



**Advanced Energy® AE 3TL 8 ... 23 IEC**  
**Installation and use**  
**Operating instructions**  
**November 2014**





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## Exclusion and limitation of liability



### WARNING

AE assumes no liability in the event of damage as a consequence of the failure to observe the warning instructions in these operating instructions or of improper usage.

The operating, maintenance and safety instructions are to be read carefully prior to installation and commissioning.

The installation, commissioning and safety-related check must be undertaken by a qualified electrician.

Error-free and safe operation of the device requires proper and professional transport, storage, assembly, and installation, as well as careful operation and maintenance.

Only accessories and spare parts approved by the manufacturer are permitted.

Technical modifications to the device are not permitted.

Adherence to the safety regulations and provisions of the country in which the inverter will be used are to be observed.

The environmental conditions, technical calculation data and connection conditions of the grid operator given in the product documentation must be upheld.

For European countries, the valid EU guidelines are to be observed when using the inverter.

The technical data, calculation, connection and installation conditions are to be derived from the product documentation and must be observed under all circumstances.

No liability is assumed for damages in connection with force majeure and disaster situations.

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## Feedback from customers

The technical editor of Advanced Energy has carefully developed this handbook on the basis of research-based document design principles. Suggestions for improvements are always welcome. Please send your comments regarding the content, structure or format of these operating instructions to: [mail.aei-power@aei.com](mailto:mail.aei-power@aei.com).

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# 1. About these Operating Instructions

These operating instructions form part of the product.

- ⇒ Read the operating instructions carefully before installing and using the product.
- ⇒ Keep the operating instructions readily available with the device for the entire service life of the product.
- ⇒ Provide all future users of the device access to the operating instructions.
- ⇒ For more information on the device, troubleshooting, and options under: [http://www.advanced-energy.de/de/1TL\\_3TL\\_Downloads.html](http://www.advanced-energy.de/de/1TL_3TL_Downloads.html)

## 1.1. SYMBOLS AND MARKUP

☑	Prerequisite
⇒	One-step instruction
1.	Multiple-step instruction
•	Bulleted list
<b>Highlighting</b>	Highlighting within a text
↪	Result

## 1.2. WARNING NOTICES

### 1.2.1. Layout of a Warning Notice

 <b>WARNING</b> <b>TEXT</b>	<p><b>The type and source of danger are described here.</b></p> <p>⇒ Measures for avoiding the danger are shown here.</p>
<b>Example</b>	
 <b>DANGER</b>	<p><b>Death or severe injury due to high discharge current when opening the device.</b></p> <p>⇒ It is essential to ensure an earthing connection has been established prior to connection to the supply current circuit.</p>

### 1.2.2. Categories of warning notices

There are three categories of warning notices.

 <b>DANGER</b>	<p>"DANGER" designates a safety notice, the disregarding of which will lead directly to death or severe injury!</p>
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 <b>WARNING</b>	"WARNING" designates a safety notice, the disregarding of which can lead to death or severe injury!
 <b>CAUTION</b>	"CAUTION" designates a safety notice, the disregarding of which can lead to property damage or minor injury!

### 1.3. INFORMATION



**Note:**

A **notice** describes information which is important for the optimum and cost-effective operation of the equipment.

## 2. Safety Information

### 2.1. DESIGNATED USE

The AE 3TL 08 ... 23 inverter, also referred to in these operating instructions as the inverter, is a solar inverter, which transforms the direct current generated by the PV generator (photovoltaic modules) into alternating current and feeds this to the public power supply network.

The AE 3TL 08 ... 23 is connected directly to the low-voltage distribution grid as a transformer-less inverter.

The inverter is manufactured according to the rules and current state of technology and takes into account the valid EU guidelines.

The inverter fulfils the requirements according to housing guard level IP65 and can be used indoors and outdoors.

Any other use is not considered to be a designated use. The manufacturer accepts no liability for damages resulting from this.

### 2.2. QUALIFICATION OF PERSONNEL

Target group for these instructions are professionals who can assess the assigned tasks due to their professional training, knowledge and experience as well as knowledge of the relevant provisions and recognize possible dangers.

Electrical work must only be carried out by qualified electricians.

Only suitably trained and qualified personnel are allowed to work on this inverter. Personnel are regarded as being qualified if they are sufficiently familiar with the assembly, installation, and operation of the product as well as with all warnings and safety measures set out in these operating instructions.

## 2.3. DANGERS ARISING FROM MISUSE

 <b>DANGER</b>	<p><b>Danger to life from electric shock</b></p> <ul style="list-style-type: none"> <li>⇒ Device may only be installed and serviced by qualified specialist technical personnel.</li> <li>⇒ Only class A modules according to IEC 61730 must be used.</li> <li>⇒ The PV generator must be free of earth potential.</li> <li>⇒ The PV generator must be designed in accordance with the technical data of the inverter.</li> <li>⇒ Before connecting or disconnecting the DC plug always open DC switch.</li> <li>⇒ Every power supply line must be equipped with an appropriate line protection switch.</li> <li>⇒ A consumer must never be switched between an inverter and line protection switch.</li> <li>⇒ Access to the shutdown mechanism must always be free.</li> <li>⇒ Installation and commissioning must be carried out properly.</li> </ul>
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 <b>DANGER</b>	<p><b>Danger to life from electric shock</b></p> <p><b>After the device has been switched off, the interior may still contain life-threatening voltage</b></p> <ul style="list-style-type: none"> <li>⇒ Do not open inverter.</li> <li>⇒ Discharge time is at least 15 minutes.</li> </ul>
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 <b>DANGER</b>	<p><b>Danger to life from high discharge current</b></p> <ul style="list-style-type: none"> <li>⇒ It is essential to ensure an earthing connection has been established prior to connection to the supply current circuit.</li> </ul>
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## 2.4. PROTECTION AGAINST CONTACT WITH ELECTRICAL PARTS

 <b>DANGER</b>	<p><b>Danger to life, danger of injury due to high electrical voltage</b></p> <ul style="list-style-type: none"> <li>⇒ Installation of the inverter must only be carried out by trained specialist personnel. In addition, the installer must be accredited by the responsible utility company.</li> <li>⇒ General assembly and safety stipulations relating to working on high current facilities must be followed.</li> <li>⇒ Before switching on, a check must be made to ensure that the plugs are firmly in place (locked).</li> <li>⇒ Before plugging or unplugging the DC plug, always disconnect</li> </ul>
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	<p>the connection to the PV generator.</p> <p>⇒ The feeder must be isolated and secured against being switched on again before working at the AC grid.</p>
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## 2.5. PROTECTION AGAINST CONTACT WITH HOT PARTS

 <b>CAUTION</b>	<p><b>Danger of burns caused by hot surfaces on housings</b></p> <p>At an ambient temperature of 45°C, the upper part of the housing as well as the refrigeration unit can reach a surface temperature of more than 75°C.</p> <p>⇒ Do not touch the housing surface near to heat sources.</p> <p>⇒ Allow the device to cool down for 15 minutes before touching the surface of the device.</p>
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## 2.6. PROTECTION DURING HANDLING AND ASSEMBLY

 <b>WARNING</b>	<p><b>Danger of injury during improper handling caused by crushing, shearing, cutting, striking, and lifting</b></p> <p>⇒ The weight of the inverter amounts to 38.4 kg!</p> <p>⇒ Follow the general setup and safety regulations for handling and assembly.</p> <p>⇒ Use suitable assembly and transportation equipment.</p> <p>⇒ Avoid trap and crush injuries by taking suitable precautions.</p> <p>⇒ Only use suitable tools. Use special tools where this is prescribed.</p> <p>⇒ Use lifting equipment and tools in a technically correct manner.</p> <p>⇒ If necessary, use suitable protective equipment (for example, goggles, safety footwear, protective gloves).</p> <p>⇒ Do not stand under hanging loads.</p> <p>⇒ Remove any liquids onto the floor immediately to avoid the danger of slipping.</p>
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## 2.7. PLEASE NOTE BEFORE STARTING UP

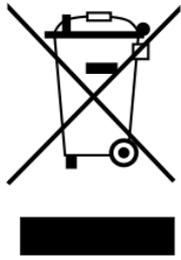
- In the event of installation in France, the device must be furnished with the warning sticker laid down by UTE C 15-712-1. The warning stickers are included in delivery.
- Problem-free and safe operation of the inverter is conditional upon due and specialised transportation, storage, assembly and installation as well as careful operation and maintenance.
- Only use accessories and spare parts approved by the manufacturer.

