PECON+®

Protective earth monitoring for single and three phase networks

Instruction manual

For mobile use of frequency inverters and servo drives

The 3.5 mA-limit as per DIN EN 50178 / VDE 0160 may be exceeded

For networks with rated voltages of 100 VAC up to 480 VAC with or without neutral·

IP 20

EPA
www.epa.de

Thank you for choosing the **PE**CON+© protective earth monitoring system 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.epa.de.

Contents

1 Important basic information

1.1 Publication details

Published by: EPA GmbH
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Validity of device version:

PECON+®

PECON+® **S1** / **S2** / **S3** / **S4**

PECON+® **NVT-1** / **-2**

PECON+® **NVF-1** / **-2**

PECON+® **IT**

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. Because 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.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
⚠ **DANGER**	Draws your attention to a hazardous situation that will result in serious injury or death if not avoided.
⚠ **WARNING**	Draws your attention to a hazardous situation that may result in serious injury or death if not avoided.
⚠ **CAUTION**	Draws your attention to a hazardous situation that may result in minor to moderate injury if not avoided.
IMPORTANT NOTE	Draws your attention to the handling and impact of safety information.
NOTE	Draws your attention to the handling and impact of safety information.
	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

The marking on the device may vary depending on the product version.

Illustration	Description
 Fig. 1: Example: **PECON+®**	**Front panel** LED status displays Labelling of terminals Test key
 Fig. 2: Example: **PECON+®**	**Type plate** Technical data and manufacturer information
 Fig. 3: Example: **PECON+®**	**Terminal assignment** Product-specific terminal assignment

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 section "Declaration of conformity" or downloaded from www.epa.de.

1.9 EMC Limit Class

The device complies with the limits for emitted interference according to DIN EN 55011 class B group 1.

The device's interference immunity corresponds to DIN EN 61000-6-2 for the industrial environment.

The device is classified in accordance with DIN EN 61326-1 (VDE 0843-20-1) and is suitable for use in residential, business and commercial areas as well as in industrial environments.

1.10 Declaration of Conformity

SO 5.2.3-05

EU Konformitätserklärung
EU Declaration of Conformity

Dokument Nr.: Document No.:	CEK1808001
Hersteller: Manufacturer:	EPA GmbH, Fliederstraße 8, 63486 Bruchköbel, Germany
Produktbezeichnung: Product description:	Schutzleiterüberwachungsgerät Protection conductor monitoring device
Produktgruppe: Product category:	Elektrische Mess-, Steuer-, Regel- und Laborgeräte Electrical equipment for measurement, control and laboratory use
Typenbezeichnung: Type / Model:	**PE**CON+®

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:

Anwendungsbereich: Scope of application:	DIN EN 50178; VDE 0160 :1998-04
Sicherheitsbestimmungen: Safety requirements:	DIN EN 61010-1; VDE 0411-1 :2011-07 DIN EN 60204-1; VDE 0113-1 :2007-06
EMV-Anforderungen: EMC requirements:	DIN EN 61326-1; VDE 0843-20-1 :2013-07
Ort, Datum: Place and date of issue:	Bruchköbel, 23.08.2018
Unterschrift: Signature:	Dipl.-Ing. (FH) Thorsten Pemsel [1) 2) 3)]

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

1.11 Product description

A familiar problem for manufacturers of machinery and pluggable devices:
Due to modern drive regulators such as frequency converters or servo controllers, the operational leakage current of the device or machine may increase.

However, DIN EN 50178/VDE 0160 only permits an operational leakage current of up to 3.5 mA AC. If this value is exceeded, the standard stipulates that the protective earth requires a fixed connection. This limits the mobility of the machines or devices.

However, this leakage current can be minimised through the careful arrangement of the individual components as well as with complex network filters. Unfortunately, this implementation is usually too expensive, and in many cases the operational leakage current is still above 3.5 mA due to the system.

The notion of the standard is reasonable and understandable as it protects the users of the machines or devices from electric shock if such a device is disconnected from the protective earth system due to a defective connection cable, plug or extension cable. But in addition, the standard expressly allows higher leakage currents if the availability of the protective earth system is permanently monitored. This is where the **PE**CON+® comes in.

The **PE**CON+® is a monitoring device that is installed directly at the feed point of the mobile machine.

The quality of the protective earth is permanently monitored by the **PE**CON+®. If it is working flawlessly, the integrated signal contact of the **PE**CON+® releases the main contactor of the machine.

The device, which is only 45 mm wide, is mounted on a DIN rail and reliably monitors all common voltage ranges.

The **PE**CON+® is used for monitoring the protective earth of single phase and 3-phase pluggable consumers. Depending on the product, polarity reversal of phase (L) and neutral conductor (N) is also monitored. Other product variants with special functions are also available.

The **PE**CON+® **IT** is available for networks without neutral conductor (N).

1.12 Area of application

Leakage current >3.5 mA = danger to life!?

Manufacturers and operators of machinery as well as portable or mobile electrical devices are equally affected. If an electrical device continuously exceeds a leakage current of AC 3.5 mA (in some regulations the limit is set to AC 10 mA) during normal use, it is subject to special regulations.

Why this strict limit?

When a residual current circuit breaker (RCCB) is used, you can rest assured that the personnel is adequately protected. Or are they?

Of course not every instance of touching electricity leads to injury or even death. If a live object is merely touched, the person generally removes the affected body part from the danger by virtue of the natural muscle reflex.

A more critical danger presents itself when we clasp a live machine part. Door handles, control levers, climbing aids etc. present typical risks. Internationally recognised standards already define body currents of only 15 mA as a "release limit", meaning that the muscles of the energised body part cramp and render the victim unable to release their grip.

All is well for the residual current circuit breaker!

Innovative machine concepts and electromobility often cannot be realised without inverters, frequency converters, servo drives or intelligent charging concepts.

