format	Standard	Decimal Places	0
Coding	RW		

The inertia in *Motor And Load Inertia* (03.018) is in kgm^2 if this parameter is zero, otherwise if it is one the inertia is in $1000kgm^2$ units.

Parameter	04.036 *Motor Protection Accumulator Power-up Value*		
Short description	Defines the initial power-up value of the motor protection accumulator		
Mode	RFC-S		
Minimum	0	Maximum	2
Default	0	Units	
Type	8 Bit User Save	Update Rate	Background write
Display Format	Standard	Decimal Places	0
Coding	RW, TE		

Value	*Text*
0	Power down
1	Zero
2	Real time

See *Motor Thermal Time Constant 1* (04.015).

Parameter	04.037 *Motor Thermal Time Constant 2*		
Short description	Can be used to define an additional motor thermal time constant		
Mode	RFC-S		
Minimum	1.0	Maximum	3000.0
Default	89.0	Units	s
Type	16 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	1
Coding	RW		

See *Motor Thermal Time Constant 1* (04.015).

Parameter	04.038 *Motor Thermal Time Constant 2 Scaling*		
Short description	Defines the ratio of the contribution to the motor protection accumulator value from each of the time constants		
Mode	RFC-S		
Minimum	0	Maximum	100
Default	0	Units	%
Type	8 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW		

See *Motor Thermal Time Constant 1* (04.015).

Parameter	04.039 *Rated Iron Losses As Percentage Of Losses*		
Short description	Set to the rated iron losses of the motor as a percentage of the total losses for the motor		
Mode	RFC-S		
Minimum	0	Maximum	100
Default	0	Units	%
Type	8 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW		

See *Motor Thermal Time Constant 1* (04.015).

Parameter	04.041 *Rated Torque*		
Short description	Rated torque used by the torque correction system		
Mode	RFC-S		
Minimum	0.00	Maximum	50000.00
Default	0.00	Units	Nm
Type	32 Bit User Save	Update Rate	Background Read
Display Format	Standard	Decimal Places	2
Coding	RW		

The estimated torque (*Percentage Torque* (04.026)) is given as a percentage of *Rated Torque* (04.041). If *Rated Torque* (04.041) is left at the default value of zero then *Percentage Torque* (04.026) will remain at zero under all conditions.

Parameter	04.042 *Torque Estimation Minimum Frequency*		
Short description	Minimum frequency used by the torque correction system		
Mode	RFC-S		
Minimum	0	Maximum	100
Default	5	Units	%
Type	8 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW		

The drive estimates the motor shaft torque (*Percentage Torque* (04.026)), but at low output frequencies this estimate is very inaccurate.
Torque Estimation Minimum Frequency (04.042) defines the point where the estimate of torque is too inaccurate to use as a percentage of *Rated Frequency* (05.006), i.e. $F_{Threshold}$ = *Rated Frequency* (05.006) x *Torque Estimation Minimum Frequency* (04.042) / 100.

Condition	*Percentage Torque* (04.026)
|*Output Frequency* (05.001)| < $F_{Threshold}$	Torque reference with no core loses
$F_{Threshold}$ < | *Output Frequency* (05.001) | < 2$F_{Threshold}$	Changes linearly between torque reference with no core losses and calculated torque including core losses
|*Output Frequency* (05.001)| > 2$F_{Threshold}$	Calculated torque including core losses

Parameter	04.043 *Torque Correction Time Constant*		
Short description	Time constant used by the torque correction system		
Mode	RFC-S		
Minimum	0.00	Maximum	10.00
Default	0.00	Units	s
Type	16 Bit User Save	Update Rate	Background Read
Display Format	Standard	Decimal Places	2
Coding	RW		

The torque correction system uses the *Final Torque Reference* (04.003) and the *Percentage Torque* (04.026) to calculate the error between the required and actual torque. This error is used by the torque correction system to apply a trim to the torque reference being used by the drive. If *Torque Correction Time Constant* (04.043) is set to a non-zero value this system is enabled and *Torque Correction Time Constant* (04.043) defines the time constant of the correction system. The maximum positive or negative trim that can be applied is defined by *Torque Correction Maximum* (04.044).

Parameter	04.044 *Torque Correction Maximum*		
Short description	Maximum trim that can be applied to the torque reference to correct the torque.		
Mode	RFC-S		
Minimum	0	Maximum	100
Default	20	Units	%
Type	8 Bit User Save	Update Rate	Background Read
Display Format	Standard	Decimal Places	0
Coding	RW		

See *Torque Correction Time Constant* (04.043).

Parameter	04.045 *No-load Core Loss*		
Short description	Defines the no-load core loss for the motor used by the torque correction system		
Mode	RFC-S		
Minimum	0.000	Maximum	99999.999
Default	0.000	Units	kW
Type	32 Bit User Save	Update Rate	Background Read
Display Format	Standard	Decimal Places	3
Coding	RW		

See *Percentage Torque* (04.026).

Parameter	04.046 *Rated Core Loss*		
Short description	Defines the rated core loss for the motor used by the torque correction system		
Mode	RFC-S		
Minimum	0.000	Maximum	99999.999
Default	0.000	Units	kW
Type	32 Bit User Save	Update Rate	Background Read
Display Format	Standard	Decimal Places	3
Coding	RW		

See *Percentage Torque* (04.026).

Parameter	04.049 *Magnetising Current Limit*		
Short description	Magnetising Current Limit		
Mode	RFC-S		
Minimum	0.0	Maximum	100.0
Default	100.0	Units	%
Type	16 Bit User Save	Update Rate	Background
Display Format	Standard	Decimal Places	1
Coding	RW		

Magnetising Current Limit (04.049) defines the maximum level of magnetising current used as a percentage of *Rated Current* (05.007). The magnetising current is normally at the rated level for the motor, but may increase up to this limit when the drive is enabled to raise the flux in the motor as fast as possible. The magnetising current can also be increased above the rated level when the motor is decelerated rapidly from the flux weakening range. The default value for *Magnetising Current Limit* (04.049) is normally suitable, but may be decreased if required. The maximum level of magnetising current will not be decreased below the rated level for the motor how ever low the value in *Magnetising Current Limit* (04.049). This parameter is not used in RFC-S mode.

Menu 5 Single Line Descriptions − *Motor Control*

Mode: RFC‑S

Parameter	Range	Default	Type
05.001 Output Frequency	±2000.0 Hz		RO Num ND NC PT FI
05.002 Output Voltage	±VM_AC_VOLTAGE V		RO Num ND NC PT FI
05.003 Output Power	±VM_POWER kW		RO Num ND NC PT FI
05.005 D.c. Bus Voltage	±VM_DC_VOLTAGE V		RO Num ND NC PT FI
05.007 Rated Current	±VM_RATED_CURRENT A	0.000 A	RW Num RA US
05.008 Rated Speed	0.00 to 33000.00 rpm	3000.00 rpm	RW Num US
05.009 Rated Voltage	±VM_AC_VOLTAGE_SET V	200V drive: 230 V 400V drive 50Hz: 400 V 400V drive 60Hz: 460 V 575V drive: 575 V 690V drive: 690 V	RW Num RA US
05.011 Number Of Motor Poles	Automatic (0) to 480 (240) Poles	6 (3) Poles	RW Txt US
05.012 Auto-tune	None (0), Stationary (1), Rotating (2), Inertia 1 (3), Inertia 2 (4), Full Stationary (5)	None (0)	RW Txt NC
05.013 Minimal Movement Phasing Test Mode	Free (0), Constrained (1)	Free (0)	RW Txt US
05.014 Phasing Test On Enable	Disabled (0), Short (1), Short Once (2), Long (3), Long Once (4)	Disabled (0)	RW Txt US
05.015 Minimal Movement Phasing Test Current	1% (0), 2% (1), 3% (2), 6% (3), 12% (4), 25% (5), 50% (6), 100% (7)	1% (0)	RW Txt US
05.016 Minimal Movement Phasing Test Angle	0.00 to 25.00 °	0.00 °	RW Num US
05.017 Stator Resistance	0.000000 to 1000.000000 Ω	0.000000 Ω	RW Num RA US
05.018 Maximum Switching Frequency	0 to VM_SWITCHING_FREQUENCY kHz	6 (3) kHz	RW Txt RA US
05.019 Minimal Movement Phasing Test Mechanical Load Phase	-180 to 179 °	-180 °	RW Num US
05.021 Mechanical Load Test Level	0 to 100 %	0 %	RW Num US
05.022 Enable High Speed Mode	Limit (-2), Limit (Servo) (-1), Disable (0), Enable (Servo) (1), Enable (2)	Disable (0)	RW Txt US
05.023 D.c. Bus Voltage High Range	±VM_HIGH_DC_VOLTAGE V		RO Num ND NC PT FI
05.024 Ld	0.000 to 500.000 mH	0.000 mH	RW Num RA US
05.026 High Dynamic Performance Enable	Off (0) or On (1)	Off (0)	RW Bit US
05.027 Flux Control Gain	0.1 to 10.0	1.0	RW Num US
05.028 Torque Linearisation Disable	Off (0) or On (1)	On (1)	RW Bit US
05.031 Voltage Controller Gain	1 to 30	1	RW Num US
05.032 Torque Per Amp	0.00 to 500.00 Nm/A	1.60 Nm/A	RW Num US
05.033 Volts Per 1000rpm	0 to 10000 V	98 V	RW Num US
05.035 Auto-switching Frequency Change	Enabled (0), Disabled (1), No Ripple Detect (2)	Enabled (0)	RW Txt US
05.036 Auto-switching Frequency Step Size	1 to 2	2	RW Num US
05.037 Switching Frequency	2 (0), 3 (1), 4 (2), 6 (3), 8 (4), 12 (5), 16 (6) kHz		RO Txt ND NC PT
05.038 Minimum Switching Frequency	0 to VM_MIN_SWITCHING_FREQUENCY kHz	2 (0) kHz	RW Txt US
05.039 Maximum Inverter Temperature Ripple	20 to 60 °C	60 °C	RW Num US
05.041 Voltage Headroom	0 to 20 %	0 %	RW Num US
05.042 Reverse Output Phase Sequence	Off (0) or On (1)	Off (0)	RW Bit US
05.044 Stator Temperature Source	An In 3 (0), User (1), P1 Drive (2), P1 Slot1 (3), P1 Slot2 (4), P1 Slot3 (5), P1 Slot4 (6)	An In 3 (0)	RW Txt US
05.045 User Stator Temperature	-50 to 300 °C	0 °C	RW Num US
05.046 Stator Temperature	-50 to 300 °C		RO Num ND NC PT
05.047 Stator Temperature Coefficient	0.00000 to 0.10000 1/°C	0.00390 1/°C	RW Num US
05.048 Stator Base Temperature	-50 to 300 °C	0 °C	RW Num US
05.049 Enable Stator Compensation	Off (0) or On (1)	Off (0)	RW Bit US
05.050 Temperature Compensated Stator Resistance	0.000000 to 1000.000000		RO Num ND NC PT
05.051 Rotor Temperature Source	An In 3 (0), User (1), P1 Drive (2), P1 Slot1 (3), P1 Slot2 (4), P1 Slot3 (5), P1 Slot4 (6)	An In 3 (0)	RW Txt US
05.052 User Rotor Temperature	-50 to 300 °C	0 °C	RW Num US
05.053 Rotor Temperature	-50 to 300 °C		RO Num ND NC PT
05.054 Rotor Temperature Coefficient	0.00000 to 0.10000 1/°C	0.00100 1/°C	RW Num US
05.055 Rotor Base Temperature	-50 to 300 °C	0 °C	RW Num US
05.056 Enable Rotor Compensation	Off (0) or On (1)	Off (0)	RW Bit US
05.057 Rotor Temperature Compensation	0.000 to 2.000		RO Num ND NC PT
05.059 Maximum Deadtime Compensation	0.000 to 10.000 µs	0.000 µs	RO Num NC PT US
05.060 Current At Maximum Deadtime Compensation	0.00 to 100.00 %	0.00 %	RO Num NC PT US
05.061 Disable Deadtime Compensation	Off (0) or On (1)	Off (0)	RW Bit US
05.063 Sensorless Mode Current Ramp	0.00 to 1.00 s	0.20 s	RW Num US
05.064 RFC Low Speed Mode	Injection (0), Non-salient (1), Current (2), Current No Test (3), Current Step (4), Current Only (5)	Current (2)	RW Txt US
05.065 Saliency Torque Control Select	Disabled (0), Low (1), High (2), Auto (3)	Disabled (0)	RW Txt US
05.066 Active Saliency Torque Mode	Disabled (0), Low (1), High (2)		RO Txt ND NC PT
05.067 Over-current Trip Level as Percentage Kc	0 to 100 %	0 %	RW Num US
05.068 Actual Over-current Trip Level	0 to 500 %		RO Num ND NC PT
05.069 Over-current Trip Level as Percentage of Rated Current	0 to 1000 %	0 %	RW Num US
05.070 Inverted Saturation Characteristic	Off (0) or On (1)	Off (0)	RW Bit US
05.071 Low Speed Sensorless Mode Current	0.0 to 1000.0 %	100.0 %	RW Num RA US
05.072 No-load Lq	0.000 to 500.000 mH	0.000 mH	RW Num RA US

05.075	q Axis Current For Inductance Values With Current	0 to 200 %	100 %	RW	Num			US
05.077	Phase Offset At Defined Iq Current	±90.0 °	0.0 °	RW	Num	RA		US
05.078	Lq At The Defined Iq Current	0.000 to 500.000 mH	0.000 mH	RW	Num	RA		US
05.079	Lq Incremental Inductance At Defined Iq Current	0.000 to 500.000 mH	0.000 mH	RW	Num	RA		US
05.082	d Axis Current For Inductance Values With Current	-100 to 0 %	-100 %	RW	Num			US
05.084	Lq At The Defined Id Current	0.000 to 500.000 mH	0.000 mH	RW	Num	RA		US
05.085	Lq Incremental Inductance At Defined Id Current	0.000 to 500.000 mH	0.000 mH	RW	Num	RA		US
05.087	User Defined Rated Torque Angle	0 to 90 °	0 °	RW	Num			US
05.088	Estimated Lq	0.000 to 500.000 mH		RO	Num	ND NC PT		FI
05.089	Rated Torque Angle	0 to 90 °		RO	Num	ND NC PT		

RW	Read / Write	RO	Read-only	Bit	Bit parameter	Txt	Text string	Date	Date parameter	Time	Time parameter
Chr	Character parameter	Bin	Binary parameter	IP	IP address	Mac	MAC address	Ver	Version number	SMP	Slot, menu, parameter
Num	Number parameter	DE	Destination	ND	No default value	RA	Rating dependent	NC	Non-copyable	PT	Protected
FI	Filtered	US	User save	PS	Power-down save						

Menu 5 − *Motor Control*

Mode: RFC‑S

RFC-A and RFC-S modes
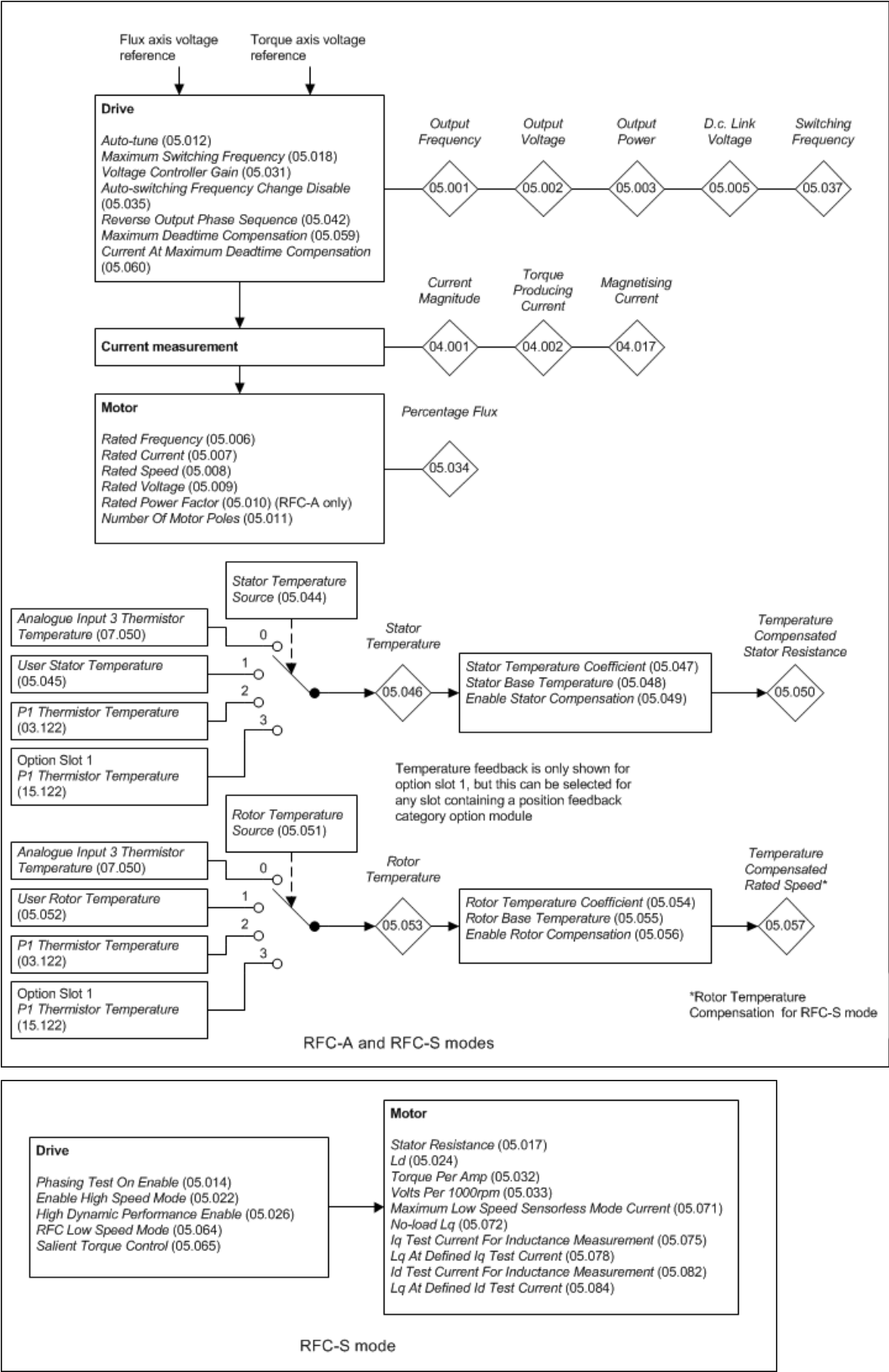
RFC-S mode

Parameter	05.001 *Output Frequency*		
Short description	Displays the frequency applied to the motor		
Mode	RFC‑S		
Minimum	-2000.0	Maximum	2000.0
Default		Units	Hz
Type	32 Bit Volatile	Update Rate	4ms write
Display Format	Standard	Decimal Places	1
Coding	RO, FI, ND, NC, PT		

The output frequency is not controlled directly, but the *Output Frequency* (05.001) is a measurement of the frequency applied to the motor.

Parameter	05.002 *Output Voltage*		
Short description	Displays the r.m.s. line to line voltage at the a.c. terminals of the drive		
Mode	RFC‑S		
Minimum	−VM_AC_VOLTAGE	Maximum	VM_AC_VOLTAGE
Default		Units	V
Type	16 Bit Volatile	Update Rate	4ms write
Display Format	Standard	Decimal Places	0
Coding	RO, FI, VM, ND, NC, PT		

The *Output Voltage* (05.002) is the r.m.s. line to line voltage at the a.c. terminals of the drive.

Parameter	05.003 *Output Power*		
Short description	Displays the power flowing via the a.c. terminals of the drive		
Mode	RFC‑S		
Minimum	−VM_POWER	Maximum	VM_POWER
Default		Units	kW
Type	32 Bit Volatile	Update Rate	4ms write
Display Format	Standard	Decimal Places	3
Coding	RO, FI, VM, ND, NC, PT		

The *Output Power* (05.003) is the power flowing via the a.c. terminals of the drive. The power is derived as the dot product of the output voltage and current vectors, and so this is correct even if the motor parameters are incorrect and the motor model does not align the reference frame with the flux axis of a motor in RFC-A mode. For Open-loop, RFC-A and RFC-S modes a positive value of power indicates power flowing from the drive to motor. For Regen mode a positive value of power indicates power flowing from the supply to the regen drive.

Parameter	05.005 *D.c. Bus Voltage*		
Short description	Displays the voltage across the d.c. link of the drive		
Mode	RFC‑S		
Minimum	−VM_DC_VOLTAGE	Maximum	VM_DC_VOLTAGE
Default		Units	V
Type	16 Bit Volatile	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RO, FI, VM, ND, NC, PT		

D.c. Bus Voltage (05.005) gives the voltage across the d.c. link of the drive.

Parameter	05.007 *Rated Current*		
Short description	Set to the rated current rated of the motor		
Mode	RFC‑S		
Minimum	−VM_RATED_CURRENT	Maximum	VM_RATED_CURRENT
Default	0.000	Units	A
Type	32 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	3
Coding	RW, VM, RA		

Rated Current (05.007) is used as follows:

Function	Details
Motor thermal protection	Defines the motor rated current.
Motor pre-heat	Motor pre-heat is set up as a percentage of rated current.
Sensorless low speed mode	The current for low speed sensorless is set-up as a percentage of rated current.
Current limits	Curent limits are set up as a percentage of rated torque producing current.

Parameter	05.008 *Rated Speed*		
Short description	Set to the rated speed of the motor		
Mode	RFC‑S		
Minimum	0.00	Maximum	33000.00
Default	3000.00	Units	rpm
Type	32 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	2
Coding	RW		

Rated Speed (05.008) is used in conjunction with *Number Of Motor Poles* (05.011) to define the rated frequency and this is used as described in the table below.

Function	Details
Sensorless control thresholds	The thresholds for changes from low speed starting mode to high speed normal operation and vice versa.
Flux controller gain	Rated frequency is to define the gain of the flux controller.

The units for *Rated Speed* (05.008) are always rpm even if a linear motor is used and *Linear Speed Select* (01.055) = 1.

Parameter	05.009 *Rated Voltage*		
Short description	Set to the rated voltage of the motor		
Mode	RFC-S		
Minimum	−VM_AC_VOLTAGE_SET	Maximum	VM_AC_VOLTAGE_SET
Default	See exceptions below	Units	V
Type	16 Bit User Save	Update Rate	4ms read
Display Format	Standard	Decimal Places	0
Coding	RW, VM, RA		

Voltage	Region	Default Value
200V	All	230
400V	50Hz	400
400V	60Hz	460
575V	All	575
690V	All	690

The *Rated Voltage* (05.009) is the maximum continuous voltage that is applied to the motor. Some headroom must be allowed if high performance is required at higher speeds. It should be noted that this limit is not applied unless *Enable High Speed Mode* (05.022) is set to 1.

Rated Voltage (05.009) is used as described in the table below.

Function	Details
Maximum motor voltage	Unless the motor voltage is limited by the maximum output voltage of the inverter the rated voltage value is used as the reference for the flux controller to limit the motor voltage.

Parameter	05.011 *Number Of Motor Poles*		
Short description	Set to the number of poles of the motor		
Mode	RFC-S		
Minimum	0	Maximum	240
Default	3	Units	PolePairs
Type	8 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW, BU		

* The units relate to the numeric value of the parameter and not the text string.

The numeric value in *Number Of Motor Poles* (05.011) should be set to the number of motor pole pairs (i.e. number of motor poles / 2). The text strings associated with *Number Of Motor Poles* (05.011) show the number of motor poles (i.e. the parameter value x 2). If a linear position feedback device is used *Number Of Motor Poles* (05.011) should be set to 1 (2 Poles).

If *Number Of Motor Poles* (05.011) = 0 the number of motor poles = 3 (6 Poles).

Parameter	05.012 *Auto-tune*		
Short description	Defines the auto-tune test to be performed		
Mode	RFC-S		
Minimum	0	Maximum	5
Default	0	Units	
Type	8 Bit Volatile	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW, TE, NC		

Value	Text
0	None
1	Stationary
2	Rotating
3	Inertia 1
4	Inertia 2
5	Full Stationary

The following describes how an auto-tune test can be initiated and normal operation can be resumed after the test for RFC-S mode:

An auto-tune test cannot be initiated if the drive is tripped or the drive inverter is active, i.e. *Drive Healthy* (10.001) = 0 or *Drive Active* (10.002) = 1. The inverter can be made inactive by ensuring that the Final drive enable is inactive, or the Final drive run is inactive and *Hold Zero Speed* (06.008) = 0.

1. An auto-tune test is initiated by setting *Auto-tune* (05.012) to a non-zero value and making the Final drive enable and the Final drive run active.
2. All tests that move the motor will move the motor in the forward direction if *Reverse Select* (01.012) = 0 or the reverse direction if *Reverse Select* (01.012) = 1.
3. If the auto-tune sequence is completed successfully the Final drive enable is set to the inactive state and *Auto-tune* (05.012) is set to zero. The Final drive enable can only be set to the active state again by removing the enable and re-applying it. The enable can be removed by setting *Drive Enable* (06.015) = 0, or by setting bit 0 of the *Control Word* (06.042) to 0 provided *Control Word Enable* (06.043) = 1, or by making *Hardware Enable* (06.029) = 0.
4. If a trip occurs during the auto-tune sequence the drive will go into the trip state and *Auto-tune* (05.012) is set to zero. As in 4 above the enable must be removed and re-applied before the drive can be restarted after the trip has been reset. However, care should be taken because if the auto-tune was not completed the drive parameters that should have been measured and set up will still have their original values.
5. If the Final drive enable is made active, the Final drive run is inactive and *Hold Zero Speed* (06.008) = 1 the drive would normally be in the Stop state (i.e. the inverter is active, but the frequency or speed reference is 0).

The following describes the effects of the auto-tune test on the drive parameters for RFC-S mode:

1. All auto-tune tests rely on the motor being stationary when the test is initiated to give accurate results.
2. If *Select Motor 2 Parameters* (11.045) = 0 then the parameters associated with motor map 1 are updated as a result of the test, and if *Select Motor 2 Parameters* (11.045) = 1 the parameters associated with motor map 2 are updated.
3. When each stage of the test is completed, the results are written to the appropriate parameters and these parameters saved in the drive non-volatile memory. If *Parameter Cloning* (11.042) is set to 3 or 4 the parameters are also written to a non-volatile media card fitted in the drive.

The table below shows the parameters required for motor control indicating which should be set by the user and which can be measured with an auto-tune test.

Parameter	Required for	Measured in test
Rated Current (05.007)	Basic control	User set-up
Rated Speed (05.008)	Basic control	User set-up
Rated Voltage (05.009)	Basic control	User set-up
Number Of Motor Poles (05.011)	Basic control	User set-up
Stator Resistance (05.017)	Basic control	1, 2, 5
Ld (05.024)	Basic control	1, 2, 5
Maximum Deadtime Compensation (05.059)	Basic control	1, 2, 5
Current At Maximum Deadtime Compensation (05.060)	Basic control	1, 2, 5
Current Controller Kp Gain (04.013)	Basic control	1, 2, 5
Current Controller Ki Gain (04.014)	Basic control	1, 2, 5
Volts Per 1000rpm (05.033)	Basic control	Not currently measured
Inverted Saturation Characteristic (05.070)	Sensorless control using current injection mode	Not currently measured
Phase Offset At Defined Iq Current (05.077)	Sensorless control using current injection mode	Not currently measured
Low Speed Sensorless Mode Current (05.071)	Sensorless control using current injection mode	Not currently measured
No-load Lq (05.072)	Sensorless control and high preformance current control	1, 2, 5
Lq At The Defined Iq Current (05.078)	Sensorless control	Not currently measured
Lq At The Defined Id Current (05.084)	Sensorless control	Not currently measured
Motor And Load Inertia (03.018)	Speed controller set-up and torque feed-forwards	3, 4
Inertia Times 1000 (04.033)	Speed controller set-up and torque feed-forwards	3, 4
Torque Per Amp (05.032)	Speed controller set-up and torque feed-forwards	Not currently measured
Position Feedback Phase Angle (03.025)	Basic control with position feedback	1, 2, 5

1: Stationary
This test can be used to measure all the necessary parameters for basic control.

1. A test is performed to locate the flux axis of the motor. If *Minimal Movement Phasing Test Angle* (05.016) = 0 then motor inductance measurement is used and the motor should not move, otherwise a minimal movement method is used. See *Minimal Movement Phasing Test Mode* (05.013) for details. If sensorless control is being used (i.e. *Sensorless Mode Active* (03.078) = 1) then inductance measurement is always used.
2. A stationary test is performed to measure *Stator Resistance* (05.017), *Maximum Deadtime Compensation* (05.059) and *Current At Maximum Deadtime Compensation* (05.060).
3. If *Enable Stator Compensation* (05.049) = 1 then *Stator Base Temperature* (05.048) is made equal to *Stator Temperature* (05.046).
4. A stationary test is performed to locate the flux axis of the motor again in case the motor has moved during the previous test.
5. If sensorless mode is not selected (i.e. *Sensorless Mode Active* (03.078) = 0) then the position feedback phasing angle measured during stage 1 of this test is compared with the value measured during this stage of the test. If there is a difference of 30° or more then a *Autotune 1*.6 trip is initiated. Otherwise *Position Feedback Phase Angle* (03.025) is set up for the position from the position feedback interface selected with *Motor Control Feedback Select* (03.026). Whether inductance measurement or minimal movement was used to locate the flux *Minimal Movement Phasing Test Angle* (05.016), *Minimal Movement Phasing Test Current* (05.015) and *Minimal Movement Phasing Test Mechanical Load Phase* (05.019) are saved. If inductance measurement is used then the values are set to thier default levels. If minimal movement is used then the values are set as a result of the test.
6. A stationary test is performed to measure *Ld* (05.024) and *No-load Lq* (05.072).
7. *Stator Resistance* (05.017) and *Ld* (05.024) are used to set up *Current Controller Kp Gain* (04.013) and *Current Controller Ki Gain* (04.014). This is only performed once during the test, and so the user can make further adjustments to the current controller gains if required.

It should be noted that because this is a stationary or minimal movement test, it is not possible to check the direction of the position feedback. If the motor power connection phase sequence is incorrect so that the position feedback counts in reverse when the drive applies a phase sequence U-V-W to operate in the forward direction then when the drive is enabled after the auto-tune the motor will jump thought 90° electrical and stop with a current in the motor defined by the current limits. This can be corrected by changing the drive output phase sequence with *Reverse Output Phase Sequence* (05.042) and then repeating the auto-tuning. This will make the motor rotate correctly in the direction defined by the position feedback rotation. If the position feedback direction is correct the motor will then rotate under control in the required direction, but if the position feedback direction is incorrect the motor will then rotate under control in the wrong direction.

When using any type of encoder with digital commutation signals (i.e. AB Servo) the absolute position is not fully defined until the motor has moved by between 1 and 2 electrical revolutions (i.e. between 120° and 240° mechanical for a 6 pole motor). This means that *Position Feedback Phase Angle* (03.025) can only be measured correctly using motor inductance measurement (i.e. *Minimal Movement Phasing Test Angle* (05.016) = 0). Also if *Position Feedback Phase Angle* (03.025) is measured for a motor using this type of position feedback using a stationary test when the motor has not moved since power-up, or after the position feedback is re-initialised, there can be an error of +/-30° in the result. When the motor subsequently moves, the drive synchronises more accurately to the commutation signal edges and adjusts *Position Feedback Phase Angle* (03.025) to be correct and then saves the value in the drive. If a stationary auto-tune is performed and the motor is not moved by at least 2 electrical revolutions before powering down again this process is not carried out and the auto-tune should be repeated. When an encoder with digital commutation signals is used there is always an error of up to 30° in the phasing angle during starting until the motor has rotated by 1/3 of an electrical revolution. It should be noted that the +/-30° error in the phasing angle can increase this error to 60° and reduce the possible torque by up to 50%. Once the motor has rotated by 2 electrical revolutions full torque will be available.

The stationary test cannot be used with commutation only type devices, and test 2 below should be used instead.

If inductance measurement is being used to locate the flux axis of the motor (see *Minimal Movement Phasing Test Mode* (05.013)) and the motor inductance is very high (i.e. low speed motor with high pole number), or the inductance is moderately high and the drive has a much higher power rating than the motor, then the drive may find it difficult to locate the flux axis. If this is a problem and position feedback is being used then the minimal movement method can be performed instead.

2: Rotating
This test can be used to measure all the necessary parameters for basic control. The motor must be unloaded for this test. This test is likely to give a more accurate value for *Position Feedback Phase Angle* (03.025) than auto-tune test 1 for motors with low saliency or no saliency. If *Volts Per 1000rpm* (05.033) / (*Number Of Motor Poles* (05.011) x (*No-load Lq* (05.072) - (*Ld* (05.024)) x *Rated Current* (05.007)) < 200 then the reluctance torque (due to saliency) compared to the torque derived from the magnet flux is too high and this test cannot be used. Note that if sensorless mode is selected Auto-tune 1 test is performed.

1. A rotating test is performed to locate the flux axis of the motor and *Position Feedback Phase Angle* (03.025) is set up for the position from the position feedback interface selected with *Motor Control Feedback Select* (03.026). This is done by rotating the motor by 2 electrical revolutions (i.e. up to 2 mechanical revolutions) in the required direction. *Minimal Movement Phasing Test Angle* (05.016), *Minimal Movement Phasing Test Current* (05.015) and *Minimal Movement Phasing Test Mechanical Load Phase* (05.019) are set to thier default values and saved.
2. A stationary test is performed to measure *Stator Resistance* (05.017), *Maximum Deadtime Compensation* (05.059) and *Current At Maximum Deadtime Compensation* (05.060).
3. If *Enable Stator Compensation* (05.049) = 1 then *Stator Base Temperature* (05.048) is made equal to *Stator Temperature* (05.046).
4. A stationary test is performed to measure *Ld* (05.024) and *No-load Lq* (05.072).
5. *Stator Resistance* (05.017) and *Ld* (05.024) are used to set up *Current Controller Kp Gain* (04.013) and *Current Controller Ki Gain* (04.014). This is only performed once during the test, and so the user can make further adjustments to the current controller gains if required.

3: Inertia 1
This test measures the mechanical characteristic of the motor and load by rotating the motor at the speed defined by the present speed reference and injecting a series of speed test signals. This test should only be used provided all the basic control parameters (including *Torque Per Amp* (05.032)) have been set-up correctly and the speed controller parameters should be set to conservative levels, such as the default values, so that the motor is stable when it runs. The test may give inaccurate results if standard ramp is active, particularly with high inertia low loss loads. The test measures the motor and load inertia, which can be used in automatic set-up of the speed controller gains and in producing a torque feed-forward term. If *Mechanical Load Test Level* (05.021) is left at its default value of zero then the peak level of the injection signal will be 1% of the maximum speed reference subject to a maximum of 500rpm. If a different test level is required then *Mechanical Load Test Level* (05.021) should be set to a non-zero value to define the level as a percentage of the maximum speed reference, again subject to a maximum of 500rpm. The user defined speed reference which defines the speed of the motor should be set to a level higher than the test level, but not high enough for flux weakening to become active. In some cases, however it is possible to perform the test at zero speed provided the motor is free to move, but it may be necessary to increase the test signal from the default value. The test will give the correct results when there is a static load applied to the motor and in the presence of mechanical damping. This test should be used if possible, however for sensorless mode, or if the speed controller cannot be set up for stable operation an alternative test is provided (*Auto-tune* (05.012) = 4) where a series of torque levels are applied to accelerate and decelerate the motor to measure the inertia.

1. A rotating test is performed in which the motor is accelerated with the currently selected ramps up to the currently selected speed reference, and this speed is maintained for

the duration of the test. *Motor And Load Inertia* (03.018) and *Inertia Times 1000* (04.033) are set up.

4: Inertia 2

Auto-tune test 3 should normally be used for mechanical load measurement, but under some circumstances this test may be used as an alternative. This test is likely to give incorrect results if standard ramp mode is active. A series of progressively larger torque levels are applied to the motor (20%, 40% ... 100% of rated torque) to accelerate the motor up to 3/4 x *Rated Speed* (05.008) to determine the inertia from the acceleration/deceleration time. The test attempts to reach the required speed within 5s, but if this fails the next torque level is used. When 100% torque is used the test allows 60s for the required speed to be reached, but if this is unsuccessful a trip is initiated. To reduce the time taken for the test it is possible to define the level of torque to be used for the test by setting *Mechanical Load Test Level* (05.021) to a non-zero value. When the test level is defined the test is only carried out at the defined test level and 60s is allowed for the motor to reached the required speed. It should be noted that if the maximum speed allows for flux weakening then it may not be possible to acheive the required torque level to accelerate the motor fast enough. If this is the case, the maximum speed reference should be reduced.

1. The motor is accelerated in the required direction up to 3/4 of the maximum speed reference and then decelerated to zero speed.
2. The test is repeated with progressively higher torques until the required speed is reached.
3. *Motor And Load Inertia* (03.018) and *Inertia Times 1000* (04.033) are set up.

5: Full Stationary

This test is intended to measure as many parameters as possible without rotating the motor. *Minimal Movement Phasing Test Mode* (05.013) should to be set to indicate whether the motor is free or constrained. The test is carried out as follows:

1. The stationary test described above is performed using inductance measurement.
2. If Stage 1 is successful the test is now complete. If position feedback is being used and the test has failed because the saturation characteristic of the motor cannot be measured (*Inductance*.004), the position feedback phasing angle is different by more than 30° between the first and second time the motor flux is located (*Autotune 1.006*), or the motor is not salient enough to use inductance measurement to locate the motor flux (*Inductance.003*) then the stationary test is repeated using minimal movement instead of inductance measurement to locate the motor flux. If *Minimal Movement Phasing Test Angle* (05.016) has a value of zero when the test is started *Minimal Movement Phasing Test Angle* (05.016) is set to an angle equivalent to at least 75 counts from the position feedback device if it is a rotary device and is connected to the P1 position feedback interface on the drive, subject to a minimum of 0.05° if the motor is constrained or 1.0° if the motor is free to rotate. The table below shows how the angle is calculated, subject to a maximum of 0.5° if the motor is constrained or 5.0° if it is free to rotate.. If the device is not included in the table, is a linear device or is not connected to the P1 interface then the minimum values are used. If *Minimal Movement Phasing Test Angle* (05.016) is non-zero when the test is started then this value is used. If position feedback is not being used or any other trips occurred during the first stationary test the test is aborted and the drive is tripped.
3. If Stage 2 is successful the test is now complete.

NOTE: Further stages will be added to this test in the future, and so it should not be assumed that the test will be complete after the stages given above in future software versions.

Position feedback type	Calculation of minimal movement phasing test angle
AB, FD, FR, AB Servo, FD Servo, FR Servo	6750 / *P1 Rotary Lines Per Revolution* (03.034)
SC, SC Hiperface, SC EnDat, SC SSI, SC Servo, SC SC	6750 / (*P1 Rotary Lines Per Revolution* (03.034) x 256)
Resolver	5°
EnDat, SSI, BiSS	$27000 / 2^{(P1\ Comms\ Bits\ (03.035)\ -\ P1\ Rotary\ Turns\ Bits\ (03.033))}$

The table below shows the trips that can occur during an auto-tune test:

Trip	Reason
Autotune Stopped	The final drive enable or the final drive run were removed before the test was completed.
Resistance.001	The measured value of *Stator Resistance* (05.017) exceeded a value of $(V_{FS} / \sqrt{2})$ / *Full Scale Current Kc* (11.061), where V_{FS} is the full scale d.c. link voltage.
Resistance.002	It has not been possible to measure the drive inverter characteristic to define *Maximum Deadtime Compensation* (05.059) and *Current At Maximum Deadtime Compensation* (05.060).
Autotune 1.001	The position feedback did not change when position feedback is being used.
Autotune 1.002	The motor did not reach the required speed.
Autotune 1.003	The required commutation signal edge could not be found with commutation signal only position feedback.
Autotune 1.004	The required angular movement did not occur during a minimal movement test.
Autotune 1.005	The fine location of the motor flux during a minimal movement test failed.
Autotune 1.006	The phasing offset angle is meaured twice during a stationary auto-tune and the two values were not within 30degrees.
Autotune 1.007	The motor was rotating when a minimal movement test was performed to find the phasing offset angle on enable.
Autotune 1.009	During the final stage of the minimal movement phasing test with a constrained motor it was not possible to achieve the required movement.
Autotune 2.001	Position feedback direction is incorrect when position feedback is being used.
Autotune 2.002	A SINCOS encoder with comms is being used for position feedback and the comms position is rotating in the opposite direction to the sine wave based position.
Autotune 3.001	The measured inertia exceeds the parameter range.
Autotune 3.003	The mechanical load test has failed to identify the inertia.
Autotune 3.002	A position feedback device with commutation signals is being used (i.e. AB Servo, FD Servo, FR Servo, SC Servo) and the commutation signals changed in the wrong direction.
Autotune 4	A position feedback device with commutation signals is being used (i.e. AB Servo, FD Servo, FR Servo, SC Servo) and U signal did not change.
Autotune 5	A position feedback device with commutation signals is being used (i.e. AB Servo, FD Servo, FR Servo, SC Servo) and V signal did not change.
Autotune 6	A position feedback device with commutation signals is being used (i.e. AB Servo, FD Servo, FR Servo, SC Servo) and W signal did not change.
Autotune 7	The motor poles or the position feedback resolution have been set up incorrectly where position feedback is being used. The trip will not occur if *Number Of Motor Poles* (05.011) ≥ 6 (i.e. 12 poles).
Inductance.003	The difference between the d and q axis inductance is not large enough to correctly determine the location of the motor flux. If position feedback is being used the measured value for *Position Feedback Phase Angle* (03.025) may not be reliable. Also the measured values of *Ld* (05.024) and *No-load Lq* (05.072) may not correspond to the d and q axis respectively. The test is completed and all the parameters saved to non-volatile memory in the drive, but the user should note that the measured results may not be correct. It should be noted that this trip is not produced if sensorless mode is selected and active (i.e. *Sensorless Mode Active* (03.078) = 1).
Inductance.004	During auto-tune test 1 when position feedback is being used (i.e. *Sensorless Mode Active* (03.078) = 0), the direction of the flux in the motor must be detected by the change of inductance with different currents. This trip is initiated if the change cannot be detected.

Parameter	05.013 *Minimal Movement Phasing Test Mode*		
Short description	Minimal Movement Phasing Test Mode		
Mode	RFC-S		
Minimum	0	Maximum	1
Default	0	Units	
Type	8 Bit User Save	Update Rate	Background Read
Display Format	Standard	Decimal Places	0
Coding	RW, TE		

Value	Text
0	Free
1	Constrained

If position feedback is being used, i.e. *Sensorless Mode Active* (03.078) = 1, it is necessary to define the relationship between the motor magnet flux and the position feedback angle with *Position Feedback Phase Angle* (03.025) (or *M2 Position Feedback Phase Angle* (21.020) for motor map 2). This can be measured during auto-tuning with a rotating or stationary test. *Minimal Movement Phasing Test Mode* (05.013), *Minimal Movement Phasing Test Current* (05.015), *Minimal Movement Phasing Test Angle* (05.016) and *Minimal Movement Phasing Test Mechanical Load Phase* (05.019) are used to define the operation of the stationary test. It is also possible to perform the stationary test on drive enable to calculate *Position Feedback Phase Angle* (03.025), see *Phasing Test On Enable* (05.014) for details. If position feedback is not being used, *Sensorless Mode Active* (03.078) = 0, then *Position Feedback Phase Angle* (03.025) is not relevant, and so these parameters are also not relevant. If *Minimal Movement Phasing Test Angle* (05.016) is left at its default value of zero the stationary test uses motor inductance measurement to locate the magnet flux in the motor to calculate *Position Feedback Phase Angle* (03.025). The inductance measurement test does not cause any deliberate movement of the motor during the test, but does rely on the motor being salient under no-load conditions. If the motor is non-salient, i.e. the ratio between the d and q inductance is too small (see *Inductance*) then inductance measurement cannot be used for the stationary test.

As an alternative to inductance measurement, a test referred to as a minimal movement test, that causes a small movement of the motor, can be used instead. The minimal movement test does not depend on motor saliency, but is not as accurate as the inductance based measurement with high saliency motors where *Volts Per 1000rpm* (05.033) / (*Number Of Motor Poles* (05.011) x (*No-load Lq* (05.072) - (*Ld* (05.024)) x *Rated Current* (05.007))) is less than 1000. If the motor has sufficient saliency the inductance test should be used in preference to the minimal movement test. The minimal movement test can be used even if the motor is constrained by a mechanical brake, provided the mechanical system allows sufficient motor movement. For the test to be reliable it is suggested that the position feedback changes by at least 75 counts during the test. If the motor is free to rotate *Minimal Movement Phasing Test Mode* (05.013) should be left at its default value of zero (Free), otherwise it should be set to one (Constrained). To select the minimal movement test, instead of the inductance measurement, *Minimal Movement Phasing Test Angle* (05.016) should be set to a non-zero value to define the peak to peak movement required during the test in 0.01^o units. For example, if the position feedback has a resolution of 16384 counts per revolution, then for a movement of 75 counts the required angle is 360° x 75 / 16384 = 1.64^o. If the motor is constrained then the required movement will need to be set to a lower value as it is unlikely that the drive will be able to achieve a large angular movement against the brake, and so a higher resolution position feedback device may be required. If the motor is free to rotate it is advisable to use an angle of at least 1.00^o to prevent non-linear effects such as motor cogging from affecting the result. If the motor is constrained an angle of at least 0.05^o should be used where possible. The minimal movement test does not apply a static torque, but an alternating torque, so there should be no net slip against the brake. If the required movement is too high the brake may prevent this and the test will fail. (If a linear position feedback device is being used 360° corresponds to one pole pitch.)

When the minimal movement phasing test is used during auto-tuning the sequence is as follows:

Stage 1:

An a.c. torque of 1% of rated torque is applied and the resulting peak to peak position movement is measured. If this is less than the required peak to peak movement defined by *Minimal Movement Phasing Test Angle* (05.016) the torque is increased to 2%, 3%, 6%, 12%, 25%, 50% and 100% of rated torque. If the required movement has not been achieved then an *Autotune 1*.004 trip is initiated and the test is aborted. Once the required movement has been achieved the test moves to the next stage.

Stage 2:

If the motor is not constrained (*Minimal Movement Phasing Test Mode* (05.013)=0) then it is assumed that the load is a damped or un-damped inertia. In which case the phase shift between the applied torque and the position movement is between -90° and -180°. If a further 90° is allowed for the delay in the current controllers, the total phase shift will be between -90° and -270°, and so it is assumed that the delay is the middle value of -180°. The mechanical load phase is required in the last two stages of this test and it is also used subsequently if a minimal movement test is used on enable to calculate *Position Feedback Phase Angle* (03.025), and so a value of -180° is written to *Minimal Movement Phasing Test Mechanical Load Phase* (05.019) and the test moves to the next stage. If the motor is constrained (*Minimal Movement Phasing Test Mode* (05.013)=1) then the load may appear as a damped or un-damped inertia, or it may appear as a damped or un-damped spring. In this case the mechanical load phase including the delay in the current controllers may be anywhere in the range from 0° to -270°. It is not possible to use a fixed estimate of -180°, and so the mechanical load phase is measured in this stage before the test moves to the next stage.

Stage 3:

The position feedback phase angle is now measured during a series of tests, using the mechanical load phase from the previous stage, and the average result is used as an estimate before proceeding to the next stage of the test.

Stage 4:

The system now has an approximate value for the position feedback phase angle, but a more accurate value can be obtained during this stage which does a series of fine trimming tests. This algorithm should not fail, but if the system is resonant for example, and the result does not converge an *Autotune 1*.005 trip will occur. If the motor is free (*Minimal Movement Phasing Test Mode* (05.013)=0) then the test is complete after this stage. If the motor is constrained (*Minimal Movement Phasing Test Mode* (05.013)=1) then the sequence proceeds to the next stage.

Stage 5:

If the motor is constrained it is possible to check that an error has not occurred in the previous stage giving the position feedback phase angle with an error of 180°. To do this a low frequency torque is applied to the motor. If the necessary movement for this test cannot be obtained an *Autotune 1*.009 trip is initiated. This stage of the test sequence cannot be used with an unconstrained motor because it would cause the motor to rotate. As the mechanical load phase shift of an unconstrained motor is more predictable this stage of the test is not required.

During the complete auto-tune sequence the series of tests given above is carried out twice (see *Auto-tune State* (10.107)) and is indicated by states 1 and 3. The results for the position feedback phase angle from each test are compared and if they are different by more than 30° then an *Autotune 1*.006 trip is initiated, or if the test is successful *Position Feedback Phase Angle* (03.025) or *M2 Position Feedback Phase Angle* (21.020), *Minimal Movement Phasing Test Current* (05.015) and *Minimal Movement Phasing Test Mechanical Load Phase* (05.019) are written and saved.

When the minimal movement test is selected to determine the phasing offset angle on enable two alternative tests can be selected with *Phasing Test On Enable* (05.014). The longer test uses the sequence described above for auto-tuning, but the sequence only runs once. If the shorter test is selected the test time is significantly reduced and the stages of the test are as follows.

Stage 1:

The current is increased in the same way as in the auto-tuning sequence except that the sequence begins with the current required for the last auto-tune which was stored in *Minimal Movement Phasing Test Current* (05.015).

Stage 2:

Not used.

Stage 3:

During auto-tuning this stage uses an average of 16 measured results. During the test on enable a minimum of 4 results are used and a maximum of 16 depending on the variation in the measured values. If consistent results cannot be achieved an *Autotune 1*.006 trip is initiated. If the motor is free (*Minimal Movement Phasing Test Mode* (05.013)=0) then the test is complete after this stage. If the motor is constrained (*Minimal Movement Phasing Test Mode* (05.013)=1) then the sequence proceeds to Stage 5.

Stage 4:

Not used.

Stage 5:

As for auto-tuning.

The results from the short test can be less accurate than for the longer test, but will be improved if a larger movement is required especially with an unconstrained motor. Also the test is only accurate if the motor is stationary before the test begins, and so if the speed is higher than the zero speed threshold (i.e. *Zero Speed* (10.003)=0) an *Autotune 1*.007 trip is initiated before the test is attempted.

The following is a summary of the parameters used to set up the stationary phasing tests and the trips that can be initiated by the tests.

Parameter	Function
Minimal Movement Phasing Test Mode (05.013)	Defines whether the motor is free to rotate or constrained by a mechanical brake for the minimal movement test.
Phasing Test On Enable (05.014)	Selects a long or short test on enable and defines when the test is carried out.
Minimal Movement Phasing Test Current (05.015)	Initial current used at the start of the phasing test on enable.
Minimal Movement Phasing Test Angle (05.016)	Required peak to peak angular movement required for the minimal movement test. If this parameter is zero then inductance measurement is used for the stationary test.
Minimal Movement Phasing Test Mechanical Load Phase (05.019)	Mechanical load phase angle between applied torque and position movement.

Trip	Reason
Inductance.003	The ratio of Ld and Lq is too small. See Inductance trip.
Inductance.004	The saturation characteristic of the motor cannot be measured.
Autotune 1.004	The required angular movement could not be achieved during the minimal movement test.
Autotune 1.005	Stage 4 of the minimal movement test during auto-tuning did not converge.
Autotune 1.006	During auto-tuning the two minimal movement tests carried out did not give consistent results. During a short minimal movement phasing test on enable Stage 3 did not give consistent results.
Autotune 1.007	The motor was moving when a minimal movement test was initiated on enable.
Autotune 1.009	The required movement could not be achieved during stage 5 of a minimal movement test.

It should be noted that the minimal movement test system can be used when position feedback is via the P1 or P2 interfaces on the drive or via a position feedback interface from an option module. However, if the position feedback is via an option module any filtering applied to the speed feedback by the option module must be disabled. This does not apply to the drive position feedback interfaces because the filtering effect of *P1 Feedback Filter* (03.042) is automatically bypassed during the test.

Parameter	05.014 *Phasing Test On Enable*		
Short description	Defines a when a stationary test is performed to calculate the Postion Feedback Phase Angle		
Mode	RFC‑S		
Minimum	0	Maximum	4
Default	0	Units	
Type	8 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW, TE		

Value	Text
0	Disabled
1	Short
2	Short Once
3	Long
4	Long Once

Phasing Test On Enable (05.014) can be used to get the drive to perform a phasing angle test when it is enabled. This test can be used when a non-absolute encoder is used for motor control feedback. The phasing test will measure and modify *Position Feedback Phase Angle* (03.025), so that the correct offset is applied to run the motor with the non-absolute encoder. Note that the value is not saved in drive non-volatile memory. A test is only carried out when sensorless mode is not active (i.e. *Sensorless Mode Active* (03.078) = 0). The test can be selected to occur after power-up and each time the position feedback is re-initialised. It is not necessary to perform the test on every enable, but this can be selected if required. The table below shows the possible options.

Phasing Test On Enable (05.014)	Action when *Minimal Movement Phasing Test Angle* (05.016) is zero	Action when *Minimal Movement Phasing Test Angle* (05.016) is non-zero
Disabled (0)	No phasing test is carried out on enable	No phasing test is carried out on enable.
Short (1)	A test lasting approximately 0.4s is carried out on every enable	A test lasting approximately 2.0s is carried out on every enable. If *Minimal Movement Phasing Test Mode* (05.013) is non-zero the test is extended to approximately 8s.
Short Once (2)	A test lasting approximately 0.4s is carried out when the drive is first enabled after power-up, and when the drive is enabled after position feedback selected with *Motor Control Feedback Select* (03.026) is initialized.	A test lasting approximately 2.0s is carried out when the drive is first enabled after power-up, and when the drive is enabled after position feedback selected with *Motor Control Feedback Select* (03.026) is initialized. If *Minimal Movement Phasing Test Mode* (05.013) is non-zero the test is extended to approximately 8s.
Long (3)	A test lasting approximately 2.5s is carried out on every enable	A test lasting approximately 60s is carried out of every enable.
Long Once (4)	A test lasting approximately 2.5s is carried out when the drive is first enabled after power-up, and when the drive is enabled after position feedback selected with *Motor Control Feedback Select* (03.026) is initialized	A test lasting approximately 60s is carried out when the drive is first enabled after power-up, and when the drive is enabled after position feedback selected with *Motor Control Feedback Select* (03.026) is initialized.

Minimal Movement Phasing Test Angle (05.016) is zero
The motor inductance is measured to determine the position of the rotor flux. It is recommended that the long test is used as this reduces measurement errors. The long test should always be used when the motor is not constrained during the test (i.e. a motor without a mechanical brake), or with motors that have a high level of saliency even if they are held in position. It should be noted that the motor inductances (*Ld* (05.024) and *No-load Lq* (05.072)) are checked before the test is carried out, and if the difference is not sufficient (see *Inductance*) then the drive will trip. Therefore, if the motor inductances have not been measured with auto-tuning or changed from their default values of zero the drive will trip when the drive is enabled. This test, in common with the stationary auto-tune test, cannot be used with commutation only type feedback, i.e. when *P1 Device Type* (03.038) is set to Commutation Only. Most motors have a positive saturation characteristic so that increasing the current in the flux axis increases motor saturation. It is possible with some motor designs for the characteristic to be reversed. If this is the case the phase angle measurement on enable will produce a value that is 180º from the real value. If this is the case *Inverted Saturation Characteristic* (05.070) should be set to one.

Minimal Movement Phasing Test Angle (05.016) is non-zero
A minimal movement test is used to determine the position of the rotor flux. See *Minimal Movement Phasing Test Mode* (05.013) for details. This test cannot be used with any position feedback devices that use commutation signals (i.e. AB Servo, FD Servo, FR Servo, SC Servo or Commutation Only). A stationary auto-tune must be carried out before minimal movement is used for the phasing test on enable as it provides values for *Minimal Movement Phasing Test Current* (05.015) and *Minimal Movement Phasing Test Mechanical Load Phase* (05.019). If the motor is constrained then *Minimal Movement Phasing Test Mode* (05.013) should be set to one during the auto-tuning so that the correct value is set in *Minimal Movement Phasing Test Mechanical Load Phase* (05.019) by the test. Normally *Minimal Movement Phasing Test Mode* (05.013) should also be set to one for the phasing test on enable, however this extends the lenght of the test. Provided the auto-tune has set the correct value in *Minimal Movement Phasing Test Mechanical Load Phase* (05.019) it should be possible to change *Minimal Movement Phasing Test Mode* (05.013) back to zero after the auto-tune to reduce the length of the phasing test on enable.

Parameter	05.015 *Minimal Movement Phasing Test Current*		
Short description	Minimal Movement Phasing Test Current		
Mode	RFC‑S		
Minimum	0	Maximum	7
Default	0	Units	
Type	8 Bit User Save	Update Rate	Background Read/Write
Display Format	Standard	Decimal Places	0
Coding	RW, TE		

Value	*Text*
0	1%
1	2%
2	3%
3	6%
4	12%
5	25%
6	50%
7	100%

See *Minimal Movement Phasing Test Mode* (05.013).

Parameter	05.016 *Minimal Movement Phasing Test Angle*		
Short description	Minimal Movement Phasing Test Angle		
Mode	RFC‑S		
Minimum	0.00	Maximum	25.00
Default	0.00	Units	°
Type	16 Bit User Save	Update Rate	Background Read
Display Format	Standard	Decimal Places	2
Coding	RW		

See *Minimal Movement Phasing Test Mode* (05.013).

Parameter	05.017 *Stator Resistance*		
Short description	Defines the resistance of the motor stator		
Mode	RFC‑S		
Minimum	0.000000	Maximum	1000.000000
Default	0.000000	Units	Ω
Type	32 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	6
Coding	RW, RA		

The motor parameters used by the drive are derived from the star connected per phase equivalent circuit of a permanent magnet motor shown below.

Star connected equivalent circuit of a
permanent magnet
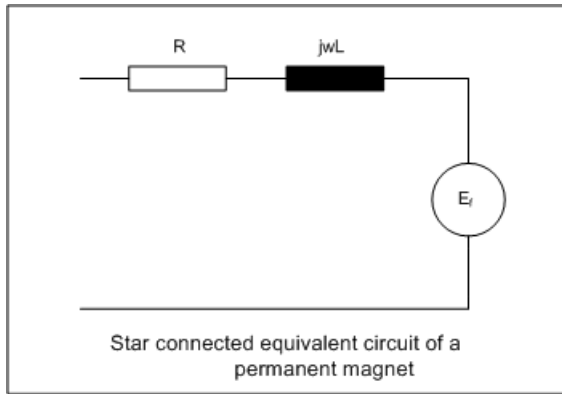
Stator Resistance (05.017) = R

Ld (05.024) = L in the d (flux) axis

No-load Lq (05.072) = L in the q (torque) axis with no current in the motor

Lq At The Defined Iq Current (05.078) = L in the q axis with Id = 0 and Iq = *Lq At The Defined Iq Current* (05.078)

Lq At The Defined Id Current (05.084) = L in the q axis with Id = *Lq At The Defined Id Current* (05.084) and Iq = 0.

Stator Resistance (05.017) is used as described in the table below.

Function	Details
Control above low speeds with sensorless control	The stator resistance is used by the algorithm that detemines the rotor position.
Current controller integral gain set-up	During auto-tuning the stator resistance is used in the calculation of the current controller integral gain.
High performance current control	If high performance current control is selected the stator resistance is used in the control for both d and q axis current.

Parameter	05.018 *Maximum Switching Frequency*		
Short description	Defines the maximum switching frequency that can be used by the drive		
Mode	RFC‑S		
Minimum	0	Maximum	VM_SWITCHING_FREQUENCY
Default	3	Units	kHz
Type	8 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW, TE, VM, RA		

Value	Text
0	2
1	3
2	4
3	6
4	8
5	12
6	16

Maximum Switching Frequency (05.018) should be set to the required PWM switching frequency. The drive inverter will operate at this frequency unless the inverter temperature becomes too hot. Under these conditions the drive will reduce the switching frequency in an attempt to avoid tripping (see *Auto-switching Frequency Change* (05.035)). The actual switching frequency is shown in *Switching Frequency* (05.037). The switching frequency has a direct effect on the sample rate for the current controllers (see *Current Controller Kp Gain* (04.013)). All other control tasks are at a fixed rate.

Task	
Speed controller (RFC-A, RFC-S)	250µs
D.c. link voltage controller	1ms
Flux controller (RFC-A, RFC-S)	1ms

Parameter	05.019 *Minimal Movement Phasing Test Mechanical Load Phase*		
Short description	Minimal Movement Phasing Test Mechanical Load Phase		
Mode	RFC‑S		
Minimum	-180	Maximum	179
Default	-180	Units	°
Type	16 Bit User Save	Update Rate	Background read/write
Display Format	Standard	Decimal Places	0
Coding	RW		

See *Minimal Movement Phasing Test Mode* (05.013).

Parameter	05.021 *Mechanical Load Test Level*		
Short description	Mechanical Load Test Level		
Mode	RFC‑S		
Minimum	0	Maximum	100
Default	0	Units	%
Type	8 Bit User Save	Update Rate	Background Read
Display Format	Standard	Decimal Places	0
Coding	RW		

See *Auto-tune* (05.012).

Parameter	05.022 *Enable High Speed Mode*	
Short description	Set to 1 to enable high speed mode	
Mode	RFC-S	
Minimum	-2	Maximum	2
Default	0	Units	
Type	8 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW, TE	

Value	Text
-2	Limit
-1	Limit (Servo)
0	Disable
1	Enable (Servo)
2	Enable

Care must be taken when high speed mode is not set to Disable (0) to avoid damaging the drive. The voltage produced by the magnet flux is proportional to speed. For high speed operation the drive must apply currents to the motor to counter-act the flux produced by the magnets. It is possible to operate the motor at very high speeds that would give a very high motor terminal voltage, but this voltage is prevented by the action of the drive. If however, the drive is disabled (or tripped) when the motor voltages would be higher than the rating of the drive without the currents to counter-act the flux from the magnets, it is possible to damage the drive. If high speed mode is enabled the motor speed must be limited to the levels given in the table below unless an additional hardware protection system is used to limit the voltages applied to the drive output terminals to a safe level.

Drive voltage rating	Maximum motor speed (rpm)	Maximum safe line to line voltage at the motor terminals (V r.m.s.)
200	400 x 1000 / (Ke x √2)	400 / √2
400	800 x 1000 / (Ke x √2)	800 / √2
575	955 x 1000 / (Ke x √2)	955 / √2
690	1145x 1000 / (Ke x √2)	1145 / √2

Ke is the ratio between r.m.s. line to line voltage produced by the motor and the speed in V/1000rpm.

Disabled (0):
The motor flux is not modified to limit the motor voltage to the level defined by *Rated Voltage* (05.009). The motor voltage will increase as the speed is increased until the motor line to line voltage x √2 is equal to the d.c. link voltage (*D.c. Bus Voltage* (05.005)). It will not be possible to further increase the speed significantly. This mode is safe because the motor voltage with no current flowing in the motor cannot exceed a level that can damage the drive provided *Position Feedback Phase Angle* (03.025) is correct for the motor. Note that if *Position Feedback Phase Angle* (03.025) is modified by the user to change the flux level in the motor then it is possible to damage the drive on disable as described above. It should be noted that if Disable mode is selected, but saliency torque is being exploited (i.e. *Active Saliency Torque Mode* (05.066) is non-zero) then the drive automatically provides protection against damage by operating in Limit (Servo) mode as described below.

Limit (Servo) (-1):
The motor flux is modified to limit the motor voltage to the level defined by *Rated Voltage* (05.009). An *Over Speed*.1 trip is initiated if the measured motor speed exceeds the levels defined in the table above to protect the drive. This mode is intended for dynamic servo type applications with motors that have relatively low saliency. If control using saliency is disabled, or it is enabled but the motor has low saliency (i.e. *Active Saliency Torque Mode* (05.066) is showing disabled or low saliency operation) then the drive will not restrict the torque requested from the motor to prevent the motor from exceeding its voltage based torque limit. If the motor is operated at or close to this limit it can become unstable, or the drive can lose control of the motor. This is not generally a problem for servo motors as they do not go close to their torque limit or only operate transiently in flux weakening during the last part of their acceleration to maximum speed, and so the flux controller is too slow to provide much flux weakening. Limit (Servo) mode should not be used with high saliency motors (i.e. *Active Saliency Torque Mode* (05.066) is showing high saliency operation), and so if this is selected for a high saliency motor the drive will automatically operate in Limit mode as described below.

Limit (-2):
This is similar to Limit (Servo) mode except that the motor torque is restricted to prevent the drive from operating close to, or beyond, the voltage based torque limit of the motor. This prevents the motor from operating in a region where it could become unstable, or the drive could lose control of the motor. This is not generally a problem for servo motors as they do not go close to their torque limit or only operate transiently in flux weakening during the last part of their acceleration to maximum speed, and so the flux controller is too slow to provide much flux weakening. However, for more general purpose motors for slower applications, such as fans and pumps, it may be necessary for the drive to prevent the motor from operating close to its voltage based torque limit.

Enable (Servo) (1):
This is similar to Limit (Servo) mode except that a trip is not produced if the motor speed exceeds the maximum safe level. An indication that cannot be cleared is stored in *Potential Drive Damage Conditions* (10.106) and saved on power-down. The motor manufacturer should always be consulted before using this mode as care must be taken not to de-magnetise the motor.

Enable (2):
This is similar to Limit mode except that a trip is not produced if the motor speed exceeds the maximum safe level. An indication that cannot be cleared is stored in *Potential Drive Damage Conditions* (10.106) and saved on power-down. The motor manufacturer should always be consulted before using this mode as care must be taken not to de-magnetise the motor.

Parameter	05.023 *D.c. Bus Voltage High Range*	
Short description	Displays the d.c. bus level but with a higher range	
Mode	RFC-S	
Minimum	−VM_HIGH_DC_VOLTAGE	Maximum	VM_HIGH_DC_VOLTAGE
Default		Units	V
Type	16 Bit Volatile	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RO, FI, VM, ND, NC, PT	

D.c. Bus Voltage High Range (05.023) provides voltage feedback that has lower resolution and a higher range than *D.c. Bus Voltage* (05.005), and so it is possible to determine the d.c. link voltage even if this exceeds the level of the over-voltage trip. It should be noted that due to tolerances, *D.c. Bus Voltage High Range* (05.023) may not correspond exactly with the level given by *D.c. Bus Voltage* (05.005). In a system with parallel power modules where the control pod is remote from any of the power modules, this parameter always shows zero.

Parameter	05.024 *Ld*	
Short description	Defines the inductance in the flux axis	
Mode	RFC-S	
Minimum	0.000	Maximum	500.000
Default	0.000	Units	mH
Type	32 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	3
Coding	RW, RA	

D axis inductance, see *Stator Resistance* (05.017) for more details.

Ld (05.024) is used as described in the table below.

Function	Details
Current controller gain set-up	During auto-tuning Ld is used in calculating the current controller gains.
High performance current control	If high performance current control is selected (*Current Controller Mode* (04.030) =1) Ld is used by the controller in d axis.
Low speed operation with sensorless control	If injection mode is used (*RFC Low Speed Mode* (05.064) = 0) for low speed operation Ld defines the gain of the system.
Flux controller gain	Ld is used in deriving the gain of the controller which controls the motor voltage at high speed.

Parameter	05.026 *High Dynamic Performance Enable*		
Short description	Set to 1 to enable High Dynamic Performance		
Mode	RFC-S		
Minimum	0	Maximum	1
Default	0	Units	
Type	1 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW		

Whatever the value of *High Dynamic Performance Enable* (05.026) a feed-forward term based on the estimated level of flux in the motor and the motor speed is used to improve the performance of the current controllers and to avoid transients during spinning start. However, if *High Dynamic Performance Enable* (05.026) = 1 additional feed-forward terms are provided to remove the effects of cross-coupling between the flux and torque axes. This improves the performance of the current controllers under dynamic conditions at high speeds. It should be noted that *High Dynamic Performance Enable* (05.026) has no effect if sensorless control is active (i.e. *Sensorless Mode Active* (03.078) = 1).

Parameter	05.027 *Flux Control Gain*		
Short description	Flux Control Gain		
Mode	RFC-S		
Minimum	0.1	Maximum	10.0
Default	1.0	Units	
Type	8 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	1
Coding	RW		

If *Flux Control Gain* (05.027) is set to the default value of unity the system that controls the motor voltage is automatically set up based on the motor parameters to give stable operation under most conditions. Some motors which have concentrated windings can cause significant harmonic currents which in turn disturb the voltage controller at higher speeds where the voltage controller is active to limit the motor voltage. To reduce this effect the gain can be reduced. The gain can also be increased for applications with fast acceleration to improve the response of the voltage controller in limiting the motor voltage.

Parameter	05.028 *Torque Linearisation Disable*		
Short description	Torque Linearisation Disable		
Mode	RFC-S		
Minimum	0	Maximum	1
Default	1	Units	
Type	1 Bit User Save	Update Rate	Background Read
Display Format	Standard	Decimal Places	0
Coding	RW, BU		

If high saliency control is active (i.e. *Active Saliency Torque Mode* (05.066) = 2) the drive applies compensation to give approximately a linear realtionship between the torque reference and actual torque for speed and torque control modes. In some cases this may introduce unacceptable system noise. If *Torque Linearisation Disable* (05.028) is left at its default value of 0 the linearisation system is active. If *Torque Linearisation Disable* (05.028) is set to 1 then the linearisation system is disabled. Torque linearisation is disabled if sensorless mode is active, i.e. *Sensorless Mode Active* (03.078) = 1.

Parameter	05.031 *Voltage Controller Gain*		
Short description	Defines the proportional gain of the d.c. link voltage controller		
Mode	RFC-S		
Minimum	1	Maximum	30
Default	1	Units	
Type	8 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW		

Voltage Controller Gain (05.031) can be used to modify the proportional gain of the d.c. link voltage controller used for standard ramp and supply loss control.

Parameter	05.032 *Torque Per Amp*		
Short description	Defines the torque per amp constant (Kt) for the motor		
Mode	RFC-S		
Minimum	0.00	Maximum	500.00
Default	1.60	Units	Nm/A
Type	16 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	2
Coding	RW, BU		

Torque Per Amp (05.032) is used for automatic speed controller gain set up and to calculate the inertia in autotune tests 3 and 4, and so the correct value for the motor should be entered if these features are used.

Parameter	05.033 *Volts Per 1000rpm*		
Short description	Volts per 1000rpm		
Mode	RFC-S		
Minimum	0	Maximum	10000
Default	98	Units	V
Type	16 Bit User Save	Update Rate	Background Read
Display Format	Standard	Decimal Places	0
Coding	RW		

Volts Per 1000rpm (05.033) defines the r.m.s. line voltage produced by the motor flux at 1000rpm, i.e. running at this speed with no current in the motor.

Volts Per 1000rpm (05.033) is used as described in the table below.

Function	Details
Voltage feed-forwards	Provides voltage feed-forwards for the current control system.
Over-speed protection	Ke is used to determine the trip speed if *Enable High Speed Mode* (05.022) is set to Limit mode
Low speed operation with sensorless control	If "non-salient" mode is selected Ke is used in defining the controller gain.
Rated torque angle	If the drive defines *Rated Torque Angle* (05.089) no-load Lq is used in the calculation.

Parameter	05.035 *Auto-switching Frequency Change*		
Short description	Defines auto-switching frequency control with thermal model		
Mode	RFC‑S		
Minimum	0	Maximum	2
Default	0	Units	
Type	8 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW, TE		

Value	Text
0	Enabled
1	Disabled
2	No Ripple Detect

The drive inverter can be damaged if the temperature is too high. The inverter can also be damaged or the lifetime of the power devices reduced, if the temperature ripple of the devices is too high. *Auto-switching Frequency Change* (05.035) defines the action taken if the drive inverter becomes too hot or the temperature ripple becomes too high.

Enabled:
If the inverter becomes too hot or the ripple temperature is higher than the level defined by *Maximum Inverter Temperature Ripple* (05.039) the switching frequency is reduced in an attempt to prevent tripping.

Disabled:
The switching frequency is not reduced, and so the drive will trip if the inverter is too hot or the temperature ripple is too high.

No Ripple Detect:
The switching frequency is reduced if the inverter temperature, but not the temperature ripple is too high. If the temperature ripple exceeds the level defined by *Maximum Inverter Temperature Ripple* (05.039) then the drive will trip.

The switching frequency is changed in steps defined by *Auto-switching Frequency Step Size* (05.036). For example with a switching frequency of 16kHz and a step size of two, the frequency will be reduced to 8kHz, then 4kHz etc. *Minimum Switching Frequency* (05.038) defines the minimum switching frequency that the system will attempt to use. If the switching frequency needs to switch to a lower level, then the drive will trip. If *Minimum Switching Frequency* is changed the new value will only become active when *Switching Frequency* is at or above the minimum value.

Parameter	05.036 *Auto-switching Frequency Step Size*		
Short description	Auto-switching frequency redcution step size		
Mode	RFC‑S		
Minimum	1	Maximum	2
Default	2	Units	
Type	8 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW		

See *Auto-switching Frequency Change* (05.035).

Parameter	05.037 *Switching Frequency*		
Short description	Displays the current switching frequency used by the drive		
Mode	RFC‑S		
Minimum	0	Maximum	6
Default		Units	kHz
Type	8 Bit Volatile	Update Rate	Background write
Display Format	Standard	Decimal Places	0
Coding	RO, TE, ND, NC, PT		

Value	Text
0	2
1	3
2	4
3	6
4	8
5	12
6	16

Shows the actual inverter switching frequency after the auto-change function.

Parameter	05.038 *Minimum Switching Frequency*		
Short description	Minuimum Switching Frequency		
Mode	RFC‑S		
Minimum	0	Maximum	VM_MIN_SWITCHING_FREQUENCY
Default	0	Units	kHz
Type	8 Bit User Save	Update Rate	Background Read
Display Format	Standard	Decimal Places	0
Coding	RW, TE, VM		

Value	Text
0	2
1	3
2	4
3	6
4	8
5	12
6	16

See *Auto-switching Frequency Change* (05.035).

Parameter	05.039 *Maximum Inverter Temperature Ripple*		
Short description	Maximum Inverter Temperature Ripple		
Mode	RFC‑S		
Minimum	20	Maximum	60
Default	60	Units	°C
Type	8 Bit User Save	Update Rate	Background Read
Display Format	Standard	Decimal Places	0
Coding	RW		

Maximum Inverter Temperature Ripple (05.039) defines the maximum inverter temperature ripple allowed before the switching frequency is reduced. See *Auto-switching Frequency Change* (05.035).

Parameter	05.041 *Voltage Headroom*		
Short description	Voltage Headroom		
Mode	RFC‑S		
Minimum	0	Maximum	20
Default	0	Units	%
Type	8 Bit User Save	Update Rate	Background Read
Display Format	Standard	Decimal Places	0
Coding	RW		

The voltage applied to the motor is always limited by *Rated Voltage* (05.009). When *Voltage Headroom* (05.041) is set to its default value of zero the output voltage of the inverter is also limited to a level equivalent to full modulation, which is the supply voltage minus voltage drops within the inverter itself. Depending on the relative values of the supply voltage and *Rated Voltage* (05.009) there may be some headroom between the rated voltage limit and the maximum possible voltage from the inverter to allow the current control system to give good dynamic performance. In some applications it is useful to enforce some headroom between the maximum allowed motor voltage and the inherent limit imposed by the inverter. If the supply voltage is known this can be done by setting *Rated Voltage* (05.009) to a suitable value below the supply voltage level, however, it is more convenient to set *Rated Voltage* (05.009) to the actual rated voltage of the motor, and to use *Voltage Headroom* (05.041) to enforce the voltage headroom. This parameter can be used to increase the headroom between the maximum modulation limit and the maximum motor voltage from zero up to 20% of the maximum modulation limit. For example, if the supply voltage is 400V then a value of 10% will give a voltage headroom of approximately 40V.

Parameter	05.042 *Reverse Output Phase Sequence*		
Short description	Set to 1 to reverse the sequence on the output phases		
Mode	RFC‑S		
Minimum	0	Maximum	1
Default	0	Units	
Type	1 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW		

If *Reverse Output Phase Sequence* (05.042) = 0 the output phase sequence is U-V-W when *Output Frequency* (05.001) is positive and W-V-U when *Output Frequency* (05.001) is negative.
If *Reverse Output Phase Sequence* (05.042) = 1 the output phase sequence is reversed so that the phase sequence in W-V-U for positive frequencies and U-V-W for negative frequencies.

Parameter	05.044 *Stator Temperature Source*		
Short description	Defines the source of the stator temperature		
Mode	RFC‑S		
Minimum	0	Maximum	6
Default	0	Units	
Type	8 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW, TE		

Value	Text
0	An In 3
1	User
2	P1 Drive
3	P1 Slot1
4	P1 Slot2
5	P1 Slot3
6	P1 Slot4

The stator temperature can be used to compensate for changes in stator resistance. See *Stator Temperature Coefficient* (05.047). *Stator Temperature Source* (05.044) is used to select the source for the stator temperature measurement.

Stator Temperature Source (05.044)	Source	Comments
0	*Analog Input 3 Thermistor Temperature* (07.050)	Analog input 3 must be set up for the correct temperature feedback device
1	*User Stator Temperature* (05.045)	The user can provide a stator temperature value. If an alternative feedback device is to be used or the user provides an algorithm to model the stator temperature.
2	*P1 Thermistor Temperature* (03.122)	P1 position feedback interface must be set up for the correct temperature feedback device
3-6	Option slot *P1 Thermistor Temperature* (xx.122)	A position feedback category option module must be fitted and the P1 position feedback must be set up for the correct temperature feedback device

Parameter	05.045 *User Stator Temperature*		
Short description	Defines the stator temperature as set by the user		
Mode	RFC‑S		
Minimum	-50	Maximum	300
Default	0	Units	°C
Type	16 Bit Volatile	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW		

See *Stator Temperature Source* (05.044).

Parameter	05.046 *Stator Temperature*		
Short description	Displays the temperature of the motor stator		
Mode	RFC‑S		
Minimum	-50	Maximum	300
Default		Units	°C
Type	16 Bit Volatile	Update Rate	Background write
Display Format	Standard	Decimal Places	0
Coding	RO, ND, NC, PT		

See *Stator Temperature Source* (05.044).

Parameter	05.047 *Stator Temperature Coefficient*		
Short description	Defines the coefficient used to calculate the temperature of the motor stator		
Mode	RFC‑S		
Minimum	0.00000	Maximum	0.10000
Default	0.00390	Units	1/°C
Type	16 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	5
Coding	RW		

Temperature Compensated Stator Resistance (05.050) shows the stator resistance from the active motor that is being used by the drive for motor control. If *Enable Stator Compensation* (05.049) = 0 and motor 1 is selected then *Temperature Compensated Stator Resistance* (05.050) is equal to *Stator Resistance* (05.017). If *Enable Stator Compensation* (05.049) = 1 the value of *Stator Resistance* (05.017) is not changed, but *Temperature Compensated Stator Resistance* (05.050) is derived as follows:

α = *Stator Temperature Coefficient* (05.047) and this is the temperature coefficient for the stator winding at 20°C as a proportion of the resistance per degree C.

Temperature Compensated Stator Resistance (05.050) = *Stator Resistance* (05.017) x [1 + (*Stator Temperature* (05.046) – 20°C) x α] / [1 + (*Stator Base Temperature* (05.048) - 20°C) x α]

Stator Resistance (05.017) and *Stator Base Temperature* (05.048) can be set up by the user with the stator resistance at a given temperature. The preferred method is for the *Stator Resistance* (05.017) to be measured and set up using the auto-tuning system (See *Auto-tune* (05.012)). If *Enable Stator Compensation* (05.049) = 1 when the auto-tuning is carried out the *Stator Base Temperature* (05.048) will be updated automatically with *Stator Temperature* (05.046).

The temperature compensation system can only function correctly if the *Stator Temperature Coefficient* (05.047) is set up correctly. The default value is suitable for copper or aluminium windings and should not need to be adjusted for these materials provided the temperature measurement is a reasonable measure of the winding temperature. If the temperature measurement is not closely coupled to the winding it may be necessary to adjust *Stator Temperature Coefficient* (05.047) for correct compensation.

Parameter	05.048 *Stator Base Temperature*		
Short description	Defines the base temperature used to calculate the temperature of the motor stator		
Mode	RFC‑S		
Minimum	-50	Maximum	300
Default	0	Units	°C
Type	16 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW		

See *Stator Temperature Coefficient* (05.047).

Parameter	05.049 *Enable Stator Compensation*		
Short description	Set to 1 to enable stator compensation		
Mode	RFC‑S		
Minimum	0	Maximum	1
Default	0	Units	
Type	1 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW		

See *Stator Temperature Coefficient* (05.047).

Parameter	05.050 *Temperature Compensated Stator Resistance*		
Short description	Final stator resistance value used by the drive including temperature compensation		
Mode	RFC‑S		
Minimum	0.000000	Maximum	1000.000000
Default		Units	
Type	32 Bit Volatile	Update Rate	Background write
Display Format	Standard	Decimal Places	6
Coding	RO, ND, NC, PT		

Temperature Compensated Stator Resistance (05.050) shows the stator resistance value for the active motor that is being used by the drive including the effect of temperature compensation.

Parameter	05.051 *Rotor Temperature Source*		
Short description	Defines the source of the rotor temperature		
Mode	RFC‑S		
Minimum	0	Maximum	6
Default	0	Units	
Type	8 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW, TE		

Value	Text
0	An In 3
1	User
2	P1 Drive
3	P1 Slot1
4	P1 Slot2
5	P1 Slot3
6	P1 Slot4

The rotor temperature can be used to compensate for changes in rotor resistance that affects the motor slip and hence the rated speed in Open-loop or RFC-A mode, or the magnet flux that affects motor torque in RFC-S mode. See *Rotor Temperature Coefficient* (05.054) for details. *Rotor Temperature Source* (05.051) is used to select the source for the rotor temperature measurement.

Rotor Temperature Source (05.051)	Source	Comments
0	*Analog Input 3 Thermistor Temperature* (07.050)	Analog input 3 must be set up for the correct temperature feedback device
1	*User Rotor Temperature* (05.052)	The user can provide a rotor temperature value if an alternative feedback device is to be used or the user provides an algorithm to model the rotor temperature
2	*P1 Thermistor Temperature* (03.122)	P1 position feedback interface must be set up for the correct temperature feedback device
3-6	Option Slot *P1 Thermistor Temperature* (xx.122)	A position feedback category option module must be fitted and the P1 position feedback must be set up for the correct temperature feedback device

Parameter	05.052 *User Rotor Temperature*		
Short description	Defines the temperature of the motor as set by the user		
Mode	RFC-S		
Minimum	-50	Maximum	300
Default	0	Units	°C
Type	16 Bit Volatile	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW		

See *Rotor Temperature Source* (05.051).

Parameter	05.053 *Rotor Temperature*		
Short description	Displays the temperature of the motor rotor		
Mode	RFC-S		
Minimum	-50	Maximum	300
Default		Units	°C
Type	16 Bit Volatile	Update Rate	Background write
Display Format	Standard	Decimal Places	0
Coding	RO, ND, NC, PT		

See *Rotor Temperature Source* (05.051).

Parameter	05.054 *Rotor Temperature Coefficient*		
Short description	Defines the coefficient used to calculate the temperature of the rotor		
Mode	RFC-S		
Minimum	0.00000	Maximum	0.10000
Default	0.00100	Units	1/°C
Type	16 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	5
Coding	RW		

The flux produced by the magnets in a permanent magnet motor varies with rotor temperature, and this in turn affects the relationship between the motor current and torque.
Rotor Temperature Compensation (05.057) shows the compensation factor that is applied to convert from the torque reference to the torque producing current reference.
If *Enable Rotor Compensation* (05.056) = 0 no compensation is applied in converting from the torque reference to the torque producing current reference (i.e.
Rotor Temperature Compensation (05.057) = 1.000). If *Enable Rotor Compensation* (05.056) = 1 then *Rotor Temperature Compensation* (05.057) is calculated as follows:

Rotor Temperature Compensation (05.057) = 1 – [(*Rotor Temperature* (05.053) – *Rotor Base Temperature* (05.055)) x *Rotor Temperature Coefficient* (05.054)]

The default value of *Rotor Temperature Coefficient* (05.054) is a typical value for the magnets used in most permanent magnet motors. However, if the thermal coupling between the rotor and the temperature measuring device is poor it may be necessary to adjust *Rotor Temperature Coefficient* (05.054) to give better compensation.

Parameter	05.055 *Rotor Base Temperature*		
Short description	Defines the base temperature used to calculate the temperature of the rotor		
Mode	RFC-S		
Minimum	-50	Maximum	300
Default	0	Units	°C
Type	16 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW		

See *Rotor Temperature Coefficient* (05.054).

Parameter	05.056 *Enable Rotor Compensation*		
Short description	Set to 1 to enable rotor compensation		
Mode	RFC-S		
Minimum	0	Maximum	1
Default	0	Units	
Type	1 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW		

See *Rotor Temperature Coefficient* (05.054).

Parameter	05.057 *Rotor Temperature Compensation*		
Short description	Factor to convert from torque to current based on rotor temperature		
Mode	RFC-S		
Minimum	0.000	Maximum	2.000
Default		Units	
Type	16 Bit Volatile	Update Rate	Background
Display Format	Standard	Decimal Places	3
Coding	RO, ND, NC, PT		

Rotor Temperature Compensation (05.057) shows the conversion factor used between the torque reference and the torque producing current.

Parameter	05.059 *Maximum Deadtime Compensation*		
Short description	Shows the deadtime compensation used to compensate for dead-time effects in the inverter		
Mode	RFC‑S		
Minimum	0.000	Maximum	10.000
Default	0.000	Units	μs
Type	16 Bit User Save	Update Rate	Background Read
Display Format	Standard	Decimal Places	3
Coding	RO, NC, PT		

Maximum Deadtime Compensation (05.059) is the deadtime compensation used to compensate for dead-time effects in the inverter. This level of compensation is used when the drive output current is above *Current At Maximum Deadtime Compensation* (05.060). Both of these values related to dead-time compensation are measured during auto-tuning and cannot be set by the user. It should be noted that if the auto-tuning test is not performed and *Maximum Deadtime Compensation* (05.059) = 0 then dead-time compensation is disabled. Although it is not recommended, it is possible to disable dead-time compensation by setting *Disable Deadtime Compensation* (05.061) = 1.

Parameter	05.060 *Current At Maximum Deadtime Compensation*		
Short description	Current at which maximum deadtime compensation is applied		
Mode	RFC‑S		
Minimum	0.00	Maximum	100.00
Default	0.00	Units	%
Type	16 Bit User Save	Update Rate	Background Read
Display Format	Standard	Decimal Places	2
Coding	RO, NC, PT		

See *Maximum Deadtime Compensation* (05.059).

Parameter	05.061 *Disable Deadtime Compensation*		
Short description	Disable Deadtime Compensation		
Mode	RFC‑S		
Minimum	0	Maximum	1
Default	0	Units	
Type	1 Bit User Save	Update Rate	Background Read
Display Format	Standard	Decimal Places	0
Coding	RW		

See *Maximum Deadtime Compensation* (05.059).

Parameter	05.063 *Sensorless Mode Current Ramp*		
Short description	Sensorless Mode Current Ramp		
Mode	RFC‑S		
Minimum	0.00	Maximum	1.00
Default	0.20	Units	s
Type	8 Bit User Save	Update Rate	Background Write
Display Format	Standard	Decimal Places	2
Coding	RW		

See *RFC Low Speed Mode* (05.064).

Parameter	05.064 *RFC Low Speed Mode*		
Short description	Defines the low speed mode of the drive when position feedback is not being used		
Mode	RFC‑S		
Minimum	0	Maximum	5
Default	2	Units	
Type	8 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW, TE		

Value	Text	Description
0	Injection	High frequency injection mode
1	Non-salient	Non-salient motor mode
2	Current	Current vector mode with initial test to determine the rotor position
3	Current No Test	Current vector mode without initial test to determine the rotor position
4	Current Step	Current vector mode with no test and step changes in current between low/high speed modes
5	Current Only	Current vector mode always active

If sensorless mode is being used and is active (i.e. *Sensorless Mode Active* (03.078) = 1) and the motor is operating at low speed then a low speed algorithm must be used to control the motor. The change between the low speed and normal operation algorithms is related to the drive output frequency. An upper threshold is provided for the change from low speed to normal operation, and a lower threshold is provided for the change back from normal to low speed operation as given in the table below. These values are a percentage of *Rated Speed* (05.008).

Switching Frequency (05.037)	Lower Threshold	Upper Threshold
2kHz	5%	10%
3kHz	5%	10%
4kHz	5%	10%
6kHz	10%	15%
8kHz	10%	15%
12kHz	15%	20%
16kHz	15%	20%

RFC Low Speed Mode (05.064) is used to select the algorithm to be used as described below.

0: Injection
A high frequency signal is injected into the motor to detect the motor flux axis. For this to operate correctly the motor must remain salient while the low speed mode is active. The no-load inductance parameters are checked by the drive on enable and if the motor is not sufficiently salient then a *Inductance* trip is initiated. See the details of this trip for the inductances required. Generally the q axis inductance falls as the q axis current is increased, i.e. the motor is loaded. While low speed operation is active the drive will apply a current limit defined by

Low Speed Sensorless Mode Current (05.071) to prevent the q axis inductance from falling to a level that would cause the motor to become non-salient. It will be necessary to limit the bandwidth of the speed controller to a level of 10Hz or less for stable operation particularly at low speeds. Provided these conditions are met this method can be used in the same way as control with position feedback, but the control performance is limited.

1: Non-salient
If the motor has low or no saliency (i.e. the conditions defined for *Inductance* cannot be met under the required load conditions) then this method can be used for low speed operation. This mode does not provide the same level of control as injection mode and the following should be considered:

1. Only speed control can be used when low speed mode operation is active.
2. When the low speed algorithm is active it will not be possible to produce more than approximately 60% to 70% of rated torque. *Low Speed Sensorless Mode Current* (05.071) defines a current applied in the motor d axis to aid starting. A value of 20% is suitable for most motors with a load of up to 60% rated torque. However, in some applications this level may need to be adjusted.
3. There may be some movement of the motor shaft in either direction as the motor starts.
4. It is not possible to measure the motor inertia using auto-tuning with *Auto-tune* (05.012) = 4.
5. Normally the ramp rate should not be slower than 5s/1000rpm when operating in the region below *Rated Speed* (05.008) / 10.
6. This mode is not intended to control the motor for prolonged periods at low speed, but is intended to allow the motor to be started from standstill to run outside the low speed region.
7. This mode is not intended to allow motor reversals. If the direction does need to be reversed, the motor should be stopped and any oscillations must die away, before the motor is restarted in the other direction.

2: Current
This method, which applies a rotating current vector at the frequency defined by the speed reference, can be used with any motor with no saliency or moderate saliency. It should only be used with motors where more of the torque is produced in conjunction with the magnet flux rather than from saliency torque. This mode does not provide the same level of control at low speed as injection mode, but is easier to set up and more flexible than "Non-salient" mode. The following should be considered:

1. Only speed control can be used when low speed mode operation is active.
2. A current specified by *Low Speed Sensorless Mode Current* (05.071) is applied when low speed mode is active. This current should be sufficient to start the motor with the highest expected load. If the motor has some saliency with no-load applied, and a suitable saturation characteristic, the drive can detect the rotor position and apply the current at the correct angle to avoid starting transient. If the motor is non-salient as defined by the conditions for *Inductance* trip then the drive will not attempt to detect the rotor position and the current will be applied at an arbitrary angle. This could cause a starting transient if the level of current applied is high, and so *Low Speed Sensorless Mode Current* (05.071) should not be set to a higher level than necessary. To minimise the movement as a result of applying the current, it is increased over the period defined by *Sensorless Mode Current Ramp* (05.063) in the form of a squared characteristic (i.e. it is increased with a low rate of change at the beginning and the rate of change is gradually increased).
3. It is not possible to measure the motor inertia using auto-tuning with *Auto-tune* (05.012) = 4.
4. As the level of current when low speed mode is active is not dependent on the applied load, but is as defined by *Low Speed Sensorless Mode Current* (05.071), and so the motor may become too hot if low speed mode is active for a prolonged period of time.
5. Generally *Low Speed Sensorless Mode Current* (05.071) should be set to a level higher than the expected maximum load, and can be set to a much higher level than the load if the saliency and saturation characteristic allow the position of the rotor to be detected on starting. However, *Low Speed Sensorless Mode Current* (05.071) should be matched more closely to the expected load under the following conditions: the load inertia is high compared to the motor interia, or there is very little damping/loss in the load system, or where the q axis inductance of the motor changes significantly with load.

3: Current no test
The "Current" method is used, but no attempt is made to determine the position of the rotor before applying the current. This can be selected for example, if the motor does not have a suitable saturation characteristic to allow the rotor position to be determined during starting, or if faster starting is required. The initial current vector angle will be at an arbitary position with respect to the actual rotor position. As the vector sweeps round it must make the rotor start to rotate. If the ramp rate is too high the rotor may not keep up with the current vector and the motor may not start. If this is the case then the ramp rate should be reduced and/or the current used to start the motor should be increased.

Torque control can be used with the "Injection" starting method in the same way as with position feedback. However if torque control is to be used in an application where the other starting methods are used then the following should be considered:

1. Torque control should not be enabled until the low speed algorithm is no longer active and the motor speed must not drop to a level where the low speed mode will become active again while torque control is active. This means that the motor must be started in speed control and torque control should only be selected when the speed is high enough.
2. To stop the motor the drive can simply be disabled or the run should be removed for the drive to stop the motor. Removing the run causes the drive to switch from torque control to speed control, and so the motor speed can be reduced back down though the range where the low speed algorithm is active.

Parameter	05.065 *Saliency Torque Control Select*		
Short description	Set the required saliency torque control mode		
Mode	RFC-S		
Minimum	0	Maximum	3
Default	0	Units	
Type	8 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW, TE		

Value	Text
0	Disabled
1	Low
2	High
3	Auto

Most permanent magnet motors include some saliency due to saturation and physical construction. Torque is normally produced by interaction between the magnet flux and the stator current, but any saliency can be exploited to produce additional torque, which can increase the torque per amp produced by the motor. If *Saliency Torque Control Select* (05.065) = 0 (disabled) torque is only produced from the magnet flux. If *Saliency Torque Control Select* (05.065) = 3 (auto) then torque can be produced from saliency and the mode to do this is selected automatically based on the value of *Rated Torque Angle* (05.089). If the torque produced by the magnet flux is more than twice the torque produced by saliency under rated conditions then *Rated Torque Angle* (05.089) < 30°, and under these conditions low saliency mode is selected, otherwise high saliency mode is selected. It is possible to specifically choose the saliency mode, *Saliency Torque Control Select* (05.065) = 1 gives low saliency mode and *Saliency Torque Control Select* (05.065) = 2 gives high saliency mode. It should be noted that if *Rated Torque Angle* (05.089) = 0 that the saliency mode remains disabled. *Active Saliency Torque Mode* (05.066) shows which mode is active.

Low saliency mode is for motors where a majority of the torque is produced from magnet flux, and high saliency mode is for motors where signficant torque is produced from saliency. The following are affected by the mode used:

1. At higher speeds there is a limit on the amount of torque that can be produced by the motor for a given motor terminal voltage. Different algorithms are used to impose this limit depending on which mode is selected. The method used with low saliency mode can be enabled or disabled depending on the setting of *Enable High Speed Mode* (05.022).
2. Different methods are used during flux weakening at higher speeds to control the motor.
3. Different sensorless control algorithms are used. The parameters required for the sensorless algorithms are similar execept for the q axis inductance when the motor is operating on load. See *No-load Lq* (05.072) for more details.

Parameter	05.066 *Active Saliency Torque Mode*		
Short description	Active Saliency Torque Mode		
Mode	RFC‑S		
Minimum	0	Maximum	2
Default		Units	
Type	8 Bit Volatile	Update Rate	Background Write
Display Format	Standard	Decimal Places	0
Coding	RO, TE, ND, NC, PT		

Value	*Text*
0	Disabled
1	Low
2	High

Active Saliency Torque Mode (05.066) shows which saliency torque control mode is active. See *Saliency Torque Control Select* (05.065) for more details.

Parameter	05.067 *Over-current Trip Level as Percentage Kc*		
Short description	Over-current trip level as a percentage of Kc		
Mode	RFC‑S		
Minimum	0	Maximum	100
Default	0	Units	%
Type	8 Bit User Save	Update Rate	Background Read When Drive Not Active
Display Format	Standard	Decimal Places	0
Coding	RW, BU		

The drive provides an over-current trip to disable the inverter quickly if the instantaneous current from the drive exceeds a specific level. This trip is provided to protect the drive in case a short circuit is applied to the outputs, but it also prevents the current into the motor from exceeding a specific maximum level. If *Over-current Trip Level as Percentage Kc* (05.067) and *Over-current Trip Level as Percentage of Rated Current* (05.069) are left at their default values of zero then the default over-current trip level is used (which is provided to protect the drive) and is set to the maximum possible safe level of current. The trip occurs when the r.m.s. output current corresponds to *Full Scale Current Kc* (11.061) (plus a margin for cable charging currents with smaller drives). The instantaneous trip level is √2 times the r.m.s. level. Unless there is a reason to limit the peak current in the motor further then these parameters should be left at their default values.

If *Over-current Trip Level as Percentage of Rated Current* (05.069) is set to a non-zero value it defines the over-current trip level as a percentage of the rated current (where the rated current is defined by *Rated Current* (05.007) or *M2 Rated Current* (21.007)). If *Over-current Trip Level as Percentage of Rated Current* (05.069) is non-zero then *Over-current Trip Level as Percentage Kc* (05.067) has no effect. The actual setting of the over-current trip in the hardware is relatively coarse, and so the trip level may be less than the selected setting. For this reason *Actual Over-current Trip Level* (05.068) shows the actual trip level as a percentage of rated current when *Over-current Trip Level as Percentage of Rated Current* (05.069) is used to define the trip level. As the over-current trip is normally reduced to protect a motor, using *Over-current Trip Level as Percentage of Rated Current* (05.069) to define this is the preferred method.

If required, the over-current trip level can be set as a percentage of *Full Scale Current Kc* (11.061) using *Over-current Trip Level as Percentage Kc* (05.067). Again due to the coarse setting in the drive hardware the actual over-current trip level may be less than the required level, and so *Actual Over-current Trip Level* (05.068) shows the actual trip level as a percentage of *Full Scale Current Kc* (11.061) when *Over-current Trip Level as Percentage Kc* (05.067) is used to define this. Either a value of zero should be used, so that the default level is applied (assuming *Over-current Trip Level as Percentage of Rated Current* (05.069) = 0) or a value from 10% to 100% should be used to define the level as a percentage of Kc. (Note there are settings from 1 to 9 which are only provided for legacy reasons and should not normally be used where the percentage is given by (*Over-current Trip Level as Percentage Kc* (05.067) + 1) x 10%.)

It should be noted that if the over-current trip level is reduced, it may be necessary to reduce the current limits from their default levels so that the maximum controllable current in the drive does not exceed the over-current trip level during normal operation, or else spurious trips will be produced.

Parameter	05.068 *Actual Over-current Trip Level*		
Short description	Actual Over-current Trip Level		
Mode	RFC‑S		
Minimum	0	Maximum	500
Default		Units	%
Type	16 Bit Volatile	Update Rate	Background Write
Display Format	Standard	Decimal Places	0
Coding	RO, ND, NC, PT, BU		

See *Over-current Trip Level as Percentage Kc* (05.067).

Parameter	05.069 *Over-current Trip Level as Percentage of Rated Current*		
Short description	Over-current trip level as a percentage of rated current		
Mode	RFC‑S		
Minimum	0	Maximum	1000
Default	0	Units	%
Type	16 Bit User Save	Update Rate	Background Read When Drive Not Active
Display Format	Standard	Decimal Places	0
Coding	RW		

If this parameter has a non-zero value it overrides *Over-current Trip Level as Percentage Kc* (05.067) and the over-current trip level is calculated as a percentage of the motor rated current. See *Over-current Trip Level as Percentage Kc* (05.067) for more details. For some drive derivatives the default for *Over-current Trip Level as Percentage of Rated Current* (05.069) is non-zero. If this is the case, the lower level has been provided to protect motors where the demagnetisation level is relatively low. Before increasing this parameter the maximum allowed motor current MUST be checked to ensure that the over-current trip level is not above this level or else the motor may be PERMANENTLY DAMAGED.

Parameter	05.070 *Inverted Saturation Characteristic*		
Short description	The motor has an inverted saturation characteristic		
Mode	RFC‑S		
Minimum	0	Maximum	1
Default	0	Units	
Type	1 Bit User Save	Update Rate	Background Read
Display Format	Standard	Decimal Places	0
Coding	RW		

The change of motor inductance with flux producing current is used to determine the flux direction in RFC-S mode when operating without position feedback. Normally an increase in flux producing current reduces Ld because the motor becomes more saturated. For some motors increasing the flux producing current can modify the flux path and Ld increases with increased flux producing current. For normal motors *Inverted Saturation Characteristic* (05.070) should be left at its default value of zero, however, for motors with an apparent inverse saturation characteristic *Inverted Saturation Characteristic* (05.070) should be set to one. If this parameter is not set and the motor has an inverted saturation characteristic this can be seen as follows:

1. Sudden jump in position during a stationary auto-tune with position feedback.
2. Sudden jump in position during auto-tuning in sensorless mode.

3. Very unstable operation or the motor runs in the wrong direction on starting in sensorless mode.

It should be noted that the saturation characteristic is also used to locate the flux axis when performing a stationary auto-tune or when measuring the phasing angle on enable. If a motor has an inverted saturation characteristic then *Inverted Saturation Characteristic* (05.070) should be set to one for these tests to operate correctly.

Parameter	05.071 *Low Speed Sensorless Mode Current*		
Short description	Maximum current limit for low speed injection mode or magnetising current for low speed non-salient mode		
Mode	RFC‑S		
Minimum	0.0	Maximum	1000.0
Default	100.0	Units	%
Type	16 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	1
Coding	RW, RA		

See *RFC Low Speed Mode* (05.064).

Parameter	05.072 *No-load Lq*		
Short description	q axis inductance with no motor current		
Mode	RFC‑S		
Minimum	0.000	Maximum	500.000
Default	0.000	Units	mH
Type	32 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	3
Coding	RW, RA		

The q axis inductance can vary significantly with the level of d and q axis current in the motor. The drive estimates a value of Lq for use by the control system as the levels of d and q axis current change and writes this to *Estimated Lq* (05.088) as shown below.

Estimation of Lq with different levels of Id and Iq. Note that outside the plane shown the estimated inductance does not change, but remains at the level at the nearest edge of the plane
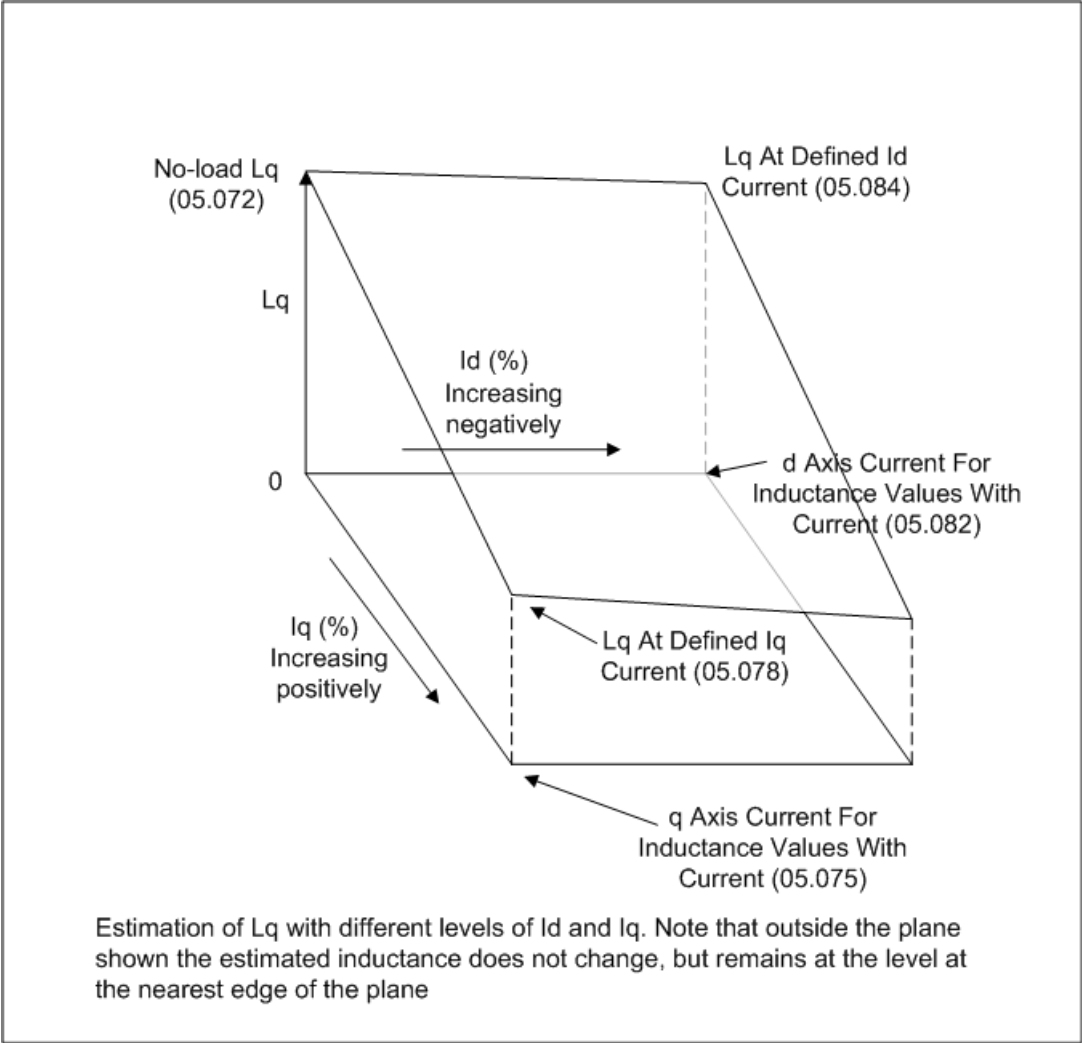
In all cases, except for the value of Lq used in estimating the rotor position for sensorless control of high saliency motors (i.e. *Active Saliency Torque Mode* (05.066) = 2), the normal (chord) q axis inductance is used and the value shown in *Estimated Lq* (05.088) is the normal inductance defined by the level of current in the motor. The following description shows how Lq is estimated except when sensorless control is being used for a high saliency motor. The q axis inductance is assumed to vary with id and iq on a flat plane where three points on the plane are defined by *No-load Lq* (05.072), *Lq At The Defined Iq Current* (05.078) and *Lq At The Defined Id Current* (05.084). The current levels that correspond to these points are (Id=0 Iq=0), (Id=0 Iq= *q Axis Current For Inductance Values With Current* (05.075)) and (Id= *d Axis Current For Inductance Values With Current* (05.082)) respectively. *No-load Lq* (05.072) should be set to the correct value or measured using auto-tuning. Lq is calculated as follows depending on how many of the other parameters required to calculate Lq are also set up. The current levels are set as a percentage of the motor rated current (*Rated Current* (05.007)).

Parameters changed from default	Parameters left at default	Action
None	*q Axis Current For Inductance Values With Current* (05.075) and *Lq At The Defined Iq Current* (05.078) and *d Axis Current For Inductance Values With Current* (05.082) and *Lq At The Defined Id Current* (05.084)	*Lq At The Defined Iq Current* (05.078) is assumed to be 80% of *No-load Lq* (05.072). Lq varies with Iq using this value of inductance and *q Axis Current For Inductance Values With Current* (05.075) = 100%. No change of Lq with Id.
q Axis Current For Inductance Values With Current (05.075)	*Lq At The Defined Iq Current* (05.078) and *d Axis Current For Inductance Values With Current* (05.082) and *Lq At The Defined Id Current* (05.084)	*Lq At The Defined Iq Current* (05.078) is assumed to be 80% of *No-load Lq* (05.072). Lq varies with Iq using this value of inductance and *q Axis Current For Inductance Values With Current* (05.075). No change of Lq with Id.
q Axis Current For Inductance Values With Current (05.075) and *Lq At The Defined Iq Current* (05.078)	*d Axis Current For Inductance Values With Current* (05.082) and *Lq At The Defined Id Current* (05.084)	*Lq At The Defined Id Current* (05.084) and *q Axis Current For Inductance Values With Current* (05.075) are used to defined Lq. No change of Lq with Id.
q Axis Current For Inductance Values With Current (05.075) and *Lq At The Defined Iq Current* (05.078) and *Lq At The Defined Id Current* (05.084) and	*d Axis Current For Inductance Values With Current* (05.082)	*Lq At The Defined Id Current* (05.084), *q Axis Current For Inductance Values With Current* (05.075) and *Lq At The Defined Id Current* (05.084) are used to defined Lq with *d Axis Current For Inductance Values With Current* (05.082)=-100%.
q Axis Current For Inductance Values With Current (05.075) and *Lq At The Defined Iq Current* (05.078) and *d Axis Current For Inductance Values With Current* (05.082) and *Lq At The Defined Id Current* (05.084)	None	*Lq At The Defined Id Current* (05.084), *q Axis Current For Inductance Values With Current* (05.075), *Lq At The Defined Id Current* (05.084) and *d Axis Current For Inductance Values With Current* (05.082) are used to defined Lq.

If sensorless mode is being used to control a high saliency motor the rotor position is estimated using the incremental inductance of the motor and *Estimated Lq* (05.088) shows the value of the q axis incremental inductance instead of the normal inductance. The system to calculate this is the same as for the normal inductance except that *Lq Incremental Inductance At Defined Iq Current* (05.079) is used instead of *Lq At The Defined Iq Current* (05.078), and *Lq Incremental Inductance At Defined Id Current* (05.085) is used instead of *Lq At The Defined Id Current* (05.084). Note that for all other functions in the drive the normal inductances are used.

No-load Lq (05.072) is used as described in the table below.

Function	Details
High performance current control	If high performance current control is selected (*Current Controller Mode* (04.030) =1) Lq is used by the controller in q axis.
Low speed operation with sensorless control	If injection mode is used (*RFC Low Speed Mode* (05.064) = 0) for low speed operation Lq defines the gain of the system.
*Control above low speeds with sensorless control	No-load Lq is used in the system that actively calculates the value of Lq with changing motor currents which is used to calculate the rotor position.
*Motor torque limit	No-load Lq (and not the dynamically calculated Lq) is used to define the torque limit of high saliency motors.
*Rated torque angle	If the drive defines *Rated Torque Angle* (05.089) no-load Lq is used in the calculation.

The following parameters are also used in the system that calculates the value of Lq with different levels of motor current, and so these also affect the functions marked with * in the table:
q Axis Current For Inductance Values With Current (05.075), *Lq At The Defined Iq Current* (05.078), *Lq Incremental Inductance At Defined Iq Current* (05.079),
d Axis Current For Inductance Values With Current (05.082), *Lq At The Defined Id Current* (05.084) and *Lq Incremental Inductance At Defined Id Current* (05.085).

Parameter	05.075 *q Axis Current For Inductance Values With Current*		
Short description	q axis current level corresponding to the inductance values with current		
Mode	RFC‑S		
Minimum	0	Maximum	200
Default	100	Units	%
Type	8 Bit User Save	Update Rate	Background Read
Display Format	Standard	Decimal Places	0
Coding	RW, BU		

See *No-load Lq* (05.072).

Parameter	05.077 *Phase Offset At Defined Iq Current*		
Short description	Defines the change in electrical angle between the point of minimum inductance around the motor as load is applied		
Mode	RFC‑S		
Minimum	-90.0	Maximum	90.0
Default	0.0	Units	°
Type	16 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	1
Coding	RW, RA		

Phase Offset At Defined Iq Current (05.077) defines the offset of the point of minimum inductance as an electrical angle from the point with no current in the motor to the point with a level of Iq equivalent to *q Axis Current For Inductance Values With Current* (05.075). When the value is left at its default value of zero no compensation for phase offset with changes in Iq are made. *Phase Offset At Defined Iq Current* (05.077) is used for low speed RFC sensorless control using injection mode. A positive value advances the point of minimum inductance with positve Iq. See *RFC Low Speed Mode* (05.064). For most motors a value of zero is acceptable.

Parameter	05.078 *Lq At The Defined Iq Current*		
Short description	q axis inductance at the defined Iq current for the inductance values		
Mode	RFC‑S		
Minimum	0.000	Maximum	500.000
Default	0.000	Units	mH
Type	32 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	3
Coding	RW, RA		

See *No-load Lq* (05.072).

Parameter	05.079 *Lq Incremental Inductance At Defined Iq Current*		
Short description	q axis incremental inductance at the defined Iq current for the inductance values		
Mode	RFC‑S		
Minimum	0.000	Maximum	500.000
Default	0.000	Units	mH
Type	32 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	3
Coding	RW, RA		

See *No-load Lq* (05.072).

Parameter	05.082 *d Axis Current For Inductance Values With Current*		
Short description	d axis current level corresponding to the inductance values with current		
Mode	RFC‑S		
Minimum	-100	Maximum	0
Default	-100	Units	%
Type	8 Bit User Save	Update Rate	Background Read
Display Format	Standard	Decimal Places	0
Coding	RW		

See *No-load Lq* (05.072).

Parameter	05.084 *Lq At The Defined Id Current*		
Short description	q axis inductance at the defined Id current for the inductance values		
Mode	RFC‑S		
Minimum	0.000	Maximum	500.000
Default	0.000	Units	mH
Type	32 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	3
Coding	RW, RA		

See *No-load Lq* (05.072).

Parameter	05.085 *Lq Incremental Inductance At Defined Id Current*		
Short description	q axis incremental inductance at the defined Id current for the inductance values		
Mode	RFC‑S		
Minimum	0.000	Maximum	500.000
Default	0.000	Units	mH
Type	32 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	3
Coding	RW, RA		

See *No-load Lq* (05.072).

Parameter	05.087 *User Defined Rated Torque Angle*		
Short description	User defined rated torque angle which will override the drive auto-calculated value.		
Mode	RFC‑S		
Minimum	0	Maximum	90
Default	0	Units	°
Type	8 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW		

Rated Torque Angle (05.089) defines the amount of torque and flux producing current required to give maximum torque from the motor with rated current (i.e. *Rated Current* (05.007)) including any torque produced from saliency. The torque angle is the angle between the q axis of the motor and the current vector required to produce the torque. This is also referred to as the current angle or phase advance angle. If *Saliency Torque Control Select* (05.065) ≥ 1 the drive will try and exploit the saliency torque of the motor by applying some negative d axis current. If *User Defined Rated Torque Angle* (05.087) is changed from its default value of zero and *Saliency Torque Control Select* (05.065) ≥ 1, the value entered in *User Defined Rated Torque Angle* (05.087) is written directly to *Rated Torque Angle* (05.089) and defines the angle used for the applied current from the q axis. As the torque angle is increased the amount of negative d axis current increases. This angle should be set to the level to give maximum torque per Amp with rated current in the motor.

It is possible for the drive to automatically calculate the rated torque angle from motor set-up parameters and those measured during autotuning. The drive will calculate and set up *Rated Torque Angle* (05.089) if *Saliency Torque Control Select* (05.065) ≥ 1 and *User Defined Rated Torque Angle* (05.087) = 0. The following parameters are used in the calculation:

Rated Current (05.007)
Ld (05.024)
No-load Lq (05.072)
Volts Per 1000rpm (05.033)
q Axis Current For Inductance Values With Current (05.075)
Lq At The Defined Iq Current (05.078)*
d Axis Current For Inductance Values With Current (05.082)
Lq At The Defined Id Current (05.084)*

*The value of Lq used in the calculation is the value estimated using the same algorithm when the drive is running. See *No-load Lq* (05.072) for the effect of leaving these parameters at their default values.

Parameter	05.088 *Estimated Lq*		
Short description	Estimated value of Lq including the effects of Id and Iq		
Mode	RFC‑S		
Minimum	0.000	Maximum	500.000
Default		Units	mH
Type	32 Bit Volatile	Update Rate	Background write
Display Format	Standard	Decimal Places	3
Coding	RO, FI, ND, NC, PT		

Estimated Lq (05.088) shows the calculated value of Lq. See *No-load Lq* (05.072).

Parameter	05.089 *Rated Torque Angle*		
Short description	Rated Torque Angle		
Mode	RFC‑S		
Minimum	0	Maximum	90
Default		Units	°
Type	8 Bit Volatile	Update Rate	Background write
Display Format	Standard	Decimal Places	0
Coding	RO, ND, NC, PT		

See *User Defined Rated Torque Angle* (05.087).

Menu 6 Single Line Descriptions − *Sequencer and Clock*

Mode: RFC‑S

Parameter	Range	Default	Type				
06.001 Stop Mode	Coast (0), Ramp (1), No Ramp (2)	No Ramp (2)	RW	Txt			US
06.002 Limit Switch Stop Mode	Stop (0), Ramp (1)	Stop (0)	RW	Txt			US
06.003 Supply Loss Mode	Disable (0), Ramp Stop (1), Ride Thru (2), Limit Stop (3)	Disable (0)	RW	Txt			US
06.008 Hold Zero Speed	Off (0) or On (1)	On (1)	RW	Bit			US
06.009 Catch A Spinning Motor	Disable (0), Enable (1), Fwd Only (2), Rev Only (3)	Enable (1)	RW	Txt			US
06.010 Enable Conditions	000000000000 to 111111111111		RO	Bin	ND	NC	PT
06.011 Sequencer State Machine Inputs	000000 to 111111		RO	Bin	ND	NC	PT
06.012 Enable Stop Key	Off (0) or On (1)	Off (0)	RW	Bit			US
06.013 Enable Auxiliary Key	Disabled (0), Forward/Reverse (1), Run Reverse (2)	Disabled (0)	RW	Txt			US
06.015 Drive Enable	Off (0) or On (1)	On (1)	RW	Bit			US
06.016 Date	00-00-00 to 31-12-99		RW	Date	ND	NC	PT
06.017 Time	00:00:00 to 23:59:59		RW	Time	ND	NC	PT
06.018 Day Of Week	Sunday (0), Monday (1), Tuesday (2), Wednesday (3), Thursday (4), Friday (5), Saturday (6)		RO	Txt	ND	NC	PT
06.019 Date/Time Selector	Set (0), Powered (1), Running (2), Acc Powered (3), Local Keypad (4), Remote Keypad (5)	Powered (1)	RW	Txt			US
06.020 Date Format	Std (0), US (1)	Std (0)	RW	Txt			US
06.021 Time Between Filter Changes	0 to 30000 Hours	0 Hours	RW	Num			US
06.022 Filter Change Required / Change Done	Off (0) or On (1)		RW	Bit	ND	NC	
06.023 Time Before Filter Change Due	0 to 30000 Hours		RO	Num	ND	NC	PT	PS
06.024 Reset Energy Meter	Off (0) or On (1)	Off (0)	RW	Bit			
06.025 Energy Meter: MWh	±999.9 MWh		RO	Num	ND	NC	PT	PS
06.026 Energy Meter: kWh	±99.99 kWh		RO	Num	ND	NC	PT	PS
06.027 Energy Cost Per kWh	0.0 to 600.0	0.0	RW	Num			US
06.028 Running Cost	±32000		RO	Num	ND	NC	PT
06.029 Hardware Enable	Off (0) or On (1)		RO	Bit	ND	NC	PT
06.030 Run Forward	Off (0) or On (1)	Off (0)	RW	Bit		NC	
06.031 Jog	Off (0) or On (1)	Off (0)	RW	Bit		NC	
06.032 Run Reverse	Off (0) or On (1)	Off (0)	RW	Bit		NC	
06.033 Forward/Reverse	Off (0) or On (1)	Off (0)	RW	Bit		NC	
06.034 Run	Off (0) or On (1)	Off (0)	RW	Bit		NC	
06.035 Forward Limit Switch	Off (0) or On (1)	Off (0)	RW	Bit		NC	
06.036 Reverse Limit Switch	Off (0) or On (1)	Off (0)	RW	Bit		NC	
06.037 Jog Reverse	Off (0) or On (1)	Off (0)	RW	Bit		NC	
06.039 Not Stop	Off (0) or On (1)	Off (0)	RW	Bit		NC	
06.040 Enable Sequencer Latching	Off (0) or On (1)	Off (0)	RW	Bit			US
06.041 Drive Event Flags	00 to 11	00	RW	Bin		NC	
06.042 Control Word	0000000000000000 to 1111111111111111	0000000000000000	RW	Bin		NC	
06.043 Control Word Enable	Off (0) or On (1)	Off (0)	RW	Bit			US
06.044 Active Supply	Off (0) or On (1)		RO	Bit	ND	NC	PT
06.045 Cooling Fan control	-10 to 11	10	RW	Num			US
06.046 Cooling Fan Speed	0 to 10		RO	Num	ND	NC	PT
06.047 Input Phase Loss Detection Mode	Full (0), Ripple Only (1), Disabled (2)	Full (0)	RW	Txt			US
06.048 Supply Loss Detection Level	±VM_SUPPLY_LOSS_LEVEL V	200V drive: 205 V 400V drive: 410 V 575V drive: 540 V 690V drive: 540 V	RW	Num		RA	US
06.051 Hold Supply Loss Active	Off (0) or On (1)	Off (0)	RW	Bit		NC	
06.052 Motor Pre‑heat Current Magnitude	0 to 100 %	0 %	RW	Num			US
06.053 Sleep / Wake Threshold	±VM_SPEED_FREQ_REF_UNIPOLAR	0.0	RW	Num			US
06.054 Sleep Time	0.0 to 250.0 s	10.0 s	RW	Num			US
06.055 Wake Time	0.0 to 250.0 s	10.0 s	RW	Num			US
06.056 Sleep Required	Off (0) or On (1)		RO	Bit	ND	NC	PT
06.057 Sleep Active	Off (0) or On (1)		RO	Bit	ND	NC	PT
06.058 Output Phase Loss Detection Time	0.5s (0), 1.0s (1), 2.0s (2), 4.0s (3)	0.5s (0)	RW	Txt			US
06.059 Output Phase Loss Detection Enable	Disabled (0), Phases (1), Devices (2)	Disabled (0)	RW	Txt			US
06.060 Standby Mode Enable	Off (0) or On (1)	Off (0)	RW	Bit			US
06.061 Standby Mode Mask	0000000 to 1111111	0000000	RW	Bin			US
06.065 Standard Under Voltage Threshold	±VM_STD_UNDER_VOLTS V	200V drive: 175 V 400V drive: 330 V 575V drive: 435 V 690V drive: 435 V	RW	Num		RA	US

06.066	Low Under Voltage Threshold	±VM_LOW_UNDER_VOLTS V	200V drive: 175 V 400V drive: 330 V 575V drive: 435 V 690V drive: 435 V	RW	Num		RA		US
06.067	Low Under Voltage Threshold Select	Off (0) or On (1)	Off (0)	RW	Bit				US
06.068	Backup Supply Mode Enable	Off (0) or On (1)	Off (0)	RW	Bit				US
06.069	Under‑voltage System Contactor Close	Off (0) or On (1)		RO	Bit	ND	NC	PT	
06.070	Under‑voltage System Contactor Closed	Off (0) or On (1)	Off (0)	RW	Bit				
06.071	Slow Rectifier Charge Rate Enable	Off (0) or On (1)	Off (0)	RW	Bit				US
06.072	User Supply Select	Off (0) or On (1)	Off (0)	RW	Bit				US
06.073	Braking IGBT Lower Threshold	±VM_DC_VOLTAGE_SET V	200V drive: 390 V 400V drive: 780 V 575V drive: 930 V 690V drive: 1120 V	RW	Num		RA		US
06.074	Braking IGBT Upper Threshold	±VM_DC_VOLTAGE_SET V	200V drive: 390 V 400V drive: 780 V 575V drive: 930 V 690V drive: 1120 V	RW	Num		RA		US
06.075	Low Voltage Braking IGBT Threshold	±VM_DC_VOLTAGE_SET V	0 V	RW	Num		RA		US
06.076	Low Voltage Braking IGBT Threshold Select	Off (0) or On (1)	Off (0)	RW	Bit				
06.084	Date And Time Offset	±12.00 Hours	0.00 Hours	RW	Num				US

RW	Read / Write	RO	Read-only	Bit	Bit parameter	Txt	Text string	Date	Date parameter	Time	Time parameter
Chr	Character parameter	Bin	Binary parameter	IP	IP address	Mac	MAC address	Ver	Version number	SMP	Slot, menu, parameter
Num	Number parameter	DE	Destination	ND	No default value	RA	Rating dependent	NC	Non-copyable	PT	Protected
FI	Filtered	US	User save	PS	Power-down save						

Menu 6 − *Sequencer and Clock*

Mode: RFC‑S

The diagram below shows the sequencer for RFC-A and RFC-S modes.

Hardware Enable

06.029

Enable logic

Fire Mode Active

10.067

Control Word Enable (06.043)

AND

Auto/manual (Bit 7)

Control Word (06.042)

1

0

Drive Enable (06.015)
Run Forward (06.030)
Jog (06.031)
Run Reverse (06.032)
Forward/reverse (06.033)
Run (06.034)
Jog Reverse (06.037)
Not Stop (06.039)

Enable Auxiliary Key (06.013)

Enable Stop Key (06.012)

Reference Selected Indicator (01.049) = 4

OR

Run key

Stop key

Auxiliary key

Sleep Active

Sleep mode detection
Sleep/wake Threshold (06.053)
Sleep Time Delay (06.054)
Wake Time Delay (06.055)

06.057

Run excluding sleep

Trip detection system
(Menu 10)

10.080

Stop Motor

Drive tripped

Limit Switch Active

Forward Limit Switch (06.035)
Reverse Limit Switch (06.036)

10.066

Mains/phase Loss Detection System
Input Phase Loss Detection Mode (06.047)
Supply Loss Detection Level (06.048)

10.015

Supply Loss

Enable Conditions

06.010

Sequencer state machine

Stop Mode (06.001)
Limit Switch Stop Mode (06.002)
Supply Loss Mode (06.003)
Injection Braking Level (06.006)***
Injection Braking Time (06.007)***
Hold Zero Speed (06.008)
Catch A Spinning Motor (06.009)
Motor Pre-heat Current Magnitude (06.052)

Final drive enable

Sequencer logic

Enable Sequencer Latching (06.040)

Reverse Select

01.012

Jog Select

01.013

Final drive run

Under Voltage Active

10.016

*Zero Speed

10.003

**Motion Controller Mode (13.010)

Reference On

01.011

Drive Active

10.002

Sequencer State Machine Inputs

06.011

Sequencer (Open-loop, RFC-A and RFC-S modes)

*In Open-loop mode zero speed is detected when the ramp output reaches zero
** RFC-A and RFC-S modes only
*** Open-loop mode only

The sequencer, which provides overall control of the drive, is implemented in two stages. The first stage includes the enable logic and sequencer logic

and consists of static logic elements. The second stage is a state machine with internal states.

Enable logic
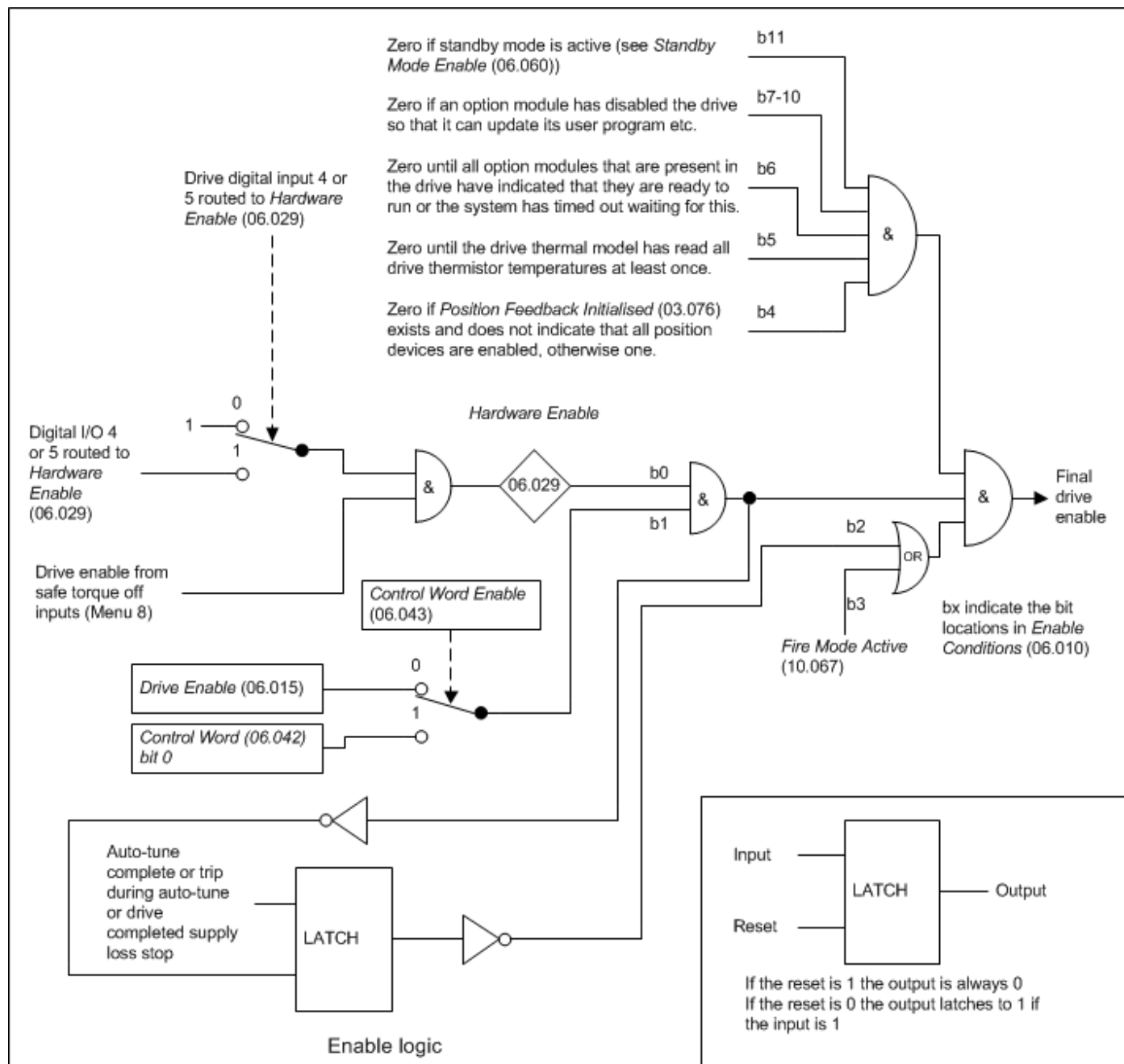
Hardware Enable (06.029) follows the safe torque off enable signal provided none of the digital inputs that are integral to the drive are routed to the *Hardware Enable* (06.029). The safe torque off hardware includes a delay in detecting a change from the enable to disable state of up to 20ms, but for most applications this is not a problem. However, a faster disable time can be achieved (600us) if digital input 4 or 5 on the drive is routed to the *Hardware Enable* (06.029).

If the safety function of the safe torque off input is required then there must not be a direct connection between the safe torque off input and any other digital I/O on the drive. If the safety function of the safe torque off input and a fast disable function are required together, then the drive should be given two separate independent enable input signals. A signal from a safe source should be connected to the safe torque off input on the drive. A second enable should be connected to the digital I/O selected for the fast disable function. The circuit must be arranged so that a fault which causes the fast input to be forced high cannot cause the safe torque off input to be forced high as well, including the case where a component such as a blocking diode has failed.

The diagram below shows the sequencer logic when *Reference Selected Indicator* (01.049) is not equal to 4 (i.e. keypad control mode is not selected). The definition of the logic symbols are given below.

Prevent the Stop key from causing the drive to run

Enable Stop Key (06.012) — OR
Drive tripped — AND

Stop key

Defined stop condition
(See Enable Stop Key (06.012))

LATCH

1

Sleep Active

06.057

Stop motor

Final drive enable

Limit switch active

&

Fire mode active

AND — OR — Final drive run

Run excluding sleep

*Run Forward (06.030)

LATCH

OR

*Run Reverse (06.032)

LATCH

OR

XOR + TIMER

OR

OR

R

J

*Run (06.034)

LATCH

Under-voltage Active (10.016)

Drive tripped

Final drive enable

Fire mode active

OR

*Not Stop (06.039)

Enable Sequencer Latching (06.040)

*Forward/reverse (06.033)

Reverse Select

OR — 01.012

R

AND

*Jog Reverse (06.037)

*Jog (06.031)

OR

AND

Motor stopped, i.e.
Drive Status (10.101) is
0 (Inhibit) OR
1 (Ready) OR
2 (Stop) OR
11 (Off) OR

R

OR

LATCH

J

Jog Select

01.013

1

* Sequencer parameters are shown, but equivalent Control
Word (06.042) bits are used instead if selected

Normal sequencer logic (Open-loop, RFC-A and RFC-S modes)

The diagram below shows the sequencer logic when *Reference Selected Indicator* (01.049) = 4 (i.e. keypad control mode is selected). The definition of the logic symbols are given below.

Note: When fire mode is active the normal mode sequencer logic is used even if *Reference Select Indicator* (01.049) = 4

Keypad control mode sequencer logic (Open-loop, RFC-A and RFC-S modes)

Latch function

If Enable = 0 THEN Output = Input
If Enable = 1 AND Reset = 1 THEN Output = 0
If Enable = 1 AND Reset = 0 AND Input = 1 THEN Output latches to 1

Exclusive OR with timer function

1. C = A XOR B
2. If A = 1 AND B = 1 THEN C = 0 with a delay of 60ms
3. If A = 0 AND B = 0 THEN C = 0 immediately, except in Open-loop mode when *Stop Mode* (06.001) is 0, 3, 4 or 5 in which case C = 0 with a delay of 60ms
4. D = B with no delay, except in Open-loop mode when *Stop Mode* (06.001) is 0, 3 or 4 in which case D = 0 with a delay of 60ms when B becomes 0

Toggle function

1. Output changes state on each 0 to 1 transition of Input
2. Reset = 1 THEN Output = 0

Definition of logic symbols for sequencer logic diagrams

Parameter	06.001 *Stop Mode*		
Short description	Defines how the motor is controlled when the run signal is removed from the drive		
Mode	RFC‑S		
Minimum	0	Maximum	2
Default	2	Units	
Type	8 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW, TE		

Value	Text
0	Coast
1	Ramp
2	No Ramp

There is only one phase during the stopping sequence as shown in the table below for each of the possible values of *Stop Mode* (06.001).

Stop Mode (06.001)	**Action**
0: Coast	Inverter disabled
1: Ramp	Stop with ramp
2: No ramp	Stop with no ramp

The following should be noted:

1. *Stop Mode* (06.001) = 0 (Coast) the inverter is inhibited immediately when the Final drive run is de-activated. If however, *Hold Zero Speed* (06.008) = 1, then the inverter will be re-enabled to hold zero speed. The result is that the inverter is disabled for one sample and then enabled to ramp the motor to a stop. Therefore is coast stop is required *Hold Zero Speed* (06.008) should be set to 0.
2. If *Stop Mode* (06.001) = 1 (stop with ramp) the relevant ramp rate is used to stop the motor even if *Ramp Enable* (02.002) = 0.
3. The motor can be stopped with position orientation after stopping. This mode is selected with *Standard Motion Controller Mode* (13.010). When orientation stop is selected *Stop Mode* (06.001) has no effect.

Parameter	06.002 *Limit Switch Stop Mode*		
Short description	Defines the behaviour of the drive when limit switch is active		
Mode	RFC‑S		
Minimum	0	Maximum	1
Default	0	Units	
Type	8 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW, TE		

Value	Text
0	Stop
1	Ramp

If *Limit Switch Stop Mode* (06.002) = 0 then when Limit switch active is activated the motor is stopped without ramps. If *Limit Switch Stop Mode* (06.002) = 1 then the motor is stopped with the currently selected ramp rate.

Parameter	06.003 *Supply Loss Mode*		
Short description	Defines the behaviour of the drive when the supply voltage is reduced		
Mode	RFC‑S		
Minimum	0	Maximum	3
Default	0	Units	
Type	8 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW, TE		

Value	Text
0	Disable
1	Ramp Stop
2	Ride Thru
3	Limit Stop

If *Supply Loss Mode* (06.003) > 0 and the *D.c. Bus Voltage* (05.005) falls below *Supply Loss Detection Level* (06.048) - 0.05 x VM_SUPPLY_LOSS_LEVEL[MIN] then the supply loss condition is detected and *Supply Loss* (10.015) = 1. If the supply subsequently rises above *Supply Loss Detection Level* (06.048) + 0.05 x VM_SUPPLY_LOSS_LEVEL[MIN] then the supply loss condition is no longer active and *Supply Loss* (10.015) = 0.

0: Disable
No supply loss detection is provided by monitoring the *D.c. Bus Voltage* (05.005). The drive will continue to operate normally unless the under voltage condition is detected.

1: Ramp Stop
The action taken by the drive is the same as for ride through mode, except that the ramp down rate is at least as fast as the currently selected deceleration ramp and the drive will continue to decelerate and stop even if the supply is re-applied. Once the sequencer state machine has reached the DISABLE state, it will be necessary to disable and re-enable the drive for it to run again because bit 2 of *Enable Conditions* (06.010) is set when the sequencer state machine changes from the DECELERATION state. It should be noted that even if S ramps are enabled (i.e. *S Ramp Enable* (02.006) = 1) this is ignored while the drive is stopping in this mode, and a linear ramp is always used.

2: Ride through
The drive attempts to control the d.c. link voltage to take energy from the motor and load inertia to ride through the Supply loss condition for as long as possible.

3: Limit Stop
The speed reference is set to zero and the ramps are disabled allowing the drive to decelerate the motor to a stop under current limit. If the supply is re-applied while the motor is stopping any run signal is ignored until the motor has stopped. If the current limit value is set at a very low level the drive may enter the Under Voltage state before the motor has stopped. Once the sequencer state machine has reached the DISABLE state, it will be necessary

to disable and re-enable the drive for it to run again because bit 2 of *Enable Conditions* (06.010) is set when the sequencer state machine changes from the DECELERATION state.

Parameter	06.008 *Hold Zero Speed*		
Short description	Set to 1 to hold the motor at zero speed		
Mode	RFC‑S		
Minimum	0	Maximum	1
Default	1	Units	
Type	1 Bit User Save	Update Rate	4ms read
Display Format	Standard	Decimal Places	0
Coding	RW		

If *Hold Zero Speed* (06.008) = 0 the sequencer state machine goes to the DISABLE state and the inverter is disabled when the Final drive run is de-activated and the motor reaches standstill.

If *Hold Zero Speed* (06.008) = 1 and *Motor Pre-heat Current Magnitude* (06.052) = 0% the sequencer state machine goes to the STOP state when the Final drive run is de-activated and the motor reaches standstill. The drive remains enabled with a frequency or speed reference of zero. If *Motor Pre-heat Current Magnitude* (06.052) is set to a non-zero value it defines the current in the motor when the sequencer state machine is in the STOP state. This is intended for applications where there is no motor load at standstill, but motor current is required to prevent condensation in the motor when it is stopped. If the motor is not force cooled the motor cooling is less effective at standstill than when the motor is rotating, and so care should be taken not to damage the motor by leaving it at standstill for prolonged periods with a high level of current.

Parameter	06.009 *Catch A Spinning Motor*		
Short description	Defines the behaviour of the drive when the drive is enabled whilst the motor is not at zero speed		
Mode	RFC‑S		
Minimum	0	Maximum	3
Default	1	Units	
Type	8 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW, TE		

Value	*Text*
0	Disable
1	Enable
2	Fwd Only
3	Rev Only

When the drive is enabled the ramp output can be set up so that the inital speed reference (i.e. combination of the ramp output and the hard speed reference if enabled) matches the speed of the motor, so that there is no transient speed change on enable. To do this *Post Ramp Reference* (02.001) is pre-loaded with *Speed Feedback* (03.002) - *Hard Speed Reference* (03.022) if the hard speed reference is enabled, or with *Speed Feedback* (03.002) if not. If *Catch A Spinning Motor* (06.009) = 1 then the ramp output is reloaded in this way, however different settings of *Catch A Spinning Motor* (06.009) can be used to restrict the initial speed reference if required as given in the table below. If the initial speed reference is forced to zero then *Post Ramp Reference* (02.001) is pre-loaded with *Speed Feedback* (03.002) - *Hard Speed Reference* (03.022) if the hard speed reference is enabled, or with zero if not.

Catch A Spinning Motor (06.009)	Initial speed reference
0	Always zero
1	In either direction
2	Zero or positive
3	Zero or negative

Parameter	06.010 *Enable Conditions*		
Short description	Displays all the conditions needed to change the state of the final drive enable		
Mode	RFC‑S		
Minimum	0 (Display: 000000000000)	Maximum	4095 (Display: 111111111111)
Default		Units	
Type	16 Bit Volatile	Update Rate	2ms write
Display Format	Binary	Decimal Places	0
Coding	RO, ND, NC, PT		

The Final drive enable is a combination of the *Hardware Enable* (06.029), *Drive Enable* (06.015) and other conditions that can prevent the drive from being enabled. All of these conditions are shown as bits in *Enable Conditions* (06.010) as given in the table below.

Enable Conditions (06.010) bits	Enable condition
0	*Hardware Enable* (06.029)
1	*Drive Enable* (06.015)
2	0 if auto-tune completed or trip during auto-tune, or if the drive stops when supply loss stop is active, but the drive needs to be disabled and re-enabled. (Always 1 in Regen mode).
3	1 if fire mode is active.
4	Zero if *Position Feedback Initialized* (03.076) is present and all devices are not indicated as initialised, otherwise one.
5	Zero until the drive thermal model has obtained temperatures from all drive thermistors at least once.
6	Zero until all option modules that are present in the drive have indicated that they are ready to run or the system has timed out waiting for this.
7-10	Zero if an option module has forced the drive to be disabled if for example it is updating its user program. Bit 7 corresponds to slot 1, bit 8 to slot 2, etc.
11	Zero if the drive is in standby mode. See *Standby Mode Enable* (06.060)

Parameter	06.011 *Sequencer State Machine Inputs*		
Short description	Displays the states of inputs into the sequencer state machine		
Mode	RFC-S		
Minimum	0 (Display: 000000)	Maximum	63 (Display: 111111)
Default		Units	
Type	8 Bit Volatile	Update Rate	2ms write
Display Format	Binary	Decimal Places	0
Coding	RO, ND, NC, PT		

The bits in *Sequencer State Machine Inputs* (06.011) show the state of the inputs to the sequencer state machine as given in the tables below.

Sequencer State Machine Inputs (06.011)	Signal	Indicates
0	Final drive enable	The drive inverter is allowed to be enabled.
1	Final drive run	The motor can move away from standstill.
2	*Under Voltage Active* (10.016)	The under voltage condition has been detected.
3	*Zero Speed* (10.003)	Indicated when the motor has stopped.
4	Drive tripped	The drive is tripped.
5	*Supply Loss* (10.015)	Supply loss condition has been detected.

Parameter	06.012 *Enable Stop Key*		
Short description	Set to 1 to enable the use of the stop key		
Mode	RFC-S		
Minimum	0	Maximum	1
Default	0	Units	
Type	1 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW		

The Stop key can be used to stop the drive if *Enable Stop Key* (06.012) = 1 or *Reference Selected Indicator* (01.049) = 4. The Stop key is also used to reset the drive from the keypad. If *Enable Stop Key* (06.012) = 0 and *Reference Selected Indicator* (01.049) is not equal to 4 the Stop key is not active and can be used to initiate a drive reset and without stopping the drive from running. If *Enable Stop Key* (06.012) = 1 or *Reference Selected Indicator* (01.049) = 4 the drive reset can be initiated without stopping the drive by holding the Run key and then pressing the Stop key.

It should be noted that if the drive is tripped and is then reset from any source other than the keypad Stop key then the drive may start immediately under the following conditions:

Enable Sequencer Latching (06.040) = 0, the Final drive enable is active and one of the sequencer bits (*Run Forward* (06.030), *Run Reverse* (06.032) or *Run* (06.034) is active.

Enable Sequencer Latching (06.040) = 1, the Final drive enable is active, *Not Stop* (06.039) is active and one of the sequencer bits (*Run Forward* (06.030), *Run Reverse* (06.032) or *Run* (06.034) is active.

The drive sequencer has been designed so that pressing the Stop key, whatever the value of *Enable Stop Key* (06.012) or *Reference Selected Indicator* (01.049), does not make the drive state change from stopped to running. As pressing the Stop key could reset a drive trip which could then restart the drive, the run output from the sequencer is held off until the following conditions are met when the drive is tripped and the Stop key is pressed.

(*Run Forward* (06.030) = 0 and *Run Reverse* (06.032) = 0 and *Run* (06.034) = 0 and *Not Stop* (06.039) = 0*

OR (*Run Forward* (06.030) = 1 and *Run Reverse* (06.032) = 1 for at least 60ms*

OR The *Hardware Enable* (06.029) = 0 or software enable is zero+

OR The sequencer is in the UNDER_VOLTAGE state

Not Stop (06.039) is only used with latching logic (i.e. *Enable Sequencer Latching* (06.040) = 1). When latching logic is not used then *Not Stop*

(06.039) is normally zero, and so it does not affect the conditions required to reapply the drive run.
+The software enable is either *Drive Enable* (06.015) or the enable from *Control Word* (06.042) as selected by *Control Word Enable* (06.043).

Once the necessary conditions have been met the drive can then be restarted by activating the necessary bits for a normal start.

Parameter	06.013 *Enable Auxiliary Key*		
Short description	Defines the behaviour of the drive when the auxilliary button is pressed		
Mode	RFC‑S		
Minimum	0	Maximum	2
Default	0	Units	
Type	8 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW, TE		

Value	Text
0	Disabled
1	Forward/Reverse
2	Run Reverse

If Hand/Off/Auto mode is active (see *Hand/Off/Auto Operating Mode* (01.052)) then *Enable Auxiliary Key* (06.013) has no effect. Otherwise if *Reference Selected Indicator* (01.049) = 4 then *Enable Auxiliary Key* (06.013) can be used to enable the Auxiliary key as a reverse key. If *Enable Auxiliary Key* (06.013) = 1 then each time the Auxiliary key is pressed *Reverse Select* (01.012) is toggled. If *Enable Auxiliary Key* (06.013) = 2 then the Auxiliary key behaves in a similar way to the Run key except that the drive runs in the reverse direction when it is pressed.

Parameter	06.015 *Drive Enable*		
Short description	Set to 1 to enable the drive		
Mode	RFC‑S		
Minimum	0	Maximum	1
Default	1	Units	
Type	1 Bit User Save	Update Rate	2ms read
Display Format	Standard	Decimal Places	0
Coding	RW, BU		

Drive Enable (06.015) must be active for the drive to be enabled. See description of enable logic.

Parameter	06.016 *Date*		
Short description	Displays the current date		
Mode	RFC‑S		
Minimum	0 (Display: 00-00-00)	Maximum	311299 (Display: 31-12-99)
Default		Units	
Type	32 Bit Volatile	Update Rate	Background read/write
Display Format	Date	Decimal Places	0
Coding	RW, ND, NC, PT		

Date (06.016), *Time* (06.017) and *Day Of Week* (06.018) show the date and time as selected by *Date/Time Selector* (06.019). *Date* (06.016) stores the date in dd.mm.yy format regardless of the setting made in *Date Format* (06.020) however if the parameter is viewed using a keypad the date will be displayed in the format selected in *Date Format* (06.020). If a real time clock is selected from an option module then the days, months and years are from the real time clock and the day of the week is displayed in *Day Of Week* (06.018). Otherwise the days have a minimum value of 0 and roll over after 30, the months have a minimum value of 0 and roll over after 11, and *Day Of Week* (06.018) is always 0 (Sunday).

If when setting the date/time this parameter is being written via comms or from and applications module then the value should be written in standard dd/mm/yy format as described below.

The value of this parameter as seen over comms or to an applications module is as follows.

Value = (day[1..31] x 10000) + (month[1..12] x 100) + year[0..99]

Parameter	06.017 *Time*		
Short description	Dispalys the current time		
Mode	RFC‑S		
Minimum	0 (Display: 00:00:00)	Maximum	235959 (Display: 23:59:59)
Default		Units	
Type	32 Bit Volatile	Update Rate	Background read/write
Display Format	Time	Decimal Places	0
Coding	RW, ND, NC, PT		

See *Date* (06.016).

The value of this parameter as seen over comms or to an applications module is as follows.

Value = (hour[0..23] x 10000) + (minute[0..59] x 100) + seconds[0..59]

Parameter	06.018 *Day Of Week*		
Short description	Displays the current day of the week		
Mode	RFC‑S		
Minimum	0	Maximum	6
Default		Units	
Type	8 Bit Volatile	Update Rate	Background write
Display Format	Standard	Decimal Places	0
Coding	RO, TE, ND, NC, PT		

Value	Text
0	Sunday
1	Monday
2	Tuesday
3	Wednesday
4	Thursday
5	Friday
6	Saturday

See *Date* (06.016).

Parameter	06.019 *Date/Time Selector*		
Short description	Defines which clock is used to display the current time, date and day of the week		
Mode	RFC‑S		
Minimum	0	Maximum	5
Default	1	Units	
Type	8 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW, TE		

Value	Text
0	Set
1	Powered
2	Running
3	Acc Powered
4	Local Keypad
5	Remote Keypad

Date/Time Selector (06.019) is used to select the drive date and time as shown in the table below.

Date/Time Selector (06.019)	Date/Time Source
0: Set	Date and time parameters can be written by the user.
1: Power	Time since the drive was powered up.
2: Running	Accumulated drive running time since the drive was manufactured.
3: Acc Power	Accumulated powered-up time since the drive was manufactured.
4: Local Keypad	If a keypad fitted to the front of the drive includes a real-time clock then the date/time from this clock is displayed, otherwise the date/time is set to zero.
5: Remote Keypad	If a keypad connected to the user comms port of a drive with a 485 includes a real-time clock then the date/time from this clock is displayed, otherwise the date/time is set to zero.

When *Date/Time Selector* (06.019) = 0 the *Date* (06.016) and *Time* (06.017) can be written by the user and the values in these parameters are transferred to the real time clocks in keypads that support this feature that are fitted to the drive. When *Date/Time Selector* (06.019) is changed to any other value, the real time clocks are allowed to run normally again. When *Date/Time Selector* (06.019) is changed from any value to 0 the date and time from a real time clock, if present, is automatically loaded into *Date* (06.016) and *Time* (06.017), so that this date and time is used as the initial value for editing. If more than one real time clock is present the date/time from the local keypad is used, if present.

Date (06.016) and *Time* (06.017) are used by the timers in Menu 09 and for time stamping trips. These features will continue to use the originally selected clock even if *Date/Time Selector* (06.019) is changed until a drive reset is initiated. If *Date/Time Selector* (06.019) has been changed and a reset is initiated *Timer 1 Repeat Function* (09.039) and *Timer 2 Repeat Function* (09.049) are set to zero to disable the timers, and the trip dates and times (10.041 to 10.060) are reset to zero.

Parameter	06.020 *Date Format*		
Short description	Defines if the US date format is used or not		
Mode	RFC‑S		
Minimum	0	Maximum	1
Default	0	Units	
Type	8 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW, TE		

Value	Text
0	Std
1	US

Date Format (06.020) selects the display style for *Date* (06.016), *Timer 1 Start Date* (09.035), *Timer 1 Stop Date* (09.037), *Timer 2 Start Date* (09.045), *Timer 2 Stop Date* (09.047), and for the trip time stamping date parameters (10.041, 10.043, 10.045, 10.047, 10.049, 10.051, 10.053, 10.055, 10.057 and 10.059) when displayed on a keypad connected to the drive. The format selection made in this parameter does not affect the value of these parameters if they are read using comms or by an applications program.

If *Date Format* (06.020) is 0 then standard format is used and the date is displayed on the keypad as dd.mm.yy and if *Date Format* (06.020) is 1 then US format is used and the date is displayed on the keypad as mm.dd.yy.

Parameter	06.021 *Time Between Filter Changes*		
Short description	Defines the time between filter changes		
Mode	RFC‑S		
Minimum	0	Maximum	30000
Default	0	Units	Hours
Type	16 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW		

Time Between Filter Changes (06.021) should be set to a non-zero value to enable the filter change timer system. Each time *Filter Change Required / Change Done* (06.022) is changed by the user from 1 to 0 the value of *Time Between Filter Changes* (06.021) is copied to *Time Before Filter Change Due* (06.023). For each hour while *Drive Active* (10.002) = 1 the *Time Before Filter Change Due* (06.023) is reduced by 1 until it reaches zero. When *Time Before Filter Change Due* (06.023) reaches 0 *Filter Change Required / Change Done* (06.022) is set to 1 to indicate that a filter change is required. The filter should be changed and the system reset again by resetting *Filter Change Required / Change Done* (06.022) to 0.

When a non-zero value is written to *Time Between Filter Changes* (06.021) to enable the system, *Filter Change Required / Change Done* (06.022) should be set to 1 and then back to 0 to transfer the required time to *Time Before Filter Change Due* (06.023) and to enable the count down.

Parameter	06.022 *Filter Change Required / Change Done*		
Short description	Set to 0 when a filter change has taken place		
Mode	RFC‑S		
Minimum	0	Maximum	1
Default		Units	
Type	1 Bit Volatile	Update Rate	Background read/write
Display Format	Standard	Decimal Places	0
Coding	RW, ND, NC		

See *Time Between Filter Changes* (06.021).

Parameter	06.023 *Time Before Filter Change Due*		
Short description	Displays the time before a filter change is required		
Mode	RFC‑S		
Minimum	0	Maximum	30000
Default		Units	Hours
Type	16 Bit Power Down Save	Update Rate	Background write
Display Format	Standard	Decimal Places	0
Coding	RO, ND, NC, PT		

See *Time Between Filter Changes* (06.021).

Parameter	06.024 *Reset Energy Meter*		
Short description	Set to 1 to reset the energy meter		
Mode	RFC‑S		
Minimum	0	Maximum	1
Default	0	Units	
Type	1 Bit Volatile	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW		

Energy Meter: MWh (06.025) and *Energy Meter: kWh* (06.026) accumulate the energy transferred through the drive. A positive energy value indicates net transfer of energy from the drive to the motor. If *Reset Energy Meter* (06.024) = 1 then *Energy Meter: MWh* (06.025) and *Energy Meter: kWh* (06.026) are held at zero. If *Reset Energy Meter* (06.024) = 0 then the energy meter is enabled and will accumulate the energy flow. If the maximum or minimum of *Energy Meter: MWh* (06.025) is reached the parameter does not rollover and is instead clamped at the maximum or minimum value.

Parameter	06.025 *Energy Meter: MWh*		
Short description	Displays the energy accumulated by through the drive in MWh		
Mode	RFC‑S		
Minimum	-999.9	Maximum	999.9
Default		Units	MWh
Type	16 Bit Power Down Save	Update Rate	Background write
Display Format	Standard	Decimal Places	1
Coding	RO, ND, NC, PT		

See *Reset Energy Meter* (06.024).

Parameter	06.026 *Energy Meter: kWh*		
Short description	Displays the energy accumulated by through the drive in kWh		
Mode	RFC‑S		
Minimum	-99.99	Maximum	99.99
Default		Units	kWh
Type	16 Bit Power Down Save	Update Rate	Background write
Display Format	Standard	Decimal Places	2
Coding	RO, ND, NC, PT		

See *Reset Energy Meter* (06.024).

Parameter	06.027 *Energy Cost Per kWh*		
Short description	Defines the cost of energy per kWh		
Mode	RFC‑S		
Minimum	0.0	Maximum	600.0
Default	0.0	Units	
Type	16 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	1
Coding	RW		

Running Cost (06.028) is derived from the *Output Power* (05.003) and the *Energy Cost Per kWh* (06.027) in cost per hour. The sign of *Running Cost* (06.028) is the same as the sign of *Output Power* (05.003).

Parameter	06.028 *Running Cost*		
Short description	Displays the running cost of the drive		
Mode	RFC‑S		
Minimum	-32000	Maximum	32000
Default		Units	
Type	16 Bit Volatile	Update Rate	Background write
Display Format	Standard	Decimal Places	0
Coding	RO, ND, NC, PT		

See *Energy Cost Per kWh* (06.027).

Parameter	06.029 *Hardware Enable*		
Short description	Set to 1 to enable the hardware of the drive		
Mode	RFC‑S		
Minimum	0	Maximum	1
Default		Units	
Type	1 Bit Volatile	Update Rate	2ms read
Display Format	Standard	Decimal Places	0
Coding	RO, ND, NC, PT		

Hardware Enable (06.029) normally shows the hardware enable state based on the state of the safe torque off system. However, drive I/O can be routed to *Hardware Enable* (06.029) to reduce the disable time. See description of the enable logic for more details.

Parameter	06.030 *Run Forward*		
Short description	Set to to give the drive a run forward signal		
Mode	RFC‑S		
Minimum	0	Maximum	1
Default	0	Units	
Type	1 Bit Volatile	Update Rate	2ms read
Display Format	Standard	Decimal Places	0
Coding	RW, NC		

If *Reference Selected Indicator* (01.049) is not equal to 4 then *Run Forward* (06.030) can be used to make the Final drive run active and *Reverse Select* (01.012) = 0, i.e. to make the drive run in the forward direction. See description of sequencer logic for more details.

Parameter	06.031 *Jog*		
Short description	Set to 1 to give the drive a jog signal		
Mode	RFC‑S		
Minimum	0	Maximum	1
Default	0	Units	
Type	1 Bit Volatile	Update Rate	2ms read
Display Format	Standard	Decimal Places	0
Coding	RW, NC		

If *Reference Selected Indicator* (01.049) is not equal to 4 then *Jog* (06.031) can be used to make the Final drive run active and *Jog Select* (01.013) = 1, i.e. to make the drive run using the jog reference and jog ramps rates. The jog function is disabled if the run is made active through the normal running sequencing bits. See description of sequencer logic for more details.

Parameter	06.032 *Run Reverse*		
Short description	Set to 1 to give the drive a run reverse signal		
Mode	RFC‑S		
Minimum	0	Maximum	1
Default	0	Units	
Type	1 Bit Volatile	Update Rate	2ms read
Display Format	Standard	Decimal Places	0
Coding	RW, NC		

If *Reference Selected Indicator* (01.049) is not equal to 4 then *Run Reverse* (06.032) can be used to make the Final drive run active and *Reverse Select* (01.012) = 1, i.e. to make the drive run in the reverse direction. See description of sequencer logic for more details.

Parameter	06.033 *Forward/Reverse*		
Short description	Set to 1 to reverse the direction of the motor		
Mode	RFC‑S		
Minimum	0	Maximum	1
Default	0	Units	
Type	1 Bit Volatile	Update Rate	2ms read
Display Format	Standard	Decimal Places	0
Coding	RW, NC		

If *Reference Selected Indicator* (01.049) is not equal to 4 then *Forward/Reverse* (06.033) can be used to force the state of Reverse Select (01.012). If *Forward/Reverse* (06.033) = 1 then *Reverse Select* (01.012) = 1. If *Forward/Reverse* (06.033) = 0 then *Forward/Reverse* (06.033) = 0 unless it is set to 1 by the rest of the normal run or jog logic. See description of sequencer logic for more details.

Parameter	06.034 *Run*		
Short description	Set to 1 to give the drive a run signal		
Mode	RFC‑S		
Minimum	0	Maximum	1
Default	0	Units	
Type	1 Bit Volatile	Update Rate	2ms read
Display Format	Standard	Decimal Places	0
Coding	RW, NC		

If *Reference Selected Indicator* (01.049) is not equal to 4 then *Run* (06.034) can be used to make the Final drive run active, but not to affect the state of *Reverse Select* (01.012). Normally *Run* (06.034) would be used in conjunction with *Forward/Reverse* (06.033) if control of the direction is required. See description of sequencer logic for more details.

Parameter	06.035 *Forward Limit Switch*		
Short description	Set to 1 to activate the forward limit switch and remove the final drive run signal		
Mode	RFC‑S		
Minimum	0	Maximum	1
Default	0	Units	
Type	1 Bit Volatile	Update Rate	2ms or 250µs read
Display Format	Standard	Decimal Places	0
Coding	RW, NC		

Forward Limit Switch (06.035) and *Reverse Limit Switch* (06.036) can be used to activate *Limit Switch Active* (10.066) and remove the Final drive run signal. When *Limit Switch Active* (10.066) is active and *Limit Switch Stop Mode* (06.002) = 0 the motor is stopped without ramps, otherwise it is stopped with the currently selected ramp rate. If digital input 4 or 5 are routed to *Forward Limit Switch* (06.035) or *Reverse Limit Switch* (06.036) the maximum delay is approximately 600us. The limit switches are direction dependant as shown below, so that the motor can rotate in a direction that allows the system to move away from the limit switch.

Condition	Forward Limit Switch (06.035)	Reverse Limit Switch (06.036)
Pre-ramp Reference (01.003) + *Hard Speed Reference* (03.022) > 0.0	Enabled	Not enabled
Pre-ramp Reference (01.003) + *Hard Speed Reference* (03.022) < 0.0	Not enabled	Enabled
Pre-ramp Reference (01.003) + *Hard Speed Reference* (03.022) = 0.0	Enabled	Enabled

Note that if *Hard Speed Reference Select* (03.023) = 0 then the *Hard Speed Reference* (03.022) is taken as 0.

Parameter	06.036 *Reverse Limit Switch*		
Short description	Set to 1 to activate the reverse limit switch and remove the final drive run signal		
Mode	RFC‑S		
Minimum	0	Maximum	1
Default	0	Units	
Type	1 Bit Volatile	Update Rate	2ms or 250µs read
Display Format	Standard	Decimal Places	0
Coding	RW, NC		

See *Forward Limit Switch* (06.035).

Parameter	06.037 *Jog Reverse*		
Short description	Set to 1 to give the drive a jog reverse signal		
Mode	RFC‑S		
Minimum	0	Maximum	1
Default	0	Units	
Type	1 Bit Volatile	Update Rate	2ms read
Display Format	Standard	Decimal Places	0
Coding	RW, NC		

If *Reference Selected Indicator* (01.049) is not equal to 4 then *Jog Reverse* (06.037) can be used to make the Final drive run active, *Jog Select* (01.013) = 1 and *Reverse Select* (01.012) = 1, i.e. to make the drive run using the jog reference and jog ramps rates in the reverse direction. The jog function is disabled if the run is made active through the normal running sequencing bits. See description of sequencer logic for more details.

Parameter	06.039 *Not Stop*		
Short description	Set to 1 to reset the latched sequencer bits if sequencer latching is enabled		
Mode	RFC‑S		
Minimum	0	Maximum	1
Default	0	Units	
Type	1 Bit Volatile	Update Rate	2ms read
Display Format	Standard	Decimal Places	0
Coding	RW, NC		

If *Enable Sequencer Latching* (06.040) = 1 then the sequencer bits can be latched. *Not Stop* (06.039) should be used to reset the latched sequencer bits. If *Not Stop* (06.039) = 1 then the sequencer bits can be latched. If *Not Stop* (06.039) = 0 then the latches are cleared and their outputs are forced to zero which will de-activate the Final drive run. See description of sequencer logic for more details.

Parameter	06.040 *Enable Sequencer Latching*		
Short description	Set to 1 to enable sequencer latching		
Mode	RFC‑S		
Minimum	0	Maximum	1
Default	0	Units	
Type	1 Bit User Save	Update Rate	2ms read
Display Format	Standard	Decimal Places	0
Coding	RW		

See *Not Stop* (06.039).

Parameter	06.041 *Drive Event Flags*		
Short description	Displays if certain actions have occurred within the drive		
Mode	RFC‑S		
Minimum	0 (Display: 00)	Maximum	3 (Display: 11)
Default	0 (Display: 00)	Units	
Type	8 Bit Volatile	Update Rate	Background write
Display Format	Binary	Decimal Places	0
Coding	RW, NC		

Drive Event Flags (06.041) indicates that certain actions have occurred within the drive as described below.

Bit	Corresponding event
0	Defaults loaded
1	Drive mode changed

Bit 0: Defaults loaded
The drive sets bit 0 when defaults have been loaded and the associated parameter save has been completed. The drive does not reset this flag except at power-up.

Bit 1: Drive mode changed
The drive sets bit 1 when the drive mode has changed and the associated parameter save has been completed. The drive does not reset this flag except at power-up.

Parameter	06.042 *Control Word*		
Short description	Controls the sequencer state machine inputs if the control word is enabled		
Mode	RFC‑S		
Minimum	0 (Display: 000000000000000)	Maximum	32767 (Display: 111111111111111)
Default	0 (Display: 000000000000000)	Units	
Type	16 Bit Volatile	Update Rate	Bits 9,7-0: 2ms read. Other bits: Background read
Display Format	Binary	Decimal Places	0
Coding	RW, NC		

If *Control Word Enable* (06.043) = 0 then *Control Word* (06.042) has no effect. If *Control Word Enable* (06.043) = 1 the bits in *Control Word* (06.042) are used instead of their corresponding parameters or to initiate drive functions as shown in the table below.

Bit	Corresponding parameter or function
0	*Drive Enable* (06.015)
1	*Run Forward* (06.030)
2	*Jog* (06.031)
3	*Run Reverse* (06.032)
4	*Forward/Reverse* (06.033)
5	*Run* (06.034)
6	*Not Stop* (06.039)
7	Auto/manual
8	Analogue/Preset reference
9	*Jog Reverse* (06.037)
10	Not used
11	Not used
12	Trip drive
13	*Drive Reset* (10.033)
14	Watchdog

Bits 0-7 and bit 9: Sequencer control
When Auto/manual bit (bit7) = 1 then bits 0 to 6 and bit 9 of the *Control Word* (06.042) become active. The equivalent parameters are not modified by these bits, but become inactive when the equivalent bits in the *Control Word* (06.042) are active. When the bits are active they replace the functions of the equivalent parameters.

Bit 8: Analogue/preset reference
The state of Analogue/Preset Reference (bit 8) is written continuously to *Reference Select Flag 2* (01.042). With default drive settings (i.e. *Reference Selector* (01.014) = 0) this selects *Analog Reference 1* (01.036) when bit 8 = 0 or *Preset Reference 1* (01.021) when bit8 = 1. If any other drive parameters are routed to *Reference Select Flag 2* (01.042) the value of this parameter is undefined.

Bit 10 and bit 11: Not used
The values of these bits have no effect on the drive.

Bit 12: Trip drive
If bit 12 = 1 then a *Control Word* trip is repeatedly initiated. The trip cannot be cleared until bit 12 = 0.

Bit 13: Reset drive
If bit 13 is changed from 0 to 1 a drive reset is initiated. Bit 13 does not modify *Drive Reset* (10.033).

Bit 14: Watchdog
A watchdog system can be enabled or serviced each time bit 14 is changed from 0 to 1. Once bit 14 has been changed from 0 to 1 to enable the watchdog, this must be repeated every 1s or else a *Watchdog* trip will be initiated. The watchdog is disabled when the trip occurs and must be re-enabled if required when the trip is reset.

Parameter	06.043 *Control Word Enable*		
Short description	Set to 1 to enable the control word		
Mode	RFC‑S		
Minimum	0	Maximum	1
Default	0	Units	
Type	1 Bit User Save	Update Rate	2ms read
Display Format	Standard	Decimal Places	0
Coding	RW		

See *Control Word* (06.042).

Parameter	06.044 *Active Supply*		
Short description	Indicates when the backup supply mode is enabled and the dc link voltage is below the upper under voltage threshold		
Mode	RFC‑S		
Minimum	0	Maximum	1
Default		Units	
Type	1 Bit Volatile	Update Rate	Background write
Display Format	Standard	Decimal Places	0
Coding	RO, ND, NC, PT		

If *Backup Supply Mode Enable* (06.068) = 0 then *Active Supply* (06.044) = 0. If *Backup Supply Mode Enable* (06.068) = 1 then *Active Supply* (06.044) = 0 when the d.c. link voltage is above the upper under-voltage threshold otherwise it is one. In Regen mode *Active Supply* (06.044) is always zero.

Parameter	06.045 *Cooling Fan control*		
Short description	Defines the maximum speed of the drive cooling fan		
Mode	RFC‑S		
Minimum	-10	Maximum	11
Default	10	Units	
Type	8 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW		

Cooling Fan control (06.045) can be used to select various fan control functions as shown in the table below. The actual control speed of the fan(s) in given in *Cooling Fan Speed* (06.046). There are 10 control speeds for the fan(s) in the drive, however the actual hardware control is more coarse than this, and so there may not be an actual change of fan speed as *Cooling Fan Speed* (06.046) changes from one value to the next. The default value for *Cooling Fan control* (06.045) is 10, which gives maximum cooling and does not limit the fan speed below its maximum. It should be noted that if the speed is limited, by setting a lower value, then the drive may trip prematurely under load.

Cooling Fan control (06.045)	Function Selected
-10 to -1	Minimum fan noise function with fan speed limited to the value of *Cooling Fan control* (06.045).
0	Fan does not run.
1 to 10	Maximum cooling with fan speed limited to the modulus of *Cooling Fan control* (06.045).
11	Fan runs continuously at full speed.

The two possible control characteristics are shown in the diagram below.
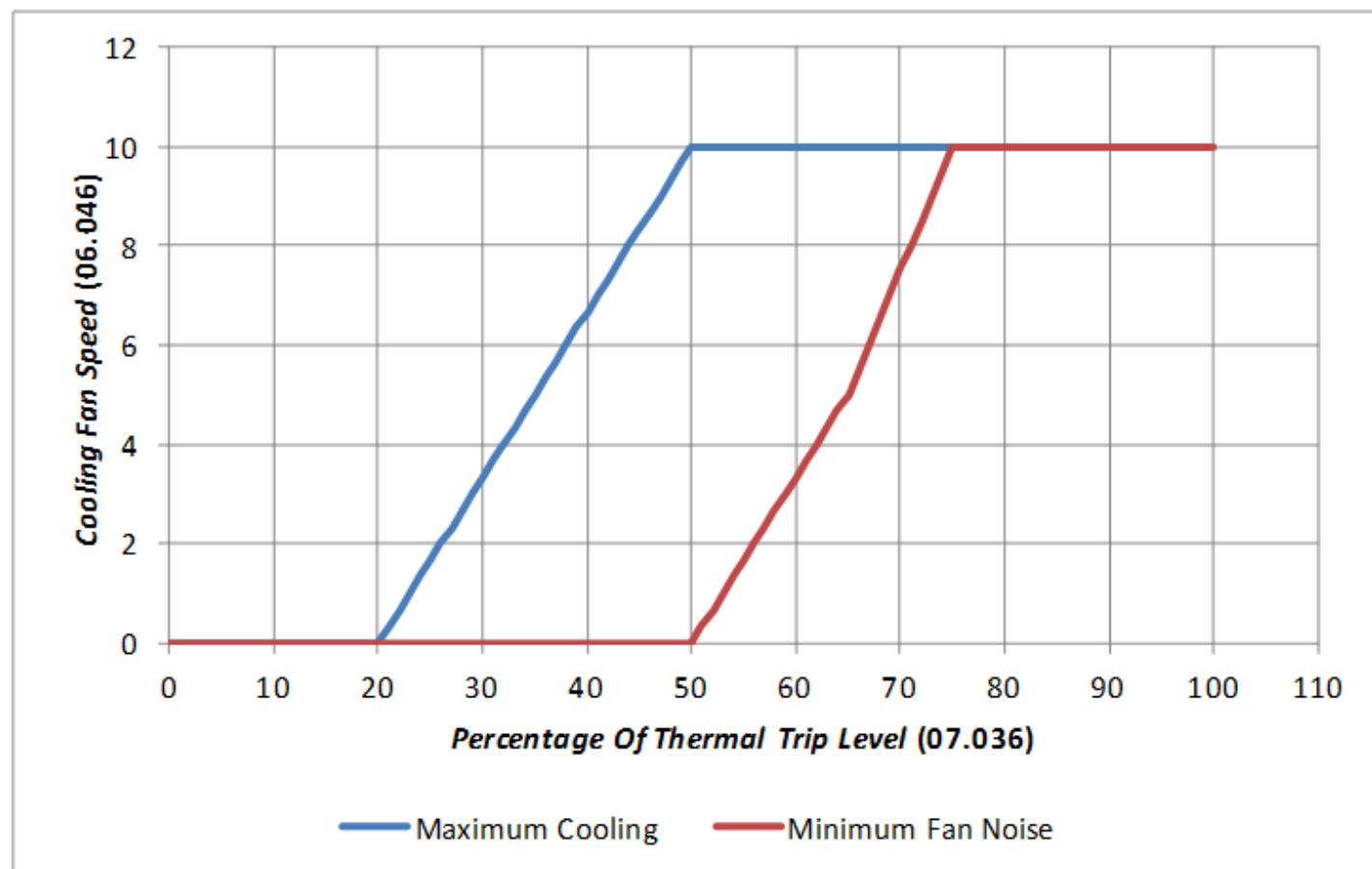
The fan speed is derived from *Percentage Of Drive Thermal Trip Level* (07.036) which shows the percentage to the trip level of the hottest monitored point in the drive. The "Maximum Cooling" characteristic brings the fan(s) on at a relatively low temperature to give maximum cooling. The "Minimum Fan Noise" characteristic does not switch on the fan(s) until the drive temperature has risen significantly, and the characteristic has a lower gradient. Therefore with lighter continuous loads the fan noise is kept to a minimum. This characteristic also prevents the fan(s) from coming on when the drive is disabled and operating in a high ambient. With both characteristics a filter is applied to *Percentage Of Drive Thermal Trip Level* (07.036) to avoid the fans switching on and off during short high transient loads. The "Minimum Fan Noise" characteristic also includes a hysteresis band of 15% that is applied to the percentage of drive thermal trip level at the input to the control algorithm to prevent the feedback from changing the speed back again. This reduces the chance of the fan repetitively changing speed under constant load conditions.

Parameter	06.046 *Cooling Fan Speed*		
Short description	Cooling Fan Speed		
Mode	RFC‑S		
Minimum	0	Maximum	10
Default		Units	
Type	8 Bit Volatile	Update Rate	Background Write
Display Format	Standard	Decimal Places	0
Coding	RO, ND, NC, PT		

See *Cooling Fan control* (06.045).

Parameter	06.047 *Input Phase Loss Detection Mode*		
Short description	Defines how the input phase loss is detected		
Mode	RFC‑S		
Minimum	0	Maximum	2
Default	0	Units	
Type	8 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW, TE		

Value	Text
0	Full
1	Ripple Only
2	Disabled

Input phase loss is detected by monitoring the d.c. link voltage ripple which increases with load. When compared to normal operation, if an input phase is missing or there is excessive input phase imbalance the d.c. link the ripple level is higher. For frame sizes 07 and above additional input phase loss detection is provided by direct monitoring of the supply voltages. Unlike the d.c. voltage ripple based detection which can only operate when the drive is enabled and on load, the additional input phase loss detection can operate whether the drive is enabled or not. *Input Phase Loss Detection Mode* (06.047) defines the methods used for input phase loss detection provided by the drive.