- Adherence must be ensured to the prescriptions and stipulations regarding safety of the country in which the inverter is to be used.
- The ambient conditions stated in the product documentation must be observed.
- Starting up is prohibited until the entire system meets the national regulations and safety rules regarding use.
- Operation is only permitted with adherence to the national EMC prescriptions for the present use case.
- The manufacturer of the equipment or machine is responsible for ensuring compliance with the thresholds required by the respective national regulations.
- For European countries, the EU Directive 2004/108/EU (EMC Directive) is to be observed when using the inverter.
- The technical data, connection and installation conditions are to be taken from the product documentation and must be observed under all circumstances.
- Switching off of the inverter must first be effected on the AC side via the circuit breaker. Then the inverter is to be switched off on the DC side, should maintenance work need to be carried out on the DC side.
- It is not necessary to switch off the inverter overnight, as the inverter switches off completely as soon as no DC voltage is present at the input. If no switch-off is effected, the inverter switches on automatically in the morning when the PV generator supplies sufficiently high voltage. This means that the maximum output is generated.

## 2.8. ADDITIONAL SYMBOLS AND WARNING NOTICES ON THE INVERTER

	<p>This symbol advises that the user handbook must be read before the device is used.</p>
	<p>Hot surface! The housing can get hot during use.</p>
	<p>Discharging time of the device longer than 15 minutes.</p>
 <p><b>WARNING</b> <b>Dual Supply</b></p>	<p>Do not work on this device before it is disconnected from both power sources (grid and PV generator).</p>

## 2.9. DISPOSAL



Dispose of the packaging and replaced parts according to the rules applicable in the country where the inverter is installed.

Do not dispose of the inverter with normal domestic waste.

The inverter conforms to RoHS. That means that the device can be taken to municipal disposal sites for household appliances.

AE takes the inverter back completely. Please contact the Service team!

## 3. Description of Device

### 3.1. INFRASTRUCTURE REQUIREMENTS

Additional required equipment	AE 3 TL 8 ... 20 at the low voltage network	AE 3 TL 23 at the medium voltage network
AC-Trenneinrichtung	necessary	necessary
Zentraler NA-Schutz mit Kuppelschalter (VDE-AR-N 4105)	only for systems above 30 kVA required	only for systems above 30 kVA required
NS-/MS-Trenntrafo	not necessary	necessary

The following points are to be considered when planning the infrastructure:

- The AE 3 TL 8 ... 20 can only feed into the low-voltage grid.
- The AE 3 TL 23 can only feed into the medium-voltage grid.
- The 5-wire power supply line must be equipped with an appropriate AC disconnecting device.
- The AE 3 TL 8 ... 23 is not equipped with internal potential isolation.
- If the inverters are connected with the medium-voltage-grid, it must be operated with electrically isolating transformers.
- No other equipment may be connected between the transformer and inverters.

The following standards and technical regulations are also to be observed:

IEC 60364-4-41	Protection: Protection against electric shock
IEC 60364-4-43	Protection for safety - Protection against overcurrent
IEC 60364-5-52	Selection and erection of electrical equipment - wiring systems
BDEW	Technical Guidelines
VDN	Technical Guidelines

For the AE TL 23 an isolating transformer with the following specifications is required:

Specification of medium voltage transformers	AE 3 TL 23
Rated power	23 kVA
Rated voltage OS	Electric Supply Company
Rated voltage US	3 x 460 V PE + N
Frequency	50/60 Hz
Short-circuit voltage $u_k$	Electric Supply Company
Switching group	Dyn5 oder Dyn11
Protection	Outdoor use IP65 or protected

### 3.2. FEATURES OF AE 3TL 8 ... 23

The AE 3TL is a transformer-less, three-phase solar inverter, which has a particularly

high efficiency at any operating point. Depending on type, it is suitable for connection of a PV generation with an output of 8 kW to 23 kW. Heat is dissipated only by convection. An internal monitor prevents the device from exceeding the permissible ambient temperature. The inverter is designed such that the device does not have to be opened for assembly and connection work. All electrical connections are exclusively made with lockable connectors. The device features an integrated DC isolating switch according to EN 60947-3, which reduces the overall installation work. The inverter provides the usual communication interfaces RS485 and Ethernet. An illuminated graphical display shows the development of the feed-in power and other operating data in a clearly arranged manner. An 8-key control panel below the display also provides excellent control and navigation convenience. Based on its design in protection class IP 65, the inverter can be installed at an outside location as long as it is not in direct sunlight. An installation protected against sunlight under the solar modules is ideal here.

Optionally, the inverter (867R ...) is also available in a version for concentrator modules (867C ...). Here, the inverter is supplied from the AC side.