In most instances, mains filters with Y capacitors (C between outer conductor and PE) are used for EMC reasons. However, two small Y-suppressor capacitors of only 100 nF can already cause leakage currents well above the 10 mA limit.

This is where VDE, TÜV and BG come in:
Producing leakage currents for trouble-free operation is generally permitted. However, developers are obliged to ensure that the electrical equipment is equipped with suitable protective earthing. Only then can the risk of a dangerous potential increase of touchable, conductive parts of the machine be safely ruled out.

In general, the relevant standards (e.g. DIN EN 50178) equally permit the following solutions for leakage currents AC > 3.5 mA:

- Installation of a second protective earth

- Installation of a separate isolating transformer

- Automatic disconnection of the power supply if the protective earth is interrupted

1.13 Delivery contents

Protective earth monitoring **PE**CON+®	
Instruction manual **PE**CON+®	

2 Safety instructions

2.1 Intended use

The EPA **PE**CON+® is used to safely monitor and automatically disconnect the power supply in the event of interruption of the protective earth (PE) in single and 3-phase networks in accordance with standard DIN EN 50178 / VDE 0160:1998-04.

The **PE**CON+® determines the availability of the protective earth of consumers (usually pluggable connected) by measurement and actuates an internal release relay if the protective earth is present.

The monitoring device must be installed directly on the feed point of the machine/system.

Depending on the product, the polarity reversal of phase (L) and neutral conductor (N) is also monitored and reported. Other product variants with special functions are available, e.g. for switching phases and the neutral conductor after release (for all **PE**CON+® **NV** variants).

The **PE**CON+® **IT** is available for networks without neutral conductor.

NOTE

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

2.2 Inadmissible operating conditions

⚠ CAUTION

The **PE**CON+® must only be used under the conditions and for the purposes for which it was designed (see section "Intended use").

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

The device is not suitable for reducing leakage currents.*

The **PE**CON+® does not replace a residual current device.

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 of the device.

External mechanical loads are not allowed.

Use in potentially explosive atmospheres is prohibited.

* EPA GmbH offers various other products for this purpose.

2.3 Requirements for personnel

⚠ WARNING

Installation and work on the **PE**CON+® 1C 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 who, based on their technical training, are also familiar with the relevant standards and provisions.

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 GmbH.

2.4 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.

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.

2.5 Connection

⚠ WARNING of hazardous electrical voltage

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

To avoid electric shock, take appropriate precautions.

Follow the accident prevention regulations for electrical systems and equipment when carrying out all work.

⚠ WARNING

The terminals are intended solely for the purpose for which they are defined in the connection description. These must not be used for any other purpose.

The potential at the terminals can be at the mains voltage level under certain circumstances. For safety reasons, the connecting cables must therefore have a corresponding dielectric strength and be sufficiently insulated.

⚠ CAUTION

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

Surge voltages between the terminals can destroy the device.

The device must be fixed firmly into place while the power supply is disconnected and no parts are live.

A fixed, low-impedance connection is required between the PE connection and the protective earth.

The **PE**CON+® may only be operated in TN-S systems (separate neutral and protective earth throughout the system; grounded star point).

2.6 Follow the operating instructions

IMPORTANT NOTE

Please read this manual carefully. It contains important information about the installation and operation of the **PE**CON+®.

The **PE**CON+® 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 **PE**CON+® protective earth monitoring device 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.

The current edition of this operating manual can be downloaded from www.epa.de.

3 Technical data

3.1 Rating data PECON+®

Testable networks	Single phase: L / N / PE 3-phase with N: L1 / L2 / L3 / N / PE
Network configuration	TN-S system
Rated voltage	200..230 VAC (±10%)
Rated frequency	50 / 60 Hz (±5%)
Response lag	<0.4 s
Response threshold	<1000 Ω
Power loss	5 VA
Ambient temperature	Operation: -15...+40ºC Storage: -25...+70ºC Transport: -25...+70ºC
Rel. humidity	max. 98%, without condensation
Atmospheric pressure	70..106ºC,
Dimensions	75 x 45 x 125 mm
Weight	Approx. 400 g
Mounting / fitting	on TS35 mounting rail according to DIN EN 50022, installation position as required
Connections	Mains connection: L / N Protective earth terminal: PE Release relay: Alarm/operation (change-over contact) Other connections: External Test key (break contact)
Contact rating	max. 250 VAC / 5 A; 30 VDC / 2 A
Cable cross-section	max. 4.0 mm² (12 AWG) solid max. 2.5 mm² (14 AWG) flexible with sleeve
Tightening torque	max. 0.8 Nm
LED displays	green: OK (operating mode display) yellow: Phase an N (polarity reversal L / N) red: Alarm (PE interruption)
Function test	via test key on front cover or ext. test key
Protection class	IP20 (terminals), IP40 (housing)
Direct contact protection	DGUV V3 (BGV A3)
Flammability	UL94 V-0
Housing material	PC-GF
Normative basis	DIN EN 50178 / VDE 0160:1998-04
Safety	DIN EN 61010-1, DIN EN 60204-1
EMC	DIN EN 61326-1, DIN EN 55011
Conformity	CE, RoHS (2011/65/EU), LVD (2006/95/EG), EMCD (2004/108/EG), MD (2006/42/EG)

