

Leakage current compensation in networks with single phase  
servo-drives and frequency inverters

## Instruction manual

Fix value  
compensation  
of operational  
leakage currents  
up to 50 mA (RMS)!

Increases the  
operational safety  
of the system

Use of a single-  
phase inverters  
on the residual  
current circuit  
breaker with  
30 mA or higher  
according to  
DIN VDE 0100-530  
possible



German  
Engineering &  
Design

**EPA**   
[www.epa.de](http://www.epa.de)



Thank you for choosing the **LEAKCOMP® 1P** leakage current compensation unit from EPA.

If you have any technical questions, please give us a call:

Phone: +49 (0)6181 – 9704 – 0

For the latest information on this product, visit [www.leakcomp.de](http://www.leakcomp.de) and [www.epa.de](http://www.epa.de).

## Contents

<b>1</b>	<b>Important basic information .....</b>	<b>4</b>
1.1	Publication details .....	4
1.2	Target group.....	5
1.3	Liability .....	5
1.4	General equal treatment.....	5
1.5	Registered trademarks .....	5
1.6	Symbols and signal words.....	6
1.7	Marking on the product.....	7
1.8	CE mark.....	7
1.9	Declaration of Conformity.....	8
1.10	EMC Limit Class.....	9
1.11	Product description.....	9
1.12	Delivery contents.....	10
<b>2</b>	<b>Safety instructions .....</b>	<b>11</b>
2.1	Intended use of the unit.....	11
2.2	Requirements for personnel .....	13
2.3	Responsibility.....	13
2.4	Follow the operating instructions .....	14
<b>3</b>	<b>Technical data.....</b>	<b>15</b>
3.1	Rating.....	15
3.2	Dimensions .....	16
<b>4</b>	<b>Function .....</b>	<b>17</b>
4.1	Functional description .....	17
4.2	Comparing leakage current with and without the <b>LEAKCOMP® 1P</b> .....	18
<b>5</b>	<b>Delivery, internal transport, unpacking.....</b>	<b>20</b>
5.1	Delivery.....	20
5.2	Internal transport.....	20
5.3	Unpacking .....	20
<b>6</b>	<b>Storage and transport .....</b>	<b>21</b>
6.1	Ambient conditions .....	21
6.2	Storage .....	21
6.3	Transport.....	21
<b>7</b>	<b>Installation .....</b>	<b>22</b>
7.1	Safety instructions.....	22
7.2	Installation conditions .....	23
7.3	Connections .....	24
7.4	Typical wiring .....	27

<b>8</b>	<b>Startup / Operation .....</b>	<b>28</b>
8.1	LED displays / soft start process .....	28
8.2	Switching compensation on and off / equalisation .....	29
8.3	Shutdown .....	29
<b>9</b>	<b>Troubleshooting .....</b>	<b>30</b>
9.1	Green LED does not come on .....	30
9.2	Fault during the soft start process .....	30
9.3	RCCB trips when the unit is switched on .....	30
9.4	Potential difference between N and PE .....	30
9.5	The RCCB trips when the motor is carrying current .....	31
9.6	Fault detection and rectification .....	31
9.7	Service address .....	32
<b>10</b>	<b>Maintenance.....</b>	<b>32</b>
<b>11</b>	<b>System tests .....</b>	<b>33</b>
<b>12</b>	<b>Repairs .....</b>	<b>33</b>
<b>13</b>	<b>Disposal .....</b>	<b>33</b>

## 1 Important basic information

### 1.1 Publication details

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## **1.2 Target group**

This documentation is intended for qualified personnel as defined in IEC 60364.

Qualified personnel are persons who have the appropriate qualifications for the work to be performed during the installation, assembly, startup and operation of the product.

## **1.3 Liability**

The common names, trade names, descriptions of goods and other designations used in this publication may be legally protected even if not specifically marked as such (for example as trademarks). EPA GmbH accepts no liability or warranty for their free availability.

The illustrations and text were compiled with the utmost care. Nevertheless, errors cannot be excluded.

The publication is provided without guarantee.

The information it contains is provided solely for the purpose of customer information and contains no representations or binding warranties. Binding statements are possible only in response to specific inquiries.

The contents of this instruction manual are accurate at the date of printing. Since it is under continuous development, the manufacturer reserves the right to change the specification of the product and its performance data as well as the contents of this instruction manual, in both technical and commercial terms, without prior notice. The current version is available at [www.leakcomp.de](http://www.leakcomp.de) or [www.epa.de](http://www.epa.de).

Liability of the company EPA GmbH for any damage resulting from incorrect use of this instruction manual or incorrect, erroneous or inappropriate installation or adjustment is excluded. Interruptions to operation, loss of profit as well as loss of information and data or consequential damages are excluded insofar as liability is not mandatory in accordance with the law on product liability or in cases of intent, gross negligence or breach of fundamental contractual obligations.

## **1.4 General equal treatment**

EPA GmbH is aware of the importance of language with respect to the equal rights of women and men and makes every effort to take this into account. To ensure better readability, however, it was necessary to abstain from the consistent use of differentiated formulations.




## **1.5 Registered trademarks**

Brand names and trademarks are the property of their respective owners and are not generally marked as such in this manual.

The absence of such marking does not mean that a name is free within the meaning of brand and trademark law.

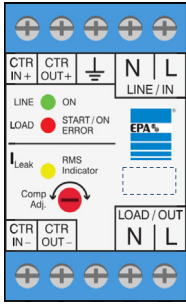


## 1.6 Symbols and signal words

The following symbols and signal words are used in this documentation to indicate hazards and important information:

Symbol/signal word	Meaning
	Warning of hazardous electrical voltage
<b>⚠ IMPORTANT NOTE</b>	Draws your attention to the handling and impact of safety information.
<b>⚠ DANGER</b>	Draws your attention to a hazardous situation that will result in serious injury or death if not avoided.
<b>⚠ WARNING</b>	Draws your attention to a hazardous situation that may result in serious injury or death if not avoided.
<b>⚠ CAUTION</b>	Draws your attention to a hazardous situation that may result in minor to moderate injury if not avoided.
	Draws your attention to possible damage to property and other important information.
	The installation must be carried out by a qualified electrician (IEC 60417-6182).