Fig. 1: AE 3TL 8 ... 23

### 3.3. EXTERNAL DIMENSIONS

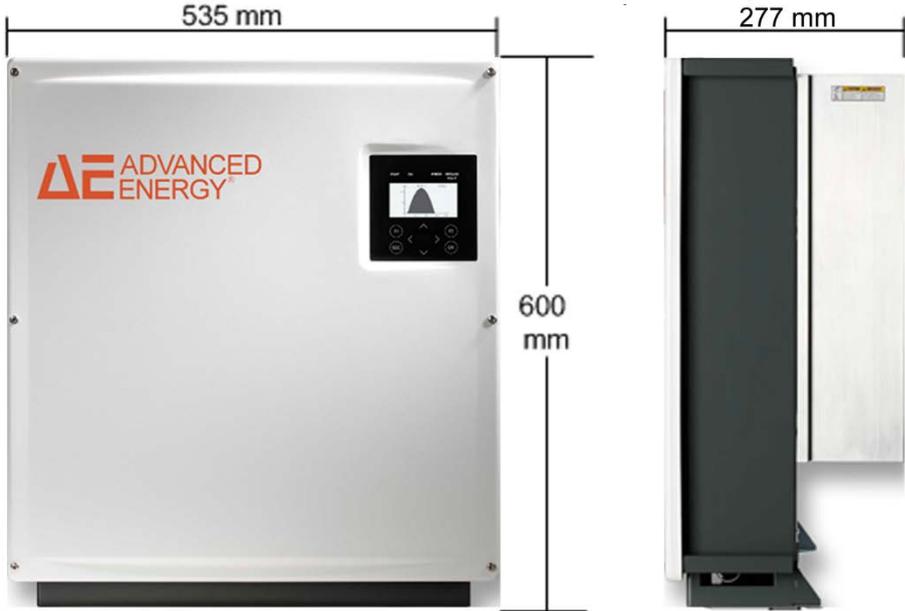


Fig. 2: External dimensions

### 3.4. BLOCK DIAGRAM

#### 3.4.1. AE 3TL 8 ... 23

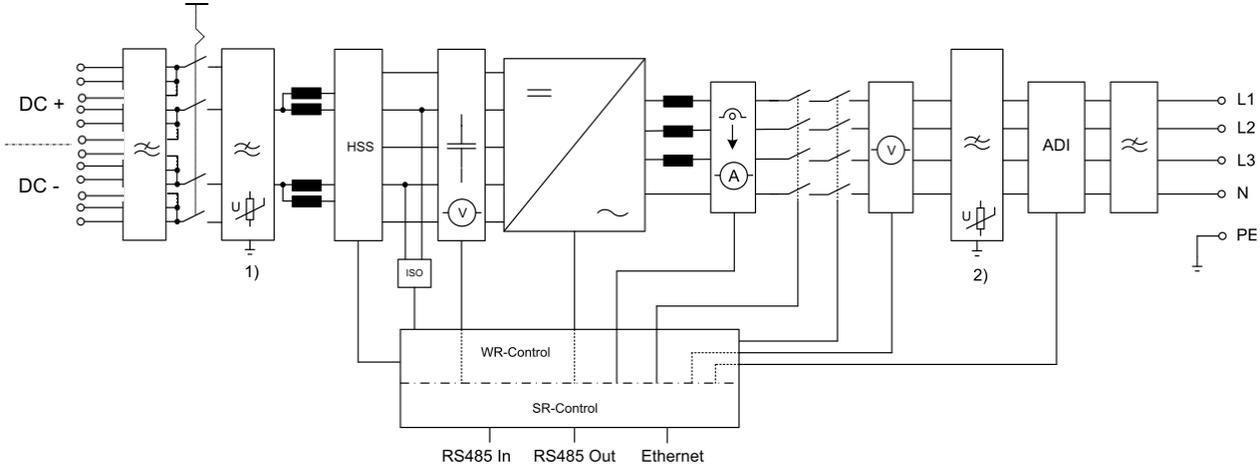


Fig. 3: Block diagram 3TL 8 ... 23

- 1) DC overvoltage protection, type 3
- 2) AC overvoltage protection, type 3

### 3.5. DC CONNECTION

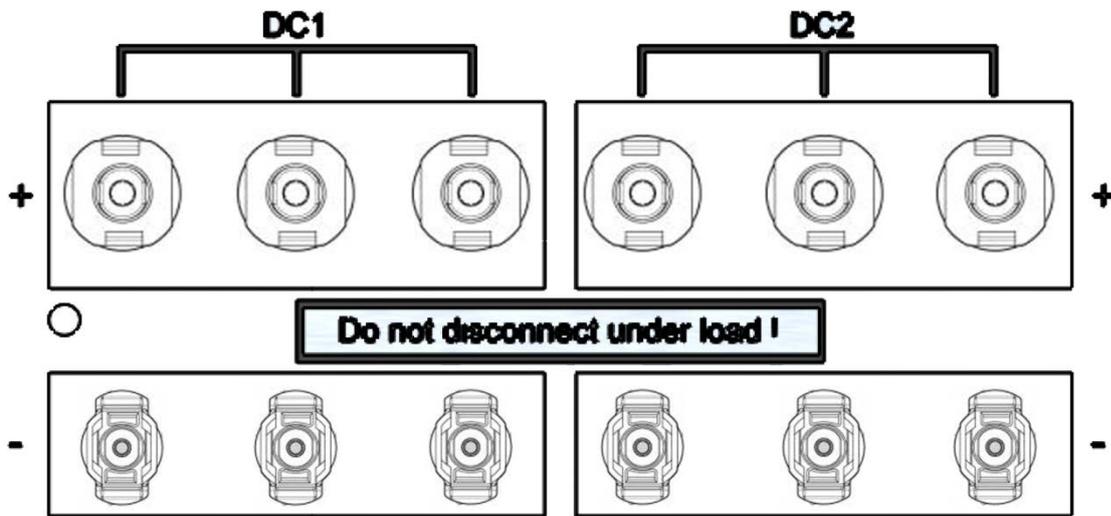


Fig. 4: Connection diagram

### 3.6. CONTROL PANEL

The graphical user interface which is integrated on the front of the device and comprises 128 x 64 pixels can be used to display the development of data, such as the feed-in power or yield. The parameters required are selected and entered on the 8-key control panel. The control panel is illuminated when a key is pressed and turns dark automatically.

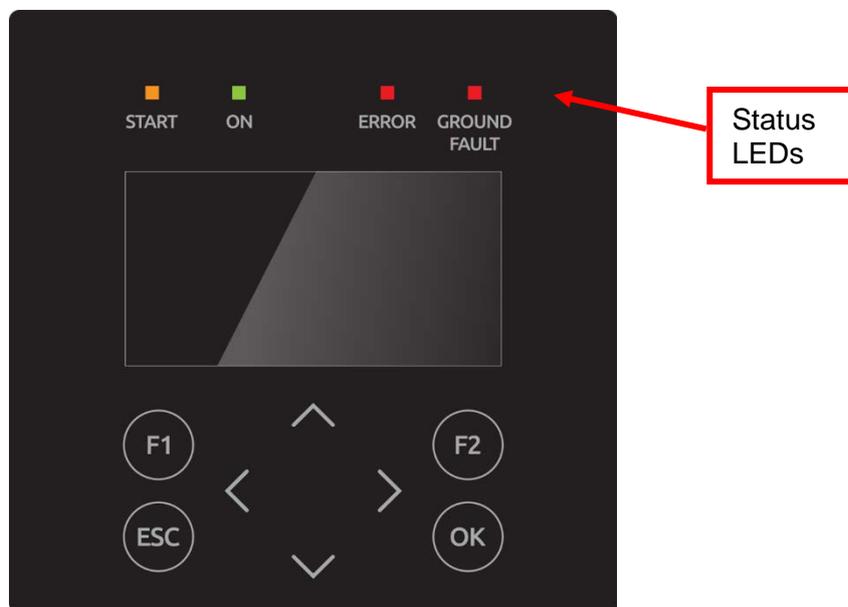


Fig. 5: Control panel

### 3.7. INTERNAL DATA LOGGER

The inverter features an internal data logger that allows measured values to be simultaneously recorded in the form of parameters. If the storage capacity is full, the oldest data

is overwritten. With the default setting on delivery, the data logger logs 16 measuring channels, which can be displayed and analyzed by AE SiteLink.

Recording cycle	Storage time
1 minute	2.5 years
2 minutes	5 years
5 minutes	12.5 years
10 minutes	25 years

## 4. Installation

### 4.1. ASSEMBLY SITE REQUIREMENTS

 <p><b>DANGER</b></p>	<p><b>Danger to life due to fire or explosion.</b></p> <ul style="list-style-type: none"><li>⇒ Do not install inverter in areas with risk of explosion.</li><li>⇒ Do not install inverter on flammable materials. Uphold fire protection class F30.</li><li>⇒ Do not install inverter in areas where easily flammable materials are stored.</li><li>⇒ Under no circumstances are the cooling ribs of the heat sink to be covered.</li></ul>
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 <p><b>WARNING</b></p>	<p><b>Danger of accident</b></p> <ul style="list-style-type: none"><li>⇒ When installing and servicing, unrestricted and safe access to the devices must be ensured.</li></ul>
---	--

The following requirements of the installation site must be upheld:

- Only vertical installation is permitted as otherwise the cooling of the device cannot be guaranteed (convection cooling).
- Do not subject the inverter to any direct sunlight.
- A fixed wall or a metal construction is necessary for installation. The weight of an inverter amounts up to 38.4 kg. Relevant construction regulations must be observed.
- The device is to be mounted at an appropriate distance from combustible materials.
- To allow for the heat dissipation required, keep the following minimum distances from the ceiling and wall as well as from neighbouring devices:



Fig. 6: Minimum distance

The device is best operated if the display is at eye level.

Owing to its protection type (IP65), the device can also be mounted in outside areas.

## 4.2. TRANSPORT

The devices must be transported under clean and dry conditions, if possible in their original packaging. The transport temperature must be between  $-25^{\circ}\text{C}$  and  $+70^{\circ}\text{C}$ . Permissible variations in temperature may not exceed  $20^{\circ}\text{C}$  per hour.

## 4.3. STORAGE

The devices must be stored in clean and dry premises, if possible in their original packaging. The storage temperature must be between  $-25^{\circ}\text{C}$  and  $+55^{\circ}\text{C}$ . Permissible variations in temperature may not exceed  $20^{\circ}\text{C}$  per hour.



### Note:

The inverter contains electrolyte capacitors which can be stored for no more than 1 year and at a storage temperature of  $\leq 40^{\circ}\text{C}$  while in a de-energized state. If the storage time of two years has been exceeded, please contact the AEI Power GmbH Service before connecting the inverter to your system!