Input Phase Loss Detection Mode (06.047)	Drive Active (10.002) = 0	Drive Active (10.002) = 1
0	*Direct input phase loss detection	*Direct input phase loss detection D.c. link voltage ripple detection
1	No input phase loss detection	D.c. link voltage ripple detection
2	No input phase loss detection	No input phase loss detection

*Frame sizes 07 and above

Input phase loss detection can be disabled when the drive is required to operate from a d.c. supply connected to the d.c. link or from a single phase supply. If the drive operates from a single phase supply or a supply with high levels of phase imbalanced under load the input stage and d.c. link thermal protection system may produce an *OHt dc bus* trip.

When frame sizes 10 and above are operated with parallel power modules a trip is initiated if the supply is completely removed from the input to any of the parallel modules. This additional detection is disabled if *Input Phase Loss Detection Mode* (06.047) > 0.

Parameter	06.048 *Supply Loss Detection Level*		
Short description	Defines the threshold for indicating when the supply loss condition is detected		
Mode	RFC‑S		
Minimum	−VM_SUPPLY_LOSS_LEVEL	Maximum	VM_SUPPLY_LOSS_LEVEL
Default	See exceptions below	Units	V
Type	16 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW, VM, RA		

Voltage	Default Value
200V	205
400V	410
575V	540
690V	540

See *Supply Loss Mode* (06.003).

Parameter	06.051 *Hold Supply Loss Active*		
Short description	Hold Supply Loss Active		
Mode	RFC‑S		
Minimum	0	Maximum	1
Default	0	Units	
Type	1 Bit Volatile	Update Rate	2ms Read
Display Format	Standard	Decimal Places	0
Coding	RW, NC		

If supply loss is detected (i.e. *Supply Loss* (10.015) = 1) or *Hold Supply Loss Active* (06.051) = 1 the supply loss indication and the action taken on supply loss will be active. For example, *Hold Supply Loss Active* (06.051) can be controlled by an external rectifier or a Regen system (via a digital input) to prevent power from being taken from the supply if supply loss ride-through mode is being used until the input system is ready to provide power. For example, this can allow a charge system in an external rectifier to complete the charging of the d.c. link and become inactive before power is taken from the supply. A Regen system connected between the supply and the drive can operate in auto-synchronisation mode for a short time when the supply is removed. *Hold Supply Loss Active* (06.051) can be used to make the supply loss state persist for a short time after the supply is reapplied while the Regen system recovers. See *Disable Charge System / Close Contactor* (03.007) for more details.

Parameter	06.052 *Motor Pre-heat Current Magnitude*		
Short description	Defines the current in the motor when the state machine is in the stop state		
Mode	RFC‑S		
Minimum	0	Maximum	100
Default	0	Units	%
Type	8 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW		

See *Hold Zero Speed* (06.008).

Parameter	06.053 *Sleep / Wake Threshold*		
Short description	Defines the threshold used for enabling the sleep/wake function		
Mode	RFC‑S		
Minimum	−VM_SPEED_FREQ_REF_UNIPOLAR	Maximum	VM_SPEED_FREQ_REF_UNIPOLAR
Default	0.0	Units	
Type	32 Bit User Save	Update Rate	Background Read
Display Format	Standard	Decimal Places	1
Coding	RW, VM		

The diagram below shows the sleep mode detection system. If Fire mode active = 1, *Reference Selected Indicator* (01.049) = 4, the Run excluding sleep = 0 or *Sleep / Wake Threshold* (06.053) = 0 then the sleep mode system is disabled, and so *Sleep Required* (06.056) and *Sleep Active* (06.057) are held at zero.

Sleep Mode Detection
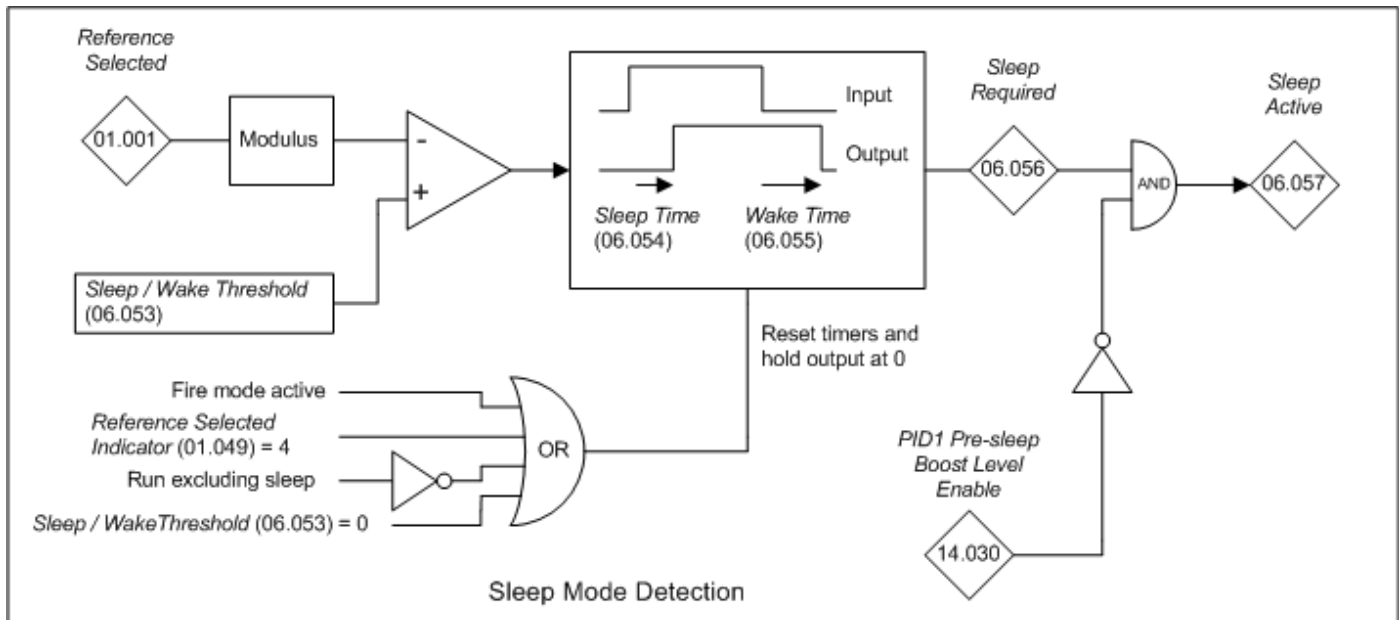
The sleep mode system will stop the motor if |*Reference Selected* (01.001)| < *Sleep / Wake Threshold* (06.053) for a time equal to *Sleep Time* (06.054) and restart the motor if |*Reference Selected* (01.001)| ≥ *Sleep / Wake Threshold* (06.053) for a time equal to *Wake Time* (06.055). If *Bipolar Reference Enable* (01.010) = 0 (i.e. unipolar mode is being used) then negative values of *Reference Selected* (01.001) are treated as zero. It is possible for the PID controller (Menu 14) to hold off sleep mode by setting *PID1 Pre-sleep Boost Level* (14.028) to 1.

Parameter	06.054 *Sleep Time*		
Short description	Defines the time that the drive will stop the motor if the sleep function is active		
Mode	RFC‑S		
Minimum	0.0	Maximum	250.0
Default	10.0	Units	s
Type	16 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	1
Coding	RW		

See *Sleep / Wake Threshold* (06.053).

Parameter	06.055 *Wake Time*		
Short description	Defines the time that the drive will restartthe motor if the wake function is active		
Mode	RFC‑S		
Minimum	0.0	Maximum	250.0
Default	10.0	Units	s
Type	16 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	1
Coding	RW		

See *Sleep / Wake Threshold* (06.053).

Parameter	06.056 *Sleep Required*		
Short description	Indicates if the pre-requisites of the sleep mode system are in the state to enable the sleep function		
Mode	RFC‑S		
Minimum	0	Maximum	1
Default		Units	
Type	1 Bit Volatile	Update Rate	Background write
Display Format	Standard	Decimal Places	0
Coding	RO, ND, NC, PT		

See *Sleep / Wake Threshold* (06.053).

Parameter	06.057 *Sleep Active*		
Short description	Displays if the sleep function has been activated		
Mode	RFC‑S		
Minimum	0	Maximum	1
Default		Units	
Type	1 Bit Volatile	Update Rate	Background write
Display Format	Standard	Decimal Places	0
Coding	RO, ND, NC, PT		

See *Sleep / Wake Threshold* (06.053).

Parameter	06.058 *Output Phase Loss Detection Time*		
Short description	Output Phase Loss Detection Time		
Mode	RFC‑S		
Minimum	0	Maximum	3
Default	0	Units	
Type	8 Bit User Save	Update Rate	Background Read
Display Format	Standard	Decimal Places	0
Coding	RW, TE		

Value	Text
0	0.5s
1	1.0s
2	2.0s
3	4.0s

See *Output Phase Loss Detection Enable* (06.059). This parameter has no effect in RFC-S mode.

Parameter	06.059 *Output Phase Loss Detection Enable*		
Short description	Set to non-zero value to enable output phase loss detection		
Mode	RFC‑S		
Minimum	0	Maximum	2
Default	0	Units	
Type	8 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW, TE		

Value	Text
0	Disabled
1	Phases
2	Devices

Output phase loss detection can be used to detect a disconnected motor phase or a failed power device if *Output Phase Loss Detection Enable* (06.059) is set to a non-zero value.

0: Disabled
Output phase loss detection is not active.

1: Phases
A test is carried out each time the drive is enabled to run to check if all three phases are connected. If the test fails a *Out Phase Loss*.X trip is initiated where X indicates which phase is not connected (1 = U, 2 = V, 3 = W). It should be noted that this test is not carried out in Open-loop mode if "catch a spinning motor is enabled (i.e. *Catch A Spinning Motor* (06.009) > 0).

2: Devices
This test is similar to the "Phases" test above except that additional tests are carried out when the drive is enabled to run which can detect if a either the positive or negative power device has failed in each phase. If a phase is disconnected or the positive power device has failed then a *Out Phase Loss*.X trip is initiated where X is between 1 and 3 and indicates the phase that is not connected or has a failed positive device (1 = U, 2 = V, 3 = W). If X is between 5 and 7 it indicates that the negative power device in a phase has failed (5 = U, 6 = V, 7 = W).

The "Phases" test requires that 1/2 rated motor current flows to indicate that the phase is connected. The "Devices" test only requires 1/8 of rated current, and so it produces much less acoustic noise on starting. In either mode the tests take approximately 50ms. The "Devices" test is the preferred test as it tests all the power devices and produces less acoustic noise. The "Phases" test is provided for legacy reasons.

Parameter	06.060 *Standby Mode Enable*		
Short description	Set to 1 enable standby mode		
Mode	RFC‑S		
Minimum	0	Maximum	1
Default	0	Units	
Type	1 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW		

If *Standby Mode Enable* (06.060) = 1 then the drive will go into the standby power state whenever *Drive Active* (10.002) = 0 with a delay of 30s. In this state the LED on the front of the drive flashes 0.5s on and 5s off, the drive cannot be enabled and the following actions are taken as defined by the *Standby Mode Mask* (06.061). Actions are enabled by setting the appropriate bit to 1. Once standby mode has become active it will remain active, even if an attempt is made subsequently to enable the drive, until *Standby Mode Enable* (06.060) is set to 0.

Standby Mode Mask (06.061) bits	Action
0	Turn off the drive position feedback power supply. On leaving standby mode the drive position feedback interfaces will be re-initialised.
1	Turn off the power supply to a keypad fitted to the drive.
2	Turn off the drive 24V output.
3	Request that the option module in option slot 1 to go into the standby power mode
4	Request that the option module in option slot 2 to go into the standby power mode
5	Request that the option module in option slot 3 to go into the standby power mode
6	Request that the option module in option slot 4 to go into the standby power mode

Parameter	06.061 *Standby Mode Mask*		
Short description	Defines the actions of the drive with standby mode is enabled		
Mode	RFC‑S		
Minimum	0 (Display: 0000000)	Maximum	127 (Display: 1111111)
Default	0 (Display: 0000000)	Units	
Type	8 Bit User Save	Update Rate	Background read
Display Format	Binary	Decimal Places	0
Coding	RW		

See *Standby Mode Enable* (06.060).

Parameter	06.065 *Standard Under Voltage Threshold*	
Short description	Defines the standard under voltage threshold	
Mode	RFC-S	
Minimum	−VM_STD_UNDER_VOLTS	Maximum	VM_STD_UNDER_VOLTS
Default	See exceptions below	Units	V
Type	16 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW, VM, RA	

Parameter	06.065 *Standard Under Voltage Threshold*
Short description	Defines the standard under voltage threshold
Mode	RFC-S
Minimum	−VM_STD_UNDER_VOLTS	Maximum	VM_STD_UNDER_VOLTS
Default	See exceptions below	Units	V
Type	16 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW, VM, RA		

Voltage	Default Value
200V	175
400V	330
575V	435
690V	435

Under-voltage and power supply control

Under-voltage and power supply control
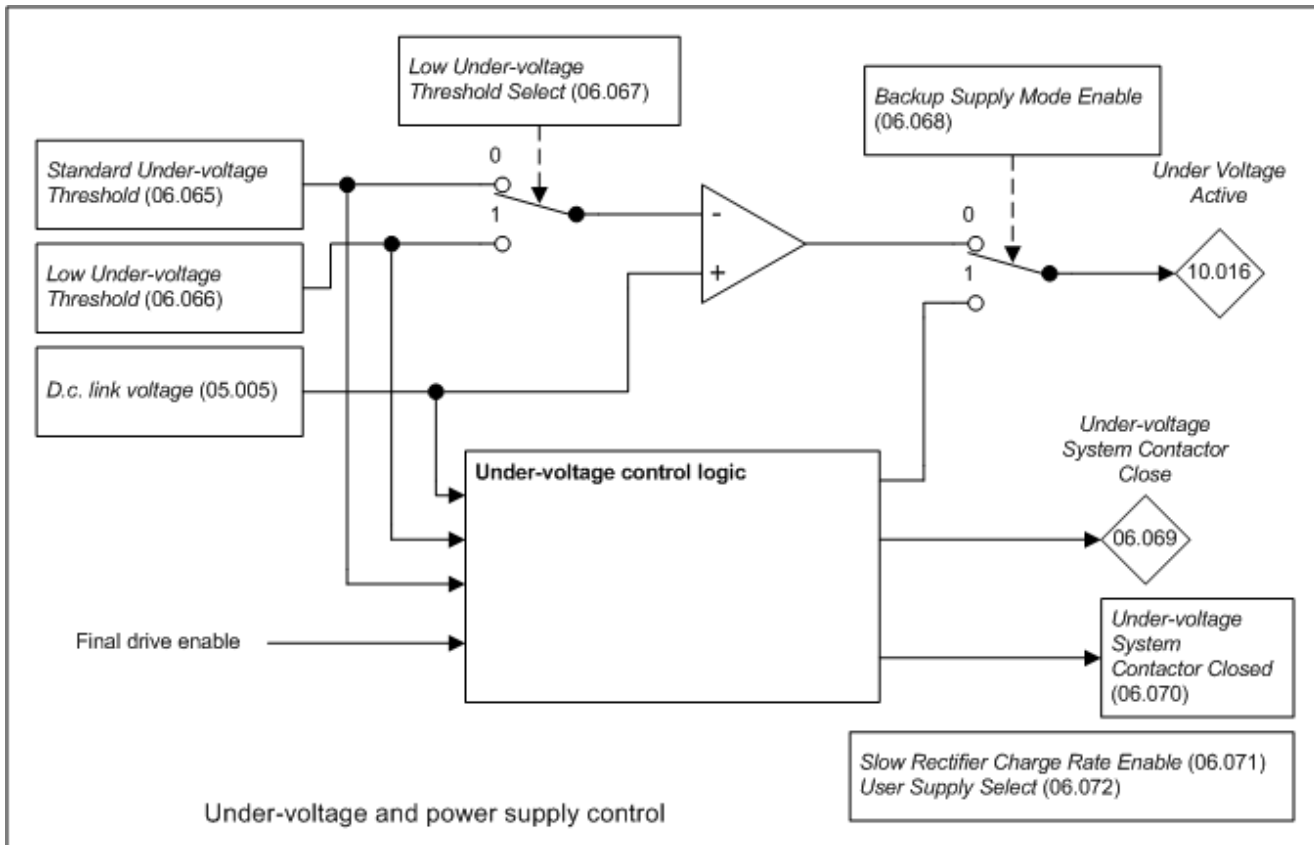
Under-voltage system
The under-voltage system controls the state of *Under Voltage Active* (10.016) which is then used by the sequencer state machine. Normally one detector is used to detect when the under-voltage state is active, unless back-up mode is being used with smaller drives (see below). The detector(s) include 5% hysteresis subject to a minimum of 5V. If *D.c. Bus Voltage* (05.005) is below the threshold *Under Voltage Active* (10.016) = 0. If *D.c. Bus Voltage* (05.005) is above the threshold, but below the threshold plus the 5% hyseteresis there is no change of state. If *D.c. Bus Voltage* (05.005) is above the threshold plus 5% hysteresis *Under Voltage Active* (10.016) changes to one with a delay of 250ms. The delay is provided to allow the d.c. link voltage to stop rising before the charging system is disabled.

When *Under Voltage Active* (10.016) = 1 the sequencer state machine will change to the UNDER_VOLTAGE state and when the UNDER_VOLTAGE state is active it is not possible to enable the drive inverter. The under-voltage system operates in different ways depending on the setting of *Backup Supply Mode Enable* (06.068).

If the low under-voltage threshold is used or if back-up supply mode is selected the internal drive power supplies are normally powered from the 24V supply input (i.e. Digital I/O 13). See *User Supply Select* (06.072) for details. (It should be noted that in Regen mode *Backup Supply Mode Enable* (06.068) is not present, and so back-up supply mode cannot be selected.)

Drive frame sizes 06 and below use a charging system based on a charge resistor and shorting relay. For larger drive frame sizes a thyristor based charge system is used. The type of charge system does not alter the operation of the drive except for the times allowed for soft-start state changes and the method used for back-up supply mode. The setting for the under-voltage level is used to detect the under-voltage condition based on the d.c. link voltage. If a thyristor charging system is used this level is also passed to the thyristor rectifier system so that it is fully deactivated (i.e. the thyristors are phased forwards so that the drive can take power from the supply) by the time the d.c. link voltage reaches the under-voltage level and allows the drive inverter to become active. It should be noted that the under-voltage threshold used with a thyristor based charge system and the charging rate (*Slow Rectifier Charge Rate Enable* (06.071)) are automatically saved within the rectifier units each time the value is changed because these will be required at the next power-up before the drive control system is active. These values will be retained when they are changed 128 times. If any more changes are made between power-up and power-down the new values are not retained.

Standard mode: Backup Supply Mode Enable (06.068) = 0
If *Low Under Voltage Threshold Select* (06.067) = 0 then the under voltage threshold is defined by *Standard Under Voltage Threshold* (06.065). If *Low Under Voltage Threshold Select* (06.067) = 1 then the under voltage threshold is defined by *Low Under Voltage Threshold* (06.066). For drives

which have a d.c. link charge system based on a charge resistor and shorting contactor, the charge system is normally active (contactor open) when *Under Voltage Active* (10.016) = 1, and inactive when *Under Voltage Active* (10.016) = 0. The exception is that there is a delay of 50ms while the contactor changes state and during these periods *Under Voltage Active* (10.016) = 1.

If the d.c. link voltage is above the under-voltage threshold and *Under Voltage Active* (10.016) = 0 a large surge of current can occur if the a.c. supply is removed and then reapplied to the drive. For a given level of supply voltage the worst case surge occurs when the supply is applied at the point where one of the line voltages is at its peak. The surge is proportional to the difference between the d.c. link voltage before the supply is reconnected and the magnitude of the supply voltage. The minimum setting and default for *Standard Under Voltage Threshold* (06.065) corresponds to the lowest d.c. link voltage level where the maximum allowed a.c. supply voltage can be applied without damaging the drive or rupturing the recommended supply fuses. Therefore it is safe to adjust the under-voltage threshold using the *Standard Under Voltage Threshold* (06.065). If the under-voltage threshold needs to be lower than the minimum of *Standard Under Voltage Threshold* (06.065), then the *Low Under Voltage Threshold* (06.066) should be used. It is important that the difference between the under-voltage threshold level and the peak of the supply voltage is never larger than the difference between the minimum *Standard Under Voltage Threshold* (06.065) and the peak of the maximum allowed a.c. supply voltage for the drive. For example:

The minimum *Standard Under Voltage Threshold* (06.065) for a 400V drive is 330V

The maximum allowed supply voltage for this drive is 480V + 10%

The peak of the maximum allowed supply voltage = $480 \times 1.1 \times \sqrt{2} = 747V$

The difference between the under-voltage threshold and the peak supply voltage = 747 - 330 = 417V

Therefore for this drive voltage rating the peak line to line voltage must never be higher than *Low Under Voltage Threshold* (06.066) + 417V.

If *Low Under Voltage Threshold Select* (06.067) is set to one and *Low Under Voltage Threshold* (06.066) is reduced below the variable maximum level VM_STD_UNDER_VOLTAGE[MIN], or if *Backup Supply Mode Enable* (06.068) is set to one, an indication is stored in *Potential Drive Damage Conditions* (10.106) that cannot be cleared by the user. This marks the drive, so that if it is damaged as a result of an input current surge, this can be detected by service personnel.

For frame size 07 drives and larger, which use a d.c. link charge system based on a half controlled thyristor input bridge, the charge system is activated based on the level of the voltage at the a.c. supply terminals of the drive. The threshold for the charge system is set so that the rectified supply will give the required under-voltage threshold level. The under-voltage system operates in exactly the same way as for smaller drives except that the delay during the transition out of the under-voltage state is extended. For single power module drive the delay is 1.0s to allow the thyristor charge system to charge the d.c. link. For parallel power modules the delay is extended to 2.5s to ensure that all modules power up correctly.

Under-voltage timing with *Back-up Supply Mode Enable* (06.068) = 0
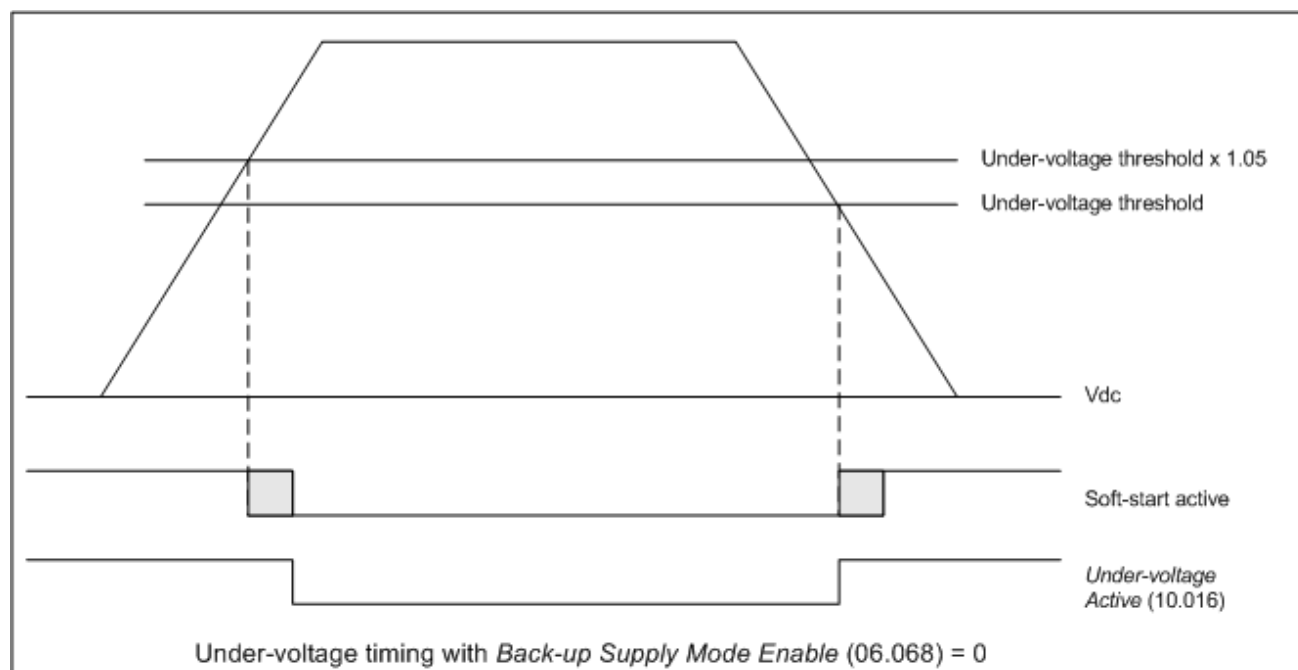
Backup Supply Mode for frame size 06 drives and smaller: Backup Supply Mode Enable (06.068) = 1
Backup supply mode is intended to provide a smooth transition, without disabling the drive, from a high voltage a.c. supply to a low voltage d.c. backup supply. It is necessary to disable the drive for the transition back to the high voltage a.c. supply. The following diagram is a simple representation of the power circuit required. This does not include the necessary circuit protection components or possible battery charger, etc.

Backup supply mode for frame size 06 drives and smaller
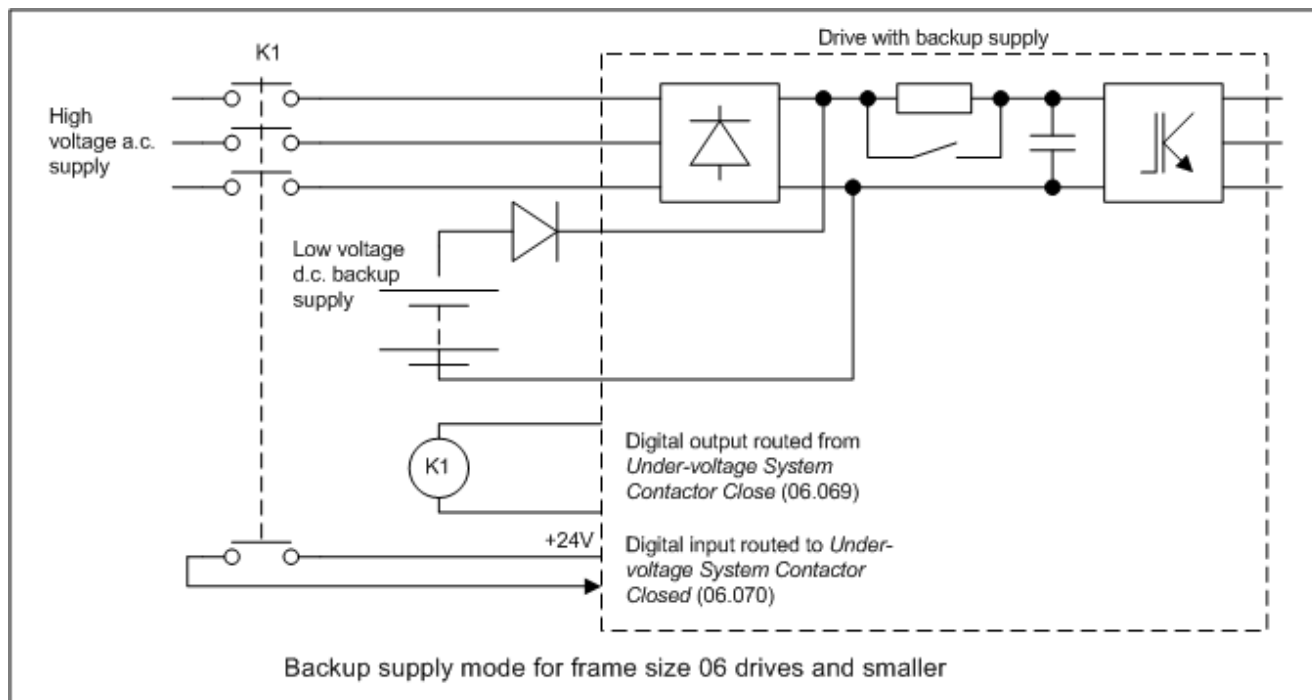
The diagram below shows the state of *Under Voltage Active* (10.016), the control signal to the external contactor (*Under-voltage System Contactor Close* (06.069)) and *Active Supply* (06.044). When *Backup Supply Mode Enable* (06.068) is set to one the maximum applied to *Low Under Voltage Threshold* (06.066) prevents this from being increased above *Standard Under Voltage Threshold* (06.065) / 1.1 so that the 5% hysteresis band on the low under-voltage threshold does not overlap the standard under-voltage threshold.

Backup supply mode states for frame size 06 drives and smaller
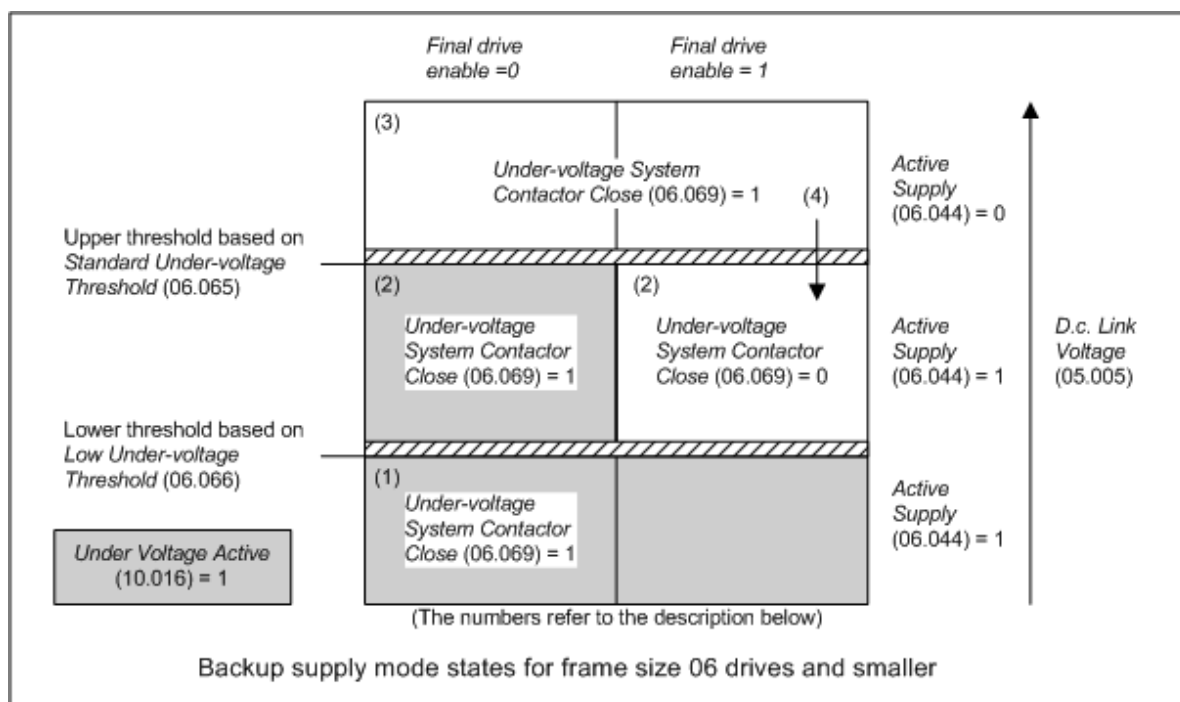
The numbers below correspond to the numbers shown in the diagram:

1. If the *D.c. Bus Voltage* (05.005) is below the Lower Threshold the drive is in the under-voltage state and the internal charge system is active to limit the charging current either from the low voltage d.c. backup supply or the high voltage a.c. supply. *Under-voltage System Contactor Close* (06.069) = 1, and so it is possible for the high voltage a.c. supply to charge the d.c. link.
2. If the *D.c. Bus Voltage* (05.005) is above the Lower Threshold, but below the Upper Threshold, there are two possible states depending on whether the Final drive enable is 0 or 1. If Final drive enable = 0 then *Under Voltage Active* (10.016) = 1, the internal charge system is active and *Under-voltage System Contactor Close* (06.069) = 1, so that the d.c. link can be charged by the high voltage a.c. supply. If Final drive enable = 1 then *Under Voltage Active* (10.016) = 0 and the internal charge system is inactive so that the drive can run from the low voltage d.c. backup supply. *Under-voltage System Contactor Close* (06.069) = 0, so that it is not possible for the high voltage a.c. supply to charge the d.c. link.
3. If the *D.c. Bus Voltage* (05.005) is above the Upper Threshold then *Under Voltage Active* (10.016) = 0 and *Under-voltage System Contactor Close* (06.069) = 1, so the drive can run from the high voltage a.c. supply.
4. If the *D.c. Bus Voltage* (05.005) subsequently falls below the Upper Threshold and the Final drive enable = 1, the drive can continue to run, but *Under-voltage System Contactor Close* (06.069) is set to zero to open the high voltage a.c. supply contactor. The d.c. link voltage will fall until it reaches the low voltage d.c. backup supply level. This gives a smooth changeover to the backup supply without stopping the motor.

To ensure that the soft-start is in the correct state to protect the drive the following additional restrictions are applied:

1. The soft-start cannot change to the inactive state (i.e. internal soft-start relay closed) unless the d.c. link voltage is above the upper under-voltage threshold or *Under-voltage System Contactor Closed* (06.070) = 0. This is shown in the diagram below which shows the drive operation when the d.c. link voltage is between the upper and lower thresholds. When the Final Drive Enable becomes active the external contactor is opened to disconnect the supply because the drive is intended to run from the back-up supply. The soft-start should not be deactivated until the external contactor is opened because it is providing protection against surge currents due to the supply being reapplied. Once it is open the soft-start is deactivated (relay closed) and the drive can run. A side effect of this additional condition occurs when the d.c. link voltage falls and crosses the upper threshold when the drive in running. There should be a smooth transition, but the delay between disabling the external contector (*Under-voltage System Contactor Close* (06.069) = 0) and confirmation of this (*Under-voltage System Contactor Closed* (06.070) = 0) when the d.c. link voltage crosses the threshold will cause the soft-start to activate transiently giving a period with under-voltage active. To prevent this problem the indication that the d.c. link voltage has fallen and crossed the upper threshold is delayed by 200ms.
2. *Under-voltage System Contactor Close* (06.069) is not set to one until the soft-start is fully active (relay open) because the soft-start is required to prevent current surges from the supply being applied. This is also shown in the diagram below.

Final drive enable

Under-voltage System Contactor Close (06.069)

Under-voltage System Contactor Closed (06.070)

Soft-start active

Under-voltage Active (10.016)

Soft-start cannot change to inactive state until *Under-voltage System Contactor Closed* (06.070) = 0

Under-voltage System Contactor Close (06.069) is not set to one until the soft-start is fully active

Under-voltage timing with *Back-up Supply Mode Enable* (06.068) = 1
(Frame sizes 06 and smaller and d.c. link voltage between the upper and lower under-voltage threshold)

Backup Supply Mode for frame size 07 drives and larger: (Backup Supply Mode Enable (06.068) = 1)
Backup supply mode is intended to provide a smooth transition, without disabling the drive, from a high voltage a.c. supply to a low voltage d.c. backup supply and vice versa. The following diagram is a simple representation of the power circuit required. This does not include the necessary circuit protection components or possible battery charger, etc.

Drive with backup supply

High voltage a.c. supply

Low voltage d.c. backup supply

K1

K1

Digital output routed from *Under-voltage System Contactor Close* (06.069)

+24V

Digital input routed to *Under-voltage System Contactor Closed* (06.070)

Backup supply mode for frame size 07 drives and larger
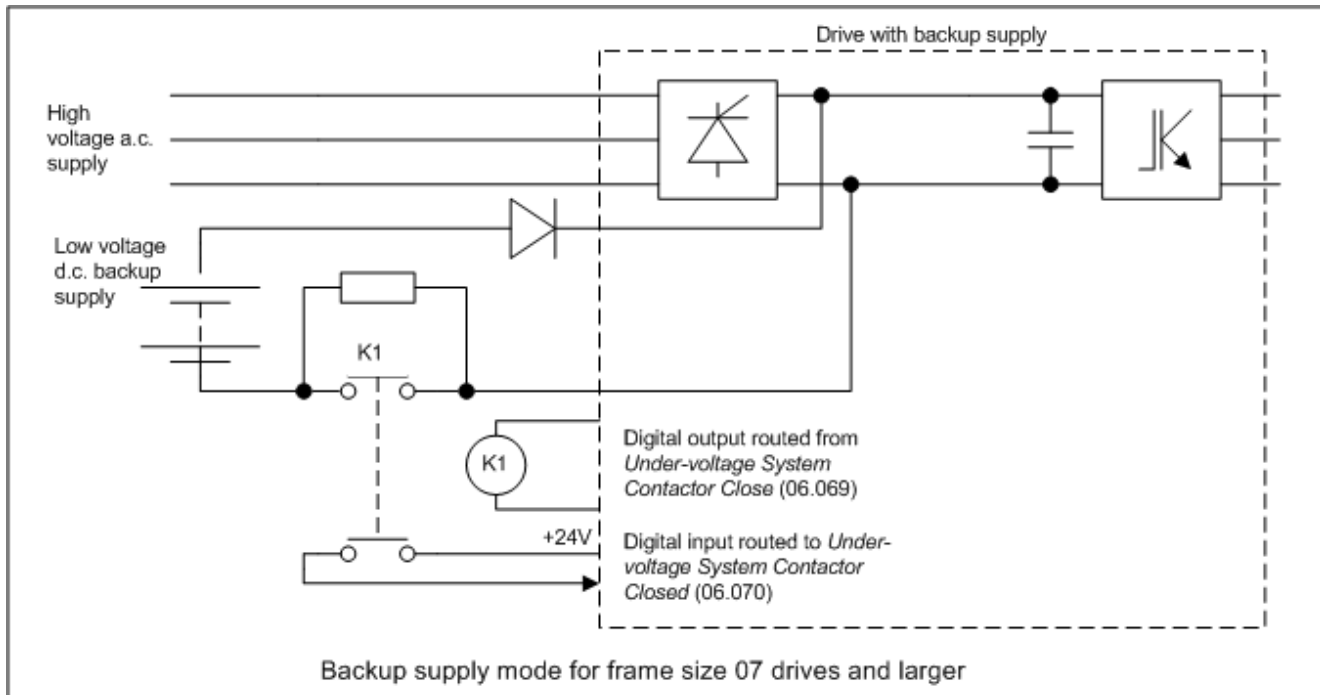
The diagram below shows the state of *Under Voltage Active* (10.016) and the control signal to the external contactor (*Under-voltage System Contactor Close* (06.069)).

Backup supply mode states for frame size 07 drives and larger
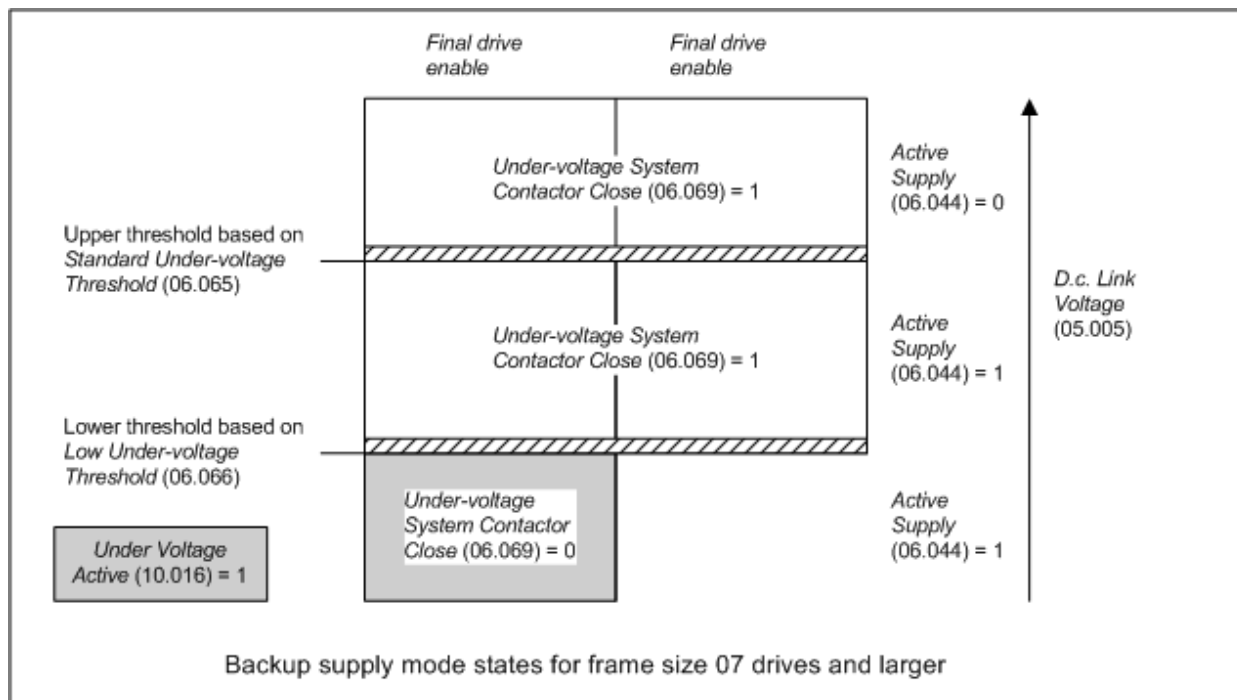
The backup supply system contactor is used to provide the charge system for the low voltage d.c. backup supply. The charge system for the high voltage a.c. supply is provided by the half controlled thyristor input bridge within the drive. The system operates in a similar way to standard mode (i.e. back-up mode not enabled) with the following differences.

1. The thyristor charge system always uses a threshold voltage related to the upper under-voltage threshold.
2. *Under-voltage System Contactor Close* (06.069) is set to one when the d.c. link voltage is above the lower under-voltage threshold.
3. *Under Voltage Active* (10.016) cannot be zero to allow the drive to be enabled if *Under-voltage System Contactor Closed* (06.070) is zero. This prevents power from being taken from the back-up supply if the mains supply is not present when the external soft-start system contactor is open.

The following diagram shows how these differences apply to the system operation.

Under-voltage Active (10.016) cannot be zero until
Under-voltage System Contactor Closed (06.070) = 1

Under-voltage timing with *Back-up Supply Mode Enable* (06.068) = 1
(Frame sizes 07 and larger)
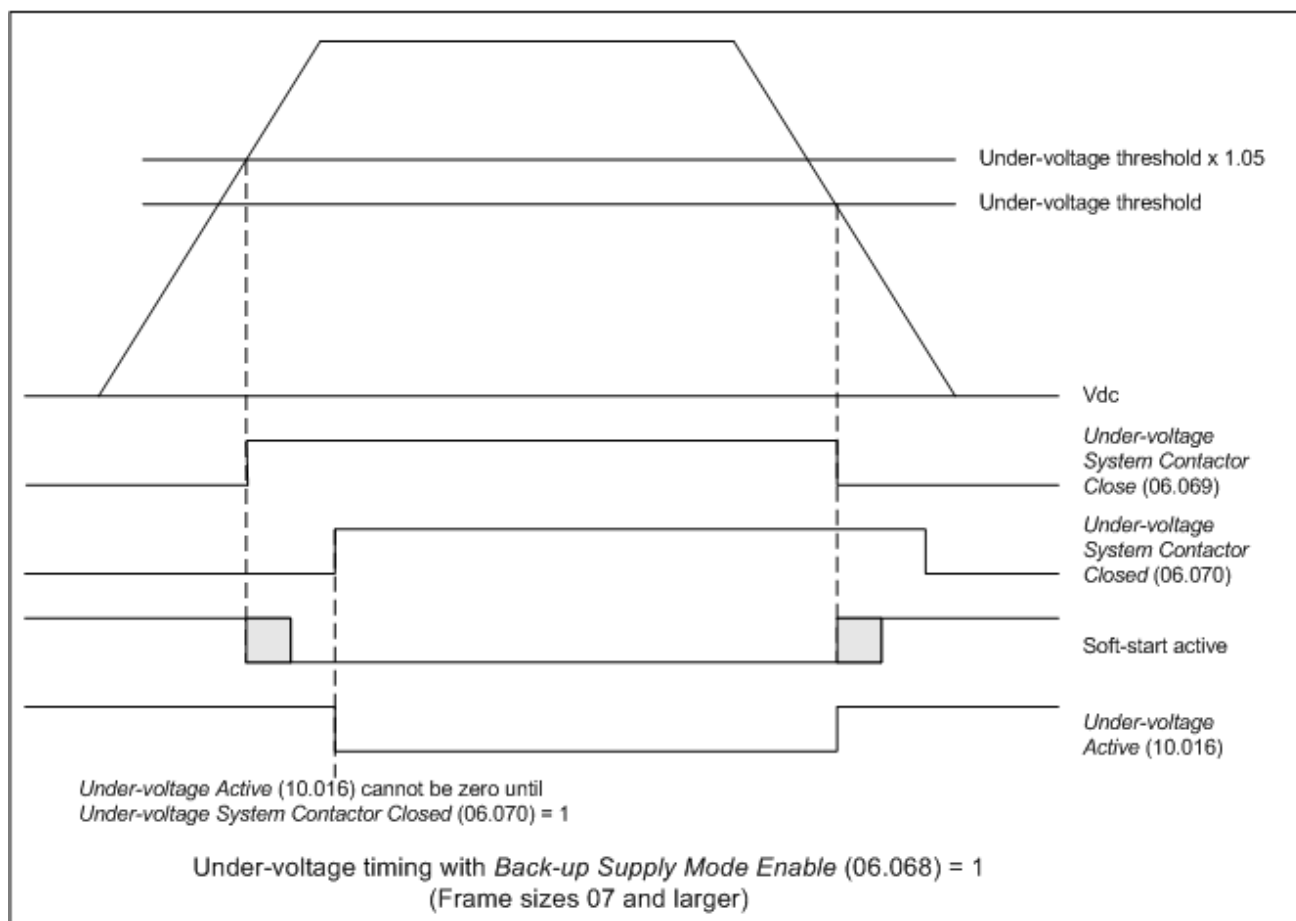
Parameter	06.066 *Low Under Voltage Threshold*		
Short description	Defines the low under voltage threshold		
Mode	RFC‑S		
Minimum	−VM_LOW_UNDER_VOLTS	Maximum	VM_LOW_UNDER_VOLTS
Default	See exceptions below	Units	V
Type	16 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW, VM, RA		

Voltage	*Default Value*
200V	175
400V	330
575V	435
690V	435

See *Standard Under Voltage Threshold* (06.065).

Parameter	06.067 *Low Under Voltage Threshold Select*		
Short description	Set to 1 to use the low under voltage threshold		
Mode	RFC‑S		
Minimum	0	Maximum	1
Default	0	Units	
Type	1 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW		

See *Standard Under Voltage Threshold* (06.065). Also see *User Supply Select* (06.072) for details of when and how drive parameters can be saved, and when a *User 24V* trip can occur.

Parameter	06.068 *Backup Supply Mode Enable*		
Short description	Set to 1 to enable the backup supply mode		
Mode	RFC‑S		
Minimum	0	Maximum	1
Default	0	Units	
Type	1 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW		

See *Standard Under Voltage Threshold* (06.065). Also see *User Supply Select* (06.072) for details of when and how drive parameters can be saved, and when a *User 24V* trip can occur.

Parameter	06.069 *Under-voltage System Contactor Close*		
Short description	Should be used as the source of a digital output to control an external supply contactor when using low voltage operation		
Mode	RFC‑S		
Minimum	0	Maximum	1
Default		Units	
Type	1 Bit Volatile	Update Rate	4ms write
Display Format	Standard	Decimal Places	0
Coding	RO, ND, NC, PT		

See *Standard Under Voltage Threshold* (06.065).

Parameter	06.070 *Under-voltage System Contactor Closed*		
Short description	Should be the destination of a digital input that indicates the state of an external suppply contactor when using low voltage operation		
Mode	RFC‑S		
Minimum	0	Maximum	1
Default	0	Units	
Type	1 Bit Volatile	Update Rate	4ms read
Display Format	Standard	Decimal Places	0
Coding	RW		

See *Standard Under Voltage Threshold* (06.065).

Parameter	06.071 *Slow Rectifier Charge Rate Enable*		
Short description	Set to 1 to reduce the charge rate of the d.c. bus		
Mode	RFC‑S		
Minimum	0	Maximum	1
Default	0	Units	
Type	1 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW		

For frame size 07 drives and larger, which use a d.c. link charge system based on a half controlled thyristor input bridge, the rate at which the d.c. bus is charged can be reduced by setting *Slow Rectifier Charge Rate Enable* (06.071) to one. This will reduce the charging current which may be required if significant additional capacitance is added to the d.c. link to prevent rupturing of input fuses.

Parameter	06.072 *User Supply Select*		
Short description	Set to 1 to select the supply from the user 24V input		
Mode	RFC‑S		
Minimum	0	Maximum	1
Default	0	Units	
Type	1 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW		

The power for the drive control system is either taken from the user 24V power supply or the main supply (i.e. derived from the power circuit d.c. link). If *Low Under Voltage Threshold Select* (06.067) = 0 and *Backup Supply Mode Enable* (06.068) = 0 and *User Supply Select* (06.072) = 0 then the supply used is determined as follows for drive sizes 5 and below. (For drive sizes 6 and above a diode OR system is used to select the required power supply, and so this is done automatically in hardware.)

1. When the drive first powers up it tries to use the main supply or the user 24V supply in turn until the drive starts up, begining with the main supply.
2. If the main supply is active and the d.c. link voltage (*D.c. Bus Voltage* (05.005)) falls to a level where it is no longer possible to communicate with the power stage then the drive attempts to switch over to the user 24V supply. If the user 24V supply is not present then the drive will power down, otherwise it will continue to run off the user 24V supply. The level at which the power stage powers down depends on whether the user 24V supply is present or not. However this is maybe below half the minimum for *Standard Under Voltage Threshold* (06.065) depending on the drive power supply loading from option modules, encoders, I/O etc..
3. If the user 24V supply is being used and the d.c. link voltage (*D.c. Bus Voltage* (05.005)) rises above 95% of the minimum for *Standard Under Voltage Threshold* (06.065) then the drive attempts to switch to the main supply.

The following should be noted:

1. Parameters can be saved by setting *Parameter mm.000* (mm.000) to 1000 (not in under-voltage state), or to 1 or 1001 (in any state) and initiating a drive reset. Power-down save parameters are saved when the under-voltage state becomes active.
2. If the drive is powered from the user 24V supply and then the main supply is activated but is not above 95% of the minimum for *Standard Under Voltage Threshold* (06.065) then the drive will continue to be powered from the user 24V supply. If the user 24V supply is subsequently removed the drive will power down, but then if the main supply is high enough will power up again on the main supply.
3. Although the drive can run off power derived from its d.c. link at a level well below the minimum for *Standard Under Voltage Threshold* (06.065) the level down to which it will operate depends on the loading applied by option modules, position feedback devices and I/O. For reliable operation it is advisable that the d.c. link voltage is above 90% of the minimum for *Standard Under Voltage Threshold* (06.065) when the 24V supply is not present.
4. It is possible to initiate saving power-down save parameters by forcing the drive into the under-voltage state by changing *Low Under Voltage Threshold Select* (06.067) from 1 to 0 when the d.c. link voltage is below 90% of the minimum of *Standard Under Voltage Threshold* (06.065). This is not advisable because failure of the 24V supply or the main supply at this point could result in corruption of the drive parameters saved in non-volatile memory.

If *Low Under Voltage Threshold Select* (06.067) = 1 or *Backup Supply Mode Enable* (06.068) = 1 or *User Supply Select* (06.072) = 1 then the 24V user supply is always selected. If the user 24V supply is not present then a *User 24V* is initiated. The following should be noted:

1. The drive will still power-up on the main supply even if the user 24V supply is not present because the drive tries each supply in turn to power up, however the drive will remain in the tripped state until the user 24V supply is activated.
2. Parameters can only be saved by setting *Parameter mm.000* (mm.000) to 1001 and initiating a drive reset. Power-down save parameters are not saved when the under-voltage state becomes active.

Parameter	06.073 *Braking IGBT Lower Threshold*		
Short description	Defines the lowest level of the d.c. bus voltage where the braking IGBT becomes active		
Mode	RFC‑S		
Minimum	−VM_DC_VOLTAGE_SET	Maximum	VM_DC_VOLTAGE_SET
Default	See exceptions below	Units	V
Type	16 Bit User Save	Update Rate	4ms read
Display Format	Standard	Decimal Places	0
Coding	RW, VM, RA		

Voltage	Default Value
200V	390
400V	780
575V	930
690V	1120

Braking IGBT Lower Threshold (06.073) defines the lowest level of *D.c. Bus Voltage* (05.005) where the braking IGBT will become active and *Braking IGBT Upper Threshold* (06.074) defines the level of *D.c. Bus Voltage* (05.005) where the braking IGBT will be on continuously. When the braking IGBT is turned on it will remain on for at least 1ms. The braking IGBT on-time is defined by the thresholds and the d.c. link voltage as given in the table below where L = *Braking IGBT Lower Threshold* (06.073) and U = *Braking IGBT Upper Threshold* (06.074).

D.c. link voltage level	On-time
D.c. Bus Voltage (05.005)	0%
L ≤ *D.c. Bus Voltage* (05.005)	[(*D.c. Bus Voltage* (05.005) - L) / (U - L)] x 100%
D.c. Bus Voltage (05.005) ≥ U	100%

As the *D.c. Bus Voltage* (05.005) rises above the lower threshold the braking IGBT is active with an on/off ratio of 1/100. As the voltage rises further, the on/off ratio increases until at the upper threshold the braking IGBT is on continuously. The upper and lower voltage threshold can be set up so that braking resistors in drives with parallel connected d.c. links will share the braking load.

If *Braking IGBT Lower Threshold* (06.073) ≥ *Braking IGBT Upper Threshold* (06.074) then the braking IGBT is off when *D.c. Bus Voltage* (05.005) < *Braking IGBT Upper Threshold* (06.074) and on if *D.c. Bus Voltage* (05.005) ≥ *Braking IGBT Upper Threshold* (06.074). This method of control is the same as that used in Unidrive SP and the default values for the braking thresholds are equal to the braking thresholds in Unidrive SP.

Unless sharing between braking resistors is required the braking thresholds do not normally need to be adjusted. Care should be taken when reducing the thresholds because if either threshold is below the maximum value of the peak rectified supply voltage the braking resistor could take power from the supply.

The list below gives conditions that will disable the braking IGBT:

1. *Braking IGBT Upper Threshold* (06.074) = 0, or *Low Voltage Braking IGBT Threshold Select* (06.076) = 1 and *Low Voltage Braking IGBT Threshold* (06.075) = 0.
2. The drive is in the under-voltage state.
3. A priority 1, 2 or 3 trip is active (see *Trip 0* (10.020)).
4. One of the following trips is active or would be active if another trip is not already active: *OI Brake*, *PSU*, *Th Brake Res* or *OHt Inverter*.
5. *Percentage Of Drive Thermal Trip Level* (07.036) = 100%. This is an indication that some part of the drive is too hot and is used to indicate if an internally fitted braking resistor is too hot.
6. *Brake R Too Hot* is active or the system has been set up to disable the braking IGBT based on the braking resistor temperature and the resistor is too hot (i.e. bit 2 of *Action On Trip Detection* (10.037) is set).

Parameter	06.074 *Braking IGBT Upper Threshold*		
Short description	Defines the level of the d.c. bus voltage where the braking IGBT will be on continuously		
Mode	RFC-S		
Minimum	−VM_DC_VOLTAGE_SET	Maximum	VM_DC_VOLTAGE_SET
Default	See exceptions below	Units	V
Type	16 Bit User Save	Update Rate	4ms read
Display Format	Standard	Decimal Places	0
Coding	RW, VM, RA		

Voltage	Default Value
200V	390
400V	780
575V	930
690V	1120

See *Braking IGBT Lower Threshold* (06.073).

Parameter	06.075 *Low Voltage Braking IGBT Threshold*		
Short description	Defines the threshold used for low voltage braking		
Mode	RFC-S		
Minimum	−VM_DC_VOLTAGE_SET	Maximum	VM_DC_VOLTAGE_SET
Default	0	Units	V
Type	16 Bit User Save	Update Rate	4ms read
Display Format	Standard	Decimal Places	0
Coding	RW, VM, RA		

If *Low Voltage Braking IGBT Threshold Select* (06.076) = 0 the normal thresholds are used. If *Low Voltage Braking IGBT Threshold Select* (06.076) = 1 then *Low Voltage Braking IGBT Threshold* (06.075) is used, so that the braking IGBT is on with a minimum on time of 1ms is the d.c. link voltage is above this level, or off if the d.c. link voltage is below this level.

Parameter	06.076 *Low Voltage Braking IGBT Threshold Select*		
Short description	Set to 1 enable low voltage IGBT braking		
Mode	RFC‑S		
Minimum	0	Maximum	1
Default	0	Units	
Type	1 Bit Volatile	Update Rate	4ms read
Display Format	Standard	Decimal Places	0
Coding	RW		

See *Low Voltage Braking IGBT Threshold* (06.075).

Parameter	06.084 *Date And Time Offset*		
Short description	Date And Time Offset		
Mode	RFC‑S		
Minimum	-12.00	Maximum	12.00
Default	0.00	Units	Hours
Type	16 Bit User Save	Update Rate	Background Read
Display Format	Standard	Decimal Places	2
Coding	RW		

Date And Time Offset (06.084) is an offset, specified in hours, that can be applied to the *Time* (06.017). If the offset applied causes the time to roll-over midnight then the *Date* (06.016) and *Day Of Week* (06.018) are also modified. The offset is only applied when the clock source is a clock derived from a keypad, i.e. *Date/Time Selector* (06.019) > 3. The offset can be used for time zone offsets or daylight saving time etc.

Menu 7 Single Line Descriptions − *Analog I/O*

Mode: RFC‑S

Parameter		Range	Default	Type					
07.001	Analog Input 1	±100.00 %		RO	Num	ND	NC	PT	FI
07.002	Analog Input 2	±100.00 %		RO	Num	ND	NC	PT	FI
07.003	Analog Input 3	±100.00 %		RO	Num	ND	NC	PT	FI
07.004	Monitored Temperature 1	±250 °C		RO	Num	ND	NC	PT	
07.005	Monitored Temperature 2	±250 °C		RO	Num	ND	NC	PT	
07.006	Monitored Temperature 3	±250 °C		RO	Num	ND	NC	PT	
07.007	Analog Input 1 Mode	4‑20mA Low (-4), 20‑4mA Low (-3), 4‑20mA Hold (-2), 20‑4mA Hold (-1), 0‑20mA (0), 20‑0mA (1), 4‑20mA Trip (2), 20‑4mA Trip (3), 4‑20mA (4), 20‑4mA (5), Volt (6), Therm Short Cct (7), Thermistor (8), Therm No Trip (9)	Volt (6)	RW	Txt				US
07.008	Analog Input 1 Scaling	0.000 to 10.000	1.000	RW	Num				US
07.009	Analog Input 1 Invert	Off (0) or On (1)	Off (0)	RW	Bit				US
07.010	Analog Input 1 Destination	0.000 to 59.999	1.036	RW	Num	DE		PT	US
07.011	Analog Input 2 Mode	4‑20mA Low (-4), 20‑4mA Low (-3), 4‑20mA Hold (-2), 20‑4mA Hold (-1), 0‑20mA (0), 20‑0mA (1), 4‑20mA Trip (2), 20‑4mA Trip (3), 4‑20mA (4), 20‑4mA (5), Volt (6), Therm Short Cct (7), Thermistor (8), Therm No Trip (9)	Volt (6)	RW	Txt				US
07.012	Analog Input 2 Scaling	0.000 to 10.000	1.000	RW	Num				US
07.013	Analog Input 2 Invert	Off (0) or On (1)	Off (0)	RW	Bit				US
07.014	Analog Input 2 Destination	0.000 to 59.999	1.037	RW	Num	DE		PT	US
07.015	Analog Input 3 Mode	Volt (6), Therm Short Cct (7), Thermistor (8), Therm No Trip (9), Disabled (10)	Volt (6)	RW	Txt				US
07.016	Analog Input 3 Scaling	0.000 to 10.000	1.000	RW	Num				US
07.017	Analog Input 3 Invert	Off (0) or On (1)	Off (0)	RW	Bit				US
07.018	Analog Input 3 Destination	0.000 to 59.999	0.000	RW	Num	DE		PT	US
07.019	Analog Output 1 Source	0.000 to 59.999	3.002	RW	Num			PT	US
07.020	Analog Output 1 Scaling	0.000 to 10.000	1.000	RW	Num				US
07.022	Analog Output 2 Source	0.000 to 59.999	4.002	RW	Num			PT	US
07.023	Analog Output 2 Scaling	0.000 to 10.000	1.000	RW	Num				US
07.025	Calibrate Analog Input 1 Full Scale	Off (0) or On (1)	Off (0)	RW	Bit		NC		
07.026	Analogue Input 1 Fast Update Active	Off (0) or On (1)		RO	Bit	ND	NC	PT	
07.027	Analogue Input 2 Fast Update Active	Off (0) or On (1)		RO	Bit	ND	NC	PT	
07.028	Analog Input 1 Current Loop Loss	Off (0) or On (1)		RO	Bit	ND	NC	PT	
07.029	Analog Input 2 Current Loop Loss	Off (0) or On (1)		RO	Bit	ND	NC	PT	
07.030	Analog Input 1 Offset	±100.00 %	0.00 %	RW	Num				US
07.031	Analog Input 2 Offset	±100.00 %	0.00 %	RW	Num				US
07.032	Analog Input 3 Offset	±100.00 %	0.00 %	RW	Num				US
07.033	Power Output	±100.0 %		RO	Num	ND	NC	PT	
07.034	Inverter Temperature	±250 °C		RO	Num	ND	NC	PT	
07.035	Percentage Of d.c. Link Thermal Trip Level	0 to 100 %		RO	Num	ND	NC	PT	
07.036	Percentage Of Drive Thermal Trip Level	0 to 100 %		RO	Num	ND	NC	PT	
07.037	Temperature Nearest To Trip Level	0 to 20999		RO	Num	ND	NC	PT	
07.038	Temperature Monitor Select 1	0 to 1999	1001	RW	Num				US
07.039	Temperature Monitor Select 2	0 to 1999	1002	RW	Num				US
07.040	Analog Input 1 Minimum	±100.00 %	-100.00 %	RW	Num				US
07.041	Analog Input 2 Minimum	±100.00 %	-100.00 %	RW	Num				US
07.042	Analog Input 3 Minimum	±100.00 %	-100.00 %	RW	Num				US
07.043	Analog Input 1 Maximum	±100.00 %	100.00 %	RW	Num				US
07.044	Analog Input 2 Maximum	±100.00 %	100.00 %	RW	Num				US
07.045	Analog Input 3 Maximum	±100.00 %	100.00 %	RW	Num				US
07.046	Analog Input 3 Thermistor Type	DIN44082 (0), KTY84 (1), PT100 (4W) (2), PT1000 (4W) (3), PT2000 (4W) (4), 2.0mA (4W) (5), PT100 (2W) (6),	DIN44082 (0)	RW	Txt				US

		PT1000 (2W) (7), PT2000 (2W) (8), 2.0mA (2W) (9)							
07.047	Analog Input 3 Thermistor Feedback	0 to 5000 Ω		RO	Num	ND	NC	PT	
07.048	Analog Input 3 Thermistor Trip Threshold	0 to 5000 Ω	3300 Ω	RW	Num				US
07.049	Analog Input 3 Thermistor Reset Threshold	0 to 5000 Ω	1800 Ω	RW	Num				US
07.050	Analog Input 3 Thermistor Temperature	-50 to 300 °C		RO	Num	ND	NC	PT	
07.051	Analog Input 1 Full Scale	0 to 65535		RO	Num	ND	NC	PT	PS
07.052	Temperature Monitor Select 3	0 to 1999	1	RW	Num				US

RW	Read / Write	RO	Read-only	Bit	Bit parameter	Txt	Text string	Date	Date parameter	Time	Time parameter
Chr	Character parameter	Bin	Binary parameter	IP	IP address	Mac	MAC address	Ver	Version number	SMP	Slot, menu, parameter
Num	Number parameter	DE	Destination	ND	No default value	RA	Rating dependent	NC	Non-copyable	PT	Protected
FI	Filtered	US	User save	PS	Power-down save						

Menu 7 − *Analog I/O*

Mode: RFC‑S

Analog Outputs
The update rate for analog outputs is 250μs; although the output will only change at the update rate defined by the source parameter for the input. The following exceptions apply:

1. *Speed Feedback* (03.002) has an update rate of 4ms and includes a 16ms window filter. If this parameter is selected as a source for output 2 the update rate of the source changes to 250us and the only filter applied is the window filter associated with the position feedback interface (i.e. *P1 Feedback Filter* (03.042) for the P1 interface). It should be noted that this feature is only provided when the position feedback is from a drive interface and not from an option module.
2. If either analogue output is set up for current mode then the update rate for both analogue outputs is 4ms.

Analog Inputs
The normal sample rate for the analog inputs is 4ms, however this is increased to 250us for analogue inputs 1 and 2 under the following conditions:

1. The maximum and the minimum for the input are at their default values of 100.00% and -100.00% respectively.
2. The input is set to voltage mode.
3. One of the destinations given in the table below must be selected.
4. If the destination is *Analog Reference 1* (01.036) or *Analog Reference 2* (01.037) the reference system must not be in uinpolar mode, i.e. *Bipolar Reference Enable* (01.010) must be one.

Note that *Analogue Input 1 Fast Update Active* (07.026) and *Analogue Input 2 Fast Update Active* (07.027) indicate if fast updating is active for each input.

Parameter	Drive modes	Comment
Analog Reference 1 (01.036)	RFC-A, RFC-S	The data from *Analog Reference 1* (01.036) is processed in the 250us task so that the reference to the speed controller is updated every 250us.
Analog Reference 2 (01.037)	RFC-A, RFC-S	The data from *Analog Reference 2* (01.037) is processed in the 250us task so that the reference to the speed controller is updated every 250us.
Hard Speed Reference (03.022)	RFC-A, RFC-S	
Torque Reference (04.008)	RFC-A, RFC-S	
Power Input 1 (03.010) *Power Input 2* (03.013) *Power Input 3* (03.014)	Regen	

The diagram below shows the parameter structure for each I/O. See *Internal I/O Identifier* (11.068) for details of which I/O is present for different I/O options.

Analog Input 1 Maximum (07.043)
Analog Input 2 Maximum (07.044)
Analog Input 3 Maximum (07.045)

Analog input

Set-up and monitoring

Analog Input 1 Mode (07.007)
Analog Input 2 Mode (07.011)
Analog Input 3 Mode (07.015)
Calibrate Analog Input 1 Full Scale (07.25)
Analog Input 1 Current Loop Loss (07.028)
Analog Input 2 Current Loop Loss (07.029)

Analog Input 1 (07.001)
Analog Input 2 (07.002)
Analog Input 3 (07.003)

Analog Input 1 Minimum (07.040)
Analog Input 2 Minimum (07.041)
Analog Input 3 Minimum (07.042)

Analog Input 1 Destination (07.010)
Analog Input 2 Destination (07.014)
Analog Input 3 Destination (07.018)

Analog Input 1 Offset (07.030)
Analog Input 2 Offset (07.031)
Analog Input 3 Offset (07.032)

Analog Input 1 Invert (07.009)
Analog Input 2 Invert (07.013)
Analog Input 3 Invert (07.017)

Analog Input 1 Scaling (07.008)
Analog Input 2 Scaling (07.012)
Analog Input 3 Scaling (07.016)

x-1

Analog Input 1 Mode (07.007) = 7
Analog Input 2 Mode (07.011) = 7
Analog Input 3 Mode (07.015) = 7

Analog Input 1 Thermistor Feedback (07.054)
Analog Input 2 Thermistor Feedback (07.059)
Analog Input 3 Thermistor Feedback (07.047)

Th Short Circuit trip

Short circuit detect

Analog Input 1 Thermistor Type (07.053)
Analog Input 1 Thermistor Trip Threshold (07.055)
Analog Input 1 Thermsitor Reset Threshold (07.056)

Analog Input 2 Thermistor Type (07.058)
Analog Input 2 Thermistor Trip Threshold (07.060)
Analog Input 2 Thermsitor Reset Threshold (07.061)

Analog Input 3 Thermistor Type (07.046)
Analog Input 3 Thermistor Trip Threshold (07.048)
Analog Input 3 Thermsitor Reset Threshold (07.049)

Thermistor trip

Analog Input 1 Thermistor Temperature (07.057)
Analog Input 2 Thermistor Temperature (07.062)
Analog Input 3 Thermistor Temperature (07.050)

Resistance to temperature
conversion

Analog Output 1 Source (07.019)
Analog Output 2 Source (07.022)

Set-up
Analog Output 1 Mode (07.021)
Analog Output 2 Mode (07.024)

Analog Output 1 Scaling (07.020)
Analog Output 2 Scaling (07.023)

Analog
output

Analog I/O

Parameter	07.001 *Analog Input 1*		
Short description	Displays the value of analog input 1		
Mode	RFC‑S		
Minimum	-100.00	Maximum	100.00
Default		Units	%
Type	16 Bit Volatile	Update Rate	4ms write
Display Format	Standard	Decimal Places	2
Coding	RO, FI, ND, NC, PT		

Each analogue input has a resolution of 11 bits plus sign. The inputs can operate in different modes (defined by *Analog Input 1 Mode* (07.007) for analogue input 1). These modes include voltage, current and thermistor modes. The available modes depend on the hardware configuration and are given in the table below.

Internal I/O Identifier (11.068)	Analogue Input 1	Analogue Input 2	Analogue Input 3
0: Standard Analogue and Digital I/O	Bipolar Voltage, Current	Bipolar Voltage, Current	Bipolar Voltage, Thermistor
1: Digital I/O	Not present	Not present	Thermistor, Disabled
2: HVAC Analogue and Digital I/O	Unipolar Voltage, Current, Thermistor	Unipolar Voltage, Current, Thermistor	Not present

The "Input Level" is defined for the different modes in the table below.

Mode	Input Level
Voltage	(Input Voltage / 10V) x 100.00%
0-20mA	(Input Current / 20mA) x 100.00%
20-0mA	((20mA - Input Current) / 20mA) x 100.00%
4-20mA	((Input Current - 4mA) / 16mA) x 100.00%
20-4mA	((20mA - Input Current) / 16mA) x 100.00%
Thermistor	(Input resistance / 10K Ohm) x 100%

Analog Input 1 (07.001) is derived as follows:

Limits
A_1 is the value after the minimum and maximum limits are applied.

If *Analog Input 1 Minimum* (07.040) ≥ *Analog Input 1 Maximum* (07.043) then:
A_1 = 0.00% whatever the input level.

If *Analog Input 1 Minimum* (07.040) < 0.00% and *Analog Input 1 Maximum* (07.043) > 0.00% then:
A_1 = Input Level x (100.00% / *Analog Input 1 Maximum* (07.043))
A_1 is then limited between -100% and +100%.

Otherwise:
Input Level is limited between *Analog Input 1 Minimum* (07.040) and *Analog Input 1 Maximum* (07.043)
A_1 = [Input Level - *Analog Input 1 Minimum* (07.040)] x 100.00% / (*Analog Input 1 Maximum* (07.043) - *Analog Input 1 Minimum* (07.040))

For thermistor modes it should be noted that *Analog Input 1 Minimum* (07.040) and *Analog Input 1 Minimum* (07.040) have no effect and that the input resistance is limited between 0 and 5kΩ.

Parameter	07.002 *Analog Input 2*		
Short description	Displays the value of analog input 2		
Mode	RFC‑S		
Minimum	-100.00	Maximum	100.00
Default		Units	%
Type	16 Bit Volatile	Update Rate	4ms write
Display Format	Standard	Decimal Places	2
Coding	RO, FI, ND, NC, PT		

See *Analog Input 1* (07.001).

Parameter	07.003 *Analog Input 3*		
Short description	Displays the value of analog input 3		
Mode	RFC‑S		
Minimum	-100.00	Maximum	100.00
Default		Units	%
Type	16 Bit Volatile	Update Rate	4ms write
Display Format	Standard	Decimal Places	2
Coding	RO, FI, ND, NC, PT		

See *Analog Input 1* (07.001).

Parameter	07.004 *Monitored Temperature 1*		
Short description	Displays the temperature set up by Temperature Monitor Select 1		
Mode	RFC‑S		
Minimum	-250	Maximum	250
Default		Units	°C
Type	16 Bit Volatile	Update Rate	Background write
Display Format	Standard	Decimal Places	0
Coding	RO, ND, NC, PT		

Thermal monitoring is provided within the drive to protect the power stage and the control system from over temperature.

Monitored Temperature 1 (07.004), *Monitored Temperature 2* (07.005) and *Monitored Temperature 3* (07.006) give an indication of the temperature of three selected monitoring points within the drive power system or control system. The required monitoring points can be selected using *Temperature Monitor Select 1* (07.038), *Temperature Monitor Select 2* (07.039) and *Temperature Monitor Select 3* (07.052) respectively. The default values give two monitoring points in the power system in *Monitored Temperature 1* (07.004) and *Monitored Temperature 2* (07.005), and control board temperature 1 in *Monitored Temperature 3* (07.006).

Drive temperature monitoring
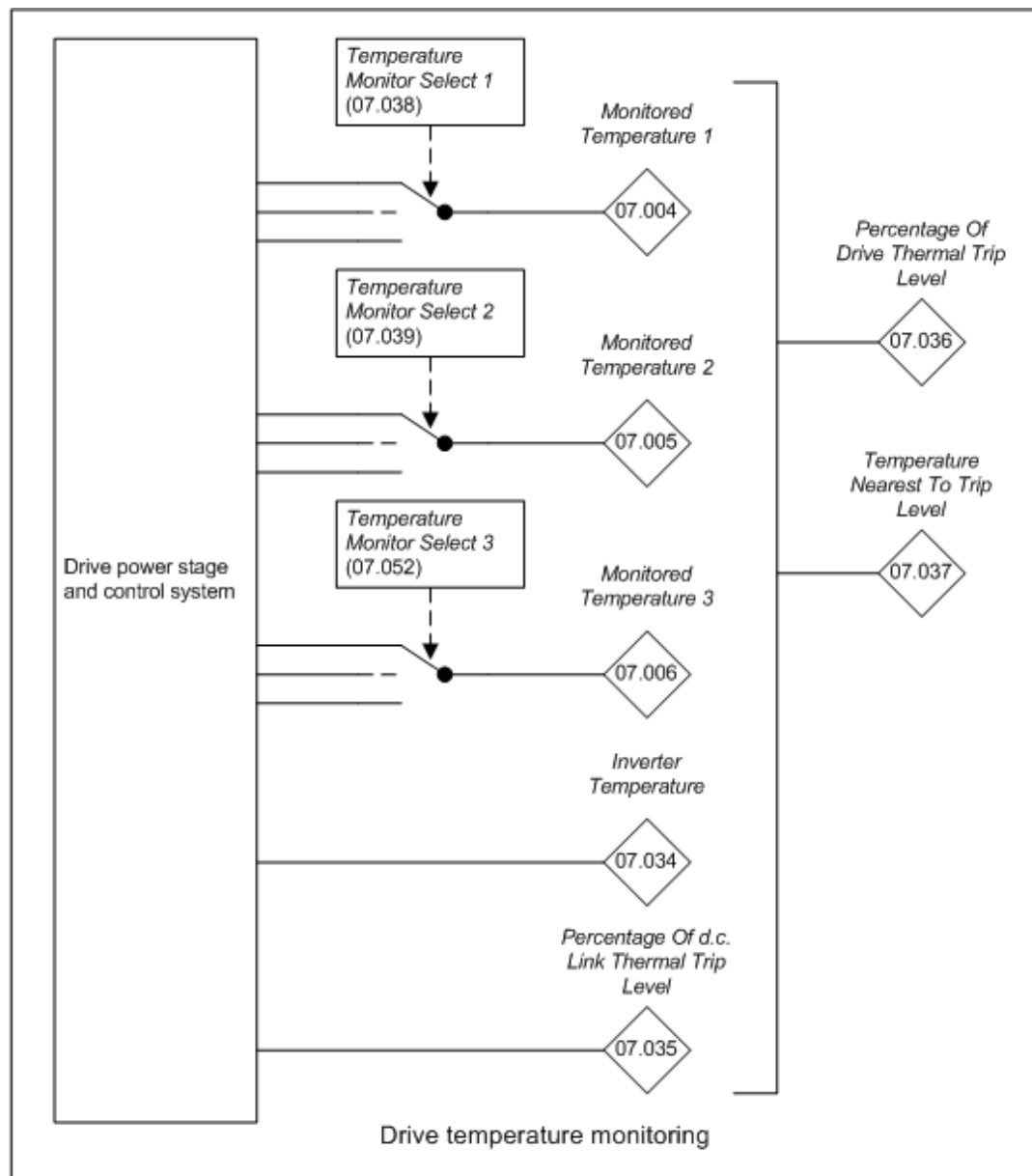
Parameter	07.005 *Monitored Temperature 2*		
Short description	Displays the temperature set up by Temperature Monitor Select 2		
Mode	RFC‑S		
Minimum	-250	Maximum	250
Default		Units	°C
Type	16 Bit Volatile	Update Rate	Background write
Display Format	Standard	Decimal Places	0
Coding	RO, ND, NC, PT		

See *Monitored Temperature 1* (07.004) for details.

Parameter	07.006 *Monitored Temperature 3*		
Short description	Displays the temperature set up by Temperature Monitor Select 3		
Mode	RFC‑S		
Minimum	-250	Maximum	250
Default		Units	°C
Type	16 Bit Volatile	Update Rate	Background write
Display Format	Standard	Decimal Places	0
Coding	RO, ND, NC, PT		

See *Monitored Temperature 1* (07.004) for details.

Parameter	07.007 *Analog Input 1 Mode*		
Short description	Defines the mode of analog input 1		
Mode	RFC‑S		
Minimum	-4	Maximum	6
Default	6	Units	
Type	8 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW, TE		

Value	Text	Description
-4	4-20mA Low	4-20mA low value on current loss
-3	20-4mA Low	20-4mA low value on current loss
-2	4-20mA Hold	4-20mA hold at level before loss on current loss
-1	20-4mA Hold	20-4mA hold at level before loss on current loss
0	0-20mA	0-20mA
1	20-0mA	20-0mA
2	4-20mA Trip	4-20mA trip on current loss
3	20-4mA Trip	20-4mA trip on current loss
4	4-20mA	4-20mA no action on loss
5	20-4mA	20-4mA no action on loss
6	Volt	Voltage
7	Therm Short Cct	Temperature measurement input with short circuit detection
8	Thermistor	Temperature measurement without short circuit detection
9	Therm No Trip	Temperature measurement input with no trips

The table below gives all the possible input modes for analog inputs 1 and 2.

Mode	Function
4-20mA Low	4-20mA low value on current loss (1)
20-4mA Low	20-4mA low value on current loss (1)
4-20mA Hold	4-20mA hold at level before loss on current loss (2)
20-4mA Hold	20-4mA hold at level before loss on current loss (2)
0-20mA	0-20mA
20-0mA	20-0mA
4-20mA Trip	4-20mA trip on current loss (1), (3)
20-4mA Trip	20-4mA trip on current loss (1), (3)
4-20mA	4-20mA no action on loss (1)
20-4mA	20-4mA no action on loss (1)
Voltage	Voltage
Therm Short Cct	Temperature measurement input with short circuit detection
Thermistor	Temperature measurement without short circuit detection
Therm No Trip	Temperature measurement input with no trips
Disabled	Input always zero (4)

(1) Analogue input level is 0.00% if the current is below 3mA.

(2) Analogue input level remains at the value it had in the previous sample before the current fell below 3mA.

(3) A *An Input 1 Loss* is initiated if the current falls below 3mA.

(4) When the Digital I/O only is present this mode is used disable the current source as the input is on a shared connection with Digital Output 2.

Parameter	07.008 *Analog Input 1 Scaling*		
Short description	Defines the scaling factor of analog input 1		
Mode	RFC‑S		
Minimum	0.000	Maximum	10.000
Default	1.000	Units	
Type	16 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	3
Coding	RW		

Analog Input 1 (07.001) is modified by *Analog Input 1 Scaling* (07.008), *Analog Input 1 Offset* (07.030) and *Analog Input 1 Invert* (07.009) before it is routed to its destination as follows:

A_{1O} = *Analog Input 1* (07.001) + *Analog Input 1 Offset* (07.030)

A_{1O} is the value after the offset has been applied and is limited between -100.00% and 100.00%

A_{1S} = A_{1O} x *Analog Input 1 Scaling* (07.008)

A_{1S} is the value after the scaling and the offset have been applied and is limited between -100.00% and 100.00%

If *Analog Input 1 Invert* (07.009) = 0 then A_{1I} = A_{1S} otherwise A_{1I} = -A_{1S}

A_{1I} is the value after the invert, scaling and offset have been applied and is the final value that is routed to the destination defined by *Analog Input 1 Destination* (07.010).

Parameter	07.009 *Analog Input 1 Invert*		
Short description	Inverts the signal for analog input 1		
Mode	RFC‑S		
Minimum	0	Maximum	1
Default	0	Units	
Type	1 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW		

See *Analog Input 1 Scaling* (07.008).

Parameter	07.010 *Analog Input 1 Destination*		
Short description	Defines the output parameter for analog input 1		
Mode	RFC‑S		
Minimum	0.000	Maximum	59.999
Default	1.036	Units	
Type	16 Bit User Save	Update Rate	Drive reset read
Display Format	Standard	Decimal Places	3
Coding	RW, DE, PT, BU		

See *Analog Input 1 Scaling* (07.008).

Parameter	07.011 *Analog Input 2 Mode*		
Short description	Defines the mode for analog input 2		
Mode	RFC‑S		
Minimum	-4	Maximum	6
Default	6	Units	
Type	8 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW, TE		

Value	Text	Description
-4	4-20mA Low	4-20mA low value on current loss
-3	20-4mA Low	20-4mA low value on current loss
-2	4-20mA Hold	4-20mA hold at level before loss on current loss
-1	20-4mA Hold	20-4mA hold at level before loss on current loss
0	0-20mA	0-20mA
1	20-0mA	20-0mA
2	4-20mA Trip	4-20mA trip on current loss
3	20-4mA Trip	20-4mA trip on current loss
4	4-20mA	4-20mA no action on loss
5	20-4mA	20-4mA no action on loss
6	Volt	Voltage
7	Therm Short Cct	Temperature measurement input with short circuit detection
8	Thermistor	Temperature measurement without short circuit detection
9	Therm No Trip	Temperature measurement input with no trips

See *Analog Input 1 Mode* (07.007).

Parameter	07.012 *Analog Input 2 Scaling*		
Short description	Defines the scaling factor for analog input 2		
Mode	RFC‑S		
Minimum	0.000	Maximum	10.000
Default	1.000	Units	
Type	16 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	3
Coding	RW		

The scaling, offset and invert functions for analog input 2 are defined in the same way as for analog input 1. See *Analog Input 1 Scaling* (07.008).

Parameter	07.013 *Analog Input 2 Invert*		
Short description	Inverts the signal for analog input 2		
Mode	RFC‑S		
Minimum	0	Maximum	1
Default	0	Units	
Type	1 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW		

The scaling, offset and invert functions for analog input 2 are defined in the same way as for analog input 1. See *Analog Input 1 Scaling* (07.008).

Parameter	07.014 *Analog Input 2 Destination*		
Short description	Defines the output parameter for analog input 2		
Mode	RFC‑S		
Minimum	0.000	Maximum	59.999
Default	1.037	Units	
Type	16 Bit User Save	Update Rate	Drive reset read
Display Format	Standard	Decimal Places	3
Coding	RW, DE, PT, BU		

The scaling, offset and invert functions for analog input 2 are defined in the same way as for analog input 1. See *Analog Input 1 Scaling* (07.008).

Parameter	07.015 *Analog Input 3 Mode*		
Short description	Defines the mode of analog input 3		
Mode	RFC‑S		
Minimum	6	Maximum	9
Default	6	Units	
Type	8 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW, TE		

Value	Text	Description
6	Volt	Voltage
7	Therm Short Cct	Temperature measurement input with short circuit detection
8	Thermistor	Temperature measurement without short circuit detection
9	Therm No Trip	Temperature measurement input with no trips
10	Disabled	Input always zero

The table below gives all the possible input modes for analog input 3.

Mode	Function
Voltage	Voltage
Therm Short Cct	Temperature measurement input with short circuit detection
Thermistor	Temperature measurement without short circuit detection
Therm No Trip	Temperature measurement input with no trips
Disabled	Input always zero (1)

(1) When the Digital I/O only is present this mode is used disable the current source as the input is on a shared connection with Digital Input 5.

Parameter	07.016 *Analog Input 3 Scaling*		
Short description	Defines the scaling factor for analog input 3		
Mode	RFC‑S		
Minimum	0.000	Maximum	10.000
Default	1.000	Units	
Type	16 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	3
Coding	RW		

The scaling, offset and invert functions for analog input 3 are defined in the same way as for analog input 1. See *Analog Input 1 Scaling* (07.008).

Parameter	07.017 *Analog Input 3 Invert*		
Short description	Inverts the signal of analog input 3		
Mode	RFC‑S		
Minimum	0	Maximum	1
Default	0	Units	
Type	1 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW		

The scaling, offset and invert functions for analog input 3 are defined in the same way as for analog input 1. See *Analog Input 1 Scaling* (07.008).

Parameter	07.018 *Analog Input 3 Destination*		
Short description	Defines the ouput paramter for analog input 3		
Mode	RFC‑S		
Minimum	0.000	Maximum	59.999
Default	0.000	Units	
Type	16 Bit User Save	Update Rate	Drive reset read
Display Format	Standard	Decimal Places	3
Coding	RW, DE, PT, BU		

The scaling, offset and invert functions for analog input 3 are defined in the same way as for analog input 1. See *Analog Input 1 Scaling* (07.008).

Parameter	07.019 *Analog Output 1 Source*		
Short description	Defines the input parameter for analog output 1		
Mode	RFC‑S		
Minimum	0.000	Maximum	59.999
Default	3.002	Units	
Type	16 Bit User Save	Update Rate	Drive reset read
Display Format	Standard	Decimal Places	3
Coding	RW, PT, BU		

Analog Output 1 Source (07.019) defines the source parameter for analog output 1. The value of the source parameter is scaled with *Analog Output 1 Scaling* (07.020) and if the scaling is greater than 1.000 the value is clamped between -100% and +100% or between 0% and 100% depending on whether the output is bipolar or unipolar. The resulting value is then used to control the output. It should be noted that the normal rules for parameter routing do not apply, but the scaling always makes -100% to +100% correspond to the range from minus source parameter maximum to plus source parameter maximum, and 0% corresponds to the source parameter value of zero. This means for example that a parameter with a minimum of 1 and a maximum of 10 will produce an output that changes from 10% to 100% as the parameter is change from minimum to maximum.

The outputs provided with different hardware are given in the table below.

Internal I/O Identifier (11.068)	Analogue Output 1	Analogue Output 2
0: Standard Analogue and Digital I/O	Bipolar Voltage	Bipolar Voltage
1: Basic I/O	No output	No output
2: HVAC Analogue and Digital I/O	Unipolar Voltage or Current	Unipolar Voltage or Current

The output mode is defined by *Analogue Output 1 Mode* (07.021) as shown in the table below.

Analogue Output 1 Mode (07.021)	Standard Analogue and Digital I/O	HVAC Analogue and Digital I/O
Volt	-10V to + 10V	0V to +10V
0-20mA	Not possible	0mA to 20mA
20-0mA	Not possible	20mA to 0mA
4-20mA	Not possible	4mA to 20mA
20-4mA	Not possible	20mA to 4mA

Parameter	07.020 *Analog Output 1 Scaling*		
Short description	Defines the scaling factor for analog output 1		
Mode	RFC‑S		
Minimum	0.000	Maximum	10.000
Default	1.000	Units	
Type	16 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	3
Coding	RW		

See *Analog Output 1 Source* (07.019).

Parameter	07.022 *Analog Output 2 Source*		
Short description	Defines the input source for analog output 2		
Mode	RFC‑S		
Minimum	0.000	Maximum	59.999
Default	4.002	Units	
Type	16 Bit User Save	Update Rate	Drive reset read
Display Format	Standard	Decimal Places	3
Coding	RW, PT, BU		

Analog Output 2 Source (07.022) defines the source parameter for analog output 1. The value of the source parameter is scaled with *Analog Output 2 Scaling* (07.023) and if the scaling is greater than 1.000 the value is clamped between -100% and +100% or between 0% and 100% depending on whether the output is biploar or uniploar. The resulting value is then used to control the output. The outputs provided with different hardware are given in the table below.

Internal I/O Identifier (11.068)	Analogue Output 1	Analogue Output 2
0: Standard Analogue and Digital I/O	Bipolar Voltage	Bipolar Voltage
1: Basic I/O	No output	No output
2: HVAC Analogue and Digital I/O	Unipolar Voltage or Current	Unipolar Voltage or Current

The output mode is defined by *Analogue Output 2 Mode* (07.024) as shown in the table below.

Analogue Output 2 Mode (07.024)	Standard Analogue and Digital I/O	HVAC Analogue and Digital I/O
Volt	-10V to + 10V	0V to +10V
0-20mA	Not possible	0mA to 20mA
20-0mA	Not possible	20mA to 0mA
4-20mA	Not possible	4mA to 20mA
20-4mA	Not possible	20mA to 4mA

Parameter	07.023 *Analog Output 2 Scaling*		
Short description	Defines the scaling factor for analog output 2		
Mode	RFC‑S		
Minimum	0.000	Maximum	10.000
Default	1.000	Units	
Type	16 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	3
Coding	RW		

See *Analog Output 2 Source* (07.022).

Parameter	07.025 *Calibrate Analog Input 1 Full Scale*		
Short description	Caibrates the input level for analog input 1		
Mode	RFC‑S		
Minimum	0	Maximum	1
Default	0	Units	
Type	1 Bit Volatile	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW, NC		

For analog input 1, and in voltage mode only, the full scale value used to determine the input level can be changed from 10V by calibrating the input. The calibration process is triggered by setting *Calibrate Analog Input 1 Full Scale* (07.025) to one. *Calibrate Analog Input 1 Full Scale* (07.025) is cleared automatically when the calibration process is complete. After calibration the actions are as follows:

Input voltage during calibration	Result
V < 1.5V	The calibration result is ignored and the full scale is set to 10V. *Analog Input 1 Full Scale* (07.051) is set to zero.
1.5V < V < 2.5V	The calibration result is ignored and the full scale or *Analog Input 1 Full Scale* (07.051) are not affected.
V > 2.5V	The calibration result is used to set full scale and the value is also stored in *Analog Input 1 Full Scale* (07.051).

It should be noted that *Analog Input 1 Full Scale* (07.051) is a power-down save parameter, and so the result is automatically retained after power-down.

Parameter	07.026 *Analogue Input 1 Fast Update Active*		
Short description	Analogue Input 1 Fast Update Active		
Mode	RFC‑S		
Minimum	0	Maximum	1
Default		Units	
Type	1 Bit Volatile	Update Rate	Background write
Display Format	Standard	Decimal Places	0
Coding	RO, ND, NC, PT		

Analogue Input 1 Fast Update Active (07.026) is one if the destination for analogue input 1 is being updated at the fast rate of 250us.

Parameter	07.027 *Analogue Input 2 Fast Update Active*		
Short description	Analogue Input 2 Fast Update Active		
Mode	RFC‑S		
Minimum	0	Maximum	1
Default		Units	
Type	1 Bit Volatile	Update Rate	Background write
Display Format	Standard	Decimal Places	0
Coding	RO, ND, NC, PT		

Analogue Input 2 Fast Update Active (07.027) is one if the destination for analogue input 1 is being updated at the fast rate of 250us.

Parameter	07.028 *Analog Input 1 Current Loop Loss*		
Short description	Displays when analog input 1 falls below 3mA		
Mode	RFC‑S		
Minimum	0	Maximum	1
Default		Units	
Type	1 Bit Volatile	Update Rate	Background write
Display Format	Standard	Decimal Places	0
Coding	RO, ND, NC, PT		

If *Analog Input 1 Mode* (07.007) is set to any of the 4-20mA or 20-4mA modes and the current falls below 3mA then *Analog Input 1 Current Loop Loss* (07.028) is set to one. If the current is more than 3mA or any other mode is selected then *Analog Input 1 Current Loop Loss* (07.028) is set to zero.

Parameter	07.029 *Analog Input 2 Current Loop Loss*		
Short description	Displays when analog input 2 falls below 3mA		
Mode	RFC‑S		
Minimum	0	Maximum	1
Default		Units	
Type	1 Bit Volatile	Update Rate	Background write
Display Format	Standard	Decimal Places	0
Coding	RO, ND, NC, PT		

See *Analog Input 1 Current Loop Loss* (07.028).

Parameter	07.030 *Analog Input 1 Offset*		
Short description	Defines the offset of analog input 1		
Mode	RFC‑S		
Minimum	-100.00	Maximum	100.00
Default	0.00	Units	%
Type	16 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	2
Coding	RW		

See *Analog Input 1 Scaling* (07.008).

Parameter	07.031 *Analog Input 2 Offset*		
Short description	Defines the offset of analog input 2		
Mode	RFC‑S		
Minimum	-100.00	Maximum	100.00
Default	0.00	Units	%
Type	16 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	2
Coding	RW		

The scaling, offset and invert functions for analog input 2 are defined in the same way as for analog input 1. See *Analog Input 1 Scaling* (07.008).

Parameter	07.032 *Analog Input 3 Offset*		
Short description	Defines the offset of analog input 3		
Mode	RFC‑S		
Minimum	-100.00	Maximum	100.00
Default	0.00	Units	%
Type	16 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	2
Coding	RW		

The scaling, offset and invert functions for analog input 3 are defined in the same way as for analog input 1. See *Analog Input 1 Scaling* (07.008).

Parameter	07.033 *Power Output*		
Short description	Instant output power		
Mode	RFC‑S		
Minimum	-100.0	Maximum	100.0
Default		Units	%
Type	16 Bit Volatile	Update Rate	250µs write
Display Format	Standard	Decimal Places	1
Coding	RO, ND, NC, PT		

This is an instantaneous power output with fast update rate that is primarily intended to be used as a power feed-forward for applications with a Regen system front end. The full scale (100.0%) value is equal to a power of 3 x (VM_DC_VOLTAGE[MAX] / 2√2) x *Full Scale Current Kc* (11.061). This is compatible with the power output provided in Unidrive SP and is directly comptible with *Power Input 1* (03.010) (and the other power feed-forward parameters) in Regen mode. The scaling is intended to cover the maximum range of likely power in the drive. For example with a 400V 7.5kW drive the full scale d.c. link voltage is 831V and Kc=38.222A, and so the full scale value of this parameter is 3 x (831 / 2√2) x 38.222 = 33.689kW. For Open-loop, RFC-A and RFC-S modes a positive value of power indicates power flowing from the drive to motor. For Regen mode a positive value of power indicates power flowing from the supply to the regen drive.

Parameter	07.034 *Inverter Temperature*		
Short description	Displays the estimated junction temperature of the hottest power device within the drive inverter		
Mode	RFC‑S		
Minimum	-250	Maximum	250
Default		Units	°C
Type	16 Bit Volatile	Update Rate	Background write
Display Format	Standard	Decimal Places	0
Coding	RO, ND, NC, PT		

Inverter Temperature (07.034) shows the estimated junction temperature of the hottest power device within the drive inverter. If this temperature exceeds the switch down threshold defined for the power stage the switching frequency is reduced provided this feature has not been disabled (see *Auto-switching Frequency Change* (05.035)).

Parameter	07.035 *Percentage Of d.c. Link Thermal Trip Level*		
Short description	Displays the percentage of the maximum allowed temperature as estimated by the thermal model of the d.c. link components		
Mode	RFC‑S		
Minimum	0	Maximum	100
Default		Units	%
Type	8 Bit Volatile	Update Rate	Background write
Display Format	Standard	Decimal Places	0
Coding	RO, ND, NC, PT		

Percentage Of d.c. Link Thermal Trip Level (07.035) gives the percentage of the maximum allowed temperature as estimated by the thermal model of the d.c. link components.

Parameter	07.036 *Percentage Of Drive Thermal Trip Level*		
Short description	Displays the percentage of the thermal trip level of the temperature monitoring point or thermal model in the drive that is highest		
Mode	RFC‑S		
Minimum	0	Maximum	100
Default		Units	%
Type	8 Bit Volatile	Update Rate	Background write
Display Format	Standard	Decimal Places	0
Coding	RO, ND, NC, PT		

Percentage Of Drive Thermal Trip Level (07.036) gives the percentage of the thermal trip level of the temperature monitoring point or thermal model in the drive that is highest. This includes all thermal monitoring points (not just those selected by *Monitored Temperature 1* (07.004), *Monitored Temperature 2* (07.005) and *Monitored Temperature 3* (07.006)), *Inverter Temperature* (07.034) and *Percentage Of d.c. Link Thermal Trip Level* (07.035).

Percentage Of d.c. Link Thermal Trip Level (07.035) is used directly to give *Percentage Of Drive Thermal Trip Level* (07.036), but for all other monitored values which are temperatures this is given by Percentage of thermal trip level = (Temperature - 40°C) / (Trip temperature - 40°C) x 100%

The location of the measurement or the thermal model that is related to this temperature is given in *Temperature Nearest To Trip Level* (07.037). If *Percentage Of Drive Thermal Trip Level* (07.036) exceeds 90% *Drive Over-temperature Alarm* (10.018) is set to one. If *Percentage Of Drive Thermal Trip Level* (07.036) reaches 100% one of the trips given in the table below is initiated. The trip can be reset when the percentage of thermal trip level fall below 95%.

Temperature	Trip
Inverter Temperature (07.034)	OHt Inverter
Power system temperature	OHt Power
Percentage Of d.c. Link Thermal Trip Level (07.035)	OHt dc Link
Control system temperature	OHt Control

Parameter	07.037 *Temperature Nearest To Trip Level*		
Short description	Displays the thermistor location or the model that corresponds to the value shown in Percentage Of Drive Thermal Trip Level		
Mode	RFC‑S		
Minimum	0	Maximum	20999
Default		Units	
Type	16 Bit Volatile	Update Rate	Background write
Display Format	Standard	Decimal Places	0
Coding	RO, ND, NC, PT		

Temperature Nearest To Trip Level (07.037) shows the thermistor location or the model that corresponds to the value shown in *Percentage Of Drive Thermal Trip Level* (07.036) in the form xxyzz as shown in the table below.

Source	xx	y	zz
Control system	00	0	01: Control board thermistor 1
Control system	00	0	02: Control board thermistor 2
Control system	00	0	03: I/O board thermistor (or internal braking resistor in servo Drive)
Control system	00	1	00: Inverter thermal model
Control system	00	2	00: D.c. link thermal model
Control system	00	3	00: Braking IGBT thermal model
Power system	01	0	zz: Thermistor location defined by zz in the power system
Power system	01	Rectifier number	zz: Thermistor location defined by zz in the rectifier

Parameter	07.038 *Temperature Monitor Select 1*		
Short description	Defines the temperature to be monitored in Monitored Temperature 1		
Mode	RFC‑S		
Minimum	0	Maximum	1999
Default	1001	Units	
Type	16 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW		

Temperature Monitor Select 1 (07.038) selects the temperature to be monitored in *Monitored Temperature 1* (07.004) using the format given for *Temperature Nearest To Trip Level* (07.037). If the monitoring point selected does not exist then the monitored temperature is always zero. The table below shows the monitoring points that can be selected.

Source	xx	y	zz
Control system	00	0	01: Control board thermistor 1
Control system	00	0	02: Control board thermistor 2
Control system	00	0	03: I/O board thermistor (or internal braking resistor in Servo Drive)
Control system	00	1	00: Inverter thermal model
Control system	00	3	00: Braking IGBT thermal model
Control system	00	4	00: Rectifier thermal model
Power system	01	0	zz: Thermistor location defined by zz in the power system
Power system	01	Rectifier number	zz: Thermistor location defined by zz in the rectifier

For a multi-module power system the power system measurement that can be selected is shown in the table below. It should be noted that the specific power module cannot be selected and that the highest temperature from each of the power modules is given.

Source	xx	y	zz
Power system	01	0	01: U phase power device thermistor
Power system	01	0	02: V phase power device thermistor
Power system	01	0	03: W phase power device thermistor
Power system	01	0	04: General rectifier thermistors
Power system	01	0	05: General power system thermistor

Parameter	07.039 *Temperature Monitor Select 2*		
Short description	Defines the temperature to be monitored in Monitored Temperature 2		
Mode	RFC‑S		
Minimum	0	Maximum	1999
Default	1002	Units	
Type	16 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW		

See *Temperature Monitor Select 1* (07.038).

Parameter	07.040 *Analog Input 1 Minimum*		
Short description	Defines the minimum value for analog input 1		
Mode	RFC‑S		
Minimum	-100.00	Maximum	100.00
Default	-100.00	Units	%
Type	16 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	2
Coding	RW		

See *Analog Input 1* (07.001).

Parameter	07.041 *Analog Input 2 Minimum*		
Short description	Defines the minimum value for analog input 2		
Mode	RFC‑S		
Minimum	-100.00	Maximum	100.00
Default	-100.00	Units	%
Type	16 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	2
Coding	RW		

See *Analog Input 1* (07.001).

Parameter	07.042 _Analog Input 3 Minimum_		
Short description	Defines the minimum value for analog input 3		
Mode	RFC‑S		
Minimum	-100.00	Maximum	100.00
Default	-100.00	Units	%
Type	16 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	2
Coding	RW		

See _Analog Input 1_ (07.001).

Parameter	07.043 _Analog Input 1 Maximum_		
Short description	Defines the maximum value for analog input 1		
Mode	RFC‑S		
Minimum	-100.00	Maximum	100.00
Default	100.00	Units	%
Type	16 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	2
Coding	RW		

See _Analog Input 1_ (07.001).

Parameter	07.044 _Analog Input 2 Maximum_		
Short description	Defines the maximum value for analog input 2		
Mode	RFC‑S		
Minimum	-100.00	Maximum	100.00
Default	100.00	Units	%
Type	16 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	2
Coding	RW		

See _Analog Input 1_ (07.001).

Parameter	07.045 _Analog Input 3 Maximum_		
Short description	Defines the maximum value for analog input 3		
Mode	RFC‑S		
Minimum	-100.00	Maximum	100.00
Default	100.00	Units	%
Type	16 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	2
Coding	RW		

See _Analog Input 1_ (07.001).

Parameter	07.046 _Analog Input 3 Thermistor Type_		
Short description	Defines the thermistor type for analog input 3		
Mode	RFC‑S		
Minimum	0	Maximum	9
Default	0	Units	
Type	8 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW, TE		

Value	Text
0	DIN44082
1	KTY84
2	PT100 (4W)
3	PT1000 (4W)
4	PT2000 (4W)
5	2.0mA (4W)
6	PT100 (2W)
7	PT1000 (2W)
8	PT2000 (2W)
9	2.0mA (2W)

Analog Input 3 Thermistor Type (07.046) defines the operation of the temperature feedback interface for analog input 3 when _Analog Input 3 Mode_ (07.015) is set up for a temperature feedback mode. When a temperature feedback mode is selected a 2mA current source is connected to analog input 3 to supply the temperature feedback device that is connected to the input.

Analog Input 3 Thermistor Type (07.046)	Compatible devices
0: DIN44082	Three thermistors in series as specified in DIN44082 standard
1: KTY84	KTY84 PTC thermistor
2: PT100 (4W)	PT100 PTC thermistor with 4 wire connection
3: PT1000 (4W)	PT1000 PTC thermistor with 4 wire connection
4:PT2000 (4W)	PT2000 PTC thermistor with 4 wire connection
5: 2.0mA (4W)	Any device. Full scale equivalent to a resistance of 5k Ohms with 4 wire connection
6: PT100 (2W)	PT100 PTC thermistor with 2 wire connection
7: PT1000 (2W)	PT1000 PTC thermistor with 2 wire connection
8: PT2000 (2W)	PT2000 PTC thermistor with 2 wire connection
9: 2.0mA (2W)	Any device. Full scale equivalent to a resistance of 5k Ohms with 2 wire connection

DIN44082 and KTY84 devices should always be connected directly to analog input 3. The other devices can be connected directly to analog input 3 if the 2 wire connection option is selected. Alternatively these devices can be used with a 4 wire connection to remove the effect of voltage drops due to the 2mA supply current via the path shown below. If a 4 wire connection is selected analog input 1 is disabled and *Analog Input 1* (07.001) always reads as 0.0%. It should be noted that the input system takes account of the input impedance of analogue input 3 when 2 wire mode is used, and of both analogue input 1 and analogue input 3 when 4 wire mode is used. For this reason it is important that 2 wire mode is selected when the connection between Analogue Input 1+ and Analogue input 3 is not present, and that 4 wire mode is selected if the connection is present.

Connection for PT100, PT1000 and PT2000 thermistors
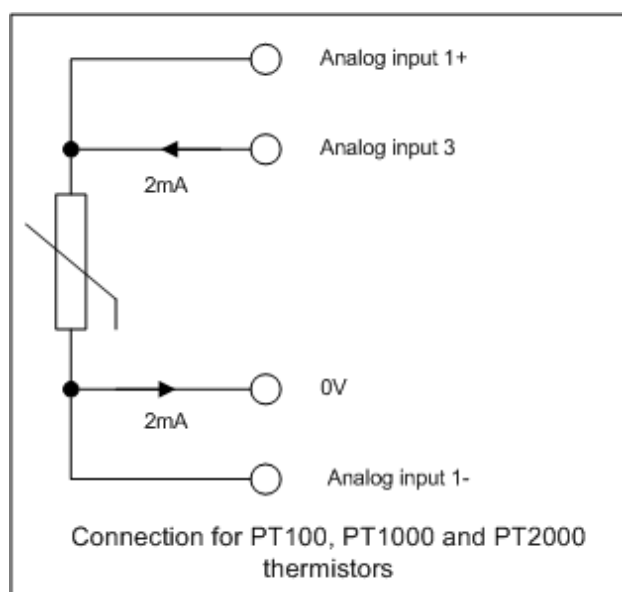
Parameter	07.047 *Analog Input 3 Thermistor Feedback*		
Short description	Displays the measured resistance of analog input 3		
Mode	RFC‑S		
Minimum	0	Maximum	5000
Default		Units	Ω
Type	16 Bit Volatile	Update Rate	Background write
Display Format	Standard	Decimal Places	0
Coding	RO, ND, NC, PT		

Analog Input 3 Thermistor Feedback (07.047) shows the measured resistance.

Parameter	07.048 *Analog Input 3 Thermistor Trip Threshold*		
Short description	Defines the thermistor trip threshold for analog input 3		
Mode	RFC‑S		
Minimum	0	Maximum	5000
Default	3300	Units	Ω
Type	16 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW		

Over-temperature detection becomes active for input 3 if *Analog Input 3 Thermistor Feedback* (07.047) > *Analog Input 3 Thermistor Trip Threshold* (07.048). Over-temperature becomes inactive for input 3 if *Analog Input 3 Thermistor Feedback* (07.047) < *Analog Input 3 Thermistor Reset Threshold* (07.049). If *Analog Input 3 Mode* (07.015) is 7 or 8 (i.e. tripping is enabled) an *Thermistor*.003 trip is initiated. The default values for
Analog Input 3 Thermistor Trip Threshold (07.048) and *Analog Input 3 Thermistor Reset Threshold* (07.049) are the levels specified in the DIN 44082 standard.

Parameter	07.049 *Analog Input 3 Thermistor Reset Threshold*		
Short description	Defines the thermistor reset threshold for analog input 3		
Mode	RFC‑S		
Minimum	0	Maximum	5000
Default	1800	Units	Ω
Type	16 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW		

See *Analog Input 3 Thermistor Trip Threshold* (07.048).

Parameter	07.050 *Analog Input 3 Thermistor Temperature*		
Short description	Displays the temperature of the device based on the resistance to temperature characteristic for the specified device		
Mode	RFC‑S		
Minimum	-50	Maximum	300
Default		Units	°C
Type	16 Bit Volatile	Update Rate	Background write
Display Format	Standard	Decimal Places	0
Coding	RO, ND, NC, PT		

If a KTY84, PT100, PT1000 or PT2000 type device is selected for temperature feedback then *Analog Input 3 Thermistor Temperature* (07.050) shows the temperature of the device based on the resistance to temperature characteristic specified for this device. Otherwise *Analog Input 3 Thermistor Temperature* (07.050) = 0.0.

Parameter	07.051 *Analog Input 1 Full Scale*		
Short description	Displays the full scale value of analog input 1		
Mode	RFC‑S		
Minimum	0	Maximum	65535
Default		Units	
Type	16 Bit Power Down Save	Update Rate	Background write
Display Format	Standard	Decimal Places	0
Coding	RO, ND, NC, PT, BU		

See *Calibrate Analog Input 1 Full Scale* (07.025).

Parameter	07.052 *Temperature Monitor Select 3*		
Short description	Defines the temperature to be monitored in Monitored Temperature 3		
Mode	RFC‑S		
Minimum	0	Maximum	1999
Default	1	Units	
Type	16 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW		

See *Temperature Monitor Select 1* (07.038).

Menu 8 Single Line Descriptions − *Digital I/O*

Mode: RFC‑S

Parameter	Range	Default	Type				
08.001 Digital I/O 01 State	Off (0) or On (1)		RO	Bit	ND	NC	PT	
08.002 Digital I/O 02 State	Off (0) or On (1)		RO	Bit	ND	NC	PT	
08.003 Digital I/O 03 State	Off (0) or On (1)		RO	Bit	ND	NC	PT	
08.004 Digital Input 04 State	Off (0) or On (1)		RO	Bit	ND	NC	PT	
08.005 Digital Input 05 State	Off (0) or On (1)		RO	Bit	ND	NC	PT	
08.006 Digital Input 06 State	Off (0) or On (1)		RO	Bit	ND	NC	PT	
08.007 Relay Output State	Off (0) or On (1)		RO	Bit	ND	NC	PT	
08.008 24V Supply Output State	Off (0) or On (1)		RO	Bit	ND	NC	PT	
08.009 STO Input 01 State	Off (0) or On (1)		RO	Bit	ND	NC	PT	
08.010 External Trip Mode	Disable (0), STO 1 (1), STO 2 (2), STO 1 OR STO 2 (3)	Disable (0)	RW	Txt				US
08.011 Digital I/O 01 Invert	Not Invert (0), Invert (1)	Not Invert (0)	RW	Txt				US
08.012 Digital I/O 02 Invert	Not Invert (0), Invert (1)	Not Invert (0)	RW	Txt				US
08.013 Digital I/O 03 Invert	Not Invert (0), Invert (1)	Not Invert (0)	RW	Txt				US
08.014 Digital Input 04 Invert	Not Invert (0), Invert (1)	Not Invert (0)	RW	Txt				US
08.015 Digital Input 05 Invert	Not Invert (0), Invert (1)	Not Invert (0)	RW	Txt				US
08.016 Digital Input 06 Invert	Not Invert (0), Invert (1)	Not Invert (0)	RW	Txt				US
08.017 Relay Invert	Not Invert (0), Invert (1)	Not Invert (0)	RW	Txt				US
08.018 24V Supply Output Invert	Not Invert (0), Invert (1)	Invert (1)	RW	Txt				US
08.020 Digital I/O Read Word	0 to 511		RO	Num	ND	NC	PT	
08.021 Digital I/O 01 Source/Destination	0.000 to 59.999	10.003	RW	Num	DE		PT	US
08.022 Digital I/O 02 Source/Destination	0.000 to 59.999	10.033	RW	Num	DE		PT	US
08.023 Digital I/O 03 Source/Destination	0.000 to 59.999	6.030	RW	Num	DE		PT	US
08.024 Digital Input 04 Destination	0.000 to 59.999	6.032	RW	Num	DE		PT	US
08.025 Digital Input 05 Destination	0.000 to 59.999	1.041	RW	Num	DE		PT	US
08.026 Digital Input 06 Destination	0.000 to 59.999	6.031	RW	Num	DE		PT	US
08.027 Relay Output Source	0.000 to 59.999	10.001	RW	Num			PT	US
08.028 24V Supply Output Source	0.000 to 59.999	0.000	RW	Num			PT	US
08.029 Input Logic Polarity	Negative Logic (0), Positive Logic (1)	Positive Logic (1)	RW	Txt				US
08.031 Digital I/O 01 Output Select	Off (0) or On (1)	On (1)	RW	Bit				US
08.032 Digital I/O 02 Output Select	Off (0) or On (1)	Off (0)	RW	Bit				US
08.033 Digital I/O 03 Output Select	Off (0) or On (1)	Off (0)	RW	Bit				US
08.040 STO Input 02 State	Off (0) or On (1)		RO	Bit	ND	NC	PT	
08.041 Keypad Run Button State	Off (0) or On (1)		RO	Bit	ND	NC	PT	
08.042 Keypad Auxiliary Button State	Off (0) or On (1)		RO	Bit	ND	NC	PT	
08.043 24V Supply Input State	Off (0) or On (1)		RO	Bit	ND	NC	PT	
08.044 Keypad Stop Button State	Off (0) or On (1)		RO	Bit	ND	NC	PT	
08.051 Keypad Run Button Invert/Toggle	Not Invert (0), Invert (1), Toggle (2)	Not Invert (0)	RW	Txt				US
08.052 Keypad Auxiliary Button Invert/Toggle	Not Invert (0), Invert (1), Toggle (2)	Not Invert (0)	RW	Txt				US
08.053 24V Supply Input Invert	Not Invert (0), Invert (1)	Not Invert (0)	RW	Txt				US
08.061 Keypad Run Button Destination	0.000 to 59.999	0.000	RW	Num	DE		PT	US
08.062 Keypad Auxiliary Button Destination	0.000 to 59.999	0.000	RW	Num	DE		PT	US
08.063 24V Supply Input Destination	0.000 to 59.999	0.000	RW	Num	DE		PT	US
08.071 Digital I/O Output Enable Register 1	0000000000000000 to 1111111111111111	0000000000000000	RW	Bin			PT	US
08.072 Digital I/O Input Register 1	0000000000000000 to 1111111111111111		RO	Bin	ND	NC	PT	
08.073 Digital I/O Output Register 1	0000000000000000 to 1111111111111111	0000000000000000	RW	Bin			PT	

RW	Read / Write	RO	Read-only	Bit	Bit parameter	Txt	Text string	Date	Date parameter	Time	Time parameter
Chr	Character parameter	Bin	Binary parameter	IP	IP address	Mac	MAC address	Ver	Version number	SMP	Slot, menu, parameter
Num	Number parameter	DE	Destination	ND	No default value	RA	Rating dependent	NC	Non-copyable	PT	Protected
FI	Filtered	US	User save	PS	Power-down save						

Menu 8 − *Digital I/O*

Mode: RFC‑S

Digital I/O Interface
The normal sample rate for the digital I/O system is 2ms, however it is possible to obtain a faster update rate for some parameters with certain inputs as described below. (Note that the keypad buttons and the rest button are always updated at the background rate and cannot be used for fast updating.)

Direction, read and write register parameters
Digital I/O Output Enable Register 1 (08.071), *Digital I/O Input Register 1* (08.072) and *Digital I/O Output Register 1* (08.073) provide direct access to read/control the digital I/O that is integral to the drive.

Limit Switches
If digital inputs 4 or 5 are routed to either the *Forward Limit Switch* (06.035) or *Reverse Limit Switch* (06.036) in RFC-A or RFC-S modes the update rate is 250us.

Parameters
The parameter structure for each digital I/O is shown in the diagram below.
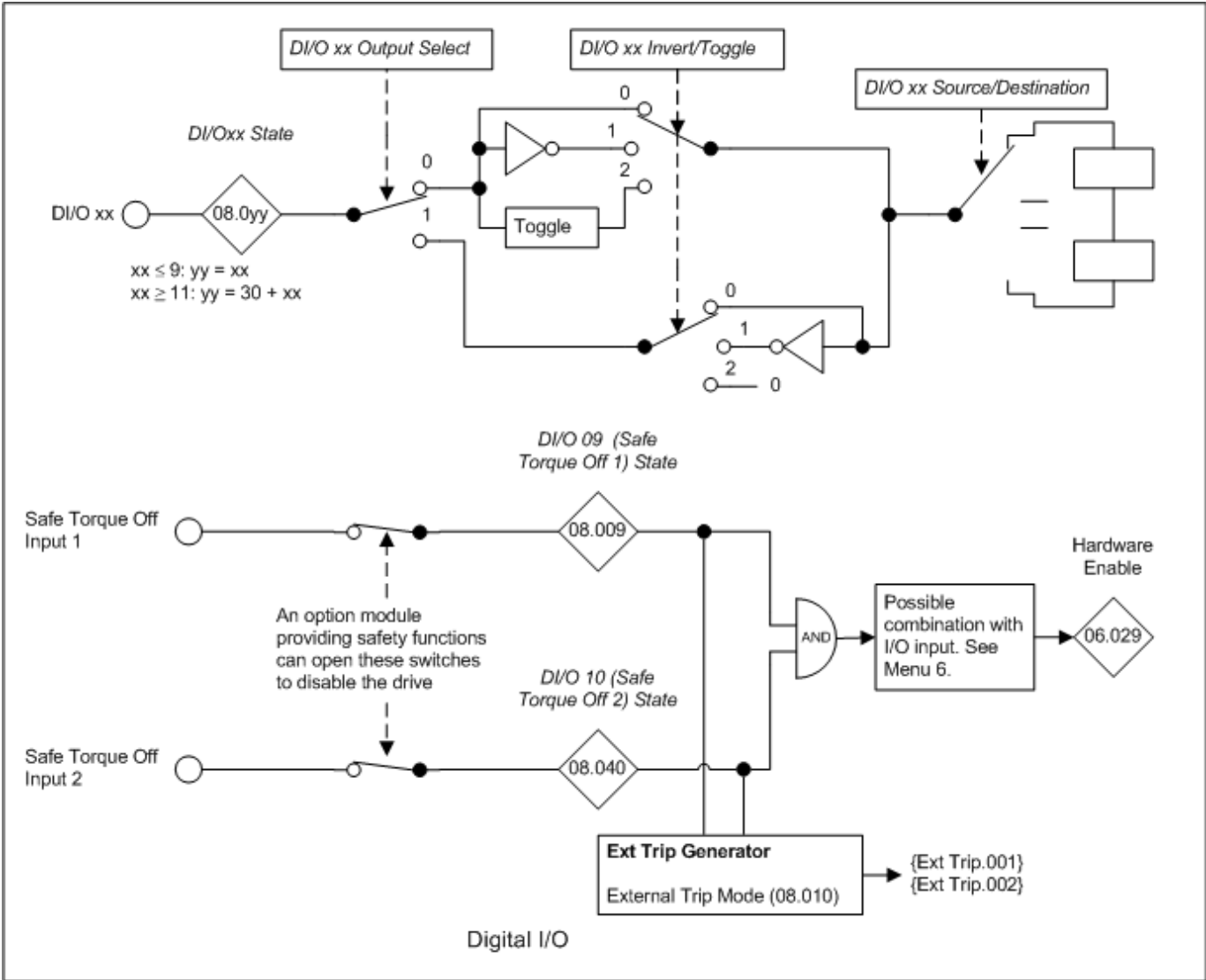
The table below covers all the possible digital I/O parameters. See *Internal I/O Identifier* (11.068) for details of which I/O is present for different I/O options.

DI/O	Function	State	Invert/Toggle	Source/Destination	Output Select
1	Input/Output	08.001	08.011	08.021	08.031
2	Input/Output	08.002	08.012	08.022	08.032
3	Input/Output	08.003	08.013	08.023	08.033
4	Input	08.004	08.014	08.024	
5	Input	08.005	08.015	08.025	
6	Input	08.006	08.016	08.026	
7	Relay Output	08.007	08.017	08.027	
8	24V Supply Output	08.008	08.018	08.028	
9	Safe Torque Off 1	08.009			
10	Safe Torque Off 2	08.040			
11	Keypad Run Button	08.041	08.051	08.061	
12	Keypad Auxiliary Button	08.042	08.052	08.062	
13	24V Supply Input	08.043	08.053	08.063	
14	Keypad Stop Button	08.044			
15	Relay 2 Output	08.045	08.055	08.065	
16	Drive Reset button	08.046			

Parameter	08.001 *Digital I/O 01 State*		
Short description	Displays the state for digtial input/output1		
Mode	RFC‑S		
Minimum	0	Maximum	1
Default		Units	
Type	1 Bit Volatile	Update Rate	2ms write
Display Format	Standard	Decimal Places	0
Coding	RO, ND, NC, PT		

The Digtial I/O State parameter shows the state of digital I/O on the drive. All I/O except Digital Input 11 (Keypad Run Button), Digital Input 12 (Keypad Auxiliary Button), Digital Input 13 (24V Supply Input) and Digital Input 14 (Keypad Stop Button) use IEC61131-2 logic levels. As default the inputs use positive logic, and so the state parameter is 0 if the digital I/O is low or 1 if the digital I/O is high. *Input Logic Polarity* (08.029) can be set to zero to change the logic for Digital I/O1-6 to negative logic, so that the state parameter is 0 if the digital I/O is high or 1 if the digital I/O is low. The state parameter represents the digital I/O state whether it is an input or an output. If the digital I/O is configured as an output to be controlled using the *Digital I/O Output Register 1* (08.073) then the state parameter will still show the state of the output even though the route source is zero and the invert parameter has no effect.

Digital Input 11 (Keypad Run Button), Digital Input 12 (Keypad Auxiliary Button) and Digital Input 14 (Keypad Stop Button) represent the state of the Run, Auxiliary and Stop buttons on any keypad fitted to the drive; the input state is determined by ORing the state of the button on each keypad connected to the drive, if the button is pressed the state parameter is one otherwise it is zero. If a keypad is not fitted the state parameters are zero.

Digital Input 13 (24V Supply Input) is an external 24V supply input that is monitored and can be used as a 24V digital input if an external 24V supply is not required. The state parameter is low for the voltage range from 0V to 17V and high for the voltage range above 18V. As the input is a power supply it will consume significant current if the level is taken above 24V when the drive is running from its internal power supply, or at any voltage level if this input is the only power supply to the drive.

Digital Input 09 (STO input 1) and Digital Input 10 (STO input 2) correspond to two safe torque off channels within the drive. Both channels must be in the high state for the drive to be enabled. The state parameters are 0 if the digital input is low, or 1 if the digital input is high. If option slot 3 does not contain an option module providing safety functions then both safe torque off channels are connected to their state parameters and the safe torque off input can enable/disable the drive. If an option module providing safety functions is fitted in option slot 3 then the option module can disable the drive by breaking the path of either one or both safe torque off channels. See Menu 6 for details of the drive enable system.

Parameter	08.002 *Digital I/O 02 State*		
Short description	Displays the state for digtial input/output 2		
Mode	RFC‑S		
Minimum	0	Maximum	1
Default		Units	
Type	1 Bit Volatile	Update Rate	2ms write
Display Format	Standard	Decimal Places	0
Coding	RO, ND, NC, PT		

See *Digital I/O 01 State* (08.001).

Parameter	08.003 *Digital I/O 03 State*		
Short description	Displays the state for digtial input/output 3		
Mode	RFC‑S		
Minimum	0	Maximum	1
Default		Units	
Type	1 Bit Volatile	Update Rate	2ms write
Display Format	Standard	Decimal Places	0
Coding	RO, ND, NC, PT		

See *Digital I/O 01 State* (08.001).

Parameter	08.004 *Digital Input 04 State*		
Short description	Displays the state for digtial input 4		
Mode	RFC‑S		
Minimum	0	Maximum	1
Default		Units	
Type	1 Bit Volatile	Update Rate	2ms write
Display Format	Standard	Decimal Places	0
Coding	RO, ND, NC, PT		

See *Digital I/O 01 State* (08.001).

Parameter	08.005 *Digital Input 05 State*		
Short description	Displays the state for digtial input 5		
Mode	RFC‑S		
Minimum	0	Maximum	1
Default		Units	
Type	1 Bit Volatile	Update Rate	2ms write
Display Format	Standard	Decimal Places	0
Coding	RO, ND, NC, PT		

See *Digital I/O 01 State* (08.001).

Parameter	08.006 *Digital Input 06 State*		
Short description	Displays the state for digtial input 6		
Mode	RFC‑S		
Minimum	0	Maximum	1
Default		Units	
Type	1 Bit Volatile	Update Rate	2ms write
Display Format	Standard	Decimal Places	0
Coding	RO, ND, NC, PT		

See *Digital I/O 01 State* (08.001).

Parameter	08.007 *Relay Output State*		
Short description	Displays the state for relay output		
Mode	RFC‑S		
Minimum	0	Maximum	1
Default		Units	
Type	1 Bit Volatile	Update Rate	2ms write
Display Format	Standard	Decimal Places	0
Coding	RO, ND, NC, PT		

See *Digital I/O 01 State* (08.001).

Parameter	08.008 *24V Supply Output State*		
Short description	Displays the state for 24V supply output		
Mode	RFC‑S		
Minimum	0	Maximum	1
Default		Units	
Type	1 Bit Volatile	Update Rate	2ms write
Display Format	Standard	Decimal Places	0
Coding	RO, ND, NC, PT		

See *Digital I/O 01 State* (08.001).

Parameter	08.009 *STO Input 01 State*		
Short description	Displays the state for Safe Torque Off 1 input		
Mode	RFC‑S		
Minimum	0	Maximum	1
Default		Units	
Type	1 Bit Volatile	Update Rate	2ms write
Display Format	Standard	Decimal Places	0
Coding	RO, ND, NC, PT		

See *Digital I/O 01 State* (08.001).

Parameter	08.010 *External Trip Mode*		
Short description	Defines behaviour of drive if STOs are low		
Mode	RFC-S		
Minimum	0	Maximum	3
Default	0	Units	
Type	8 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW, TE		

Value	*Text*
0	Disable
1	STO 1
2	STO 2
3	STO 1 OR STO 2

If *External Trip Mode* (08.010) = 0 the safe torque off inputs simply enable or disable the drive. If External Trip Mode (08.010) > 0 it is possible to enable the following trip functions.

External Trip Mode (08.010)	Actions
0	Safe torque off inputs do not initiate trips
1	*External Trip.001* if Safe Torque Off Input 1 is low
2	*External Trip.002* if Safe Torque Off Input 2 is low
3	*External Trip.001* if Safe Torque Off is low OR *External Trip.002* if Safe Torque Off Input 2 is low

Parameter	08.011 *Digital I/O 01 Invert*		
Short description	Set to invert Digital I/O 01		
Mode	RFC-S		
Minimum	0	Maximum	1
Default	0	Units	
Type	8 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW, TE		

Value	*Text*
0	Not Invert
1	Invert

A value of 0 or 1 allows the digital I/O to be non-inverted or inverted respectively.

Parameter	08.012 *Digital I/O 02 Invert*		
Short description	Set to invert Digital I/O 02		
Mode	RFC-S		
Minimum	0	Maximum	1
Default	0	Units	
Type	8 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW, TE		

Value	*Text*
0	Not Invert
1	Invert

See *Digital I/O 01 Invert* (08.011).

Parameter	08.013 *Digital I/O 03 Invert*		
Short description	Set to invert Digital I/O 03		
Mode	RFC-S		
Minimum	0	Maximum	1
Default	0	Units	
Type	8 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW, TE		

Value	Text
0	Not Invert
1	Invert

See *Digital I/O 01 Invert* (08.011).

Parameter	08.014 *Digital Input 04 Invert*		
Short description	Set to invert Digital Input 04		
Mode	RFC‑S		
Minimum	0	Maximum	1
Default	0	Units	
Type	8 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW, TE		

Value	Text
0	Not Invert
1	Invert

See *Digital I/O 01 Invert* (08.011).

Parameter	08.015 *Digital Input 05 Invert*		
Short description	Set to invert Digital Input 05		
Mode	RFC‑S		
Minimum	0	Maximum	1
Default	0	Units	
Type	8 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW, TE		

Value	Text
0	Not Invert
1	Invert

See *Digital I/O 01 Invert* (08.011).

Parameter	08.016 *Digital Input 06 Invert*		
Short description	Set to invert Digital Input 06		
Mode	RFC‑S		
Minimum	0	Maximum	1
Default	0	Units	
Type	8 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW, TE		

Value	Text
0	Not Invert
1	Invert

See *Digital I/O 01 Invert* (08.011).

Parameter	08.017 *Relay Invert*		
Short description	Set to invert the Relay Output		
Mode	RFC‑S		
Minimum	0	Maximum	1
Default	0	Units	
Type	8 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW, TE		

Value	Text
0	Not Invert
1	Invert

See *Digital I/O 01 Invert* (08.011).

Parameter	08.018 *24V Supply Output Invert*		
Short description	Set to invert 24V Supply Output		
Mode	RFC‑S		
Minimum	0	Maximum	1
Default	1	Units	
Type	8 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW, TE		

Value	*Text*
0	Not Invert
1	Invert

See *Digital I/O 01 Invert* (08.011).

Parameter	08.020 *Digital I/O Read Word*		
Short description	Displays the states for digital I/O 1 to 8		
Mode	RFC‑S		
Minimum	0	Maximum	511
Default		Units	
Type	16 Bit Volatile	Update Rate	Background write
Display Format	Standard	Decimal Places	0
Coding	RO, ND, NC, PT		

Digital I/O Read Word (08.020) reflects the state of digital input/output 1 to STO input 1 as given below. Each bit matches the value of the state parameter for the respective digital input or output.

Digital I/O Read Word (08.020) bit	Digital I/O
0	Digital I/O 1
1	Digital I/O 2
2	Digital I/O 3
3	Digital Input 4
4	Digital Input 5
5	Digital Input 6
6	Relay
7	24V Output
8	STO Input 1

Parameter	08.021 *Digital I/O 01 Source/Destination*		
Short description	Defines the source or destination parameter for Digital I/O 1		
Mode	RFC‑S		
Minimum	0.000	Maximum	59.999
Default	10.003	Units	
Type	16 Bit User Save	Update Rate	Drive Reset Read
Display Format	Standard	Decimal Places	3
Coding	RW, DE, PT, BU		

The Digital I/O Source/Destination parameters provide the routing for the source and/or destination for the digital I/O.

Parameter	08.022 *Digital I/O 02 Source/Destination*		
Short description	Defines the source or destination parameter for Digital I/O 2		
Mode	RFC‑S		
Minimum	0.000	Maximum	59.999
Default	10.033	Units	
Type	16 Bit User Save	Update Rate	Drive Reset Read
Display Format	Standard	Decimal Places	3
Coding	RW, DE, PT, BU		

See *Digital I/O 01 Source/Destination* (08.021).

Parameter	08.023 *Digital I/O 03 Source/Destination*		
Short description	Defines the source or destination parameter for Digital I/O 3		
Mode	RFC‑S		
Minimum	0.000	Maximum	59.999
Default	6.030	Units	
Type	16 Bit User Save	Update Rate	Drive Reset Read
Display Format	Standard	Decimal Places	3
Coding	RW, DE, PT, BU		

See *Digital I/O 01 Source/Destination* (08.021).

Parameter	08.024 *Digital Input 04 Destination*		
Short description	Defines the destination parameter for Digital Input 4		
Mode	RFC‑S		
Minimum	0.000	Maximum	59.999
Default	6.032	Units	
Type	16 Bit User Save	Update Rate	Drive Reset Read
Display Format	Standard	Decimal Places	3
Coding	RW, DE, PT, BU		

See *Digital I/O 01 Source/Destination* (08.021).

Parameter	08.025 *Digital Input 05 Destination*		
Short description	Defines the destination parameter for Digital Input 5		
Mode	RFC‑S		
Minimum	0.000	Maximum	59.999
Default	1.041	Units	
Type	16 Bit User Save	Update Rate	Drive Reset Read
Display Format	Standard	Decimal Places	3
Coding	RW, DE, PT, BU		

See *Digital I/O 01 Source/Destination* (08.021).

Parameter	08.026 *Digital Input 06 Destination*		
Short description	Defines the destination parameter for Digital Input 6		
Mode	RFC‑S		
Minimum	0.000	Maximum	59.999
Default	6.031	Units	
Type	16 Bit User Save	Update Rate	Drive Reset Read
Display Format	Standard	Decimal Places	3
Coding	RW, DE, PT, BU		

See *Digital I/O 01 Source/Destination* (08.021).

Parameter	08.027 *Relay Output Source*		
Short description	Defines the source parameter for the Relay Output		
Mode	RFC‑S		
Minimum	0.000	Maximum	59.999
Default	10.001	Units	
Type	16 Bit User Save	Update Rate	Drive Reset Read
Display Format	Standard	Decimal Places	3
Coding	RW, PT, BU		

See *Digital I/O 01 Source/Destination* (08.021).

Parameter	08.028 *24V Supply Output Source*		
Short description	Defines the source parameter for 24V Supply Output		
Mode	RFC‑S		
Minimum	0.000	Maximum	59.999
Default	0.000	Units	
Type	16 Bit User Save	Update Rate	Drive Reset Read
Display Format	Standard	Decimal Places	3
Coding	RW, PT, BU		

See *Digital I/O 01 Source/Destination* (08.021).

Parameter	08.029 *Input Logic Polarity*		
Short description	Defines the polarity of the input logic		
Mode	RFC‑S		
Minimum	0	Maximum	1
Default	1	Units	
Type	8 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW, TE, BU		

Value	Text
0	Negative Logic
1	Positive Logic

See *Digital I/O 01 State* (08.001).

Parameter	08.031 *Digital I/O 01 Output Select*		
Short description	Defines if Digital I/O 1 is an input or output. 0 = input, 1 = output		
Mode	RFC‑S		
Minimum	0	Maximum	1
Default	1	Units	
Type	1 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW, BU		

The Digital I/O Output Select parameters allow the I/O to be selected as an input (0) or an output (1). These parameters are only present for digital I/O that can be used as an input or output.

Parameter	08.032 *Digital I/O 02 Output Select*		
Short description	Defines if Digital I/O 2 is an input or output. 0 = input, 1 = output		
Mode	RFC‑S		
Minimum	0	Maximum	1
Default	0	Units	
Type	1 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW		

See *Digital I/O 01 Output Select* (08.031).

Parameter	08.033 *Digital I/O 03 Output Select*		
Short description	Defines if Digital I/O 3 is an input or output. 0 = input, 1 = output		
Mode	RFC‑S		
Minimum	0	Maximum	1
Default	0	Units	
Type	1 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW		

See *Digital I/O 01 Output Select* (08.031).

Parameter	08.040 *STO Input 02 State*		
Short description	Displays the state for the Safe Torque Off 2 input		
Mode	RFC‑S		
Minimum	0	Maximum	1
Default		Units	
Type	1 Bit Volatile	Update Rate	2ms write
Display Format	Standard	Decimal Places	0
Coding	RO, ND, NC, PT		

See *Digital I/O 01 State* (08.001).

Parameter	08.041 *Keypad Run Button State*		
Short description	Displays the state for the Keypad Run Forward button		
Mode	RFC‑S		
Minimum	0	Maximum	1
Default		Units	
Type	1 Bit Volatile	Update Rate	Background write
Display Format	Standard	Decimal Places	0
Coding	RO, ND, NC, PT		

See *Digital I/O 01 State* (08.001).

Parameter	08.042 *Keypad Auxiliary Button State*		
Short description	Displays the state for the Keypad Auxilary button		
Mode	RFC-S		
Minimum	0	Maximum	1
Default		Units	
Type	1 Bit Volatile	Update Rate	Background write
Display Format	Standard	Decimal Places	0
Coding	RO, ND, NC, PT		

See *Digital I/O 01 State* (08.001).

Parameter	08.043 *24V Supply Input State*		
Short description	Displays the state for the 24V Supply Input		
Mode	RFC-S		
Minimum	0	Maximum	1
Default		Units	
Type	1 Bit Volatile	Update Rate	2ms write
Display Format	Standard	Decimal Places	0
Coding	RO, ND, NC, PT		

See *Digital I/O 01 State* (08.001).

Parameter	08.044 *Keypad Stop Button State*		
Short description	Displays the state for the Keypad Stop button		
Mode	RFC-S		
Minimum	0	Maximum	1
Default		Units	
Type	1 Bit Volatile	Update Rate	Background write
Display Format	Standard	Decimal Places	0
Coding	RO, ND, NC, PT		

See *Digital I/O 01 State* (08.001).

Parameter	08.051 *Keypad Run Button Invert/Toggle*		
Short description	Set to invert/toggle Keypad Run Button		
Mode	RFC-S		
Minimum	0	Maximum	2
Default	0	Units	
Type	8 Bit User Save	Update Rate	Background Read
Display Format	Standard	Decimal Places	0
Coding	RW, TE		

Value	Text
0	Not Invert
1	Invert
2	Toggle

A value of 0 or 1 allows the input state to be non-inverted or inverted respectively. An additional toggle function is provided for Keypad Run button inputs. The toggle function output changes state on each rising edge (0 to 1 change) at its input.

Parameter	08.052 *Keypad Auxiliary Button Invert/Toggle*		
Short description	Set to invert/toggle Keypad Auxiliary Button		
Mode	RFC-S		
Minimum	0	Maximum	2
Default	0	Units	
Type	8 Bit User Save	Update Rate	Background Read
Display Format	Standard	Decimal Places	0
Coding	RW, TE		

Value	Text
0	Not Invert
1	Invert
2	Toggle

A value of 0 or 1 allows the input state to be non-inverted or inverted respectively. An additional toggle function is provided for Keypad Auxiliary button inputs. The toggle function output changes state on each rising edge (0 to 1 change) at its input.

Parameter	08.053 *24V Supply Input Invert*		
Short description	Set to invert/toggle 24V Supply Input		
Mode	RFC‑S		
Minimum	0	Maximum	1
Default	0	Units	
Type	8 Bit User Save	Update Rate	Backgeound Read
Display Format	Standard	Decimal Places	0
Coding	RW, TE		

Value	*Text*
0	Not Invert
1	Invert

See *Digital I/O 01 Source/Destination* (08.021).

Parameter	08.061 *Keypad Run Button Destination*		
Short description	Defines the destination parameter for the keypad run button		
Mode	RFC‑S		
Minimum	0.000	Maximum	59.999
Default	0.000	Units	
Type	16 Bit User Save	Update Rate	Drive Reset Read
Display Format	Standard	Decimal Places	3
Coding	RW, DE, PT, BU		

See *Digital I/O 01 Source/Destination* (08.021).

Parameter	08.062 *Keypad Auxiliary Button Destination*		
Short description	Defines the destination parameter for the keypad auxiliary button		
Mode	RFC‑S		
Minimum	0.000	Maximum	59.999
Default	0.000	Units	
Type	16 Bit User Save	Update Rate	Drive Reset Read
Display Format	Standard	Decimal Places	3
Coding	RW, DE, PT, BU		

See *Digital I/O 01 Source/Destination* (08.021).

Parameter	08.063 *24V Supply Input Destination*		
Short description	Defines the destination parameter for the 24V input		
Mode	RFC‑S		
Minimum	0.000	Maximum	59.999
Default	0.000	Units	
Type	16 Bit User Save	Update Rate	Drive Reset Read
Display Format	Standard	Decimal Places	3
Coding	RW, DE, PT, BU		

See *Digital I/O 01 Source/Destination* (08.021).

Parameter	08.071 *Digital I/O Output Enable Register 1*		
Short description	Displays the binary form of the DI/O output enable register		
Mode	RFC‑S		
Minimum	0 (Display: 0000000000000000)	Maximum	65535 (Display: 1111111111111111)
Default	0 (Display: 0000000000000000)	Units	
Type	16 Bit User Save	Update Rate	Background read
Display Format	Binary	Decimal Places	0
Coding	RW, PT, BU		

The bits in the *Digital I/O Output Enable Register 1* (08.071), *Digital I/O Input Register 1* (08.072) and *Digital I/O Output Register 1* (08.073) each correspond with one digital I/O as shown below. The update rate of the individual bits in these registers differs depending upon the I/O.

DI/O	Bit	Function	Bit update rate		
			Input Register	Output Register	Output Enable Register
1	0	Digital Input/Output	2ms	250μs	Background
2	1	Digital Input/Output	2ms	250μs	Background
3	2	Digital Input/Output	2ms	2ms	Background
4	3	Digital Input	250μs	Not applicable	Not applicable
5	4	Digital Input	250μs	Not applicable	Not applicable
6	5	Digital Input	2ms	Not applicable	Not applicable
7	6	Relay Output	Bit always 0	2ms	Background
8	7	24V Supply Output	Bit always 0	2ms	Background
9	8	Safe Torque Off 1	2ms	Not applicable	Not applicable
10	9	Safe Torque Off 2	2ms	Not applicable	Not applicable
11	10	Keypad Run Button	Background	Not applicable	Not applicable
12	11	Keypad Auxiliary Button	Background	Not applicable	Not applicable
13	12	24V Supply Input	2ms	Not applicable	Not applicable
14	13	Keypad Stop Button	Background	Not applicable	Not applicable
15	14	Relay 2 Output	Bit always 0	2ms	Background
16	15	Drive Reset Button	Background	Not applicable	Not applicable

The *Digital I/O Input Register 1* (08.072) is always active and shows the value in the Digital I/O State parameter for all digital I/O configured as inputs. Bits in the *Digital I/O Output Register 1* (08.073) can be used to control the digital I/O directly. The bits control the output directly and are not modified by the corresponding Digital I/O Invert/Toggle function. The bits in the *Digital I/O Output Register 1* (08.073) only control the corresponding digital output if all the conditions below are met:

1. The corresponding bit in the *Digital I/O Output Enable Register 1* (08.071) must be set to 1.
2. The digital I/O must be an output, or it must be an input/output and the corresponding Digital I/O Output Select parameter must be one.
3. The corresponding Digital I/O Source/Destination parameter is not as valid source (e.g. 0.000) and the drive has been powered-up or reset since it was first selected.

If the above conditions are not met, the digital output is controlled by the normal logic.

Parameter	08.072 *Digital I/O Input Register 1*		
Short description	Displays the binary form of the DI/O input register		
Mode	RFC-S		
Minimum	0 (Display: 0000000000000000)	Maximum	65535 (Display: 1111111111111111)
Default		Units	
Type	16 Bit Volatile	Update Rate	250μs write
Display Format	Binary	Decimal Places	0
Coding	RO, ND, NC, PT, BU		

See *Digital I/O Output Enable Register 1* (08.071).

Parameter	08.073 *Digital I/O Output Register 1*		
Short description	Displays the binary form of the DI/O output register		
Mode	RFC-S		
Minimum	0 (Display: 0000000000000000)	Maximum	65535 (Display: 1111111111111111)
Default	0 (Display: 0000000000000000)	Units	
Type	16 Bit Volatile	Update Rate	250μs read
Display Format	Binary	Decimal Places	0
Coding	RW, PT, BU		

See *Digital I/O Output Enable Register 1* (08.071).

Menu 9 Single Line Descriptions − *User Functions 1*

Mode: RFC‑S

Parameter	Range	Default	Type					
09.001 Logic Function 1 Output	Off (0) or On (1)		RO	Bit	ND	NC	PT	
09.002 Logic Function 2 Output	Off (0) or On (1)		RO	Bit	ND	NC	PT	
09.003 Motorised Pot Output	±100.00 %		RO	Num	ND	NC	PT	PS
09.004 Logic Function 1 Source 1	0.000 to 59.999	0.000	RW	Num			PT	US
09.005 Logic Function 1 Source 1 Invert	Off (0) or On (1)	Off (0)	RW	Bit				US
09.006 Logic Function 1 Source 2	0.000 to 59.999	0.000	RW	Num			PT	US
09.007 Logic Function 1 Source 2 Invert	Off (0) or On (1)	Off (0)	RW	Bit				US
09.008 Logic Function 1 Output Invert	Off (0) or On (1)	Off (0)	RW	Bit				US
09.009 Logic Function 1 Delay	±25.0 s	0.0 s	RW	Num				US
09.010 Logic Function 1 Destination	0.000 to 59.999	0.000	RW	Num	DE		PT	US
09.014 Logic Function 2 Source 1	0.000 to 59.999	0.000	RW	Num			PT	US
09.015 Logic Function 2 Source 1 Invert	Off (0) or On (1)	Off (0)	RW	Bit				US
09.016 Logic Function 2 Source 2	0.000 to 59.999	0.000	RW	Num			PT	US
09.017 Logic Function 2 Source 2 Invert	Off (0) or On (1)	Off (0)	RW	Bit				US
09.018 Logic Function 2 Output Invert	Off (0) or On (1)	Off (0)	RW	Bit				US
09.019 Logic Function 2 Delay	±25.0 s	0.0 s	RW	Num				US
09.020 Logic Function 2 Destination	0.000 to 59.999	0.000	RW	Num	DE		PT	US
09.021 Motorised Pot Mode	0 to 4	0	RW	Num				US
09.022 Motorised Pot Bipolar Select	Off (0) or On (1)	Off (0)	RW	Bit				US
09.023 Motorised Pot Rate	0 to 250 s	20 s	RW	Num				US
09.024 Motorised Pot Scaling	0.000 to 4.000	1.000	RW	Num				US
09.025 Motorised Pot Destination	0.000 to 59.999	0.000	RW	Num	DE		PT	US
09.026 Motorised Pot Up	Off (0) or On (1)	Off (0)	RW	Bit		NC		
09.027 Motorised Pot Down	Off (0) or On (1)	Off (0)	RW	Bit		NC		
09.028 Motorised Pot Reset	Off (0) or On (1)	Off (0)	RW	Bit		NC		
09.029 Binary Sum Ones	Off (0) or On (1)	Off (0)	RW	Bit		NC		
09.030 Binary Sum Twos	Off (0) or On (1)	Off (0)	RW	Bit		NC		
09.031 Binary Sum Fours	Off (0) or On (1)	Off (0)	RW	Bit		NC		
09.032 Binary Sum Output	0 to 255		RO	Num	ND	NC	PT	
09.033 Binary Sum Destination	0.000 to 59.999	0.000	RW	Num	DE		PT	US
09.034 Binary Sum Offset	0 to 248	0	RW	Num				US
09.035 Timer 1 Start Date	00-00-00 to 31-12-99	00-00-00	RW	Date				US
09.036 Timer 1 Start Time	00:00:00 to 23:59:59	00:00:00	RW	Time				US
09.037 Timer 1 Stop Date	00-00-00 to 31-12-99	00-00-00	RW	Date				US
09.038 Timer 1 Stop Time	00:00:00 to 23:59:59	00:00:00	RW	Time				US
09.039 Timer 1 Repeat Function	None (0), Hour (1), Day (2), Week (3), Month (4), Year (5), One off (6), Minute (7)	None (0)	RW	Txt				US
09.040 Timer 1 Enable	Off (0) or On (1)	Off (0)	RW	Bit				US
09.041 Timer 1 Invert	Off (0) or On (1)	Off (0)	RW	Bit				US
09.042 Timer 1 Output	Off (0) or On (1)		RO	Bit	ND	NC	PT	
09.043 Timer 1 Destination	0.000 to 59.999	0.000	RW	Num	DE		PT	US
09.045 Timer 2 Start Date	00-00-00 to 31-12-99	00-00-00	RW	Date				US
09.046 Timer 2 Start Time	00:00:00 to 23:59:59	00:00:00	RW	Time				US
09.047 Timer 2 Stop Date	00-00-00 to 31-12-99	00-00-00	RW	Date				US
09.048 Timer 2 Stop Time	00:00:00 to 23:59:59	00:00:00	RW	Time				US
09.049 Timer 2 Repeat Function	None (0), Hour (1), Day (2), Week (3), Month (4), Year (5), One off (6), Minute (7)	None (0)	RW	Txt				US
09.050 Timer 2 Enable	Off (0) or On (1)	Off (0)	RW	Bit				US
09.051 Timer 2 Invert	Off (0) or On (1)	Off (0)	RW	Bit				US
09.052 Timer 2 Output	Off (0) or On (1)		RO	Bit	ND	NC	PT	
09.053 Timer 2 Destination	0.000 to 59.999	0.000	RW	Num	DE		PT	US
09.055 Scope Trace 1 Source	0.000 to 59.999	0.000	RW	Num			PT	US
09.056 Scope Trace 2 Source	0.000 to 59.999	0.000	RW	Num			PT	US
09.057 Scope Trace 3 Source	0.000 to 59.999	0.000	RW	Num			PT	US
09.058 Scope Trace 4 Source	0.000 to 59.999	0.000	RW	Num			PT	US
09.059 Scope Trigger	Off (0) or On (1)	Off (0)	RW	Bit				
09.060 Scope Trigger Source	0.000 to 59.999	0.000	RW	Num			PT	US
09.061 Scope Trigger Threshold	-2147483648 to 2147483647	0	RW	Num				US
09.062 Scope Trigger Invert	Off (0) or On (1)	Off (0)	RW	Bit				US
09.063 Scope Mode	Single (0), Normal (1), Auto (2)	Single (0)	RW	Txt				US
09.064 Scope Arm	Off (0) or On (1)	Off (0)	RW	Bit		NC		
09.065 Scope Data Not Ready	Off (0) or On (1)		RO	Bit	ND	NC	PT	

09.066	Scope Saving Data	Off (0) or On (1)			RO	Bit	ND	NC	PT	
09.067	Scope Sample Time	1 to 200	1		RW	Num				US
09.068	Scope Trigger Delay	0 to 100 %	0 %		RW	Num				US
09.069	Scope Time Period	0.00 to 200000.00 ms			RO	Num	ND	NC	PT	
09.070	Scope Auto‑save Mode	Disabled (0), Overwrite (1), Keep (2)	Disabled (0)		RW	Txt				US
09.071	Scope Auto‑save File Number	0 to 99	0		RO	Num		NC		PS
09.072	Scope Auto‑save Reset	Off (0) or On (1)	Off (0)		RW	Bit				
09.073	Scope Auto‑save Status	Disabled (0), Active (1), Stopped (2), Failed (3)	Disabled (0)		RO	Txt		NC		PS

RW	Read / Write	RO	Read-only	Bit	Bit parameter	Txt	Text string	Date	Date parameter	Time	Time parameter
Chr	Character parameter	Bin	Binary parameter	IP	IP address	Mac	MAC address	Ver	Version number	SMP	Slot, menu, parameter
Num	Number parameter	DE	Destination	ND	No default value	RA	Rating dependent	NC	Non-copyable	PT	Protected
FI	Filtered	US	User save	PS	Power-down save						

Menu 9 − *User Functions 1*

Mode: RFC‑S

Menu 9 provides the parameters for the following features:

1. Logic functions
2. Motorised Pot
3. Binary Sum
4. Timers
5. Scope function

Logic functions

The logic functions are always active even if the sources and destinations are not routed to valid parameters. If the sources are not valid parameters then the source values are taken as 0. The update rate for each of the logic functions is always 4ms.
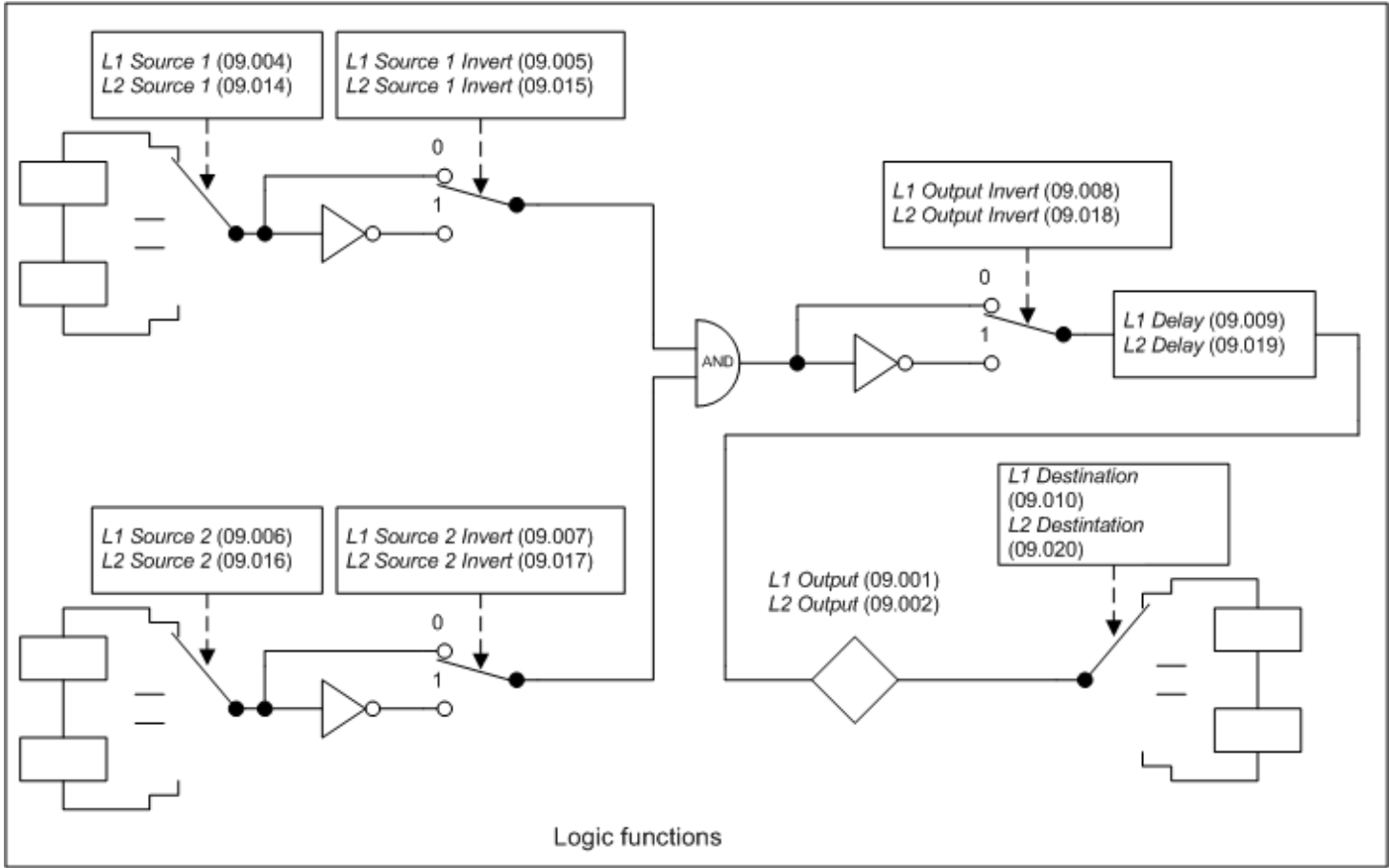
Logic functions

The logic function consists of an AND gate with inverters on each input and an inverter on the output. Some of the other standard logic functions can be produced as shown in the table below.

Logic function	Source 1 Invert	Source 2 Invert	Output Invert
AND	0	0	0
NAND	0	0	1
OR	1	1	1
NOR	1	1	0

A delay function is provided at the output of the logic functions. If *Logic Function 1 Delay* (09.009) or *Logic Function 2 Delay* (09.019) is positive then the output does not become 1 until the input to the delay has been at 1 for the delay time. If *Logic Function 1 Delay* (09.009) or *Logic Function 2 Delay* (09.019) is negative then the output remains at 1 until the input to the delay has been 0 for the delay time.

Logic function delay
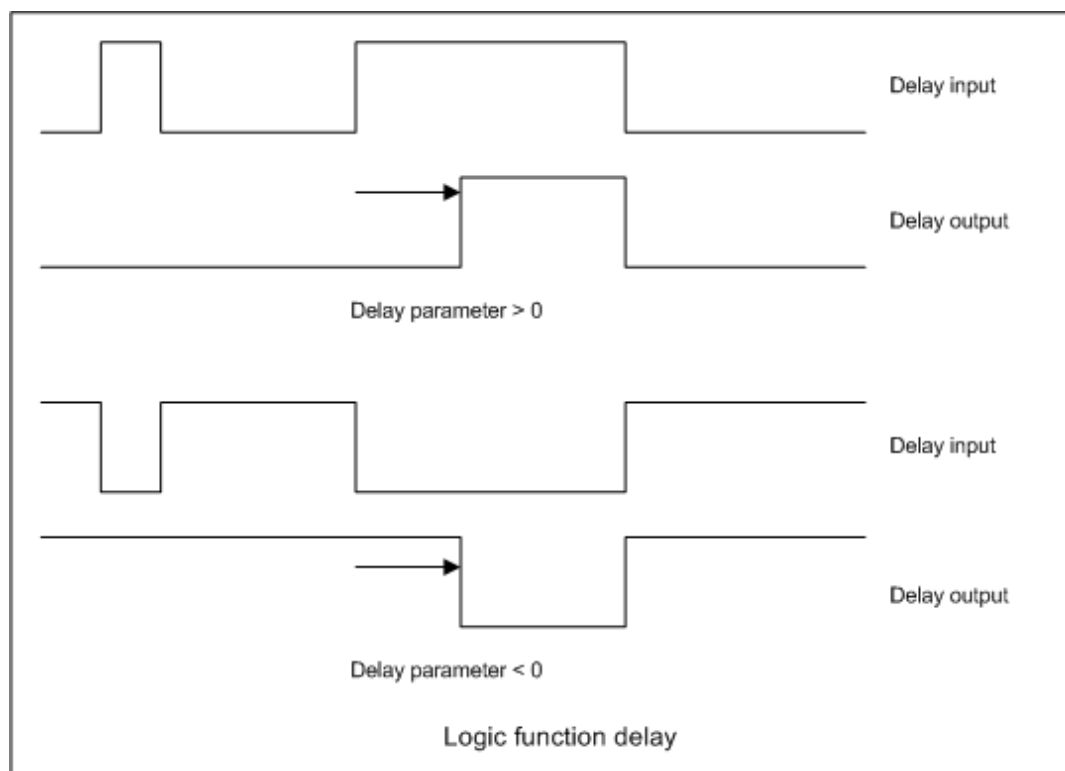
Motorised pot
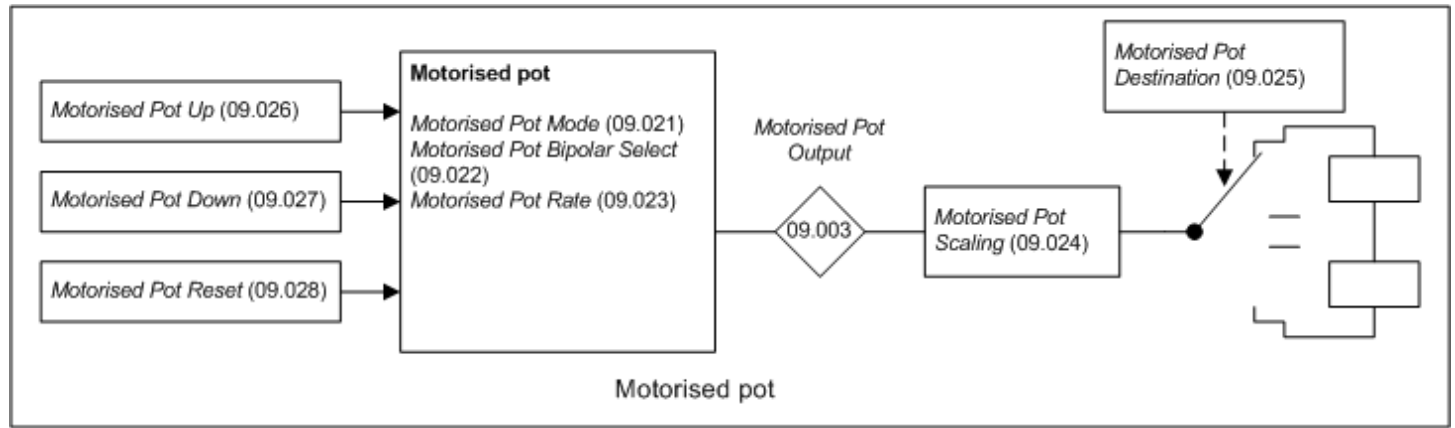
Motorised pot

If *Motorised Pot Reset* (09.028) = 1 then the motorised pot is disabled and held in its reset state with *Motorised Pot Output* (09.003) = 0.0%. If *Motorised Pot Reset* (09.028) = 0 the motorised pot is enabled even if *Motorised Pot Destination* (09.025) is not routed to a valid parameter. The sample rate of the motorised pot is always 4ms.

When the motorised pot is active *Motorised Pot Output* (09.003) can be increased or decreased by setting *Motorised Pot Up* (09.026) or *Motorised Pot Down* (09.027) to 1 respectively. If both *Motorised Pot Up* (09.026) and *Motorised Pot Down* (09.027) are 1 then *Motorised Pot Output* (09.003) is increased. The rate of change of *Motorised Pot Output* (09.003) is defined by *Motorised Pot Rate* (09.023) which gives the time to change from 0 to 100%. The time to change from -100% to 100% is *Motorised Pot Rate* (09.023) x 2. If *Motorised Pot Bipolar Select* (09.022) = 0 then *Motorised Pot Output* (09.003) is limited in the range 0.00% to 100.00%, otherwise it is allowed to change in the range from -100.00% to 100.00%.

Motorised Pot Mode (09.021) defines the mode of operation as given in the table below.

Motorised Pot Mode (09.021)	*Motorised Pot Output* (09.003)	*Motorised Pot Up* (09.026) and *Motorised Pot Down* (09.027) active
0	Reset to zero at power-up	Always
1	Set to power-down value at power-up	Always
2	Reset to zero at power-up	When *Drive Active* (10.002) = 1
3	Set to power-down value at power-up	When *Drive Active* (10.002) = 1
4	Reset to zero at power-up and when *Drive Active* (10.002) = 0	When *Drive Active* (10.002) = 1

Motorised Pot Scaling (09.024) introduces a scaling factor at the output of the motorised pot before the output is routed to the destination. If *Motorised Pot Scaling* (09.024) *Motorised Pot Scaling* (09.024) > 1.000 the output will exceed the range of the destination parameter, and so the destination parameter will be at its maximum or minimum before the output of the motorised pot reaches the limits of its range.

Binary sum function

The binary sum function is always active even if the destination is not routed to valid a parameter. The update rate for the binary sum is always 4ms.

Binary sum

The output of the binary sum block is given by:

> *Binary Sum Output* (09.032) = *Binary Sum Offset* (09.034) + (*Binary Sum Ones* (09.029) x 1) + (*Binary Sum Twos* (09.030) x 2) + (*Binary Sum Fours* (09.031) x 4)

Binary Sum Destination (09.033) defines the destination for the binary sum output. The routing for this destination is special if the maximum of the destination parameter ≤ 7 + *Binary Sum Offset* (09.034) as follows:

> Destination parameter = *Binary Sum Output* (09.032), subject to the parameter minimum.

If the maximum of the destination parameter > 7, *Binary Sum Output* (09.032) is routed in the same way as any other destination where the destination target is at its full scale value when the *Binary Sum Output* (09.032) = 7 + *Binary Sum Offset* (09.034).

Timers

If the enable input to a timer is active and the repeat function is set to a non-zero value then the timer is active even if the destination is not routed to valid a parameter. The timers are updated in the background task and have a resolution of 1s.
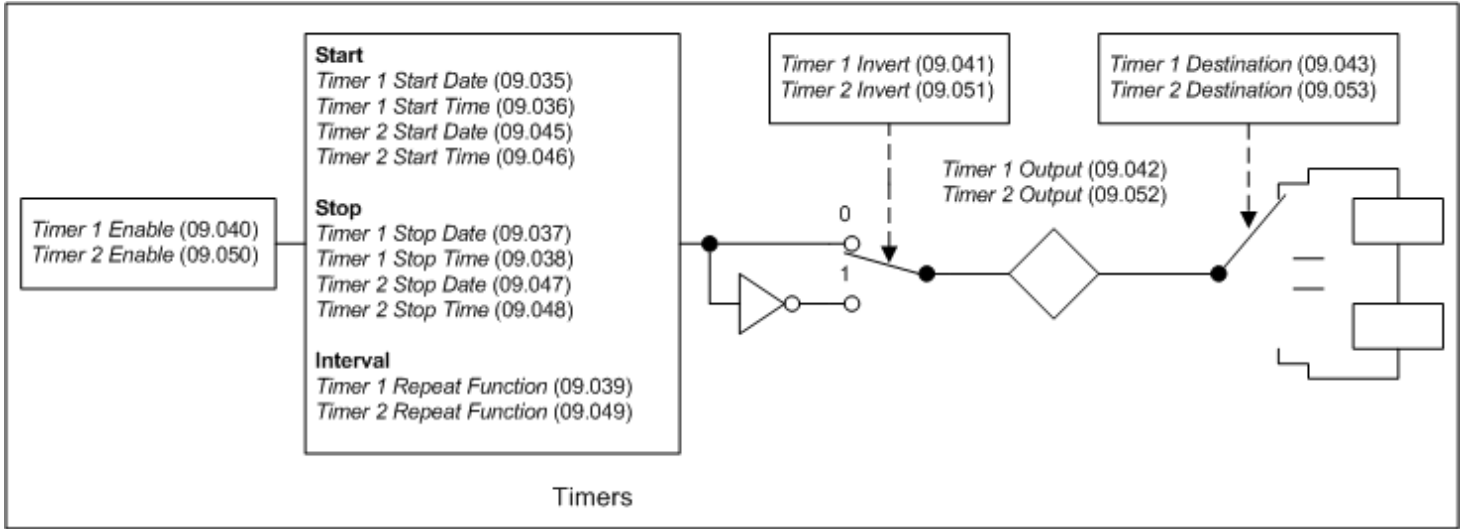
Timers

The following is a description of Timer 1, but Timer 2 behaves in the same way. If *Timer 1 Invert* (09.041) = 0 then *Timer 1 Output* (09.042) is inactive before the *Timer 1 Start Date* (09.035) / *Timer 1 Start Time* (09.036), active between this date/time and *Timer 1 Stop Date* (09.037) / *Timer 1 Stop Time* (09.038) and then inactive after the stop time/date within the timer 1 repeat period as shown in the diagram below.
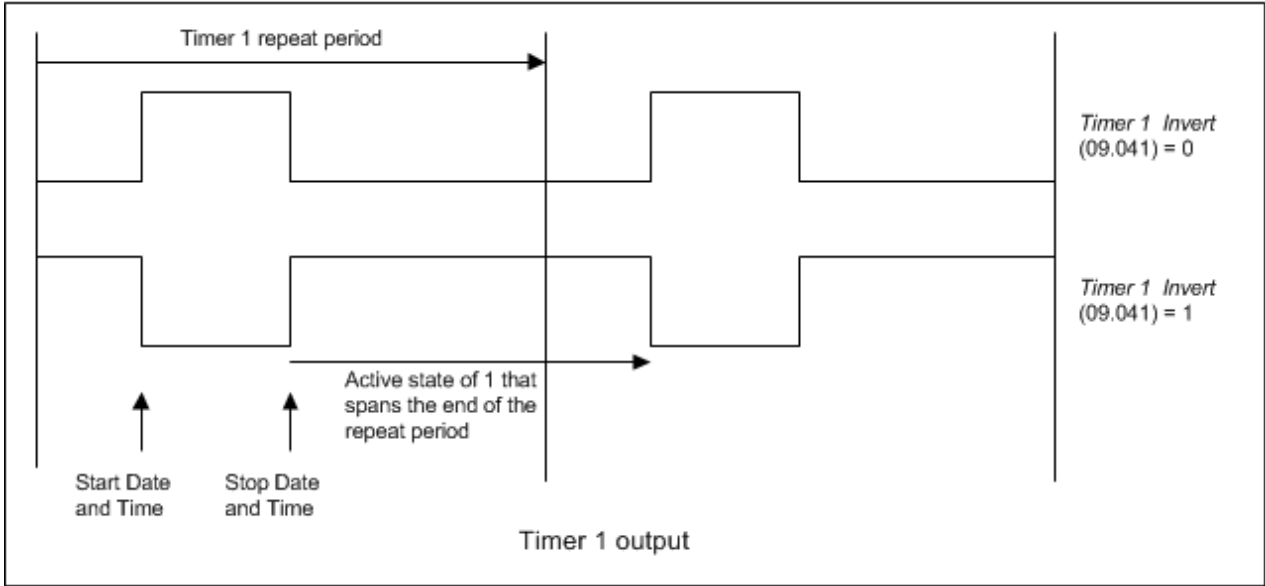
Timer 1 output

Timer 1 Repeat Function (09.039) defines the length of the repeat period. For example, if *Timer 1 Repeat Function* (09.039) = 2 then the repeat period is one day. The output is inactive until the time reaches the hour, minute and second defined in *Timer 1 Start Time* (09.036), and remains active until the time reaches the hour, minute and second defined in *Timer 1 Stop Time* (09.038). Different repeat periods may be selected as given in the table below. The table shows the constituent parts of the date and time that are used to determine the start and stop events. If the repeat period is set to every week then *Timer 1 Start Date* (09.035) and *Timer 1 Stop Date* (09.037) define the day of the week and not the date (i.e. 00.00.00 = Sunday, 00.00.01 = Monday, etc.). The week repeat period starts at 00.00.00 on sunday morning and ends at 23.59.59 on Saturday night. If the stop time event is set to occur at or before the start time event or the *Timer 1 Repeat Function* (09.039) = 0 or *Timer 1 Enable* (09.040) = 0 the output remains inactive at all times (i.e. *Timer 1 Output* (09.042) = 0 if *Timer 1 Invert* (09.041) = 0).

Timer 1 Repeat Function (09.039)	Repeat period	Second	Minute	Hour	Day	Month	Year	Day of week
0	None							
1	Hour	•	•					
2	Day	•	•	•				
3	Week	•	•	•				•
4	Month	•	•	•	•			
5	Year	•	•	•	•	•		
6	One off	•	•	•	•	•	•	
7	Minute	•						

As *Timer 1 Invert* (09.041) inverts the timer output it can be used to give an active state of 0 instead of 1. Alternatively it can be used to give an active state of 1, but for a time period that spans the ends of the repeat period as shown in the example above. It should be noted that if this method is used to allow the active period to span the ends of the repeat period then if the timer is disabled the output of the timer block before the invert becomes 0, and so the final output of the timer after the invert is 1.

If *Date/Time Selector* (06.019) is changed and the drive is reset then the source for the timers will change, therefore *Timer 1 Repeat Function* (09.039) and *Timer 2 Repeat Function* (09.049) are reset to 0 to disable the timers, and the date and time entries in the trip log are cleared.

Scope function
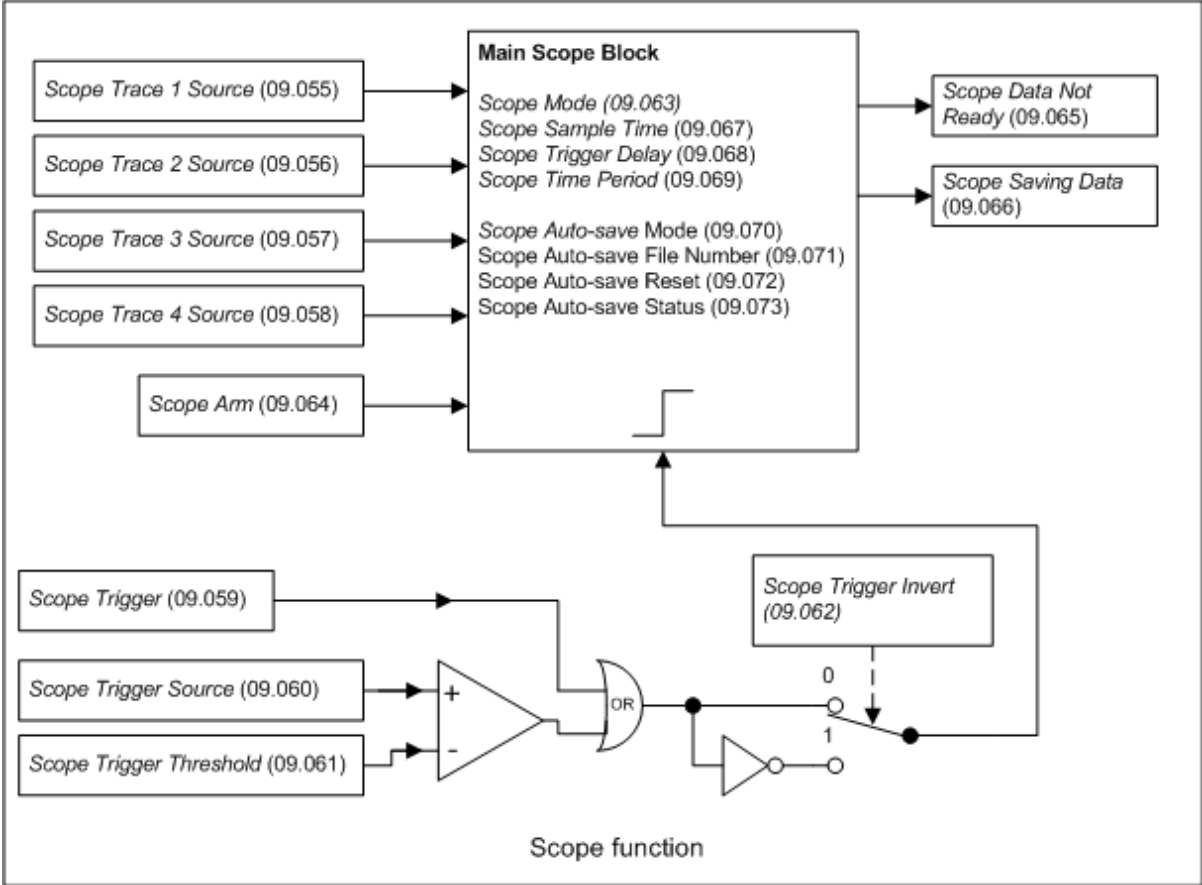
Parameter	09.001 *Logic Function 1 Output*		
Short description	Shows the output state of logic function 1		
Mode	RFC-S		
Minimum	0	Maximum	1
Default		Units	
Type	1 Bit Volatile	Update Rate	4ms write
Display Format	Standard	Decimal Places	0
Coding	RO, ND, NC, PT		

Logic Function 1 Output (09.001) shows the output of logic function 1.

Parameter	09.002 *Logic Function 2 Output*		
Short description	Shows the output state of logic function 2		
Mode	RFC-S		
Minimum	0	Maximum	1
Default		Units	
Type	1 Bit Volatile	Update Rate	4ms write
Display Format	Standard	Decimal Places	0
Coding	RO, ND, NC, PT		

Logic Function 2 Output (09.002) shows the output of logic function 2.

Parameter	09.003 *Motorised Pot Output*		
Short description	Shows the output level of the motorised pot function		
Mode	RFC-S		
Minimum	-100.00	Maximum	100.00
Default		Units	%
Type	16 Bit Power Down Save	Update Rate	4ms write
Display Format	Standard	Decimal Places	2
Coding	RO, ND, NC, PT		

Motorised Pot Output (09.003) shows the output of the motorised pot function.

Parameter	09.004 *Logic Function 1 Source 1*		
Short description	Defines input source 1 of logic function 1		
Mode	RFC‑S		
Minimum	0.000	Maximum	59.999
Default	0.000	Units	
Type	16 Bit User Save	Update Rate	Drive reset read
Display Format	Standard	Decimal Places	3
Coding	RW, PT, BU		

Logic Function 1 Source 1 (09.004) defines input source 1 of logic function 1.

Parameter	09.005 *Logic Function 1 Source 1 Invert*		
Short description	Set to invert input 1 of logic function 1		
Mode	RFC‑S		
Minimum	0	Maximum	1
Default	0	Units	
Type	1 Bit User Save	Update Rate	4ms read
Display Format	Standard	Decimal Places	0
Coding	RW		

Setting *Logic Function 1 Source 1 Invert* (09.005) inverts input 1 of logic function 1.