1.7 Marking on the product

Illustration	Description
<p><b>Front panel</b></p> 	<p><b>LED displays</b></p> <p>Green LED: Operating display(LINE ON) Red LED: Status display(LOAD START / ON / ERROR) Yellow LED: Residual leakage current display (<math>I_{LeakRMS}</math> Indicator)</p> <p><b>Terminal assignment</b></p> <p>Mains connection: PE / N / L (LINE / IN) Load connection: N / L (LOAD / OUT) Control voltage: CTR IN+ / CTR OUT+ CTR IN- / CTR OUT-</p> <p><b>Compensation potentiometer</b> (Comp. Adj.)</p> <p><b>Device designation</b> space beneath the EPA logo </p>
<p><b>Type plate</b></p> 	<p><b>Manufacturer's details and technical data</b></p>

1.8 CE mark

The CE mark is on the device nameplate.



The device complies with the relevant essential requirements of all applicable EU directives.

The declaration of conformity can be found in the following chapter.

## 1.9 Declaration of Conformity

SO 5.2.3-05



### Konformitätserklärung

Declaration of Conformity

Dokument Nr.: CEK1707003  
Document No.:

Hersteller: EPA GmbH, Fliederstraße 8, 63486 Bruchköbel, Germany  
Manufacturer:

Produktbezeichnung: Ableitstrom-Festkompensation  
Product description: Leakage current fixed-compensation

Produktgruppe: Elektrische Mess-, Steuer-, Regel- und Laborgeräte  
Product category: Electrical equipment for measurement, control and laboratory use

Typenbezeichnung: LEAKCOMP® 1P  
Type / Model:

Die Produkte sind in Übereinstimmung mit den folgenden Richtlinien:  
The products are in accordance with the following directives:

Niederspannungsrichtlinie 2014/35/EU vom 26. Februar 2014  
Low-Voltage Directive 2014/35/EC as of February 26, 2014

EMV-Richtlinie 2014/30/EU vom 26. Februar 2014  
EMC Directive 2014/30/EC as of February 26, 2014

Bei der Fertigung und Prüfung der Produkte wurden die folgenden Normen zur Anwendung gebracht:  
The products have been manufactured and tested in accordance with the following standards:

Sicherheitsbestimmungen: DIN EN 61010-1:2011-07; VDE 0411-1:2011-07  
Safety requirements:

EMV-Anforderungen: DIN EN 61326-1:2013-07; VDE 0843-20-1:2013-07  
EMC requirements:

Ort, Datum: Bruchköbel, 25.07.2017  
Place and date of issue:



Unterschrift: Dipl.-Ing. (FH) Thorsten Pemsel <sup>1)2)3)</sup>  
Signature:

<sup>1)</sup> Bevollmächtigter zur Ausstellung dieser Erklärung im Namen des Herstellers /  
Authorized representative to issue this declaration in the name of the manufacturer  
<sup>2)</sup> Bevollmächtigter zur Zusammenstellung der technischen Unterlagen /  
Authorized representative for compilation of technical documents  
<sup>3)</sup> Funktion: Geschäftsführer / Function: Managing Director



## 1.10 EMC Limit Class

**LEAKCOMP® 1P** is a Class A, Group 1 device in accordance with EN 55011 / CISPR 11.

The device is classified in accordance with DIN EN 61326-1 (VDE 0843-20-1) and is intended for use in an industrial environment with its own mains supply that is separated from the public low-voltage grid via a transformer.

When used in a domestic environment, this device can cause high frequency interference, which may require the use of additional interference suppression measures.

## 1.11 Product description

There is an increasing use of residual current circuit breakers in industry for personal safety and fire protection. The modern components used in automation technology (such as frequency inverters, RFI filters, switching power supplies, shielded motor cables etc.) generate leakage currents when the system is operating. These so-called "operational" leakage currents are interpreted by the RCDs as differential currents and thus often lead to unreliable operating states or to their complete shutdown. The residual current circuit breaker cannot distinguish between the operational leakage currents and true fault currents.

The EPA **LEAKCOMP® 1P** is designed for the compensation of capacitive leakage currents with a frequency of 50 Hz.

The **LEAKCOMP® 1P** leakage current compensation unit is used in electrical plant or machines where single-phase frequency inverters and/or servo controllers are to be operated on RCDs (residual current devices) or RCCBs (residual current circuit breakers).

The **LEAKCOMP® 1P** compensates for the leakage currents occurring in the system during operation preventing inadvertent or 'nuisance' tripping of residual current devices caused by excessively high 50 Hz leakage currents. The device works with all common RCCBs of the types A, F, B and B+.

The size of the compensation current must be permanently set via a potentiometer, located in the front panel of the device. The value of the compensation current can be increased by turning the potentiometer clockwise. At optimal compensation, the compensated 50 Hz leakage current approaches zero. If the potentiometer is turned fully anticlockwise there is no compensation.

The integrated soft start function minimises the occurrence of leakage current peaks that are caused by the capacitors charging when the inverter is switched on.

The **LEAKCOMP® 1P** detects if the phase and neutral conductors are transposed during the startup process and corrects it where necessary.

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Continued

The **LEAKCOMP® 1P** has three LED indicators.

The green LED functions as the operating display and indicates the presence of the power supply. The flashing red LED indicates an error.

The yellow LED indicates the level of the overall leakage current. The dimmer the LED appears, the lower the overall leakage current. The flashing yellow LED warns of an inadmissible overcompensation. The yellow LED can thus be used to manually adjust the level of compensation.