## 4.4. CHECKING SCOPE OF DELIVERY

The scope of delivery includes a wall-mounting bracket and an enclosed bag (item no. 0030532) containing:

- 1 x 5-pin contact insert, IP67, VC-TFS5-PEA for grid connection (item no. 0028463)
- 1 x adapter housing IP67 VC-K-T3-R(10-25) PLOMB for grid connection (item no. 003206)
- 2 x cross-recessed flat-head screw, M5x20 => for mechanically securing the device in the wall bracket (item no. 0031253)
- 1 x warning label in according UTE C 15-712-1 for installing in France (item no. 0033733)

The screws for attachment to the wall are not included.

The IP67 VC-K-T3-R(10-25) PLOMB adapter housing allows sealing.

## 4.5. UNPACKING THE DEVICE



**Note:**

Moisture and dirt can get in through the openings after unpacking. Therefore, only unpack the device when it is to be connected. Failure to do so voids your warranty!

The inverters are heaviest at the top. They are therefore packed upside down to facilitate transport. You will therefore see the bottom side of the device (connectors) after having opened the package. Take the device at the two holding grips that are visible on the side and remove it from the packaging. When being unpacked, the device keeps the packaging grid locked in place on its housing. The packaging grid can be used to deposit the device on the floor. This prevents the cover from being damaged.



Fig. 7: Holding grip rear side positions

## 4.6. INSTALLATION

⇒ Check the delivery before installation (see page 22).

 <b>CAUTION</b>	<p><b>Danger of injury or damage to property</b></p> <p>⇒ Do not use the cover to hold the device. Only use the four holding grips to move the device.</p> <p>⇒ When designing the attachment of the wall-mounting plate, take the 38.4 kg weight into account.</p> <p>⇒ Do not open device. Opening the device voids the warranty.</p>
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The inverter is mounted using the wall-mounting plate which is included in the scope of delivery.

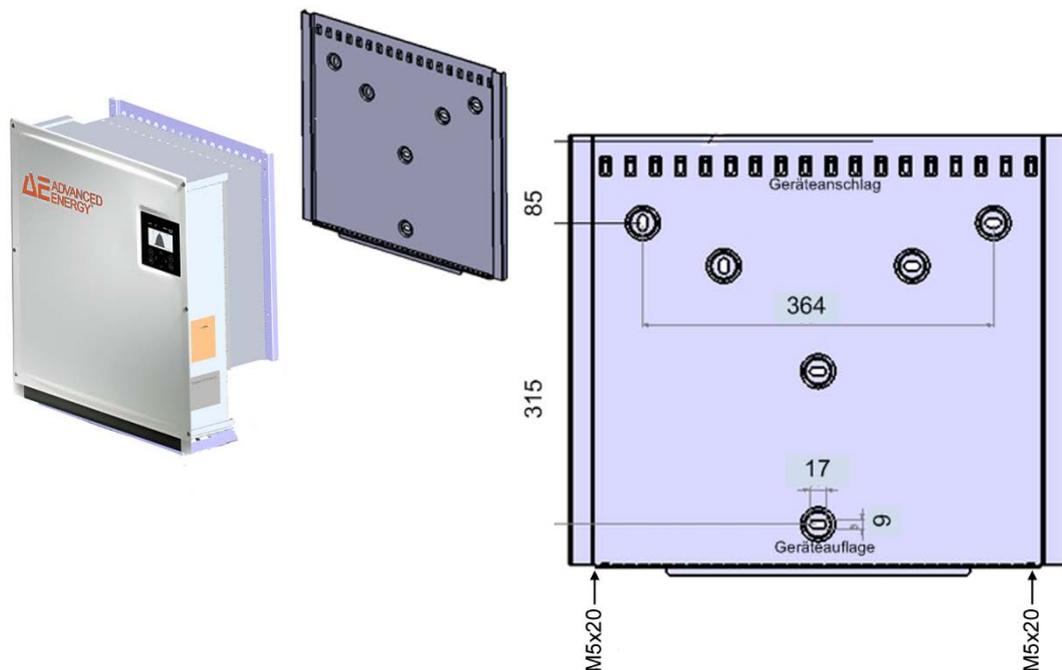


Fig. 8: Mounting the inverter

1. Use the wall bracket to mark the positions of the holes to be drilled.
1. Attach the mounting plate to the wall with the outer holes. The screws for attachment to the wall are not included. Screws with a diameter of 6 mm must be used.
2. Push the cooling ribs of the inverter into the tabs of the wall mounting plate. Push the inverter upwards until it stops. Place the lower edge of the cooler onto the wall holder. Ensure that the rib profile is locked behind the nuts.
3. Secure the inverter in these nuts using the enclosed screws (M5x20). As an alternative, you can also use a padlock (shackle 4 mm in diameter) to protect the inverter against theft. The design of the wall bracket ensures that the inverter is automatically centred in this bracket.

- In order to avoid adhesive residue on the display, remove the display protection immediately after installation.

## 4.7. DEVICE CONNECTORS

The following figure shows the connectors of the inverter on its bottom side.

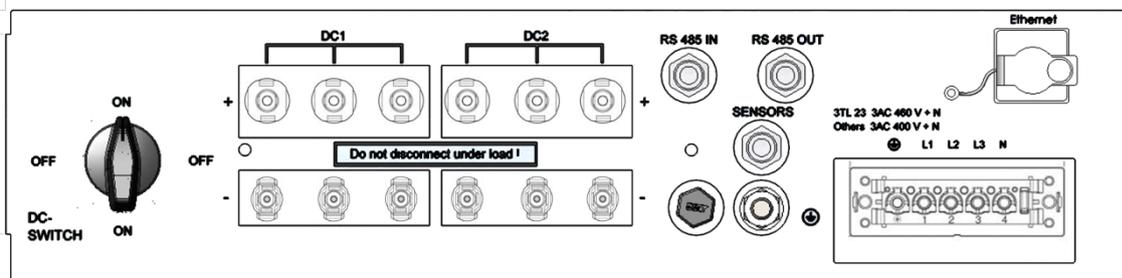


Fig. 9: Device connectors 3TL 8 ... 23

The inverter is provided with the following connectors, as seen from left to right, top to bottom:

- 6 (3TL 17 ... 23) pair of PV generator connections
- RS485 connectors (IN and OUT)
- SENSOR (connection: Irradiation and temperature sensor, AE WirelessConnect, Outdoor Ethernet Switch, Powercap)
- Ethernet interface port
- Power Connection

## 4.8. GROUNDING

 <b>DANGER</b>	<p><b>Danger to life from electric shock</b></p> <p>The inverter must be earthed with the grounding bolt, otherwise a potential difference can build up, causing a risk of electric shock!</p>
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The inverter features a threaded bolt below the power supply port on the connection side for additional grounding. Grounding is intended to comply with the EMC requirements and to ensure optimum overvoltage protection. The ground wire cross-section must be bigger than the cross-section of the power supply line. In addition, ensure that the ground wire is placed as far away from and not directly in parallel to the power supply line.

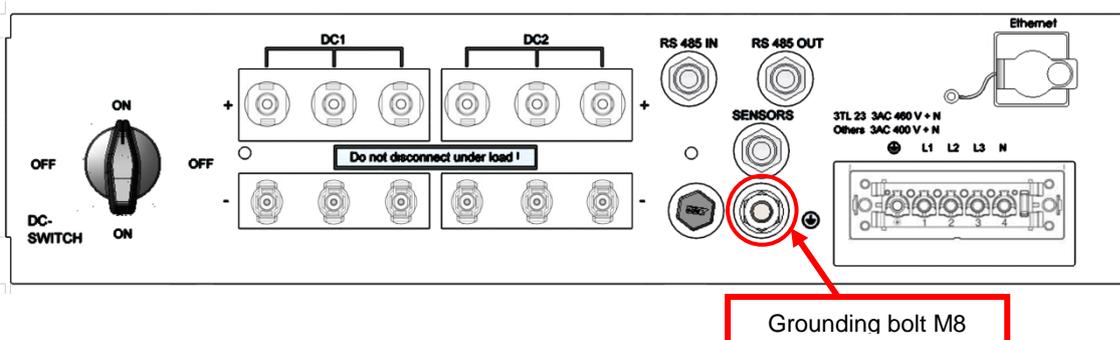


Fig. 10: Grounding bolt

## 4.9. RESIDUAL CURRENT PROTECTION

Since February 2009 in Germany, RCDs (residual current protective devices) have been prescribed for receptacle circuits of up to 20 A in interior rooms and of up to 32 A in outside areas which are used by electrotechnical non-professionals.