Parameter	09.006 *Logic Function 1 Source 2*		
Short description	Defines input source 2 of logic function 1		
Mode	RFC‑S		
Minimum	0.000	Maximum	59.999
Default	0.000	Units	
Type	16 Bit User Save	Update Rate	Drive reset read
Display Format	Standard	Decimal Places	3
Coding	RW, PT, BU		

Logic Function 1 Source 2 (09.006) defines input source 2 of logic function 1.

Parameter	09.007 *Logic Function 1 Source 2 Invert*		
Short description	Set to invert input 2 of logic function 1		
Mode	RFC‑S		
Minimum	0	Maximum	1
Default	0	Units	
Type	1 Bit User Save	Update Rate	4ms read
Display Format	Standard	Decimal Places	0
Coding	RW		

Setting *Logic Function 1 Source 2 Invert* (09.007) inverts input 2 of logic function 1.

Parameter	09.008 *Logic Function 1 Output Invert*		
Short description	Set to invert the ouptut of logic function 1		
Mode	RFC‑S		
Minimum	0	Maximum	1
Default	0	Units	
Type	1 Bit User Save	Update Rate	4ms read
Display Format	Standard	Decimal Places	0
Coding	RW		

Setting *Logic Function 1 Output Invert* (09.008) inverts the output of logic function 1.

Parameter	09.009 *Logic Function 1 Delay*		
Short description	Defines the output delay of logic function 1		
Mode	RFC‑S		
Minimum	-25.0	Maximum	25.0
Default	0.0	Units	s
Type	16 Bit User Save	Update Rate	4ms read
Display Format	Standard	Decimal Places	1
Coding	RW		

Logic Function 1 Delay (09.009) defines the delay at the output of logic function 1. If *Logic Function 1 Delay* (09.009) is positive then the output does not become 1 until the input to the delay has been at 1 for the delay time. If *Logic Function 1 Delay* (09.009) is negative then the output remains at 1 until the input to the delay has been 0 for the delay time.

Logic function delay
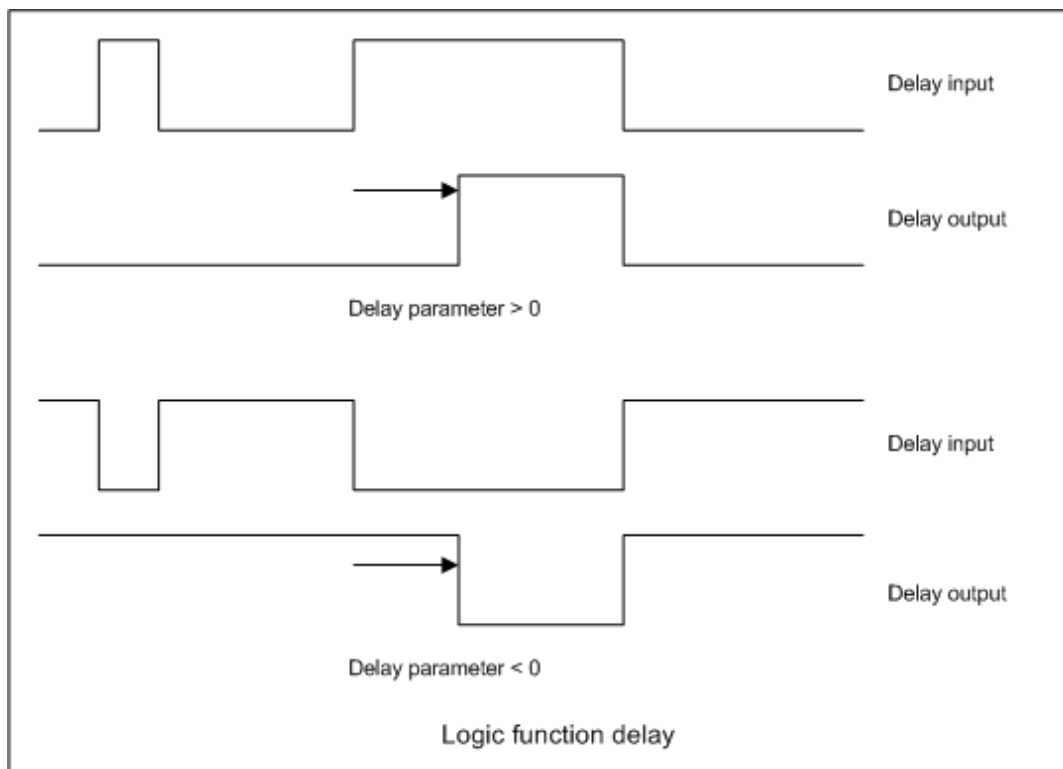
Parameter	09.010 *Logic Function 1 Destination*		
Short description	Defines the output destination of logic function 1		
Mode	RFC‑S		
Minimum	0.000	Maximum	59.999
Default	0.000	Units	
Type	16 Bit User Save	Update Rate	Drive reset read
Display Format	Standard	Decimal Places	3
Coding	RW, DE, PT, BU		

Logic Function 1 Destination (09.010) defines the output destination of logic function 1.

Parameter	09.014 *Logic Function 2 Source 1*		
Short description	Defines input source 1 of logic function 2		
Mode	RFC‑S		
Minimum	0.000	Maximum	59.999
Default	0.000	Units	
Type	16 Bit User Save	Update Rate	Drive reset read
Display Format	Standard	Decimal Places	3
Coding	RW, PT, BU		

Logic Function 2 Source 1 (09.014) defines input source 1 of logic function 2.

Parameter	09.015 *Logic Function 2 Source 1 Invert*		
Short description	Set to invert input 1 of logic function 2		
Mode	RFC‑S		
Minimum	0	Maximum	1
Default	0	Units	
Type	1 Bit User Save	Update Rate	4ms read
Display Format	Standard	Decimal Places	0
Coding	RW		

Setting *Logic Function 2 Source 1 Invert* (09.015) inverts input 1 of logic function 2.

Parameter	09.016 *Logic Function 2 Source 2*		
Short description	Defines input source 2 of logic function 2		
Mode	RFC‑S		
Minimum	0.000	Maximum	59.999
Default	0.000	Units	
Type	16 Bit User Save	Update Rate	Drive reset read
Display Format	Standard	Decimal Places	3
Coding	RW, PT, BU		

Logic Function 2 Source 2 (09.016) defines input source 2 of logic function 2.

Parameter	09.017 *Logic Function 2 Source 2 Invert*		
Short description	Set to invert input 2 of logic function 2		
Mode	RFC‑S		
Minimum	0	Maximum	1
Default	0	Units	
Type	1 Bit User Save	Update Rate	4ms read
Display Format	Standard	Decimal Places	0
Coding	RW		

Setting *Logic Function 2 Source 2 Invert* (09.017) inverts input 2 of logic function 2.

Parameter	09.018 *Logic Function 2 Output Invert*		
Short description	Set to invert the ouptut of logic function 2		
Mode	RFC‑S		
Minimum	0	Maximum	1
Default	0	Units	
Type	1 Bit User Save	Update Rate	4ms read
Display Format	Standard	Decimal Places	0
Coding	RW		

Setting *Logic Function 2 Output Invert* (09.018) inverts the output of logic function 2.

Parameter	09.019 *Logic Function 2 Delay*		
Short description	Defines the output delay of logic function 2		
Mode	RFC‑S		
Minimum	-25.0	Maximum	25.0
Default	0.0	Units	s
Type	16 Bit User Save	Update Rate	4ms read
Display Format	Standard	Decimal Places	1
Coding	RW		

Logic Function 2 Delay (09.019) defines the delay at the output of logic function 1. If *Logic Function 2 Delay* (09.019) is positive then the output does not become 1 until the input to the delay has been at 1 for the delay time. If *Logic Function 2 Delay* (09.019) is negative then the output remains at 1 until the input to the delay has been 0 for the delay time.

Logic function delay
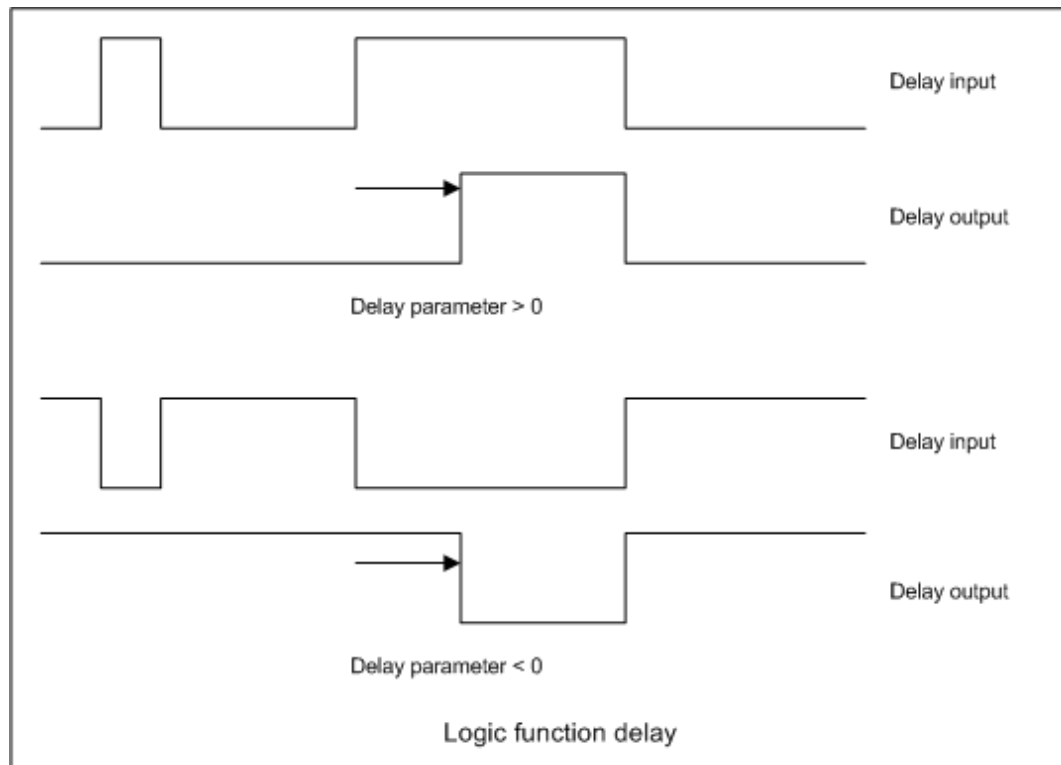
Parameter	09.020 *Logic Function 2 Destination*		
Short description	Defines the output destination of logic function 2		
Mode	RFC-S		
Minimum	0.000	Maximum	59.999
Default	0.000	Units	
Type	16 Bit User Save	Update Rate	Drive reset read
Display Format	Standard	Decimal Places	3
Coding	RW, DE, PT, BU		

Logic Function 2 Destination (09.020) defines the output destination of logic function 2.

Parameter	09.021 *Motorised Pot Mode*		
Short description	Defines the motorised pot mode		
Mode	RFC-S		
Minimum	0	Maximum	4
Default	0	Units	
Type	8 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW		

Motorised Pot Mode (09.021) defines the mode of operation as given in the table below.

Motorised Pot Mode (09.021)	*Motorised Pot Output* (09.003)	*Motorised Pot Up* (09.026) and *Motorised Pot Down* (09.027) active
0	Reset to zero at power-up	Always
1	Set to power-down value at power-up	Always
2	Reset to zero at power-up	When *Drive Active* (10.002) = 1
3	Set to power-down value at power-up	When *Drive Active* (10.002) = 1
4	Reset to zero at power-up and when *Drive Active* (10.002) = 0	When *Drive Active* (10.002) = 1

Parameter	09.022 *Motorised Pot Bipolar Select*		
Short description	Set to enable bipolar operation of the motorised pot		
Mode	RFC-S		
Minimum	0	Maximum	1
Default	0	Units	
Type	1 Bit User Save	Update Rate	4ms read
Display Format	Standard	Decimal Places	0
Coding	RW		

If *Motorised Pot Bipolar Select* (09.022) = 0 then *Motorised Pot Output* (09.003) is limited in the range 0.00% to 100.00%, otherwise it is allowed to change in the range from -100.00% to 100.00%.

Parameter	09.023 *Motorised Pot Rate*		
Short description	Defines the rate of change of the motorised pot output		
Mode	RFC-S		
Minimum	0	Maximum	250
Default	20	Units	s
Type	8 Bit User Save	Update Rate	Background
Display Format	Standard	Decimal Places	0
Coding	RW, BU		

The rate of change of *Motorised Pot Output* (09.003) is defined by *Motorised Pot Rate* (09.023) which gives the time to change from 0 to 100%. The time to change from -100% to 100% is *Motorised Pot Rate* (09.023) x 2.

Parameter	09.024 *Motorised Pot Scaling*		
Short description	Defines the scaling factor for the motorised pot output		
Mode	RFC-S		
Minimum	0.000	Maximum	4.000
Default	1.000	Units	
Type	16 Bit User Save	Update Rate	4ms read
Display Format	Standard	Decimal Places	3
Coding	RW		

Motorised Pot Scaling (09.024) introduces a scaling factor at the output of the motorised pot before the output is routed to the destination. If *Motorised Pot Scaling* (09.024) *Motorised Pot Scaling* (09.024) > 1.000 the output will exceed the range of the destination parameter, and so the destination parameter will be at its maximum or minimum before the output of the motorised pot reaches the limits of its range.

Parameter	09.025 *Motorised Pot Destination*		
Short description	Defines the output destination of the motorised pot		
Mode	RFC-S		
Minimum	0.000	Maximum	59.999
Default	0.000	Units	
Type	16 Bit User Save	Update Rate	Drive reset read
Display Format	Standard	Decimal Places	3
Coding	RW, DE, PT, BU		

Logic Function 2 Destination (09.020) defines the output destination of the motorised pot function.

Parameter	09.026 *Motorised Pot Up*		
Short description	Set to increase the motorised pot output		
Mode	RFC-S		
Minimum	0	Maximum	1
Default	0	Units	
Type	1 Bit Volatile	Update Rate	4ms read
Display Format	Standard	Decimal Places	0
Coding	RW, NC		

If *Motorised Pot Up* (09.026) = 1, then the *Motorised Pot Output* (09.003) will increase.

Parameter	09.027 *Motorised Pot Down*		
Short description	Set to decrese the motorised pot output		
Mode	RFC-S		
Minimum	0	Maximum	1
Default	0	Units	
Type	1 Bit Volatile	Update Rate	4ms read
Display Format	Standard	Decimal Places	0
Coding	RW, NC		

If *Motorised Pot Down* (09.027) = 1, then the *Motorised Pot Output* (09.003) will decrease.

Parameter	09.028 *Motorised Pot Reset*		
Short description	Set to reset the motorised pot output to zero		
Mode	RFC-S		
Minimum	0	Maximum	1
Default	0	Units	
Type	1 Bit Volatile	Update Rate	4ms read
Display Format	Standard	Decimal Places	0
Coding	RW, NC		

If *Motorised Pot Reset* (09.028) = 1 then the motorised pot is disabled and held in its reset state with *Motorised Pot Output* (09.003) = 0.0%. If *Motorised Pot Reset* (09.028) = 0 the motorised pot is enabled even if *Motorised Pot Destination* (09.025) is not routed to a valid parameter.

Parameter	09.029 *Binary Sum Ones*		
Short description	Set to add one to the binary sum output		
Mode	RFC-S		
Minimum	0	Maximum	1
Default	0	Units	
Type	1 Bit Volatile	Update Rate	4ms read
Display Format	Standard	Decimal Places	0
Coding	RW, NC		

See *Binary Sum Output* (09.032).

Parameter	09.030 *Binary Sum Twos*		
Short description	Set to add two to the binary sum output		
Mode	RFC-S		
Minimum	0	Maximum	1
Default	0	Units	
Type	1 Bit Volatile	Update Rate	4ms read
Display Format	Standard	Decimal Places	0
Coding	RW, NC		

See *Binary Sum Output* (09.032).

Parameter	09.031 *Binary Sum Fours*		
Short description	Set to add three to the binary sum output		
Mode	RFC‑S		
Minimum	0	Maximum	1
Default	0	Units	
Type	1 Bit Volatile	Update Rate	4ms read
Display Format	Standard	Decimal Places	0
Coding	RW, NC		

See *Binary Sum Output* (09.032).

Parameter	09.032 *Binary Sum Output*		
Short description	Shows the output level of the binary sum		
Mode	RFC‑S		
Minimum	0	Maximum	255
Default		Units	
Type	8 Bit Volatile	Update Rate	4ms write
Display Format	Standard	Decimal Places	0
Coding	RO, ND, NC, PT, BU		

The output of the binary sum block is given by:

Binary Sum Output (09.032) = *Binary Sum Offset* (09.034) + (*Binary Sum Ones* (09.029) x 1) + (*Binary Sum Twos* (09.030) x 2) + (*Binary Sum Fours* (09.031) x 4)

Binary Sum Destination (09.033) defines the destination for the binary sum output. The routing for this destination is special if the maximum of the destination parameter ≤ 7 + *Binary Sum Offset* (09.034) as follows:

Destination parameter = *Binary Sum Output* (09.032), subject to the parameter minimum.

If the maximum of the destination parameter > 7, *Binary Sum Output* (09.032) is routed in the same way as any other destination where the destination target is at its full scale value when the *Binary Sum Output* (09.032) = 7 + *Binary Sum Offset* (09.034).

Parameter	09.033 *Binary Sum Destination*		
Short description	Defines the output destination of the binary sum		
Mode	RFC‑S		
Minimum	0.000	Maximum	59.999
Default	0.000	Units	
Type	16 Bit User Save	Update Rate	Drive reset read
Display Format	Standard	Decimal Places	3
Coding	RW, DE, PT, BU		

Binary Sum Destination (09.033) defines the destination for the binary sum output.

See *Binary Sum Output* (09.032) for more information.

Parameter	09.034 *Binary Sum Offset*		
Short description	Defines the offset added to the output of the binary sum		
Mode	RFC‑S		
Minimum	0	Maximum	248
Default	0	Units	
Type	8 Bit User Save	Update Rate	4ms read
Display Format	Standard	Decimal Places	0
Coding	RW, BU		

See *Binary Sum Output* (09.032).

Parameter	09.035 *Timer 1 Start Date*		
Short description	Defines the start date for timer 1		
Mode	RFC‑S		
Minimum	0 (Display: 00-00-00)	Maximum	311299 (Display: 31-12-99)
Default	0 (Display: 00-00-00)	Units	
Type	32 Bit User Save	Update Rate	Background read
Display Format	Date	Decimal Places	0
Coding	RW		

Timer 1 Start Date (09.035) defines the start date within the repeat period of timer 1.

See *Timer 1 Repeat Function* (09.039) for more information.

Parameter	09.036 *Timer 1 Start Time*		
Short description	Defines the start time for timer 1		
Mode	RFC‑S		
Minimum	0 (Display: 00:00:00)	Maximum	235959 (Display: 23:59:59)
Default	0 (Display: 00:00:00)	Units	
Type	32 Bit User Save	Update Rate	Background read
Display Format	Time	Decimal Places	0
Coding	RW		

Timer 1 Start Time (09.036) defines the start time within the repeat period of timer 1.

See *Timer 1 Repeat Function* (09.039) for more information.

Parameter	09.037 *Timer 1 Stop Date*		
Short description	Defines the stop date for timer 1		
Mode	RFC‑S		
Minimum	0 (Display: 00-00-00)	Maximum	311299 (Display: 31-12-99)
Default	0 (Display: 00-00-00)	Units	
Type	32 Bit User Save	Update Rate	Background read
Display Format	Date	Decimal Places	0
Coding	RW		

Timer 1 Stop Date (09.037) defines the stop date within the repeat period of timer 1.

See *Timer 1 Repeat Function* (09.039) for more information.

Parameter	09.038 *Timer 1 Stop Time*		
Short description	Defines the stop time for timer 1		
Mode	RFC‑S		
Minimum	0 (Display: 00:00:00)	Maximum	235959 (Display: 23:59:59)
Default	0 (Display: 00:00:00)	Units	
Type	32 Bit User Save	Update Rate	Background read
Display Format	Time	Decimal Places	0
Coding	RW		

Timer 1 Stop Time (09.038) defines the stop time within the repeat period of timer 1.

See *Timer 1 Repeat Function* (09.039) for more information.

Parameter	09.039 *Timer 1 Repeat Function*		
Short description	Defines the length of the repeat period		
Mode	RFC‑S		
Minimum	0	Maximum	7
Default	0	Units	
Type	8 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW, TE		

| Value	Text
0	None
1	Hour
2	Day
3	Week
4	Month
5	Year
6	One off
7	Minute

Timer 1 Repeat Function (09.039) defines the length of the repeat period. For example, if *Timer 1 Repeat Function* (09.039) = 2 then the repeat period is one day. The result is inactive until the time reaches the hour, minute and second defined in *Timer 1 Start Time* (09.036), and remains active until the time reaches the hour, minute and second defined in *Timer 1 Stop Time* (09.038). Different repeat periods may be selected as given in the table below. The table shows the constituent parts of the date and time that are used to determine the start and stop events. If the repeat period is set to every week then *Timer 1 Start Date* (09.035) and *Timer 1 Stop Date* (09.037) define the day of the week and not the date (i.e. 00.00.00 = Sunday, 00.00.01 = Monday, etc.). If the stop time event is set to occur at or before the start time event or the *Timer 1 Repeat Function* (09.039) = 0 or *Timer 1 Enable* (09.040) = 0 the result remains inactive at all times (i.e. *Timer 1 Output* (09.042) = 0 if *Timer 1 Invert* (09.041) = 0).

Timer 1 Repeat Function (09.039)	Repeat period	Second	Minute	Hour	Day	Month	Year	Day of week
0	None							
1	Hour	•	•					
2	Day	•	•	•				
3	Week	•	•	•				•
4	Month	•	•	•	•			
5	Year	•	•	•	•	•		
6	One off	•	•	•	•	•	•	
7	Minute	•						

Parameter	09.040 Timer 1 Enable		
Short description	Set to enable the timer 1 function		
Mode	RFC‑S		
Minimum	0	Maximum	1
Default	0	Units	
Type	1 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW		

Timer 1 Enable (09.040) enables the timer 1 function. If *Timer 1 Enable* (09.040) = 0, then the output of the timer is always inactive, i.e. *Timer 1 Output* (09.042) = 0.

Parameter	09.041 Timer 1 Invert		
Short description	Set to invert the output of timer 1		
Mode	RFC‑S		
Minimum	0	Maximum	1
Default	0	Units	
Type	1 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW		

Timer 1 Invert (09.041) inverts the timer output to give an active state of 0 instead of 1. Alternatively it can be used to give an active state of 1, but for a time period that spans the ends of the repeat period as shown in the example above. It should be noted that if this method is used to allow the active period to span the ends of the repeat period then if the timer is disabled the output of the timer block before the invert becomes 0, and so the final output of the timer after the invert is 1.

See *Timer 1 Repeat Function* (09.039) for more information.

Parameter	09.042 Timer 1 Output		
Short description	Shows the output state of timer function 1		
Mode	RFC‑S		
Minimum	0	Maximum	1
Default		Units	
Type	1 Bit Volatile	Update Rate	Background write
Display Format	Standard	Decimal Places	0
Coding	RO, ND, NC, PT		

Timer 1 Output (09.042) shows the output of timer function 1.

Parameter	09.043 Timer 1 Destination		
Short description	Defines the output destination of timer function 1		
Mode	RFC‑S		
Minimum	0.000	Maximum	59.999
Default	0.000	Units	
Type	16 Bit User Save	Update Rate	Drive reset read
Display Format	Standard	Decimal Places	3
Coding	RW, DE, PT, BU		

Timer 1 Destination (09.043) defines the output destination of timer function 1.

Parameter	09.045 *Timer 2 Start Date*		
Short description	Defines the start date for timer 2		
Mode	RFC‑S		
Minimum	0 (Display: 00-00-00)	Maximum	311299 (Display: 31-12-99)
Default	0 (Display: 00-00-00)	Units	
Type	32 Bit User Save	Update Rate	Background read
Display Format	Date	Decimal Places	0
Coding	RW		

Timer 2 Start Date (09.045) defines the start date within the repeat period of timer 2.

See *Timer 1 Repeat Function* (09.039) for more information.

Parameter	09.046 *Timer 2 Start Time*		
Short description	Defines the start time for timer 2		
Mode	RFC‑S		
Minimum	0 (Display: 00:00:00)	Maximum	235959 (Display: 23:59:59)
Default	0 (Display: 00:00:00)	Units	
Type	32 Bit User Save	Update Rate	Background read
Display Format	Time	Decimal Places	0
Coding	RW		

Timer 2 Start Time (09.046) defines the start time within the repeat period of timer 2.

See *Timer 1 Repeat Function* (09.039) for more information.

Parameter	09.047 *Timer 2 Stop Date*		
Short description	Defines the stop date for timer 2		
Mode	RFC‑S		
Minimum	0 (Display: 00-00-00)	Maximum	311299 (Display: 31-12-99)
Default	0 (Display: 00-00-00)	Units	
Type	32 Bit User Save	Update Rate	Background read
Display Format	Date	Decimal Places	0
Coding	RW		

Timer 2 Stop Date (09.047) defines the stop date within the repeat period of timer 2.

See *Timer 1 Repeat Function* (09.039) for more information.

Parameter	09.048 *Timer 2 Stop Time*		
Short description	Defines the stop time for timer 2		
Mode	RFC‑S		
Minimum	0 (Display: 00:00:00)	Maximum	235959 (Display: 23:59:59)
Default	0 (Display: 00:00:00)	Units	
Type	32 Bit User Save	Update Rate	Background read
Display Format	Time	Decimal Places	0
Coding	RW		

Timer 2 Stop Time (09.048) defines the stop time within the repeat period of timer 2.

See *Timer 1 Repeat Function* (09.039) for more information.

Parameter	09.049 *Timer 2 Repeat Function*		
Short description	Defines the length of the repeat period		
Mode	RFC‑S		
Minimum	0	Maximum	7
Default	0	Units	
Type	8 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW, TE		

Value	Text
0	None
1	Hour
2	Day
3	Week
4	Month
5	Year
6	One off
7	Minute

See *Timer 1 Repeat Function* (09.039).

Parameter	09.050 *Timer 2 Enable*		
Short description	Set to enable the timer 2 function		
Mode	RFC‑S		
Minimum	0	Maximum	1
Default	0	Units	
Type	1 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW		

Timer 2 Enable (09.050) enables the timer 2 function. If *Timer 2 Enable* (09.050) = 0, then the output of the timer is always inactive, i.e. *Timer 2 Output* (09.052) = 0.

Parameter	09.051 *Timer 2 Invert*		
Short description	Set to invert the output of timer 2		
Mode	RFC‑S		
Minimum	0	Maximum	1
Default	0	Units	
Type	1 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW		

Timer 2 Invert (09.051) inverts the timer output to give an active state of 0 instead of 1.

See *Timer 1 Invert* (09.041) for more information.

Parameter	09.052 *Timer 2 Output*		
Short description	Shows the output state of timer function 2		
Mode	RFC‑S		
Minimum	0	Maximum	1
Default		Units	
Type	1 Bit Volatile	Update Rate	Background write
Display Format	Standard	Decimal Places	0
Coding	RO, ND, NC, PT		

Timer 2 Output (09.052) shows the output of timer function 2.

Parameter	09.053 *Timer 2 Destination*		
Short description	Defines the output destination of timer function 2		
Mode	RFC‑S		
Minimum	0.000	Maximum	59.999
Default	0.000	Units	
Type	16 Bit User Save	Update Rate	Drive reset read
Display Format	Standard	Decimal Places	3
Coding	RW, DE, PT, BU		

Timer 2 Destination (09.053) defines the output destination of timer function 2.

Parameter	09.055 *Scope Trace 1 Source*		
Short description	Defines the source of scope trace 1		
Mode	RFC‑S		
Minimum	0.000	Maximum	59.999
Default	0.000	Units	
Type	16 Bit User Save	Update Rate	Drive reset read
Display Format	Standard	Decimal Places	3
Coding	RW, PT, BU		

Up to four scope sources can be selected using *Scope Trace 1 Source* (09.055) to *Scope Trace 4 Source* (09.058). If the source value is set to 0.000, or the source parameter does not exist or is non-visible, then no source is selected. The sources do not operate in the same way as normal source

parameters in that the input to the scope is the actual value of the parameter and not a value scaled to a percentage based on the range of the parameter. If a scope trace source parameter is modified the actual change is not effective until the drive is reset.

Parameter	09.056 *Scope Trace 2 Source*		
Short description	Defines the source of scope trace 2		
Mode	RFC‑S		
Minimum	0.000	Maximum	59.999
Default	0.000	Units	
Type	16 Bit User Save	Update Rate	Drive reset read
Display Format	Standard	Decimal Places	3
Coding	RW, PT, BU		

See *Scope Trace 1 Source* (09.055).

Parameter	09.057 *Scope Trace 3 Source*		
Short description	Defines the source of scope trace 3		
Mode	RFC‑S		
Minimum	0.000	Maximum	59.999
Default	0.000	Units	
Type	16 Bit User Save	Update Rate	Drive reset read
Display Format	Standard	Decimal Places	3
Coding	RW, PT, BU		

See *Scope Trace 1 Source* (09.055).

Parameter	09.058 *Scope Trace 4 Source*		
Short description	Defines the source of scope trace 4		
Mode	RFC‑S		
Minimum	0.000	Maximum	59.999
Default	0.000	Units	
Type	16 Bit User Save	Update Rate	Drive reset read
Display Format	Standard	Decimal Places	3
Coding	RW, PT, BU		

See *Scope Trace 1 Source* (09.055).

Parameter	09.059 *Scope Trigger*		
Short description	Set to trigger the scope function		
Mode	RFC‑S		
Minimum	0	Maximum	1
Default	0	Units	
Type	1 Bit Volatile	Update Rate	250µs read
Display Format	Standard	Decimal Places	0
Coding	RW		

The scope is triggered by a rising edge at the input to the main scope block. If *Scope Trigger Source* (09.060) is set at its default value of 0.000 then the output of the trigger threshold comparator is 0, and so the scope can be triggered with *Scope Trigger* (09.059). *Scope Trigger Invert* (09.062) can be used to invert the trigger signal.

Parameter	09.060 *Scope Trigger Source*		
Short description	Defines the source of the scope trigger		
Mode	RFC‑S		
Minimum	0.000	Maximum	59.999
Default	0.000	Units	
Type	16 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	3
Coding	RW, PT, BU		

If *Scope Trigger* (09.059) = 0, the scope can be triggered based on the level of a parameter defined by *Scope Trigger Source* (09.060) and the *Scope Trigger Threshold* (09.061). This source operates in the same way as the trace sources and a direct comparison is made between the actual parameter value and the threshold. Decimal places are ignored. The threshold detector output is 1 when the value from the scope trigger source is greater than *Scope Trigger Threshold* (09.061). If *Scope Trigger Source* (09.060) = 0.000, or it is used to select a parameter that does not exist or is non-visible, then the output of the threshold detector is 0.

Parameter	09.061 *Scope Trigger Threshold*		
Short description	Defines the scope trigger threshold		
Mode	RFC-S		
Minimum	-2147483648	Maximum	2147483647
Default	0	Units	
Type	32 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW		

See *Scope Trigger Source* (09.060).

Parameter	09.062 *Scope Trigger Invert*		
Short description	Set to invert the scope trigger		
Mode	RFC-S		
Minimum	0	Maximum	1
Default	0	Units	
Type	1 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW		

See *Scope Trigger* (09.059).

Parameter	09.063 *Scope Mode*		
Short description	Defines the mode of the scope		
Mode	RFC-S		
Minimum	0	Maximum	2
Default	0	Units	
Type	8 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW, TE		

Value	*Text*
0	Single
1	Normal
2	Auto

Single (0):
If *Scope Arm* (09.064) is set to 1 the scope starts to acquire pre-trigger data (i.e. enough data to provide information for the pre-trigger period) and *Scope Data Not Ready* (09.065) is set to 1. The scope can then be triggered on the next trigger event (i.e. a rising edge on the trigger input of the main scope block). Note that the scope can only be triggered once the required amount of pre-trigger data has been sampled. Failure to do this will result in the scope function not triggering correctly. When the trigger event occurs *Scope Arm* (09.064) is set to 0, and when the post-trigger data has been stored *Scope Data Not Ready* (09.065) is set to 0. If *Scope Auto-save Mode* (09.070) is non-zero, the data in the scope trace buffer is saved to a non-volatile media card fitted in the drive. When the save is complete (or data cannot be saved, i.e. no card fitted or no space left) the scope is ready again to receive data. If *Scope Arm* (09.064) is set to 1 the scope will start to acquire data again.

Scope trigger with *Scope Mode* (09.063) = Single (0) and *Scope Auto-save Mode* (09.070) > 0
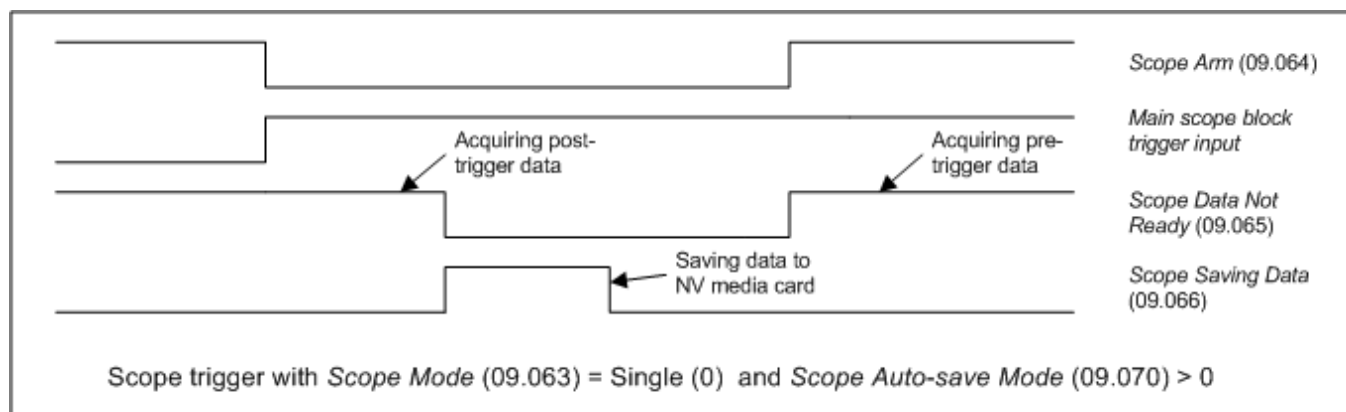
It is possible to read scope files via comms or into an option module. However, scope file transfer can only be initiated when *Scope Arm* (09.064) = 0, *Scope Data Not Ready* (09.065) = 0, *Scope Saving Data* (09.066) = 0 and at least one trace has been set up. While the file transfer is in progress *Scope Saving Data* (09.066) is set to 1.

The scope system is reset under any of the following conditions:

1. At power-up.
2. If the drive is reset when *Scope Trace 1 Source* (09.055) to *Scope Trace 4 Source* (09.058) have been modified.
3. The drive mode is changed.
4. If *Scope Mode* (09.063), *Scope Sample Time* (09.067) or *Scope Trigger Delay* (09.068) are modified.

When the scope is reset *Scope Arm* (09.064) is reset to 0 and the trace data is all cleared to 0..

Normal (1):
The scope operates in the same way as single mode except that *Scope Arm* (09.064) is automatically set back to 1 after a time delay of 1s once the post-trigger data has been acquired, and the scope data has been saved to a non-volatile media card if *Scope Auto-save Mode* (09.070) > 0.

Auto (2):
After the scope system is reset *Scope Data Not Ready* (09.065) is set to 1 and the scope begins to acquire data. Once the buffer is full *Scope Data Not Ready* (09.065) is set to 0 and the scope continues to acquire data. *Scope Arm* (09.064) has no effect on data acquisition. Provided *Scope Data Not Ready* (09.065) = 0 and *Scope Saving Data* (09.066) = 0 it is possible to read the data from the scope buffer as a scope file. Data acquisition is stopped when the file transfer begins. When the file transfer is complete, data acquisition begins again and *Scope Data Not Ready* (09.065) is set to 1 for a period that is long enough to fill the scope buffer with new data.

Parameter	09.064 *Scope Arm*		
Short description	Set to arm the scope		
Mode	RFC‑S		
Minimum	0	Maximum	1
Default	0	Units	
Type	1 Bit Volatile	Update Rate	250μs read
Display Format	Standard	Decimal Places	0
Coding	RW, NC		

See *Scope Mode* (09.063).

Parameter	09.065 *Scope Data Not Ready*		
Short description	Shows that the data in the scope buffer is not ready to be read out		
Mode	RFC‑S		
Minimum	0	Maximum	1
Default		Units	
Type	1 Bit Volatile	Update Rate	250μs write
Display Format	Standard	Decimal Places	0
Coding	RO, ND, NC, PT		

See *Scope Mode* (09.063).

Parameter	09.066 *Scope Saving Data*		
Short description	Shows when the scope is saving data		
Mode	RFC‑S		
Minimum	0	Maximum	1
Default		Units	
Type	1 Bit Volatile	Update Rate	Background write
Display Format	Standard	Decimal Places	0
Coding	RO, ND, NC, PT		

See *Scope Mode* (09.063).

Parameter	09.067 *Scope Sample Time*		
Short description	Defines the sample time of the scope		
Mode	RFC‑S		
Minimum	1	Maximum	200
Default	1	Units	
Type	8 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW, BU		

Scope Sample Time (09.067) defines the sample rate of the scope function for all traces in 250μs units (i.e. if *Scope Sample Time* (09.067) = 4, the sample time is 1ms).

Parameter	09.068 *Scope Trigger Delay*		
Short description	Defines how much pre-trigger data is stored by the scope		
Mode	RFC‑S		
Minimum	0	Maximum	100
Default	0	Units	%
Type	8 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW		

Scope Trigger Delay (09.068) defines how much data is stored before and after the scope is triggered. If *Scope Trigger Delay* (09.068) = 0% then no data is stored before the trigger and all the data is after the trigger. If *Scope Trigger Delay* (09.068) = 100% then no data is stored after the trigger, but all the data is before the trigger.

Parameter	09.069 *Scope Time Period*		
Short description	Shows the time period covered by the scope buffer		
Mode	RFC‑S		
Minimum	0.00	Maximum	200000.00
Default		Units	ms
Type	32 Bit Volatile	Update Rate	Background write
Display Format	Standard	Decimal Places	2
Coding	RO, ND, NC, PT		

The scope function can capture up to 4000 bytes of parameter data. The *Scope Time Period* (09.069) gives the length of the time period covered by the scope buffer in milliseconds which depends on the number of traces stored, the sample time and the size of the parameters used as trace sources.

Sample time in milliseconds = (250 x 10^{-6} x *Scope Sample Time* (09.067)) x 1000

Size of trace data is the sum of the number of bytes in each of the trace sources selected by *Scope Trace 1 Source* (09.055) to *Scope Trace 4 Source* (09.058).

Scope Time Period (09.069) (ms) = 4000 x Sample time in milliseconds / Size of trace data

Parameter	09.070 *Scope Auto-save Mode*		
Short description	Defines the mode for auto-saving scope files to the NV media card		
Mode	RFC‑S		
Minimum	0	Maximum	2
Default	0	Units	
Type	8 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW, TE		

Value	*Text*
0	Disabled
1	Overwrite
2	Keep

Auto-save mode can be used to store a scope file on a non-volatile media card at each trigger event. The auto-save system is held in reset if *Scope Auto-save Reset* (09.072) = 1. When the auto-save system is reset all the scope files in scope file folder on the NV media card are deleted, *Scope Auto-save File Number* (09.071) is reset to 0 and the auto-save system is inactive. If any of the file operations fail during reset *Scope Auto-save Status* (09.073) is 3 (Failed) when the reset is removed.

The following conditions must be met for auto-saving to be active:

1. *Scope Auto-save Mode* (09.070) is non-zero
2. *Scope Auto-save Reset* (09.072) = 0
3. *Scope Auto-save Status* (09.073) = 1 (Active)
4. *Scope Mode* (09.063) = 0 (Single) or 1 (Normal)

If auto-saving is active an attempt is made to copy the scope file to a non-volatile media card fitted to the drive each time the post-trigger data has been acquired. The file name is SCP00XY.DAT, where XY is defined by *Scope Auto-save File Number* (09.071). If *Scope Auto-save Mode* (09.070) = 1 (Overwrite) then a file is over-written if it already exists. If *Scope Auto-save Mode* (09.070) = 2 (Keep) then if the file already exists the auto-save process is aborted. *Scope Auto-save File Number* (09.071) is incremented after a file is saved successfully and rolls over to 0 if it exceeds its maximum value.

If *Scope Auto-save Status* (09.073) = 0 (Disabled) and all the other conditions listed above for auto-saving to be active are met, then *Scope Auto-save Status* (09.073) changes to 1 (Active), so that auto-saving becomes active. If the scope file cannot be saved because the file exists and *Scope Auto-save Mode* (09.070) = 2 (Keep) then *Scope Auto-save Status* (09.073) is set to 2 (Stopped). If the scope file cannot be saved for any other reason then *Scope Auto-save Status* (09.073) is set to 3 (Failed). If *Scope Auto-save Status* (09.073) is no longer 1 (Active), auto-saving is aborted. Auto-saving can be made active again by setting *Scope Auto-save Reset* (09.072) to 1 and then to 0. If *Scope Auto-save Mode* (09.070) = 0 (Disabled) then *Scope Auto-save Status* (09.073) is set to 0 (Disabled), or if *Scope Auto-save Mode* (09.070) is non-zero then *Scope Auto-save Status* (09.073) is set to 1 (Active). It should be noted that *Scope Auto-save Status* (09.073) is a power-down save parameter, and so auto-save will remain inactive if *Scope Auto-save Status* (09.073) is 2 or 3 even if the drive is powered down and then powered up again.

Parameter	09.071 *Scope Auto-save File Number*		
Short description	Shows the file number to be used for the next auto-saved scope file		
Mode	RFC‑S		
Minimum	0	Maximum	99
Default	0	Units	
Type	8 Bit Power Down Save	Update Rate	Background read/write
Display Format	Standard	Decimal Places	0
Coding	RO, NC		

See *Scope Auto-save Mode* (09.070).

Parameter	09.072 *Scope Auto-save Reset*		
Short description	Set to reset the scope auto-save function		
Mode	RFC-S		
Minimum	0	Maximum	1
Default	0	Units	
Type	1 Bit Volatile	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW		

See *Scope Auto-save Mode* (09.070).

Parameter	09.073 *Scope Auto-save Status*		
Short description	Shows the status of the scope auto-save function		
Mode	RFC-S		
Minimum	0	Maximum	3
Default	0	Units	
Type	8 Bit Power Down Save	Update Rate	Background write
Display Format	Standard	Decimal Places	0
Coding	RO, TE, NC		

Value	*Text*
0	Disabled
1	Active
2	Stopped
3	Failed

See *Scope Auto-save Mode* (09.070).

Menu 10 Single Line Descriptions − *Status and Trips*

Mode: RFC‑S

Parameter	Range	Default	Type					
10.001 Drive Healthy	Off (0) or On (1)		RO	Bit	ND	NC	PT	
10.002 Drive Active	Off (0) or On (1)		RO	Bit	ND	NC	PT	
10.003 Zero Speed	Off (0) or On (1)		RO	Bit	ND	NC	PT	
10.004 Running At Or Below Minimum Speed	Off (0) or On (1)		RO	Bit	ND	NC	PT	
10.005 Below Set Speed	Off (0) or On (1)		RO	Bit	ND	NC	PT	
10.006 At Speed	Off (0) or On (1)		RO	Bit	ND	NC	PT	
10.007 Above Set Speed	Off (0) or On (1)		RO	Bit	ND	NC	PT	
10.008 Rated Load Reached	Off (0) or On (1)		RO	Bit	ND	NC	PT	
10.009 Current Limit Active	Off (0) or On (1)		RO	Bit	ND	NC	PT	
10.010 Regenerating	Off (0) or On (1)		RO	Bit	ND	NC	PT	
10.011 Braking IGBT Active	Off (0) or On (1)		RO	Bit	ND	NC	PT	
10.012 Braking Resistor Alarm	Off (0) or On (1)		RO	Bit	ND	NC	PT	
10.013 Reverse Direction Commanded	Off (0) or On (1)		RO	Bit	ND	NC	PT	
10.014 Reverse Direction Running	Off (0) or On (1)		RO	Bit	ND	NC	PT	
10.015 Supply Loss	Off (0) or On (1)		RO	Bit	ND	NC	PT	
10.016 Under Voltage Active	Off (0) or On (1)		RO	Bit	ND	NC	PT	
10.017 Motor Overload Alarm	Off (0) or On (1)		RO	Bit	ND	NC	PT	
10.018 Drive Over‑temperature Alarm	Off (0) or On (1)		RO	Bit	ND	NC	PT	
10.019 Drive Warning	Off (0) or On (1)		RO	Bit	ND	NC	PT	
10.020 Trip 0	0 to 255		RO	Txt	ND	NC	PT	PS
10.021 Trip 1	0 to 255		RO	Txt	ND	NC	PT	PS
10.022 Trip 2	0 to 255		RO	Txt	ND	NC	PT	PS
10.023 Trip 3	0 to 255		RO	Txt	ND	NC	PT	PS
10.024 Trip 4	0 to 255		RO	Txt	ND	NC	PT	PS
10.025 Trip 5	0 to 255		RO	Txt	ND	NC	PT	PS
10.026 Trip 6	0 to 255		RO	Txt	ND	NC	PT	PS
10.027 Trip 7	0 to 255		RO	Txt	ND	NC	PT	PS
10.028 Trip 8	0 to 255		RO	Txt	ND	NC	PT	PS
10.029 Trip 9	0 to 255		RO	Txt	ND	NC	PT	PS
10.030 Braking Resistor Rated Power	0.000 to 99999.999 kW	0.000 kW	RW	Num				US
10.031 Braking Resistor Thermal Time Constant	0.000 to 1500.000 s	0.000 s	RW	Num				US
10.032 External Trip	Off (0) or On (1)	Off (0)	RW	Bit		NC		
10.033 Drive Reset	Off (0) or On (1)	Off (0)	RW	Bit		NC		
10.034 Number Of Auto‑reset Attempts	None (0), 1 (1), 2 (2), 3 (3), 4 (4), 5 (5), Infinite (6)	None (0)	RW	Txt				US
10.035 Auto‑reset Delay	1.0 to 600.0 s	1.0 s	RW	Num				US
10.036 Auto‑reset Hold Drive Healthy	Off (0) or On (1)	Off (0)	RW	Bit				US
10.037 Action On Trip Detection	00000 to 11111	00000	RW	Bin				US
10.038 User Trip	0 to 255		RW	Num	ND	NC		
10.039 Braking Resistor Thermal Accumulator	0.0 to 100.0 %		RO	Num	ND	NC	PT	
10.040 Status Word	000000000000000 to 111111111111111		RO	Bin	ND	NC	PT	
10.041 Trip 0 Date	00-00-00 to 31-12-99		RO	Date	ND	NC	PT	PS
10.042 Trip 0 Time	00:00:00 to 23:59:59		RO	Time	ND	NC	PT	PS
10.043 Trip 1 Date	00-00-00 to 31-12-99		RO	Date	ND	NC	PT	PS
10.044 Trip 1 Time	00:00:00 to 23:59:59		RO	Time	ND	NC	PT	PS
10.045 Trip 2 Date	00-00-00 to 31-12-99		RO	Date	ND	NC	PT	PS
10.046 Trip 2 Time	00:00:00 to 23:59:59		RO	Time	ND	NC	PT	PS
10.047 Trip 3 Date	00-00-00 to 31-12-99		RO	Date	ND	NC	PT	PS
10.048 Trip 3 Time	00:00:00 to 23:59:59		RO	Time	ND	NC	PT	PS
10.049 Trip 4 Date	00-00-00 to 31-12-99		RO	Date	ND	NC	PT	PS
10.050 Trip 4 Time	00:00:00 to 23:59:59		RO	Time	ND	NC	PT	PS
10.051 Trip 5 Date	00-00-00 to 31-12-99		RO	Date	ND	NC	PT	PS
10.052 Trip 5 Time	00:00:00 to 23:59:59		RO	Time	ND	NC	PT	PS
10.053 Trip 6 Date	00-00-00 to 31-12-99		RO	Date	ND	NC	PT	PS
10.054 Trip 6 Time	00:00:00 to 23:59:59		RO	Time	ND	NC	PT	PS
10.055 Trip 7 Date	00-00-00 to 31-12-99		RO	Date	ND	NC	PT	PS
10.056 Trip 7 Time	00:00:00 to 23:59:59		RO	Time	ND	NC	PT	PS
10.057 Trip 8 Date	00-00-00 to 31-12-99		RO	Date	ND	NC	PT	PS
10.058 Trip 8 Time	00:00:00 to 23:59:59		RO	Time	ND	NC	PT	PS
10.059 Trip 9 Date	00-00-00 to 31-12-99		RO	Date	ND	NC	PT	PS
10.060 Trip 9 Time	00:00:00 to 23:59:59		RO	Time	ND	NC	PT	PS
10.061 Braking Resistor Resistance	0.00 to 10000.00 Ω	0.00 Ω	RW	Num				US
10.062 Low Load Detected Alarm	Off (0) or On (1)		RO	Bit	ND	NC	PT	
10.063 Local Keypad Battery Low	Off (0) or On (1)		RO	Bit	ND	NC	PT	

10.064	Remote Keypad Battery Low	Off (0) or On (1)		RO	Bit	ND	NC	PT	
10.065	Auto‑tune Active	Off (0) or On (1)		RO	Bit	ND	NC	PT	
10.066	Limit Switch Active	Off (0) or On (1)		RO	Bit	ND	NC	PT	
10.067	Fire Mode Active	Off (0) or On (1)		RO	Bit	ND	NC	PT	
10.068	Hold Drive Healthy on Under Voltage	Off (0) or On (1)	Off (0)	RW	Bit				US
10.069	Additional Status Bits	0000000000 to 1111111111		RO	Bin	ND	NC	PT	
10.070	Trip 0 Sub‑trip Number	0 to 65535		RO	Num	ND	NC	PT	PS
10.071	Trip 1 Sub‑trip Number	0 to 65535		RO	Num	ND	NC	PT	PS
10.072	Trip 2 Sub‑trip Number	0 to 65535		RO	Isum	ND	NC	PT	PS
10.073	Trip 3 Sub‑trip Number	0 to 65535		RO	Num	ND	NC	PT	PS
10.074	Trip 4 Sub‑trip Number	0 to 65535		RO	Num	ND	NC	PT	PS
10.075	Trip 5 Sub‑trip Number	0 to 65535		RO	Num	ND	NC	PT	PS
10.076	Trip 6 Sub‑trip Number	0 to 65535		RO	Num	ND	NC	PT	PS
10.077	Trip 7 Sub‑trip Number	0 to 65535		RO	Num	ND	NC	PT	PS
10.078	Trip 8 Sub‑trip Number	0 to 65535		RO	Num	ND	NC	PT	PS
10.079	Trip 9 Sub‑trip Number	0 to 65535		RO	Num	ND	NC	PT	PS
10.080	Stop Motor	Off (0) or On (1)		RO	Bit	ND	NC	PT	
10.081	Phase Loss	Off (0) or On (1)		RO	Bit	ND	NC	PT	
10.101	Drive Status	Inhibit (0), Ready (1), Stop (2), Scan (3), Run (4), Supply Loss (5), Deceleration (6), dc Injection (7), Position (8), Trip (9), Active (10), Off (11), Hand (12), Auto (13), Heat (14), Under Voltage (15), Phasing (16)		RO	Txt	ND	NC	PT	
10.102	Trip Reset Source	0 to 1023		RO	Num	ND	NC	PT	PS
10.103	Trip Time Identifier	-2147483648 to 2147483647 ms		RO	Num	ND	NC	PT	
10.104	Active Alarm	None (0), Brake Resistor (1), Motor Overload (2), Ind Overload (3), Drive Overload (4), Auto Tune (5), Limit Switch (6), Fire Mode (7), Low Load (8), Option Slot 1 (9), Option Slot 2 (10), Option Slot 3 (11), Option Slot 4 (12)		RO	Txt	ND	NC	PT	
10.105	Hand Off Auto State	Not Active (0), Off (1), Hand (2), Auto (3)		RO	Txt	ND	NC	PT	PS
10.106	Potential Drive Damage Conditions	0000 to 1111		RO	Bin	ND	NC	PT	PS
10.107	Auto‑tune State	Not Active (0), Resistance (1), pLs (2), Ls (3), Flux (4), Flux Repeat (5), Ld Lq No‑load (6), Lq (7), Ke (8), Inertia (9)		RO	Txt	ND	NC	PT	

RW	Read / Write	RO	Read-only	Bit	Bit parameter	Txt	Text string	Date	Date parameter	Time	Time parameter
Chr	Character parameter	Bin	Binary parameter	IP	IP address	Mac	MAC address	Ver	Version number	SMP	Slot, menu, parameter
Num	Number parameter	DE	Destination	ND	No default value	RA	Rating dependent	NC	Non-copyable	PT	Protected
FI	Filtered	US	User save	PS	Power-down save						

Menu 10 − *Status and Trips*

Mode: RFC‑S

Status and trip system
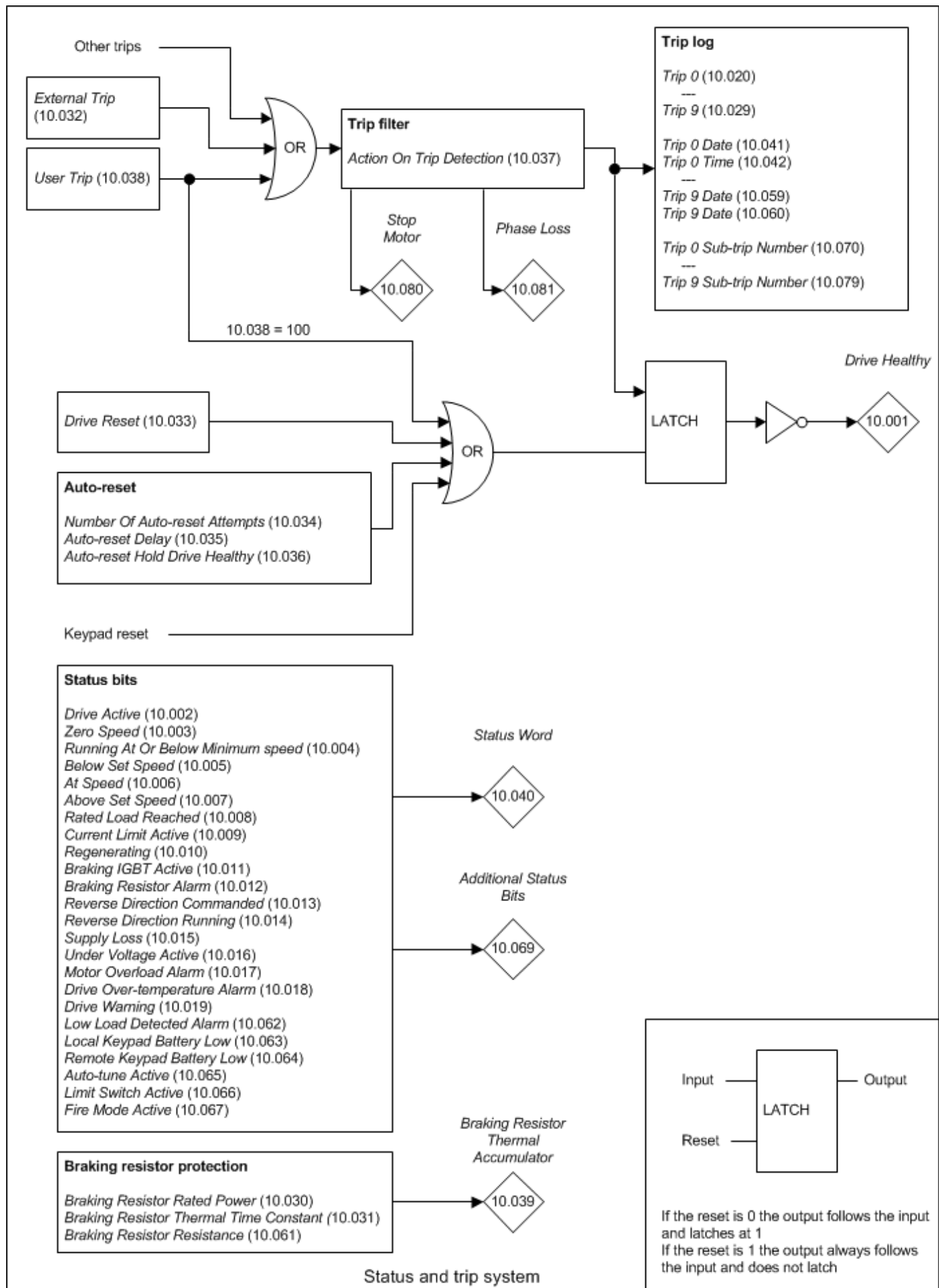
Parameter	10.001 *Drive Healthy*		
Short description	Indicates that the drive is healthy		
Mode	RFC‑S		
Minimum	0	Maximum	1
Default		Units	
Type	1 Bit Volatile	Update Rate	Background write
Display Format	Standard	Decimal Places	0
Coding	RO, ND, NC, PT		

Drive Healthy (10.001) indicates that the drive is not in the trip or the under voltage state if it is set to one. If *Auto-reset Hold Drive Healthy* (10.036) = 1 and auto-reset is being used, *Drive Healthy* (10.001) is not cleared until all auto-resets have been attempted and the next trip occurs. The LED on the front of the drive gives an indication of the drive state as shown in the table below.

Drive State	LED
Normal power and *Drive Healthy* (10.001) = 1	On continuously
Normal power and *Drive Healthy* (10.001) = 0	Flashing: 0.5s on and 0.5s off
Standby power state	Flashing: 0.5s on and 7.5s off

Parameter	10.002 *Drive Active*		
Short description	Indicates that the inverter is active		
Mode	RFC‑S		
Minimum	0	Maximum	1
Default		Units	
Type	1 Bit Volatile	Update Rate	2ms write
Display Format	Standard	Decimal Places	0
Coding	RO, ND, NC, PT		

If the drive inverter is active *Drive Active* (10.002) is set to one, otherwise it is zero.

Parameter	10.003 *Zero Speed*		
Short description	Indicates that the speed is below the zero speed threshold		
Mode	RFC‑S		
Minimum	0	Maximum	1
Default		Units	
Type	1 Bit Volatile	Update Rate	Background write
Display Format	Standard	Decimal Places	0
Coding	RO, ND, NC, PT		

Zero Speed (10.003) is set to one under the zero speed conditions, otherwise it is zero. See *Zero Speed Threshold* (03.005).

Parameter	10.004 *Running At Or Below Minimum Speed*		
Short description	Indicates that the drive is running at or below the minimum speed		
Mode	RFC‑S		
Minimum	0	Maximum	1
Default		Units	
Type	1 Bit Volatile	Update Rate	Background write
Display Format	Standard	Decimal Places	0
Coding	RO, ND, NC, PT		

If *Bipolar Reference Enable* (01.010) = 1 then *Running At Or Below Minimum Speed* (10.004) operates in the same way as *Zero Speed* (10.003). If *Bipolar Reference Enable* (01.010) = 0 then *Running At Or Below Minimum Speed* (10.004) is set if the following conditions are true:

Speed Feedback (03.002) ≤ *Minimum Reference Clamp* (01.007) + 5rpm

If motor map 2 is active then *M2 Minimum Reference Clamp* (21.002) is used instead of *Minimum Reference Clamp* (01.007). If *Linear Speed Select* (01.055) = 1 then 5mm s^{-1} is used instead of 5rpm.

Parameter	10.005 *Below Set Speed*		
Short description	Indicates that the drive is running below the set speed		
Mode	RFC‑S		
Minimum	0	Maximum	1
Default		Units	
Type	1 Bit Volatile	Update Rate	Background write
Display Format	Standard	Decimal Places	0
Coding	RO, ND, NC, PT		

See *At Speed Lower Limit* (03.006).

Parameter	10.006 *At Speed*		
Short description	Indicates that the drive is running at the set speed		
Mode	RFC‑S		
Minimum	0	Maximum	1
Default		Units	
Type	1 Bit Volatile	Update Rate	Background write
Display Format	Standard	Decimal Places	0
Coding	RO, ND, NC, PT		

See *At Speed Lower Limit* (03.006).

Parameter	10.007 *Above Set Speed*		
Short description	Indicates that the drive is running above the set speed		
Mode	RFC‑S		
Minimum	0	Maximum	1
Default		Units	
Type	1 Bit Volatile	Update Rate	Background write
Display Format	Standard	Decimal Places	0
Coding	RO, ND, NC, PT		

See *At Speed Lower Limit* (03.006).

Parameter	10.008 *Rated Load Reached*		
Short description	Indicates that rated load has been reached		
Mode	RFC‑S		
Minimum	0	Maximum	1
Default		Units	
Type	1 Bit Volatile	Update Rate	Background write
Display Format	Standard	Decimal Places	0
Coding	RO, ND, NC, PT		

Rated Load Reached (10.008) is set to one when the torque producing current is at or above its rated level. This condition is detected when the modulus of *Percentage Load* (04.020) is greater or equal to 100.0%. It should be noted that this is an indication based on the level of current and not torque, which means that if field weakening is active a value of one in *Rated Load Reached* (10.008) does not necessarily mean that the motor is producing rated torque.

Parameter	10.009 *Current Limit Active*		
Short description	Indicates that the current limit is active		
Mode	RFC‑S		
Minimum	0	Maximum	1
Default		Units	
Type	1 Bit Volatile	Update Rate	4ms write
Display Format	Standard	Decimal Places	0
Coding	RO, ND, NC, PT		

Current Limit Active (10.009) is set to one if the current limit is active. It should be noted that the current limit system is used in RFC-A and RFC-S modes when standard ramp control is active (*Ramp Mode* (02.004)), or supply loss control is in ramp stop or limit stop mode (*Supply Loss Mode* (06.003)). Therefore *Current Limit Active* (10.009) is likely to change to one under these conditions, even if the user defined current limits are not active.

Parameter	10.010 *Regenerating*		
Short description	Indicates that power is being transferred from the motor to the drive		
Mode	RFC‑S		
Minimum	0	Maximum	1
Default		Units	
Type	1 Bit Volatile	Update Rate	Background write
Display Format	Standard	Decimal Places	0
Coding	RO, ND, NC, PT		

Regenerating (10.010) is set to one if power is being transferred from the motor to the drive.

Parameter	10.011 *Braking IGBT Active*		
Short description	Indicates that the braking IGBT is active		
Mode	RFC‑S		
Minimum	0	Maximum	1
Default		Units	
Type	1 Bit Volatile	Update Rate	Background write
Display Format	Standard	Decimal Places	0
Coding	RO, ND, NC, PT		

Braking IGBT Active (10.011) is set to one if the braking IGBT is active. As the braking IGBT active periods may be short, each time the braking IGBT is

switched on *Braking IGBT Active* (10.011) is set to one and remains at one for at least 0.5s.

Parameter	10.012 *Braking Resistor Alarm*		
Short description	Indicates that the braking IGBT is active and the braking resistor thermal accumulator is greater than 75%		
Mode	RFC‑S		
Minimum	0	Maximum	1
Default		Units	
Type	1 Bit Volatile	Update Rate	Background write
Display Format	Standard	Decimal Places	0
Coding	RO, ND, NC, PT		

Braking Resistor Alarm (10.012) is set when the braking IGBT is active and *Braking Resistor Thermal Accumulator* (10.039) is greater than 75.0%. As the braking IGBT on periods may be short *Braking Resistor Alarm* (10.012) is always held on for at least 0.5s.

Parameter	10.013 *Reverse Direction Commanded*		
Short description	Indicates that the reverse direction has been commanded		
Mode	RFC‑S		
Minimum	0	Maximum	1
Default		Units	
Type	1 Bit Volatile	Update Rate	Background write
Display Format	Standard	Decimal Places	0
Coding	RO, ND, NC, PT		

Reverse Direction Commanded (10.013) indicates the reference direction at the input to the ramp system. If the *Pre-ramp Reference* (01.003) is negative *Reverse Direction Commanded* (10.013) is one otherwise *Reverse Direction Commanded* (10.013) is zero.

Parameter	10.014 *Reverse Direction Running*		
Short description	Indicates that the drive is running in the reverse direction		
Mode	RFC‑S		
Minimum	0	Maximum	1
Default		Units	
Type	1 Bit Volatile	Update Rate	Background write
Display Format	Standard	Decimal Places	0
Coding	RO, ND, NC, PT		

Reverse Direction Running (10.014) is set to one if the *Speed Feedback* (03.002) is negative otherwise it is set to zero.

Parameter	10.015 *Supply Loss*		
Short description	Indicates that the drive is in the supply loss state		
Mode	RFC‑S		
Minimum	0	Maximum	1
Default		Units	
Type	1 Bit Volatile	Update Rate	Background write
Display Format	Standard	Decimal Places	0
Coding	RO, ND, NC, PT		

Supply Loss (10.015) indicates that the drive is in the supply loss state. This condition can only occur if supply loss detection is enabled, i.e. *Supply Loss Mode* (06.003) is set to a non-zero value. In the supply loss state the drive will attempt to stop the motor.

Parameter	10.016 *Under Voltage Active*		
Short description	Indicates that the drive is in the under voltage state		
Mode	RFC‑S		
Minimum	0	Maximum	1
Default		Units	
Type	1 Bit Volatile	Update Rate	4ms write
Display Format	Standard	Decimal Places	0
Coding	RO, ND, NC, PT		

Under Voltage Active (10.016) indicates that the drive is in the under voltage state. See *Standard Under Voltage Threshold* (06.065) for more details.

Parameter	10.017 *Motor Overload Alarm*		
Short description	Indicates that the motor overload accumulator is above 75% and the output current is high		
Mode	RFC‑S		
Minimum	0	Maximum	1
Default		Units	
Type	1 Bit Volatile	Update Rate	Background write
Display Format	Standard	Decimal Places	0
Coding	RO, ND, NC, PT		

Motor Overload Alarm (10.017) is set if the drive output current is higher than the level that will eventually cause a *Motor Too Hot* trip and the *Motor Protection Accumulator* (04.019) is higher than 75.0%. See *Motor Thermal Time Constant 1* (04.015) for more details.

Parameter	10.018 *Drive Over-temperature Alarm*		
Short description	Indicates that the drive over-temperature alarm is active		
Mode	RFC‑S		
Minimum	0	Maximum	1
Default		Units	
Type	1 Bit Volatile	Update Rate	Background write
Display Format	Standard	Decimal Places	0
Coding	RO, ND, NC, PT		

Drive Over-temperature Alarm (10.018) is set if *Percentage Of Drive Thermal Trip Level* (07.036) is greater than 90%.

Parameter	10.019 *Drive Warning*		
Short description	Indicates that one or more of the drive warning alarms are active		
Mode	RFC‑S		
Minimum	0	Maximum	1
Default		Units	
Type	1 Bit Volatile	Update Rate	Background write
Display Format	Standard	Decimal Places	0
Coding	RO, ND, NC, PT		

Drive Warning (10.019) is set to one if any of the drive warnings is active, and is defined as:

Drive Warning (10.019) = *Braking Resistor Alarm* (10.012) OR *Motor Overload Alarm* (10.017) OR *Drive Over-temperature Alarm* (10.018) OR *Low Load Detected Alarm* (10.062)

Parameter	10.020 *Trip 0*		
Short description	Shows the current or last trip to have occurred		
Mode	RFC‑S		
Minimum	0	Maximum	255
Default		Units	
Type	8 Bit Power Down Save	Update Rate	Write on trip
Display Format	Standard	Decimal Places	0
Coding	RO, TE, ND, NC, PT, BU		

Click here to view trips in numerical order.

Value	Text
28	An Input 1 Loss
29	An Input 2 Loss
219	An Output Calib
217	App Menu Changed
11	Autotune 1
12	Autotune 2
13	Autotune 3
14	Autotune 4
15	Autotune 5
16	Autotune 6
17	Autotune 7
18	Autotune Stopped
19	Brake R Too Hot
99	CAM
185	Card Access
177	Card Boot
178	Card Busy
188	Card Compare
179	Card Data Exists
187	Card Drive Mode
182	Card Error
184	Card Full
183	Card No Data
180	Card Option
175	Card Product
186	Card Rating
181	Card Read Only
174	Card Slot
102	Cloning
111	Configuration
35	Control Word
225	Current Offset
97	Data Changing
247	Derivative ID
248	Derivative Image
199	Destination
224	Drive Size
31	EEPROM Fail
189	Encoder 1
190	Encoder 2
191	Encoder 3
192	Encoder 4
193	Encoder 5
194	Encoder 6
195	Encoder 7
196	Encoder 8
197	Encoder 9
162	Encoder 12
163	Encoder 13
164	Encoder 14
6	External Trip
26	I/O Overload
8	Inductance
93	Inductor Too Hot
103	Inter-connect
160	Island
34	Keypad Mode
39	Line Sync
38	Low Load
20	Motor Too Hot
176	Name Plate
0	None
101	OHt Brake

23	OHt Control
27	OHt dc bus
21	OHt Inverter
22	OHt Power
3	OI ac
4	OI Brake
109	OI dc
92	OI Snubber
215	Option Disable
98	Out Phase Loss
7	Over Speed
2	Over Volts
32	Phase Loss
198	Phasing Error
90	Power Comms
220	Power Data
37	Power Down Save
5	PSU
9	PSU 24V
223	Rating Mismatch
94	Rectifier Set-up
1	Reserved 001
95	Reserved 095
104	Reserved 104
105	Reserved 105
106	Reserved 106
107	Reserved 107
108	Reserved 108
161	Reserved 161
165	Reserved 165
166	Reserved 166
167	Reserved 167
168	Reserved 168
170	Reserved 170
171	Reserved 171
172	Reserved 172
173	Reserved 173
222	Reserved 222
228	Reserved 228
229	Reserved 229
230	Reserved 230
231	Reserved 231
232	Reserved 232
233	Reserved 233
234	Reserved 234
235	Reserved 235
236	Reserved 236
237	Reserved 237
238	Reserved 238
239	Reserved 239
240	Reserved 240
241	Reserved 241
242	Reserved 242
243	Reserved 243
244	Reserved 244
245	Reserved 245
246	Reserved 246
100	Reset
255	Reset Logs
33	Resistance
204	Slot1 Different
202	Slot1 Error
200	Slot1 HF
203	Slot1 Not Fitted
201	Slot1 Watchdog

209	Slot2 Different
207	Slot2 Error
205	Slot2 HF
208	Slot2 Not Fitted
206	Slot2 Watchdog
214	Slot3 Different
212	Slot3 Error
210	Slot3 HF
213	Slot3 Not Fitted
211	Slot3 Watchdog
254	Slot4 Different
252	Slot4 Error
250	Slot4 HF
253	Slot4 Not Fitted
251	Slot4 Watchdog
216	Slot App Menu
226	Soft Start
221	Stored HF
227	Sub-array RAM
218	Temp Feedback
10	Th Brake Res
25	Th Short Circuit
24	Thermistor
110	Undefined
91	User 24V
96	User Prog Trip
249	User Program
36	User Save
40	User Trip 40
41	User Trip 41
42	User Trip 42
43	User Trip 43
44	User Trip 44
45	User Trip 45
46	User Trip 46
47	User Trip 47
48	User Trip 48
49	User Trip 49
50	User Trip 50
51	User Trip 51
52	User Trip 52
53	User Trip 53
54	User Trip 54
55	User Trip 55
56	User Trip 56
57	User Trip 57
58	User Trip 58
59	User Trip 59
60	User Trip 60
61	User Trip 61
62	User Trip 62
63	User Trip 63
64	User Trip 64
65	User Trip 65
66	User Trip 66
67	User Trip 67
68	User Trip 68
69	User Trip 69
70	User Trip 70
71	User Trip 71
72	User Trip 72
73	User Trip 73
74	User Trip 74
75	User Trip 75
76	User Trip 76

77	User Trip 77
78	User Trip 78
79	User Trip 79
80	User Trip 80
81	User Trip 81
82	User Trip 82
83	User Trip 83
84	User Trip 84
85	User Trip 85
86	User Trip 86
87	User Trip 87
88	User Trip 88
89	User Trip 89
112	User Trip 112
113	User Trip 113
114	User Trip 114
115	User Trip 115
116	User Trip 116
117	User Trip 117
118	User Trip 118
119	User Trip 119
120	User Trip 120
121	User Trip 121
122	User Trip 122
123	User Trip 123
124	User Trip 124
125	User Trip 125
126	User Trip 126
127	User Trip 127
128	User Trip 128
129	User Trip 129
130	User Trip 130
131	User Trip 131
132	User Trip 132
133	User Trip 133
134	User Trip 134
135	User Trip 135
136	User Trip 136
137	User Trip 137
138	User Trip 138
139	User Trip 139
140	User Trip 140
141	User Trip 141
142	User Trip 142
143	User Trip 143
144	User Trip 144
145	User Trip 145
146	User Trip 146
147	User Trip 147
148	User Trip 148
149	User Trip 149
150	User Trip 150
151	User Trip 151
152	User Trip 152
153	User Trip 153
154	User Trip 154
155	User Trip 155
156	User Trip 156
157	User Trip 157
158	User Trip 158
159	User Trip 159
169	Voltage Range
30	Watchdog

Trip 0 (10.020) to *Trip 9* (10.029) store the most recent 10 trips that have occurred where *Trip 0* (10.020) is the most recent and *Trip 9* (10.029) is the

oldest. When a new trip occurs it is written to *Trip 0* (10.020) and all the other trips move down the log, with oldest being lost. The date and time when each trip occurs are also stored in the date and time log, i.e. *Trip 0 Date* (10.041) to *Trip 9 Time* (10.060). The date and time are taken from *Date* (06.016) and *Time* (06.017). Some trips have sub-trip numbers which give more detail about the reason for the trip. If a trip has a sub-trip number its value is stored in the sub-trip log, i.e. *Trip 0 Sub-trip Number* (10.070) to *Trip 9 Sub-trip Number* (10.079). If the trip does not have a sub-trip number then zero is stored in the sub-trip log.

Trip categories and priorities
Trips are grouped into the categories given in the table below. A trip can only occur when the drive is not tripped, or if it is already tripped and the new trip has a higher priority than the active trip (i.e. lower priority number). Unless otherwise stated a trip cannot be reset until 1.0s after it has been initiated.

Priority	Category	Trips	Comments
1	Internal faults	*HF01 – HF20*	These are fatal problems that cannot be reset. All drive features are inactive after any of these trips occur. If a basic keypad is fitted it will show the trip, but the keypad will not function. These trips are not stored in the trip log.
1	Stored HF trip	*Stored HF*	This trip cannot be cleared unless 1299 is entered into *Parameter mm.000* (mm.000) and a reset is initiated.
2	Non-resettable trips	Trip numbers 218 to 247, *Slot1 HF*, *Slot2 HF*, *Slot3 HF* or *Slot4 HF*	These trips cannot be reset.
3	Volatile memory failure	*EEPROM Fail*	This can only be reset if *Parameter mm.000* (mm.000) is set to 1233 or 1244, or if *Load Defaults* (11.043) is set to a non-zero value.
4	Internal 24V power supply	*PSU 24V*	
5	Non-volatile media trips	Trip numbers 174, 175 and 177 to 188	These trips are priority 6 during power-up.
5	Position feedback interface power supply	*Encoder 1*	This trip can override *Encoder 2* to *Encoder 6* trips.
6	Trips with extended reset times	*OI ac*, *OI Brake*, and *OI dc*	These trips cannot be reset until 10s after the trip was initiated.
6	Phase loss and d.c. link power circuit protection	*Phase Loss* and *OHt dc bus*	The drive will attempt to stop the motor before tripping if a *Phase Loss*.000 trip occurs unless this feature has been disabled (see *Action On Trip Detection* (10.037). The drive will always attempt to stop the motor before tripping if an *OHt dc bus* occurs.
6	Standard trips	All other trips	

Internal faults
Trips {*HF01*} to {*HF20*} are internal faults that do not have trip numbers. If one of these trips occurs, the main drive processor has detected an irrecoverable error. All drive functions are stopped and the trip message will be displayed on the drive keypad. The error can only be reset by powering the drive down and up again. The table below gives the reasons for internal faults and their corresponding trip.

Trip	Reason
{*HF01*}	CPU has detected an address error
{*HF02*}	CPU DMAC has detected an address error
{*HF03*}	CPU has detected an Illegal opcode
{*HF04*}	CPU has detected an Illegal slot instruction
{*HF05*}	An interrupt has occurred that does not have a defined function (Undefined exception)
{*HF06*}	An interrupt has occurred which is reserved (Reserved exception)
{*HF07*}	Watchdog failure
{*HF08*}	CPU Interrupt crash
{*HF09*}	Free store overflow
{*HF10*}	Parameter routing system error
{*HF11*}	Non-volatile memory comms error
{*HF12*}	Stack overflow. Sub-trip is shown to indicate which stack: 1 – background tasks 2 – timed tasks 3 – main system interrupts
{*HF13*}	The control hardware is not compatible with the firmware. The sub-trip number gives the actual ID code of the control board hardware.
{*HF14*}	CPU register bank error
{*HF15*}	CPU divide error
{*HF16*}	RTOS error (the background task has returned)
{*HF17*}	The clock supplied to the control board logic is out of specification
{*HF18*}	The internal flash memory has failed when writing option module parameter data. Sub-trip is shown to indicate which failure: 1 - Programming error while writing menu in flash 2 - Erase flash block containing setup menus failed 3 - Erase flash block containing application menus failed
{*HF19*}	Invalid main application firmware CRC. Reprogramming required.
{*HF20*}	The ASIC is not compatible with the firmware. The sub-trip number displayed is the ASIC version.
{HF23}	If this trip occurs please consult the drive supplier.
{HF24}	If this trip occurs please consult the drive supplier.
{HF25}	If this trip occurs please consult the drive supplier.

When the drive is subsequently powered up a *Stored HF* trip is initiated where the sub-trip number is the number of the HF trip that last occurred. This trip will occur at every power-up until it is reset. The trip can only be reset by first entering 1299 into *Parameter mm.000* (mm.000). If the drive is powered up and a *Stored HF* trip occurs, *Onboard User Program: Enable* (11.047) is reset to zero to prevent the on-board user program from running. This ensures that the user program can be changed or erased in case it causes an HF trip at every power-up. Once the *Stored HF* is cleared, it is necessary to power cycle the drive or to re-download the user program to allow the program to restart.

Similar trips that can be initiated by the control system or the power system

Trips shown in the table below can be generated either from the drive control system or from the power system. The sub-trip number which is in the form xxyzz is used to identify the source of the trip. The digits xx are 00 for a trip generated by the control system or the number of a power module if generated by the power system. If the drive is not a multi-power module drive then xx will always have a value of 1 the trip is related to the power system. The y digit is used to identify the location of a trip which is generated by a rectifier module connected to a power module. Where the y digit is relevant it will have a value of 1 or more, otherwise it will be 0. The zz digits give the reason for the trip and are defined in each trip description.

Over Volts	*OHt dc bus*
OI ac	*Phase Loss*
OI Brake	*Power Comms*
PSU	*OI Snubber*
OHt Inverter	*Cloning*
OHt Power	*Temp Feedback*
OHt Control	*Power Data*

Braking IGBT

The list below gives conditions that will disable the braking IGBT:

1. *Braking IGBT Upper Threshold* (06.074) = 0, or *Low Voltage Braking IGBT Threshold Select* (06.076) = 1 and *Low Voltage Braking IGBT Threshold* (06.075) = 0.
2. The drive is in the under-voltage state.
3. A priority 1, 2 or 3 trip is active (see *Trip 0* (10.020)).
4. One of the following trips is active or would be active if another trip is not already active: *OI Brake*, *PSU*, *Th Brake Res* or *OHt Inverter*.
5. *Percentage Of Drive Thermal Trip Level* (07.036) = 100%. This is an indication that some part of the drive is too hot and is used to indicate if an internally fitted braking resistor is too hot.
6. *Brake R Too Hot* is active or the system has been set up to disable the braking IGBT based on the braking resistor temperature and the resistor is too hot (i.e. bit 2 of *Action On Trip Detection* (10.037) is set).

Note that the braking IGBT over-current trip cannot be reset until 10s after it is initiated. This period consists of a 9s period after the trip where the braking IGBT cannot be switched on again and the *OI Brake* trip is held active and cannot be reset. This 9s period is followed by the normal 1s delay, that is present for other trips, before the trip can be reset. During this 1s period it is possible for the braking IGBT to switch on again. If the conditions

are still present that caused the trip then the trip will be initiated again with a further 9s hold-off period etc.

Parameter	10.021 *Trip 1*		
Short description	Shows the 2nd from last trip to have occurred		
Mode	RFC‑S		
Minimum	0	Maximum	255
Default		Units	
Type	8 Bit Power Down Save	Update Rate	Write on trip
Display Format	Standard	Decimal Places	0
Coding	RO, TE, ND, NC, PT, BU		

See *Trip 0* (10.020).

Parameter	10.022 *Trip 2*		
Short description	Shows the 3rd from last trip to have occurred		
Mode	RFC‑S		
Minimum	0	Maximum	255
Default		Units	
Type	8 Bit Power Down Save	Update Rate	Write on trip
Display Format	Standard	Decimal Places	0
Coding	RO, TE, ND, NC, PT, BU		

See *Trip 0* (10.020).

Parameter	10.023 *Trip 3*		
Short description	Shows the 4th from last trip to have occurred		
Mode	RFC‑S		
Minimum	0	Maximum	255
Default		Units	
Type	8 Bit Power Down Save	Update Rate	Write on trip
Display Format	Standard	Decimal Places	0
Coding	RO, TE, ND, NC, PT, BU		

See *Trip 0* (10.020).

Parameter	10.024 *Trip 4*		
Short description	Shows the 5th from last trip to have occurred		
Mode	RFC‑S		
Minimum	0	Maximum	255
Default		Units	
Type	8 Bit Power Down Save	Update Rate	Write on trip
Display Format	Standard	Decimal Places	0
Coding	RO, TE, ND, NC, PT, BU		

See *Trip 0* (10.020).

Parameter	10.025 *Trip 5*		
Short description	Shows the 6th from last trip to have occurred		
Mode	RFC‑S		
Minimum	0	Maximum	255
Default		Units	
Type	8 Bit Power Down Save	Update Rate	Write on trip
Display Format	Standard	Decimal Places	0
Coding	RO, TE, ND, NC, PT, BU		

See *Trip 0* (10.020).

Parameter	10.026 *Trip 6*		
Short description	Shows the 7th from last trip to have occurred		
Mode	RFC‑S		
Minimum	0	Maximum	255
Default		Units	
Type	8 Bit Power Down Save	Update Rate	Write on trip
Display Format	Standard	Decimal Places	0
Coding	RO, TE, ND, NC, PT, BU		

See *Trip 0* (10.020).

Parameter	10.027 *Trip 7*		
Short description	Shows the 8th from last trip to have occurred		
Mode	RFC-S		
Minimum	0	Maximum	255
Default		Units	
Type	8 Bit Power Down Save	Update Rate	Write on trip
Display Format	Standard	Decimal Places	0
Coding	RO, TE, ND, NC, PT, BU		

See *Trip 0* (10.020).

Parameter	10.028 *Trip 8*		
Short description	Shows the 9th from last trip to have occurred		
Mode	RFC-S		
Minimum	0	Maximum	255
Default		Units	
Type	8 Bit Power Down Save	Update Rate	Write on trip
Display Format	Standard	Decimal Places	0
Coding	RO, TE, ND, NC, PT, BU		

See *Trip 0* (10.020).

Parameter	10.029 *Trip 9*		
Short description	Shows the 10th from last trip to have occurred		
Mode	RFC-S		
Minimum	0	Maximum	255
Default		Units	
Type	8 Bit Power Down Save	Update Rate	Write on trip
Display Format	Standard	Decimal Places	0
Coding	RO, TE, ND, NC, PT, BU		

See *Trip 0* (10.020).

Parameter	10.030 *Braking Resistor Rated Power*		
Short description	Set to the rated power of the braking resistor		
Mode	RFC-S		
Minimum	0.000	Maximum	99999.999
Default	0.000	Units	kW
Type	32 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	3
Coding	RW		

A thermal protection system is provided for the braking resistor. If *Braking Resistor Rated Power* (10.030) is set to zero this protection system is disabled and the *Braking Resistor Thermal Accumulator* (10.039) is held at zero. If braking resistor thermal protection is required the *Braking Resistor Rated Power* (10.030), *Braking Resistor Thermal Time Constant* (10.031) and *Braking Resistor Resistance* (10.061) should be set up with the braking resistor parameters. The thermal time constant of the resistor can be calculated from the single pulse energy rating (E) and continuous power rating (P) of the resistor.

Braking Resistor Thermal Time Constant (10.031) = τ = E / P

The braking resistor is protected with a single time constant model as shown below.

Braking resistor protection system
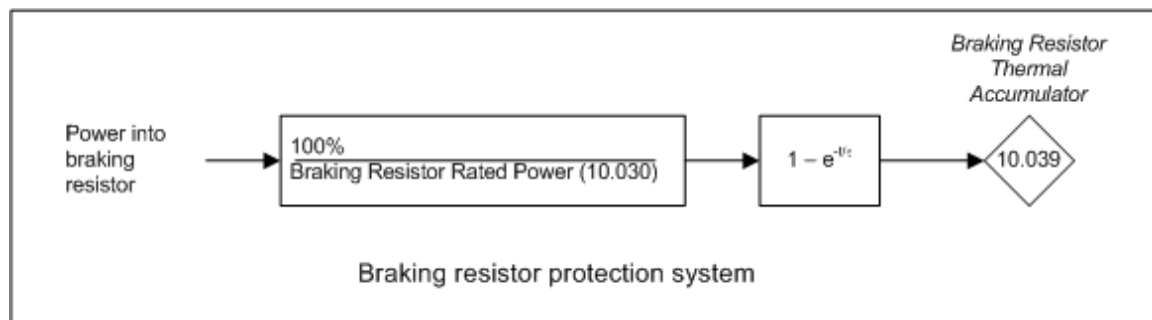
The drive monitors the power flowing into the braking resistor and updates the *Braking Resistor Thermal Accumulator* (10.039). If bit 1 of *Action On Trip Detection* (10.037) = 0 and the accumulator reaches 100% an *Brake R Too Hot* trip is initiated. If bit 1 of *Action On Trip Detection* (10.037) = 1 and the accumulator reaches 100% the braking IGBT is disabled until the accumulator falls below 95.0%.

Parameter	10.031 *Braking Resistor Thermal Time Constant*		
Short description	Set to the thermal time constant of the braking resistor		
Mode	RFC‑S		
Minimum	0.000	Maximum	1500.000
Default	0.000	Units	s
Type	32 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	3
Coding	RW		

See *Braking Resistor Rated Power* (10.030).

Parameter	10.032 *External Trip*		
Short description	Set to initiate an external trip		
Mode	RFC‑S		
Minimum	0	Maximum	1
Default	0	Units	
Type	1 Bit Volatile	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW, NC		

If *External Trip* (10.032) is set to one an *External Trip*.003 is initiated. A digital input can be routed to *External Trip* (10.032) to provide an external trip input function.

Parameter	10.033 *Drive Reset*		
Short description	Set to initiate a drive reset		
Mode	RFC‑S		
Minimum	0	Maximum	1
Default	0	Units	
Type	1 Bit Volatile	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW, NC		

A 0 to 1 transition in *Drive Reset* (10.033) causes a drive reset. If a drive reset terminal is required a digital input should be routed to *Drive Reset* (10.033).

Parameter	10.034 *Number Of Auto-reset Attempts*		
Short description	Set to the number of required auto-reset attempts		
Mode	RFC‑S		
Minimum	0	Maximum	6
Default	0	Units	
Type	8 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW, TE		

Value	Text
0	None
1	1
2	2
3	3
4	4
5	5
6	Infinite

If *Number Of Auto-reset Attempts* (10.034) = 0 then no auto-reset attempts are made. Any other value will cause the drive to automatically reset following a trip for the number of times programmed after a delay defined by *Auto-reset Delay* (10.035) subject to the minimum reset time allowed for the type of trip. Note that for some trips the minimum is 10s. The auto-reset count is only incremented when the trip is the same as the previous trip otherwise it is reset to 0. When the auto-reset count reaches the programmed value, any further trip of the same value will not cause an auto-reset. If the number of auto-reset attempts defined by *Number Of Auto-reset Attempts* (10.034) has not been reached and there has been no trip for 5 minutes then the auto-reset count is cleared. Auto reset will not occur after any trips with priority levels 1, 2 or 3 as defined in *Trip 0* (10.020). When a manual reset occurs the auto-reset counter is reset to zero.

If *Number Of Auto-reset Attempts* (10.034) = 6 the auto-reset counter is held at zero, and so there is no limit on the number of auto-reset attempts.

Parameter	10.035 *Auto-reset Delay*		
Short description	Set to the required auto-reset delay		
Mode	RFC‑S		
Minimum	1.0	Maximum	600.0
Default	1.0	Units	s
Type	16 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	1
Coding	RW		

See *Number Of Auto-reset Attempts* (10.034).

Parameter	10.036 *Auto-reset Hold Drive Healthy*		
Short description	Set to hold drive healthy if futher auto-reset attempts are possible		
Mode	RFC‑S		
Minimum	0	Maximum	1
Default	0	Units	
Type	1 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW		

If *Auto-reset Hold Drive Healthy* (10.036) = 0 then *Drive Healthy* (10.001) is cleared every time the drive trips regardless of any auto-reset that may occur. If *Auto-reset Hold Drive Healthy* (10.036) = 1 then *Drive Healthy* (10.001) is not cleared on a trip if any further auto-reset attempts are possible. Note that if the under voltage state becomes active *Drive Healthy* (10.001) will be set to zero unless *Hold Drive Healthy on Under Voltage* (10.068) = 1.

Parameter	10.037 *Action On Trip Detection*		
Short description	Defines the action of the drive on detection of a trip		
Mode	RFC‑S		
Minimum	0 (Display: 00000)	Maximum	31 (Display: 11111)
Default	0 (Display: 00000)	Units	
Type	8 Bit User Save	Update Rate	Background read
Display Format	Binary	Decimal Places	0
Coding	RW		

The bits in *Action On Trip Detection* (10.037) are defined as follows:

Bit 0: Stop on defined non-important trips
If bit 0 is set to one the drive will attempt to stop before tripping if any of the following trip conditions are detected: *I/O Overload*, *An Input 1 Loss*, *An Input 2 Loss* or *Keypad Mode*. (This bit has no effect in Regen mode.)

Bit 1: Disable braking resistor overload detection
See *Braking Resistor Rated Power* (10.030).

Bit 2: Disable phase loss stop
Normally the drive will stop when the input phase loss condition is detected. If this bit is set to 1 the drive will continue to run and will only trip when the drive is brought to a stop by the user. (This bit has no effect in Regen mode.)

Bit 3: Not Used

Bit 4: Disable parameter freeze on trip
If this bit is 0 then the parameters listed below are frozen on trip until the trip is cleared. If this bit is 1 then this feature is disabled.

Open-loop mode	RFC-A or RFC-S modes	Regen
Reference Selected (01.001)	*Reference Selected* (01.001)	
Pre-skip Filter Reference (01.002)	*Pre-skip Filter Reference* (01.002)	
Pre-ramp Reference (01.003)	*Pre-ramp Reference* (01.003)	
Post Ramp Reference (02.001)	*Post Ramp Reference* (02.001)	
Frequency Slaving Demand (03.001)	*Final Speed Reference* (03.001)	*Reactive Power* (03.001)
	Speed Feedback (03.002)	
	Speed Error (03.003)	
	Speed Controller Output (03.004)	
Current Magnitude (04.001)	*Current Magnitude* (04.001)	*Current Magnitude* (04.001)
Iq, Torque Producing Current (04.002)	*Iq, Torque Producing Current* (04.002)	*Active Current* (04.002)
Id, Magnetising Current (04.017)	*Id, Magnetising Current* (04.017)	*Reactive Current* (04.017)
Output Frequency (05.001)	*Output Frequency* (05.001)	*Output Frequency* (05.001)
Output Voltage (05.002)	*Output Voltage* (05.002)	*Output Voltage* (05.002)
Output Power (05.003)	*Output Power* (05.003)	*Output Power* (05.003)
D.c. Bus Voltage (05.005)	*D.c. Bus Voltage* (05.005)	*D.c. Bus Voltage* (05.005)
Analog Input 1 (07.001)	*Analog Input 1* (07.001)	*Analog Input 1* (07.001)
Analog Input 2 (07.002)	*Analog Input 2* (07.002)	*Analog Input 2* (07.002)
Analog Input 3 (07.003)	*Analog Input 3* (07.003)	*Analog Input 3* (07.003)

Parameter	10.038 *User Trip*		
Short description	Can be used to generate a trip on the drive		
Mode	RFC-S		
Minimum	0	Maximum	255
Default		Units	
Type	8 Bit Volatile	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW, ND, NC, BU		

When a value other than zero is written to the *User Trip* (10.038) the actions described in the following table are performed. The drive immediately writes the value back to zero. If the value is not included in the table, then the action is the same as if the trip with the same number (with sub-trip zero) occurred provided the drive is not already tripped.

Action	*User Trip* (10.038)
No action	Numbers corresponding to priority 1, 2 or 3 trips.
Drive reset	100
Clear trip logs (parameters 10.020 to 10.029, 10.041 to 10.060 and 10.070 to 10.079)	255

Parameter	10.039 *Braking Resistor Thermal Accumulator*		
Short description	Shows the level of the braking resistor thermal accumulator		
Mode	RFC-S		
Minimum	0.0	Maximum	100.0
Default		Units	%
Type	16 Bit Volatile	Update Rate	Background write
Display Format	Standard	Decimal Places	1
Coding	RO, ND, NC, PT		

See *Braking Resistor Rated Power* (10.030).

Parameter	10.040 *Status Word*		
Short description	Shows the status word for the drive		
Mode	RFC-S		
Minimum	0 (Display: 000000000000000)	Maximum	32767 (Display: 111111111111111)
Default		Units	
Type	16 Bit Volatile	Update Rate	Background write
Display Format	Binary	Decimal Places	0
Coding	RO, ND, NC, PT		

The bits in *Status Word* (10.040) mirror the status bit parameters as shown below. Where the parameters do not exist in any mode the bit remains at zero.

Bit	Status parameter
0	*Drive Healthy* (10.001)
1	*Drive Active* (10.002)
2	*Zero Speed* (10.003)
3	*Running At Or Below Minimum Speed* (10.004)
4	*Below Set Speed* (10.005)
5	*At Speed* (10.006)
6	*Above Set Speed* (10.007)
7	*Rated Load Reached* (10.008)
8	*Current Limit Active* (10.009)
9	*Regenerating* (10.010)
10	*Braking IGBT Active* (10.011)
11	*Braking Resistor Alarm* (10.012)
12	*Reverse Direction Commanded* (10.013)
13	*Reverse Direction Running* (10.014)
14	*Supply Loss* (10.015)

Parameter	10.041 *Trip 0 Date*		
Short description	Shows the date at which trip 0 occurred		
Mode	RFC‑S		
Minimum	0 (Display: 00-00-00)	Maximum	311299 (Display: 31-12-99)
Default		Units	
Type	32 Bit Power Down Save	Update Rate	Write on trip
Display Format	Date	Decimal Places	0
Coding	RO, ND, NC, PT		

See *Trip 0* (10.020).

Parameter	10.042 *Trip 0 Time*		
Short description	Shows the time at which trip 0 occurred		
Mode	RFC‑S		
Minimum	0 (Display: 00:00:00)	Maximum	235959 (Display: 23:59:59)
Default		Units	
Type	32 Bit Power Down Save	Update Rate	Write on trip
Display Format	Time	Decimal Places	0
Coding	RO, ND, NC, PT		

See *Trip 0* (10.020).

Parameter	10.043 *Trip 1 Date*		
Short description	Shows the date at which trip 1 occurred		
Mode	RFC‑S		
Minimum	0 (Display: 00-00-00)	Maximum	311299 (Display: 31-12-99)
Default		Units	
Type	32 Bit Power Down Save	Update Rate	Write on trip
Display Format	Date	Decimal Places	0
Coding	RO, ND, NC, PT		

See *Trip 0* (10.020).

Parameter	10.044 *Trip 1 Time*		
Short description	Shows the time at which trip 1 occurred		
Mode	RFC‑S		
Minimum	0 (Display: 00:00:00)	Maximum	235959 (Display: 23:59:59)
Default		Units	
Type	32 Bit Power Down Save	Update Rate	Write on trip
Display Format	Time	Decimal Places	0
Coding	RO, ND, NC, PT		

See *Trip 0* (10.020).

Parameter	10.045 *Trip 2 Date*		
Short description	Shows the date at which trip 2 occurred		
Mode	RFC‑S		
Minimum	0 (Display: 00-00-00)	Maximum	311299 (Display: 31-12-99)
Default		Units	
Type	32 Bit Power Down Save	Update Rate	Write on trip
Display Format	Date	Decimal Places	0
Coding	RO, ND, NC, PT		

See *Trip 0* (10.020).

Parameter	10.046 *Trip 2 Time*		
Short description	Shows the time at which trip 2 occurred		
Mode	RFC‑S		
Minimum	0 (Display: 00:00:00)	Maximum	235959 (Display: 23:59:59)
Default		Units	
Type	32 Bit Power Down Save	Update Rate	Write on trip
Display Format	Time	Decimal Places	0
Coding	RO, ND, NC, PT		

See *Trip 0* (10.020).

Parameter	10.047 *Trip 3 Date*		
Short description	Shows the date at which trip 3 occurred		
Mode	RFC‑S		
Minimum	0 (Display: 00-00-00)	Maximum	311299 (Display: 31-12-99)
Default		Units	
Type	32 Bit Power Down Save	Update Rate	Write on trip
Display Format	Date	Decimal Places	0
Coding	RO, ND, NC, PT		

See *Trip 0* (10.020).

Parameter	10.048 *Trip 3 Time*		
Short description	Shows the time at which trip 3 occurred		
Mode	RFC‑S		
Minimum	0 (Display: 00:00:00)	Maximum	235959 (Display: 23:59:59)
Default		Units	
Type	32 Bit Power Down Save	Update Rate	Write on trip
Display Format	Time	Decimal Places	0
Coding	RO, ND, NC, PT		

See *Trip 0* (10.020).

Parameter	10.049 *Trip 4 Date*		
Short description	Shows the date at which trip 4 occurred		
Mode	RFC‑S		
Minimum	0 (Display: 00-00-00)	Maximum	311299 (Display: 31-12-99)
Default		Units	
Type	32 Bit Power Down Save	Update Rate	Write on trip
Display Format	Date	Decimal Places	0
Coding	RO, ND, NC, PT		

See *Trip 0* (10.020).

Parameter	10.050 *Trip 4 Time*		
Short description	Shows the time at which trip 4 occurred		
Mode	RFC‑S		
Minimum	0 (Display: 00:00:00)	Maximum	235959 (Display: 23:59:59)
Default		Units	
Type	32 Bit Power Down Save	Update Rate	Write on trip
Display Format	Time	Decimal Places	0
Coding	RO, ND, NC, PT		

See *Trip 0* (10.020).

Parameter	10.051 *Trip 5 Date*		
Short description	Shows the date at which trip 5 occurred		
Mode	RFC‑S		
Minimum	0 (Display: 00-00-00)	Maximum	311299 (Display: 31-12-99)
Default		Units	
Type	32 Bit Power Down Save	Update Rate	Write on trip
Display Format	Date	Decimal Places	0
Coding	RO, ND, NC, PT		

See *Trip 0* (10.020).

Parameter	10.052 *Trip 5 Time*		
Short description	Shows the time at which trip 5 occurred		
Mode	RFC‑S		
Minimum	0 (Display: 00:00:00)	Maximum	235959 (Display: 23:59:59)
Default		Units	
Type	32 Bit Power Down Save	Update Rate	Write on trip
Display Format	Time	Decimal Places	0
Coding	RO, ND, NC, PT		

See *Trip 0* (10.020).

Parameter	10.053 *Trip 6 Date*		
Short description	Shows the date at which trip 6 occurred		
Mode	RFC‑S		
Minimum	0 (Display: 00-00-00)	Maximum	311299 (Display: 31-12-99)
Default		Units	
Type	32 Bit Power Down Save	Update Rate	Write on trip
Display Format	Date	Decimal Places	0
Coding	RO, ND, NC, PT		

See *Trip 0* (10.020).

Parameter	10.054 *Trip 6 Time*		
Short description	Shows the time at which trip 6 occurred		
Mode	RFC‑S		
Minimum	0 (Display: 00:00:00)	Maximum	235959 (Display: 23:59:59)
Default		Units	
Type	32 Bit Power Down Save	Update Rate	Write on trip
Display Format	Time	Decimal Places	0
Coding	RO, ND, NC, PT		

See *Trip 0* (10.020).

Parameter	10.055 *Trip 7 Date*		
Short description	Shows the date at which trip 7 occurred		
Mode	RFC‑S		
Minimum	0 (Display: 00-00-00)	Maximum	311299 (Display: 31-12-99)
Default		Units	
Type	32 Bit Power Down Save	Update Rate	Write on trip
Display Format	Date	Decimal Places	0
Coding	RO, ND, NC, PT		

See *Trip 0* (10.020).

Parameter	10.056 *Trip 7 Time*		
Short description	Shows the time at which trip 7 occurred		
Mode	RFC‑S		
Minimum	0 (Display: 00:00:00)	Maximum	235959 (Display: 23:59:59)
Default		Units	
Type	32 Bit Power Down Save	Update Rate	Write on trip
Display Format	Time	Decimal Places	0
Coding	RO, ND, NC, PT		

See *Trip 0* (10.020).

Parameter	10.057 *Trip 8 Date*		
Short description	Shows the date at which trip 8 occurred		
Mode	RFC‑S		
Minimum	0 (Display: 00-00-00)	Maximum	311299 (Display: 31-12-99)
Default		Units	
Type	32 Bit Power Down Save	Update Rate	Write on trip
Display Format	Date	Decimal Places	0
Coding	RO, ND, NC, PT		

See *Trip 0* (10.020).

Parameter	10.058 *Trip 8 Time*		
Short description	Shows the time at which trip 8 occurred		
Mode	RFC‑S		
Minimum	0 (Display: 00:00:00)	Maximum	235959 (Display: 23:59:59)
Default		Units	
Type	32 Bit Power Down Save	Update Rate	Write on trip
Display Format	Time	Decimal Places	0
Coding	RO, ND, NC, PT		

See *Trip 0* (10.020).

Parameter	10.059 *Trip 9 Date*		
Short description	Shows the date at which trip 9 occurred		
Mode	RFC‑S		
Minimum	0 (Display: 00-00-00)	Maximum	311299 (Display: 31-12-99)
Default		Units	
Type	32 Bit Power Down Save	Update Rate	Write on trip
Display Format	Date	Decimal Places	0
Coding	RO, ND, NC, PT		

See *Trip 0* (10.020).

Parameter	10.060 *Trip 9 Time*		
Short description	Shows the time at which trip 9 occurred		
Mode	RFC‑S		
Minimum	0 (Display: 00:00:00)	Maximum	235959 (Display: 23:59:59)
Default		Units	
Type	32 Bit Power Down Save	Update Rate	Write on trip
Display Format	Time	Decimal Places	0
Coding	RO, ND, NC, PT		

See *Trip 0* (10.020).

Parameter	10.061 *Braking Resistor Resistance*		
Short description	Set the resistance value of the braking resistor		
Mode	RFC‑S		
Minimum	0.00	Maximum	10000.00
Default	0.00	Units	Ω
Type	32 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	2
Coding	RW		

See *Braking Resistor Rated Power* (10.030).

Parameter	10.062 *Low Load Detected Alarm*		
Short description	Indicates that the low load alarm is active		
Mode	RFC‑S		
Minimum	0	Maximum	1
Default		Units	
Type	1 Bit Volatile	Update Rate	Background write
Display Format	Standard	Decimal Places	0
Coding	RO, ND, NC, PT		

Low Load Detected Alarm (10.062) is set to one when the low load alarm is active. See *Low Load Detection Level* (04.027).

Parameter	10.063 *Local Keypad Battery Low*		
Short description	Indicates that the real time clock battery in the local keypad is low		
Mode	RFC‑S		
Minimum	0	Maximum	1
Default		Units	
Type	1 Bit Volatile	Update Rate	Background write
Display Format	Standard	Decimal Places	0
Coding	RO, ND, NC, PT		

Local Keypad Battery Low (10.063) is set to one when a keypad is fitted to the front of the drive with an internal real-time clock and the battery is not

fitted or the voltage is below the minimum threshold.

Parameter	10.064 *Remote Keypad Battery Low*		
Short description	Indicates that the real time clock battery in the remote keypad is low		
Mode	RFC‑S		
Minimum	0	Maximum	1
Default		Units	
Type	1 Bit Volatile	Update Rate	Background write
Display Format	Standard	Decimal Places	0
Coding	RO, ND, NC, PT		

Remote Keypad Battery Low (10.064) is set to one when a keypad is connected to the drive user comms port with an internal real-time clock and the battery is not fitted or the voltage is below the minimum threshold.

Parameter	10.065 *Auto-tune Active*		
Short description	Indicates that an auto-tune sequence is active		
Mode	RFC‑S		
Minimum	0	Maximum	1
Default		Units	
Type	1 Bit Volatile	Update Rate	Background write
Display Format	Standard	Decimal Places	0
Coding	RO, ND, NC, PT		

Auto-tune Active (10.065) is set to one while an auto-tune sequence is active.

Parameter	10.066 *Limit Switch Active*		
Short description	Indicates that a limit switch is enabled and active		
Mode	RFC‑S		
Minimum	0	Maximum	1
Default		Units	
Type	1 Bit Volatile	Update Rate	Background write
Display Format	Standard	Decimal Places	0
Coding	RO, ND, NC, PT		

Limit Switch Active (10.066) is set to one when a limit switch is enabled and active.

Parameter	10.067 *Fire Mode Active*		
Short description	Indicates that fire mode is enabled and active		
Mode	RFC‑S		
Minimum	0	Maximum	1
Default		Units	
Type	1 Bit Volatile	Update Rate	Background write
Display Format	Standard	Decimal Places	0
Coding	RO, ND, NC, PT		

Fire Mode Active (10.067) is set to one when fire mode is enabled and active.

Parameter	10.068 *Hold Drive Healthy on Under Voltage*		
Short description	Set to hold drive healthy if the drive is in the under voltage state		
Mode	RFC‑S		
Minimum	0	Maximum	1
Default	0	Units	
Type	1 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW		

Hold Drive Healthy on Under Voltage (10.068) can be used to hold the drive healthy active (*Drive Healthy* (10.001) = 1 and not flash the status LED on the front of the drive) when the drive is in the under voltage state (*Under Voltage Active* (10.016) = 1).

If *Hold Drive Healthy on Under Voltage* (10.068) = 0 and *Under Voltage Active* (10.016) = 1, then *Drive Healthy* (10.001) will be set to 0 and the status LED on the front of the drive will flash.

If *Hold Drive Healthy on Under Voltage* (10.068) = 1, *Under Voltage Active* (10.016) = 1 and the drive is not tripped (i.e. *Drive Status* (10.101) does not equal 9), then *Drive Healthy* (10.001) will be set to 1 and the status LED on the front of the drive will not flash.

If the drive is tripped then *Drive Healthy* (10.001) will be set to 0 and the status LED will flash independent of what *Hold Drive Healthy on Under Voltage* (10.068) is set to.

Parameter	10.069 *Additional Status Bits*		
Short description	Shows the additional status bits for the drive		
Mode	RFC‑S		
Minimum	0 (Display: 0000000000)	Maximum	1023 (Display: 1111111111)
Default		Units	
Type	16 Bit Volatile	Update Rate	Background write
Display Format	Binary	Decimal Places	0
Coding	RO, ND, NC, PT		

The bits in *Additional Status Bits* (10.069) mirror the status bits parameters as shown below. Where the parameters do not exist in any mode the bit remains at zero.

Bit	Status parameter
0	*Under Voltage Active* (10.016)
1	*Motor Overload Alarm* (10.017) or *Inductor Overload Alarm* (10.017)
2	*Drive Over-temperature Alarm* (10.018)
3	*Drive Warning* (10.019)
4	*Low Load Detected Alarm* (10.062)
5	*Local Keypad Battery Low* (10.063)
6	*Remote Keypad Battery Low* (10.064)
7	*Auto-tune Active* (10.065)
8	*Limit Switch Active* (10.066)
9	*Fire Mode Active* (10.067)

Parameter	10.070 *Trip 0 Sub-trip Number*		
Short description	Shows the sub-trip number for trip 0		
Mode	RFC‑S		
Minimum	0	Maximum	65535
Default		Units	
Type	16 Bit Power Down Save	Update Rate	Write on trip
Display Format	Standard	Decimal Places	0
Coding	RO, ND, NC, PT, BU		

See *Trip 0* (10.020).

Parameter	10.071 *Trip 1 Sub-trip Number*		
Short description	Shows the sub-trip number for trip 1		
Mode	RFC‑S		
Minimum	0	Maximum	65535
Default		Units	
Type	16 Bit Power Down Save	Update Rate	Write on trip
Display Format	Standard	Decimal Places	0
Coding	RO, ND, NC, PT, BU		

See *Trip 0* (10.020).

Parameter	10.072 *Trip 2 Sub-trip Number*		
Short description	Shows the sub-trip number for trip 2		
Mode	RFC‑S		
Minimum	0	Maximum	65535
Default		Units	
Type	16 Bit Power Down Save	Update Rate	Write on trip
Display Format	Standard	Decimal Places	0
Coding	RO, ND, NC, PT, BU		

See *Trip 0* (10.020).

Parameter	10.073 *Trip 3 Sub-trip Number*		
Short description	Shows the sub-trip number for trip 3		
Mode	RFC‑S		
Minimum	0	Maximum	65535
Default		Units	
Type	16 Bit Power Down Save	Update Rate	Write on trip
Display Format	Standard	Decimal Places	0
Coding	RO, ND, NC, PT, BU		

See *Trip 0* (10.020).

Parameter	10.074 *Trip 4 Sub-trip Number*		
Short description	Shows the sub-trip number for trip 4		
Mode	RFC‑S		
Minimum	0	Maximum	65535
Default		Units	
Type	16 Bit Power Down Save	Update Rate	Write on trip
Display Format	Standard	Decimal Places	0
Coding	RO, ND, NC, PT, BU		

See *Trip 0* (10.020).

Parameter	10.075 *Trip 5 Sub-trip Number*		
Short description	Shows the sub-trip number for trip 5		
Mode	RFC‑S		
Minimum	0	Maximum	65535
Default		Units	
Type	16 Bit Power Down Save	Update Rate	Write on trip
Display Format	Standard	Decimal Places	0
Coding	RO, ND, NC, PT, BU		

See *Trip 0* (10.020).

Parameter	10.076 *Trip 6 Sub-trip Number*		
Short description	Shows the sub-trip number for trip 6		
Mode	RFC‑S		
Minimum	0	Maximum	65535
Default		Units	
Type	16 Bit Power Down Save	Update Rate	Write on trip
Display Format	Standard	Decimal Places	0
Coding	RO, ND, NC, PT, BU		

See *Trip 0* (10.020).

Parameter	10.077 *Trip 7 Sub-trip Number*		
Short description	Shows the sub-trip number for trip 7		
Mode	RFC‑S		
Minimum	0	Maximum	65535
Default		Units	
Type	16 Bit Power Down Save	Update Rate	Write on trip
Display Format	Standard	Decimal Places	0
Coding	RO, ND, NC, PT, BU		

See *Trip 0* (10.020).

Parameter	10.078 *Trip 8 Sub-trip Number*		
Short description	Shows the sub-trip number for trip 8		
Mode	RFC‑S		
Minimum	0	Maximum	65535
Default		Units	
Type	16 Bit Power Down Save	Update Rate	Write on trip
Display Format	Standard	Decimal Places	0
Coding	RO, ND, NC, PT, BU		

See *Trip 0* (10.020).

Parameter	10.079 *Trip 9 Sub-trip Number*		
Short description	Shows the sub-trip number for trip 9		
Mode	RFC‑S		
Minimum	0	Maximum	65535
Default		Units	
Type	16 Bit Power Down Save	Update Rate	Write on trip
Display Format	Standard	Decimal Places	0
Coding	RO, ND, NC, PT, BU		

See *Trip 0* (10.020).

Parameter	10.080 *Stop Motor*		
Short description	Indicates that the motor is being stopped before the drive trips		
Mode	RFC‑S		
Minimum	0	Maximum	1
Default		Units	
Type	1 Bit Volatile	Update Rate	Background write
Display Format	Standard	Decimal Places	0
Coding	RO, ND, NC, PT		

It is possible for some trips to cause the motor to stop before the trip is initiated (see *Action On Trip Detection* (10.037)). During the period while the motor is being stopped before the trip is initiated *Stop Motor* (10.080) is set to one. Once the motor stops *Stop Motor* (10.080) is set back to zero.

Parameter	10.081 *Phase Loss*		
Short description	Indicates that the drive has detected an input phase loss		
Mode	RFC‑S		
Minimum	0	Maximum	1
Default		Units	
Type	1 Bit Volatile	Update Rate	Background write
Display Format	Standard	Decimal Places	0
Coding	RO, ND, NC, PT		

If phase loss or imbalance is detected that would initiate a phase loss trip with sub-trip 0, i.e. *Phase Loss*.000, then *Phase Loss* (10.081) is set to one. Either the motor will be stopped and the drive tripped or the drive will continue to operate normally until the user stops the motor and the drive trips (see *Action On Trip Detection* (10.037)). In either case *Phase Loss* (10.081) is set to one when the phase loss condition is detected and remains set until the drive trips.

Parameter	10.101 *Drive Status*		
Short description	Shows the present status of the drive		
Mode	RFC‑S		
Minimum	0	Maximum	16
Default		Units	
Type	8 Bit Volatile	Update Rate	Background write
Display Format	Standard	Decimal Places	0
Coding	RO, TE, ND, NC, PT, BU		

Value	*Text*
0	Inhibit
1	Ready
2	Stop
3	Scan
4	Run
5	Supply Loss
6	Deceleration
7	dc Injection
8	Position
9	Trip
10	Active
11	Off
12	Hand
13	Auto
14	Heat
15	Under Voltage
16	Phasing

Drive Status (10.101) shows the present status of the drive. The strings from this parameter are also used by the basic keypad to provide the status display text.

Parameter	10.102 *Trip Reset Source*		
Short description	Indicates whether a trip in the trip log has been reset.		
Mode	RFC‑S		
Minimum	0	Maximum	1023
Default		Units	
Type	16 Bit Power Down Save	Update Rate	Write on trip
Display Format	Standard	Decimal Places	0
Coding	RO, ND, NC, PT, BU		

The bits in *Trip Reset Source* (10.102) correspond to each of the trips in the trip log (i.e. bit 0 corresponds to trip 0, bit 1 corresponds to trip 1, etc.). When a trip occurs, bit 0 is set to one and the other bits corresponding to the trips already in the trip log are shifted left one bit. If the trip is reset then bit 0 is set back to zero, otherwise if a higher priority trip occurs bit 0 is shifted left by one bit. The result is that each of the bits in *Trip Reset Source*

(10.102) show whether trips in the trip log were reset or moved up the trip log by a higher priority trip.

Parameter	10.103 _Trip Time Identifier_		
Short description	Shows time in milliseconds since the drive powered up when a trip occurred		
Mode	RFC‑S		
Minimum	-2147483648	Maximum	2147483647
Default		Units	ms
Type	32 Bit Volatile	Update Rate	Write on trip
Display Format	Standard	Decimal Places	0
Coding	RO, ND, NC, PT		

When a trip occurs the time in milliseconds since the drive powered up is stored in _Trip Time Identifier_ (10.103). The time rolls-over when it reaches 2^{31} - 1, but if the time is 0 a value of 1 is written. _Trip Time Identifier_ (10.103) can be used to determine when a new trip has occurred as the value will change (unless there were exactly 2^{32}ms between trips) and will be non-zero.

Parameter	10.104 _Active Alarm_		
Short description	Shows the value of the active alarm		
Mode	RFC‑S		
Minimum	0	Maximum	12
Default		Units	
Type	8 Bit Volatile	Update Rate	Background write
Display Format	Standard	Decimal Places	0
Coding	RO, TE, ND, NC, PT, BU		

Value	Text
0	None
1	Brake Resistor
2	Motor Overload
3	Ind Overload
4	Drive Overload
5	Auto Tune
6	Limit Switch
7	Fire Mode
8	Low Load
9	Option Slot 1
10	Option Slot 2
11	Option Slot 3
12	Option Slot 4

If there is no alarm then _Active Alarm_ (10.104) = 0. If one alarm is active then _Active Alarm_ (10.104) shows the value of the alarm. If more than one alarm is active then _Active Alarm_ (10.104) shows the active alarm with the lowest value. The strings from this parameter are also used by the basic keypad to provide the status display text except for option slot warnings where the option module may supply the string.

Parameter	10.105 _Hand Off Auto State_		
Short description	Shows the state of the hand/off/auto system		
Mode	RFC‑S		
Minimum	0	Maximum	3
Default		Units	
Type	8 Bit Power Down Save	Update Rate	Background write
Display Format	Standard	Decimal Places	0
Coding	RO, TE, ND, NC, PT		

Value	Text
0	Not Active
1	Off
2	Hand
3	Auto

See _Hand/Off/Auto Operating Mode_ (01.052) for details of the hand/off/auto system. _Hand Off Auto State_ (10.105) shows the state of this system and is used at power-up to restore the previous state if required.

Parameter	10.106 *Potential Drive Damage Conditions*		
Short description	Indicates that the user has put the drive in a condition that could potentially damage the drive		
Mode	RFC‑S		
Minimum	0 (Display: 0000)	Maximum	15 (Display: 1111)
Default		Units	
Type	8 Bit Power Down Save	Update Rate	Background write
Display Format	Binary	Decimal Places	0
Coding	RO, ND, NC, PT, BU		

The bits in *Potential Drive Damage Conditions* **(10.106)** are set under the conditions shown in the table below to indicate that the user has put the drive in a condition that could potentially damage the drive. The bits in this parameter cannot be cleared by users.

Potential Drive Damage Conditions (10.106) bit	Condition
0	Fire mode has been active. See *Fire Mode Reference* (01.053).
1	*Low Under Voltage Threshold (06.066)* has been reduced from its default value.
2	High speed RFC-S mode has been used. See *Enable High Speed Mode* (05.022).
3	Not used.

Parameter	10.107 *Auto-tune State*		
Short description	Shows progress through auto-tuning		
Mode	RFC‑S		
Minimum	0	Maximum	9
Default		Units	
Type	8 Bit Volatile	Update Rate	Background write
Display Format	Standard	Decimal Places	0
Coding	RO, TE, ND, NC, PT		

Value	*Text*
0	Not Active
1	Resistance
2	pLs
3	Ls
4	Flux
5	Flux Repeat
6	Ld Lq No-load
7	Lq
8	Ke
9	Inertia

Auto-tune State (10.107) is zero unless an auto-tune is active when it shows the current state of the auto-tune sequence as follows:

Parameter value	Auto-tune state
1	Stator resistance measurement
4	Locate rotor flux
5	Locate rotor flux repeat
6	Ld and Lq measurement with no-load
7	Lq measurement with load
8	Ke measurement
9	Inertia measurement

Menu 11 Single Line Descriptions − *Miscellaneous*

Mode: RFC‑S

Parameter	Range	Default	Type				
11.001 Option Synchronisation Select	Not Active (0), Slot 1 (1), Slot 2 (2), Slot 3 (3), Slot 4 (4), Automatic (5)	Slot 4 (4)	RW	Txt				US
11.002 Option synchronisation Active	Not Active (0), Slot 1 (1), Slot 2 (2), Slot 3 (3), Slot 4 (4)		RO	Txt	ND	NC	PT	
11.018 Status Mode Parameter 1	0.000 to 59.999	0.000	RW	Num			PT	US
11.019 Status Mode Parameter 2	0.000 to 59.999	0.000	RW	Num			PT	US
11.021 Parameter 00.030 Scaling	0.000 to 10.000	1.000	RW	Num				US
11.022 Parameter Displayed At Power‑up	0.000 to 0.080	0.010	RW	Num			PT	US
11.028 Drive Derivative	0 to 255		RO	Num	ND	NC	PT	
11.029 Software Version	0 to 99999999		RO	Num	ND	NC	PT	
11.030 User Security Code	0 to 2147483647		RW	Num	ND	NC	PT	US
11.031 User Drive Mode	Open‑loop (1), RFC‑A (2), RFC‑S (3), Regen (4)		RW	Txt	ND	NC	PT	
11.032 Maximum Heavy Duty Rating	0.000 to 99999.999 A		RO	Num	ND	NC	PT	
11.033 Drive Rated Voltage	200V (0), 400V (1), 575V (2), 690V (3)		RO	Txt	ND	NC	PT	
11.034 Software Sub‑version	0 to 99		RO	Num	ND	NC	PT	
11.035 Number Of Power Modules Test	-1 to 20	-1	RW	Num				US
11.036 NV Media Card File Previously Loaded	0 to 999	0	RO	Num		NC	PT	
11.037 NV Media Card File Number	0 to 999	0	RW	Num				
11.038 NV Media Card File Type	None (0), Open‑loop (1), RFC‑A (2), RFC‑S (3), Regen (4), User Prog (5)		RO	Txt	ND	NC	PT	
11.039 NV Media Card File Version	0 to 9999		RO	Num	ND	NC	PT	
11.040 NV Media Card File Checksum	-2147483648 to 2147483647		RO	Num	ND	NC	PT	
11.042 Parameter Cloning	None (0), Read (1), Program (2), Auto (3), Boot (4)	None (0)	RW	Txt		NC		US
11.043 Load Defaults	None (0), Standard (1), US (2)	None (0)	RW	Txt		NC		
11.044 User Security Status	Menu 0 (0), All Menus (1), Read‑only Menu 0 (2), Read‑only (3), Status Only (4), No Access (5)		RW	Txt	ND		PT	
11.045 Select Motor 2 Parameters	Motor 1 (0), Motor 2 (1)	Motor 1 (0)	RW	Txt				US
11.046 Defaults Previously Loaded	0 to 2000		RO	Num	ND	NC	PT	US
11.047 Onboard User Program: Enable	Reset And Run (-1), Stop (0), Run (1)	Run (1)	RW	Txt				US
11.048 Onboard User Program: Status	-2147483648 to 2147483647		RO	Num	ND	NC	PT	
11.049 Onboard User Program: Programming Events	0 to 65535		RO	Num	ND	NC	PT	
11.050 Onboard User Program: FreewheelingTasks Per Second	0 to 65535		RO	Num	ND	NC	PT	
11.051 Onboard User Program: Clock Task Time Used	0.0 to 100.0 %		RO	Num	ND	NC	PT	
11.052 Serial Number LS	000000000 to 999999999		RO	Num	ND	NC	PT	
11.053 Serial Number MS	0 to 999999999		RO	Num	ND	NC	PT	
11.054 Drive Date Code	0 to 65535		RO	Num	ND	NC	PT	
11.055 Onboard User Program: Clock Task Scheduled Interval	0 to 262140 ms		RO	Num	ND	NC	PT	
11.056 Option Slot Identifiers	1234 (0), 1243 (1), 1324 (2), 1342 (3), 1423 (4), 1432 (5), 4123 (6), 3124 (7), 4132 (8), 2134 (9), 3142 (10), 2143 (11), 3412 (12), 4312 (13), 2413 (14), 4213 (15), 2314 (16), 3214 (17), 2341 (18), 2431 (19), 3241 (20), 3421 (21), 4231 (22), 4321 (23)	1234 (0)	RW	Txt			PT	
11.060 Maximum Rated Current	0.000 to 99999.999 A		RO	Num	ND	NC	PT	
11.061 Full Scale Current Kc	0.000 to 99999.999 A		RO	Num	ND	NC	PT	
11.062 Power Board Software Version Number	0.00 to 99.99		RO	Num	ND	NC	PT	
11.063 Product Type	0 to 255		RO	Num	ND	NC	PT	
11.064 Product Identifier Characters	1295462448 to 2147483647		RO	Num	ND	NC	PT	
11.065 Drive Rating And Configuration	00000000 to 99999999		RO	Num	ND	NC	PT	
11.066 Power Stage Identifier	0 to 255		RO	Num	ND	NC	PT	
11.067 Control Board Identifier	0.000 to 65.535		RO	Num	ND	NC	PT	
11.068 Internal I/O Identifier	0 to 255		RO	Num	ND	NC	PT	
11.069 Position Feedback Interface Identifier	0 to 255		RO	Num	ND	NC	PT	
11.070 Core Parameter Database Version	0.00 to 99.99		RO	Num	ND	NC	PT	
11.071 Number Of Power Modules Detected	0 to 20		RO	Num	ND	NC	PT	US
11.072 NV Media Card Create Special File	0 to 1	0	RW	Num		NC		
11.073 NV Media Card Type	None (0), SMART Card (1), SD Card (2)		RO	Txt	ND	NC	PT	

11.075	NV Media Card Read‑only Flag	Off (0) or On (1)		RO	Bit	ND	NC	PT	
11.076	NV Media Card Warning Suppression Flag	Off (0) or On (1)		RO	Bit	ND	NC	PT	
11.077	NV Media Card File Required Version	0 to 9999		RW	Num	ND	NC	PT	
11.079	Drive Name Characters 1‑4	-2147483648 to 2147483647	0	RW	Num			PT	US
11.080	Drive Name Characters 5‑8	-2147483648 to 2147483647	0	RW	Num			PT	US
11.081	Drive Name Characters 9‑12	-2147483648 to 2147483647	0	RW	Num			PT	US
11.082	Drive Name Characters 13‑16	-2147483648 to 2147483647	0	RW	Num			PT	US
11.084	Drive Mode	Open‑loop (1), RFC‑A (2), RFC‑S (3), Regen (4)		RO	Txt	ND	NC	PT	US
11.085	Security Status	None (0), Read‑only (1), Status‑only (2), No Access (3)		RO	Txt	ND	NC	PT	PS
11.086	Menu Access Status	Menu 0 (0), All Menus (1)		RO	Txt	ND	NC	PT	PS
11.090	Keypad Port Serial Address	1 to 16	1	RW	Num				US
11.091	Additional Identifier Characters 1	-2147483648 to 2147483647		RO	Num	ND	NC	PT	
11.092	Additional Identifier Characters 2	-2147483648 to 2147483647		RO	Num	ND	NC	PT	
11.093	Additional Identifier Characters 3	-2147483648 to 2147483647		RO	Num	ND	NC	PT	
11.095	Number Of Rectifiers Detected	0 to 9		RO	Num	ND	NC	PT	
11.096	Number Of Rectifiers Expected	0 to 9	0	RW	Num				US

RW	Read / Write	RO	Read-only	Bit	Bit parameter	Txt	Text string	Date	Date parameter	Time	Time parameter
Chr	Character parameter	Bin	Binary parameter	IP	IP address	Mac	MAC address	Ver	Version number	SMP	Slot, menu, parameter
Num	Number parameter	DE	Destination	ND	No default value	RA	Rating dependent	NC	Non-copyable	PT	Protected
FI	Filtered	US	User save	PS	Power-down save						

Menu 11 − *Miscellaneous*

Mode: RFC‑S

Menu 11 provides parameters for the following features:

1. General drive set-up and identification
2. Serial communications interface
3. Non-volatile media card access
4. Onboard user programming

Non-Volatile Media Card Support

The drive supports two types of non-volatile media cards; smart cards and FAT formatted SD cards.

The NV Media Card can be used for:

- Parameter copying between drives
- Saving drive parameter sets
- Saving an onboard user program
- Storing of onboard scope data (SD card only)
- Storing of complete drive cloning information (SD card only)
- Storing of MCi module user programs (SD card only)

The NV Media Card can be used to store drive parameter sets and/or PLC programs set from the drive in data blocks 001 to 499 on the card.

The Unidrive M is compatible with a Unidrive SP smart card and is able to read and translate the Unidrive SP parameter set into a compatible parameter set for Unidrive M. This is only possible if the Unidrive SP parameter set was transferred to the smart card using the difference from defaults transfer method (i.e. 4yyy transfer). The Unidrive M is not able to read any other type of Unidrive SP data block on the card. Although it is possible to transfer difference from default data blocks from a Unidrive SP into the Unidrive M, the following should be noted:

1. If a parameter from the source drive does not exist in the target drive then no data is transferred for that parameter.
2. If the data for the parameter in the target drive is out of range then the data is limited to the range of the target parameter.
3. If the target drive has a different rating to the source drive then the normal rules for this type of transfer apply.

SD Card File system layout

The folder <MCDF/> ("Motor Control Data Files") must be present on a FAT-formatted SD card. Other folders can be added, but this folder and its contents must not be altered. This folder structure is created when a *Card Error* trip is reset. The drive will place files in a <MCDF/> folder in the card root. When individual items are saved by the drive (e.g. drive parameters or a user program), this will generate a numbered file in the root of this folder; the number is that specified in the triggering command, and this number must be specified in the command used to restore the item from the file. This is equivalent functionality to that provided on a smart card. When saving a parameter file, in addition to the drive parameters, the drive will also read the option parameters from each of the installed options, and include those that have changed in the parameter file.

Changing the drive mode

If the source drive mode is different from the target drive mode then the mode will be changed to the source drive mode before the parameters are transferred. If the required drive mode is outside the allowed range for the target then a *Card Drive Mode* trip is initiated and no data is transferred.

Different voltage ratings

If the voltage rating of the source and target drives is different then all parameters except those that are rating dependent are transferred to the target drive. The rating dependent parameters are left at their default values. After the parameters have been transferred and saved to non-volatile memory a *Card Rating* trip is given as a warning. The table below gives a list of the rating dependent parameters.

Parameters
Standard Ramp Voltage (02.008)
Voltage Set-point (03.005)
Reactive Power Input kVAR (03.020)
Regen Supply Loss a.c. Level (03.023)
Regen Minimum Voltage (03.026)
Regen Maximum Voltage (03.027)
Supply Voltage (03.028)
Motoring Current Limit / Power From Supply Current Limit (04.005) *M2 Motoring Current Limit / M2 Power From Supply Current Limit* (21.027)
Regenerating Current Limit / Power To Supply Current Limit (04.006) *M2 Regenerating Current Limit / M2 Power To Supply Current Limit* (21.028)
Symmetrical Current Limit (04.007) *M2 Symmetrical Current Limit* (21.029)
User Current Maximum Scaling (04.024)
Rated Current (05.007) *M2 Rated Current* (21.007)
Rated Voltage (05.009) *M2 Rated Voltage* (21.009)
Rated Power Factor (05.010) *M2 Rated Power Factor* (21.010)
Stator Resistance (05.017) *M2 Stator Resistance* (21.012)
Maximum Switching Frequency (05.018*)*
Transient Inductance /Ld (05.024) *M2 Transient Inductance /Ld* (21.014)
Stator Inductance (05.025) *M2 Stator Inductance* (21.024)
No-load Lq (05.068) *M2 No-load Lq* (21.041)
Rated Load Lq (05.069) *M2 Rated Load Lq* (21.042)
No-load Phase Offset (05.070) *M2 No-load Phase Offset* (21.043)
Rated Load Phase Offset (05.071) *M2 Rated Load Phase Offset* (21.044)

Maximum Low Speed Sensorless Mode Current (05.072)					
M2 Maximum Low Speed Sensorless Mode Current (05.045)					

Injection Braking Level (06.006)	

Supply Loss Detection Level (06.048)	

Braking IGBT Lower Threshold (06.073)
Braking IGBT Upper Threshold (06.074)
Low Voltage Braking IGBT Threshold (06.075)

Different option modules fitted

If the *Option ID Code* (MM.001) is different for any option module fitted to the source drive compared to the destination drive then the parameters for the set-up and application menus for that option module are not transferred, but the parameters are set to their default values. After the parameters have been transferred and saved to non-volatile memory a {Card Option} trip is given as a warning

Different current ratings

If any of the current rating parameters (*Maximum Heavy Duty Rating* (11.032), *Maximum Rated Current* (11.060) or Full Scale *Current Kc* (11.061)) are different between the source and target then all parameters are still written to the target drive, but some may be limited by their allowed range. To give similar performance in the target compared to the source drive the speed and current controller gains are modified as shown below.

Gains	Multiplier
Speed Controller Proportional Gain Kp1 (03.010) *Speed Controller Integral Gain Ki1* (03.011) *Speed Controller Proportional Gain Kp2* (03.013) *Speed Controller Integral Gain Ki2* (03.014) *M2 Speed Controller Proportional Gain Kp* (21.017) *M2 Speed Controller Integral Gain Ki* (21.018)	[Source *Full Scale Current Kc* (11.061)] / [Target *Full Scale Current Kc* (11.061)]
Current Controller Kp Gain (04.013) *Current Controller Ki Gain* (04.014) *M2 Current Controller Kp Gain* (21.022) *M2 Current Controller Ki Gain* (21.023)	[Target *Full Scale Current Kc* (11.061)] / [Source *Full Scale Current Kc* (11.061)]

Different variable maximums

It should be noted that if ratings of the source and target drives are different, or the option modules fitted to the source and target drives are different, it is possible that some parameters with variable maximums may be limited and not have the same values as in the source drive.

Macro files

Macro files are created in the same way as parameter files except that *NV Media Card Create Special File* (11.072) must be set to 1 before the file is created on the NV media card. *NV Media Card Create Special File* (11.072) is set to zero after the file has been created or the transfer fails. When a macro file is transferred to a drive the drive mode is not changed even if the actual mode is different to that in the file and defaults are not loaded before the parameters are copied from the file to the drive. The first three identification bytes at the start of a macro file are "MAC".

Onboard user program files

Onboard user program files are created with *Parameter mm.000* (mm.000) = 5xxx and the onboard user program image is transferred to the NV media card. The onboard user program image can be loaded from an onboard user program file with *Parameter mm.000* (mm.000) = 6xxx. If the drive does not have an onboard user program loaded when the onboard user program file is created then a file is created with an empty image. If this file is then transferred to a drive with an onboard user program loaded, the onboard user program will be erased.

Option module applications file

An option module applications file is intended to hold user program from an applications module. An option module applications file from the option module in slot 1 can be created with *Parameter mm.000* (mm.000) = 15xxx. An option module applications file can be transferred from an option module in slot 1 to an option module applications file with *Parameter mm.000* (mm.000) = 18xxx. If the transfer fails because the option module does not respond correctly a *Card Slot* trip is initiated where the sub-trip number is 1 (i.e. the option module slot number). Transfer to and from other option slots are initiated with other codes in *Parameter mm.000* (mm.000) as defined previously.

Parameter	11.001 *Option Synchronisation Select*		
Short description	Option Synchronisation Select		
Mode	RFC-S		
Minimum	0	Maximum	5
Default	4	Units	
Type	8 Bit User Save	Update Rate	Background Read
Display Format	Standard	Decimal Places	0
Coding	RW, TE		

Value	Text
0	Not Active
1	Slot 1
2	Slot 2
3	Slot 3
4	Slot 4
5	Automatic

Option Synchronisation Select (11.001) is used to select and enable timing synchronisation between the communications system associated with an option module fitted to the drive and the drive control system. If "Not Active" is selected then the drive control system operates using it's own processor crystal for control sample timing. If one of the option modules is selected and is making a request to provide synchronisation then the drive control sample timing will be synchronised to the communication system. *Option synchronisation Active* (11.002) shows the synchronisation source, where "Not Active" indicates that the drive is providing the timing for the control system. Any other value indicates if an option module is providing synchronisation. If required the synchronisation source can be selected automatically by setting *Option Synchronisation Select* (11.001) to "Automatic". In this case the option module in the lowest numbered slot that is making a request to provide synchronisation will be selected.

Parameter	11.002 *Option synchronisation Active*		
Short description	Option synchronisation Active		
Mode	RFC‑S		
Minimum	0	Maximum	4
Default		Units	
Type	8 Bit Volatile	Update Rate	Background Write
Display Format	Standard	Decimal Places	0
Coding	RO, TE, ND, NC, PT		

Value	Text
0	Not Active
1	Slot 1
2	Slot 2
3	Slot 3
4	Slot 4

See *Option Synchronisation Select* (11.001).

Parameter	11.018 *Status Mode Parameter 1*		
Short description	Defines the parameter displayed on the upper row of the keypad when in status mode		
Mode	RFC‑S		
Minimum	0.000	Maximum	59.999
Default	0.000	Units	
Type	16 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	3
Coding	RW, PT, BU		

See *Parameter Displayed At Power-up* (11.022).

Parameter	11.019 *Status Mode Parameter 2*		
Short description	Defines the parameter displayed on the lower row of the keypad when in status mode		
Mode	RFC‑S		
Minimum	0.000	Maximum	59.999
Default	0.000	Units	
Type	16 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	3
Coding	RW, PT, BU		

See *Parameter Displayed At Power-up* (11.022).

Parameter	11.021 *Parameter 00.030 Scaling*		
Short description	Defines the scaling for Pr 00.030		
Mode	RFC‑S		
Minimum	0.000	Maximum	10.000
Default	1.000	Units	
Type	16 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	3
Coding	RW		

Parameter 00.030 Scaling (11.021) defines the scaling applied to parameter 00.030 when it is displayed on a basic keypad. The scaling is only applied in the status and view modes. If the parameter is edited via the keypad it reverts to its unscaled value during editing.

Parameter	11.022 *Parameter Displayed At Power-up*		
Short description	Defines which parameter is displayed at power-up		
Mode	RFC‑S		
Minimum	0.000	Maximum	0.080
Default	0.010	Units	
Type	8 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	3
Coding	RW, PT		

If *Status Mode Parameter 1* (11.018) and *Status Mode Parameter 2* (11.019) are set to zero, then *Parameter Displayed At Power-up* (11.022) defines which Menu 0 parameter is initially displayed at power-up. If *Status Mode Parameter 1* (11.018) or *Status Mode Parameter 2* (11.019) are set to valid parameter numbers, then *Parameter Displayed At Power-up* (11.022) defines the active parameter at power-up, i.e. the parameter first displayed when going in to parameter view mode on the keypad. *Status Mode Parameter 1* (11.018) and *Status Mode Parameter 2* (11.019) define the parameter values to be displayed on the upper and lower rows of the keypad repectively, when in status mode. If only one of these parameters is set correctly the other row will display the value of the current active parameter. If both *Status Mode Parameter 1* (11.018) and *Status Mode Parameter 2* (11.019) are set to the same parameter number then the parameter value is displayed as double height characters.

Parameter	11.028 *Drive Derivative*		
Short description	Displays the drive derivative identifier		
Mode	RFC‑S		
Minimum	0	Maximum	255
Default		Units	
Type	8 Bit Volatile	Update Rate	Power-up write
Display Format	Standard	Decimal Places	0
Coding	RO, ND, NC, PT, BU		

Drive Derivative (11.028) shows the derivative identifier.

Parameter	11.029 *Software Version*		
Short description	Displays the software version in the drive		
Mode	RFC‑S		
Minimum	0	Maximum	99999999
Default		Units	
Type	32 Bit Volatile	Update Rate	Power-up write
Display Format	Version	Decimal Places	0
Coding	RO, ND, NC, PT		

Software Version (11.029) displays the drive software version number as a decimal number wwxxyyzz. A keypad will display the value in this parameter as ww.xx.yy.zz.

Parameter	11.030 *User Security Code*		
Short description	Defines the user security code of the drive		
Mode	RFC‑S		
Minimum	0	Maximum	2147483647
Default		Units	
Type	32 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW, ND, NC, PT		

See *User Security Status* (11.044).

Parameter	11.031 *User Drive Mode*		
Short description	Defines the mode of the drive		
Mode	RFC‑S		
Minimum	1	Maximum	4
Default		Units	
Type	8 Bit Volatile	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW, TE, ND, NC, PT		

Value	Text
1	Open-loop
2	RFC-A
3	RFC-S
4	Regen

User Drive Mode (11.031) is set to the current drive mode at power-up. The user can change the drive mode as follows:

1. Set *Parameter mm.000* (mm.000) to 1253, 1254, 1255 or 1256
2. Change *User Drive Mode* (11.031) to the required mode
3. Initiate a drive reset

Provided *Drive Active* (10.002) = 0 the drive will change to the new drive mode, and then load and save parameters to non-volatile memory.
If *Parameter mm.000* (mm.000) is not set to one of the specified values then the drive mode does not change on drive reset. The value in *Parameter mm.000* (mm.000) determines which defaults are loaded as follows.

Parameter mm.000 (mm.000)	Defaults loaded
1253	50Hz defaults to all menus
1254	60Hz defaults to all menus
1255	50Hz defaults to all menus except 15 to 20 and 24 to 28
1256	60Hz defaults to all menus except 15 to 20 and 24 to 28

Parameter	11.032 *Maximum Heavy Duty Rating*		
Short description	Displays the maximum heavy duty current rating of the drive		
Mode	RFC‑S		
Minimum	0.000	Maximum	99999.999
Default		Units	A
Type	32 Bit Volatile	Update Rate	Power-up write
Display Format	Standard	Decimal Places	3
Coding	RO, ND, NC, PT		

Maximum Heavy Duty Rating (11.032) defines the maximum setting for *Rated Current* (05.007) that gives heavy duty operation. If *Maximum Heavy Duty Rating* (11.032) = 0.000 then heavy duty operation is not possible. If *Maximum Heavy Duty Rating* (11.032) = VM_RATED_CURRENT[MAX] then normal duty operation is not possible.

Parameter	11.033 *Drive Rated Voltage*		
Short description	Displays the voltage rating of the drive		
Mode	RFC‑S		
Minimum	0	Maximum	3
Default		Units	
Type	8 Bit Volatile	Update Rate	Power-up write
Display Format	Standard	Decimal Places	0
Coding	RO, TE, ND, NC, PT		

Value	*Text*
0	200V
1	400V
2	575V
3	690V

Drive Rated Voltage (11.033) shows the voltage rating of the drive.

Parameter	11.034 *Software Sub-version*		
Short description	Software Sub-version		
Mode	RFC‑S		
Minimum	0	Maximum	99
Default		Units	
Type	8 Bit Volatile	Update Rate	Power-up Write
Display Format	Standard	Decimal Places	0
Coding	RO, ND, NC, PT		

For legacy applications *Software Sub-version* (11.034) shows the yy part of *Software Version* (11.029).

Parameter	11.035 *Number Of Power Modules Test*		
Short description	Tests the number of power modules within the drive		
Mode	RFC‑S		
Minimum	-1	Maximum	20
Default	-1	Units	
Type	8 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW		

Number Of Power Modules Detected (11.071) shows the number of power modules detected in the drive when communications with the power system is established. The number of modules can be checked and a trip initiated depending on the value of *Number Of Power Modules Test* (11.035) as follows:

Number Of Power Modules Test (11.035)	Test	Trip if test fails
-1	The number of modules detected is compared to the value in *Number Of Power Modules Detected* (11.071) before it is updated with the number of modules present	*Configuration.mmm* where mmm is the value of *Number Of Power Modules Detected* (11.071) before it is updated
0	None	None
>0	The number of modules detected is compared to the value in *Number Of Power Modules Test* (11.035)	*Configuration.mmm* where mmm is the value of *Number Of Power Modules Test* (11.035)

If *Number Of Power Modules Test* (11.035) = -1 a test is being carried out to see if the number of modules detected has changed. *Number Of Power Modules Detected* (11.071) is a user save parameter, and so on power-up the number of modules can be compared with the number last saved when the system last powered up correctly.

If *Number Of Power Modules Test* (11.035) > 0 the expected number of modules are stored in *Number Of Power Modules Test* (11.035), and if the number powering up successfully changes then this can be detected.

The sub-trip number always indicates the expected number of power modules. The actual number detected can always be seen in *Number Of Power Modules Detected* (11.071).

Parameter	11.036 *NV Media Card File Previously Loaded*		
Short description	Displays the number of the last parameter file transferred from an NV Media Card to the drive		
Mode	RFC‑S		
Minimum	0	Maximum	999
Default	0	Units	
Type	16 Bit Volatile	Update Rate	Background write
Display Format	Standard	Decimal Places	0
Coding	RO, NC, PT		

NV Media Card File Previously Loaded (11.036) shows the number of the last parameter file transferred from an NV Media Card to the drive. If defaults are subsequently reloaded *NV Media Card File Previously Loaded* (11.036) is set to 0.

Parameter	11.037 *NV Media Card File Number*		
Short description	Selects a file by its file identification number		
Mode	RFC‑S		
Minimum	0	Maximum	999
Default	0	Units	
Type	16 Bit Volatile	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW		

NV Media Card File Number (11.037) is used to select a file by its file identification number. When *NV Media Card File Number* (11.037) corresponds to the number of a file the following data about the file is shown.

Parameter
NV Media Card File Type (11.038)
NV Media Card File Version (11.039)
NV Media Card File Checksum (11.040)

The actions of erasing a card, erasing a file, creating a new file, changing a Menu 0 parameter or removing a card resets *NV Media Card File Number* (11.037) to 0.

Parameter	11.038 *NV Media Card File Type*		
Short description	Displays the file type of the file selected		
Mode	RFC‑S		
Minimum	0	Maximum	5
Default		Units	
Type	8 Bit Volatile	Update Rate	Background write
Display Format	Standard	Decimal Places	0
Coding	RO, TE, ND, NC, PT		

Value	Text
0	None
1	Open-loop
2	RFC-A
3	RFC-S
4	Regen
5	User Prog

NV Media Card File Type (11.038) shows the file type of the file selected with *NV Media Card File Number* (11.037) as shown in the table below.

NV Media Card File Type (11.038)	File
0	No file selected
1	Open-loop mode parameter file
2	RFC-A mode parameter file
3	RFC-S mode parameter file
4	Regen mode parameter file
5	Onboard user program file

Parameter	11.039 *NV Media Card File Version*		
Short description	Displays the version number stored with the file selected		
Mode	RFC‑S		
Minimum	0	Maximum	9999
Default		Units	
Type	16 Bit Volatile	Update Rate	Background write
Display Format	Standard	Decimal Places	0
Coding	RO, ND, NC, PT		

NV Media Card File Version (11.039) shows the version number stored with the file selected with *NV Media Card File Number* (11.037).

To set a file version number on a NV media card, the number required must be set in *NV Media Card File Required Version* (11.077) and then the data must be written to the NV media card. Failure to do this will result in no version number being displayed when selecting the NV media card file number in *NV Media Card File Number* (11.037).

Parameter	11.040 *NV Media Card File Checksum*		
Short description	Displays the checksum from the file selected		
Mode	RFC‑S		
Minimum	-2147483648	Maximum	2147483647
Default		Units	
Type	32 Bit Volatile	Update Rate	Background write
Display Format	Standard	Decimal Places	0
Coding	RO, ND, NC, PT		

NV Media Card File Checksum (11.040) shows the checksum from the file selected with *NV Media Card File Number* (11.037). If the media file is a Unidrive SP SMARTCARD file, the checksum is the sum of all bytes except the checksum modulo 65536. If the file was generated by a Unidrive M, a value of zero will be displayed.

Parameter	11.042 *Parameter Cloning*		
Short description	Can be used to initiate a data transfer to or from an NV media card		
Mode	RFC‑S		
Minimum	0	Maximum	4
Default	0	Units	
Type	8 Bit User Save	Update Rate	Background write
Display Format	Standard	Decimal Places	0
Coding	RW, TE, NC		

Value	Text
0	None
1	Read
2	Program
3	Auto
4	Boot

* Only a value of 3 or 4 in this parameter is saved.

Parameter Cloning (11.042) can also be used to initiate data transfer to or from an NV media card as described below for each possible value of this parameter.

1: Read
Provided a parameter file with file identification number 1 exists on the NV media card then setting *Parameter Cloning* (11.042) = 1 and initiating a drive reset will transfer the parameter data to the drive (i.e. the same action as writing 6001 to *Parameter mm.000* (mm.000)). When the action is complete *Parameter Cloning* (11.042) is automatically reset to zero.

2: Program
Setting *Parameter Cloning* (11.042) = 2 and initiating a drive reset will transfer the parameter data from the drive to a parameter file with file identification number 1. This is the same action as writing 4001 to *Parameter mm.000* (mm.000) except that the file will be overwritten if it already exists. When the action is complete *Parameter Cloning* (11.042) is automatically reset to zero.

3: Auto
Setting *Parameter Cloning* (11.042) = 3 and initiating a drive reset will transfer the parameter data from the drive to a parameter file with file identification number 1. This is the same action as writing 4001 to *Parameter mm.000* (mm.000) except that the file will be overwritten if it already exists. When the action is complete *Parameter Cloning* (11.042) remains at 3. It should be noted that if the drive is to remain in Auto mode after power-down and subsequent power-up a parameter save is required, unless *Parameter Cloning* (11.042) is being accessed from Menu 0, in which case it will be saved automatically.

If the card is removed when *Parameter Cloning* (11.042) = 3, then Parameter *Parameter Cloning* (11.042) is set to 0, which forces the user to change *Parameter Cloning* (11.042) back to 3 if auto mode is still required. The user will need to set *Parameter Cloning* (11.042) = 3 and initiate a drive reset to write the complete parameter set to the new card.

When a parameter in Menu zero is changed via the keypad and *Parameter Cloning* (11.042) = 3 the parameter is saved both to the drive non-volatile memory and to the parameter file with identification number 1 on the card. Only the new value of the modified parameter, and not the value of all the other drive parameters, is stored each time. If the drive did not automatically clear *Parameter Cloning* (11.042) when a card is removed, then when a new card is inserted that contains a parameter file with identification number 1 the modified parameter would be written to the existing file on the new card and the rest of the parameters in this file may not be the same as those in the drive.

When *Parameter Cloning* (11.042) = 3 and the drive parameters are saved to non-volatile memory, the file on the card is also updated, therefore this file becomes a copy of the drive parameters. At power up, if *Parameter Cloning* (11.042) = 3, the drive will save its complete parameter set to the card. This is done to ensure that if a card is inserted whilst the drive is powered down the new card will have the correct data after the drive is powered up again.

4: Boot
When *Parameter Cloning* (11.042) = 4 the drive operates in a similar way to *Parameter Cloning* (11.042) = 3 and automatically creates a copy of its parameters on the NV Media card. The NC (not clonable) attribute for *Parameter Cloning* (11.042) is 1, and so it does not have a value stored in the parameter file on the card in the normal way. However, the value of *Parameter Cloning* (11.042) is held in the parameter file header. If *Parameter Cloning* (11.042) = 4 in the parameter file with a file identification value of 1 on an NV media card fitted to a drive at power-up then the parameters from the parameter file with file identification number 1 are transferred to the drive and then saved in non-volatile memory. *Parameter Cloning* (11.042) is then set to 0 after the data transfer is complete.

It is possible to create a bootable parameter file by setting *Parameter mm.000* (mm.000) = 2001 and initiating a drive reset. This file is created in one operation and is not updated when further parameter changes are made.

When the drive is powered up it detects which option modules are fitted before loading parameters from an NV media card which has been set up for boot mode. If a new option module has been fitted since the last time the drive was powered up, a *Slot1 Different* trip is initiated and then the parameters are transferred from the card. If the parameter file includes the parameters for the newly fitted option module then these are also transferred to the drive and the *Slot1 Different* trip is reset. If the parameter file does not include the parameters for the newly fitted option module then the drive does not reset the *Slot1 Different* trip. Once the transfer is complete the drive parameters are saved to non-volatile memory. The trip can be reset either by initiating a drive reset or by powering down and then powering up again.

Parameter	11.043 *Load Defaults*		
Short description	Defines which defaults are to be loaded into the drive		
Mode	RFC‑S		
Minimum	0	Maximum	2
Default	0	Units	
Type	8 Bit Volatile	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW, TE, NC		

Value	Text
0	None
1	Standard
2	US

If *Load Defaults* (11.043) is non-zero and a drive reset is initiated then the drive will load and save default parameters. If *Load Defaults* (11.043) = 1 then 50Hz defaults are loaded and if *Load Defaults* (11.043) = 2 then 60Hz defaults are loaded. This parameter has priority over actions defined by *Parameter mm.000* (mm.000) and *Parameter Cloning* (11.042). If *Load Defaults* (11.043) is used to initiate loading defaults the it is cleared along with *Parameter mm.000* (mm.000) and *Parameter Cloning* (11.042) when the action is completed.

Parameter	11.044 *User Security Status*		
Short description	defines the security level within the drive		
Mode	RFC‑S		
Minimum	0	Maximum	5
Default		Units	
Type	8 Bit Volatile	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW, TE, ND, PT		

Value	Text
0	Menu 0
1	All Menus
2	Read-only Menu 0
3	Read-only
4	Status Only
5	No Access

Security

The drive provides a number of different levels of security that can be set by the user via *User Security Status* (11.044); these are shown in the table below.

Security Level	Description	User Security Status (11.044)
Menu 0	All writable parameters are available to be edited but only parameters in Menu 0 are visible.	0
All menus	All writable parameters are visible and available to be edited.	1
Read-only Menu 0	All parameters are read-only. Access is limited to Menu 0 parameters only.	2
Read-only	All parameters are read-only however all menus and parameters are visible.	3
Status only	The keypad remains in status mode and no parameters can be viewed or edited	4
No access	The keypad remains in status mode and no parameters can be viewed or edited. Drive parameters cannot be accessed via a comms/fieldbus interface in the drive or any option module.	5

When security has been set up the drive can either be in the locked or unlocked state. In the locked state the security level that has been set up applies. In the unlocked state the security is not active, but when the drive is powered down and powered up again the drive will be in the locked state. The drive may be relocked without powering down by selecting the required security level with the *User Security Status* (11.044) and initiating a drive reset.

Security can be set up as follows:

1. The *User Security Code* (11.030) should be set to the desired security unlock code (not zero). For security to remain set after power down then a parameter save should be performed to retain the set value.
2. If no further action is taken when the drive is powered down and then powered up read-only security will be set up and locked.
3. If at any time the *User Security Status* (11.044) is set to a value corresponding the one of the security levels shown in the table above and a drive reset is performed the security level is changed to that level. The desired security level is automatically saved and retained after power down, the keypad state changes to status mode and security is locked. (The security level that is active, provided *User Security Code* (11.030) has been saved as a non-zero value, if shown in *Security Status* (11.085).)

When security is set up and locked:

1. Parameter access is restricted as shown in the table above.
2. *User Security Code* (11.030) reads as zero except in parameter edit mode. Therefore it is not possible to read the value of the security code when any level of security is active and locked.

Security can be unlocked as follows:

1. If read-only security is set and locked then any attempt to edit any read/write parameter causes "Security code" to be displayed on the first row of the display. When the Up or Down keys are pressed the second row shows the code being adjusted. On setting the code the user presses the Enter key. If the correct code has been entered then the drive switches to Parameter edit mode on the parameter the user selected to edit, but if the correct code has not been entered the notification "Incorrect security code" is displayed for 2s and the drive returns to Parameter view mode.
2. If Status only or No access security is set and locked then any attempt to leave status mode causes the security code to be requested as per the process described above. If the security code entered must be correct for the keypad state machine to switch to the Parameter view mode. It is then possible to access all parameters normally.

Security can be cleared as follows:

1. Security must be unlocked.
2. The *User Security Code* (11.030) should be set to zero. For security to remain cleared after power down then a parameter save should be performed.

At any time *Security Status* (11.085) can be changed between 0 and 1 to restrict access to Menu 0 alone or to all menus. If the change is made by a keypad the new value becomes active on leaving parameter edit mode.

It should be that *Security Status* (11.085) is a volatile parameter and that the actual state of the security system is stored in *Security Status* (11.085) and *Menu Access Status* (11.086), which are both power-down save parameters. Therefore the security status will be stored when the drive goes into the under-voltage state. If the drive is already in the under-voltage state the security state should be saved by writing 1001 to *Parameter mm.000* (mm.000) and initiating a reset.

Parameter	11.045 *Select Motor 2 Parameters*		
Short description	Set to 1 to select motor 2 parameters		
Mode	RFC-S		
Minimum	0	Maximum	1
Default	0	Units	
Type	8 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW, TE		

Value	Text
0	Motor 1
1	Motor 2

Select Motor 2 Parameters (11.045) is used to select the motor map 2 parameters from Menu 21 to be substituted for the standard motor parameters. If *Select Motor 2 Parameters* (11.045) is modified when *Drive Active* (10.002) = 1 the change only becomes effective when *Drive Active* (10.002) = 0. When *Select Motor 2 Parameters* (11.045) = 1 the results from auto-tuning are written to the motor map 2 parameters in Menu 21 instead of to the standard parameters. Each time *Select Motor 2 Parameters* (11.045) is changed *Motor Protection Accumulator* (04.019) is reset to zero. *Select Motor 2 Parameters* (11.045) operates in the same way in Regen mode, but *Inductor Protection Accumulator* (04.019) is reset to zero each time the value is changed. *Motor 2 Active* (21.015) shows the motor map that is active.

Parameter	11.046 *Defaults Previously Loaded*		
Short description	Displays the defaults previously loaded in the drive		
Mode	RFC‑S		
Minimum	0	Maximum	2000
Default		Units	
Type	16 Bit User Save	Update Rate	Background write
Display Format	Standard	Decimal Places	0
Coding	RO, ND, NC, PT		

Defaults Previously Loaded (11.046) shows the value used to load the previously loaded defaults (i.e. 1233 for 50Hz defaults, or 1244 for 60Hz defaults).

Parameter	11.047 *Onboard User Program: Enable*		
Short description	Enables the onboard user program		
Mode	RFC‑S		
Minimum	-1	Maximum	1
Default	1	Units	
Type	8 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW, TE		

Value	Text
-1	Reset And Run
0	Stop
1	Run

Onboard user programming provided a background task that loops continuously and a timed task that is executed each time at a defined rate.
Onboard User Program: Enable (11.047) allows the onboard user program to be controlled as follows:.

-1: Reset And Run
The onboard user program will run. If *Onboard User Program: Enable* (11.047) is changed from 0 (Stop) to -1 (Reset And Run) all variables will be reset to their initial values and the user program will run from the start.

0: Stop
The onboard user program is stopped.

1: Run
The onboard user program will run. If *Onboard User Program: Enable* (11.047) is changed from 0 (Stop) to 1 (Run) all variables will be unchanged and the user program will run from the start.

The effect of the above is as follows:

- If the drive powers up with *Onboard User Program: Enable* (11.047) set to either 1 or -1 then all variables will be reset to their initial values before the user program starts.
- If the drive powers up with *Onboard User Program: Enable* (11.047) set to 0, and then *Onboard User Program: Enable* (11.047) is changed to either 1 or -1 then all variables will be reset to their initial values before the user program starts.
- If *Onboard User Program: Enable* (11.047) is set to 0 and then to -1 then all variables will be reset to their initial values before the user program starts.
- If *Onboard User Program: Enable* (11.047) is set to 0 and then to 1 then all variables will be left at their previous values before the user program starts.

Parameter	11.048 *Onboard User Program: Status*		
Short description	Displays the status of the onboard user program		
Mode	RFC‑S		
Minimum	-2147483648	Maximum	2147483647
Default		Units	
Type	32 Bit Volatile	Update Rate	Background write
Display Format	Standard	Decimal Places	0
Coding	RO, ND, NC, PT		

Onboard User Program: Status (11.048) shows the status of the onboard user program.

Value	Description
0	A user program is present but is stopped
1	The user program is running
2	The user program has an exception
3	No user program is present

Parameter	11.049 *Onboard User Program: Programming Events*		
Short description	Displays the number of programming events of the onboard user program		
Mode	RFC‑S		
Minimum	0	Maximum	65535
Default		Units	
Type	16 Bit Volatile	Update Rate	Background write
Display Format	Standard	Decimal Places	0
Coding	RO, ND, NC, PT, BU		

Onboard User Program: Programming Events (11.049) = 0 when the drive is manufactured and is incremented each time an onboard user program image is written to the drive. If an onboard user program image is written more than 65535 times *Onboard User Program: Programming Events* (11.049) = 65535. *Onboard User Program: Programming Events* (11.049) shows how many times the flash memory within the drive has been reprogrammed.

Parameter	11.050 *Onboard User Program: FreewheelingTasks Per Second*		
Short description	Displays the rate of freewheeling tasks of the onboard user program		
Mode	RFC‑S		
Minimum	0	Maximum	65535
Default		Units	
Type	16 Bit Volatile	Update Rate	Background write
Display Format	Standard	Decimal Places	0
Coding	RO, ND, NC, PT, BU		

During each scan in a freewheeling task it is possible to give an indication to the drive that the scan loop is starting. If this indication is given then *Onboard User Program: FreewheelingTasks Per Second* (11.050) will give the number of times this indication is given per second.

Parameter	11.051 *Onboard User Program: Clock Task Time Used*		
Short description	Displays the percentage of the available time used by the onboard user program clock task		
Mode	RFC‑S		
Minimum	0.0	Maximum	100.0
Default		Units	%
Type	16 Bit Volatile	Update Rate	Background write
Display Format	Standard	Decimal Places	1
Coding	RO, ND, NC, PT		

Onboard User Program: Clock Task Time Used (11.051) shows the percentage of the available time used by the onboard user program clock task.

Parameter	11.052 *Serial Number LS*		
Short description	Shows the least significant 9 decimal digits of the drive serial number		
Mode	RFC‑S		
Minimum	0 (Display: 000000000)	Maximum	999999999 (Display: 999999999)
Default		Units	
Type	32 Bit Volatile	Update Rate	Power-up write
Display Format	Lead Zero Pad	Decimal Places	0
Coding	RO, ND, NC, PT		

The drive serial number is available as a pair of 32 bit values where *Serial Number LS* (11.052) provides the least significant 9 decimal digits and *Serial Number MS* (11.053) provides the most significant 9 decimal digits. The reconstructed serial number is ((11.053 * 1000000000) + 11.052).

Example 1
Serial number "1234567898765" would be stored as 11.053 = 1234, 11.052 = 567898765.

Example 2
Serial number "1234000056789" would be stored as 11.053 = 1234, 11.052 = 56789. *Serial Number LS* (11.052) will be shown on the keypad as 000056789 (i.e. including the leading zeros).

Parameter	11.053 *Serial Number MS*		
Short description	Shows the most significant 9 decimal digits of the drive serial number		
Mode	RFC‑S		
Minimum	0	Maximum	999999999
Default		Units	
Type	32 Bit Volatile	Update Rate	Power-up write
Display Format	Standard	Decimal Places	0
Coding	RO, ND, NC, PT		

See *Serial Number LS* (11.052).

Parameter	11.054 *Drive Date Code*		
Short description	Shows the drive date code		
Mode	RFC‑S		
Minimum	0	Maximum	65535
Default		Units	
Type	16 Bit Volatile	Update Rate	Background write
Display Format	Standard	Decimal Places	0
Coding	RO, ND, NC, PT, BU		

Drive Date Code (11.054) is a four-digit number in the form yyww where yy is the year and ww the week number.

Parameter	11.055 *Onboard User Program: Clock Task Scheduled Interval*		
Short description	Displays the interval at which the clock task is scheduled in ms		
Mode	RFC‑S		
Minimum	0	Maximum	262140
Default		Units	ms
Type	32 Bit Volatile	Update Rate	Background write
Display Format	Standard	Decimal Places	0
Coding	RO, ND, NC, PT		

Onboard User Program: Clock Task Scheduled Interval (11.055) shows the interval at which the clock task is scheduled to run at in ms.

Parameter	11.056 *Option Slot Identifiers*		
Short description	Defines the order that option slots are used by the drive		
Mode	RFC‑S		
Minimum	0	Maximum	23
Default	0	Units	
Type	8 Bit Volatile	Update Rate	Power-up and drive reset read
Display Format	Standard	Decimal Places	0
Coding	RW, TE, PT		

Value	*Text*
0	1234
1	1243
2	1324
3	1342
4	1423
5	1432
6	4123
7	3124
8	4132
9	2134
10	3142
11	2143
12	3412
13	4312
14	2413
15	4213
16	2314
17	3214
18	2341
19	2431
20	3241
21	3421
22	4231
23	4321

If *Option Slot Identifiers* (11.056) is set to its default value of 0 each option module is assigned the same slot number as its physical slot. For example the module in physical slot 1 appears in slot 1 to all drive and option module software systems (i.e. it uses Menu 15 as its set-up menu and Menu 25 as its application menu etc.). This arrangement can be changed by selecting a different value for *Option Slot Identifiers* (11.056). Although *Option Slot Identifiers* (11.056) is a volatile parameter its value is saved in non-volatile memory when parameters are saved. If *Option Slot Identifiers* (11.056) is changed the drive must be powered down and then powered up again for the change to take effect.

Parameter	11.060 *Maximum Rated Current*		
Short description	Displays the maximum rated current or normal duty rating of the drive		
Mode	RFC‑S		
Minimum	0.000	Maximum	99999.999
Default		Units	A
Type	32 Bit Volatile	Update Rate	Power-up write
Display Format	Standard	Decimal Places	3
Coding	RO, ND, NC, PT		

Maximum Rated Current (11.060) defines the variable maximum VM_RATED_CURRENT[MAX] which defines the maximum *Rated Current* (05.007).
Therefore *Maximum Rated Current* (11.060) is the maximum rated current for normal duty operation (if normal duty operation is allowed).

Parameter	11.061 *Full Scale Current Kc*		
Short description	Displays the full scale current Kc		
Mode	RFC‑S		
Minimum	0.000	Maximum	99999.999
Default		Units	A
Type	32 Bit Volatile	Update Rate	Power-up write
Display Format	Standard	Decimal Places	3
Coding	RO, ND, NC, PT		

Full Scale Current Kc (11.061) shows the full scale current in r.m.s. Amps. If the drive current exceeds this level it will cause an over current trip.

Parameter	11.062 *Power Board Software Version Number*		
Short description	Power Board Software Version Number		
Mode	RFC‑S		
Minimum	0.00	Maximum	99.99
Default		Units	
Type	16 Bit Volatile	Update Rate	Background Write
Display Format	Standard	Decimal Places	2
Coding	RO, ND, NC, PT		

Power Board Software Version Number (11.062) gives the version for the power board connected to the control board or the power board in node 1 of a multi-power module drive.

Parameter	11.063 *Product Type*		
Short description	Displays the core product type		
Mode	RFC‑S		
Minimum	0	Maximum	255
Default		Units	
Type	8 Bit Volatile	Update Rate	Power-up write
Display Format	Standard	Decimal Places	0
Coding	RO, ND, NC, PT, BU		

Product Type (11.063) shows the core product type as given in the table below. The drive could be the basic product or a derivative of the basic product as defined by *Drive Derivative* (11.028).

Product Type (11.063)	Core product range
0	Unidrive M

Parameter	11.064 *Product Identifier Characters*		
Short description	Displays the product identifier characters		
Mode	RFC‑S		
Minimum	1295462448	Maximum	2147483647
Default		Units	
Type	32 Bit Volatile	Update Rate	Power-up write
Display Format	String	Decimal Places	0
Coding	RO, ND, NC, PT		

The drive model and rating can be identified as AAAA B nnnnnnnn CCCC DD EE FFF where each section of the model identifier is taken from a parameter. AAAA, B, CCCC, DDDD, EE and FFF are alpha-numeric characters. nnnnnnnn are decimal digits.

Section of Identifier	Parameter
AAAA	*Product Identifier Characters* (11.064)
nnnnnnnn	*Drive Rating And Configuration* (11.065)
CCCC	*Additional Identifier Characters 1* (11.091)
DDEE	*Additional Identifier Characters 2* (11.092)
FFFB	*Additional Identifier Characters 3* (11.093)

Drive Rating And Configuration (11.065) is split into a number of fields as defined in the table below.

Digits	Meaning
7 and 6	Frame size
5	Voltage code (2 = 200V, 4 = 400V, 5 = 575V, 6 = 690V)
4 and 0	Current rating multiplied by 10. If the drive has a heavy and normal duty rating (i.e. *Maximum Heavy Duty Rating* (11.032) > 0 and *Maximum Rated Current* (11.060) > *Maximum Heavy Duty Rating* (11.032)), or the drive only has a heavy duty rating (i.e. *Maximum Heavy Duty Rating* (11.032) = *Maximum Rated Current* (11.060)), then the current rating is derived from *Maximum Heavy Duty Rating* (11.032). Otherwise if the drive only has a normal duty rating (i.e. *Maximum Heavy Duty Rating* (11.032) = 0) then the current rating is derived from *Maximum Rated Current* (11.060).

Example

The model number M700-03400078 A001 00 AB100 would be displayed in parameters as follows

Parameter	Value
Product Identifier Characters (11.064)	M700
Drive Rating And Configuration (11.065)	03400078
Additional Identifier Characters 1 (11.091)	A001
Additional Identifier Characters 2 (11.092)	00AB
Additional Identifier Characters 3 (11.093)	100-

Parameter	11.065 *Drive Rating And Configuration*		
Short description	Displays the drive rating and configuration		
Mode	RFC‑S		
Minimum	0 (Display: 00000000)	Maximum	99999999 (Display: 99999999)
Default		Units	
Type	32 Bit Volatile	Update Rate	Power-up write
Display Format	Lead Zero Pad	Decimal Places	0
Coding	RO, ND, NC, PT		

See *Product Identifier Characters* (11.064).

Parameter	11.066 *Power Stage Identifier*		
Short description	Displays the power stage identifiers within the drive		
Mode	RFC‑S		
Minimum	0	Maximum	255
Default		Units	
Type	8 Bit Volatile	Update Rate	Power-up write
Display Format	Standard	Decimal Places	0
Coding	RO, ND, NC, PT, BU		

Power Stage Identifier (11.066) is used to show power stages that require changes to the drive user parameters (i.e. visibility, range or defaults). It should be noted that this parameter does not identify the rating of the power stage.

Power Stage Identifier (11.066)	Power Stage
0	Standard Unidrive M
1	Unidrive M with no braking IGBT
2	Servo drive

Parameter	11.067 *Control Board Identifier*		
Short description	Displays the control board identifiers within the drive		
Mode	RFC‑S		
Minimum	0.000	Maximum	65.535
Default		Units	
Type	16 Bit Volatile	Update Rate	Power-up write
Display Format	Standard	Decimal Places	3
Coding	RO, ND, NC, PT, BU		

Control Board Identifier (11.067) identifies the control board hardware in the form A.BBB. BBB is the hardware identifier from the control board and A indicates whether this is a standard or high speed product as given in the table below.

A	BBB	Control Board
0	002 or 003	Unidrive M - Standard
1	002 or 003	Unidrive M - High Speed
0	004	Servo

Parameter	11.068 *Internal I/O Identifier*		
Short description	Displays the internal I/O identifiers within the drive		
Mode	RFC‑S		
Minimum	0	Maximum	255
Default		Units	
Type	8 Bit Volatile	Update Rate	Power-up write
Display Format	Standard	Decimal Places	0
Coding	RO, ND, NC, PT, BU		

Internal I/O Identifier (11.068) identifies the internally fitted I/O option as given in the table below.

Internal I/O Identifier **(11.068)**	Internal I/O
0	Analog and digital I/O
1	Digtial only I/O
2	Analogue and digital I/O with additional relay
3	Servo drive I/O

The tables below show which I/O functions are available for each of the internally fitted I/O options.

AI/O	0	1	2	3
Analogue Input 1	All except Disable		All except Disable	Voltage
Analogue Input 2	All except Disable		All except Disable	
Analogue Input 3	Voltage, Thermistor	Thermistor, Disable	Voltage	
Analogue Output 1	Voltage		All	
Analogue Output 2	Voltage		All	

DI/O	Function	0	1	2	3
1	Input/Output	Input/Output	Output	Input/Output	Output
2	Input/Output	Input/Output	Output	Input/Output	Output
3	Input/Output	Input/Output		Input/Output	
4	Input	Input	Input	Input	Input
5	Input	Input	Input	Input	Input
6	Input	Input		Input	
7	Relay Output	Output	Output	Output	
8	24V Supply Output	Output	Output	Output	Output
9	Safe Torque Off 1	Input	Input	Input	Input
10	Safe Torque Off 2	Input[1]	Input	Input[1]	Input
11	Keypad Run Button	Input	Input	Input	
12	Keypad Auxiliary Button	Input	Input	Input	
13	24V Supply Input	Input	Input	Input	
14	Keypad Stop Button	Input	Input	Input	
15	Relay 2 Output			Output	
16	Reset button				Input

1 Only one hardware input is provided which is shared by STO1 and STO2.

Parameter	11.069 *Position Feedback Interface Identifier*		
Short description	Displays the position feedback interface identifier within the drive		
Mode	RFC‑S		
Minimum	0	Maximum	255
Default		Units	
Type	8 Bit Volatile	Update Rate	Power-up write
Display Format	Standard	Decimal Places	0
Coding	RO, ND, NC, PT, BU		

Position Feedback Interface Identifier (11.069) identifies the type of interface fitted in the position feedback interface option location as given in the table below.

Position Feedback Interface Identifier (11.069)	Position feedback interface
0	Standard Position Feedback
1	None
2	User Comms Module

Parameter	11.070 _Core Parameter Database Version_		
Short description	Displays the core parameter database version within the drive		
Mode	RFC‑S		
Minimum	0.00	Maximum	99.99
Default		Units	
Type	16 Bit Volatile	Update Rate	Power-up write
Display Format	Standard	Decimal Places	2
Coding	RO, ND, NC, PT		

Core Parameter Database Version (11.070) gives the version number of the parameter database used to define the core parameter menus in the drive (Menu 1 to 14 and 21 to 23) in 2 digit BCD format. All other menus are customisable and if these menus are changed their default values are automatically loaded. However, if the drive software is changed it may be necessary to load defaults for all menus, although this will only be required rarely. Defaults for all menus are loaded when the most significant digit of _Core Parameter Database Version_ (11.070) changes. Therefore if the drive firmware is modified and the most significant digit of the core database version has changed an _EEPROM Fail.001_ trip is initiated and default parameters are loaded.

Parameter	11.071 _Number Of Power Modules Detected_		
Short description	Displays the number of power modules detected in the drive		
Mode	RFC‑S		
Minimum	0	Maximum	20
Default		Units	
Type	8 Bit User Save	Update Rate	Write on power system detection
Display Format	Standard	Decimal Places	0
Coding	RO, ND, NC, PT		

Number Of Power Modules Detected (11.071) shows the number of power modules detected in a drive. See _Number Of Power Modules Test_ (11.035) for details.

Parameter	11.072 _NV Media Card Create Special File_		
Short description	Defines if a parameter file is created as a macro file during transfer		
Mode	RFC‑S		
Minimum	0	Maximum	1
Default	0	Units	
Type	8 Bit Volatile	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW, NC		

If _NV Media Card Create Special File_ (11.072) = 1 when a parameter file is transferred to an NV media card the file is created as a macro file. _NV Media Card Create Special File_ (11.072) is reset to 0 after the file is created or the transfer fails.