A separate control voltage is unnecessary in the delivered state. Other options are possible (see Chapter 7 *Installation*).

#### NOTE

Along with 50 Hz leakage currents, leakage currents of other frequencies can also occur that are not compensated by the **LEAKCOMP® 1P**. EPA also offer a suitable solution for these cases.

For leakage current measurement with analysis of the utilisation of the residual current circuit breaker, we recommend using the leakage current analysis system EPA **LEAKWATCH** (further information at [www.leakwatch.de](http://www.leakwatch.de)).

### 1.12 Delivery contents

<p>Leakage current compensation unit <b>LEAKCOMP® 1P</b></p> <p>EPA Article No.: 5S031129</p>	
<p>Operating manual <b>LEAKCOMP® 1P</b></p> <p>EPA Article No.: 50275668</p>	

## 2 Safety instructions

### 2.1 Intended use of the unit

#### 2.1.1 Area of application

The EPA **LEAKCOMP® 1P** is designed for the compensation of capacitive leakage currents with a frequency of 50 Hz.

The **LEAKCOMP® 1P** leakage current compensation unit is used in electrical plants or machines where single-phase frequency inverters and/or servo controllers are to be operated on RCDs (residual current devices) or RCCBs (residual current circuit breakers) with a trip current of 30 mA.

The **LEAKCOMP® 1P** compensates for the leakage currents occurring in the plant/machine during operation thus preventing inadvertent or 'nuisance' tripping of residual current devices that can be caused by excessively high 50 Hz leakage currents. Fault currents are not compensated for when the device is used as intended.

The device works with all common RCCBs of the types A, F, B and B+ (a suitable type must be chosen according to the regulations!).

#### NOTE

Operational leakage currents can accept frequencies  $\neq$  50 Hz and cause a malfunction of the residual current device.

EPA also provide corresponding solutions for these cases (see **LEAKCOMP® HP** at [www.leakcomp.de](http://www.leakcomp.de) and leakage current reduction filter.-**DAR** at [www.epa.de](http://www.epa.de)).

#### 2.1.2 Inadmissible operating conditions

##### DANGER

To prevent overcompensation, it is important that the **LEAKCOMP® 1P** is always switched on and off together with the leakage current generator.

The **LEAKCOMP® 1P** must only be used in a compensated state.

An overcompensation is inadmissible, i.e. the compensation current must not be higher than the leakage current.

A stand-alone operation without a leakage current generator is not permissible.

*Continued on next page*

Continued

**⚠ CAUTION**

The **LEAKCOMP® 1P** must only be used under the conditions and for the purposes for which it was designed (see also *Intended use* chapter).

Particular attention should be paid to the safety instructions and the technical data setting out the ambient conditions.

Operational safety is not guaranteed in the event of modification or improper use.

High voltage differences between the neutral conductor and the protective earth conductor can overload or destroy the device.

Strong electromagnetic fields can affect the function and measuring accuracy of the device.

External mechanical loads are not allowed.

The **LEAKCOMP® 1P** must only be used in TN-S networks.

**⚠ IMPORTANT NOTE**

The device is **not** suitable for:

- The reduction of ≠ 50 Hz leakage currents,
- The reduction of 150 Hz operational leakage currents on three-phase devices (servo or frequency inverters),
- The reduction of operational leakage currents for the purpose of compliance with maximum permitted limits for leakage currents (e.g. 3.5 mA limit for mobile devices) in compliance with EN 50178 and 10 mA limit for machines in compliance with EN 60204-1),
- The reduction of leakage currents higher than those specified for the device,
- Use on AC-type residual current circuit breakers (prohibited in Germany!),
- Systems/machines with power regeneration.
- Potentially explosive atmospheres.

## 2.2 Requirements for personnel

### **WARNING**



Installation and work on the **LEAKCOMP® 1P** may only be carried out by qualified personnel.

Qualified personnel as defined by this instruction manual are electricians who are familiar with the installation, assembly, startup and operation of the device, with the hazards involved and, as a result of their technical training, are also familiar with the relevant standards and regulations.

Repairs may only be carried out by authorised repair centres. Unauthorised tampering can lead to property damage and will void the warranty provided by EPA.

## 2.3 Responsibility:

### **WARNING**

Electronic devices are never fail-safe. The installer and/or operator of the machine or system is responsible for ensuring that the system/machine is restored to a safe state if the device fails or the residual current device is tripped.

The safety requirements for electrical controllers are set out in DIN EN 60204-1; VDE 0113-1 "Safety of machinery" in the section titled "Electrical equipment of machines". These provisions ensure the safety of persons and machines as well as the maintenance of the functional capability of the machine or system and must be observed.

## 2.4 Follow the operating instructions

### **IMPORTANT NOTE**

Please read this manual carefully. It contains important information about the installation and operation of the **LEAKCOMP® 1P**.

The **LEAKCOMP® 1P** has been subjected to extensive testing and left the factory in a technically and operationally safe condition. To maintain this condition, the user must follow the safety instructions in this manual.

We assume no liability for damage caused by failure to follow these instructions.

This manual is an integral part of the product and is valid only for the **LEAKCOMP® 1P** leakage current compensation unit manufactured by EPA GmbH.

Please pass this manual on to the system operator/end customer/service technician so that it is available when required.

Keep these operating instructions and all other applicable documents in a safe place to ensure that they are available when required.

This is a translation of the original German instruction manual.