### Note:



The photovoltaic power supply inverters without transformers meet the fault protection requirements according to DIN VDE 0100-712, IEC 60364-7-712:2002 and CEI 64-8/7 and can be operated with a type A residual-current circuit breaker without any functional impairment of the protection or the inverter.

The rated leakage current should be at least 100 mA per inverter.

## 4.10. POWER CONNECTION

 <b>DANGER</b>	<p><b>Risk of electric shock and fire caused by high discharge current!</b></p> <p>⇒ Before connecting the device to the supply circuit, establish a ground connection by means of the labelled ground stud!</p>
--	--

### Note:



To ensure the IP65 protection class, only use the male and female connectors provided and connect them according to the connector manufacturer's mounting instructions. To prevent any penetration of moisture and dirt, unused inputs and outputs must be properly closed. Failure to do so could void your warranty!

The following mains systems are allowed:

- TN-C-Net
- TN-C-S-Net
- TN-S-Net

The connection to the power supply must be via a 5-wire line. For safety reasons, the PE protective conductor must always be connected.

The power supply line must be equipped with an appropriate line protection. More information regarding the power connection you will find in the Technical Data, page 64. Reducing factors must be taken into account if circuit breakers are connected in series.

Always observe the following standards:

DIN VDE 0298-4	Types of cable placement and current carrying capacity
DIN VDE 0100; Part 430	Protective measures: protection of cable and lines against overcurrent
DIN VDE 0100; Part 410	Protective measures: protection against electric shock

The respectively national standards are to be upheld.

The following specifications of the local grid operator are to be observed:

- Pertinent technical and special regulations
- Installation approval must be in place

 <b>DANGER</b>	<b>Danger to life from electric shock</b>  ⇒ Before connecting the inverter to the AC network, isolate the power connection, verify that the system is de-energized, and protect the circuit breaker against reactivation.
--	--

- Check the line voltage. It must be within the technical data for that device. If the line voltage is higher, contact your local network operator.
- The AC side must not be measured by inserting test probes into the AC plug, because this will damage the plug contacts.



**Note:**

When using wire end ferrules with isolating collar, make sure you do not introduce the insulation of the wire end ferrule into the clamping area of the terminal.

## 4.11. POWER SUPPLY LINE

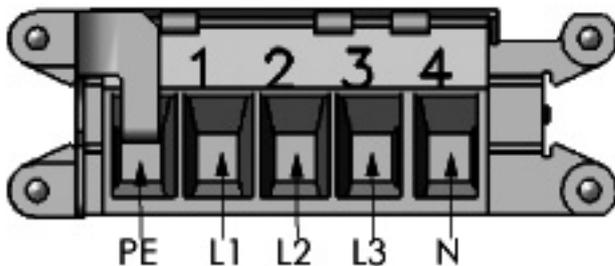


Fig. 11: Power Connection

Select the cross-section of the power supply line such that line losses are as low as possible. However, observe the following points:

- the plant raiser must be selected according to the case of operation (installation location and laying type) and the national regulations of the cable material.
- Due to the construction, the recommended feed line for all cross-sections is a fine wire.
- Copper wires must be used.
- The wires are to be installed in the correct position in order to minimise lateral forces on the net connection. The lateral forces must not exceed 250 N.
- Rigid wires are not recommended for the use of 16 mm<sup>2</sup> cables.
- The seal is run through a hole in the screw (below the screw head of the adapter housing) and the opening provided and attached to the housing of the device.

The following table shows the maximum wire lengths upon use of an AE 3TL 8 ... 23 depending on the cable cross section with a voltage drop  $\leq 1\%$ :

Line cross section	6.0 mm <sup>2</sup>	10.0 mm <sup>2</sup>	16.0 mm <sup>2</sup>
Max. line length	30 m	50 m	70 m

**Note:**

In order to ensure IP65 protection, the AC connection housing supplied must be used.

#### 4.11.1. Fitting of supplied power plug

The cable fitting of the standard connector housing supplied allows 5 x 6 mm<sup>2</sup> to 5 x 16 mm<sup>2</sup> cables to be connected. The maximum outside diameter of the power supply line may be 30.3 mm (e.g. Lapptherm 145, 5 x 6 mm<sup>2</sup>).

1. Bend cable into position.
2. Strip the cable as shown in the illustration.

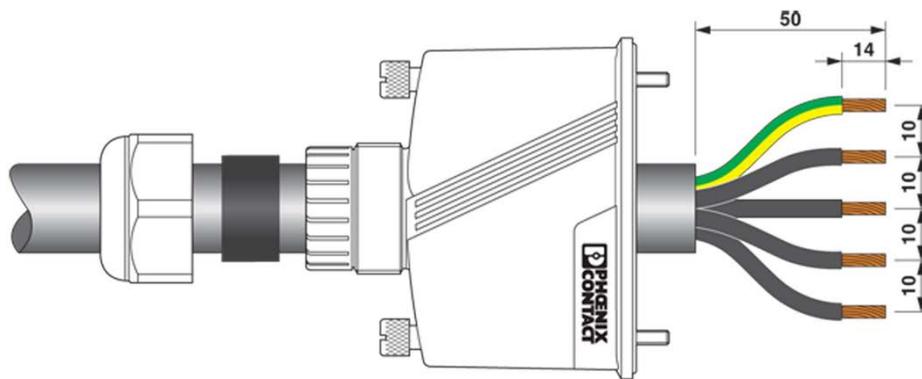


Fig. 12: Preparation of plug cable

3. Screw in plug.
4. Note torque specification according to illustration.

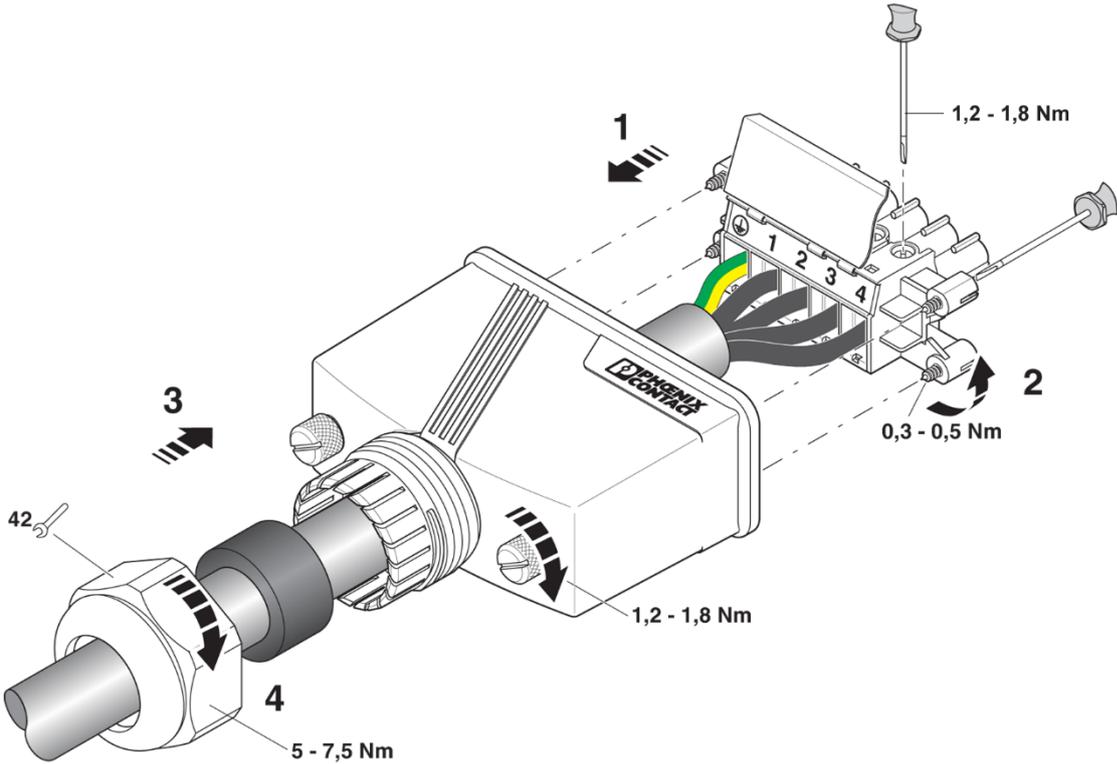


Fig. 13: Screw in plug

- 5. Determine diameter.
- 6. Seal connection.