3.2 Rating data PECON+® S1 / S2

Testable networks	Single phase: L / N / PE 3-phase with N: L1 / L2 / L3 / N / PE
Network configuration	TN-S system
Rated voltage	200..230 VAC (±10%)
Rated frequency	50 / 60 Hz (±5%)
Response lag	<0.4 s
Response threshold	<1000 Ω
Power loss	5 VA
Ambient temperature	Operation: -15...+40°C Storage: -25...+70°C Transport: -25...+70°C
Rel. humidity	max. 98%, without condensation
Atmospheric pressure	70..106 kPa
Dimensions	75 x 45 x 125 mm
Weight	Approx. 400 g
Mounting / fitting	on TS35 mounting rail according to DIN EN 50022, installation position as required
Connections	Mains connection: L / N Protective earth terminal: PE Release relay: Alarm/operation (change-over contact) Other connections: Polarity reversal L / N (normally open)
Contact rating	max. 250 VAC / 5 A; 30 VDC / 2 A
Cable cross-section	max. 4.0 mm² (12 AWG) solid max. 2.5 mm² (14 AWG) flexible with sleeve
Tightening torque	max. 0.8 Nm
LED displays	green: OK (operating mode display) yellow: Phase an N (polarity reversal L / N) red: Alarm (PE interruption)
Function test	via test key on front cover
Protection class	IP20 (terminals), IP40 (housing)
Direct contact protection	DGUV V3 (BGV A3)
Flammability	UL94 V-0
Housing material	PC-GF
Normative basis	DIN EN 50178 / VDE 0160:1998-04
Safety	DIN EN 61010-1, DIN EN 60204-1
EMC	DIN EN 61326-1, DIN EN 55011
Conformity	CE, RoHS (2011/65/EU), LVD (2006/95/EG), EMCD (2004/108/EG), MD (2006/42/EG)

3.3 Rating data PECON+® S3 / S4

Testable networks	Single phase: L / N / PE 3-phase with N: L1 / L2 / L3 / N / PE
Network configuration	TN-S system
Rated voltage	100..125 VAC (±10%)
Rated frequency	50 / 60 Hz (±5%)
Response lag	<0.4 s
Response threshold	<1000 Ω
Power loss	<5 VA
Ambient temperature	Operation: -15...+40ºC Storage: -25...+70ºC Transport: -25...+70ºC
Rel. humidity	max. 98%, without condensation
Atmospheric pressure	70..106 kPa
Dimensions	75 x 45 x 125 mm
Weight	Approx. 400 g
Mounting / fitting	on TS35 mounting rail according to DIN EN 50022, installation position as required
Connections	Mains connection: L / N Protective earth terminal: PE Release relay: Alarm/operation (change-over contact) Other connections: Polarity reversal L / N (normally open)
Contact rating	max. 250 VAC / 5 A; 30 VDC / 2 A
Cable cross-section	max. 4.0 mm² (12 AWG) solid max. 2.5 mm² (14 AWG) flexible with sleeve
Tightening torque	max. 0.8 Nm
LED displays	green: OK (operating mode display) yellow: Phase an N (polarity reversal L / N) red: Alarm (PE interruption)
Function test	via test key on front cover
Protection class	IP20 (terminals), IP40 (housing)
Direct contact protection	DGUV V3 (BGV A3)
Flammability	UL94 V-0
Housing material	PC-GF
Normative basis	DIN EN 50178 / VDE 0160:1998-04
Safety	DIN EN 61010-1, DIN EN 60204-1
EMC	DIN EN 61326-1, DIN EN 55011
Conformity	CE, RoHS (2011/65/EU), LVD (2006/95/EG), EMCD (2004/108/EG), MD (2006/42/EG)

3.4 Rating data PECON+® NVT-1 / NVF-1

Testable networks	Single phase: L / N / PE 3-phase with N: L1 / L2 / L3 / N / PE
Network configuration	TN-S system
Rated voltage	200..230 VAC (±10%)
Rated frequency	50 / 60 Hz (±5%)
Response lag	<0.4 s
Response threshold	<1000 Ω
Power loss	5 VA
Ambient temperature	Operation: -15...+40°C Storage: -25...+70°C Transport: -25...+70°C
Rel. humidity	max. 98%, without condensation
Atmospheric pressure	70..106 kPa
Dimensions	75 x 45 x 125 mm
Weight	Approx. 400 g
Mounting / fitting	on TS35 mounting rail according to DIN EN 50022, installation position as required
Connections	Mains connection: L / N Protective earth terminal: PE Release relay 1: Alarm/operation (change-over contact) Release relay 2: Operation (NO contact) Other connections: External Test key (break contact)
Contact rating	max. 250 VAC / 16 A
Cable cross-section	max. 4.0 mm² (12 AWG) solid max. 2.5 mm² (14 AWG) flexible with sleeve
Tightening torque	0.8 Nm
LED displays	green: OK (operating mode display) yellow: Phase an N (polarity reversal L / N) red: Alarm (PE interruption)
Function test	via test key on front cover or ext. test key
Protection class	IP20 (terminals), IP40 (housing)
Direct contact protection	DGUV V3 (BGV A3)
Flammability	UL94 V-0
Housing material	PC-GF
Normative basis	DIN EN 50178 / VDE 0160:1998-04
Safety	DIN EN 61010-1, DIN EN 60204-1
EMC	DIN EN 61326-1, DIN EN 55011
Conformity	CE, RoHS (2011/65/EU), LVD (2006/95/EG), EMCD (2004/108/EG), MD (2006/42/EG)