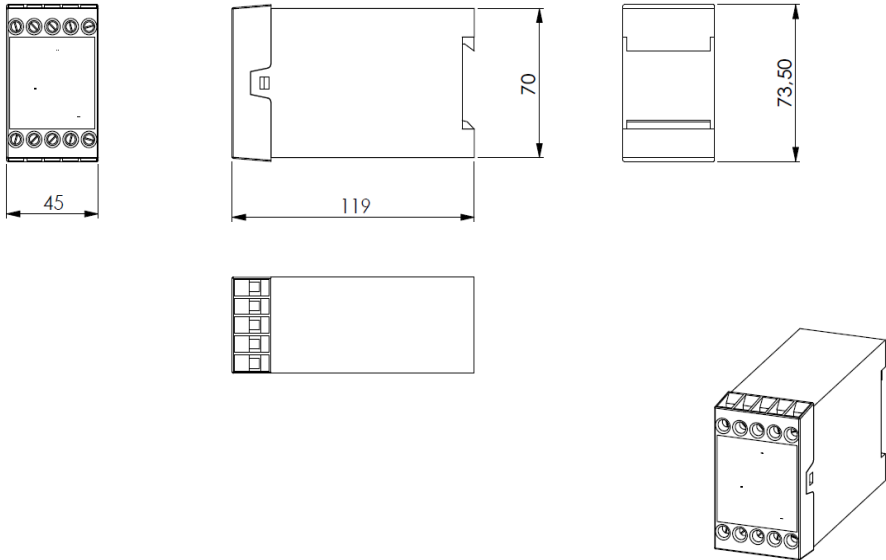
### 3 Technical data

#### 3.1 Rating

Network configuration	TN-S system (L / N / PE)
Rated voltage	230 VAC $\pm 10\%$ , single phase
Rated frequency <sup>1)</sup>	50 Hz $\pm 1\%$
Max. ampere capacity	16 A (max. overload protection: 16A, B characteristic)
Compensation frequency	50 Hz (capacitive)
Compensation current	0..50 mA RMS (adjustable via potentiometer)
Intermediate circuit capacity	$\leq 6800 \mu\text{F}$
Power loss	$< 5 \text{ VA}$
Ambient temperature	Operation: $+10..40^\circ\text{C}$ , Storage: $-25...+55^\circ\text{C}$ / transport: $-25..+70^\circ\text{C}$
Mounting / fitting	on DIN EN 50022 mounting rail, position as required
Connections	<p>Terminal assignment</p> <p>Mains connection: <i>PE / N / L (LINE / IN)</i></p> <p>Load connection: <i>N / L (LOAD / OUT)</i></p> <p>Internal control voltage: <i>CTR IN+ / CTR OUT+ / CTR IN- / CTR OUT-</i></p> <p>Max. cable cross-section <i>2x 2.5 mm<sup>2</sup> solid wire</i> <i>2x 1.5 mm<sup>2</sup> flexible with sleeve</i></p> <p>Max. tightening torque <i>0.8 Nm</i></p>
External control voltage <sup>2)</sup>	24 V AC / DC ( $\pm 10\%$ ) max. 5 mA
Dimensions	L: 73.5 mm W: 45 mm D: 119 mm
Weight	Approx. 300 g
Protection class	IP20
Direct contact protection	DGUV V3 (BGV A3)
Flammability	UL94 V-0 / IEC 60707 BH 2-30
Displays	<p>LED displays</p> <p>Green LED: Operating display (<i>LINE ON</i>)</p> <p>Red LED: Status display (<i>LOAD START / ON / ERROR</i>)</p> <p>Yellow LED: Residual leakage current display (<i>I<sub>Leak RMS</sub> Indicator</i>)</p>
Setting options	Compensation current adjustable via potentiometer
EMV	EN 61326-1, EN 55011 Class A, Group 1 (Industry)
Conformity	CE, RoHS (2011/65/EU)

1) also available as 60 Hz version 2) optional; supplied with factory-installed internal control voltage

### 3.2 Dimensions



All dimensions are specified in mm. Tolerance  $\pm 1$  mm.

CAD files can be downloaded at [www.epa.de](http://www.epa.de).

## 4 Function

### 4.1 Functional description

The **LEAKCOMP® 1P** compensates operational leakage currents with a frequency of 50 Hz generated by single phase frequency inverters and/or servo inverters. The RCCB is thus relieved of 50 Hz leakage currents. This specifically prevents accidental triggering of RCCBs in a fault-free installation.

True fault currents continue to be detected by the residual current circuit breaker in accordance with its specifications and operational safety is maintained.

The value of compensation current can be set via a potentiometer on the front panel of the device. The value of the compensation current can be increased by turning the potentiometer clockwise. At optimal compensation, the compensated 50 Hz leakage current approaches 0 mA. The yellow LED supports compensation. If the potentiometer is turned fully anticlockwise, there is no compensation.

The integrated soft start function minimises the occurrence of leakage current peaks that are caused by the capacitors charging when the inverter is switched on.

The **LEAKCOMP® 1P** requires a phase-related connection. The **LEAKCOMP® 1P** detects if the phase and neutral conductors are transposed during the startup process and corrects it where necessary.

The **LEAKCOMP® 1P** has three LED indicators.

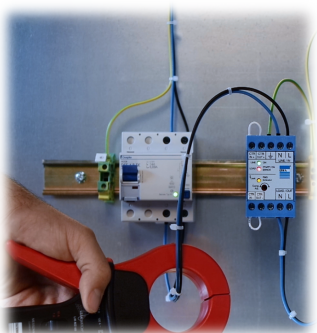
The green LED functions as the operating display and indicates the presence of the power supply. The red LED first flashes rapidly during the first stage of the soft start process and then more slowly during the second stage. Once the soft start process is complete, the red LED is lit continuously (operation). If a fault occurs during the soft start process, the red LED flashes (see *Troubleshooting* chapter). The yellow LED indicates the level of the leakage current. The dimmer the yellow LED appears, the lower the overall compensated leakage current. The yellow LED thus assists in the manual adjustment of compensation. The flashing yellow LED indicates an inadmissible overcompensation.