Parameter	11.073 _NV Media Card Type_		
Short description	Displays the type of the currently fitted NV media card		
Mode	RFC‑S		
Minimum	0	Maximum	2
Default		Units	
Type	8 Bit Volatile	Update Rate	Background write
Display Format	Standard	Decimal Places	0
Coding	RO, TE, ND, NC, PT		

Value	_Text_	_Description_
0	None	No media card has been inserted
1	SMART Card	A SMART Card has been inserted
2	SD Card	A FAT formatted SD card has been inserted

NV Media Card File Type (11.038) shows the type of non-volatile media card inserted in the drive.

Parameter	11.075 _NV Media Card Read-only Flag_		
Short description	Displays the state of the read-only flag for the currently fitted card		
Mode	RFC‑S		
Minimum	0	Maximum	1
Default		Units	
Type	1 Bit Volatile	Update Rate	Background write
Display Format	Standard	Decimal Places	0
Coding	RO, ND, NC, PT		

NV Media Card Read-only Flag (11.075) shows the state of the read-only flag for the currently fitted card.

Parameter	11.076 *NV Media Card Warning Suppression Flag*		
Short description	Displays the state of the warning flag for the currently fitted card		
Mode	RFC‑S		
Minimum	0	Maximum	1
Default		Units	
Type	1 Bit Volatile	Update Rate	Background write
Display Format	Standard	Decimal Places	0
Coding	RO, ND, NC, PT		

NV Media Card Warning Suppression Flag (11.076) shows the state of the warning flag for the currently fitted card.

Parameter	11.077 *NV Media Card File Required Version*		
Short description	Displays the version number for a file when it is created on an NV media card		
Mode	RFC‑S		
Minimum	0	Maximum	9999
Default		Units	
Type	16 Bit Volatile	Update Rate	Background write
Display Format	Standard	Decimal Places	0
Coding	RW, ND, NC, PT		

The value of *NV Media Card File Required Version* (11.077) is used as the version number for a file when it is created on an NV media card.
NV Media Card File Required Version (11.077) is reset to 0 when the file is created or the transfer fails.

Parameter	11.079 *Drive Name Characters 1-4*		
Short description	Defines characters 1-4 of a string which can be used to identify the drive		
Mode	RFC‑S		
Minimum	-2147483648	Maximum	2147483647
Default	0	Units	
Type	32 Bit User Save	Update Rate	N/A
Display Format	String	Decimal Places	0
Coding	RW, PT		

Drive Name Characters 1-4 (11.079) to *Drive Name Characters 13-16* (11.082) can be used to store a 16 character string which can be used to identify the drive. The string is arranged as shown below.

This uses the standard ASCII character set.

Parameter	11.080 *Drive Name Characters 5-8*		
Short description	Defines characters 5-8 of a string which can be used to identify the drive		
Mode	RFC‑S		
Minimum	-2147483648	Maximum	2147483647
Default	0	Units	
Type	32 Bit User Save	Update Rate	N/A
Display Format	String	Decimal Places	0
Coding	RW, PT		

See *Drive Name Characters 1-4* (11.079).

Parameter	11.081 *Drive Name Characters 9-12*		
Short description	Defines characters 9-12 of a string which can be used to identify the drive		
Mode	RFC‑S		
Minimum	-2147483648	Maximum	2147483647
Default	0	Units	
Type	32 Bit User Save	Update Rate	N/A
Display Format	String	Decimal Places	0
Coding	RW, PT		

See *Drive Name Characters 1-4* (11.079).

Parameter	11.082 *Drive Name Characters 13-16*		
Short description	Defines characters 13-16 of a string which can be used to identify the drive		
Mode	RFC‑S		
Minimum	-2147483648	Maximum	2147483647
Default	0	Units	
Type	32 Bit User Save	Update Rate	N/A
Display Format	String	Decimal Places	0
Coding	RW, PT		

See *Drive Name Characters 1-4* (11.079).

Parameter	11.084 *Drive Mode*		
Short description	Defines and displays the current drive mode		
Mode	RFC‑S		
Minimum	1	Maximum	4
Default		Units	
Type	8 Bit User Save	Update Rate	Background read/write
Display Format	Standard	Decimal Places	0
Coding	RO, TE, ND, NC, PT		

Value	*Text*
1	Open-loop
2	RFC-A
3	RFC-S
4	Regen

Drive Mode (11.084) is used to hold the currently active drive mode.

Parameter	11.085 *Security Status*		
Short description	Displays the security status within the drive		
Mode	RFC‑S		
Minimum	0	Maximum	3
Default		Units	
Type	8 Bit Power Down Save	Update Rate	Background write
Display Format	Standard	Decimal Places	0
Coding	RO, TE, ND, NC, PT		

Value	*Text*
0	None
1	Read-only
2	Status-only
3	No Access

Security Status (11.085) shows the security that will apply when security is enabled by setting a non-zero value for *User Security Code* (11.030).

Parameter	11.086 *Menu Access Status*		
Short description	Displays the amount of access of the menus within the drive		
Mode	RFC‑S		
Minimum	0	Maximum	1
Default		Units	
Type	8 Bit Power Down Save	Update Rate	Background write
Display Format	Standard	Decimal Places	0
Coding	RO, TE, ND, NC, PT		

Value	*Text*
0	Menu 0
1	All Menus

If *Menu Access Status* (11.086) = 0 then only Menu 0 can be accessed with a keypad. If *Menu Access Status* (11.086) = 1 then all menus can be accessed with a keypad.

Parameter	11.090 *Keypad Port Serial Address*		
Short description	Defines the node address for the keypad port serial comms interface		
Mode	RFC‑S		
Minimum	1	Maximum	16
Default	1	Units	
Type	8 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW		

Keypad Port Serial Address (11.090) defines the node address for the keypad port serial comms interface. Normally the default value of 1 is used, but this can be changed if required. The keypad attached to the port will sense the address automatically.

Parameter	11.091 *Additional Identifier Characters 1*		
Short description	Displays the additional identifier characters		
Mode	RFC‑S		
Minimum	-2147483648	Maximum	2147483647
Default		Units	
Type	32 Bit Volatile	Update Rate	Power-up write
Display Format	String	Decimal Places	0
Coding	RO, ND, NC, PT		

See *Product Identifier Characters* (11.064).

Parameter	11.092 *Additional Identifier Characters 2*		
Short description	Displays the additional identifier characters		
Mode	RFC‑S		
Minimum	-2147483648	Maximum	2147483647
Default		Units	
Type	32 Bit Volatile	Update Rate	Power-up write
Display Format	String	Decimal Places	0
Coding	RO, ND, NC, PT		

See *Product Identifier Characters* (11.064).

Parameter	11.093 *Additional Identifier Characters 3*		
Short description	Displays the additional identifier characters		
Mode	RFC‑S		
Minimum	-2147483648	Maximum	2147483647
Default		Units	
Type	32 Bit Volatile	Update Rate	Power-up write
Display Format	String	Decimal Places	0
Coding	RO, ND, NC, PT		

See *Product Identifier Characters* (11.064).

Parameter	11.095 *Number Of Rectifiers Detected*		
Short description	Number Of Rectifiers Detected		
Mode	RFC‑S		
Minimum	0	Maximum	9
Default		Units	
Type	8 Bit Volatile	Update Rate	Background Write
Display Format	Standard	Decimal Places	0
Coding	RO, ND, NC, PT		

Indicates how many controlled rectifiers connected to the drive have been detected. See *Number Of Rectifiers Expected* (11.096).

Parameter	11.096 *Number Of Rectifiers Expected*		
Short description	Number of rectifiers expected on each power stage		
Mode	RFC‑S		
Minimum	0	Maximum	9
Default	0	Units	
Type	8 Bit User Save	Update Rate	Background Read
Display Format	Standard	Decimal Places	0
Coding	RW		

Number Of Rectifiers Expected (11.096) defines how many controlled rectifiers are expected on each power module. Within a complete drive with a diode input stage there are no controlled rectifiers. Within a complete drive with a controlled rectifier input stage there is one controlled rectifier. For a drive where external rectifiers are used the system can register up to nine controlled rectifiers. If *Number Of Rectifiers Expected* (11.096) = 0 then the rectifier monitoring system is disabled and the drive does not check how many controlled rectifiers are present. This is the default setting and should be used for complete drives with internal rectifiers because the monitoring function is not necessary. If *Number Of Rectifiers Expected* (11.096) is set to a

non-zero value a check is made to ensure that at least this number of external rectifiers are connected to each power module. If there are less external rectifiers than defined by *Number Of Rectifiers Expected* (11.096) then a *Configuration* is initiated with the sub-trip indicating how many rectifers should be present. See *Trip 0* (10.020).

Menu 12 Single Line Descriptions − *User Functions 2 and Brake Control*

Mode: RFC‑S

Parameter		Range	Default	Type					
12.001	Threshold Detector 1 Output	Off (0) or On (1)		RO	Bit	ND	NC	PT	
12.002	Threshold Detector 2 Output	Off (0) or On (1)		RO	Bit	ND	NC	PT	
12.003	Threshold Detector 1 Source	0.000 to 59.999	0.000	RW	Num			PT	US
12.004	Threshold Detector 1 Level	0.00 to 100.00 %	0.00 %	RW	Num				US
12.005	Threshold Detector 1 Hysteresis	0.00 to 25.00 %	0.00 %	RW	Num				US
12.006	Threshold Detector 1 Output Invert	Off (0) or On (1)	Off (0)	RW	Bit				US
12.007	Threshold Detector 1 Destination	0.000 to 59.999	0.000	RW	Num	DE		PT	US
12.008	Variable Selector 1 Source 1	0.000 to 59.999	0.000	RW	Num			PT	US
12.009	Variable Selector 1 Source 2	0.000 to 59.999	0.000	RW	Num			PT	US
12.010	Variable Selector 1 Mode	Input 1 (0), Input 2 (1), Add (2), Subtract (3), Multiply (4), Divide (5), Time Const (6), Ramp (7), Modulus (8), Powers (9), Sectional (10)	Input 1 (0)	RW	Txt				US
12.011	Variable Selector 1 Destination	0.000 to 59.999	0.000	RW	Num	DE		PT	US
12.012	Variable Selector 1 Output	±100.00 %		RO	Num	ND	NC	PT	
12.013	Variable Selector 1 Source 1 Scaling	±4.000	1.000	RW	Num				US
12.014	Variable Selector 1 Source 2 Scaling	±4.000	1.000	RW	Num				US
12.015	Variable Selector 1 Control	0.00 to 100.00	0.00	RW	Num				US
12.016	Variable Selector 1 Enable	Off (0) or On (1)	On (1)	RW	Bit				US
12.023	Threshold Detector 2 Source	0.000 to 59.999	0.000	RW	Num			PT	US
12.024	Threshold Detector 2 Level	0.00 to 100.00 %	0.00 %	RW	Num				US
12.025	Threshold Detector 2 Hysteresis	0.00 to 25.00 %	0.00 %	RW	Num				US
12.026	Threshold Detector 2 Output Invert	Off (0) or On (1)	Off (0)	RW	Bit				US
12.027	Threshold Detector 2 Destination	0.000 to 59.999	0.000	RW	Num	DE		PT	US
12.028	Variable Selector 2 Source 1	0.000 to 59.999	0.000	RW	Num			PT	US
12.029	Variable Selector 2 Source 2	0.000 to 59.999	0.000	RW	Num			PT	US
12.030	Variable Selector 2 Mode	Input 1 (0), Input 2 (1), Add (2), Subtract (3), Multiply (4), Divide (5), Time Const (6), Ramp (7), Modulus (8), Powers (9), Sectional (10)	Input 1 (0)	RW	Txt				US
12.031	Variable Selector 2 Destination	0.000 to 59.999	0.000	RW	Num	DE		PT	US
12.032	Variable Selector 2 Output	±100.00 %		RO	Num	ND	NC	PT	
12.033	Variable Selector 2 Source 1 Scaling	±4.000	1.000	RW	Num				US
12.034	Variable Selector 2 Source 2 Scaling	±4.000	1.000	RW	Num				US
12.035	Variable Selector 2 Control	0.00 to 100.00	0.00	RW	Num				US
12.036	Variable Selector 2 Enable	Off (0) or On (1)	On (1)	RW	Bit				US
12.040	Brake Control: Brake Release	Off (0) or On (1)		RO	Bit	ND	NC	PT	
12.041	Brake Control: Enable	Off (0) or On (1)	Off (0)	RW	Bit				US
12.043	Brake Control: Lower Current Threshold	0 to 200 %	10 %	RW	Num				US
12.045	Brake Control: Brake Apply Speed	0 to 200	5	RW	Num				US
12.046	Brake Control: Brake Delay	0.0 to 25.0 s	1.0 s	RW	Num				US
12.047	Brake Control: Post‑brake Release Delay	0.0 to 25.0 s	1.0 s	RW	Num				US
12.048	Brake Control: Brake Apply Delay	0.0 to 25.0 s	1.0 s	RW	Num				US
12.049	Brake Control: Enable Position Control During Brake Release	Off (0) or On (1)	Off (0)	RW	Bit				US
12.054	External Brake Released Indicator	Off (0) or On (1)	Off (0)	RW	Bit		NC		
12.055	Brake Release Source	Off (0) or On (1)	Off (0)	RW	Bit				US

RW	Read / Write	RO	Read-only	Bit	Bit parameter	Txt	Text string	Date	Date parameter	Time	Time parameter
Chr	Character parameter	Bin	Binary parameter	IP	IP address	Mac	MAC address	Ver	Version number	SMP	Slot, menu, parameter
Num	Number parameter	DE	Destination	ND	No default value	RA	Rating dependent	NC	Non-copyable	PT	Protected
FI	Filtered	US	User save	PS	Power-down save						

Menu 12 − *User Functions 2 and Brake Control*

Mode: RFC‑S

Menu 12 provides parameters for the following features:

1. Threshold detectors
2. Variable selectors
3. Mechanical brake controller

Parameter	12.001 *Threshold Detector 1 Output*		
Short description	Displays the output of threshold detector 1		
Mode	RFC‑S		
Minimum	0	Maximum	1
Default		Units	
Type	1 Bit Volatile	Update Rate	4ms write
Display Format	Standard	Decimal Places	0
Coding	RO, ND, NC, PT		

The threshold detector functions are always active even if the source and destination are not routed to valid parameters. If the source is not a valid parameter then the source value is taken as 0. The update rate for each of the threshold detector functions is always 4ms.

Threshold detectors
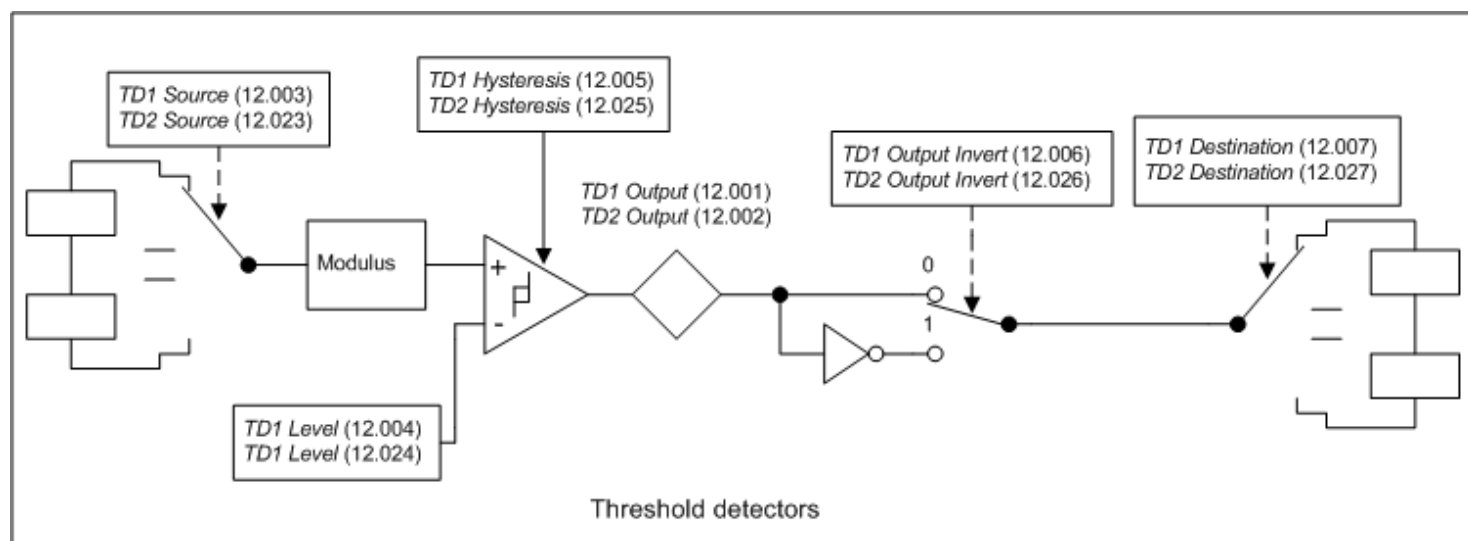
The following description is for threshold detector 1, but threshold detector 2 operates in the same way. The level of the parameter defined by *Threshold Detector 1 Source* (12.003) is converted to a percentage and compared to *Threshold Detector 1 Level* (12.004) with hysteresis to give *Threshold Detector 1 Output* (12.001) as follows:

Source	*Threshold Detector 1 Output* (12.001)
Source	0
Lower threshold ≤ Source	No change of state
Source ≥ Upper threshold	1

Lower threshold = *Threshold Detector 1 Level* (12.004) - *Threshold Detector 1 Hysteresis* (12.005)
Upper threshold = *Threshold Detector 1 Level* (12.004) + *Threshold Detector 1 Hysteresis* (12.005)

The output value can then be inverted with *Threshold Detector 1 Output Invert* (12.006) before being routed to the destination defined by *Threshold Detector 1 Destination* (12.007).

Parameter	12.002 *Threshold Detector 2 Output*		
Short description	Displays the output of threshold detector 1		
Mode	RFC‑S		
Minimum	0	Maximum	1
Default		Units	
Type	1 Bit Volatile	Update Rate	4ms write
Display Format	Standard	Decimal Places	0
Coding	RO, ND, NC, PT		

See *Threshold Detector 1 Output* (12.001).

Parameter	12.003 *Threshold Detector 1 Source*		
Short description	Defines the source paramter for threshold detector 1		
Mode	RFC‑S		
Minimum	0.000	Maximum	59.999
Default	0.000	Units	
Type	16 Bit User Save	Update Rate	Drive reset read
Display Format	Standard	Decimal Places	3
Coding	RW, PT, BU		

See *Threshold Detector 1 Output* (12.001).

Parameter	12.004 *Threshold Detector 1 Level*		
Short description	Defines the reference level for threshold detector 1		
Mode	RFC‑S		
Minimum	0.00	Maximum	100.00
Default	0.00	Units	%
Type	16 Bit User Save	Update Rate	4ms read
Display Format	Standard	Decimal Places	2
Coding	RW		

See *Threshold Detector 1 Output* (12.001).

Parameter	12.005 *Threshold Detector 1 Hysteresis*		
Short description	Defines the hysteresis for threshold detector 1		
Mode	RFC‑S		
Minimum	0.00	Maximum	25.00
Default	0.00	Units	%
Type	16 Bit User Save	Update Rate	4ms read
Display Format	Standard	Decimal Places	2
Coding	RW		

See *Threshold Detector 1 Output* (12.001).

Parameter	12.006 *Threshold Detector 1 Output Invert*		
Short description	Set to 1 to invert the output of threshold detector 1		
Mode	RFC‑S		
Minimum	0	Maximum	1
Default	0	Units	
Type	1 Bit User Save	Update Rate	4ms read
Display Format	Standard	Decimal Places	0
Coding	RW		

See *Threshold Detector 1 Output* (12.001).

Parameter	12.007 *Threshold Detector 1 Destination*		
Short description	Defines the destination parameter for threshold detector 1		
Mode	RFC‑S		
Minimum	0.000	Maximum	59.999
Default	0.000	Units	
Type	16 Bit User Save	Update Rate	Drive reset read
Display Format	Standard	Decimal Places	3
Coding	RW, DE, PT, BU		

See *Threshold Detector 1 Output* (12.001).

Parameter	12.008 *Variable Selector 1 Source 1*		
Short description	Defines the 1st source parameter for variable selector 1		
Mode	RFC‑S		
Minimum	0.000	Maximum	59.999
Default	0.000	Units	
Type	16 Bit User Save	Update Rate	Drive reset read
Display Format	Standard	Decimal Places	3
Coding	RW, PT, BU		

The variable selector functions are always active even if the source and destination are not routed to valid parameters. If a source is not a valid parameter then the source value is taken as 0. The update rate for each of the variable selector functions is always 4ms.

Variable Selectors
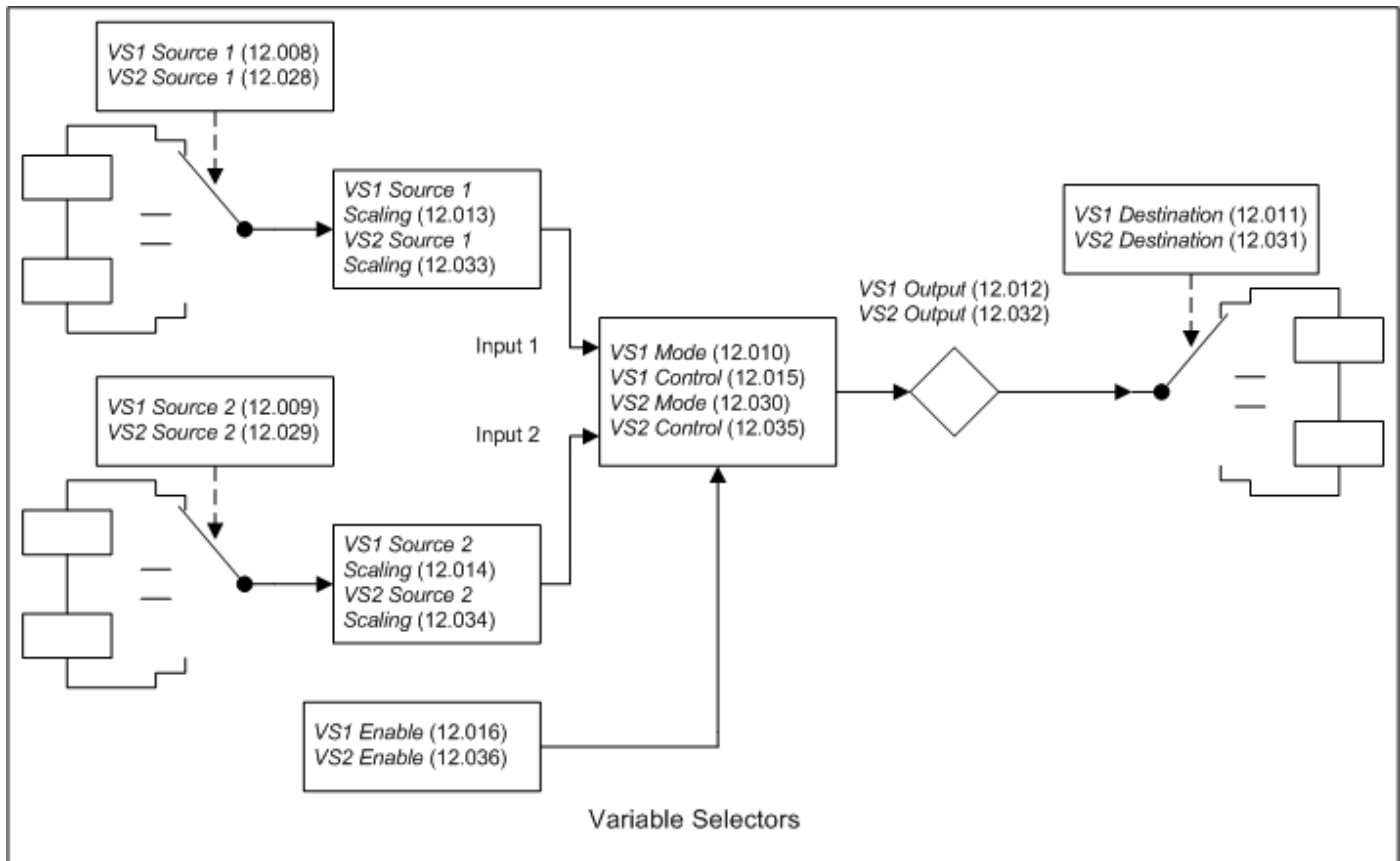
The following description is for variable selector 1, but variable selector 2 operates in the same way. The source parameters selected with *Variable Selector 1 Source 1* (12.008) and *Variable Selector 1 Source 2* (12.009) are converted to a percentage value, scaled with *Variable Selector 1 Source 1 Scaling* (12.013) and *Variable Selector 1 Source 2 Scaling* (12.014) respectively and then combined with a function defined by *Variable Selector 1 Mode* (12.010) to give *Variable Selector 1 Output* (12.012) as a percentage value. If *Variable Selector 1 Enable* (12.016) = 1 then the function operates normally. If *Variable Selector 1 Enable* (12.016) = 0 then *Variable Selector 1 Output* (12.012) = 0.00% and any states within the function are reset (i.e. the time constant function accumulator is held at zero). If the value of *Variable Selector 1 Mode* (12.010) is changed then all internal function state are also reset.

The table below shows the functions that can be selected with *Variable Selector 1 Mode* (12.010).

Variable Selector 1 Mode (12.010)	Variable Selector 1 Output (12.012)
0: Input 1	Input 1
1: Input 2	Input 2
2: Add	Input 1 + Input 2
3: Subtract	Input 1 - Input 2
4: Multiply	(Input 1 x Input 2) / 100.00%
5: Divide	(Input 1 x 100.00%) / Input 2
6: Time Const	Input 1 / (1 + тs) where т = *Variable Selector 1 Control* (12.015) seconds
7: Ramp	Input 1 as an input to a linear ramp function where the time to ramp from 0.00% to 100.00% is defined by *Variable Selector 1 Control* (12.015) seconds
8: Modulus	|Input1|
9: Powers	If *Variable Selector 1 Control* (12.015) = 0.02 then $Input^2$ / 100.00% Else if *Variable Selector 1 Control* (12.015) = 0.03 then $Input^3$ / 100.00% Else Input 1
10: Sectional	See description below

Sectional Controller

If *Variable Selector 1 Mode* (12.010) = 10 then the variable selector can be used to provide a sectional control function. (Variable selector 2 operates in the same way.) The sectional control function is intended to apply scaling and a speed offset to a 16 bit position value to generate a new 16 bit position value. The output can be used as an input to the Standard motion controller (Menu 13) and to generate an encoder simulation output (Menu 3).

Sectional controller
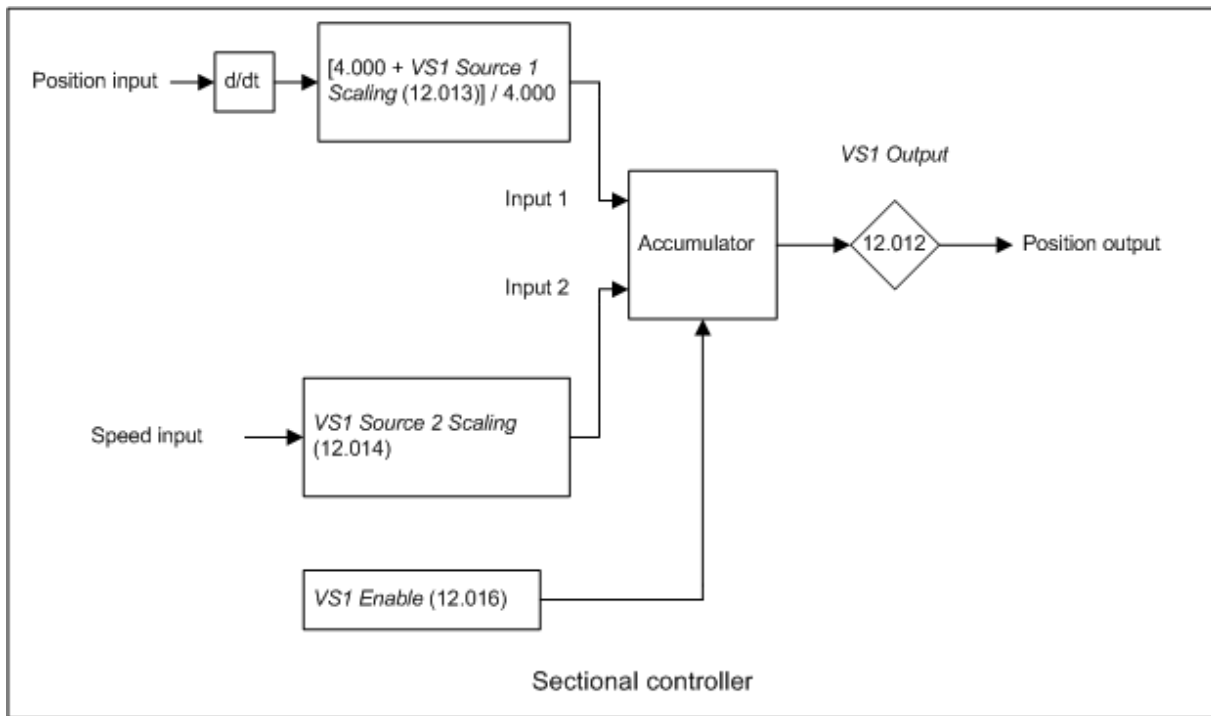
The position input is selected with *Variable Selector 1 Source 1* (12.008) and can be derived from any parameter. However, it is intended to be used with a position value that has a range from 0 to 65535 (e.g. *P1 Position* (03.029)). The input is scaled so that as *Variable Selector 1 Source 1 Scaling* (12.013) is changed between -4.000 and 4.000 so the proportion of the input position change added to the accumulator varies from 0.000 to 2.000 (i.e. the change of position input value is added without scaling if *Variable Selector 1 Source 1 Scaling* (12.013) = 0.000). The remainder from the scaling division is stored and then added at the next sample to maintain an exact ratio between the position input and the position output, provided the speed from source 2 is zero. The controller only takes the change of position from the input source parameter, and not the absolute value, so that when the controller is first made active the output does not jump to the source position, but only moves with any changes of source position after that point in time.

Although the sectional controller is intended to use a source parameter with a range from 0 to 65535, it is possible to use parameters with a different range provided the maximum is a power of two minus 1, i.e. 2^{31} - 1. It should be noted that the change of position is scaled based on the maximum of the parameter, and so a signed position value such as *P1 Normalised Position* (03.058) which has a maximum that corresponds to half its range will give twice the change of position when compared to *P1 Position* (03.029). To counteract this effect the scaling applied to the change of position in the sectional controller should be set to 0.5.

The range of *Variable Selector 1 Output* (12.012) is 0.00% and 100.00%. Unlike other functions the value is not simply limited, but rolls under or over respectively. Although the output destination can be any parameter it is intended to be used with a position value that has a range from 0 to 65535.

The speed input defines a speed offset with a resolution of 0.1rpm. Full scale of the source parameter corresponds to 1000.0rpm. Scaling may be applied using *Variable Selector 1 Source 2 Scaling* (12.014) to give a full scale value up to 4000.0rpm. The speed input is added to the accumulator to move the output position forwards or backwards with respect to the position input.

The sample time for the variable selector is 4ms and the input or output position must not change by more than half a revolution over this time. Therefore the input or output speed must not exceed 7500rpm.

The diagram below shows an example of how the sectional controller function could be configured. The section input position is provided from the previous section via the P1 position feedback interface. The destination of the variable selector is the *Standard Motion Local Reference Position* (13.021) in the standard motion controller which is used to provide the speed reference and to control the local motor attached to the drive. The encoder simulation system is used to generate the section output to be fed into the next drive. The source for the encoder simulation is *Standard Motion Local Reference Position* (13.021).

Sectional controller example
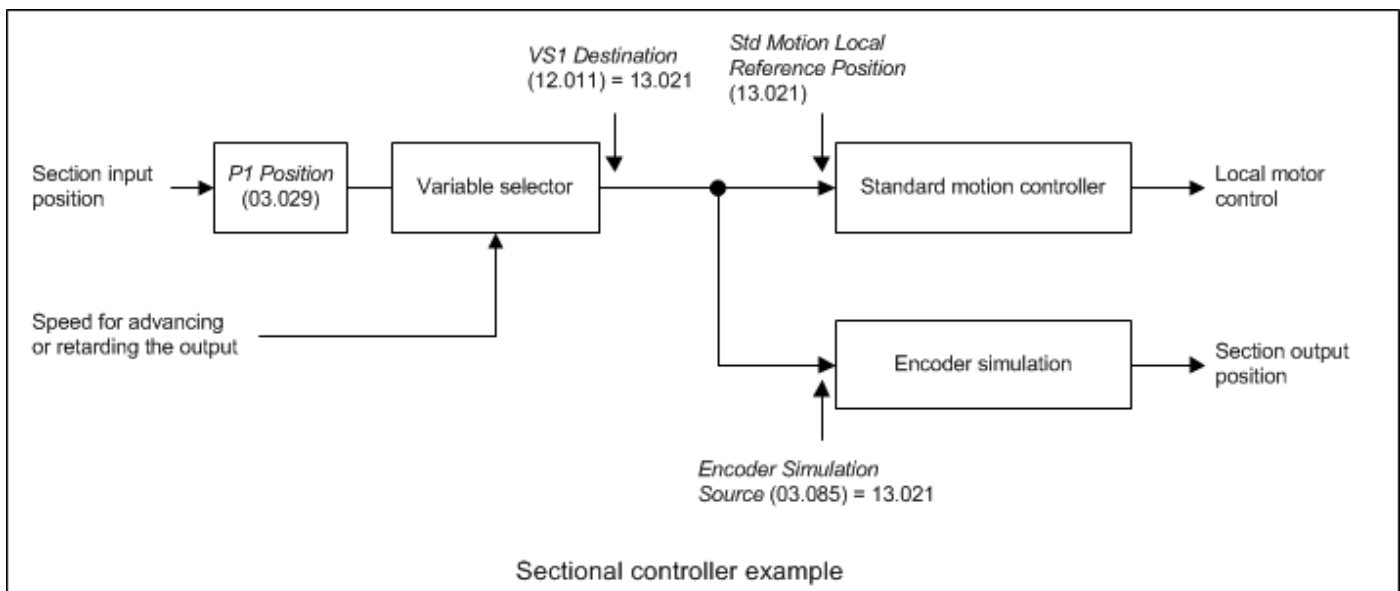
Parameter	12.009 *Variable Selector 1 Source 2*		
Short description	Defines the 2nd source parameter for variable selector 1		
Mode	RFC‑S		
Minimum	0.000	Maximum	59.999
Default	0.000	Units	
Type	16 Bit User Save	Update Rate	Drive reset read
Display Format	Standard	Decimal Places	3
Coding	RW, PT, BU		

See *Variable Selector 1 Source 1* (12.008).

Parameter	12.010 *Variable Selector 1 Mode*		
Short description	Defines the mode for variable selector 1		
Mode	RFC‑S		
Minimum	0	Maximum	10
Default	0	Units	
Type	8 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW, TE		

Value	Text
0	Input 1
1	Input 2
2	Add
3	Subtract
4	Multiply
5	Divide
6	Time Const
7	Ramp
8	Modulus
9	Powers
10	Sectional

See *Variable Selector 1 Source 1* (12.008).

Parameter	12.011 *Variable Selector 1 Destination*		
Short description	Defines the destination parameter for variable selector 1		
Mode	RFC‑S		
Minimum	0.000	Maximum	59.999
Default	0.000	Units	
Type	16 Bit User Save	Update Rate	Drive reset read
Display Format	Standard	Decimal Places	3
Coding	RW, DE, PT, BU		

See *Variable Selector 1 Source 1* (12.008).

Parameter	12.012 *Variable Selector 1 Output*		
Short description	Displays the output of variable selector 1		
Mode	RFC‑S		
Minimum	-100.00	Maximum	100.00
Default		Units	%
Type	16 Bit Volatile	Update Rate	4ms write
Display Format	Standard	Decimal Places	2
Coding	RO, ND, NC, PT		

See *Variable Selector 1 Source 1* (12.008).

Parameter	12.013 *Variable Selector 1 Source 1 Scaling*		
Short description	Defines the scaling for the 1st input for variable selector 1		
Mode	RFC‑S		
Minimum	-4.000	Maximum	4.000
Default	1.000	Units	
Type	16 Bit User Save	Update Rate	4ms read
Display Format	Standard	Decimal Places	3
Coding	RW		

See *Variable Selector 1 Source 1* (12.008).

Parameter	12.014 *Variable Selector 1 Source 2 Scaling*		
Short description	Defines the scaling for the 2nd input for variable selector 1		
Mode	RFC‑S		
Minimum	-4.000	Maximum	4.000
Default	1.000	Units	
Type	16 Bit User Save	Update Rate	4ms read
Display Format	Standard	Decimal Places	3
Coding	RW		

See *Variable Selector 1 Source 1* (12.008).

Parameter	12.015 *Variable Selector 1 Control*		
Short description	Defines the control for variable selector 1		
Mode	RFC‑S		
Minimum	0.00	Maximum	100.00
Default	0.00	Units	
Type	16 Bit User Save	Update Rate	4ms read
Display Format	Standard	Decimal Places	2
Coding	RW		

See *Variable Selector 1 Source 1* (12.008).

Parameter	12.016 *Variable Selector 1 Enable*		
Short description	Enables variable selector 1		
Mode	RFC‑S		
Minimum	0	Maximum	1
Default	1	Units	
Type	1 Bit User Save	Update Rate	4ms read
Display Format	Standard	Decimal Places	0
Coding	RW, BU		

See *Variable Selector 1 Source 1* (12.008) for more details.

Variable Selector 1 Enable (12.016) and *Variable Selector 2 Enable* (12.036) have a default of 1 so that if these parameters are not used the variable selectors will still function.

Parameter	12.023 *Threshold Detector 2 Source*		
Short description	Defines the source paramter for threshold detector 2		
Mode	RFC‑S		
Minimum	0.000	Maximum	59.999
Default	0.000	Units	
Type	16 Bit User Save	Update Rate	Drive reset read
Display Format	Standard	Decimal Places	3
Coding	RW, PT, BU		

See *Threshold Detector 1 Output* (12.001).

Parameter	12.024 *Threshold Detector 2 Level*		
Short description	Defines the reference level for threshold detector 2		
Mode	RFC‑S		
Minimum	0.00	Maximum	100.00
Default	0.00	Units	%
Type	16 Bit User Save	Update Rate	4ms read
Display Format	Standard	Decimal Places	2
Coding	RW		

See *Threshold Detector 1 Output* (12.001).

Parameter	12.025 *Threshold Detector 2 Hysteresis*		
Short description	Defines the hysteresis for threshold detector 2		
Mode	RFC‑S		
Minimum	0.00	Maximum	25.00
Default	0.00	Units	%
Type	16 Bit User Save	Update Rate	4ms read
Display Format	Standard	Decimal Places	2
Coding	RW		

See *Threshold Detector 1 Output* (12.001).

Parameter	12.026 *Threshold Detector 2 Output Invert*		
Short description	Set to 1 to invert the output of threshold detector 2		
Mode	RFC‑S		
Minimum	0	Maximum	1
Default	0	Units	
Type	1 Bit User Save	Update Rate	4ms read
Display Format	Standard	Decimal Places	0
Coding	RW		

See *Threshold Detector 1 Output* (12.001).

Parameter	12.027 *Threshold Detector 2 Destination*		
Short description	Defines the destination parameter for threshold detector 2		
Mode	RFC‑S		
Minimum	0.000	Maximum	59.999
Default	0.000	Units	
Type	16 Bit User Save	Update Rate	Drive reset read
Display Format	Standard	Decimal Places	3
Coding	RW, DE, PT, BU		

See *Threshold Detector 1 Output* (12.001).

Parameter	12.028 *Variable Selector 2 Source 1*		
Short description	Defines the 1st source parameter for variable selector 2		
Mode	RFC‑S		
Minimum	0.000	Maximum	59.999
Default	0.000	Units	
Type	16 Bit User Save	Update Rate	Drive reset read
Display Format	Standard	Decimal Places	3
Coding	RW, PT, BU		

See *Variable Selector 1 Source 1* (12.008).

Parameter	12.029 *Variable Selector 2 Source 2*		
Short description	Defines the 2nd source parameter for variable selector 2		
Mode	RFC‑S		
Minimum	0.000	Maximum	59.999
Default	0.000	Units	
Type	16 Bit User Save	Update Rate	Drive reset read
Display Format	Standard	Decimal Places	3
Coding	RW, PT, BU		

See *Variable Selector 1 Source 1* (12.008).

Parameter	12.030 *Variable Selector 2 Mode*		
Short description	Defines the mode for variable selector 2		
Mode	RFC‑S		
Minimum	0	Maximum	10
Default	0	Units	
Type	8 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW, TE		

Value	Text
0	Input 1
1	Input 2
2	Add
3	Subtract
4	Multiply
5	Divide
6	Time Const
7	Ramp
8	Modulus
9	Powers
10	Sectional

See *Variable Selector 1 Source 1* (12.008).

Parameter	12.031 *Variable Selector 2 Destination*		
Short description	Defines the destination parameter for variable selector 2		
Mode	RFC‑S		
Minimum	0.000	Maximum	59.999
Default	0.000	Units	
Type	16 Bit User Save	Update Rate	Drive reset read
Display Format	Standard	Decimal Places	3
Coding	RW, DE, PT, BU		

See *Variable Selector 1 Source 1* (12.008).

Parameter	12.032 *Variable Selector 2 Output*		
Short description	Displays the output of variable selector 2		
Mode	RFC‑S		
Minimum	-100.00	Maximum	100.00
Default		Units	%
Type	16 Bit Volatile	Update Rate	4ms write
Display Format	Standard	Decimal Places	2
Coding	RO, ND, NC, PT		

See *Variable Selector 1 Source 1* (12.008).

Parameter	12.033 *Variable Selector 2 Source 1 Scaling*		
Short description	Defines the scaling for the 1st input for variable selector 2		
Mode	RFC‑S		
Minimum	-4.000	Maximum	4.000
Default	1.000	Units	
Type	16 Bit User Save	Update Rate	4ms read
Display Format	Standard	Decimal Places	3
Coding	RW		

See *Variable Selector 1 Source 1* (12.008).

Parameter	12.034 *Variable Selector 2 Source 2 Scaling*		
Short description	Defines the scaling for the 2nd input for variable selector 2		
Mode	RFC‑S		
Minimum	-4.000	Maximum	4.000
Default	1.000	Units	
Type	16 Bit User Save	Update Rate	4ms read
Display Format	Standard	Decimal Places	3
Coding	RW		

Parameter	12.035 *Variable Selector 2 Control*		
Short description	Defines the control for variable selector 2		
Mode	RFC‑S		
Minimum	0.00	Maximum	100.00
Default	0.00	Units	
Type	16 Bit User Save	Update Rate	4ms read
Display Format	Standard	Decimal Places	2
Coding	RW		

See *Variable Selector 1 Source 1* (12.008).

Parameter	12.036 *Variable Selector 2 Enable*		
Short description	Enables variable selector 2		
Mode	RFC‑S		
Minimum	0	Maximum	1
Default	1	Units	
Type	1 Bit User Save	Update Rate	4ms read
Display Format	Standard	Decimal Places	0
Coding	RW, BU		

See *Variable Selector 1 Source 1* (12.008).

Parameter	12.040 *Brake Control: Brake Release*		
Short description	Enables the brake release function		
Mode	RFC‑S		
Minimum	0	Maximum	1
Default		Units	
Type	1 Bit Volatile	Update Rate	4ms write
Display Format	Standard	Decimal Places	0
Coding	RO, ND, NC, PT		

The mechanical brake control function can be used to control an electro-mechanical brake via digital I/O. *Brake Control: Brake Release* (12.040) = 0 when the brake should be applied and 1 when the brake should be released. Normally this should be routed to a digital output to control the mechanical brake. See *Brake Control: Enable* (12.041) for details.

Parameter	12.041 *Brake Control: Enable*		
Short description	Enables the brake control function		
Mode	RFC‑S		
Minimum	0	Maximum	1
Default	0	Units	
Type	1 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW		

If *Brake Control: Enable* (12.041) = 0 then the brake controller is disabled. The following parameters which are used by the brake controller to operate the drive are reset to 0 on the transition of *Brake Control: Enable* (12.041) from 1 to 0.

Parameter
Ramp Hold (02.003)
Hold Zero Speed (06.008)
Standard Motion Reference Source (13.004) *
Standard Motion Controller Mode (13.010) *

* If *Brake Control: Enable Position Control During Brake Release* (12.049) = 1

RFC-S mode
In RFC-S mode the following brake controller is provided.

Brake controller: RFC-S mode

Latch function

Reset = 1 THEN Output = 0
Reset = 0 AND Input = 1 THEN
Output latches to 1
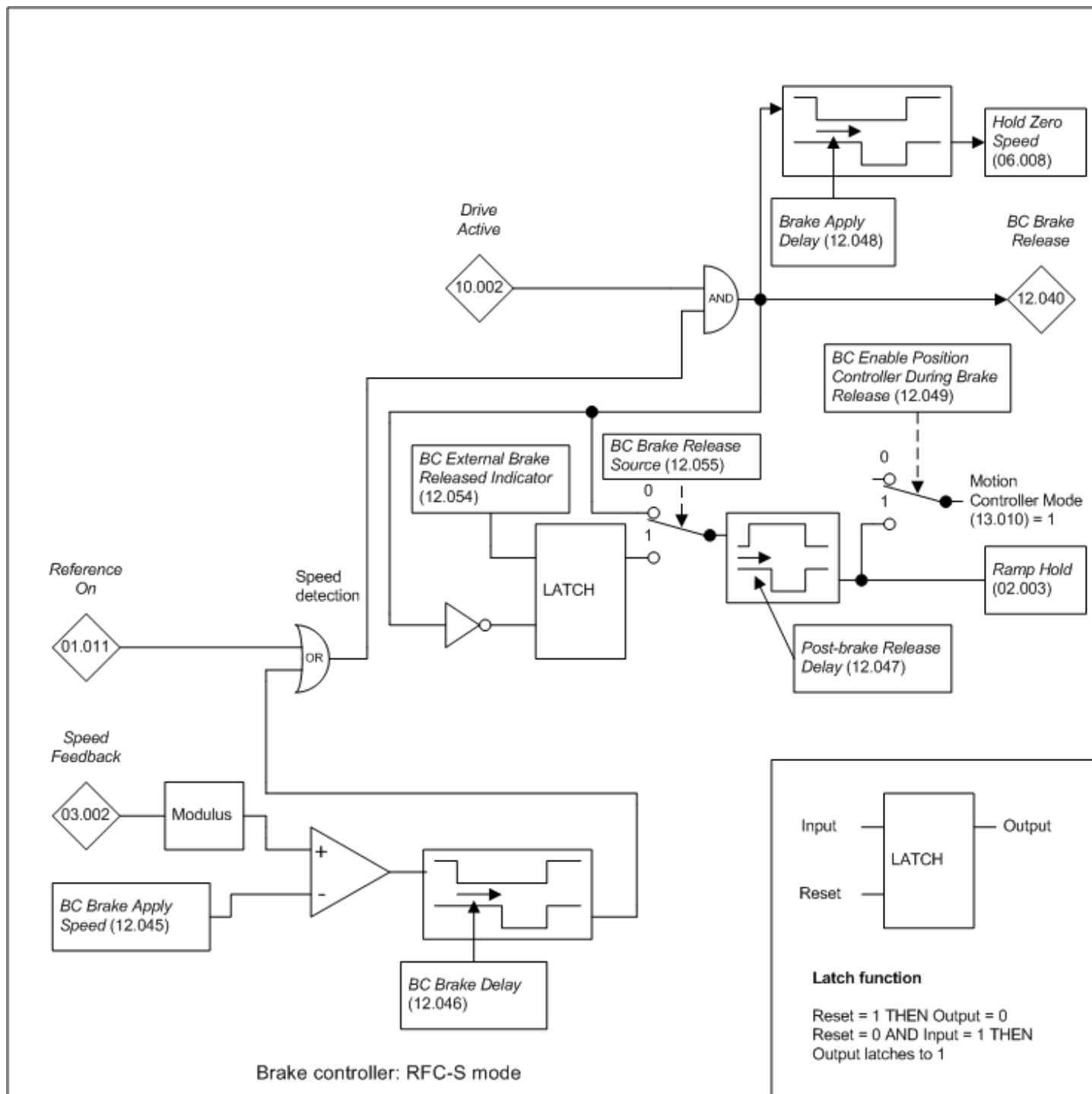
Speed detection

If *Reference On* (01.011) = 1 then the speed detection signal is active. When *Reference On* (01.011) is de-activated the speed detection signal is not de-activated until the modulus of *Speed Feedback* (03.002) falls below *Brake Control: Brake Apply Speed* (12.045) and an additional delay defined by *Brake Control: Brake Delay* (12.046).

Brake controller sequence

The brake controller sequence is shown for forward movement in the diagram below.

Brake controller sequence: RFC-A mode (*BC Mode* (12.052) = 0) and RFC-S mode
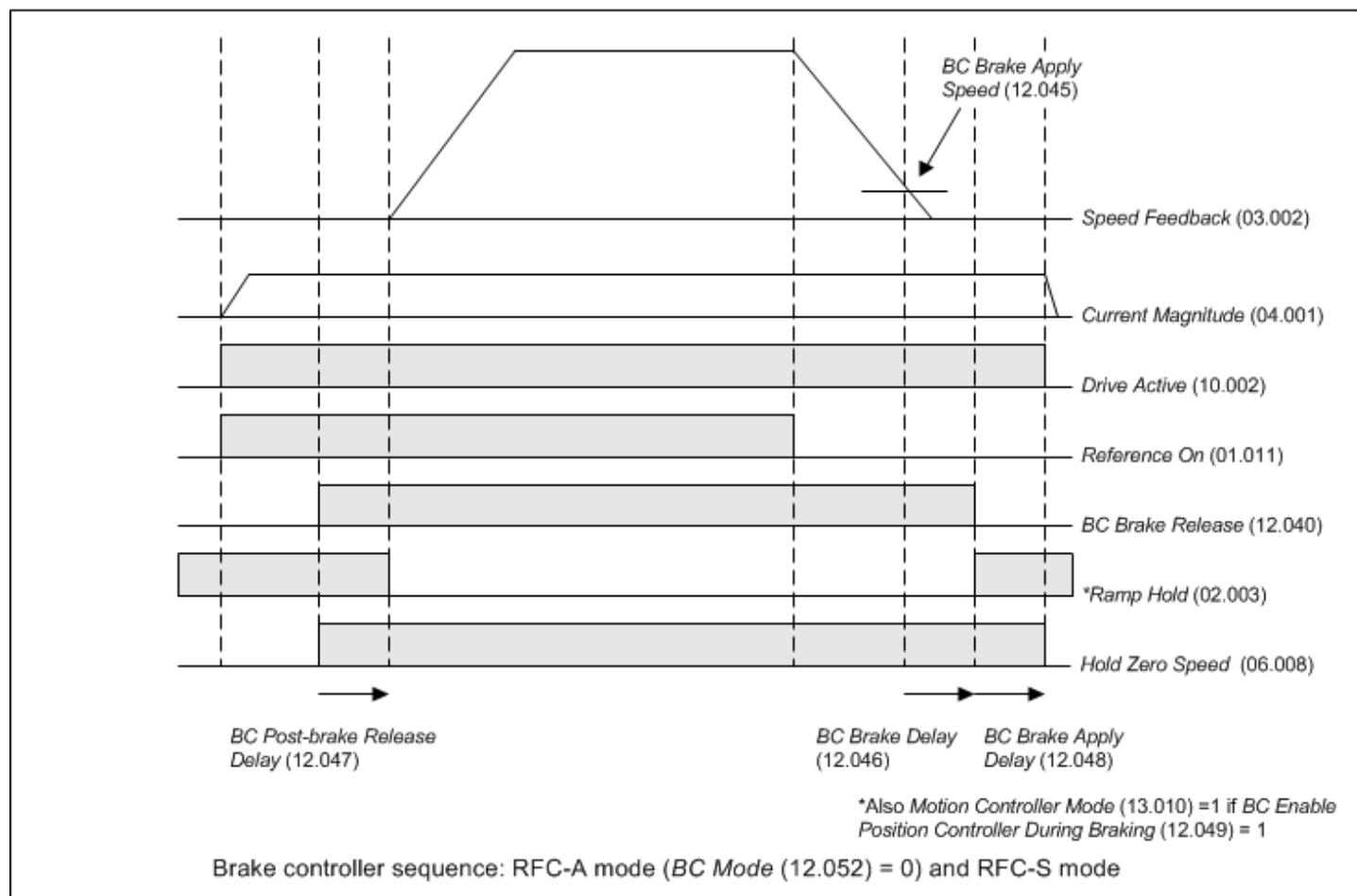
The brake is released when *Drive Active* (10.002) = 1 and speed detection is active. The ramp hold is released after a further delay to allow the motor to accelerate away from standstill. When the *Speed Feedback* (03.002) subsequently falls below *Brake Control: Brake Apply Speed* (12.045) and *Reference On* (01.011) = 0 (i.e. the motor is required to stop) then the brake is applied after a delay defined by *Brake Control: Brake Delay* (12.046). The motor is held at zero speed for a further delay to allow the brake to apply, i.e. *Brake Control: Brake Apply Delay* (12.048). *Ramp Hold* (02.003) is held at 1 while the brake is being applied in case the reference is reapplied during this period to prevent the motor running against the brake. Also *Ramp Hold* (02.003) will already be active when the drive restarts to hold the speed reference at zero. It is also possible for the Standard motion controller to be active during this period to help prevent the motor from moving even under load after the brake has been released by setting *Brake Control: Enable Position Control During Brake Release* (12.049) = 1.

If required, an input can be routed to *External Brake Released Indicator* (12.054) to delay the the motor from starting until an external indication is given that the brake has released. To use an external indication *Brake Release Source* (12.055) should be set to one.

Parameter	12.043 *Brake Control: Lower Current Threshold*		
Short description	Defines the lower current limit for the brake		
Mode	RFC-S		
Minimum	0	Maximum	200
Default	10	Units	%
Type	8 Bit User Save	Update Rate	4ms read
Display Format	Standard	Decimal Places	0
Coding	RW, BU		

See *Brake Control: Enable* (12.041).

Parameter	12.045 *Brake Control: Brake Apply Speed*		
Short description	Defines the apply speed of the brake		
Mode	RFC-S		
Minimum	0	Maximum	200
Default	5	Units	
Type	8 Bit User Save	Update Rate	4ms read
Display Format	Standard	Decimal Places	0
Coding	RW, BU		

See *Brake Control: Enable* (12.041).

Parameter	**12.046** *Brake Control: Brake Delay*		
Short description	Defines the pre-brake release delay		
Mode	RFC‑S		
Minimum	0.0	Maximum	25.0
Default	1.0	Units	s
Type	8 Bit User Save	Update Rate	4ms read
Display Format	Standard	Decimal Places	1
Coding	RW, BU		

See *Brake Control: Enable* (12.041).

Parameter	**12.047** *Brake Control: Post-brake Release Delay*		
Short description	Defines the post-brake release delay		
Mode	RFC‑S		
Minimum	0.0	Maximum	25.0
Default	1.0	Units	s
Type	8 Bit User Save	Update Rate	4ms read
Display Format	Standard	Decimal Places	1
Coding	RW, BU		

See *Brake Control: Enable* (12.041).

Parameter	**12.048** *Brake Control: Brake Apply Delay*		
Short description	Defines the delay for applying the brake		
Mode	RFC‑S		
Minimum	0.0	Maximum	25.0
Default	1.0	Units	s
Type	8 Bit User Save	Update Rate	4ms read
Display Format	Standard	Decimal Places	1
Coding	RW, BU		

See *Brake Control: Enable* (12.041)

Parameter	**12.049** *Brake Control: Enable Position Control During Brake Release*		
Short description	Enables position control during brake release		
Mode	RFC‑S		
Minimum	0	Maximum	1
Default	0	Units	
Type	1 Bit User Save	Update Rate	4ms read
Display Format	Standard	Decimal Places	0
Coding	RW		

See *Brake Control: Enable* (12.041)

Parameter	**12.054** *External Brake Released Indicator*		
Short description	External Brake Released Indicator		
Mode	RFC‑S		
Minimum	0	Maximum	1
Default	0	Units	
Type	1 Bit Volatile	Update Rate	4ms Read
Display Format	Standard	Decimal Places	0
Coding	RW, NC		

See *Brake Control: Enable* (12.041).

Parameter	**12.055** *Brake Release Source*		
Short description	Brake Release Source		
Mode	RFC‑S		
Minimum	0	Maximum	1
Default	0	Units	
Type	1 Bit User Save	Update Rate	Background Read
Display Format	Standard	Decimal Places	0
Coding	RW		

See *Brake Control: Enable* (12.041).

Menu 13 Single Line Descriptions − *Standard Motion Controller*

Mode: RFC‑S

Parameter	Range	Default	Type					
13.001 Standard Motion Revolutions Error	-32768 to 32767 Revs		RO	Num	ND	NC	PT	
13.002 Standard Motion Position Error	-32768 to 32767		RO	Num	ND	NC	PT	
13.003 Standard Motion Fine Position Error	-32768 to 32767		RO	Num	ND	NC	PT	
13.004 Standard Motion Reference Source	P1 Drive (0), P2 Drive (1), P1 Slot1 (2), P2 Slot1 (3), P1 Slot2 (4), P2 Slot2 (5), P1 Slot3 (6), P2 Slot3 (7), Local (10)	P1 Drive (0)	RW	Txt				US
13.005 Standard Motion Feedback Source	P1 Drive (0), P2 Drive (1), P1 Slot1 (2), P2 Slot1 (3), P1 Slot2 (4), P2 Slot2 (5), P1 Slot3 (6), P2 Slot3 (7), Sensorless (10)	P1 Drive (0)	RW	Txt				US
13.006 Standard Motion Reference Invert	Off (0) or On (1)	Off (0)	RW	Bit				US
13.007 Standard Motion Ratio Numerator	0.000 to 10.000	1.000	RW	Num				US
13.008 Standard Motion Ratio Denominator	0.000 to 4.000	1.000	RW	Num				US
13.009 Standard Motion Proportional Gain Kp	0.00 to 100.00	25.00	RW	Num				US
13.010 Standard Motion Controller Mode	Disabled (0), Rigid Spd FF (1), Rigid (2), Non‑rigid Spd FF (3), Non‑rigid (4), Orientate Stop (5), Orientate (6)	Disabled (0)	RW	Txt				US
13.011 Standard Motion Absolute Mode Enable	Off (0) or On (1)	Off (0)	RW	Bit				US
13.012 Standard Motion Speed Clamp	0 to 250 rpm	150 rpm	RW	Num				US
13.013 Standard Motion Orientation Position Reference	0 to 65535	0	RW	Num				US
13.014 Standard Motion Orientation Acceptance Window	0 to 4096	256	RW	Num				US
13.015 Standard Motion Orientation Complete	Off (0) or On (1)		RO	Bit	ND	NC	PT	
13.016 Standard Motion Position Error Reset	Off (0) or On (1)	Off (0)	RW	Bit		NC		
13.017 Standard Motion Relative Jog Reference	0.0 to 4000.0 rpm	0.0 rpm	RW	Num				US
13.018 Standard Motion Relative Jog Enable	Off (0) or On (1)	Off (0)	RW	Bit		NC		
13.019 Standard Motion Relative Jog Reverse	Off (0) or On (1)	Off (0)	RW	Bit		NC		
13.020 Standard Motion Local Reference Revolutions	0 to 65535 Revs	0 Revs	RW	Num		NC		
13.021 Standard Motion Local Reference Position	0 to 65535	0	RW	Num		NC		
13.022 Standard Motion Local Reference Fine Position	0 to 65535	0	RW	Num		NC		
13.023 Standard Motion Local Reference Disable	Off (0) or On (1)	Off (0)	RW	Bit		NC		
13.024 Standard Motion Ignore Local Reference Revolutions	Off (0) or On (1)	Off (0)	RW	Bit				US
13.026 Standard Motion Sample Rate	Not Active (0), 4ms (1)	Not Active (0)	RO	Txt		NC		US

RW	Read / Write	RO	Read-only	Bit	Bit parameter	Txt	Text string	Date	Date parameter	Time	Time parameter
Chr	Character parameter	Bin	Binary parameter	IP	IP address	Mac	MAC address	Ver	Version number	SMP	Slot, menu, parameter
Num	Number parameter	DE	Destination	ND	No default value	RA	Rating dependent	NC	Non-copyable	PT	Protected
FI	Filtered	US	User save	PS	Power-down save						

Menu 13 − *Standard Motion Controller*

Mode: RFC‑S

Motion controller format

The diagram below shows the format and interface for the standard motion controller.

Fig.13.1: RFC Standard motion controller format
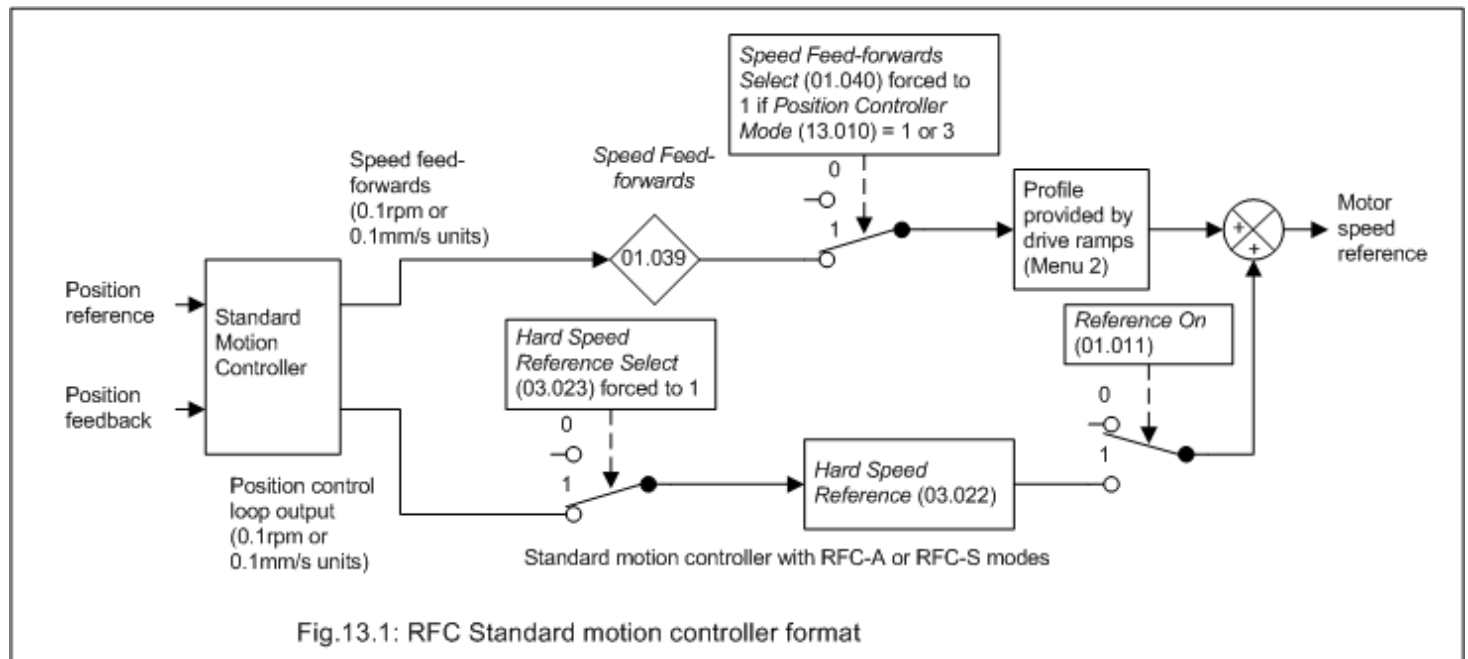
Standard motion controller

The standard motion controller outputs are speed feed-forwards and position control loop output both in 0.1rpm or 0.1mm/s units that can be used directly by the drive. The conversion to the output speed is based on the set-up parameters of the position feedback selected to control the motor. The position control loop output is always fed into the *Hard Speed Reference* (03.022). The speed feed-forwards from the motion controller can be used as a profile input, with the drive ramp system as the profile generator, by setting *Standard Motion Controller Mode* (13.010) to a value of 1 or 3. Alternatively the speed feed-forwards can be derived from the speed reference if required.

Changing *Standard Motion Controller Mode* (13.010) affects other drive parameters as shown in the table below.

Standard Motion Controller Mode (13.010)	Action
0	On changing from any value to 0: *Speed Feed-forwards* (01.039) = 0 *Speed Feed-forwards Select* (01.040) = 0 *Hard Speed Reference* (03.022) = 0 *Hard Speed Reference Select* (03.023) = 0
1 or 3	*Speed Feed-forwards* (01.039) = speed feed-forward *Speed Feed-forwards Select* (01.040) = 1 *Hard Speed Reference* (03.022) = position control loop output *Hard Speed Reference Select* (03.023) = 1
2,4,5 or 6	*Speed Feed-forwards* (01.039) = 0 *Speed Feed-forwards Select* (01.040) = 0 *Hard Speed Reference* (03.022) = position control loop output *Hard Speed Reference Select* (03.023) = 1

Standard motion controller

The standard motion controller is compatible with the motion controller in Unidrive SP with a sample rate of 4ms. The drive ramp system (Menu 2) operates normally when the standard motion controller is enabled.
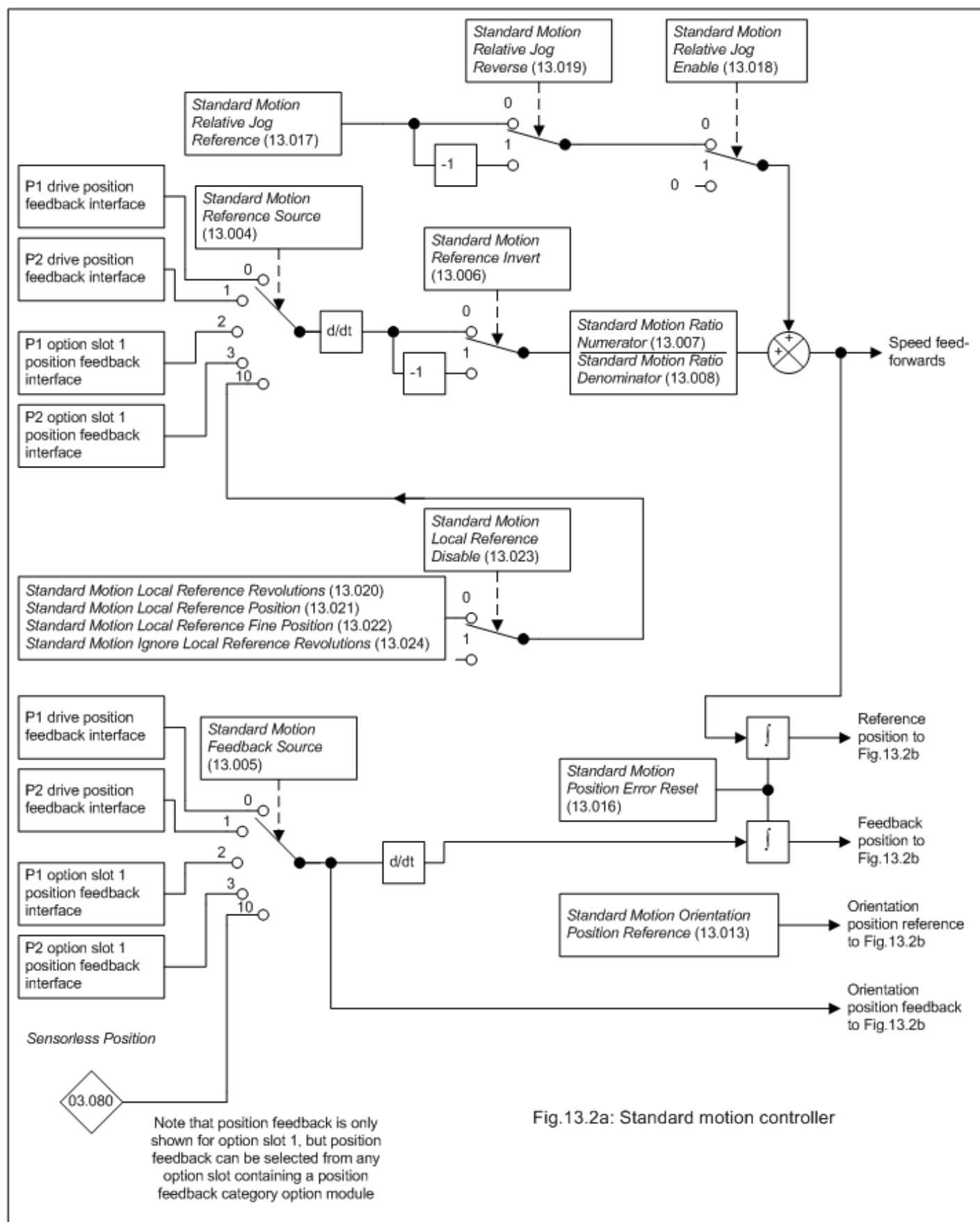
Fig.13.2a: Standard motion controller

Note that position feedback is only shown for option slot 1, but position feedback can be selected from any option slot containing a position feedback category option module
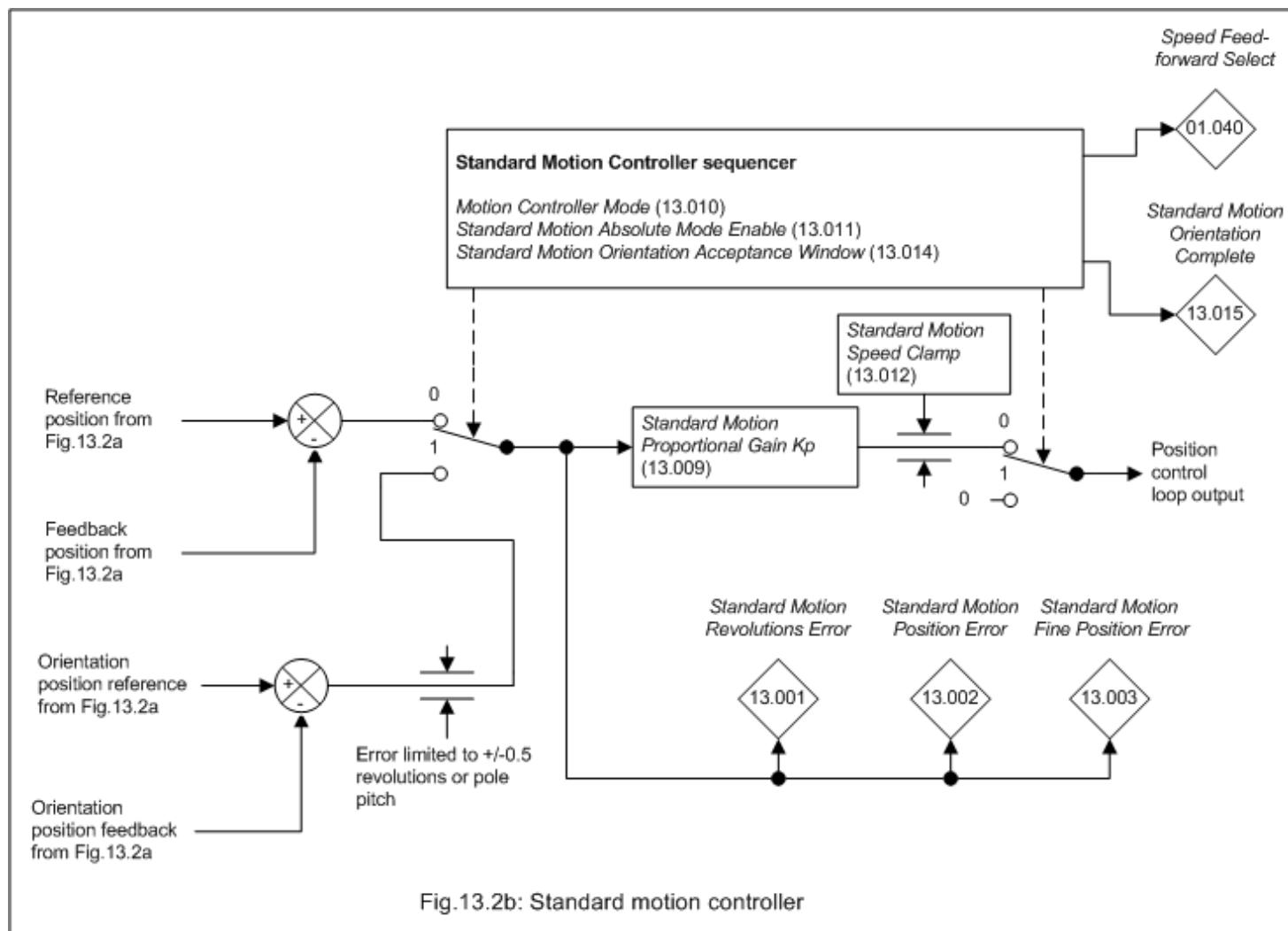
Fig.13.2b: Standard motion controller

The Standard Motion Controller uses the full 48 bit position feedback from the position feedback interfaces (Turns, Position and Fine Position), and so it is not affected by the number of turns bits selected to normalise the position for the selected position feedback interface. If *Sensorless Position* (03.080) is used for the feedback position the 16 fine position bits are zero. The motion controller outputs are converted from the internal speed units of the motion controller into a speed in rpm or mm/s (see *Linear Speed Select* (01.055)).

Parameter	13.001 *Standard Motion Revolutions Error*		
Short description	Displays the revolutions error for the Standard Motion Controller		
Mode	RFC‑S		
Minimum	-32768	Maximum	32767
Default		Units	Revs
Type	16 Bit Volatile	Update Rate	250µs write
Display Format	Standard	Decimal Places	0
Coding	RO, ND, NC, PT		

Standard Motion Revolutions Error (13.001), *Standard Motion Position Error* (13.002) and *Standard Motion Fine Position Error* (13.003) show the difference between the accumulated reference and feedback positions. The integrators are large enough to guarantee that the position controller can operate with a position error from -32768 to 32767 turns before rolling over. For orientation mode the error between the orientation position and the feedback position is shown in *Standard Motion Position Error* (13.002) only.

Parameter	13.002 *Standard Motion Position Error*		
Short description	Displays the position error for the Standard Motion Controller		
Mode	RFC‑S		
Minimum	-32768	Maximum	32767
Default		Units	
Type	16 Bit Volatile	Update Rate	250µs write
Display Format	Standard	Decimal Places	0
Coding	RO, ND, NC, PT		

See *Standard Motion Revolutions Error* (13.001).

Parameter	13.003 *Standard Motion Fine Position Error*		
Short description	Displays the fine position error for the Standard Motion Controller		
Mode	RFC‑S		
Minimum	-32768	Maximum	32767
Default		Units	
Type	16 Bit Volatile	Update Rate	250µs write
Display Format	Standard	Decimal Places	0
Coding	RO, ND, NC, PT		

See *Standard Motion Revolutions Error* (13.001).

Parameter	13.004 *Standard Motion Reference Source*		
Short description	Defines the input source for the Standard Motion Controller reference		
Mode	RFC‑S		
Minimum	0	Maximum	10
Default	0	Units	
Type	8 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW, TE		

Value	*Text*
0	P1 Drive
1	P2 Drive
2	P1 Slot1
3	P2 Slot1
4	P1 Slot2
5	P2 Slot2
6	P1 Slot3
7	P2 Slot3
10	Local

The reference source can be selected from one of the drive position feedback interfaces, a position feedback interface in an option module or from the local reference. If the selected position feedback interface does not exist then it will not be possible to enable the motion controller.

Parameter	13.005 *Standard Motion Feedback Source*		
Short description	Defines the input source for the Standard Motion Controller feedback		
Mode	RFC‑S		
Minimum	0	Maximum	10
Default	0	Units	
Type	8 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW, TE		

Value	*Text*
0	P1 Drive
1	P2 Drive
2	P1 Slot1
3	P2 Slot1
4	P1 Slot2
5	P2 Slot2
6	P1 Slot3
7	P2 Slot3
10	Sensorless

The feedback source can be selected from one of the drive position feedback interfaces, a position feedback interface in an option module or from the *Sensorless Position* (03.080). If the selected position feedback interface does not exist or *Sensorless Position* (03.080) is selected, but sensorless mode is not active then it will not be possible to enable the motion controller.

Parameter	13.006 *Standard Motion Reference Invert*		
Short description	Set to 1 to invert the Standard Motion Controller reference		
Mode	RFC‑S		
Minimum	0	Maximum	1
Default	0	Units	
Type	1 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW		

If *Standard Motion Reference Invert* (13.006) = 1 the reference position direction is reversed.

Parameter	13.007 *Standard Motion Ratio Numerator*		
Short description	Defines the numerator for the Standard Motion Controller ratio		
Mode	RFC‑S		
Minimum	0.000	Maximum	10.000
Default	1.000	Units	
Type	16 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	3
Coding	RW		

A ratio of *Standard Motion Ratio Numerator* (13.007) / *Standard Motion Ratio Denominator* (13.008) can be applied to the change of reference position. The ratio cannot be changed when the drive is enabled without causing abrupt changes of position. Although it is possible to set up ratios with a high gain or even with a denominator of zero, the drive limits the resultant gain of the ratio block to 10.000.

Parameter	13.008 *Standard Motion Ratio Denominator*		
Short description	Defines the denominator for the Standard Motion Controller ratio		
Mode	RFC‑S		
Minimum	0.000	Maximum	4.000
Default	1.000	Units	
Type	16 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	3
Coding	RW		

See *Standard Motion Ratio Numerator* (13.007).

Parameter	13.009 *Standard Motion Proportional Gain Kp*		
Short description	Defines the Kp gain used by the Standard Motion Controller		
Mode	RFC‑S		
Minimum	0.00	Maximum	100.00
Default	25.00	Units	
Type	16 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	2
Coding	RW		

The gain of the position control loop is specified in position units/s / position unit. The speed units used in the drive (rpm or mm/s) are dependent on the type of feedback device used and the value of *Linear Speed Select* (01.055). If rpm are used then the gain units are rev/s / rev (60 x rpm / rev), or if mm/s are used then the gain units are mm/s / mm.

Parameter	13.010 *Standard Motion Controller Mode*		
Short description	Defines the mode of the Standard Motion Controller		
Mode	RFC‑S		
Minimum	0	Maximum	6
Default	0	Units	
Type	8 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW, TE		

Value	*Text*
0	Disabled
1	Rigid Spd FF
2	Rigid
3	Non-rigid Spd FF
4	Non-rigid
5	Orientate Stop
6	Orientate

0: Disabled
The Standard Motion Controller is disabled if *Standard Motion Controller Mode* (13.010) = 0. The Standard Motion Controller is also disabled if *Reference On* (01.011) = 0 (except for orientation control), or if the reference or feedback sources are not valid. When *Standard Motion Controller Mode* (13.010) is changed the Standard Motion Controller is disabled for one sample after the change.

1: Rigid lock with speed feed-forwards
The diagram below shows the effect of rigid lock. Once the motion controller has been started it will always try to match the position and speed of the reference source. If for example the slave shaft is slowed down due to excessive load, the target position will eventually be recovered by running at a higher speed when the load is removed.

The motion controller generates a speed feed-forward term from the speed of the reference source. This value is passed through Menu 1, and so the ramps (Menu 2) may be included if required. As the motion controller only has a proportional gain, it is necessary to use speed feed-forwards to prevent a constant position error.

Fig.13.3: Non-rigid and rigid locking
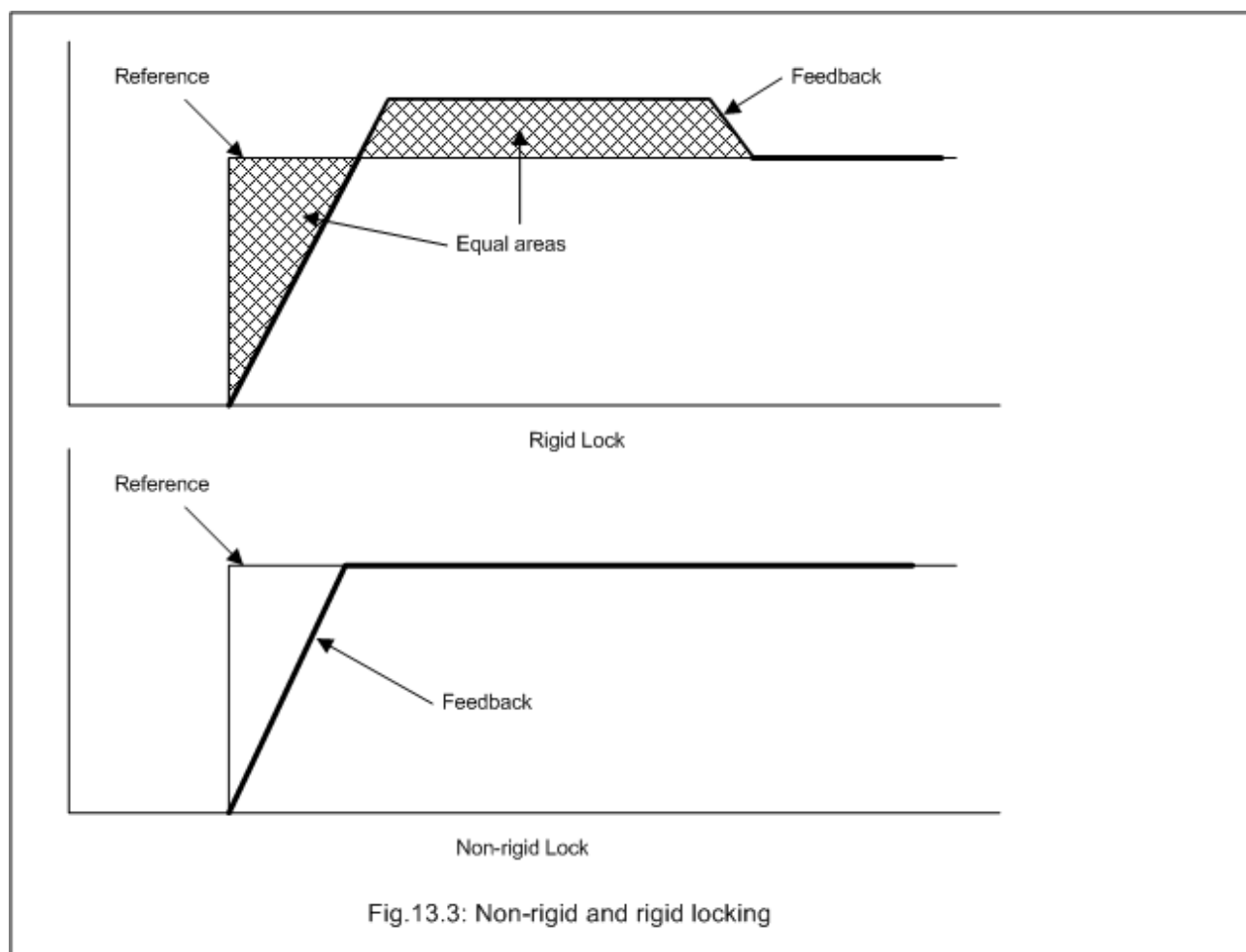
2: Rigid lock without speed feed-forwards
Rigid lock without speed feed-forwards operates in the same way as rigid lock with speed feed-forwards except that the speed feed-forwards from the reference source is not provided. If speed feed-forwards is required then this should be supplied via Menu 1.

3: Non-rigid lock with speed feed-forwards
The position control loop is only active when *At Speed* (10.006) = 1. See *At Speed Lower Limit* (03.006) for details. This provides position locking once the feedback speed is close to the reference speed. Speed feed-forwards is generated from the reference source speed.

4: Non-rigid lock without speed feed-forwards
Non-rigid lock without speed feed-forwards operates in the same way as non-rigid lock with speed feed-forwards except that the speed feed-forwards from the reference source is not provided. If speed feed-forwards is required then this should be supplied via Menu 1.

5: Orientation on stop
The motion controller orientates the motor following a stop command. If hold zero speed is enabled (*Hold Zero Speed* (06.008) = 1) the drive remains in position control when orientation is complete and holds the orientation position. If hold zero speed is not enabled the drive is disabled when orientation is complete.

When orientating from a stop command the drive goes through the following sequence:

1. The motor is decelerated or accelerated to the speed defined by the *Standard Motion Speed Clamp* (13.012), using ramps if these are enabled, in the direction the motor was previously running.
2. When the ramp output reaches the set speed, ramps are disabled and the motor continues to rotate until the position is found to be close to the target position (i.e. within 1/32 of a turn). At this point the speed demand is set to 0 and the position loop is closed.
3. When the position is within the *Standard Motion Orientation Acceptance Window* (13.014) the orientation complete indication is given by setting *Standard Motion Orientation Complete* (13.015) to 1.

The stop mode selected by *Stop Mode* (06.001) has no effect if orientation is enabled.

6: Orientation on stop and when the drive is enabled
This mode is the same as orientation on stop, except that orientation is performed whenever the drive is enabled and not just when a stop is required.

Parameter	13.011 *Standard Motion Absolute Mode Enable*		
Short description	Enables the Absolute mode for the Standard Motion Controller		
Mode	RFC-S		
Minimum	0	Maximum	1
Default	0	Units	
Type	1 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW		

If *Standard Motion Absolute Mode Enable* (13.011) = 0 the reference and feedback integrators are held at 0 while the motion controller is disabled, and

so the controller operates in incremental mode when it is enabled. If *Standard Motion Absolute Mode Enable* (13.011) = 1 the reference and feedback integrators are preset with the position from the reference and feedback sources, and so the controller operates in absolute mode when it is enabled. It should be noted that *Standard Motion Reference Invert* (13.006), *Standard Motion Ratio Numerator* (13.007) and *Standard Motion Ratio Denominator* (13.008) are not applied to the value stored in the reference integrator. Therefore the inversion should not be applied and a ratio of unity should be used in absolute mode.

Parameter	13.012 *Standard Motion Speed Clamp*		
Short description	Defines the limit applied to the output of the position control loop		
Mode	RFC‑S		
Minimum	0	Maximum	250
Default	150	Units	rpm
Type	8 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW, BU		

Standard Motion Speed Clamp (13.012) is the limit applied to the output of the position control loop.

Parameter	13.013 *Standard Motion Orientation Position Reference*		
Short description	Defines the orientation position within a turn with a resolution of 1/65536ths of a turn		
Mode	RFC‑S		
Minimum	0	Maximum	65535
Default	0	Units	
Type	16 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW, BU		

Standard Motion Orientation Position Reference (13.013) defines the orientation position within a turn with a resolution of 1/216 of a turn. *Standard Motion Orientation Acceptance Window* (13.014) defines the acceptance window with a resolution of 1/216 of a turn. The orientation is complete when:

Standard Motion Orientation Position Reference (13.013) - *Standard Motion Orientation Acceptance Window* (13.014) ≤ feedback position ≤ *Standard Motion Orientation Position Reference* (13.013) + *Standard Motion Orientation Acceptance Window* (13.014)

Parameter	13.014 *Standard Motion Orientation Acceptance Window*		
Short description	Defines the acceptance window with a resolution of 1/65536ths of a turn		
Mode	RFC‑S		
Minimum	0	Maximum	4096
Default	256	Units	
Type	16 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW		

See *Standard Motion Orientation Position Reference* (13.013).

Parameter	13.015 *Standard Motion Orientation Complete*		
Short description	Shows when the orientation sequence is complete for the Standard Motion Controller		
Mode	RFC‑S		
Minimum	0	Maximum	1
Default		Units	
Type	1 Bit Volatile	Update Rate	4ms write
Display Format	Standard	Decimal Places	0
Coding	RO, ND, NC, PT		

Standard Motion Orientation Complete (13.015) is set to 1 when the orientation sequence is complete.

Parameter	13.016 *Standard Motion Position Error Reset*		
Short description	Resets the reference and feedback integrators		
Mode	RFC‑S		
Minimum	0	Maximum	1
Default	0	Units	
Type	1 Bit Volatile	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW, NC		

If *Standard Motion Position Error Reset* (13.016) = 1 the reference and feedback integrators are held at their reset values (See *Standard Motion Absolute Mode Enable* (13.011)).

Parameter	13.017 *Standard Motion Relative Jog Reference*		
Short description	Defines the speed that the reference position is moved at		
Mode	RFC-S		
Minimum	0.0	Maximum	4000.0
Default	0.0	Units	rpm
Type	16 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	1
Coding	RW, BU		

If *Standard Motion Relative Jog Enable* (13.018) = 1 the reference position is moved at the speed defined by *Standard Motion Relative Jog Reference* (13.017) and in the direction defined by *Standard Motion Relative Jog Reverse* (13.019). The relative jog is forwards if *Standard Motion Relative Jog Reverse* (13.019) = 0 and reverse if it is 1.

Parameter	13.018 *Standard Motion Relative Jog Enable*		
Short description	Enables the use of the relative jog reference		
Mode	RFC-S		
Minimum	0	Maximum	1
Default	0	Units	
Type	1 Bit Volatile	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW, NC		

See *Standard Motion Relative Jog Reference* (13.017).

Parameter	13.019 *Standard Motion Relative Jog Reverse*		
Short description	Sets the direction of the relative jog reference		
Mode	RFC-S		
Minimum	0	Maximum	1
Default	0	Units	
Type	1 Bit Volatile	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW, NC		

See *Standard Motion Relative Jog Reference* (13.017).

Parameter	13.020 *Standard Motion Local Reference Revolutions*		
Short description	Defines the revolutions for the local reference		
Mode	RFC-S		
Minimum	0	Maximum	65535
Default	0	Units	Revs
Type	16 Bit Volatile	Update Rate	250µs read
Display Format	Standard	Decimal Places	0
Coding	RW, NC, BU		

The local reference (*Standard Motion Local Reference Revolutions* (13.020), *Standard Motion Local Reference Position* (13.021) and *Standard Motion Local Reference Fine Position* (13.022)) can be used as the reference position. If *Standard Motion Local Reference Disable* (13.023) = 1 then the previously written value is used. This allows all three parts of the local reference position to be changed without data skew problems.

Parameter	13.021 *Standard Motion Local Reference Position*		
Short description	Defines the position for the local reference		
Mode	RFC-S		
Minimum	0	Maximum	65535
Default	0	Units	
Type	16 Bit Volatile	Update Rate	250µs read
Display Format	Standard	Decimal Places	0
Coding	RW, NC, BU		

See *Standard Motion Local Reference Revolutions* (13.020).

Parameter	13.022 *Standard Motion Local Reference Fine Position*		
Short description	Defines the fine position for the local reference		
Mode	RFC-S		
Minimum	0	Maximum	65535
Default	0	Units	
Type	16 Bit Volatile	Update Rate	250µs read
Display Format	Standard	Decimal Places	0
Coding	RW, NC, BU		

See *Standard Motion Local Reference Revolutions* (13.020).

Parameter	13.023 *Standard Motion Local Reference Disable*		
Short description	Disables the use of the local reference		
Mode	RFC‑S		
Minimum	0	Maximum	1
Default	0	Units	
Type	1 Bit Volatile	Update Rate	250µs read
Display Format	Standard	Decimal Places	0
Coding	RW, NC		

See *Standard Motion Local Reference Revolutions* (13.020).

Parameter	13.024 *Standard Motion Ignore Local Reference Revolutions*		
Short description	Disables the use of the local reference revolutions		
Mode	RFC‑S		
Minimum	0	Maximum	1
Default	0	Units	
Type	1 Bit User Save	Update Rate	250µs read
Display Format	Standard	Decimal Places	0
Coding	RW		

If *Standard Motion Ignore Local Reference Revolutions* (13.024) = 0 all three parts of the local reference are used. If Std *Standard Motion Ignore Local Reference Revolutions* (13.024) = 1 and *Standard Motion Absolute Mode Enable* (13.011) = 0 only the position and fine position parts of the local reference are used as a 32 bit roll-over counter to define the local reference position.

Parameter	13.026 *Standard Motion Sample Rate*		
Short description	Standard Motion Sample Rate		
Mode	RFC‑S		
Minimum	0	Maximum	1
Default	0	Units	
Type	8 Bit User Save	Update Rate	Background Write
Display Format	Standard	Decimal Places	0
Coding	RO, TE, NC		

Value	*Text*
0	Not Active
1	4ms

Standard Motion Sample Rate (13.026) indicates whether the Standard Motion Controller is active or not, and the sample rate being used. The sample rate for the Standard Motion Controller is not selectable and will always be 4ms if the controller is active. It should be noted that both the Advanced and Standard motion controllers cannot be active at the same time. If both are selected at power-up then only the Advanced Motion Controller becomes active. If one controller is active and the other is subsequently enabled without disabling the active controller then the active controller remains active until the drive is powered down and back up again.

Menu 14 Single Line Descriptions − *User PID Controller*

Mode: RFC‑S

Parameter	Range	Default	Type					
14.001 PID1 Output	±100.00 %		RO	Num	ND	NC	PT	
14.002 PID1 Feed-forwards Reference Source	0.000 to 59.999	0.000	RW	Num			PT	US
14.003 PID1 Reference Source	0.000 to 59.999	0.000	RW	Num			PT	US
14.004 PID1 Feedback Source	0.000 to 59.999	0.000	RW	Num			PT	US
14.005 PID1 Reference Invert	Off (0) or On (1)	Off (0)	RW	Bit				US
14.006 PID1 Feedback Invert	Off (0) or On (1)	Off (0)	RW	Bit				US
14.007 PID1 Reference Slew Rate	0.0 to 3200.0 s	0.0 s	RW	Num				US
14.008 PID1 Enable	Off (0) or On (1)	Off (0)	RW	Bit				US
14.009 PID1 Enable Source 1	0.000 to 59.999	0.000	RW	Num			PT	US
14.010 PID1 Proportional Gain	0.000 to 4.000	1.000	RW	Num				US
14.011 PID1 Integral Gain	0.000 to 4.000	0.500	RW	Num				US
14.012 PID1 Differential Gain	0.000 to 4.000	0.000	RW	Num				US
14.013 PID1 Output Upper Limit	0.00 to 100.00 %	100.00 %	RW	Num				US
14.014 PID1 Output Lower Limit	±100.00 %	-100.00 %	RW	Num				US
14.015 PID1 Output Scaling	0.000 to 4.000	1.000	RW	Num				US
14.016 PID1 Destination	0.000 to 59.999	0.000	RW	Num	DE		PT	US
14.017 PID1 Integral Hold	Off (0) or On (1)	Off (0)	RW	Bit				
14.018 PID1 Symmetrical Limit Enable	Off (0) or On (1)	Off (0)	RW	Bit				US
14.019 PID1 Feed-forwards Reference	±100.00 %		RO	Num	ND	NC	PT	
14.020 PID1 Reference	±100.00 %		RO	Num	ND	NC	PT	
14.021 PID1 Feedback	±100.00 %		RO	Num	ND	NC	PT	
14.022 PID1 Error	±100.00 %		RO	Num	ND	NC	PT	
14.023 PID1 Reference Scaling	0.000 to 4.000	1.000	RW	Num				US
14.024 PID1 Feedback Scaling	0.000 to 4.000	1.000	RW	Num				US
14.025 PID1 Digital Reference	±100.00 %	0.00 %	RW	Num				US
14.026 PID1 Digital Feedback	±100.00 %	0.00 %	RW	Num				US
14.027 PID1 Enable Source 2	0.000 to 59.999	0.000	RW	Num			PT	US
14.028 PID1 Pre-sleep Boost Level	0.00 to 100.00 %	0.00 %	RW	Num				US
14.029 PID1 Maximum Boost Time	0.0 to 250.0 s	0.0 s	RW	Num				US
14.030 PID1 Pre-sleep Boost Level Enable	Off (0) or On (1)		RO	Bit	ND	NC	PT	
14.031 PID2 Output	±100.00 %		RO	Num	ND	NC	PT	
14.032 PID2 Feed-forwards Reference Source	0.000 to 59.999	0.000	RW	Num			PT	US
14.033 PID2 Reference Source	0.000 to 59.999	0.000	RW	Num			PT	US
14.034 PID2 Feedback Source	0.000 to 59.999	0.000	RW	Num			PT	US
14.035 PID2 Reference Invert	Off (0) or On (1)	Off (0)	RW	Bit				US
14.036 PID2 Feedback Invert	Off (0) or On (1)	Off (0)	RW	Bit				US
14.037 PID2 Reference Slew Rate Limit	0.0 to 3200.0 s	0.0 s	RW	Num				US
14.038 PID2 Enable	Off (0) or On (1)	Off (0)	RW	Bit				US
14.039 PID2 Enable Source 1	0.000 to 59.999	0.000	RW	Num			PT	US
14.040 PID2 Proportional Gain	0.000 to 4.000	1.000	RW	Num				US
14.041 PID2 Integral Gain	0.000 to 4.000	0.500	RW	Num				US
14.042 PID2 Differential Gain	0.000 to 4.000	0.000	RW	Num				US
14.043 PID2 Output Upper Limit	0.00 to 100.00 %	100.00 %	RW	Num				US
14.044 PID2 Output Lower Limit	±100.00 %	-100.00 %	RW	Num				US
14.045 PID2 Output Scaling	0.000 to 4.000	1.000	RW	Num				US
14.046 PID2 Destination	0.000 to 59.999	0.000	RW	Num	DE		PT	US
14.047 PID2 Integral Hold	Off (0) or On (1)	Off (0)	RW	Bit				
14.048 PID2 Symmetrical Limit Enable	Off (0) or On (1)	Off (0)	RW	Bit				US
14.049 PID2 Feed-forwards Reference	±100.00 %		RO	Num	ND	NC	PT	
14.050 PID2 Reference	±100.00 %		RO	Num	ND	NC	PT	
14.051 PID2 Feedback	±100.00 %		RO	Num	ND	NC	PT	
14.052 PID2 Error	±100.00 %		RO	Num	ND	NC	PT	
14.053 PID2 Reference Scaling	0.000 to 4.000	1.000	RW	Num				US
14.054 PID2 Feedback Scaling	0.000 to 4.000	1.000	RW	Num				US
14.055 PID2 Digital Reference	±100.00 %	0.00 %	RW	Num				US
14.056 PID2 Digital Feedback	±100.00 %	0.00 %	RW	Num				US
14.057 PID2 Enable Source 2	0.000 to 59.999	0.000	RW	Num			PT	US
14.058 PID1 Feedback Output Scaling	0.000 to 4.000	1.000	RW	Num				US
14.059 PID1 Mode Selector	Fbk1 (0), Fbk2 (1), Fbk1 + Fbk2 (2), Min Fbk (3), Max Fbk (4), Av Fbk (5), Min Error (6), Max Error (7)	Fbk1 (0)	RW	Txt				US
14.060 PID1 Feedback Square Root Enable 1	Off (0) or On (1)	Off (0)	RW	Bit				US
14.061 PID2 Feedback Square Root Enable	Off (0) or On (1)	Off (0)	RW	Bit				US

| 14.062 | PID1 Feedback Square Root Enable 2 | | Off (0) or On (1) | | Off (0) | | RW | Bit | | | | US |

RW	Read / Write	RO	Read-only	Bit	Bit parameter	Txt	Text string	Date	Date parameter	Time	Time parameter
Chr	Character parameter	Bin	Binary parameter	IP	IP address	Mac	MAC address	Ver	Version number	SMP	Slot, menu, parameter
Num	Number parameter	DE	Destination	ND	No default value	RA	Rating dependent	NC	Non-copyable	PT	Protected
FI	Filtered	US	User save	PS	Power-down save						

Menu 14 − *User PID Controller*

Mode: RFC‑S

PID controllers

Two general purpose PID controllers are provided as shown in the diagram below. Both operate in the same way except that PID controller 2 does not include a pre-sleep boost reference or alternative feedback and error selection. In the following sections a description is given for PID controller 1. The descriptions also apply to PID controller 2 except where stated. The sample rate for the PID controllers is always 4ms.

PID controllers

PID references

Input ───

LATCH ─── Output

Reset ───

If the reset is 1 the output is always 0
If the reset is 0 the output latches to 1 if
the input is 1

PID feedback

Only the parameters for PID controller 1 are shown for clarity. The equivalent parameters for PID controller 2 have a parameter number that is the number of the PID 1 controller parameter plus 30.

PID controllers (standard mode)

PID1 alternative feedback and error selectors

Parameter	14.001 *PID1 Output*		
Short description	Displays the output for PID1		
Mode	RFC‑S		
Minimum	-100.00	Maximum	100.00
Default		Units	%
Type	16 Bit Volatile	Update Rate	4ms write
Display Format	Standard	Decimal Places	2
Coding	RO, ND, NC, PT		

Controller

The controller section for the PID controllers is shown in the introduction. The structure of PID controller 1 shown in the introduction is when *PID1 Mode Selector* (14.059) = 0, *PID1 Feedback Output Scaling* (14.058) = 1.000, and *PID1 Feedback Square Root Enable 2* (14.062) = 0. The additional features provided by these parameters are not available for PID controller 2, and so this controller always has the structure shown. If the combined enable is inactive then all internal states are held at zero and the destination parameter will be defined by *PID1 Feed-forwards Reference* (14.019) alone. If the enable is active the PID controller is active even if the destination is not routed to a valid parameter or to 0.000. It should be noted that if either of the enable sources is routed to 0.000 or to a non-valid parameter the source value is taken as 1, therefore with default settings, *PID1 Enable Source 1* (14.009) = 0.000 and *PID1 Enable Source 2* (14.027) = 0.000, the PID controller can be enabled by simply setting *PID1 Enable* (14.008).

PID1 Error (14.022) is the difference between the reference and feedback produced by the reference and feedback systems described in the previous sections. The PID controller output is defined as follows:

PID1 Output (14.001) = *PID1 Error* (14.022) x [Kp + Ki/s + sKd/(0.064s + 1)]

Kp = *PID1 Proportional Gain* (14.010)

Ki = *PID1 Integral Gain* (14.011)

Kd = *PID1 Differential Gain* (14.012)

Therefore:

    1. If *PID1 Error* (14.022) = 100.00% the proportional term gives a value of 100.00% if *PID1 Proportional Gain* (14.010) = 1.000.

    2. If *PID1 Error* (14.022) = 100.00% the integral term gives a value that increases linearly by 100.00% per second if *PID1 Integral Gain* (14.011) = 1.000.

    3. If *PID1 Error* (14.022) increases linearly by 100.00% per second the differential term gives a value of 100.00% if *PID1 Differential Gain* (14.012) = 1.000. (A filter with a time constant of 64ms is provided on the differential gain to reduce the noise produced by this term.)

The output may be limited to a range that is less than the maximum range of *PID1 Output* (14.001) using *PID1 Output Upper Limit* (14.013) and *PID1 Output Lower Limit* (14.014). If *PID1 Output Lower Limit* (14.014) > *PID1 Output Upper Limit* (14.013) then the output is held at the value defined by *PID1 Output Upper Limit* (14.013). If *PID1 Symmetrical Limit Enable* (14.018) = 1 then the lower limit = -(*PID1 Output Upper Limit* (14.013)). If the output reaches either of these limits the integral term accumulator is frozen until the output moves away from the limit to prevent integral wind-up. The integral hold function can also be enabled by the user by setting *PID1 Integral Hold* (14.017) = 1.

PID1 Output Scaling (14.015) can be used to scale the output, which is limited to a range from -100.00% to 100.00% after this function. The output is then added to *PID1 Feed-forwards Reference* (14.019) and is again limited to the range from -100.00% to 100.00% before being routed to the destination defined by *PID1 Destination* (14.016).

Parameter	14.002 *PID1 Feed-forwards Reference Source*		
Short description	Defines the input source for the feed-forwards reference source for PID1		
Mode	RFC-S		
Minimum	0.000	Maximum	59.999
Default	0.000	Units	
Type	16 Bit User Save	Update Rate	Drive reset read
Display Format	Standard	Decimal Places	3
Coding	RW, PT, BU		

See *PID1 Output* (14.001).

Parameter	14.003 *PID1 Reference Source*		
Short description	Defines the input source for the reference for PID1		
Mode	RFC-S		
Minimum	0.000	Maximum	59.999
Default	0.000	Units	
Type	16 Bit User Save	Update Rate	Drive reset read
Display Format	Standard	Decimal Places	3
Coding	RW, PT, BU		

The reference section for the PID controllers is shown in the introduction. The pre-sleep boost control is only included in PID controller 1. The reference sections are always active even if the PID controller itself is disabled or the reference sources are not routed to valid parameters. If a reference source is not a valid parameter or is 0.000 then the value is taken as zero.

The reference is the sum of the reference source, the *PID1 Digital Reference* (14.025) and the *PID1 Pre-sleep Boost Level* (14.028) when it is active. The result is multiplied by *PID1 Reference Scaling* (14.023) and then limited to +/-100.00%. The reference can then be inverted if required (*PID1 Reference Invert* (14.005) = 1) and then a slew rate limit is applied with *PID1 Reference Slew Rate* (14.007). This limits the maximum rate of change so that a change from 0.00 to 100.00% takes the time given in *PID1 Reference Slew Rate* (14.007).

Sleep mode is used to stop the motor if the frequency or speed reference falls below a specified level so that the system does not run inefficiently at low speeds (see *Sleep / Wake Threshold* (06.053)). If the frequency or speed reference is controlled by PID controller 1 then the PID controller feedback will fall when sleep mode becomes active because the motor has stopped. The PID controller output will rise again above the sleep/wake threshold and the motor will restart. To minimise the number of transitions into and out of sleep mode the sleep condition can be delayed and an increased reference applied during this period by setting *PID1 Pre-sleep Boost Level* (14.028) to a non-zero value. When *Sleep Required* (06.056) = 1 the *PID1 Pre-sleep Boost Level* (14.028) is added to the reference until *PID1 Error* (14.022) is reduced below zero or until this additional reference has been applied for *PID1 Maximum Boost Time* (14.029). This system is only intended for applications where PID controller 1 alone is used to control the motor frequency or speed via the Menu 1 reference system and the motor rotates in the positive direction under normal conditions. When the PID output first falls below the *Sleep / Wake Threshold* (06.053) it is possible for *PID1 Error* (14.022) to be negative because of a positive value remaining in the integral accumulator. To allow the error to become positive so that the boost period is not terminated immediately, the *PID1 Pre-sleep Boost Level* (14.028) is applied for a minimum of 100ms before the end of the boost period can be terminated because *PID1 Error* (14.022) is greater than or equal to zero.

Parameter	14.004 *PID1 Feedback Source*		
Short description	Defines the input source for the feedback for PID1		
Mode	RFC-S		
Minimum	0.000	Maximum	59.999
Default	0.000	Units	
Type	16 Bit User Save	Update Rate	Drive reset read
Display Format	Standard	Decimal Places	3
Coding	RW, PT, BU		

Feedback

The feedback section for the PID controllers is shown in the introduction. The feedback sections are always active even if the PID controller itself is disabled or the feedback sources are not routed to valid parameters. If a reference source is not a valid parameter or is 0.000 then the value is taken as zero.

The feedback is the sum of the feedback source and the *PID1 Digital Feedback* (14.026). The result is multiplied by *PID1 Feedback Scaling* (14.024) and then limited to +/-100.00%. A square root function can be applied (*PID1 Feedback Square Root Enable 1* (14.060) = 1) and the feedback can then be inverted if required (*PID1 Feedback Invert* (14.006) = 1). The square root function is defined as follows.

Square root function output = Sign(Input) x 100.00% x $\sqrt{(|Input| / 100.00\%)}$

where Sign(Input) = 1 if Input ≥ 0 or -1 otherwise

The square root function is useful in applications where the PID controller is operating with air flow as its reference and feedback and the motor is controlling a fan. It is easier to use a pressure transducer than a flow transducer, and so the feedback from the transducer needs to be converted from pressure to flow. As flow = Constant x $\sqrt{Pressure}$ the square root function can be used in the conversion.

Parameter	14.005 *PID1 Reference Invert*		
Short description	Set to 1 to invert PID1 reference		
Mode	RFC‑S		
Minimum	0	Maximum	1
Default	0	Units	
Type	1 Bit User Save	Update Rate	4ms read
Display Format	Standard	Decimal Places	0
Coding	RW		

See *PID1 Reference Source* (14.003).

Parameter	14.006 *PID1 Feedback Invert*		
Short description	Set to 1 to invert the PID1 feedback		
Mode	RFC‑S		
Minimum	0	Maximum	1
Default	0	Units	
Type	1 Bit User Save	Update Rate	4ms read
Display Format	Standard	Decimal Places	0
Coding	RW		

See *PID1 Feedback Source* (14.004).

Parameter	14.007 *PID1 Reference Slew Rate*		
Short description	Defines the rate in change of output for PID1		
Mode	RFC‑S		
Minimum	0.0	Maximum	3200.0
Default	0.0	Units	s
Type	16 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	1
Coding	RW		

See *PID1 Reference Source* (14.003).

Parameter	14.008 *PID1 Enable*		
Short description	Enables the use of PID1		
Mode	RFC‑S		
Minimum	0	Maximum	1
Default	0	Units	
Type	1 Bit User Save	Update Rate	4ms read
Display Format	Standard	Decimal Places	0
Coding	RW		

See *PID1 Output* (14.001).

Parameter	14.009 *PID1 Enable Source 1*		
Short description	Defines the input source for enabling PID1		
Mode	RFC‑S		
Minimum	0.000	Maximum	59.999
Default	0.000	Units	
Type	16 Bit User Save	Update Rate	Drive reset read
Display Format	Standard	Decimal Places	3
Coding	RW, PT, BU		

See *PID1 Output* (14.001).

Parameter	14.010 *PID1 Proportional Gain*		
Short description	Defines the Kp gain used for PID1		
Mode	RFC‑S		
Minimum	0.000	Maximum	4.000
Default	1.000	Units	
Type	16 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	3
Coding	RW		

See *PID1 Output* (14.001).

Parameter	14.011 *PID1 Integral Gain*		
Short description	Defines the Ki gain used for PID1		
Mode	RFC‑S		
Minimum	0.000	Maximum	4.000
Default	0.500	Units	
Type	16 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	3
Coding	RW		

See *PID1 Output* (14.001).

Parameter	14.012 *PID1 Differential Gain*		
Short description	Defines the Kd gain used for PID1		
Mode	RFC‑S		
Minimum	0.000	Maximum	4.000
Default	0.000	Units	
Type	16 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	3
Coding	RW		

See *PID1 Output* (14.001).

Parameter	14.013 *PID1 Output Upper Limit*		
Short description	Defines the maximum value of the output for PID1		
Mode	RFC‑S		
Minimum	0.00	Maximum	100.00
Default	100.00	Units	%
Type	16 Bit User Save	Update Rate	4ms read
Display Format	Standard	Decimal Places	2
Coding	RW		

See *PID1 Output* (14.001).

Parameter	14.014 *PID1 Output Lower Limit*		
Short description	Defines the minimum value of the output for PID1		
Mode	RFC‑S		
Minimum	-100.00	Maximum	100.00
Default	-100.00	Units	%
Type	16 Bit User Save	Update Rate	4ms read
Display Format	Standard	Decimal Places	2
Coding	RW		

See *PID1 Output* (14.001).

Parameter	14.015 *PID1 Output Scaling*		
Short description	Defines the scaling factor of the output for PID1		
Mode	RFC‑S		
Minimum	0.000	Maximum	4.000
Default	1.000	Units	
Type	16 Bit User Save	Update Rate	4ms read
Display Format	Standard	Decimal Places	3
Coding	RW		

See *PID1 Output* (14.001).

Parameter	14.016 *PID1 Destination*		
Short description	Defines the output parameter for PID1		
Mode	RFC‑S		
Minimum	0.000	Maximum	59.999
Default	0.000	Units	
Type	16 Bit User Save	Update Rate	Drive reset read
Display Format	Standard	Decimal Places	3
Coding	RW, DE, PT, BU		

See *PID1 Output* (14.001).

Parameter	14.017 *PID1 Integral Hold*		
Short description	Enables the integral hold function for PID1		
Mode	RFC‑S		
Minimum	0	Maximum	1
Default	0	Units	
Type	1 Bit Volatile	Update Rate	4ms read
Display Format	Standard	Decimal Places	0
Coding	RW		

See *PID1 Output* (14.001).

Parameter	14.018 *PID1 Symmetrical Limit Enable*		
Short description	Enables the symmetrical limit for PID1		
Mode	RFC‑S		
Minimum	0	Maximum	1
Default	0	Units	
Type	1 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW		

See *PID1 Output* (14.001).

Parameter	14.019 *PID1 Feed-forwards Reference*		
Short description	Displays the value of the feed-forwards reference for PID1		
Mode	RFC‑S		
Minimum	-100.00	Maximum	100.00
Default		Units	%
Type	16 Bit Volatile	Update Rate	4ms write
Display Format	Standard	Decimal Places	2
Coding	RO, ND, NC, PT		

See *PID1 Output* (14.001).

Parameter	14.020 *PID1 Reference*		
Short description	Displays the value of the reference for PID1		
Mode	RFC‑S		
Minimum	-100.00	Maximum	100.00
Default		Units	%
Type	16 Bit Volatile	Update Rate	4ms write
Display Format	Standard	Decimal Places	2
Coding	RO, ND, NC, PT		

See *PID1 Reference Source* (14.003).

Parameter	14.021 *PID1 Feedback*		
Short description	Displays the value of the feedback for PID1		
Mode	RFC‑S		
Minimum	-100.00	Maximum	100.00
Default		Units	%
Type	16 Bit Volatile	Update Rate	4ms write
Display Format	Standard	Decimal Places	2
Coding	RO, ND, NC, PT		

See *PID1 Feedback Source* (14.004).

Parameter	14.022 *PID1 Error*		
Short description	Displays the value of the error for PID1		
Mode	RFC‑S		
Minimum	-100.00	Maximum	100.00
Default		Units	%
Type	16 Bit Volatile	Update Rate	4ms write
Display Format	Standard	Decimal Places	2
Coding	RO, ND, NC, PT		

See *PID1 Output* (14.001).

Parameter	14.023 *PID1 Reference Scaling*		
Short description	Defines the scaling factor for the reference for PID1		
Mode	RFC-S		
Minimum	0.000	Maximum	4.000
Default	1.000	Units	
Type	16 Bit User Save	Update Rate	4ms read
Display Format	Standard	Decimal Places	3
Coding	RW		

See *PID1 Reference Source* (14.003).

Parameter	14.024 *PID1 Feedback Scaling*		
Short description	Defines the scaling factor of the feedback for PID1		
Mode	RFC-S		
Minimum	0.000	Maximum	4.000
Default	1.000	Units	
Type	16 Bit User Save	Update Rate	4ms read
Display Format	Standard	Decimal Places	3
Coding	RW		

See *PID1 Feedback Source* (14.004).

Parameter	14.025 *PID1 Digital Reference*		
Short description	Defines the value of the digital reference for PID1		
Mode	RFC-S		
Minimum	-100.00	Maximum	100.00
Default	0.00	Units	%
Type	16 Bit User Save	Update Rate	4ms read
Display Format	Standard	Decimal Places	2
Coding	RW		

See *PID1 Reference Source* (14.003).

Parameter	14.026 *PID1 Digital Feedback*		
Short description	Defines the value of the digital feedback for PID1		
Mode	RFC-S		
Minimum	-100.00	Maximum	100.00
Default	0.00	Units	%
Type	16 Bit User Save	Update Rate	4ms read
Display Format	Standard	Decimal Places	2
Coding	RW		

See *PID1 Feedback Source* (14.004).

Parameter	14.027 *PID1 Enable Source 2*		
Short description	Defines the input source for enabling PID1		
Mode	RFC-S		
Minimum	0.000	Maximum	59.999
Default	0.000	Units	
Type	16 Bit User Save	Update Rate	Drive reset read
Display Format	Standard	Decimal Places	3
Coding	RW, PT, BU		

See *PID1 Output* (14.001).

Parameter	14.028 *PID1 Pre-sleep Boost Level*		
Short description	Defines the level of the pre-sleep boost function		
Mode	RFC-S		
Minimum	0.00	Maximum	100.00
Default	0.00	Units	%
Type	16 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	2
Coding	RW		

See *PID1 Reference Source* (14.003).

Parameter	14.029 *PID1 Maximum Boost Time*		
Short description	Defines the maximum time that the boost level can be used		
Mode	RFC-S		
Minimum	0.0	Maximum	250.0
Default	0.0	Units	s
Type	16 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	1
Coding	RW, BU		

See *PID1 Reference Source* (14.003).

Parameter	14.030 *PID1 Pre-sleep Boost Level Enable*		
Short description	Enables the pre-sleep boost function		
Mode	RFC-S		
Minimum	0	Maximum	1
Default		Units	
Type	1 Bit Volatile	Update Rate	Background write
Display Format	Standard	Decimal Places	0
Coding	RO, ND, NC, PT		

See *PID1 Reference Source* (14.003).

Parameter	14.031 *PID2 Output*		
Short description	Displays the output for PID2		
Mode	RFC-S		
Minimum	-100.00	Maximum	100.00
Default		Units	%
Type	16 Bit Volatile	Update Rate	4ms write
Display Format	Standard	Decimal Places	2
Coding	RO, ND, NC, PT		

See *PID1 Output* (14.001).

Parameter	14.032 *PID2 Feed-forwards Reference Source*		
Short description	Defines the input source for the feed-forwards reference source for PID2		
Mode	RFC-S		
Minimum	0.000	Maximum	59.999
Default	0.000	Units	
Type	16 Bit User Save	Update Rate	Drive reset read
Display Format	Standard	Decimal Places	3
Coding	RW, PT, BU		

See *PID1 Feed-forwards Reference Source* (14.002).

Parameter	14.033 *PID2 Reference Source*		
Short description	Defines the input source for the reference for PID2		
Mode	RFC-S		
Minimum	0.000	Maximum	59.999
Default	0.000	Units	
Type	16 Bit User Save	Update Rate	Drive reset read
Display Format	Standard	Decimal Places	3
Coding	RW, PT, BU		

See *PID1 Reference Source* (14.003).

Parameter	14.034 *PID2 Feedback Source*		
Short description	Defines the input source for the feedback for PID2		
Mode	RFC-S		
Minimum	0.000	Maximum	59.999
Default	0.000	Units	
Type	16 Bit User Save	Update Rate	Drive reset read
Display Format	Standard	Decimal Places	3
Coding	RW, PT, BU		

See *PID1 Feedback Source* (14.004).

Parameter	14.035 *PID2 Reference Invert*		
Short description	Set to 1 to invert PID2 reference		
Mode	RFC-S		
Minimum	0	Maximum	1
Default	0	Units	
Type	1 Bit User Save	Update Rate	4ms read
Display Format	Standard	Decimal Places	0
Coding	RW		

See *PID1 Reference Invert* (14.005).

Parameter	14.036 *PID2 Feedback Invert*		
Short description	Set to 1 to invert PID2 feedback		
Mode	RFC-S		
Minimum	0	Maximum	1
Default	0	Units	
Type	1 Bit User Save	Update Rate	4ms read
Display Format	Standard	Decimal Places	0
Coding	RW		

See *PID1 Feedback Invert* (14.006).

Parameter	14.037 *PID2 Reference Slew Rate Limit*		
Short description	Defines the rate in change of output for PID2		
Mode	RFC-S		
Minimum	0.0	Maximum	3200.0
Default	0.0	Units	s
Type	16 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	1
Coding	RW		

See *PID1 Reference Slew Rate* (14.007).

Parameter	14.038 *PID2 Enable*		
Short description	Enables the use of PID2		
Mode	RFC-S		
Minimum	0	Maximum	1
Default	0	Units	
Type	1 Bit User Save	Update Rate	4ms read
Display Format	Standard	Decimal Places	0
Coding	RW		

See *PID1 Enable* (14.008).

Parameter	14.039 *PID2 Enable Source 1*		
Short description	Defines the input source for enabling PID2		
Mode	RFC-S		
Minimum	0.000	Maximum	59.999
Default	0.000	Units	
Type	16 Bit User Save	Update Rate	Drive reset read
Display Format	Standard	Decimal Places	3
Coding	RW, PT, BU		

See *PID1 Enable Source 1* (14.009).

Parameter	14.040 *PID2 Proportional Gain*		
Short description	Defines the Kp gain used for PID2		
Mode	RFC-S		
Minimum	0.000	Maximum	4.000
Default	1.000	Units	
Type	16 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	3
Coding	RW		

See *PID1 Proportional Gain* (14.010).

Parameter	14.041 *PID2 Integral Gain*		
Short description	Defines the Ki gain used for PID2		
Mode	RFC‑S		
Minimum	0.000	Maximum	4.000
Default	0.500	Units	
Type	16 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	3
Coding	RW		

See *PID1 Integral Gain* (14.011).

Parameter	14.042 *PID2 Differential Gain*		
Short description	Defines the Kd gain used for PID2		
Mode	RFC‑S		
Minimum	0.000	Maximum	4.000
Default	0.000	Units	
Type	16 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	3
Coding	RW		

See *PID1 Differential Gain* (14.012).

Parameter	14.043 *PID2 Output Upper Limit*		
Short description	Defines the maximum value of the output for PID2		
Mode	RFC‑S		
Minimum	0.00	Maximum	100.00
Default	100.00	Units	%
Type	16 Bit User Save	Update Rate	4ms read
Display Format	Standard	Decimal Places	2
Coding	RW		

See *PID1 Output Upper Limit* (14.013).

Parameter	14.044 *PID2 Output Lower Limit*		
Short description	Defines the minimum value of the output for PID2		
Mode	RFC‑S		
Minimum	-100.00	Maximum	100.00
Default	-100.00	Units	%
Type	16 Bit User Save	Update Rate	4ms read
Display Format	Standard	Decimal Places	2
Coding	RW		

See *PID1 Output Lower Limit* (14.014).

Parameter	14.045 *PID2 Output Scaling*		
Short description	Defines the scaling factor of the output for PID2		
Mode	RFC‑S		
Minimum	0.000	Maximum	4.000
Default	1.000	Units	
Type	16 Bit User Save	Update Rate	4ms read
Display Format	Standard	Decimal Places	3
Coding	RW		

See *PID1 Output Scaling* (14.015).

Parameter	14.046 *PID2 Destination*		
Short description	Defines the output parameter for PID2		
Mode	RFC‑S		
Minimum	0.000	Maximum	59.999
Default	0.000	Units	
Type	16 Bit User Save	Update Rate	Drive reset read
Display Format	Standard	Decimal Places	3
Coding	RW, DE, PT, BU		

See *PID1 Destination* (14.016).

Parameter	14.047 *PID2 Integral Hold*		
Short description	Enables the integral hold function for PID2		
Mode	RFC-S		
Minimum	0	Maximum	1
Default	0	Units	
Type	1 Bit Volatile	Update Rate	4ms read
Display Format	Standard	Decimal Places	0
Coding	RW		

See *PID1 Integral Hold* (14.017).

Parameter	14.048 *PID2 Symmetrical Limit Enable*		
Short description	Enables the symmetrical limit for PID2		
Mode	RFC-S		
Minimum	0	Maximum	1
Default	0	Units	
Type	1 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW		

See *PID1 Symmetrical Limit Enable* (14.018).

Parameter	14.049 *PID2 Feed-forwards Reference*		
Short description	Displays the value of the feed-forwards reference for PID2		
Mode	RFC-S		
Minimum	-100.00	Maximum	100.00
Default		Units	%
Type	16 Bit Volatile	Update Rate	4ms write
Display Format	Standard	Decimal Places	2
Coding	RO, ND, NC, PT		

See *PID1 Feed-forwards Reference* (14.019).

Parameter	14.050 *PID2 Reference*		
Short description	Displays the value of the reference for PID2		
Mode	RFC-S		
Minimum	-100.00	Maximum	100.00
Default		Units	%
Type	16 Bit Volatile	Update Rate	4ms write
Display Format	Standard	Decimal Places	2
Coding	RO, ND, NC, PT		

See *PID1 Reference* (14.020).

Parameter	14.051 *PID2 Feedback*		
Short description	Displays the value of the feedback for PID2		
Mode	RFC-S		
Minimum	-100.00	Maximum	100.00
Default		Units	%
Type	16 Bit Volatile	Update Rate	4ms write
Display Format	Standard	Decimal Places	2
Coding	RO, ND, NC, PT		

See *PID1 Feedback* (14.021).

Parameter	14.052 *PID2 Error*		
Short description	Displays the value of the error for PID2		
Mode	RFC-S		
Minimum	-100.00	Maximum	100.00
Default		Units	%
Type	16 Bit Volatile	Update Rate	4ms write
Display Format	Standard	Decimal Places	2
Coding	RO, ND, NC, PT		

See *PID1 Error* (14.022).

Parameter	14.053 *PID2 Reference Scaling*		
Short description	Defines the scaling factor for the reference for PID2		
Mode	RFC-S		
Minimum	0.000	Maximum	4.000
Default	1.000	Units	
Type	16 Bit User Save	Update Rate	4ms read
Display Format	Standard	Decimal Places	3
Coding	RW		

See *PID1 Reference Scaling* (14.023).

Parameter	14.054 *PID2 Feedback Scaling*		
Short description	Defines the scaling factor of the feedback for PID2		
Mode	RFC-S		
Minimum	0.000	Maximum	4.000
Default	1.000	Units	
Type	16 Bit User Save	Update Rate	4ms read
Display Format	Standard	Decimal Places	3
Coding	RW		

See *PID1 Feedback Scaling* (14.024).

Parameter	14.055 *PID2 Digital Reference*		
Short description	Defines the value of the digital reference for PID2		
Mode	RFC-S		
Minimum	-100.00	Maximum	100.00
Default	0.00	Units	%
Type	16 Bit User Save	Update Rate	4ms read
Display Format	Standard	Decimal Places	2
Coding	RW		

See *PID1 Digital Reference* (14.025).

Parameter	14.056 *PID2 Digital Feedback*		
Short description	Defines the value of the digital feedback for PID2		
Mode	RFC-S		
Minimum	-100.00	Maximum	100.00
Default	0.00	Units	%
Type	16 Bit User Save	Update Rate	4ms read
Display Format	Standard	Decimal Places	2
Coding	RW		

See *PID1 Digital Feedback* (14.026).

Parameter	14.057 *PID2 Enable Source 2*		
Short description	Defines the input source for enabling PID2		
Mode	RFC-S		
Minimum	0.000	Maximum	59.999
Default	0.000	Units	
Type	16 Bit User Save	Update Rate	Drive reset read
Display Format	Standard	Decimal Places	3
Coding	RW, PT, BU		

See *PID1 Enable Source 2* (14.027).

Parameter	14.058 *PID1 Feedback Output Scaling*		
Short description	Defines the scaling factor of the output feedback for PID1		
Mode	RFC-S		
Minimum	0.000	Maximum	4.000
Default	1.000	Units	
Type	16 Bit User Save	Update Rate	4ms read
Display Format	Standard	Decimal Places	3
Coding	RW		

PID1 alternative feedback and error selection

The description given in *PID1 Output* (14.001) assumed that *PID1 Mode Selector* (14.059) = 0 so that PID controller 1 uses its own feedback (FBK1). It is possible to select alternative configurations that allow various combinations of feedback or error from either PID controller to be used as shown below.

PID1 Mode Selector (14.059) can be used to select the feedback and error as shown in the table below. It should be noted that PID controller 2 will operate normally even when its feedback or error has been selected for PID controller 1. However, if *PID1 Mode Selector* (14.059) is non-zero PID controller 2 enable is controlled directly by the enable state of PID controller 1.

PID1 Mode Selector (14.059)	Feedback	Error
0: Fbk1	FBK1	ERR1
1: Fbk2	FBK2	ERR1
2: Fbk1 + Fbk2	FBK1 + FBK2	ERR1
3: Min Fbk	Lowest of FBK1 or FBK2	ERR1
4: Max Fbk	Highest of FBK1 or FBK2	ERR1
5: Av Fbk	(FBK1 + FBK2) / 2	ERR1
6: Min Error	FBK1	If |ERR1| ≤ |ERR2| then ERR1 Else ERR2
7: Max Error	FBK1	If |ERR1| ≥ |ERR2| then ERR1 Else ERR2

PID1 Feedback Output Scaling (14.058) can then be used to scale the results. *PID1 Feedback Square Root Enable 2* (14.062) can be used in converting the output of the combined feedback from pressure to flow. It is easier to use a pressure transducer than a flow transducer, and so the feedback from the transducer needs to be converted from pressure to flow. As flow = Constant x √Pressure the square root function can be used in the conversion.

Parameter	14.059 *PID1 Mode Selector*		
Short description	Defines the mode of PID1		
Mode	RFC‑S		
Minimum	0	Maximum	7
Default	0	Units	
Type	8 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW, TE		

Value	Text
0	Fbk1
1	Fbk2
2	Fbk1 + Fbk2
3	Min Fbk
4	Max Fbk
5	Av Fbk
6	Min Error
7	Max Error

See *PID1 Feedback Output Scaling* (14.058).

Parameter	14.060 *PID1 Feedback Square Root Enable 1*		
Short description	Enables the squre root function of PID1		
Mode	RFC‑S		
Minimum	0	Maximum	1
Default	0	Units	
Type	1 Bit User Save	Update Rate	4ms read
Display Format	Standard	Decimal Places	0
Coding	RW		

See *PID1 Feedback Source* (14.004).

Parameter	14.061 *PID2 Feedback Square Root Enable*		
Short description	Enables the squre root function of PID2		
Mode	RFC‑S		
Minimum	0	Maximum	1
Default	0	Units	
Type	1 Bit User Save	Update Rate	4ms read
Display Format	Standard	Decimal Places	0
Coding	RW		

See *PID1 Feedback Square Root Enable 1* (14.060)

Parameter	14.062 *PID1 Feedback Square Root Enable 2*		
Short description	Enables the squre root function of PID1		
Mode	RFC‑S		
Minimum	0	Maximum	1
Default	0	Units	
Type	1 Bit User Save	Update Rate	4ms read
Display Format	Standard	Decimal Places	0
Coding	RW		

See *PID1 Feedback Output Scaling* (14.058).

Menu 18 Single Line Descriptions − *Application Menu 1*

Mode: RFC‑S

Parameter	Range	Default	Type					
18.001 Application Menu 1 Power‑down Save Integer	-32768 to 32767	0	RW	Num				PS
18.002 Application Menu 1 Read‑only Integer 2	-32768 to 32767		RO	Num	ND	NC		
18.003 Application Menu 1 Read‑only Integer 3	-32768 to 32767		RO	Num	ND	NC		
18.004 Application Menu 1 Read‑only Integer 4	-32768 to 32767		RO	Num	ND	NC		
18.005 Application Menu 1 Read‑only Integer 5	-32768 to 32767		RO	Num	ND	NC		
18.006 Application Menu 1 Read‑only Integer 6	-32768 to 32767		RO	Num	ND	NC		
18.007 Application Menu 1 Read‑only Integer 7	-32768 to 32767		RO	Num	ND	NC		
18.008 Application Menu 1 Read‑only Integer 8	-32768 to 32767		RO	Num	ND	NC		
18.009 Application Menu 1 Read‑only Integer 9	-32768 to 32767		RO	Num	ND	NC		
18.010 Application Menu 1 Read‑only Integer 10	-32768 to 32767		RO	Num	ND	NC		
18.011 Application Menu 1 Read‑write Integer 11	-32768 to 32767	0	RW	Num				US
18.012 Application Menu 1 Read‑write Integer 12	-32768 to 32767	0	RW	Num				US
18.013 Application Menu 1 Read‑write Integer 13	-32768 to 32767	0	RW	Num				US
18.014 Application Menu 1 Read‑write Integer 14	-32768 to 32767	0	RW	Num				US
18.015 Application Menu 1 Read‑write Integer 15	-32768 to 32767	0	RW	Num				US
18.016 Application Menu 1 Read‑write Integer 16	-32768 to 32767	0	RW	Num				US
18.017 Application Menu 1 Read‑write Integer 17	-32768 to 32767	0	RW	Num				US
18.018 Application Menu 1 Read‑write Integer 18	-32768 to 32767	0	RW	Num				US
18.019 Application Menu 1 Read‑write Integer 19	-32768 to 32767	0	RW	Num				US
18.020 Application Menu 1 Read‑write Integer 20	-32768 to 32767	0	RW	Num				US
18.021 Application Menu 1 Read‑write Integer 21	-32768 to 32767	0	RW	Num				US
18.022 Application Menu 1 Read‑write Integer 22	-32768 to 32767	0	RW	Num				US
18.023 Application Menu 1 Read‑write Integer 23	-32768 to 32767	0	RW	Num				US
18.024 Application Menu 1 Read‑write Integer 24	-32768 to 32767	0	RW	Num				US
18.025 Application Menu 1 Read‑write Integer 25	-32768 to 32767	0	RW	Num				US
18.026 Application Menu 1 Read‑write Integer 26	-32768 to 32767	0	RW	Num				US
18.027 Application Menu 1 Read‑write Integer 27	-32768 to 32767	0	RW	Num				US
18.028 Application Menu 1 Read‑write Integer 28	-32768 to 32767	0	RW	Num				US
18.029 Application Menu 1 Read‑write Integer 29	-32768 to 32767	0	RW	Num				US
18.030 Application Menu 1 Read‑write Integer 30	-32768 to 32767	0	RW	Num				US
18.031 Application Menu 1 Read‑write bit 31	Off (0) or On (1)	Off (0)	RW	Bit				US
18.032 Application Menu 1 Read‑write bit 32	Off (0) or On (1)	Off (0)	RW	Bit				US
18.033 Application Menu 1 Read‑write bit 33	Off (0) or On (1)	Off (0)	RW	Bit				US
18.034 Application Menu 1 Read‑write bit 34	Off (0) or On (1)	Off (0)	RW	Bit				US
18.035 Application Menu 1 Read‑write bit 35	Off (0) or On (1)	Off (0)	RW	Bit				US
18.036 Application Menu 1 Read‑write bit 36	Off (0) or On (1)	Off (0)	RW	Bit				US
18.037 Application Menu 1 Read‑write bit 37	Off (0) or On (1)	Off (0)	RW	Bit				US
18.038 Application Menu 1 Read‑write bit 38	Off (0) or On (1)	Off (0)	RW	Bit				US
18.039 Application Menu 1 Read‑write bit 39	Off (0) or On (1)	Off (0)	RW	Bit				US
18.040 Application Menu 1 Read‑write bit 40	Off (0) or On (1)	Off (0)	RW	Bit				US
18.041 Application Menu 1 Read‑write bit 41	Off (0) or On (1)	Off (0)	RW	Bit				US
18.042 Application Menu 1 Read‑write bit 42	Off (0) or On (1)	Off (0)	RW	Bit				US
18.043 Application Menu 1 Read‑write bit 43	Off (0) or On (1)	Off (0)	RW	Bit				US
18.044 Application Menu 1 Read‑write bit 44	Off (0) or On (1)	Off (0)	RW	Bit				US
18.045 Application Menu 1 Read‑write bit 45	Off (0) or On (1)	Off (0)	RW	Bit				US
18.046 Application Menu 1 Read‑write bit 46	Off (0) or On (1)	Off (0)	RW	Bit				US
18.047 Application Menu 1 Read‑write bit 47	Off (0) or On (1)	Off (0)	RW	Bit				US
18.048 Application Menu 1 Read‑write bit 48	Off (0) or On (1)	Off (0)	RW	Bit				US
18.049 Application Menu 1 Read‑write bit 49	Off (0) or On (1)	Off (0)	RW	Bit				US
18.050 Application Menu 1 Read‑write bit 50	Off (0) or On (1)	Off (0)	RW	Bit				US
18.051 Application Menu 1 Power‑down Save Long Integer 51	-2147483648 to 2147483647	0	RW	Num				PS
18.052 Application Menu 1 Power‑down Save Long Integer 52	-2147483648 to 2147483647	0	RW	Num				PS
18.053 Application Menu 1 Power‑down Save Long Integer 53	-2147483648 to 2147483647	0	RW	Num				PS
18.054 Application Menu 1 Power‑down Save Long Integer 54	-2147483648 to 2147483647	0	RW	Num				PS

RW	Read / Write	RO	Read-only	Bit	Bit parameter	Txt	Text string	Date	Date parameter	Time	Time parameter
Chr	Character parameter	Bin	Binary parameter	IP	IP address	Mac	MAC address	Ver	Version number	SMP	Slot, menu, parameter
Num	Number parameter	DE	Destination	ND	No default value	RA	Rating dependent	NC	Non-copyable	PT	Protected
FI	Filtered	US	User save	PS	Power-down save						

Menu 18 − *Application Menu 1*

Mode: RFC‑S

Menus 18-20 are general application menus that can be used by one of the option modules fitted to the drive. These menus are customisable and the following RAM is provided to be shared between all 3 menus. This is based on increasing the RAM provided for Unidrive SP by approximately 20%.

	1	8	16	32
Volatile	0	32	64	32
User save	64	32	48	12
Power-down save	0	0	2	8

If no option modules provide customisation tables for these menus then the drive provides the customisation tables to give the following parameters.

Parameter	18.001 *Application Menu 1 Power-down Save Integer*		
Short description	General power-down save integer application parameter		
Mode	RFC‑S		
Minimum	-32768	Maximum	32767
Default	0	Units	
Type	16 Bit Power Down Save	Update Rate	N/A
Display Format	Standard	Decimal Places	0
Coding	RW		

Parameter	18.002 *Application Menu 1 Read-only Integer 2*		
Short description	General read-only integer application parameter		
Mode	RFC‑S		
Minimum	-32768	Maximum	32767
Default		Units	
Type	16 Bit Volatile	Update Rate	N/A
Display Format	Standard	Decimal Places	0
Coding	RO, PR, ND, NC		

Parameter	18.003 *Application Menu 1 Read-only Integer 3*		
Short description	General read-only integer application parameter		
Mode	RFC‑S		
Minimum	-32768	Maximum	32767
Default		Units	
Type	16 Bit Volatile	Update Rate	N/A
Display Format	Standard	Decimal Places	0
Coding	RO, PR, ND, NC		

Parameter	18.004 *Application Menu 1 Read-only Integer 4*		
Short description	General read-only integer application parameter		
Mode	RFC‑S		
Minimum	-32768	Maximum	32767
Default		Units	
Type	16 Bit Volatile	Update Rate	N/A
Display Format	Standard	Decimal Places	0
Coding	RO, PR, ND, NC		

Parameter	18.005 *Application Menu 1 Read-only Integer 5*		
Short description	General read-only integer application parameter		
Mode	RFC‑S		
Minimum	-32768	Maximum	32767
Default		Units	
Type	16 Bit Volatile	Update Rate	N/A
Display Format	Standard	Decimal Places	0
Coding	RO, PR, ND, NC		

Parameter	18.006 *Application Menu 1 Read-only Integer 6*		
Short description	General read-only integer application parameter		
Mode	RFC‑S		
Minimum	-32768	Maximum	32767
Default		Units	
Type	16 Bit Volatile	Update Rate	N/A
Display Format	Standard	Decimal Places	0
Coding	RO, PR, ND, NC		

Parameter	18.007 *Application Menu 1 Read-only Integer 7*		
Short description	General read-only integer application parameter		
Mode	RFC‑S		
Minimum	-32768	Maximum	32767
Default		Units	
Type	16 Bit Volatile	Update Rate	N/A
Display Format	Standard	Decimal Places	0
Coding	RO, PR, ND, NC		

Parameter	18.008 *Application Menu 1 Read-only Integer 8*		
Short description	General read-only integer application parameter		
Mode	RFC‑S		
Minimum	-32768	Maximum	32767
Default		Units	
Type	16 Bit Volatile	Update Rate	N/A
Display Format	Standard	Decimal Places	0
Coding	RO, PR, ND, NC		

Parameter	18.009 *Application Menu 1 Read-only Integer 9*		
Short description	General read-only integer application parameter		
Mode	RFC‑S		
Minimum	-32768	Maximum	32767
Default		Units	
Type	16 Bit Volatile	Update Rate	N/A
Display Format	Standard	Decimal Places	0
Coding	RO, PR, ND, NC		

Parameter	18.010 *Application Menu 1 Read-only Integer 10*		
Short description	General read-only integer application parameter		
Mode	RFC‑S		
Minimum	-32768	Maximum	32767
Default		Units	
Type	16 Bit Volatile	Update Rate	N/A
Display Format	Standard	Decimal Places	0
Coding	RO, PR, ND, NC		

Parameter	18.011 *Application Menu 1 Read-write Integer 11*		
Short description	General read-write integer application parameter		
Mode	RFC‑S		
Minimum	-32768	Maximum	32767
Default	0	Units	
Type	16 Bit User Save	Update Rate	N/A
Display Format	Standard	Decimal Places	0
Coding	RW		

Parameter	18.012 *Application Menu 1 Read-write Integer 12*		
Short description	General read-write integer application parameter		
Mode	RFC‑S		
Minimum	-32768	Maximum	32767
Default	0	Units	
Type	16 Bit User Save	Update Rate	N/A
Display Format	Standard	Decimal Places	0
Coding	RW		

Parameter	**18.013** *Application Menu 1 Read-write Integer 13*		
Short description	General read-write integer application parameter		
Mode	RFC-S		
Minimum	-32768	Maximum	32767
Default	0	Units	
Type	16 Bit User Save	Update Rate	N/A
Display Format	Standard	Decimal Places	0
Coding	RW		

Parameter	**18.014** *Application Menu 1 Read-write Integer 14*		
Short description	General read-write integer application parameter		
Mode	RFC-S		
Minimum	-32768	Maximum	32767
Default	0	Units	
Type	16 Bit User Save	Update Rate	N/A
Display Format	Standard	Decimal Places	0
Coding	RW		

Parameter	**18.015** *Application Menu 1 Read-write Integer 15*		
Short description	General read-write integer application parameter		
Mode	RFC-S		
Minimum	-32768	Maximum	32767
Default	0	Units	
Type	16 Bit User Save	Update Rate	N/A
Display Format	Standard	Decimal Places	0
Coding	RW		

Parameter	**18.016** *Application Menu 1 Read-write Integer 16*		
Short description	General read-write integer application parameter		
Mode	RFC-S		
Minimum	-32768	Maximum	32767
Default	0	Units	
Type	16 Bit User Save	Update Rate	N/A
Display Format	Standard	Decimal Places	0
Coding	RW		

Parameter	**18.017** *Application Menu 1 Read-write Integer 17*		
Short description	General read-write integer application parameter		
Mode	RFC-S		
Minimum	-32768	Maximum	32767
Default	0	Units	
Type	16 Bit User Save	Update Rate	N/A
Display Format	Standard	Decimal Places	0
Coding	RW		

Parameter	**18.018** *Application Menu 1 Read-write Integer 18*		
Short description	General read-write integer application parameter		
Mode	RFC-S		
Minimum	-32768	Maximum	32767
Default	0	Units	
Type	16 Bit User Save	Update Rate	N/A
Display Format	Standard	Decimal Places	0
Coding	RW		

Parameter	**18.019** *Application Menu 1 Read-write Integer 19*		
Short description	General read-write integer application parameter		
Mode	RFC-S		
Minimum	-32768	Maximum	32767
Default	0	Units	
Type	16 Bit User Save	Update Rate	N/A
Display Format	Standard	Decimal Places	0
Coding	RW		

Parameter	**18.020** *Application Menu 1 Read-write Integer 20*		
Short description	General read-write integer application parameter		
Mode	RFC‑S		
Minimum	-32768	Maximum	32767
Default	0	Units	
Type	16 Bit User Save	Update Rate	N/A
Display Format	Standard	Decimal Places	0
Coding	RW		

Parameter	**18.021** *Application Menu 1 Read-write Integer 21*		
Short description	General read-write integer application parameter		
Mode	RFC‑S		
Minimum	-32768	Maximum	32767
Default	0	Units	
Type	16 Bit User Save	Update Rate	N/A
Display Format	Standard	Decimal Places	0
Coding	RW		

Parameter	**18.022** *Application Menu 1 Read-write Integer 22*		
Short description	General read-write integer application parameter		
Mode	RFC‑S		
Minimum	-32768	Maximum	32767
Default	0	Units	
Type	16 Bit User Save	Update Rate	N/A
Display Format	Standard	Decimal Places	0
Coding	RW		

Parameter	**18.023** *Application Menu 1 Read-write Integer 23*		
Short description	General read-write integer application parameter		
Mode	RFC‑S		
Minimum	-32768	Maximum	32767
Default	0	Units	
Type	16 Bit User Save	Update Rate	N/A
Display Format	Standard	Decimal Places	0
Coding	RW		

Parameter	**18.024** *Application Menu 1 Read-write Integer 24*		
Short description	General read-write integer application parameter		
Mode	RFC‑S		
Minimum	-32768	Maximum	32767
Default	0	Units	
Type	16 Bit User Save	Update Rate	N/A
Display Format	Standard	Decimal Places	0
Coding	RW		

Parameter	**18.025** *Application Menu 1 Read-write Integer 25*		
Short description	General read-write integer application parameter		
Mode	RFC‑S		
Minimum	-32768	Maximum	32767
Default	0	Units	
Type	16 Bit User Save	Update Rate	N/A
Display Format	Standard	Decimal Places	0
Coding	RW		

Parameter	**18.026** *Application Menu 1 Read-write Integer 26*		
Short description	General read-write integer application parameter		
Mode	RFC‑S		
Minimum	-32768	Maximum	32767
Default	0	Units	
Type	16 Bit User Save	Update Rate	N/A
Display Format	Standard	Decimal Places	0
Coding	RW		

Parameter	18.027 *Application Menu 1 Read-write Integer 27*		
Short description	General read-write integer application parameter		
Mode	RFC‑S		
Minimum	-32768	Maximum	32767
Default	0	Units	
Type	16 Bit User Save	Update Rate	N/A
Display Format	Standard	Decimal Places	0
Coding	RW		

Parameter	18.028 *Application Menu 1 Read-write Integer 28*		
Short description	General read-write integer application parameter		
Mode	RFC‑S		
Minimum	-32768	Maximum	32767
Default	0	Units	
Type	16 Bit User Save	Update Rate	N/A
Display Format	Standard	Decimal Places	0
Coding	RW		

Parameter	18.029 *Application Menu 1 Read-write Integer 29*		
Short description	General read-write integer application parameter		
Mode	RFC‑S		
Minimum	-32768	Maximum	32767
Default	0	Units	
Type	16 Bit User Save	Update Rate	N/A
Display Format	Standard	Decimal Places	0
Coding	RW		

Parameter	18.030 *Application Menu 1 Read-write Integer 30*		
Short description	General read-write integer application parameter		
Mode	RFC‑S		
Minimum	-32768	Maximum	32767
Default	0	Units	
Type	16 Bit User Save	Update Rate	N/A
Display Format	Standard	Decimal Places	0
Coding	RW		

Parameter	18.031 *Application Menu 1 Read-write bit 31*		
Short description	General read-write bit application parameter		
Mode	RFC‑S		
Minimum	0	Maximum	1
Default	0	Units	
Type	1 Bit User Save	Update Rate	N/A
Display Format	Standard	Decimal Places	0
Coding	RW		

Parameter	18.032 *Application Menu 1 Read-write bit 32*		
Short description	General read-write bit application parameter		
Mode	RFC‑S		
Minimum	0	Maximum	1
Default	0	Units	
Type	1 Bit User Save	Update Rate	N/A
Display Format	Standard	Decimal Places	0
Coding	RW		

Parameter	18.033 *Application Menu 1 Read-write bit 33*		
Short description	General read-write bit application parameter		
Mode	RFC‑S		
Minimum	0	Maximum	1
Default	0	Units	
Type	1 Bit User Save	Update Rate	N/A
Display Format	Standard	Decimal Places	0
Coding	RW		

Parameter	**18.034** *Application Menu 1 Read-write bit 34*		
Short description	General read-write bit application parameter		
Mode	RFC‑S		
Minimum	0	Maximum	1
Default	0	Units	
Type	1 Bit User Save	Update Rate	N/A
Display Format	Standard	Decimal Places	0
Coding	RW		

Parameter	**18.035** *Application Menu 1 Read-write bit 35*		
Short description	General read-write bit application parameter		
Mode	RFC‑S		
Minimum	0	Maximum	1
Default	0	Units	
Type	1 Bit User Save	Update Rate	N/A
Display Format	Standard	Decimal Places	0
Coding	RW		

Parameter	**18.036** *Application Menu 1 Read-write bit 36*		
Short description	General read-write bit application parameter		
Mode	RFC‑S		
Minimum	0	Maximum	1
Default	0	Units	
Type	1 Bit User Save	Update Rate	N/A
Display Format	Standard	Decimal Places	0
Coding	RW		

Parameter	**18.037** *Application Menu 1 Read-write bit 37*		
Short description	General read-write bit application parameter		
Mode	RFC‑S		
Minimum	0	Maximum	1
Default	0	Units	
Type	1 Bit User Save	Update Rate	N/A
Display Format	Standard	Decimal Places	0
Coding	RW		

Parameter	**18.038** *Application Menu 1 Read-write bit 38*		
Short description	General read-write bit application parameter		
Mode	RFC‑S		
Minimum	0	Maximum	1
Default	0	Units	
Type	1 Bit User Save	Update Rate	N/A
Display Format	Standard	Decimal Places	0
Coding	RW		

Parameter	**18.039** *Application Menu 1 Read-write bit 39*		
Short description	General read-write bit application parameter		
Mode	RFC‑S		
Minimum	0	Maximum	1
Default	0	Units	
Type	1 Bit User Save	Update Rate	N/A
Display Format	Standard	Decimal Places	0
Coding	RW		

Parameter	**18.040** *Application Menu 1 Read-write bit 40*		
Short description	General read-write bit application parameter		
Mode	RFC‑S		
Minimum	0	Maximum	1
Default	0	Units	
Type	1 Bit User Save	Update Rate	N/A
Display Format	Standard	Decimal Places	0
Coding	RW		

Parameter	18.041 *Application Menu 1 Read-write bit 41*		
Short description	General read-write bit application parameter		
Mode	RFC-S		
Minimum	0	Maximum	1
Default	0	Units	
Type	1 Bit User Save	Update Rate	N/A
Display Format	Standard	Decimal Places	0
Coding	RW		

Parameter	18.042 *Application Menu 1 Read-write bit 42*		
Short description	General read-write bit application parameter		
Mode	RFC-S		
Minimum	0	Maximum	1
Default	0	Units	
Type	1 Bit User Save	Update Rate	N/A
Display Format	Standard	Decimal Places	0
Coding	RW		

Parameter	18.043 *Application Menu 1 Read-write bit 43*		
Short description	General read-write bit application parameter		
Mode	RFC-S		
Minimum	0	Maximum	1
Default	0	Units	
Type	1 Bit User Save	Update Rate	N/A
Display Format	Standard	Decimal Places	0
Coding	RW		

Parameter	18.044 *Application Menu 1 Read-write bit 44*		
Short description	General read-write bit application parameter		
Mode	RFC-S		
Minimum	0	Maximum	1
Default	0	Units	
Type	1 Bit User Save	Update Rate	N/A
Display Format	Standard	Decimal Places	0
Coding	RW		

Parameter	18.045 *Application Menu 1 Read-write bit 45*		
Short description	General read-write bit application parameter		
Mode	RFC-S		
Minimum	0	Maximum	1
Default	0	Units	
Type	1 Bit User Save	Update Rate	N/A
Display Format	Standard	Decimal Places	0
Coding	RW		

Parameter	18.046 *Application Menu 1 Read-write bit 46*		
Short description	General read-write bit application parameter		
Mode	RFC-S		
Minimum	0	Maximum	1
Default	0	Units	
Type	1 Bit User Save	Update Rate	N/A
Display Format	Standard	Decimal Places	0
Coding	RW		

Parameter	18.047 *Application Menu 1 Read-write bit 47*		
Short description	General read-write bit application parameter		
Mode	RFC-S		
Minimum	0	Maximum	1
Default	0	Units	
Type	1 Bit User Save	Update Rate	N/A
Display Format	Standard	Decimal Places	0
Coding	RW		

Parameter	18.048 *Application Menu 1 Read-write bit 48*		
Short description	General read-write bit application parameter		
Mode	RFC‑S		
Minimum	0	Maximum	1
Default	0	Units	
Type	1 Bit User Save	Update Rate	N/A
Display Format	Standard	Decimal Places	0
Coding	RW		

Parameter	18.049 *Application Menu 1 Read-write bit 49*		
Short description	General read-write bit application parameter		
Mode	RFC‑S		
Minimum	0	Maximum	1
Default	0	Units	
Type	1 Bit User Save	Update Rate	N/A
Display Format	Standard	Decimal Places	0
Coding	RW		

Parameter	18.050 *Application Menu 1 Read-write bit 50*		
Short description	General read-write bit application parameter		
Mode	RFC‑S		
Minimum	0	Maximum	1
Default	0	Units	
Type	1 Bit User Save	Update Rate	N/A
Display Format	Standard	Decimal Places	0
Coding	RW		

Parameter	18.051 *Application Menu 1 Power-down Save Long Integer 51*		
Short description	General power-down save long integer application parameter		
Mode	RFC‑S		
Minimum	-2147483648	Maximum	2147483647
Default	0	Units	
Type	32 Bit Power Down Save	Update Rate	N/A
Display Format	Standard	Decimal Places	0
Coding	RW		

Parameter	18.052 *Application Menu 1 Power-down Save Long Integer 52*		
Short description	General power-down save long integer application parameter		
Mode	RFC‑S		
Minimum	-2147483648	Maximum	2147483647
Default	0	Units	
Type	32 Bit Power Down Save	Update Rate	N/A
Display Format	Standard	Decimal Places	0
Coding	RW		

Parameter	18.053 *Application Menu 1 Power-down Save Long Integer 53*		
Short description	General power-down save long integer application parameter		
Mode	RFC‑S		
Minimum	-2147483648	Maximum	2147483647
Default	0	Units	
Type	32 Bit Power Down Save	Update Rate	N/A
Display Format	Standard	Decimal Places	0
Coding	RW		

Parameter	18.054 *Application Menu 1 Power-down Save Long Integer 54*		
Short description	General power-down save long integer application parameter		
Mode	RFC‑S		
Minimum	-2147483648	Maximum	2147483647
Default	0	Units	
Type	32 Bit Power Down Save	Update Rate	N/A
Display Format	Standard	Decimal Places	0
Coding	RW		

Menu 19 Single Line Descriptions − *Application Menu 2*

Mode: RFC‑S

Parameter	Range	Default	Type					
19.001 Application Menu 2 Power‑down Save Integer	-32768 to 32767	0	RW	Num				PS
19.002 Application Menu 2 Read‑only Integer 2	-32768 to 32767		RO	Num	ND	NC		
19.003 Application Menu 2 Read‑only Integer 3	-32768 to 32767		RO	Num	ND	NC		
19.004 Application Menu 2 Read‑only Integer 4	-32768 to 32767		RO	Num	ND	NC		
19.005 Application Menu 2 Read‑only Integer 5	-32768 to 32767		RO	Num	ND	NC		
19.006 Application Menu 2 Read‑only Integer 6	-32768 to 32767		RO	Num	ND	NC		
19.007 Application Menu 2 Read‑only Integer 7	-32768 to 32767		RO	Num	ND	NC		
19.008 Application Menu 2 Read‑only Integer 8	-32768 to 32767		RO	Num	ND	NC		
19.009 Application Menu 2 Read‑only Integer 9	-32768 to 32767		RO	Num	ND	NC		
19.010 Application Menu 2 Read‑only Integer 10	-32768 to 32767		RO	Num	ND	NC		
19.011 Application Menu 2 Read‑write Integer 11	-32768 to 32767	0	RW	Num				US
19.012 Application Menu 2 Read‑write Integer 12	-32768 to 32767	0	RW	Num				US
19.013 Application Menu 2 Read‑write Integer 13	-32768 to 32767	0	RW	Num				US
19.014 Application Menu 2 Read‑write Integer 14	-32768 to 32767	0	RW	Num				US
19.015 Application Menu 2 Read‑write Integer 15	-32768 to 32767	0	RW	Num				US
19.016 Application Menu 2 Read‑write Integer 16	-32768 to 32767	0	RW	Num				US
19.017 Application Menu 2 Read‑write Integer 17	-32768 to 32767	0	RW	Num				US
19.018 Application Menu 2 Read‑write Integer 18	-32768 to 32767	0	RW	Num				US
19.019 Application Menu 2 Read‑write Integer 19	-32768 to 32767	0	RW	Num				US
19.020 Application Menu 2 Read‑write Integer 20	-32768 to 32767	0	RW	Num				US
19.021 Application Menu 2 Read‑write Integer 21	-32768 to 32767	0	RW	Num				US
19.022 Application Menu 2 Read‑write Integer 22	-32768 to 32767	0	RW	Num				US
19.023 Application Menu 2 Read‑write Integer 23	-32768 to 32767	0	RW	Num				US
19.024 Application Menu 2 Read‑write Integer 24	-32768 to 32767	0	RW	Num				US
19.025 Application Menu 2 Read‑write Integer 25	-32768 to 32767	0	RW	Num				US
19.026 Application Menu 2 Read‑write Integer 26	-32768 to 32767	0	RW	Num				US
19.027 Application Menu 2 Read‑write Integer 27	-32768 to 32767	0	RW	Num				US
19.028 Application Menu 2 Read‑write Integer 28	-32768 to 32767	0	RW	Num				US
19.029 Application Menu 2 Read‑write Integer 29	-32768 to 32767	0	RW	Num				US
19.030 Application Menu 2 Read‑write Integer 30	-32768 to 32767	0	RW	Num				US
19.031 Application Menu 2 Read‑write bit 31	Off (0) or On (1)	Off (0)	RW	Bit				US
19.032 Application Menu 2 Read‑write bit 32	Off (0) or On (1)	Off (0)	RW	Bit				US
19.033 Application Menu 2 Read‑write bit 33	Off (0) or On (1)	Off (0)	RW	Bit				US
19.034 Application Menu 2 Read‑write bit 34	Off (0) or On (1)	Off (0)	RW	Bit				US
19.035 Application Menu 2 Read‑write bit 35	Off (0) or On (1)	Off (0)	RW	Bit				US
19.036 Application Menu 2 Read‑write bit 36	Off (0) or On (1)	Off (0)	RW	Bit				US
19.037 Application Menu 2 Read‑write bit 37	Off (0) or On (1)	Off (0)	RW	Bit				US
19.038 Application Menu 2 Read‑write bit 38	Off (0) or On (1)	Off (0)	RW	Bit				US
19.039 Application Menu 2 Read‑write bit 39	Off (0) or On (1)	Off (0)	RW	Bit				US
19.040 Application Menu 2 Read‑write bit 40	Off (0) or On (1)	Off (0)	RW	Bit				US
19.041 Application Menu 2 Read‑write bit 41	Off (0) or On (1)	Off (0)	RW	Bit				US
19.042 Application Menu 2 Read‑write bit 42	Off (0) or On (1)	Off (0)	RW	Bit				US
19.043 Application Menu 2 Read‑write bit 43	Off (0) or On (1)	Off (0)	RW	Bit				US
19.044 Application Menu 2 Read‑write bit 44	Off (0) or On (1)	Off (0)	RW	Bit				US
19.045 Application Menu 2 Read‑write bit 45	Off (0) or On (1)	Off (0)	RW	Bit				US
19.046 Application Menu 2 Read‑write bit 46	Off (0) or On (1)	Off (0)	RW	Bit				US
19.047 Application Menu 2 Read‑write bit 47	Off (0) or On (1)	Off (0)	RW	Bit				US
19.048 Application Menu 2 Read‑write bit 48	Off (0) or On (1)	Off (0)	RW	Bit				US
19.049 Application Menu 2 Read‑write bit 49	Off (0) or On (1)	Off (0)	RW	Bit				US
19.050 Application Menu 2 Read‑write bit 50	Off (0) or On (1)	Off (0)	RW	Bit				US
19.051 Application Menu 2 Power‑down Save Long Integer 51	-2147483648 to 2147483647	0	RW	Num				PS
19.052 Application Menu 2 Power‑down Save Long Integer 52	-2147483648 to 2147483647	0	RW	Num				PS
19.053 Application Menu 2 Power‑down Save Long Integer 53	-2147483648 to 2147483647	0	RW	Num				PS
19.054 Application Menu 2 Power‑down Save Long Integer 54	-2147483648 to 2147483647	0	RW	Num				PS

RW	Read / Write	RO	Read-only	Bit	Bit parameter	Txt	Text string	Date	Date parameter	Time	Time parameter
Chr	Character parameter	Bin	Binary parameter	IP	IP address	Mac	MAC address	Ver	Version number	SMP	Slot, menu, parameter
Num	Number parameter	DE	Destination	ND	No default value	RA	Rating dependent	NC	Non-copyable	PT	Protected
FI	Filtered	US	User save	PS	Power-down save						

Menu 19 − *Application Menu 2*

Mode: RFC‑S

See the introduction to menu 18.

Parameter	19.001 *Application Menu 2 Power-down Save Integer*		
Short description	General power-down save integer application parameter		
Mode	RFC‑S		
Minimum	-32768	Maximum	32767
Default	0	Units	
Type	16 Bit Power Down Save	Update Rate	N/A
Display Format	Standard	Decimal Places	0
Coding	RW		

Parameter	19.002 *Application Menu 2 Read-only Integer 2*		
Short description	General read-only integer application parameter		
Mode	RFC‑S		
Minimum	-32768	Maximum	32767
Default		Units	
Type	16 Bit Volatile	Update Rate	N/A
Display Format	Standard	Decimal Places	0
Coding	RO, PR, ND, NC		

Parameter	19.003 *Application Menu 2 Read-only Integer 3*		
Short description	General read-only integer application parameter		
Mode	RFC‑S		
Minimum	-32768	Maximum	32767
Default		Units	
Type	16 Bit Volatile	Update Rate	N/A
Display Format	Standard	Decimal Places	0
Coding	RO, PR, ND, NC		

Parameter	19.004 *Application Menu 2 Read-only Integer 4*		
Short description	General read-only integer application parameter		
Mode	RFC‑S		
Minimum	-32768	Maximum	32767
Default		Units	
Type	16 Bit Volatile	Update Rate	N/A
Display Format	Standard	Decimal Places	0
Coding	RO, PR, ND, NC		

Parameter	19.005 *Application Menu 2 Read-only Integer 5*		
Short description	General read-only integer application parameter		
Mode	RFC‑S		
Minimum	-32768	Maximum	32767
Default		Units	
Type	16 Bit Volatile	Update Rate	N/A
Display Format	Standard	Decimal Places	0
Coding	RO, PR, ND, NC		

Parameter	19.006 *Application Menu 2 Read-only Integer 6*		
Short description	General read-only integer application parameter		
Mode	RFC‑S		
Minimum	-32768	Maximum	32767
Default		Units	
Type	16 Bit Volatile	Update Rate	N/A
Display Format	Standard	Decimal Places	0
Coding	RO, PR, ND, NC		

Parameter	19.007 *Application Menu 2 Read-only Integer 7*		
Short description	General read-only integer application parameter		
Mode	RFC‑S		
Minimum	-32768	Maximum	32767
Default		Units	
Type	16 Bit Volatile	Update Rate	N/A
Display Format	Standard	Decimal Places	0
Coding	RO, PR, ND, NC		

Parameter	19.008 *Application Menu 2 Read-only Integer 8*		
Short description	General read-only integer application parameter		
Mode	RFC‑S		
Minimum	-32768	Maximum	32767
Default		Units	
Type	16 Bit Volatile	Update Rate	N/A
Display Format	Standard	Decimal Places	0
Coding	RO, PR, ND, NC		

Parameter	19.009 *Application Menu 2 Read-only Integer 9*		
Short description	General read-only integer application parameter		
Mode	RFC‑S		
Minimum	-32768	Maximum	32767
Default		Units	
Type	16 Bit Volatile	Update Rate	N/A
Display Format	Standard	Decimal Places	0
Coding	RO, PR, ND, NC		

Parameter	19.010 *Application Menu 2 Read-only Integer 10*		
Short description	General read-only integer application parameter		
Mode	RFC‑S		
Minimum	-32768	Maximum	32767
Default		Units	
Type	16 Bit Volatile	Update Rate	N/A
Display Format	Standard	Decimal Places	0
Coding	RO, PR, ND, NC		

Parameter	19.011 *Application Menu 2 Read-write Integer 11*		
Short description	General read-write integer application parameter		
Mode	RFC‑S		
Minimum	-32768	Maximum	32767
Default	0	Units	
Type	16 Bit User Save	Update Rate	N/A
Display Format	Standard	Decimal Places	0
Coding	RW		

Parameter	19.012 *Application Menu 2 Read-write Integer 12*		
Short description	General read-write integer application parameter		
Mode	RFC‑S		
Minimum	-32768	Maximum	32767
Default	0	Units	
Type	16 Bit User Save	Update Rate	N/A
Display Format	Standard	Decimal Places	0
Coding	RW		

Parameter	19.013 *Application Menu 2 Read-write Integer 13*		
Short description	General read-write integer application parameter		
Mode	RFC‑S		
Minimum	-32768	Maximum	32767
Default	0	Units	
Type	16 Bit User Save	Update Rate	N/A
Display Format	Standard	Decimal Places	0
Coding	RW		

Parameter	19.014 *Application Menu 2 Read-write Integer 14*		
Short description	General read-write integer application parameter		
Mode	RFC‑S		
Minimum	-32768	Maximum	32767
Default	0	Units	
Type	16 Bit User Save	Update Rate	N/A
Display Format	Standard	Decimal Places	0
Coding	RW		

Parameter	19.015 *Application Menu 2 Read-write Integer 15*		
Short description	General read-write integer application parameter		
Mode	RFC‑S		
Minimum	-32768	Maximum	32767
Default	0	Units	
Type	16 Bit User Save	Update Rate	N/A
Display Format	Standard	Decimal Places	0
Coding	RW		

Parameter	19.016 *Application Menu 2 Read-write Integer 16*		
Short description	General read-write integer application parameter		
Mode	RFC‑S		
Minimum	-32768	Maximum	32767
Default	0	Units	
Type	16 Bit User Save	Update Rate	N/A
Display Format	Standard	Decimal Places	0
Coding	RW		

Parameter	19.017 *Application Menu 2 Read-write Integer 17*		
Short description	General read-write integer application parameter		
Mode	RFC‑S		
Minimum	-32768	Maximum	32767
Default	0	Units	
Type	16 Bit User Save	Update Rate	N/A
Display Format	Standard	Decimal Places	0
Coding	RW		

Parameter	19.018 *Application Menu 2 Read-write Integer 18*		
Short description	General read-write integer application parameter		
Mode	RFC‑S		
Minimum	-32768	Maximum	32767
Default	0	Units	
Type	16 Bit User Save	Update Rate	N/A
Display Format	Standard	Decimal Places	0
Coding	RW		

Parameter	19.019 *Application Menu 2 Read-write Integer 19*		
Short description	General read-write integer application parameter		
Mode	RFC‑S		
Minimum	-32768	Maximum	32767
Default	0	Units	
Type	16 Bit User Save	Update Rate	N/A
Display Format	Standard	Decimal Places	0
Coding	RW		

Parameter	19.020 *Application Menu 2 Read-write Integer 20*		
Short description	General read-write integer application parameter		
Mode	RFC‑S		
Minimum	-32768	Maximum	32767
Default	0	Units	
Type	16 Bit User Save	Update Rate	N/A
Display Format	Standard	Decimal Places	0
Coding	RW		

Parameter	19.021 *Application Menu 2 Read-write Integer 21*		
Short description	General read-write integer application parameter		
Mode	RFC‑S		
Minimum	-32768	Maximum	32767
Default	0	Units	
Type	16 Bit User Save	Update Rate	N/A
Display Format	Standard	Decimal Places	0
Coding	RW		

Parameter	19.022 *Application Menu 2 Read-write Integer 22*		
Short description	General read-write integer application parameter		
Mode	RFC‑S		
Minimum	-32768	Maximum	32767
Default	0	Units	
Type	16 Bit User Save	Update Rate	N/A
Display Format	Standard	Decimal Places	0
Coding	RW		

Parameter	19.023 *Application Menu 2 Read-write Integer 23*		
Short description	General read-write integer application parameter		
Mode	RFC‑S		
Minimum	-32768	Maximum	32767
Default	0	Units	
Type	16 Bit User Save	Update Rate	N/A
Display Format	Standard	Decimal Places	0
Coding	RW		

Parameter	19.024 *Application Menu 2 Read-write Integer 24*		
Short description	General read-write integer application parameter		
Mode	RFC‑S		
Minimum	-32768	Maximum	32767
Default	0	Units	
Type	16 Bit User Save	Update Rate	N/A
Display Format	Standard	Decimal Places	0
Coding	RW		

Parameter	19.025 *Application Menu 2 Read-write Integer 25*		
Short description	General read-write integer application parameter		
Mode	RFC‑S		
Minimum	-32768	Maximum	32767
Default	0	Units	
Type	16 Bit User Save	Update Rate	N/A
Display Format	Standard	Decimal Places	0
Coding	RW		

Parameter	19.026 *Application Menu 2 Read-write Integer 26*		
Short description	General read-write integer application parameter		
Mode	RFC‑S		
Minimum	-32768	Maximum	32767
Default	0	Units	
Type	16 Bit User Save	Update Rate	N/A
Display Format	Standard	Decimal Places	0
Coding	RW		

Parameter	19.027 *Application Menu 2 Read-write Integer 27*		
Short description	General read-write integer application parameter		
Mode	RFC‑S		
Minimum	-32768	Maximum	32767
Default	0	Units	
Type	16 Bit User Save	Update Rate	N/A
Display Format	Standard	Decimal Places	0
Coding	RW		

Parameter	19.028 *Application Menu 2 Read-write Integer 28*		
Short description	General read-write integer application parameter		
Mode	RFC‑S		
Minimum	-32768	Maximum	32767
Default	0	Units	
Type	16 Bit User Save	Update Rate	N/A
Display Format	Standard	Decimal Places	0
Coding	RW		

Parameter	19.029 *Application Menu 2 Read-write Integer 29*		
Short description	General read-write integer application parameter		
Mode	RFC‑S		
Minimum	-32768	Maximum	32767
Default	0	Units	
Type	16 Bit User Save	Update Rate	N/A
Display Format	Standard	Decimal Places	0
Coding	RW		

Parameter	19.030 *Application Menu 2 Read-write Integer 30*		
Short description	General read-write integer application parameter		
Mode	RFC‑S		
Minimum	-32768	Maximum	32767
Default	0	Units	
Type	16 Bit User Save	Update Rate	N/A
Display Format	Standard	Decimal Places	0
Coding	RW		

Parameter	19.031 *Application Menu 2 Read-write bit 31*		
Short description	General read-write bit application parameter		
Mode	RFC‑S		
Minimum	0	Maximum	1
Default	0	Units	
Type	1 Bit User Save	Update Rate	N/A
Display Format	Standard	Decimal Places	0
Coding	RW		

Parameter	19.032 *Application Menu 2 Read-write bit 32*		
Short description	General read-write bit application parameter		
Mode	RFC‑S		
Minimum	0	Maximum	1
Default	0	Units	
Type	1 Bit User Save	Update Rate	N/A
Display Format	Standard	Decimal Places	0
Coding	RW		

Parameter	19.033 *Application Menu 2 Read-write bit 33*		
Short description	General read-write bit application parameter		
Mode	RFC‑S		
Minimum	0	Maximum	1
Default	0	Units	
Type	1 Bit User Save	Update Rate	N/A
Display Format	Standard	Decimal Places	0
Coding	RW		

Parameter	19.034 *Application Menu 2 Read-write bit 34*		
Short description	General read-write bit application parameter		
Mode	RFC‑S		
Minimum	0	Maximum	1
Default	0	Units	
Type	1 Bit User Save	Update Rate	N/A
Display Format	Standard	Decimal Places	0
Coding	RW		

Parameter	19.035 *Application Menu 2 Read-write bit 35*		
Short description	General read-write bit application parameter		
Mode	RFC‑S		
Minimum	0	Maximum	1
Default	0	Units	
Type	1 Bit User Save	Update Rate	N/A
Display Format	Standard	Decimal Places	0
Coding	RW		

Parameter	19.036 *Application Menu 2 Read-write bit 36*		
Short description	General read-write bit application parameter		
Mode	RFC‑S		
Minimum	0	Maximum	1
Default	0	Units	
Type	1 Bit User Save	Update Rate	N/A
Display Format	Standard	Decimal Places	0
Coding	RW		

Parameter	19.037 *Application Menu 2 Read-write bit 37*		
Short description	General read-write bit application parameter		
Mode	RFC‑S		
Minimum	0	Maximum	1
Default	0	Units	
Type	1 Bit User Save	Update Rate	N/A
Display Format	Standard	Decimal Places	0
Coding	RW		

Parameter	19.038 *Application Menu 2 Read-write bit 38*		
Short description	General read-write bit application parameter		
Mode	RFC‑S		
Minimum	0	Maximum	1
Default	0	Units	
Type	1 Bit User Save	Update Rate	N/A
Display Format	Standard	Decimal Places	0
Coding	RW		

Parameter	19.039 *Application Menu 2 Read-write bit 39*		
Short description	General read-write bit application parameter		
Mode	RFC‑S		
Minimum	0	Maximum	1
Default	0	Units	
Type	1 Bit User Save	Update Rate	N/A
Display Format	Standard	Decimal Places	0
Coding	RW		

Parameter	19.040 *Application Menu 2 Read-write bit 40*		
Short description	General read-write bit application parameter		
Mode	RFC‑S		
Minimum	0	Maximum	1
Default	0	Units	
Type	1 Bit User Save	Update Rate	N/A
Display Format	Standard	Decimal Places	0
Coding	RW		

Parameter	19.041 *Application Menu 2 Read-write bit 41*		
Short description	General read-write bit application parameter		
Mode	RFC‑S		
Minimum	0	Maximum	1
Default	0	Units	
Type	1 Bit User Save	Update Rate	N/A
Display Format	Standard	Decimal Places	0
Coding	RW		

Parameter	19.042 *Application Menu 2 Read-write bit 42*		
Short description	General read-write bit application parameter		
Mode	RFC‑S		
Minimum	0	Maximum	1
Default	0	Units	
Type	1 Bit User Save	Update Rate	N/A
Display Format	Standard	Decimal Places	0
Coding	RW		

Parameter	19.043 *Application Menu 2 Read-write bit 43*		
Short description	General read-write bit application parameter		
Mode	RFC‑S		
Minimum	0	Maximum	1
Default	0	Units	
Type	1 Bit User Save	Update Rate	N/A
Display Format	Standard	Decimal Places	0
Coding	RW		

Parameter	19.044 *Application Menu 2 Read-write bit 44*		
Short description	General read-write bit application parameter		
Mode	RFC‑S		
Minimum	0	Maximum	1
Default	0	Units	
Type	1 Bit User Save	Update Rate	N/A
Display Format	Standard	Decimal Places	0
Coding	RW		

Parameter	19.045 *Application Menu 2 Read-write bit 45*		
Short description	General read-write bit application parameter		
Mode	RFC‑S		
Minimum	0	Maximum	1
Default	0	Units	
Type	1 Bit User Save	Update Rate	N/A
Display Format	Standard	Decimal Places	0
Coding	RW		

Parameter	19.046 *Application Menu 2 Read-write bit 46*		
Short description	General read-write bit application parameter		
Mode	RFC‑S		
Minimum	0	Maximum	1
Default	0	Units	
Type	1 Bit User Save	Update Rate	N/A
Display Format	Standard	Decimal Places	0
Coding	RW		

Parameter	19.047 *Application Menu 2 Read-write bit 47*		
Short description	General read-write bit application parameter		
Mode	RFC‑S		
Minimum	0	Maximum	1
Default	0	Units	
Type	1 Bit User Save	Update Rate	N/A
Display Format	Standard	Decimal Places	0
Coding	RW		

Parameter	19.048 *Application Menu 2 Read-write bit 48*		
Short description	General read-write bit application parameter		
Mode	RFC‑S		
Minimum	0	Maximum	1
Default	0	Units	
Type	1 Bit User Save	Update Rate	N/A
Display Format	Standard	Decimal Places	0
Coding	RW		

Parameter	19.049 *Application Menu 2 Read-write bit 49*		
Short description	General read-write bit application parameter		
Mode	RFC‑S		
Minimum	0	Maximum	1
Default	0	Units	
Type	1 Bit User Save	Update Rate	N/A
Display Format	Standard	Decimal Places	0
Coding	RW		

Parameter	19.050 *Application Menu 2 Read-write bit 50*		
Short description	General read-write bit application parameter		
Mode	RFC‑S		
Minimum	0	Maximum	1
Default	0	Units	
Type	1 Bit User Save	Update Rate	N/A
Display Format	Standard	Decimal Places	0
Coding	RW		

Parameter	19.051 *Application Menu 2 Power-down Save Long Integer 51*		
Short description	General power-down save long integer application parameter		
Mode	RFC‑S		
Minimum	-2147483648	Maximum	2147483647
Default	0	Units	
Type	32 Bit Power Down Save	Update Rate	N/A
Display Format	Standard	Decimal Places	0
Coding	RW		

Parameter	19.052 *Application Menu 2 Power-down Save Long Integer 52*		
Short description	General power-down save long integer application parameter		
Mode	RFC‑S		
Minimum	-2147483648	Maximum	2147483647
Default	0	Units	
Type	32 Bit Power Down Save	Update Rate	N/A
Display Format	Standard	Decimal Places	0
Coding	RW		

Parameter	19.053 *Application Menu 2 Power-down Save Long Integer 53*		
Short description	General power-down save long integer application parameter		
Mode	RFC‑S		
Minimum	-2147483648	Maximum	2147483647
Default	0	Units	
Type	32 Bit Power Down Save	Update Rate	N/A
Display Format	Standard	Decimal Places	0
Coding	RW		

Parameter	19.054 *Application Menu 2 Power-down Save Long Integer 54*		
Short description	General power-down save long integer application parameter		
Mode	RFC‑S		
Minimum	-2147483648	Maximum	2147483647
Default	0	Units	
Type	32 Bit Power Down Save	Update Rate	N/A
Display Format	Standard	Decimal Places	0
Coding	RW		

Menu 20 Single Line Descriptions − *Application Menu 3*

Mode: RFC‑S

Parameter	Range	Default	Type						
20.001 Application Menu 3 Read‑write Integer 1	-32768 to 32767	0	RW	Num					
20.002 Application Menu 3 Read‑write Integer 2	-32768 to 32767	0	RW	Num					
20.003 Application Menu 3 Read‑write Integer 3	-32768 to 32767	0	RW	Num					
20.004 Application Menu 3 Read‑write Integer 4	-32768 to 32767	0	RW	Num					
20.005 Application Menu 3 Read‑write Integer 5	-32768 to 32767	0	RW	Num					
20.006 Application Menu 3 Read‑write Integer 6	-32768 to 32767	0	RW	Num					
20.007 Application Menu 3 Read‑write Integer 7	-32768 to 32767	0	RW	Num					
20.008 Application Menu 3 Read‑write Integer 8	-32768 to 32767	0	RW	Num					
20.009 Application Menu 3 Read‑write Integer 9	-32768 to 32767	0	RW	Num					
20.010 Application Menu 3 Read‑write Integer 10	-32768 to 32767	0	RW	Num					
20.011 Application Menu 3 Read‑write Integer 11	-32768 to 32767	0	RW	Num					
20.012 Application Menu 3 Read‑write Integer 12	-32768 to 32767	0	RW	Num					
20.013 Application Menu 3 Read‑write Integer 13	-32768 to 32767	0	RW	Num					
20.014 Application Menu 3 Read‑write Integer 14	-32768 to 32767	0	RW	Num					
20.015 Application Menu 3 Read‑write Integer 15	-32768 to 32767	0	RW	Num					
20.016 Application Menu 3 Read‑write Integer 16	-32768 to 32767	0	RW	Num					
20.017 Application Menu 3 Read‑write Integer 17	-32768 to 32767	0	RW	Num					
20.018 Application Menu 3 Read‑write Integer 18	-32768 to 32767	0	RW	Num					
20.019 Application Menu 3 Read‑write Integer 19	-32768 to 32767	0	RW	Num					
20.020 Application Menu 3 Read‑write Integer 20	-32768 to 32767	0	RW	Num					
20.021 Application Menu 3 Read‑write Long Integer 21	-2147483648 to 2147483647	0	RW	Num					
20.022 Application Menu 3 Read‑write Long Integer 22	-2147483648 to 2147483647	0	RW	Num					
20.023 Application Menu 3 Read‑write Long Integer 23	-2147483648 to 2147483647	0	RW	Num					
20.024 Application Menu 3 Read‑write Long Integer 24	-2147483648 to 2147483647	0	RW	Num					
20.025 Application Menu 3 Read‑write Long Integer 25	-2147483648 to 2147483647	0	RW	Num					
20.026 Application Menu 3 Read‑write Long Integer 26	-2147483648 to 2147483647	0	RW	Num					
20.027 Application Menu 3 Read‑write Long Integer 27	-2147483648 to 2147483647	0	RW	Num					
20.028 Application Menu 3 Read‑write Long Integer 28	-2147483648 to 2147483647	0	RW	Num					
20.029 Application Menu 3 Read‑write Long Integer 29	-2147483648 to 2147483647	0	RW	Num					
20.030 Application Menu 3 Read‑write Long Integer 30	-2147483648 to 2147483647	0	RW	Num					
20.031 Application Menu 3 Read‑write Long Integer 31	-2147483648 to 2147483647	0	RW	Num					
20.032 Application Menu 3 Read‑write Long Integer 32	-2147483648 to 2147483647	0	RW	Num					
20.033 Application Menu 3 Read‑write Long Integer 33	-2147483648 to 2147483647	0	RW	Num					
20.034 Application Menu 3 Read‑write Long Integer 34	-2147483648 to 2147483647	0	RW	Num					
20.035 Application Menu 3 Read‑write Long Integer 35	-2147483648 to 2147483647	0	RW	Num					
20.036 Application Menu 3 Read‑write Long Integer 36	-2147483648 to 2147483647	0	RW	Num					
20.037 Application Menu 3 Read‑write Long Integer 37	-2147483648 to 2147483647	0	RW	Num					
20.038 Application Menu 3 Read‑write Long Integer 38	-2147483648 to 2147483647	0	RW	Num					
20.039 Application Menu 3 Read‑write Long Integer 39	-2147483648 to 2147483647	0	RW	Num					
20.040 Application Menu 3 Read‑write Long Integer 40	-2147483648 to 2147483647	0	RW	Num					

RW	Read / Write	RO	Read-only	Bit	Bit parameter	Txt	Text string	Date	Date parameter	Time	Time parameter
Chr	Character parameter	Bin	Binary parameter	IP	IP address	Mac	MAC address	Ver	Version number	SMP	Slot, menu, parameter
Num	Number parameter	DE	Destination	ND	No default value	RA	Rating dependent	NC	Non-copyable	PT	Protected
FI	Filtered	US	User save	PS	Power-down save						

Menu 20 − *Application Menu 3*

Mode: RFC‑S

See the introduction to menu 18.