3.5 Rating data PECON+® NVT-2 / NVF-2

Testable networks	Single phase: L / N / PE 3-phase with N: L1 / L2 / L3 / N / PE
Network configuration	TN-S system
Rated voltage	200..230 VAC (±10%)
Rated frequency	50 / 60 Hz (±5%)
Response lag	<0.4 s
Response threshold	<1000 Ω
Power loss	5 VA
Ambient temperature	Operation: -15...+40ºC Storage: -25...+70ºC Transport: -25...+70ºC
Rel. humidity	max. 98%, without condensation
Atmospheric pressure	70..106 kPa
Dimensions	75 x 45 x 125 mm
Weight	Approx. 400 g
Mounting / fitting	on TS35 mounting rail according to DIN EN 50022, installation position as required
Connections	Mains connection: L / N Protective earth terminal: PE Release relay 1: Alarm/operation (change-over contact) Release relay 2: Operation (NO contact) Other connections: Polarity reversal L / N (normally open)
Contact rating	Release relay 1 + 2: max. 250 VAC / 16 A Signal contact: max. 60 VDC / 1 A
Cable cross-section	max. 4.0 mm² (12 AWG) solid max. 2.5 mm² (14 AWG) flexible with sleeve
Tightening torque	0.8 Nm
LED displays	green: OK (operating mode display) yellow: Phase an N (polarity reversal L / N) red: Alarm (PE interruption)
Function test	via test key on front cover
Protection class	IP20 (terminals), IP40 (housing)
Direct contact protection	DGUV V3 (BGV A3)
Flammability	UL94 V-0
Housing material	PC-GF
Normative basis	DIN EN 50178 / VDE 0160:1998-04
Safety	DIN EN 61010-1, DIN EN 60204-1
EMC	DIN EN 61326-1, DIN EN 55011
Conformity	CE, RoHS (2011/65/EU), LVD (2006/95/EG), EMCD (2004/108/EG), MD (2006/42/EG)

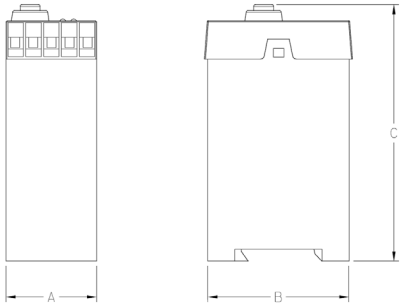
3.6 Rating data PECON+® IT

Testable networks	3-phase without N: L1/ L2/ L3 / PE
Network configuration	TN-S system
Rated voltage	400 VAC (±10%)
Rated frequency	50 / 60 Hz (±5%)
Response lag	<0.4 s
Response threshold	<1000 Ω
Power loss	<23 VA
Ambient temperature	Operation: -15...+40ºC Storage: -25...+70ºC Transport: -25...+70ºC
Rel. humidity	max. 98%, without condensation
Atmospheric pressure	70..106 kPa
Dimensions	75 x 45 x 125 mm
Weight	Approx. 500 g
Mounting / fitting	on TS35 mounting rail according to DIN EN 50022, installation position as required
Connections	Mains connection: L / N Protective earth terminal: PE Release relay: Alarm/operation (change-over contact) Other connections: External Test key (break contact)
Contact rating	max. 250 VAC / 5 A; 30 VDC / 2 A
Cable cross-section	max. 4.0 mm² (12 AWG) solid max. 2.5 mm² (14 AWG) flexible with sleeve
Tightening torque	0.8 Nm
LED displays	green: OK (operating mode display) yellow: Mains phase fault (high voltage difference) red: Alarm (PE interruption)
Function test	via test key on front cover or ext. test key
Protection class	IP20 (terminals), IP40 (housing)
Direct contact protection	DGUV V3 (BGV A3)
Flammability	UL94 V-0
Housing material	PC-GF
Normative basis	DIN EN 50178 / VDE 0160:1998-04
Safety	DIN EN 61010-1, DIN EN 60204-1
EMC	DIN EN 61326-1, DIN EN 55011
Conformity	CE, RoHS (2011/65/EU), LVD (2006/95/EG), EMCD (2004/108/EG), MD (2006/42/EG)

3.7 Dimensions

All dimensions are specified in mm. Tolerance ±1 mm. Subject to change.

3D and CAD files can be downloaded at www.epa.de.



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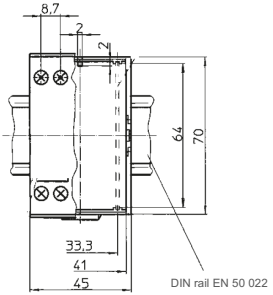
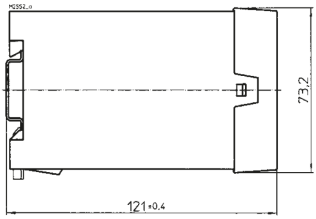


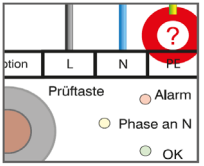


4 Function

4.1 Operating principle

The **PE**CON+® determines the availability of the protective earth of single and 3-phase networks by measurement.

If the protective earth is available, an internal release relay (potential-free contacts) is actuated. A separate line contactor can now be switched via the signal contact in order to supply the consumer(s) with voltage.

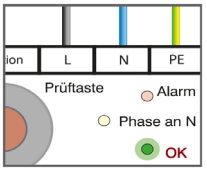


4.2 Normal state

When the **PE**CON+® is ready for operation, the green LED "OK" on the front cover is illuminated and the "Betrieb" (“Operation”) signal contact is activated.

For the **PE**CON+® **NVT** and **PE**CON+® **NVF** models, two internal release relays are activated (signal contacts “Freigabe-Relais 1” ("Release relay 1") and “Freigabe-Relais 2” ("Release relay 2").

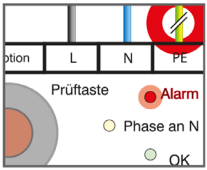
Contact position release relay in working position ➔ Protective earth OK



4.3 Fault

When the protective earth is interrupted, the release relay in the **PE**CON+® trips immediately. The fault is signalled by the red "Alarm" LED in the front cover, and the "Alarm" signal contact is actuated.

Contact position release relay in idle position ➔ Protective interrupted (alarm)

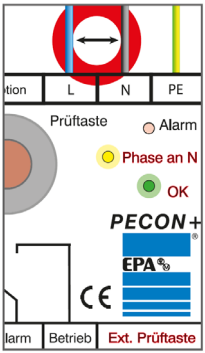


4.4 Additional functions

4.4.1 Interchanging of L and N

The yellow LED “Phase an N” ("Phase to N") lights up if terminal L is connected to neutral and terminal N is connected to a phase.

A typical case: The plug was inserted the wrong way in a Schuko socket.



This function does not apply for **PE**CON+® **IT**.