The **LEAKCOMP® 1P** offers the possibility of switching the downstream load on and off via the *CTR IN+* and *CTR IN-* control inputs by applying a control voltage (in the extra low voltage range) through a PLC, as with a standard contactor. Unlike when using a contactor, the complete soft start cycle is gone through during every switching operation, and the leakage current is constantly compensated. The control voltage of the **LEAKCOMP® 1P** can either be supplied via the mains connection (if both jumpers on *CTR IN* and *CTR OUT* are fitted) or via a separate power pack on the two *CTR IN* terminals. The factory setting has jumpers fitted to the *CTR-* terminals, so an external control voltage is not essential (for more information refer to the chapters 'Installation' and 'Control Terminals').

#### 4.2 Comparing leakage current with and without the **LEAKCOMP® 1P**

For leakage current measurement with an analysis of the RCCB utilisation, we recommend using the leakage current analysis system EPA **LEAKWATCH** (further information at [www.leakwatch.de](http://www.leakwatch.de)).

The leakage current that flows through RCCB and forces it to trip can be measured very accurately with the help of the **LEAKWATCH** LW-SOFT software and the measuring equipment ( LW-MK3plus DAQ board + LW-MZ-50 current clamp).



To measure the leakage current correctly, the current clamp must enclose the outgoing wires from the RCCB (only the phase(s) and the neutral conductor, not the protective earth conductor!).

On the next page, we would like to illustrate the effectiveness of leakage current compensation using measured results. The illustrations show the Fourier analyses of the leakage current, effective values at certain frequencies and frequency ranges, the overall leakage current and the RCCB utilisation. A standard commercial single-phase frequency inverter was used as a leakage current generator and an EPA RCCB1 30 mA selected for the assessment in the **LEAKWATCH** software.

Note: Normatively, at a frequency of 50 Hz, an RCCB with  $I_{\Delta n} = 30 \text{ mA}$  (personal protection) can already trip from 15 mA.

Fig. 4.2.1:

In addition to the high 50 Hz leakage current, harmonics can also be detected (multiples of 50 Hz, particularly 150 Hz). In our example, the tripping threshold of the 30 mA RCCB is clearly exceeded at 50 Hz. The 50 Hz leakage current is 38 mA and the utilisation of the RCCB is 154%.

Fig. 4.2.2:

The leakage currents are compensated for by the use of **LEAKCOMP® 1P**. This reduces the values to 1 mA at 50 Hz and 7 mA at 150 Hz, which are tolerable for the RCCB. The tripping threshold of the 30 mA RCCB is thereby significantly undershot, thus reducing the utilisation of the RCCB to 21%.

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### Leakage current without the LEAKCOMP® 1P

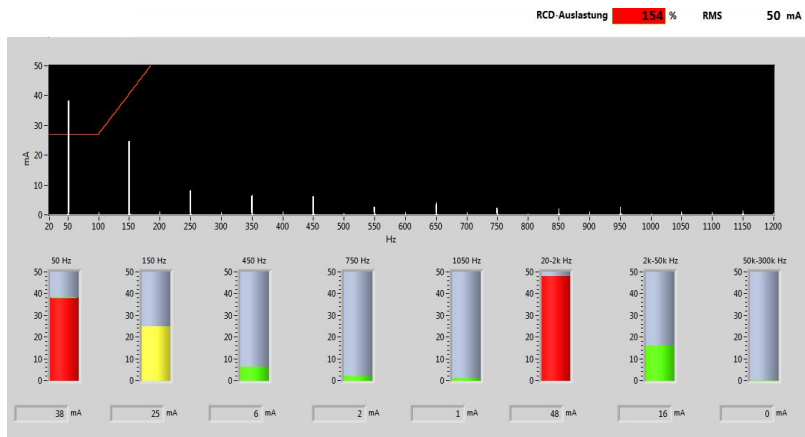


Fig. 4.2.1

→ The RCCB detects the high leakage current and involuntarily trips.

### Leakage current with the LEAKCOMP® 1P

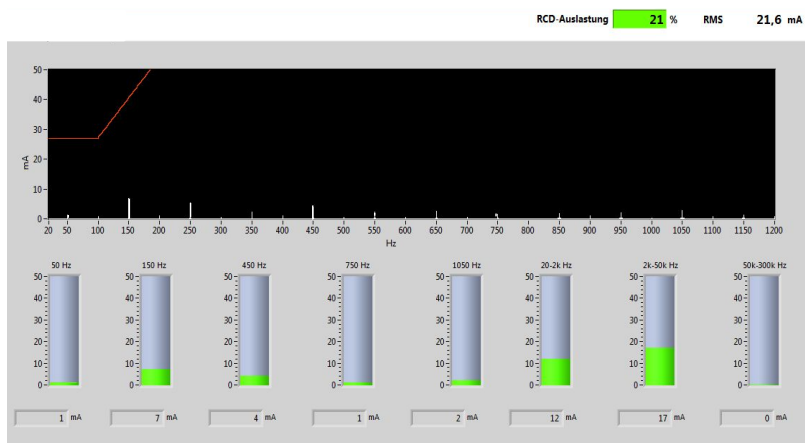


Fig. 4.2.2

→ The RCCB is relieved of leakage currents and does not trip.

## 5 Delivery, internal transport, unpacking

### 5.1 Delivery

For the components included in delivery, please refer to the section titled "*Delivery contents*".

All **LEAKCOMP® 1P** devices have been subjected to extensive testing and have left the factory in a technically and operationally safe condition.

#### **⚠ WARNING**

Read the operating instructions carefully before use.

### 5.2 Internal transport

The device must be protected against external influences for transport (knocks, vibration, temperature, dirt etc.). The transport conditions are set out in the section titled "*Storage and transport*".

### 5.3 Unpacking

#### **⚠ IMPORTANT NOTE**

Check the unit for external damage.

Please keep the original packaging and operating instructions.