Parameter	20.001 *Application Menu 3 Read-write Integer 1*		
Short description	General read-write integer application parameter		
Mode	RFC‑S		
Minimum	-32768	Maximum	32767
Default	0	Units	
Type	16 Bit Volatile	Update Rate	N/A
Display Format	Standard	Decimal Places	0
Coding	RW		

Parameter	20.002 *Application Menu 3 Read-write Integer 2*		
Short description	General read-write integer application parameter		
Mode	RFC‑S		
Minimum	-32768	Maximum	32767
Default	0	Units	
Type	16 Bit Volatile	Update Rate	N/A
Display Format	Standard	Decimal Places	0
Coding	RW		

Parameter	20.003 *Application Menu 3 Read-write Integer 3*		
Short description	General read-write integer application parameter		
Mode	RFC‑S		
Minimum	-32768	Maximum	32767
Default	0	Units	
Type	16 Bit Volatile	Update Rate	N/A
Display Format	Standard	Decimal Places	0
Coding	RW		

Parameter	20.004 *Application Menu 3 Read-write Integer 4*		
Short description	General read-write integer application parameter		
Mode	RFC‑S		
Minimum	-32768	Maximum	32767
Default	0	Units	
Type	16 Bit Volatile	Update Rate	N/A
Display Format	Standard	Decimal Places	0
Coding	RW		

Parameter	20.005 *Application Menu 3 Read-write Integer 5*		
Short description	General read-write integer application parameter		
Mode	RFC‑S		
Minimum	-32768	Maximum	32767
Default	0	Units	
Type	16 Bit Volatile	Update Rate	N/A
Display Format	Standard	Decimal Places	0
Coding	RW		

Parameter	20.006 *Application Menu 3 Read-write Integer 6*		
Short description	General read-write integer application parameter		
Mode	RFC‑S		
Minimum	-32768	Maximum	32767
Default	0	Units	
Type	16 Bit Volatile	Update Rate	N/A
Display Format	Standard	Decimal Places	0
Coding	RW		

Parameter	20.007 *Application Menu 3 Read-write Integer 7*		
Short description	General read-write integer application parameter		
Mode	RFC‑S		
Minimum	-32768	Maximum	32767
Default	0	Units	
Type	16 Bit Volatile	Update Rate	N/A
Display Format	Standard	Decimal Places	0
Coding	RW		

Parameter	20.008 *Application Menu 3 Read-write Integer 8*		
Short description	General read-write integer application parameter		
Mode	RFC‑S		
Minimum	-32768	Maximum	32767
Default	0	Units	
Type	16 Bit Volatile	Update Rate	N/A
Display Format	Standard	Decimal Places	0
Coding	RW		

Parameter	20.009 *Application Menu 3 Read-write Integer 9*		
Short description	General read-write integer application parameter		
Mode	RFC‑S		
Minimum	-32768	Maximum	32767
Default	0	Units	
Type	16 Bit Volatile	Update Rate	N/A
Display Format	Standard	Decimal Places	0
Coding	RW		

Parameter	20.010 *Application Menu 3 Read-write Integer 10*		
Short description	General read-write integer application parameter		
Mode	RFC‑S		
Minimum	-32768	Maximum	32767
Default	0	Units	
Type	16 Bit Volatile	Update Rate	N/A
Display Format	Standard	Decimal Places	0
Coding	RW		

Parameter	20.011 *Application Menu 3 Read-write Integer 11*		
Short description	General read-write integer application parameter		
Mode	RFC‑S		
Minimum	-32768	Maximum	32767
Default	0	Units	
Type	16 Bit Volatile	Update Rate	N/A
Display Format	Standard	Decimal Places	0
Coding	RW		

Parameter	20.012 *Application Menu 3 Read-write Integer 12*		
Short description	General read-write integer application parameter		
Mode	RFC‑S		
Minimum	-32768	Maximum	32767
Default	0	Units	
Type	16 Bit Volatile	Update Rate	N/A
Display Format	Standard	Decimal Places	0
Coding	RW		

Parameter	20.013 *Application Menu 3 Read-write Integer 13*		
Short description	General read-write integer application parameter		
Mode	RFC‑S		
Minimum	-32768	Maximum	32767
Default	0	Units	
Type	16 Bit Volatile	Update Rate	N/A
Display Format	Standard	Decimal Places	0
Coding	RW		

Parameter	20.014 *Application Menu 3 Read-write Integer 14*		
Short description	General read-write integer application parameter		
Mode	RFC‑S		
Minimum	-32768	Maximum	32767
Default	0	Units	
Type	16 Bit Volatile	Update Rate	N/A
Display Format	Standard	Decimal Places	0
Coding	RW		

Parameter	20.015 *Application Menu 3 Read-write Integer 15*		
Short description	General read-write integer application parameter		
Mode	RFC‑S		
Minimum	-32768	Maximum	32767
Default	0	Units	
Type	16 Bit Volatile	Update Rate	N/A
Display Format	Standard	Decimal Places	0
Coding	RW		

Parameter	20.016 *Application Menu 3 Read-write Integer 16*		
Short description	General read-write integer application parameter		
Mode	RFC‑S		
Minimum	-32768	Maximum	32767
Default	0	Units	
Type	16 Bit Volatile	Update Rate	N/A
Display Format	Standard	Decimal Places	0
Coding	RW		

Parameter	20.017 *Application Menu 3 Read-write Integer 17*		
Short description	General read-write integer application parameter		
Mode	RFC‑S		
Minimum	-32768	Maximum	32767
Default	0	Units	
Type	16 Bit Volatile	Update Rate	N/A
Display Format	Standard	Decimal Places	0
Coding	RW		

Parameter	20.018 *Application Menu 3 Read-write Integer 18*		
Short description	General read-write integer application parameter		
Mode	RFC‑S		
Minimum	-32768	Maximum	32767
Default	0	Units	
Type	16 Bit Volatile	Update Rate	N/A
Display Format	Standard	Decimal Places	0
Coding	RW		

Parameter	20.019 *Application Menu 3 Read-write Integer 19*		
Short description	General read-write integer application parameter		
Mode	RFC‑S		
Minimum	-32768	Maximum	32767
Default	0	Units	
Type	16 Bit Volatile	Update Rate	N/A
Display Format	Standard	Decimal Places	0
Coding	RW		

Parameter	20.020 *Application Menu 3 Read-write Integer 20*		
Short description	General read-write integer application parameter		
Mode	RFC‑S		
Minimum	-32768	Maximum	32767
Default	0	Units	
Type	16 Bit Volatile	Update Rate	N/A
Display Format	Standard	Decimal Places	0
Coding	RW		

Parameter	**20.021** *Application Menu 3 Read-write Long Integer 21*		
Short description	General read-write long integer application parameter		
Mode	RFC‑S		
Minimum	-2147483648	Maximum	2147483647
Default	0	Units	
Type	32 Bit Volatile	Update Rate	N/A
Display Format	Standard	Decimal Places	0
Coding	RW		

Parameter	**20.022** *Application Menu 3 Read-write Long Integer 22*		
Short description	General read-write long integer application parameter		
Mode	RFC‑S		
Minimum	-2147483648	Maximum	2147483647
Default	0	Units	
Type	32 Bit Volatile	Update Rate	N/A
Display Format	Standard	Decimal Places	0
Coding	RW		

Parameter	**20.023** *Application Menu 3 Read-write Long Integer 23*		
Short description	General read-write long integer application parameter		
Mode	RFC‑S		
Minimum	-2147483648	Maximum	2147483647
Default	0	Units	
Type	32 Bit Volatile	Update Rate	N/A
Display Format	Standard	Decimal Places	0
Coding	RW		

Parameter	**20.024** *Application Menu 3 Read-write Long Integer 24*		
Short description	General read-write long integer application parameter		
Mode	RFC‑S		
Minimum	-2147483648	Maximum	2147483647
Default	0	Units	
Type	32 Bit Volatile	Update Rate	N/A
Display Format	Standard	Decimal Places	0
Coding	RW		

Parameter	**20.025** *Application Menu 3 Read-write Long Integer 25*		
Short description	General read-write long integer application parameter		
Mode	RFC‑S		
Minimum	-2147483648	Maximum	2147483647
Default	0	Units	
Type	32 Bit Volatile	Update Rate	N/A
Display Format	Standard	Decimal Places	0
Coding	RW		

Parameter	**20.026** *Application Menu 3 Read-write Long Integer 26*		
Short description	General read-write long integer application parameter		
Mode	RFC‑S		
Minimum	-2147483648	Maximum	2147483647
Default	0	Units	
Type	32 Bit Volatile	Update Rate	N/A
Display Format	Standard	Decimal Places	0
Coding	RW		

Parameter	**20.027** *Application Menu 3 Read-write Long Integer 27*		
Short description	General read-write long integer application parameter		
Mode	RFC‑S		
Minimum	-2147483648	Maximum	2147483647
Default	0	Units	
Type	32 Bit Volatile	Update Rate	N/A
Display Format	Standard	Decimal Places	0
Coding	RW		

Parameter	20.028 *Application Menu 3 Read-write Long Integer 28*		
Short description	General read-write long integer application parameter		
Mode	RFC‑S		
Minimum	-2147483648	Maximum	2147483647
Default	0	Units	
Type	32 Bit Volatile	Update Rate	N/A
Display Format	Standard	Decimal Places	0
Coding	RW		

Parameter	20.029 *Application Menu 3 Read-write Long Integer 29*		
Short description	General read-write long integer application parameter		
Mode	RFC‑S		
Minimum	-2147483648	Maximum	2147483647
Default	0	Units	
Type	32 Bit Volatile	Update Rate	N/A
Display Format	Standard	Decimal Places	0
Coding	RW		

Parameter	20.030 *Application Menu 3 Read-write Long Integer 30*		
Short description	General read-write long integer application parameter		
Mode	RFC‑S		
Minimum	-2147483648	Maximum	2147483647
Default	0	Units	
Type	32 Bit Volatile	Update Rate	N/A
Display Format	Standard	Decimal Places	0
Coding	RW		

Parameter	20.031 *Application Menu 3 Read-write Long Integer 31*		
Short description	General read-write long integer application parameter		
Mode	RFC‑S		
Minimum	-2147483648	Maximum	2147483647
Default	0	Units	
Type	32 Bit Volatile	Update Rate	N/A
Display Format	Standard	Decimal Places	0
Coding	RW		

Parameter	20.032 *Application Menu 3 Read-write Long Integer 32*		
Short description	General read-write long integer application parameter		
Mode	RFC‑S		
Minimum	-2147483648	Maximum	2147483647
Default	0	Units	
Type	32 Bit Volatile	Update Rate	N/A
Display Format	Standard	Decimal Places	0
Coding	RW		

Parameter	20.033 *Application Menu 3 Read-write Long Integer 33*		
Short description	General read-write long integer application parameter		
Mode	RFC‑S		
Minimum	-2147483648	Maximum	2147483647
Default	0	Units	
Type	32 Bit Volatile	Update Rate	N/A
Display Format	Standard	Decimal Places	0
Coding	RW		

Parameter	20.034 *Application Menu 3 Read-write Long Integer 34*		
Short description	General read-write long integer application parameter		
Mode	RFC‑S		
Minimum	-2147483648	Maximum	2147483647
Default	0	Units	
Type	32 Bit Volatile	Update Rate	N/A
Display Format	Standard	Decimal Places	0
Coding	RW		

Parameter	20.035 *Application Menu 3 Read-write Long Integer 35*		
Short description	General read-write long integer application parameter		
Mode	RFC‑S		
Minimum	-2147483648	Maximum	2147483647
Default	0	Units	
Type	32 Bit Volatile	Update Rate	N/A
Display Format	Standard	Decimal Places	0
Coding	RW		

Parameter	20.036 *Application Menu 3 Read-write Long Integer 36*		
Short description	General read-write long integer application parameter		
Mode	RFC‑S		
Minimum	-2147483648	Maximum	2147483647
Default	0	Units	
Type	32 Bit Volatile	Update Rate	N/A
Display Format	Standard	Decimal Places	0
Coding	RW		

Parameter	20.037 *Application Menu 3 Read-write Long Integer 37*		
Short description	General read-write long integer application parameter		
Mode	RFC‑S		
Minimum	-2147483648	Maximum	2147483647
Default	0	Units	
Type	32 Bit Volatile	Update Rate	N/A
Display Format	Standard	Decimal Places	0
Coding	RW		

Parameter	20.038 *Application Menu 3 Read-write Long Integer 38*		
Short description	General read-write long integer application parameter		
Mode	RFC‑S		
Minimum	-2147483648	Maximum	2147483647
Default	0	Units	
Type	32 Bit Volatile	Update Rate	N/A
Display Format	Standard	Decimal Places	0
Coding	RW		

Parameter	20.039 *Application Menu 3 Read-write Long Integer 39*		
Short description	General read-write long integer application parameter		
Mode	RFC‑S		
Minimum	-2147483648	Maximum	2147483647
Default	0	Units	
Type	32 Bit Volatile	Update Rate	N/A
Display Format	Standard	Decimal Places	0
Coding	RW		

Parameter	20.040 *Application Menu 3 Read-write Long Integer 40*		
Short description	General read-write long integer application parameter		
Mode	RFC‑S		
Minimum	-2147483648	Maximum	2147483647
Default	0	Units	
Type	32 Bit Volatile	Update Rate	N/A
Display Format	Standard	Decimal Places	0
Coding	RW		

Menu 21 Single Line Descriptions − *Motor 2 Parameters*

Mode: RFC‑S

Parameter	Range	Default	Type					
21.001 M2 Maximum Reference Clamp	±VM_POSITIVE_REF_CLAMP2	3000.0	RW	Num				US
21.002 M2 Minimum Reference Clamp	±VM_NEGATIVE_REF_CLAMP2	0.0	RW	Num				US
21.003 M2 Reference Selector	A1 A2 (0), A1 Preset (1), A2 Preset (2), Preset (3), Keypad (4), Precision (5), Keypad Ref (6)	A1 A2 (0)	RW	Txt				US
21.004 M2 Acceleration Rate 1	±VM_ACCEL_RATE s	0.200 s	RW	Num				US
21.005 M2 Deceleration Rate 1	±VM_ACCEL_RATE s	0.200 s	RW	Num				US
21.007 M2 Rated Current	±VM_RATED_CURRENT A	0.000 A	RW	Num		RA		US
21.008 M2 Rated Speed	0.00 to 33000.00 rpm	3000.00 rpm	RW	Num				US
21.009 M2 Rated Voltage	±VM_AC_VOLTAGE_SET V	200V drive: 230 V 400V drive 50Hz: 400 V 400V drive 60Hz: 460 V 575V drive: 575 V 690V drive: 690 V	RW	Num		RA		US
21.011 M2 Number Of Motor Poles	Automatic (0) to 480 (240) Poles	6 (3) Poles	RW	Txt				US
21.012 M2 Stator Resistance	0.000000 to 1000.000000 Ω	0.000000 Ω	RW	Num		RA		US
21.014 M2 Ld	0.000 to 500.000 mH	0.000 mH	RW	Num		RA		US
21.015 Motor 2 Active	Off (0) or On (1)		RO	Bit	ND	NC	PT	
21.016 M2 Motor Thermal Time Constant 1	1.0 to 3000.0 s	89.0 s	RW	Num				US
21.017 M2 Speed Controller Proportional Gain Kp1	0.0000 to 200.0000 s/rad	0.0100 s/rad	RW	Num				US
21.018 M2 Speed Controller Integral Gain Ki1	0.00 to 655.35 s²/rad	1.00 s²/rad	RW	Num				US
21.019 M2 Speed Controller Differential Feedback Gain Kd1	0.00000 to 0.65535 1/rad	0.00000 1/rad	RW	Num				US
21.020 M2 Position Feedback Phase Angle	0.0 to 359.9 °		RW	Num	ND			US
21.021 M2 Motor Control Feedback Select	P1 Drive (0), P2 Drive (1), P1 Slot1 (2), P2 Slot1 (3), P1 Slot2 (4), P2 Slot2 (5), P1 Slot3 (6), P2 Slot3 (7)	P1 Drive (0)	RW	Txt				US
21.022 M2 Current Controller Kp Gain	0 to 30000	150	RW	Num				US
21.023 M2 Current Controller Ki Gain	0 to 30000	2000	RW	Num				US
21.027 M2 Motoring Current Limit	±VM_MOTOR2_CURRENT_LIMIT %	0.0 %	RW	Num		RA		US
21.028 M2 Regenerating Current Limit	±VM_MOTOR2_CURRENT_LIMIT %	0.0 %	RW	Num		RA		US
21.029 M2 Symmetrical Current Limit	±VM_MOTOR2_CURRENT_LIMIT %	0.0 %	RW	Num		RA		US
21.030 M2 Volts Per 1000rpm	0 to 10000 V	98 V	RW	Num				US
21.032 M2 Current Reference Filter Time Constant 1	0.0 to 25.0 ms	0.0 ms	RW	Num				US
21.033 M2 Low Speed Thermal Protection Mode	0 to 1	0	RW	Num				US
21.034 M2 Current Controller Mode	Off (0) or On (1)	Off (0)	RW	Bit				US
21.035 M2 Notch Filter Centre Frequency	50 to 1000 Hz	100 Hz	RW	Num				US
21.036 M2 Notch Filter Bandwidth	0 to 500 Hz	0 Hz	RW	Num				US
21.039 M2 Motor Thermal Time Constant 2	1.0 to 3000.0 s	89.0 s	RW	Num				US
21.040 M2 Motor Thermal Time Constant 2 Scaling	0 to 100 %	0 %	RW	Num				US
21.043 M2 Torque Per Amp	0.00 to 500.00 Nm/A	1.60 Nm/A	RW	Num				US
21.044 M2 No‑load Core Loss	0.000 to 99999.999 kW	0.000 kW	RW	Num				US
21.045 M2 Rated Core Loss	0.000 to 99999.999 kW	0.000 kW	RW	Num				US
21.046 M2 Inverted Motor Saturation Characteristic	Off (0) or On (1)	Off (0)	RW	Bit				US
21.048 M2 No‑load Lq	0.000 to 500.000 mH	0.000 mH	RW	Num		RA		US

RW	Read / Write	RO	Read-only	Bit	Bit parameter	Txt	Text string	Date	Date parameter	Time	Time parameter
Chr	Character parameter	Bin	Binary parameter	IP	IP address	Mac	MAC address	Ver	Version number	SMP	Slot, menu, parameter
Num	Number parameter	DE	Destination	ND	No default value	RA	Rating dependent	NC	Non-copyable	PT	Protected
FI	Filtered	US	User save	PS	Power-down save						

Menu 21 − *Motor 2 Parameters*

Mode: RFC‑S

Contains parameter relative to the set up for motor map 2.

Parameter	21.001 *M2 Maximum Reference Clamp*		
Short description	Defines the maximum reference clamp for motor map 2		
Mode	RFC‑S		
Minimum	−VM_POSITIVE_REF_CLAMP2	Maximum	VM_POSITIVE_REF_CLAMP2
Default	3000.0	Units	
Type	32 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	1
Coding	RW, VM		

This is the motor map 2 equivalent parameter for *Maximum Reference Clamp* (01.006).

Parameter	21.002 *M2 Minimum Reference Clamp*		
Short description	Defines the minimum reference clamp for motor map 2		
Mode	RFC‑S		
Minimum	−VM_NEGATIVE_REF_CLAMP2	Maximum	VM_NEGATIVE_REF_CLAMP2
Default	0.0	Units	
Type	32 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	1
Coding	RW, VM		

This is the motor map 2 equivalent parameter for *Minimum Reference Clamp* (01.007).

Parameter	21.003 *M2 Reference Selector*		
Short description	Defines which reference is used for motor map 2		
Mode	RFC‑S		
Minimum	0	Maximum	6
Default	0	Units	
Type	8 Bit User Save	Update Rate	4ms read
Display Format	Standard	Decimal Places	0
Coding	RW, TE		

Value	Text
0	A1 A2
1	A1 Preset
2	A2 Preset
3	Preset
4	Keypad
5	Precision
6	Keypad Ref

This is the motor map 2 equivalent parameter for *Reference Selector* (01.014).

Parameter	21.004 *M2 Acceleration Rate 1*		
Short description	Defines the acceleration rate used for motor map 2		
Mode	RFC‑S		
Minimum	−VM_ACCEL_RATE	Maximum	VM_ACCEL_RATE
Default	0.200	Units	s
Type	32 Bit User Save	Update Rate	4ms read
Display Format	Standard	Decimal Places	3
Coding	RW, VM		

This is the motor map 2 equivalent parameter for *Acceleration Rate 1* (02.011).

Parameter	21.005 *M2 Deceleration Rate 1*		
Short description	Defines the deceleration rate used for motor map 2		
Mode	RFC‑S		
Minimum	−VM_ACCEL_RATE	Maximum	VM_ACCEL_RATE
Default	0.200	Units	s
Type	32 Bit User Save	Update Rate	4ms read
Display Format	Standard	Decimal Places	3
Coding	RW, VM		

This is the motor map 2 equivalent parameter for *Deceleration Rate 1* (02.021).

Parameter	21.007 *M2 Rated Current*		
Short description	Defines the motor rated used for motor map 2		
Mode	RFC‑S		
Minimum	−VM_RATED_CURRENT	Maximum	VM_RATED_CURRENT
Default	0.000	Units	A
Type	32 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	3
Coding	RW, VM, RA		

This is the motor map 2 equivalent parameter for *Rated Current* (05.007).

Parameter	21.008 *M2 Rated Speed*		
Short description	Defines the motor rated speed used for motor map 2		
Mode	RFC‑S		
Minimum	0.00	Maximum	33000.00
Default	3000.00	Units	rpm
Type	32 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	2
Coding	RW		

This is the motor map 2 equivalent parameter for *Rated Speed* (05.008).

Parameter	21.009 *M2 Rated Voltage*		
Short description	Defines the motor rated voltage used for motor map 2		
Mode	RFC‑S		
Minimum	−VM_AC_VOLTAGE_SET	Maximum	VM_AC_VOLTAGE_SET
Default	See exceptions below	Units	V
Type	16 Bit User Save	Update Rate	4ms read
Display Format	Standard	Decimal Places	0
Coding	RW, VM, RA		

Voltage	*Region*	*Default Value*
200V	All	230
400V	50Hz	400
400V	60Hz	460
575V	All	575
690V	All	690

This is the motor map 2 equivalent parameter for *Rated Voltage* (05.009).

Parameter	21.011 *M2 Number Of Motor Poles*		
Short description	Defines the number of motor poles used for motor map 2		
Mode	RFC‑S		
Minimum	0	Maximum	240
Default	3	Units	PolePairs
Type	8 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW, BU		

This is the motor map 2 equivalent parameter for *Number Of Motor Poles* (05.011).

Parameter	21.012 *M2 Stator Resistance*		
Short description	Defines the stator resistance used for motor map 2		
Mode	RFC‑S		
Minimum	0.000000	Maximum	1000.000000
Default	0.000000	Units	Ω
Type	32 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	6
Coding	RW, RA		

This is the motor map 2 equivalent parameter for *Stator Resistance* (05.017).

Parameter	21.014 *M2 Ld*		
Short description	Defines the value of inductance in the flux axis for motor map 2		
Mode	RFC‑S		
Minimum	0.000	Maximum	500.000
Default	0.000	Units	mH
Type	32 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	3
Coding	RW, RA		

This is the motor map 2 equivalent parameter for *Ld* (05.024).

Parameter	21.015 *Motor 2 Active*		
Short description	Indicates if motor 2 parameters are being used by the drive		
Mode	RFC‑S		
Minimum	0	Maximum	1
Default		Units	
Type	1 Bit Volatile	Update Rate	Background write
Display Format	Standard	Decimal Places	0
Coding	RO, ND, NC, PT		

If *Motor 2 Active* (21.015) = 0 then the standard motor set-up parameters are being used or if *Motor 2 Active* (21.015) = 1 then the motor 2 parameters are being used. The motor set-up parameters do not necessarily change immediately when *Select Motor 2 Parameters* (11.045) is changed (i.e. the drive may be enabled). *Motor 2 Active* (21.015) shows the actual motor parameters being used and only changes when the new parameters start being used by the drive.

Parameter	21.016 *M2 Motor Thermal Time Constant 1*		
Short description	Defines the thermal time constant of the motor used for motor map 2		
Mode	RFC‑S		
Minimum	1.0	Maximum	3000.0
Default	89.0	Units	s
Type	16 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	1
Coding	RW		

This is the motor map 2 equivalent parameter for *Motor Thermal Time Constant 1* (04.015).

Parameter	21.017 *M2 Speed Controller Proportional Gain Kp1*		
Short description	Defines the Kp value of the speed controller used for motor map 2		
Mode	RFC‑S		
Minimum	0.0000	Maximum	200.0000
Default	0.0100	Units	s/rad
Type	32 Bit User Save	Update Rate	4ms read
Display Format	Standard	Decimal Places	4
Coding	RW		

This is the motor map 2 equivalent parameter for *Speed Controller Proportional Gain Kp1* (03.010).

Parameter	21.018 *M2 Speed Controller Integral Gain Ki1*		
Short description	Defines the Ki value of the speed controller used for motor map 2		
Mode	RFC‑S		
Minimum	0.00	Maximum	655.35
Default	1.00	Units	s²/rad
Type	16 Bit User Save	Update Rate	4ms read
Display Format	Standard	Decimal Places	2
Coding	RW, BU		

This is the motor map 2 equivalent parameter for *Speed Controller Integral Gain Ki1* (03.011).

Parameter	21.019 *M2 Speed Controller Differential Feedback Gain Kd1*		
Short description	Defines the Kd value of the speed controller used for motor map 2		
Mode	RFC‑S		
Minimum	0.00000	Maximum	0.65535
Default	0.00000	Units	1/rad
Type	16 Bit User Save	Update Rate	4ms read
Display Format	Standard	Decimal Places	5
Coding	RW, BU		

This is the motor map 2 equivalent parameter for *Speed Controller Differential Feedback Gain Kd1* (03.012).

Parameter	21.020 *M2 Position Feedback Phase Angle*		
Short description	Defines the phase angle between the rotor flux and the feedback position for motor map 2		
Mode	RFC‑S		
Minimum	0.0	Maximum	359.9
Default		Units	°
Type	16 Bit User Save	Update Rate	4ms read
Display Format	Standard	Decimal Places	1
Coding	RW, ND		

This is the motor map 2 equivalent parameter for *Position Feedback Phase Angle* (03.025).

Parameter	21.021 *M2 Motor Control Feedback Select*		
Short description	Defines the source for the feedback device used for motor map 2		
Mode	RFC‑S		
Minimum	0	Maximum	7
Default	0	Units	
Type	8 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW, TE		

Value	*Text*
0	P1 Drive
1	P2 Drive
2	P1 Slot1
3	P2 Slot1
4	P1 Slot2
5	P2 Slot2
6	P1 Slot3
7	P2 Slot3

This is the motor map 2 equivalent parameter for *Motor Control Feedback Select* (03.026).

Parameter	21.022 *M2 Current Controller Kp Gain*		
Short description	Defines the Kp value of the current controller used for motor map 2		
Mode	RFC‑S		
Minimum	0	Maximum	30000
Default	150	Units	
Type	16 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW		

This is the motor map 2 equivalent parameter for *Current Controller Kp Gain* (04.013).

Parameter	21.023 *M2 Current Controller Ki Gain*		
Short description	Defines the Ki value of the current controller used for motor map 2		
Mode	RFC‑S		
Minimum	0	Maximum	30000
Default	2000	Units	
Type	16 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW		

This is the motor map 2 equivalent parameter for *Current Controller Ki Gain* (04.014).

Parameter	21.027 *M2 Motoring Current Limit*		
Short description	Defines the motoring current limit used for motor map 2		
Mode	RFC‑S		
Minimum	−VM_MOTOR2_CURRENT_LIMIT	Maximum	VM_MOTOR2_CURRENT_LIMIT
Default	0.0	Units	%
Type	16 Bit User Save	Update Rate	4ms read
Display Format	Standard	Decimal Places	1
Coding	RW, VM, RA		

This is the motor map 2 equivalent parameter for *Motoring Current Limit* (04.005).

Parameter	21.028 *M2 Regenerating Current Limit*		
Short description	Defines the regenerating current limit used for motor map 2		
Mode	RFC‑S		
Minimum	−VM_MOTOR2_CURRENT_LIMIT	Maximum	VM_MOTOR2_CURRENT_LIMIT
Default	0.0	Units	%
Type	16 Bit User Save	Update Rate	4ms read
Display Format	Standard	Decimal Places	1
Coding	RW, VM, RA		

This is the motor map 2 equivalent parameter for *Regenerating Current Limit* (04.006).

Parameter	21.029 *M2 Symmetrical Current Limit*		
Short description	Defines the symmetrical current limit used for motor map 2		
Mode	RFC‑S		
Minimum	−VM_MOTOR2_CURRENT_LIMIT	Maximum	VM_MOTOR2_CURRENT_LIMIT
Default	0.0	Units	%
Type	16 Bit User Save	Update Rate	4ms read
Display Format	Standard	Decimal Places	1
Coding	RW, VM, RA		

This is the motor map 2 equivalent parameter for *Symmetrical Current Limit* (04.007).

Parameter	21.030 *M2 Volts Per 1000rpm*		
Short description	M2 Volts Per 1000rpm		
Mode	RFC‑S		
Minimum	0	Maximum	10000
Default	98	Units	V
Type	16 Bit User Save	Update Rate	Background Read
Display Format	Standard	Decimal Places	0
Coding	RW		

This is the motor map 2 equivalent parameter for *Volts Per 1000rpm* (05.033).

Parameter	21.032 *M2 Current Reference Filter Time Constant 1*		
Short description	Defines the time constant of a first order filter that can be applied to the final current reference for motor map 2		
Mode	RFC‑S		
Minimum	0.0	Maximum	25.0
Default	0.0	Units	ms
Type	8 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	1
Coding	RW, BU		

This is the motor map 2 equivalent parameter for *Current Reference Filter 1 Time Constant* (04.012).

Parameter	21.033 *M2 Low Speed Thermal Protection Mode*		
Short description	Set to enable low speed thermal protection mode		
Mode	RFC‑S		
Minimum	0	Maximum	1
Default	0	Units	
Type	8 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW		

This is the motor map 2 equivalent parameter for *Low Speed Thermal Protection Mode* (04.025).

Parameter	21.034 *M2 Current Controller Mode*		
Short description	Set to enable high performance current controller mode		
Mode	RFC‑S		
Minimum	0	Maximum	1
Default	0	Units	
Type	1 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW		

This is the motor map 2 equivalent parameter for *Current Controller Mode* (04.030).

Parameter	21.035 *M2 Notch Filter Centre Frequency*		
Short description	Defines the centre frequency for a notch filter to cancel a mechanical resonance		
Mode	RFC‑S		
Minimum	50	Maximum	1000
Default	100	Units	Hz
Type	16 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW		

This is the motor map 2 equivalent parameter for *Notch Filter Centre Frequency* (04.031).

Parameter	21.036 *M2 Notch Filter Bandwidth*		
Short description	Defines the bandwidth for a notch filter to cancel a mechanical resonance		
Mode	RFC‑S		
Minimum	0	Maximum	500
Default	0	Units	Hz
Type	16 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW		

This is the motor map 2 equivalent parameter for *Notch Filter Bandwidth* (04.032).

Parameter	21.039 *M2 Motor Thermal Time Constant 2*		
Short description	Can be used to define an additional motor thermal time constant for motor map 2		
Mode	RFC‑S		
Minimum	1.0	Maximum	3000.0
Default	89.0	Units	s
Type	16 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	1
Coding	RW		

This is the motor map 2 equivalent parameter for *Motor Thermal Time Constant 2* (04.037).

Parameter	21.040 *M2 Motor Thermal Time Constant 2 Scaling*		
Short description	Defines the ratio of the contribution to the motor protection accumulator value from each of the time constants for motor map 2		
Mode	RFC‑S		
Minimum	0	Maximum	100
Default	0	Units	%
Type	8 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW		

This is the motor map 2 equivalent parameter for *Motor Thermal Time Constant 2 Scaling* (04.038).

Parameter	21.043 *M2 Torque Per Amp*		
Short description	Displays the torque per amp of the motor used for motor map 2		
Mode	RFC‑S		
Minimum	0.00	Maximum	500.00
Default	1.60	Units	Nm/A
Type	16 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	2
Coding	RW, BU		

This is the motor map 2 equivalent parameter for *Torque Per Amp* (05.032).

Parameter	21.044 *M2 No-load Core Loss*		
Short description	M2 No-load Core Loss		
Mode	RFC‑S		
Minimum	0.000	Maximum	99999.999
Default	0.000	Units	kW
Type	32 Bit User Save	Update Rate	Background Read
Display Format	Standard	Decimal Places	3
Coding	RW		

This is the motor map 2 equivalent parameter for *No-load Core Loss* (04.045).

Parameter	21.045 *M2 Rated Core Loss*		
Short description	M2 Rated Core Loss		
Mode	RFC-S		
Minimum	0.000	Maximum	99999.999
Default	0.000	Units	kW
Type	32 Bit User Save	Update Rate	Background Read
Display Format	Standard	Decimal Places	3
Coding	RW		

This is the motor map 2 equivalent parameter for *Rated Core Loss* (04.046).

Parameter	21.046 *M2 Inverted Motor Saturation Characteristic*		
Short description	The motor has an inverted saturation characteristic		
Mode	RFC-S		
Minimum	0	Maximum	1
Default	0	Units	
Type	1 Bit User Save	Update Rate	Background Read
Display Format	Standard	Decimal Places	0
Coding	RW		

This is the motor map 2 equivalent parameter for *Inverted Saturation Characteristic* (05.070).

Parameter	21.048 *M2 No-load Lq*		
Short description	Defines the inductance in the q axis with no current in the motor		
Mode	RFC-S		
Minimum	0.000	Maximum	500.000
Default	0.000	Units	mH
Type	32 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	3
Coding	RW, RA		

This is the motor map 2 equivalent parameter for *No-load Lq* (05.072).

Menu 22 Single Line Descriptions − *Menu 0 Set-up*

Mode: RFC‑S

Parameter	Range	Default	Type					
22.001 Parameter 00.001 Set-up	0.000 to 59.999	1.007	RW	Num			PT	US
22.002 Parameter 00.002 Set-up	0.000 to 59.999	1.006	RW	Num			PT	US
22.003 Parameter 00.003 Set-up	0.000 to 59.999	2.011	RW	Num			PT	US
22.004 Parameter 00.004 Set-up	0.000 to 59.999	2.021	RW	Num			PT	US
22.005 Parameter 00.005 Set-up	0.000 to 59.999	1.014	RW	Num			PT	US
22.006 Parameter 00.006 Set-up	0.000 to 59.999	4.007	RW	Num			PT	US
22.007 Pareter 00.007 Set-up	0.000 to 59.999	3.010	RW	Num			PT	US
22.008 Parameter Eth 00.008 Set-up	0.000 to 59.999	3.011	RW	Num			PT	US
22.009 Parameter 00.009 Set-up	0.000 to 59.999	3.012	RW	Num			PT	US
22.010 Parameter 00.010 Set-up	0.000 to 59.999	3.002	RW	Num			PT	US
22.011 Parameter 00.011 Set-up	0.000 to 59.999	3.029	RW	Num			PT	US
22.012 Parameter 00.012 Set-up	0.000 to 59.999	4.001	RW	Num			PT	US
22.013 Parameter 00.013 Set-up	0.000 to 59.999	4.002	RW	Num			PT	US
22.014 Parameter 00.014 Set-up	0.000 to 59.999	4.011	RW	Num			PT	US
22.015 Parameter 00.015 Set-up	0.000 to 59.999	2.004	RW	Num			PT	US
22.016 Parameter 00.016 Set-up	0.000 to 59.999	2.002	RW	Num			PT	US
22.017 Parameter 00.017 Set-up	0.000 to 59.999	4.012	RW	Num			PT	US
22.018 Parameter 00.018 Set-up	0.000 to 59.999	3.123	RW	Num			PT	US
22.019 Parameter 00.019 Set-up	0.000 to 59.999	7.011	RW	Num			PT	US
22.020 Parameter 00.020 Set-up	0.000 to 59.999	7.014	RW	Num			PT	US
22.021 Parameter 00.021 Set-up	0.000 to 59.999	7.015	RW	Num			PT	US
22.022 Parameter 00.022 Set-up	0.000 to 59.999	1.010	RW	Num			PT	US
22.023 Parameter 00.023 Set-up	0.000 to 59.999	1.005	RW	Num			PT	US
22.024 Parameter 00.024 Set-up	0.000 to 59.999	1.021	RW	Num			PT	US
22.025 Parameter 00.025 Set-up	0.000 to 59.999	1.022	RW	Num			PT	US
22.026 Parameter 00.026 Set-up	0.000 to 59.999	3.008	RW	Num			PT	US
22.027 Parameter 00.027 Set-up	0.000 to 59.999	3.034	RW	Num			PT	US
22.028 Parameter 00.028 Set-up	0.000 to 59.999	6.013	RW	Num			PT	US
22.029 Parameter 00.029 Set-up	0.000 to 59.999	11.036	RW	Num			PT	US
22.030 Parameter 00.030 Set-up	0.000 to 59.999	11.042	RW	Num			PT	US
22.031 Parameter 00.031 Set-up	0.000 to 59.999	11.033	RW	Num			PT	US
22.032 Parameter 00.032 Set-up	0.000 to 59.999	11.032	RW	Num			PT	US
22.033 Parameter 00.033 Set-up	0.000 to 59.999	0.000	RW	Num			PT	US
22.034 Parameter 00.034 Set-up	0.000 to 59.999	11.030	RW	Num			PT	US
22.035 Parameter 00.035 Set-up	0.000 to 59.999	0.000	RW	Num			PT	US
22.036 Parameter 00.036 Set-up	0.000 to 59.999	0.000	RW	Num			PT	US
22.037 Parameter 00.037 Set-up	0.000 to 59.999	24.010	RW	Num			PT	US
22.038 Parameter 00.038 Set-up	0.000 to 59.999	4.013	RW	Num			PT	US
22.039 Parameter 00.039 Set-up	0.000 to 59.999	4.014	RW	Num			PT	US
22.040 Parameter 00.040 Set-up	0.000 to 59.999	5.012	RW	Num			PT	US
22.041 Parameter 00.041 Set-up	0.000 to 59.999	5.018	RW	Num			PT	US
22.042 Parameter 00.042 Set-up	0.000 to 59.999	5.011	RW	Num			PT	US
22.043 Parameter 00.043 Set-up	0.000 to 59.999	3.025	RW	Num			PT	US
22.044 Parameter 00.044 Set-up	0.000 to 59.999	5.009	RW	Num			PT	US
22.045 Parameter 00.045 Set-up	0.000 to 59.999	5.008	RW	Num			PT	US
22.046 Parameter 00.046 Set-up	0.000 to 59.999	5.007	RW	Num			PT	US
22.047 Parameter 00.047 Set-up	0.000 to 59.999	5.033	RW	Num			PT	US
22.048 Parameter 00.048 Set-up	0.000 to 59.999	11.031	RW	Num			PT	US
22.049 Parameter 00.049 Set-up	0.000 to 59.999	11.044	RW	Num			PT	US
22.050 Parameter 00.050 Set-up	0.000 to 59.999	11.029	RW	Num			PT	US
22.051 Parameter 00.051 Set-up	0.000 to 59.999	10.037	RW	Num			PT	US
22.052 Parameter 00.052 Set-up	0.000 to 59.999	0.000	RW	Num			PT	US
22.053 Parameter 00.053 Set-up	0.000 to 59.999	4.015	RW	Num			PT	US
22.054 Parameter 00.054 Set-up	0.000 to 59.999	0.000	RW	Num			PT	US
22.055 Parameter 00.055 Set-up	0.000 to 59.999	0.000	RW	Num			PT	US
22.056 Parameter 00.056 Set-up	0.000 to 59.999	0.000	RW	Num			PT	US
22.057 Parameter 00.057 Set-up	0.000 to 59.999	0.000	RW	Num			PT	US
22.058 Parameter 00.058 Set-up	0.000 to 59.999	0.000	RW	Num			PT	US
22.059 Parameter 00.059 Set-up	0.000 to 59.999	0.000	RW	Num			PT	US
22.060 Parameter 00.060 Set-up	0.000 to 59.999	0.000	RW	Num			PT	US
22.061 Parameter 00.061 Set-up	0.000 to 59.999	0.000	RW	Num			PT	US
22.062 Parameter 00.062 Set-up	0.000 to 59.999	0.000	RW	Num			PT	US
22.063 Parameter 00.063 Set-up	0.000 to 59.999	0.000	RW	Num			PT	US

22.064	Parameter 00.064 Set-up	0.000 to 59.999	0.000	RW	Num			PT	US
22.065	Parameter 00.065 Set-up	0.000 to 59.999	0.000	RW	Num			PT	US
22.066	Parameter 00.066 Set-up	0.000 to 59.999	0.000	RW	Num			PT	US
22.067	Parameter 00.067 Set-up	0.000 to 59.999	0.000	RW	Num			PT	US
22.068	Parameter 00.068 Set-up	0.000 to 59.999	0.000	RW	Num			PT	US
22.069	Parameter 00.069 Set-up	0.000 to 59.999	0.000	RW	Num			PT	US
22.070	Parameter 00.070 Set-up	0.000 to 59.999	0.000	RW	Num			PT	US
22.071	Parameter 00.071 Set-up	0.000 to 59.999	0.000	RW	Num			PT	US
22.072	Parameter 00.072 Set-up	0.000 to 59.999	0.000	RW	Num			PT	US
22.073	Parameter 00.073 Set-up	0.000 to 59.999	0.000	RW	Num			PT	US
22.074	Parameter 00.074 Set-up	0.000 to 59.999	0.000	RW	Num			PT	US
22.075	Parameter 00.075 Set-up	0.000 to 59.999	0.000	RW	Num			PT	US
22.076	Parameter 00.076 Set-up	0.000 to 59.999	0.000	RW	Num			PT	US
22.077	Parameter 00.077 Set-up	0.000 to 59.999	0.000	RW	Num			PT	US
22.078	Parameter 00.078 Set-up	0.000 to 59.999	0.000	RW	Num			PT	US
22.079	Parameter 00.079 Set-up	0.000 to 59.999	0.000	RW	Num			PT	US
22.080	Parameter 00.080 Set-up	0.000 to 59.999	0.000	RW	Num			PT	US

RW	Read / Write	RO	Read-only	Bit	Bit parameter	Txt	Text string	Date	Date parameter	Time	Time parameter
Chr	Character parameter	Bin	Binary parameter	IP	IP address	Mac	MAC address	Ver	Version number	SMP	Slot, menu, parameter
Num	Number parameter	DE	Destination	ND	No default value	RA	Rating dependent	NC	Non-copyable	PT	Protected
FI	Filtered	US	User save	PS	Power-down save						

Menu 22 − *Menu 0 Set-up*

Mode: RFC‑S

The parameters in this menu are used to set up which parameters are shown in Menu 0.

Parameter	22.001 *Parameter 00.001 Set-up*		
Short description	Defines the parameter to be shown in 00.001		
Mode	RFC‑S		
Minimum	0.000	Maximum	59.999
Default	1.007	Units	
Type	16 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	3
Coding	RW, PT, BU		

Each parameter is used to set up the equivalent parameter in Menu 0, for example *Parameter 00.001 Set-up* (22.001) is used to set up which parameter is shown in *Menu 0 Parameter 1* (00.001), etc. 80 selectable Menu 0 parameters (00.001 to 00.080) and equivalent set-up parameters (22.001 to 22.080) are provided. When a Menu 0 set-up parameter is set to 00.000 or a value that is not a valid parameter outside Menu 0, the equivalent Menu 0 parameter is not visible. If a parameter has an equivalent motor 2 parameter in Menu 21 then when *Motor 2 Active* (21.015) = 0 the original parameter is displayed, but when *Motor 2 Active* (21.015) = 1 the equivalent motor 2 parameter from Menu 21 is displayed.

Parameter	22.002 *Parameter 00.002 Set-up*		
Short description	Defines the parameter to be shown in 00.002		
Mode	RFC‑S		
Minimum	0.000	Maximum	59.999
Default	1.006	Units	
Type	16 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	3
Coding	RW, PT, BU		

See *Parameter 00.001 Set-up* (22.001).

Parameter	22.003 *Parameter 00.003 Set-up*		
Short description	Defines the parameter to be shown in 00.003		
Mode	RFC‑S		
Minimum	0.000	Maximum	59.999
Default	2.011	Units	
Type	16 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	3
Coding	RW, PT, BU		

See *Parameter 00.001 Set-up* (22.001).

Parameter	22.004 *Parameter 00.004 Set-up*		
Short description	Defines the parameter to be shown in 00.004		
Mode	RFC‑S		
Minimum	0.000	Maximum	59.999
Default	2.021	Units	
Type	16 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	3
Coding	RW, PT, BU		

See *Parameter 00.001 Set-up* (22.001).

Parameter	22.005 *Parameter 00.005 Set-up*		
Short description	Defines the parameter to be shown in 00.005		
Mode	RFC‑S		
Minimum	0.000	Maximum	59.999
Default	1.014	Units	
Type	16 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	3
Coding	RW, PT, BU		

See *Parameter 00.001 Set-up* (22.001).

Parameter	22.006 *Parameter 00.006 Set-up*		
Short description	Defines the parameter to be shown in 00.006		
Mode	RFC-S		
Minimum	0.000	Maximum	59.999
Default	4.007	Units	
Type	16 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	3
Coding	RW, PT, BU		

See *Parameter 00.001 Set-up* (22.001).

Parameter	22.007 *Parameter 00.007 Set-up*		
Short description	Defines the parameter to be shown in 00.007		
Mode	RFC-S		
Minimum	0.000	Maximum	59.999
Default	3.010	Units	
Type	16 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	3
Coding	RW, PT, BU		

See *Parameter 00.001 Set-up* (22.001).

Parameter	22.008 *Parameter 00.008 Set-up*		
Short description	Defines the parameter to be shown in 00.008		
Mode	RFC-S		
Minimum	0.000	Maximum	59.999
Default	3.011	Units	
Type	16 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	3
Coding	RW, PT, BU		

See *Parameter 00.001 Set-up* (22.001).

Parameter	22.009 *Parameter 00.009 Set-up*		
Short description	Defines the parameter to be shown in 00.009		
Mode	RFC-S		
Minimum	0.000	Maximum	59.999
Default	3.012	Units	
Type	16 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	3
Coding	RW, PT, BU		

See *Parameter 00.001 Set-up* (22.001).

Parameter	22.010 *Parameter 00.010 Set-up*		
Short description	Defines the parameter to be shown in 00.010		
Mode	RFC-S		
Minimum	0.000	Maximum	59.999
Default	3.002	Units	
Type	16 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	3
Coding	RW, PT, BU		

See *Parameter 00.001 Set-up* (22.001).

Parameter	22.011 *Parameter 00.011 Set-up*		
Short description	Defines the parameter to be shown in 00.011		
Mode	RFC-S		
Minimum	0.000	Maximum	59.999
Default	3.029	Units	
Type	16 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	3
Coding	RW, PT, BU		

See *Parameter 00.001 Set-up* (22.001).

Parameter	22.012 *Parameter 00.012 Set-up*		
Short description	Defines the parameter to be shown in 00.012		
Mode	RFC‑S		
Minimum	0.000	Maximum	59.999
Default	4.001	Units	
Type	16 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	3
Coding	RW, PT, BU		

See *Parameter 00.001 Set-up* (22.001).

Parameter	22.013 *Parameter 00.013 Set-up*		
Short description	Defines the parameter to be shown in 00.013		
Mode	RFC‑S		
Minimum	0.000	Maximum	59.999
Default	4.002	Units	
Type	16 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	3
Coding	RW, PT, BU		

See *Parameter 00.001 Set-up* (22.001).

Parameter	22.014 *Parameter 00.014 Set-up*		
Short description	Defines the parameter to be shown in 00.014		
Mode	RFC‑S		
Minimum	0.000	Maximum	59.999
Default	4.011	Units	
Type	16 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	3
Coding	RW, PT, BU		

See *Parameter 00.001 Set-up* (22.001).

Parameter	22.015 *Parameter 00.015 Set-up*		
Short description	Defines the parameter to be shown in 00.015		
Mode	RFC‑S		
Minimum	0.000	Maximum	59.999
Default	2.004	Units	
Type	16 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	3
Coding	RW, PT, BU		

See *Parameter 00.001 Set-up* (22.001).

Parameter	22.016 *Parameter 00.016 Set-up*		
Short description	Defines the parameter to be shown in 00.016		
Mode	RFC‑S		
Minimum	0.000	Maximum	59.999
Default	2.002	Units	
Type	16 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	3
Coding	RW, PT, BU		

See *Parameter 00.001 Set-up* (22.001).

Parameter	22.017 *Parameter 00.017 Set-up*		
Short description	Defines the parameter to be shown in 00.017		
Mode	RFC‑S		
Minimum	0.000	Maximum	59.999
Default	4.012	Units	
Type	16 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	3
Coding	RW, PT, BU		

See *Parameter 00.001 Set-up* (22.001).

Parameter	22.018 *Parameter 00.018 Set-up*		
Short description	Defines the parameter to be shown in 00.018		
Mode	RFC‑S		
Minimum	0.000	Maximum	59.999
Default	3.123	Units	
Type	16 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	3
Coding	RW, PT, BU		

See *Parameter 00.001 Set-up* (22.001).

Parameter	22.019 *Parameter 00.019 Set-up*		
Short description	Defines the parameter to be shown in 00.019		
Mode	RFC‑S		
Minimum	0.000	Maximum	59.999
Default	7.011	Units	
Type	16 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	3
Coding	RW, PT, BU		

See *Parameter 00.001 Set-up* (22.001).

Parameter	22.020 *Parameter 00.020 Set-up*		
Short description	Defines the parameter to be shown in 00.020		
Mode	RFC‑S		
Minimum	0.000	Maximum	59.999
Default	7.014	Units	
Type	16 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	3
Coding	RW, PT, BU		

See *Parameter 00.001 Set-up* (22.001).

Parameter	22.021 *Parameter 00.021 Set-up*		
Short description	Defines the parameter to be shown in 00.021		
Mode	RFC‑S		
Minimum	0.000	Maximum	59.999
Default	7.015	Units	
Type	16 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	3
Coding	RW, PT, BU		

See *Parameter 00.001 Set-up* (22.001).

Parameter	22.022 *Parameter 00.022 Set-up*		
Short description	Defines the parameter to be shown in 00.022		
Mode	RFC‑S		
Minimum	0.000	Maximum	59.999
Default	1.010	Units	
Type	16 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	3
Coding	RW, PT, BU		

See *Parameter 00.001 Set-up* (22.001).

Parameter	22.023 *Parameter 00.023 Set-up*		
Short description	Defines the parameter to be shown in 00.023		
Mode	RFC‑S		
Minimum	0.000	Maximum	59.999
Default	1.005	Units	
Type	16 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	3
Coding	RW, PT, BU		

See *Parameter 00.001 Set-up* (22.001).

Parameter	**22.024** *Parameter 00.024 Set-up*		
Short description	Defines the parameter to be shown in 00.024		
Mode	RFC‑S		
Minimum	0.000	Maximum	59.999
Default	1.021	Units	
Type	16 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	3
Coding	RW, PT, BU		

See *Parameter 00.001 Set-up* (22.001).

Parameter	**22.025** *Parameter 00.025 Set-up*		
Short description	Defines the parameter to be shown in 00.025		
Mode	RFC‑S		
Minimum	0.000	Maximum	59.999
Default	1.022	Units	
Type	16 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	3
Coding	RW, PT, BU		

See *Parameter 00.001 Set-up* (22.001).

Parameter	**22.026** *Parameter 00.026 Set-up*		
Short description	Defines the parameter to be shown in 00.026		
Mode	RFC‑S		
Minimum	0.000	Maximum	59.999
Default	3.008	Units	
Type	16 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	3
Coding	RW, PT, BU		

See *Parameter 00.001 Set-up* (22.001).

Parameter	**22.027** *Parameter 00.027 Set-up*		
Short description	Defines the parameter to be shown in 00.027		
Mode	RFC‑S		
Minimum	0.000	Maximum	59.999
Default	3.034	Units	
Type	16 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	3
Coding	RW, PT, BU		

See *Parameter 00.001 Set-up* (22.001).

Parameter	**22.028** *Parameter 00.028 Set-up*		
Short description	Defines the parameter to be shown in 00.028		
Mode	RFC‑S		
Minimum	0.000	Maximum	59.999
Default	6.013	Units	
Type	16 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	3
Coding	RW, PT, BU		

See *Parameter 00.001 Set-up* (22.001).

Parameter	**22.029** *Parameter 00.029 Set-up*		
Short description	Defines the parameter to be shown in 00.029		
Mode	RFC‑S		
Minimum	0.000	Maximum	59.999
Default	11.036	Units	
Type	16 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	3
Coding	RW, PT, BU		

See *Parameter 00.001 Set-up* (22.001).

Parameter	22.030 *Parameter 00.030 Set-up*		
Short description	Defines the parameter to be shown in 00.030		
Mode	RFC‑S		
Minimum	0.000	Maximum	59.999
Default	11.042	Units	
Type	16 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	3
Coding	RW, PT, BU		

See *Parameter 00.001 Set-up* (22.001).

Parameter	22.031 *Parameter 00.031 Set-up*		
Short description	Defines the parameter to be shown in 00.031		
Mode	RFC‑S		
Minimum	0.000	Maximum	59.999
Default	11.033	Units	
Type	16 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	3
Coding	RW, PT, BU		

See *Parameter 00.001 Set-up* (22.001).

Parameter	22.032 *Parameter 00.032 Set-up*		
Short description	Defines the parameter to be shown in 00.032		
Mode	RFC‑S		
Minimum	0.000	Maximum	59.999
Default	11.032	Units	
Type	16 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	3
Coding	RW, PT, BU		

See *Parameter 00.001 Set-up* (22.001).

Parameter	22.033 *Parameter 00.033 Set-up*		
Short description	Defines the parameter to be shown in 00.033		
Mode	RFC‑S		
Minimum	0.000	Maximum	59.999
Default	0.000	Units	
Type	16 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	3
Coding	RW, PT, BU		

See *Parameter 00.001 Set-up* (22.001).

Parameter	22.034 *Parameter 00.034 Set-up*		
Short description	Defines the parameter to be shown in 00.034		
Mode	RFC‑S		
Minimum	0.000	Maximum	59.999
Default	11.030	Units	
Type	16 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	3
Coding	RW, PT, BU		

See *Parameter 00.001 Set-up* (22.001).

Parameter	22.035 *Parameter 00.035 Set-up*		
Short description	Defines the parameter to be shown in 00.035		
Mode	RFC‑S		
Minimum	0.000	Maximum	59.999
Default	0.000	Units	
Type	16 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	3
Coding	RW, PT, BU		

See *Parameter 00.001 Set-up* (22.001).

Parameter	22.036 *Parameter 00.036 Set-up*		
Short description	Defines the parameter to be shown in 00.036		
Mode	RFC‑S		
Minimum	0.000	Maximum	59.999
Default	0.000	Units	
Type	16 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	3
Coding	RW, PT, BU		

See *Parameter 00.001 Set-up* (22.001).

Parameter	22.037 *Parameter 00.037 Set-up*		
Short description	Defines the parameter to be shown in 00.037		
Mode	RFC‑S		
Minimum	0.000	Maximum	59.999
Default	24.010	Units	
Type	16 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	3
Coding	RW, PT, BU		

See *Parameter 00.001 Set-up* (22.001).

Parameter	22.038 *Parameter 00.038 Set-up*		
Short description	Defines the parameter to be shown in 00.038		
Mode	RFC‑S		
Minimum	0.000	Maximum	59.999
Default	4.013	Units	
Type	16 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	3
Coding	RW, PT, BU		

See *Parameter 00.001 Set-up* (22.001).

Parameter	22.039 *Parameter 00.039 Set-up*		
Short description	Defines the parameter to be shown in 00.039		
Mode	RFC‑S		
Minimum	0.000	Maximum	59.999
Default	4.014	Units	
Type	16 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	3
Coding	RW, PT, BU		

See *Parameter 00.001 Set-up* (22.001).

Parameter	22.040 *Parameter 00.040 Set-up*		
Short description	Defines the parameter to be shown in 00.040		
Mode	RFC‑S		
Minimum	0.000	Maximum	59.999
Default	5.012	Units	
Type	16 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	3
Coding	RW, PT, BU		

See *Parameter 00.001 Set-up* (22.001).

Parameter	22.041 *Parameter 00.041 Set-up*		
Short description	Defines the parameter to be shown in 00.041		
Mode	RFC‑S		
Minimum	0.000	Maximum	59.999
Default	5.018	Units	
Type	16 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	3
Coding	RW, PT, BU		

See *Parameter 00.001 Set-up* (22.001).

Parameter	**22.042** *Parameter 00.042 Set-up*		
Short description	Defines the parameter to be shown in 00.042		
Mode	RFC‑S		
Minimum	0.000	Maximum	59.999
Default	5.011	Units	
Type	16 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	3
Coding	RW, PT, BU		

See *Parameter 00.001 Set-up* (22.001).

Parameter	**22.043** *Parameter 00.043 Set-up*		
Short description	Defines the parameter to be shown in 00.043		
Mode	RFC‑S		
Minimum	0.000	Maximum	59.999
Default	3.025	Units	
Type	16 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	3
Coding	RW, PT, BU		

See *Parameter 00.001 Set-up* (22.001).

Parameter	**22.044** *Parameter 00.044 Set-up*		
Short description	Defines the parameter to be shown in 00.044		
Mode	RFC‑S		
Minimum	0.000	Maximum	59.999
Default	5.009	Units	
Type	16 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	3
Coding	RW, PT, BU		

See *Parameter 00.001 Set-up* (22.001).

Parameter	**22.045** *Parameter 00.045 Set-up*		
Short description	Defines the parameter to be shown in 00.045		
Mode	RFC‑S		
Minimum	0.000	Maximum	59.999
Default	5.008	Units	
Type	16 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	3
Coding	RW, PT, BU		

See *Parameter 00.001 Set-up* (22.001).

Parameter	**22.046** *Parameter 00.046 Set-up*		
Short description	Defines the parameter to be shown in 00.046		
Mode	RFC‑S		
Minimum	0.000	Maximum	59.999
Default	5.007	Units	
Type	16 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	3
Coding	RW, PT, BU		

See *Parameter 00.001 Set-up* (22.001).

Parameter	**22.047** *Parameter 00.047 Set-up*		
Short description	Defines the parameter to be shown in 00.047		
Mode	RFC‑S		
Minimum	0.000	Maximum	59.999
Default	5.033	Units	
Type	16 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	3
Coding	RW, PT, BU		

See *Parameter 00.001 Set-up* (22.001).

Parameter	22.048 *Parameter 00.048 Set-up*		
Short description	Defines the parameter to be shown in 00.048		
Mode	RFC‑S		
Minimum	0.000	Maximum	59.999
Default	11.031	Units	
Type	16 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	3
Coding	RW, PT, BU		

See *Parameter 00.001 Set-up* (22.001).

Parameter	22.049 *Parameter 00.049 Set-up*		
Short description	Defines the parameter to be shown in 00.049		
Mode	RFC‑S		
Minimum	0.000	Maximum	59.999
Default	11.044	Units	
Type	16 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	3
Coding	RW, PT, BU		

See *Parameter 00.001 Set-up* (22.001).

Parameter	22.050 *Parameter 00.050 Set-up*		
Short description	Defines the parameter to be shown in 00.050		
Mode	RFC‑S		
Minimum	0.000	Maximum	59.999
Default	11.029	Units	
Type	16 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	3
Coding	RW, PT, BU		

See *Parameter 00.001 Set-up* (22.001).

Parameter	22.051 *Parameter 00.051 Set-up*		
Short description	Defines the parameter to be shown in 00.051		
Mode	RFC‑S		
Minimum	0.000	Maximum	59.999
Default	10.037	Units	
Type	16 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	3
Coding	RW, PT, BU		

See *Parameter 00.001 Set-up* (22.001).

Parameter	22.052 *Parameter 00.052 Set-up*		
Short description	Defines the parameter to be shown in 00.052		
Mode	RFC‑S		
Minimum	0.000	Maximum	59.999
Default	0.000	Units	
Type	16 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	3
Coding	RW, PT, BU		

See *Parameter 00.001 Set-up* (22.001).

Parameter	22.053 *Parameter 00.053 Set-up*		
Short description	Defines the parameter to be shown in 00.053		
Mode	RFC‑S		
Minimum	0.000	Maximum	59.999
Default	4.015	Units	
Type	16 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	3
Coding	RW, PT, BU		

See *Parameter 00.001 Set-up* (22.001).

Parameter	22.054 *Parameter 00.054 Set-up*		
Short description	Defines the parameter to be shown in 00.054		
Mode	RFC‑S		
Minimum	0.000	Maximum	59.999
Default	0.000	Units	
Type	16 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	3
Coding	RW, PT, BU		

See *Parameter 00.001 Set-up* (22.001).

Parameter	22.055 *Parameter 00.055 Set-up*		
Short description	Defines the parameter to be shown in 00.055		
Mode	RFC‑S		
Minimum	0.000	Maximum	59.999
Default	0.000	Units	
Type	16 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	3
Coding	RW, PT, BU		

See *Parameter 00.001 Set-up* (22.001).

Parameter	22.056 *Parameter 00.056 Set-up*		
Short description	Defines the parameter to be shown in 00.056		
Mode	RFC‑S		
Minimum	0.000	Maximum	59.999
Default	0.000	Units	
Type	16 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	3
Coding	RW, PT, BU		

See *Parameter 00.001 Set-up* (22.001).

Parameter	22.057 *Parameter 00.057 Set-up*		
Short description	Defines the parameter to be shown in 00.057		
Mode	RFC‑S		
Minimum	0.000	Maximum	59.999
Default	0.000	Units	
Type	16 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	3
Coding	RW, PT, BU		

See *Parameter 00.001 Set-up* (22.001).

Parameter	22.058 *Parameter 00.058 Set-up*		
Short description	Defines the parameter to be shown in 00.058		
Mode	RFC‑S		
Minimum	0.000	Maximum	59.999
Default	0.000	Units	
Type	16 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	3
Coding	RW, PT, BU		

See *Parameter 00.001 Set-up* (22.001).

Parameter	22.059 *Parameter 00.059 Set-up*		
Short description	Defines the parameter to be shown in 00.059		
Mode	RFC‑S		
Minimum	0.000	Maximum	59.999
Default	0.000	Units	
Type	16 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	3
Coding	RW, PT, BU		

See *Parameter 00.001 Set-up* (22.001).

Parameter	22.060 *Parameter 00.060 Set-up*		
Short description	Defines the parameter to be shown in 00.060		
Mode	RFC-S		
Minimum	0.000	Maximum	59.999
Default	0.000	Units	
Type	16 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	3
Coding	RW, PT, BU		

See *Parameter 00.001 Set-up* (22.001).

Parameter	22.061 *Parameter 00.061 Set-up*		
Short description	Defines the parameter to be shown in 00.061		
Mode	RFC-S		
Minimum	0.000	Maximum	59.999
Default	0.000	Units	
Type	16 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	3
Coding	RW, PT, BU		

See *Parameter 00.001 Set-up* (22.001).

Parameter	22.062 *Parameter 00.062 Set-up*		
Short description	Defines the parameter to be shown in 00.062		
Mode	RFC-S		
Minimum	0.000	Maximum	59.999
Default	0.000	Units	
Type	16 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	3
Coding	RW, PT, BU		

See *Parameter 00.001 Set-up* (22.001).

Parameter	22.063 *Parameter 00.063 Set-up*		
Short description	Defines the parameter to be shown in 00.063		
Mode	RFC-S		
Minimum	0.000	Maximum	59.999
Default	0.000	Units	
Type	16 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	3
Coding	RW, PT, BU		

See *Parameter 00.001 Set-up* (22.001).

Parameter	22.064 *Parameter 00.064 Set-up*		
Short description	Defines the parameter to be shown in 00.064		
Mode	RFC-S		
Minimum	0.000	Maximum	59.999
Default	0.000	Units	
Type	16 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	3
Coding	RW, PT, BU		

See *Parameter 00.001 Set-up* (22.001).

Parameter	22.065 *Parameter 00.065 Set-up*		
Short description	Defines the parameter to be shown in 00.065		
Mode	RFC-S		
Minimum	0.000	Maximum	59.999
Default	0.000	Units	
Type	16 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	3
Coding	RW, PT, BU		

See *Parameter 00.001 Set-up* (22.001).

Parameter	22.066 *Parameter 00.066 Set-up*		
Short description	Defines the parameter to be shown in 00.066		
Mode	RFC‑S		
Minimum	0.000	Maximum	59.999
Default	0.000	Units	
Type	16 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	3
Coding	RW, PT, BU		

See *Parameter 00.001 Set-up* (22.001).

Parameter	22.067 *Parameter 00.067 Set-up*		
Short description	Defines the parameter to be shown in 00.067		
Mode	RFC‑S		
Minimum	0.000	Maximum	59.999
Default	0.000	Units	
Type	16 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	3
Coding	RW, PT, BU		

See *Parameter 00.001 Set-up* (22.001).

Parameter	22.068 *Parameter 00.068 Set-up*		
Short description	Defines the parameter to be shown in 00.068		
Mode	RFC‑S		
Minimum	0.000	Maximum	59.999
Default	0.000	Units	
Type	16 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	3
Coding	RW, PT, BU		

See *Parameter 00.001 Set-up* (22.001).

Parameter	22.069 *Parameter 00.069 Set-up*		
Short description	Defines the parameter to be shown in 00.069		
Mode	RFC‑S		
Minimum	0.000	Maximum	59.999
Default	0.000	Units	
Type	16 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	3
Coding	RW, PT, BU		

See *Parameter 00.001 Set-up* (22.001).

Parameter	22.070 *Parameter 00.070 Set-up*		
Short description	Defines the parameter to be shown in 00.070		
Mode	RFC‑S		
Minimum	0.000	Maximum	59.999
Default	0.000	Units	
Type	16 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	3
Coding	RW, PT, BU		

See *Parameter 00.001 Set-up* (22.001).

Parameter	22.071 *Parameter 00.071 Set-up*		
Short description	Defines the parameter to be shown in 00.071		
Mode	RFC‑S		
Minimum	0.000	Maximum	59.999
Default	0.000	Units	
Type	16 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	3
Coding	RW, PT, BU		

See *Parameter 00.001 Set-up* (22.001).

Parameter	22.072 *Parameter 00.072 Set-up*		
Short description	Defines the parameter to be shown in 00.072		
Mode	RFC‑S		
Minimum	0.000	Maximum	59.999
Default	0.000	Units	
Type	16 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	3
Coding	RW, PT, BU		

See *Parameter 00.001 Set-up* (22.001).

Parameter	22.073 *Parameter 00.073 Set-up*		
Short description	Defines the parameter to be shown in 00.073		
Mode	RFC‑S		
Minimum	0.000	Maximum	59.999
Default	0.000	Units	
Type	16 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	3
Coding	RW, PT, BU		

See *Parameter 00.001 Set-up* (22.001).

Parameter	22.074 *Parameter 00.074 Set-up*		
Short description	Defines the parameter to be shown in 00.074		
Mode	RFC‑S		
Minimum	0.000	Maximum	59.999
Default	0.000	Units	
Type	16 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	3
Coding	RW, PT, BU		

See *Parameter 00.001 Set-up* (22.001).

Parameter	22.075 *Parameter 00.075 Set-up*		
Short description	Defines the parameter to be shown in 00.075		
Mode	RFC‑S		
Minimum	0.000	Maximum	59.999
Default	0.000	Units	
Type	16 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	3
Coding	RW, PT, BU		

See *Parameter 00.001 Set-up* (22.001).

Parameter	22.076 *Parameter 00.076 Set-up*		
Short description	Defines the parameter to be shown in 00.076		
Mode	RFC‑S		
Minimum	0.000	Maximum	59.999
Default	0.000	Units	
Type	16 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	3
Coding	RW, PT, BU		

See *Parameter 00.001 Set-up* (22.001).

Parameter	22.077 *Parameter 00.077 Set-up*		
Short description	Defines the parameter to be shown in 00.077		
Mode	RFC‑S		
Minimum	0.000	Maximum	59.999
Default	0.000	Units	
Type	16 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	3
Coding	RW, PT, BU		

See *Parameter 00.001 Set-up* (22.001).

Parameter	**22.078** *Parameter 00.078 Set-up*		
Short description	Defines the parameter to be shown in 00.078		
Mode	RFC‑S		
Minimum	0.000	Maximum	59.999
Default	0.000	Units	
Type	16 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	3
Coding	RW, PT, BU		

See *Parameter 00.001 Set-up* (22.001).

Parameter	**22.079** *Parameter 00.079 Set-up*		
Short description	Defines the parameter to be shown in 00.079		
Mode	RFC‑S		
Minimum	0.000	Maximum	59.999
Default	0.000	Units	
Type	16 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	3
Coding	RW, PT, BU		

See *Parameter 00.001 Set-up* (22.001).

Parameter	**22.080** *Parameter 00.080 Set-up*		
Short description	Defines the parameter to be shown in 00.080		
Mode	RFC‑S		
Minimum	0.000	Maximum	59.999
Default	0.000	Units	
Type	16 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	3
Coding	RW, PT, BU		

See *Parameter 00.001 Set-up* (22.001).

Menu 24 Single Line Descriptions − *Ethernet Setup*

Mode: RFC‑S

Parameter		Range	Default	Type					
24.001	Module ID	0 to 65535		RO	Num	ND	NC	PT	
24.002	Software Version	0 to 99999999		RO	Num	ND	NC	PT	
24.003	Hardware Version	0.00 to 99.99		RO	Num	ND	NC	PT	
24.004	Serial Number LS	00000000 to 99999999		RO	Num	ND	NC	PT	
24.005	Serial Number MS	0 to 99999999		RO	Num	ND	NC	PT	
24.006	Status	Bootldr‑Update (-2), Bootldr‑Idle (-1), Initialising (0), OK (1), Config (2), Error (3)		RO	Txt	ND	NC	PT	
24.007	Reset	Off (0) or On (1)	Off (0)	RW	Bit		NC		
24.008	Default	Off (0) or On (1)	Off (0)	RW	Bit		NC		
24.009	Active Alarm Bits	0000000000000000 to 1111111111111111	0000000000000000	RO	Bin		NC		
24.010	Active IP Address	128.0.0.0 to 127.255.255.255	0.0.0.0	RO	IP		NC	PT	
24.011	Date Code	0 to 65535		RO	Num	ND	NC	PT	

RW	Read / Write	RO	Read-only	Bit	Bit parameter	Txt	Text string	Date	Date parameter	Time	Time parameter
Chr	Character parameter	Bin	Binary parameter	IP	IP address	Mac	MAC address	Ver	Version number	SMP	Slot, menu, parameter
Num	Number parameter	DE	Destination	ND	No default value	RA	Rating dependent	NC	Non-copyable	PT	Protected
FI	Filtered	US	User save	PS	Power-down save						

Menu 24 − *Ethernet Setup*

Mode: RFC‑S

Menu 24 is a duplication of slot 4 menu 0. For a description of a particular parameter, click on the relevant slot parameter in the table below.

Drive Parameter	Slot Parameter
24.001 *Module ID*	4.00.001 *Module ID*
24.002 *Software Version*	4.00.002 *Software Version*
24.003 *Hardware Version*	4.00.003 *Hardware Version*
24.004 *Serial Number LS*	4.00.004 *Serial Number LS*
24.005 *Serial Number MS*	4.00.005 *Serial Number MS*
24.006 *Status*	4.00.006 *Status*
24.007 *Reset*	4.00.007 *Reset*
24.008 *Default*	4.00.008 *Default*
24.009 *Active Alarm Bits*	4.00.009 *Active Alarm Bits*
24.010 *Active IP Address*	4.00.010 *Active IP Address*
24.011 *Date Code*	4.00.011 *Date Code*

Menu 31 Single Line Descriptions − *AMC General Set-up*

Mode: RFC‑S

Parameter	Range	Default	Type				
31.001 AMC Select	Off (0) or On (1)	Off (0)	RW	Bit			US
31.002 AMC Absolute Mode Enable	Off (0) or On (1)	Off (0)	RW	Bit			US
31.003 AMC Incremental Position Reset Mode	Off (0) or On (1)	Off (0)	RW	Bit			US
31.004 AMC Master User Units Ratio Numerator	1 to 2147483647	1000	RW	Num			US
31.005 AMC Master User Units Ratio Denominator	1 to 2147483647	1000	RW	Num			US
31.006 AMC Slave User Units Ratio Numerator	1 to 2147483647	1000	RW	Num			US
31.007 AMC Slave User Units Ratio Denominator	1 to 2147483647	1000	RW	Num			US
31.008 AMC Output User Units Ratio Numerator	1 to 2147483647	1000	RW	Num			US
31.009 AMC Output User Units Ratio Denominator	1 to 2147483647	1000	RW	Num			US
31.010 AMC Roll‑over Limit	0 to VM_AMC_ROLLOVER UU	0 UU	RW	Num			US
31.011 AMC Synchronise To Onboard User Program Clock Task	Off (0) or On (1)	Off (0)	RW	Bit			US
31.012 AMC Rate Select	4ms (1), 2ms (2), 1ms (3), 500us (4), 250us (5)	250us (5)	RW	Txt			US
31.013 AMC Rate Selected	Not Active (0), 4ms (1), 2ms (2), 1ms (3), 500us (4), 250us (5)		RO	Txt	ND	NC	PT	
31.014 AMC Speed Mode Enable	Off (0) or On (1)	Off (0)	RW	Bit			US
31.015 AMC Auto Resolution Enable	Off (0) or On (1)	Off (0)	RW	Bit			US
31.016 AMC Auto Resolution Scaling	1 to 2147483647		RO	Num	ND	NC	PT	

RW	Read / Write	RO	Read-only	Bit	Bit parameter	Txt	Text string	Date	Date parameter	Time	Time parameter
Chr	Character parameter	Bin	Binary parameter	IP	IP address	Mac	MAC address	Ver	Version number	SMP	Slot, menu, parameter
Num	Number parameter	DE	Destination	ND	No default value	RA	Rating dependent	NC	Non-copyable	PT	Protected
FI	Filtered	US	User save	PS	Power-down save						

Menu 31 − *AMC General Set-up*

Mode: RFC‑S

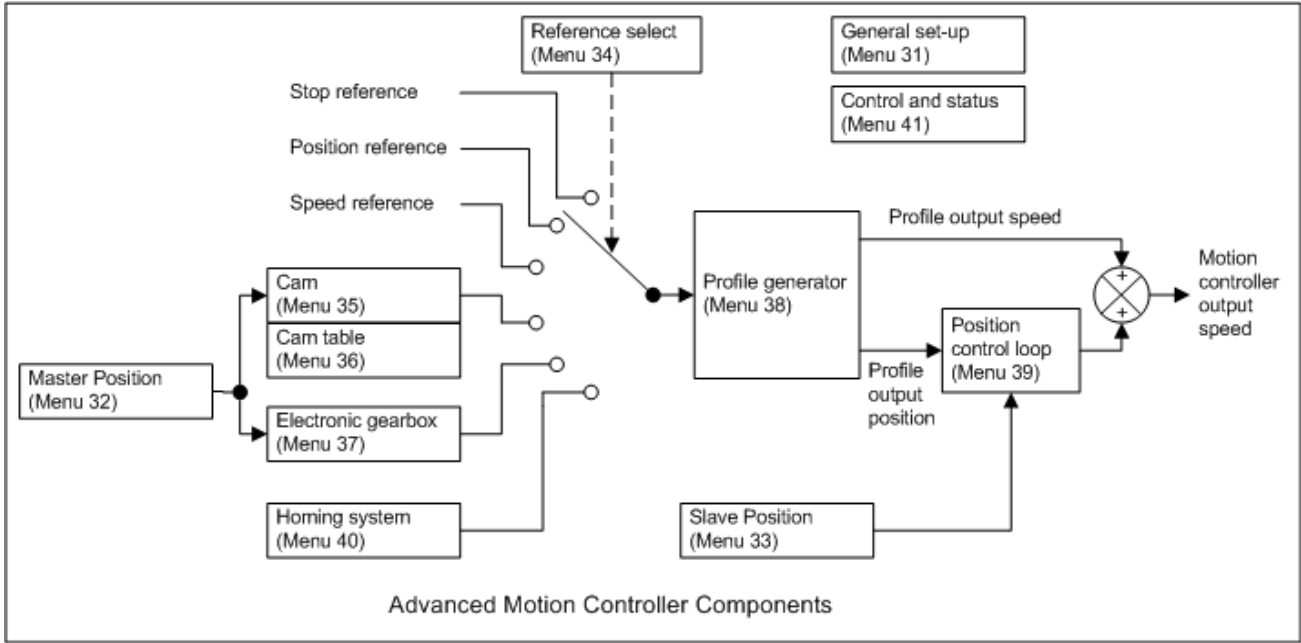**System components**

The diagram below shows the format and interface for the Advance Motion Controller.

Advanced Motion Controller Format
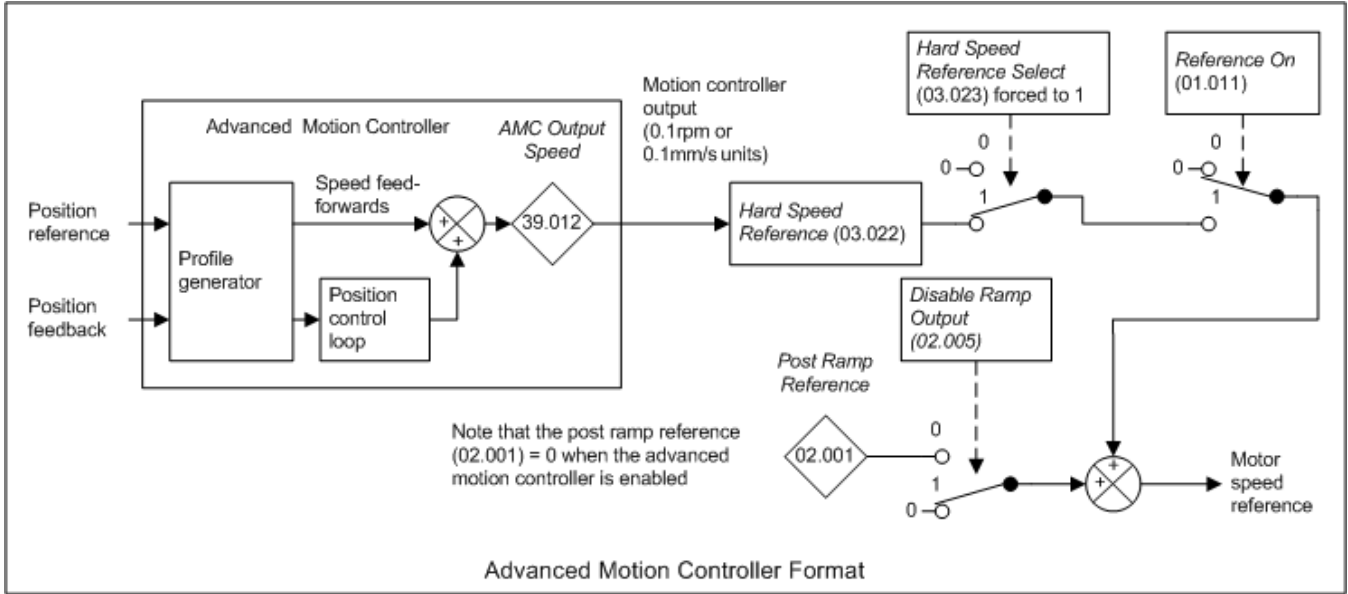
The Advanced Motion Controller includes its own profile generator and combines the speed feed-forwards from the profile with the output of its position control loop to give a single speed reference in 0.1rpm or 0.1mm/s units. The conversion to the output speed is based on the set-up parameters of the position feedback selected to control the motor.

The Advanced Motion Controller is made up from the components shown in the diagram below. Individual menus are provided for each of the components.

Advanced Motion Controller Components

Position units

Position feedback from a drive or option module position feedback interface is given as a 32 bit signed value (normalised position) including the effect of the marker input for the interface (if relevant). The number of bits that represent turns (for a rotary position feedback device) or motor poles (for a linear position feedback device) can be selected for each position feedback device with a parameter in the set-up menu for that interface. Position is represented in the Advanced Motion Controller as a 32 bit signed value. Conversion ratios can be applied to the master position (*AMC Master User Units Ratio Numerator* (31.004) / *AMC Master User Units Ratio Denominator* (31.005)), the slave position (*AMC Slave User Units Ratio Numerator* (31.006) / *AMC Slave User Units Ratio Denominator* (31.007)) and the motion controller output (*AMC Output User Units Ratio Numerator* (31.008) / *AMC Output User Units Ratio Denominator* (31.009)). The slave position can be provided by the encoder used to control the motor or from an additional encoder attached to the load (i.e. dual loop configuration) as shown below.

Position Feedback Configuration
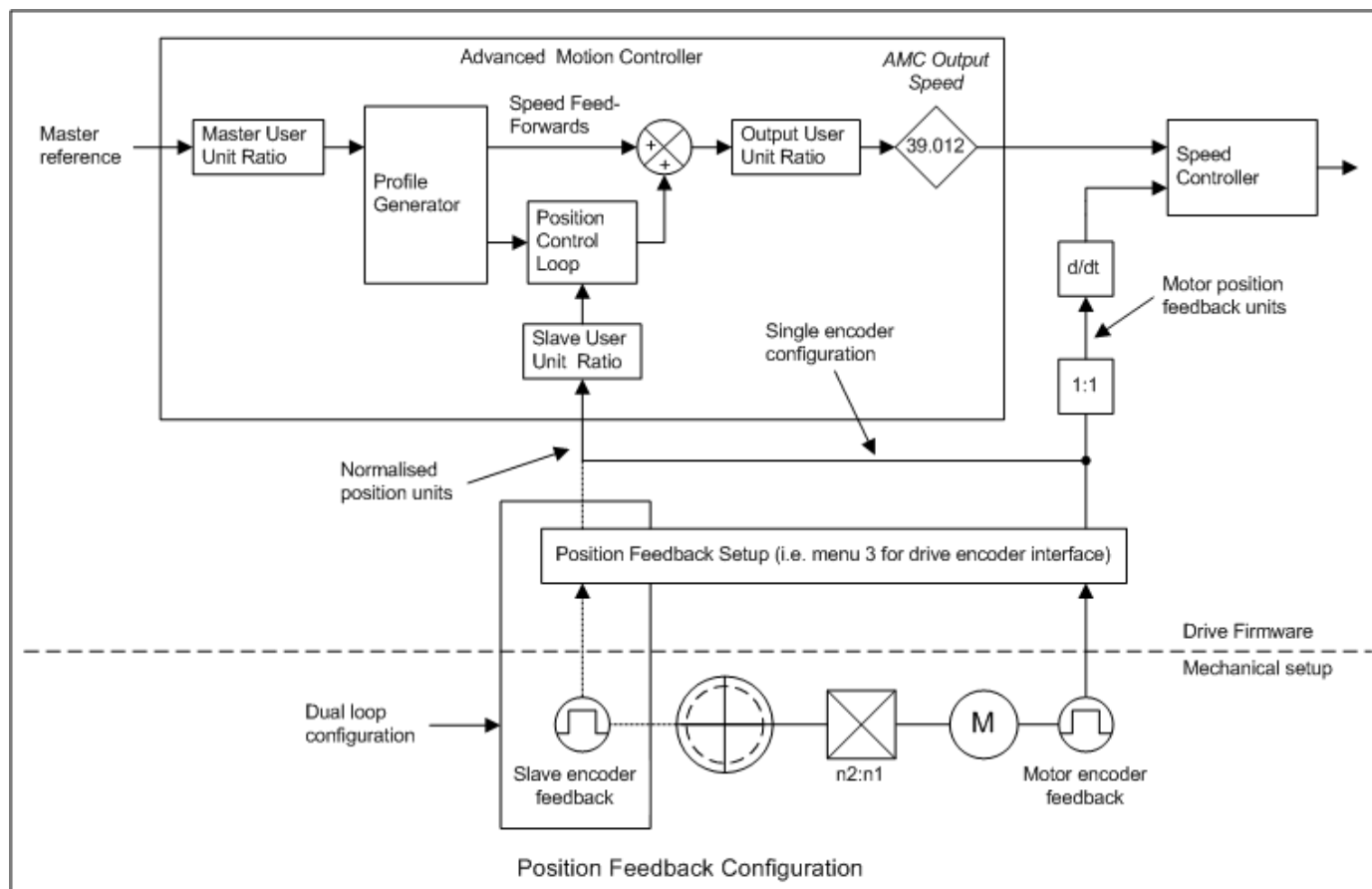
The input ratios should be used to convert the normalised master and slave position to the required user units used for position within the motion controller and the output ratio should be setup to convert from user units to the normalised position units for the feedback device used to control the motor. If the slave feedback is derived from the position feedback used to control the motor the output ratio will be the inverse of the slave ratio. In a dual loop configuration the output ratio must be

setup to correct for any differences between the configuration of the normalised units and the speed of the slave (load) and motor feedback, i.e. mechanical gearing. The conversion from position units to user units (input ratio) and from user units back into position units (output ratio) is demonstrated in the following examples. In these examples the parameter references refer to a feedback device connected to the drives P1 or P2 interface but any drive or option module interface can be used.

Example 1 - Rotary encoder

Position feedback configuration and user units requirements:

- The normalised position for the slave position feedback has 16 *P1 Normalisation Turns* (03.057) and 16 position bits
- One revolution of the slave gives a movement of 1m
- User units are to represent an item that is 3.57cm long with a resolution of 3 decimal places (1 user unit = 3.57cm/1000 = 35.7μm)

The slave user units ratio can be setup to convert the 32 bit normalised position into 35.7μm units as follows:

- Change of user units over the required range = 1m / 35.7^{-6}m = 10^7 / 357
- Change of normalised position over the required range = $2^{\text{Position bits}}$

AMC Slave User Units Ratio Numerator (31.006) = 10^7

AMC Slave User Units Ratio Denominator (31.007) = 2^{16} x 357 = 23396352

The output ratio is the inverse of the input ratio:

AMC Output User Units Ratio Numerator (31.008) = 2^{16} x 357 = 23396352

AMC Output User Units Ratio Denominator (31.009) = 10^7

Example 2: Linear Encoder

Position feedback configuration and user units requirements:

- The normalised position for the slave position feedback has 8 *P1 Normalisation Turns* (03.057) and 24 position bits.
- 64 poles correspond to a linear movement of 10m (*P1 Pole Pitch* (03.055) = 1000 x 10 / 64 = 156.25 mm).
- The position units require a resolution of 1μm.

The slave user units ratio can be setup to convert the 32 bit normalised position into 0.001mm units as follows:

- Change of user units over the required range = 10m / 10^{-6}m = 10^7
- Change of normalised position over the required range = 64 x $2^{\text{Position bits}}$ = 2^{30}

AMC Slave User Units Ratio Numerator (31.006) = 10^7

AMC Slave User Units Ratio Denominator (31.007) = 2^{30}

The output ratio is the inverse of the input ratio:

AMC Output User Units Ratio Numerator (31.008) = 2^{30}

AMC Output User Units Ratio Denominator (31.009) = 10^7

Example 3 - Rotary encoders with different motor and slave feedback devices (i.e. dual loop configuration)

Position feedback configuration and user units requirements:

- The normalised position for the slave position feedback has 12 *P1 Normalisation Turns* (03.057) and 20 position bits
- The normalised position for the motor feedback has 16 *P2 Normalisation Turns* (03.157) and 16 position bits
- User units are to represent one revolution in degrees with three decimal places (1 revolution = 360000 user units)
- There is a gear ratio of 16:1 between the motor and slave feedback

The slave user units ratio can be setup to convert the 32 bit normalised position into 0.001 degree units as follows:

- Change of user units over the required range = 360000
- Change of normalised position over the required range = 2^{20}

AMC Slave User Units Ratio Numerator (31.006) = 360000

AMC Slave User Units Ratio Denominator (31.007) = 2^{20}

In this example the output ratio is setup to convert from user units to the normalised position units for the motor feedback and must include the inverse of the gear ratio to ensure that the required output speed is seen at the slave feedback.

AMC Output User Units Ratio Numerator (31.008) = 2^{16} x 16

AMC Output User Units Ratio Denominator (31.009) = 360000

Speed units

Speed parameters are 32 bit values specified in User units/ms with a range from -2^{31} to 2^{31}-1. The speed parameters have two decimal places. If PosBits are the number of bits representing the number of counts per revolution for a rotary position feedback device then the speed resolution is calculated as follows:

Speed resolution

$$= 0.01 \text{ user units/ms}$$
$$= (0.01 \text{ / User units ratio}) \text{ PosBits/ms}$$
$$= (0.01 \text{ / } 2^{\text{PosBits}} \text{ / User units ratio}) \text{ revs/ms}$$
$$= (10 \text{ / } 2^{\text{PosBits}} \text{ / User units ratio}) \text{ revs/s}$$

= (600 / 2^{PosBits} / User units ratio) rpm

If PosBits are the number of bits representing the counts per pole pitch (PolePitch) for a linear feedback device then the speed resolution is calculated as follows:

Speed resolution

= 0.01 user units/ms
= (0.01 / User units ratio) PosBits/ms
= (0.01 / 2^{PosBits} / User units ratio) poles/ms
= (0.01 x PolePitch / 2^{PosBits} / User units ratio) mm/ms
= (10 x PolePitch / 2^{PosBits} / User units ratio) mm/s

The speed resolution and the maximum speed can be calculated using the equations in the table below.

Speed	Calculation	Units
Resolution with rotary position feedback device	(600 / 2^{PosBits}) / User units ratio	rpm
Maximum speed with rotary position feedback device	Resolution x 2^{31}-1	rpm
Resolution with linear position feedback device	(10 x PolePitch / 2^{PosBits}) / User units ratio	mm/s
Maximum speed with linear position feedback device	Resolution x 2^{31}-1	mm/s

The resolution can be used to relate the parameter value to the speed of the position feedback device as follows.

Speed parameter value = Speed of position feedback device / Resolution

The table below shows the speed resolution and the maximum possible speed for a rotary application in rpm and for a linear application with a pole pitch of 50mm in mm/s with a user units ratio of unity. A user units ratio of more than unity will not change the resolution, but a user units ratio of less than unity will make the resolution coarser.

Turns bits	Position bits	Resolution (rpm)	Maximum speed (rpm)	Resolution (mm/s)	Maximum speed (mm/s)
8	24	3.58x10^{-5}	7.68x10^4	2.98x10^{-5}	6.40x10^4
12	20	5.72x10^{-4}	1.23x10^6	4.77x10^{-4}	1.02x10^6
16	16	9.16x10^{-3}	1.97x10^7	7.63x10^{-3}	1.64x10^7
20	12	1.46x10^{-1}	3.15x10^8	1.22x10^{-1}	2.62x10^8
24	8	2.34	5.03x10^9	1.95	4.19x10^9

To allow the profile generator to work at the minimum acceleration (0.001 user units/ms/ms) the internal speed resolution used by the profile generator is defined by the minimum acceleration unit. When the profile generator is enabled (*AMC Profile Disable* (38.005) = 0) the maximum speed can be limited by the output of the profile generator. As above, the maximum profile speed is calculated from the speed resolution and the internal speed resolution of the profile generator is calculated as follows:

Profile speed resolution = Speed resolution / 10.24 x (1ms / *AMC Rate Selected* (31.013))

The table below shows the internal profile speed resolution and the maximum speed when *AMC Rate Selected* (31.013) = 250μs.

Turns bits	Position bits	Profile Internal Resolution (rpm)	Profile Maximum Speed (rpm)	Profile Internal Resolution (mm/s)	Profile Maximum Speed (mm/s)
8	24	8.73x10^{-7}	1.87x10^3	7.28x10^{-7}	1.56x10^3
12	20	1.40x10^{-5}	3.00x10^4	1.16x10^{-5}	2.50x10^4
16	16	2.24x10^{-4}	4.80x10^5	1.86x10^{-4}	4.00x10^5
20	12	3.58x10^{-3}	7.68x10^6	2.98x10^{-3}	6.40x10^6
24	8	5.72x10^{-2}	1.23x10^8	4.77x10^{-2}	1.02x10^8

If a higher maximum profile speed is required the resolution can be decreased by using a user unit ratio less than unity or *AMC Rate Selected* (31.013) can be increased.

Acceleration units

Acceleration parameters are 32 bit values specified in User units/ms/ms with a range from 0 to 2^{30} - 1. The acceleration parameters have 4 decimal places. If PosBits are the number of counts per revolution for a rotary position feedback device then the acceleration resolution is calculated as follows:

Acceleration resolution

= 0.001 user units/ms/ms
= (0.001 / User units ratio) PosBits/ms/ms
= (0.001 / 2^{PosBits} / User units ratio) revs/ms/ms
= (1000 / 2^{PosBits} / User units ratio) revs/s/s
= (60000 / 2^{PosBits} / User units ratio) rpm/s

If PosBits are the number bits representing the counts per pole pitch (PolePitch) for a linear feedback device then the acceleration resolution is calculated as follows:

Acceleration resolution

= 0.001 user units/ms/ms
= (0.001 / User units ratio) PosBits/ms/ms
= (0.001 / 2^{PosBits} / User units ratio) poles/ms/ms
= (0.001 x PolePitch / 2^{PosBits} / User units ratio) mm/ms/ms
= (1000 x PolePitch / 2^{PosBits} / User units ratio) mm/s^2

The acceleration resolution and the maximum acceleration can be calculated using the equations in the table below.

Acceleration	Calculation	Units
Resolution with rotary position feedback device	(60000 / $2^{PosBits}$) / User units ratio	rpm/s
Maximum acceleration with rotary position feedback device	Resolution x 2^{30}-1	rpm/s
Resolution with linear position feedback device	(1000 x PolePitch / $2^{PosBits}$) / User units ratio	mm/s^2
Maximum acceleration with linear position feedback device	Resolution x 2^{30}-1	mm/s^2

The resolution can be used to relate the parameter value to the acceleration of the position feedback device as follows:

Acceleration parameter value = Acceleration of position feedback device / Resolution

The table below shows the minimum and maximum time that can be set up to acceleration from zero to 3000rpm for a rotary application and zero to 1m/s for a linear application with a user units ratio of unity. A user units ratio of more than unity will not change the resolution, but a user units ratio of less than unity will make the resolution coarser.

Turns bits	Position bits	Maximum acceleration time to 3000rpm (s)	Minimum acceleration time to 3000rpm (s)	Maximum acceleration time to 1ms^{-1} (s)	Minimum acceleration time to 1ms^{-1} (s)
8	24	8.39×10^5	7.81×10^{-4}	3.36×10^5	3.13×10^{-4}
12	20	5.24×10^4	4.88×10^{-5}	2.10×10^4	1.95×10^{-5}
16	16	3.28×10^3	3.05×10^{-6}	1.31×10^3	1.22×10^{-6}
20	12	2.05×10^5	1.91×10^{-7}	8.19×10^1	7.63×10^{-8}
24	8	1.28×10^1	1.19×10^{-8}	5.12	4.77×10^{-9}

Parameter	31.001 *AMC Select*		
Short description	Set to 1 to write the output of the motion controller to the Hard Speed Reference		
Mode	RFC-S		
Minimum	0	Maximum	1
Default	0	Units	
Type	1 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW		

When the Advanced Motion Controller is selected (i.e. *AMC Select* (31.001) = 1) the output of the motion controller is written to *Hard Speed Reference* (03.022). The table below shows the effect of changing the value of *AMC Select* (31.001).

AMC Select (31.001)	Action
0	On changing from 1 to 0: *Hard Speed Reference* (03.022) = 0 *Hard Speed Reference Select* (03.023) = 0
1	On changing from 0 to 1: *Hard Speed Reference* (03.022) = *AMC Output Speed* (39.012) *Hard Speed Reference Select* (03.023) = 1

If *Hard Speed Reference Select* (03.023) is turned off after the motion controller has been initialised the motion controller will operate as expected but *AMC Output Speed* (39.012) will not be written to *Hard Speed Reference* (03.022). If the motion controller is not selected (i.e. *AMC Select* (31.001) = 0) none of the functionality in menu 31 to menu 41 is enabled.

Parameter	31.002 *AMC Absolute Mode Enable*		
Short description	Set to 1 to enable the absolute mode of the advance motion controller		
Mode	RFC-S		
Minimum	0	Maximum	1
Default	0	Units	
Type	1 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW		

AMC Absolute Mode Enable (31.002) defines how the position feedback information is transferred to the integrators for the master and slave source positions.

If *AMC Absolute Mode Enable* (31.002) = 0 then the integrators are either held at zero (*AMC Incremental Position Reset Mode* (31.003) = 0), or continue to operate normally (*AMC Incremental Position Reset Mode* (31.003) = 1), when the motion controller is disabled. (See *AMC Enable* (41.001) for details on how to enable or disable the motion controller.) Therefore both the master and slave positions are incremental relative to zero when the motion controller is enabled or when the drive was powered up respectively. When the motion controller is enabled the change of position from the position feedback device is modified by the user unit ratio, and inverted if required, before being accumulated in the integrator.

If *AMC Absolute Mode Enable* (31.002) = 1 then the position is taken from the position feedback device, modified by the user units ratio, inverted if required and then written to the integrator when the motion controller is initialised or any parameter which results in a change of absolute position is modified. After the feedback has been initialised the change of position from the position feedback device is modified by the user unit ratio, and inverted if required, before being accumulated in the

integrator when the motion controller is enabled or disabled. If the user unit ratio is above unity the master and slave position integrators can rollover the boundary during initialisation. When *AMC Roll-over Limit* (31.010) > 0 the initialisation of the slave position is handled differently to allow the position within the rollover limit to be recovered correctly after the normalised position or the internal user position has rolled over a boundary, see *AMC Roll-over Limit* (31.010).

Integrator value after Initialisation with *AMC Absolute Mode Enable (P31.002) = 1*
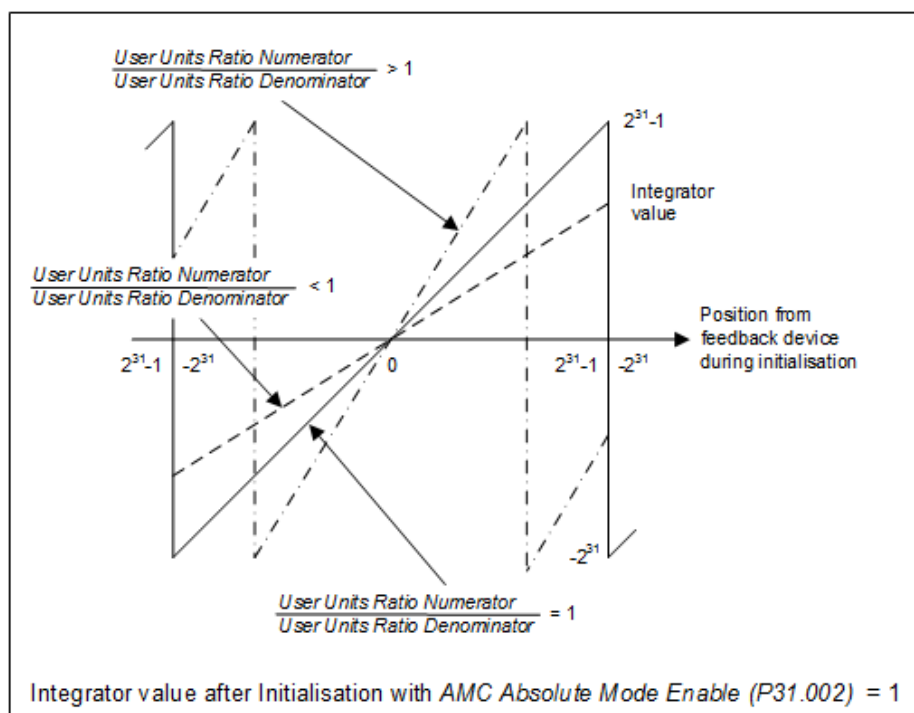
Parameter	31.003 *AMC Incremental Position Reset Mode*		
Short description	If set to 0 the integrators are held at zero when the AMC is disabled, and if set to 1 the integrators continue to operate normally when the AMC is disabled		
Mode	RFC-S		
Minimum	0	Maximum	1
Default	0	Units	
Type	1 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW		

See *AMC Absolute Mode Enable* (31.002).

Parameter	31.004 *AMC Master User Units Ratio Numerator*		
Short description	Defines the numerator of the AMC Master User Units Ratio		
Mode	RFC-S		
Minimum	1	Maximum	2147483647
Default	1000	Units	
Type	32 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW		

The master user units ratio (*AMC Master User Units Ratio Numerator* (31.004) / *AMC Master User Units Ratio Denominator* (31.005)) is applied to the master position to convert the feedback position from normalised units to user units. Similar ratios are provided for the slave position and the output of the motion controller. The configuration of these ratios is described in *AMC General Set-up* (31).

Parameter	31.005 *AMC Master User Units Ratio Denominator*		
Short description	Defines the denominator of the AMC Master User Units Ratio		
Mode	RFC-S		
Minimum	1	Maximum	2147483647
Default	1000	Units	
Type	32 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW		

See *AMC Master User Units Ratio Numerator* (31.004).

Parameter	31.006 *AMC Slave User Units Ratio Numerator*		
Short description	Defines the numerator of the AMC Slave User Units Ratio		
Mode	RFC-S		
Minimum	1	Maximum	2147483647
Default	1000	Units	
Type	32 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW		

See *AMC Master User Units Ratio Numerator* (31.004).

Parameter	31.007 *AMC Slave User Units Ratio Denominator*		
Short description	Defines the denominator of the AMC Slave User Units Ratio		
Mode	RFC‑S		
Minimum	1	Maximum	2147483647
Default	1000	Units	
Type	32 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW		

See *AMC Master User Units Ratio Numerator* (31.004).

Parameter	31.008 *AMC Output User Units Ratio Numerator*		
Short description	Defines the numerator of the AMC Output User Units Ratio		
Mode	RFC‑S		
Minimum	1	Maximum	2147483647
Default	1000	Units	
Type	32 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW		

See *AMC Master User Units Ratio Numerator* (31.004).

Parameter	31.009 *AMC Output User Units Ratio Denominator*		
Short description	Defines the denominator of the AMC Output User Units Ratio		
Mode	RFC‑S		
Minimum	1	Maximum	2147483647
Default	1000	Units	
Type	32 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW		

See *AMC Master User Units Ratio Numerator* (31.004).

Parameter	31.010 *AMC Roll-over Limit*		
Short description			
Mode	RFC‑S		
Minimum	0	Maximum	VM_AMC_ROLLOVER
Default	0	Units	UU
Type	32 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW, VM		

If *AMC Roll-over Limit* (31.010) = 0 the motion controller operates over a range from -2^{31} to 2^{31}-1, i.e. VM_AMC_POSITION[MIN] = -2^{31} and VM_AMC_POSITION[MAX] = 2^{31}-1, and the system can rollover the VM_AMC_POSITION[MIN] and VM_AMC_POSITION[MAX] boundaries without a transient. When *AMC Roll-over Limit* (31.010) is set to a non-zero value the motion controller continues to operate over a range from -2^{31} to 2^{31}-1 internally but the position parameters display a position from zero to *AMC Roll-over Limit* (31.010) - 1, i.e. VM_AMC_POSITION[MIN] = 0 and VM_AMC_POSITION[MAX] = *AMC Roll-over Limit* (31.010) - 1, and the system can rollover the zero or VM_AMC_POSITION[MAX] boundaries without a transient. Note that when *AMC Auto Resolution Enable* (31.015) is enabled VM_AMC_ROLLOVER[MAX] = 2^{30}-1 / *AMC Auto Resolution Scaling* (31.016).

When *AMC Absolute Mode Enable* (31.002) = 0 the position parameters are always set to zero during initialisation. When *AMC Absolute Mode Enable* (31.002) = 1 the absolute slave position is recovered from the user and normalised positions saved on power down. This allows an absolute encoder to be homed once and for the correct position within the rollover limit to be recovered after the internal user position or the normalised position has rolled over the minimum or maximum boundary one or more times. Note that the correct absolute position will only be recovered if the normalised position has moved by less than half of the maximum range when the drive is off and absolute mode is enabled when the motion controller is initialised. Note that when using the control word to configure the absolute mode *AMC Control Word Enable* (41.021) should be set to mode 2 to ensure the absolute position is recovered correctly during initialisation. The master position is always initialised with the absolute position calculated using the normalised position and the master user unit ratio. The initial position (*AMC Master Position* (32.004)) within the rollover limit is derived from this position as shown in the diagram below.

Position displayed in user units when the master feedback is initialised

AMC Rollover Limit (P31.010) - 1

$2^{31}-1$

Integrator value in user units

$\dfrac{User\ Units\ Ratio\ Numerator}{User\ Units\ Ratio\ Denominator} = 1$

$2^{31}-1$ -2^{31} Normalised position

-2^{31}

Integrator value in user units

$2^{31}-1$

$\dfrac{User\ Units\ Ratio\ Numerator}{User\ Units\ Ratio\ Denominator} < 1$

Normalised position

-2^{31}

$2^{31}-1$

Integrator value in user units

$\dfrac{User\ Units\ Ratio\ Numerator}{User\ Units\ Ratio\ Denominator} > 1$

Normalised position

-2^{31}

Absolute Master Position with *AMC Roll-over Limit (P31.010) > 0*

When *AMC Absolute Mode Enable* (31.002) is enabled the slave position is initialised using the same method as the master position, but after the internal user or normalised positions have rolled over one of the boundaries the slave position may no longer be directly related to the normalised position of the feedback device.

Parameter	31.011 *AMC Synchronise To Onboard User Program Clock Task*		
Short description	Set to 1 to allow the AMC to be controlled synchronously by an onboard user program clock task		
Mode	RFC-S		
Minimum	0	Maximum	1
Default	0	Units	
Type	1 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW		

Most time critical parts of the Advanced Motion Controller operate at the sample rate set in *AMC Rate Select* (31.012). The homing function and most parameter access operate at a 4ms rate. The timing of the controller (*AMC Rate Select* (31.012) = 250μs) and parameter reading and writing is shown below with respect to other tasks in the drive.

1 Cache 250us read parameters
2 Advanced Motion Controller
3 Read or write 4ms read and write parameters

Timing with *AMC Synchronise To Timed Tasks* (13.011) = 0

1 Cache 250us read parameters
2 Advanced Motion Controller
3 Read or write 4ms read and write parameters
4 User program

Timing with *AMC Synchronise To Timed Tasks* (13.011) = 1
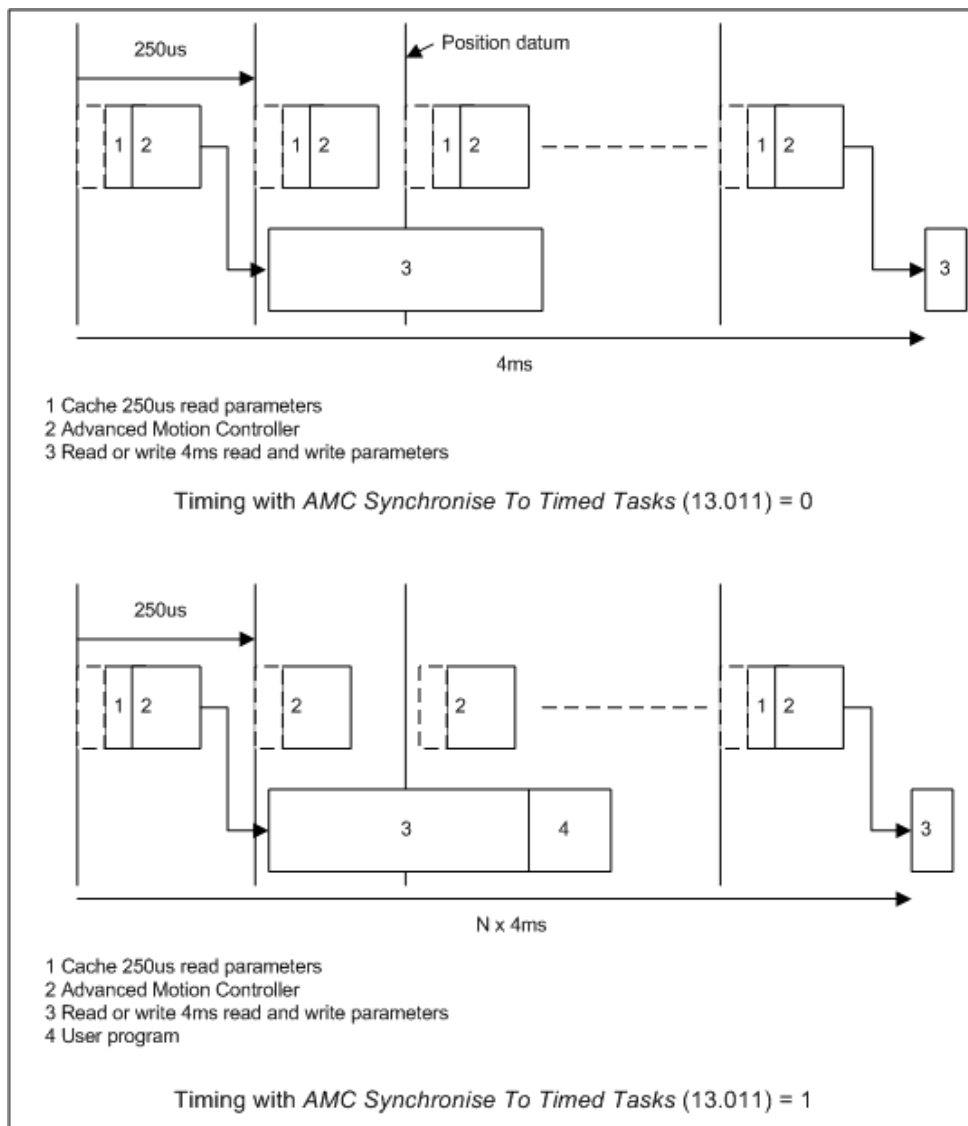
The following examples show how the Advanced Motion Controller can be controlled in different configurations. Note that
AMC Synchronise To Onboard User Program Clock Task (31.011) should only be enabled when the onboard user program is writing to one of the parameters updated at the beginning of every motion controller task.

Stand-alone motion controller

Most parameters are set up during commissioning and are not time critical. *AMC Action On Event* (34.008) can be used to set up triggered time critical events, or the position and speed references can be controlled via communications from an external controller.

Simple position control loop with option module providing the rest of the motion controller

AMC External Position Reference (39.002), *AMC External Speed Reference* (39.004) and *AMC External Acceleration Reference* (39.014) can be used by an option module as the references for a simple position control loop. These values should be updated outside the active period of the motion controller.

Motion controller controlled by an option module

AMC Master User Position Reference (32.009), *AMC Slave User Position Reference* (33.009), *AMC Position Reference* (34.003), *AMC Speed Reference* (34.006) and *AMC Reference Select* (34.007) can be modified every 250µs and should be updated outside the active period of the motion controller. *AMC Action On Event* (34.008) can be used to set up triggered time critical events.

Motion controller controlled by an on-board user program

All 250µs read parameters are cached for use by the motion controller at the start of the thread where the user program timed task will be started and not at the start of every thread in which the motion controller runs. This means that the values that were updated during the previous timed task are read together.

Parameter	31.012 *AMC Rate Select*		
Short description	Defines the sample rate of the AMC		
Mode	RFC-S		
Minimum	1	Maximum	5
Default	5	Units	
Type	8 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW, TE		

Value	Text
1	4ms
2	2ms
3	1ms
4	500us
5	250us

AMC Rate Selected (31.013) indicates whether the Advanced Motion Controller is active or not, and the sample rate being used. The sample rate for the Advanced Motion Controller is selected with *AMC Rate Select* (31.012). It should be noted that both the Advanced and Standard motion controllers cannot be active at the same time and can only be enabled or disabled when the drive is in the disabled state. If both motion controllers are selected at power-up the Standard Motion Controller will take priority.

The sample rate of the Advanced Motion Controller is limited in each of conditions shown in the table below. If more than one of the conditions is active the motion controller will operate at the slower of the two update rates, i.e. if an option module is used to provide the position feedback and an s-ramp profile is enabled then *AMC Rate Selected* (31.013) is limited to 1ms.

Mode	Description	Maximum sample rate
AMC Master Source Select (32.001) ≥ 4	Option module feedback interface	500μs
AMC Slave Source Select (33.001) ≥ 4	Option module feedback interface	500μs
AMC Roll-over Limit (31.010) > 0		500μs
AMC Profile Jerk 1 (38.011) > 0	S-ramp profile active	1ms
Sensorless Mode Active (03.078) = On (1)		4ms

Parameter	31.013 *AMC Rate Selected*		
Short description	Shows the actual sample rate of the AMC		
Mode	RFC‑S		
Minimum	0	Maximum	5
Default		Units	
Type	8 Bit Volatile	Update Rate	Background write
Display Format	Standard	Decimal Places	0
Coding	RO, TE, ND, NC, PT		

Value	Text
0	Not Active
1	4ms
2	2ms
3	1ms
4	500us
5	250us

See *AMC Rate Select* (31.012).

Parameter	31.014 *AMC Speed Mode Enable*		
Short description	Set to 1 to enable speed mode		
Mode	RFC‑S		
Minimum	0	Maximum	1
Default	0	Units	
Type	1 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW		

Speed mode is active when *AMC Speed Mode Enable* (31.014) = 1 and *AMC Reference Select* (34.007) = 2 (speed reference). When speed mode is active *AMC Profile Maximum Speed* (38.003) is ignored, *AMC Profile Input Position* (38.006) and *AMC Profile Output Position* (38.008) are set to *AMC Slave Position* (33.004) at the beginning of each sample and *AMC Position Error* (39.008) is held at zero. If *AMC Position Error* (39.008) is not zero when speed mode is activated *AMC Position Error* (39.008) x *AMC Position Control Loop Kp Gain* (39.007) / 1000 (clamped by *AMC Output Speed Clamp* (39.011)) is added to *AMC Profile Output Speed* (38.009) to prevent a transient in *AMC Output Speed* (39.012).

Parameter	31.015 *AMC Auto Resolution Enable*		
Short description			
Mode	RFC‑S		
Minimum	0	Maximum	1
Default	0	Units	
Type	1 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW		

When *AMC Auto Resolution Enable* (31.015) = 0 the Advanced Motion Controller works in the resolution of the user units. If the output ratio (*AMC Output User Units Ratio Numerator* (31.008) / *AMC Output User Units Ratio Denominator* (31.009)) > 1 the resolution of the user units is lower than the resolution of the normalised position of the motor feedback device. For example, if the slave moves 100mm for every revolution of the motor and the motor normalised position has 16 position bits per revolution.

AMC Output User Units Ratio Numerator (31.008) / *AMC Output User Units Ratio Denominator* (31.009) = 65536 / 100

Speed resolution (0.01 User units / ms) = 0.01 x 60,000 / 100 = 6 rpm

To improve the speed resolution the user unit resolution could be increased from mm to µm. In this condition the output ratio will be less than unity and the resolution of the Advanced Motion Controller is limited by the resolution of the normalised position (0.0091 rpm).

Alternately, when *AMC Auto Resolution Enable* (31.015) = 1 the resolution of the internal units used by the Advanced Motion Controller is automatically increased by an internal scaling factor (*AMC Auto Resolution Scaling* (31.016)) which is the largest value (power of two) that maintains the output ratio at or above unity. This ensures that the maximum position reference (*AMC Position Reference* (34.003)) is greater than or equal to the number of normalised turns or poles of the motor feedback device and the internal speed resolution is never less than half the resolution of the normalised units. Note that the maximum value for *AMC Auto Resolution Scaling* (31.016) is the minimum of 2^{31}-1/*AMC Master User Units Ratio Numerator* (31.004), 2^{31}-1/*AMC Slave User Units Ratio Numerator* (31.006) and 2^{31}-1/*AMC Output User Units Ratio Denominator* (31.009). When this mode is used the internal resolution is increased but all of the user parameters are defined in user units, i.e. mm.

If this mode is enable in the example above (output ratio >> 1) the internal resolution can be increased as shown below.

AMC Output User Units Ratio Numerator (31.008) / (*AMC Auto Resolution Scaling* (31.016) x *AMC Output User Units Ratio Denominator* (31.009)) >= 1

AMC Auto Resolution Scaling (31.016) = 512 (largest power of 2 that satisfies the above requirements, i.e. output ratio >= 1)

Speed resolution (0.01 User units / ms) = 0.01 x 60,000 / (100 x 512) = 0.0117 rpm

If the output ratio is less than or equal to unity the resolution of the user units is limited by the resolution of the normalised units and *AMC Auto Resolution Scaling* (31.016) is set to unity.

Parameter	31.016 *AMC Auto Resolution Scaling*		
Short description			
Mode	RFC-S		
Minimum	1	Maximum	2147483647
Default		Units	
Type	32 Bit Volatile	Update Rate	Background write
Display Format	Standard	Decimal Places	0
Coding	RO, ND, NC, PT		

See *AMC Auto Resolution Enable* (31.015).

Menu 32 Single Line Descriptions − *AMC Master Position*

Mode: RFC‑S

Parameter	Range	Default	Type					
32.001 AMC Master Source Select	Speed (0), User Position (1), P1 Drive (2), P2 Drive (3), P1 Slot1 (4), P2 Slot1 (5), P1 Slot2 (6), P2 Slot2 (7), P1 Slot3 (8), P2 Slot3 (9)	P2 Drive (3)	RW	Txt				US
32.002 AMC Master Invert	Off (0) or On (1)	Off (0)	RW	Bit				US
32.003 AMC Master Offset	±VM_AMC_POSITION UU	0 UU	RW	Num				US
32.004 AMC Master Position	±VM_AMC_POSITION UU		RO	Num	ND	NC	PT	
32.005 AMC Master Speed	±VM_AMC_SPEED UU/ms		RO	Num	ND	NC	PT	FI
32.006 AMC Master Freeze Position	±VM_AMC_POSITION UU		RO	Num	ND	NC	PT	
32.007 AMC Master Freeze Select	Off (0) or On (1)	Off (0)	RW	Bit				US
32.008 AMC Master Speed Reference	±VM_AMC_SPEED UU/ms	0.00 UU/ms	RW	Num				US
32.009 AMC Master User Position Reference	-2147483648 to 2147483647	0	RW	Num		NC		
32.010 AMC Master Freeze Flag	Off (0) or On (1)	Off (0)	RW	Bit		NC		

RW	Read / Write	RO	Read-only	Bit	Bit parameter	Txt	Text string	Date	Date parameter	Time	Time parameter
Chr	Character parameter	Bin	Binary parameter	IP	IP address	Mac	MAC address	Ver	Version number	SMP	Slot, menu, parameter
Num	Number parameter	DE	Destination	ND	No default value	RA	Rating dependent	NC	Non-copyable	PT	Protected
FI	Filtered	US	User save	PS	Power-down save						

Menu 32 − *AMC Master Position*

Mode: RFC‑S

Master position
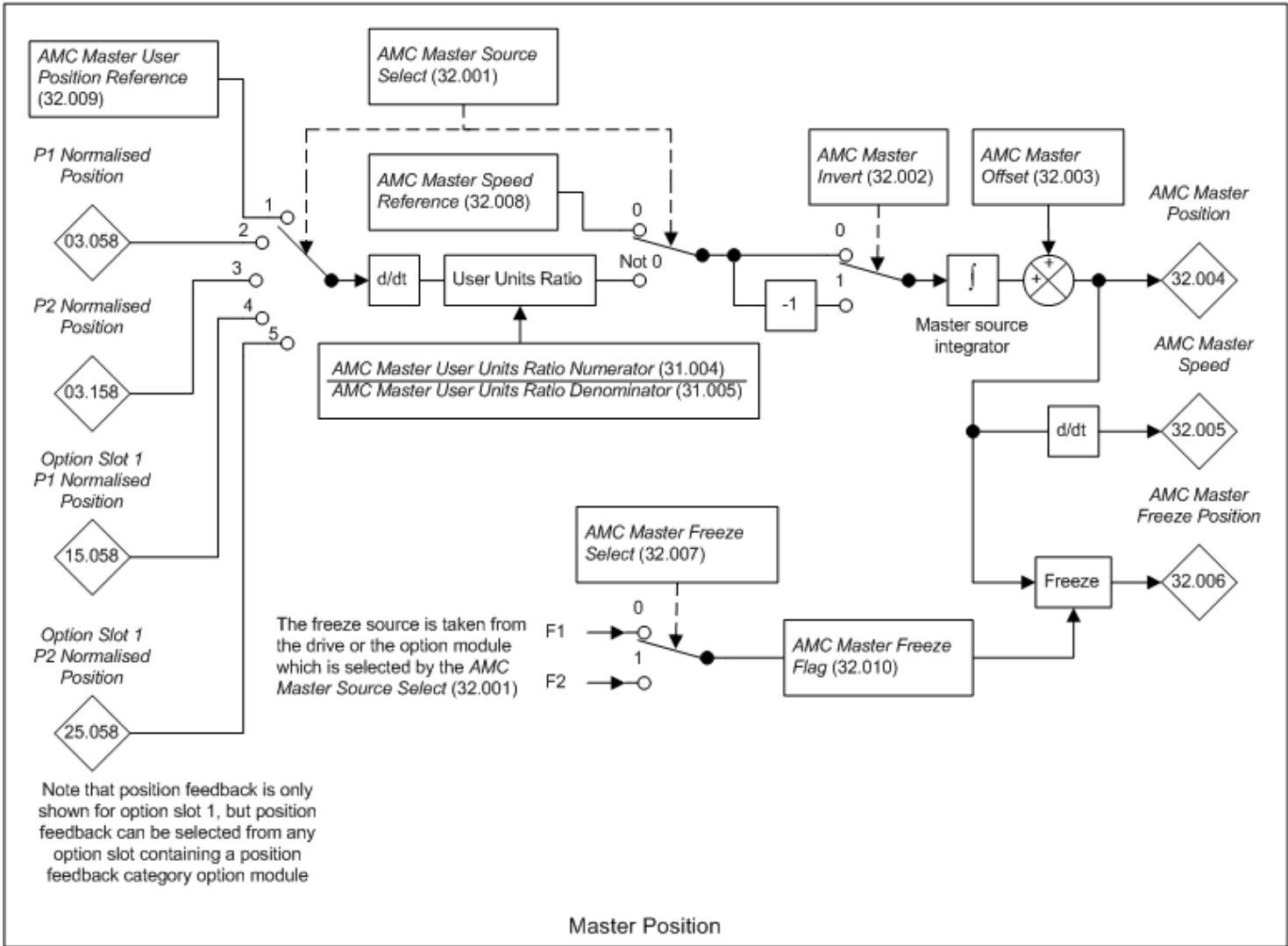
Master Position

Parameter	32.001 *AMC Master Source Select*		
Short description	Defines the position feedback source used by the master reference		
Mode	RFC‑S		
Minimum	0	Maximum	9
Default	3	Units	
Type	8 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW, TE		

Value	Text
0	Speed
1	User Position
2	P1 Drive
3	P2 Drive
4	P1 Slot1
5	P2 Slot1
6	P1 Slot2
7	P2 Slot2
8	P1 Slot3
9	P2 Slot3

AMC Master Source Select (32.001) can be set to a value between 2 and 11 to select a position feedback source as the master reference from the drive position feedback interface or from the position feedback interface in a position feedback category option module. It should be noted that the position includes the effect of the marker function of the position source. If the selected position feedback source does not exist (i.e. it is not present in the drive or option module, or the option module cannot provide position feedback) the source position will remain at zero.

If *AMC Master Source Select* (32.001) is set to 0 then *AMC Master Speed Reference* (32.008) is used as the source and provides a position that changes at a

constant rate against time. This allows profiles to be produced with a time base instead of a synchronous profile related to master position.

If *AMC Master Source Select* (32.001) is set to 1 then *AMC Master User Position Reference* (32.009) is used as the source. This allows the master position to be provided by the user, or to be provided from a fieldbus interface.

Parameter	32.002 *AMC Master Invert*		
Short description	Set to 1 to invert the AMC master position		
Mode	RFC‑S		
Minimum	0	Maximum	1
Default	0	Units	
Type	1 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW		

AMC Master Invert (32.002) negates the delta position values that are accumulated by the slave source integrator. If *AMC Absolute Mode Enable* (31.002) is enabled the master position is taken from the position feedback device, modified by the user units ratio, inverted if required (*AMC Master Invert* (32.002) = 1) and then written to the slave source integrator. Note that the feedback is initialised on power-up or after any parameter which results in a change to the absolute position is modified.

Parameter	32.003 *AMC Master Offset*		
Short description	Defines the offset used for the AMC Master Position		
Mode	RFC‑S		
Minimum	−VM_AMC_POSITION	Maximum	VM_AMC_POSITION
Default	0	Units	UU
Type	32 Bit User Save	Update Rate	4ms read
Display Format	Standard	Decimal Places	0
Coding	RW, VM		

see *AMC Master Position* (32.004).

Parameter	32.004 *AMC Master Position*		
Short description	Displays the AMC Master Position		
Mode	RFC‑S		
Minimum	−VM_AMC_POSITION	Maximum	VM_AMC_POSITION
Default		Units	UU
Type	32 Bit Volatile	Update Rate	4ms write
Display Format	Standard	Decimal Places	0
Coding	RO, VM, ND, NC, PT		

AMC Master Position (32.004) is the sum of the position in the master source integrator and *AMC Master Offset* (32.003).

Parameter	32.005 *AMC Master Speed*		
Short description	Displays the rate of change of the AMC Master Position		
Mode	RFC‑S		
Minimum	−VM_AMC_SPEED	Maximum	VM_AMC_SPEED
Default		Units	UU/ms
Type	32 Bit Volatile	Update Rate	4ms write
Display Format	Standard	Decimal Places	2
Coding	RO, FI, VM, ND, NC, PT		

AMC Master Speed (32.005) gives the rate of change of the *AMC Master Position* (32.004).

Parameter	32.006 *AMC Master Freeze Position*		
Short description			
Mode	RFC‑S		
Minimum	−VM_AMC_POSITION	Maximum	VM_AMC_POSITION
Default		Units	UU
Type	32 Bit Volatile	Update Rate	4ms write
Display Format	Standard	Decimal Places	0
Coding	RO, VM, ND, NC, PT		

AMC Master Freeze Select (32.007) is used to select which freeze source associated with the master should be used to provide *AMC Master Freeze Position* (32.006). For example, if a position interface within the drive is being used as the master source then the F1 or F2 freeze source provided in the drive can be selected. In the sample after a freeze event occurs *AMC Master Position* (32.004) at the point in time when the freeze event occurred is stored in *AMC Master Freeze Position* (32.006). Note that the freeze flag in the position menu is updated every 250µs but *AMC Master Freeze Select* (32.007) is only updated every 4ms. To ensure that *AMC Master Freeze Select* (32.007) has been updated *AMC Master Freeze Flag* (32.010) should be used to indicate when a freeze event has occurred and to clear the master source freeze flag in the position feedback menu.

If an option module is being used as the master source then a freeze source in the option module can be selected. If a freeze source selected in an option module does not exist then *AMC Master Freeze Position* (32.006) will remain at its present value.

Parameter	32.007 *AMC Master Freeze Select*		
Short description			
Mode	RFC‑S		
Minimum	0	Maximum	1
Default	0	Units	
Type	1 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW		

See *AMC Master Freeze Position* (32.006).

Parameter	32.008 *AMC Master Speed Reference*		
Short description	Defines the Master Speed Reference that can be used by the AMC Master Source		
Mode	RFC‑S		
Minimum	−VM_AMC_SPEED	Maximum	VM_AMC_SPEED
Default	0.00	Units	UU/ms
Type	32 Bit User Save	Update Rate	250us read
Display Format	Standard	Decimal Places	2
Coding	RW, VM		

See *AMC Master Source Select* (32.001).

Parameter	32.009 *AMC Master User Position Reference*		
Short description	Defines the Master User Position Reference that can be used by the AMC Master Source		
Mode	RFC‑S		
Minimum	-2147483648	Maximum	2147483647
Default	0	Units	
Type	32 Bit Volatile	Update Rate	250us read
Display Format	Standard	Decimal Places	0
Coding	RW, NC		

See *AMC Master Source Select* (32.001).

Parameter	32.010 *AMC Master Freeze Flag*		
Short description	Master freeze flag status		
Mode	RFC‑S		
Minimum	0	Maximum	1
Default	0	Units	
Type	1 Bit Volatile	Update Rate	4ms write
Display Format	Standard	Decimal Places	0
Coding	RW, NC		

See *AMC Master Source Select* (32.001).

Menu 33 Single Line Descriptions − *AMC Slave Position*

Mode: RFC‑S

Parameter		Range	Default	Type					
33.001	AMC Slave Source Select	User Position (0), Sensorless (1), P1 Drive (2), P2 Drive (3), P1 Slot1 (4), P2 Slot1 (5), P1 Slot2 (6), P2 Slot2 (7), P1 Slot3 (8), P2 Slot3 (9)	P1 Drive (2)	RW	Txt				US
33.002	AMC Slave Invert	Off (0) or On (1)	Off (0)	RW	Bit				US
33.003	AMC Slave Offset	±VM_AMC_POSITION UU	0 UU	RW	Num				US
33.004	AMC Slave Position	±VM_AMC_POSITION UU		RO	Num	ND	NC	PT	
33.005	AMC Slave Speed	±VM_AMC_SPEED UU/ms		RO	Num	ND	NC	PT	FI
33.006	AMC Slave Freeze Position	±VM_AMC_POSITION UU		RO	Num	ND	NC	PT	
33.007	AMC Slave Freeze Select	Off (0) or On (1)	Off (0)	RW	Bit				US
33.009	AMC Slave User Position Reference	-2147483648 to 2147483647	0	RW	Num		NC		
33.010	AMC Slave Freeze Flag	Off (0) or On (1)	Off (0)	RW	Bit		NC		

RW	Read / Write	RO	Read-only	Bit	Bit parameter	Txt	Text string	Date	Date parameter	Time	Time parameter
Chr	Character parameter	Bin	Binary parameter	IP	IP address	Mac	MAC address	Ver	Version number	SMP	Slot, menu, parameter
Num	Number parameter	DE	Destination	ND	No default value	RA	Rating dependent	NC	Non-copyable	PT	Protected
FI	Filtered	US	User save	PS	Power-down save						

Menu 33 − *AMC Slave Position*

Mode: RFC‑S

Slave position
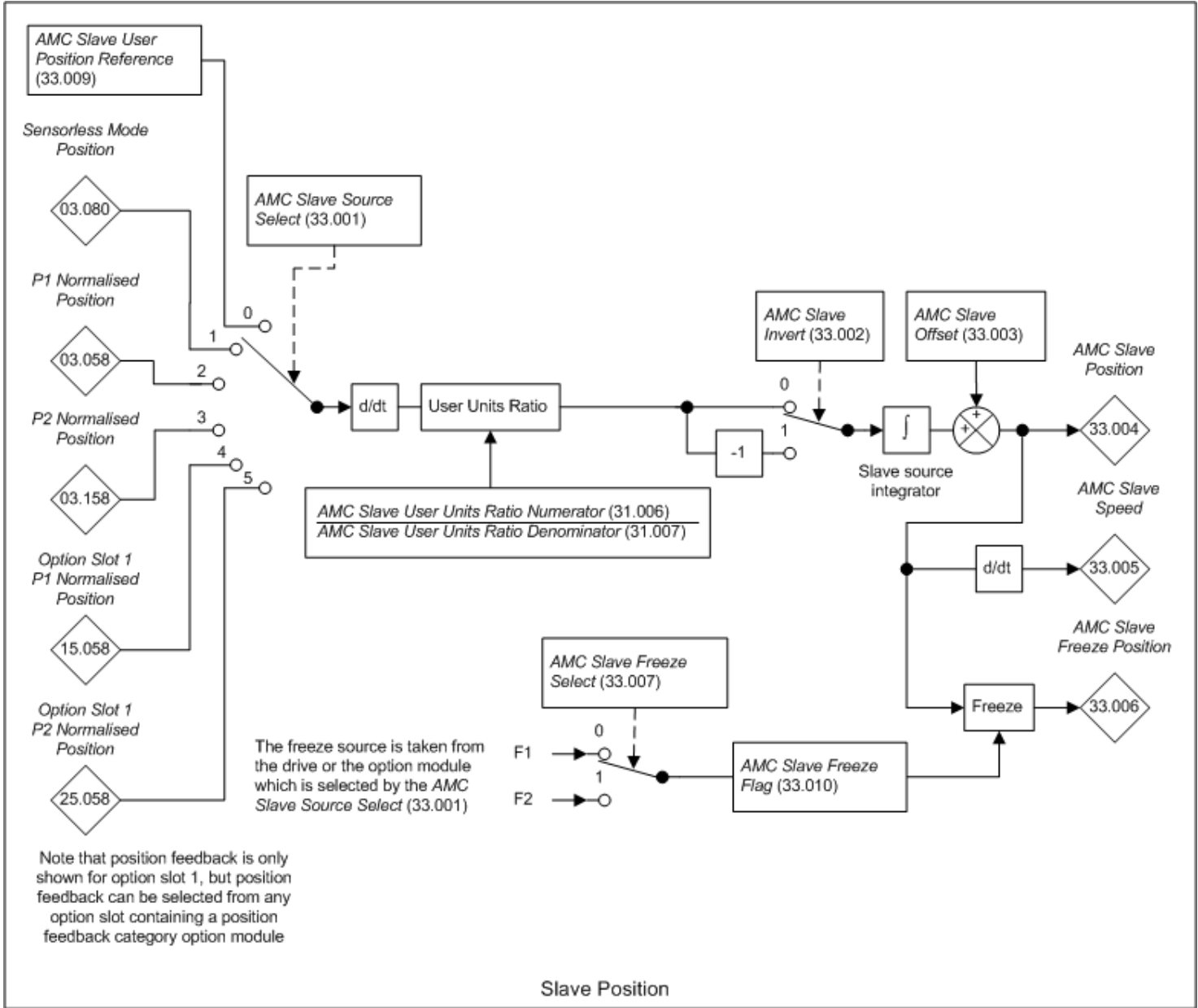
Slave Position

Parameter	33.001 *AMC Slave Source Select*		
Short description	Defines the position feedback source used by the slave reference		
Mode	RFC‑S		
Minimum	0	Maximum	9
Default	2	Units	
Type	8 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW, TE		

Value	Text
0	User Position
1	Sensorless
2	P1 Drive
3	P2 Drive
4	P1 Slot1
5	P2 Slot1
6	P1 Slot2
7	P2 Slot2
8	P1 Slot3
9	P2 Slot3

The slave position system operates in the same way as the master position system except that if *AMC Slave Source Select* (33.001) = 1 the position is taken from *Sensorless Position* (03.080). The least significant 16bits of *Sensorless Position* (03.080) represents a movement equivalent to one pole of the motor and the most significant 16 bits represent turns where one turn is the movement associated with one pole. To use *Sensorless Position* (03.080) as the slave feedback source *AMC Slave User Units Ratio Denominator* (31.007) must be multiplied by the number of pole pairs so that the least significant 16 bits of the position represents one mechanical revolution.

Parameter	33.002 *AMC Slave Invert*		
Short description	Set to 1 to invert the AMC slave position		
Mode	RFC‑S		
Minimum	0	Maximum	1
Default	0	Units	
Type	1 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW		

AMC Slave Invert (33.002) negates the delta position values that are accumulated by the slave source integrator. If *AMC Absolute Mode Enable* (31.002) is enabled the slave position is taken from the position feedback device, modified by the user units ratio, inverted if required (*AMC Slave Invert* (33.002) = 1) and then written to the slave source integrator. Note that the feedback is initialised on power-up or after any parameter which results in a change to the absolute position is modified.

Parameter	33.003 *AMC Slave Offset*		
Short description	Displays the offset used for the AMC Slave Position		
Mode	RFC‑S		
Minimum	−VM_AMC_POSITION	Maximum	VM_AMC_POSITION
Default	0	Units	UU
Type	32 Bit User Save	Update Rate	4ms read
Display Format	Standard	Decimal Places	0
Coding	RW, VM		

AMC Slave Offset (33.003) is used to add an offset to the value in the slave source integrator and is used during homing to move the alignment of the slave position. When a new value is written to *AMC Slave Offset* (33.003) the profile position integrators are automatically modified with the change of offset position allowing the offset to be adjusted without a transient at the output of the motion controller. If *AMC Slave Offset* (33.003) is changed when the motion controller is enabled and *AMC Reference Select* (34.007) is set to one of the absolute position references (Stop or Position Abs) the slave will move to the absolute position under the constraints of the profile generator. If the slave is stationary when the slave offset is applied the slave will move a relative position equal to -Δ*AMC Slave Offset* (33.003). Note that the slave offset should not be modified when *AMC Reference Select* (34.007) is set to the home reference because the homing sequence will not be completed correctly and the profile integrators are not automatically modified in this condition.

Parameter	33.004 *AMC Slave Position*		
Short description	Displays the AMC Slave Position		
Mode	RFC‑S		
Minimum	−VM_AMC_POSITION	Maximum	VM_AMC_POSITION
Default		Units	UU
Type	32 Bit Volatile	Update Rate	4ms write
Display Format	Standard	Decimal Places	0
Coding	RO, VM, ND, NC, PT		

AMC Slave Position (33.004) is the sum of the position in the slave source integrator and *AMC Slave Offset* (33.003).

Parameter	33.005 *AMC Slave Speed*		
Short description	Displays the rate of change of the AMC Slave Position		
Mode	RFC‑S		
Minimum	−VM_AMC_SPEED	Maximum	VM_AMC_SPEED
Default		Units	UU/ms
Type	32 Bit Volatile	Update Rate	4ms write
Display Format	Standard	Decimal Places	2
Coding	RO, FI, VM, ND, NC, PT		

AMC Slave Speed (33.005) gives the rate of change of the *AMC Slave Position* (33.004).

Parameter	33.006 *AMC Slave Freeze Position*		
Short description	Displays the AMC Slave Position after a freeze event has occurred		
Mode	RFC‑S		
Minimum	−VM_AMC_POSITION	Maximum	VM_AMC_POSITION
Default		Units	UU
Type	32 Bit Volatile	Update Rate	4ms write
Display Format	Standard	Decimal Places	0
Coding	RO, VM, ND, NC, PT		

AMC Slave Freeze Select (33.007) is used to select which freeze source associated with the master should be used to provide *AMC Slave Freeze Position* (33.006). For example, if a position interface within the drive is being used as the master source then the F1 or F2 freeze source provided in the drive can be selected. In the sample after a freeze event occurs *AMC Slave Position* (33.004) at the point in time when the freeze event occurred is stored in *AMC Slave Freeze Position* (33.006). Note that the freeze flag in the position menu is updated every 250μs but *AMC Slave Freeze Position* (33.006) is only updated every 4ms. To ensure that *AMC Slave Freeze Position* (33.006) has been updated *AMC Slave Freeze Flag* (33.010) should be used to indicate when a freeze event has occurred and to clear the slave source freeze flag in the position feedback menu.

If an option module is being used as the slave source then a freeze source in the option module can be selected. If a freeze source selected in an option module does not exist then *AMC Slave Freeze Position* (33.006) will remain at its present value.

Parameter	33.007 *AMC Slave Freeze Select*		
Short description			
Mode	RFC-S		
Minimum	0	Maximum	1
Default	0	Units	
Type	1 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW		

See *AMC Slave Freeze Position* (33.006).

Parameter	33.009 *AMC Slave User Position Reference*		
Short description	Defines the Slave User Position Reference that can be used by the AMC Slave Source		
Mode	RFC-S		
Minimum	-2147483648	Maximum	2147483647
Default	0	Units	
Type	32 Bit Volatile	Update Rate	250µs read
Display Format	Standard	Decimal Places	0
Coding	RW, NC		

See *AMC Slave Source Select* (33.001).

Parameter	33.010 *AMC Slave Freeze Flag*		
Short description	Slave freeze flag status		
Mode	RFC-S		
Minimum	0	Maximum	1
Default	0	Units	
Type	1 Bit Volatile	Update Rate	4ms write
Display Format	Standard	Decimal Places	0
Coding	RW, NC		

See *AMC Slave Freeze Position* (33.006).

Menu 34 Single Line Descriptions − *AMC Reference Selector*

Mode: RFC‑S

Parameter		Range	Default	Type					
34.001	AMC Stop Mode	Profile (0), No Profile (1), Profile Stop (2), No Profile Stop (3)	Profile (0)	RW	Txt				US
34.002	AMC Stop Reference	±VM_AMC_POSITION UU		RO	Num	ND	NC	PT	
34.003	AMC Position Reference	±VM_AMC_POSITION_REF UU	0 UU	RW	Num				US
34.005	AMC Rotary Mode	0 to 6	0	RW	Num				US
34.006	AMC Speed Reference	±VM_AMC_SPEED UU/ms	0.00 UU/ms	RW	Num				US
34.007	AMC Reference Select	Stop (0), Position Abs (1), Speed (2), Cam (3), EGB (4), Home (5), Position Rel (6), Position Profile (7)	Stop (0)	RW	Txt				US
34.008	AMC Action On Event	None (0), Cam On Freeze (1), EGB On Freeze (2)	None (0)	RW	Txt				US
34.009	AMC Reference Select Trigger	Stop (0), Position Abs (1), Speed (2), Cam (3), EGB (4), Home (5), Position Rel (6), Position Profile (7)	Stop (0)	RW	Txt				

RW	Read / Write	RO	Read-only	Bit	Bit parameter	Txt	Text string	Date	Date parameter	Time	Time parameter
Chr	Character parameter	Bin	Binary parameter	IP	IP address	Mac	MAC address	Ver	Version number	SMP	Slot, menu, parameter
Num	Number parameter	DE	Destination	ND	No default value	RA	Rating dependent	NC	Non-copyable	PT	Protected
FI	Filtered	US	User save	PS	Power-down save						

Menu 34 − *AMC Reference Selector*

Mode: RFC‑S

Reference selector
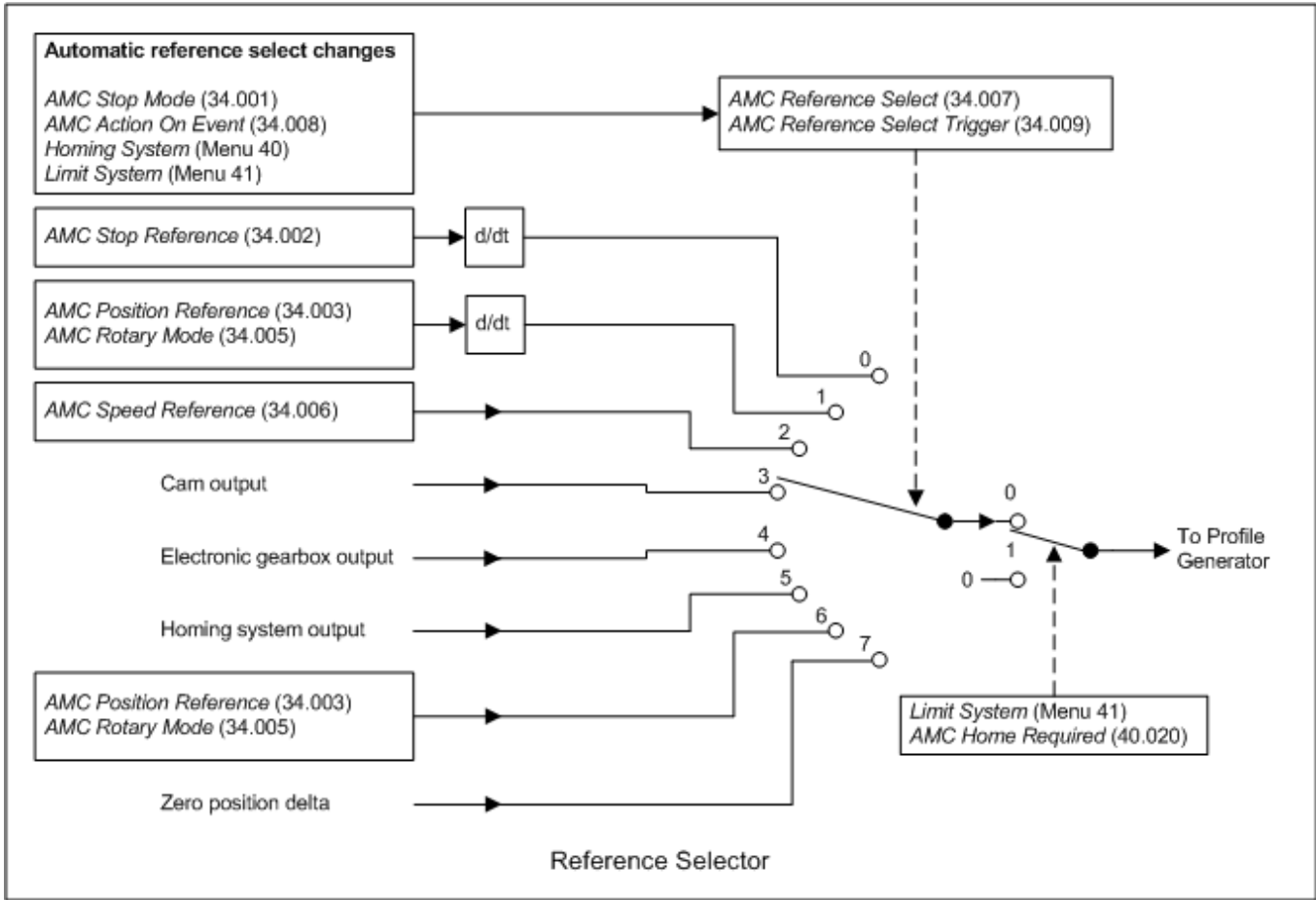
Parameter	34.001 *AMC Stop Mode*		
Short description	Defines the stopping mode used by AMC		
Mode	RFC‑S		
Minimum	0	Maximum	3
Default	0	Units	
Type	8 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW, TE		

Value	Text
0	Profile
1	No Profile
2	Profile Stop
3	No Profile Stop

AMC Stop Mode (34.001) defines the actions taken when *AMC Stop Reference* (34.002) is selected. When the motion controller is enabled *AMC Stop Reference* (34.002) is continuously updated with stop position until the stop reference is selected. *AMC Stop Reference* (34.002) is then used as the target position for the profile generator.

0 (Profile)

When *AMC Stop Mode* (34.001) = 0 the stop reference is updated with the position at which the profile would reach zero speed based on the current profile constrains and outputs, i.e. *AMC Profile Output Position* (38.008), *AMC Profile Output Speed* (38.009) and *AMC Profile Output Acceleration* (38.010). When *AMC Stop Reference* (34.002) is set to 0 (stop) the slave will stop under the constraints applied to the profile generator when the stop was requested.

1 (No profile)

When *AMC Stop Mode* (34.001) = 1 the stop reference is updated with *AMC Slave Position* (33.004). When *AMC Stop Reference* (34.002) is set to 0 (stop) the profile generator is disabled and the slave will stop as quickly as possible.

2 (Profile Stop)

This mode is the same as the profiled stop mode except that *AMC Reference Select* (34.007) is automatically changed to 0 if the following error

exceeds the limit defined by *AMC Following Error Window* (41.007).

3 (No Profile Stop)

This mode is the same as the no profile stop mode except that *AMC Reference Select* (34.007) is automatically changed to 0 if the following error exceeds the limit defined by *AMC Following Error Window* (41.007).

Note that when a software or hardware limit is active *AMC Stop Reference* (34.002) is updated with the stop position for the stop mode selected in *AMC Hardware Limit Stop Mode* (41.023) or *AMC Software Limit Stop Mode* (41.024).

Parameter	34.002 *AMC Stop Reference*		
Short description	Defines the reference used when the stop reference is selected		
Mode	RFC‑S		
Minimum	−VM_AMC_POSITION	Maximum	VM_AMC_POSITION
Default		Units	UU
Type	32 Bit Volatile	Update Rate	4ms write
Display Format	Standard	Decimal Places	0
Coding	RO, VM, ND, NC, PT		

See *AMC Stop Mode* (34.001).

Parameter	34.003 *AMC Position Reference*		
Short description	Defines the reference used when AMC Reference Select = 1		
Mode	RFC‑S		
Minimum	−VM_AMC_POSITION_REF	Maximum	VM_AMC_POSITION_REF
Default	0	Units	UU
Type	32 Bit User Save	Update Rate	AMC sample rate read
Display Format	Standard	Decimal Places	0
Coding	RW, VM		

See *AMC Reference Select* (34.007).

Parameter	34.005 *AMC Rotary Mode*		
Short description			
Mode	RFC‑S		
Minimum	0	Maximum	6
Default	0	Units	
Type	8 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW		

When *AMC Roll-over Limit* (31.010) is set to a none zero value and *AMC Rate Selected* (31.013) >= 500µs the change of position added to the input integrator of the profile generator is controlled by *AMC Rotary Mode* (34.005). Although the position parameters are shown with a range from zero to *AMC Roll-over Limit* (31.010) - 1 additional "turns" information is used internally to allow the rotary modes to operate correctly. The maximum number of turns that can be accumulated is given by 2^{31}-1 / *AMC Roll-over Limit* (31.010) rounded down to the nearest integer, e.g. if *AMC Roll-over Limit* (31.010) = 10^6 then the maximum number of "turns" is limited to 2^{31}-1/10^6 = 2147. For the following modes to operate correctly the difference between the internal value of the profile input integrator, profile output integrator and the slave source integrator in any rotary mode must not exceed this maximum value. If the system does not remain within this limit there will be movement in the opposite direction to that expected.

Note that in relative position mode the change of position is the value in *AMC Position Reference* (34.003) when a relative move is selected and in absolute position mode it is the difference between *AMC Position Reference* (34.003) and *AMC Profile Input Position* (38.006), i.e. Δ = *AMC Position Reference* (34.003) - *AMC Profile Input Position* (38.006).

In modes 4, 5 and 6 the variable maximum VM_AMC_POSITION_REF is modified to allow *AMC Position Reference* (34.003) to be positive or negative with a maximum value greater than *AMC Roll-over Limit* (31.010) - 1, i.e. a movement of more than one "turn" can be requested. Note that because *AMC Position Reference* (34.003) can be greater than *AMC Roll-over Limit* (31.010) the change of position in absolute mode is only calculated when *AMC Reference Select* (34.007) is changed to 1 from another reference or when *AMC Reference Select* (34.007) = 1 and a change of *AMC Position Reference* (34.003) is detected. In absolute position mode the number of "turns" moved by the slave is *AMC Position Reference* (34.003) / *AMC Roll-over Limit* (31.010) rounded down to the nearest integer and the final position within the rollover limit is the remainder from this calculation for a positive position reference or the remainder + *AMC Roll-over Limit* (31.010) for a negative position reference.

0 (Shortest)

The change of position at the input integrator of the profile generator is limited to ±*AMC Roll-over Limit* (31.010)/2. In this mode the profile output position will move to the input position by the shortest path and can rollover the zero or *AMC Roll-over Limit* (31.010) -1 boundary as required.

1 (Forward)

If the change of position at the input integrator of the profile generator is negative the change of position added to the integrator is modified so that -Δ becomes *AMC Roll-over Limit* (31.010) - Δ. This has the effect of making any reverse movements into forward movements by forcing the profile to rollover the *AMC Roll-over Limit* (31.010) - 1 boundary as shown below.

Negative movement with AMC Rotary Mode (34.005) = 1 (Forward)
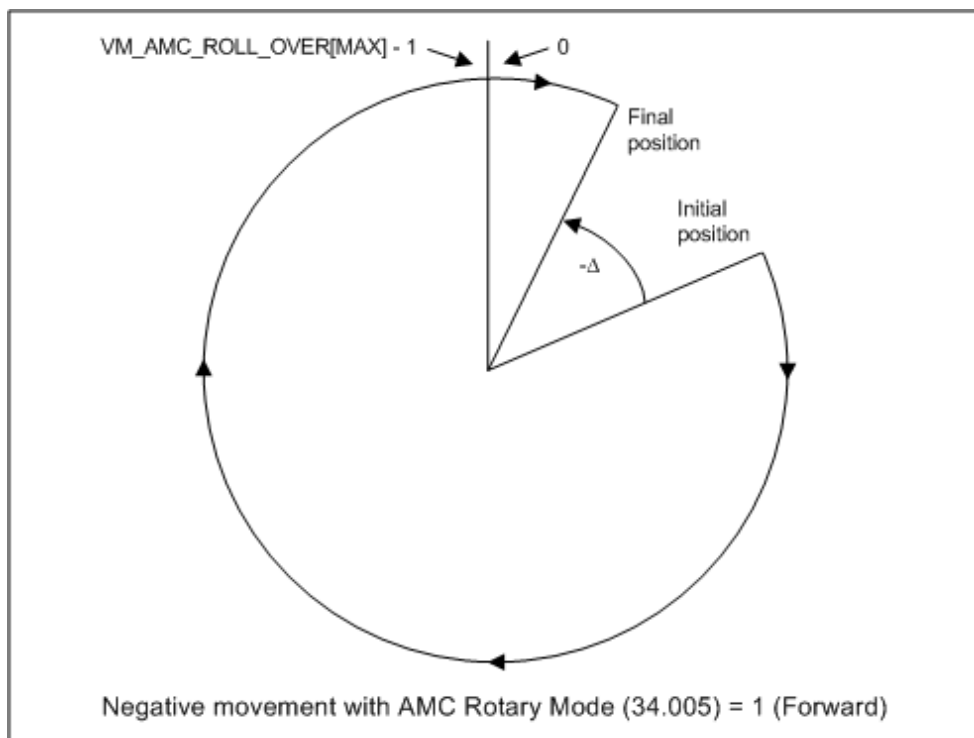
2 (Reverse)

If the change of position at the input integrator of the profile generator is positive the change of position added to the integrator is modified so that +Δ becomes Δ - *AMC Roll-over Limit* (31.010). This has the effect of making any forward movements into reverse movements by forcing the profile to rollover the zero boundary as shown below.

Positive movement with AMC Rotary Mode (34.005) = 2 (Backward)
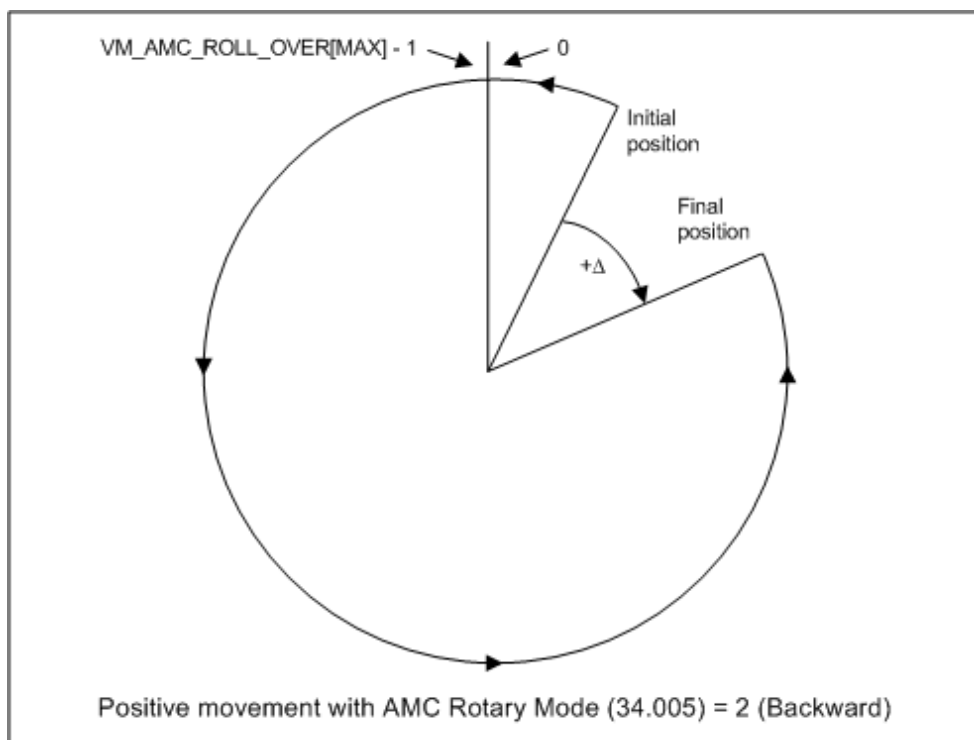
3 (No Rollover)

If the change of position at the input integrator of the profile generator would cause the integrator to rollover the zero or *AMC Roll-over Limit* (31.010) - 1 boundary the change of position is modified so that -Δ (rollover the zero boundary) becomes *AMC Roll-over Limit* (31.010) - Δ and +Δ (rollover the *AMC Roll-over Limit* (31.010) boundary) becomes Δ - *AMC Roll-over Limit* (31.010). This has the effect of preventing the profile input position from crossing the zero or *AMC Roll-over Limit* (31.010) - 1 boundary.

Positive movement with AMC Rotary Mode (34.005) = 3 (No Rollover)
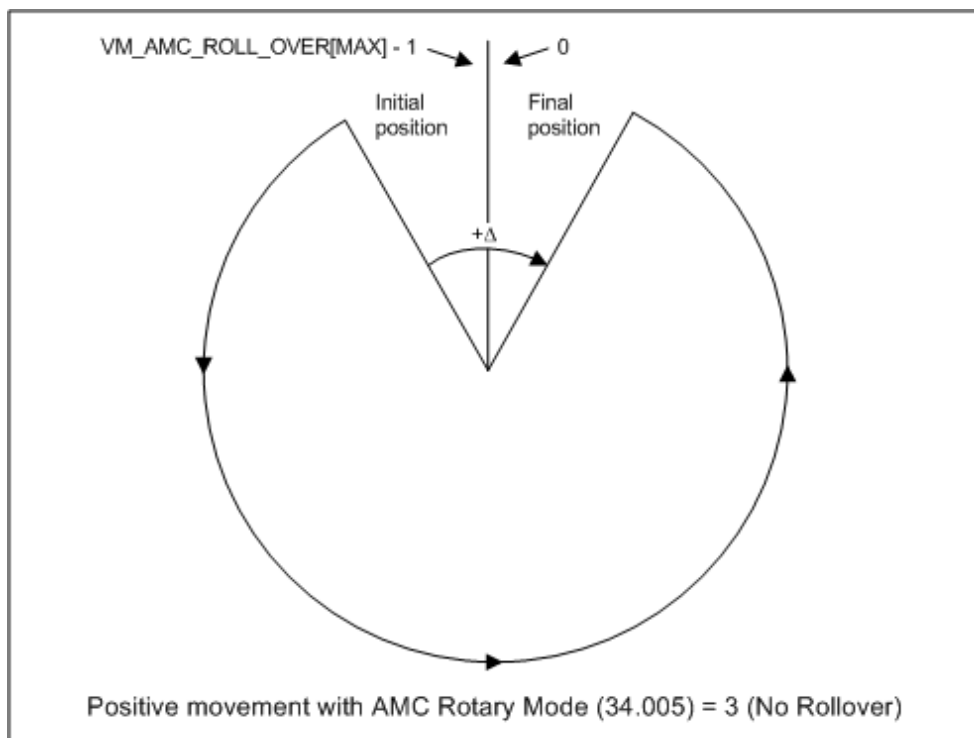
Note that if *AMC Rotary Mode* (34.005) is set to 3 when the motion controller is enabled and *AMC Profile Output Speed* (38.009) > 0 it may not be possible to stop the slave under the constraints of the profile generator before it crosses a boundary.

4 (Multiple Turns Forward)

If the change of position at the input integrator of the profile generator is negative and greater than -*AMC Roll-over Limit* (31.010) the change of position added to the integrator is modified so that -Δ becomes *AMC Roll-over Limit* (31.010) - Δ. This has the effect of making any reverse movements into forward movements by forcing the profile to rollover the *AMC Roll-over Limit* (31.010) - 1 boundary. The change of position is ignored by the profile if it is less than -*AMC Roll-over Limit* (31.010).

5 (Multiple Turns Reverse)

If the change of position at the input integrator of the profile generator is positive and less than *AMC Roll-over Limit* (31.010) the change of position added to the integrator is modified so that +Δ becomes Δ - *AMC Roll-over Limit* (31.010). This has the effect of making any forward movements into reverse movements by forcing the profile to rollover the zero boundary. The change of position is ignored by the profile if it is greater than *AMC Roll-over Limit* (31.010).

6 (Multiple Turns Delta)

In this mode the change of position is added directly to the input integrator of the profile generator and the direction of movement is defined by the sign of the position change.

Parameter	34.006 *AMC Speed Reference*		
Short description	Defines the speed reference used when AMC Reference Select = 2		
Mode	RFC‑S		
Minimum	−VM_AMC_SPEED	Maximum	VM_AMC_SPEED
Default	0.00	Units	UU/ms
Type	32 Bit User Save	Update Rate	AMC sample rate read
Display Format	Standard	Decimal Places	2
Coding	RW, VM		

AMC Speed Reference (34.006) is used as the input to the profile generator when *AMC Reference Select* (34.007) = 2.

Parameter	34.007 *AMC Reference Select*		
Short description	Defines the input to the profile generator		
Mode	RFC‑S		
Minimum	0	Maximum	7
Default	0	Units	
Type	8 Bit User Save	Update Rate	AMC sample rate read
Display Format	Standard	Decimal Places	0
Coding	RW, TE		

Value	Text
0	Stop
1	Position Abs
2	Speed
3	Cam
4	EGB
5	Home
6	Position Rel
7	Position Profile

AMC Reference Select (34.007) selects the input to the profile generator as shown below.

AMC Reference Select (34.007)	Reference	Action on select
0	*AMC Stop Reference* (34.002)	*AMC Stop Reference* (34.002) is no longer updated
1	*AMC Position Reference* (34.003)	See position mode below
2	*AMC Speed Reference* (34.006)	
3	Cam system output	Cam system started from *AMC Cam Start Index* (35.001) and *AMC Cam Start Position In Segment* (35.002)
4	Electronic gearbox output	Electronic gearbox is started
5	Homing system output	Homing sequence is started
6	*AMC Position Reference* (34.003)	See position mode below
7	*AMC Profile Input Position* (38.006)	See position mode below

Position Mode

Example 1 - Absolute Move

When *AMC Reference Select* (34.007) is set to 1 the position delta between *AMC Position Reference* (34.003) and *AMC Profile Input Position* (38.006) is continuously written to *AMC Profile Input Position* (38.006) and the slave will move to the reference position.

Absolute Positioning
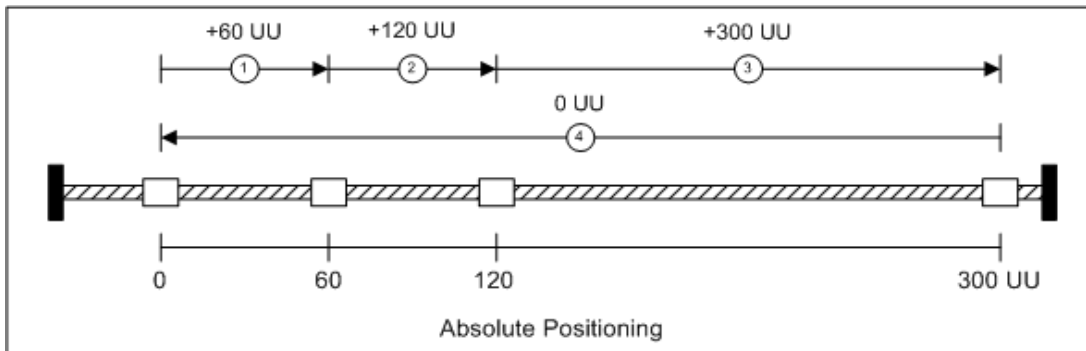
Index	*AMC Position Reference* (34.003)	*AMC Reference Select* (34.007)
1	60	1
2	120	1
3	300	1
4	0	1

Example 2 - Relative Move

When *AMC Reference Select* (34.007) is set to 6 and a change of reference position is detected or when *AMC Reference Select* (34.007) is changed to 6 from another reference then *AMC Position Reference* (34.003) is added to *AMC Profile Input Position* (38.006) and the slave will move relative to *AMC Profile Input Position* (38.006). If the slave is required to move by the same distance in successive moves then *AMC Position Reference* (34.003) can be changed to zero and then set to the required reference or *AMC Reference Select* (34.007) can be toggled between mode 6 and 7. When *AMC Reference Select* (34.007) is set to 7 (profile position) the *AMC Profile Input Position* (38.006) is held at the previous value and the slave will continue to move to or remain at the profile input position.

Relative Positioning
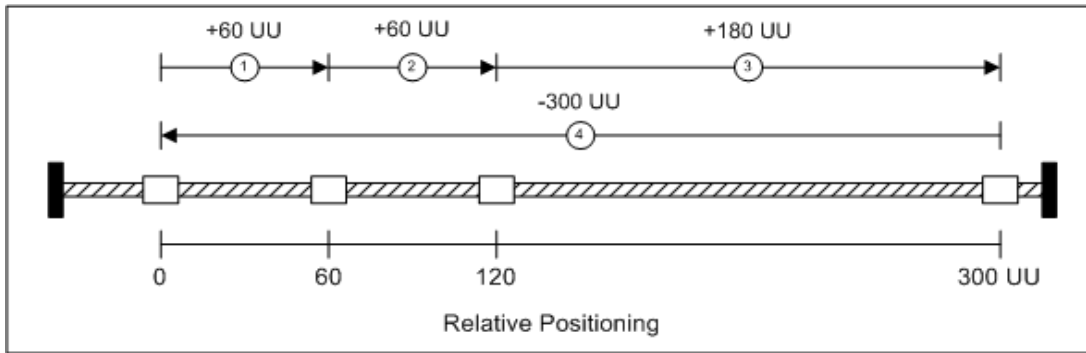
Index	*AMC Position Reference* (34.003)	*AMC Reference Select* (34.007)
1	+60	6
2	+60 to 0 to +60	6
3	+120	6
4	-300	6

It should be noted that instead of changing *AMC Position Reference* (34.003) it is possible to toggle *AMC Reference Select* (34.007) between modes 6 and 7 to initiate another relative move of 60 user units for index 2.

Reference Selector and Trigger

AMC Reference Select (34.007) can be automatically changed in the following modes.

Mode	Reference after change
AMC Stop Mode (34.001) = 2 or 3	0
AMC Action On Event (34.008) = Cam On Freeze	3
AMC Action On Event (34.008) = EGB On Freeze	4
Homing system (menu 40)	0

AMC Reference Select Trigger (34.009) can be used to set *AMC Reference Select* (34.007) on a change of reference. This allows *AMC Reference Select* (34.007) to be changed automatically and a reference to be continuously written to *AMC Reference Select Trigger* (34.009). It should be noted that when *AMC Reference Select* (34.007) and *AMC Reference Select Trigger* (34.009) are changed in the same sample *AMC Reference Select* (34.007) = *AMC Reference Select Trigger* (34.009).

Parameter	34.008 *AMC Action On Event*		
Short description	Defines the function of the AMC on a positive transition of the master freeze flag		
Mode	RFC‑S		
Minimum	0	Maximum	2
Default	0	Units	
Type	8 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW, TE		

Value	Text
0	None
1	Cam On Freeze
2	EGB On Freeze

0 (None)
This feature is disabled.

1 (Cam On Freeze)
The cam system is started and *AMC Reference Select* (34.007) is set to 3 when a freeze event is produced by the freeze system (positive transition of the master freeze flag) in the position feedback interface selected by the *AMC Master Source Select* (32.001) and *AMC Master Freeze Select* (32.007). The diagram below shows the effect of selecting the Cam by writing directly to *AMC Reference Select* (34.007) or by using the action on a freeze event.