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Continued

Depending on the model, swapping the phase and neutral can be interpreted as a fault or deemed acceptable for release.

An additional signal contact for "Reverse polarity L / N" is provided for models **PE**CON+® **S1** / **S2** / **S3** / **S4** and **PE**CON+® **NVT-2** / **NVF-2**.

The differences between the various models are explained below:

PECON+®
- The device is ready for operation despite polarity reversal (polarity reversal L / N is tolerated)

PECON+® **S1** and **PE**CON+® **S3**:
- The device is not ready for operation if the polarity is reversed (interpreted as fault).
- An additional signal contact is actuated if the polarity is reversed.
- The connection option “Ext. Prüftaste” (“Ext. test key”) cannot be used.

PECON+® **S2** and **PE**CON+® **S4**:
- The device is ready for operation despite polarity reversal (polarity reversal L / N is tolerated)
- An additional signal contact is actuated if the polarity is reversed.
- The connection option “Ext. Prüftaste“ (“Ext. test key”) cannot be used.

PECON+® **NVT-1**:
- The device is ready for operation despite polarity reversal (polarity reversal L / N is tolerated)

PECON+® **NVF-1**:
- The device is not ready for operation if the polarity is reversed (interpreted as fault).

PECON+® **NVT-2**:
- The device is ready for operation despite polarity reversal (polarity reversal L / N is tolerated)
- An additional signal contact is actuated if the polarity is reversed.
- The connection option “Ext. Prüftaste” (“Ext. test key”) cannot be used.

PECON+® **NVF-2**:
- The device is not ready for operation if the polarity is reversed (interpreted as fault).
- An additional signal contact is actuated if the polarity is reversed.
- The connection option “Ext. Prüftaste” (“Ext. test key”) cannot be used.

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4.4.2 Network phases fault

This function only applies to the **PE**CON+® **IT**.

All three mains phases must be connected to the device. A neutral connection is not provided/required. The connection terminals for phases L1, L2 and L3 can be assigned in any phase relation. The phase relation does not impact the functionality of the **PE**CON+® **IT**.

If a voltage difference between the three phases L1, L2 and L3 of well above 10% is present, the yellow LED “Fehler Netzphasen” ("Fault mains phase") lights up. The red LED "Alarm" also lights up and there is no release via the internal relay.

4.4.3 Reset function

⚠ CAUTION

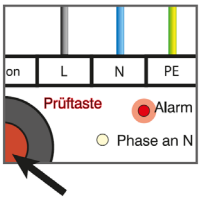
The **PE**CON+® resets automatically!

If the protective earth is interrupted for a short period and then present again, it is automatically re-enabled.

The hysteresis of the response and fallback values prevents possible fluttering of the release relay.

4.4.4 Function test with test key

Proper function of the “Schutzleiterunterbrechung” ("Protective earth interruption") can be checked manually at any time using the test key on the front cover.



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4.4.5 Function test with ext. test key

If needed, an external test key can be connected to the “Ext. Prüftaste” ("Ext. test key") terminal in place of the factory-fitted jumper. The button must be implemented as a normally open contact.

Functional testing with external test key is possible with the following product variants:

PECON+®
PECON+® **IT**
PECON+® **NVT-1**
PECON+® **NVF-1**

Functional testing with external test key is not possible with the following product variants:

PECON+® **S1**
PECON+® **S2**
PECON+® **S3**
PECON+® **S4**
PECON+® **NVT-2**
PECON+® **NVF-2**

4.5 Type overview

4.5.1 Operating voltage / neutral connection

Device version	EPA article no.	Operating voltage	Neutral conductor mandatory
PECON+®	50275390	200-230 VAC +/-10% 50/60 Hz	yes
PECON+® **S1**	50275459		
PECON+® **S2**	50275460		
PECON+® **S3**	50275461	100-125 VAC +/-10% 50/60 Hz	
PECON+® **S4**	50275462		
PECON+® **NVT-1**	50275694	200-230 VAC +/-10% 50/60 Hz	
PECON+® **NVF-1**	50275695		
PECON+® **NVT-2**	50275696		
PECON+® **NVF-2**	50275697		
PECON+® **IT**	50275391	400 VAC +/-10% 50/60 Hz	no

4.5.2 Optional terminals

Device version	Terminal for external test button	Terminal for reverse polarity L / N	2nd release relay
PECON+®	yes	no	no
PECON+® **S1**	no	yes	
PECON+® **S2**			
PECON+® **S3**			
PECON+® **S4**			
PECON+® **NVT-1**	yes	no	yes
PECON+® **NVF-1**			
PECON+® **NVT-2**	no	yes	yes
PECON+® **NVF-2**			
PECON+® **IT**	yes	no	no

4.5.3 Additional function reverse polarity L / N

Device version	yellow LED lights up if polarity is reversed	additional signal contact		red LED (alarm) lights up if polarity is reversed	Release relay is energised despite reversed polarity
		present	switches in case of reversed polarity		
PECON+®	yes	no	no	no	yes
PECON+® **S1**		yes	yes	yes	no
PECON+® **S2**				no	yes
PECON+® **S3**				yes	no
PECON+® **S4**				no	yes
PECON+® **NVT-1**		no	no	no	yes
PECON+® **NVF-1**				yes	no
PECON+® **NVT-2**		yes	yes	no	yes
PECON+® **NVF-2**				yes	no
PECON+® **IT**	irrelevant				

5 Delivery, internal transport, unpacking

5.1 Delivery

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

All **PE**CON+® 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 +70°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 ≤ 98%
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 store **PE**CON+® devices properly.

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

6.3 Transport

Transport the **PE**CON+® properly in the original packaging.

The packaging included in delivery can be used for transport.

7 Installation

7.1 Safety instructions for installation

⚠ WARNING of hazardous electrical voltage

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

Take appropriate precautions to prevent electric shocks.