## 6 Storage and transport

### 6.1 Ambient conditions

Storage	-25°C to +55°C (EN 60721-3-1, 1K3)
Transport	-25°C to +70°C (EN 60721-3-1, 2K3)
Moisture and humidity	Condensation not allowed, relative humidity ≤ 80%
Soiling	Pollution degree 2 (EN 50178)

#### CAUTION

##### Damage possible

Risk of damage to the unit from improper storage or transport.

#### NOTE

If the unit has been transported at extreme temperatures, it requires an acclimatisation period of at least 2 hours before operation.

Strong vibrations, knocks, shocks and soiling (liquids and solid foreign bodies) must be avoided at all times as they can cause damage to the unit.

### 6.2 Storage

Always ensure that the **LEAKCOMP® 1P** is stored in a correct and proper manner.

The unit must be stored in a dry, enclosed space.

### 6.3 Transport

Where possible, transport the **LEAKCOMP® 1P** properly in its original packaging.

The packaging included in delivery can be used for transport.

## 7 Installation

### 7.1 Safety instructions

#### DANGER



#### **Warning of hazardous electrical voltage!**

**Risk to life from electric shocks! Death or serious injury!**

Take appropriate precautions to prevent electric shocks.

The **LEAKCOMP® 1P** must only be installed by an authorised and qualified specialist who is familiar with the relevant safety provisions.

Work in hazardous proximity to electrical systems should only be performed under the instruction of a responsible electrician and not carried out alone.

The accident prevention regulations for electrical systems and equipment must be observed when carrying out all work.

The installation must only be carried out when the system is completely de-energised.

#### WARNING

To prevent overcompensation, it is important that the **LEAKCOMP® 1P** is always switched on and off together with the leakage current generator.

An overcompensation is inadmissible, i.e. the compensation current must not be higher than the leakage current.

The housing of the **LEAKCOMP® 1P** must not be opened.

High load currents can overload or destroy the sensitive hardware.  
Suitable overload protection must be provided.

The device must be supplied with the voltage specified in the technical data. Higher voltages higher can destroy the device.

Surge voltages between the terminals can destroy the device.

The internal control voltage at the *CTR OUT* terminals is approximately 12V DC and is exclusively intended for the purpose of controlling the **LEAKCOMP® 1P**.  
It must not be used for any other purpose!

The potential of the control voltage of  $\pm 12V$  DC is on level N of the mains voltage.  
For safety reasons, the relay contacts must therefore have a dielectric strength of at least 230V AC, and the connecting cables including the jumpers at *CTR OUT* and *CTR /N* must be insulated accordingly!



## 7.2 Installation conditions

### ⚠ WARNING

The safety instructions and technical data must be observed.

### 7.2.1 Operating conditions

Operating temperature	+10°C to +40°C
Moisture and humidity	Without condensation, relative humidity $\leq 80\%$
Installation altitude	$\leq 2000$ m above sea level
Soiling	Pollution degree 2 (EN 50178)

### 7.2.2 Mounting

The **LEAKCOMP® 1P** operates independently of position and is designed for mounting on a top-hat rail in accordance with DIN 50022.

A minimum distance of approx. 20 mm should be maintained from adjacent assemblies (heat).

When tightening the terminals, the maximum tightening torque of 0.8 Nm must not be exceeded.

The device must be firmly installed in the distribution board. Ideally, the **LEAKCOMP® 1P** should be positioned directly behind the residual current circuit breaker.

The **LEAKCOMP® 1P** must have a fixed, low-impedance connection with the protective earth conductor (PE).



### 7.2.3 Network structure

The **LEAKCOMP® 1P** is designed for single-phase TN-S networks (L/N/PE).

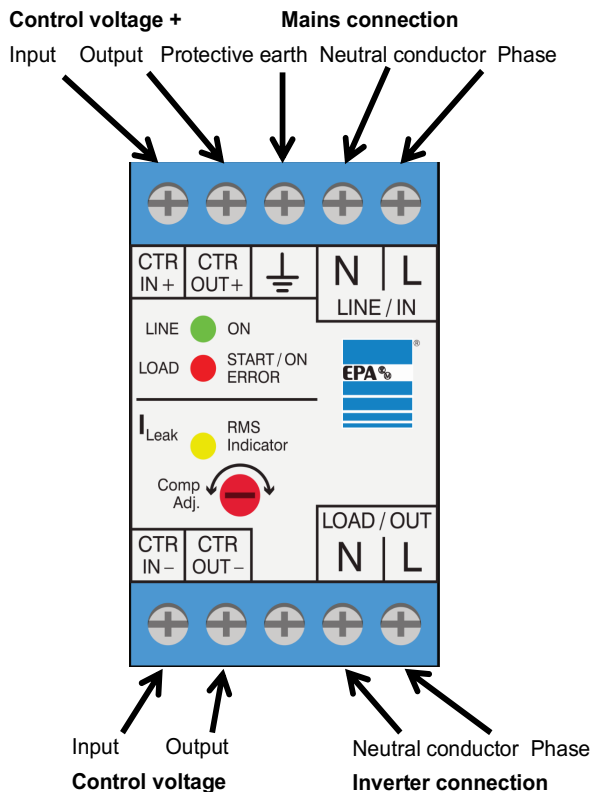
### 7.2.4 Overload protection

Suitable overload protection must be provided. The protection must not exceed 16 A with characteristic B

## 7.3 Connections

### ⚠ WARNING

The safety instructions and technical data must be observed.



### 7.3.1 Power connections

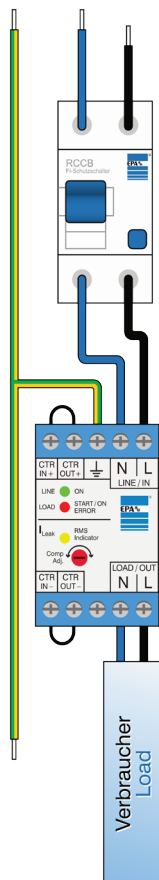
#### Mains connection (*LINE / IN*):

The phase must be connected to terminal *L*, the neutral conductor must be connected to terminal *N* and the protective earth (PE) to  $\perp$ .