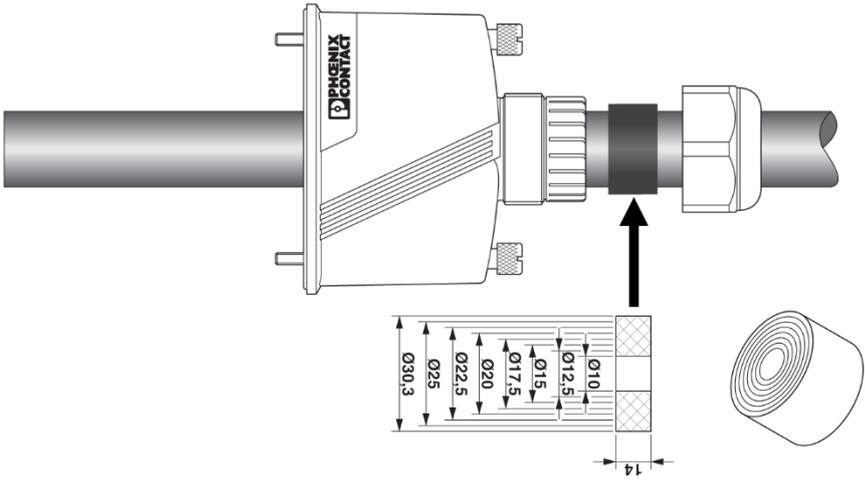


Fig. 14: Diameter

## 4.12. GRID LINE IMPEDANCE

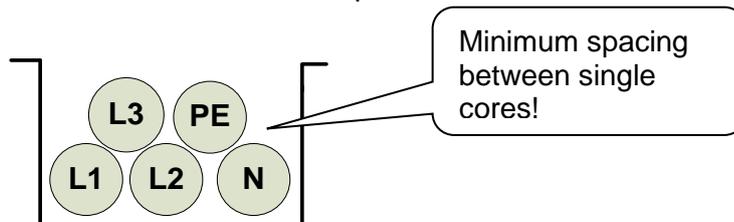
For better efficiency, large line cross-sections in single cables are increasingly used for power supply lines, especially if local conditions require long supply lines.

The considerable line lengths between inverter and the transformer station result in a high cable inductance and therefore an increased line impedance. This presents high resistances for harmonics of the fundamental frequency (50 Hz) of the line voltage and causes voltage distortions in the inverters as well as error messages with regard to:

- controller voltage
- Grid frequency
- grid overvoltage
- sometimes increased operating noise of the inverters

To avoid these disadvantageous conditions, twisted lines should be used for power supply if possible. If laying of twisted lines is not possible, the following requirements must be met for single cores:

- The spacing between single cores may not be too large.
- It is not allowed to lay single cores in closed, magnetically conducting materials (e.g., sheet steel pipe).
- If laid in open cable ducts, single cores should be laid such that the spacings between them are as small as possible.



- Single cores should not be laid along magnetic materials.



### Note:

The sum total of the ohmic and inductive voltage drop on the power supply line at nominal load should not exceed 1% of the line voltage.

## 4.13. DC CONNECTION PV GENERATOR

 <b>DANGER</b>	<p><b>Danger to life due to high voltages from active PV strings</b></p> <p>Before connecting the PV strings, connect the inverter to the power supply network and to the ground bolt to ensure that the device is <b><u>safely connected to the protective conductor</u></b>.</p> <p>The connection of the PV strings to the inverter or the CombinerBox can only take place <b>without voltage</b>.</p> <p>Live PV strings can be under lethal voltages.</p>
--	--

The maximum allowable voltage of 25 A per DC block must be upheld. The maximum DC voltage via all inputs must under no circumstances be exceeded.

- The DC connection is effected with Sunclix-plugs and sockets. More information see

see "DC-Connection",p. 30.

- Before connecting the PV strings an isolation measurement must be taken. Whenever it is switched on, the inverter automatically checks the insulation of the PV generator. If the isolation is defective, the inverter switches off automatically. The inverter can only be started once the PV generator isolation error has been removed.
- Be absolutely sure to verify proper polarity when connecting the PV strings. Any inappropriate connection of individual strings may damage the PV generator.

Protect the connectors such that they cannot be pulled off inadvertently.

The PV generator may not exceed the following operational characteristics under any circumstances!

Device type	AE 3TL 8 ... 23
Max. DC voltage at each input ( $U_{sc}$ )	1000 V
Max. voltage per DC block (DC1/DC2)	25 A
Max. DC current via all DC inputs	See "Technical data", p. 64



**Note:**

Failure to observe this can lead to damage to the DC circuit breaker and therefore void the warranty.



**Note:**

Do not ground the positive or negative pole of the PV generator. Otherwise, the modules may experience a loss of power.



**Note:**

Reverse currents are fault currents that occur in PV systems comprising parallel strings. Given short circuits of individual modules or cells in a module, the open circuit voltage of the string in question can drop so far that the intact parallel strings will drive a reverse current through the defective string. This may result in significant heating and therefore to destruction of the string.

What is more, the reverse current may cause secondary damage.

As no separation of the strings takes place within the inverter, each string must be separately protected by a string fuse connected in series with the other string fuses. In the event of a failure, this isolates the string from the intact strings so that destruction is prevented.

#### 4.13.1. DC-Connection

Please note the following information (plug type, cross section) regarding the DC power cable:

Designation	Type	Type no. AE	Art.-Nr. PHOENIX CONTACT	Diameter with wire insulation	Cable cross section
Connectors	PV-CM-S 2.5-6 (-)	0034848	1774687	5 – 8 mm	4 – 6 mm <sup>2</sup>

Connectors	PV-CF-S 2.5-6 (+)	0034847	1774674	5 – 8 mm	4 – 6 mm <sup>2</sup>
PV-C PROTECTION CAP		0034844	1785430		

If necessary, the following photovoltaic Y distributors may be used:

Type	Type no. AE	Type no. PHOENIX CONTACT
PV-YC 6/ 1-0,12-SO3 (-/++)	0035216	1787726
PV-YC 6/ 1-0,12-SO3 (+/-)	0035217	1787739

For the adjustment of MC4 to Sunclix use the following adapter cable:

Typ	Type no. AE	Type no. PHOENIX CONTACT
PV-AS-MC4/6-150-MN-SET	0035043	1704982

**Note:**



In order to ensure IP65 protection, plug connectors and power supply connection cables must be matched to each other and all unused connectors shall be fitted with blanking plugs. Only the original components by PHOENIX CONTACT can be used! Failure to do so could void your warranty!