⚠ DANGER

The **PE**CON+® 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.

Follow the accident prevention regulations for electrical systems and equipment when carrying out all work.

Installation should only be carried while the power supply is disconnected and no parts in the system are live.

The **PE**CON+® is designed for mounting on a rail in accordance with DIN 50022.

The device must be firmly installed in the distribution board.

The housing of the **PE**CON+® should not be opened.

IMPORTANT NOTE

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

The protective earth is connected to the protective earth terminal (PE) of the device with a fixed, low-impedance connection.

7.2 Installation conditions

⚠ WARNING

Follow the safety instructions in the section titled "Safety" and note the technical data in the section titled "*Technical data*".

7.3 Operating conditions

The **PE**CON+® operates independently of its position and is designed for mounting on a top-hat rail in accordance with DIN 50022.

It is designed for single and 3-phase TN-S networks.

Moisture and humidity	Without condensation, relative humidity ≤ 98%
Installation altitude	≤ 2000 m above sea level
Soiling	Pollution degree 2 (EN 50178)

Other conditions can be found in the section "Technical data".

7.4 Connection conditions

⚠ WARNING of hazardous electrical voltage

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

To avoid electric shock, take appropriate precautions. The accident prevention regulations for electrical systems and equipment must be observed when carrying out all work.

⚠ WARNING

The terminals are intended solely for the purpose described in this operating manual. These must not be used for any other purpose.

For safety reasons, the cables installed at the terminals must have a sufficiently high dielectric strength and be insulated accordingly.

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

The device must be fixed firmly into place while the power supply is disconnected and no parts are live.

Improper wiring can destroy the device.

7.5 Overload protection

The power supply of the device is max. 2 A (inert).

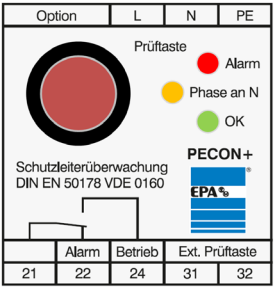
The switching contacts must be protected in accordance with the specifications in the technical data (see "Contact rating").

7.6 Connections

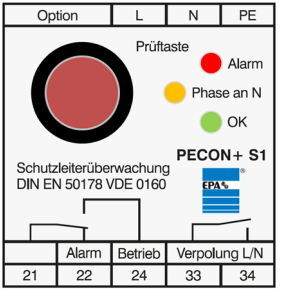
7.6.1 Pin assignment

7.6.2

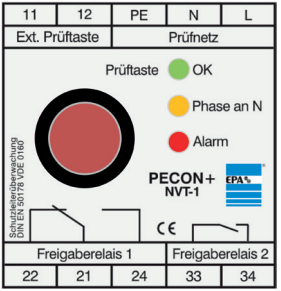
PECON+®



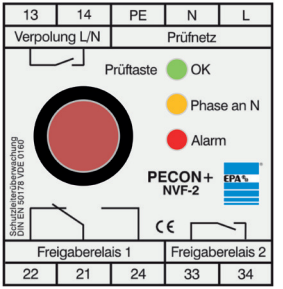
PECON+® **S1** / **S2** / **S3** / **S4**



PECON+® **NVT-1** / **NVF-1**



PECON+® **NVT-2** / **NVF-2**



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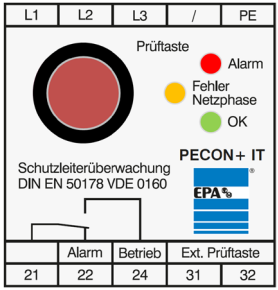
PECON+® **IT**



7.6.3 Power supply

The following applies to all product variants except the **PE**CON+® **IT:**

A phase (L), the neutral conductor (N) and the protective earth (PE) of the network to be tested must be connected to the **PE**CON+® to supply power.

The following applies to the **PE**CON+® **IT**:

All three phases (L1, L2, L3) and the protective earth (PE) of the network to be tested must be connected to the **PE**CON+® **IT** to supply power.
A neutral connection is not available/required for this model.

7.6.4 Switching/signal contacts

The internal release relay is led out via connection terminals 21, 22 and 24 (potential-free contacts). Terminal 21 is the relay root contact, terminal 22 the break contact and terminal 24 the NO contact.
The relay engages when ready for operation (connection 21-24) and disengages in the event of a fault (connection 21-22).

A mains contactor can be switched via the internal release relay, which shuts down the consumer immediately in the event of a fault (see wiring example).

An additional release relay is integrated in product variants **PE**CON+® **NVT** and **NVF**. The NO contact is connected to terminals 31 and 32.
For consumers with a maximum current consumption of 16 A and an operating voltage of up to 250 VAC, the consumer can be switched directly via the two release relays (e.g. release relay 1 switches the phase and release relay 2 switches the neutral conductor); see wiring example).

7.6.5 Polarity reversal phase / neutral conductor

Only valid for models **PE**CON+® **S1** / **S2** / **S3** / **S4** / **NVT-2** / **NVF-2**.

Connections 13 and 14 or 33 and 34 (NO contact) can be used to check whether the phase and neutral conductor were swapped, which can then be signalled or switched accordingly.

7.6.6 External test key

An external test key can be used to simulate a protective earth interruption, which provides a means to regularly and manually check the function.

This function is not provided for models **PE**CON+® **S1** / **S2** / **S3** / **S4** / **NVT-2** / **NVF-2**.