#### Inverter connection (*LOAD / OUT*)

The phase of the inverter must be connected to terminal *L*, the neutral conductor must be connected to terminal *N*.

Schematic representation of the wiring of the **LEAKCOMP® 1P** with an RCCB.



### 7.3.2 Control connections

#### **WARNING**

The internal control voltage at the *CTR OUT* terminals is approximately 12V DC and is exclusively intended for the purpose of controlling the **LEAKCOMP® 1P**. It must not be used for any other purpose!

The potential of the control voltage of  $\pm 12V$  DC is on level N of the mains voltage. For safety reasons, the relay contacts must therefore have a dielectric strength of at least 230V AC, and the connecting cables including the jumpers at *CTR OUT* and *CTR IN* must be insulated accordingly!

#### **NOTE**

The factory setting has jumpers fitted to the *CTR* terminals, so an external control voltage is not essential (see 4.2.3).

The **LEAKCOMP® 1P** offers the possibility of switching the downstream load on and off via the *CTR IN+* and *CTR IN-* control inputs by applying a control voltage (in the extra low voltage range) through a PLC, as with a standard contactor. Unlike when using a contactor, the complete soft start cycle is gone through during every switching operation, and the leakage current is constantly compensated.

The following three configurations are possible:

### 7.3.3 External control voltage

- Terminals *CTR OUT+* and *CTR OUT-* open
- Terminal *CTR IN+* at external control voltage plus (+)
- Terminal *CTR IN-* at external control voltage minus (-)

When the mains voltage is applied the device first goes into standby mode (green LED on, red LED off, load double-pole isolated from mains, no compensation current).

When the control voltage is applied, the startup process is initiated (cf. description).

The control voltage must remain applied until there is a wish to switch off the load. When the control voltage is switched off, an orderly shutdown of the load is carried out. This procedure can be repeated several times.

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Continued

It is not necessary to disconnect the **LEAKCOMP® 1P** from the mains to perform another soft start. A maximum of 60 cycles per hour are permitted with a total charging capacity of 6800 µF (total of all DC link capacities).

The control inputs **CTR IN** are completely potential-free.

The control voltage can range between 12 V and 36 V DC (recommended 24 V DC).

The maximum control current is 5 mA.

## 7.3.4 Control with an external relay

- Terminals **CTR OUT+** and **CTR IN+** on the centre and normally open contact of the control relay
- Terminals **CTR OUT-** and **CTR IN-** connected by an insulated jumper

If there is no DC control voltage available, the internal control voltage of the **LEAKCOMP® 1P** can be used in conjunction with a free relay contact.

The operating characteristics of the **LEAKCOMP® 1P** correspond to those when using an external control voltage.

## 7.3.5 Auto start (factory setting)

- Terminals **CTR OUT+** and **CTR IN+** connected by an insulated jumper
- Terminals **CTR OUT-** and **CTR IN-** connected by an insulated jumper

When the mains voltage is applied, the soft start cycle described above is executed after a pause of approximately one second.

## 7.4 Typical wiring

**LEAKCOMP® 1P** with an RCCB and a frequency inverter.



## 8 Startup / Operation

### DANGER

To prevent overcompensation, it is important that the **LEAKCOMP® 1P** is always switched on and off together with the leakage current generator.

An overcompensation is inadmissible, i.e. the compensation current must not be higher than the leakage current.

### 8.1 LED displays / soft start process

The **LEAKCOMP® 1P** has three LED indicators.

The green LED functions as the operating display and indicates the presence of the mains supply or the supply voltage of the **LEAKCOMP® 1P**.

When the supply voltage is switched on, the device first carries out a self-test that detects and if necessary corrects the correct assignment of the phase and neutral conductors. The connected loads are then switched on by the multistage soft start process.

The red LED first flashes rapidly during the first stage of the soft start process and then more slowly during the second stage. Once the soft start process is complete, the red LED is lit continuously (operation).

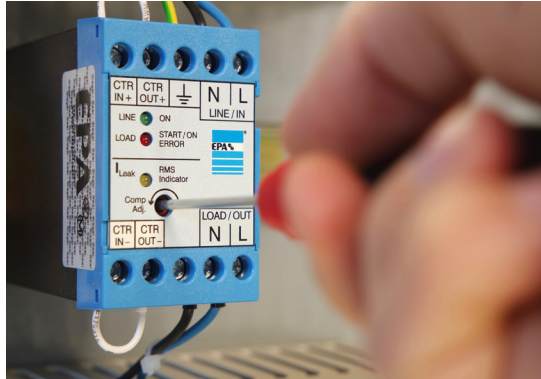
If a fault occurs during the soft start process, the red LED flashes (see *Troubleshooting* chapter).

### IMPORTANT NOTE

The connected loads are only switched on after the self-test has been successfully completed.

Before the startup of the **LEAKCOMP® 1P** connected to one or more frequency/servo inverters, the compensation current on the **LEAKCOMP® 1P** must be equalised via the potentiometer.

## 8.2 Switching compensation on and off / equalisation



The value of the compensation current can be increased from 0 to 50 mA by turning the potentiometer in the front panel clockwise. At optimal compensation, the compensated 50 Hz leakage current approaches zero.

If the potentiometer is turned fully anticlockwise, there is no compensation.

The yellow LED indicates the level of the leakage current.

The dimmer the LED appears, the lower the overall leakage current.

If the yellow LED is flashing, an inadmissible overcompensation is present.

The potentiometer must be adjusted so that the yellow LED has its minimum luminosity. For an optimal adjustment a differential current measurement can be carried out - for this purpose lead L and N at LINE/IN through a suitable current clamp.

## 8.3 Shutdown

In order to shut down the **LEAKCOMP® 1P**, it is necessary to interrupt the control voltage supply at the **CTR IN+** and **CTR IN-** terminals or to switch off the power supply via the **LINE / IN** terminals.