#### 4.13.2. Connect PHOENIX CONTACT connector (SUNCLIX)

 <b>DANGER</b>	<p><b>Danger to life due to high voltages from active PV strings</b></p> <ul style="list-style-type: none"> <li>⇒ The SUNCLIX connectors are only to be connected by electro-technically trained personnel.</li> <li>⇒ Never connect or disconnect SUNCLIX connectors when under load.</li> </ul>
--	---

 <b>CAUTION</b>	<p><b>Danger of injury or damage to property</b></p> <ul style="list-style-type: none"><li>⇒ Only use the SUNCLIX connectors together with a PV1-F type 2.5-6 mm<sup>2</sup> solar cable or UL-certified solar cable (ZKLA stranded copper wire, AWG 10-14). A safe electrical connection is only guaranteed with this cable. Further cable types can be requested from PHOENIX CONTACT.</li><li>⇒ When laying the solar cable, observe the bend radii specified by the manufacturer.</li><li>⇒ Only connect the connectors to other SUNCLIX connectors.</li><li>⇒ When connecting, always observe the specifications for rated voltage and rated current. The smallest mutual value is valid.</li><li>⇒ Protect the connector against moisture and dirt.</li><li>⇒ Do not submerge the connectors under water.</li><li>⇒ Do not lay the plug directly on the roofing.</li><li>⇒ Protect unplugged connectors with a protective cap (e.g. PV-C PROTECTION CAP, 1785430).</li></ul>
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#### 4.13.2.1. CONNECT CABLE

1. Strip the cable by 15 mm with a suitable tool. Ensure no individual strands are cut off.
2. Carefully add stripped conductors with drilled bunched conductors until impact. The bunched conductor ends must be visible in the spring.
3. Close spring. Ensure that the spring is locked in place.
4. Push insert into the barrel.
5. Tighten the cable screws with 2 Nm.
6. Bring together plug and bush. The connection latches.
7. By pulling the coupler, check the correct connection.

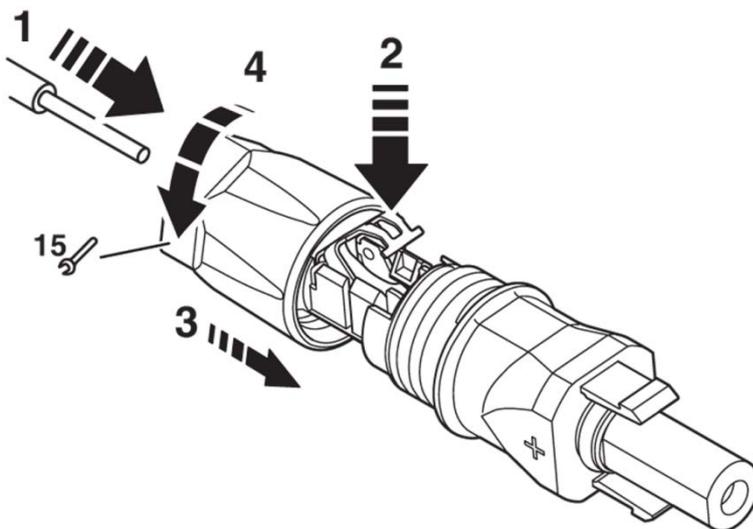


Fig. 15: Connect cable

#### 4.13.2.2. DISCONNECT CONNECTOR

A slit screwdriver is required with 3 mm wide blade (e.g. SZF 1-0,6X3,5, 1204517).

1. Enter screwdriver as demonstrated in picture below.
2. Leave screwdriver attached and separate bush and plug from one another.

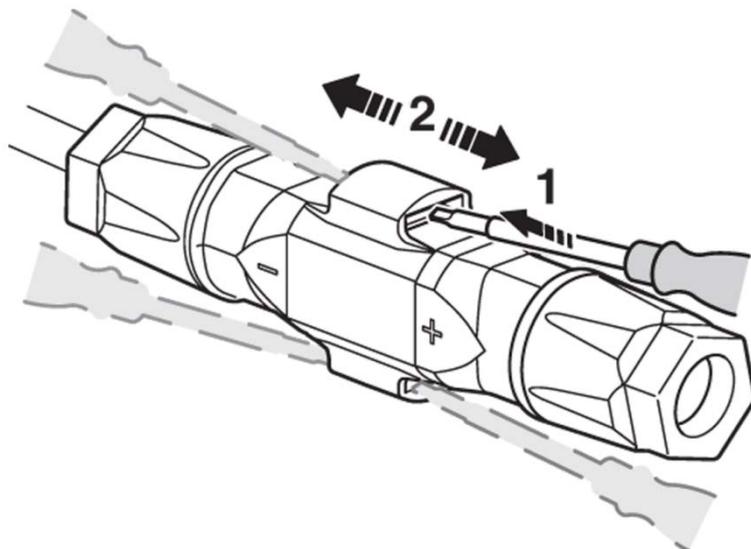


Fig. 16: Disconnect connector

#### 4.13.2.3. REMOVE CABLE

1. Unscrew cable screwing.
2. Enter screwdriver as demonstrated in picture below.
3. Pry open connection and separate barrel and insert from one another.
4. Open spring with screwdriver. Remove cable.

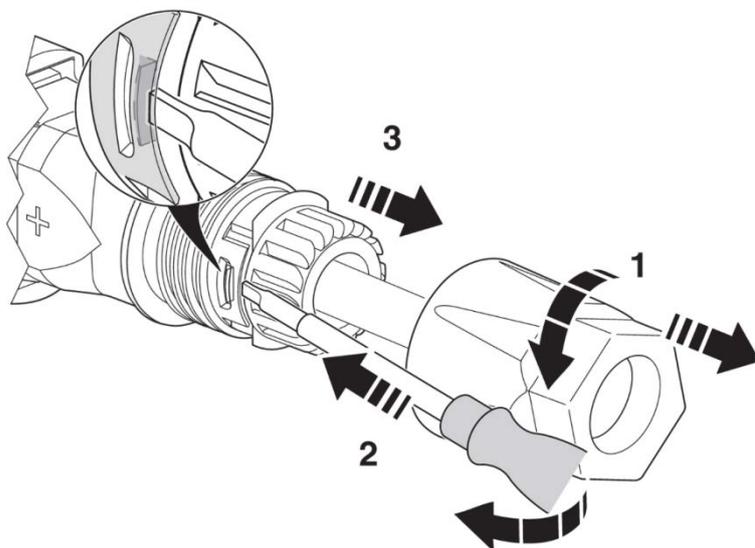


Fig. 17: Remove cable

### 4.14. INTERFACE PORT RS485

RS485 OUT	RS485 IN
-----------	----------

Pin 1	Bus termination +	Pin 1	Reference +
Pin 2	RS485+ OUT	Pin 2	RS485+ IN
Pin 3	RS485- OUT	Pin 3	RS485- IN
Pin 4	Bus termination -	Pin 4	Reference -

Bus termination (wire jumper)

The RS485 interface supports the USS protocol (Universal Serial Interface Protocol) which can be used for transmission of data, for example, to a data logger of a remote monitoring system.

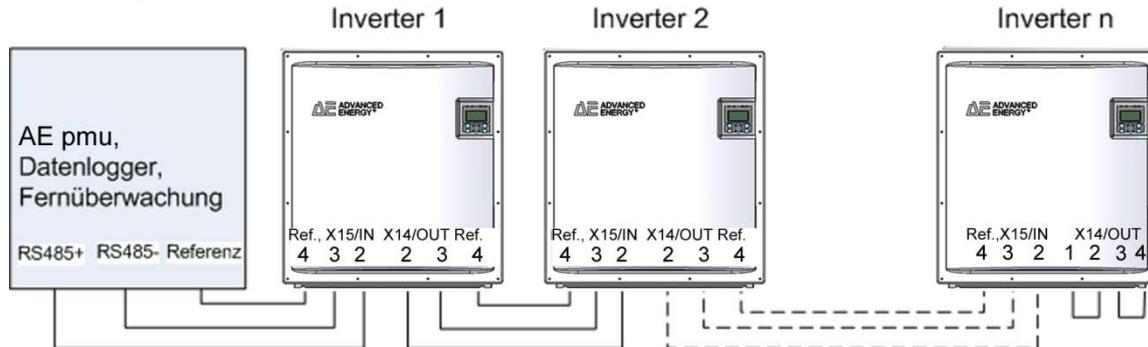


Fig. 18: Standard interface

When using this interface, please note that each device using the bus requires a unique address.