The following applies for the **PE**CON+® and **PE**CON+® **IT**:

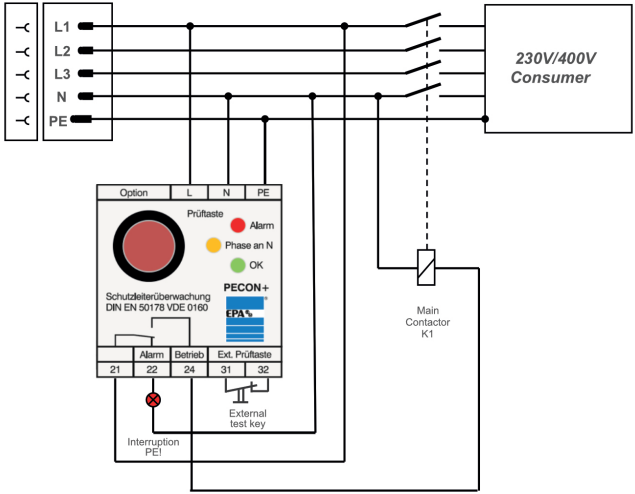
The button must be implemented as a normally open contact.
The designated terminals 31 and 32 are equipped with a bridge from factory.

The following applies for the **PE**CON+® **NVT-1** and **NVF-1**:

The button must be implemented as a normally open contact.
The designated terminals 11 and 12 are equipped with a bridge from factory.

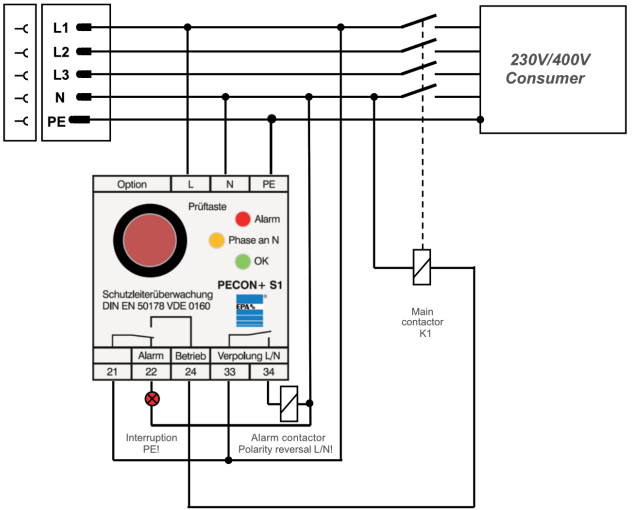
7.7 Wiring diagram

7.7.1 Wiring example **PE**CON+®



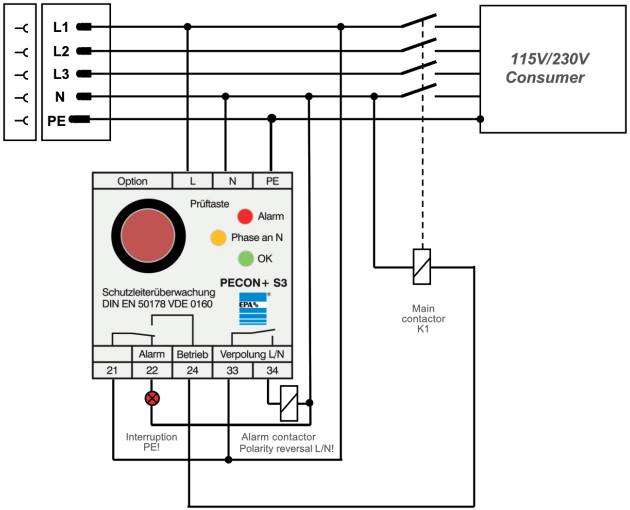
Option	-	Option
Prüftaste	-	Test key
Alarm	-	Alarm
Phase N	-	Phase N
OK	-	OK
Schutzleiterüberwachung	-	Protective earth monitoring
Alarm	-	Alarm
Betrieb	-	Operation
Ext. Prüftaste	-	External test key

7.7.2 Wiring example **PE**CON+® **S1** / **S2**



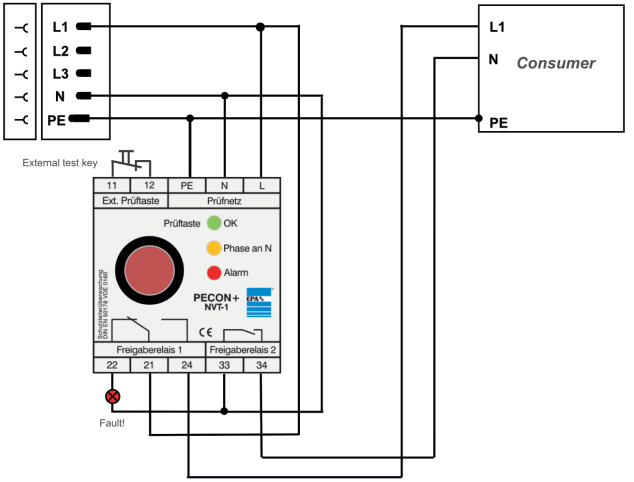
Option	-	Option
Prüftaste	-	Test key
Alarm	-	Alarm
Phase N	-	Phase N
OK	-	OK
Schutzleiterüberwachung	-	Protective earth monitoring
Alarm	-	Alarm
Betrieb	-	Operation
Verpolung	-	Polarity reversal

7.7.3 Wiring example **PE**CON+® **S3** / **S4**



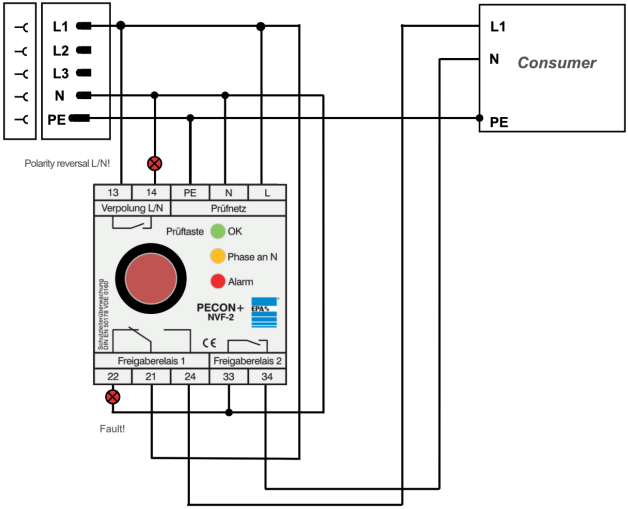
Option	-	Option
Prüftaste	-	Test key
Alarm	-	Alarm
Phase N	-	Phase N
OK	-	OK
Schutzleiterüberwachung	-	Protective earth monitoring
Alarm	-	Alarm
Betrieb	-	Operation
Verpolung	-	Polarity reversal