### ▲ NOTE

Interrupting the control voltage of the **LEAKCOMP® 1P** leads to the switching off of the loads connected via the **LOAD / OUT** terminals.

## 9 Troubleshooting

### 9.1 Green LED does not come on

The green LED functions as the operating display and indicates the presence of the mains supply or the control voltage of the **LEAKCOMP® 1P**. Make sure that the phase, neutral and protective earth conductors are correctly connected and the mains supply is present.

### 9.2 Fault during the soft start process

When the supply voltage is switched on, the device first carries out a self-test that detects, and where necessary, corrects the assignment of the phase and neutral conductors. The connected loads are then switched on by the multistage soft start process. The red LED first flashes rapidly during the first stage of the soft start process and then more slowly during the second stage. Once the soft start process is complete, the red LED is lit continuously (operation).

If a fault occurs during the soft start process, the red LED flashes and the load is not switched on.

### 9.3 RCCB trips when the unit is switched on

Before the startup of the **LEAKCOMP® 1P** connected to one or more frequency/servo inverters, the compensation current on the **LEAKCOMP® 1P** must be equalised via the potentiometer.

The yellow LED indicates the level of the leakage current. The darker the LED appears, the lower the compensated leakage current. The yellow LED thus assists in the manual adjustment of compensation.

The RCCB may trip if the compensation current is either too high or too low. An optimal adjustment of the **LEAKCOMP® 1P** is the precondition for the safe operation of one or more frequency or servo inverters connected to the RCCB.

### 9.4 Potential difference between N and PE

Please measure the voltage between the neutral and protective earth conductors. If there is voltage between the neutral and protective earth conductors, there is an installation problem with the system wiring that must be dealt with before the starting the **LEAKCOMP® 1P**. This does not generally cause a defect in the device.

#### **WARNING**

In the event of a permanently raised voltage (>10 V) between the neutral and protective earth conductors or terminals *N* and *COMP*, a defect may occur in the **LEAKCOMP® 1P**.

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## 9.5 The RCCB trips when the motor is carrying current.

This could be caused by a drive system that is generating very high leakage current values in the frequency range above 2 kHz (usually due to long motor leads). These high-frequency leakage currents could lie above the trip threshold of the RCCB.

In this case, we recommend conducting a leakage current analysis to determine the cause (for example, with the help of EPA **LEAKWATCH**), and to assess the effectiveness of remedial measures.

## 9.6 Fault detection and rectification

Fault/error message	Possible cause(s)	Remedy
RCCB trips, despite the use of the <b>LEAKCOMP® 1P</b> .	Wiring error – neutral conductor tapped before residual current circuit breaker	Check wiring and tap N after residual current circuit breaker
	Compensation current not optimally adjusted	Adjust compensation current with the potentiometer and measure the residual current
	Fault current due to insulation fault	Correct insulation fault
	High leakage current at 150 Hz	Compensate leakage current of three-phase inverter (e. g. <b>LEAKCOMP® HP</b> )
	External EMC filter /mains filter with high leakage current	Use low leakage current or 4-wire mains filter (e.g. EPA NF-KC-LL, NF-4)
	Network asymmetries due to power regeneration by inverters (energy recovery)	Use an additional line reactor (e.g. EPA3N)
	High leakage currents in the range of the inverter switching frequency	Use additional mains filters to reduce high-frequency leakage currents (e.g. EPA NF-DAR, NF-KC-DAR)
	Leakage current too high (with unknown frequency)	Carry out a leakage current analysis (e.g. with EPA <b>LEAKWATCH</b> )
Green LED off	No power supply	Check the power supply at the LINE IN terminal

Fault/error message	Possible cause(s)	Remedy
Red and yellow LEDs remain unlit (only the green LED is lit)	No control voltage	Check the wiring at the <i>CTR</i> terminals
	Jumpers at <i>CTR</i> terminals loose or missing	Insert or tighten jumpers at <i>CTR</i> terminals
Yellow LED shines brightly	Compensation current is too low	Turn the potentiometer clockwise
Yellow LED is flashing	Compensation current is too high	Turn the potentiometer anticlockwise
Red LED is flashing	Fault during the soft start process	Check wiring; Load with unusual leakage current ; Reduce inverter amount

## 9.7 Service address

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## 10 Maintenance

When used as intended, the **LEAKCOMP® 1P** is maintenance-free.

### IMPORTANT NOTE

Inspection or maintenance of the **LEAKCOMP® 1P** should only be carried out by qualified electricians.

Unless explicitly described in these operating instructions, modifications to the device may only be carried out by EPA or persons authorised by EPA.

Always follow the accident prevention regulations.

## 11 System tests

### WARNING

These tests must be carried out by a qualified electrician who is competent to carry out the tests, has experience of testing and possesses a knowledge based on the testing of comparable systems.

For the initial test of electrical systems and stationary equipment, the requirements of the standard DIN VDE 0100-600 "Low-voltage electrical installations – Part 6: Verification" must be met.

For the repeat test of electrical systems and stationary equipment, the requirements of the standard DIN VDE 0105-100 "Operation of electrical installations – Part 100: General requirements" must be met.

## 12 Repairs

### IMPORTANT NOTE

Failure to comply with instructions can result in the **LEAKCOMP® 1P** being damaged or destroyed.

Repairs may only be carried out by EPA or repair centres authorised by EPA. Unauthorised tampering can lead to property damage and will void the warranty provided by EPA.

The housing should not be opened.

## 13 Disposal

### IMPORTANT NOTE

The **LEAKCOMP® 1P** is a device intended for commercial use. These devices should not be disposed of at municipal collection points for electrical appliances. The devices contain electronic components and must be disposed of properly.

If you have any questions, please contact us.



All information without liability for correctness and accuracy.

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