Alternative Start Methods
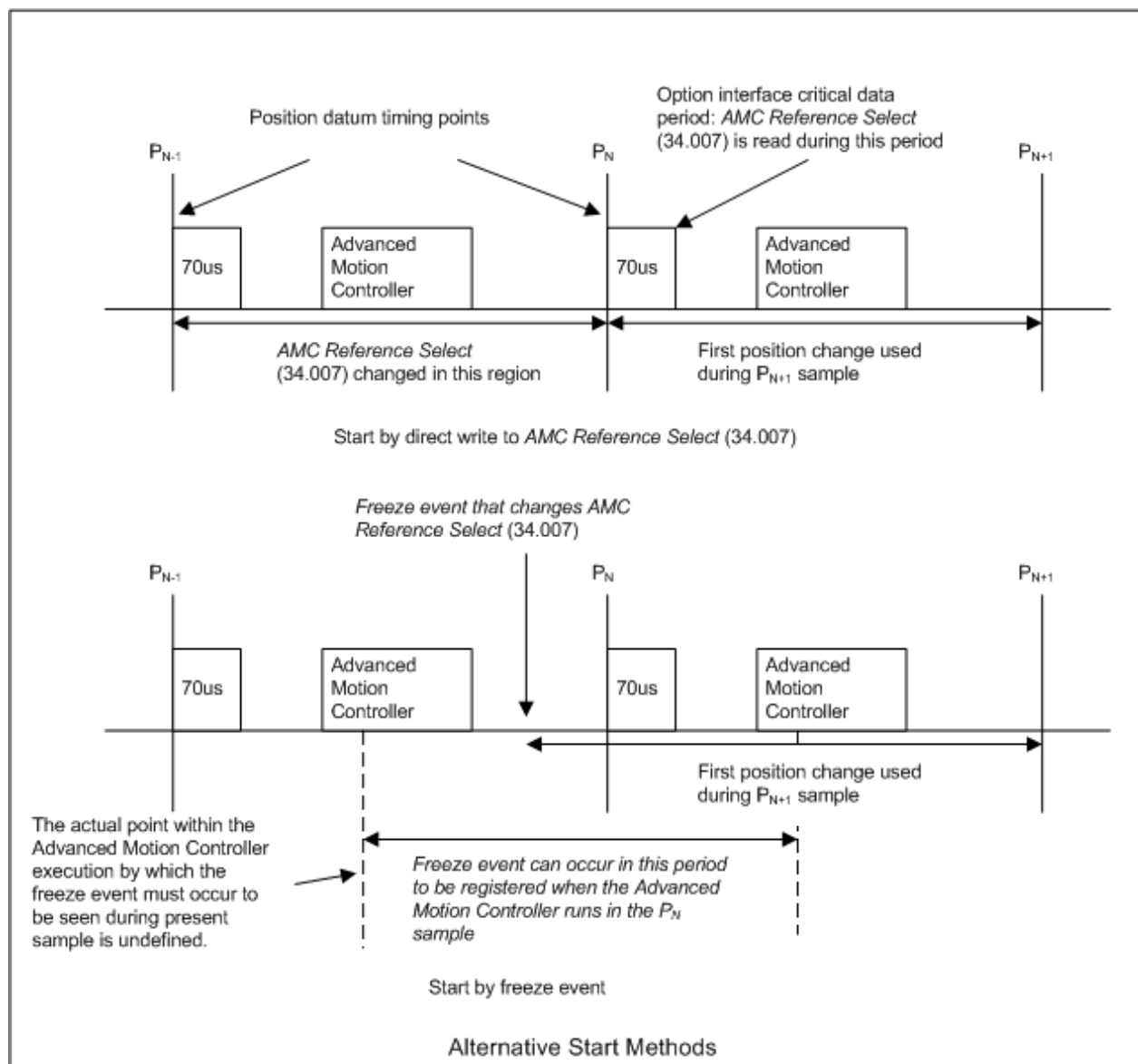
When *AMC Reference Select* (34.007) is written directly the first position change used by the Cam is taken between position datum P_N and position datum P_{N+1}. Therefore the change of position used by the Cam begins at position datum P_N, which is the first datum after *AMC Reference Select* (34.007) is modified. When the freeze event is used to change *AMC Reference Select* (34.007) the first position change used by the Cam always starts at the point where the freeze event occurred, and so the change of position seen at the input to the Cam is with reference to the position at the freeze event.

2 (EGB On Freeze)
The EGB system is started and *AMC Reference Select* (34.007) is set to 4 when a freeze event is produced by the freeze system in the position feedback interface selected by the *AMC Master Source Select* (32.001) and *AMC Master Freeze Select* (32.007). The input position is derived in the same way as described for the Cam.

It should be noted that *AMC Action On Event* (34.008) is disabled when a hardware or software limit is active.

Parameter	34.009 *AMC Reference Select Trigger*		
Short description	The reference selector is set to the reference trigger when a change is detected		
Mode	RFC-S		
Minimum	0	Maximum	7
Default	0	Units	
Type	8 Bit Volatile	Update Rate	AMC sample rate read
Display Format	Standard	Decimal Places	0
Coding	RW, TE		

Value	Text
0	Stop
1	Position Abs
2	Speed
3	Cam
4	EGB
5	Home
6	Position Rel
7	Position Profile

See *AMC Reference Select* (34.007).

Menu 35 Single Line Descriptions − *AMC Cam*

Mode: RFC‑S

Parameter	Range	Default	Type				
35.001 AMC Cam Start Index	0 to 19	0	RW	Num				US
35.002 AMC Cam Start Position In Segment	0 to VM_AMC_POSITION_UNIPOLAR UU	0 UU	RW	Num				US
35.003 AMC Cam Size	1 to 20	1	RW	Num				US
35.004 AMC Cam Single Shot Enable	Off (0) or On (1)	Off (0)	RW	Bit				US
35.005 AMC Cam Output Ratio Numerator	1 to 2147483647	1000	RW	Num				US
35.006 AMC Cam Output Ratio Denominator	1 to 2147483647	1000	RW	Num				US
35.007 AMC Cam Index	0 to 19		RO	Num	ND	NC	PT	
35.008 AMC Cam Position In Segment	0 to VM_AMC_POSITION_UNIPOLAR UU		RO	Num	ND	NC	PT	
35.009 AMC Cam Final Speed Coefficient	-21474836.48 to 21474836.47 UU		RO	Num	ND	NC	PT	
35.010 AMC Cam Complete	Off (0) or On (1)	Off (0)	RW	Bit				
35.011 AMC Cam Force Repeat	Off (0) or On (1)	On (1)	RW	Bit				US
35.012 AMC Cam Mode	0 to 1	0	RW	Num				US

RW	Read / Write	RO	Read-only	Bit	Bit parameter	Txt	Text string	Date	Date parameter	Time	Time parameter
Chr	Character parameter	Bin	Binary parameter	IP	IP address	Mac	MAC address	Ver	Version number	SMP	Slot, menu, parameter
Num	Number parameter	DE	Destination	ND	No default value	RA	Rating dependent	NC	Non-copyable	PT	Protected
FI	Filtered	US	User save	PS	Power-down save						

Menu 35 − *AMC Cam*

Mode: RFC‑S

Cam
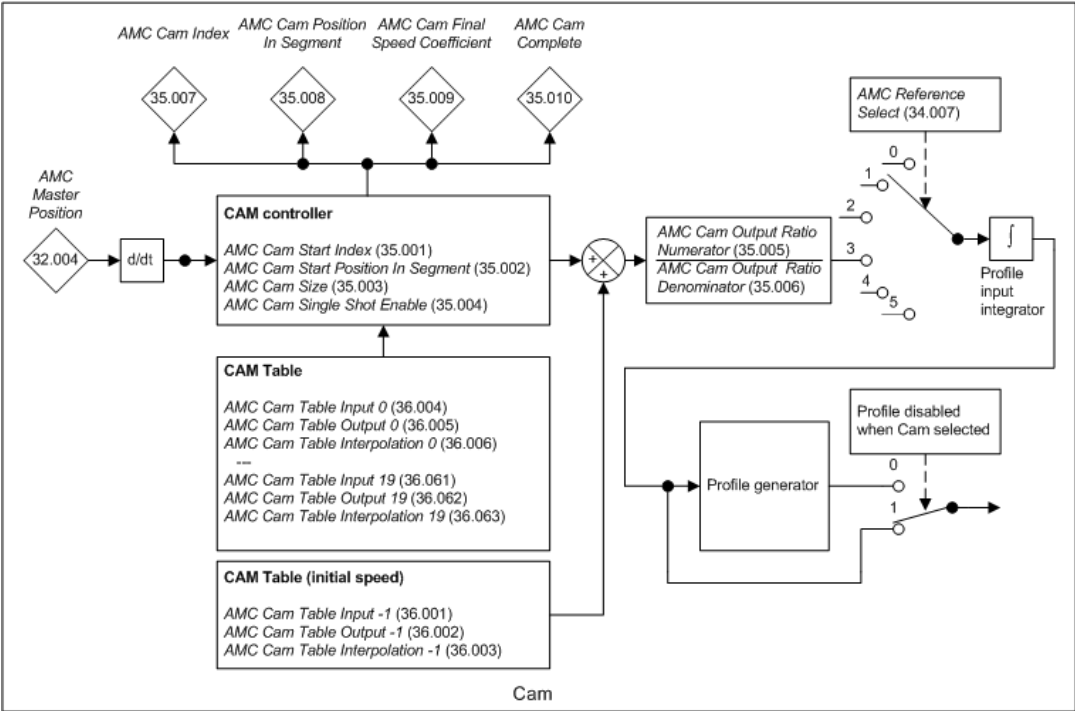
Parameter	35.001 *AMC Cam Start Index*		
Short description	Defines which index of the cam table the AMC cam controller starts at		
Mode	RFC‑S		
Minimum	0	Maximum	19
Default	0	Units	
Type	8 Bit User Save	Update Rate	4ms read
Display Format	Standard	Decimal Places	0
Coding	RW		

Cam input
The cam is enabled when the motion controller is enabled and *AMC Reference Select* (34.007) is changed to a value of 3. When enabled *AMC Cam Index* (35.007) and *AMC Cam Position In Segment* (35.008) are set to *AMC Cam Start Index* (35.001) and *AMC Cam Start Position In Segment* (35.002). If *AMC Cam Start Index* (35.001) ≥ *AMC Cam Size* (35.003) or *AMC Cam Position In Segment* (35.008) is larger than the input position for the start segment then a *CAM.001* trip is initiated. This causes the drive to go into the trip state and the motion controller is disabled.

Any change of *AMC Master Position* (32.004) is used to move forwards (positive change of master position) or backwards (negative change of master position) through the cam table. The number of input user units for each segment are defined in the cam table parameters (*AMC Cam Table In 0* (36.004), *AMC Cam Table In 1* (36.007), etc.) and *AMC Cam Table In 0* (36.004) corresponds to segment 0. *AMC Cam Index* (35.007) is incremented when the end of the segment is reached (forwards) or decremented when the beginning of the segment is reached (backwards). When the end of the last segment is reached in the forwards direction the cam index wraps around to the start of the next cam table and when the start of the first segment is reached in the reverse direction the index wraps around to the end of the next cam table. *AMC Cam Mode* (35.012), *AMC Cam Start Index* (35.001) and *AMC Cam Size* (35.003) are used to configure the actions taken when the cam wraps around.

It should be noted that if the change of input position causes *AMC Cam Index* (35.007) to change by more than two segments then a *CAM.002* trip is initiated. In addition, the maximum change of master position is limited to 1,000,000,000 user units and a *CAM.004* trip is initiated if the maximum value is exceeded.

Cam Output
The cam table parameters provide an output value and an interpolation method for each cam segment. *AMC Cam Table Out 0* (36.005) and *AMC Cam Table Interpolation 0* (36.006) correspond to segment 0, etc. As *AMC Cam Start Position In Segment* (35.002) moves over the range from 0 to *AMC Cam Table In 0* (36.004) the output changes from 0 to *AMC Cam Table Out 0* (36.005). The change of position is fed out of the cam controller, the cam ratio is applied and the result is accumulated in the profile input integrator. Therefore for a given change of input position defined by *AMC Cam Table In 0* (36.004) there is a change of output position defined by *AMC Cam Table Out 0* (36.005) multiplied by the cam output ratio.

The interpolation method for each segment defines the relationship between the input and output positions. The interpolation functions are designed so that there are no speed discontinuities at segment boundaries, and so the rate of change of output position with respect to input position is the same either side of a segment boundary. It is the responsibility of the user to ensure that the rate of change of the output is 0 at the end of the last segment to prevent a speed discontinuity as the cam table wraps round. The diagram below shows an example of interpolation within the Nth segment.
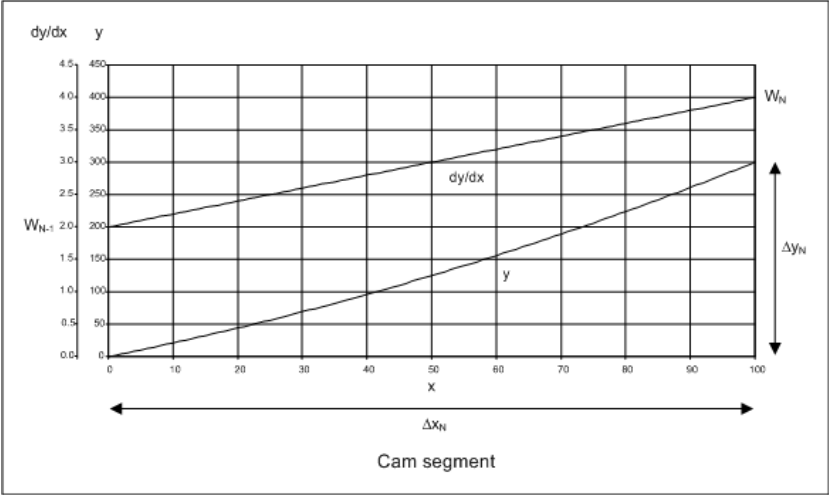
Cam segment

x is *AMC Cam Start Position In Segment* (35.002)

y is the output position

ΔX_N is the cam input table value for the segment

ΔY_N is the cam output table value for the segment

W_N is dy/dx at the end of this segment

W_{N-1} is dy/dx at the end of the last segment

The following coefficients are calculated for each segment based on the rate of change of position at the end of the previous segment.

$A_N = W_{N-1} \Delta X_N$

$B_N = \Delta Y_N - A_N$

The output position is calculated using the following function.

$y = (A_N X) + (B_N f(X))$

where X is the input position as a proportion of the total input position over the segment, i.e. $X = x/\Delta X_N$. The term $A_N X$ produces a constant rate of change of output position against input position, and so if the input speed is constant this will provide a constant output speed that is equivalent to the speed at the start of the segment. This term prevents speed discontinuities between segments. The term $B_N f(X)$ produces the required change of output position ΔY_N over the segment using the required interpolation function f(X). Different functions can be used to give different types of interpolation, but f(0) must be 0 and f(1) must be 1 to give the correct output position change over the segment. The rate of change of output position with respect to the input position is given by

$dy/dx = A_N/\Delta X_N + B_N \, df(X)/dx$

It should be noted that the rate of change used internally by the motion controller is scaled by 256 and is rounded to the nearest integer. If the magnitude of the rate of change (dy/dx) at the end of any segment (W_{N-1}) exceeds $2^{31}/256$ a *CAM.003* trip is initiated. This causes the drive to go into the trip state and the Advanced Motion Controller will be disabled.

Interpolation functions with no speed change
If $W_N = W_{N-1}$ then the speed at the start and end of the segment will be the same for a constant input speed. If the whole cam table is filled with segments that use an interpolation method where this is true, then the speed will return to 0 at the end of every segment. Such a function can be selected if the cam table interpolation parameter for a segment is set to 0 (Cos1). The following function is used:

$f(X) = X - (1/(2\pi)) \sin (2\pi X)$

As already defined $X = x / \Delta X_N$, and so

$f(X) = x/\Delta X_N - (1/(2\pi)) \sin (2\pi x / \Delta X_N)$

Differentiating with respect to x gives

$df(X)/dx = (1 - \cos (2\pi X)) / \Delta X_N$

$df(0)/dx = df(1)/dx = 0$, and so $W_N = W_{N-1}$. The diagram below shows this function where $W_{N-1} = W_N = 0$.

Cos1 interpolation
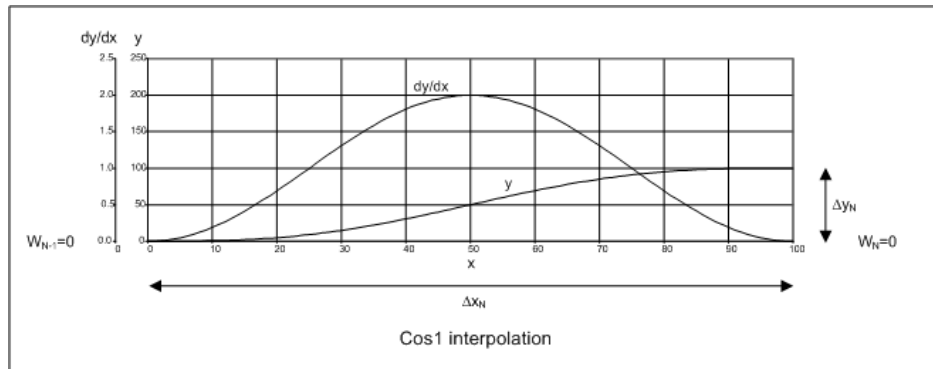
It should be noted that if $\Delta Y_N = A_N$ then the output will be a constant speed for a constant speed input.

Interpolation functions that give a speed change
If it is not a requirement to have the same speed at the start and end of a segment then a function can be used where $df(0)/dx = 0$ and $df(1)/dx = 2/\Delta X_N$. In this case $W_N = A_N + 2B_N/\Delta X_N$. One of two functions can be selected by setting the cam table interpolation parameter for a segment to 1 (Square) or 2 (Cos2). These are described below.

For square interpolation $f(X) = X^2$ which gives a linear change of dy/dx. The diagram below shows the position and speed for an acceleration from 0. If $\Delta Y_N/ \Delta X_N$ is less than W_{N-1} at the start of the segment then dy/dx will fall over the segment and W_N will be less than W_{N-1}.

Square interpolation
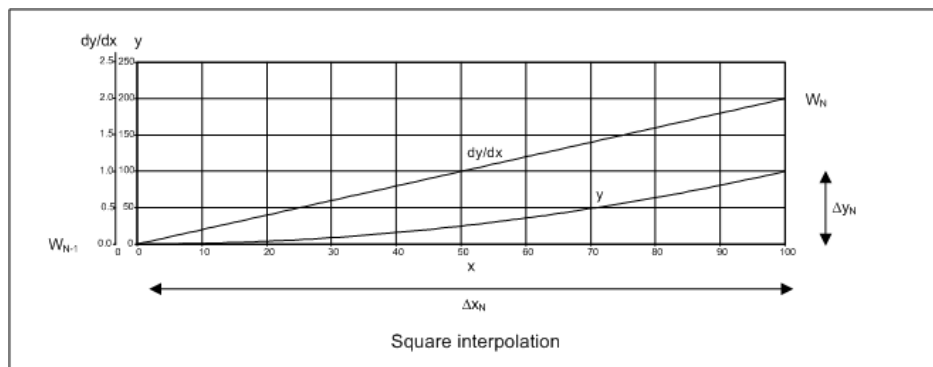
For the Cos2 interpolation $f(X) = X - (1/\pi) \sin (\pi X)$ which gives sinusoidal changes in dy/dx. The diagram below shows the position and speed for an acceleration from 0. If $\Delta Y_N/ \Delta X_N$ is less than W_{N-1} at the start of the segment dy/dx will fall over the segment and W_N will be less than W_{N-1}.

Cos2 interpolation
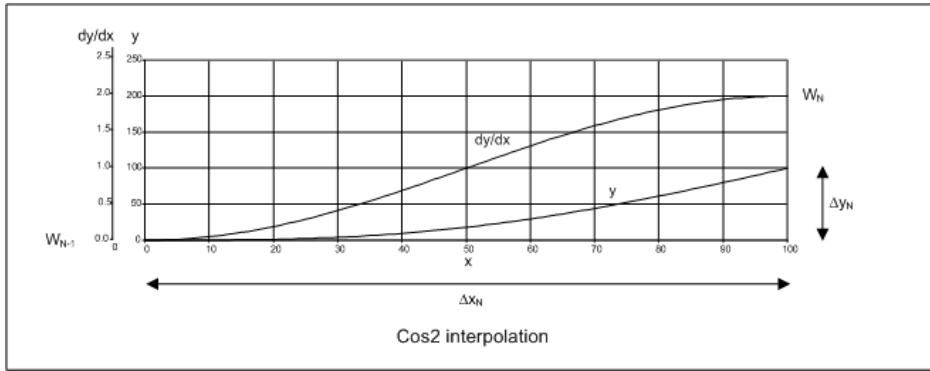
Initial speed segment

One cam segment (*AMC Cam Table In -1* (36.001), *AMC Cam Table Out -1* (36.002), *AMC Cam Table Interpolation -1* (36.003)) is provided to give an initial speed to the cam output. When the cam is enabled this segment becomes active and its output is added to the output provided by the main cam table. If *AMC Cam Table Interpolation -1* (36.003) is set for Square or Cos2 interpolation and the end of this segment is passed in the forward direction the output speed is maintained by applying a ratio of 2ΔY/ ΔX to the change of *AMC Master Position* (32.004). If the initial master speed is negative the input wraps around the end of the segment and will continue until the start of the segment is reached. Again the output speed is then maintained by applying a ratio of 2ΔY/ ΔX to the change of *AMC Master Position* (32.004). *AMC Cam Table Interpolation -1* (36.003) can also be set to linear interpolation, and if this is selected the initial speed segment always applies a ratio of ΔY/ ΔX to the change of *AMC Master Position* (32.004). If *AMC Cam Table In -1* (36.001) is left at its default value of 0 then this initial segment is disabled and no position is added to the main cam system.

Parameter	35.002 *AMC Cam Start Position In Segment*		
Short description	Defines the position in segment that the AMC Cam controller uses when the cam is enabled		
Mode	RFC-S		
Minimum	0	Maximum	VM_AMC_POSITION_UNIPOLAR
Default	0	Units	UU
Type	32 Bit User Save	Update Rate	4ms read
Display Format	Standard	Decimal Places	0
Coding	RW, VM		

See *AMC Cam Start Index* (35.001).

Parameter	35.003 *AMC Cam Size*		
Short description	Defines the number of segments from the cam table that are used to define the cam profile		
Mode	RFC-S		
Minimum	1	Maximum	20
Default	1	Units	
Type	8 Bit User Save	Update Rate	4ms read
Display Format	Standard	Decimal Places	0
Coding	RW		

AMC Cam Size (35.003) defines the number of segments from the cam table that are used to define the cam profile.

Parameter	35.004 *AMC Cam Single Shot Enable*		
Short description	Set to 1 to disable the cam system from running continuously		
Mode	RFC-S		
Minimum	0	Maximum	1
Default	0	Units	
Type	1 Bit User Save	Update Rate	4ms read
Display Format	Standard	Decimal Places	0
Coding	RW		

When *AMC Cam Single Shot Enable* (35.004) = 0 the cam will run until it is deselected. If *AMC Cam Single Shot Enable* (35.004) = 1 the cam will stop when either end of the cam table is reached. For single shot operation the following apply:

1. The cam function cannot be started unless *AMC Cam Complete* (35.010) = 0. The cam function can be restarted again by clearing *AMC Cam Complete* (35.010). Note that *AMC Cam Complete* (35.010) is cleared automatically when *AMC Cam Single Shot Enable* (35.004) is enabled.
2. Once the cam function has stopped it can be restarted by changing *AMC Reference Select* (34.007) to a value other than 3 (cam) and then back to 3, or by disabling and re-enabling the motion controller.
3. Once the cam function has stopped it can be restarted by a freeze event (see *AMC Action On Event* (34.008)) provided the freeze event occurs in a sample after the one in which the cam function stopped.
4. The cam function is not stopped the first time it wraps around in reverse if it is selected or restarted with *AMC Cam Start Index* (35.001) = 0 and *AMC Cam Start Position In Segment* (35.002) = first segment.

Note that when *AMC Cam Single Shot Enable* (35.004) is enabled the cam will stop at the beginning of the first segment when running forwards or the end of the last segment when running in reverse.

Parameter	35.005 *AMC Cam Output Ratio Numerator*		
Short description	Defines the numerator for the ratio that is applied to the change of output position from the Cam function		
Mode	RFC-S		
Minimum	1	Maximum	2147483647
Default	1000	Units	
Type	32 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW		

The Cam output ratio (*AMC Cam Output Ratio Numerator* (35.005) / *AMC Cam Output Ratio Denominator* (35.006)) is applied to the change of output position from the Cam function before it is accumulated by the profile input integrator.

Parameter	35.006 *AMC Cam Output Ratio Denominator*		
Short description	Defines the denominator for the ratio that is applied to the change of output position from the Cam function		
Mode	RFC-S		
Minimum	1	Maximum	2147483647
Default	1000	Units	
Type	32 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW		

See *AMC Cam Output Ratio Numerator* (35.005).

Parameter	35.007 *AMC Cam Index*		
Short description	Displays which index in the Cam table the Cam controller is using		
Mode	RFC-S		
Minimum	0	Maximum	19
Default		Units	
Type	8 Bit Volatile	Update Rate	4ms write
Display Format	Standard	Decimal Places	0
Coding	RO, ND, NC, PT		

See *AMC Cam Start Index* (35.001).

Parameter	35.008 *AMC Cam Position In Segment*		
Short description	Displays the position in the segment that the cam controller is using		
Mode	RFC-S		
Minimum	0	Maximum	VM_AMC_POSITION_UNIPOLAR
Default		Units	UU
Type	32 Bit Volatile	Update Rate	4ms write
Display Format	Standard	Decimal Places	0
Coding	RO, VM, ND, NC, PT		

See *AMC Cam Start Index* (35.001).

Parameter	35.009 *AMC Cam Final Speed Coefficient*		
Short description	Displays the Final Speed Coefficient that the cam controller uses		
Mode	RFC-S		
Minimum	-21474836.48	Maximum	21474836.47
Default		Units	UU
Type	32 Bit Volatile	Update Rate	Background write
Display Format	Standard	Decimal Places	2
Coding	RO, ND, NC, PT		

AMC Cam Final Speed Coefficient (35.009) shows the value of A_K which is calculated using the rate of change at the end of the last segment and ΔX_K, i.e. $A_K = W_N \Delta X_K$ where N = *AMC Cam Size* (35.003) and K is the first segment in the cam table. Note that the first segment is always segment 0 when *AMC Cam Mode* (35.012) = 0 or *AMC Cam Start Index* (35.001) when *AMC Cam Mode* (35.012) = 1.

When *AMC Cam Force Repeat* (35.011) is enabled the rate of change at the boundary between the first and last segment is set to zero when the cam is running forwards or to the rate of change at the end of the last segment when running backwards. This forces the interpolated output position to be identical when the cam repeats in either direction, but will introduce a speed discontinuity at the boundary of the first and last segment if *AMC Cam Final Speed Coefficient* (35.009) is not zero. An example of the speed discontinuity which can occur when *AMC Cam Force Repeat* (35.011) is enabled and the rate of change (dy/dx) at the end of the last segment is not zero is shown in the figure below.

Cam wrap around with AMC Cam Force Repeat (35.011) = 1
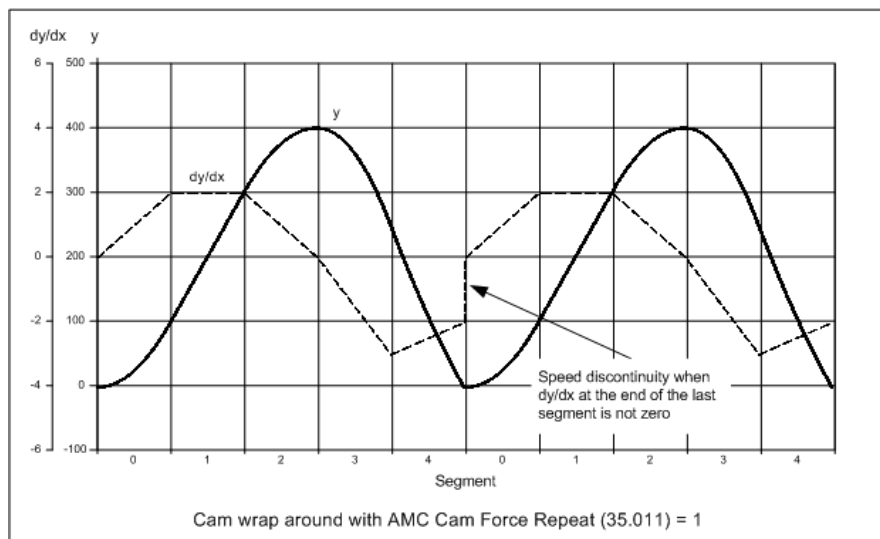
If *AMC Cam Force Repeat* (35.011) is disabled the rate of change calculated at the end of the last segment is used to calculate the interpolated position in the next segment. This removes the discontinuity caused by the rate of change at the end of the last segment but will cause the interpolated position between segment boundaries to change when the cam repeats and the rate of change at the end of the last segment is not zero. The effect of turning *AMC Cam Force Repeat* (35.011) off is shown in the figure below.

Cam wrap around with AMC Cam Force Repeat (35.011) = 0
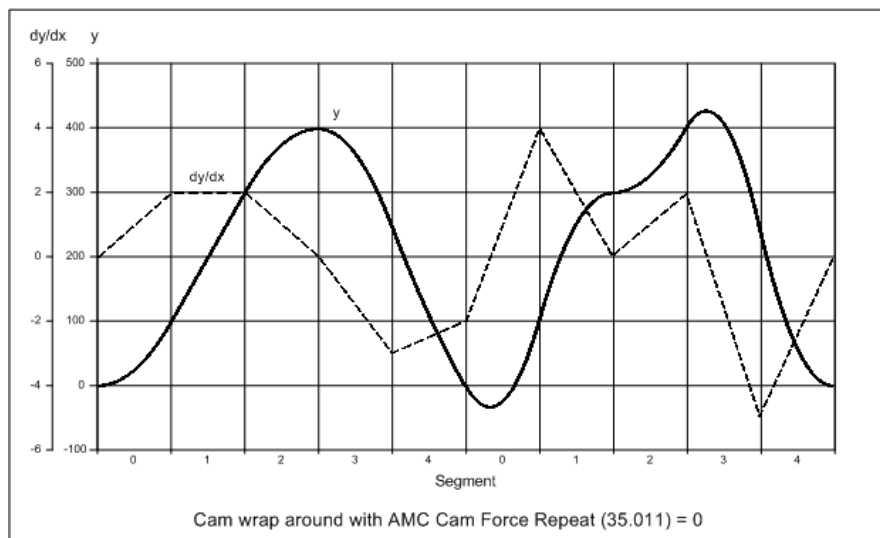
In this example the speed is continuous but the interpolated position between segment boundaries has changed. This is caused by the rate of change used at the beginning of segment 0 in the second cam which is not forced to zero when *AMC Cam Force Repeat* (35.011) is off. Note that the rate of change used to calculate the position in the first segment of the first cam is always zero. This mode is intended to be used when writing cam table parameters (more than 20 points) from a controller or *AMC Cam Mode* (35.012) is set to 2 and the rate of change at the end of the last segment is not zero.

Parameter	35.010 *AMC Cam Complete*		
Short description	Displays when the cam controller reaches the end of the cam table		
Mode	RFC-S		
Minimum	0	Maximum	1
Default	0	Units	
Type	1 Bit Volatile	Update Rate	4ms write
Display Format	Standard	Decimal Places	0
Coding	RW		

AMC Cam Complete (35.010) is set to one when the cam function wraps around either end of the cam table. *AMC Cam Complete* (35.010) is not set the first time the cam wraps around the first segment (running in the reverse direction) if *AMC Cam Start Position In Segment* (35.002) = 0 and *AMC Cam Start Index* (35.001) = first segment. Note that the first segment is always set to segment 0 when *AMC Cam Mode* (35.012) = 0 or *AMC Cam Start Index* (35.001) when *AMC Cam Mode* (35.012) = 1.

Parameter	35.011 *AMC Cam Force Repeat*		
Short description			
Mode	RFC-S		
Minimum	0	Maximum	1
Default	1	Units	
Type	1 Bit User Save	Update Rate	4ms read
Display Format	Standard	Decimal Places	0
Coding	RW, BU		

See *AMC Cam Final Speed Coefficient* (35.009).

Parameter	35.012 *AMC Cam Mode*		
Short description			
Mode	RFC-S		
Minimum	0	Maximum	1
Default	0	Units	
Type	8 Bit User Save	Update Rate	4ms read
Display Format	Standard	Decimal Places	0
Coding	RW		

AMC Cam Mode (35.012) is used to select between the functionality shown in the table below.

AMC Cam Mode (35.012)	AMC Cam Index (35.007) when the cam is enabled	AMC Cam Index (35.007) when the cam wraps around the last segment in the forward direction	AMC Cam Index (35.007) when the cam wraps around the first segment in the reverse direction	Parameter update
0	*AMC Cam Start Index* (35.001)	0	*AMC Cam Size* (35.003) - 1	*AMC Cam Start Index* (35.001) and *AMC Cam Size* (35.003) are updated when the cam is disabled
1	*AMC Cam Start Index* (35.001)	*AMC Cam Start Index* (35.001)	*AMC Cam Start Index* (35.001) + *AMC Cam Size* (35.003) - 1	*AMC Cam Start Index* (35.001) and *AMC Cam Size* (35.003) are updated when the cam is disabled and when the cam wraps around the last segment in either direction

When *AMC Cam Mode* (35.012) = 1 the last index in the cam table (*AMC Cam Start Index* (35.001) + *AMC Cam Size* (35.003) - 1) is automatically limited to the maximum value (i.e. segment 19). For example, if *AMC Cam Start Index* (35.001) = 10 and *AMC Cam Size* (35.003) = 20 the cam would operate between index 10 and 19.

When *AMC Cam Mode* (35.012) = 0 the cam will run between index 0 and *AMC Cam Size* (35.003) - 1. The figure below shows a trapezoidal cam with three segments (i.e. ramp in, running and ramp out). In single shot mode the cam runs once and stops at the beginning of the first segment (i.e. *AMC Cam Index* (35.007) = 0 and *AMC Cam Position In Segment* (35.008) = 0).
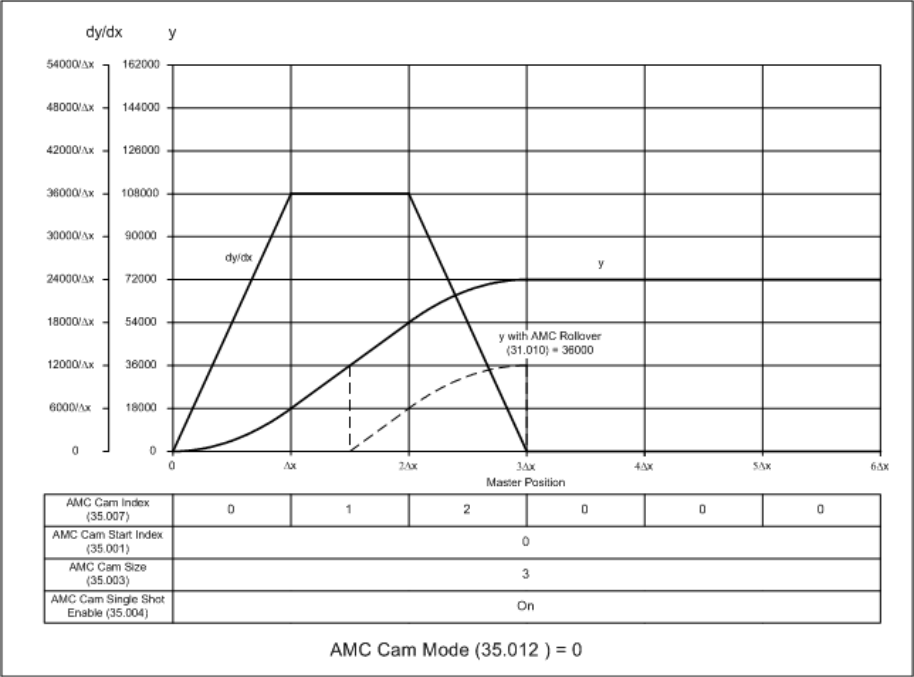
AMC Cam Mode (35.012) = 0

In some applications (e.g. rotary knife) the ramp in and ramp out segments are only required at the beginning and end of a process. When *AMC Cam Mode* (35.012) = 1 it is possible to change *AMC Cam Start Index* (35.001), *AMC Cam Size* (35.003) and *AMC Cam Single Shot Enable* (35.004) while the cam is running to produce the cam profile shown below, i.e. the cam remains in the running segment until the ramp out is required.

AMC Cam Index (35.007)	0	1	1	1	2	0
AMC Cam Start Index (35.001)	0	1	1	2	0	0
AMC Cam Size (35.003)	2	1	1	1	2	2
AMC Cam Single Shot Enable (35.004)	Off	Off	Off	Off	On	Off

AMC Cam Mode (35.012) = 1
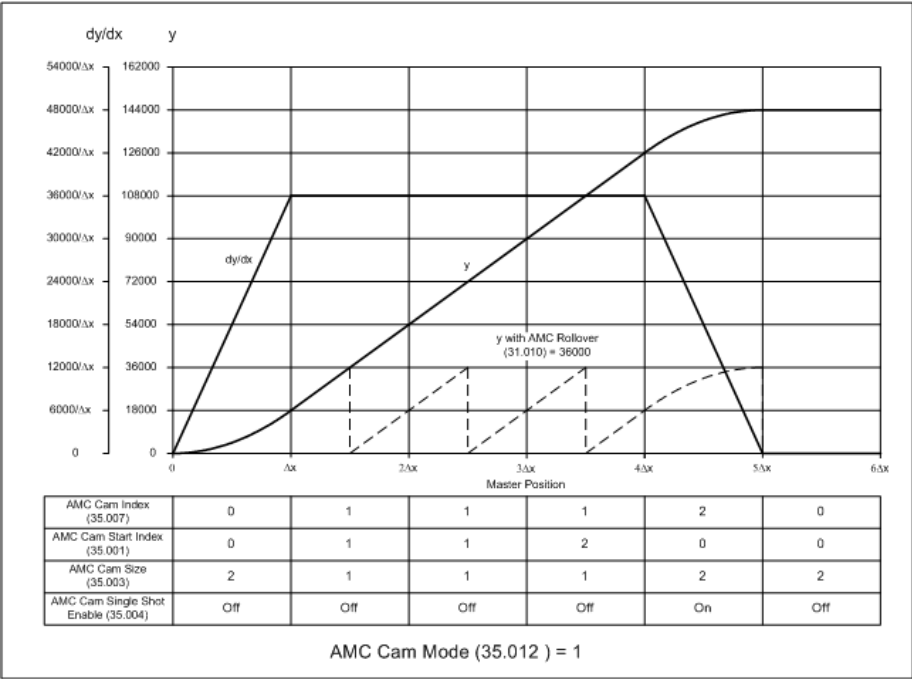
Note that any parameter in *AMC Cam* (35) or *AMC Cam Table* (36) must be updated at least 4ms before the cam enters the segment in which the new value is applied, e.g. when running forwards *AMC Cam Size* (35.003) must be updated 4ms before the end of the last segment is reached.

Menu 36 Single Line Descriptions − *AMC Cam Table*

Mode: RFC‑S

Parameter		Range	Default	Type				
36.001	AMC Cam Table In -1	0 to VM_AMC_POSITION_CAM_UNIPOLAR UU	0 UU	RW	Num			US
36.002	AMC Cam Table Out -1	±VM_AMC_POSITION_CAM UU	0 UU	RW	Num			US
36.003	AMC Cam Table Interpolation -1	Linear (0), Square (1), Cos2 (2)	Linear (0)	RW	Txt			US
36.004	AMC Cam Table In 0	0 to VM_AMC_POSITION_CAM_UNIPOLAR UU	0 UU	RW	Num			US
36.005	AMC Cam Table Out 0	±VM_AMC_POSITION_CAM UU	0 UU	RW	Num			US
36.006	AMC Cam Table Interpolation 0	Cos1 (0), Square (1), Cos2 (2)	Cos1 (0)	RW	Txt			US
36.007	AMC Cam Table In 1	0 to VM_AMC_POSITION_CAM_UNIPOLAR UU	0 UU	RW	Num			US
36.008	AMC Cam Table Out 1	±VM_AMC_POSITION_CAM UU	0 UU	RW	Num			US
36.009	AMC Cam Table Interpolation 1	Cos1 (0), Square (1), Cos2 (2)	Cos1 (0)	RW	Txt			US
36.010	AMC Cam Table In 2	0 to VM_AMC_POSITION_CAM_UNIPOLAR UU	0 UU	RW	Num			US
36.011	AMC Cam Table Out 2	±VM_AMC_POSITION_CAM UU	0 UU	RW	Num			US
36.012	AMC Cam Table Interpolation 2	Cos1 (0), Square (1), Cos2 (2)	Cos1 (0)	RW	Txt			US
36.013	AMC Cam Table In 3	0 to VM_AMC_POSITION_CAM_UNIPOLAR UU	0 UU	RW	Num			US
36.014	AMC Cam Table Out 3	±VM_AMC_POSITION_CAM UU	0 UU	RW	Num			US
36.015	AMC Cam Table Interpolation 3	Cos1 (0), Square (1), Cos2 (2)	Cos1 (0)	RW	Txt			US
36.016	AMC Cam Table In 4	0 to VM_AMC_POSITION_CAM_UNIPOLAR UU	0 UU	RW	Num			US
36.017	AMC Cam Table Out 4	±VM_AMC_POSITION_CAM UU	0 UU	RW	Num			US
36.018	AMC Cam Table Interpolation 4	Cos1 (0), Square (1), Cos2 (2)	Cos1 (0)	RW	Txt			US
36.019	AMC Cam Table In 5	0 to VM_AMC_POSITION_CAM_UNIPOLAR UU	0 UU	RW	Num			US
36.020	AMC Cam Table Out 5	±VM_AMC_POSITION_CAM UU	0 UU	RW	Num			US
36.021	AMC Cam Table Interpolation 5	Cos1 (0), Square (1), Cos2 (2)	Cos1 (0)	RW	Txt			US
36.022	AMC Cam Table In 6	0 to VM_AMC_POSITION_CAM_UNIPOLAR UU	0 UU	RW	Num			US
36.023	AMC Cam Table Out 6	±VM_AMC_POSITION_CAM UU	0 UU	RW	Num			US
36.024	AMC Cam Table Interpolation 6	Cos1 (0), Square (1), Cos2 (2)	Cos1 (0)	RW	Txt			US
36.025	AMC Cam Table In 7	0 to VM_AMC_POSITION_CAM_UNIPOLAR UU	0 UU	RW	Num			US
36.026	AMC Cam Table Out 7	±VM_AMC_POSITION_CAM UU	0 UU	RW	Num			US
36.027	AMC Cam Table Interpolation 7	Cos1 (0), Square (1), Cos2 (2)	Cos1 (0)	RW	Txt			US
36.028	AMC Cam Table In 8	0 to VM_AMC_POSITION_CAM_UNIPOLAR UU	0 UU	RW	Num			US
36.029	AMC Cam Table Out 8	±VM_AMC_POSITION_CAM UU	0 UU	RW	Num			US
36.030	AMC Cam Table Interpolation 8	Cos1 (0), Square (1), Cos2 (2)	Cos1 (0)	RW	Txt			US
36.031	AMC Cam Table In 9	0 to VM_AMC_POSITION_CAM_UNIPOLAR UU	0 UU	RW	Num			US
36.032	AMC Cam Table Out 9	±VM_AMC_POSITION_CAM UU	0 UU	RW	Num			US
36.033	AMC Cam Table Interpolation 9	Cos1 (0), Square (1), Cos2 (2)	Cos1 (0)	RW	Txt			US
36.034	AMC Cam Table In 10	0 to VM_AMC_POSITION_CAM_UNIPOLAR UU	0 UU	RW	Num			US
36.035	AMC Cam Table Out 10	±VM_AMC_POSITION_CAM UU	0 UU	RW	Num			US
36.036	AMC Cam Table Interpolation 10	Cos1 (0), Square (1), Cos2 (2)	Cos1 (0)	RW	Txt			US
36.037	AMC Cam Table In 11	0 to VM_AMC_POSITION_CAM_UNIPOLAR UU	0 UU	RW	Num			US
36.038	AMC Cam Table Out 11	±VM_AMC_POSITION_CAM UU	0 UU	RW	Num			US
36.039	AMC Cam Table Interpolation 11	Cos1 (0), Square (1), Cos2 (2)	Cos1 (0)	RW	Txt			US
36.040	AMC Cam Table In 12	0 to VM_AMC_POSITION_CAM_UNIPOLAR UU	0 UU	RW	Num			US
36.041	AMC Cam Table Out 12	±VM_AMC_POSITION_CAM UU	0 UU	RW	Num			US
36.042	AMC Cam Table Interpolation 12	Cos1 (0), Square (1), Cos2 (2)	Cos1 (0)	RW	Txt			US
36.043	AMC Cam Table In 13	0 to VM_AMC_POSITION_CAM_UNIPOLAR UU	0 UU	RW	Num			US
36.044	AMC Cam Table Out 13	±VM_AMC_POSITION_CAM UU	0 UU	RW	Num			US
36.045	AMC Cam Table Interpolation 13	Cos1 (0), Square (1), Cos2 (2)	Cos1 (0)	RW	Txt			US
36.046	AMC Cam Table In 14	0 to VM_AMC_POSITION_CAM_UNIPOLAR UU	0 UU	RW	Num			US
36.047	AMC Cam Table Out 14	±VM_AMC_POSITION_CAM UU	0 UU	RW	Num			US
36.048	AMC Cam Table Interpolation 14	Cos1 (0), Square (1), Cos2 (2)	Cos1 (0)	RW	Txt			US
36.049	AMC Cam Table In 15	0 to VM_AMC_POSITION_CAM_UNIPOLAR UU	0 UU	RW	Num			US
36.050	AMC Cam Table Out 15	±VM_AMC_POSITION_CAM UU	0 UU	RW	Num			US
36.051	AMC Cam Table Interpolation 15	Cos1 (0), Square (1), Cos2 (2)	Cos1 (0)	RW	Txt			US
36.052	AMC Cam Table In 16	0 to VM_AMC_POSITION_CAM_UNIPOLAR UU	0 UU	RW	Num			US
36.053	AMC Cam Table Out 16	±VM_AMC_POSITION_CAM UU	0 UU	RW	Num			US
36.054	AMC Cam Table Interpolation 16	Cos1 (0), Square (1), Cos2 (2)	Cos1 (0)	RW	Txt			US
36.055	AMC Cam Table In 17	0 to VM_AMC_POSITION_CAM_UNIPOLAR UU	0 UU	RW	Num			US
36.056	AMC Cam Table Out 17	±VM_AMC_POSITION_CAM UU	0 UU	RW	Num			US
36.057	AMC Cam Table Interpolation 17	Cos1 (0), Square (1), Cos2 (2)	Cos1 (0)	RW	Txt			US
36.058	AMC Cam Table In 18	0 to VM_AMC_POSITION_CAM_UNIPOLAR UU	0 UU	RW	Num			US
36.059	AMC Cam Table Out 18	±VM_AMC_POSITION_CAM UU	0 UU	RW	Num			US
36.060	AMC Cam Table Interpolation 18	Cos1 (0), Square (1), Cos2 (2)	Cos1 (0)	RW	Txt			US
36.061	AMC Cam Table In 19	0 to VM_AMC_POSITION_CAM_UNIPOLAR UU	0 UU	RW	Num			US
36.062	AMC Cam Table Out 19	±VM_AMC_POSITION_CAM UU	0 UU	RW	Num			US
36.063	AMC Cam Table Interpolation 19	Cos1 (0), Square (1), Cos2 (2)	Cos1 (0)	RW	Txt			US

RW	Read / Write	RO	Read-only	Bit	Bit parameter	Txt	Text string	Date	Date parameter	Time	Time parameter
Chr	Character parameter	Bin	Binary parameter	IP	IP address	Mac	MAC address	Ver	Version number	SMP	Slot, menu, parameter
Num	Number parameter	DE	Destination	ND	No default value	RA	Rating dependent	NC	Non-copyable	PT	Protected
FI	Filtered	US	User save	PS	Power-down save						

Menu 36 − *AMC Cam Table*

Mode: RFC‑S

Parameter	36.001 *AMC Cam Table In -1*		
Short description	Defines the input entry to the cam table for the initial start segment		
Mode	RFC‑S		
Minimum	0	Maximum	VM_AMC_POSITION_CAM_UNIPOLAR
Default	0	Units	UU
Type	32 Bit User Save	Update Rate	Read when the cam is enabled
Display Format	Standard	Decimal Places	0
Coding	RW, VM		

AMC Cam Table In -1 (36.001), *AMC Cam Table Out -1* (36.002) and *AMC Cam Table Interpolation -1* (36.003) are the cam table entries for the initial start segment.

Parameter	36.002 *AMC Cam Table Out -1*		
Short description	Defines the output entry to the cam table for the initial start segment		
Mode	RFC‑S		
Minimum	−VM_AMC_POSITION_CAM	Maximum	VM_AMC_POSITION_CAM
Default	0	Units	UU
Type	32 Bit User Save	Update Rate	Read when the cam is enabled
Display Format	Standard	Decimal Places	0
Coding	RW, VM		

See *AMC Cam Table In -1* (36.001).

Parameter	36.003 *AMC Cam Table Interpolation -1*		
Short description	Defines the interpolation entry to the cam table for the initial start segment		
Mode	RFC‑S		
Minimum	0	Maximum	2
Default	0	Units	
Type	8 Bit User Save	Update Rate	Read when the cam is enabled
Display Format	Standard	Decimal Places	0
Coding	RW, TE		

Value	*Text*
0	Linear
1	Square
2	Cos2

See *AMC Cam Table In -1* (36.001).

Parameter	36.004 *AMC Cam Table In 0*		
Short description	Defines the input entry to the cam table for segment 0		
Mode	RFC‑S		
Minimum	0	Maximum	VM_AMC_POSITION_CAM_UNIPOLAR
Default	0	Units	UU
Type	32 Bit User Save	Update Rate	4ms read
Display Format	Standard	Decimal Places	0
Coding	RW, VM		

AMC Cam Table In 0 (36.004), *AMC Cam Table Out 0* (36.005) and *AMC Cam Table Interpolation 0* (36.006) are the cam table entries for segment 0. These parameters are read in a 4ms task and transferred to an internal RAM array for use by the cam system.

The parameter numbers for the cam table entries for each of the other segments are calculated using the following, where 1 ≤ X ≤ 19.

Entry	Parameter Number
AMC Cam Table In X	36.004 + 3X
AMC Cam Table Out X	36.005 + 3X
AMC Cam Table Interpolation X	36.006 + 3X

Parameter	36.005 *AMC Cam Table Out 0*		
Short description	Defines the output entry to the cam table for segment 0		
Mode	RFC‑S		
Minimum	−VM_AMC_POSITION_CAM	Maximum	VM_AMC_POSITION_CAM
Default	0	Units	UU
Type	32 Bit User Save	Update Rate	4ms read
Display Format	Standard	Decimal Places	0
Coding	RW, VM		

See *AMC Cam Table In 0* (36.004).

Parameter	36.006 *AMC Cam Table Interpolation 0*		
Short description	Defines the interpolation entry to the cam table for segment 0		
Mode	RFC‑S		
Minimum	0	Maximum	2
Default	0	Units	
Type	8 Bit User Save	Update Rate	4ms read
Display Format	Standard	Decimal Places	0
Coding	RW, TE		

Value	Text
0	Cos1
1	Square
2	Cos2

See *AMC Cam Table In 0* (36.004).

Parameter	36.007 *AMC Cam Table In 1*		
Short description	Defines the input entry to the cam table for segment 1		
Mode	RFC‑S		
Minimum	0	Maximum	VM_AMC_POSITION_CAM_UNIPOLAR
Default	0	Units	UU
Type	32 Bit User Save	Update Rate	4ms read
Display Format	Standard	Decimal Places	0
Coding	RW, VM		

See *AMC Cam Table In 0* (36.004).

Parameter	36.008 *AMC Cam Table Out 1*		
Short description	Defines the output entry to the cam table for segment 1		
Mode	RFC‑S		
Minimum	−VM_AMC_POSITION_CAM	Maximum	VM_AMC_POSITION_CAM
Default	0	Units	UU
Type	32 Bit User Save	Update Rate	4ms read
Display Format	Standard	Decimal Places	0
Coding	RW, VM		

See *AMC Cam Table In 0* (36.004).

Parameter	36.009 *AMC Cam Table Interpolation 1*		
Short description	Defines the interpolation entry to the cam table for segment 1		
Mode	RFC‑S		
Minimum	0	Maximum	2
Default	0	Units	
Type	8 Bit User Save	Update Rate	4ms read
Display Format	Standard	Decimal Places	0
Coding	RW, TE		

Value	Text
0	Cos1
1	Square
2	Cos2

See *AMC Cam Table In 0* (36.004).

Parameter	36.010 *AMC Cam Table In 2*		
Short description	Defines the input entry to the cam table for segment 2		
Mode	RFC‑S		
Minimum	0	Maximum	VM_AMC_POSITION_CAM_UNIPOLAR
Default	0	Units	UU
Type	32 Bit User Save	Update Rate	4ms read
Display Format	Standard	Decimal Places	0
Coding	RW, VM		

See *AMC Cam Table In 0* (36.004).

Parameter	36.011 *AMC Cam Table Out 2*		
Short description	Defines the output entry to the cam table for segment 2		
Mode	RFC‑S		
Minimum	−VM_AMC_POSITION_CAM	Maximum	VM_AMC_POSITION_CAM
Default	0	Units	UU
Type	32 Bit User Save	Update Rate	4ms read
Display Format	Standard	Decimal Places	0
Coding	RW, VM		

See *AMC Cam Table In 0* (36.004).

Parameter	36.012 *AMC Cam Table Interpolation 2*		
Short description	Defines the interpolation entry to the cam table for segment 2		
Mode	RFC‑S		
Minimum	0	Maximum	2
Default	0	Units	
Type	8 Bit User Save	Update Rate	4ms read
Display Format	Standard	Decimal Places	0
Coding	RW, TE		

Value	Text
0	Cos1
1	Square
2	Cos2

See *AMC Cam Table In 0* (36.004).

Parameter	36.013 *AMC Cam Table In 3*		
Short description	Defines the input entry to the cam table for segment 3		
Mode	RFC‑S		
Minimum	0	Maximum	VM_AMC_POSITION_CAM_UNIPOLAR
Default	0	Units	UU
Type	32 Bit User Save	Update Rate	4ms read
Display Format	Standard	Decimal Places	0
Coding	RW, VM		

See *AMC Cam Table In 0* (36.004).

Parameter	36.014 *AMC Cam Table Out 3*		
Short description	Defines the output entry to the cam table for segment 3		
Mode	RFC‑S		
Minimum	−VM_AMC_POSITION_CAM	Maximum	VM_AMC_POSITION_CAM
Default	0	Units	UU
Type	32 Bit User Save	Update Rate	4ms read
Display Format	Standard	Decimal Places	0
Coding	RW, VM		

See *AMC Cam Table In 0* (36.004).

Parameter	36.015 *AMC Cam Table Interpolation 3*		
Short description	Defines the interpolation entry to the cam table for segment 3		
Mode	RFC‑S		
Minimum	0	Maximum	2
Default	0	Units	
Type	8 Bit User Save	Update Rate	4ms read
Display Format	Standard	Decimal Places	0
Coding	RW, TE		

Value	Text
0	Cos1
1	Square
2	Cos2

See *AMC Cam Table In 0* (36.004).

Parameter	36.016 *AMC Cam Table In 4*		
Short description	Defines the input entry to the cam table for segment 4		
Mode	RFC‑S		
Minimum	0	Maximum	VM_AMC_POSITION_CAM_UNIPOLAR
Default	0	Units	UU
Type	32 Bit User Save	Update Rate	4ms read
Display Format	Standard	Decimal Places	0
Coding	RW, VM		

See *AMC Cam Table In 0* (36.004).

Parameter	36.017 *AMC Cam Table Out 4*		
Short description	Defines the output entry to the cam table for segment 4		
Mode	RFC‑S		
Minimum	−VM_AMC_POSITION_CAM	Maximum	VM_AMC_POSITION_CAM
Default	0	Units	UU
Type	32 Bit User Save	Update Rate	4ms read
Display Format	Standard	Decimal Places	0
Coding	RW, VM		

See *AMC Cam Table In 0* (36.004).

Parameter	36.018 *AMC Cam Table Interpolation 4*		
Short description	Defines the interpolation entry to the cam table for segment 4		
Mode	RFC‑S		
Minimum	0	Maximum	2
Default	0	Units	
Type	8 Bit User Save	Update Rate	4ms read
Display Format	Standard	Decimal Places	0
Coding	RW, TE		

Value	Text
0	Cos1
1	Square
2	Cos2

See *AMC Cam Table In 0* (36.004).

Parameter	36.019 *AMC Cam Table In 5*		
Short description	Defines the input entry to the cam table for segment 5		
Mode	RFC‑S		
Minimum	0	Maximum	VM_AMC_POSITION_CAM_UNIPOLAR
Default	0	Units	UU
Type	32 Bit User Save	Update Rate	4ms read
Display Format	Standard	Decimal Places	0
Coding	RW, VM		

See *AMC Cam Table In 0* (36.004).

Parameter	36.020 *AMC Cam Table Out 5*		
Short description	Defines the output entry to the cam table for segment 5		
Mode	RFC‑S		
Minimum	−VM_AMC_POSITION_CAM	Maximum	VM_AMC_POSITION_CAM
Default	0	Units	UU
Type	32 Bit User Save	Update Rate	4ms read
Display Format	Standard	Decimal Places	0
Coding	RW, VM		

See *AMC Cam Table In 0* (36.004).

Parameter	36.021 *AMC Cam Table Interpolation 5*		
Short description	Defines the interpolation entry to the cam table for segment 5		
Mode	RFC‑S		
Minimum	0	Maximum	2
Default	0	Units	
Type	8 Bit User Save	Update Rate	4ms read
Display Format	Standard	Decimal Places	0
Coding	RW, TE		

Value	*Text*
0	Cos1
1	Square
2	Cos2

See *AMC Cam Table In 0* (36.004).

Parameter	36.022 *AMC Cam Table In 6*		
Short description	Defines the input entry to the cam table for segment 6		
Mode	RFC‑S		
Minimum	0	Maximum	VM_AMC_POSITION_CAM_UNIPOLAR
Default	0	Units	UU
Type	32 Bit User Save	Update Rate	4ms read
Display Format	Standard	Decimal Places	0
Coding	RW, VM		

See *AMC Cam Table In 0* (36.004).

Parameter	36.023 *AMC Cam Table Out 6*		
Short description	Defines the output entry to the cam table for segment 6		
Mode	RFC‑S		
Minimum	−VM_AMC_POSITION_CAM	Maximum	VM_AMC_POSITION_CAM
Default	0	Units	UU
Type	32 Bit User Save	Update Rate	4ms read
Display Format	Standard	Decimal Places	0
Coding	RW, VM		

See *AMC Cam Table In 0* (36.004).

Parameter	36.024 *AMC Cam Table Interpolation 6*		
Short description	Defines the interpolation entry to the cam table for segment 6		
Mode	RFC‑S		
Minimum	0	Maximum	2
Default	0	Units	
Type	8 Bit User Save	Update Rate	4ms read
Display Format	Standard	Decimal Places	0
Coding	RW, TE		

Value	*Text*
0	Cos1
1	Square
2	Cos2

See *AMC Cam Table In 0* (36.004).

Parameter	36.025 *AMC Cam Table In 7*		
Short description	Defines the input entry to the cam table for segment 6		
Mode	RFC‑S		
Minimum	0	Maximum	VM_AMC_POSITION_CAM_UNIPOLAR
Default	0	Units	UU
Type	32 Bit User Save	Update Rate	4ms read
Display Format	Standard	Decimal Places	0
Coding	RW, VM		

See *AMC Cam Table In 0* (36.004).

Parameter	36.026 *AMC Cam Table Out 7*		
Short description	Defines the output entry to the cam table for segment 7		
Mode	RFC‑S		
Minimum	−VM_AMC_POSITION_CAM	Maximum	VM_AMC_POSITION_CAM
Default	0	Units	UU
Type	32 Bit User Save	Update Rate	4ms read
Display Format	Standard	Decimal Places	0
Coding	RW, VM		

See *AMC Cam Table In 0* (36.004).

Parameter	36.027 *AMC Cam Table Interpolation 7*		
Short description	Defines the interpolation entry to the cam table for segment 7		
Mode	RFC‑S		
Minimum	0	Maximum	2
Default	0	Units	
Type	8 Bit User Save	Update Rate	4ms read
Display Format	Standard	Decimal Places	0
Coding	RW, TE		

Value	Text
0	Cos1
1	Square
2	Cos2

See *AMC Cam Table In 0* (36.004).

Parameter	36.028 *AMC Cam Table In 8*		
Short description	Defines the input entry to the cam table for segment 8		
Mode	RFC‑S		
Minimum	0	Maximum	VM_AMC_POSITION_CAM_UNIPOLAR
Default	0	Units	UU
Type	32 Bit User Save	Update Rate	4ms read
Display Format	Standard	Decimal Places	0
Coding	RW, VM		

See *AMC Cam Table In 0* (36.004).

Parameter	36.029 *AMC Cam Table Out 8*		
Short description	Defines the output entry to the cam table for segment 8		
Mode	RFC‑S		
Minimum	−VM_AMC_POSITION_CAM	Maximum	VM_AMC_POSITION_CAM
Default	0	Units	UU
Type	32 Bit User Save	Update Rate	4ms read
Display Format	Standard	Decimal Places	0
Coding	RW, VM		

See *AMC Cam Table In 0* (36.004).

Parameter	36.030 *AMC Cam Table Interpolation 8*		
Short description	Defines the interpolation entry to the cam table for segment 8		
Mode	RFC‑S		
Minimum	0	Maximum	2
Default	0	Units	
Type	8 Bit User Save	Update Rate	4ms read
Display Format	Standard	Decimal Places	0
Coding	RW, TE		

Value	Text
0	Cos1
1	Square
2	Cos2

See *AMC Cam Table In 0* (36.004).

Parameter	36.031 *AMC Cam Table In 9*		
Short description	Defines the input entry to the cam table for segment 9		
Mode	RFC‑S		
Minimum	0	Maximum	VM_AMC_POSITION_CAM_UNIPOLAR
Default	0	Units	UU
Type	32 Bit User Save	Update Rate	4ms read
Display Format	Standard	Decimal Places	0
Coding	RW, VM		

See *AMC Cam Table In 0* (36.004).

Parameter	36.032 *AMC Cam Table Out 9*		
Short description	Defines the output entry to the cam table for segment 9		
Mode	RFC‑S		
Minimum	−VM_AMC_POSITION_CAM	Maximum	VM_AMC_POSITION_CAM
Default	0	Units	UU
Type	32 Bit User Save	Update Rate	4ms read
Display Format	Standard	Decimal Places	0
Coding	RW, VM		

See *AMC Cam Table In 0* (36.004).

Parameter	36.033 *AMC Cam Table Interpolation 9*		
Short description	Defines the interpolation entry to the cam table for segment 9		
Mode	RFC‑S		
Minimum	0	Maximum	2
Default	0	Units	
Type	8 Bit User Save	Update Rate	4ms read
Display Format	Standard	Decimal Places	0
Coding	RW, TE		

Value	Text
0	Cos1
1	Square
2	Cos2

See *AMC Cam Table In 0* (36.004).

Parameter	36.034 *AMC Cam Table In 10*		
Short description	Defines the input entry to the cam table for segment 10		
Mode	RFC‑S		
Minimum	0	Maximum	VM_AMC_POSITION_CAM_UNIPOLAR
Default	0	Units	UU
Type	32 Bit User Save	Update Rate	4ms read
Display Format	Standard	Decimal Places	0
Coding	RW, VM		

See *AMC Cam Table In 0* (36.004).

Parameter	36.035 *AMC Cam Table Out 10*		
Short description	Defines the output entry to the cam table for segment 10		
Mode	RFC‑S		
Minimum	−VM_AMC_POSITION_CAM	Maximum	VM_AMC_POSITION_CAM
Default	0	Units	UU
Type	32 Bit User Save	Update Rate	4ms read
Display Format	Standard	Decimal Places	0
Coding	RW, VM		

See *AMC Cam Table In 0* (36.004).

Parameter	36.036 *AMC Cam Table Interpolation 10*		
Short description	Defines the interpolation entry to the cam table for segment 10		
Mode	RFC‑S		
Minimum	0	Maximum	2
Default	0	Units	
Type	8 Bit User Save	Update Rate	4ms read
Display Format	Standard	Decimal Places	0
Coding	RW, TE		

Value	Text
0	Cos1
1	Square
2	Cos2

See *AMC Cam Table In 0* (36.004).

Parameter	36.037 *AMC Cam Table In 11*		
Short description	Defines the input entry to the cam table for segment 11		
Mode	RFC‑S		
Minimum	0	Maximum	VM_AMC_POSITION_CAM_UNIPOLAR
Default	0	Units	UU
Type	32 Bit User Save	Update Rate	4ms read
Display Format	Standard	Decimal Places	0
Coding	RW, VM		

See *AMC Cam Table In 0* (36.004).

Parameter	36.038 *AMC Cam Table Out 11*		
Short description	Defines the output entry to the cam table for segment 11		
Mode	RFC‑S		
Minimum	−VM_AMC_POSITION_CAM	Maximum	VM_AMC_POSITION_CAM
Default	0	Units	UU
Type	32 Bit User Save	Update Rate	4ms read
Display Format	Standard	Decimal Places	0
Coding	RW, VM		

See *AMC Cam Table In 0* (36.004).

Parameter	36.039 *AMC Cam Table Interpolation 11*		
Short description	Defines the interpolation entry to the cam table for segment 11		
Mode	RFC‑S		
Minimum	0	Maximum	2
Default	0	Units	
Type	8 Bit User Save	Update Rate	4ms read
Display Format	Standard	Decimal Places	0
Coding	RW, TE		

Value	Text
0	Cos1
1	Square
2	Cos2

See *AMC Cam Table In 0* (36.004).

Parameter	36.040 *AMC Cam Table In 12*		
Short description	Defines the input entry to the cam table for segment 12		
Mode	RFC‑S		
Minimum	0	Maximum	VM_AMC_POSITION_CAM_UNIPOLAR
Default	0	Units	UU
Type	32 Bit User Save	Update Rate	4ms read
Display Format	Standard	Decimal Places	0
Coding	RW, VM		

See *AMC Cam Table In 0* (36.004).

Parameter	36.041 *AMC Cam Table Out 12*		
Short description	Defines the output entry to the cam table for segment 12		
Mode	RFC‑S		
Minimum	−VM_AMC_POSITION_CAM	Maximum	VM_AMC_POSITION_CAM
Default	0	Units	UU
Type	32 Bit User Save	Update Rate	4ms read
Display Format	Standard	Decimal Places	0
Coding	RW, VM		

See *AMC Cam Table In 0* (36.004).

Parameter	36.042 *AMC Cam Table Interpolation 12*		
Short description	Defines the interpolation entry to the cam table for segment 12		
Mode	RFC‑S		
Minimum	0	Maximum	2
Default	0	Units	
Type	8 Bit User Save	Update Rate	4ms read
Display Format	Standard	Decimal Places	0
Coding	RW, TE		

Value	*Text*
0	Cos1
1	Square
2	Cos2

See *AMC Cam Table In 0* (36.004).

Parameter	36.043 *AMC Cam Table In 13*		
Short description	Defines the input entry to the cam table for segment 13		
Mode	RFC‑S		
Minimum	0	Maximum	VM_AMC_POSITION_CAM_UNIPOLAR
Default	0	Units	UU
Type	32 Bit User Save	Update Rate	4ms read
Display Format	Standard	Decimal Places	0
Coding	RW, VM		

See *AMC Cam Table In 0* (36.004).

Parameter	36.044 *AMC Cam Table Out 13*		
Short description	Defines the output entry to the cam table for segment 13		
Mode	RFC‑S		
Minimum	−VM_AMC_POSITION_CAM	Maximum	VM_AMC_POSITION_CAM
Default	0	Units	UU
Type	32 Bit User Save	Update Rate	4ms read
Display Format	Standard	Decimal Places	0
Coding	RW, VM		

See *AMC Cam Table In 0* (36.004).

Parameter	36.045 *AMC Cam Table Interpolation 13*		
Short description	Defines the interpolation entry to the cam table for segment 13		
Mode	RFC‑S		
Minimum	0	Maximum	2
Default	0	Units	
Type	8 Bit User Save	Update Rate	4ms read
Display Format	Standard	Decimal Places	0
Coding	RW, TE		

Value	*Text*
0	Cos1
1	Square
2	Cos2

See *AMC Cam Table In 0* (36.004).

Parameter	36.046 *AMC Cam Table In 14*		
Short description	Defines the input entry to the cam table for segment 14		
Mode	RFC‑S		
Minimum	0	Maximum	VM_AMC_POSITION_CAM_UNIPOLAR
Default	0	Units	UU
Type	32 Bit User Save	Update Rate	4ms read
Display Format	Standard	Decimal Places	0
Coding	RW, VM		

See *AMC Cam Table In 0* (36.004).

Parameter	36.047 *AMC Cam Table Out 14*		
Short description	Defines the output entry to the cam table for segment 14		
Mode	RFC‑S		
Minimum	−VM_AMC_POSITION_CAM	Maximum	VM_AMC_POSITION_CAM
Default	0	Units	UU
Type	32 Bit User Save	Update Rate	4ms read
Display Format	Standard	Decimal Places	0
Coding	RW, VM		

See *AMC Cam Table In 0* (36.004).

Parameter	36.048 *AMC Cam Table Interpolation 14*		
Short description	Defines the interpolation entry to the cam table for segment 14		
Mode	RFC‑S		
Minimum	0	Maximum	2
Default	0	Units	
Type	8 Bit User Save	Update Rate	4ms read
Display Format	Standard	Decimal Places	0
Coding	RW, TE		

Value	Text
0	Cos1
1	Square
2	Cos2

See *AMC Cam Table In 0* (36.004).

Parameter	36.049 *AMC Cam Table In 15*		
Short description	Defines the input entry to the cam table for segment 15		
Mode	RFC‑S		
Minimum	0	Maximum	VM_AMC_POSITION_CAM_UNIPOLAR
Default	0	Units	UU
Type	32 Bit User Save	Update Rate	4ms read
Display Format	Standard	Decimal Places	0
Coding	RW, VM		

See *AMC Cam Table In 0* (36.004).

Parameter	36.050 *AMC Cam Table Out 15*		
Short description	Defines the output entry to the cam table for segment 15		
Mode	RFC‑S		
Minimum	−VM_AMC_POSITION_CAM	Maximum	VM_AMC_POSITION_CAM
Default	0	Units	UU
Type	32 Bit User Save	Update Rate	4ms read
Display Format	Standard	Decimal Places	0
Coding	RW, VM		

See *AMC Cam Table In 0* (36.004).

Parameter	36.051 *AMC Cam Table Interpolation 15*		
Short description	Defines the interpolation entry to the cam table for segment 15		
Mode	RFC‑S		
Minimum	0	Maximum	2
Default	0	Units	
Type	8 Bit User Save	Update Rate	4ms read
Display Format	Standard	Decimal Places	0
Coding	RW, TE		

Value	Text
0	Cos1
1	Square
2	Cos2

See *AMC Cam Table In 0* (36.004).

Parameter	36.052 *AMC Cam Table In 16*		
Short description	Defines the input entry to the cam table for segment 16		
Mode	RFC‑S		
Minimum	0	Maximum	VM_AMC_POSITION_CAM_UNIPOLAR
Default	0	Units	UU
Type	32 Bit User Save	Update Rate	4ms read
Display Format	Standard	Decimal Places	0
Coding	RW, VM		

See *AMC Cam Table In 0* (36.004).

Parameter	36.053 *AMC Cam Table Out 16*		
Short description	Defines the output entry to the cam table for segment 16		
Mode	RFC‑S		
Minimum	−VM_AMC_POSITION_CAM	Maximum	VM_AMC_POSITION_CAM
Default	0	Units	UU
Type	32 Bit User Save	Update Rate	4ms read
Display Format	Standard	Decimal Places	0
Coding	RW, VM		

See *AMC Cam Table In 0* (36.004).

Parameter	36.054 *AMC Cam Table Interpolation 16*		
Short description	Defines the interpolation entry to the cam table for segment 16		
Mode	RFC‑S		
Minimum	0	Maximum	2
Default	0	Units	
Type	8 Bit User Save	Update Rate	4ms read
Display Format	Standard	Decimal Places	0
Coding	RW, TE		

Value	Text
0	Cos1
1	Square
2	Cos2

See *AMC Cam Table In 0* (36.004).

Parameter	36.055 *AMC Cam Table In 17*		
Short description	Defines the input entry to the cam table for segment 17		
Mode	RFC‑S		
Minimum	0	Maximum	VM_AMC_POSITION_CAM_UNIPOLAR
Default	0	Units	UU
Type	32 Bit User Save	Update Rate	4ms read
Display Format	Standard	Decimal Places	0
Coding	RW, VM		

See *AMC Cam Table In 0* (36.004).

Parameter	36.056 *AMC Cam Table Out 17*		
Short description	Defines the output entry to the cam table for segment 17		
Mode	RFC‑S		
Minimum	−VM_AMC_POSITION_CAM	Maximum	VM_AMC_POSITION_CAM
Default	0	Units	UU
Type	32 Bit User Save	Update Rate	4ms read
Display Format	Standard	Decimal Places	0
Coding	RW, VM		

See *AMC Cam Table In 0* (36.004).

Parameter	36.057 *AMC Cam Table Interpolation 17*		
Short description	Defines the interpolation entry to the cam table for segment 17		
Mode	RFC‑S		
Minimum	0	Maximum	2
Default	0	Units	
Type	8 Bit User Save	Update Rate	4ms read
Display Format	Standard	Decimal Places	0
Coding	RW, TE		

Value	Text
0	Cos1
1	Square
2	Cos2

See *AMC Cam Table In 0* (36.004).

Parameter	36.058 *AMC Cam Table In 18*		
Short description	Defines the input entry to the cam table for segment 18		
Mode	RFC‑S		
Minimum	0	Maximum	VM_AMC_POSITION_CAM_UNIPOLAR
Default	0	Units	UU
Type	32 Bit User Save	Update Rate	4ms read
Display Format	Standard	Decimal Places	0
Coding	RW, VM		

See *AMC Cam Table In 0* (36.004).

Parameter	36.059 *AMC Cam Table Out 18*		
Short description	Defines the output entry to the cam table for segment 18		
Mode	RFC‑S		
Minimum	−VM_AMC_POSITION_CAM	Maximum	VM_AMC_POSITION_CAM
Default	0	Units	UU
Type	32 Bit User Save	Update Rate	4ms read
Display Format	Standard	Decimal Places	0
Coding	RW, VM		

See *AMC Cam Table In 0* (36.004).

Parameter	36.060 *AMC Cam Table Interpolation 18*		
Short description	Defines the interpolation entry to the cam table for segment 18		
Mode	RFC‑S		
Minimum	0	Maximum	2
Default	0	Units	
Type	8 Bit User Save	Update Rate	4ms read
Display Format	Standard	Decimal Places	0
Coding	RW, TE		

Value	Text
0	Cos1
1	Square
2	Cos2

See *AMC Cam Table In 0* (36.004).

Parameter	36.061 *AMC Cam Table In 19*		
Short description	Defines the input entry to the cam table for segment 19		
Mode	RFC‑S		
Minimum	0	Maximum	VM_AMC_POSITION_CAM_UNIPOLAR
Default	0	Units	UU
Type	32 Bit User Save	Update Rate	4ms read
Display Format	Standard	Decimal Places	0
Coding	RW, VM		

See *AMC Cam Table In 0* (36.004).

Parameter	36.062 *AMC Cam Table Out 19*		
Short description	Defines the output entry to the cam table for segment 19		
Mode	RFC‑S		
Minimum	−VM_AMC_POSITION_CAM	Maximum	VM_AMC_POSITION_CAM
Default	0	Units	UU
Type	32 Bit User Save	Update Rate	4ms read
Display Format	Standard	Decimal Places	0
Coding	RW, VM		

See *AMC Cam Table In 0* (36.004).

Parameter	36.063 *AMC Cam Table Interpolation 19*		
Short description	Defines the interpolation entry to the cam table for segment 19		
Mode	RFC-S		
Minimum	0	Maximum	2
Default	0	Units	
Type	8 Bit User Save	Update Rate	4ms read
Display Format	Standard	Decimal Places	0
Coding	RW, TE		

Value	*Text*
0	Cos1
1	Square
2	Cos2

See *AMC Cam Table In 0* (36.004).

Menu 37 Single Line Descriptions − *AMC Electronic Gear Box*

Mode: RFC‑S

Parameter	Range	Default	Type				
37.001 AMC EGB Enable Rigid Lock	Off (0) or On (1)	Off (0)	RW	Bit			US
37.002 AMC EGB Ratio Numerator	1 to 2147483647	1000	RW	Num			US
37.003 AMC EGB Ratio Denominator	1 to 2147483647	1000	RW	Num			US
37.004 AMC EGB Locking Speed Band	±VM_AMC_SPEED_UNIPOLAR UU/ms	10.92 UU/ms	RW	Num			US
37.005 AMC EGB Locking Position Band	0 to VM_AMC_POSITION_UNIPOLAR UU	256 UU	RW	Num			US
37.006 AMC EGB Locked	Off (0) or On (1)		RO	Bit	ND	NC	PT

RW	Read / Write	RO	Read-only	Bit	Bit parameter	Txt	Text string	Date	Date parameter	Time	Time parameter
Chr	Character parameter	Bin	Binary parameter	IP	IP address	Mac	MAC address	Ver	Version number	SMP	Slot, menu, parameter
Num	Number parameter	DE	Destination	ND	No default value	RA	Rating dependent	NC	Non-copyable	PT	Protected
FI	Filtered	US	User save	PS	Power-down save						

Menu 37 − *AMC Electronic Gear Box*

Mode: RFC‑S

Electronic gearbox

Electronic Gearbox
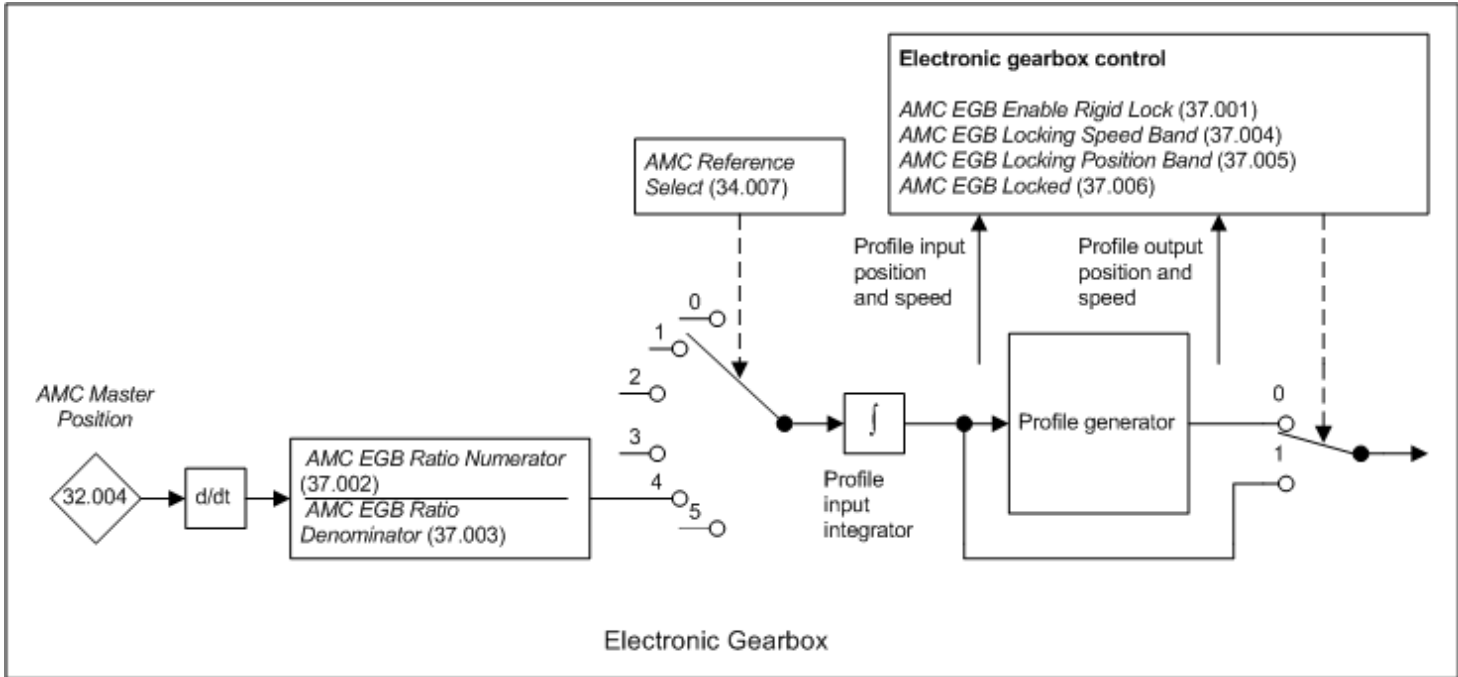
Parameter	37.001 *AMC EGB Enable Rigid Lock*		
Short description	Set to 1 to enable rigid locking of the electronic gearbox		
Mode	RFC‑S		
Minimum	0	Maximum	1
Default	0	Units	
Type	1 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW		

When the electronic gearbox is not selected or the Advanced Motion Controller is disabled *AMC EGB Locked* (37.006) = 0 and the electronic gearbox control is in the inactive state. The electronic gearbox is enabled when the motion controller is enabled and *AMC Reference Select* (34.007) is changed to a value of 4 (electronic gear box).

If *AMC EGB Enable Rigid Lock* (37.001) = 0 the system attempts to match the speed of the slave with the speed of the master. The speed at the output of the profile generator can only change within the acceleration/deceleration constraints set up for the profile generator (i.e. *AMC Profile Acceleration* (38.001), *AMC Profile Deceleration* (38.002) and *AMC Profile Maximum Speed* (38.003)). Once the modulus of the difference between the speed at the input and output of the profile generator is less than or equal to *AMC EGB Locking Speed Band* (37.004) the profile generator is disabled so that the output of the profile generator follows the input with no delay and *AMC EGB Locked* (37.006) is set to 1. *AMC EGB Locked* (37.006) can be reset and the profile generator re-enabled by selecting another reference with *AMC Reference Select* (34.007)) or by disabling the motion controller. The diagram below shows the speed of the master and slave systems with *AMC EGB Enable Rigid Lock* (37.001) = 0.

Non-rigid and rigid locking
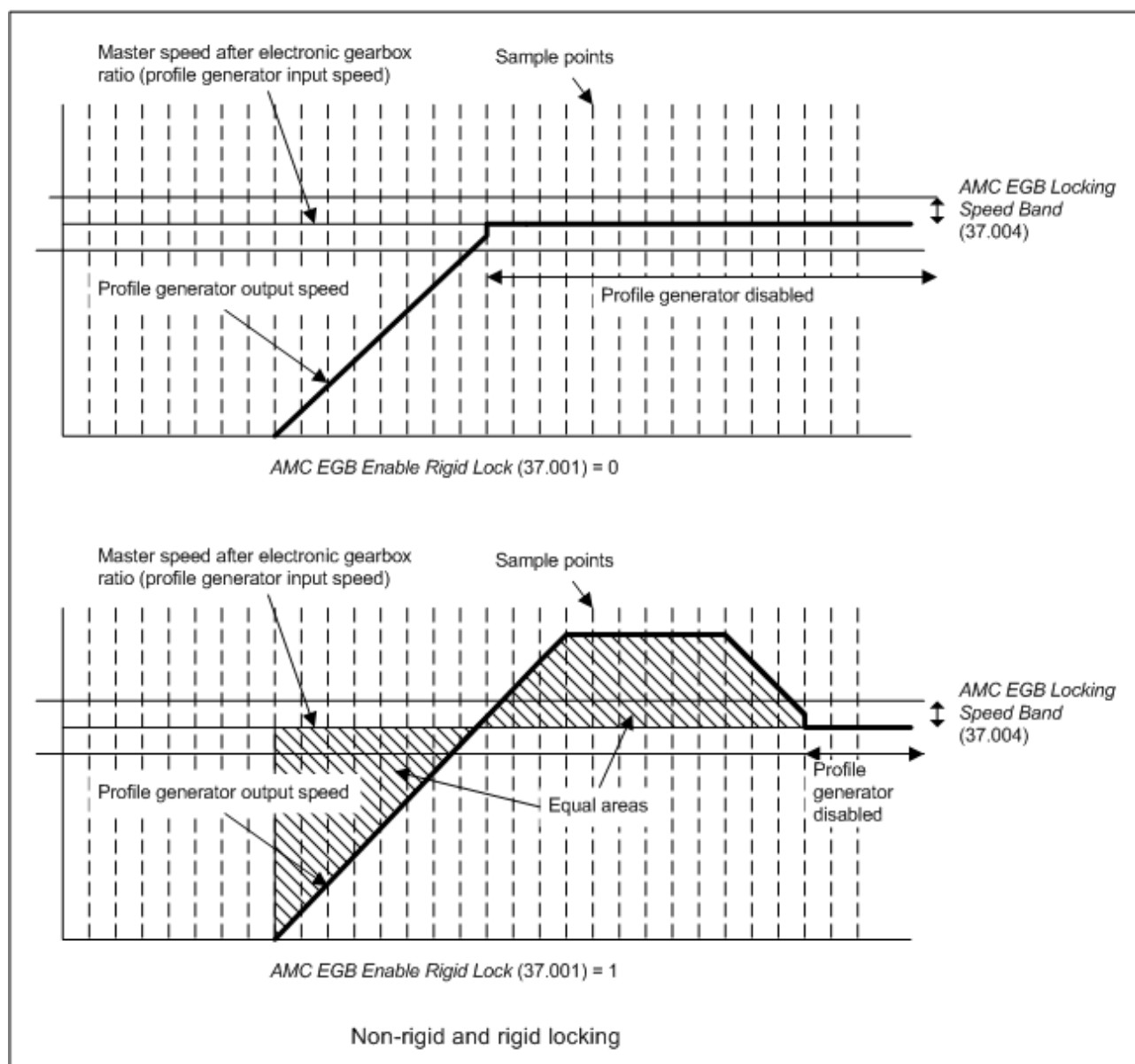
If *AMC EGB Enable Rigid Lock* (37.001) = 1 the system attempts to match the speed and position of the slave before changing to the locked state as shown above. The profile generator output will exceed the profile generator input speed to make up the position lost during acceleration. The system only changes to the locked state when the modulus of the speed difference between the input and output of the profile generator is within *AMC EGB Locking Speed Band* (37.004) and the modulus of the difference between the input and output position is within *AMC EGB Locking Position Band* (37.005).

Note that rigid lock will not be enabled when the output of the profile generator is jerk limited, i.e. *AMC Profile Jerk 1* (38.011) > 0.

Parameter	37.002 *AMC EGB Ratio Numerator*		
Short description	Defines the numerator of the ratio used at the input to the electronic gearbox		
Mode	RFC‑S		
Minimum	1	Maximum	2147483647
Default	1000	Units	
Type	32 Bit User Save	Update Rate	4ms read
Display Format	Standard	Decimal Places	0
Coding	RW		

The electronic gear box ratio (*AMC EGB Ratio Numerator* (37.002) / *AMC EGB Ratio Denominator* (37.003)) is applied to changes in the *AMC Master Position* (32.004) at the input to the electronic gearbox.

Parameter	37.003 *AMC EGB Ratio Denominator*		
Short description	Defines the denominator of the ratio used at the input to the electronic gearbox		
Mode	RFC‑S		
Minimum	1	Maximum	2147483647
Default	1000	Units	
Type	32 Bit User Save	Update Rate	4ms read
Display Format	Standard	Decimal Places	0
Coding	RW		

See *AMC EGB Ratio Numerator* (37.002).

Parameter	37.004 *AMC EGB Locking Speed Band*		
Short description	Defines the speed band used to lock the electronic gearbox		
Mode	RFC‑S		
Minimum	0.00	Maximum	VM_AMC_SPEED_UNIPOLAR
Default	10.92	Units	UU/ms
Type	32 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	2
Coding	RW, VM		

The default value of 10.92 UU/ms is the equivalent of 10rpm for a feedback device with 16 normalised position bits per revolution and a user unit ratio of unity.

See *AMC EGB Enable Rigid Lock* (37.001).

Parameter	37.005 *AMC EGB Locking Position Band*		
Short description	Defines the position band used to lock the electronic gearbox		
Mode	RFC‑S		
Minimum	0	Maximum	VM_AMC_POSITION_UNIPOLAR
Default	256	Units	UU
Type	32 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW, VM		

See *AMC EGB Enable Rigid Lock* (37.001).

Parameter	37.006 *AMC EGB Locked*		
Short description	Displays when the electronic gearbox is locked		
Mode	RFC‑S		
Minimum	0	Maximum	1
Default		Units	
Type	1 Bit Volatile	Update Rate	4ms write
Display Format	Standard	Decimal Places	0
Coding	RO, ND, NC, PT		

See *AMC EGB Enable Rigid Lock* (37.001).

Menu 38 Single Line Descriptions − *AMC Profile Generator*

Mode: RFC‑S

Parameter	Range	Default	Type					
38.001 AMC Profile Acceleration	±VM_AMC_RATE_UNIPOLAR UU/ms²	1.092 UU/ms²	RW	Num				US
38.002 AMC Profile Deceleration	±VM_AMC_RATE_UNIPOLAR UU/ms²	1.092 UU/ms²	RW	Num				US
38.003 AMC Profile Maximum Speed	±VM_AMC_SPEED_UNIPOLAR UU/ms	1092.00 UU/ms	RW	Num				US
38.005 AMC Profile Disable	Off (0) or On (1)	Off (0)	RW	Bit				
38.006 AMC Profile Input Position	±VM_AMC_POSITION UU		RO	Num	ND	NC	PT	
38.007 AMC Profile Input Speed	±VM_AMC_SPEED UU/ms		RO	Num	ND	NC	PT	FI
38.008 AMC Profile Output Position	±VM_AMC_POSITION UU		RO	Num	ND	NC	PT	
38.009 AMC Profile Output Speed	±VM_AMC_SPEED UU/ms		RO	Num	ND	NC	PT	FI
38.010 AMC Profile Output Acceleration	±VM_AMC_RATE UU/ms²		RO	Num	ND	NC	PT	
38.011 AMC Profile Jerk 1	±VM_AMC_JERK_UNIPOLAR UU/ms³	0.0000 UU/ms³	RW	Num				US
38.012 AMC Profile Jerk 2	±VM_AMC_JERK_UNIPOLAR UU/ms³	0.0000 UU/ms³	RW	Num				US
38.013 AMC Profile Jerk 3	±VM_AMC_JERK_UNIPOLAR UU/ms³	0.0000 UU/ms³	RW	Num				US
38.014 AMC Profile Jerk 4	±VM_AMC_JERK_UNIPOLAR UU/ms³	0.0000 UU/ms³	RW	Num				US
38.015 AMC Profile Update Mode	0 to 1	1	RW	Num				US

RW	Read / Write	RO	Read-only	Bit	Bit parameter	Txt	Text string	Date	Date parameter	Time	Time parameter
Chr	Character parameter	Bin	Binary parameter	IP	IP address	Mac	MAC address	Ver	Version number	SMP	Slot, menu, parameter
Num	Number parameter	DE	Destination	ND	No default value	RA	Rating dependent	NC	Non-copyable	PT	Protected
FI	Filtered	US	User save	PS	Power-down save						

Menu 38 − *AMC Profile Generator*

Mode: RFC‑S

Profile generator
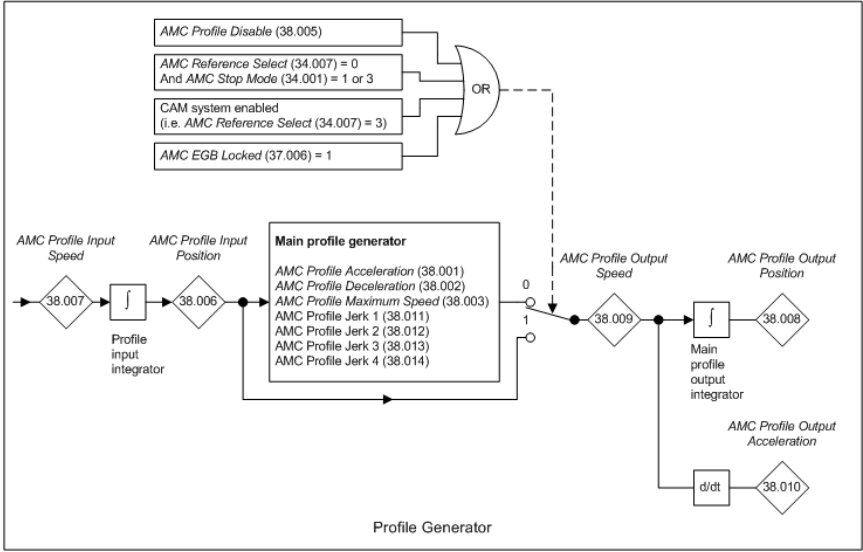
Profile Generator

Main profile

AMC Profile Input Speed (38.007) is the rate of change of position over each sample from any of the references. This provides the speed target for the profile generator and this is integrated to give *AMC Profile Input Position* (38.006) which is the position target. When the profile generator is enabled it produces *AMC Profile Output Speed* (38.009) which is the rate of change of output position and this is integrated to give *AMC Profile Output Position* (38.008). Depending on the profile mode the profile generator aims to make either the *AMC Profile Output Speed* (38.009) equal to the *AMC Profile Input Speed* (38.007), the *AMC Profile Output Position* (38.008) equal to the *AMC Profile Input Position* (38.006) at zero speed, or both. The profile target mode depends on the input to the profile generator as follows.

Input	Target
AMC Stop Reference (34.002)	Stop reference at zero speed
AMC Position Reference (34.003) (*AMC Reference Select* (34.007) = 1 or 6)	Position reference at zero speed
AMC Speed Reference (34.006)	Speed reference
Cam	Profile disabled
Electronic gearbox with non-rigid lock	Input speed when not locked Profile disabled when locked
Electronic gearbox with rigid lock	Input speed and position when not locked Profile disabled when locked
Homing system	Input speed while finding home position Input position at zero speed when moving to home reset position
Profile input position (*AMC Reference Select* (34.007) = 7)	Constant target position at zero speed

The profile generator can operate with a linear ramp (*AMC Profile Jerk 1* (38.011) = 0) or an s-ramp profile (*AMC Profile Jerk 1* (38.011) > 0). When the profile is operating in linear mode the rate of change of *AMC Profile Output Speed* (38.009) is constrained by the profile generator. If an s-ramp profile is enabled the rate of change of acceleration is also constrained and up to four unique jerk values can be defined, see *AMC Profile Jerk 1* (38.011).

If the profile generator is disabled *AMC Profile Output Speed* (38.009) = *AMC Profile Input Speed* (38.007) and *AMC Profile Output Position* (38.008) = *AMC Profile Input Position* (38.006). The profile generator can be disabled under any of the following conditions.

Conditions for profile generator disable	Comments
AMC Profile Disable (38.005) = 1	Profile disabled by the user
AMC Reference Select (34.007) = 0 and *AMC Stop Mode* (34.001) = 1 or 3	Stop reference selected and no profile stop required
Cam system enabled (i.e. *AMC Reference Select* (34.007) = 3)	The Cam system provides its own profile, and so the profile generator is not required
AMC EGB Locked (37.006) = 1	Electronic gearbox output is locked and should follow the master position without any delay

Parameter	38.001 *AMC Profile Acceleration*		
Short description			
Mode	RFC-S		
Minimum	−VM_AMC_RATE_UNIPOLAR	Maximum	VM_AMC_RATE_UNIPOLAR
Default	1.092	Units	UU/ms²
Type	32 Bit User Save	Update Rate	4ms read
Display Format	Standard	Decimal Places	3
Coding	RW, VM		

The default value of 1.092 UU/ms^2 is the equivalent of an acceleration of 1000rpm/s for a feedback device with 16 normalised position bits per revolution and a user unit ratio of unity.

The profile generator applies the constraints to the output speed defined by *AMC Profile Acceleration* (38.001) when the speed is moving away from 0, *AMC Profile Deceleration* (38.002) when the speed is moving towards 0, and *AMC Profile Maximum Speed* (38.003) in either direction.

Parameter	38.002 *AMC Profile Deceleration*		
Short description			
Mode	RFC-S		
Minimum	−VM_AMC_RATE_UNIPOLAR	Maximum	VM_AMC_RATE_UNIPOLAR
Default	1.092	Units	UU/ms²
Type	32 Bit User Save	Update Rate	4ms read
Display Format	Standard	Decimal Places	3
Coding	RW, VM		

The default value of 1.092 UU/ms^2 is the equivalent of a deceleration of 1000rpm/s for a feedback device with 16 normalised position bits per revolution and a user unit ratio of unity.

See *AMC Profile Acceleration* (38.001).

Parameter	38.003 *AMC Profile Maximum Speed*		
Short description			
Mode	RFC-S		
Minimum	0.00	Maximum	VM_AMC_SPEED_UNIPOLAR
Default	1092.00	Units	UU/ms
Type	32 Bit User Save	Update Rate	4ms read
Display Format	Standard	Decimal Places	2
Coding	RW, VM		

The default value of 1092 UU/ms is the equivalent of 1000rpm for a feedback device with 16 normalised position bits per revolution and a user unit ratio of unity.

See *AMC Profile Acceleration* (38.001).

Parameter	38.005 *AMC Profile Disable*		
Short description			
Mode	RFC-S		
Minimum	0	Maximum	1
Default	0	Units	
Type	1 Bit Volatile	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW		

See the introduction to menu 38.

Parameter	38.006 *AMC Profile Input Position*		
Short description			
Mode	RFC-S		
Minimum	−VM_AMC_POSITION	Maximum	VM_AMC_POSITION
Default		Units	UU
Type	32 Bit Volatile	Update Rate	4ms write
Display Format	Standard	Decimal Places	0
Coding	RO, VM, ND, NC, PT		

See the introduction to menu 38.

Parameter	38.007 *AMC Profile Input Speed*		
Short description			
Mode	RFC-S		
Minimum	−VM_AMC_SPEED	Maximum	VM_AMC_SPEED
Default		Units	UU/ms
Type	32 Bit Volatile	Update Rate	4ms write
Display Format	Standard	Decimal Places	2
Coding	RO, FI, VM, ND, NC, PT		

See the introduction to menu 38.

Parameter	38.008 *AMC Profile Output Position*		
Short description			
Mode	RFC-S		
Minimum	−VM_AMC_POSITION	Maximum	VM_AMC_POSITION
Default		Units	UU
Type	32 Bit Volatile	Update Rate	4ms write
Display Format	Standard	Decimal Places	0
Coding	RO, VM, ND, NC, PT		

See the introduction to menu 38.

Parameter	38.009 *AMC Profile Output Speed*		
Short description			
Mode	RFC-S		
Minimum	−VM_AMC_SPEED	Maximum	VM_AMC_SPEED
Default		Units	UU/ms
Type	32 Bit Volatile	Update Rate	4ms write
Display Format	Standard	Decimal Places	2
Coding	RO, FI, VM, ND, NC, PT		

See the introduction to menu 38.

Parameter	38.010 *AMC Profile Output Acceleration*		
Short description			
Mode	RFC-S		
Minimum	−VM_AMC_RATE	Maximum	VM_AMC_RATE
Default		Units	UU/ms²
Type	32 Bit Volatile	Update Rate	4ms write
Display Format	Standard	Decimal Places	3
Coding	RO, VM, ND, NC, PT		

See the introduction to menu 38.

Parameter	38.011 *AMC Profile Jerk 1*		
Short description			
Mode	RFC-S		
Minimum	−VM_AMC_JERK_UNIPOLAR	Maximum	VM_AMC_JERK_UNIPOLAR
Default	0.0000	Units	UU/ms³
Type	32 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	4
Coding	RW, VM		

If *AMC Profile Jerk 1* (38.011) > 0 and *AMC Rate Selected* (31.013) >= 1ms the maximum rate of change of *AMC Profile Output Acceleration* (38.010) is constrained by the jerk parameters in *AMC Profile Generator* (38). Note that it is only possible to change between the s-ramp profile and the linear profile when the drive or motion controller is disabled.

Jerk configuration

It is possible to configure up to four independent jerk values as shown in the diagram below.

S-Ramp profile set-up with four Jerk values
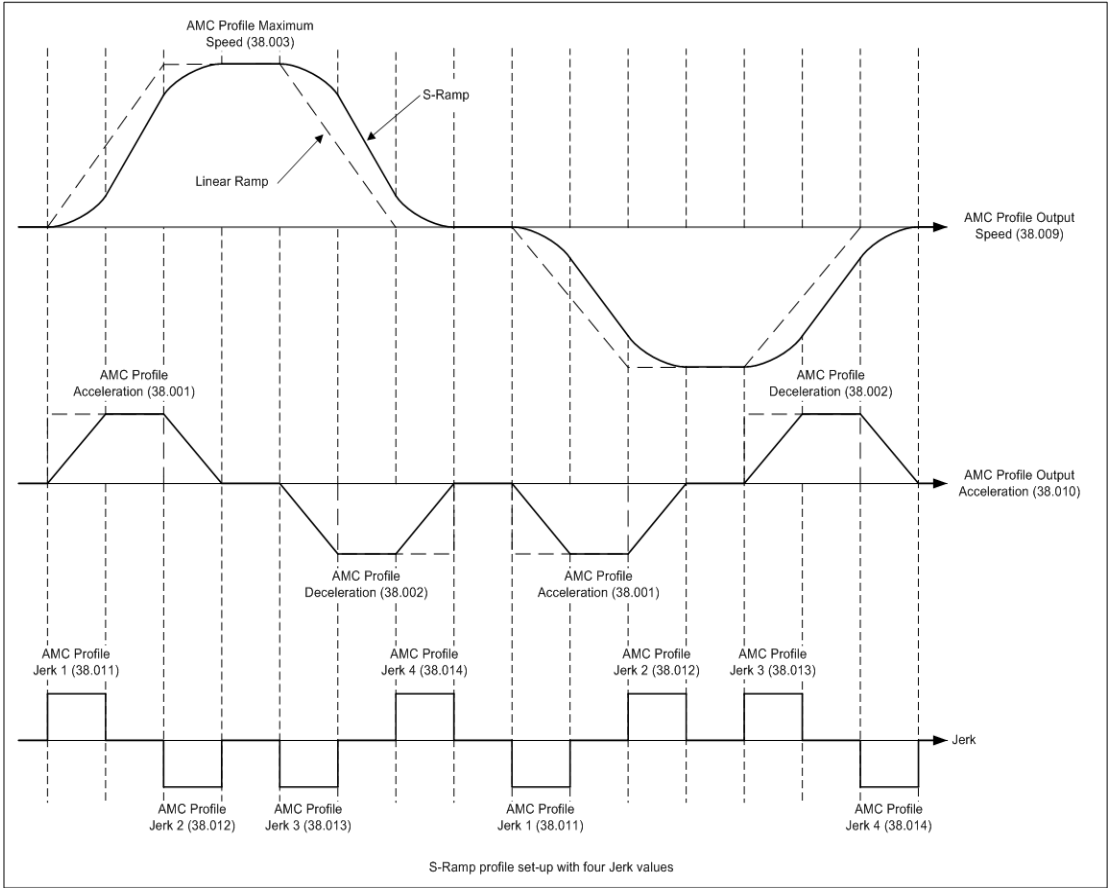
To minimise the error between *AMC Profile Input Position* (38.006) and *AMC Profile Output Position* (38.008) after the initial profile has been completed the maximum values of *AMC Profile Jerk 3* (38.013) and *AMC Profile Jerk 4* (38.014) which are used during the profile are limited to the following ratios.

AMC Profile Jerk 3 (38.013) ≤ 100 × *AMC Profile Jerk 4* (38.014)

AMC Profile Jerk 4 (38.014) ≤ 100 × *AMC Profile Jerk 3* (38.013)

If any of the jerk parameters are set to zero the jerk used in that section is inherited from the previous section. This allows the s-ramp to be setup in one of the following configurations without changing all of the jerk parameters individually. If a linear change of speed is required in a section of the s-ramp the corresponding jerk parameter must be set to a value that ensures that the maximum rate (*AMC Profile Acceleration* (38.001) or *AMC Profile Deceleration* (38.002)) is achieved in a single sample.

Note that if *AMC Profile Update Mode* (38.015) is configured to allow a change of jerk during a profile and *AMC Profile Jerk 1* (38.011) is set to zero before the profile has been completed the minimum jerk (0.0001 uu/ms^3) will be used until *AMC Profile Output Speed* (38.009) reaches standstill.

Profile 1 - Single jerk
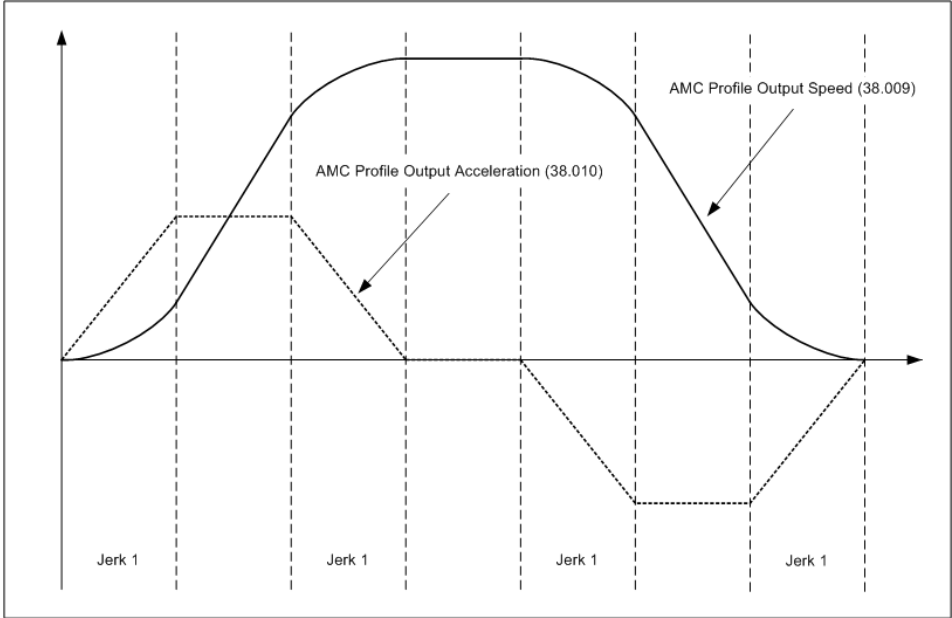
AMC Profile Jerk 1 (38.011) > 0

AMC Profile Jerk 2 (38.012) = 0

AMC Profile Jerk 3 (38.013) = 0

AMC Profile Jerk 4 (38.014) = 0

Profile 2 - Acceleration and deceleration jerk
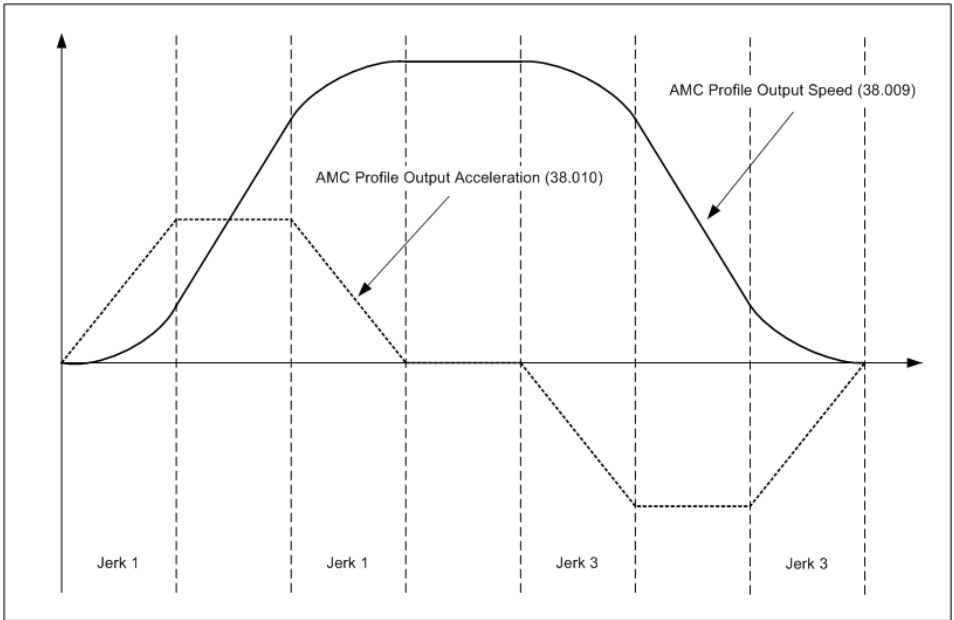
AMC Profile Jerk 1 (38.011) > 0

AMC Profile Jerk 2 (38.012) = 0

AMC Profile Jerk 3 (38.013) > 0

AMC Profile Jerk 4 (38.014) = 0

Profile operation

If *AMC Profile Output Speed* (38.009) crosses the zero boundary without stopping (i.e. *AMC Speed Reference* (34.006) is changed from a positive to negative value) *AMC Profile Output Acceleration* (38.010) is limited by the deceleration parameters (*AMC Profile Deceleration* (38.002), *AMC Profile Jerk 3* (38.013) and *AMC Profile Jerk 4* (38.014)) until the acceleration is reduced to zero (constant speed) as shown in the diagram below.

S-Ramp profile crossing zero speed
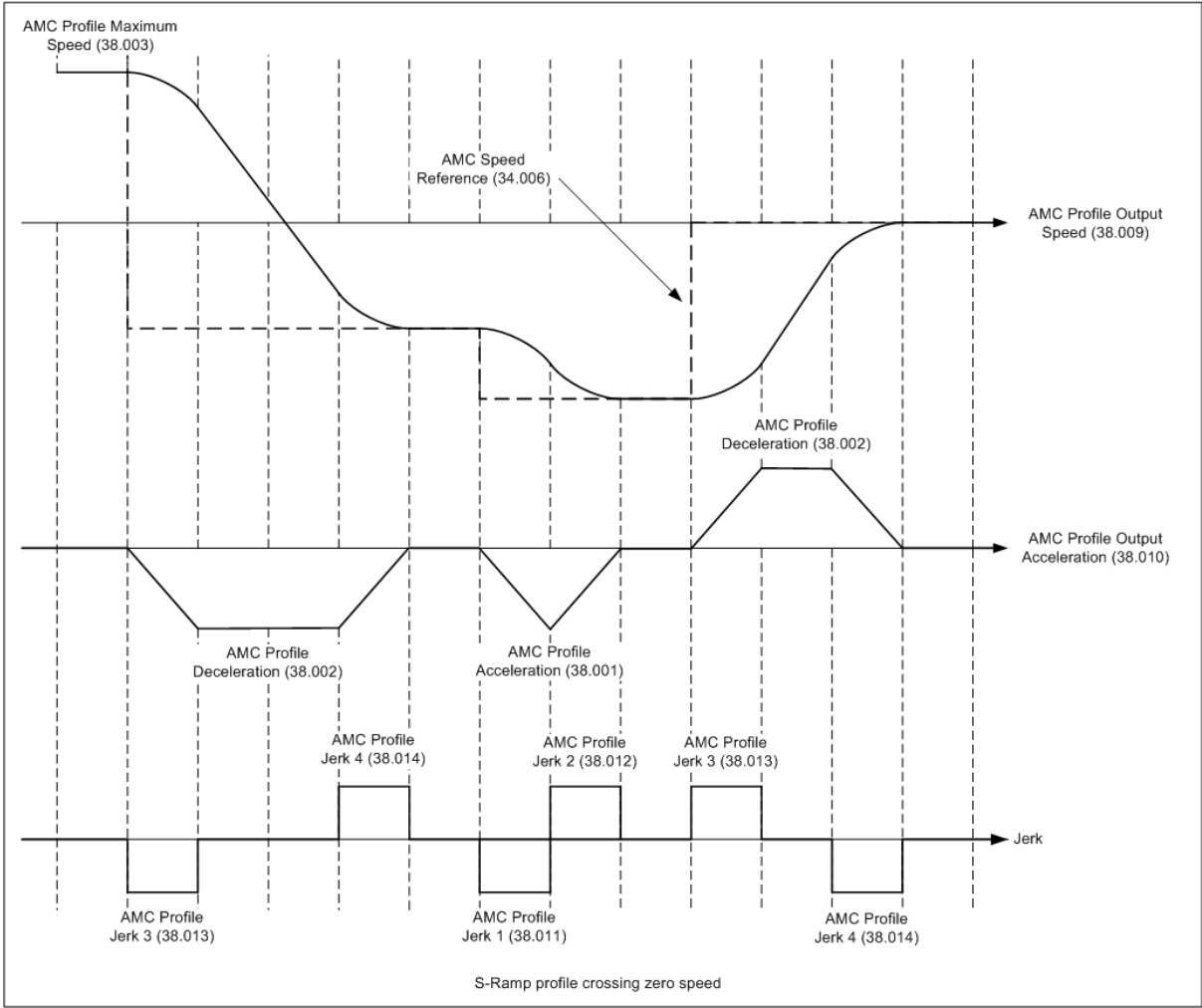
The above description also applies when the s-ramp is operating in position mode. If *AMC Profile Input Position* (38.006) is changed when the output of the profile is at standstill (*AMC Profile Output Speed* (38.009) and *AMC Profile Output Acceleration* (38.010) = 0) the profile will accelerate to the target speed under the constraints of *AMC Profile Acceleration* (38.001), *AMC Profile Jerk 1* (38.011) and *AMC Profile Jerk 2* (38.012) and decelerate to zero speed under the constraints of *AMC Profile Deceleration* (38.002), *AMC Profile Jerk 3* (38.013) and *AMC Profile Jerk 4* (38.014). This is shown in the diagram below. Note that when *AMC Profile Complete Window* (41.005) is set to zero *AMC Profile Complete Flag* (41.006) can be used to detect when the output of the profile has reached the target position and is at standstill.

AMC Position
Reference (34.003)

AMC Profile Output
Position (38.008)

AMC Profile Maximum
Speed (38.003)

AMC Profile Complete Flag (41.006) = 1
(AMC Profile Complete Window = 0)

AMC Profile Output
Speed (38.009)

Target
Speed

AMC Profile
Acceleration (38.001)

AMC Profile
Deceleration (38.002)

AMC Profile Output
Acceleration (38.010)

AMC Profile
Deceleration (38.002)

AMC Profile
Acceleration (38.001)

AMC Profile
Jerk 1 (38.011)

AMC Profile
Jerk 4 (38.014)

AMC Profile
Jerk 2 (38.012)

AMC Profile
Jerk 3 (38.013)

Jerk

AMC Profile
Jerk 2 (38.012)

AMC Profile
Jerk 3 (38.013)

AMC Profile
Jerk 1 (38.011)

AMC Profile
Jerk 4 (38.014)

S-Ramp position index changed after profile complete flag is set (P41.006 = 1)

If *AMC Profile Input Position* (38.006) is changed before the profile has been completed and *AMC Profile Output Speed* (38.009) must cross the zero boundary to reach the new target speed the profile will be constrained by the deceleration parameters for the entire movement as shown in the diagram below.

S-Ramp position reference changed before profile complete flag is set (P41.006 = 0)
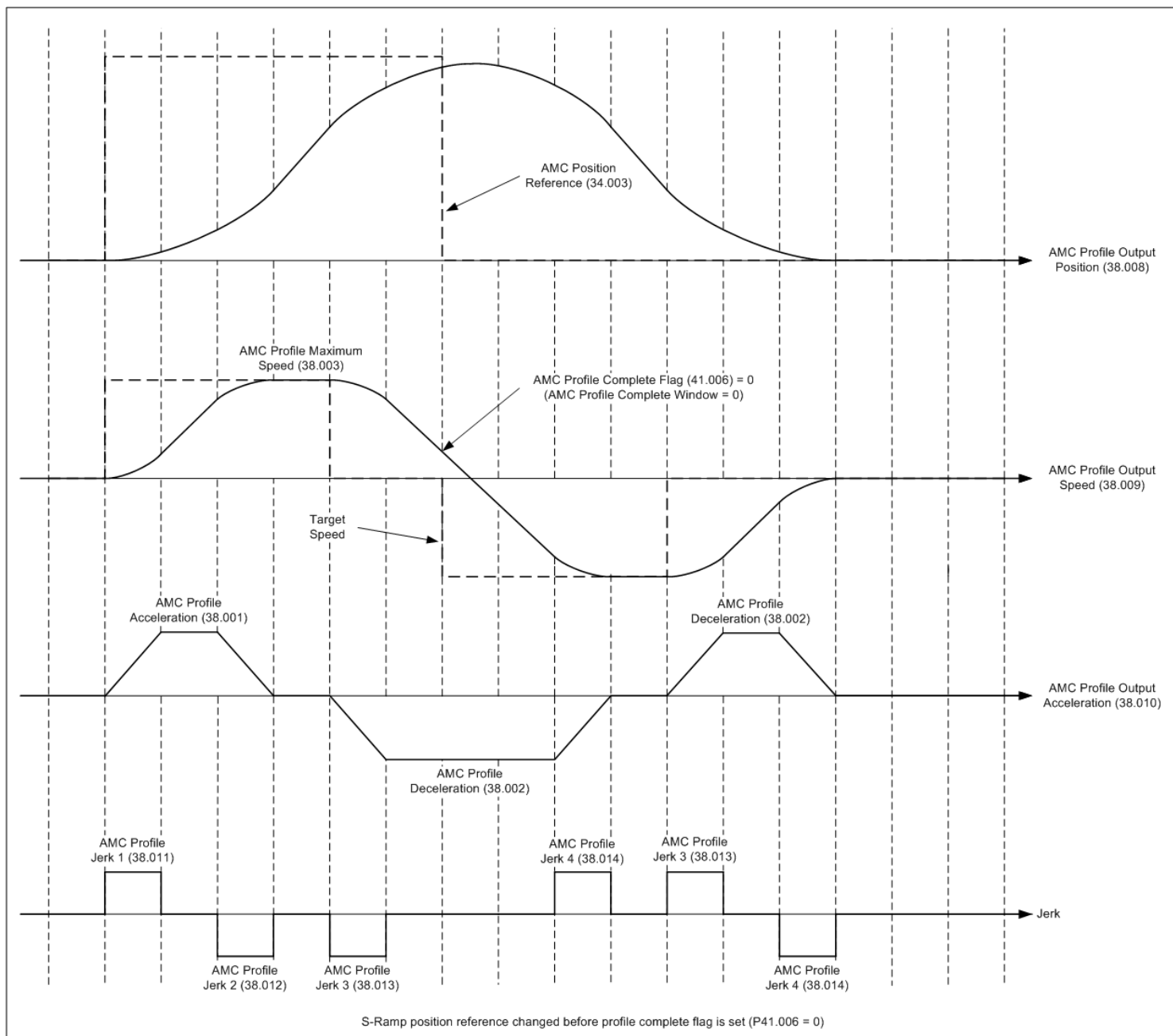
Parameter	38.012 *AMC Profile Jerk 2*		
Short description			
Mode	RFC-S		
Minimum	−VM_AMC_JERK_UNIPOLAR	Maximum	VM_AMC_JERK_UNIPOLAR
Default	0.0000	Units	UU/ms³
Type	32 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	4
Coding	RW, VM		

See *AMC Profile Jerk 1* (38.011).

Parameter	38.013 *AMC Profile Jerk 3*		
Short description			
Mode	RFC-S		
Minimum	−VM_AMC_JERK_UNIPOLAR	Maximum	VM_AMC_JERK_UNIPOLAR
Default	0.0000	Units	UU/ms³
Type	32 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	4
Coding	RW, VM		

See *AMC Profile Jerk 1* (38.011).

Parameter	38.014 *AMC Profile Jerk 4*		
Short description			
Mode	RFC-S		
Minimum	−VM_AMC_JERK_UNIPOLAR	Maximum	VM_AMC_JERK_UNIPOLAR
Default	0.0000	Units	UU/ms³
Type	32 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	4
Coding	RW, VM		

See *AMC Profile Jerk 1* (38.011).

Parameter	38.015 *AMC Profile Update Mode*		
Short description			
Mode	RFC-S		
Minimum	0	Maximum	1
Default	1	Units	
Type	8 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW		

AMC Profile Update Mode (38.015) can be used to select when a change to the profile acceleration, deceleration or jerk parameter is applied to the profile generator.

AMC Profile Update Mode (38.015)	Profile update	Ramp type
0	Profile acceleration, deceleration and jerk values are updated in the sample after the parameter has been read by the drive.	Linear ramp and S-ramp
1	When the s-ramp profile is enabled (*AMC Profile Jerk 1* (38.011) > 0) the profile acceleration, deceleration and jerk values are only updated when the output of the profile generator is at standstill (speed and acceleration = 0). This prevents a change to the profile constraints causing an overshoot of the target speed or position. Note that an overshoot can still occur if the target speed or position is changed when the profile generator is not at standstill. If the profile generator is disabled (see the introduction to menu 38) or the linear ramp is enabled the profile parameters are updated as described in the previous mode.	S-ramp

Menu 39 Single Line Descriptions − *AMC Position Control Loop*

Mode: RFC‑S

Parameter	Range	Default	Type					
39.001 AMC External Position Reference Select	Off (0) or On (1)	Off (0)	RW	Bit				US
39.002 AMC External Position Reference	-2147483648 to 2147483647 UU	0 UU	RW	Num				
39.004 AMC External Speed Reference	±VM_AMC_SPEED UU/ms	0.00 UU/ms	RW	Num				
39.005 AMC Inertia Compensation Mode	None (0), Acceleration (1), Torque (2)	None (0)	RW	Txt				US
39.007 AMC Position Control Loop Kp Gain	0.000 to 500.000	25.000	RW	Num				US
39.008 AMC Position Error	±VM_AMC_POSITION UU		RO	Num	ND	NC	PT	FI
39.009 AMC Position Control Loop Speed Clamp	±VM_AMC_SPEED_UNIPOLAR UU/ms	109.20 UU/ms	RW	Num				US
39.010 AMC Speed Feed‑forwards Gain	0.000 to 2.000	1.000	RW	Num				US
39.011 AMC Output Speed Clamp	±VM_SPEED_FREQ_REF	1000.0	RW	Num				US
39.012 AMC Output Speed	±VM_SPEED_FREQ_REF		RO	Num	ND	NC	PT	FI
39.013 AMC Output Invert	Off (0) or On (1)	Off (0)	RW	Bit				US
39.014 AMC External Acceleration Reference	±VM_AMC_RATE UU/ms²	0.000 UU/ms²	RW	Num				
39.015 AMC External Reference Mode	0 to 1	0	RW	Num				US
39.016 AMC External Control State	0 to 17		RO	Num	ND	NC	PT	

RW	Read / Write	RO	Read-only	Bit	Bit parameter	Txt	Text string	Date	Date parameter	Time	Time parameter
Chr	Character parameter	Bin	Binary parameter	IP	IP address	Mac	MAC address	Ver	Version number	SMP	Slot, menu, parameter
Num	Number parameter	DE	Destination	ND	No default value	RA	Rating dependent	NC	Non-copyable	PT	Protected
FI	Filtered	US	User save	PS	Power-down save						

Menu 39 − *AMC Position Control Loop*

Mode: RFC‑S

Position control loop

Position Control Loop
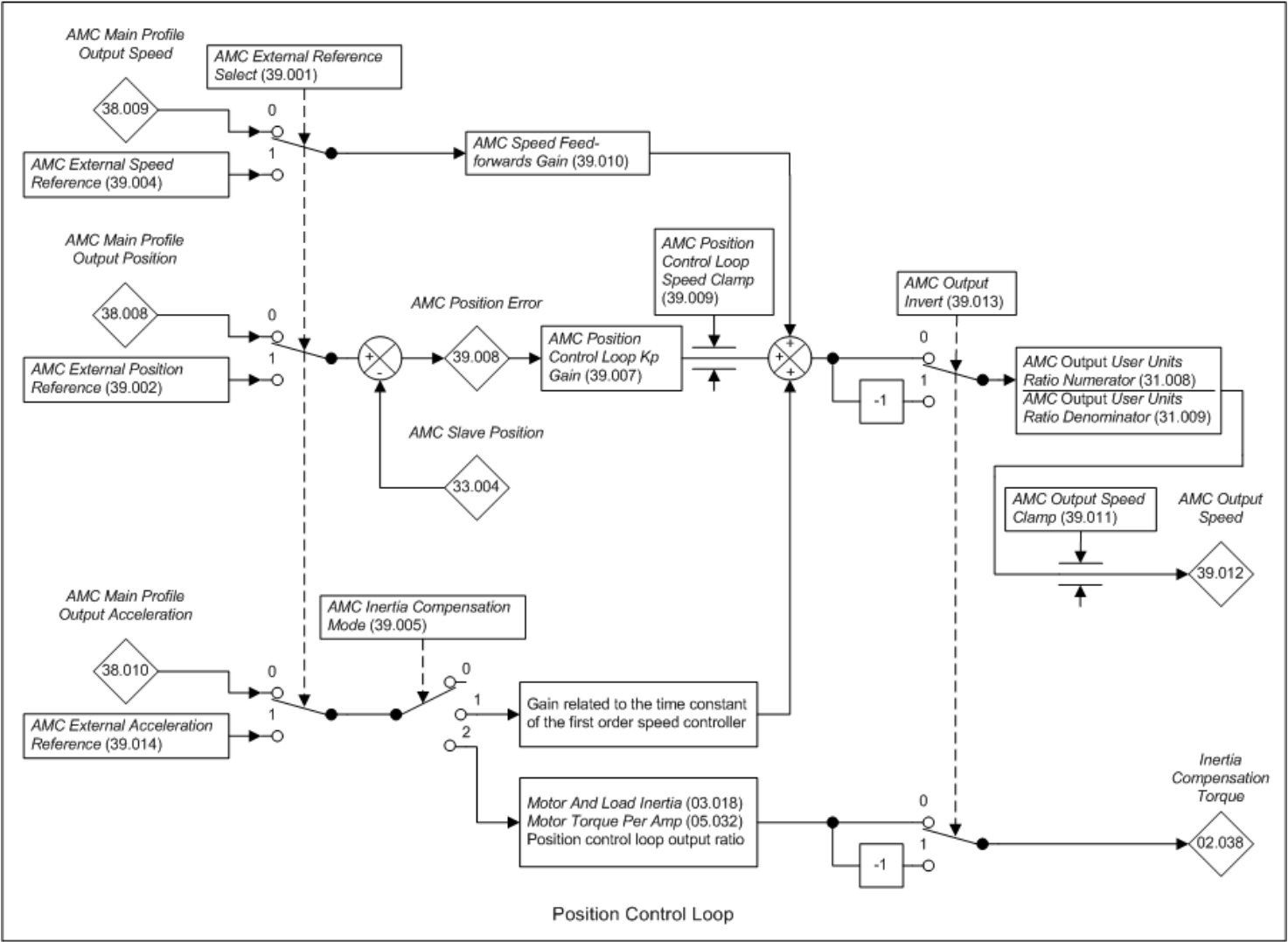
Parameter	39.001 *AMC External Position Reference Select*		
Short description			
Mode	RFC‑S		
Minimum	0	Maximum	1
Default	0	Units	
Type	1 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW		

If *AMC External Position Reference Select* (39.001) = 0 the position, speed and acceleration reference for the position control loop are taken from the output of the profile generator. However, it is possible to provide these references from an external application (i.e. an applications category module program). If *AMC External Position Reference Select* (39.001) = 1 the position reference is taken from *AMC External Position Reference* (39.002), the speed reference is taken from *AMC External Speed Reference* (39.004) and the acceleration reference is taken from *AMC External Acceleration Reference* (39.014).

Parameter	39.002 *AMC External Position Reference*		
Short description			
Mode	RFC‑S		
Minimum	-2147483648	Maximum	2147483647
Default	0	Units	UU
Type	32 Bit Volatile	Update Rate	AMC sample rate read
Display Format	Standard	Decimal Places	0
Coding	RW		

See *AMC External Position Reference Select* (39.001).

Parameter	39.004 *AMC External Speed Reference*		
Short description			
Mode	RFC-S		
Minimum	−VM_AMC_SPEED	Maximum	VM_AMC_SPEED
Default	0.00	Units	UU/ms
Type	32 Bit Volatile	Update Rate	AMC sample rate read
Display Format	Standard	Decimal Places	2
Coding	RW, VM		

See *AMC External Position Reference Select* (39.001).

Parameter	39.005 *AMC Inertia Compensation Mode*		
Short description			
Mode	RFC-S		
Minimum	0	Maximum	2
Default	0	Units	
Type	8 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW, TE		

Value	*Text*
0	None
1	Acceleration
2	Torque

AMC Inertia Compensation Mode (39.005) selects the inertia compensation mode as shown below.

0 (None)

No inertia compensation.

1 (Acceleration feed-forwards)

When acceleration feed-forwards is selected a gain term is automatically calculated based on the currently active drive speed controller gains, *Motor And Load Inertia* (03.018) and *Torque Per Amp* (05.032). The acceleration feed-forwards term is intended to cancel the effect of the speed controller time constant and give a faster position control loop response. The acceleration feed-forwards term is only compatible with a first order speed controller, i.e. *Speed Controller Set-up Method* (03.017) = 7.

2 (Torque feed-forwards)

When torque feed-forwards is selected the acceleration from the profile generator is used to define the torque feed-forwards. The *Motor And Load Inertia* (03.018), *Torque Per Amp* (05.032) and the output user units ratio are used to convert from acceleration to torque. It should be noted that the *Inertia Compensation Torque* (02.038) is added to the output of the speed controller when *Inertia Compensation Enable* (04.022) = 1 and inertia compensation is disabled when *AMC External Position Reference Select* (39.001) = 1.

Parameter	39.007 *AMC Position Control Loop Kp Gain*		
Short description			
Mode	RFC-S		
Minimum	0.000	Maximum	500.000
Default	25.000	Units	
Type	32 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	3
Coding	RW		

AMC Position Control Loop Kp Gain (39.007) is the proportional gain with units of (User units/s) / User units. A *AMC Position Control Loop Kp Gain* (39.007) of unity and a *AMC Position Error* (39.008) of one User unit will give a position control loop speed of 1 User unit/s.

Parameter	39.008 *AMC Position Error*		
Short description			
Mode	RFC-S		
Minimum	−VM_AMC_POSITION	Maximum	VM_AMC_POSITION
Default		Units	UU
Type	32 Bit Volatile	Update Rate	4ms write
Display Format	Standard	Decimal Places	0
Coding	RO, FI, VM, ND, NC, PT		

AMC Position Error (39.008) gives the difference between the final position reference and the *AMC Slave Position* (33.004) in User units.

Parameter	39.009 *AMC Position Control Loop Speed Clamp*		
Short description			
Mode	RFC-S		
Minimum	0.00	Maximum	VM_AMC_SPEED_UNIPOLAR
Default	109.20	Units	UU/ms
Type	32 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	2
Coding	RW, VM		

The default value of 109.2 UU/ms is the equivalent of 100rpm for a feedback device with 16 normalised position bits per revolution and a user unit ratio of unity.

The *AMC Position Control Loop Speed Clamp* (39.009) defines the maximum positive or negative speed output from the position control loop in User units/ms.

Parameter	39.010 *AMC Speed Feed-forwards Gain*		
Short description			
Mode	RFC-S		
Minimum	0.000	Maximum	2.000
Default	1.000	Units	
Type	16 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	3
Coding	RW		

Normally the speed feed-forwards is used directly to provide the speed reference for the drive, with the position controller used as a trim to compensate for system and load effects to give the correct position. The default value of *AMC Speed Feed-forwards Gain* (39.010) is unity, but in some applications it may be necessary to reduce the speed feed-forward component to reduce overshoot.

Parameter	39.011 *AMC Output Speed Clamp*		
Short description			
Mode	RFC-S		
Minimum	−VM_SPEED_FREQ_REF	Maximum	VM_SPEED_FREQ_REF
Default	1000.0	Units	
Type	32 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	1
Coding	RW, VM		

AMC Output Speed Clamp (39.011) provides a final clamp on the output speed in drive speed parameter units (i.e. rpm or mm/s).

Parameter	39.012 *AMC Output Speed*		
Short description			
Mode	RFC-S		
Minimum	−VM_SPEED_FREQ_REF	Maximum	VM_SPEED_FREQ_REF
Default		Units	
Type	32 Bit Volatile	Update Rate	4ms write
Display Format	Standard	Decimal Places	1
Coding	RO, FI, VM, ND, NC, PT		

AMC Output Speed (39.012) is the final output from the Advanced Motion Controller in 0.1rpm or 0.1mm/s. Although the update rate for this parameter is 4ms the output speed is written to the *Hard Speed Reference* (03.022) at the sample rate selected in *AMC Rate Select* (31.012). The output speed is written in internal units (2^{32}cpr/250µs) to increase the maximum speed resolution to $5.59e^{-5}$rpm or Pole Pitch x $9.31e^{-7}$mm/s.

Parameter	39.013 *AMC Output Invert*		
Short description	Set to 1 to invert the AMC output speed		
Mode	RFC-S		
Minimum	0	Maximum	1
Default	0	Units	
Type	1 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW		

If *AMC Output Invert* (39.013) = 1 then *AMC Output Speed* (39.012) and the output torque (*AMC Inertia Compensation Mode* (39.005) = 2) is inverted.

Parameter	39.014 *AMC External Acceleration Reference*		
Short description			
Mode	RFC-S		
Minimum	−VM_AMC_RATE	Maximum	VM_AMC_RATE
Default	0.000	Units	UU/ms²
Type	32 Bit Volatile	Update Rate	AMC sample rate read
Display Format	Standard	Decimal Places	3
Coding	RW, VM		

See *AMC External Position Reference Select* (39.001).

Parameter	39.015 *AMC External Reference Mode*		
Short description			
Mode	RFC-S		
Minimum	0	Maximum	1
Default	0	Units	
Type	8 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW		

AMC External Reference Mode (39.015) can be used to modify the operation of the Advanced Motion Controller when an external profile generator is being used to provide the references for the position control loop. When an external profile is used it is important that the profile is always synchronised to *AMC Slave Position* (33.004) and the outputs of the profile are written to the external references before the drive is enabled. If this is not done the position error may cause the slave to move.

If *AMC External Reference Mode* (39.015) = 0 the external references are always used when selected (*AMC External Position Reference Select* (39.001) = 1) and no other changes are made to the operation of the Advanced Motion Controller.

If *AMC External Reference Mode* (39.015) = 1 the following apply when the external references are selected. This mode of operation is intended to be used with an external motion controller, such as the MCi option module.

1. The state machine described in *AMC External Control State* (39.016) is enabled. *AMC External Control State* (39.016) provides the state of the drive (unhealthy or disabled), indicates the active reference, the status of a homing routine and if an error has occurred, i.e. the stop reference has been selected while the external reference or homing routine was active, a limits has become active, etc. To synchronise the external profile with the slave position *AMC External Control State* (39.016) should be in one of the stopped states. In a stopped state the reference selector is set to stop and *AMC Profile Input Position* (38.006) = *AMC Profile Output Position* (38.008) which ensures that the external profile can be updated without introducing a position error when the external reference is activated.
2. The external references are not used when *AMC Reference Select* (34.007) is set to stop or home. This allows the on-board profile generator to perform a stop or homing routine without having to change *AMC External Position Reference Select* (39.001).
3. When the external references are being used the outputs of the on-board profile generator are set to the slave position, speed and acceleration. This allows the stop reference to be selected while the slave is moving and for a ramped stop to be performed.
4. *AMC Reference Select* (34.007) is set to stop when the drive is disabled. This ensures that the slave will be held at the slave position until the external profile is synchronised and is ready to provide the external reference.
5. *AMC Profile Input Position* (38.006) displays the rollover position when rollover mode is enabled (*AMC Profile Output Position* (38.008) > 0). This allows the external profile to be synchronised with the internal (*AMC Profile Output Position* (38.008)) and rollover (*AMC Slave Position* (33.004)) positions.
6. If a hardware or software limit is active and the output speed due to the position error or velocity feedforwards is towards the active limit *AMC Output Speed* (39.012) is set to zero and *AMC Reference Select* (34.007) is set to stop.

Parameter	39.016 *AMC External Control State*		
Short description			
Mode	RFC-S		
Minimum	0	Maximum	17
Default		Units	
Type	8 Bit Volatile	Update Rate	4ms write
Display Format	Standard	Decimal Places	0
Coding	RO, ND, NC, PT		

AMC External Control State (39.016) shows the current state of the state machine shown in the diagram below. This state machine is active when *AMC External Reference Mode* (39.015) is set. See *AMC External Reference Mode* (39.015) for a description of how the state machine is used.
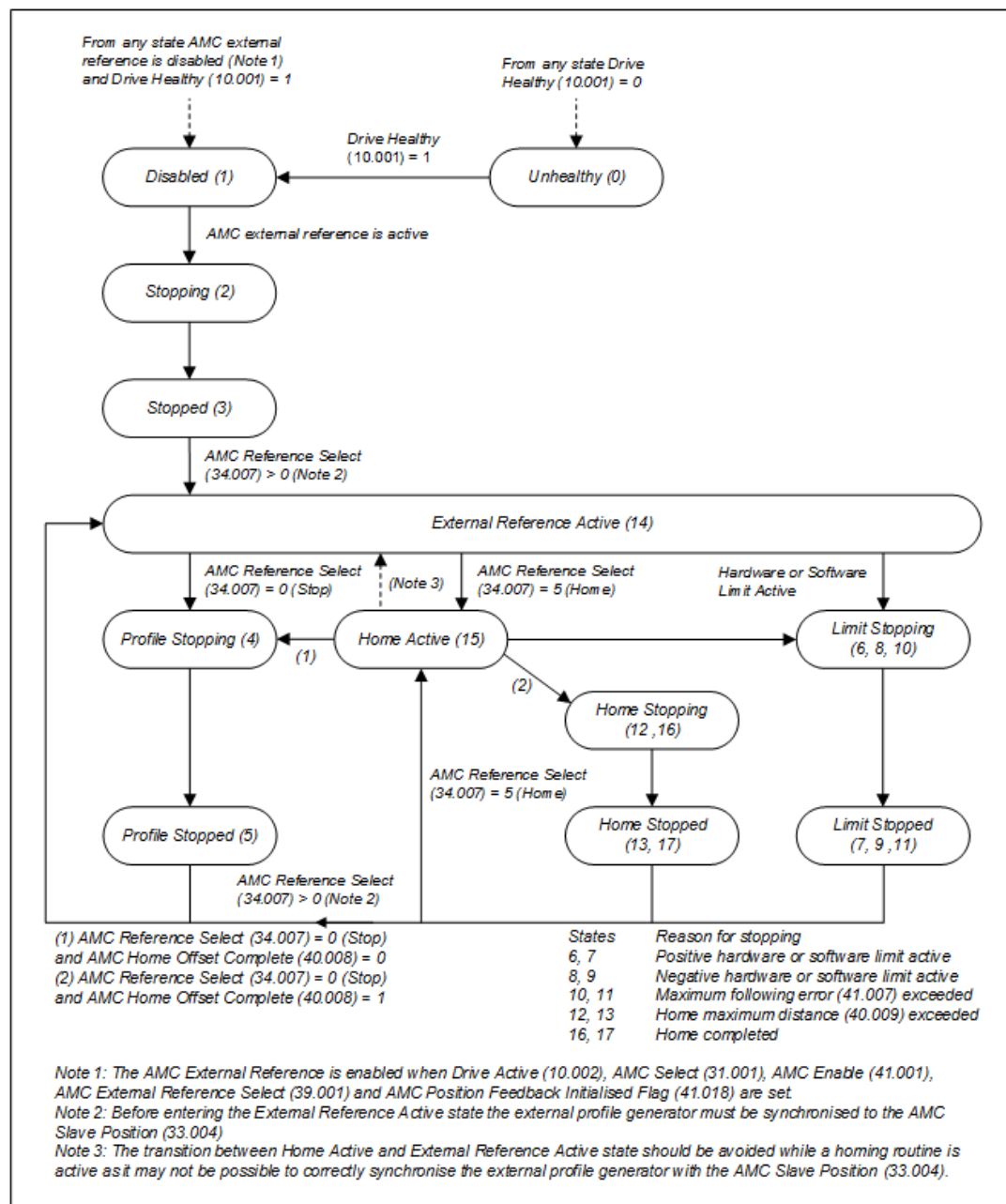
Menu 40 Single Line Descriptions − *AMC Homing System*

Mode: RFC‑S

Parameter		Range	Default	Type					
40.001	AMC Home Direction	Off (0) or On (1)	Off (0)	RW	Bit				US
40.002	AMC Home Mode	0 to 8	0	RW	Num				US
40.003	AMC Home Maximum Speed	±VM_AMC_SPEED_UNIPOLAR UU/ms	10.92 UU/ms	RW	Num				US
40.004	AMC Home Position	±VM_AMC_POSITION UU	0 UU	RW	Num				US
40.005	AMC Home Complete	Off (0) or On (1)		RO	Bit	ND	NC	PT	
40.006	AMC Home Offset Maximum Speed	±VM_AMC_SPEED_UNIPOLAR UU/ms	10.92 UU/ms	RW	Num				US
40.007	AMC Home Offset Position	±VM_AMC_POSITION UU	0 UU	RW	Num				US
40.008	AMC Home Offset Complete	Off (0) or On (1)		RO	Bit	ND	NC	PT	
40.009	AMC Home Maximum Allowed Move	0 to VM_AMC_POSITION_UNIPOLAR UU	0 UU	RW	Num				US
40.010	AMC Home Complete Window	0 to VM_AMC_POSITION_UNIPOLAR UU	0 UU	RW	Num				US
40.011	AMC Home On Freeze	Off (0) or On (1)	Off (0)	RW	Bit				US
40.012	AMC Home Switch	Off (0) or On (1)	Off (0)	RW	Bit		NC		
40.013	AMC Home Positive Limit	Off (0) or On (1)	Off (0)	RW	Bit		NC		
40.014	AMC Home Negative Limit	Off (0) or On (1)	Off (0)	RW	Bit		NC		
40.015	AMC Home Positive Limit Selector	0 to 2	0	RW	Num				US
40.016	AMC Home Negative Limit Selector	0 to 2	0	RW	Num				US
40.017	AMC Home Torque Limit Active	Off (0) or On (1)		RO	Bit	ND	NC	PT	
40.018	AMC Home Hard Stop Torque Threshold	0.0 to 1000.0 %	0.0 %	RW	Num				US
40.019	AMC Home Hard Stop Delay Time	0.000 to 60.000 s	0.000 s	RW	Num				US
40.020	AMC Home Required	Off (0) or On (1)	Off (0)	RW	Bit				US
40.021	AMC Home Slave Source	None (-1), User Position (0), Sensorless (1), P1 Drive (2), P2 Drive (3), P1 Slot1 (4), P2 Slot1 (5), P1 Slot2 (6), P2 Slot2 (7), P1 Slot3 (8), P2 Slot3 (9)	None (-1)	RW	Txt				US

RW	Read / Write	RO	Read-only	Bit	Bit parameter	Txt	Text string	Date	Date parameter	Time	Time parameter
Chr	Character parameter	Bin	Binary parameter	IP	IP address	Mac	MAC address	Ver	Version number	SMP	Slot, menu, parameter
Num	Number parameter	DE	Destination	ND	No default value	RA	Rating dependent	NC	Non-copyable	PT	Protected
FI	Filtered	US	User save	PS	Power-down save						

Mode: RFC‑S

Homing system

Homing System

Parameter	40.001 *AMC Home Direction*		
Short description			
Mode	RFC-S		
Minimum	0	Maximum	1
Default	0	Units	
Type	1 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW		

The *AMC Home Direction* (40.001) is used to select the direction of movement to the freeze input associated with the slave position source, where 0 is forwards and 1 is backwards.

Parameter	40.002 *AMC Home Mode*		
Short description			
Mode	RFC-S		
Minimum	0	Maximum	8
Default	0	Units	
Type	8 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW		

The homing sequence always runs at a sample rate of 4ms and cannot be changed using *AMC Rate Select* (31.012). Homing begins when *AMC Reference Select* (34.007) is set to 5 and the motion controller is enabled. The following sequence then occurs.

Homing Phase

1. *AMC Home Complete* (40.005) and *AMC Home Offset Complete* (40.008) are reset to 0
2. A speed reference with a magnitude defined by *AMC Home Maximum Speed* (40.003) is applied to the profile generator until the home position is detected. During the homing phase the direction of movement is controlled by *AMC Home Mode* (40.002) and *AMC Home Direction* (40.001).
3. If *AMC Home On Freeze* (40.011) = 1 the home position is set to the *AMC Slave Freeze Position* (33.006) or when *AMC Home On Freeze* (40.011) = 0 the home position is set to *AMC Slave Position* (33.004) in the sample after the home event, i.e. the correct transition has been detected.
4. The difference between *AMC Home Position* (40.004) and the home position above is added to *AMC Slave Offset* (33.003). This has the effect of making *AMC Slave Position* (33.004) equal to *AMC Home Position* (40.004) at the physical home position. The profile output position is automatically adjusted to prevent any position transients.
5. *AMC Home Complete* (40.005) is set to 1.

Reset Phase

1. The homing reference becomes a position reference instead of a speed reference and the target position is set to *AMC Home Position* (40.004) + *AMC Home Offset Position*

(40.007). The system will move towards the position reference, which is the position relative to the home position, with the maximum speed limited to *AMC Home Offset Maximum Speed* (40.006).

2. *AMC Home Offset Complete* (40.008) is set to 1 and *AMC Reference Select* (34.007) is set to 0 when |(*AMC Home Position* (40.004) + *AMC Home Offset Position* (40.007)) - *AMC Slave Position* (33.004)| ≤ *AMC Home Complete Window* (40.010).

The table below shows a summary of the actions performed by *AMC Home Switch* (40.012), *AMC Home Positive Limit* (40.013) and *AMC Home Negative Limit* (40.014) in each mode. If the positive or negative limits are not required to complete the homing sequence and a limit is reached (state = 1) before the home position has been detected or while moving to the reset position then *AMC Reference Select* (34.007) is set to 0 (stop) to force the system to stop.

AMC Home Mode (40.002)	Slave Freeze Flag	AMC Home Switch (40.012)	AMC Home Positive Limit (40.013)	AMC Home Negative Limit (40.014)
0	Not used	Home position = *AMC Slave Position* (33.004)	Home backwards	Home forwards
1	Home position = *AMC Slave Position* (33.004)	Not used	Force stop*	Force stop*
2	Home position = *AMC Slave Position* (33.004) when *AMC Home On Freeze* = 1	Not used	Home position = *AMC Slave Position* (33.004) when *AMC Home On Freeze* = 0	Force stop*
3	Home position = *AMC Slave Position* (33.004) when *AMC Home On Freeze* = 1	Not used	Force stop*	Home position = *AMC Slave Position* (33.004) when *AMC Home On Freeze* = 0
4	Home position = *AMC Slave Position* (33.004) when *AMC Home On Freeze* = 1	Home position = *AMC Slave Position* (33.004) when *AMC Home On Freeze* = 0	Force stop*	Force stop*
5	Home position = *AMC Slave Position* (33.004) when *AMC Home On Freeze* = 1	Home position = *AMC Slave Position* (33.004) when *AMC Home On Freeze* = 0	Home backwards	Force stop*
6	Home position = *AMC Slave Position* (33.004) when *AMC Home On Freeze* = 1	Home position = *AMC Slave Position* (33.004) when *AMC Home On Freeze* = 0	Home backwards	Force stop*
7	Home position = *AMC Slave Position* (33.004) when *AMC Home On Freeze* = 1	Home position = *AMC Slave Position* (33.004) when *AMC Home On Freeze* = 0	Force stop*	Home forwards
8	Home position = *AMC Slave Position* (33.004) when *AMC Home On Freeze* = 1	Home position = *AMC Slave Position* (33.004) when *AMC Home On Freeze* = 0	Force stop*	Home forwards

* If the limit becomes active during the homing sequence *AMC Reference Select* (34.007) is set to 0 and the slave will stop under the constraints defined by *AMC Stop Mode* (34.001).

If the freeze flag for the slave source is used as the home event the home position is set to *AMC Slave Freeze Position* (33.006) and *AMC Home Maximum Speed* (40.003) will not have any influence on the accuracy of the home position. However, if *AMC Home Switch* (40.012) is used as the home event the home position is set to *AMC Slave Position* (33.004) in the sample after the home event occurs. The time between when the home event occurs and the home position is set to *AMC Slave Position* (33.004) will be no more than one complete sample (4ms) and the home position will be within 4ms × *AMC Home Maximum Speed* (40.003) of the physical home position.

Homing Modes

The direction of movement during the homing sequence is controlled by *AMC Home Mode* (40.002) and *AMC Home Direction* (40.001). The homing sequence for each mode is described in more detail below. In each example it is assumed that the slave feedback device is connected to the drives P1 interface and uses *F1 Freeze Flag* (03.104) as the freeze source. The actual freeze flag used during the homing sequence is defined by *AMC Slave Source Select* (33.001) and *AMC Slave Freeze Select* (33.007).

Symbol	Description
◆	Slave position at the beginning of the home sequence
→	Slave moving in a positive direction
◁—	Slave moving in a negative direction
↕	Home to *AMC Home Switch* (40.012), *AMC Home Positive Limit* (40.013) or *AMC Home Negative Limit* (40.014) is complete when a positive transition is detected and the slave is moving in a positive direction or a negative transition is detected and the slave is moving in a negative direction
↕	Home to *AMC Home Switch* (40.012), *AMC Home Positive Limit* (40.013) or *AMC Home Negative Limit* (40.014) is complete when a negative transition is detected and the slave is moving in a positive direction or a positive transition is detected and the slave is moving in a negative direction
↑	Positive freeze flag transition

Mode 0 - Manual
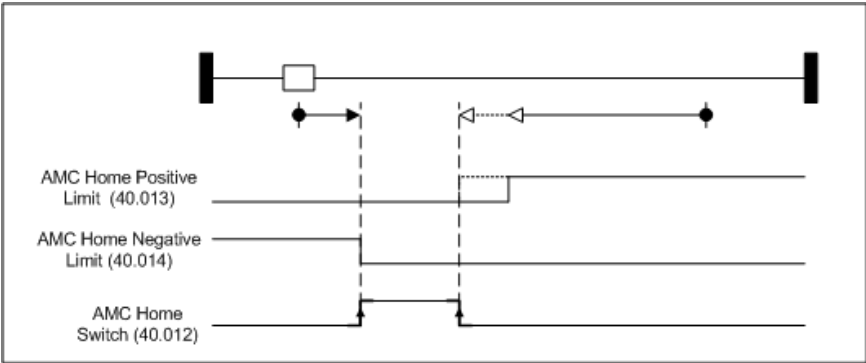
In manual mode the direction of movement is controlled by *AMC Home Positive Limit* (40.013) and *AMC Home Negative Limit* (40.014). When *AMC Home Negative Limit* (40.014) is set to 1 a positive homing reference is applied to the profile generator and when *AMC Home Positive Limit* (40.013) is set to 1 a negative reference is applied. If both limits are set at the same time the homing reference is set to 0 and the slave will profile to a stop. The home position is set to *AMC Slave Position* (33.004) when a positive transition of *AMC Home Switch* (40.012) is detected.

Mode 1 - Home on freeze flag
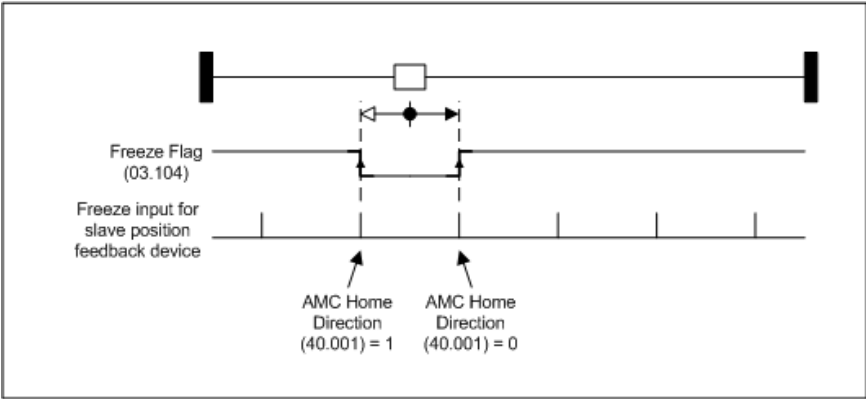
The slave will move in the direction defined by *AMC Home Direction* (40.001) until a positive transition of *F1 Freeze Flag* (03.104) is detected. The home position is then set to *AMC Slave Position* (33.004). Note that *F1 Freeze Flag* (03.104) is reset at the beginning of the homing sequence.

Mode 2 - Home on positive limit
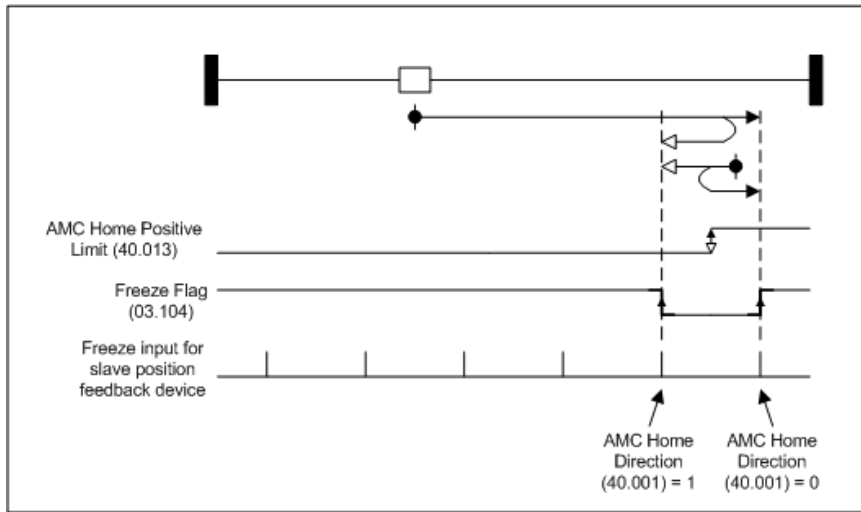
If *AMC Home Positive Limit* (40.013) = 0 when the homing sequence begins the slave will move forwards until a positive transition of *AMC Home Positive Limit* (40.013) is detected otherwise when *AMC Home Positive Limit* (40.013) = 1 the slave will move backwards until a negative transition of *AMC Home Positive Limit* (40.013) is detected. If *AMC Home On Freeze* (40.011) = 0 the home position is set to *AMC Slave Position* (33.004) at the transition of *AMC Home Positive Limit* (40.013) or when *AMC Home On Freeze* (40.011) = 1 the freeze flag is reset and the slave will move in the direction defined by *AMC Home Direction* (40.001) until a positive transition of *F1 Freeze Flag* (03.104) is detected. The home position is then set to *AMC Slave Freeze Position* (33.006).

Mode 3 - Home on negative limit
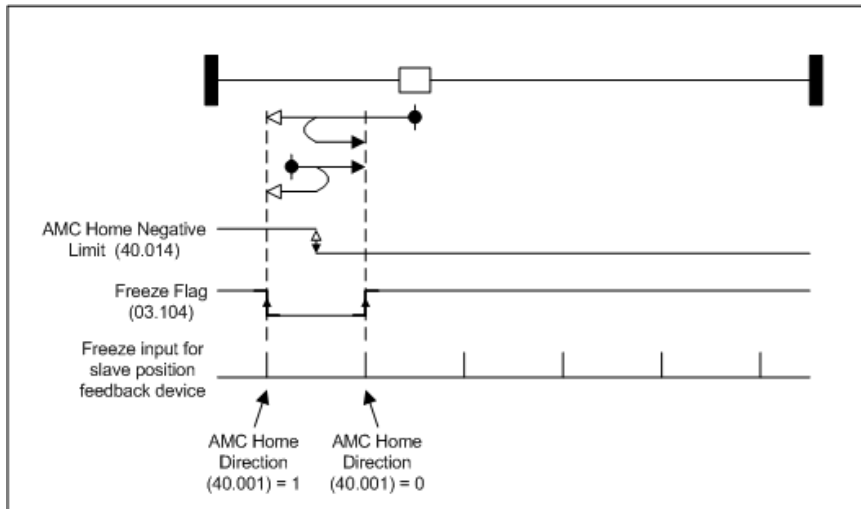
If *AMC Home Negative Limit* (40.014) = 0 when the homing sequence begins the slave will move backwards until a positive transition of *AMC Home Negative Limit* (40.014) is detected otherwise when *AMC Home Negative Limit* (40.014) = 1 the slave will move forwards until a negative transition of *AMC Home Negative Limit* (40.014) is detected. If *AMC Home On Freeze* (40.011) = 0 the home position is set to *AMC Slave Position* (33.004) at the transition of *AMC Home Negative Limit* (40.014) or when *AMC Home On Freeze* (40.011) = 1 the freeze flag is reset and the slave will move in the direction defined by *AMC Home Direction* (40.001) until a positive transition of *F1 Freeze Flag* (03.104) is detected. The home position is then set to *AMC Slave Freeze Position* (33.006).

Mode 4 - Home on home switch

If *AMC Home Switch* (40.012) = 0 when the homing sequence begins the slave will move forwards until a positive transition of *AMC Home Switch* (40.012) is detected otherwise when *AMC Home Switch* (40.012) = 1 the slave will move backwards until a negative transition of *AMC Home Switch* (40.012) is detected. If *AMC Home On Freeze* (40.011) = 0 the home position is set to *AMC Slave Position* (33.004) at the transition of *AMC Home Switch* (40.012) or when *AMC Home On Freeze* (40.011) = 1 the freeze flag is reset and the slave will move in the direction defined by *AMC Home Direction* (40.001) until a positive transition of *F1 Freeze Flag* (03.104) is detected. The home position is then set to the *AMC Slave Freeze Position* (33.006).

Mode 5 and 6 - Home on home switch with positive limit

Homing modes 5 and 6 use the same general sequence but home to different sides of the active home region. When *AMC Home Mode* (40.002) = 5 the slave will home to the negative side of the home region and when *AMC Home Mode* (40.002) = 6 the slave will home to the positive side. The homing sequence for mode 5 is as follows.
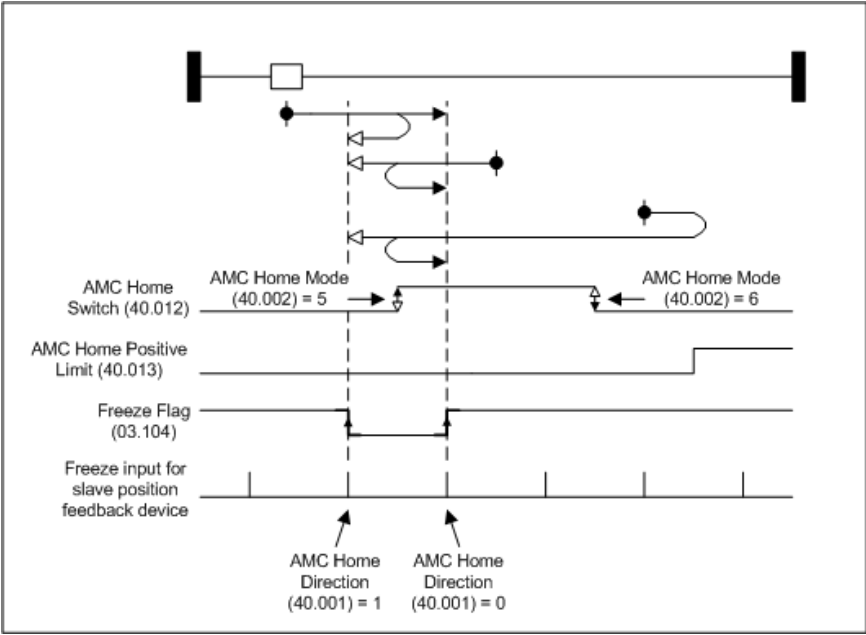
AMC Home Switch (40.012)
AMC Home Mode (40.002) = 5
AMC Home Mode (40.002) = 6
AMC Home Positive Limit (40.013)
Freeze Flag (03.104)
Freeze input for slave position feedback device
AMC Home Direction (40.001) = 1
AMC Home Direction (40.001) = 0

If *AMC Home Switch* (40.012) = 0 when the homing sequence begins the slave will move forwards until a positive transition of *AMC Home Switch* (40.012) is detected otherwise when *AMC Home Switch* (40.012) = 1 the slave will move backwards until a negative transition of *AMC Home Switch* (40.012) is detected. If the slave is initially on the positive side of the active home region *AMC Home Positive Limit* (40.013) will be set to 1 before the home position is detected. If this happens the slave will move backwards until a negative transition of *AMC Home Switch* (40.012) is detected. If *AMC Home On Freeze* (40.011) = 0 the home position is set to *AMC Slave Position* (33.004) at the transition of *AMC Home Switch* (40.012) or when *AMC Home On Freeze* (40.011) = 1 the freeze flag is reset and the slave will move in the direction defined by *AMC Home Direction* (40.001) until a positive transition of *F1 Freeze Flag* (03.104) is detected. The home position is then set to *AMC Slave Freeze Position* (33.006).

Mode 7 and 8 - Home on home switch with negative limit

Homing modes 7 and 8 use the same general sequence but home to different sides of an active home region. When *AMC Home Mode* (40.002) = 7 the slave will home to the negative side of the home region and when *AMC Home Mode* (40.002) = 8 the slave will home to the positive side. The homing sequence for mode 8 is as follows.
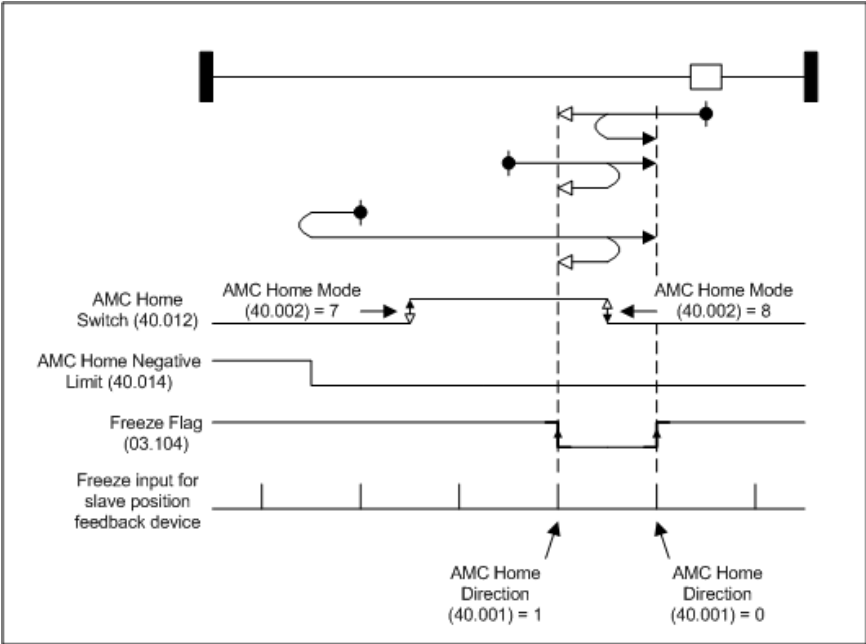
AMC Home Switch (40.012)
AMC Home Mode (40.002) = 7
AMC Home Mode (40.002) = 8
AMC Home Negative Limit (40.014)
Freeze Flag (03.104)
Freeze input for slave position feedback device
AMC Home Direction (40.001) = 1
AMC Home Direction (40.001) = 0

If *AMC Home Switch* (40.012) = 0 when the homing sequence begins the slave will move backwards until a positive transition of *AMC Home Switch* (40.012) is detected otherwise when *AMC Home Switch* (40.012) = 1 the slave will move forwards until a negative transition of *AMC Home Switch* (40.012) is detected. If the slave is initially on the negative side of the active home region *AMC Home Negative Limit* (40.014) will be set to 1 before the home position is detected. If this happens the slave will move forwards until a negative transition of *AMC Home Switch* (40.012) is detected. If *AMC Home On Freeze* (40.011) = 0 the home position is set to *AMC Slave Position* (33.004) at the transition of *AMC Home Switch* (40.012) or when *AMC Home On Freeze* (40.011) = 1 the freeze flag is reset and the slave will move in the direction defined by *AMC Home Direction* (40.001) until a positive transition of *F1 Freeze Flag* (03.104) is detected. The home position is then set to the *AMC Slave Freeze Position* (33.006).

Parameter	40.003 *AMC Home Maximum Speed*		
Short description			
Mode	RFC-S		
Minimum	0.00	Maximum	VM_AMC_SPEED_UNIPOLAR
Default	10.92	Units	UU/ms
Type	32 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	2
Coding	RW, VM		

The default value of 10.92 UU/ms is the equivalent of 10rpm for a feedback device with 16 normalised position bits per revolution and a user unit ratio of unity.

See *AMC Home Mode* (40.002).

Parameter	40.004 *AMC Home Position*		
Short description			
Mode	RFC-S		
Minimum	−VM_AMC_POSITION	Maximum	VM_AMC_POSITION
Default	0	Units	UU
Type	32 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW, VM		

The *AMC Home Position* (40.004) is the required *AMC Slave Position* (33.004) at the point where the homing sequence is complete (*AMC Home Complete* (40.005) = 1).

Parameter	40.005 *AMC Home Complete*		
Short description			
Mode	RFC-S		
Minimum	0	Maximum	1
Default		Units	
Type	1 Bit Volatile	Update Rate	4ms write
Display Format	Standard	Decimal Places	0
Coding	RO, ND, NC, PT		

See *AMC Home Mode* (40.002).

Parameter	40.006 *AMC Home Offset Maximum Speed*		
Short description			
Mode	RFC-S		
Minimum	0.00	Maximum	VM_AMC_SPEED_UNIPOLAR
Default	10.92	Units	UU/ms
Type	32 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	2
Coding	RW, VM		

The default value of 10.92 UU/ms is the equivalent of 10rpm for a feedback device with 16 normalised position bits per revolution and a user unit ratio of unity.

If *AMC Home Offset Maximum Speed* (40.006) = 0 then *AMC Profile Maximum Speed* (38.003) is used during the reset phase. See *AMC Home Mode* (40.002).

Parameter	40.007 *AMC Home Offset Position*		
Short description			
Mode	RFC-S		
Minimum	−VM_AMC_POSITION	Maximum	VM_AMC_POSITION
Default	0	Units	UU
Type	32 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW, VM		

AMC Home Offset Position (40.007) is the position that the system should move to at the end of the homing sequence (*AMC Home Complete* (40.005) = 1) relative to the new home position. If *AMC Home Offset Position* (40.007) = 0 the slave will stop at *AMC Home Position* (40.004).

Parameter	40.008 *AMC Home Offset Complete*		
Short description			
Mode	RFC-S		
Minimum	0	Maximum	1
Default		Units	
Type	1 Bit Volatile	Update Rate	4ms write
Display Format	Standard	Decimal Places	0
Coding	RO, ND, NC, PT		

See *AMC Home Mode* (40.002).

Parameter	40.009 *AMC Home Maximum Allowed Move*		
Short description			
Mode	RFC-S		
Minimum	0	Maximum	VM_AMC_POSITION_UNIPOLAR
Default	0	Units	UU
Type	32 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW, VM		

If the modulus of the change in *AMC Slave Position* (33.004) exceeds *AMC Home Maximum Allowed Move* (40.009) before the event required to indicate the home position occurs and *AMC Home Maximum Allowed Move* (40.009) > 0, the system is forced to stop by setting *AMC Reference Select* (34.007) to 0.

Parameter	40.010 *AMC Home Complete Window*		
Short description			
Mode	RFC-S		
Minimum	0	Maximum	VM_AMC_POSITION_UNIPOLAR
Default	0	Units	UU
Type	32 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW, VM		

When the home position has been detected *AMC Profile Input Position* (38.006) is set to *AMC Home Offset Position* (40.007). The homing sequence is complete (*AMC Home Offset Complete* (40.008) = 1) when |*AMC Profile Input Position* (38.006) - *AMC Slave Position* (33.004)| ≤ *AMC Home Complete Window* (40.010).

Parameter	40.011 *AMC Home On Freeze*		
Short description			
Mode	RFC-S		
Minimum	0	Maximum	1
Default	0	Units	
Type	1 Bit User Save	Update Rate	Read when homing is enabled
Display Format	Standard	Decimal Places	0
Coding	RW		

See *AMC Home Mode* (40.002).

Parameter	40.012 *AMC Home Switch*		
Short description			
Mode	RFC-S		
Minimum	0	Maximum	1
Default	0	Units	
Type	1 Bit Volatile	Update Rate	4ms read
Display Format	Standard	Decimal Places	0
Coding	RW, NC		

See *AMC Home Mode* (40.002).

Parameter	40.013 *AMC Home Positive Limit*		
Short description			
Mode	RFC-S		
Minimum	0	Maximum	1
Default	0	Units	
Type	1 Bit Volatile	Update Rate	4ms read
Display Format	Standard	Decimal Places	0
Coding	RW, NC		

See *AMC Home Mode* (40.002).

Parameter	40.014 *AMC Home Negative Limit*		
Short description			
Mode	RFC-S		
Minimum	0	Maximum	1
Default	0	Units	
Type	1 Bit Volatile	Update Rate	4ms read
Display Format	Standard	Decimal Places	0
Coding	RW, NC		

See *AMC Home Mode* (40.002).

Parameter	40.015 *AMC Home Positive Limit Selector*		
Short description			
Mode	RFC-S		
Minimum	0	Maximum	2
Default	0	Units	
Type	8 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW		

AMC Home Positive Limit (40.013) is used to indicate that the positive limit has been reached. If *AMC Home Positive Limit Selector* (40.015) is set to 0 then *AMC Home Positive Limit* (40.013) can be set by writing directly to the parameter or using bit 4 in *AMC Control Word* (41.019).

If *AMC Home Positive Limit Selector* (40.015) is set to 1 then *AMC Home Positive Limit* (40.013) is set to the output of the hard stop detector which is configured using *AMC Home Hard Stop Torque Threshold* (40.018) and *AMC Home Hard Stop Delay Time* (40.019).

If *AMC Home Positive Limit Selector* (40.015) is set to 2 then *AMC Home Positive Limit* (40.013) is set to *AMC Positive Hardware Limit Flag* (41.013). Note that when *AMC Positive Hardware Limit Flag* (41.013) is used as the positive limit for the homing sequence the positive hardware and software limits configured in *AMC Control and Status* (41) are disabled.

Parameter	40.016 *AMC Home Negative Limit Selector*		
Short description			
Mode	RFC-S		
Minimum	0	Maximum	2
Default	0	Units	
Type	8 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW		

AMC Home Negative Limit (40.014) is used to indicate that the positive limit has been reached. If *AMC Home Negative Limit Selector* (40.016) is set to 0 then *AMC Home Negative Limit* (40.014) can be set by writing directly to the parameter or using bit 5 in *AMC Control Word* (41.019).

If *AMC Home Negative Limit Selector* (40.016) is set to 1 then *AMC Home Negative Limit* (40.014) is set to the output of the hard stop detector which is configured using *AMC Home Hard Stop Torque Threshold* (40.018) and *AMC Home Hard Stop Delay Time* (40.019).

If *AMC Home Negative Limit Selector* (40.016) is set to 2 then *AMC Home Negative Limit* (40.014) is set to *AMC Negative Hardware Limit Flag* (41.014). Note that when *AMC Negative Hardware Limit Flag* (41.014) is used as the negative limit for the homing sequence the negative hardware and software limits configured in *AMC Control and Status* (41) are disabled.

Parameter	40.017 *AMC Home Torque Limit Active*	
Short description		
Mode	RFC-S	
Minimum	0	Maximum	1
Default		Units	
Type	1 Bit Volatile	Update Rate	4ms write
Display Format	Standard	Decimal Places	0
Coding	RO, ND, NC, PT	

AMC Profile Input Speed

AMC Hard Stop Torque Threshold (40.018)

04.003 Final Torque Reference

Modulus

AMC Torque Limit Active

40.017

38.007 >= 0

AND Positive home limit

AMC Hard Stop Delay Time (40.019)

38.007 < 0

AND Negative home limit

AMC Profile Input Speed

Hard Stop Detector

AMC Home Torque Limit Active (40.017) is set to 1 when *Final Torque Reference* (04.003) ≥ *AMC Home Hard Stop Torque Threshold* (40.018). A hard stop is detected when *AMC Home Torque Limit Active* (40.017) has been continuously active for the *AMC Home Hard Stop Delay Time* (40.019). To allow the hard stop detector to perform the correct action in each *AMC Home Mode* (40.002) the home reference is used to differentiate between a positive and negative limit.

Parameter	40.018 *AMC Home Hard Stop Torque Threshold*	
Short description		
Mode	RFC-S	
Minimum	0.0	Maximum	1000.0
Default	0.0	Units	%
Type	16 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	1
Coding	RW	

See *AMC Home Torque Limit Active* (40.017).

Parameter	40.019 *AMC Home Hard Stop Delay Time*	
Short description		
Mode	RFC-S	
Minimum	0.000	Maximum	60.000
Default	0.000	Units	s
Type	16 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	3
Coding	RW, BU	

See *AMC Home Torque Limit Active* (40.017).

Parameter	40.020 *AMC Home Required*	
Short description		
Mode	RFC-S	
Minimum	0	Maximum	1
Default	0	Units	
Type	1 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW	

AMC Home Required (40.020) can be used to prevent *AMC Profile Input Position* (38.006) from being changed until a home sequence has been completed.

If *AMC Home Required* (40.020) is enabled and *AMC Home Slave Source* (40.021) is not the same as *AMC Slave Source Select* (33.001) then *AMC Profile Input Speed* (38.007) is held at zero unless *AMC Reference Select* (34.007) is set to Home, i.e. no motion other than a home is possible until a home has been completed using the slave feedback device selected in *AMC Slave Source Select* (33.001). Under this condition *AMC Home Required Flag* (41.017) and the corresponding bit in *AMC Status* (41.002) are set to indicate that a home is required before a reference can be applied to the input of the profile generator.

When a home has been completed *AMC Home Slave Source* (40.021) is set to *AMC Slave Source Select* (33.001) and the following parameters are saved automatically if the position feedback is configured to be absolute.

Parameters saved
AMC Home Slave Source (40.021)
AMC Slave Offset (33.003)

AMC Home Slave Source (40.021) is automatically reset (None) forcing another home to be completed in the following conditions.

Reset conditions	*AMC Home Slave Source* (40.021) saved
Home reference is selected	No
Absolute mode is disabled after the motion controller has been initialised	Yes
AMC Slave Source Select (33.001) is changed	Yes
AMC Slave Source Select (33.001) is set to the P1 or P2 feedback interface on the drive and an encoder trip is detected on the feedback device selected by *AMC Slave Source Select* (33.001). Note that *AMC Home Slave Source* (40.021) is not automatically reset if an encoder trip is detected when an option module is used to provide the slave feedback.	Yes

Note that if *AMC Home Required* (40.020) is disabled then *AMC Home Required Flag* (41.017) and the corresponding bit in *AMC Status* (41.002) are reset.