7.7.4 Wiring example **PE**CON+® **NVT-1** / **NVF-1**



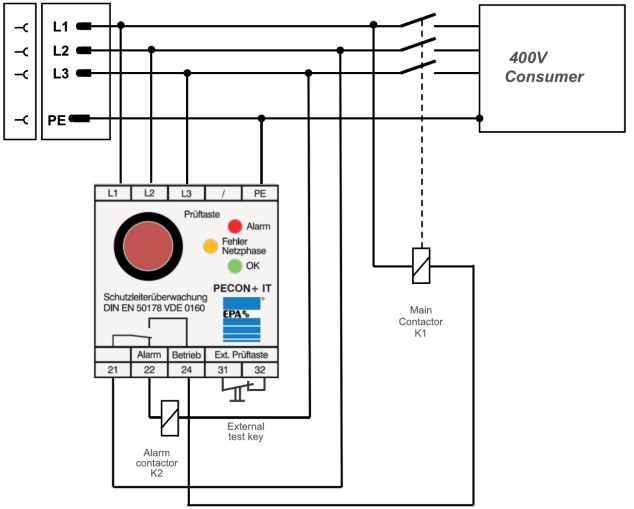
Ext. Prüftaste	-	External test key
Prüfnetz	-	Test mains
Prüftaste	-	Test key
OK	-	OK
Phase N	-	Phase N
Alarm	-	Alarm
Schutzleiterüberwachung	-	Protective earth monitoring
Freigaberelais	-	Release relay

7.7.5 Wiring example **PE**CON+® **NVT-2** / **NVF-2**



Verpolung	-	Polartiy reversal
Prüfnetz	-	Test mains
Prüftaste	-	Test key
OK	-	OK
Phase N	-	Phase N
Alarm	-	Alarm
Schutzleiterüberwachung	-	Protective earth monitoring
Freigaberelais	-	Release relay

7.7.6 Wiring example **PE**CON+® **IT**



Prüftaste	-	Test key
Alarm	-	Alarm
Fehler Netzphase	-	Fault mains phase
OK	-	OK
Schutzleiterüberwachung	-	Protective earth monitoring
Alarm	-	Alarm
Betrieb	-	Operation
Ext. Prüftaste	-	External test key

8 Startup / operation

8.1 Switching on

After connecting the supply voltage, the presence of the protective earth (PE) is determined by measurement. If the required minimum resistance of the protective earth connection is present, this is indicated by the green LED "OK" and the release is actuated.

Depending on the product version (see section "Function"), a possible swap of the phase and neutral conductor is also checked. If the phase and neutral are reversed or if the protective earth is missing, this is signalled via the "Alarm" LED (depending on the product version) and no release is issued via the relay and/or a signalling contact is actuated.

If the voltage difference of the three phases L1, L2, L3 is >10% in case of the **PE**CON+® **IT**, no release is issued via the internal relay and a fault is signalled via the red "Alarm" LED.

8.2 Shutdown

To de-energise the device, the voltage supply on the L and N terminals (for **PE**CON+®) and L1, L2 and L3 (for **PE**CON+® **IT**) must be disconnected on all poles.

8.3 LED display elements

The **PE**CON+® has three coloured LEDs as display elements:

PECON+® and **PE**CON+® **S2** / **S4** / **NVT-1** / **NVT-2**

Display	Status
Red LED	Protective earth connection interrupted
Yellow LED	Phase and neutral reversed
Green LED	Fault-free operation

PECON+® **S1** / **S3** / **NVF-1** / **NVF-2**

Display	Status
Red LED	Protective earth connection interrupted / phase and neutral conductor swapped
Yellow LED	Phase and neutral reversed
Green LED	Fault-free operation

PECON+® **IT**

Display	Status
Red LED	Protective earth connection interrupted / mains phases fault
Yellow LED	Network phases fault
Green LED	Fault-free operation

9 Troubleshooting

9.1 All LEDs remain dark

Ensure that the phase and neutral connector are properly connected and that the device is supplied with the required voltage.

> For the **PE**CON+® **IT**, all three phases must be connected.
>
> A neutral connection is not provided/required.

9.2 Red LED is illuminated

9.2.1 Protective earth connection interrupted

Ensure that the connection between the PE connection on the device and the protective earth system is adequately low-resistance.

PECON+® **S1** / **S3** / **NVF-1** / **NVF-2**:
Check the assignment of phase and neutral conductor to make sure the L and N polarity are not switched.

9.2.2 Network phases fault

PECON+® **IT**:
Ensure that all three phases are connected to the device and that they carry the correct voltage. The voltage difference between the individual phases must not exceed 10% by too much.

9.3 Service address

Please contact our service department if you have any questions.

EPA GmbH
Fliederstraße 8
63486 Bruchköbel
Germany

Phone: +49 (0) 6181 - 97 04- 0
Fax: +49 (0) 6181 - 97 04- 99

E-mail: info@epa.de
Web: www.epa.de

10 System inspection and maintenance

The function must be checked regularly.

The test key can be used to check whether the protective earth is interrupted.

⚠ 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.

Always follow the DGUV Accident Prevention Regulations.

IMPORTANT NOTE

Inspection or maintenance 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.

11 Repairs

IMPORTANT NOTE

The device can be damaged or destroyed if the instructions are not followed.

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.

12 Disposal

IMPORTANT NOTE

The **PE**CON+® 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.

Presented by:

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