Parameter	40.021 *AMC Home Slave Source*		
Short description			
Mode	RFC-S		
Minimum	-1	Maximum	9
Default	-1	Units	
Type	8 Bit User Save	Update Rate	Background write
Display Format	Standard	Decimal Places	0
Coding	RW, TE		

Value	*Text*
-1	None
0	User Position
1	Sensorless
2	P1 Drive
3	P2 Drive
4	P1 Slot1
5	P2 Slot1
6	P1 Slot2
7	P2 Slot2
8	P1 Slot3
9	P2 Slot3

See *AMC Home Required* (40.020).

Mode: RFC‑S

Parameter	Range	Default	Type				
41.001 AMC Enable	Off (0) or On (1)	Off (0)	RW	Bit				US
41.002 AMC Status	0000000000000000 to 1111111111111111	0000000000000000	RO	Bin		NC		
41.003 AMC Movement Complete Window	0 to VM_AMC_POSITION_UNIPOLAR UU	256 UU	RW	Num				US
41.004 AMC Movement Complete Flag	Off (0) or On (1)		RO	Bit	ND	NC	PT	
41.005 AMC Profile Complete Window	0 to VM_AMC_POSITION_UNIPOLAR UU	256 UU	RW	Num				US
41.006 AMC Profile Complete Flag	Off (0) or On (1)		RO	Bit	ND	NC	PT	
41.007 AMC Following Error Window	0 to VM_AMC_POSITION_UNIPOLAR UU	256 UU	RW	Num				US
41.008 AMC Following Error Flag	Off (0) or On (1)		RO	Bit	ND	NC	PT	
41.009 AMC At Speed Window	±VM_AMC_SPEED_UNIPOLAR UU/ms	10.92 UU/ms	RW	Num				US
41.010 AMC At Speed Flag	Off (0) or On (1)		RO	Bit	ND	NC	PT	
41.011 AMC Master Speed Too High Flag	Off (0) or On (1)		RO	Bit	ND	NC	PT	
41.012 AMC Following Error Stop Flag	Off (0) or On (1)		RO	Bit	ND	NC	PT	
41.013 AMC Positive Hardware Limit Flag	Off (0) or On (1)		RO	Bit	ND	NC	PT	
41.014 AMC Negative Hardware Limit Flag	Off (0) or On (1)		RO	Bit	ND	NC	PT	
41.015 AMC Positive Software Limit Flag	Off (0) or On (1)		RO	Bit	ND	NC	PT	
41.016 AMC Negative Software Limit Flag	Off (0) or On (1)		RO	Bit	ND	NC	PT	
41.017 AMC Home Required Flag	Off (0) or On (1)		RO	Bit	ND	NC	PT	
41.018 AMC Position Feedback Initialised Flag	Off (0) or On (1)		RO	Bit	ND	NC	PT	
41.019 AMC Control Word	0000000000000000 to 1111111111111111	0000000000000000	RW	Bin		NC		
41.020 AMC Control Word Mask	0000000000000000 to 1111111111111111	1111111111111111	RW	Bin				US
41.021 AMC Control Word Enable	0 to 2	0	RW	Num				US
41.022 AMC Active Control Word	0000000000000000 to 1111111111111111	0000000000000000	RO	Bin			PT	PS
41.023 AMC Hardware Limit Stop Mode	Profile (0), No Profile (1)	No Profile (1)	RW	Txt				US
41.024 AMC Software Limit Stop Mode	Profile (0), No Profile (1)	Profile (0)	RW	Txt				US
41.025 AMC Enable Software Limits	Off (0) or On (1)	Off (0)	RW	Bit				US
41.026 AMC Positive Software Limit Position	±VM_AMC_POSITION UU	0 UU	RW	Num				US
41.027 AMC Negative Software Limit Position	±VM_AMC_POSITION UU	0 UU	RW	Num				US

RW	Read / Write	RO	Read-only	Bit	Bit parameter	Txt	Text string	Date	Date parameter	Time	Time parameter
Chr	Character parameter	Bin	Binary parameter	IP	IP address	Mac	MAC address	Ver	Version number	SMP	Slot, menu, parameter
Num	Number parameter	DE	Destination	ND	No default value	RA	Rating dependent	NC	Non-copyable	PT	Protected
FI	Filtered	US	User save	PS	Power-down save						

Menu 41 − *AMC Control and Status*

Mode: RFC‑S

Control and status

AMC Enable (41.001)

AMC Status (41.002)

AMC Control Word Mask (41.020)

AMC Control Word Enable (41.021)

AMC Control Word (41.019)

AMC Profile Input Position (38.006) → AMC Movement Complete Window (41.003)
AMC Slave Position (33.004) →
→ AMC Movement Complete Flag (41.004)

AMC Profile Input Position (38.006) → AMC Profile Complete Window (41.005)
AMC Profile Output Position (38.008) →
→ AMC Profile Complete Flag (41.006)

AMC Profile Output Position (38.008) → AMC Following Error Window (41.007)
AMC Slave Position (33.004) →
→ AMC Following Error Flag (41.008)

AMC Profile Input Speed (38.007) → AMC At Speed Window (41.009)
AMC Profile Output Speed (38.009) →
→ AMC At Speed Flag (41.010)

AMC Profile Maximum Speed (38.003) →
AMC Master Speed (32.005) →
→ AMC Master Speed Too High Flag (41.011)

AMC Following Error Flag (41.008) →
AMC Stop Mode (34.001) →
→ AMC Following Error Stop Flag (41.012)

AMC Hardware Limit Stop Mode (41.023) →
Forward Limit Switch (06.035) →
Negative Limit Switch (06.036) →
→ AMC Positive Hardware Limit Flag (41.013)
→ AMC Negative Hardware Limit Flag (41.014)

AMC Software Limit Stop Mode (41.024) →
AMC Software Limit Enable (41.025) →
AMC Software Limit Positive Position (41.026) →
AMC Software Limit Negative Position (41.027) →
→ AMC Positive Software Limit Flag (41.015)
→ AMC Negative Software Limit Flag (41.016)

AMC Home Required (40.020) →
AMC Home Slave Source (40.021) →
→ AMC Home Required Flag (41.017)

Position Feedback Initialised (03.076) →
→ AMC Position Initialised Flag (41.018)

Control and Status

Parameter	41.001 *AMC Enable*		
Short description	Enables or disables the AMC		
Mode	RFC‑S		
Minimum	0	Maximum	1
Default	0	Units	
Type	1 Bit User Save	Update Rate	AMC sample rate read
Display Format	Standard	Decimal Places	0
Coding	RW		

If *AMC Enable* (41.001), *Reference On* (01.011) or *AMC Position Feedback Initialised Flag* (41.018) = 0 the Advanced Motion Controller is held in the disabled state. The parameters given in the table below are held at the values given while the motion controller is disabled.

Parameter	Value in disable state
AMC Stop Reference (34.002)	*AMC Slave Position* (33.004)
AMC Profile Input Position (38.006) if *AMC Reference Select* (34.007) is 4	*AMC Master Position* (32.004) x Electronic gearbox ratio
AMC Profile Input Position (38.006) if *AMC Reference Select* (34.007) is not 4	*AMC Slave Position* (33.004)
AMC Profile Output Position (38.008)	*AMC Slave Position* (33.004)

When the motion controller is disabled the electronic gearbox is held in the unlocked state and the cam system is held at its start position.

Parameter	41.002 AMC Status		
Short description	Shows the status of the AMC		
Mode	RFC-S		
Minimum	0 (Display: 0000000000000000)	Maximum	65535 (Display: 1111111111111111)
Default	0 (Display: 0000000000000000)	Units	
Type	16 Bit Volatile	Update Rate	4ms write
Display Format	Binary	Decimal Places	0
Coding	RO, NC, BU		

AMC Status (41.002) gives the status of the motion controller with the bits shown in the table below.

Bit	Status
0	*AMC EGB Locked (37.006)*
1	*AMC Cam Complete (35.010)*
2	*AMC Movement Complete Flag (41.004)*
3	*AMC Profile Complete Flag (41.006)*
4	*AMC Following Error Flag (41.008)*
5	*AMC At Speed Flag (41.010)*
6	*AMC Master Speed Too High Flag (41.011)*
7	*AMC Following Error Stop Flag (41.012)*
8	*AMC Home Complete (40.005)*
9	*AMC Home Offset Complete (40.008)*
10	*AMC Positive Hardware Limit Flag (41.013)*
11	*AMC Negative Hardware Limit Flag (41.014)*
12	*AMC Positive Software Limit Flag (41.015)*
13	*AMC Negative Software Limit Flag (41.016)*
14	*AMC Home Required Flag (41.017)*
15	*AMC Position Feedback Initialised Flag (41.018)*

Parameter	41.003 AMC Movement Complete Window		
Short description			
Mode	RFC-S		
Minimum	0	Maximum	VM_AMC_POSITION_UNIPOLAR
Default	256	Units	UU
Type	32 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW, VM		

AMC Movement Complete Flag (41.004) is set to 1 if |*AMC Profile Input Position* (38.006) - *AMC Slave Position* (33.004)| ≤ *AMC Movement Complete Window* (41.003).

Parameter	41.004 AMC Movement Complete Flag		
Short description			
Mode	RFC-S		
Minimum	0	Maximum	1
Default		Units	
Type	1 Bit Volatile	Update Rate	4ms write
Display Format	Standard	Decimal Places	0
Coding	RO, ND, NC, PT		

See *AMC Movement Complete Window* (41.003).

Parameter	41.005 AMC Profile Complete Window		
Short description			
Mode	RFC-S		
Minimum	0	Maximum	VM_AMC_POSITION_UNIPOLAR
Default	256	Units	UU
Type	32 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW, VM		

AMC Profile Complete Flag (41.006) is set to 1 if |*AMC Profile Input Position* (38.006) - *AMC Profile Output Position* (38.008)| ≤ *AMC Profile Complete Window* (41.005). If *AMC Profile Complete Window* (41.005) is set to zero when the s-ramp profile is enabled (*AMC Profile Jerk 1* (38.011) > 0) then *AMC Profile Complete Flag* (41.006) is not set until *AMC Profile Input Position* (38.006) = *AMC Profile Output Position* (38.008) and the output of the profile is at standstill, i.e. *AMC Profile Output Speed* (38.009) = 0 and *AMC Profile Output Acceleration* (38.010) = 0.

Parameter	41.006 AMC Profile Complete Flag		
Short description			
Mode	RFC-S		
Minimum	0	Maximum	1
Default		Units	
Type	1 Bit Volatile	Update Rate	4ms write
Display Format	Standard	Decimal Places	0
Coding	RO, ND, NC, PT		

See *AMC Profile Complete Window* (41.005).

Parameter	41.007 AMC Following Error Window		
Short description			
Mode	RFC-S		
Minimum	0	Maximum	VM_AMC_POSITION_UNIPOLAR
Default	256	Units	UU
Type	32 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW, VM		

AMC Following Error Flag (41.008) is set to 1 if *AMC Profile Output Position* (38.008) - *AMC Slave Position* (33.004)| > *AMC Following Error Window* (41.007).

Parameter	41.008 AMC Following Error Flag		
Short description			
Mode	RFC-S		
Minimum	0	Maximum	1
Default		Units	
Type	1 Bit Volatile	Update Rate	4ms write
Display Format	Standard	Decimal Places	0
Coding	RO, ND, NC, PT		

See *AMC Following Error Window* (41.007).

Parameter	41.009 AMC At Speed Window		
Short description			
Mode	RFC-S		
Minimum	0.00	Maximum	VM_AMC_SPEED_UNIPOLAR
Default	10.92	Units	UU/ms
Type	32 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	2
Coding	RW, VM		

*10rpm for a 16 bits per revolution device (user units ratio = 1)

AMC At Speed Flag (41.010) is set to 1 if *AMC Profile Output Speed* (38.009) - *AMC Profile Input Speed* (38.007)| ≤ *AMC At Speed Window* (41.009).

Parameter	41.010 *AMC At Speed Flag*		
Short description			
Mode	RFC-S		
Minimum	0	Maximum	1
Default		Units	
Type	1 Bit Volatile	Update Rate	4ms write
Display Format	Standard	Decimal Places	0
Coding	RO, ND, NC, PT		

See *AMC At Speed Window* (41.009).

Parameter	41.011 *AMC Master Speed Too High Flag*		
Short description			
Mode	RFC-S		
Minimum	0	Maximum	1
Default		Units	
Type	1 Bit Volatile	Update Rate	4ms write
Display Format	Standard	Decimal Places	0
Coding	RO, ND, NC, PT		

AMC Master Speed Too High Flag (41.011) is set to 1 if |*AMC Master Speed* (32.005)| > *AMC Profile Maximum Speed* (38.003).

Parameter	41.012 *AMC Following Error Stop Flag*		
Short description			
Mode	RFC-S		
Minimum	0	Maximum	1
Default		Units	
Type	1 Bit Volatile	Update Rate	4ms write
Display Format	Standard	Decimal Places	0
Coding	RO, ND, NC, PT		

AMC Following Error Stop Flag (41.012) is set to 1 when *AMC Reference Select* (34.007) is automatically changed to 0 because a following error stop mode has been selected (*AMC Stop Mode* (34.001) = 2 or 3) and *AMC Following Error Flag* (41.008) is set, i.e. the following error has exceeded *AMC Following Error Window* (41.007) during a motion sequence. *AMC Following Error Stop Flag* (41.012) is cleared when *AMC Reference Select* (34.007) is changed.

Parameter	41.013 *AMC Positive Hardware Limit Flag*		
Short description			
Mode	RFC-S		
Minimum	0	Maximum	1
Default		Units	
Type	1 Bit Volatile	Update Rate	4ms write
Display Format	Standard	Decimal Places	0
Coding	RO, ND, NC, PT		

The following diagram shows a typical configuration for the hardware and software limits.

Typical Limit System Configuration
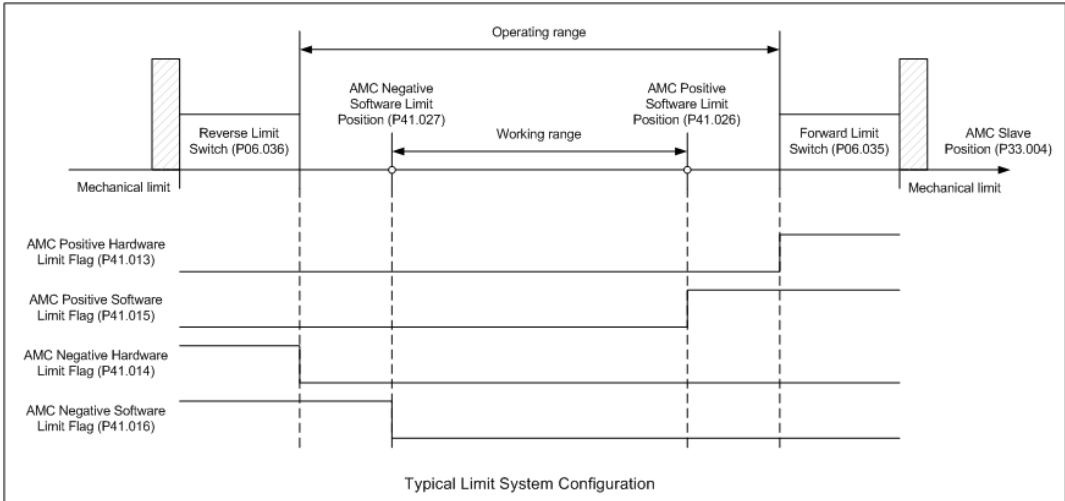
The operating range of the Advanced Motion Controller is defined by the physical position of the hardware limit switches which are routed to *Forward Limit Switch* (06.035) and *Reverse Limit Switch* (06.036). If digital input 4 or 5 are routed to *Forward Limit Switch* (06.035) or *Reverse Limit Switch* (06.036) the maximum delay between a limit switch being reached and the motion controller taking action is 4.35ms. The software limits are configured using *AMC Positive Software Limit Position* (41.026) and *AMC Negative Software Limit Position* (41.027) and these limits are active when *AMC Enable Software Limits* (41.025) = 1. The software position limits can be used to define a working range which will normally be within the operating range defined by the hardware limits. Unlike the operating range the working range is flexible and can be configured for an individual motion sequence. The maximum delay for a software limit is 4ms. Note that the software limits are disabled when performing a homing routine (*AMC Reference Select* (34.007) = 7).

The logic diagram for the limit switches is shown below.
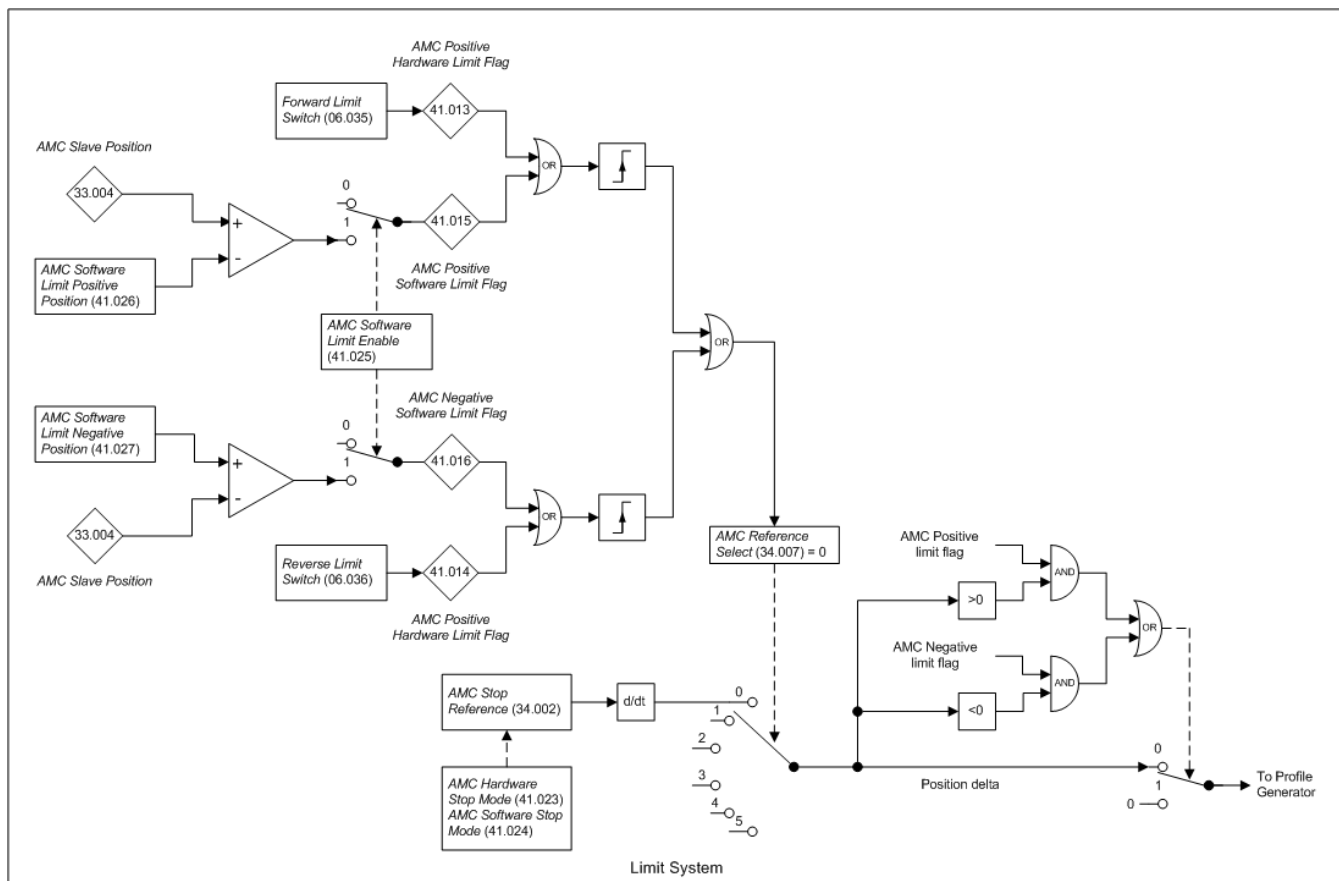
The hardware and software limits are active in the following conditions.

Limit switch	0	1
AMC Positive Hardware Limit Flag (41.013)	Forward Limit Switch (06.035) = 0	Forward Limit Switch (06.035) = 1
AMC Negative Hardware Limit Flag (41.014)	Reverse Limit Switch (06.036) = 0	Reverse Limit Switch (06.036) = 1
AMC Positive Software Limit Flag (41.015)	AMC Enable Software Limits (41.025) = 0 or AMC Slave Position (33.004) < (AMC Positive Software Limit Position (41.026) + Hysteresis)	AMC Slave Position (33.004) >= AMC Positive Software Limit Position (41.026)
AMC Negative Software Limit Flag (41.016)	AMC Enable Software Limits (41.025) = 0 or AMC Slave Position (33.004) > (AMC Negative Software Limit Position (41.027) + Hysteresis)	AMC Slave Position (33.004) <= AMC Negative Software Limit Position (41.027)

Note: When a software limit is active a hysteresis is applied to prevent the limit being disabled until the slave has moved away from the limit. This is required to prevent a small change of slave position from reactivating the limit when the slave is close to the position limit. The hysteresis applied is 4 x AMC Slave User Units Ratio Numerator (31.006) / AMC Slave User Units Ratio Denominator (31.007).

When a positive or negative limit is reached (positive transition of limit flag) AMC Stop Reference (34.002) is updated with the stop position and AMC Reference Select (34.007) is set to the stop reference. The stop mode used by the profile when a limit is reached is selected by AMC Hardware Limit Stop Mode (41.023) and AMC Software Limit Stop Mode (41.024). If AMC Hardware Limit Stop Mode (41.023) or AMC Software Limit Stop Mode (41.024) = 0 (profile) AMC Stop Reference (34.002) is set to AMC Profile Output Position (38.008) + stop position delta (position taken to reduce AMC Profile Output Speed (38.009) to zero under the constraints of the profile generator). Note that the target position for the slave will include AMC Position Error (39.008). When AMC Hardware Limit Stop Mode (41.023) or AMC Software Limit Stop Mode (41.024) = 1 (no profile) AMC Stop Reference (34.002) is set to AMC Slave Position (33.004) bringing the slave to a hard stop. If a limit is reached during a profiled stop and the stop mode for this limit is set to no profile the no profile stop will take priority and override the profile stop. When a limit is active the change of position applied to the input of the profile generator can only be in the direction that moves the slave away from the active limit. If a positive and negative limit are active no movement will be allowed.

Parameter	41.014 AMC Negative Hardware Limit Flag		
Short description			
Mode	RFC-S		
Minimum	0	Maximum	1
Default		Units	
Type	1 Bit Volatile	Update Rate	4ms write
Display Format	Standard	Decimal Places	0
Coding	RO, ND, NC, PT		

See AMC Positive Hardware Limit Flag (41.013).

Parameter	41.015 AMC Positive Software Limit Flag		
Short description			
Mode	RFC-S		
Minimum	0	Maximum	1
Default		Units	
Type	1 Bit Volatile	Update Rate	4ms write
Display Format	Standard	Decimal Places	0
Coding	RO, ND, NC, PT		

See AMC Positive Hardware Limit Flag (41.013).

Parameter	41.016 AMC Negative Software Limit Flag		
Short description			
Mode	RFC-S		
Minimum	0	Maximum	1
Default		Units	
Type	1 Bit Volatile	Update Rate	4ms write
Display Format	Standard	Decimal Places	0
Coding	RO, ND, NC, PT		

See AMC Positive Hardware Limit Flag (41.013).

Parameter	41.017 AMC Home Required Flag		
Short description			
Mode	RFC-S		
Minimum	0	Maximum	1
Default		Units	
Type	1 Bit Volatile	Update Rate	4ms Write
Display Format	Standard	Decimal Places	0
Coding	RO, ND, NC, PT		

AMC Home Required Flag (41.017) is set to 1 if *AMC Home Required* (40.020) is enabled and *AMC Home Slave Source* (40.021) is not the same as *AMC Slave Source Select* (33.001).

Parameter	41.018 AMC Position Feedback Initialised Flag		
Short description			
Mode	RFC-S		
Minimum	0	Maximum	1
Default		Units	
Type	1 Bit Volatile	Update Rate	Background write
Display Format	Standard	Decimal Places	0
Coding	RO, ND, NC, PT		

AMC Position Feedback Initialised Flag (41.018) is set to 1 when the master and slave position accumulators have been initialised. The motion controller cannot enter the enabled state (see *AMC Enable* (41.001)) until this flag is set. Note that the initialisation of the master and slave position feedback cannot be completed until all of the position feedback devices connected to the drive (see *Position Feedback Initialized* (03.076)) have been initialised and *AMC Position Feedback Initialised Flag* (41.018) is reset if any bit in *Position Feedback Initialized* (03.076) is cleared (e.g. *Initialise Position Feedback* (03.075) = 1).

Parameter	41.019 AMC Control Word		
Short description	Controls the AMC if the control word is enabled		
Mode	RFC-S		
Minimum	0 (Display: 0000000000000000)	Maximum	65535 (Display: 1111111111111111)
Default	0 (Display: 0000000000000000)	Units	
Type	16 Bit Volatile	Update Rate	4ms read
Display Format	Binary	Decimal Places	0
Coding	RW, NC, BU		

When *AMC Control Word Enable* (41.021) = 0 the control word is disabled and *AMC Control Word* (41.019), *AMC Control Word Mask* (41.020) and *AMC Active Control Word* (41.022) are not used by the motion controller. If *AMC Control Word Enable* (41.021) = 1 the bits in *AMC Control Word* (41.019) can be used instead of the parameters listed in the table below. Note that in this mode *AMC Active Control Word* (41.022) is always set to *AMC Control Word* (41.019) and bit 15 in the control word is ignored.

Bits	Corresponding parameter or function
0	*AMC Enable* (41.001)
1	*AMC Absolute Mode Enable* (31.002)
2	*AMC Incremental Position Reset Mode* (31.003)
3	*AMC Home Switch* (40.012)
4	*AMC Home Positive Limit* (40.013)
5	*AMC Home Negative Limit* (40.014)
6	*AMC Master Invert* (32.002)
7	*AMC Slave Invert* (33.002)
8	*AMC Output Invert* (39.013)
9	*AMC EGB Enable Rigid Lock* (37.001)
10	*AMC Speed Mode Enable* (31.014)
11	*AMC Enable Software Limits* (41.025)
12	*AMC Auto Resolution Enable* (31.015)
13	*AMC Home Required* (40.020)
14	Not used
15	Control word valid

Note that bits 4 and 5 are only used when the corresponding selector (*AMC Home Positive Limit Selector* (40.015) or *AMC Home Negative Limit Selector* (40.016)) is set to zero.

Each bit in the control word can be enabled or disabled independently by selecting or deselecting the corresponding bits in *AMC Control Word Mask* (41.020). None of the parameters in the table above have any effect when the control word is enabled unless the corresponding bit in the control word is disabled by the mask.

When *AMC Control Word Enable* (41.021) = 2 and a valid control word is written to *AMC Control Word* (41.019) (bit 15 = 1) the control word is copied to *AMC Active Control Word* (41.022) and the motion controller uses the control word to control the motion. If the control word is invalid (bit 15 = 0) the motion controller will continue to use the control word in *AMC Active Control Word* (41.022) until another valid control word is written to *AMC Control Word* (41.019). If the control word is being used to enable absolute mode then *AMC Control Word Enable* (41.021) should always be set to mode 2 otherwise the home position with rollover enabled will not be correct when the drive is power cycled.

Parameter	41.020 AMC Control Word Mask		
Short description	Controls the active bits in the AMC control word		
Mode	RFC-S		
Minimum	0 (Display: 0000000000000000)	Maximum	65535 (Display: 1111111111111111)
Default	65535 (Display: 1111111111111111)	Units	
Type	16 Bit User Save	Update Rate	4ms read
Display Format	Binary	Decimal Places	0
Coding	RW, BU		

See *AMC Control Word* (41.019).

Parameter	41.021 AMC Control Word Enable		
Short description	Set to 1 to enable the AMC control word		
Mode	RFC-S		
Minimum	0	Maximum	2
Default	0	Units	
Type	8 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW		

See *AMC Control Word* (41.019).

Parameter	41.022 AMC Active Control Word		
Short description	Control word used by the AMC		
Mode	RFC-S		
Minimum	0 (Display: 0000000000000000)	Maximum	65535 (Display: 1111111111111111)
Default	0 (Display: 0000000000000000)	Units	
Type	16 Bit Power Down Save	Update Rate	4ms write
Display Format	Binary	Decimal Places	0
Coding	RO, PT, BU		

See *AMC Control Word* (41.019).

Parameter	41.023 AMC Hardware Limit Stop Mode		
Short description	Stop mode used when a hardware limit is active		
Mode	RFC-S		
Minimum	0	Maximum	1
Default	1	Units	
Type	8 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW, TE		

Value	Text
0	Profile
1	No Profile

See *AMC Positive Hardware Limit Flag* (41.013).

Parameter	41.024 *AMC Software Limit Stop Mode*		
Short description	Stop mode used when a software limit is active		
Mode	RFC-S		
Minimum	0	Maximum	1
Default	0	Units	
Type	8 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW, TE		

Value	Text
0	Profile
1	No Profile

See *AMC Positive Hardware Limit Flag* (41.013).

Parameter	41.025 *AMC Enable Software Limits*		
Short description			
Mode	RFC-S		
Minimum	0	Maximum	1
Default	0	Units	
Type	1 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW		

See *AMC Positive Hardware Limit Flag* (41.013).

Parameter	41.026 *AMC Positive Software Limit Position*		
Short description			
Mode	RFC-S		
Minimum	−VM_AMC_POSITION	Maximum	VM_AMC_POSITION
Default	0	Units	UU
Type	32 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW, VM		

See *AMC Positive Hardware Limit Flag* (41.013).

Parameter	41.027 *AMC Negative Software Limit Position*		
Short description			
Mode	RFC-S		
Minimum	−VM_AMC_POSITION	Maximum	VM_AMC_POSITION
Default	0	Units	UU
Type	32 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW, VM		

See *AMC Positive Hardware Limit Flag* (41.013).

Slot 4 Menu 0 Single Line Descriptions − *Ethernet Setup*

Mode: RFC‑S

Parameter		Range	Default	Type					
4.00.001	Module ID	0 to 65535		RO	Num	ND	NC	PT	
4.00.002	Software Version	0 to 99999999		RO	Num	ND	NC	PT	
4.00.003	Hardware Version	0.00 to 99.99		RO	Num	ND	NC	PT	
4.00.004	Serial Number LS	00000000 to 99999999		RO	Num	ND	NC	PT	
4.00.005	Serial Number MS	0 to 99999999		RO	Num	ND	NC	PT	
4.00.006	Status	Bootldr ‑ Update (-2), Bootldr ‑ Idle (-1), Initialising (0), OK (1), Config (2), Error (3)		RO	Txt	ND	NC	PT	
4.00.007	Reset	Off (0) or On (1)	Off (0)	RW	Bit		NC		
4.00.008	Default	Off (0) or On (1)	Off (0)	RW	Bit		NC		
4.00.009	Active Alarm Bits	0000000000000000 to 1111111111111111	0000000000000000	RO	Bin		NC		
4.00.010	Active IP Address	128.0.0.0 to 127.255.255.255	0.0.0.0	RO	IP		NC	PT	
4.00.011	Date Code	0 to 65535		RO	Num	ND	NC	PT	

RW	Read / Write	RO	Read-only	Bit	Bit parameter	Txt	Text string	Date	Date parameter	Time	Time parameter
Chr	Character parameter	Bin	Binary parameter	IP	IP address	Mac	MAC address	Ver	Version number	SMP	Slot, menu, parameter
Num	Number parameter	DE	Destination	ND	No default value	RA	Rating dependent	NC	Non-copyable	PT	Protected
FI	Filtered	US	User save	PS	Power-down save						

Slot 4 Menu 0 − *Ethernet Setup*

Mode: RFC‑S

Parameter	4.00.001 *Module ID*		
Short description	Module ID		
Minimum	0	Maximum	65535
Default		Units	
Type	16 Bit Volatile	Update Rate	
Display Format	Standard	Decimal Places	0
Coding	RO, ND, NC, PT, BU		

The Module ID. Ethernet Factory Fit Module (FFM) = 430.

Parameter	4.00.002 *Software Version*		
Short description	Software Version		
Minimum	0	Maximum	99999999
Default		Units	
Type	32 Bit Volatile	Update Rate	
Display Format	Version	Decimal Places	0
Coding	RO, ND, NC, PT		

Module firmare version in ww.xx.yy.zz format

Parameter	4.00.003 *Hardware Version*		
Short description	Hardware Version		
Minimum	0.00	Maximum	99.99
Default		Units	
Type	16 Bit Volatile	Update Rate	
Display Format	Standard	Decimal Places	2
Coding	RO, ND, NC, PT		

Contains the module's hardware version information in the format xx.yy.

Parameter	4.00.004 *Serial Number LS*		
Short description	Serial Number LS		
Minimum	0 (Display: 00000000)	Maximum	99999999 (Display: 99999999)
Default		Units	
Type	32 Bit Volatile	Update Rate	Power-up write
Display Format	Lead Zero Pad	Decimal Places	0
Coding	RO, ND, NC, PT		

The module serial number is available as a pair of 32 bit values where *Serial Number LS* (MM.004) provides the least significant 8 decimal digits and *Serial Number MS* (MM.005) provides the most significant 8 decimal digits. The reconstructed serial number is ((MM.005* 100000000) + MM.004). For example serial number "0001234567898765" would be stored as MM.005 = 12345, MM.004 = 67898765.

Parameter	4.00.005 *Serial Number MS*		
Short description	Serial Number MS		
Minimum	0	Maximum	99999999
Default		Units	
Type	32 Bit Volatile	Update Rate	Power-up write
Display Format	Standard	Decimal Places	0
Coding	RO, ND, NC, PT		

See *Serial Number LS* (MM.004).

Parameter	4.00.006 *Status*		
Short description	Status		
Minimum	-2	Maximum	3
Default		Units	
Type	8 Bit Volatile	Update Rate	Background
Display Format	Standard	Decimal Places	0
Coding	RO, TE, ND, NC, PT		

Value	Text	Description
-2	Bootldr - Update	The bootloader is performing a flash update
-1	Bootldr - Idle	The bootloader is idle
0	Initialising	
1	OK	Module is initialised with no errors present
2	Config	A configuration error has been detected
3	Error	An error has occured preventing the module from running correctly

Parameter	4.00.007 *Reset*		
Short description	Reset		
Minimum	0	Maximum	1
Default	0	Units	
Type	1 Bit Volatile	Update Rate	Read every 200ms, Written to 0 on module initialisation
Display Format	Standard	Decimal Places	0
Coding	RW, NC		

When set the module performs a warm reset. When the reset has been performed and the module is performing its initialization routines the parameter will be cleared to zero. Note: The drive, and any other modules fitted to the drive will not be affected by the reset.

Parameter	4.00.008 *Default*		
Short description	Default		
Minimum	0	Maximum	1
Default	0	Units	
Type	1 Bit Volatile	Update Rate	Read every 200ms, Written to 0 on module initialisation
Display Format	Standard	Decimal Places	0
Coding	RW, NC		

If set to "ON" when the module is reset, this parameter will cause the option module to return to its "Out of Box configuration" any settings stored on the module will be returned to their default values. This will include any Web page customisations, e-mail settings etc. Following the default the module will set the parameter to "OFF" and the module will reset.

Take care using this parameter as any configuration information will be irretrievably lost!

Note: The password for the 'root' account is not reset back to default.

Parameter	4.00.009 *Active Alarm Bits*		
Short description			
Minimum	0 (Display: 0000000000000000)	Maximum	65535 (Display: 1111111111111111)
Default	0 (Display: 0000000000000000)	Units	
Type	16 Bit Volatile	Update Rate	Background
Display Format	Binary	Decimal Places	0
Coding	RO, NC, BU		

Bit	Alarm
0	User Program
1	eCMP
2	Modbus
3	Ethernet/IP
4	Reserved
5	Filesystem
6	Too Hot

Parameter	4.00.010 *Active IP Address*		
Short description			
Minimum	-2147483648 (Display: 128.0.0.0)	Maximum	2147483647 (Display: 127.255.255.255)
Default	0 (Display: 0.0.0.0)	Units	
Type	32 Bit Volatile	Update Rate	Background
Display Format	IP Address	Decimal Places	0
Coding	RO, NC, PT		

Modules active IP address.

Parameter	4.00.011 *Date Code*		
Short description			
Minimum	0	Maximum	65535
Default		Units	
Type	16 Bit Volatile	Update Rate	Background
Display Format	Standard	Decimal Places	0
Coding	RO, ND, NC, PT, BU		

Date Code (4.0.011) is a two-digit number in the form yyww where yy is the year and ww the week number.

Parameter	4.00.011 *Date Code*		
Short description			
Minimum	0	Maximum	65535
Default		Units	
Type	16 Bit Volatile	Update Rate	Background
Display Format	Standard	Decimal Places	0
Coding	RO, ND, NC, PT, BU		

Slot 4 Menu 2 Single Line Descriptions − *Ethernet Configuration*

Mode: RFC‑S

Parameter		Range	Default	Type					
4.02.003	Network Status	Initialising (0), Links Down (1), DHCP In Progress (2), No Address (3), Ready (4), Active (5)		RO	Txt	ND	NC	PT	
4.02.004	Network Message Count	0 to 65535 Messages/s		RO	Num	ND	NC	PT	
4.02.005	DHCP Enable	Off (0) or On (1)	On (1)	RW	Bit				US
4.02.006	IP Address	0.0.0.0 to 255.255.255.255	192.168.1.100	RW	IP				US
4.02.007	Subnet Mask	0.0.0.0 to 255.255.255.255	255.255.255.0	RW	IP				US
4.02.008	Default Gateway	0.0.0.0 to 255.255.255.255	192.168.1.254	RW	IP				US
4.02.009	Primary DNS	0.0.0.0 to 255.255.255.255	0.0.0.0	RW	IP				US
4.02.010	Secondary DNS	0.0.0.0 to 255.255.255.255	0.0.0.0	RW	IP				US
4.02.011	MAC Address	00:00:00:00:00:00 to FF:FF:FF:FF:FF:FF		RO	Mac	ND	NC	PT	
4.02.020	Priority Protocol	None (0), Modbus TCP (1), EtherNet/IP (2)	None (0)	RW	Txt				US
4.02.021	Web Server Enable	Off (0) or On (1)	On (1)	RW	Bit				US
4.02.022	Web Server Port	0 to 65535	80	RW	Num				US
4.02.024	Ethernet MTU	158 to 1500 Bytes	1500 Bytes	RW	Num				US
4.02.025	Gateway Mode	Switch (0), Gateway (1), Strict Gateway (2)	Switch (0)	RW	Txt				US
4.02.030	VLAN Enable	Off (0) or On (1)	Off (0)	RW	Bit				US
4.02.031	Drive VLAN ID	0 to 255	0	RW	Num				US
4.02.034	Drive compatibility mode	Unidrive M (0), Unidrive SP (1)	Unidrive M (0)	RW	Txt				US
4.02.035	Non cyclic enable	Off (0) or On (1)	Off (0)	RW	Bit				US
4.02.036	Non cyclic base parameter	0 to 59999	0	RW	Num				US

RW	Read / Write	RO	Read-only	Bit	Bit parameter	Txt	Text string	Date	Date parameter	Time	Time parameter
Chr	Character parameter	Bin	Binary parameter	IP	IP address	Mac	MAC address	Ver	Version number	SMP	Slot, menu, parameter
Num	Number parameter	DE	Destination	ND	No default value	RA	Rating dependent	NC	Non-copyable	PT	Protected
FI	Filtered	US	User save	PS	Power-down save						

Slot 4 Menu 2 − *Ethernet Configuration*

Mode: RFC‑S

Note: The maximum Ethernet packet size is 400 bytes.

Parameter	4.02.003 *Network Status*		
Short description	Shows the module status		
Minimum	0	Maximum	5
Default		Units	
Type	8 Bit Volatile	Update Rate	Written every second
Display Format	Standard	Decimal Places	0
Coding	RO, TE, ND, NC, PT, BU		

Value	*Text*	*Description*
0	Initialising	The network interface is being initialised
1	Links Down	No link connection has been detected on either of the Ethernet ports
2	DHCP In Progress	The module is apptempting to obtain an IP address, subnet mask, default gateway and DNS server addresses from a DHCP server
3	No Address	The module does not have an IP address - either the user has not provided one manually or one could not be allocated via DHCP
4	Ready	The network interface has been successfully configured but no data is being received or transmitted
5	Active	The network interface is receiving or transmitting data

This parameter indicates the status of the network that the module is connected to.

Parameter	4.02.004 *Network Message Count*		
Short description	Shows the number of messages per second		
Minimum	0	Maximum	65535
Default		Units	Messages/s
Type	16 Bit Volatile	Update Rate	Written every second
Display Format	Standard	Decimal Places	0
Coding	RO, ND, NC, PT, BU		

The number of frames that the module is transmitting / receiving every second.

Parameter	4.02.005 *DHCP Enable*		
Short description	Set to enable DHCP		
Minimum	0	Maximum	1
Default	1	Units	
Type	1 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW, BU		

Controls whether or not the module will attempt to use a Dynamic Host Configuration Protocol (DHCP) server to obtain an IP address, subnet mask, default gateway and DNS servers.

When DHCP is enabled, the following parameters will become read-only immediately (no reset required):

IP Address (4.02.006)

Subnet Mask (4.02.007)

Default Gateway (4.02.008)

Primary DNS (4.02.009)

Secondary DNS (4.02.010)

Parameter	4.02.006 *IP Address*		
Short description	Sets and/or shows the IP address of the module		
Minimum	0 (Display: 0.0.0.0)	Maximum	4294967295 (Display: 255.255.255.255)
Default	3232235876 (Display: 192.168.1.100)	Units	
Type	32 Bit User Save	Update Rate	DHCP enabled : write on event; DHCP disabled : read on reset
Display Format	IP Address	Decimal Places	0
Coding	RW, BU		

Controls and displays the IP address of the module.

If DHCP is enabled (*DHCP Enable* (4.02.005)) this parameter becomes read-only and, until an IP address is allocated to the module, will display 0.0.0.0.

If DHCP is disabled the module will initialise, on reset or power cycle, with the IP address stored for the parameter.

Parameter	4.02.007 *Subnet Mask*		
Short description	Sets and/or shows the subnet mask of the module		
Minimum	0 (Display: 0.0.0.0)	Maximum	4294967295 (Display: 255.255.255.255)
Default	4294967040 (Display: 255.255.255.0)	Units	
Type	32 Bit User Save	Update Rate	DHCP enabled : write on event; DHCP disabled : read on reset
Display Format	IP Address	Decimal Places	0
Coding	RW, BU		

Controls and displays the subnet mask of the module.

If DHCP is enabled (*DHCP Enable* (4.02.005)) this parameter becomes read-only and, until a subnet mask is allocated to the module, will display 0.0.0.0.

If DHCP is disabled the module will initialise, on reset or power cycle, with the subnet mask stored for the parameter.

Parameter	4.02.008 *Default Gateway*		
Short description	Sets and/or shows the default gateway of the module		
Minimum	0 (Display: 0.0.0.0)	Maximum	4294967295 (Display: 255.255.255.255)
Default	3232236030 (Display: 192.168.1.254)	Units	
Type	32 Bit User Save	Update Rate	DHCP enabled : write on event; DHCP disabled : read on reset
Display Format	IP Address	Decimal Places	0
Coding	RW, BU		

Controls and displays the default gateway of the module.

If DHCP is enabled (*DHCP Enable* (4.02.005)) this parameter becomes read-only and, until a default gateway is allocated to the module, will display 0.0.0.0.

If DHCP is disabled the module will initialise, on reset or power cycle, with the default gateway stored for the parameter.

Parameter	4.02.009 *Primary DNS*		
Short description	Sets and/or shows the primary DNS address of the module		
Minimum	0 (Display: 0.0.0.0)	Maximum	4294967295 (Display: 255.255.255.255)
Default	0 (Display: 0.0.0.0)	Units	
Type	32 Bit User Save	Update Rate	DHCP enabled : write on event; DHCP disabled : read on reset
Display Format	IP Address	Decimal Places	0
Coding	RW, BU		

The module can use this IP address when it wishes to resolve the IP address for a domain name. This parameter performs the same function as the Secondary DNS parameter *Secondary DNS* (4.02.010) , however the address specified in this parameter will be tried first. Only when this address is unsuccessful will the Secondary DNS address be tried.

If DHCP is enabled (*DHCP Enable* (4.02.005)) this parameter becomes read-only and, until a primary DNS address is allocated to the module, will display 0.0.0.0.

If DHCP is disabled the module will initialise, on reset or power cycle, with the primary DNS address stored for the parameter.

Parameter	4.02.010 *Secondary DNS*		
Short description	Sets and/or shows the secondary DNS address of the module		
Minimum	0 (Display: 0.0.0.0)	Maximum	4294967295 (Display: 255.255.255.255)
Default	0 (Display: 0.0.0.0)	Units	
Type	32 Bit User Save	Update Rate	DHCP enabled : write on event; DHCP disabled : read on reset
Display Format	IP Address	Decimal Places	0
Coding	RW, BU		

The module can use this IP address when it wishes to resolve the IP address for a domain name. This parameter performs the same function as the Primary DNS parameter *Primary DNS* (4.02.009) , however the address specified in this parameter will be tried only when the Primary DNS address is unsuccessful.

If DHCP is enabled (*DHCP Enable* (4.02.005)) this parameter becomes read-only and, until a secondary DNS address is allocated to the module, will display 0.0.0.0.

If DHCP is disabled the module will initialise, on reset or power cycle, with the secondary DNS address stored for the parameter.

Parameter	4.02.011 *MAC Address*		
Short description	Shows the MAC address of the module		
Minimum	0 (Display: 00:00:00:00:00:00)	Maximum	281474976710655 (Display: FF:FF:FF:FF:FF:FF)
Default		Units	
Type	64 Bit Volatile	Update Rate	Power-up write
Display Format	MAC Address	Decimal Places	0
Coding	RO, ND, NC, PT, BU		

The 48-bit MAC address of the module.

Parameter	4.02.020 *Priority Protocol*		
Short description	Sets the Priority Protocol		
Minimum	0	Maximum	2
Default	0	Units	
Type	8 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW, TE, BU		

Selection of the fieldbus protocol to have priority over all other protocols.

Value	Text	Description
0	None	All protocols have equal priority
1	Modbus TCP	Modbus TCP has highest priority
2	EtherNet/IP	EtherNet/IP has highest priority

Enables selection of one fieldbus protocol to have priority over others. A tick period of 1 ms will be given to the highest priority fieldbus protocol, 5 ms to all other fieldbus protocols (equal priority).

If no fieldbus protocol has been selected to have priority over others all protocols will have equal priority and a tick rate of 5 ms.

Parameter	4.02.021 *Web Server Enable*		
Short description	Enables the Web Server		
Minimum	0	Maximum	1
Default	1	Units	
Type	1 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW, BU		

Controls the running of the webserver on the module.

Parameter	4.02.022 *Web Server Port*		
Short description	Specifies the web server port		
Minimum	0	Maximum	65535
Default	80	Units	
Type	16 Bit User Save	Update Rate	Read on module reset and HTTP_ENABLE
Display Format	Standard	Decimal Places	0
Coding	RW, BU		

The web server port. This may be changed for added security.

Parameter	4.02.024 *Ethernet MTU*		
Short description	Specifies the MTU for the Ethernet interface		
Minimum	158	Maximum	1500
Default	1500	Units	Bytes
Type	16 Bit User Save	Update Rate	Read on module reset
Display Format	Standard	Decimal Places	0
Coding	RW, BU		

This parameter is now deprecated. The maximum Ethernet packet size is now 400 bytes.

Parameter	4.02.025 *Gateway Mode*		
Short description	Specifies the operation mode of the gateway		
Minimum	0	Maximum	2
Default	0	Units	
Type	8 Bit User Save	Update Rate	Read on module reset
Display Format	Standard	Decimal Places	0
Coding	RW, TE, BU		

Value	Text
0	Switch
1	Gateway
2	Strict Gateway

Specifies the operation mode of the gateway. By default the gateway is disabled and the switch operates in normal switch mode, by enabling the gateway mode all packets are filtered by the module and prioritised before being forwarded on. In strict mode the gateway will drop packets from unsupported protocols.

VLAN must be enabled *VLAN Enable* (4.02.030) when the gateway is enabled.

Parameter	4.02.030 *VLAN Enable*		
Short description	Enables VLAN tagging		
Minimum	0	Maximum	1
Default	0	Units	
Type	1 Bit User Save	Update Rate	Read on module reset
Display Format	Standard	Decimal Places	0
Coding	RW		

Controls whether the module will use VLAN tagging.

When used in conjunction with *Drive VLAN ID* (4.02.031) network traffic from the interface will be tagged with the chosen VLAN identifier.

When default values for *Drive VLAN ID* (4.02.031) is set, enabling this parameter will add VLAN prioritisation to all packets helping to ensure real-time packets are not delayed by those of lower priority. If disabled, prioritisation will use the Diffserv field in IP traffic only, meaning non-IP traffic can still affect real-time IP traffic.

Parameter	4.02.031 *Drive VLAN ID*		
Short description	Specifies a VLAN ID that the drive (Port 0) will be a member of		
Minimum	0	Maximum	255
Default	0	Units	
Type	8 Bit User Save	Update Rate	Read on module reset and VLAN_ENABLE
Display Format	Standard	Decimal Places	0
Coding	RW, BU		

Specifies the VLAN ID that the interface will be a member of. Any packets entering the switch without this VLAN ID will not be handled.

Parameter	4.02.034 *Drive compatibility mode*		
Short description	Specifies the mimic of the GT8 from a PLC for EthernetIP and Modbus		
Minimum	0	Maximum	1
Default	0	Units	
Type	8 Bit User Save	Update Rate	Read on module reset
Display Format	Standard	Decimal Places	0
Coding	RW, TE, BU		

Defines the parameter conversion for EthernetIP and Modbus.

Value	Text
0	Unidrive M
1	Unidrive SP

Parameter	4.02.035 *Non cyclic enable*		
Short description	Specify non cyclic enable		
Minimum	0	Maximum	1
Default	0	Units	
Type	1 Bit User Save	Update Rate	Background
Display Format	Standard	Decimal Places	0
Coding	RW		

Enable the Non cyclic data transfer.

Parameter	4.02.036 *Non cyclic base parameter*		
Short description	Specify the base parameter of the user program non cyclic handling		
Minimum	0	Maximum	59999
Default	0	Units	
Type	16 Bit User Save	Update Rate	Background
Display Format	Slot Menu Parameter	Decimal Places	0
Coding	RW, BU		

The value in this parameter points to the base address of a group of parameters which used for handling non cyclic data by user programs.

Suppose the base address is S.MM.PPP, the following are the functions of the group of the parameters. Please note that these parameters should be at least 16 bits in size.

Parameter	S.MM.PPP		
Description	Command and Status		
Identifier			
Mode(s)			
Minimum	0	Maximum	0x0403
Default	0	Units	
Type	16 bit user save	Update rate	

		FL	Floating point parameter	0	ND	No default	0
		DF	Display format	0	RA	Rating dependent	0
		PR	Pseudo read-only	0	NC	Not clonable	1
		FI	Filtered	0	NV	Not visible	0
		DE	Destination parameter	0	PT	Protected	0
		TE	Text parameter	0	NR	Not readable	0
		VM	Variable minimum/maximum	0	W	Writable	1
UNIT	0	DP	Decimal places	0	BU	Default (1 bit types) / Unipolar (all other types):	1

The MSB is used for Status and the LSB is used for Command.

Possible values for the Command are:

Value	Meaning	Description
0	No Command	No command or Abort during a command process
1	Check / Abort	Check if the status idle or abort from read or write command.
2	Read	Read one parameter
3	Write	Write one parameter

Possible values for the Status are:

Value	Meaning	Description
0	IDLE	Idle
1	READY	The parameter channel is ready to take commands
2	PROCESSING	Processing the command
3	OK	The command processed successfully
4	ERROR	Error is detected, detail will be found in the first parameter.
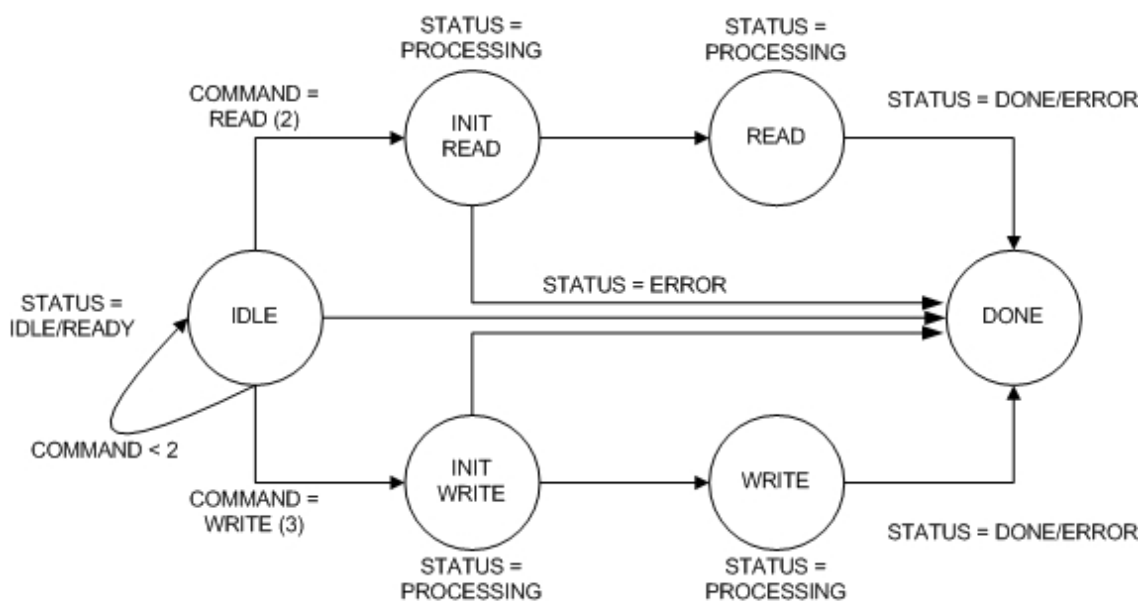
Note:
COMMAND = ABORT (0) in ANY state causes immediate transition to IDLE state

Parameter	S.MM.PPP + 1		
Description	Destination IP Address www.xxx		
Identifier			
Mode(s)			
Minimum	0	Maximum	0xFFFF
Default	0	Units	
Type	16 Bit User Save	Update rate	

		FL	Floating point parameter	0	ND	No default	0
		DF	Display format	0	RA	Rating dependent	0
		PR	Pseudo read-only	0	NC	Not clonable	0
		FI	Filtered	0	NV	Not visible	0
		DE	Destination parameter	1	PT	Protected	0
		TE	Text parameter	0	NR	Not readable	0
		VM	Variable minimum/maximum	0	W	Writable	1
UNIT	0	DP	Decimal places	0	BU	Default (1 bit types) / Unipolar (all other types):	1

The higher two sections for the destination IP address. 0xFF000000 (127.0.0.1) represents the current drive.

Parameter	S.MM.PPP + 2		
Description	Destination IP Address yyy.zzz		
Identifier			
Mode(s)			
Minimum	0	Maximum	0xFFFF
Default	0	Units	
Type	16 Bit User Save	Update rate	

		FL	Floating point parameter	0	ND	No default	0
		DF	Display format	0	RA	Rating dependent	0
		PR	Pseudo read-only	0	NC	Not clonable	0
		FI	Filtered	0	NV	Not visible	0
		DE	Destination parameter	1	PT	Protected	0
		TE	Text parameter	0	NR	Not readable	0
		VM	Variable minimum/maximum	0	W	Writable	1
UNIT	0	DP	Decimal places	0	BU	Default (1 bit types) / Unipolar (all other types):	1

The lower two sections for the destination IP address

Parameter	S.MM.PPP + 3		
Description	Parameter Address SMM		
Identifier			
Mode(s)			
Minimum	0	Maximum	499
Default	0	Units	
Type	16 Bit User Save	Update rate	

		FL	Floating point parameter	0	ND	No default	0
		DF	Display format	0	RA	Rating dependent	0
		PR	Pseudo read-only	0	NC	Not clonable	0
		FI	Filtered	0	NV	Not visible	0
		DE	Destination parameter	0	PT	Protected	0
		TE	Text parameter	0	NR	Not readable	0
		VM	Variable minimum/maximum	0	W	Writable	1
UNIT	0	DP	Decimal places	0	BU	Default (1 bit types) / Unipolar (all other types):	1

Destination parameter address – Slot and Menu sections.

Parameter	S.MM.PPP + 4		
Description	Parameter Address PPP		
Identifier			
Mode(s)			
Minimum	0	Maximum	999
Default	0	Units	
Type	16 Bit User Save	Update rate	

		FL	Floating point parameter	0	ND	No default	0
		DF	Display format	0	RA	Rating dependent	0
		PR	Pseudo read-only	0	NC	Not clonable	0
		FI	Filtered	0	NV	Not visible	0
		DE	Destination parameter	0	PT	Protected	0
		TE	Text parameter	0	NR	Not readable	0
		VM	Variable minimum/maximum	0	W	Writable	1
UNIT	0	DP	Decimal places	0	BU	Default (1 bit types) / Unipolar (all other types):	1

Destination parameter address - parameter section

Parameter	S.MM.PPP + 5		
Description	Parameter Value LSW / Error Code		
Identifier			
Mode(s)			
Minimum	-2^{15}	Maximum	$2^{15}-1$
Default	0	Units	
Type	16 Bit User Save	Update rate	

		FL	Floating point parameter	0	ND	No default	0
		DF	Display format	4	RA	Rating dependent	0
		PR	Pseudo read-only	0	NC	Not clonable	0
		FI	Filtered	0	NV	Not visible	0
		DE	Destination parameter	0	PT	Protected	0
		TE	Text parameter	0	NR	Not readable	0
		VM	Variable minimum/maximum	0	W	Writable	1
UNIT	0	DP	Decimal places	0	BU	Default (1 bit types) / Unipolar (all other types):	0

It stores the least significant word of the value to be write in to the destination parameter if the command is Write (2)

It stores the least significant word of the value read from the destination parameter if the command is read and the status is Done.

It is the error code for the process if the status is Error.

The following table list the possible error codes:

Value	Meaning	Description
-1	Address Type	The addressing type is not supported
-2	Timeout	A timeout occurred trying to access the specified item
-3	Access Denied	The requesting device does not have sufficient access rights
-4	Does not exist	The specified item does not exist
-5	Data Type	The data could not be converted from the specified type
-6	Failed Read	The value could not be read, reason unknown
-7	Failed Write	The value could not be written, reason unknown
-8	Not Readable	The data could not be read as the source does not allow read access.
-9	Not Writeable	The data could not be written as the destination does not allow write access.
-10	Over Range	The specified value is outside the suitable range for the item.
-11	Request Invalid	The request contained invalid information.
-12	Response Too Big	The response will not fit in the maximum response size.
-13	Decimal Place	The decimal place information is invalid (i.e. out of range of allowed values for a write).
-14	Invalid Param	Invalid parameter in the parameter channel.
-15	Invalid CMD	Invalid command
-16	Invalid IP	Invalid IP address
-17	Unknown Error	An unknown error happens
-18 to -128	*Reserved*	

Parameter	S.MM.PPP + 6		
Description	Parameter Value MSW		
Identifier			
Mode(s)			
Minimum	-2^{15}	Maximum	$2^{15}-1$
Default	0	Units	
Type	16 Bit User Save	Update rate	

		FL	Floating point parameter	0	ND	No default	0
		DF	Display format	4	RA	Rating dependent	0
		PR	Pseudo read-only	0	NC	Not clonable	0
		FI	Filtered	0	NV	Not visible	0
		DE	Destination parameter	0	PT	Protected	0
		TE	Text parameter	0	NR	Not readable	0
		VM	Variable minimum/maximum	0	W	Writable	1
UNIT	0	DP	Decimal places	0	BU	Default (1 bit types) / Unipolar (all other types):	0

It stores the most significant word of the value to be write in to the destination parameter if the command is Write (2)

It stores the most significant word of the value read from the destination parameter if the command is read and the status is Done.

Slot 4 Menu 9 Single Line Descriptions − *Resources*

Mode: RFC‑S

Parameter	Range	Default	Type					
4.09.001 Cyclic Tx Links Free	0 to 255		RO	Num	ND	NC	PT	
4.09.002 Cyclic Rx Links Free	0 to 255		RO	Num	ND	NC	PT	
4.09.003 Fieldbus Links Free	0 to 255		RO	Num	ND	NC	PT	
4.09.004 Cyclic Mappings Free	0 to 255		RO	Num	ND	NC	PT	
4.09.008 Background cycles per second	0 to 65535		RO	Num	ND	NC	PT	
4.09.010 Synchronous Task % Free	0 to 255 %		RO	Num	ND	NC	PT	
4.09.020 Synchronous Task Worst % Free	0 to 255 %		RO	Num	ND	NC	PT	
4.09.030 PCB Temperature	-128 to 127 °C		RO	Num	ND	NC	PT	

RW	Read / Write	RO	Read-only	Bit	Bit parameter	Txt	Text string	Date	Date parameter	Time	Time parameter
Chr	Character parameter	Bin	Binary parameter	IP	IP address	Mac	MAC address	Ver	Version number	SMP	Slot, menu, parameter
Num	Number parameter	DE	Destination	ND	No default value	RA	Rating dependent	NC	Non-copyable	PT	Protected
FI	Filtered	US	User save	PS	Power-down save						

Slot 4 Menu 9 − *Resources*

Mode: RFC‑S

Message Load

The Ethernet interface can accomodate multiple protocols running concurrently, each protocol demanding system resources. To ensure that the interface is not overloaded the following limitations should be followed.

1. maximum number of parameter accesses per second is 6000 (Unidrive M Ethernet interface) / 200 (SI-Ethernet on Unidrive M200 - M600)
2. maximum number of messages per second (02.004) is 8000

When checking that the message loading on a device is going to be acceptable, consider all protocols, e.g.:

Protocol	Number of Parameters	Rate	Parameters Accesses / Second	Message Rate / Second
Modbus TCP/IP	10 read	100 ms	100	10
EtherNet/IP	5 read	10 ms	500	100
	5 write	10 ms	500	100
RTMoE	2 write	500 µs	4000	2000
Total			5100	2210
Max. supported on M700/M800			6000	8000
Within Capability?			Yes	Yes

Cyclic data, with the exception of synchronous cyclic data, is exchanged with the drive and other options in the interface's background task. *Background cycles per second* (4.09.008) can be used to view the cycle rate of the background task. If the value drops to zero then a *BG Overrun* drive trip will occur.

RTMoE

RTMoE is an industrial Ethernet protocol for both cyclic and acyclic communication. The Ethernet interface RTMoE capabilities can be found in the table below.

Capability	Support Level
Non-cyclic communication	Supported
Total transmit cyclic links	5
Total receive cyclic links	5
Max number of transmit synchronous cyclic links	1 (Unidrive M interface only)
Max number of receive synchronous cyclic links	1 (Unidrive M interface only)
Max length of non-synchronous cyclic link	10 x 32 bit
Max length of synchronous cyclic link	2 x 32 bit
Min transmission period	500 µs
Synchronized with AMC	Yes (when cycle time >= 500us)
Synchronized with onboard program	Yes (when cycle time = 4ms)

Parameter	4.09.001 *Cyclic Tx Links Free*		
Short description			
Minimum	0	Maximum	255
Default		Units	
Type	8 Bit Volatile	Update Rate	Background write
Display Format	Standard	Decimal Places	0
Coding	RO, ND, NC, PT, BU		

The number of available transmit cyclic links.

Parameter	4.09.002 *Cyclic Rx Links Free*		
Short description			
Minimum	0	Maximum	255
Default		Units	
Type	8 Bit Volatile	Update Rate	Background write
Display Format	Standard	Decimal Places	0
Coding	RO, ND, NC, PT, BU		

The number of available receive cyclic links.

Parameter	4.09.003 *Fieldbus Links Free*		
Short description			
Minimum	0	Maximum	255
Default		Units	
Type	8 Bit Volatile	Update Rate	Background write
Display Format	Standard	Decimal Places	0
Coding	RO, ND, NC, PT, BU		

The number of available transmit / receive process images for fieldbus protocols such as Ethernet/IP.

Parameter	4.09.004 *Cyclic Mappings Free*		
Short description			
Minimum	0	Maximum	255
Default		Units	
Type	8 Bit Volatile	Update Rate	Background write
Display Format	Standard	Decimal Places	0
Coding	RO, ND, NC, PT, BU		

The number of available mappings in the system for use in cyclic links.

Parameter	4.09.008 *Background cycles per second*		
Short description			
Minimum	0	Maximum	65535
Default		Units	
Type	16 Bit Volatile	Update Rate	Background write
Display Format	Standard	Decimal Places	0
Coding	RO, ND, NC, PT, BU		

The background task cycles per second represents the number of times per second the background task is currently executing. The background task is responsible for cyclic data exchange with the drive. With more cyclic data mapped the cycle rate of the task will decrease.

Parameter	4.09.010 *Synchronous Task % Free*		
Short description			
Minimum	0	Maximum	255
Default		Units	%
Type	8 Bit Volatile	Update Rate	Background write
Display Format	Standard	Decimal Places	0
Coding	RO, ND, NC, PT, BU		

Note: Synchronous Cyclic Links are supported on (Unidrive M Ethernet interface) but not on (SI-Ethernet on Unidrive M200 - M600).

Parameter	4.09.020 *Synchronous Task Worst % Free*		
Short description			
Minimum	0	Maximum	255
Default		Units	%
Type	8 Bit Volatile	Update Rate	Background write
Display Format	Standard	Decimal Places	0
Coding	RO, ND, NC, PT, BU		

Worst case free resource of the synchronous task.

Note: Synchronous Cyclic Links are supported on (Unidrive M Ethernet interface) but not on (SI-Ethernet on Unidrive M200 - M600).

Parameter	4.09.030 *PCB Temperature*		
Short description			
Minimum	-128	Maximum	127
Default		Units	°C
Type	8 Bit Volatile	Update Rate	Background write
Display Format	Standard	Decimal Places	0
Coding	RO, ND, NC, PT		

Slot 4 Menu 10 Single Line Descriptions − *Easy Mode Cyclic Data*

Mode: RFC‑S

Parameter		Range	Default	Type					
4.10.001	Enable	Off (0) or On (1)	On (1)	RW	Bit				US
4.10.002	Reset	Off (0) or On (1)	Off (0)	RW	Bit		NC		
4.10.003	Default	Off (0) or On (1)	Off (0)	RW	Bit		NC		
4.10.004	Cyclic Messages Per Second	0 to 65535 Messages/s		RO	Num	ND	NC	PT	
4.10.005	Configuration Valid	Off (0) or On (1)		RO	Bit	ND	NC	PT	
4.10.006	Operational	Off (0) or On (1)		RO	Bit	ND	NC	PT	
4.10.007	Active Configuration	None (0), Easy Mode (1), Offline (2)		RO	Txt	ND	NC	PT	
4.10.008	Timeout Count	0 to 65535		RO	Num	ND	NC	PT	
4.10.009	Data Late Count	0 to 65535		RO	Num	ND	NC	PT	
4.10.010	Tx1 Link Profile	Std (0), Sync (1)	Std (0)	RW	Txt				US
4.10.011	Tx1 Link Number	0 to 255	0	RW	Num				US
4.10.012	Tx1 Source Parameter	0 to 499999	0	RW	Num			PT	US
4.10.013	Tx1 Parameter Count	0 to 10	0	RW	Num				US
4.10.014	Tx1 Link Transmission Type	Unicast (0), Broadcast (1), Multicast1 (2), Multicast2 (3), Multicast3 (4), Multicast4 (5), Multicast5 (6), Multicast6 (7), Multicast7 (8), Multicast8 (9), Multicast9 (10), Multicast10 (11)	Unicast (0)	RW	Txt				US
4.10.015	Tx1 Destination Address	0.0.0.0 to 255.255.255.255	0.0.0.0	RW	IP				US
4.10.016	Tx1 Message Rate	0 to 100 ms	0 ms	RW	Num				US
4.10.019	Tx1 Link Status	Disabled (-31), VLAN disabled (-30), Reserved 29 (-29), Reserved 28 (-28), Reserved 27 (-27), Reserved 26 (-26), Reserved 25 (-25), Reserved 24 (-24), Reserved 23 (-23), Invalid DST IP (-22), SYNC unsupported (-21), MEC offset (-20), Invalid tx rate (-19), Too many mapping (-18), Link busy (-17), Invalid profile (-16), Invalid mapping (-15), Read only param (-14), Msg mismatch (-13), Msg too long (-12), Attrib NA (-11), Attrib RO (-10), Attrib missing (-9), Timeout (-8), In error (-7), Link num in use (-6), Not editable (-5), Invalid link num (-4), Invalid args (-3), Too many links (-2), Out of memory (-1), OK (0), Not running (1), OK sync (2)		RO	Txt	ND	NC	PT	
4.10.020	Tx2 Link Profile	Std (0), Sync (1)	Std (0)	RW	Txt				US
4.10.021	Tx2 Link Number	0 to 255	0	RW	Num				US
4.10.022	Tx2 Source Parameter	0 to 499999	0	RW	Num			PT	US
4.10.023	Tx2 Parameter Count	0 to 10	0	RW	Num				US
4.10.024	Tx2 Link Transmission Type	Unicast (0), Broadcast (1), Multicast1 (2), Multicast2 (3), Multicast3 (4), Multicast4 (5), Multicast5 (6), Multicast6 (7), Multicast7 (8), Multicast8 (9), Multicast9 (10), Multicast10 (11)	Unicast (0)	RW	Txt				US
4.10.025	Tx2 Destination Address	0.0.0.0 to 255.255.255.255	0.0.0.0	RW	IP				US
4.10.026	Tx2 Message Rate	0 to 100 ms	0 ms	RW	Num				US
4.10.029	Tx2 Link Status	Disabled (-31), VLAN disabled (-30), Reserved 29 (-29), Reserved 28 (-28), Reserved 27 (-27), Reserved 26 (-26), Reserved 25 (-25), Reserved 24 (-24), Reserved 23 (-23), Invalid DST IP (-22), SYNC unsupported (-21), MEC offset (-20), Invalid tx rate (-19), Too many mapping (-18), Link busy (-17), Invalid profile (-16), Invalid mapping (-15), Read only param (-14), Msg mismatch (-13), Msg too long (-12), Attrib NA (-11), Attrib RO (-10), Attrib missing (-9), Timeout (-8), In error (-7), Link num in use (-6), Not editable (-5), Invalid link num (-4), Invalid args (-3), Too many links (-2), Out of memory (-1), OK (0), Not running (1), OK sync (2)		RO	Txt	ND	NC	PT	
4.10.030	Tx3 Link Profile	Std (0), Sync (1)	Std (0)	RW	Txt				US

4.10.031	Tx3 Link Number	0 to 255	0	RW	Num				US
4.10.032	Tx3 Source Parameter	0 to 499999	0	RW	Num			PT	US
4.10.033	Tx3 Parameter Count	0 to 10	0	RW	Num				US
4.10.034	Tx3 Link Transmission Type	Unicast (0), Broadcast (1), Multicast1 (2), Multicast2 (3), Multicast3 (4), Multicast4 (5), Multicast5 (6), Multicast6 (7), Multicast7 (8), Multicast8 (9), Multicast9 (10), Multicast10 (11)	Unicast (0)	RW	Txt				US
4.10.035	Tx3 Destination Address	0.0.0.0 to 255.255.255.255	0.0.0.0	RW	IP				US
4.10.036	Tx3 Message Rate	0 to 100 ms	0 ms	RW	Num				US
4.10.039	Tx3 Link Status	Disabled (-31), VLAN disabled (-30), Reserved 29 (-29), Reserved 28 (-28), Reserved 27 (-27), Reserved 26 (-26), Reserved 25 (-25), Reserved 24 (-24), Reserved 23 (-23), Invalid DST IP (-22), SYNC unsupported (-21), MEC offset (-20), Invalid tx rate (-19), Too many mapping (-18), Link busy (-17), Invalid profile (-16), Invalid mapping (-15), Read only param (-14), Msg mismatch (-13), Msg too long (-12), Attrib NA (-11), Attrib RO (-10), Attrib missing (-9), Timeout (-8), In error (-7), Link num in use (-6), Not editable (-5), Invalid link num (-4), Invalid args (-3), Too many links (-2), Out of memory (-1), OK (0), Not running (1), OK sync (2)		RO	Txt	ND	NC	PT	
4.10.040	Rx1 Link Profile	Std (0), Sync (1)	Std (0)	RW	Txt				US
4.10.041	Rx1 Link Number	0 to 255	0	RW	Num				US
4.10.042	Rx1 Destination Parameter	0 to 499999	0	RW	Num				US
4.10.043	Rx1 Parameter Count	0 to 10	0	RW	Num				US
4.10.044	Rx1 Source Type	Direct (0), Multicast1 (1), Multicast2 (2), Multicast3 (3), Multicast4 (4), Local (5), Multicast5 (6), Multicast6 (7), Multicast7 (8), Multicast8 (9), Multicast9 (10), Multicast10 (11)	Direct (0)	RW	Txt				US
4.10.045	Rx1 Timeout	0 to 65535 ms	100 ms	RW	Num				US
4.10.046	Rx1 Timeout Action	Trip (0), Clear output (1), Hold last (2)	Trip (0)	RW	Txt				US
4.10.047	Rx1 Timeout Event Destination	This slot (0), Slot 1 (1), Slot 2 (2), Slot 3 (3), Slot 4 (4)	This slot (0)	RW	Txt				US
4.10.048	Rx1 Timeout Event Type	No Event (0), Event (1), Event1 (2), Event2 (3), Event3 (4)	No Event (0)	RW	Txt				US
4.10.049	Rx1 Link Status	Disabled (-31), VLAN disabled (-30), Reserved 29 (-29), Reserved 28 (-28), Reserved 27 (-27), Reserved 26 (-26), Reserved 25 (-25), Reserved 24 (-24), Reserved 23 (-23), Invalid DST IP (-22), SYNC unsupported (-21), MEC offset (-20), Invalid tx rate (-19), Too many mapping (-18), Link busy (-17), Invalid profile (-16), Invalid mapping (-15), Read only param (-14), Msg mismatch (-13), Msg too long (-12), Attrib NA (-11), Attrib RO (-10), Attrib missing (-9), Timeout (-8), In error (-7), Link num in use (-6), Not editable (-5), Invalid link num (-4), Invalid args (-3), Too many links (-2), Out of memory (-1), OK (0), Not running (1), OK sync (2)		RO	Txt	ND	NC	PT	
4.10.050	Rx2 Link Profile	Std (0), Sync (1)	Std (0)	RW	Txt				US
4.10.051	Rx2 Link Number	0 to 255	0	RW	Num				US
4.10.052	Rx2 Destination Parameter	0 to 499999	0	RW	Num				US
4.10.053	Rx2 Parameter Count	0 to 10	0	RW	Num				US
4.10.054	Rx2 Source Type	Direct (0), Multicast1 (1), Multicast2 (2), Multicast3 (3), Multicast4 (4), Local (5), Multicast5 (6), Multicast6 (7), Multicast7 (8), Multicast8 (9),	Direct (0)	RW	Txt				US

		Multicast9 (10), Multicast10 (11)							
4.10.055	Rx2 Timeout	0 to 65535 ms	100 ms	RW	Num				US
4.10.056	Rx2 Timeout Action	Trip (0), Clear output (1), Hold last (2)	Trip (0)	RW	Txt				US
4.10.057	Rx2 Timeout Event Destination	This slot (0), Slot 1 (1), Slot 2 (2), Slot 3 (3), Slot 4 (4)	This slot (0)	RW	Txt				US
4.10.058	Rx2 Timeout Event Type	No Event (0), Event (1), Event1 (2), Event2 (3), Event3 (4)	No Event (0)	RW	Txt				US
4.10.059	Rx2 Link Status	Disabled (-31), VLAN disabled (-30), Reserved 29 (-29), Reserved 28 (-28), Reserved 27 (-27), Reserved 26 (-26), Reserved 25 (-25), Reserved 24 (-24), Reserved 23 (-23), Invalid DST IP (-22), SYNC unsupported (-21), MEC offset (-20), Invalid tx rate (-19), Too many mapping (-18), Link busy (-17), Invalid profile (-16), Invalid mapping (-15), Read only param (-14), Msg mismatch (-13), Msg too long (-12), Attrib NA (-11), Attrib RO (-10), Attrib missing (-9), Timeout (-8), In error (-7), Link num in use (-6), Not editable (-5), Invalid link num (-4), Invalid args (-3), Too many links (-2), Out of memory (-1), OK (0), Not running (1), OK sync (2)		RO	Txt	ND	NC	PT	
4.10.060	Rx3 Link Profile	Std (0), Sync (1)	Std (0)	RW	Txt				US
4.10.061	Rx3 Link Number	0 to 255	0	RW	Num				US
4.10.062	Rx3 Destination Parameter	0 to 499999	0	RW	Num				US
4.10.063	Rx3 Parameter Count	0 to 10	0	RW	Num				US
4.10.064	Rx3 Source Type	Direct (0), Multicast1 (1), Multicast2 (2), Multicast3 (3), Multicast4 (4), Local (5), Multicast5 (6), Multicast6 (7), Multicast7 (8), Multicast8 (9), Multicast9 (10), Multicast10 (11)	Direct (0)	RW	Txt				US
4.10.065	Rx3 Timeout	0 to 65535 ms	100 ms	RW	Num				US
4.10.066	Rx3 Timeout Action	Trip (0), Clear output (1), Hold last (2)	Trip (0)	RW	Txt				US
4.10.067	Rx3 Timeout Event Destination	This slot (0), Slot 1 (1), Slot 2 (2), Slot 3 (3), Slot 4 (4)	This slot (0)	RW	Txt				US
4.10.068	Rx3 Timeout Event Type	No Event (0), Event (1), Event1 (2), Event2 (3), Event3 (4)	No Event (0)	RW	Txt				US
4.10.069	Rx3 Link Status	Disabled (-31), VLAN disabled (-30), Reserved 29 (-29), Reserved 28 (-28), Reserved 27 (-27), Reserved 26 (-26), Reserved 25 (-25), Reserved 24 (-24), Reserved 23 (-23), Invalid DST IP (-22), SYNC unsupported (-21), MEC offset (-20), Invalid tx rate (-19), Too many mapping (-18), Link busy (-17), Invalid profile (-16), Invalid mapping (-15), Read only param (-14), Msg mismatch (-13), Msg too long (-12), Attrib NA (-11), Attrib RO (-10), Attrib missing (-9), Timeout (-8), In error (-7), Link num in use (-6), Not editable (-5), Invalid link num (-4), Invalid args (-3), Too many links (-2), Out of memory (-1), OK (0), Not running (1), OK sync (2)		RO	Txt	ND	NC	PT	

RW	Read / Write	RO	Read-only	Bit	Bit parameter	Txt	Text string	Date	Date parameter	Time	Time parameter
Chr	Character parameter	Bin	Binary parameter	IP	IP address	Mac	MAC address	Ver	Version number	SMP	Slot, menu, parameter
Num	Number parameter	DE	Destination	ND	No default value	RA	Rating dependent	NC	Non-copyable	PT	Protected
FI	Filtered	US	User save	PS	Power-down save						

Slot 4 Menu 10 − *Easy Mode Cyclic Data*

Mode: RFC‑S

Overview

The minimum parameters required to configure a 3 transmit links and 3 receive links are specified below. In addition to these each receive link can have its own timeout configured with an additional custom action.

Base link parameters

Link	Sync Enable	Link No.	Src/Dst Par	Par Count	Type	IP Address	Message Period
Tx 1	S.10.010	S.10.011	S.10.012‡	S.10.013	S.10.014†	S.10.015†	S.10.016
Tx 2	S.10.020	S.10.021	S.10.022‡	S.10.023	S.10.024†	S.10.025†	S.10.026
Tx 3	S.10.030	S.10.031	S.10.032‡	S.10.033	S.10.034†	S.10.035†	S.10.036
Rx 1	S.10.040	S.10.041	S.10.042	S.10.043	S.10.044	n/a	n/a
Rx 2	S.10.050	S.10.051	S.10.052	S.10.053	S.10.054	n/a	n/a
Rx 3	S.10.060	S.10.061	S.10.062	S.10.063	S.10.064	n/a	n/a

† Required if Type == 'direct'

Parameter Mapping Configuration

For each cyclic link a start parameter and number of consecutive parameters must be defined. A typical requirement is to transmit and receive parameter values from non-consecutive parameters. This can be performed by configuring a suitable Menu 0 parameter as the start parameter and the required number of parameters as the count. Menu 22 of the drive can be used to configure what parameters the selected Menu 0 parameters point to.

For example to configure a 1ms transmit cyclic link with control word and speed reference the following parameter changes would be required:

Pr S.10.011	1
Pr S.10.012	0.00.020
Pr S.10.013	2
Pr S.10.014	Broadcast (1)
Pr S.10.016	1
Pr 0.22.020	6.042
Pr 0.22.021	1.021

Synchronous Cyclic Data

Note: Synchronous Cyclic Links are supported on Unidrive M onboard Ethernet interface but not on SI-Ethernet on Unidrive M200 - M600.

Cyclic data links can be made synchronous, utilising the IEEE1588 clock time distributed across the network. The IEEE1588 clock can synchronise the drive's control loops, Pr 11.002 displays the active option slot providing synchronisation. With synchronised control loops the Ethernet interface can be used to transfer drive parameters containing motion information, including those from the AMC.

Synchronous links work by including the time of when the data should be used along with the data values. This time allows enough time for the cyclic link to reach all destination devices, the time allowed for can be set in *Easy Mode Maximum Network Delay* (11.030). The receiving interface will wait for its current time to match the timestamp in the cyclic link before processing the message.

Transmit

1 link can be synchronous with a maximum of 2 x 32bit parameters.

Receive

1 link can be synchronous with a maximum of 2 x 32bit parameters.

VLAN

To guarantee the timing of synchronous links VLANs must be enabled using *Drive VLAN ID* (4.02.031). VLANs include a priority field that is applied to all messages. This field is used to apply a higher priority to synchronous cyclic data than other non-deterministic traffic.

AMC & Onboard User Program Timing

Synchronous cyclic data can be used with both the AMC and the drives user program. When using synchronous cyclic data with the AMC ensure that the AMC Rate Select (Pr 31.012) is the same as the transmission rate; 250us, 500us, 1ms, 2ms or 4ms. the clock task of the onboard user program can be scheduled for periods 4ms and greater. For the clock task on multiple drives synchronised with IEEE1588 to be synchronised and in phase all clock tasks must be set to 4ms only. If synchronous cyclic data is used both for the AMC and the user program interacting with the AMC then Pr 31.012 and the clock task must be 4ms.

Virtual Master

It is possible to send cyclic data to devices on the network and use the same data on the transmitting device. The cyclic links must be synchronous to include timing information. On the transmitting device a rceieve link must also be configured with a matching link number to the transmit. for this link you must set the source type *Rx1 Source Type* (4.10.044) to be *Local*. The Ethernet interface will delay the usage of the data transmitted until the same point in time that all receiving slaves will use the data.

Parameter Update Rate

Parameters are exchange over the network. The value exchanged with the network must be exchanged with the drive or option parameter. The rate of

data exchange differs for synchronous / non-synchronous cyclic links as well as for drive/option destinations.

The diagram below depicts the update cycles used within the Ethernet interface. Cyclic link mappings being exchanged with the drive will be updated at the background task rate. This rate *Background cycles per second* (4.09.008) varies with the load on the Ethernet interface; Ethernet/IP data exchange also takes place in the background task.
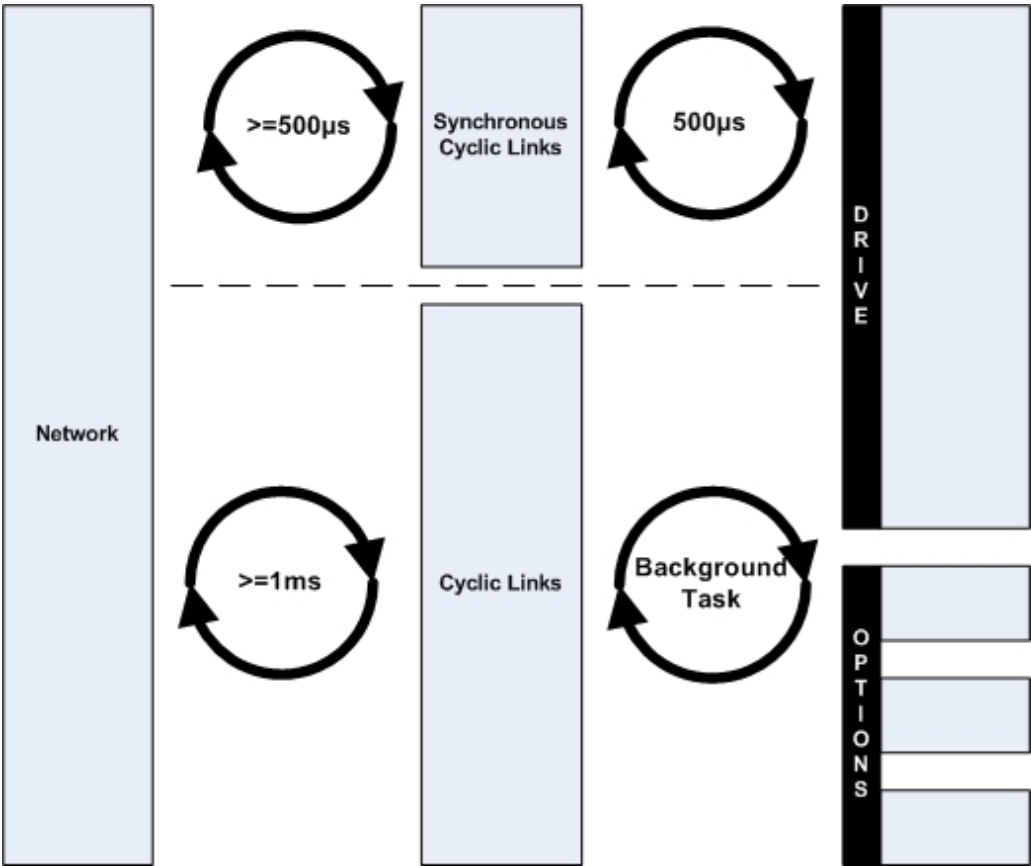
Parameter	4.10.001 *Enable*		
Short description	Easy mode enable		
Minimum	0	Maximum	1
Default	1	Units	
Type	1 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW, BU		

Parameter	4.10.002 *Reset*		
Short description	Set to reset the interface		
Minimum	0	Maximum	1
Default	0	Units	
Type	1 Bit Volatile	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW, NC		

This parameter is used to perform a warm reset of the protocol interface. When set and the protocol has reset, the parameter will be reset to zero (Off).

Parameter	4.10.003 *Default*		
Short description	Set to default the protocol interface		
Minimum	0	Maximum	1
Default	0	Units	
Type	1 Bit Volatile	Update Rate	Read on reset
Display Format	Standard	Decimal Places	0
Coding	RW, NC		

This parameter allows the protocol to be defaulted to factory settings. This includes all of the protocol features, configuration, mappings and stored objects.

Parameter	4.10.004 *Cyclic Messages Per Second*		
Short description	Displays the total number of received amd transmitted per second		
Minimum	0	Maximum	65535
Default		Units	Messages/s
Type	16 Bit Volatile	Update Rate	Background
Display Format	Standard	Decimal Places	0
Coding	RO, ND, NC, PT, BU		

Displays the total number of cyclic (Rx and Tx) messages per second. This includes Easy Mode and Offline configurations.

Parameter	4.10.005 *Configuration Valid*		
Short description	Indicates that the active configuration is valid		
Minimum	0	Maximum	1
Default		Units	
Type	1 Bit Volatile	Update Rate	Reset, Background
Display Format	Standard	Decimal Places	0
Coding	RO, ND, NC, PT		

If the active configuration identified by *Active Configuration* (4.10.007) has no configuration errors then the configuration is valid and this parameter will be On (1).

If the active configuration is *Easy Mode* made effective through a *Reset* (4.10.002) to On; *Configuration Valid* (4.10.005) value can be read once *Reset* (4.10.002) returns to Off as shown in the associated timing diagram.

If the active configuration is *Offline* (representing a configuration provided by a PC tool) the configuration was created in conjunction with the user application.
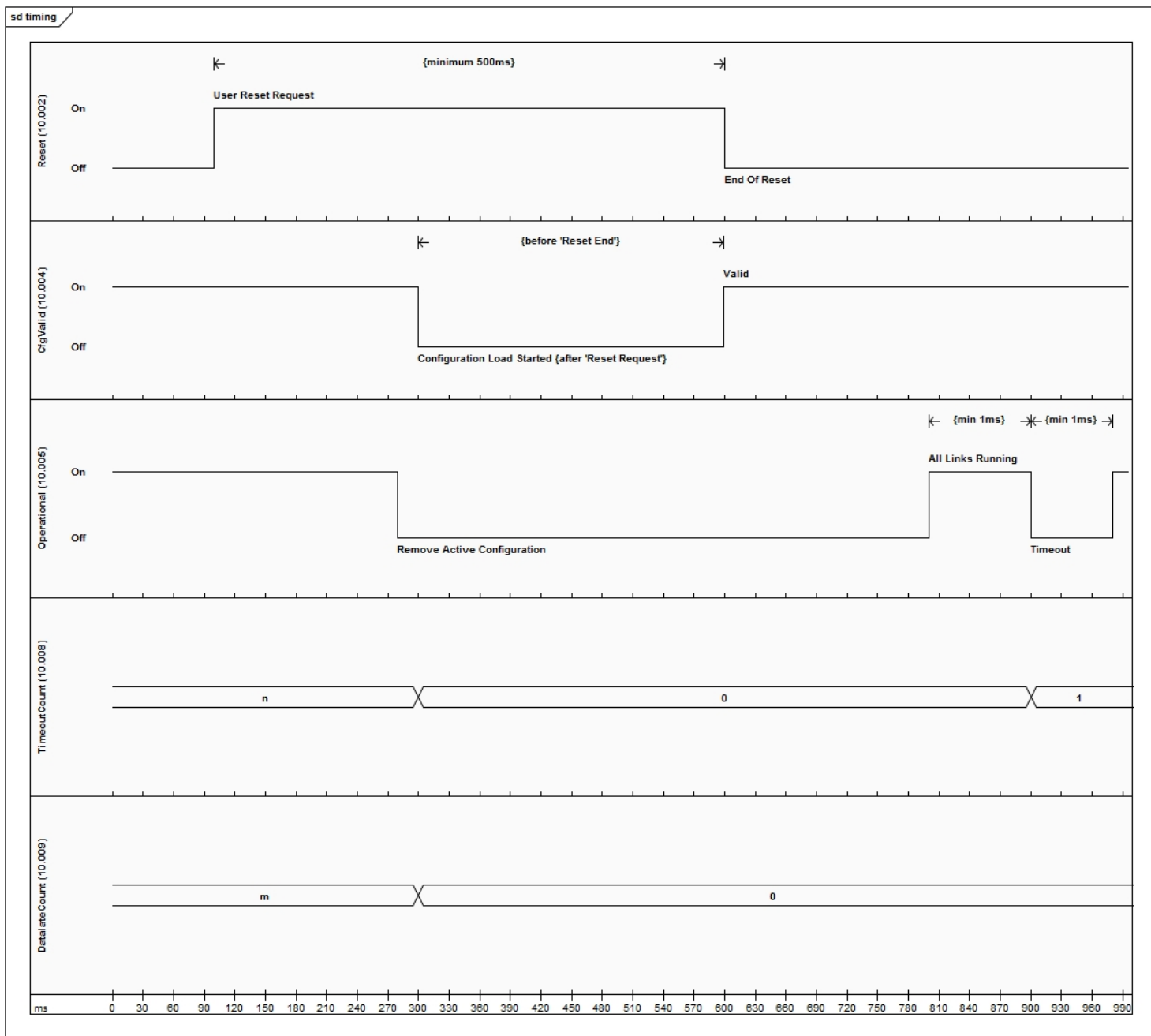
Parameter	4.10.006 *Operational*		
Short description	Indicates that the all links in the active configuration are receiving/transmitting successfully		
Minimum	0	Maximum	1
Default		Units	
Type	1 Bit Volatile	Update Rate	1ms
Display Format	Standard	Decimal Places	0
Coding	RO, ND, NC, PT		

This parameter provides an indication that all links in the active configuration are:

1. Receiving new messages successfully AND
2. Transmitting links; this however does not mean the destination devices are receiving the messages; this will be dependent on their own state.

A receive link timeout will cause this parameter to become cleared until a new message is received. A single data late event will cause this parameter to be Off until the next cyclic message is received on time. This parameter is updated every 1ms; if low latency reactions to timeout and data late events are required then appropriate actions should be configured for the links, see *Rx1 Timeout Action* (4.10.046) and *Rx1 Late Synchronisation Frame Action* (4.11.040) for further details.

See timing diagram in *Configuration Valid* (4.10.005).

A user program utilising cyclic data may use this parameter along with *Configuration Valid* (4.10.005) to detect when cyclic communication is operational; once detected if the user program wishes to monitor for timeout or data late events the provided counters (*Timeout Count* (4.10.008) and *Data Late Count* (4.10.009)) can be used.

Parameter	4.10.007 *Active Configuration*		
Short description	Displays the active configuration source of cyclic data		
Minimum	0	Maximum	2
Default		Units	
Type	8 Bit Volatile	Update Rate	Reset
Display Format	Standard	Decimal Places	0
Coding	RO, TE, ND, NC, PT, BU		

Value	Text	Description
0	None	No configuration active
1	Easy Mode	Easy Mode configuration active
2	Offline	Offline configuration from PC tools active

Displays the active configuration source of cyclic data.

Parameter	4.10.008 *Timeout Count*		
Short description	Displays the number of receive timeout events		
Minimum	0	Maximum	65535
Default		Units	
Type	16 Bit Volatile	Update Rate	1ms
Display Format	Standard	Decimal Places	0
Coding	RO, ND, NC, PT, BU		

This parameter displays the total number of receive timeout events; the parameter value will wrap over to zero.

A reset of the configuration will clear this count; see the timing diagram of *Configuration Valid* (4.10.005). Each timeout event will increment the count. The count can be sampled by a user application in order to detect change since the last sample; this enables custom reaction to a timeout event occurring on any cyclic receive link which has a timeout value configured, irrespective of the timeout action for the link.

If a custom timeout reaction is required on a per-link basis then the link action must be chosen appropriately in *Rx1 Timeout Action* (4.10.046); this could be *Clear output* to write zero to all of the cyclic parameters and implement monitoring code for this condition in the user application.

Parameter	4.10.009 *Data Late Count*		
Short description	Displays the number of receive data late events		
Minimum	0	Maximum	65535
Default		Units	
Type	16 Bit Volatile	Update Rate	1ms
Display Format	Standard	Decimal Places	0
Coding	RO, ND, NC, PT, BU		

This parameter displays the total number of receive data late events; the parameter value will wrap over to zero.

A reset of the configuration will clear this count; see the timing diagram of *Configuration Valid* (4.10.005). Each data late event will increment the count. The count can be sampled by a user application in order to detect change since the last sample; this enables custom reaction to a data late event occurring on a synchronous cyclic receive link which has a received a message containing a time that is now in the past irrespective the defined action for the link.

Parameter	4.10.010 *Tx1 Link Profile*		
Short description	Selects the Tx1 link as a standard or synchronous cyclic link		
Minimum	0	Maximum	1
Default	0	Units	
Type	8 Bit User Save	Update Rate	Read on reset
Display Format	Standard	Decimal Places	0
Coding	RW, TE		

Value	Text	Description
0	Std	Standard link
1	Sync	Synchronized link

Used to select Tx1 as a standard or synchronous cyclic link.

Parameter	4.10.011 *Tx1 Link Number*		
Short description	Sets the link number for the Tx1 link		
Minimum	0	Maximum	255
Default	0	Units	
Type	8 Bit User Save	Update Rate	Read on reset
Display Format	Standard	Decimal Places	0
Coding	RW, BU		

This is used to set the link number for the Tx1 link.

Parameter	4.10.012 *Tx1 Source Parameter*		
Short description	Sets the source parameter for the Tx1 link		
Minimum	0	Maximum	499999
Default	0	Units	
Type	32 Bit User Save	Update Rate	Read on reset
Display Format	Slot Menu Parameter	Decimal Places	0
Coding	RW, PT, BU		

This sets the source parameter for the Tx1 link.

Parameter	4.10.013 *Tx1 Parameter Count*		
Short description	Sets the number of parameters for the Tx1 link		
Minimum	0	Maximum	10
Default	0	Units	
Type	8 Bit User Save	Update Rate	Read on reset
Display Format	Standard	Decimal Places	0
Coding	RW, BU		

This is used to set the number of contiguous parameters for the Tx1 link.

Parameter	4.10.014 *Tx1 Link Transmission Type*		
Short description	Sets the transmission type of the Tx1 link		
Minimum	0	Maximum	11
Default	0	Units	
Type	8 Bit User Save	Update Rate	Read on reset
Display Format	Standard	Decimal Places	0
Coding	RW, TE, BU		

Value	Text	Description
0	Unicast	Link is unicast to the IP address specified
1	Broadcast	Link is broadcast (255.255.255.255)
2	Multicast1	Link is multicast to the IP address
3	Multicast2	Link is multicast to the IP address
4	Multicast3	Link is multicast to the IP address
5	Multicast4	Link is multicast to the IP address
6	Multicast5	Link is multicast to the IP address
7	Multicast6	Link is multicast to the IP address
8	Multicast7	Link is multicast to the IP address
9	Multicast8	Link is multicast to the IP address
10	Multicast9	Link is multicast to the IP address
11	Multicast10	Link is multicast to the IP address

This specifies the type of transmission for the Tx1 link.

Parameter	4.10.015 *Tx1 Destination Address*		
Short description	Sets the destination address of the Tx1 link		
Minimum	0 (Display: 0.0.0.0)	Maximum	4294967295 (Display: 255.255.255.255)
Default	0 (Display: 0.0.0.0)	Units	
Type	32 Bit User Save	Update Rate	Read on reset
Display Format	IP Address	Decimal Places	0
Coding	RW, BU		

This specifies the IP address of the destination device for the Tx1 link. If *Tx1 Link Transmission Type* (4.10.014) is set to either broadcast or multicast this parameter will display the appropiate address.

Parameter	4.10.016 *Tx1 Message Rate*		
Short description	Defines the period at which Tx1 Link will be transmitted. Zero disables the transmission.		
Minimum	0	Maximum	100
Default	0	Units	ms
Type	8 Bit User Save	Update Rate	Read on reset
Display Format	Standard	Decimal Places	0
Coding	RW, BU		

Defines, in milliseconds, the period at which Tx1 Link will be transmitted. A value of zero disables the transmission of data.

Parameter	4.10.019 *Tx1 Link Status*		
Short description	Link status when loaded		
Minimum	-31	Maximum	2
Default		Units	
Type	8 Bit Volatile	Update Rate	Write on reset
Display Format	Standard	Decimal Places	0
Coding	RO, TE, ND, NC, PT		

Value	*Text*	*Description*
-31	Disabled	Easy Mode protocol is disabled or link number is set to 0
-30	VLAN disabled	VLAN is required in order to guarantee timing in synchronous mode but it is disabled.
-29	Reserved 29	
-28	Reserved 28	
-27	Reserved 27	
-26	Reserved 26	
-25	Reserved 25	
-24	Reserved 24	
-23	Reserved 23	
-22	Invalid DST IP	The destination IP address is invalid
-21	SYNC unsupported	Sync link does not support mappings to other option parameters
-20	MEC offset	Incorrect MEC offset
-19	Invalid tx rate	Tx rate must be a factor of 1 second
-18	Too many mapping	The number of mapping items exceeds the range supported
-17	Link busy	The link specified is busy
-16	Invalid profile	The profile is invalid
-15	Invalid mapping	The mapped parameter does not exist
-14	Read only param	The mapped parameter is read only
-13	Msg mismatch	Link number and direction do not match
-12	Msg too long	Resulting message is too long
-11	Attrib NA	Attribute not available
-10	Attrib RO	Attribute is read only
-9	Attrib missing	Attribute is missing
-8	Timeout	Timeout
-7	In error	The link specified is in Error state
-6	Link num in use	The link number specified is already in use
-5	Not editable	The link specified is not editable
-4	Invalid link num	An invalid link number was specified
-3	Invalid args	Link Number or another argument specified was zero or some other invalid number
-2	Too many links	Operation failed as the maximum number of links in use has been reached
-1	Out of memory	Failed to allocate memory.
0	OK	Configuration of link successful
1	Not running	OK. Not running.
2	OK sync	Configuration of synchronous link successful

This reports the links status if it has been loaded. A *Reset* (4.10.002) is required to load any changes.

Parameter	4.10.020 *Tx2 Link Profile*		
Short description	Selects the Tx2 link as a standard or synchronous cyclic link		
Minimum	0	Maximum	1
Default	0	Units	
Type	8 Bit User Save	Update Rate	Read on reset
Display Format	Standard	Decimal Places	0
Coding	RW, TE		

Value	*Text*	*Description*
0	Std	Standard link
1	Sync	Synchronized link

Used to select Tx2 as a standard or synchronous cyclic link.

Parameter	4.10.021 *Tx2 Link Number*		
Short description	Sets the link number for the Tx2 link		
Minimum	0	Maximum	255
Default	0	Units	
Type	8 Bit User Save	Update Rate	Read on reset
Display Format	Standard	Decimal Places	0
Coding	RW, BU		

This is used to set the link number for the Tx2 link.

Parameter	4.10.022 *Tx2 Source Parameter*		
Short description	Sets the source parameter for the Tx2 link		
Minimum	0	Maximum	499999
Default	0	Units	
Type	32 Bit User Save	Update Rate	Read on reset
Display Format	Slot Menu Parameter	Decimal Places	0
Coding	RW, PT, BU		

This sets the source parameter for the Tx2 link.

Parameter	4.10.023 *Tx2 Parameter Count*		
Short description	Sets the number of parameters for the Tx2 link		
Minimum	0	Maximum	10
Default	0	Units	
Type	8 Bit User Save	Update Rate	Read on reset
Display Format	Standard	Decimal Places	0
Coding	RW, BU		

This is used to set the number of contiguous parameters for the Tx2 link.

Parameter	4.10.024 *Tx2 Link Transmission Type*		
Short description	Sets the transmission type of the Tx2 link		
Minimum	0	Maximum	11
Default	0	Units	
Type	8 Bit User Save	Update Rate	Read on reset
Display Format	Standard	Decimal Places	0
Coding	RW, TE, BU		

Value	Text	Description
0	Unicast	Link is unicast to the IP address specified
1	Broadcast	Link is broadcast (255.255.255.255)
2	Multicast1	Link is multicast to the IP address
3	Multicast2	Link is multicast to the IP address
4	Multicast3	Link is multicast to the IP address
5	Multicast4	Link is multicast to the IP address
6	Multicast5	Link is multicast to the IP address
7	Multicast6	Link is multicast to the IP address
8	Multicast7	Link is multicast to the IP address
9	Multicast8	Link is multicast to the IP address
10	Multicast9	Link is multicast to the IP address
11	Multicast10	Link is multicast to the IP address

This specifies the type of transmission for the Tx2 link.

Parameter	4.10.025 *Tx2 Destination Address*		
Short description	Sets the destination address of the Tx2 link		
Minimum	0 (Display: 0.0.0.0)	Maximum	4294967295 (Display: 255.255.255.255)
Default	0 (Display: 0.0.0.0)	Units	
Type	32 Bit User Save	Update Rate	Read on reset
Display Format	IP Address	Decimal Places	0
Coding	RW, BU		

This specifies the IP address of the destination device for the Tx1 link. If *Tx2 Link Transmission Type* (4.10.024) is set to either broadcast or multicast this parameter will display the appropiate address.

Parameter	4.10.026 *Tx2 Message Rate*		
Short description	Sets and shows the Tx2 message rate		
Minimum	0	Maximum	100
Default	0	Units	ms
Type	8 Bit User Save	Update Rate	Read on reset
Display Format	Standard	Decimal Places	0
Coding	RW, BU		

Defines, in milliseconds, the period at which Tx2 Link will be transmitted. A value of zero disables the transmission of data.

Parameter	4.10.029 *Tx2 Link Status*		
Short description	Link status when loaded		
Minimum	-31	Maximum	2
Default		Units	
Type	8 Bit Volatile	Update Rate	Write on reset
Display Format	Standard	Decimal Places	0
Coding	RO, TE, ND, NC, PT		

Value	*Text*	*Description*
-31	Disabled	Easy Mode protocol is disabled or link number is set to 0
-30	VLAN disabled	VLAN is required in order to guarantee timing in synchronous mode but it is disabled.
-29	Reserved 29	
-28	Reserved 28	
-27	Reserved 27	
-26	Reserved 26	
-25	Reserved 25	
-24	Reserved 24	
-23	Reserved 23	
-22	Invalid DST IP	The destination IP address is invalid
-21	SYNC unsupported	Sync link does not support mappings to other option parameters
-20	MEC offset	Incorrect MEC offset
-19	Invalid tx rate	Tx rate must be a factor of 1 second
-18	Too many mapping	The number of mapping items exceeds the range supported
-17	Link busy	The link specified is busy
-16	Invalid profile	The profile is invalid
-15	Invalid mapping	The mapped parameter does not exist
-14	Read only param	The mapped parameter is read only
-13	Msg mismatch	Link number and direction do not match
-12	Msg too long	Resulting message is too long
-11	Attrib NA	Attribute not available
-10	Attrib RO	Attribute is read only
-9	Attrib missing	Attribute is missing
-8	Timeout	Timeout
-7	In error	The link specified is in Error state
-6	Link num in use	The link number specified is already in use
-5	Not editable	The link specified is not editable
-4	Invalid link num	An invalid link number was specified
-3	Invalid args	Link Number or another argument specified was zero or some other invalid number
-2	Too many links	Operation failed as the maximum number of links in use has been reached
-1	Out of memory	Failed to allocate memory.
0	OK	Configuration of link successful
1	Not running	OK. Not running.
2	OK sync	Configuration of synchronous link successful

This reports the links status if it has been loaded. A *Reset* (4.10.002) is required to load any changes.

Parameter	4.10.030 *Tx3 Link Profile*		
Short description	Selects the Tx3 link as a standard or synchronous cyclic link		
Minimum	0	Maximum	1
Default	0	Units	
Type	8 Bit User Save	Update Rate	Read on reset
Display Format	Standard	Decimal Places	0
Coding	RW, TE		

Value	Text	Description
0	Std	Standard link
1	Sync	Synchronized link

Used to select Tx3 as a standard or synchronous cyclic link.

Parameter	4.10.031 *Tx3 Link Number*		
Short description	Sets the link number for the Tx3 link		
Minimum	0	Maximum	255
Default	0	Units	
Type	8 Bit User Save	Update Rate	Read on reset
Display Format	Standard	Decimal Places	0
Coding	RW, BU		

This is used to set the link number for the Tx3 link.

Parameter	4.10.032 *Tx3 Source Parameter*		
Short description	Sets the source parameter for the Tx3 link		
Minimum	0	Maximum	499999
Default	0	Units	
Type	32 Bit User Save	Update Rate	Read on reset
Display Format	Slot Menu Parameter	Decimal Places	0
Coding	RW, PT, BU		

This sets the source parameter for the Tx3 link.

Parameter	4.10.033 *Tx3 Parameter Count*		
Short description	Sets the number of parameters for the Tx3 link		
Minimum	0	Maximum	10
Default	0	Units	
Type	8 Bit User Save	Update Rate	Read on reset
Display Format	Standard	Decimal Places	0
Coding	RW, BU		

This is used to set the number of contiguous parameters for the Tx3 link.

Parameter	4.10.034 *Tx3 Link Transmission Type*		
Short description	Sets the transmission type of the Tx3 link		
Minimum	0	Maximum	11
Default	0	Units	
Type	8 Bit User Save	Update Rate	Read on reset
Display Format	Standard	Decimal Places	0
Coding	RW, TE, BU		

Value	Text	Description
0	Unicast	Link is unicast to the IP address specified
1	Broadcast	Link is broadcast (255.255.255.255)
2	Multicast1	Link is multicast to the IP address
3	Multicast2	Link is multicast to the IP address
4	Multicast3	Link is multicast to the IP address
5	Multicast4	Link is multicast to the IP address
6	Multicast5	Link is multicast to the IP address
7	Multicast6	Link is multicast to the IP address
8	Multicast7	Link is multicast to the IP address
9	Multicast8	Link is multicast to the IP address
10	Multicast9	Link is multicast to the IP address
11	Multicast10	Link is multicast to the IP address

This specifies the type of transmission for the Tx3 link.

Parameter	4.10.035 *Tx3 Destination Address*		
Short description	Sets the destination address of the Tx3 link		
Minimum	0 (Display: 0.0.0.0)	Maximum	4294967295 (Display: 255.255.255.255)
Default	0 (Display: 0.0.0.0)	Units	
Type	32 Bit User Save	Update Rate	Read on reset
Display Format	IP Address	Decimal Places	0
Coding	RW, BU		

This specifies the IP address of the destination device for the Tx1 link. If *Tx3 Link Transmission Type* (4.10.034) is set to either broadcast or multicast this parameter will display the appropiate address.

Parameter	4.10.036 *Tx3 Message Rate*		
Short description	Sets and shows the Tx3 message rate		
Minimum	0	Maximum	100
Default	0	Units	ms
Type	8 Bit User Save	Update Rate	Read on reset
Display Format	Standard	Decimal Places	0
Coding	RW, BU		

Defines, in milliseconds, the period at which Tx3 Link will be transmitted. A value of zero disables the transmission of data.

Parameter	4.10.039 *Tx3 Link Status*		
Short description	Link status when loaded		
Minimum	-31	Maximum	2
Default		Units	
Type	8 Bit Volatile	Update Rate	Write on reset
Display Format	Standard	Decimal Places	0
Coding	RO, TE, ND, NC, PT		

Value	*Text*	*Description*
-31	Disabled	Easy Mode protocol is disabled or link number is set to 0
-30	VLAN disabled	VLAN is required in order to guarantee timing in synchronous mode but it is disabled.
-29	Reserved 29	
-28	Reserved 28	
-27	Reserved 27	
-26	Reserved 26	
-25	Reserved 25	
-24	Reserved 24	
-23	Reserved 23	
-22	Invalid DST IP	The destination IP address is invalid
-21	SYNC unsupported	Sync link does not support mappings to other option parameters
-20	MEC offset	Incorrect MEC offset
-19	Invalid tx rate	Tx rate must be a factor of 1 second
-18	Too many mapping	The number of mapping items exceeds the range supported
-17	Link busy	The link specified is busy
-16	Invalid profile	The profile is invalid
-15	Invalid mapping	The mapped parameter does not exist
-14	Read only param	The mapped parameter is read only
-13	Msg mismatch	Link number and direction do not match
-12	Msg too long	Resulting message is too long
-11	Attrib NA	Attribute not available
-10	Attrib RO	Attribute is read only
-9	Attrib missing	Attribute is missing
-8	Timeout	Timeout
-7	In error	The link specified is in Error state
-6	Link num in use	The link number specified is already in use
-5	Not editable	The link specified is not editable
-4	Invalid link num	An invalid link number was specified
-3	Invalid args	Link Number or another argument specified was zero or some other invalid number
-2	Too many links	Operation failed as the maximum number of links in use has been reached
-1	Out of memory	Failed to allocate memory.
0	OK	Configuration of link successful
1	Not running	OK. Not running.
2	OK sync	Configuration of synchronous link successful

This reports the links status if it has been loaded. A *Reset* (4.10.002) is required to load any changes.

Parameter	4.10.040 *Rx1 Link Profile*		
Short description	Selects the Rx1 link as a standard or synchronous cyclic link		
Minimum	0	Maximum	1
Default	0	Units	
Type	8 Bit User Save	Update Rate	Read on reset
Display Format	Standard	Decimal Places	0
Coding	RW, TE		

Value	Text	Description
0	Std	Standard link
1	Sync	Synchronized link

Used to select Rx1 as a standard or synchronous cyclic link.

Parameter	4.10.041 *Rx1 Link Number*		
Short description	Sets the link number for the Rx1 link		
Minimum	0	Maximum	255
Default	0	Units	
Type	8 Bit User Save	Update Rate	Read on reset
Display Format	Standard	Decimal Places	0
Coding	RW, BU		

This parameter is used to set the link number for the Rx1 link.

Parameter	4.10.042 *Rx1 Destination Parameter*		
Short description	Sets the destination parameter for the Rx1 link		
Minimum	0	Maximum	499999
Default	0	Units	
Type	32 Bit User Save	Update Rate	Read on reset
Display Format	Slot Menu Parameter	Decimal Places	0
Coding	RW, BU		

This parameter sets the desintation parameter for the Rx1 link.

Parameter	4.10.043 *Rx1 Parameter Count*		
Short description	Sets the number of parameters for the Rx1 link		
Minimum	0	Maximum	10
Default	0	Units	
Type	8 Bit User Save	Update Rate	Read on reset
Display Format	Standard	Decimal Places	0
Coding	RW, BU		

This parameter is used to set the number of contiguous parameters for the Rx1 link.

Parameter	4.10.044 *Rx1 Source Type*		
Short description	Sets the transmission type of the Rx1 link		
Minimum	0	Maximum	11
Default	0	Units	
Type	8 Bit User Save	Update Rate	Read on reset
Display Format	Standard	Decimal Places	0
Coding	RW, TE, BU		

Value	Text	Description
0	Direct	Link is unicast or broadcast
1	Multicast1	Link is multicast to the IP address
2	Multicast2	Link is multicast to the IP address
3	Multicast3	Link is multicast to the IP address
4	Multicast4	Link is multicast to the IP address
5	Local	Link will receive from local transmit link
6	Multicast5	Link is multicast to the IP address
7	Multicast6	Link is multicast to the IP address
8	Multicast7	Link is multicast to the IP address
9	Multicast8	Link is multicast to the IP address
10	Multicast9	Link is multicast to the IP address
11	Multicast10	Link is multicast to the IP address

This parameter specifies the type of transmission for the Rx1 link.

Parameter	4.10.045 *Rx1 Timeout*		
Short description	Sets the timeout value for the Rx1 link		
Minimum	0	Maximum	65535
Default	100	Units	ms
Type	16 Bit User Save	Update Rate	Read on reset
Display Format	Standard	Decimal Places	0
Coding	RW, BU		

This parameter specifies the watchdog timer for the Rx1 link. If no cyclic data is received on the Rx1 link the action taken will be determined by the setting in *Rx1 Timeout Action* (4.10.046).

Note:
It is good system design to allow for some message loss by setting the timeout duration to be greater than the transmit period by a factor of 2 or more.

Parameter	4.10.046 *Rx1 Timeout Action*		
Short description	Defines the timeout action for the Rx1 link		
Minimum	0	Maximum	2
Default	0	Units	
Type	8 Bit User Save	Update Rate	Read on reset
Display Format	Standard	Decimal Places	0
Coding	RW, TE, BU		

Value	Text	Description
0	Trip	Trip drive with Slx.Er and sub-trip code
1	Clear output	PLC output parameters will have their values set to zero
2	Hold last	Hold the last value in output parameters

Defines the action to be taken for a timeout on the Rx1 link.

Parameter	4.10.047 *Rx1 Timeout Event Destination*		
Short description	Defines the timeout event destination slot for the Rx1 link		
Minimum	0	Maximum	4
Default	0	Units	
Type	8 Bit User Save	Update Rate	Read on reset
Display Format	Standard	Decimal Places	0
Coding	RW, TE, BU		

Value	Text	Description
0	This slot	Trigger module event in this slot
1	Slot 1	Trigger module event in slot 1
2	Slot 2	Trigger module event in slot 2
3	Slot 3	Trigger module event in slot 3
4	Slot 4	Trigger module event in slot 4

This parameter defines the slot in which an event will occur if a cyclic data timeout occurs on the Rx1 link.

<< This feature is not currently supported >>

Parameter	4.10.048 *Rx1 Timeout Event Type*		
Short description	Defines the event to trigger for a timeout on the Rx1 link		
Minimum	0	Maximum	4
Default	0	Units	
Type	8 Bit User Save	Update Rate	Read on reset
Display Format	Standard	Decimal Places	0
Coding	RW, TE, BU		

Value	Text	Description
0	No Event	No event
1	Event	Trigger module event
2	Event1	Trigger module event 1
3	Event2	Trigger module event 2
4	Event3	Trigger module event 3

Defines the event to trigger in the given destination, as specified in *Rx1 Timeout Event Destination* (4.10.047), if a cyclic data timeout occurs on the Rx1 link.

Parameter	4.10.049 *Rx1 Link Status*		
Short description	Link status when loaded		
Minimum	-31	Maximum	2
Default		Units	
Type	8 Bit Volatile	Update Rate	Write on reset
Display Format	Standard	Decimal Places	0
Coding	RO, TE, ND, NC, PT		

Value	*Text*	*Description*
-31	Disabled	Easy Mode protocol is disabled or link number is set to 0
-30	VLAN disabled	VLAN is required in order to guarantee timing in synchronous mode but it is disabled.
-29	Reserved 29	
-28	Reserved 28	
-27	Reserved 27	
-26	Reserved 26	
-25	Reserved 25	
-24	Reserved 24	
-23	Reserved 23	
-22	Invalid DST IP	The destination IP address is invalid
-21	SYNC unsupported	Sync link does not support mappings to other option parameters
-20	MEC offset	Incorrect MEC offset
-19	Invalid tx rate	Tx rate must be a factor of 1 second
-18	Too many mapping	The number of mapping items exceeds the range supported
-17	Link busy	The link specified is busy
-16	Invalid profile	The profile is invalid
-15	Invalid mapping	The mapped parameter does not exist
-14	Read only param	The mapped parameter is read only
-13	Msg mismatch	Link number and direction do not match
-12	Msg too long	Resulting message is too long
-11	Attrib NA	Attribute not available
-10	Attrib RO	Attribute is read only
-9	Attrib missing	Attribute is missing
-8	Timeout	Timeout
-7	In error	The link specified is in Error state
-6	Link num in use	The link number specified is already in use
-5	Not editable	The link specified is not editable
-4	Invalid link num	An invalid link number was specified
-3	Invalid args	Link Number or another argument specified was zero or some other invalid number
-2	Too many links	Operation failed as the maximum number of links in use has been reached
-1	Out of memory	Failed to allocate memory.
0	OK	Configuration of link successful
1	Not running	OK. Not running.
2	OK sync	Configuration of synchronous link successful

This reports the links status if it has been loaded. A *Reset* (4.10.002) is required to load any changes.

Parameter	4.10.050 *Rx2 Link Profile*		
Short description	Selects the Rx2 link as a standard or synchronous cyclic link		
Minimum	0	Maximum	1
Default	0	Units	
Type	8 Bit User Save	Update Rate	Read on reset
Display Format	Standard	Decimal Places	0
Coding	RW, TE		

Value	*Text*	*Description*
0	Std	Standard link
1	Sync	Synchronized link

Used to select Rx2 as a standard or synchronous cyclic link.

Parameter	4.10.051 *Rx2 Link Number*		
Short description	Sets the link number for the Rx2 link		
Minimum	0	Maximum	255
Default	0	Units	
Type	8 Bit User Save	Update Rate	Read on reset
Display Format	Standard	Decimal Places	0
Coding	RW, BU		

This parameter is used to set the link number for the Rx2 link.

Parameter	4.10.052 *Rx2 Destination Parameter*		
Short description	Sets the destination parameter for the Rx2 link		
Minimum	0	Maximum	499999
Default	0	Units	
Type	32 Bit User Save	Update Rate	Read on reset
Display Format	Slot Menu Parameter	Decimal Places	0
Coding	RW, BU		

This parameter sets the desintation parameter for the Rx2 link.

Parameter	4.10.053 *Rx2 Parameter Count*		
Short description	Sets the number of parameters for the Rx2 link		
Minimum	0	Maximum	10
Default	0	Units	
Type	8 Bit User Save	Update Rate	Read on reset
Display Format	Standard	Decimal Places	0
Coding	RW, BU		

This parameter is used to set the number of contiguous parameters for the Rx2 link.

Parameter	4.10.054 *Rx2 Source Type*		
Short description	Sets the transmission type of the Rx2 link		
Minimum	0	Maximum	11
Default	0	Units	
Type	8 Bit User Save	Update Rate	Read on reset
Display Format	Standard	Decimal Places	0
Coding	RW, TE, BU		

Value	*Text*	*Description*
0	Direct	Link is unicast or broadcast
1	Multicast1	Link is multicast to the IP address
2	Multicast2	Link is multicast to the IP address
3	Multicast3	Link is multicast to the IP address
4	Multicast4	Link is multicast to the IP address
5	Local	Link will receive from local transmit link
6	Multicast5	Link is multicast to the IP address
7	Multicast6	Link is multicast to the IP address
8	Multicast7	Link is multicast to the IP address
9	Multicast8	Link is multicast to the IP address
10	Multicast9	Link is multicast to the IP address
11	Multicast10	Link is multicast to the IP address

This parameter specifies the type of transmission for the Rx2 link.

Parameter	4.10.055 *Rx2 Timeout*		
Short description	Sets the timeout value for the Rx2 link		
Minimum	0	Maximum	65535
Default	100	Units	ms
Type	16 Bit User Save	Update Rate	Read on reset
Display Format	Standard	Decimal Places	0
Coding	RW, BU		

This parameter specifies the watchdog timer for the Rx1 link. If no cyclic data is received on the Rx1 link the action taken will be determined by the setting in *Rx2 Timeout Action* (4.10.056).

Note:
It is good system design to allow for some message loss by setting the timeout duration to be greater than the transmit period by a factor of 2 or more.

Parameter	4.10.056 *Rx2 Timeout Action*		
Short description	Defines the timeout action for the Rx2 link		
Minimum	0	Maximum	2
Default	0	Units	
Type	8 Bit User Save	Update Rate	Read on reset
Display Format	Standard	Decimal Places	0
Coding	RW, TE, BU		

Value	Text	Description
0	Trip	Trip drive with Slx.Er and sub-trip code
1	Clear output	PLC output parameters will have their values set to zero
2	Hold last	Hold the last value in output parameters

Defines the action to be taken for a timeout on the Rx2 link.

Parameter	4.10.057 *Rx2 Timeout Event Destination*		
Short description	Defines the timeout event destination slot for the Rx2 link		
Minimum	0	Maximum	4
Default	0	Units	
Type	8 Bit User Save	Update Rate	Read on reset
Display Format	Standard	Decimal Places	0
Coding	RW, TE, BU		

Value	Text	Description
0	This slot	Trigger module event in this slot
1	Slot 1	Trigger module event in slot 1
2	Slot 2	Trigger module event in slot 2
3	Slot 3	Trigger module event in slot 3
4	Slot 4	Trigger module event in slot 4

This parameter defines the slot in which an event will occur if a cyclic data timeout occurs on the Rx2 link.

<< This feature is not currently supported >>

Parameter	4.10.058 *Rx2 Timeout Event Type*		
Short description	Defines the event to trigger for a timeout on the Rx2 link		
Minimum	0	Maximum	4
Default	0	Units	
Type	8 Bit User Save	Update Rate	Read on reset
Display Format	Standard	Decimal Places	0
Coding	RW, TE, BU		

Value	Text	Description
0	No Event	No event
1	Event	Trigger module event
2	Event1	Trigger module event 1
3	Event2	Trigger module event 2
4	Event3	Trigger module event 3

Defines the event to trigger in the given destination, as specified in *Rx2 Timeout Event Destination* (4.10.057), if a cyclic data timeout occurs on the Rx2 link.

Parameter	4.10.059 *Rx2 Link Status*		
Short description	Link status when loaded		
Minimum	-31	Maximum	2
Default		Units	
Type	8 Bit Volatile	Update Rate	Write on reset
Display Format	Standard	Decimal Places	0
Coding	RO, TE, ND, NC, PT		

Value	Text	Description
-31	Disabled	Easy Mode protocol is disabled or link number is set to 0
-30	VLAN disabled	VLAN is required in order to guarantee timing in synchronous mode but it is disabled.
-29	Reserved 29	
-28	Reserved 28	
-27	Reserved 27	
-26	Reserved 26	
-25	Reserved 25	
-24	Reserved 24	
-23	Reserved 23	
-22	Invalid DST IP	The destination IP address is invalid
-21	SYNC unsupported	Sync link does not support mappings to other option parameters
-20	MEC offset	Incorrect MEC offset
-19	Invalid tx rate	Tx rate must be a factor of 1 second
-18	Too many mapping	The number of mapping items exceeds the range supported
-17	Link busy	The link specified is busy
-16	Invalid profile	The profile is invalid
-15	Invalid mapping	The mapped parameter does not exist
-14	Read only param	The mapped parameter is read only
-13	Msg mismatch	Link number and direction do not match
-12	Msg too long	Resulting message is too long
-11	Attrib NA	Attribute not available
-10	Attrib RO	Attribute is read only
-9	Attrib missing	Attribute is missing
-8	Timeout	Timeout
-7	In error	The link specified is in Error state
-6	Link num in use	The link number specified is already in use
-5	Not editable	The link specified is not editable
-4	Invalid link num	An invalid link number was specified
-3	Invalid args	Link Number or another argument specified was zero or some other invalid number
-2	Too many links	Operation failed as the maximum number of links in use has been reached
-1	Out of memory	Failed to allocate memory.
0	OK	Configuration of link successful
1	Not running	OK. Not running.
2	OK sync	Configuration of synchronous link successful

This reports the links status if it has been loaded. A *Reset* (4.10.002) is required to load any changes.

Parameter	4.10.060 *Rx3 Link Profile*		
Short description	Selects the Rx3 link as a standard or synchronous cyclic link		
Minimum	0	Maximum	1
Default	0	Units	
Type	8 Bit User Save	Update Rate	Read on reset
Display Format	Standard	Decimal Places	0
Coding	RW, TE		

Value	Text	Description
0	Std	Standard link
1	Sync	Synchronized link

Used to select Rx3 as a standard or synchronous cyclic link.

Parameter	4.10.061 *Rx3 Link Number*		
Short description	Sets the link number for the Rx3 link		
Minimum	0	Maximum	255
Default	0	Units	
Type	8 Bit User Save	Update Rate	Read on reset
Display Format	Standard	Decimal Places	0
Coding	RW, BU		

This parameter is used to set the link number for the Rx3 link.

Parameter	4.10.062 *Rx3 Destination Parameter*		
Short description	Sets the destination parameter for the Rx3 link		
Minimum	0	Maximum	499999
Default	0	Units	
Type	32 Bit User Save	Update Rate	Read on reset
Display Format	Slot Menu Parameter	Decimal Places	0
Coding	RW, BU		

This parameter sets the desintation parameter for the Rx3 link.

Parameter	4.10.063 *Rx3 Parameter Count*		
Short description	Sets the number of parameters for the Rx3 link		
Minimum	0	Maximum	10
Default	0	Units	
Type	8 Bit User Save	Update Rate	Read on reset
Display Format	Standard	Decimal Places	0
Coding	RW, BU		

This parameter is used to set the number of contiguous parameters for the Rx3 link.

Parameter	4.10.064 *Rx3 Source Type*		
Short description	Sets the transmission type of the Rx3 link		
Minimum	0	Maximum	11
Default	0	Units	
Type	8 Bit User Save	Update Rate	Read on reset
Display Format	Standard	Decimal Places	0
Coding	RW, TE, BU		

Value	Text	Description
0	Direct	Link is unicast or broadcast
1	Multicast1	Link is multicast to the IP address
2	Multicast2	Link is multicast to the IP address
3	Multicast3	Link is multicast to the IP address
4	Multicast4	Link is multicast to the IP address
5	Local	Link will receive from local transmit link
6	Multicast5	Link is multicast to the IP address
7	Multicast6	Link is multicast to the IP address
8	Multicast7	Link is multicast to the IP address
9	Multicast8	Link is multicast to the IP address
10	Multicast9	Link is multicast to the IP address
11	Multicast10	Link is multicast to the IP address

This parameter specifies the type of transmission for the Rx3 link.

Parameter	4.10.065 *Rx3 Timeout*		
Short description	Sets the timeout value for the Rx3 link		
Minimum	0	Maximum	65535
Default	100	Units	ms
Type	16 Bit User Save	Update Rate	Read on reset
Display Format	Standard	Decimal Places	0
Coding	RW, BU		

This parameter specifies the watchdog timer for the Rx1 link. If no cyclic data is received on the Rx1 link the action taken will be determined by the setting in *Rx3 Timeout Action* (4.10.066).

Note:
It is good system design to allow for some message loss by setting the timeout duration to be greater than the transmit period by a factor of 2 or more.

Parameter	4.10.066 *Rx3 Timeout Action*		
Short description	Defines the timeout action for the Rx3 link		
Minimum	0	Maximum	2
Default	0	Units	
Type	8 Bit User Save	Update Rate	Read on reset
Display Format	Standard	Decimal Places	0
Coding	RW, TE, BU		

Value	Text	Description
0	Trip	Trip drive with Slx.Er and sub-trip code
1	Clear output	PLC output parameters will have their values set to zero
2	Hold last	Hold the last value in output parameters

Defines the action to be taken for a timeout on the Rx3 link.

Parameter	4.10.067 *Rx3 Timeout Event Destination*		
Short description	Defines the timeout event destination slot for the Rx3 link		
Minimum	0	Maximum	4
Default	0	Units	
Type	8 Bit User Save	Update Rate	Read on reset
Display Format	Standard	Decimal Places	0
Coding	RW, TE, BU		

Value	Text	Description
0	This slot	Trigger module event in this slot
1	Slot 1	Trigger module event in slot 1
2	Slot 2	Trigger module event in slot 2
3	Slot 3	Trigger module event in slot 3
4	Slot 4	Trigger module event in slot 4

This parameter defines the slot in which an event will occur if a cyclic data timeout occurs on the Rx3 link.

<< This feature is not currently supported >>

Parameter	4.10.068 *Rx3 Timeout Event Type*		
Short description	Defines the event to trigger for a timeout on the Rx3 link		
Minimum	0	Maximum	4
Default	0	Units	
Type	8 Bit User Save	Update Rate	Read on reset
Display Format	Standard	Decimal Places	0
Coding	RW, TE, BU		

Value	Text	Description
0	No Event	No event
1	Event	Trigger module event
2	Event1	Trigger module event 1
3	Event2	Trigger module event 2
4	Event3	Trigger module event 3

Defines the event to trigger in the given destination, as specified in *Rx3 Timeout Event Destination* (4.10.067), if a cyclic data timeout occurs on the Rx3 link.

Parameter	4.10.069 *Rx3 Link Status*		
Short description	Link status when loaded		
Minimum	-31	Maximum	2
Default		Units	
Type	8 Bit Volatile	Update Rate	Write on reset
Display Format	Standard	Decimal Places	0
Coding	RO, TE, ND, NC, PT		

Value	Text	Description
-31	Disabled	Easy Mode protocol is disabled or link number is set to 0
-30	VLAN disabled	VLAN is required in order to guarantee timing in synchronous mode but it is disabled.
-29	Reserved 29	
-28	Reserved 28	
-27	Reserved 27	
-26	Reserved 26	
-25	Reserved 25	
-24	Reserved 24	
-23	Reserved 23	
-22	Invalid DST IP	The destination IP address is invalid
-21	SYNC unsupported	Sync link does not support mappings to other option parameters
-20	MEC offset	Incorrect MEC offset
-19	Invalid tx rate	Tx rate must be a factor of 1 second
-18	Too many mapping	The number of mapping items exceeds the range supported
-17	Link busy	The link specified is busy
-16	Invalid profile	The profile is invalid
-15	Invalid mapping	The mapped parameter does not exist
-14	Read only param	The mapped parameter is read only
-13	Msg mismatch	Link number and direction do not match
-12	Msg too long	Resulting message is too long
-11	Attrib NA	Attribute not available
-10	Attrib RO	Attribute is read only
-9	Attrib missing	Attribute is missing
-8	Timeout	Timeout
-7	In error	The link specified is in Error state
-6	Link num in use	The link number specified is already in use
-5	Not editable	The link specified is not editable
-4	Invalid link num	An invalid link number was specified
-3	Invalid args	Link Number or another argument specified was zero or some other invalid number
-2	Too many links	Operation failed as the maximum number of links in use has been reached
-1	Out of memory	Failed to allocate memory.
0	OK	Configuration of link successful
1	Not running	OK. Not running.
2	OK sync	Configuration of synchronous link successful

This reports the links status if it has been loaded. A *Reset* (4.10.002) is required to load any changes.

Slot 4 Menu 11 Single Line Descriptions − *Synchronisation*

Mode: RFC‑S

Parameter		Range	Default	Type					
4.11.001	Preferred Sync Master	0 to 4	1	RW	Num				US
4.11.002	Master Clock Domain	0 to 3	0	RW	Num				US
4.11.005	Grandmaster MAC Address	00:00:00:00:00:00 to FF:FF:FF:FF:FF:FF		RO	Mac	ND	NC	PT	
4.11.006	Synchronisation Jitter From Grandmaster	-2147483648 to 2147483647 ns		RO	Num	ND	NC	PT	
4.11.007	Synchronisation Jitter Threshold	500 to 1000000 ns	1000 ns	RW	Num				US
4.11.008	Module Synchronised Flag	Off (0) or On (1)	Off (0)	RO	Bit				
4.11.009	Inhibit Drive Synchronisation	Off (0) or On (1)	Off (0)	RW	Bit				US
4.11.010	PTP Date	00-00-00 to 31-12-99		RO	Date	ND	NC	PT	
4.11.011	PTP Time	00:00:00 to 23:59:59		RO	Time	ND	NC	PT	
4.11.015	PTP Delay Measurement Select	P2P DELAY (1), OFF (2)	P2P DELAY (1)	RW	Txt				US
4.11.016	PTP Sync Rate	-4 to 0	-4	RW	Num				US
4.11.017	In sync window length	3 to 255 s	20 s	RW	Num				US
4.11.020	Network Error Count	0 to 4294967295		RO	Num	ND	NC	PT	
4.11.022	Interoption Sync Status	MASTER (0), PRODUCER (1), INDEPENDENT (2)		RO	Txt	ND	NC	PT	
4.11.030	Easy Mode Maximum Network Delay	1 to 100 ms	3 ms	RW	Num				US
4.11.040	Rx1 Late Synchronisation Frame Action	Trip (1), Do not use (2), Use (3)	Trip (1)	RW	Txt				US
4.11.041	Rx1 Late Synchronisation Frame Destination	This slot (0), Slot 1 (1), Slot 2 (2), Slot 3 (3), Slot 4 (4)	This slot (0)	RW	Txt				US
4.11.042	Rx1 Late Synchronisation Frame Event	No Event (0), Event (1), Event1 (2), Event2 (3), Event3 (4)	No Event (0)	RW	Txt				US
4.11.050	Rx2 Late Synchronisation Frame Action	Trip (1), Do not use (2), Use (3)	Trip (1)	RW	Txt				US
4.11.051	Rx2 Late Synchronisation Frame Destination	This slot (0), Slot 1 (1), Slot 2 (2), Slot 3 (3), Slot 4 (4)	This slot (0)	RW	Txt				US
4.11.052	Rx2 Late Synchronisation Frame Event	No Event (0), Event (1), Event1 (2), Event2 (3), Event3 (4)	No Event (0)	RW	Txt				US
4.11.060	Rx3 Late Synchronisation Frame Action	Trip (1), Do not use (2), Use (3)	Trip (1)	RW	Txt				US
4.11.061	Rx3 Late Synchronisation Frame Destination	This slot (0), Slot 1 (1), Slot 2 (2), Slot 3 (3), Slot 4 (4)	This slot (0)	RW	Txt				US
4.11.062	Rx3 Late Synchronisation Frame Event	No Event (0), Event (1), Event1 (2), Event2 (3), Event3 (4)	No Event (0)	RW	Txt				US

RW	Read / Write	RO	Read-only	Bit	Bit parameter	Txt	Text string	Date	Date parameter	Time	Time parameter
Chr	Character parameter	Bin	Binary parameter	IP	IP address	Mac	MAC address	Ver	Version number	SMP	Slot, menu, parameter
Num	Number parameter	DE	Destination	ND	No default value	RA	Rating dependent	NC	Non-copyable	PT	Protected
FI	Filtered	US	User save	PS	Power-down save						

Slot 4 Menu 11 − *Synchronisation*

Mode: RFC‑S

Note: Synchronous Cyclic Links are supported on the Unidrive M onboard Ethernet interface but not on SI-Ethernet on Unidrive M200 - M600.

Parameter	4.11.001 *Preferred Sync Master*		
Short description	Defines the module's synchronisation master preferences		
Minimum	0	Maximum	4
Default	1	Units	
Type	8 Bit User Save	Update Rate	Read on reset
Display Format	Standard	Decimal Places	0
Coding	RW, BU		

Parameter	4.11.002 *Master Clock Domain*		
Short description	Specifies the clock domain for the grandmaster clock		
Minimum	0	Maximum	3
Default	0	Units	
Type	8 Bit User Save	Update Rate	Read on reset
Display Format	Standard	Decimal Places	0
Coding	RW, BU		

Specifies the clock domain for the module to act as a grandmaster clock.

Parameter	4.11.005 *Grandmaster MAC Address*		
Short description	Displays the MAC address of the synchronisation grandmaster		
Minimum	0 (Display: 00:00:00:00:00:00)	Maximum	18446744073709551615 (Display: FF:FF:FF:FF:FF:FF)
Default		Units	
Type	64 Bit Volatile	Update Rate	Background write
Display Format	MAC Address	Decimal Places	0
Coding	RO, ND, NC, PT, BU		

This parameter displays the MAC address, as a 64-bit hexadecimal value, of the synchronisation grandmaster (if there is a grandmaster).

Parameter	4.11.006 *Synchronisation Jitter From Grandmaster*		
Short description	Displays the jitter from the grandmaster		
Minimum	-2147483648	Maximum	2147483647
Default		Units	ns
Type	32 Bit Volatile	Update Rate	Written every 500ms
Display Format	Standard	Decimal Places	0
Coding	RO, ND, NC, PT		

This parameter displays the synchronisation jitter in nanoseconds. The value is filtered to be human readable.

Parameter	4.11.007 *Synchronisation Jitter Threshold*		
Short description	Synchronisation Jitter Threshold		
Minimum	500	Maximum	1000000
Default	1000	Units	ns
Type	32 Bit User Save	Update Rate	Read on reset
Display Format	Standard	Decimal Places	0
Coding	RW, BU		

Sets the application tolerable clock jitter in ns from the grandmaster. If *Synchronisation Jitter From Grandmaster* (4.11.006) is within the tolerance the local clock is synchronised to the grandmaster and synchronsied cyclic data links will be processed.

Parameter	4.11.008 *Module Synchronised Flag*		
Short description	Module synchronised flag		
Minimum	0	Maximum	1
Default	0	Units	
Type	1 Bit Volatile	Update Rate	Written every 10ms
Display Format	Standard	Decimal Places	0
Coding	RO		

The parameter displays the module's synchronisation status. 1 = Synhronised, 0 = Not synchronised.

Parameter	4.11.009 *Inhibit Drive Synchronisation*		
Short description	Specifies whether the module should synchronise with the grandmaster		
Minimum	0	Maximum	1
Default	0	Units	
Type	1 Bit User Save	Update Rate	Immediate
Display Format	Standard	Decimal Places	0
Coding	RW		

This parameter controls whether the module synchronises the OPT_SYNC with the network grandmaster. A value of ON inhibits this.

Parameter	4.11.010 *PTP Date*		
Short description	PTP Date		
Minimum	0 (Display: 00-00-00)	Maximum	311299 (Display: 31-12-99)
Default		Units	
Type	32 Bit Volatile	Update Rate	Written every 500ms
Display Format	Date	Decimal Places	0
Coding	RO, ND, NC, PT, BU		

This parameter displays the current date. If the module has no time source it will display the date based on its power-up date of 1st January 1970.

Parameter	4.11.011 *PTP Time*		
Short description	PTP Time		
Minimum	0 (Display: 00:00:00)	Maximum	235959 (Display: 23:59:59)
Default		Units	
Type	32 Bit Volatile	Update Rate	Written every 500ms
Display Format	Time	Decimal Places	0
Coding	RO, ND, NC, PT, BU		

This parameter displays the current time. If the module has no time source it will display the date based on its power-up date of 00:00:00.

Parameter	4.11.015 *PTP Delay Measurement Select*		
Short description	PTP delay measurement select		
Minimum	1	Maximum	2
Default	1	Units	
Type	8 Bit User Save	Update Rate	Read on reset
Display Format	Standard	Decimal Places	0
Coding	RW, TE, BU		

Value	*Text*	*Description*
1	P2P DELAY	Peer-to-peer delay
2	OFF	Delay off

In Factory Fit Ethernet / SI-Ethernet firmare V01.03.00.00 onwards, this parameter is no longer supported. PTP Delay Measurement is always Peer-to-Peer.

This parameter selects the delay measurement. 0 = End-to-end; 1 = Peer-to-peer, 2 = OFF

End-to-end is the delay mechanism between slave clocks and the master clock.

Peer-to-peer delay mechanism provides not only the PTP event transit time information, but also provides the corrections for the propagation delay of the link connected to the port receiving the PTP event message.

OFF disables the PTP messages so that the module will not respond to a PTP delay request message or initiate a PTP delay request message and will therefore not synchronise with the master.

Parameter	4.11.016 *PTP Sync Rate*		
Short description	PTP Sync rate		
Minimum	-4	Maximum	0
Default	-4	Units	
Type	8 Bit User Save	Update Rate	Read on reset
Display Format	Standard	Decimal Places	0
Coding	RW		

This parameter controls the rate at which PTP Sync frames are sent. the message rate is determined by raising 2 to the power of this parameter. E.g the default value here of -2 results in four sync messages per second.

Parameter	4.11.017 *In sync window length*		
Short description			
Minimum	3	Maximum	255
Default	20	Units	s
Type	8 Bit User Save	Update Rate	Read on reset
Display Format	Standard	Decimal Places	0
Coding	RW, BU		

Duration that the jitter *Synchronisation Jitter From Grandmaster* (4.11.006) must be below the jitter threshold for before the in sync flag *Module Synchronised Flag* (4.11.008) is set.

For a system the duration depends upon the number of IEEE1588 capable master on the network. To use lower values here the number of devices who are capable of acting as a synchronisation master must be kept as low as possible by setting *Preferred Sync Master* (4.11.001) to 0 on all interfaces except those who may be master.

Parameter	4.11.020 *Network Error Count*		
Short description	Displays the number of errors detected on the network		
Minimum	0	Maximum	4294967295
Default		Units	
Type	32 Bit Volatile	Update Rate	Written every 500ms
Display Format	Standard	Decimal Places	0
Coding	RO, ND, NC, PT, BU		

The parameter displays a count of network errors since startup. It can be used as an indication of a problem.

Parameter	4.11.022 *Interoption Sync Status*		
Short description	Interoption Sync Status		
Minimum	0	Maximum	2
Default		Units	
Type	8 Bit Volatile	Update Rate	Background
Display Format	Standard	Decimal Places	0
Coding	RO, TE, ND, NC, PT, BU		

This module does not support Slave mode

Value	Text	Description
0	MASTER	The module is master but not producing
1	PRODUCER	The module is master and producing
2	INDEPENDENT	The module is not master

Parameter	4.11.030 *Easy Mode Maximum Network Delay*		
Short description	Defines the maximum allowable delay for Easy Mode cyclic transmit links		
Minimum	1	Maximum	100
Default	3	Units	ms
Type	8 Bit User Save	Update Rate	Read on reset
Display Format	Standard	Decimal Places	0
Coding	RW, BU		

This defines the allowable network delay (in milliseconds) for the Easy Mode synchronous transmit cyclic links to arrive at their destination.

In Factory Fit Ethernet / SI-Ethernet firmare V01.03.00.00 onwards, the default delay has been changed to 3ms (previous value 0ms). If the old default of 0ms is encountered, this is automatically changed to 3ms as the new minimum is 1ms).

Parameter	4.11.040 *Rx1 Late Synchronisation Frame Action*		
Short description	Defines the action to take when synchronised frame is received late		
Minimum	1	Maximum	3
Default	1	Units	
Type	8 Bit User Save	Update Rate	Read on reset
Display Format	Standard	Decimal Places	0
Coding	RW, TE, BU		

Value	Text	Description
1	Trip	Trip drive with Slx.Er and sub-trip code
2	Do not use	The data is ignored
3	Use	The data is used immediately

This parameter defines the action to be taken when a late synchronised frame is received.

In Factory Fit Ethernet / SI-Ethernet firmare V01.03.00.00 onwards there are a reduced range of actions. Since the option zero has been deprecated, the new default action is Trip (1st option).

Parameter	4.11.041 *Rx1 Late Synchronisation Frame Destination*		
Short description	Sets the slot to trigger an event		
Minimum	0	Maximum	4
Default	0	Units	
Type	8 Bit User Save	Update Rate	Read on reset
Display Format	Standard	Decimal Places	0
Coding	RW, TE, BU		

Value	Text	Description
0	This slot	Trigger module event in this slot
1	Slot 1	Trigger module event in slot 1
2	Slot 2	Trigger module event in slot 2
3	Slot 3	Trigger module event in slot 3
4	Slot 4	Trigger module event in slot 4

Defines the destination (slot) to trigger the event when a late synchronised frame is received.

Parameter	4.11.042 *Rx1 Late Synchronisation Frame Event*		
Short description	Sets the event number to trigger		
Minimum	0	Maximum	4
Default	0	Units	
Type	8 Bit User Save	Update Rate	Read on reset
Display Format	Standard	Decimal Places	0
Coding	RW, TE, BU		

Value	Text	Description
0	No Event	No event
1	Event	Trigger module event
2	Event1	Trigger module event 1
3	Event2	Trigger module event 2
4	Event3	Trigger module event 3

Defines the event number to trigger in the given destination (slot) when a late synchronised frame is received.

Parameter	4.11.050 *Rx2 Late Synchronisation Frame Action*		
Short description	Defines the action to take when synchronised frame is received late		
Minimum	1	Maximum	3
Default	1	Units	
Type	8 Bit User Save	Update Rate	Read on reset
Display Format	Standard	Decimal Places	0
Coding	RW, TE, BU		

Value	Text	Description
1	Trip	Trip drive with Slx.Er and sub-trip code
2	Do not use	The data is ignored
3	Use	The data is used immediately

This parameter defines the action to be taken when a late synchronised frame is received.

In Factory Fit Ethernet / SI-Ethernet firmare V01.03.00.00 onwards there are a reduced range of actions. Since the option zero has been deprecated, the new default action is Trip (1st option).

Parameter	4.11.051 *Rx2 Late Synchronisation Frame Destination*		
Short description	Sets the slot to trigger an event		
Minimum	0	Maximum	4
Default	0	Units	
Type	8 Bit User Save	Update Rate	Read on reset
Display Format	Standard	Decimal Places	0
Coding	RW, TE, BU		

Value	Text	Description
0	This slot	Trigger module event in this slot
1	Slot 1	Trigger module event in slot 1
2	Slot 2	Trigger module event in slot 2
3	Slot 3	Trigger module event in slot 3
4	Slot 4	Trigger module event in slot 4

Defines the destination (slot) to trigger the event when a late synchronised frame is received.

Parameter	4.11.052 *Rx2 Late Synchronisation Frame Event*		
Short description	Sets the event number to trigger		
Minimum	0	Maximum	4
Default	0	Units	
Type	8 Bit User Save	Update Rate	Read on reset
Display Format	Standard	Decimal Places	0
Coding	RW, TE, BU		

Value	*Text*	*Description*
0	No Event	No event
1	Event	Trigger module event
2	Event1	Trigger module event 1
3	Event2	Trigger module event 2
4	Event3	Trigger module event 3

Defines the event number to trigger in the given destination (slot) when a late synchronised frame is received.

Parameter	4.11.060 *Rx3 Late Synchronisation Frame Action*		
Short description	Defines the action to take when synchronised frame is received late		
Minimum	1	Maximum	3
Default	1	Units	
Type	8 Bit User Save	Update Rate	Read on reset
Display Format	Standard	Decimal Places	0
Coding	RW, TE, BU		

Value	*Text*	*Description*
1	Trip	Trip drive with Slx.Er and sub-trip code
2	Do not use	The data is ignored
3	Use	The data is used immediately

This parameter defines the action to be taken when a late synchronised frame is received.

In Factory Fit Ethernet / SI-Ethernet firmware V01.03.00.00 onwards there are a reduced range of actions. Since the option zero has been deprecated, the new default action is Trip (1st option).

Parameter	4.11.061 *Rx3 Late Synchronisation Frame Destination*		
Short description	Sets the slot to trigger an event		
Minimum	0	Maximum	4
Default	0	Units	
Type	8 Bit User Save	Update Rate	Read on reset
Display Format	Standard	Decimal Places	0
Coding	RW, TE, BU		

Value	*Text*	*Description*
0	This slot	Trigger module event in this slot
1	Slot 1	Trigger module event in slot 1
2	Slot 2	Trigger module event in slot 2
3	Slot 3	Trigger module event in slot 3
4	Slot 4	Trigger module event in slot 4

Defines the destination (slot) to trigger the event when a late synchronised frame is received.

Parameter	4.11.062 *Rx3 Late Synchronisation Frame Event*		
Short description	Sets the event number to trigger		
Minimum	0	Maximum	4
Default	0	Units	
Type	8 Bit User Save	Update Rate	Read on reset
Display Format	Standard	Decimal Places	0
Coding	RW, TE, BU		

Value	*Text*	*Description*
0	No Event	No event
1	Event	Trigger module event
2	Event1	Trigger module event 1
3	Event2	Trigger module event 2
4	Event3	Trigger module event 3

Defines the event number to trigger in the given destination (slot) when a late synchronised frame is received.

Slot 4 Menu 15 Single Line Descriptions − *Modbus TCP/IP Setup*

Mode: RFC‑S

Parameter	Range	Default	Type					
4.15.001 Enable	Off (0) or On (1)	On (1)	RW	Bit				US
4.15.002 Reset	Off (0) or On (1)	Off (0)	RW	Bit		NC		
4.15.003 Default	Off (0) or On (1)	Off (0)	RW	Bit		NC		
4.15.004 Modbus Configuration Error	No error (0), Port in use (1), Timeout event (2), Num Connections (3)		RO	Txt	ND	NC	PT	
4.15.005 Modbus Listening Port	0 to 65535	502	RW	Num				US
4.15.006 Maximum Connections	0 to 4	2	RW	Num				US
4.15.007 Maximum Priority Connections	0 to 5	0	RW	Num				US
4.15.008 Maximum Connections Per Client	1 to 4	2	RW	Num				US
4.15.009 Modbus Timeout	1 to 10000 ms	100 ms	RW	Num				US
4.15.010 Modbus Timeout Action	Trip (0), No action (1)	No action (1)	RW	Txt				US
4.15.011 Modbus Timeout Event Destination	This slot (0), Slot 1 (1), Slot 2 (2), Slot 3 (3), Slot 4 (4)	This slot (0)	RW	Txt				US
4.15.012 Modbus Timeout Event Type	No event (0), Trigger Event (1), Trigger Event 1 (2), Trigger Event 2 (3), Trigger Event 3 (4), Trigger Event 4 (5)	No event (0)	RW	Txt				US
4.15.013 Modbus Register Addressing Mode	Standard (0), Modified (1)	Standard (0)	RW	Txt				US
4.15.020 Priority Connection 1	0.0.0.0 to 255.255.255.255	0.0.0.0	RW	IP				US
4.15.021 Priority Connection 2	0.0.0.0 to 255.255.255.255	0.0.0.0	RW	IP				US
4.15.022 Priority Connection 3	0.0.0.0 to 255.255.255.255	0.0.0.0	RW	IP				US
4.15.023 Priority Connection 4	0.0.0.0 to 255.255.255.255	0.0.0.0	RW	IP				US

RW	Read / Write	RO	Read-only	Bit	Bit parameter	Txt	Text string	Date	Date parameter	Time	Time parameter
Chr	Character parameter	Bin	Binary parameter	IP	IP address	Mac	MAC address	Ver	Version number	SMP	Slot, menu, parameter
Num	Number parameter	DE	Destination	ND	No default value	RA	Rating dependent	NC	Non-copyable	PT	Protected
FI	Filtered	US	User save	PS	Power-down save						

Slot 4 Menu 15 − *Modbus TCP/IP Setup*

Mode: RFC‑S

Modbus TCP/IP is one of the most widely supported industrial Ethernet based protocols offering the functionality and simplicity of the Modbus protocol, with the flexibility of Ethernet. The table below shows the supported Modbus function codes.

The implementation of Modbus TCP/IP follows the specification provided by the Modbus organisation. Modbus TCP/IP uses the standard Protocol Data Unit (PDU) but without the CRC bytes and encapsulates it within a Modbus TCP/IP Application Data Unit (ADU) for transmission. This means that the Modbus PDU is the same for both standard and Ethernet based transmission.

Code	Description
3	Read multiple 16 bit registers
6	Write single 16 bit register
16	Write multiple 16 bit registers
23	Read and write multiple 16 bit registers

Parameter	4.15.001 *Enable*		
Short description	Set to enable Modbus functionality		
Minimum	0	Maximum	1
Default	1	Units	
Type	1 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW, BU		

This parameter is used to enable or disable Modbus master and slave functionality.

Parameter	4.15.002 *Reset*		
Short description	Set to reset the interface		
Minimum	0	Maximum	1
Default	0	Units	
Type	1 Bit Volatile	Update Rate	Background read; written to 0 on initialisation
Display Format	Standard	Decimal Places	0
Coding	RW, NC		

This parameter is used to perform a warm reset of the protocol interface. When set and the protocol has reset, the parameter will be reset to zero (Off).

Parameter	4.15.003 *Default*		
Short description	Set to default the protocol interface		
Minimum	0	Maximum	1
Default	0	Units	
Type	1 Bit Volatile	Update Rate	On module reset, protocol interface reset or protocol enable
Display Format	Standard	Decimal Places	0
Coding	RW, NC		

This parameter allows the protocol to be defaulted to factory settings. This includes all of the protocol features, configuration, mappings and stored objects.

Parameter	4.15.004 *Modbus Configuration Error*		
Short description	Displays the Modbus configuration error		
Minimum	0	Maximum	3
Default		Units	
Type	8 Bit Volatile	Update Rate	Module reset, Modbus interface reset or Modbus interface enable
Display Format	Standard	Decimal Places	0
Coding	RO, TE, ND, NC, PT, BU		

Value	*Text*	*Description*
0	No error	No error
1	Port in use	Specified port is currently in use by another protocol
2	Timeout event	Timeout trigger event location is not valid
3	Num Connections	The Max priority connection is greater than the max connections

This parameter will indicate any Modbus configuration errors.

Parameter	4.15.005 *Modbus Listening Port*		
Short description	Defines the Modbus TCP/IP port		
Minimum	0	Maximum	65535
Default	502	Units	
Type	16 Bit User Save	Update Rate	MODBUS_THREAD_TICK_TIME
Display Format	Standard	Decimal Places	0
Coding	RW, BU		

This parameter can be changed from its default port of 502, however it is the user's responsibility to ensure that a valid port is set.

Parameter	4.15.006 *Maximum Connections*		
Short description	Defines the maximum number of connections to the module		
Minimum	0	Maximum	4
Default	2	Units	
Type	8 Bit User Save	Update Rate	Module reset, Modbus interface reset or Modbus interface enable
Display Format	Standard	Decimal Places	0
Coding	RW, BU		

This parameter permits the user to specify the total number of connections that one or more clients can open with the module at any one time.

Parameter	4.15.007 *Maximum Priority Connections*		
Short description	Defines the maximum number of priority connections		
Minimum	0	Maximum	5
Default	0	Units	
Type	8 Bit User Save	Update Rate	Module reset, Modbus interface reset or Modbus interface enable
Display Format	Standard	Decimal Places	0
Coding	RW, BU		

This parameter defines the how many of the maximum connections specified in *Maximum Connections* (4.15.006) can be configured as a priority connection. A connection is accepted into the priority connections pool if the client's IP address matches one of the values stored in parameters *Priority Connection 1* (4.15.020), *Priority Connection 2* (4.15.021), *Priority Connection 3* (4.15.022) or *Priority Connection 4* (4.15.023).

The priority connections are permanent and, once made will only be deleted at the request of the client or due to a communications error.

Any connections not in the priority connections pool are kept in the non-priority connections pool. If a client attempts to establish a priority connection and all available non-priority connections are in use, the non-priority connection that has not been used for the longest will be closed to make way for the new priority connection.

Parameter	4.15.008 *Maximum Connections Per Client*		
Short description	Defines the maximum number of connections per client		
Minimum	1	Maximum	4
Default	2	Units	
Type	8 Bit User Save	Update Rate	Module reset, Modbus interface reset or Modbus interface enable
Display Format	Standard	Decimal Places	0
Coding	RW, BU		

This parameter defines the maximum number of connections that any one client can establish. This check is only performed on the connections in the priority connections pool.

Parameter	4.15.009 *Modbus Timeout*		
Short description	Defines the Modbus timeout value		
Minimum	1	Maximum	10000
Default	100	Units	ms
Type	16 Bit User Save	Update Rate	Module reset, Modbus interface reset or Modbus interface enable
Display Format	Standard	Decimal Places	0
Coding	RW, BU		

This parameter defines the time period in which the Modbus server must receive a message before any specified action (as defined in) is performed. When the timeout occurs, bit 1 in the module's alarm parameter () will be set and the specified action will be performed.

The timeout is enabled when the server receives its first message.

Note:
It is good system design to allow for some message loss by setting the timeout duration to be greater than the transmit period by a factor of 2 or more.

Parameter	4.15.010 *Modbus Timeout Action*		
Short description	Defines the action to perform on a Modbus timeout		
Minimum	0	Maximum	1
Default	1	Units	
Type	8 Bit User Save	Update Rate	Module reset, Modbus interface reset or Modbus interface enable
Display Format	Standard	Decimal Places	0
Coding	RW, TE, BU		

Value	Text	Description
0	Trip	Trip drive and raise error
1	No action	No action

Defines the action when no message is received within the time period specified in *Modbus Timeout* (4.15.009). Note: if a Trip is enabled, this will be triggered by Unidrive M Connect scanning the network since Unidrive M Connect sends a Modbus function code 64. Similar Acyclic Read/Write PC Tools can cause a Timeout Trip for the same reason.

Parameter	4.15.011 *Modbus Timeout Event Destination*		
Short description	Defines the destination for the Modbus timeout event		
Minimum	0	Maximum	4
Default	0	Units	
Type	8 Bit User Save	Update Rate	Module reset, Modbus interface reset or Modbus interface enable
Display Format	Standard	Decimal Places	0
Coding	RW, TE, BU		

Value	Text	Description
0	This slot	Trigger event in this slot
1	Slot 1	Trigger event in slot 1
2	Slot 2	Trigger event in slot 2
3	Slot 3	Trigger event in slot 3
4	Slot 4	Trigger event in slot 4

Defines the destination slot to trigger the event (defined by *Modbus Timeout Event Type* (4.15.012)) when a timeout occurs.

<< This feature is not currently supported >>

Parameter	4.15.012 *Modbus Timeout Event Type*		
Short description	Defines the event type to trigger		
Minimum	0	Maximum	5
Default	0	Units	
Type	8 Bit User Save	Update Rate	Module reset, Modbus interface reset or Modbus interface enable
Display Format	Standard	Decimal Places	0
Coding	RW, TE, BU		

Value	Text	Description
0	No event	No event
1	Trigger Event	Trigger module Event
2	Trigger Event 1	Trigger module Event 1
3	Trigger Event 2	Trigger module Event 2
4	Trigger Event 3	Trigger module Event 3
5	Trigger Event 4	Trigger module Event 4

Defines the event to trigger when a timeout occurs. *Modbus Timeout Event Destination* (4.15.011) must specify an appropriate consumer (slot option) of the event.

Parameter	4.15.013 *Modbus Register Addressing Mode*		
Short description	Defines the Modbus register addressing mode		
Minimum	0	Maximum	1
Default	0	Units	
Type	8 Bit User Save	Update Rate	Module reset, Modbus interface reset or Modbus interface enable
Display Format	Standard	Decimal Places	0
Coding	RW, TE, BU		

Value	Text	Description
0	Standard	(mm x 100) + ppp - mm<=162 and ppp<=99
1	Modified	(mm x 256) + ppp - mm<=63 and ppp<=255

Specifies the Modbus register addressing mode.

Parameter	4.15.020 *Priority Connection 1*		
Short description	Specifies the IP address for the connection		
Minimum	0 (Display: 0.0.0.0)	Maximum	4294967295 (Display: 255.255.255.255)
Default	0 (Display: 0.0.0.0)	Units	
Type	32 Bit User Save	Update Rate	Module reset, Modbus interface reset or Modbus interface enable
Display Format	IP Address	Decimal Places	0
Coding	RW, BU		

This parameter specifies an IP address for a priority connection.

Note: parameters 20 through 23 must be filled in the order starting from the Priority_Connection_1 thruogh Priority_Connection_4. If a higher numbered Priority Connection is specified without the lower ones being filled, then it will be ignored.

Parameter	4.15.021 *Priority Connection 2*		
Short description	Specifies the IP address for the connection		
Minimum	0 (Display: 0.0.0.0)	Maximum	4294967295 (Display: 255.255.255.255)
Default	0 (Display: 0.0.0.0)	Units	
Type	32 Bit User Save	Update Rate	Module reset, Modbus interface reset or Modbus interface enable
Display Format	IP Address	Decimal Places	0
Coding	RW, BU		

This parameter specifies an IP address for a priority connection.

Note: parameters 20 through 23 must be filled in the order starting from the Priority_Connection_1 thruogh Priority_Connection_4. If a higher numbered Priority Connection is specified without the lower ones being filled, then it will be ignored.

Parameter	4.15.022 *Priority Connection 3*		
Short description	Specifies the IP address for the connection		
Minimum	0 (Display: 0.0.0.0)	Maximum	4294967295 (Display: 255.255.255.255)
Default	0 (Display: 0.0.0.0)	Units	
Type	32 Bit User Save	Update Rate	Module reset, Modbus interface reset or Modbus interface enable
Display Format	IP Address	Decimal Places	0
Coding	RW, BU		

This parameter specifies an IP address for a priority connection.

Note: parameters 20 through 23 must be filled in the order starting from the Priority_Connection_1 thruogh Priority_Connection_4. If a higher numbered Priority Connection is specified without the lower ones being filled, then it will be ignored.

Parameter	4.15.023 *Priority Connection 4*		
Short description	Specifies the IP address for the connection		
Minimum	0 (Display: 0.0.0.0)	Maximum	4294967295 (Display: 255.255.255.255)
Default	0 (Display: 0.0.0.0)	Units	
Type	32 Bit User Save	Update Rate	Module reset, Modbus interface reset or Modbus interface enable
Display Format	IP Address	Decimal Places	0
Coding	RW, BU		

This parameter specifies an IP address for a priority connection.

Note: fill parameters 20 through 23 from the Priority_Connection_1. If a higher numbered Priority Connection is specified without the lower ones being filled, then it will be ignored.

Slot 4 Menu 20 Single Line Descriptions − *EtherNet/IP Setup*

Mode: RFC‑S

Parameter	Range	Default	Type					
4.20.001 Enable EtherNet/IP	Off (0) or On (1)	On (1)	RW	Bit				US
4.20.002 Reset	Off (0) or On (1)	Off (0)	RW	Bit		NC		
4.20.003 Default	Off (0) or On (1)	Off (0)	RW	Bit		NC		
4.20.004 Configuration error	No error (0), RPI event dst (1), RPI event type (2), IDLE event dst (3), IDLE event type (4), Input mapping (5), Output mapping (6), In cons trig pr (7), Out cons trig pr (8)		RO	Txt	ND	NC	PT	
4.20.007 Cyclic data transfers per second	0 to 65535 Messages/s		RO	Num	ND	NC	PT	
4.20.011 RPI timeout action	Trip (0), Send flt values (1), Clear output (2), Hold last (3), No Action (4)	Hold last (3)	RW	Txt				US
4.20.012 RPI timeout event destination	This slot (0), Slot 1 (1), Slot 2 (2), Slot 3 (3), Slot 4 (4)	This slot (0)	RW	Txt				US
4.20.013 RPI timeout event type	No event (0), Trigger Event (1), Trigger Event 1 (2), Trigger Event 2 (3), Trigger Event 3 (4), Trigger Event 4 (5)	No event (0)	RW	Txt				US
4.20.015 PLC idle action	Trip (0), Send flt values (1), Clear output (2), Hold last (3), No Action (4)	No Action (4)	RW	Txt				US
4.20.016 PLC idle event destination	This slot (0), Slot 1 (1), Slot 2 (2), Slot 3 (3), Slot 4 (4)	This slot (0)	RW	Txt				US
4.20.017 PLC idle event type	No event (0), Trigger Event (1), Trigger Event 1 (2), Trigger Event 2 (3), Trigger Event 3 (4), Trigger Event 4 (5)	No event (0)	RW	Txt				US
4.20.018 Active input assembly object	100‑PrimaryI (0), 70‑BscSpdCtrlI (1), 71‑ExtSpdCtrlI (2), 72‑SpdTqCtrlI (3), 73‑ExtSpdTqCtrlI (4)		RO	Txt	ND	NC	PT	
4.20.019 Active output assembly object	101‑PrimaryO (0), 20‑BscSpdCtrlO (1), 21‑ExtSpdCtrlO (2), 22‑SpdTqCtrlO (3), 23‑ExtSpdTqCtrlO (4)		RO	Txt	ND	NC	PT	
4.20.020 Input assembly object size	4 to 128 Bytes	8 Bytes	RW	Num				US
4.20.021 Output assembly object size	4 to 128 Bytes	8 Bytes	RW	Num				US
4.20.024 Input assembly object process time	0 to 65535 ms		RO	Num	ND	NC	PT	
4.20.025 Output assembly object process time	0 to 65535 ms		RO	Num	ND	NC	PT	
4.20.026 Input assembly object consistency enable	Off (0) or On (1)	Off (0)	RW	Bit				US
4.20.027 Input assembly object consistency trigger parameter	0 to 499999	0	RW	Num				US
4.20.028 Output assembly object consistency enable	Off (0) or On (1)	Off (0)	RW	Bit				US
4.20.029 Output assembly object consistency trigger parameter	0 to 499999	0	RW	Num				US
4.20.030 Custom Vendor ID	257 - CT (0), 553 - CT AMERICA (1)	257 - CT (0)	RW	Txt				US
4.20.031 Custom product code	0 to 65535	0	RW	Num				US
4.20.032 Custom product revision code	0 to 65535	0	RW	Num				US
4.20.033 Actual Product Code	0 to 65535		RO	Num	ND	NC	PT	
4.20.034 Actual Product Revision	0 to 65535		RO	Num	ND	NC	PT	
4.20.040 Type of Motor 1	2‑FC DC (0), 6‑WRI (1), 7‑SCI (2), 9‑Sin PM BL (3), 10‑Trap PM BL (4)	7‑SCI (2)	RO	Txt			PT	US
4.20.041 Type of Motor 2	2‑FC DC (0), 6‑WRI (1), 7‑SCI (2), 9‑Sin PM BL (3), 10‑Trap PM BL (4)	7‑SCI (2)	RO	Txt			PT	US

RW	Read / Write	RO	Read-only	Bit	Bit parameter	Txt	Text string	Date	Date parameter	Time	Time parameter
Chr	Character parameter	Bin	Binary parameter	IP	IP address	Mac	MAC address	Ver	Version number	SMP	Slot, menu, parameter
Num	Number parameter	DE	Destination	ND	No default value	RA	Rating dependent	NC	Non-copyable	PT	Protected
FI	Filtered	US	User save	PS	Power-down save						

Slot 4 Menu 20 − *EtherNet/IP Setup*

Mode: RFC‑S

The Ethernet interface supports the EtherNet/IP protocol and conforms to the EtherNet/IP adaptation of the Common Industrial Protocol (CIP) Specification. This is the same upper-layer protocol and object model as used in DeviceNet.

The Ethernet interface will operate as a slave device and the following functionality is supported.

- Variable length input assembly object (instance 100)
- Variable length output assembly object (instance 101)
- Maximum assembly object size of 128 bytes (32 parameters)
- Explicit (non-cyclic) access to parameters
- A.C. drive profiles
- Management of consistent data transfer between the Ethernet interface and user programs.
- Configuration via parameters

Parameter Update Rate

Parameters are exchange over the network. The value exchanged with the network must be exchanged with the drive or option parameter. The rate of data exchange differs for drive/option destinations.

The diagram below depicts the update cycles used within the Ethernet interface. CIP assembly mappings being exchanged with the drive will be updated at the background task rate. This rate (*Background cycles per second* (09.008)) varies with the load on the Ethernet interface; Easy Mode data exchange also takes place in the background task.

Network — Ethernet/IP RPI — CIP Assembly — Background Task — DRIVE / OPTIONS
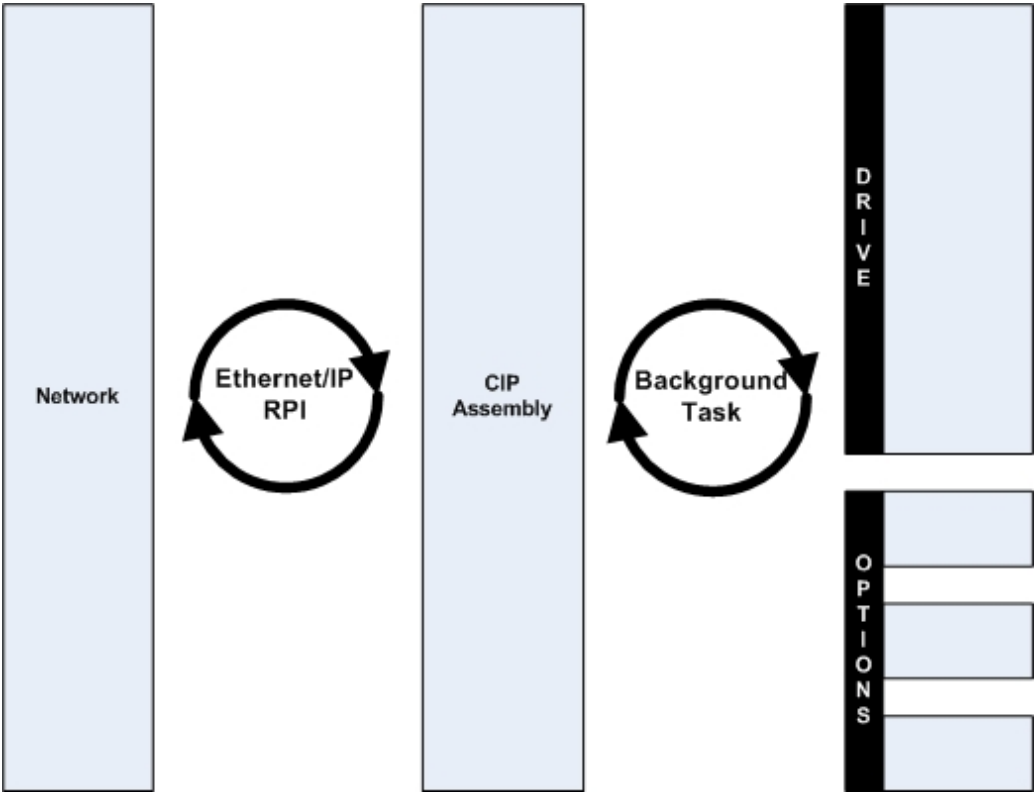
Parameter	4.20.001 *Enable EtherNet/IP*		
Short description	Set to enable the EtherNet/IP interface		
Minimum	0	Maximum	1
Default	1	Units	
Type	1 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW, BU		

This parameter is used to enable or disable Ethernet/IP slave functionality.

Parameter	4.20.002 *Reset*		
Short description	Set to reset the interface		
Minimum	0	Maximum	1
Default	0	Units	
Type	1 Bit Volatile	Update Rate	Background read; written to 0 on initialisation
Display Format	Standard	Decimal Places	0
Coding	RW, NC		

This parameter is used to perform a warm reset of the protocol interface. When set and the protocol has reset, the parameter will be reset to zero (Off).

Parameter	4.20.003 *Default*		
Short description	Set to default the protocol interface		
Minimum	0	Maximum	1
Default	0	Units	
Type	1 Bit Volatile	Update Rate	On module reset, protocol interface reset or protocol enable
Display Format	Standard	Decimal Places	0
Coding	RW, NC		

This parameter allows the protocol to be defaulted to factory settings. This includes all of the protocol features, configuration, mappings and stored objects.

Parameter	4.20.004 *Configuration error*		
Short description	Displays the EtherNet/IP configuration error		
Minimum	0	Maximum	8
Default		Units	
Type	8 Bit Volatile	Update Rate	Background
Display Format	Standard	Decimal Places	0
Coding	RO, TE, ND, NC, PT, BU		

Value	Text	Description
0	No error	No error
1	RPI event dst	RPI timeout event desination not valid
2	RPI event type	RPI timeout event type not valid
3	IDLE event dst	PLC IDLE event desination not valid
4	IDLE event type	PLC IDLE event type not valid
5	Input mapping	Output mapping parameter not valid
6	Output mapping	Output mapping parameter not valid
7	In cons trig pr	Input consistency trigger parameter not valid
8	Out cons trig pr	Output consistency trigger parameter not valid

This parameter is used to display the error code if an Ethernet/IP configuration error occurs.

Parameter	4.20.007 *Cyclic data transfers per second*		
Short description	Showing the EIP cyclic data transfer rate		
Minimum	0	Maximum	65535
Default		Units	Messages/s
Type	16 Bit Volatile	Update Rate	Background
Display Format	Standard	Decimal Places	0
Coding	RO, ND, NC, PT, BU		

This parameter shows the EtherNet/IP cyclic data transfer rate.

Parameter	4.20.011 *RPI timeout action*		
Short description	Defines the action when an RPI timeout occurs		
Minimum	0	Maximum	4
Default	3	Units	
Type	8 Bit User Save	Update Rate	Module reset, EtherNet/IP interface reset or EtherNet/IP interface enable
Display Format	Standard	Decimal Places	0
Coding	RW, TE, BU		

Value	Text	Description
0	Trip	Trip drive with Slx.Er and sub-trip code
1	Send flt values	Send configured fault values to the output parameters
2	Clear output	PLC output parameters will have their values set to zero
3	Hold last	Hold the last value in output parameters
4	No Action	No action with output parameters

This timeout is defined by the EtherNet/IP protocol and is configured in the PLC master. The interface will monitor the data traffic and if data is not received within the specified time, it will perform the requested action. This indicates that the interface has detected that the cyclic data communication has been interrupted.

Trip
On an RPI timeout the interface will cause a slot trip with sub trip value 101 (EtherNet/IP RPI Timeout).

Send Fault Values
On an RPI timeout the interface will not trip the drive. It will write the values specified in Fault Values menu (23) to the PLC output mappings for the assembly object 101 if active.

Clear Output
On an RPI timeout the interface will not trip the drive. It will write all PLC output mappings for the assembly object 101 if active to zero.

Hold Last
On an RPI timeout the interface will not trip the drive. The last value received will be maintained.

No Action
On an RPI timeout the interface will not trip the drive. The last value received will be maintained.

Parameter	4.20.012 *RPI timeout event destination*		
Short description	Defines the destination for the RPI timeout event		
Minimum	0	Maximum	4
Default	0	Units	
Type	8 Bit User Save	Update Rate	Module reset, EtherNet/IP interface reset or EtherNet/IP interface enable
Display Format	Standard	Decimal Places	0
Coding	RW, TE, BU		

Value	Text	Description
0	This slot	Trigger event in this slot
1	Slot 1	Trigger event in slot 1
2	Slot 2	Trigger event in slot 2
3	Slot 3	Trigger event in slot 3
4	Slot 4	Trigger event in slot 4

This parameter defines the destination slot to trigger the event upon an RPI timeout.

<< This feature is not currently supported >>

Parameter	4.20.013 *RPI timeout event type*		
Short description	Sets the event to trigger on RPI timeout		
Minimum	0	Maximum	5
Default	0	Units	
Type	8 Bit User Save	Update Rate	Module reset, EtherNet/IP interface reset or EtherNet/IP interface enable
Display Format	Standard	Decimal Places	0
Coding	RW, TE, BU		

Value	Text	Description
0	No event	No event
1	Trigger Event	Trigger module Event
2	Trigger Event 1	Trigger module Event 1
3	Trigger Event 2	Trigger module Event 2
4	Trigger Event 3	Trigger module Event 3
5	Trigger Event 4	Trigger module Event 4

Defines the event to trigger in the specified destination (*RPI timeout event destination* (4.20.012)) upon an RPI timeout

Parameter	4.20.015 *PLC idle action*		
Short description	Defines the action for a PLC idle event		
Minimum	0	Maximum	4
Default	4	Units	
Type	8 Bit User Save	Update Rate	Module reset, EtherNet/IP interface reset or EtherNet/IP interface enable
Display Format	Standard	Decimal Places	0
Coding	RW, TE, BU		

Value	Text	Description
0	Trip	Trip drive with Slx.Er and sub-trip code
1	Send flt values	Send configured fault values to the output parameters
2	Clear output	PLC output parameters will have their values set to zero
3	Hold last	Hold the last value in output parameters
4	No Action	No action with output parameters

This parameter defines the action to be taken upon a PLC idle event.

Parameter	4.20.016 *PLC idle event destination*		
Short description	Defines the destination for a PLC idle event		
Minimum	0	Maximum	4
Default	0	Units	
Type	8 Bit User Save	Update Rate	Module reset, EtherNet/IP interface reset or EtherNet/IP interface enable
Display Format	Standard	Decimal Places	0
Coding	RW, TE, BU		

Value	Text	Description
0	This slot	Trigger event in this slot
1	Slot 1	Trigger event in slot 1
2	Slot 2	Trigger event in slot 2
3	Slot 3	Trigger event in slot 3
4	Slot 4	Trigger event in slot 4

This parameter defines the destination slot to trigger the event upon a PLC idle event.

<< This feature is not currently supported >>

Parameter	4.20.017 *PLC idle event type*		
Short description	Sets the event to trigger on PLC idle		
Minimum	0	Maximum	5
Default	0	Units	
Type	8 Bit User Save	Update Rate	Module reset, EtherNet/IP interface reset or EtherNet/IP interface enable
Display Format	Standard	Decimal Places	0
Coding	RW, TE, BU		

Value	Text	Description
0	No event	No event
1	Trigger Event	Trigger module Event
2	Trigger Event 1	Trigger module Event 1
3	Trigger Event 2	Trigger module Event 2
4	Trigger Event 3	Trigger module Event 3
5	Trigger Event 4	Trigger module Event 4

Defines the event to trigger in the specified destination (*PLC idle event destination* (4.20.016)) upon a PLC idle event.

Parameter	4.20.018 *Active input assembly object*		
Short description	Sets and displays the active input assembly object		
Minimum	0	Maximum	4
Default		Units	
Type	8 Bit Volatile	Update Rate	Module reset, EtherNet/IP interface reset or EtherNet/IP interface enable
Display Format	Standard	Decimal Places	0
Coding	RO, TE, ND, NC, PT, BU		

Value	Text	Description
0	100-PrimaryI	Primary input (100)
1	70-BscSpdCtrlI	Basic speed control input (70)
2	71-ExtSpdCtrlI	Extended speed control input (71)
3	72-SpdTqCtrlI	Speed and torque control input (72)
4	73-ExtSpdTqCtrlI	Extended speed and torque control input (73)

This parameter defines and shows the required input assembly object.

Parameter	4.20.019 *Active output assembly object*		
Short description	Sets and displays the active ouput assembly object		
Minimum	0	Maximum	4
Default		Units	
Type	8 Bit Volatile	Update Rate	Module reset, EtherNet/IP interface reset or EtherNet/IP interface enable
Display Format	Standard	Decimal Places	0
Coding	RO, TE, ND, NC, PT, BU		

Value	Text	Description
0	101-PrimaryO	Primary output (101)
1	20-BscSpdCtrlO	Basic speed control output (20)
2	21-ExtSpdCtrlO	Extended speed control output (21)
3	22-SpdTqCtrlO	Speed and torque control output (22)
4	23-ExtSpdTqCtrlO	Extended speed and torque control output (23)

This parameter defines and shows the required output assembly object.

Parameter	4.20.020 *Input assembly object size*		
Short description	Defines the size of the input assembly object		
Minimum	4	Maximum	128
Default	8	Units	Bytes
Type	8 Bit User Save	Update Rate	Module reset, EtherNet/IP interface reset or EtherNet/IP interface enable
Display Format	Standard	Decimal Places	0
Coding	RW, BU		

This parameter defines the size of the input assembly object (100).

Parameter	4.20.021 *Output assembly object size*		
Short description	Defines the size of the output assembly object		
Minimum	4	Maximum	128
Default	8	Units	Bytes
Type	8 Bit User Save	Update Rate	Module reset, EtherNet/IP interface reset or EtherNet/IP interface enable
Display Format	Standard	Decimal Places	0
Coding	RW, BU		

This parameter defines the size of the output assembly object (101).

Parameter	4.20.024 *Input assembly object process time*		
Short description	Displays the input assembly object process time		
Minimum	0	Maximum	65535
Default		Units	ms
Type	16 Bit Volatile	Update Rate	Background
Display Format	Standard	Decimal Places	0
Coding	RO, ND, NC, PT, BU		

This is the time between getting the input value from the master and it being sent successfully to the drive.

Parameter	4.20.025 *Output assembly object process time*		
Short description	Displays the output assembly object process time		
Minimum	0	Maximum	65535
Default		Units	ms
Type	16 Bit Volatile	Update Rate	Background
Display Format	Standard	Decimal Places	0
Coding	RO, ND, NC, PT, BU		

This is the time between getting the output value from the drive and it being sent successfully to the master.

Parameter	4.20.026 *Input assembly object consistency enable*		
Short description	Enables or disables consistency on the input assembly object		
Minimum	0	Maximum	1
Default	0	Units	
Type	1 Bit User Save	Update Rate	Module reset, EtherNet/IP interface reset or EtherNet/IP interface enable
Display Format	Standard	Decimal Places	0
Coding	RW		

This parameter allows for enabling and disabling input assembly object consistency.

Under normal conditions, cyclic data is sampled and transmitted at the Requested Packet Interval (RPI). However, if an option module was in the process of modifying the mapped parameters while these parameters were being sampled, then the data transmitted across the network may not be consistent across the entire assembly object. If read consistency is enabled (and a trigger parameter specified in *Input assembly object consistency trigger parameter* (4.20.027)) then data will only be sampled when the trigger parameter *Input assembly object consistency trigger parameter* (4.20.027) contains a non-zero value. This trigger parameter will then be set to zero after the data has been sampled.

It is therefore possible, by controlling the trigger parameters, that a user program in the drive or option module can ensure that the values in the cyclic data parameters are not sampled until all values are updated. Whether consistency is enabled or not, data will always be consistent for an individual parameter, i.e. all 4 bytes of a 32 bit value will be consistent.

Parameter	4.20.027 *Input assembly object consistency trigger parameter*		
Short description	Sets the trigger parameter for input assembly object consistency		
Minimum	0	Maximum	499999
Default	0	Units	
Type	32 Bit User Save	Update Rate	Module reset, EtherNet/IP interface reset or EtherNet/IP interface enable
Display Format	Slot Menu Parameter	Decimal Places	0
Coding	RW, BU		

This parameter specifies the parameter to use for triggering input assembly object consistency. See *Input assembly object consistency enable* (4.20.026) for more information on consistency.

Parameter	4.20.028 *Output assembly object consistency enable*		
Short description	Enables or disables consistency on the output assembly object		
Minimum	0	Maximum	1
Default	0	Units	
Type	1 Bit User Save	Update Rate	Module reset, EtherNet/IP interface reset or EtherNet/IP interface enable
Display Format	Standard	Decimal Places	0
Coding	RW		

This parameter allows for enabling and disabling output assembly object consistency.

Sampling of data can be controlled using consistency by enabling this parameter and setting a trigger parameter (*Output assembly object consistency trigger parameter* (4.20.029)).

Consistency enabled

When output assembly object consistency is enabled, the value in the output assembly object consistency trigger parameter (*Output assembly object consistency trigger parameter* (4.20.029)) is checked at the beginning of the writing routine. If it is zero then data is written to the cyclic data destination parameters and the trigger parameter is set to 1. If the value is non-zero then new data is discarded.

Consistency disabled

When output assembly object consistency is disabled, new data is written to the cyclic data destination parameters just after it has been received.

Note : If write consistency is enabled, then at reset or at power-up, the value in the trigger parameter is set to zero.

Parameter	4.20.029 *Output assembly object consistency trigger parameter*		
Short description	Sets the trigger parameter for input assembly object consistency		
Minimum	0	Maximum	499999
Default	0	Units	
Type	32 Bit User Save	Update Rate	Module reset, EtherNet/IP interface reset or EtherNet/IP interface enable
Display Format	Slot Menu Parameter	Decimal Places	0
Coding	RW, BU		

This parameter specifies the parameter to use for triggering output assembly object consistency. See *Output assembly object consistency enable* (4.20.028) for more information on consistency.

Parameter	4.20.030 *Custom Vendor ID*		
Short description	Custom Defined Vendor ID		
Minimum	0	Maximum	1
Default	0	Units	
Type	8 Bit User Save	Update Rate	Module reset, EtherNet/IP interface reset or EtherNet/IP interface enable
Display Format	Standard	Decimal Places	0
Coding	RW, TE, BU		

Value	*Text*	*Description*
0	257 - CT	EtherNet/IP interface
1	553 - CT AMERICA	EtherNet/IP America interface

This parameter defines the customised vendor ID.

Parameter	4.20.031 *Custom product code*		
Short description	Sets and displays the custom product code		
Minimum	0	Maximum	65535
Default	0	Units	
Type	16 Bit User Save	Update Rate	Module reset, EtherNet/IP interface reset or EtherNet/IP interface enable
Display Format	Standard	Decimal Places	0
Coding	RW, BU		

This parameter defines a custom product type value which is used to identify the product on the network.

Parameter	4.20.032 *Custom product revision code*		
Short description	Sets and displays the custom product revision code		
Minimum	0	Maximum	65535
Default	0	Units	
Type	16 Bit User Save	Update Rate	Module reset, EtherNet/IP interface reset or EtherNet/IP interface enable
Display Format	Standard	Decimal Places	0
Coding	RW, BU		

This parameter defines a custom product revision value which is used to identify the product on the network.

Parameter	4.20.033 *Actual Product Code*		
Short description	Displays the actual product code		
Minimum	0	Maximum	65535
Default		Units	
Type	16 Bit Volatile	Update Rate	Module reset, EtherNet/IP interface reset or EtherNet/IP interface enable
Display Format	Standard	Decimal Places	0
Coding	RO, ND, NC, PT, BU		

This parameter defines the actual product code.

Parameter	4.20.034 *Actual Product Revision*		
Short description	Display the actual product revision		
Minimum	0	Maximum	65535
Default		Units	
Type	16 Bit Volatile	Update Rate	Module reset, EtherNet/IP interface reset or EtherNet/IP interface enable
Display Format	Standard	Decimal Places	0
Coding	RO, ND, NC, PT, BU		

This parameter defines the actual revision number.

Parameter	4.20.040 *Type of Motor 1*		
Short description	The type of motor 1		
Minimum	0	Maximum	4
Default	2	Units	
Type	8 Bit User Save	Update Rate	Reset
Display Format	Standard	Decimal Places	0
Coding	RO, TE, PT, BU		

Value	Text	Description
0	2-FC DC	FC DC Motor
1	6-WRI	Wound Rotor Induction Motor
2	7-SCI	Squirrel Cage Induction Motor
3	9-Sin PM BL	Sinusoidal PM BL Motor
4	10-Trap PM BL	Trapezoidal PM BL Motor

This parameter defines the type of motor 1

Parameter	4.20.041 *Type of Motor 2*		
Short description	The type of motor 2		
Minimum	0	Maximum	4
Default	2	Units	
Type	8 Bit User Save	Update Rate	Reset
Display Format	Standard	Decimal Places	0
Coding	RO, TE, PT, BU		

Value	Text	Description
0	2-FC DC	FC DC Motor
1	6-WRI	Wound Rotor Induction Motor
2	7-SCI	Squirrel Cage Induction Motor
3	9-Sin PM BL	Sinusoidal PM BL Motor
4	10-Trap PM BL	Trapezoidal PM BL Motor

This parameter defines the type of motor 2

Slot 4 Menu 21 Single Line Descriptions − *EtherNet/IP In Mappings*

Mode: RFC‑S

Parameter		Range	Default	Type						
4.21.001	Input mapping parameter 1	0 to 499999	10040	RW	Num			PT	US	
4.21.002	Input mapping parameter 2	0 to 499999	2001	RW	Num			PT	US	
4.21.003	Input mapping parameter 3	0 to 499999	0	RW	Num			PT	US	
4.21.004	Input mapping parameter 4	0 to 499999	0	RW	Num			PT	US	
4.21.005	Input mapping parameter 5	0 to 499999	0	RW	Num			PT	US	
4.21.006	Input mapping parameter 6	0 to 499999	0	RW	Num			PT	US	
4.21.007	Input mapping parameter 7	0 to 499999	0	RW	Num			PT	US	
4.21.008	Input mapping parameter 8	0 to 499999	0	RW	Num			PT	US	
4.21.009	Input mapping parameter 9	0 to 499999	0	RW	Num			PT	US	
4.21.010	Input mapping parameter 10	0 to 499999	0	RW	Num			PT	US	
4.21.011	Input mapping parameter 11	0 to 499999	0	RW	Num			PT	US	
4.21.012	Input mapping parameter 12	0 to 499999	0	RW	Num			PT	US	
4.21.013	Input mapping parameter 13	0 to 499999	0	RW	Num			PT	US	
4.21.014	Input mapping parameter 14	0 to 499999	0	RW	Num			PT	US	
4.21.015	Input mapping parameter 15	0 to 499999	0	RW	Num			PT	US	
4.21.016	Input mapping parameter 16	0 to 499999	0	RW	Num			PT	US	
4.21.017	Input mapping parameter 17	0 to 499999	0	RW	Num			PT	US	
4.21.018	Input mapping parameter 18	0 to 499999	0	RW	Num			PT	US	
4.21.019	Input mapping parameter 19	0 to 499999	0	RW	Num			PT	US	
4.21.020	Input mapping parameter 20	0 to 499999	0	RW	Num			PT	US	
4.21.021	Input mapping parameter 21	0 to 499999	0	RW	Num			PT	US	
4.21.022	Input mapping parameter 22	0 to 499999	0	RW	Num			PT	US	
4.21.023	Input mapping parameter 23	0 to 499999	0	RW	Num			PT	US	
4.21.024	Input mapping parameter 24	0 to 499999	0	RW	Num			PT	US	
4.21.025	Input mapping parameter 25	0 to 499999	0	RW	Num			PT	US	
4.21.026	Input mapping parameter 26	0 to 499999	0	RW	Num			PT	US	
4.21.027	Input mapping parameter 27	0 to 499999	0	RW	Num			PT	US	
4.21.028	Input mapping parameter 28	0 to 499999	0	RW	Num			PT	US	
4.21.029	Input mapping parameter 29	0 to 499999	0	RW	Num			PT	US	
4.21.030	Input mapping parameter 30	0 to 499999	0	RW	Num			PT	US	
4.21.031	Input mapping parameter 31	0 to 499999	0	RW	Num			PT	US	
4.21.032	Input mapping parameter 32	0 to 499999	0	RW	Num			PT	US	

RW	Read / Write	RO	Read-only	Bit	Bit parameter	Txt	Text string	Date	Date parameter	Time	Time parameter
Chr	Character parameter	Bin	Binary parameter	IP	IP address	Mac	MAC address	Ver	Version number	SMP	Slot, menu, parameter
Num	Number parameter	DE	Destination	ND	No default value	RA	Rating dependent	NC	Non-copyable	PT	Protected
FI	Filtered	US	User save	PS	Power-down save						

Slot 4 Menu 21 − *EtherNet/IP In Mappings*

Mode: RFC‑S

Parameter	4.21.001 *Input mapping parameter 1*		
Short description	Sets input mapping parameter 1		
Minimum	0	Maximum	499999
Default	10040	Units	
Type	32 Bit User Save	Update Rate	Module reset, EtherNet/IP interface reset or EtherNet/IP interface enable
Display Format	Slot Menu Parameter	Decimal Places	0
Coding	RW, PT, BU		

This parameters defines a source parameter for the data that will be transmitted to the PLC. The default value for the parameter is zero.

Parameter	4.21.002 *Input mapping parameter 2*		
Short description	Sets input mapping parameter 2		
Minimum	0	Maximum	499999
Default	2001	Units	
Type	32 Bit User Save	Update Rate	Module reset, EtherNet/IP interface reset or EtherNet/IP interface enable
Display Format	Slot Menu Parameter	Decimal Places	0
Coding	RW, PT, BU		

This parameters defines a source parameter for the data that will be transmitted to the PLC. The default value for the parameter is zero.

Parameter	4.21.003 *Input mapping parameter 3*		
Short description	Sets input mapping parameter 3		
Minimum	0	Maximum	499999
Default	0	Units	
Type	32 Bit User Save	Update Rate	Module reset, EtherNet/IP interface reset or EtherNet/IP interface enable
Display Format	Slot Menu Parameter	Decimal Places	0
Coding	RW, PT, BU		

This parameters defines a source parameter for the data that will be transmitted to the PLC. The default value for the parameter is zero.

Parameter	4.21.004 *Input mapping parameter 4*		
Short description	Sets input mapping parameter 4		
Minimum	0	Maximum	499999
Default	0	Units	
Type	32 Bit User Save	Update Rate	Module reset, EtherNet/IP interface reset or EtherNet/IP interface enable
Display Format	Slot Menu Parameter	Decimal Places	0
Coding	RW, PT, BU		

This parameters defines a source parameter for the data that will be transmitted to the PLC. The default value for the parameter is zero.

Parameter	4.21.005 *Input mapping parameter 5*		
Short description	Sets input mapping parameter 5		
Minimum	0	Maximum	499999
Default	0	Units	
Type	32 Bit User Save	Update Rate	Module reset, EtherNet/IP interface reset or EtherNet/IP interface enable
Display Format	Slot Menu Parameter	Decimal Places	0
Coding	RW, PT, BU		

This parameters defines a source parameter for the data that will be transmitted to the PLC. The default value for the parameter is zero.

Parameter	4.21.006 *Input mapping parameter 6*		
Short description	Sets input mapping parameter 6		
Minimum	0	Maximum	499999
Default	0	Units	
Type	32 Bit User Save	Update Rate	Module reset, EtherNet/IP interface reset or EtherNet/IP interface enable
Display Format	Slot Menu Parameter	Decimal Places	0
Coding	RW, PT, BU		

This parameters defines a source parameter for the data that will be transmitted to the PLC. The default value for the parameter is zero.

Parameter	4.21.007 *Input mapping parameter 7*		
Short description	Sets input mapping parameter 7		
Minimum	0	Maximum	499999
Default	0	Units	
Type	32 Bit User Save	Update Rate	Module reset, EtherNet/IP interface reset or EtherNet/IP interface enable
Display Format	Slot Menu Parameter	Decimal Places	0
Coding	RW, PT, BU		

This parameters defines a source parameter for the data that will be transmitted to the PLC. The default value for the parameter is zero.

Parameter	4.21.008 *Input mapping parameter 8*		
Short description	Sets input mapping parameter 8		
Minimum	0	Maximum	499999
Default	0	Units	
Type	32 Bit User Save	Update Rate	Module reset, EtherNet/IP interface reset or EtherNet/IP interface enable
Display Format	Slot Menu Parameter	Decimal Places	0
Coding	RW, PT, BU		

This parameters defines a source parameter for the data that will be transmitted to the PLC. The default value for the parameter is zero.

Parameter	4.21.009 *Input mapping parameter 9*		
Short description	Sets input mapping parameter 9		
Minimum	0	Maximum	499999
Default	0	Units	
Type	32 Bit User Save	Update Rate	Module reset, EtherNet/IP interface reset or EtherNet/IP interface enable
Display Format	Slot Menu Parameter	Decimal Places	0
Coding	RW, PT, BU		

This parameters defines a source parameter for the data that will be transmitted to the PLC. The default value for the parameter is zero.

Parameter	4.21.010 *Input mapping parameter 10*		
Short description	Sets input mapping parameter 10		
Minimum	0	Maximum	499999
Default	0	Units	
Type	32 Bit User Save	Update Rate	Module reset, EtherNet/IP interface reset or EtherNet/IP interface enable
Display Format	Slot Menu Parameter	Decimal Places	0
Coding	RW, PT, BU		

This parameters defines a source parameter for the data that will be transmitted to the PLC. The default value for the parameter is zero.

Parameter	4.21.011 *Input mapping parameter 11*		
Short description	Sets input mapping parameter 11		
Minimum	0	Maximum	499999
Default	0	Units	
Type	32 Bit User Save	Update Rate	Module reset, EtherNet/IP interface reset or EtherNet/IP interface enable
Display Format	Slot Menu Parameter	Decimal Places	0
Coding	RW, PT, BU		

This parameters defines a source parameter for the data that will be transmitted to the PLC. The default value for the parameter is zero.

Parameter	4.21.012 *Input mapping parameter 12*		
Short description	Sets input mapping parameter 12		
Minimum	0	Maximum	499999
Default	0	Units	
Type	32 Bit User Save	Update Rate	Module reset, EtherNet/IP interface reset or EtherNet/IP interface enable
Display Format	Slot Menu Parameter	Decimal Places	0
Coding	RW, PT, BU		

This parameters defines a source parameter for the data that will be transmitted to the PLC. The default value for the parameter is zero.

Parameter	4.21.013 *Input mapping parameter 13*		
Short description	Sets input mapping parameter 13		
Minimum	0	Maximum	499999
Default	0	Units	
Type	32 Bit User Save	Update Rate	Module reset, EtherNet/IP interface reset or EtherNet/IP interface enable
Display Format	Slot Menu Parameter	Decimal Places	0
Coding	RW, PT, BU		

This parameters defines a source parameter for the data that will be transmitted to the PLC. The default value for the parameter is zero.

Parameter	4.21.014 *Input mapping parameter 14*		
Short description	Sets input mapping parameter 14		
Minimum	0	Maximum	499999
Default	0	Units	
Type	32 Bit User Save	Update Rate	Module reset, EtherNet/IP interface reset or EtherNet/IP interface enable
Display Format	Slot Menu Parameter	Decimal Places	0
Coding	RW, PT, BU		

This parameters defines a source parameter for the data that will be transmitted to the PLC. The default value for the parameter is zero.

Parameter	4.21.015 *Input mapping parameter 15*		
Short description	Sets input mapping parameter 15		
Minimum	0	Maximum	499999
Default	0	Units	
Type	32 Bit User Save	Update Rate	Module reset, EtherNet/IP interface reset or EtherNet/IP interface enable
Display Format	Slot Menu Parameter	Decimal Places	0
Coding	RW, PT, BU		

This parameters defines a source parameter for the data that will be transmitted to the PLC. The default value for the parameter is zero.

Parameter	4.21.016 *Input mapping parameter 16*		
Short description	Sets input mapping parameter 16		
Minimum	0	Maximum	499999
Default	0	Units	
Type	32 Bit User Save	Update Rate	Module reset, EtherNet/IP interface reset or EtherNet/IP interface enable
Display Format	Slot Menu Parameter	Decimal Places	0
Coding	RW, PT, BU		

This parameters defines a source parameter for the data that will be transmitted to the PLC. The default value for the parameter is zero.

Parameter	4.21.017 *Input mapping parameter 17*		
Short description	Sets input mapping parameter 17		
Minimum	0	Maximum	499999
Default	0	Units	
Type	32 Bit User Save	Update Rate	Module reset, EtherNet/IP interface reset or EtherNet/IP interface enable
Display Format	Slot Menu Parameter	Decimal Places	0
Coding	RW, PT, BU		

This parameters defines a source parameter for the data that will be transmitted to the PLC. The default value for the parameter is zero.

Parameter	4.21.018 *Input mapping parameter 18*		
Short description	Sets input mapping parameter 18		
Minimum	0	Maximum	499999
Default	0	Units	
Type	32 Bit User Save	Update Rate	Module reset, EtherNet/IP interface reset or EtherNet/IP interface enable
Display Format	Slot Menu Parameter	Decimal Places	0
Coding	RW, PT, BU		

This parameters defines a source parameter for the data that will be transmitted to the PLC. The default value for the parameter is zero.

Parameter	4.21.019 *Input mapping parameter 19*		
Short description	Sets input mapping parameter 19		
Minimum	0	Maximum	499999
Default	0	Units	
Type	32 Bit User Save	Update Rate	Module reset, EtherNet/IP interface reset or EtherNet/IP interface enable
Display Format	Slot Menu Parameter	Decimal Places	0
Coding	RW, PT, BU		

This parameters defines a source parameter for the data that will be transmitted to the PLC. The default value for the parameter is zero.

Parameter	4.21.020 *Input mapping parameter 20*		
Short description	Sets input mapping parameter 20		
Minimum	0	Maximum	499999
Default	0	Units	
Type	32 Bit User Save	Update Rate	Module reset, EtherNet/IP interface reset or EtherNet/IP interface enable
Display Format	Slot Menu Parameter	Decimal Places	0
Coding	RW, PT, BU		

This parameters defines a source parameter for the data that will be transmitted to the PLC. The default value for the parameter is zero.

Parameter	4.21.021 *Input mapping parameter 21*		
Short description	Sets input mapping parameter 21		
Minimum	0	Maximum	499999
Default	0	Units	
Type	32 Bit User Save	Update Rate	Module reset, EtherNet/IP interface reset or EtherNet/IP interface enable
Display Format	Slot Menu Parameter	Decimal Places	0
Coding	RW, PT, BU		

This parameters defines a source parameter for the data that will be transmitted to the PLC. The default value for the parameter is zero.

Parameter	4.21.022 *Input mapping parameter 22*		
Short description	Sets input mapping parameter 22		
Minimum	0	Maximum	499999
Default	0	Units	
Type	32 Bit User Save	Update Rate	Module reset, EtherNet/IP interface reset or EtherNet/IP interface enable
Display Format	Slot Menu Parameter	Decimal Places	0
Coding	RW, PT, BU		

This parameters defines a source parameter for the data that will be transmitted to the PLC. The default value for the parameter is zero.

Parameter	4.21.023 *Input mapping parameter 23*		
Short description	Sets input mapping parameter 23		
Minimum	0	Maximum	499999
Default	0	Units	
Type	32 Bit User Save	Update Rate	Module reset, EtherNet/IP interface reset or EtherNet/IP interface enable
Display Format	Slot Menu Parameter	Decimal Places	0
Coding	RW, PT, BU		

This parameters defines a source parameter for the data that will be transmitted to the PLC. The default value for the parameter is zero.

Parameter	4.21.024 *Input mapping parameter 24*		
Short description	Sets input mapping parameter 24		
Minimum	0	Maximum	499999
Default	0	Units	
Type	32 Bit User Save	Update Rate	Module reset, EtherNet/IP interface reset or EtherNet/IP interface enable
Display Format	Slot Menu Parameter	Decimal Places	0
Coding	RW, PT, BU		

This parameters defines a source parameter for the data that will be transmitted to the PLC. The default value for the parameter is zero.

Parameter	4.21.025 *Input mapping parameter 25*		
Short description	Sets input mapping parameter 25		
Minimum	0	Maximum	499999
Default	0	Units	
Type	32 Bit User Save	Update Rate	Module reset, EtherNet/IP interface reset or EtherNet/IP interface enable
Display Format	Slot Menu Parameter	Decimal Places	0
Coding	RW, PT, BU		

This parameters defines a source parameter for the data that will be transmitted to the PLC. The default value for the parameter is zero.

Parameter	4.21.026 *Input mapping parameter 26*		
Short description	Sets input mapping parameter 26		
Minimum	0	Maximum	499999
Default	0	Units	
Type	32 Bit User Save	Update Rate	Module reset, EtherNet/IP interface reset or EtherNet/IP interface enable
Display Format	Slot Menu Parameter	Decimal Places	0
Coding	RW, PT, BU		

This parameters defines a source parameter for the data that will be transmitted to the PLC. The default value for the parameter is zero.

Parameter	4.21.027 *Input mapping parameter 27*		
Short description	Sets input mapping parameter 27		
Minimum	0	Maximum	499999
Default	0	Units	
Type	32 Bit User Save	Update Rate	Module reset, EtherNet/IP interface reset or EtherNet/IP interface enable
Display Format	Slot Menu Parameter	Decimal Places	0
Coding	RW, PT, BU		

This parameters defines a source parameter for the data that will be transmitted to the PLC. The default value for the parameter is zero.

Parameter	4.21.028 *Input mapping parameter 28*		
Short description	Sets input mapping parameter 28		
Minimum	0	Maximum	499999
Default	0	Units	
Type	32 Bit User Save	Update Rate	Module reset, EtherNet/IP interface reset or EtherNet/IP interface enable
Display Format	Slot Menu Parameter	Decimal Places	0
Coding	RW, PT, BU		

This parameters defines a source parameter for the data that will be transmitted to the PLC. The default value for the parameter is zero.

Parameter	4.21.029 *Input mapping parameter 29*		
Short description	Sets input mapping parameter 29		
Minimum	0	Maximum	499999
Default	0	Units	
Type	32 Bit User Save	Update Rate	Module reset, EtherNet/IP interface reset or EtherNet/IP interface enable
Display Format	Slot Menu Parameter	Decimal Places	0
Coding	RW, PT, BU		

This parameters defines a source parameter for the data that will be transmitted to the PLC. The default value for the parameter is zero.

Parameter	4.21.030 *Input mapping parameter 30*		
Short description	Sets input mapping parameter 30		
Minimum	0	Maximum	499999
Default	0	Units	
Type	32 Bit User Save	Update Rate	Module reset, EtherNet/IP interface reset or EtherNet/IP interface enable
Display Format	Slot Menu Parameter	Decimal Places	0
Coding	RW, PT, BU		

This parameters defines a source parameter for the data that will be transmitted to the PLC. The default value for the parameter is zero.

Parameter	4.21.031 *Input mapping parameter 31*		
Short description	Sets input mapping parameter 31		
Minimum	0	Maximum	499999
Default	0	Units	
Type	32 Bit User Save	Update Rate	Module reset, EtherNet/IP interface reset or EtherNet/IP interface enable
Display Format	Slot Menu Parameter	Decimal Places	0
Coding	RW, PT, BU		

This parameters defines a source parameter for the data that will be transmitted to the PLC. The default value for the parameter is zero.

Parameter	4.21.032 *Input mapping parameter 32*		
Short description	Sets input mapping parameter 32		
Minimum	0	Maximum	499999
Default	0	Units	
Type	32 Bit User Save	Update Rate	Module reset, EtherNet/IP interface reset or EtherNet/IP interface enable
Display Format	Slot Menu Parameter	Decimal Places	0
Coding	RW, PT, BU		

This parameters defines a source parameter for the data that will be transmitted to the PLC. The default value for the parameter is zero.

Slot 4 Menu 22 Single Line Descriptions − *EtherNet/IP Out Mappings*

Mode: RFC‑S

Parameter		Range	Default	Type					
4.22.001	Output mapping parameter 1	0 to 499999	6042	RW	Num			PT	US
4.22.002	Output mapping parameter 2	0 to 499999	1021	RW	Num			PT	US
4.22.003	Output mapping parameter 3	0 to 499999	0	RW	Num			PT	US
4.22.004	Output mapping parameter 4	0 to 499999	0	RW	Num			PT	US
4.22.005	Output mapping parameter 5	0 to 499999	0	RW	Num			PT	US
4.22.006	Output mapping parameter 6	0 to 499999	0	RW	Num			PT	US
4.22.007	Output mapping parameter 7	0 to 499999	0	RW	Num			PT	US
4.22.008	Output mapping parameter 8	0 to 499999	0	RW	Num			PT	US
4.22.009	Output mapping parameter 9	0 to 499999	0	RW	Num			PT	US
4.22.010	Output mapping parameter 10	0 to 499999	0	RW	Num			PT	US
4.22.011	Output mapping parameter 11	0 to 499999	0	RW	Num			PT	US
4.22.012	Output mapping parameter 12	0 to 499999	0	RW	Num			PT	US
4.22.013	Output mapping parameter 13	0 to 499999	0	RW	Num			PT	US
4.22.014	Output mapping parameter 14	0 to 499999	0	RW	Num			PT	US
4.22.015	Output mapping parameter 15	0 to 499999	0	RW	Num			PT	US
4.22.016	Output mapping parameter 16	0 to 499999	0	RW	Num			PT	US
4.22.017	Output mapping parameter 17	0 to 499999	0	RW	Num			PT	US
4.22.018	Output mapping parameter 18	0 to 499999	0	RW	Num			PT	US
4.22.019	Output mapping parameter 19	0 to 499999	0	RW	Num			PT	US
4.22.020	Output mapping parameter 20	0 to 499999	0	RW	Num			PT	US
4.22.021	Output mapping parameter 21	0 to 499999	0	RW	Num			PT	US
4.22.022	Output mapping parameter 22	0 to 499999	0	RW	Num			PT	US
4.22.023	Output mapping parameter 23	0 to 499999	0	RW	Num			PT	US
4.22.024	Output mapping parameter 24	0 to 499999	0	RW	Num			PT	US
4.22.025	Output mapping parameter 25	0 to 499999	0	RW	Num			PT	US
4.22.026	Output mapping parameter 26	0 to 499999	0	RW	Num			PT	US
4.22.027	Output mapping parameter 27	0 to 499999	0	RW	Num			PT	US
4.22.028	Output mapping parameter 28	0 to 499999	0	RW	Num			PT	US
4.22.029	Output mapping parameter 29	0 to 499999	0	RW	Num			PT	US
4.22.030	Output mapping parameter 30	0 to 499999	0	RW	Num			PT	US
4.22.031	Output mapping parameter 31	0 to 499999	0	RW	Num			PT	US
4.22.032	Output mapping parameter 32	0 to 499999	0	RW	Num			PT	US

RW	Read / Write	RO	Read-only	Bit	Bit parameter	Txt	Text string	Date	Date parameter	Time	Time parameter
Chr	Character parameter	Bin	Binary parameter	IP	IP address	Mac	MAC address	Ver	Version number	SMP	Slot, menu, parameter
Num	Number parameter	DE	Destination	ND	No default value	RA	Rating dependent	NC	Non-copyable	PT	Protected
FI	Filtered	US	User save	PS	Power-down save						

Slot 4 Menu 22 − *EtherNet/IP Out Mappings*

Mode: RFC‑S

Parameter	4.22.001 *Output mapping parameter 1*		
Short description	Sets output mapping parameter 1		
Minimum	0	Maximum	499999
Default	6042	Units	
Type	32 Bit User Save	Update Rate	Module reset, EtherNet/IP interface reset or EtherNet/IP interface enable
Display Format	Slot Menu Parameter	Decimal Places	0
Coding	RW, PT, BU		

This parameters defines a destination parameter for the data that will be transmitted from the PLC. The default value for the parameter is zero.

Parameter	4.22.002 *Output mapping parameter 2*		
Short description	Sets output mapping parameter 2		
Minimum	0	Maximum	499999
Default	1021	Units	
Type	32 Bit User Save	Update Rate	Module reset, EtherNet/IP interface reset or EtherNet/IP interface enable
Display Format	Slot Menu Parameter	Decimal Places	0
Coding	RW, PT, BU		

This parameters defines a destination parameter for the data that will be transmitted from the PLC. The default value for the parameter is zero.

Parameter	4.22.003 *Output mapping parameter 3*		
Short description	Sets output mapping parameter 3		
Minimum	0	Maximum	499999
Default	0	Units	
Type	32 Bit User Save	Update Rate	Module reset, EtherNet/IP interface reset or EtherNet/IP interface enable
Display Format	Slot Menu Parameter	Decimal Places	0
Coding	RW, PT, BU		

This parameters defines a destination parameter for the data that will be transmitted from the PLC. The default value for the parameter is zero.

Parameter	4.22.004 *Output mapping parameter 4*		
Short description	Sets output mapping parameter 4		
Minimum	0	Maximum	499999
Default	0	Units	
Type	32 Bit User Save	Update Rate	Module reset, EtherNet/IP interface reset or EtherNet/IP interface enable
Display Format	Slot Menu Parameter	Decimal Places	0
Coding	RW, PT, BU		

This parameters defines a destination parameter for the data that will be transmitted from the PLC. The default value for the parameter is zero.

Parameter	4.22.005 *Output mapping parameter 5*		
Short description	Sets output mapping parameter 5		
Minimum	0	Maximum	499999
Default	0	Units	
Type	32 Bit User Save	Update Rate	Module reset, EtherNet/IP interface reset or EtherNet/IP interface enable
Display Format	Slot Menu Parameter	Decimal Places	0
Coding	RW, PT, BU		

This parameters defines a destination parameter for the data that will be transmitted from the PLC. The default value for the parameter is zero.

Parameter	4.22.006 *Output mapping parameter 6*		
Short description	Sets output mapping parameter 6		
Minimum	0	Maximum	499999
Default	0	Units	
Type	32 Bit User Save	Update Rate	Module reset, EtherNet/IP interface reset or EtherNet/IP interface enable
Display Format	Slot Menu Parameter	Decimal Places	0
Coding	RW, PT, BU		

This parameters defines a destination parameter for the data that will be transmitted from the PLC. The default value for the parameter is zero.

Parameter	4.22.007 *Output mapping parameter 7*		
Short description	Sets output mapping parameter 7		
Minimum	0	Maximum	499999
Default	0	Units	
Type	32 Bit User Save	Update Rate	Module reset, EtherNet/IP interface reset or EtherNet/IP interface enable
Display Format	Slot Menu Parameter	Decimal Places	0
Coding	RW, PT, BU		

This parameters defines a destination parameter for the data that will be transmitted from the PLC. The default value for the parameter is zero.

Parameter	4.22.008 *Output mapping parameter 8*		
Short description	Sets output mapping parameter 8		
Minimum	0	Maximum	499999
Default	0	Units	
Type	32 Bit User Save	Update Rate	Module reset, EtherNet/IP interface reset or EtherNet/IP interface enable
Display Format	Slot Menu Parameter	Decimal Places	0
Coding	RW, PT, BU		

This parameters defines a destination parameter for the data that will be transmitted from the PLC. The default value for the parameter is zero.

Parameter	4.22.009 *Output mapping parameter 9*		
Short description	Sets output mapping parameter 9		
Minimum	0	Maximum	499999
Default	0	Units	
Type	32 Bit User Save	Update Rate	Module reset, EtherNet/IP interface reset or EtherNet/IP interface enable
Display Format	Slot Menu Parameter	Decimal Places	0
Coding	RW, PT, BU		

This parameters defines a destination parameter for the data that will be transmitted from the PLC. The default value for the parameter is zero.

Parameter	4.22.010 *Output mapping parameter 10*		
Short description	Sets output mapping parameter 10		
Minimum	0	Maximum	499999
Default	0	Units	
Type	32 Bit User Save	Update Rate	Module reset, EtherNet/IP interface reset or EtherNet/IP interface enable
Display Format	Slot Menu Parameter	Decimal Places	0
Coding	RW, PT, BU		

This parameters defines a destination parameter for the data that will be transmitted from the PLC. The default value for the parameter is zero.

Parameter	4.22.011 *Output mapping parameter 11*		
Short description	Sets output mapping parameter 11		
Minimum	0	Maximum	499999
Default	0	Units	
Type	32 Bit User Save	Update Rate	Module reset, EtherNet/IP interface reset or EtherNet/IP interface enable
Display Format	Slot Menu Parameter	Decimal Places	0
Coding	RW, PT, BU		

This parameters defines a destination parameter for the data that will be transmitted from the PLC. The default value for the parameter is zero.

Parameter	4.22.012 *Output mapping parameter 12*		
Short description	Sets output mapping parameter 12		
Minimum	0	Maximum	499999
Default	0	Units	
Type	32 Bit User Save	Update Rate	Module reset, EtherNet/IP interface reset or EtherNet/IP interface enable
Display Format	Slot Menu Parameter	Decimal Places	0
Coding	RW, PT, BU		

This parameters defines a destination parameter for the data that will be transmitted from the PLC. The default value for the parameter is zero.

Parameter	4.22.013 *Output mapping parameter 13*		
Short description	Sets output mapping parameter 13		
Minimum	0	Maximum	499999
Default	0	Units	
Type	32 Bit User Save	Update Rate	Module reset, EtherNet/IP interface reset or EtherNet/IP interface enable
Display Format	Slot Menu Parameter	Decimal Places	0
Coding	RW, PT, BU		

This parameters defines a destination parameter for the data that will be transmitted from the PLC. The default value for the parameter is zero.

Parameter	4.22.014 *Output mapping parameter 14*		
Short description	Sets output mapping parameter 14		
Minimum	0	Maximum	499999
Default	0	Units	
Type	32 Bit User Save	Update Rate	Module reset, EtherNet/IP interface reset or EtherNet/IP interface enable
Display Format	Slot Menu Parameter	Decimal Places	0
Coding	RW, PT, BU		

This parameters defines a destination parameter for the data that will be transmitted from the PLC. The default value for the parameter is zero.

Parameter	4.22.015 *Output mapping parameter 15*		
Short description	Sets output mapping parameter 15		
Minimum	0	Maximum	499999
Default	0	Units	
Type	32 Bit User Save	Update Rate	Module reset, EtherNet/IP interface reset or EtherNet/IP interface enable
Display Format	Slot Menu Parameter	Decimal Places	0
Coding	RW, PT, BU		

This parameters defines a destination parameter for the data that will be transmitted from the PLC. The default value for the parameter is zero.

Parameter	4.22.016 *Output mapping parameter 16*		
Short description	Sets output mapping parameter 16		
Minimum	0	Maximum	499999
Default	0	Units	
Type	32 Bit User Save	Update Rate	Module reset, EtherNet/IP interface reset or EtherNet/IP interface enable
Display Format	Slot Menu Parameter	Decimal Places	0
Coding	RW, PT, BU		

This parameters defines a destination parameter for the data that will be transmitted from the PLC. The default value for the parameter is zero.

Parameter	4.22.017 *Output mapping parameter 17*		
Short description	Sets output mapping parameter 17		
Minimum	0	Maximum	499999
Default	0	Units	
Type	32 Bit User Save	Update Rate	Module reset, EtherNet/IP interface reset or EtherNet/IP interface enable
Display Format	Slot Menu Parameter	Decimal Places	0
Coding	RW, PT, BU		

This parameters defines a destination parameter for the data that will be transmitted from the PLC. The default value for the parameter is zero.

Parameter	4.22.018 *Output mapping parameter 18*		
Short description	Sets output mapping parameter 18		
Minimum	0	Maximum	499999
Default	0	Units	
Type	32 Bit User Save	Update Rate	Module reset, EtherNet/IP interface reset or EtherNet/IP interface enable
Display Format	Slot Menu Parameter	Decimal Places	0
Coding	RW, PT, BU		

This parameters defines a destination parameter for the data that will be transmitted from the PLC. The default value for the parameter is zero.

Parameter	4.22.019 *Output mapping parameter 19*		
Short description	Sets output mapping parameter 19		
Minimum	0	Maximum	499999
Default	0	Units	
Type	32 Bit User Save	Update Rate	Module reset, EtherNet/IP interface reset or EtherNet/IP interface enable
Display Format	Slot Menu Parameter	Decimal Places	0
Coding	RW, PT, BU		

This parameters defines a destination parameter for the data that will be transmitted from the PLC. The default value for the parameter is zero.

Parameter	4.22.020 *Output mapping parameter 20*		
Short description	Sets output mapping parameter 20		
Minimum	0	Maximum	499999
Default	0	Units	
Type	32 Bit User Save	Update Rate	Module reset, EtherNet/IP interface reset or EtherNet/IP interface enable
Display Format	Slot Menu Parameter	Decimal Places	0
Coding	RW, PT, BU		

This parameters defines a destination parameter for the data that will be transmitted from the PLC. The default value for the parameter is zero.

Parameter	4.22.021 *Output mapping parameter 21*		
Short description	Sets output mapping parameter 21		
Minimum	0	Maximum	499999
Default	0	Units	
Type	32 Bit User Save	Update Rate	Module reset, EtherNet/IP interface reset or EtherNet/IP interface enable
Display Format	Slot Menu Parameter	Decimal Places	0
Coding	RW, PT, BU		

This parameters defines a destination parameter for the data that will be transmitted from the PLC. The default value for the parameter is zero.

Parameter	4.22.022 *Output mapping parameter 22*		
Short description	Sets output mapping parameter 22		
Minimum	0	Maximum	499999
Default	0	Units	
Type	32 Bit User Save	Update Rate	Module reset, EtherNet/IP interface reset or EtherNet/IP interface enable
Display Format	Slot Menu Parameter	Decimal Places	0
Coding	RW, PT, BU		

This parameters defines a destination parameter for the data that will be transmitted from the PLC. The default value for the parameter is zero.

Parameter	4.22.023 *Output mapping parameter 23*		
Short description	Sets output mapping parameter 23		
Minimum	0	Maximum	499999
Default	0	Units	
Type	32 Bit User Save	Update Rate	Module reset, EtherNet/IP interface reset or EtherNet/IP interface enable
Display Format	Slot Menu Parameter	Decimal Places	0
Coding	RW, PT, BU		

This parameters defines a destination parameter for the data that will be transmitted from the PLC. The default value for the parameter is zero.

Parameter	4.22.024 *Output mapping parameter 24*		
Short description	Sets output mapping parameter 24		
Minimum	0	Maximum	499999
Default	0	Units	
Type	32 Bit User Save	Update Rate	Module reset, EtherNet/IP interface reset or EtherNet/IP interface enable
Display Format	Slot Menu Parameter	Decimal Places	0
Coding	RW, PT, BU		

This parameters defines a destination parameter for the data that will be transmitted from the PLC. The default value for the parameter is zero.

Parameter	4.22.025 *Output mapping parameter 25*		
Short description	Sets output mapping parameter 25		
Minimum	0	Maximum	499999
Default	0	Units	
Type	32 Bit User Save	Update Rate	Module reset, EtherNet/IP interface reset or EtherNet/IP interface enable
Display Format	Slot Menu Parameter	Decimal Places	0
Coding	RW, PT, BU		

This parameters defines a destination parameter for the data that will be transmitted from the PLC. The default value for the parameter is zero.

Parameter	4.22.026 *Output mapping parameter 26*		
Short description	Sets output mapping parameter 26		
Minimum	0	Maximum	499999
Default	0	Units	
Type	32 Bit User Save	Update Rate	Module reset, EtherNet/IP interface reset or EtherNet/IP interface enable
Display Format	Slot Menu Parameter	Decimal Places	0
Coding	RW, PT, BU		

This parameters defines a destination parameter for the data that will be transmitted from the PLC. The default value for the parameter is zero.

Parameter	4.22.027 *Output mapping parameter 27*		
Short description	Sets output mapping parameter 27		
Minimum	0	Maximum	499999
Default	0	Units	
Type	32 Bit User Save	Update Rate	Module reset, EtherNet/IP interface reset or EtherNet/IP interface enable
Display Format	Slot Menu Parameter	Decimal Places	0
Coding	RW, PT, BU		

This parameters defines a destination parameter for the data that will be transmitted from the PLC. The default value for the parameter is zero.

Parameter	4.22.028 *Output mapping parameter 28*		
Short description	Sets output mapping parameter 28		
Minimum	0	Maximum	499999
Default	0	Units	
Type	32 Bit User Save	Update Rate	Module reset, EtherNet/IP interface reset or EtherNet/IP interface enable
Display Format	Slot Menu Parameter	Decimal Places	0
Coding	RW, PT, BU		

This parameters defines a destination parameter for the data that will be transmitted from the PLC. The default value for the parameter is zero.

Parameter	4.22.029 *Output mapping parameter 29*		
Short description	Sets output mapping parameter 29		
Minimum	0	Maximum	499999
Default	0	Units	
Type	32 Bit User Save	Update Rate	Module reset, EtherNet/IP interface reset or EtherNet/IP interface enable
Display Format	Slot Menu Parameter	Decimal Places	0
Coding	RW, PT, BU		

This parameters defines a destination parameter for the data that will be transmitted from the PLC. The default value for the parameter is zero.

Parameter	4.22.030 *Output mapping parameter 30*		
Short description	Sets output mapping parameter 30		
Minimum	0	Maximum	499999
Default	0	Units	
Type	32 Bit User Save	Update Rate	Module reset, EtherNet/IP interface reset or EtherNet/IP interface enable
Display Format	Slot Menu Parameter	Decimal Places	0
Coding	RW, PT, BU		

This parameters defines a destination parameter for the data that will be transmitted from the PLC. The default value for the parameter is zero.

Parameter	4.22.031 *Output mapping parameter 31*		
Short description	Sets output mapping parameter 31		
Minimum	0	Maximum	499999
Default	0	Units	
Type	32 Bit User Save	Update Rate	Module reset, EtherNet/IP interface reset or EtherNet/IP interface enable
Display Format	Slot Menu Parameter	Decimal Places	0
Coding	RW, PT, BU		

This parameters defines a destination parameter for the data that will be transmitted from the PLC. The default value for the parameter is zero.

Parameter	4.22.032 *Output mapping parameter 32*		
Short description	Sets output mapping parameter 32		
Minimum	0	Maximum	499999
Default	0	Units	
Type	32 Bit User Save	Update Rate	Module reset, EtherNet/IP interface reset or EtherNet/IP interface enable
Display Format	Slot Menu Parameter	Decimal Places	0
Coding	RW, PT, BU		

This parameters defines a destination parameter for the data that will be transmitted from the PLC. The default value for the parameter is zero.

Slot 4 Menu 23 Single Line Descriptions − *EtherNet/IP Fault Values*

Mode: RFC‑S

Parameter	Range	Default	Type					
4.23.001 Output fault value 1	-2147483648 to 2147483647	0	RW	Num			PT	US
4.23.002 Output fault value 2	-2147483648 to 2147483647	0	RW	Num			PT	US
4.23.003 Output fault value 3	-2147483648 to 2147483647	0	RW	Num			PT	US
4.23.004 Output fault value 4	-2147483648 to 2147483647	0	RW	Num			PT	US
4.23.005 Output fault value 5	-2147483648 to 2147483647	0	RW	Num			PT	US
4.23.006 Output fault value 6	-2147483648 to 2147483647	0	RW	Num			PT	US
4.23.007 Output fault value 7	-2147483648 to 2147483647	0	RW	Num			PT	US
4.23.008 Output fault value 8	-2147483648 to 2147483647	0	RW	Num			PT	US
4.23.009 Output fault value 9	-2147483648 to 2147483647	0	RW	Num			PT	US
4.23.010 Output fault value 10	-2147483648 to 2147483647	0	RW	Num			PT	US
4.23.011 Output fault value 11	-2147483648 to 2147483647	0	RW	Num			PT	US
4.23.012 Output fault value 12	-2147483648 to 2147483647	0	RW	Num			PT	US
4.23.013 Output fault value 13	-2147483648 to 2147483647	0	RW	Num			PT	US
4.23.014 Output fault value 14	-2147483648 to 2147483647	0	RW	Num			PT	US
4.23.015 Output fault value 15	-2147483648 to 2147483647	0	RW	Num			PT	US
4.23.016 Output fault value 16	-2147483648 to 2147483647	0	RW	Num			PT	US
4.23.017 Output fault value 17	-2147483648 to 2147483647	0	RW	Num			PT	US
4.23.018 Output fault value 18	-2147483648 to 2147483647	0	RW	Num			PT	US
4.23.019 Output fault value 19	-2147483648 to 2147483647	0	RW	Num			PT	US
4.23.020 Output fault value 20	-2147483648 to 2147483647	0	RW	Num			PT	US
4.23.021 Output fault value 21	-2147483648 to 2147483647	0	RW	Num			PT	US
4.23.022 Output fault value 22	-2147483648 to 2147483647	0	RW	Num			PT	US
4.23.023 Output fault value 23	-2147483648 to 2147483647	0	RW	Num			PT	US
4.23.024 Output fault value 24	-2147483648 to 2147483647	0	RW	Num			PT	US
4.23.025 Output fault value 25	-2147483648 to 2147483647	0	RW	Num			PT	US
4.23.026 Output fault value 26	-2147483648 to 2147483647	0	RW	Num			PT	US
4.23.027 Output fault value 27	-2147483648 to 2147483647	0	RW	Num			PT	US
4.23.028 Output fault value 28	-2147483648 to 2147483647	0	RW	Num			PT	US
4.23.029 Output fault value 29	-2147483648 to 2147483647	0	RW	Num			PT	US
4.23.030 Output fault value 30	-2147483648 to 2147483647	0	RW	Num			PT	US
4.23.031 Output fault value 31	-2147483648 to 2147483647	0	RW	Num			PT	US
4.23.032 Output fault value 32	-2147483648 to 2147483647	0	RW	Num			PT	US

RW	Read / Write	RO	Read-only	Bit	Bit parameter	Txt	Text string	Date	Date parameter	Time	Time parameter
Chr	Character parameter	Bin	Binary parameter	IP	IP address	Mac	MAC address	Ver	Version number	SMP	Slot, menu, parameter
Num	Number parameter	DE	Destination	ND	No default value	RA	Rating dependent	NC	Non-copyable	PT	Protected
FI	Filtered	US	User save	PS	Power-down save						

Slot 4 Menu 23 − *EtherNet/IP Fault Values*

Mode: RFC‑S

Parameter	4.23.001 *Output fault value 1*		
Short description	Sets the output fault value for mapping 1		
Minimum	-2147483648	Maximum	2147483647
Default	0	Units	
Type	32 Bit User Save	Update Rate	Module reset, EtherNet/IP interface reset or EtherNet/IP interface enable
Display Format	Standard	Decimal Places	0
Coding	RW, PT		

This parameter defines the value to be sent to the mapped output destination when fault values have been configured to be sent (with *RPI timeout action* (4.20.011) and *PLC idle action* (4.20.015)).

Parameter	4.23.002 *Output fault value 2*		
Short description	Sets the output fault value for mapping 2		
Minimum	-2147483648	Maximum	2147483647
Default	0	Units	
Type	32 Bit User Save	Update Rate	Module reset, EtherNet/IP interface reset or EtherNet/IP interface enable
Display Format	Standard	Decimal Places	0
Coding	RW, PT		

This parameter defines the value to be sent to the mapped output destination when fault values have been configured to be sent (with *RPI timeout action* (4.20.011) and *PLC idle action* (4.20.015)).

Parameter	4.23.003 *Output fault value 3*		
Short description	Sets the output fault value for mapping 3		
Minimum	-2147483648	Maximum	2147483647
Default	0	Units	
Type	32 Bit User Save	Update Rate	Module reset, EtherNet/IP interface reset or EtherNet/IP interface enable
Display Format	Standard	Decimal Places	0
Coding	RW, PT		

This parameter defines the value to be sent to the mapped output destination when fault values have been configured to be sent (with *RPI timeout action* (4.20.011) and *PLC idle action* (4.20.015)).

Parameter	4.23.004 *Output fault value 4*		
Short description	Sets the output fault value for mapping 4		
Minimum	-2147483648	Maximum	2147483647
Default	0	Units	
Type	32 Bit User Save	Update Rate	Module reset, EtherNet/IP interface reset or EtherNet/IP interface enable
Display Format	Standard	Decimal Places	0
Coding	RW, PT		

This parameter defines the value to be sent to the mapped output destination when fault values have been configured to be sent (with *RPI timeout action* (4.20.011) and *PLC idle action* (4.20.015)).

Parameter	4.23.005 *Output fault value 5*		
Short description	Sets the output fault value for mapping 5		
Minimum	-2147483648	Maximum	2147483647
Default	0	Units	
Type	32 Bit User Save	Update Rate	Module reset, EtherNet/IP interface reset or EtherNet/IP interface enable
Display Format	Standard	Decimal Places	0
Coding	RW, PT		

This parameter defines the value to be sent to the mapped output destination when fault values have been configured to be sent (with *RPI timeout action* (4.20.011) and *PLC idle action* (4.20.015)).

Parameter	4.23.006 *Output fault value 6*		
Short description	Sets the output fault value for mapping 6		
Minimum	-2147483648	Maximum	2147483647
Default	0	Units	
Type	32 Bit User Save	Update Rate	Module reset, EtherNet/IP interface reset or EtherNet/IP interface enable
Display Format	Standard	Decimal Places	0
Coding	RW, PT		

This parameter defines the value to be sent to the mapped output destination when fault values have been configured to be sent (with *RPI timeout action* (4.20.011) and *PLC idle action* (4.20.015)).

Parameter	4.23.007 *Output fault value 7*		
Short description	Sets the output fault value for mapping 7		
Minimum	-2147483648	Maximum	2147483647
Default	0	Units	
Type	32 Bit User Save	Update Rate	Module reset, EtherNet/IP interface reset or EtherNet/IP interface enable
Display Format	Standard	Decimal Places	0
Coding	RW, PT		

This parameter defines the value to be sent to the mapped output destination when fault values have been configured to be sent (with *RPI timeout action* (4.20.011) and *PLC idle action* (4.20.015)).

Parameter	4.23.008 *Output fault value 8*		
Short description	Sets the output fault value for mapping 8		
Minimum	-2147483648	Maximum	2147483647
Default	0	Units	
Type	32 Bit User Save	Update Rate	Module reset, EtherNet/IP interface reset or EtherNet/IP interface enable
Display Format	Standard	Decimal Places	0
Coding	RW, PT		

This parameter defines the value to be sent to the mapped output destination when fault values have been configured to be sent (with *RPI timeout action* (4.20.011) and *PLC idle action* (4.20.015)).

Parameter	4.23.009 *Output fault value 9*		
Short description	Sets the output fault value for mapping 9		
Minimum	-2147483648	Maximum	2147483647
Default	0	Units	
Type	32 Bit User Save	Update Rate	Module reset, EtherNet/IP interface reset or EtherNet/IP interface enable
Display Format	Standard	Decimal Places	0
Coding	RW, PT		

This parameter defines the value to be sent to the mapped output destination when fault values have been configured to be sent (with *RPI timeout action* (4.20.011) and *PLC idle action* (4.20.015)).

Parameter	4.23.010 *Output fault value 10*		
Short description	Sets the output fault value for mapping 10		
Minimum	-2147483648	Maximum	2147483647
Default	0	Units	
Type	32 Bit User Save	Update Rate	Module reset, EtherNet/IP interface reset or EtherNet/IP interface enable
Display Format	Standard	Decimal Places	0
Coding	RW, PT		

This parameter defines the value to be sent to the mapped output destination when fault values have been configured to be sent (with *RPI timeout action* (4.20.011) and *PLC idle action* (4.20.015)).

Parameter	4.23.011 *Output fault value 11*		
Short description	Sets the output fault value for mapping 11		
Minimum	-2147483648	Maximum	2147483647
Default	0	Units	
Type	32 Bit User Save	Update Rate	Module reset, EtherNet/IP interface reset or EtherNet/IP interface enable
Display Format	Standard	Decimal Places	0
Coding	RW, PT		

This parameter defines the value to be sent to the mapped output destination when fault values have been configured to be sent (with *RPI timeout action* (4.20.011) and *PLC idle action* (4.20.015)).

Parameter	4.23.012 *Output fault value 12*		
Short description	Sets the output fault value for mapping 12		
Minimum	-2147483648	Maximum	2147483647
Default	0	Units	
Type	32 Bit User Save	Update Rate	Module reset, EtherNet/IP interface reset or EtherNet/IP interface enable
Display Format	Standard	Decimal Places	0
Coding	RW, PT		

This parameter defines the value to be sent to the mapped output destination when fault values have been configured to be sent (with *RPI timeout action* (4.20.011) and *PLC idle action* (4.20.015)).

Parameter	4.23.013 *Output fault value 13*		
Short description	Sets the output fault value for mapping 13		
Minimum	-2147483648	Maximum	2147483647
Default	0	Units	
Type	32 Bit User Save	Update Rate	Module reset, EtherNet/IP interface reset or EtherNet/IP interface enable
Display Format	Standard	Decimal Places	0
Coding	RW, PT		

This parameter defines the value to be sent to the mapped output destination when fault values have been configured to be sent (with *RPI timeout action* (4.20.011) and *PLC idle action* (4.20.015)).

Parameter	4.23.014 *Output fault value 14*		
Short description	Sets the output fault value for mapping 14		
Minimum	-2147483648	Maximum	2147483647
Default	0	Units	
Type	32 Bit User Save	Update Rate	Module reset, EtherNet/IP interface reset or EtherNet/IP interface enable
Display Format	Standard	Decimal Places	0
Coding	RW, PT		

This parameter defines the value to be sent to the mapped output destination when fault values have been configured to be sent (with *RPI timeout action* (4.20.011) and *PLC idle action* (4.20.015)).

Parameter	4.23.015 *Output fault value 15*		
Short description	Sets the output fault value for mapping 15		
Minimum	-2147483648	Maximum	2147483647
Default	0	Units	
Type	32 Bit User Save	Update Rate	Module reset, EtherNet/IP interface reset or EtherNet/IP interface enable
Display Format	Standard	Decimal Places	0
Coding	RW, PT		

This parameter defines the value to be sent to the mapped output destination when fault values have been configured to be sent (with *RPI timeout action* (4.20.011) and *PLC idle action* (4.20.015)).

Parameter	4.23.016 *Output fault value 16*		
Short description	Sets the output fault value for mapping 16		
Minimum	-2147483648	Maximum	2147483647
Default	0	Units	
Type	32 Bit User Save	Update Rate	Module reset, EtherNet/IP interface reset or EtherNet/IP interface enable
Display Format	Standard	Decimal Places	0
Coding	RW, PT		

This parameter defines the value to be sent to the mapped output destination when fault values have been configured to be sent (with *RPI timeout action* (4.20.011) and *PLC idle action* (4.20.015)).

Parameter	4.23.017 *Output fault value 17*		
Short description	Sets the output fault value for mapping 17		
Minimum	-2147483648	Maximum	2147483647
Default	0	Units	
Type	32 Bit User Save	Update Rate	Module reset, EtherNet/IP interface reset or EtherNet/IP interface enable
Display Format	Standard	Decimal Places	0
Coding	RW, PT		

This parameter defines the value to be sent to the mapped output destination when fault values have been configured to be sent (with *RPI timeout action* (4.20.011) and *PLC idle action* (4.20.015)).

Parameter	4.23.018 *Output fault value 18*		
Short description	Sets the output fault value for mapping 18		
Minimum	-2147483648	Maximum	2147483647
Default	0	Units	
Type	32 Bit User Save	Update Rate	Module reset, EtherNet/IP interface reset or EtherNet/IP interface enable
Display Format	Standard	Decimal Places	0
Coding	RW, PT		

This parameter defines the value to be sent to the mapped output destination when fault values have been configured to be sent (with *RPI timeout action* (4.20.011) and *PLC idle action* (4.20.015)).

Parameter	4.23.019 *Output fault value 19*		
Short description	Sets the output fault value for mapping 19		
Minimum	-2147483648	Maximum	2147483647
Default	0	Units	
Type	32 Bit User Save	Update Rate	Module reset, EtherNet/IP interface reset or EtherNet/IP interface enable
Display Format	Standard	Decimal Places	0
Coding	RW, PT		

This parameter defines the value to be sent to the mapped output destination when fault values have been configured to be sent (with *RPI timeout action* (4.20.011) and *PLC idle action* (4.20.015)).

Parameter	4.23.020 *Output fault value 20*		
Short description	Sets the output fault value for mapping 20		
Minimum	-2147483648	Maximum	2147483647
Default	0	Units	
Type	32 Bit User Save	Update Rate	Module reset, EtherNet/IP interface reset or EtherNet/IP interface enable
Display Format	Standard	Decimal Places	0
Coding	RW, PT		

This parameter defines the value to be sent to the mapped output destination when fault values have been configured to be sent (with *RPI timeout action* (4.20.011) and *PLC idle action* (4.20.015)).

Parameter	4.23.021 *Output fault value 21*		
Short description	Sets the output fault value for mapping 21		
Minimum	-2147483648	Maximum	2147483647
Default	0	Units	
Type	32 Bit User Save	Update Rate	Module reset, EtherNet/IP interface reset or EtherNet/IP interface enable
Display Format	Standard	Decimal Places	0
Coding	RW, PT		

This parameter defines the value to be sent to the mapped output destination when fault values have been configured to be sent (with *RPI timeout action* (4.20.011) and *PLC idle action* (4.20.015)).

Parameter	4.23.022 *Output fault value 22*		
Short description	Sets the output fault value for mapping 22		
Minimum	-2147483648	Maximum	2147483647
Default	0	Units	
Type	32 Bit User Save	Update Rate	Module reset, EtherNet/IP interface reset or EtherNet/IP interface enable
Display Format	Standard	Decimal Places	0
Coding	RW, PT		

This parameter defines the value to be sent to the mapped output destination when fault values have been configured to be sent (with *RPI timeout action* (4.20.011) and *PLC idle action* (4.20.015)).

Parameter	4.23.023 *Output fault value 23*		
Short description	Sets the output fault value for mapping 23		
Minimum	-2147483648	Maximum	2147483647
Default	0	Units	
Type	32 Bit User Save	Update Rate	Module reset, EtherNet/IP interface reset or EtherNet/IP interface enable
Display Format	Standard	Decimal Places	0
Coding	RW, PT		

This parameter defines the value to be sent to the mapped output destination when fault values have been configured to be sent (with *RPI timeout action* (4.20.011) and *PLC idle action* (4.20.015)).

Parameter	4.23.024 *Output fault value 24*		
Short description	Sets the output fault value for mapping 24		
Minimum	-2147483648	Maximum	2147483647
Default	0	Units	
Type	32 Bit User Save	Update Rate	Module reset, EtherNet/IP interface reset or EtherNet/IP interface enable
Display Format	Standard	Decimal Places	0
Coding	RW, PT		

This parameter defines the value to be sent to the mapped output destination when fault values have been configured to be sent (with *RPI timeout action* (4.20.011) and *PLC idle action* (4.20.015)).

Parameter	4.23.025 *Output fault value 25*		
Short description	Sets the output fault value for mapping 25		
Minimum	-2147483648	Maximum	2147483647
Default	0	Units	
Type	32 Bit User Save	Update Rate	Module reset, EtherNet/IP interface reset or EtherNet/IP interface enable
Display Format	Standard	Decimal Places	0
Coding	RW, PT		

This parameter defines the value to be sent to the mapped output destination when fault values have been configured to be sent (with *RPI timeout action* (4.20.011) and *PLC idle action* (4.20.015)).

Parameter	4.23.026 *Output fault value 26*		
Short description	Sets the output fault value for mapping 26		
Minimum	-2147483648	Maximum	2147483647
Default	0	Units	
Type	32 Bit User Save	Update Rate	Module reset, EtherNet/IP interface reset or EtherNet/IP interface enable
Display Format	Standard	Decimal Places	0
Coding	RW, PT		

This parameter defines the value to be sent to the mapped output destination when fault values have been configured to be sent (with *RPI timeout action* (4.20.011) and *PLC idle action* (4.20.015)).

Parameter	4.23.027 *Output fault value 27*		
Short description	Sets the output fault value for mapping 27		
Minimum	-2147483648	Maximum	2147483647
Default	0	Units	
Type	32 Bit User Save	Update Rate	Module reset, EtherNet/IP interface reset or EtherNet/IP interface enable
Display Format	Standard	Decimal Places	0
Coding	RW, PT		

This parameter defines the value to be sent to the mapped output destination when fault values have been configured to be sent (with *RPI timeout action* (4.20.011) and *PLC idle action* (4.20.015)).

Parameter	4.23.028 *Output fault value 28*		
Short description	Sets the output fault value for mapping 28		
Minimum	-2147483648	Maximum	2147483647
Default	0	Units	
Type	32 Bit User Save	Update Rate	Module reset, EtherNet/IP interface reset or EtherNet/IP interface enable
Display Format	Standard	Decimal Places	0
Coding	RW, PT		

This parameter defines the value to be sent to the mapped output destination when fault values have been configured to be sent (with *RPI timeout action* (4.20.011) and *PLC idle action* (4.20.015)).

Parameter	4.23.029 *Output fault value 29*		
Short description	Sets the output fault value for mapping 29		
Minimum	-2147483648	Maximum	2147483647
Default	0	Units	
Type	32 Bit User Save	Update Rate	Module reset, EtherNet/IP interface reset or EtherNet/IP interface enable
Display Format	Standard	Decimal Places	0
Coding	RW, PT		

This parameter defines the value to be sent to the mapped output destination when fault values have been configured to be sent (with *RPI timeout action* (4.20.011) and *PLC idle action* (4.20.015)).

Parameter	4.23.030 *Output fault value 30*		
Short description	Sets the output fault value for mapping 30		
Minimum	-2147483648	Maximum	2147483647
Default	0	Units	
Type	32 Bit User Save	Update Rate	Module reset, EtherNet/IP interface reset or EtherNet/IP interface enable
Display Format	Standard	Decimal Places	0
Coding	RW, PT		

This parameter defines the value to be sent to the mapped output destination when fault values have been configured to be sent (with *RPI timeout action* (4.20.011) and *PLC idle action* (4.20.015)).

Parameter	4.23.031 *Output fault value 31*		
Short description	Sets the output fault value for mapping 31		
Minimum	-2147483648	Maximum	2147483647
Default	0	Units	
Type	32 Bit User Save	Update Rate	Module reset, EtherNet/IP interface reset or EtherNet/IP interface enable
Display Format	Standard	Decimal Places	0
Coding	RW, PT		

This parameter defines the value to be sent to the mapped output destination when fault values have been configured to be sent (with *RPI timeout action* (4.20.011) and *PLC idle action* (4.20.015)).

Parameter	4.23.032 *Output fault value 32*		
Short description	Sets the output fault value for mapping 32		
Minimum	-2147483648	Maximum	2147483647
Default	0	Units	
Type	32 Bit User Save	Update Rate	Module reset, EtherNet/IP interface reset or EtherNet/IP interface enable
Display Format	Standard	Decimal Places	0
Coding	RW, PT		

This parameter defines the value to be sent to the mapped output destination when fault values have been configured to be sent (with *RPI timeout action* (4.20.011) and *PLC idle action* (4.20.015)).

Trips

Mode: RFC‑S

Trip 0 (10.020) to *Trip 9* (10.029) store the most recent 10 trips that have occurred where *Trip 0* (10.020) is the most recent and *Trip 9* (10.029) is the oldest. When a new trip occurs it is written to *Trip 0* (10.020) and all the other trips move down the log, with oldest being lost. The date and time when each trip occurs are also stored in the date and time log, i.e. *Trip 0 Date* (10.041) to *Trip 9 Time* (10.060). The date and time are taken from *Date* (06.016) and *Time* (06.017). Some trips have sub-trip numbers which give more detail about the reason for the trip. If a trip has a sub-trip number its value is stored in the sub-trip log, i.e. *Trip 0 Sub-trip Number* (10.070) to *Trip 9 Sub-trip Number* (10.079). If the trip does not have a sub-trip number then zero is stored in the sub-trip log.

Trip categories and priorities

Trips are grouped into the categories given in the table below. A trip can only occur when the drive is not tripped, or if it is already tripped and the new trip has a higher priority than the active trip (i.e. lower priority number). Unless otherwise stated a trip cannot be reset until 1.0s after it has been initiated.

Priority	Category	Trips	Comments
1	Internal faults	*HF01 – HF20*	These are fatal problems that cannot be reset. All drive features are inactive after any of these trips occur. If a basic keypad is fitted it will show the trip, but the keypad will not function. These trips are not stored in the trip log.
1	Stored HF trip	*Stored HF*	This trip cannot be cleared unless 1299 is entered into *Parameter mm.000* (mm.000) and a reset is initiated.
2	Non-resettable trips	Trip numbers 218 to 247, *Slot1 HF*, *Slot2 HF*, *Slot3 HF* or *Slot4 HF*	These trips cannot be reset.
3	Volatile memory failure	*EEPROM Fail*	This can only be reset if *Parameter mm.000* (mm.000) is set to 1233 or 1244, or if *Load Defaults* (11.043) is set to a non-zero value.
4	Internal 24V power supply	*PSU 24V*	
5	Non-volatile media trips	Trip numbers 174, 175 and 177 to 188	These trips are priority 6 during power-up.
5	Position feedback interface power supply	*Encoder 1*	This trip can override *Encoder 2* to *Encoder 6* trips.
6	Trips with extended reset times	*OI ac*, *OI Brake*, and *OI dc*	These trips cannot be reset until 10s after the trip was initiated.
6	Phase loss and d.c. link power circuit protection	*Phase Loss* and *OHt dc bus*	The drive will attempt to stop the motor before tripping if a *Phase Loss*.000 trip occurs unless this feature has been disabled (see *Action On Trip Detection* (10.037). The drive will always attempt to stop the motor before tripping if an *OHt dc bus* occurs.
6	Standard trips	All other trips	

Internal faults

Trips {*HF01*} to {*HF20*} are internal faults that do not have trip numbers. If one of these trips occurs, the main drive processor has detected an irrecoverable error. All drive functions are stopped and the trip message will be displayed on the drive keypad. The error can only be reset by powering the drive down and up again. The table below gives the reasons for internal faults and their corresponding trip.

Trip	Reason
{*HF01*}	CPU has detected an address error
{*HF02*}	CPU DMAC has detected an address error
{*HF03*}	CPU has detected an Illegal opcode
{*HF04*}	CPU has detected an Illegal slot instruction
{*HF05*}	An interrupt has occurred that does not have a defined function (Undefined exception)
{*HF06*}	An interrupt has occurred which is reserved (Reserved exception)
{*HF07*}	Watchdog failure
{*HF08*}	CPU Interrupt crash
{*HF09*}	Free store overflow
{*HF10*}	Parameter routing system error
{*HF11*}	Non-volatile memory comms error
{*HF12*}	Stack overflow. Sub-trip is shown to indicate which stack: 1 – background tasks 2 – timed tasks 3 – main system interrupts
{*HF13*}	The control hardware is not compatible with the firmware. The sub-trip number gives the actual ID code of the control board hardware.
{*HF14*}	CPU register bank error
{*HF15*}	CPU divide error
{*HF16*}	RTOS error (the background task has returned)
{*HF17*}	The clock supplied to the control board logic is out of specification
{*HF18*}	The internal flash memory has failed when writing option module parameter data. Sub-trip is shown to indicate which failure: 1 - Programming error while writing menu in flash 2 - Erase flash block containing setup menus failed 3 - Erase flash block containing application menus failed
{*HF19*}	Invalid main application firmware CRC. Reprogramming required.
{*HF20*}	The ASIC is not compatible with the firmware. The sub-trip number displayed is the ASIC version.
{*HF23*}	If this trip occurs please consult the drive supplier.
{*HF24*}	If this trip occurs please consult the drive supplier.
{*HF25*}	If this trip occurs please consult the drive supplier.

When the drive is subsequently powered up a *Stored HF* trip is initiated where the sub-trip number is the number of the HF trip that last occurred. This trip will occur at every power-up until it is reset. The trip can only be reset by first entering 1299 into *Parameter mm.000* (mm.000). If the drive is powered up and a *Stored HF* trip occurs, *Onboard User Program: Enable* (11.047) is reset to zero to prevent the on-board user program from running. This ensures that the user program can be changed or erased in case it causes an HF trip at every power-up. Once the *Stored HF* is cleared, it is necessary to power cycle the drive or to re-download the user program to allow the program to restart.

Similar trips that can be initiated by the control system or the power system
Trips shown in the table below can be generated either from the drive control system or from the power system. The sub-trip number which is in the form xxyzz is used to identify the source of the trip. The digits xx are 00 for a trip generated by the control system or the number of a power module if generated by the power system. If the drive is not a multi-power module drive then xx will always have a value of 1 the trip is related to the power system. The y digit is used to identify the location of a trip which is generated by a rectifier module connected to a power module. Where the y digit is relevant it will have a value of 1 or more, otherwise it will be 0. The zz digits give the reason for the trip and are defined in each trip description.

Over Volts	*OHt dc bus*
OI ac	*Phase Loss*
OI Brake	*Power Comms*
PSU	*OI Snubber*
OHt Inverter	*Cloning*
OHt Power	*Temp Feedback*
OHt Control	*Power Data*

Braking IGBT
The list below gives conditions that will disable the braking IGBT:

1. *Braking IGBT Upper Threshold* (06.074) = 0, or *Low Voltage Braking IGBT Threshold Select* (06.076) = 1 and *Low Voltage Braking IGBT Threshold* (06.075) = 0.
2. The drive is in the under-voltage state.
3. A priority 1, 2 or 3 trip is active (see *Trip 0* (10.020)).
4. One of the following trips is active or would be active if another trip is not already active: *OI Brake*, *PSU*, *Th Brake Res* or *OHt Inverter*.
5. *Percentage Of Drive Thermal Trip Level* (07.036) = 100%. This is an indication that some part of the drive is too hot and is used to indicate if an internally fitted braking resistor is too hot.
6. *Brake R Too Hot* is active or the system has been set up to disable the braking IGBT based on the braking resistor temperature and the resistor is too hot (i.e. bit 2 of *Action On Trip Detection* (10.037) is set).

Note that the braking IGBT over-current trip cannot be reset until 10s after it is initiated. This period consists of a 9s period after the trip where the braking IGBT cannot be switched on again and the *OI Brake* trip is held active and cannot be reset. This 9s period is followed by the normal 1s delay, that is present for other trips, before the trip can be reset. During this 1s period it is possible for the braking IGBT to switch on again. If the conditions are still present that caused the trip then the trip will be initiated again with a further 9s hold-off period etc.

Trips Summary (numerical order)

Value	Trip
0	None
1	Reserved 001
2	Over Volts
3	OI ac
4	OI Brake
5	PSU
6	External Trip
7	Over Speed
8	Inductance
9	PSU 24V
10	Th Brake Res
11	Autotune 1
12	Autotune 2
13	Autotune 3
14	Autotune 4
15	Autotune 5
16	Autotune 6
17	Autotune 7
18	Autotune Stopped
19	Brake R Too Hot
20	Motor Too Hot
21	OHt Inverter
22	OHt Power
23	OHt Control
24	Thermistor
25	Th Short Circuit
26	I/O Overload
27	OHt dc bus
28	An Input 1 Loss
29	An Input 2 Loss
30	Watchdog
31	EEPROM Fail
32	Phase Loss
33	Resistance
34	Keypad Mode
35	Control Word
36	User Save
37	Power Down Save
38	Low Load
39	Line Sync
40	User Trip 40
41	User Trip 41
42	User Trip 42
43	User Trip 43
44	User Trip 44
45	User Trip 45
46	User Trip 46
47	User Trip 47
48	User Trip 48
49	User Trip 49
50	User Trip 50
51	User Trip 51
52	User Trip 52
53	User Trip 53
54	User Trip 54
55	User Trip 55
56	User Trip 56
57	User Trip 57
58	User Trip 58
59	User Trip 59
60	User Trip 60
61	User Trip 61
62	User Trip 62
63	User Trip 63
64	User Trip 64
65	User Trip 65
66	User Trip 66
67	User Trip 67
68	User Trip 68

69	User Trip 69
70	User Trip 70
71	User Trip 71
72	User Trip 72
73	User Trip 73
74	User Trip 74
75	User Trip 75
76	User Trip 76
77	User Trip 77
78	User Trip 78
79	User Trip 79
80	User Trip 80
81	User Trip 81
82	User Trip 82
83	User Trip 83
84	User Trip 84
85	User Trip 85
86	User Trip 86
87	User Trip 87
88	User Trip 88
89	User Trip 89
90	Power Comms
91	User 24V
92	OI Snubber
93	Inductor Too Hot
94	Rectifier Set-up
95	Reserved 095
96	User Prog Trip
97	Data Changing
98	Out Phase Loss
99	CAM
100	Reset
101	OHt Brake
102	Cloning
103	Inter-connect
104	Reserved 104
105	Reserved 105
106	Reserved 106
107	Reserved 107
108	Reserved 108
109	OI dc
110	Undefined
111	Configuration
112	User Trip 112
113	User Trip 113
114	User Trip 114
115	User Trip 115
116	User Trip 116
117	User Trip 117
118	User Trip 118
119	User Trip 119
120	User Trip 120
121	User Trip 121
122	User Trip 122
123	User Trip 123
124	User Trip 124
125	User Trip 125
126	User Trip 126
127	User Trip 127
128	User Trip 128
129	User Trip 129
130	User Trip 130
131	User Trip 131
132	User Trip 132
133	User Trip 133
134	User Trip 134
135	User Trip 135
136	User Trip 136
137	User Trip 137
138	User Trip 138

139	User Trip 139
140	User Trip 140
141	User Trip 141
142	User Trip 142
143	User Trip 143
144	User Trip 144
145	User Trip 145
146	User Trip 146
147	User Trip 147
148	User Trip 148
149	User Trip 149
150	User Trip 150
151	User Trip 151
152	User Trip 152
153	User Trip 153
154	User Trip 154
155	User Trip 155
156	User Trip 156
157	User Trip 157
158	User Trip 158
159	User Trip 159
160	Island
161	Reserved 161
162	Encoder 12
163	Encoder 13
164	Encoder 14
165	Reserved 165
166	Reserved 166
167	Reserved 167
168	Reserved 168
169	Voltage Range
171	Reserved 171
172	Reserved 172
173	Reserved 173
174	Card Slot
175	Card Product
176	Name Plate
177	Card Boot
178	Card Busy
179	Card Data Exists
180	Card Option
181	Card Read Only
182	Card Error
183	Card No Data
184	Card Full
185	Card Access
186	Card Rating
187	Card Drive Mode
188	Card Compare
189	Encoder 1
190	Encoder 2
191	Encoder 3
192	Encoder 4
193	Encoder 5
194	Encoder 6
195	Encoder 7
196	Encoder 8
197	Encoder 9
198	Phasing Error
199	Destination
200	Slot1 HF
201	Slot1 Watchdog
202	Slot1 Error
203	Slot1 Not Fitted
204	Slot1 Different
205	Slot2 HF
206	Slot2 Watchdog
207	Slot2 Error
208	Slot2 Not Fitted
209	Slot2 Different

210	Slot3 HF
211	Slot3 Watchdog
212	Slot3 Error
213	Slot3 Not Fitted
214	Slot3 Different
215	Option Disable
216	Slot App Menu
217	App Menu Changed
218	Temp Feedback
219	An Output Calib
220	Power Data
221	Stored HF
222	Reserved 222
223	Rating Mismatch
224	Drive Size
225	Current Offset
226	Soft Start
227	Sub-array RAM
228	Reserved 228
229	Reserved 229
230	Reserved 230
231	Reserved 231
232	Reserved 232
233	Reserved 233
234	Reserved 234
235	Reserved 235
236	Reserved 236
237	Reserved 237
238	Reserved 238
239	Reserved 239
240	Reserved 240
241	Reserved 241
242	Reserved 242
243	Reserved 243
244	Reserved 244
245	Reserved 245
246	Reserved 246
247	Derivative ID
248	Derivative Image
249	User Program
250	Slot4 HF
251	Slot4 Watchdog
252	Slot4 Error
253	Slot4 Not Fitted
254	Slot4 Different
255	Reset Logs

Trips (alphabetical order)

Trip	*An Input 1 Loss*
Value	28
Short description	

Indicates that a current loss was detected in current mode on Analog Input 1 (Terminal 5, 6). In 4-20mA and 20-4mA modes. loss of input is detected if the current falls below 3mA. See *Analog Input 1 Mode* (07.007) for further details.

Recommended actions:

- Check control wiring is correct.
- Check control wiring is undamaged.
- Check *Analog Input 1 Mode* (07.007).
- Check that the current signal is present and greater than 3mA.

Trip	*An Input 2 Loss*
Value	29
Short description	

Indicates that a current loss was detected in current mode on Analog Input 2 (Terminal 7). In 4-20mA and 20-4mA modes. loss of input is detected if the current falls below 3mA. See *Analog Input 2 Mode* (07.011) for further details.

Recommended actions:

- Check control wiring is correct.
- Check control wiring is undamaged.

- Check *Analog Input 2 Mode* (07.011).
- Check that the current signal is present and greater than 3mA.

Trip	*An Output Calib*
Value	219
Short description	

The zero offset calibration of one or both of the analogue outputs has failed. This indicates that the drive hardware has failed or a voltage has been applied to the output via a low impedance.

Sub-trip	Reason
1	Output 1 failed
2	Output 2 failed

Recommended actions:

- Check the wiring associated with analog outputs.
- Remove all the wiring that is connected to analog outputs and perform the calibration.
- If trip persists, replace the drive.

Trip	*App Menu Changed*
Value	217
Short description	

The customisation table for an application menu has been changed. The sub-trip indicates which menu has changed:

Sub-trip	Reason
1	Menu 18
2	Menu 19
3	Menu 20

If more than one menu has changed the lowest menu has priority. Drive user parameters must be saved to prevent this trip on the next power-up.

Recommended actions:

- Reset the trip and perform a parameter save to accept the new settings.

Trip	*Autotune 1*
Value	11
Short description	

The drive has tripped during an auto-tune. The cause of the trip can be identified from the sub-trip number.

Sub-trip	Reason	Recommended actions
1	The position feedback did not change when position feedback is being used during rotating auto-tune.	Ensure that the motor is free to turn (i.e. mechanical brake is released). Check that the position feedback is selected correctly and operates correctly.
2	The motor did not reach the required speed during mechanical load measurement.	Ensure that the motor is free to turn and that the static load plus inertia is not too large for the drive to accelerate within the test time.
3	The required commutation signal edge could not be found during a rotating auto-tune with a Commutation Only position feedback device.	Check that the position feedback signals are connected correctly.
4	The required movement angle cannot be produced during a minimal movement test.	Reduce the angular movement required.
5	The second part of the minimal movement test during auto-tuning cannot locate the motor flux position accurately.	Reduce the angular movement required.
6	The phasing offset angle is measured twice during a stationary auto-tune and the results are not within 30° of each other.	If a minimal movement test is being used and excessive motor movement is occurring during the test reduce the required angle movement. Otherwise try and increase the required angle movement.
7	The motor is moving when a phasing test on enable is selected and the drive is enabled, but the motor is still moving at a speed above the zero speed threshold.	Ensure that the motor is stationary before the drive is enabled.

Trip	*Autotune 2*
Value	12
Short description	

The drive has tripped during a rotating auto-tune. The cause of the trip can be identified from the associated sub-trip number.

Sub-trip	Reason
1	The position feedback direction is incorrect when position feedback is being used during a rotating auto-tune.
2	A SINCOS encoder with comms is being used for position feedback and the comms position is rotating in the opposite direction to the sine wave based position.

Recommeded actions:

- Check motor cable wiring is correct.
- Check feedback device wiring is correct.
- Swap any two motor phases.

Trip	Autotune 3
Value	13
Short description	

The drive has tripped during a rotating auto-tune or mechanical load measurement. The cause of the trip can be identified from the associated sub-trip number.

Sub-trip	Reason
1	Measured inertia has exceeded the parameter range during a mechanical load measurement.
2	The commutation signals changed in the wrong direction during a rotating auto-tune.
3	The mechanical load test has been unable to identify the motor inertia.

Recommended actions for sub-trip 2:

- Check motor cable wiring is correct.
- Check feedback device U, V and W commutation signal wiring is correct.

Recommended actions for sub-trip 3:

- Increase the test level.
- If the test was carried out at standstill repeat the test with the motor rotating within the recommended speed range.

Trip	Autotune 4
Value	14
Short description	

A position feedback device with commutation signals is being used (i.e AB Servo, FD Servo, FR Servo, SC Servo or Commutation Only encoder) and the U commutation signal did not change during a rotating auto-tune.

Recommended actions:

- Check feedback device U commutation signal wiring is correct (Encoder terminals 7 and 8).

Trip	Autotune 5
Value	15
Short description	

A position feedback device with commutation signals is being used (i.e AB Servo, FD Servo, FR Servo, SC Servo or Commutation Only encoder) and the V commutation signal did not change during a rotating auto-tune.

Recommended actions:

- Check feedback device V commutation signal wiring is correct (Encoder terminals 9 and 10).

Trip	Autotune 6
Value	16
Short description	

A position feedback device with commutation signals is being used (i.e AB Servo, FD Servo, FR Servo, SC Servo or Commutation Only encoder) and the W commutation signal did not change during a rotating auto-tune.

Recommended actions:

- Check feedback device W commutation signal wiring is correct (Encoder terminals 11 and 12).

Trip	Autotune 7
Value	17
Short description	

An *Autotune 7* trip is initiated during a rotating auto-tune, if the number of motor poles or the position feedback resolution have been set up incorrectly where position feedback is being used.

Recommeded actions:

- Check the lines per revolution for the feedback device.
- Check the number of poles in *Number Of Motor Poles* (05.011).

Trip	Autotune Stopped
Value	18
Short description	

The drive was prevented from completing an auto-tune, because either the Final drive enable or the Final drive run were removed.

Recommended actions:

- Check the drive enable signal (Terminal 31) was active during the auto-tune.
- Check the run command was active in *Digital Input 05 State* (08.005) during the auto-tune.

Trip	Brake R Too Hot
Value	19
Short description	

This trip indicates that braking resistor overload has timed out. The value in *Braking Resistor Thermal Accumulator* (10.039) is calculated using *Braking Resistor Rated Power* (10.030), *Braking Resistor Thermal Time Constant* (10.031) and *Braking Resistor Resistance* (10.061). This trip is initiated when *Braking Resistor Thermal Accumulator* (10.039) reaches 100%.

Recommended actions:

- Ensure the values entered in *Braking Resistor Rated Power* (10.030), *Braking Resistor Thermal Time Constant* (10.031) and *Braking Resistor Resistance* (10.061) are correct.
- If an external thermal protection device is being used and the braking resistor software overload protection is not required, set *Braking Resistor Rated Power* (10.030), *Braking Resistor Thermal Time Constant* (10.031) and *Braking Resistor Resistance* (10.061) to 0 to disable the trip.

Trip	CAM
Value	99
Short description	

Advanced motion controller cam failure.

Sub-trip	Reason
1	*AMC Cam Start Index* (35.001) > *AMC Cam Size* (35.003) or *AMC Cam Start Position In Segment* (35.002) > Cam Table In for the start index
2	*AMC Cam Index* (35.007) has change by more than 2 in one sample
3	The rate of change at a segment boundary has exceeded the maximum value
4	The sum of the *AMC Cam Position In Segment* (35.008) and the change of master position has exceeded the maximum value

Trip	Card Access
Value	185
Short description	

A communications failure has occurred with a NV media card. If this occurs during a data transfer to the card then the file being written may be corrupted. If this occurs when data is being transferred from the card then the data transfer may be incomplete. If a parameter file is transferred to the drive and this trip occurs during the transfer the parameters are not saved to non-volatile memory, and so the original parameters can be restored by powering the drive down and up again.

Recommended actions:

- Check the NV media card is installed / located correctly.
- Replace the NV media card.

Trip	Card Boot
Value	177
Short description	

A write to a Menu 0 parameter has been initiated via the keypad by exiting edit mode and *Parameter Cloning* (11.042) is set up for auto or boot mode, but the necessary boot file has not been created on the NV media card fitted to the drive to take the new parameter value. This occurs when *Parameter Cloning* (11.042) is changed to auto or boot mode, but the drive is not subsequently reset. The action of resetting the trip will create the necessary file and prevent further trips.

Recommended actions:

- Ensure that *Parameter Cloning* (11.042) is correctly set, and then reset the drive to create the necessary file on the NV media card.
- Re-attempt the parameter write to the Menu 0 parameter.

Trip	Card Busy
Value	178
Short description	

An attempt has been made to access a file on a NV media card, but the file is already being accessed be an Option Module, such as one of the Applications modules. No data is transferred.

Recommended actions:

- Wait for the Option Module to finish accessing the NV media card and re-attempt the required function.

Trip	Card Compare
Value	188
Short description	

A compare has been carried out between a file on a NV media card and the drive and these are different and no other NV media card related trips have occurred.

Recommended actions:

- Set Pr *mm.000* to 0 to reset the trip.
- Check to ensure the correct data block on the NV media card has been used for the compare.

Trip	Card Data Exists
Value	179
Short description	

An attempt has been made to store data on a NV media card, but the file already exists. No data is transferred. The file should be erased first to prevent this trip.

Recommended actions:

- Erase the data in data location.
- Write data to an alternative data location.

Trip	Card Drive Mode
Value	187
Short description	

This trip is produced during a compare if the drive mode in the file on the NV media card is different from the current drive mode and the file is a parameter file. This trip is also produced if an attempt is made to transfer a parameter file where the source and target drive modes are different and the drive mode is outside the range allowed for the target drive.

Recommended actions:

- Ensure the destination drive supports the drive operating mode in the parameter file.
- Clear the value in Pr *mm.000* and reset the drive.
- Ensure destination derive operating mode is the same as the source parameter file.

Trip	Card Error
Value	182
Short description	

An attempt has been made to access a NV media card, but an error has been detected in the data structure on the card. Resetting this trip will cause the drive to erase the <MCDF> folder from the NV media card (if it exists) and create the correct folder structure. On an SD card, whilst this trip is still present, missing directories will be created, and if the header file is missing it will be created. The following sub-trip numbers are used with this trip.

Sub-trip	Reason
1	The required folder and file structure is not present.
2	The <000> file is corrupted.
3	Two or more files in the <MCDF\> folder have the same file identification number.

Recommended actions:

- Erase all the data blocks and re-attempt the process.
- Ensure the card is located correctly.
- Replace the NV media card.

Trip	Card Full
Value	184
Short description	

An attempt has been made to write to a NV media card, but there is insufficient space available. No data is transferred.

Recommended actions:

- Delete a data block or the entire NV media card to create space.
- Replace the NV media card.

Trip	Card No Data
Value	183
Short description	

An attempt has been made to access a non-existent file on a NV media card. No data is transferred.

Recommended actions:

- Ensure data block number is correct.

Trip	Card Option
Value	180
Short description	

A parameter file has been transferred from a NV media card to the drive, but at least one of the option modules are difference between source and target drives. This trip does not stop the data transfer, but is a warning that the data for the option modules that are different will be set to the default values and not the values from the card. This trip also applies if a compare is performed between a parameter file on a card and the drive and the option modules fitted are different between the source and target.

Recommended actions:

- Ensure the correct option modules are installed.
- Ensure the option modules are in the same option module slot as the parameter set stored.
- Press the red reset button to acknowledge that the parameters for one or more of the option modules installed will be at their default vaules.
- This trip can be suppressed by setting Pr *mm.000* to 9666 and resetting the drive.

Trip	Card Product
Value	175
Short description	

If *Drive Derivative* (11.028) or *Product Type* (11.063) are different between the source and target drives then this trip is initiated either at power-up or when the card is accessed. It will have one of the following sub-trip numbers:

Sub-trip	Reason
1	If *Drive Derivative* (11.028) is different between the source and target drives, this trip is initiated either at power-up or when the SD Card is accessed. Data is still transferred, since this is a warning trip; the trip can be suppressed by entering code 9666 in parameter xx.000, and reseting the drive (this applies the warning suppression flag to the card).
2	If *Product Type* (11.063) is different between the source and target drives or if corruption is detected in the parameter file, this trip is initiated either at power-up or when the SD Card is accessed. This trip can be reset but no data are transferred in either direction between the drive and the card.
3	A Unidrive SP parameter value was found that has no equivalent parameter on the destination drive. Data is still transferred, since this is a warning trip; the trip can be suppressed by entering code 9666 in parameter xx.000, and reseting the drive (this applies the warning suppression flag to the card).

Recommended actions:

- Use a different NV media card.
- This trip can be suppressed by setting Pr *mm.000* to 9666 and resetting the drive.

Trip	Card Rating
Value	186
Short description	

A parameter file has been transferred from a NV media card to the drive, but the current and/or voltage rating are different between source and target drive. This trip does not stop the data transfer, but is a warning that the data for rating dependent parameters may not be the same on the target as the source drive. This trip also applies if a compare (using Pr *mm.000* set to 8yyy) is performed between a parameter file on the card on the drive.

Recommended actions:

- Reset the drive to clear the trip.
- This trip can be suppressed by setting Pr *mm.000* to 9666 and resetting the drive.

Trip	Card Read Only
Value	181
Short description	

An attempt has been made to modify data on a read-only NV media card or to modify a read-only file (i.e. erase the card, erase a file or create a file). No data is transferred.

Recommended actions:

- Clear the read only flag by setting Pr *mm.000* to 9777 and reset the drive. This will clear the read only flag for all data blocks in the NV media card.

Trip	Card Slot
Value	174
Short description	

The transfer of an option module application program to or from an application module can fail because the option module does not respond correctly. If this happens this trip is produced with the sub-trip indicating the option module slot number.

Sub-trip number	Reason
1	Error in option slot 1
2	Error in option slot 2
3	Error in option slot 3
4	Error in option slot 4

Recommended actions:

- Ensure the source / destination option module is installed on the correct slot.

Trip	Cloning
Value	102
Short description	

If an attempt is made to use the cloning system to back-up the drive and option modules (parameter mm.000 values from 40001 to 40999) or restore the drive and option modules (parameter mm.000 values from 60001 to 60999) and the action fails then a "Cloning" trip is initiated. The sub-trip value indicates the reason for the trip.

Sub-trip	Reason
1	The option module in Slot 1 has indicated that it will either back-up or restore its data to/from an SD card, but has failed to respond correctly and the system has timed out.
2	As 1, but for Option Slot 2.
3	As 1, but for Option Slot 3.
4	As 1, but for Option Slot 4.
5	Back-up folders exist or cannot be created when a back-up is initiated.
6	The required back-up folders do not exist when a restore is initiated.

Trip	*Configuration*
Value	111
Short description	

The *Number Of Power Modules Detected* (11.071) is different from the number expected. The sub-trip value indicates the number of power modules expected.

Recommended actions:

- Ensure that all the power modules are correctly connected and powered up.
- Ensure that the value in *Number Of Power Modules Detected* (11.071) is set to the number of power modules connected.
- Set *Number Of Power Modules Test* (11.035) to 0 to disable the trip if not required.

This trip is also initiated if the number of external rectifiers connected to each power module is less than the number defined by *Number Of Rectifiers Expected* (11.096). If this is the reason for the trip the sub-trip is 10x where x is the number of external rectifiers that should be connected.

Recommended actions:

- Ensure that all the external rectifiers are connected correctly.
- Ensure that the value in *Number Of Rectifiers Expected* (11.096) is correct.

Trip	*Control Word*
Value	35
Short description	

This trip is initiated by setting bit 12 on the control word in *Control Word* (06.042) when the control word is enabled (*Control Word Enable* (06.043) = On).

Recommended actions:

- Check the value of *Control Word* (06.042).
- Disable the control word in *Control Word Enable* (06.043).

Trip	*Current Offset*
Value	225
Short description	

The current feedback offset is too large to be trimmed correctly. The sub-trip relates to the output phase for which the offset error has been detected.

Sub-trip	Phase
1	U
2	V
3	W

Recommended actions:

- Ensure that there is no possibility of current flowing in the output phase of the drive when the drive is not enabled.
- Hardware fault - contact the supplier of the drive.

Trip	*Data Changing*
Value	97
Short description	

A user action or a file system write is active that is changing the drive parameters and the drive has become active, i.e. *Drive Active* (10.002) = 1. The user actions that change drive parameters are loading defaults, changing drive mode, or transferring data from an NV memory card or a position feedback device to the drive. The file system actions that will cause this trip to be initiated if the drive is enabled during the transfer are writing a parameter or macro file to the drive, or transferring a derivative or user program to the drive. It should be noted that none of these actions can be started if the drive is active, and so the trip only occurs if the action is started and then the drive is enabled.

Recommended actions:

- Ensure the drive is not enabled when one of the following is being carried out:
  - Loading defaults
  - Changing drive mode
  - Transferring data from a NV media card or position feedback device
  - Transferring user programs

Trip	*Derivative ID*
Value	247
Short description	

There is a problem with the identifier associated with derivative image which customises the drive. The reason for the trip is given by the sub-trip as follows.

Sub-trip	Reason for trip
1	There should be a derivative image in the product but this has been erased.
2	The identifer is out of range.
3	The derivative image has been changed.

Trip	*Derivative Image*
Value	248
Short description	

An error has been detected in the derivative product image. The sub-trip indicated the reason for the trip.

Sub-trip	Reason	Comments
1	Divide by zero	
2	Undefined trip	
3	Attempted fast parameter access set-up with non-existent parameter	
4	Attempted access to non-existent parameter	
5	Attempted write to read-only parameter	
6	Attempted and over-range write	
7	Attempted read from write-only parameter	
30	The image has failed because either its CRC is incorrect, or there are less than 6 bytes in the image or the image header version is less than 5.	Occurs when the drive powers-up or the image is programmed. The image tasks will not run.
31	The image requires more RAM for heap and stack than can be provided by the drive.	As 30.
32	The image requires an OS function call that is higher than the maximum allowed.	As 30.
40	The timed task has not completed in time and has been suspended.	
41	Undefined function called, i.e. a function in the host system vector table that has not been assigned.	As 40.
51	Core menu customisation table CRC check failed	As 30.
52	Customisable menu table CRC check failed	As 30.
53	Customisable menu table changed	Occurs when the drive powers-up or the image is programmed and the table has changed. Defaults are loaded for the derivative menu and the trip will keep occurring until drive parameters are saved.
61	The option module fitted in slot 1 is not allowed with the derivative image.	As 30.
62	The option module fitted in slot 2 is not allowed with the derivative image.	As 30.
63	The option module fitted in slot 3 is not allowed with the derivative image.	As 30.
64	The option module fitted in slot 4 is not allowed with the derivative image.	As 30.
70	An option module that is required by the derivative image is not fitted in any slot.	As 30.
71	An option module specifically required to be fitted in slot 1 not present.	As 30.
72	An option module specifically required to be fitted in slot 2 not present.	As 30.
73	An option module specifically required to be fitted in slot 3 not present.	As 30.
74	An option module specifically required to be fitted in slot 4 not present.	As 30.
80	*Image is not compatible with the control board	Initiated from within the image code.
81	*Image is not compatible with the control board serial number	As 80.

Recommended actions:

- Contact the supplier of the drive.

Trip	*Destination*
Value	199
Short description	

This trip indicated that destination output parameters of two or more logic functions (Menus 05, 07, 08, 09, 12 or 14) within the drive are writing to the same parameter.

Recommended actions:

- Set Pr *mm.000* to "Destinations" or 12001 and check all visible parameters in all menus for parameter write conflicts.

Trip	*Drive Size*
Value	224
Short description	

This trip indicates that the control PCB has not recognized the drive size of the power circuit to which it is connected.

Recommended actions:

- Ensure the drive is programmed to the latest software version.
- Hardware fault - return drive to supplier.

Trip	*EEPROM Fail*
Value	31
Short description	

EEPROM Fail trip indicates that default parameters have been loaded because of the reasons given below.

Sub-trip	Reason
1	The most significant digit of the internal parameter database version number has changed.
2	The CRC's applied to the parameter data stored in internal non-volatile memory indicate that a valid set of parameters cannot be loaded.
3	The drive mode restored from internal non-volatile memory is outside the allowed range for the product or the derivative image does not allow the previous drive mode.
4	The drive derivative image has been changed and it has changed the customisation of the drive core menus.
5	The power stage hardware has been change and changed the customisation of the drive core menus.
6	The internal I/O hardware has been change and changed the customisation of the drive core menus.
7	The position feedback interface hardware has been change and changed the customisation of the drive core menus.
8	The control board hardware has been change and changed the customisation of the drive core menus.
9	The checksum on the non-parameter area of the EEPROM has failed.

The drive holds two banks of user save parameters and two banks of power down save parameters in non-volatile memory. If the last bank of either set of parameters that was saved is corrupted a *User Save* or *Power Down Save* trip is produced. If one of these trips occurs the parameters values that were last saved successfully are used. It can take some time to save parameters when requested by the user and if the power is removed from the drive during this process it is possible to corrupt the data in the non-volatile memory.

If both banks of user save parameters or both banks of power down save parameters are corrupted or one of the other conditions given in the table above occurs *EEPROM Fail.xxx* trip is produced. If this trip occurs it is not possible to use the data that has been saved previously, and so the drive will be in lowest allowed drive mode with default parameters. The trip can only be reset if *Parameter mm.000* (mm.000) is set to 10, 11, 1233 or 1244 or if *Load Defaults* (11.043) is set to a non-zero value.

Recommended actions:

- Default the drive and perform a drive reset.
- Allow sufficient time to perform a save before the supply to the drive is removed.
- If the trip persists, return drive to the supplier.

Trip	*Encoder 1*
Value	189
Short description	

Drive position feedback interface power supply overloaded. Terminals 13 & 14 of the 15 way D-type connector can supply a maximum current of 200mA at 15V or 300mA at 5V.

Recommended actions:

- Check encoder power supply wiring.
- Disable the termination resistors (*P1 Termination Select* (03.039) set to 0) to reduce current consumption.
- For 5V encoders with long cables, select 8V (*P1 Supply Voltage* (03.036)) and fit a 5V voltage regulator close to the encoder.
- Check the encoder specification to confirm it is compatible with the encoder port power supply current capability.
- Replace the encoder.
- Use an external power supply with higher current capability.

Trip	*Encoder 2*
Value	190
Short description	

There is a wire break between the drive and the position feedback device. These trips are provided for the P1 position feedback interface only and the exact cause of the trip can be identified from the sub-trip number as given below.

Sub-trip	Signals
1	Resolver or SINCOS sine wave signals
11	Digital incremental A signal
12	Digital incremental B signal
13	Digital incremental Z signal
14	SC SC device single turn sine wave commutation signals.
15	SC SC device marker

This trip can occur if the position feedback device type selected in *P1 Device Type* (03.038) is not correct for the position feedback device connected to the drive.

Recommended actions:

- Ensure that the position feedback device type selected in *P1 Device Type* (03.038) is correct for the position feedback device connected to the P1 interface on the drive.
- If wire break detection on the drive encoder input is not required, set bit 0 of *P1 Error Detection Level* (03.040) to 0 to disable the Encoder 2 trip.
- If the trip is due to the digital incremental Z (marker signal) this is often not connected. Check that this trip is disabled by setting *P1 Termination Select* (03.039) to a value that disables the termination on this input, which will disable hardware wire break detection.
- Check cable continuity.
- Check wiring of feedback signals is correct.
- Check encoder power supply is set correctly (*P1 Supply Voltage* (03.036)).
- Replace the encoder.

Trip	*Encoder 3*
Value	191
Short description	

The drive has detected an incorrect UVW phase angle while running (RFC-S mode only) or SINCOS phase error. The feedback device which has caused the trip can be identified by the sub-trip number.

Sub-trip	Reason
1	Drive position feedback interface 1
2	Drive position feedback interface 2

Recommended actions:

- Check encoder shield connections.
- Ensure the encoder cable is one uninterrupted cable.
- Check the encoder signal for noise with an oscilloscope.
- Check the integrity of the encoder mechanical mounting.
- For a UVW servo encoder, ensure that the phase rotation of the UVW commutation signals is the same as the phase rotation of the motor.
- For a SINCOS encoder, ensure that motor and incremental SINCOS connections are correct and that for forward rotation of the motor, the encoder rotates clockwise (when looking at the shaft of the encoder).
- Repeat the offset measurement test.

Trip	*Encoder 4*
Value	192
Short description	

This trip indicates that the encoder communications has timed out or the communications position message transfer time is too long. This trip can also be caused due to a wire break in the communication channel between the drive and the encoder. The feedback device which has caused the trip can be identified by the sub-trip number.

Sub-trip	Reason
1	Drive position feedback interface 1
2	Drive position feedback interface 2

Recommended actions:

- Ensure the encoder power supply setting (*P1 Supply Voltage* (03.036)) is correct.
- Complete encoder auto-configuration (*P1 Auto-configuration Select* (03.041) = Enabled).
- Check the encoder wiring.
- Replace the feedback device.

Trip	*Encoder 5*
Value	193
Short description	

This trip indicates that there is a checksum or CRC error, or the SSI encoder is not ready. The Encoder 5 trip can also indicate a wire break to a communications based encoder.

Sub-trip	Reason
1	Drive position feedback interface 1
2	Drive position feedback interface 2

Recommended actions:

- Check the encoder cable shield connections.
- Ensure the cable is one uninterrupted cable - remove any connector blocks or if unavoidable minimise the length of any shield pigtails to the connector block.
- Check the encoder signal for noise with an oscilloscope.
- Check *P1 Comms Bits* (03.035).
- If using a Hiperface, EnDat or BiSS encoder, carry out an encoder auto-configuration (*P1 Auto-configuration Select* (03.041) = Enabled).

- Replace the encoder.

Trip	Encoder 6
Value	194
Short description	

This trip indicates that the encoder has indicated an error or that the power supply has failed to an SSI encoder. This trip can also indicate a wire break to an SSI encoder.

Sub-trip	Reason
1	Drive position feedback interface 1
2	Drive position feedback interface 2

Recommended actions:

- For SSI encoders, check the wiring and encoder power supply setting (*P1 Supply Voltage* (03.036)).
- For BiSS encoders this trip will often occur if *P1 Comms Bits* (03.035) is not set correctly because a position or CRC bit may be read instead of the /Error bit.
- Replace the encoder / contact the supplier of the encoder.

Trip	Encoder 7
Value	195
Short description	

A set-up parameter for the position feedback device has been changed. See *P1 Error Detection Level* (03.040).

Sub-trip	Reason
1	Drive position feedback interface 1
2	Drive position feedback interface 2

Trip	Encoder 8
Value	196
Short description	

This trip indicates that the position feedback interface communications time exceeds 250µs. The feedback device which has caused the trip can be indentified by the sub-trip number.

Sub-trip	Reason
1	Drive position feedback interface 1
2	Drive position feedback interface 2

Recommended actions:

- Ensure the encoder is connected correctly.
- Ensure that the encoder is compatible.
- Increase baud rate.

Trip	Encoder 9
Value	197
Short description	

- This indicates that the position feedback selected from an option slot that does not contain a position feedback category option module.

Recommended action:

- Check the setting of *Motor Control Feedback Select* (03.026) (or *M2 Motor Control Feedback Select* (21.021) if the second motor parameters have been enabled).
- Ensure that the option slot selected in *Motor Control Feedback Select* (03.026) has a feedback option module installed.

Trip	Encoder 12
Value	162
Short description	

This trip indicates that the drive is communicating with the encoder but the encoder type is not recognised.

Sub-trip	Reason
1	Drive position feedback interface 1
2	Drive position feedback interface 2

Recommended actions:

- Enter the encoder setup parameters manually.
- Check to see if the encoder supports auto-configuration.

Trip	Encoder 13
Value	163
Short description	

This trip indicates that the data read from the encoder was out of range during auto-configuration. No parameters will be modified with data read from the encoder

as a result of auto-configuration. The tens in the sub-trip number indicate the interface number (i.e. 1 for P1 interface and 2 for P2 interface).

Sub-trip	Reason
x1	Rotary lines per revolution error
x2	Linear comms pitch error
x3	Linear line pitch error
x4	Rotary turns bits error
x5	Communcations bits error
x6	Calculation time is too long
x7	Line delay measured is longer than 5µs

Recommended actions:

- Enter the encoder setup parameters manually.
- Check to see if the encoder supports auto-configuration.

Trip	*Encoder 14*
Value	164
Short description	

The data given in the additional configuration parameter for a position feedback interface is out of range. If the sub-trip number is one then the data is out of range in *P1 Additional Configuration* (03.074), or if the sub-trip number is 2 the data is out of range in *P2 Additional Configuration* (03.174). Not all position feedback devices use the additional configuration, but those that do are listed below.

BiSS
Range checking is applied to the turns padding (decimal digits 5-3) and position padding (decimal digits 2-0). If these give a padding value outside +/-16 then the trip is initiated. Note that in each case the most significant digit indicates left (0) or right (1) padding, and the least signficant 2 digits indicate the number of bits.

Trip	*External Trip*
Value	6
Short description	

External trip is initiated as shown in the table below.

Sub-trip	Reason
1	*External Trip Mode* (08.010) = 1 or 3 and SAFE TORQUE OFF Input 1 is low
2	*External Trip Mode* (08.010) = 2 or 3 and SAFE TORQUE OFF Input 2 is low
3	*External Trip* (10.032) = 1

Recommended actions:

- Check the SAFE TORQUE OFF signal voltage on terminal 31 is 24V.
- Check the value of *STO Input 01 State* (08.009) which indicates the digital state of terminal 31.
- If external trip detection of the SAFE TORQUE OFF input is not required, set *External Trip Mode* (08.010) to Off (0).
- Checl the value of *External Trip* (10.032).
- Select "Destinations" (or enter 12001) in Pr *mm.000* and check for a parameter controlling *External Trip* (10.032).
- Ensure *External Trip* (10.032) or *User Trip* (10.038) (=6) is not being used by serial comms.

Trip	*I/O Overload*
Value	26
Short description	

This trip indicates that the total current drawn from the 24V user supply or from the digital output has exceeded the limit. A trip is initiated if one or more of the following conditions is true:

- Maximum output current from one digital output is 100mA.
- The combined maximum output current from outputs 1 and 2 is 100mA.
- The combined maximum output current from output 3 and +24V output is 100mA.

Recommended actions:

- Check total loads on digital outputs.
- Check control wiring is correct.
- Check output wiring is undamaged.

Trip	*Inductance*
Value	8
Short description	

This trip occurs in RFC-S mode when the drive has detected that the motor inductances are not suitable for the operation being attempted. The trip is either caused because the ratio or difference between Ld and Lq is too small or because the saturation characteristic of the motor cannot be measured.

If the inductance ratio or difference is too small this is because one of the following conditions is true:

(*No-load Lq* (05.072)- *Ld* (05.024)) / *Ld* (05.024) < 0.1

(*No-load Lq* (05.072) - *Ld* (05.024)) < (K / *Full Scale Current Kc* (11.061))H

where:

Drive Rated Voltage (11.033)	K
200V	0.0073
400V	0.0146
575V	0.0174
690V	0.0209

If the saturation characteristic of the motor cannot be measured this is because when the flux in the motor is changed the measured value of Ld does not change sufficiently due to saturation to be measured. When half of *Rated Current* (05.007) is applied in the d axis of the motor in each direction the inductance must change by at least (K / (2 x *Full Scale Current Kc* (11.061))) H.

The specific reasons for each of the sub-trips are given in the table below.

Sub-trip	Reason
1	The inductance ratio or difference is too small when the drive has been started in sensorless mode.
2	The saturation characteristic of the motor cannot be measured when the drive has been started in sensorless mode.
3	The inductance ratio or difference is too small when an attempt is made to determine the location of the motor flux during a stationary auto-tune in RFC-S mode. This trip is also produced when the inductance ratio or inductance difference is too small when carrying out a phasing test on starting in RFC-S mode. If position feedback is being used the measured value for *Position Feedback Phase Angle* (03.025) may not be reliable. Also the measured values of *Ld* (05.024) and *No-load Lq* (05.072) may not correspond to the d and q axis respectively.
4	The direction of the flux in the motor is detected by the change of inductance with different currents. This trip is initiated if the change cannot be detected when an attempt is made to perform a stationary auto-tune when position feedback is being used, or to perform a phasing test on starting in RFC-S mode.

Trip	Inductor Too Hot
Value	93
Short description	

Regen inductor overload. See *Inductor Thermal Time Constant* (04.015).

Trip	Inter-connect
Value	103
Short description	

Multi-power module drive interconnection cable error. The sub-trip "xx.0.00" indicates which power module has detected the fault where xx is the power module number. This trip is also initated if the number of modules present changes from the number of modules detected at power-up. In this case the sub-trip is the number of modules that are still communicating correctly.

Trip	Island
Value	160
Short description	

This trip indicates that a regen system is connected to an islaned supply. The sub-trips indicate the reason for the trip.

Sub-trip	Reason
1	Island detection system has been enabled and detected an island condition
2	The minimum synchronisation voltage is non-zero and the supply voltage has been below this threshold and been simulating its own supply synchronisation for more than 2.0s.

Recommended actions:

- Check the supply / supply connections to the regen drive.

Trip	Keypad Mode
Value	34
Short description	

If keypad reference mode is enabled (*Reference Selected Indicator* (01.049) = 4 or 6) (i.e. *Reference Selector* (01.014) is set to 4 or 6 if motor map 1 is selected, or *M2 Reference Selector* (21.003) is set to 4 or 6 if motor map 2 is selected) and the keypad removed, then this trip is initiated.

Recommended actions:

- Re-install keypad and reset.
- Change *Reference Selector* (01.014) to select the reference from another source.

Trip	Line Sync
Value	39
Short description	

This trip indicates that the inverter has lost the synchronization with the ac supply in Regen mode.

Recommended actions:

- Check the supply / supply connections to the regen drive.

Trip	*Low Load*
Value	38
Short description	

This trip is initiated if the low load detector is set up to produce a trip on low load detection and this condition occurs. See *Enable Trip On Low Load* (04.029).

Trip	*Motor Too Hot*
Value	20
Short description	

This trip indicates a motor thermal overload based on the *Rated Current* (05.007) and *Motor Thermal Time Constant 1* (04.015). *Motor Protection Accumulator* (04.019) displays the motor temperature as a percentage of the maximum value. The drive will trip on *Motor Too Hot* when *Motor Protection Accumulator* (04.019) gets to 100%.

Recommended actions:

- Ensure the load is not jammed / sticking.
- Check the load on the motor has not changed.
- If seen during an auto-tune test in RFC-S mode, ensure the *Rated Current* (05.007) is = Heavy duty current rating of the drive.
- Tune the *Rated Speed* (05.008) (RFC-A mode only).
- Check feedback signal for noise.
- Ensure the motor rated current is not zero.

Trip	*Name Plate*
Value	176
Short description	

This trip is initiated if there is a problem detected when an electronic name plate transfer from the motor to the drive is initiated. The reasons for the trip are given below:

Sub-trip	Reason	Details
1	A communication error with the encoder has been detected.	It is unlikely that this sub-trip will occur as most encoder errors will cause and encoder trip. It is possible that incorrect data in the nameplate could cause this trip, and so the nameplate data should be verified.
2	A data error has been detected in the nameplate. This is either because the number of entries is out of range, i.e. less than 1 or greater than 168, or the calculated CRC does not match the CRC from the nameplate.	Either there is no valid nameplate in the position feedback device or there is a data error in the nameplate area.
3	The exchange with the encoder has timed out.	If the encoder is connected to a drive interface, then this occurs because the encoder is not connected to the drive or is not initialised. If the encoder is connected to an option module interface, then this occurs because the position feedback interface (i.e. P1 or P2) is not present on the option module, or a suitable position feedback device is not selected, or because no device is connected, or it is not initialised.

Trip	*None*
Value	0
Short description	

No trip has been stored in this position in the trip log.

Trip	*OHt Brake*
Value	101
Short description	

This trip indicates that braking IGBT over-temperature has been detected based on firmware thermal model.

Recommended actions:

- Check braking resistor value is greater than or equal to the minimum resistance value.

Trip	*OHt Control*
Value	23
Short description	

This trip indicates that a control stage over-temperature has been detected. From the sub-trip "xxyzz", the cause of the trip can be identified as follows:

Source	xx	y	zz
Control system	00	0	01: Control board thermistor 1
Control system	00	0	02: Control board thermistor 2
Control system	00	0	03: I/O board thermistor (or brake resistor thermistor)

Recommended actions:

- Check enclosure / drive fans are still functioning correctly.
- Check enclosure ventilation paths.
- Check enclosure door filters.
- Increase ventilation.
- Reduce the drive switching frequency.
- Check ambient temperature.

Trip	OHt dc bus
Value	27
Short description	

This trip indicates a DC bus component over temperature based on a firmware thermal model. The drive includes a thermal protection system to protect the DC bus components within the drive. This includes the effects of the output current and DC bus ripple. The estimated temperature is displayed as a percentage of the trip level in *Percentage Of d.c. Link Thermal Trip Level* (07.035). If this parameter reaches 100% then an *OHt dc bus* trip with sub-trip 200 is initiated. The drive will attempt to stop the motor before tripping. If the motor does not stop in 10 seconds then the drive trips immediately.

Source	xx	y	zz
Control system	00	2	00: D.c. link thermal model gives {OHt dc bus} trip with sub-trip 0.

It is also possible in a multi-power module system for d.c. link over-temperature to be detected from within the power stage. From this source the estimated temperature as a percentage of trip is not available and the trip is indicated as follows:

Source	xx	y	zz
Control system	01	0	00: Power stage gives {OHt dc bus} trip with sub-trip 0.

Recommended actions:

- Check the AC supply voltage balance and levels.
- Check the DC bus ripple level.
- Reduce duty cycle.
- Reduce motor load.
- Check output current stability. If unstable;
  - Check the motor map settings with motor nameplate (*Rated Frequency* (05.006), *Rated Current* (05.007), *Rated Speed* (05.008), *Rated Voltage* (05.009), *Rated Power Factor* (05.010) and *Number Of Motor Poles* (05.011)) - (All modes).
  - Disable slip compensation (*Enable Slip Compensation* (05.027) = Off (0)) - (Open-loop).
  - Disable dynamic V to F operation (*Dynamic V To F Select* (05.013) = Off (0)) - (Open-loop).
  - Select fixed boost (*Open-loop Control Mode* (05.014) = Fixed (2)) - (Open-loop).
  - Select high stability space vector modulation (*High Stability Space Vector Modulation* (05.019) = On (1)) - (Open-loop).
  - Disconnect the load and complete a rotating auto-tune (*Auto-tune* (05.012) = 2) - (RFC-A and RFC-S).
  - Auto-tune the rated speed value (*Rated Speed Optimisation Select* (05.016) = 1) - (RFC-A and RFC-S).
  - Reduce speed loop gains (*Speed Controller Proportional Gain Kp1* (03.010), *Speed Controller Integral Gain Ki1* (03.011) and *Speed Controller Differential Feedback Gain Kd1* (03.012)) - (RFC-A and RFC-S).
  - Add a speed feedback filter value (*P1 Feedback Filter* (03.042)) - (RFC-A and RFC-S).
  - Add a current demand filter (*Current Reference Filter 1 Time Constant* (04.012)) - (RFC-A and RFC-S).
  - Check encoder signals for noise with an oscilloscope - (RFC-A and RFC-S).
  - Check encoder mechanical coupling - (RFC-A and RFC-S).

Trip	OHt Inverter
Value	21
Short description	

This trip indicates that an IGBT junction over-temperature has been detected based on a firmware thermal model. The sub-trip indicates which model has initiated the trip in the form xxyzz as given below.

Source	xx	y	zz
Control system	00	1	00: Inverter thermal model
Control system	00	3	00: Braking IGBT thermal model
Control system	00	4	00: Rectifier thermal model

Recommended actions with sub-trip 100:

- Reduce the selected drive switching frequency.
- Ensure *Auto-switching Frequency Change* (05.035) is set to Enabled (0).
- Reduce duty cycle.
- Decrease acceleration / deceleration rates.
- Reduce motor load.
- Check the DC bus ripple.
- Ensure all three input phases are present and balanced.

Recommended actions with sub-trip 300:

- Reduce the braking load.

Recommended actions with sub-trip 400:

- Check the AC supply voltage balance and levels.
- Check the DC bus ripple level.
- Reduce duty cycle.
- Reduce motor load.

Trip	OHt Power
Value	22
Short description	

This trip indicates that a power stage over-temperature has been detected. The sub-trip "xxyzz" indicates which thermistor is indicating the over-temperature. The thermsitor numbering is different for a single module type drive (i.e. no parallel board fitted) and a multi-module type drive (i.e. parallel board fitted with one or more power modules) as shown below:

Single module type drive:

Source	xx	y	zz
Power system	01	0	zz: Thermistor location defined by zz in the power board
Power system	01	Rectifier number	zz: Thermistor location defined by zz in the rectifier

Multi-module type system:

Source	xx	y	zz
Power system	Power module number	0	01: U phase power device
Power System	Power module number	0	02: V phase power device
Power system	Power module number	0	03: W phase power device
Power system	Power module number	0	04: Rectifier
Power system	Power module number	0	05: General power system
Power system	Power module number	0	00: Braking IGBT

Note that the power module that has caused the trip cannot be identified except for the braking IGBT temperature measurement

Recommended actions:

- Check enclosure / drive fans are still functioning correctly.
- Force the heatsink fans to run at maximum speed.
- Check enclosure ventilation paths.
- Check enclosure door filters.
- Increase ventilation.
- Reduce duty cycle.
- Decrease acceleration / deceleration rates.
- Reduce motor loads.
- Check the derating tables and confirm the drive is correctly sized for the application.
- Use a drive with larger current / power rating.

Trip	OI ac
Value	3
Short description	

This trip indicates that the instantaneous drive output current has exceeded the drive over current threshold.

Source	xx	y	zz
Control system	00	0	00: Instantaneous over-current trip when the measured a.c. current exceeds over current threshold
Power system	Power module number	0	00: Instantaneous over-current trip when the measured a.c. current exceeds over current threshold.

The over current threshold is the maximum current the drive can measure and is defined by VM_DRIVE_CURRENT[MAX].

Recommended actions:

- Acceleration / deceleration rate is too short.
- If seen during auto-tune reduce the voltage boost.
- Check for short circuit on the output cabling.
- Check integrity of the motor insulation using a Megger.
- Check feedback device wiring.
- Check feedback drive mechanical coupling.
- Check feedback signals are free from noise.
- Check motor cable is within limits for the frame size.
- Reduce the speed loop gains (*Speed Controller Proportional Gain Kp1* (03.010), *Speed Controller Integral Gain Ki1* (03.011), *Speed Controller Differential Feedback Gain Kd1* (03.012)).
- Check that the phase angle auto-tune has been completed (RFC-S mode only).
- Reduce the current loop gains (RFC-A and RFC-S modes only).

Trip	OI Brake
Value	4
Short description	

This trip indicates that an over-current has been detected in braking IGBT or braking IGBT protection has been activated. The braking IGBT over-current trip is detected within the power system. If the drive is a single module drive then there is no sub-trip. If the drive is a multi-power module drive the following sub-trip is used to indicate the source of the trip.

Source	xx	y	zz
Power system	Power module number	0	00: Braking IGBT instantaneous over-current trip

Recommended actions:

- Check brake resistor wiring.
- Check braking resistor value is greater than or equal to the minimum resistance value.
- Check braking resistor insulation.

Trip	*OI dc*
Value	109
Short description	

This trip indicates that the short circuit protection for the drive output stage has been activated. The table below shows where the trip has been detected.

Source	xx	y	zz
Control system	00	0	00
Power system	Power module number	0	00

Recommended actions:

- Disconnect the motor cable at the drive end and check the motor and cable insulation with a Megger.
- Replace the drive.

Trip	*OI Snubber*
Value	92
Short description	

This trip indicates that an over-current condition has been detected in the rectifier snubbing circuit, The exact cause of the trip can be identified by the sub-trip number.

Source	xx	y	zz
Power system	01	Rectifier number*	00: Rectifier snubber over-current trip detected.

*For a parallel power-module system the rectifier number will be one as it is not possible to determine which rectifier has detected the fault.

Recommended actions:

- Ensure the internal EMC filter is installed.
- Ensure the motor cable length does not exceed the maximum for selected switching frequency.
- Check for supply voltage imbalance.
- Check for supply disturbance such as notching from a DC drive.
- Check the motor and motor cable insulation with a Megger.
- Fit an output line reactor or sinusoidal filter.

Trip	*Option Disable*
Value	215
Short description	

During drive mode changeover option modules must acknowledge that they have stopped accessing the communications system between the option slots and the drive. If an option module does not do this in the allowed time then this trip is produced.

Recommended actions:

- Reset the trip.
- If the trip persists, replace the option module.

Trip	*Out Phase Loss*
Value	98
Short description	

This trip indicates that phase loss has been detected at the drive output.

Sub-trip	Reason
1	U phase output not connected when drive is enabled*
2	V phase output not connected when drive is enabled*
3	W phase output not connected when drive is enabled*
4	Output phase loss detected when the drive is running
5	U phase lower IGBT failure detection on drive enable
6	V phase lower IGBT failure detection on drive enable
7	W phase lower IGBT failure detection on drive enable

*These sub-trips could also indicate that the upper IGBT has failed in the indicated phase.

Note that if *Reverse Output Phase Sequence* (05.042) = 1 the physical output phases are reversed, and so sub-trip 3 refers to physical output phase V and sub-trip 2 refers to physical output phase W.

Recommended actions:

- Check motor and drive connections.
- To disable the trip set *Output Phase Loss Detection Enable* (06.059) to zero.

Trip	Over Speed
Value	7
Short description	

In open-loop mode, if the *Output Frequency* (05.001) exceeds the threshold set in *Over Speed Threshold* (03.008) in either direction, an *Over Speed* trip is produced. In RFC-A and RFC-S modes, if the *Speed Feedback* (03.002) exceeds the threshold set in *Over Speed Threshold* (03.008) in either direction, an *Over Speed* trip is produced. If *Over Speed Threshold* (03.008) is set to 0.0 the threshold is then equal to 1.2 x the value set in *Maximum Reference Clamp* (01.006).

In RFC-A and RFC-S modes if an SSI encoder is being used and *P1 SSI Incremental Mode* (03.047) is set to Off, an *Over Speed* trip will beproduced when the encoder passes through the boundary between its maximum position and zero.

Recommended actions:

- Reduce the *Speed Controller Proportional Gain Kp1* (03.010) to reduce the speed overshoot (RFC-A and RFC-S modes only).
- If an SSI encoder is being used, set *P1 SSI Incremental Mode* (03.047) to On.

The above description relates to a standard over speed trip, however in RFC-S mode it is possible to produce an Overspeed trip with sub-trip 1. This is caused if the speed is allowed to exceed the safe level in RFC-S mode with flux weakening. See *Enable High Speed Mode* (05.022) for details.

Trip	Over Volts
Value	2
Short description	

This trip indicates that the DC bus voltage has exceeded VM_DC_VOLTAGE[MAX] or VM_DC_VOLTAGE_SET[MAX] for 15s. The trip threshold varies depending on voltage rating of the drive drive as shown below.

Voltage rating	VM_DC_VOLTAGE[MAX]	VM_DC_VOLTAGE_SET[MAX]
200	415	410
400	830	815
575	990	970
690	1190	1175

The exact cause of the trip can be identified by the sub-trip number.

Source	xx	y	zz
Control system	00	0	01: Instantaneous trip when the d.c. link voltage exceeds VM_DC_VOLTAGE[MAX].
Control system	00	0	02: Time delayed trip indicating that the d.c. link voltage is above VM_DC_VOLTAGE_SET[MAX].

Recommended actions:

- Increase deceleration ramp.
- Decrease the braking resistor value (staying above the minimum value).
- Check nominal AC supply level.
- Check for supply disturbances which could cause the DC bus level to rise.
- Check motor insulation using a Megger.

Trip	Phase Loss
Value	32
Short description	

This trip indicates that the drive has detected an input phase loss or large supply imbalance. Phase loss can be detected directly from the supply where the drive has a thyristor base charge system (Frame size 7 and above). If phase loss is detected using this method the drive trips immediately and the xx part of the sub-trip is set to 01. In all sizes of drive phase loss is also detected by monitoring the ripple in the d.c. link voltage in which case the drive attempts to stop the drive before tripping unless bit 2 of *Action On Trip Detection* (10.037) is set to one. When phase loss is detected by monitoring the ripple in the d.c. link voltage the xx part of the sub-trip is zero.

Source	xx	y	zz
Control system	00	0	00: Phase loss detected from d.c. link ripple
Power system (1)	01	Rectifier number (2)	00: Phase loss detected directly from the supply

(1) Input phase loss detection can be disabled when the drive required to operate from the DC supply or from a single phase supply in *Input Phase Loss Detection Mode* (06.047).

(2) For a parallel power-module system the rectifier number will be one as it is not possible to determine which rectifier has detected the fault.

This trip does not occur in regen mode.

Recommended actions:

- Check that the input power supply connections are good and tightened correctly.
- Check the AC supply voltage balance and level at full load.
- Check the DC bus ripple level with an isolated oscilloscope.

- Check the output current stability.
- Reduce the duty cycle.
- Reduce the motor load.
- Disable the phase loss detection by setting *Input Phase Loss Detection Mode* (06.047) to Disabled.

Trip	Phasing Error
Value	198
Short description	

If position feedback is being used this trip indicates that the phase offset angle in *Position Feedback Phase Angle* (03.025) (or *M2 Position Feedback Phase Angle* (21.020) if the second motor map is being used) is incorrect and that the drive is unable to control the motor correctly.

Recommended actions:

- Check the encoder wiring.
- Check the encoder signals for noise with an oscilloscope.
- Check encoder mechanical coupling.
- Perform an auto-tune to measure the encoder phase angle or manually enter the correct phase angle into *Position Feedback Phase Angle* (03.025).
- Spurious Phasing Error trips can sometimes be seen in very dynamic applications. This trip can be disabled by setting *Over Speed Threshold* (03.008) to a value greater than zero.

If sensorless control is being used this indicates that significant instability has occurred and the motor has accelerated without control. For low saliency motors (*Active Saliency Torque Mode* (05.066) < 2) this operates in the same way as when position feedback is used, based on the speed of the motor and the voltages applied. For high saliency motors (*Active Saliency Torque Mode* (05.066) = 2) this type of detection cannot be used and the over-speed trip should be used instead. However this trip is used for high saliency motors when low speed control using current injection is being used (*Active Saliency Torque Mode* (05.066) = 2) and control is lost because the motor has become non-salient. The saliency of most permanent magnet motors reduces with load, and so *Low Speed Sensorless Mode Current* (05.071) must be set to a level to limit the current so that the motor remains salient enough for control.

Recommended actions:

- Ensure that the motor parameters are set-up correctly.
- Reduce the speed controller gains.
- If high seliency control is being used ensure that *Low Speed Sensorless Mode Current* (05.071) is set to a low enough level, so that the motor remains salient at low speeds and higher loads.
- This trip can be disabled by setting *Over Speed Threshold* (03.008) to a value greater than zero.

Trip	Power Comms
Value	90
Short description	

A Power Comms trip indicates a communications problem within the power system of the drive. The reason for the trip can be identified by the sub-trip number.

Type of drive	xx	y	zz
Single power module system	01	Rectifier number*	00: Excessive communications errors detected by the rectifier module.

*For a parallel power-module system the rectifier number will be one as it is not possible to determine which rectifier has detected the fault.

Recommended actions:

- Hardware fault - contact the supplier of the drive.

Trip	Power Data
Value	220
Short description	

This trip can be generated either from the drive control system or from the power system.

This trip is produced if there is an error in the configuration data stored in the power system. If the source of the trip is the control system then the trip related to the table that is uploaded from the power system at power-up.

Source	xx	y	zz
Control system	00	0	02: There is no data table to be uploaded to the control board.
Control system	00	0	03: The power system data table is bigger than the space available in the control pod to store it.
Control system	00	0	04: The size of the table given in the table is incorrect
Control system	00	0	05: Table CRC error.
Control system	00	0	06: The version number of the generator software that produced the table is too low, i.e. a table from a newer generator is required that includes features that have been added to the table that may not be present.
Control system	00	0	07: The power board data table does not match the power board hardware identifier.
Power system	01	0	00: The power data table used internally by the power module has an error. (For a multi-power module drive this indicates any error with the code tables in the power system.)
Power system	01	0	01: The power data table that should be uploaded to the control system on power up has an error.
Power system	01	0	02: The power data table used internally by the power module does not match the hardware identification of the power module.

Recommended actions:

- Hardware fault - contact the supplier of the drive.

Trip	*Power Down Save*
Value	37
Short description	

This trip indicates that an error has been detected in the power down save parameters stored in non-volatile memory.

Recommended actions:

- Perform a 1001 save in Pr *mm.000* to ensure that the trip doesn't occur the next time the drive is powered up.

Trip	*PSU*
Value	5
Short description	

This trip indicates that one or more internal power supply rails are outside limits or overloaded.

Source	xx	Y	zz
Control system	00	0	00: Internal power supply overload.
Power system	Power module number	Rectifier number*	00: Rectifier internal power supply overload.

*For a parallel power-module system the rectifier number will be zero as it is not possible to determine which rectifier has detected the fault.

Recommended actions:

- Remove any option modules and perform a reset.
- Remove encoder connection and perform a reset.
- Hardware fault within the drive - return the drive to the supplier.

Trip	*PSU 24V*
Value	9
Short description	

The total user load of the drive and option modules has exceeded the internal 24V power supply limit. The user load consists of the drive digital outputs and main encoder supply.

Recommended actions:

- Reduce the load and reset.
- Provide an external 24V power supply on control terminal 2.
- Remove all option modules.

Trip	*Rating Mismatch*
Value	223
Short description	

This trip indicates that there is a voltage rating or current rating mismatch in a multi-module drive system. This trip is only applicable to modular drives that are connected in parallel. A mixture of power modules with different voltage or current ratings within the same multi-module drive system is not allowed and will cause a *Rating Mismatch* trip.

Recommended actions:

- Ensure that all modules in a multi-modular drive system are of the same frame size and rating (voltage and current).
- Hardware fault - contact the supplier of the drive.

Trip	Rectifier Set-up
Value	94
Short description	

A rectifier has not been set-up correctly in a multi-power module system.

Recommended actions:

- Check the inter-power module wiring

Trip	Reserved 001
Value	1
Short description	

This trip value is used in Unidrive SP for an under voltage trip. The under voltage condition is now a drive state, and so this trip is no longer used by the drive.

Trip	Reserved 095
Value	95
Short description	

Reserved trip number.

Trip	Reserved 104
Value	104
Short description	

Reserved trip number.

Trip	Reserved 105
Value	105
Short description	

Reserved trip number.

Trip	Reserved 106
Value	106
Short description	

Reserved trip number.

Trip	Reserved 107
Value	107
Short description	

Reserved trip number.

Trip	Reserved 108
Value	108
Short description	

Reserved trip number.

Trip	Reserved 161
Value	161
Short description	

Reserved trip number.

Trip	Reserved 165
Value	165
Short description	

Reserved trip number.

Trip	Reserved 166
Value	166
Short description	

Reserved trip number.

Trip	Reserved 167
Value	167
Short description	

Reserved trip number.

Trip	Reserved 168
Value	168
Short description	

Reserved trip number.

Trip	Reserved 171
Value	171
Short description	

Reserved trip number.

Trip	Reserved 172
Value	172
Short description	

Reserved trip number.

Trip	Reserved 173
Value	173
Short description	

Reserved trip number.

Trip	Reserved 222
Value	222
Short description	

If this trip occurs please consult the drive supplier.

Trip	Reserved 228
Value	228
Short description	

If this trip occurs please consult the drive supplier.

Trip	Reserved 229
Value	229
Short description	

Reserved trip number.

Trip	Reserved 230
Value	230
Short description	

Reserved trip number.

Trip	Reserved 231
Value	231
Short description	

Reserved trip number.

Trip	Reserved 232
Value	232
Short description	

Reserved trip number.

Trip	Reserved 233
Value	233
Short description	

Reserved trip number.

Trip	Reserved 234
Value	234
Short description	

Reserved trip number.

Trip	Reserved 235
Value	235
Short description	

Reserved trip number.

Trip	Reserved 236
Value	236
Short description	

Reserved trip number.

Trip	*Reserved 237*
Value	237
Short description	

Reserved trip number.

Trip	*Reserved 238*
Value	238
Short description	

Reserved trip number.

Trip	*Reserved 239*
Value	239
Short description	

Reserved trip number.

Trip	*Reserved 240*
Value	240
Short description	

Reserved trip number.

Trip	*Reserved 241*
Value	241
Short description	

Reserved trip number.

Trip	*Reserved 242*
Value	242
Short description	

Reserved trip number.

Trip	*Reserved 243*
Value	243
Short description	

Reserved trip number.

Trip	*Reserved 244*
Value	244
Short description	

Reserved trip number.

Trip	*Reserved 245*
Value	245
Short description	

Reserved trip number.

Trip	*Reserved 246*
Value	246
Short description	

Reserved trip number.

Trip	*Reset*
Value	100
Short description	

This is not a valid trip number as this value is used in *User Trip* (10.038) to reset the drive.

Trip	*Reset Logs*
Value	255
Short description	

This is not a valid trip number as this value is used in *User Trip* (10.038) to reset the trip logs.

Trip	*Resistance*
Value	33
Short description	

This trip indicates that either the value being used for motor stator resistance is too high or that an attempt to do a test involving measuring motor stator resistance has failed. The maximum for the stator resistance parameters is generally higher than the maximum value that can be used in the control algorithms. If the value exceeds (V_{FS} / v2) / *Full Scale Current Kc* (11.061), where V_{FS} is the full scale d.c. link voltage then this trip is initiated. If the value is the result of a

measurement made by the drive then sub-trip 1 is applied, or if it is because the parameter has been changed by the user then sub-trip 3 is applied. During the stator resistance section of auto-tuning an additional test is performed to measured the drive inverter characteristics to provide the compensation necessary for dead-times. If the inverter characteristic measurement fails then sub-trip 2 is applied.

Sub-trip	Reason
1	Measured stator resistance exceeded the allowed range
2	It was not possible to measure the inverter characteristic
3	The stator resistance associated with the presently selected motor map exceeds the allowed range

Recommended actions:

- Check that a value has not been entered in the stator resistance for the presently selected motor map does not exceed the alloed range.
- Check the motor cable / connections.
- Check the integrity of the motor stator winding using an insulation tester.
- Check the motor phase to phase resistance at the drive terminals.
- Check the motor phase to phase resistance at the motor terminals.
- Ensure the stator resistance of the motor falls within the range of the drive model.
- Select fixed boost mode (*Open-loop Control Mode* (05.014) = Fixed) and verify the output current waveforms with an oscilloscope.
- Replace the motor.

Trip	*Slot1 Different*
Value	204
Short description	

If the option module fitted in option slot 1 is different to the option module present at the last power-down then this trip is produced. The sub-trip number gives the identification code of the module that was originally fitted. The priority order for the option module different trips is *Slot1 Different* highest, then *Slot2 Different*, then *Slot3 Different* then *Slot4 Different*. Drive user parameters must be saved to prevent this trip on the next power-up if the module has changed. If the menus have been changed, but not the module, the trip will not occur on the next power-up. The sub-trip number gives the following indications of the reason for the trip.

Sub-trip	Reason
1	No module was fitted previously
2	A module with the same identifier is fitted, but the set-up menu for this option slot has been changed, and so default parameters have been loaded for this menu.
3	A module with the same identifier is fitted, but the applications menu for this option slot has been changed, and so default parameters have been loaded for this menu.
4	A module with the same identifier is fitted, but the set-up and applications menu for this option slot have been changed, and so default parameters have been loaded for these menus.
>99	Shows the identifier of the module previously fitted.

Recommended actions:

- Turn off the power, ensure the correct option modules are installed in the correct option slots and re-apply the power.
- Confirm that the currently installed option module is correct, ensure option module parameters are set correctly and perform a user save in Pr *mm.000*.

Trip	*Slot1 Error*
Value	202
Short description	

The option module in option slot 1 has indicated an error. The option module can give the reason for the error and this is shown in the sub-trip number. As default the sub-trip number is shown as a number on the display, however, it is possible for the option module to supply sub-trip number strings which will be displayed instead of the number if available.

Recommended actions:

- See relevant *Option Module User Guide* for details of the trip.

Trip	*Slot1 HF*
Value	200
Short description	

This trip indicates that there is a fault with the option module in option slot 1 that means that this module cannot operate. The possible causes of the trip are given by the sub-trip value.

Sub-trip	Reason
1	The module category cannot be identified
2	All the required customisable menu table information has not been supplied or the tables supplied are corrupt
3	There is insufficient memory available to allocate the comms buffers for this module.
4	The module has not indicated that it is running correctly during drive power-up
5	The module has been removed after power-up or it has ceased to indicate to the drive processor that it is still active.
6	The module has not indicated that it has stopped accessing drive parameters during a drive mode change
7	The module has failed to acknowledge that a request has been made to reset the drive processor.
8	The drive failed to read correctly the menu table from the module during drive power-up.
9	The drive failed to upload menu tables from the module and timed-out (5s).
10	Menu table CRC invalid.

Recommended actions:

- Ensure the option module is installed correctly.
- Replace the option module.
- Replace the drive.

Trip	*Slot1 Not Fitted*
Value	203
Short description	

Each option module fitted in the drive is identified at power-up and the option fitted is stored by the drive in its non-volatile memory. If an option module was fitted in slot 1 at power-down, but that option module has subsequently been removed before power up then this trip is produced. The sub-trip number gives the identification code of the option module that has been removed. The priority order for the option module not fitted trips is *Slot1 Not Fitted* highest, then *Slot2 Not Fitted*, then *Slot3 Not Fitted* then *Slot4 Not Fitted*. Drive user parameters must be saved to prevent this trip on the next power-up.

Recommended actions:

- Ensure the option module is installed correctly.
- Re-install the option module.
- To confirm that the removed option module is no longer required perform a save function in Pr *mm.000.*

Trip	*Slot1 Watchdog*
Value	201
Short description	

This trip indicates that the option module in option slot 1 has started the option watchdog function and then failed to service this watchdog correctly.

Recommended actions:

- Replace the option module.

Trip	*Slot2 Different*
Value	209
Short description	

If the option module fitted in option slot 2 is different to the option module present at the last power-down then this trip is produced. The sub-trip number gives the identification code of the module that was originally fitted. The priority order for the option module different trips is *Slot1 Different* highest, then *Slot2 Different*, then *Slot3 Different* then *Slot4 Different*. Drive user parameters must be saved to prevent this trip on the next power-up if the module has changed. If the menus have been changed, but not the module, the trip will not occur on the next power-up. The sub-trip number gives the following indications of the reason for the trip.

Sub-trip	Reason
1	No module was fitted previously
2	A module with the same identifier is fitted, but the set-up menu for this option slot has been changed, and so default parameters have been loaded for this menu.
3	A module with the same identifier is fitted, but the applications menu for this option slot has been changed, and so default parameters have been loaded for this menu.
4	A module with the same identifier is fitted, but the set-up and applications menu for this option slot have been changed, and so default parameters have been loaded for these menus.
>99	Shows the identifier of the module previously fitted.

Recommended actions:

- Turn off the power, ensure the correct option modules are installed in the correct option slots and re-apply the power.
- Confirm that the currently installed option module is correct, ensure option module parameters are set correctly and perform a user save in Pr *mm.000*.

Trip	Slot2 Error
Value	207
Short description	

The option module in option slot 2 has indicated an error. The option module can give the reason for the error and this is shown in the sub-trip number. As default the sub-trip number is shown as a number on the display, however, it is possible for the option module to supply sub-trip number strings which will be displayed instead of the number if available.

Recommended actions:

- See relevant *Option Module User Guide* for details of the trip.

Trip	Slot2 HF
Value	205
Short description	

This trip indicates that there is a fault with the option module in option slot 2 that means that this module cannot operate. The possible causes of the trip are given by the sub-trip value.

Sub-trip	Reason
1	The module category cannot be identified
2	All the required customisable menu table information has not been supplied or the tables supplied are corrupt
3	There is insufficient memory available to allocate the comms buffers for this module.
4	The module has not indicated that it is running correctly during drive power-up
5	The module has been removed after power-up or it has ceased to indicate to the drive processor that it is still active.
6	The module has not indicated that it has stopped accessing drive parameters during a drive mode change
7	The module has failed to acknowledge that a request has been made to reset the drive processor.
8	The drive failed to read correctly the menu table from the module during drive power-up.
9	The drive failed to upload menu tables from the module and timed-out (5s).
10	Menu table CRC invalid.

Recommended actions:

- Ensure the option module is installed correctly.
- Replace the option module.
- Replace the drive.

Trip	Slot2 Not Fitted
Value	208
Short description	

Each option module fitted in the drive is identified at power-up and the option fitted is stored by the drive in its non-volatile memory. If an option module was fitted in slot 2 at power-down, but that option module has subsequently been removed before power up then this trip is produced. The sub-trip number gives the identification code of the option module that has been removed. The priority order for the option module not fitted trips is *Slot1 Not Fitted* highest, then *Slot2 Not Fitted*, then *Slot3 Not Fitted* then *Slot4 Not Fitted*. Drive user parameters must be saved to prevent this trip on the next power-up.

Recommended actions:

- Ensure the option module is installed correctly.
- Re-install the option module.
- To confirm that the removed option module is no longer required perform a save function in Pr *mm.000.*

Trip	Slot2 Watchdog
Value	206
Short description	

This trip indicates that the option module in option slot 2 has started the option watchdog function and then failed to service this watchdog correctly.

Recommended actions:

- Replace the option module.

Trip	Slot3 Different
Value	214
Short description	

If the option module fitted in option slot 3 is different to the option module present at the last power-down then this trip is produced. The sub-trip number gives the identification code of the module that was originally fitted. The priority order for the option module different trips is *Slot1 Different* highest, then *Slot2 Different*, then *Slot3 Different* then *Slot4 Different*. Drive user parameters must be saved to prevent this trip on the next power-up if the module has changed. If the menus have been changed, but not the module, the trip will not occur on the next power-up. The sub-trip number gives the following indications of the reason for the trip.

Sub-trip	Reason
1	No module was fitted previously
2	A module with the same identifier is fitted, but the set-up menu for this option slot has been changed, and so default parameters have been loaded for this menu.
3	A module with the same identifier is fitted, but the applications menu for this option slot has been changed, and so default parameters have been loaded for this menu.
4	A module with the same identifier is fitted, but the set-up and applications menu for this option slot have been changed, and so default parameters have been loaded for these menus.
>99	Shows the identifier of the module previously fitted.

Recommended actions:

- Turn off the power, ensure the correct option modules are installed in the correct option slots and re-apply the power.
- Confirm that the currently installed option module is correct, ensure option module parameters are set correctly and perform a user save in Pr *mm.000.*

Trip	Slot3 Error
Value	212
Short description	

The option module in option slot 3 has indicated an error. The option module can give the reason for the error and this is shown in the sub-trip number. As default the sub-trip number is shown as a number on the display, however, it is possible for the option module to supply sub-trip number strings which will be displayed instead of the number if available.

Recommended actions:

- See relevant *Option Module User Guide* for details of the trip.

Trip	Slot3 HF
Value	210
Short description	

This trip indicates that there is a fault with the option module in option slot 3 that means that this module cannot operate. The possible causes of the trip are given by the sub-trip value.

Sub-trip	Reason
1	The module category cannot be identified
2	All the required customisable menu table information has not been supplied or the tables supplied are corrupt
3	There is insufficient memory available to allocate the comms buffers for this module.
4	The module has not indicated that it is running correctly during drive power-up
5	The module has been removed after power-up or it has ceased to indicate to the drive processor that it is still active.
6	The module has not indicated that it has stopped accessing drive parameters during a drive mode change
7	The module has failed to acknowledge that a request has been made to reset the drive processor.
8	The drive failed to read correctly the menu table from the module during drive power-up.
9	The drive failed to upload menu tables from the module and timed-out (5s).
10	Menu table CRC invalid.

Recommended actions:

- Ensure the option module is installed correctly.
- Replace the option module.
- Replace the drive.

Trip	Slot3 Not Fitted
Value	213
Short description	

Each option module fitted in the drive is identified at power-up and the option fitted is stored by the drive in its non-volatile memory. If an option module was fitted in slot 3 at power-down, but that option module has subsequently been removed before power up then this trip is produced. The sub-trip number gives the identification code of the option module that has been removed. The priority order for the option module not fitted trips is *Slot1 Not Fitted* highest, then *Slot2 Not Fitted*, then *Slot3 Not Fitted* then *Slot4 Not Fitted*. Drive user parameters must be saved to prevent this trip on the next power-up.

Recommended actions:

- Ensure the option module is installed correctly.
- Re-install the option module.
- To confirm that the removed option module is no longer required perform a save function in Pr *mm.000.*

Trip	Slot3 Watchdog
Value	211
Short description	

This trip indicates that the option module in option slot 3 has started the option watchdog function and then failed to service this watchdog correctly.

Recommended actions:

- Replace the option module.

Trip	Slot4 Different
Value	254
Short description	

If the option module fitted in option slot 4 is different to the option module present at the last power-down then this trip is produced. The sub-trip number gives the identification code of the module that was originally fitted. The priority order for the option module different trips is *Slot1 Different* highest, then *Slot2 Different*, then *Slot3 Different* then *Slot4 Different*. Drive user parameters must be saved to prevent this trip on the next power-up if the module has changed. If the menus have been changed, but not the module, the trip will not occur on the next power-up. The sub-trip number gives the following indications of the reason for the trip.

Sub-trip	Reason
1	No module was fitted previously
2	A module with the same identifier is fitted, but the set-up menu for this option slot has been changed, and so default parameters have been loaded for this menu.
3	A module with the same identifier is fitted, but the applications menu for this option slot has been changed, and so default parameters have been loaded for this menu.
4	A module with the same identifier is fitted, but the set-up and applications menu for this option slot have been changed, and so default parameters have been loaded for these menus.
>99	Shows the identifier of the module previously fitted.

Recommended actions:

- Turn off the power, ensure the correct option modules are installed in the correct option slots and re-apply the power.
- Confirm that the currently installed option module is correct, ensure option module parameters are set correctly and perform a user save in Pr *mm.000*.

Trip	*Slot4 Error*
Value	252
Short description	

The option module in option slot 4 has indicated an error. The option module can give the reason for the error and this is shown in the sub-trip number. As default the sub-trip number is shown as a number on the display, however, it is possible for the option module to supply sub-trip number strings which will be displayed instead of the number if available.

Recommended actions:

- See relevant *Option Module User Guide* for details of the trip.

Trip	*Slot4 HF*
Value	250
Short description	

This trip indicates that there is a fault with the option module in option slot 4 that means that this module cannot operate. The possible causes of the trip are given by the sub-trip value.

Sub-trip	Reason
1	The module category cannot be identified
2	All the required customisable menu table information has not been supplied or the tables supplied are corrupt
3	There is insufficient memory available to allocate the comms buffers for this module.
4	The module has not indicated that it is running correctly during drive power-up
5	The module has been removed after power-up or it has ceased to indicate to the drive processor that it is still active.
6	The module has not indicated that it has stopped accessing drive parameters during a drive mode change
7	The module has failed to acknowledge that a request has been made to reset the drive processor.
8	The drive failed to read correctly the menu table from the module during drive power-up.
9	The drive failed to upload menu tables from the module and timed-out (5s).
10	Menu table CRC invalid.

Recommended actions:

- Ensure the option module is installed correctly.
- Replace the option module.
- Replace the drive.

Trip	Slot4 Not Fitted
Value	253
Short description	

Each option module fitted in the drive is identified at power-up and the option fitted is stored by the drive in its non-volatile memory. If an option module was fitted in slot 4 at power-down, but that option module has subsequently been removed before power up then this trip is produced. The sub-trip number gives the identification code of the option module that has been removed. The priority order for the option module not fitted trips is *Slot1 Not Fitted* highest, then *Slot2 Not Fitted*, then *Slot3 Not Fitted* then *Slot4 Not Fitted*. Drive user parameters must be saved to prevent this trip on the next power-up.

Recommended actions:

- Ensure the option module is installed correctly.
- Re-install the option module.
- To confirm that the removed option module is no longer required perform a save function in Pr *mm.000.*

Trip	Slot4 Watchdog
Value	251
Short description	

This trip indicates that the option module in option slot 4 has started the option watchdog function and then failed to service this watchdog correctly.

Recommended actions:

- Replace the option module.

Trip	Slot App Menu
Value	216
Short description	

This trip indicates that more than one option slot has requested to customize application menus 18, 19 and 20. The sub-trip number indicates which option slot has been allowed to customize the menus.

Recommended actions:

- Ensure that only one of the Application modules is configured to customize the application menus 18, 19 and 20.

Trip	Soft Start
Value	226
Short description	

This trip indicates that the soft start relay in the drive has failed to close or the soft start monitoring circuit has failed.

Recommended actions:

- Hardware fault - contact the supplier of the drive.

Trip	Stored HF
Value	221
Short description	

If an HF01 to HF19 trip occurs then a *Stored HF* trip occurs each time the drive is powered up until this trip is reset. The sub-trip code is the number of the original HF trip. The *Stored HF* trip can only be reset by first writing 1299 to Pr *mm.000* and resetting the drive.

Recommended actions:

- Enter 1299 into Pr *mm.000* and press reset to clear the trip.

Trip	Sub-array RAM
Value	227
Short description	

An option module, derivative image or user program image has requested more parameter RAM than is allowed. The RAM allocation is checked in order of resulting sub-trip numbers, and so the failure with the highest sub-trip number is given. The sub-trip is calculated as (parameter size x 1000) + (parameter type x 100) + sub-array number. Note that if this trip occurs, all menu customisation provided by option modules, the derivative image or the user program image is not used. The tables below show the values corresponding to the parts of the sub-trip number.

Parameter size	Value
1 bit	1
8 bit	2
16 bit	3
32 bit	4
64 bit	5

Parameter type	Value
Volatile	0
User save	1
Power-down save	2

Sub-array	Menus	Value
Applications menus	18-20	1
Derivative image	29	2
User program image	30	3
Option slot 1 set-up	15	4
Option slot 1 applications	25	5
Option slot 2 set-up	16	6
Option slot 2 applications	26	7
Option slot 3 set-up	17	8
Option slot 3 applications	27	9
Option slot 4 set-up	24	10
Option slot 4 applications	28	11

Trip	*Temp Feedback*
Value	218
Short description	

This trip indicates a fault with a thermistor in the drive (i.e. open circuit or short circuit).

Source	xx	y	zz
Control board	00	00	01: Control board thermistor 1 02: Control board thermistor 2 03: I/O board thermistor:
Power system	Power module number	0	Zero for temperature feedback provided via power system comms. 21, 22 and 23 for direct ELV temperature feedback.
Power system	01	Rectifier number*	Always zero

*For a parallel power-module system the rectifier number will be one as it is not possible to determine which rectifier has detected the fault.

Recommended actions:

- Hardware fault - contact the supplier of the drive.

Trip	*Th Brake Res*
Value	10
Short description	

If hardware based braking resistor thermal monitoring is provided and the resistor overheats this trip is initiated. If the braking resistor is not present then this trip must be disabled with bit 3 of *Action On Trip Detection* (10.037) to prevent this trip.

Recommended actions:

- Check braking resistor wiring.
- Check braking resistor value is greater than or equal to the minimum resistance value.
- Check braking resistor insulation.

Trip	*Th Short Circuit*
Value	25
Short description	

This trip indicates that a temperature sensor connected to an analogue input or terminal 15 on the position feedback interface has a low impedance (i.e. < 50 Ohms). The cause of the trip can be identified by the sub-trip number.

Sub-trip	Source
1	Analogue input 1
2	Analogue input 2
3	Analogue input 3
4	Position feedback interface

Recommended actions:

- Check temperature feedback connection.
- Replace sensor.

Trip	*Thermistor*
Value	24
Short description	

This trip indicates that a temperature sensor connected to one of the analogue inputs or terminal 15 on the position feedback interface (15 way D-type connector) has indicated an over-temperature. The source of the trip can be identified by the sub-trip number.

Sub-trip	Source
1	Analogue input 1
2	Analogue input 2
3	Analogue input 3
4	Position feedback interface

Recommended actions:

- Check why the temperature measured by the sensor is too high temperature.
- Check temperature sensor connection.

Trip	Undefined
Value	110
Short description	

This trip indicates that the power system has generated but did not identify the trip from the power system. The cause of the trip is unknown.

Recommended actions:

- Hardware fault - contact the supplier of the drive.

Trip	User 24V
Value	91
Short description	

This trip is initiatied if *User Supply Select* (06.072) = 1 or *Low Under Voltage Threshold Select* (06.067) = 1 or *Backup Supply Mode Enable* (06.068) = 1 and no user 24V present on the user 24V input.

Recommended actions:

- Ensure that the user 24V supply is present on the control terminals.

Trip	User Prog Trip
Value	96
Short description	

This trip can be initiated from within an onboard user program using a function call which defines the sub-trip number.

Recommended actions:

- Check the user program.

Trip	User Program
Value	249
Short description	

An error has been detected in the onboard user program image. The sub-trip indicated the reason for the trip.

Sub-trip	Reason	Comments
1	Divide by zero	
2	Undefined trip	
3	Attempted fast parameter access set-up with non-existent parameter	
4	Attempted access to non-existent parameter	
5	Attempted write to read-only parameter	
6	Attempted an over-range write	
7	Attempted read from write-only parameter	
30	The image has failed because either its CRC is incorrect, or there are less than 6 bytes in the image or the image header version is less than 5.	Occurs when the drive powers-up or the image is programmed. The image tasks will not run.
31	The image requires more RAM for heap and stack than can be provided by the drive.	As 30.
32	The image requires an OS function call that is higher than the maximum allowed.	As 30.
33	The ID code within the image is not valid	As 30.
40	The timed task has not completed in time and has been suspended.	*Onboard User Program: Enable (11.047)* is reset to zero when the trip is initiated.
41	Undefined function called, i.e. a function in the host system vector table that has not been assigned.	As 40.
52	Customisable menu table CRC check failed	As 30.
53	Customisable menu table changed	Occurs when the drive powers-up or the image is programmed and the table has changed. Defaults are loaded for the user program menu and the trip will keep occurring until drive parameters are saved.
80	*Image is not compatible with the control board	Initiated from within the image code.
81	*Image is not compatible with the control board serial number	As 80.
100	Image has detected and prevented attempted pointer access outside of the IEC task's heap area.	
101	Image has detected and prevented misaligned pointer usage.	

102	Image has detected an array bounds violation and prevented its access.
103	Image has attempted to convert a data type to or from an unknown data type, has failed and has shut itself down.
104	Image has attempted to use an unknown user service function.
200	User program has invoked a "divide" service with a denominator of zero. (Note that this is raised by the downloaded image and has therefore been given a distinct error code despite being the same fundamental problem as sub-trip 1.)
201	Parameter access is not supported. An attempt to read database other than the host drive.
202	Parameter does not exist. Database was host drive but the specified parameter does not exist.
203	Parameter is read-only.
204	Parameter is write-only.
205	Unknown parameter error.
206	Invalid bit present in parameter. The parameter does not contain the specified bit.
207	Parameter format lookup failed. Failed to get parameter information data.
208	An over-range write has been attempted.

The following table gives the differences when compared to the derivative product image.

Sub-trip	Difference
40, 41	*Onboard User Program: Enable (11.047)* is reset to zero when the trip is initiated.
51	Not applicable as core menu customisation not allowed
6x	Not applicable as option module restrictions not allowed
7x	Not applicable as option module restrictions not allowed
100	Image has detected and prevented attempted pointer access outside of the IEC task's heap area.
101	Image has detected and prevented misaligned pointer usage.
102	Image has detected an array bounds violation and prevented its access.
103	Image has attempted to convert a data type to or from an unknown data type, has failed and has shut itself down.
104	Image has attempted to use an unknown user service function.
200	User program has invoked a "divide" service with a denominator of zero. (Note that this is raised by the downloaded image and has therefore been given a distinct error code despite being the same fundamental problem as sub-trip 1.)

Trip	*User Save*
Value	36
Short description	

This trip indicates that an error has been detected in the user save parameters saved in non-volatile memory. For example, fillowing a user save command, if the power to the drive was removed when the user parameters were being saved.

Recommended actions:

- Perform a user save in Pr *mm.000* to ensure that the trip doesn't occur the next time the drive is powered up.
- Ensure that the drive has enough time to complete the save before removing the power to the drive.

Trip	*User Trip 40*
Value	40
Short description	

This trip is not used by the drive and can be used for a user trip.

Trip	*User Trip 41*
Value	41
Short description	

This trip is not used by the drive and can be used for a user trip.

Trip	*User Trip 42*
Value	42
Short description	

This trip is not used by the drive and can be used for a user trip.

Trip	*User Trip 43*
Value	43
Short description	

This trip is not used by the drive and can be used for a user trip.

Trip	*User Trip 44*
Value	44
Short description	

This trip is not used by the drive and can be used for a user trip.

Trip	*User Trip 45*
Value	45
Short description	

This trip is not used by the drive and can be used for a user trip.

Trip	*User Trip 46*
Value	46
Short description	

This trip is not used by the drive and can be used for a user trip.

Trip	*User Trip 47*
Value	47
Short description	

This trip is not used by the drive and can be used for a user trip.

Trip	*User Trip 48*
Value	48
Short description	

This trip is not used by the drive and can be used for a user trip.

Trip	*User Trip 49*
Value	49
Short description	

This trip is not used by the drive and can be used for a user trip.

Trip	*User Trip 50*
Value	50
Short description	

This trip is not used by the drive and can be used for a user trip.

Trip	*User Trip 51*
Value	51
Short description	

This trip is not used by the drive and can be used for a user trip.

Trip	*User Trip 52*
Value	52
Short description	

This trip is not used by the drive and can be used for a user trip.

Trip	User Trip 53
Value	53
Short description	

This trip is not used by the drive and can be used for a user trip.

Trip	User Trip 54
Value	54
Short description	

This trip is not used by the drive and can be used for a user trip.

Trip	User Trip 55
Value	55
Short description	

This trip is not used by the drive and can be used for a user trip.

Trip	User Trip 56
Value	56
Short description	

This trip is not used by the drive and can be used for a user trip.

Trip	User Trip 57
Value	57
Short description	

This trip is not used by the drive and can be used for a user trip.

Trip	User Trip 58
Value	58
Short description	

This trip is not used by the drive and can be used for a user trip.

Trip	User Trip 59
Value	59
Short description	

This trip is not used by the drive and can be used for a user trip.

Trip	User Trip 60
Value	60
Short description	

This trip is not used by the drive and can be used for a user trip.

Trip	User Trip 61
Value	61
Short description	

This trip is not used by the drive and can be used for a user trip.

Trip	User Trip 62
Value	62
Short description	

This trip is not used by the drive and can be used for a user trip.

Trip	User Trip 63
Value	63
Short description	

This trip is not used by the drive and can be used for a user trip.

Trip	User Trip 64
Value	64
Short description	

This trip is not used by the drive and can be used for a user trip.

Trip	User Trip 65
Value	65
Short description	

This trip is not used by the drive and can be used for a user trip.

Trip	*User Trip 66*
Value	66
Short description	

This trip is not used by the drive and can be used for a user trip.

Trip	*User Trip 67*
Value	67
Short description	

This trip is not used by the drive and can be used for a user trip.

Trip	*User Trip 68*
Value	68
Short description	

This trip is not used by the drive and can be used for a user trip.

Trip	*User Trip 69*
Value	69
Short description	

This trip is not used by the drive and can be used for a user trip.

Trip	*User Trip 70*
Value	70
Short description	

This trip is not used by the drive and can be used for a user trip.

Trip	*User Trip 71*
Value	71
Short description	

This trip is not used by the drive and can be used for a user trip.

Trip	*User Trip 72*
Value	72
Short description	

This trip is not used by the drive and can be used for a user trip.

Trip	*User Trip 73*
Value	73
Short description	

This trip is not used by the drive and can be used for a user trip.

Trip	*User Trip 74*
Value	74
Short description	

This trip is not used by the drive and can be used for a user trip.

Trip	*User Trip 75*
Value	75
Short description	

This trip is not used by the drive and can be used for a user trip.

Trip	*User Trip 76*
Value	76
Short description	

This trip is not used by the drive and can be used for a user trip.

Trip	*User Trip 77*
Value	77
Short description	

This trip is not used by the drive and can be used for a user trip.

Trip	*User Trip 78*
Value	78
Short description	

This trip is not used by the drive and can be used for a user trip.

Trip	User Trip 79
Value	79
Short description	

This trip is not used by the drive and can be used for a user trip.

Trip	User Trip 80
Value	80
Short description	

This trip is not used by the drive and can be used for a user trip.

Trip	User Trip 81
Value	81
Short description	

This trip is not used by the drive and can be used for a user trip.

Trip	User Trip 82
Value	82
Short description	

This trip is not used by the drive and can be used for a user trip.

Trip	User Trip 83
Value	83
Short description	

This trip is not used by the drive and can be used for a user trip.

Trip	User Trip 84
Value	84
Short description	

This trip is not used by the drive and can be used for a user trip.

Trip	User Trip 85
Value	85
Short description	

This trip is not used by the drive and can be used for a user trip.

Trip	User Trip 86
Value	86
Short description	

This trip is not used by the drive and can be used for a user trip.

Trip	User Trip 87
Value	87
Short description	

This trip is not used by the drive and can be used for a user trip.

Trip	User Trip 88
Value	88
Short description	

This trip is not used by the drive and can be used for a user trip.

Trip	User Trip 89
Value	89
Short description	

This trip is not used by the drive and can be used for a user trip.

Trip	User Trip 112
Value	112
Short description	

This trip is not used by the drive and can be used for a user trip.

Trip	User Trip 113
Value	113
Short description	

This trip is not used by the drive and can be used for a user trip.

Trip	*User Trip 114*
Value	114
Short description	

This trip is not used by the drive and can be used for a user trip.

Trip	*User Trip 115*
Value	115
Short description	

This trip is not used by the drive and can be used for a user trip.

Trip	*User Trip 116*
Value	116
Short description	

This trip is not used by the drive and can be used for a user trip.

Trip	*User Trip 117*
Value	117
Short description	

This trip is not used by the drive and can be used for a user trip.

Trip	*User Trip 118*
Value	118
Short description	

This trip is not used by the drive and can be used for a user trip.

Trip	*User Trip 119*
Value	119
Short description	

This trip is not used by the drive and can be used for a user trip.

Trip	*User Trip 120*
Value	120
Short description	

This trip is not used by the drive and can be used for a user trip.

Trip	*User Trip 121*
Value	121
Short description	

This trip is not used by the drive and can be used for a user trip.

Trip	*User Trip 122*
Value	122
Short description	

This trip is not used by the drive and can be used for a user trip.

Trip	*User Trip 123*
Value	123
Short description	

This trip is not used by the drive and can be used for a user trip.

Trip	*User Trip 124*
Value	124
Short description	

This trip is not used by the drive and can be used for a user trip.

Trip	*User Trip 125*
Value	125
Short description	

This trip is not used by the drive and can be used for a user trip.

Trip	*User Trip 126*
Value	126
Short description	

This trip is not used by the drive and can be used for a user trip.

Trip	User Trip 127
Value	127
Short description	

This trip is not used by the drive and can be used for a user trip.

Trip	User Trip 128
Value	128
Short description	

This trip is not used by the drive and can be used for a user trip.

Trip	User Trip 129
Value	129
Short description	

This trip is not used by the drive and can be used for a user trip.

Trip	User Trip 130
Value	130
Short description	

This trip is not used by the drive and can be used for a user trip.

Trip	User Trip 131
Value	131
Short description	

This trip is not used by the drive and can be used for a user trip.

Trip	User Trip 132
Value	132
Short description	

This trip is not used by the drive and can be used for a user trip.

Trip	User Trip 133
Value	133
Short description	

This trip is not used by the drive and can be used for a user trip.

Trip	User Trip 134
Value	134
Short description	

This trip is not used by the drive and can be used for a user trip.

Trip	User Trip 135
Value	135
Short description	

This trip is not used by the drive and can be used for a user trip.

Trip	User Trip 136
Value	136
Short description	

This trip is not used by the drive and can be used for a user trip.

Trip	User Trip 137
Value	137
Short description	

This trip is not used by the drive and can be used for a user trip.

Trip	User Trip 138
Value	138
Short description	

This trip is not used by the drive and can be used for a user trip.

Trip	User Trip 139
Value	139
Short description	

This trip is not used by the drive and can be used for a user trip.

Trip	User Trip 140
Value	140
Short description	

This trip is not used by the drive and can be used for a user trip.

Trip	User Trip 141
Value	141
Short description	

This trip is not used by the drive and can be used for a user trip.

Trip	User Trip 142
Value	142
Short description	

This trip is not used by the drive and can be used for a user trip.

Trip	User Trip 143
Value	143
Short description	

This trip is not used by the drive and can be used for a user trip.

Trip	User Trip 144
Value	144
Short description	

This trip is not used by the drive and can be used for a user trip.

Trip	User Trip 145
Value	145
Short description	

This trip is not used by the drive and can be used for a user trip.

Trip	User Trip 146
Value	146
Short description	

This trip is not used by the drive and can be used for a user trip.

Trip	User Trip 147
Value	147
Short description	

This trip is not used by the drive and can be used for a user trip.

Trip	User Trip 148
Value	148
Short description	

This trip is not used by the drive and can be used for a user trip.

Trip	User Trip 149
Value	149
Short description	

This trip is not used by the drive and can be used for a user trip.

Trip	User Trip 150
Value	150
Short description	

This trip is not used by the drive and can be used for a user trip.

Trip	User Trip 151
Value	151
Short description	

This trip is not used by the drive and can be used for a user trip.

Trip	User Trip 152
Value	152
Short description	

This trip is not used by the drive and can be used for a user trip.

Trip	*User Trip 153*
Value	153
Short description	

This trip is not used by the drive and can be used for a user trip.

Trip	*User Trip 154*
Value	154
Short description	

This trip is not used by the drive and can be used for a user trip.

Trip	*User Trip 155*
Value	155
Short description	

This trip is not used by the drive and can be used for a user trip.

Trip	*User Trip 156*
Value	156
Short description	

This trip is not used by the drive and can be used for a user trip.

Trip	*User Trip 157*
Value	157
Short description	

This trip is not used by the drive and can be used for a user trip.

Trip	*User Trip 158*
Value	158
Short description	

This trip is not used by the drive and can be used for a user trip.

Trip	*User Trip 159*
Value	159
Short description	

This trip is not used by the drive and can be used for a user trip.

Trip	*Voltage Range*
Value	169
Short description	

This trip is initiated if the *Regen Minimum Voltage* (03.026) is set to a non-zero value and the supply voltage is outside the range defined by *Regen Maximum Voltage* (03.027) for more than 100ms.

Recommended actions:

- Ensure the supply voltage is operating within the drive specification.
- Ensure *Regen Minimum Voltage* (03.026) and *Regen Maximum Voltage* (03.027) are set correctly.
- Check the supply voltage waveform using an oscilloscope.
- Reduce the level of supply disturbance.
- Set *Regen Maximum Voltage* (03.027) to zero to disable this trip.

Trip	*Watchdog*
Value	30
Short description	

This trip indicates that the control word watchdog has been enabled and has timed out.