The bus termination is made by means of wire jumpers on X14 to the last bus user (inverter "n").

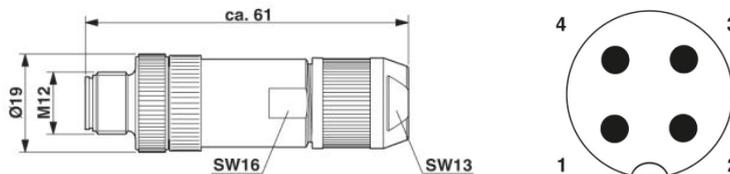


Fig. 19: Connector M12 x 1 straight, shielded; pole arrangement: male M12, 4 pins, A-coded, view of male connector side

**Note:**



In order to ensure IP65 protection and the required and declared conformity with the domestic EMC standard a PHOENIX CONTACT type M12MS SACC-4SC SH plug and a shielded cable must be used. The outer diameter of the connecting cable can be max. 8mm.

Failure to observe this can lead to damage to the inverter and therefore void the warranty.

The plug pair can be ordered with item number 0033270 at AE.

## 4.15. ETHERNET INTERFACE CONNECTION

Please use an Ethernet cable with S/FTP design (shielded foiled twisted pair) and PhoenixContact plug type Quickon VS-08-RJ45-5-Q/IP67.



**Note:**

In order to ensure IP65 protection, the plug type mentioned above must be used.

Failure to observe this can lead to damage to the inverter and therefore void the warranty.

The plug can be ordered from AE under item number 0028943.

## 5. Commissioning

Before commissioning the inverter, be sure the following steps have been completed:

- ☑ Confirm the correct power supply connection
- ☑ Confirm the correct connection of PV strings
- ☑ Confirm that connectors are protected such that they cannot be pulled off inadvertently

 <b>DANGER</b>	<p><b>Danger to life from electric shock</b></p> <p>⇒ Before switching on the device, check whether the plugs are securely fitted (locked).</p> <p>Do not pull off the connectors of the PV generator before you have met the following requirements:</p> <ul style="list-style-type: none"><li>⇒ Make the power supply line absent of voltage.</li><li>⇒ Make the device absent of voltage using DC circuit breaker.</li><li>⇒ Check that the DC cables of the PV generator are de-energized.</li><li>⇒ Protect the voltage supply from being reactivated</li></ul>
--	--

 <b>DANGER</b>	<p><b>Risk of electric shock and fire caused by high discharge current.</b></p> <p>⇒ Before connecting the device to the supply circuit, establish a ground connection.</p>
--	---

### 5.1. TURNING ON THE DEVICE

1. Verify that the device is connected to line voltage. If not, insert the external power fuse or turn on the circuit breaker.
2. Create voltage by connecting the DC circuit breaker. The inverter only starts if there is sufficient voltage available.



**Note:**

The control panel, including its status indicators, display, and operator keys, is only active when the PV generator is supplying sufficiently high voltage.

### 5.2. SETTING THE COUNTRY ABBREVIATION AND THE MENU LANGUAGE

When switching on for the first time an initial configuration is necessary.

The country abbreviation defines the country-specific grid monitoring parameters. The menu language is automatically set when the country abbreviation is selected. The menu language can subsequently be selected as desired at any time, independent of the country abbreviation set in the menu. The country abbreviation is not set on delivery.

 <b>CAUTION</b>	<p><b>The selected country code can only be changed by Service personnel.</b></p> <p>After the initial setting and confirmation of the country code the country code can no longer be altered. This is also valid for replacement devices. The country code can then only be changed by authorised Service personnel.</p>
 <b>CAUTION</b>	<p><b>Cancellation of the operating license!</b></p> <p>Operating the AE inverter with the wrong country code can lead to the withdrawal of the operating permission from the energy supplier.</p>

**Note:**

We assume no liability for the consequences of an incorrectly set country abbreviation!

**Set country code/grid guideline**

The following window appears on the display after initial switch on of the DC voltage and prompts you to set the country code. You can choose from among the offered countries. The term "country code" as such is not displayed in the menu. The display is illuminated after you press the first key.



1. Use the "▲" and "▼" keys to select the country code which is specific for your country and your location. The menu language is selected simultaneously with the country code. However, the menu language can later be changed independently of the country code.
2. Press "OK" to confirm. Then the grid feed guideline given by the energy supplier must be selected.



3. Select valid grid feed guideline with "▲" and "▼" buttons.
4. Press "OK" to confirm.

### Accepting the country code

To be certain, you will be queried whether you wish to accept the country code. After accepting the country code it can only be changed within 40 hours.



Only confirm the country code if you are absolutely sure it is correct.

If you are not sure, press "ESC" to cancel your selection. In this case the device cannot be operated.

If the country code is to be accepted, then confirm with "OK".

A restart then takes place:

⇒ "ERROR" and "GROUND FAULT" status LEDs flash red alternately.



## 5.3. DEVICE START

### Meaning of the abbreviations on the display:

PAC	Feed power in watts (W)
UAC	Line voltage in volts (V)
UDC	Solar cell voltage in volts (V)
Y day	Yield of the day (kWh)

- Solar modules are irradiated with sufficient sunlight.
- Country code is set.

The following procedure follows:

### Self-test:

⇒ All status LEDs are lit for approx. 6 seconds

# Performing Selftests

BF\_011.04.24.00

**Check:**

⇒ "Start" status LED lights orange.

<b>PAC</b>	<b>0 W</b>
VAC	402 V
UDC	731 V
E Tag	27.6 kWh

Check

**F1-Menue**

**Activation:**

⇒ "Start" status LED lights orange/LED "ON" flashes green.

<b>PAC</b>	<b>0 W</b>
VAC	403 V
UDC	730 V
E day	27.6 kWh

Activating

**F1-Menue**

This process can take several minutes.

**Feed in**

⇒ "ON" status LED lights green/normally all other status LEDs are off.

<b>PAC</b>	<b>4334 W</b>
VAC	403 V
UDC	656 V
E day	27.6 kWh

Feeding

**F1-Menue**

## 5.4. CONTROL PANEL

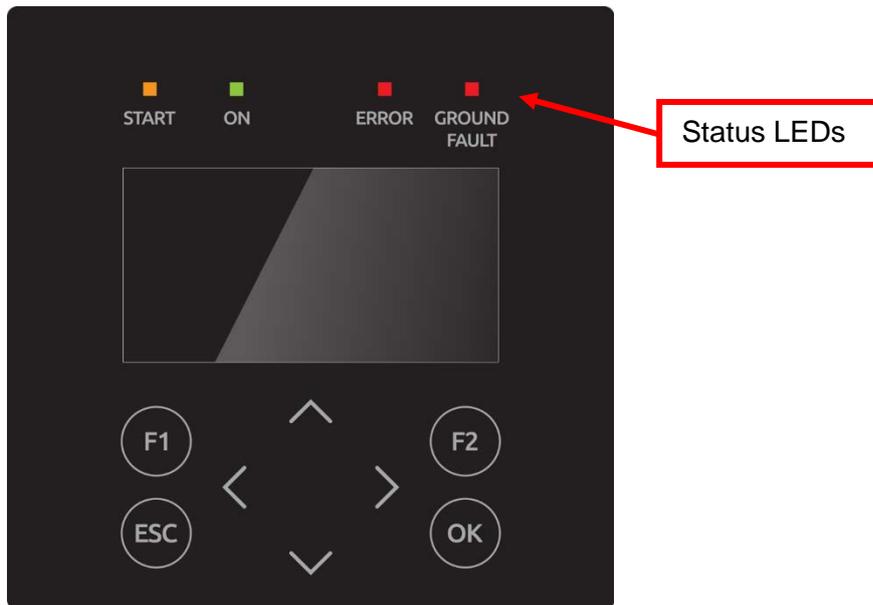


Fig. 20: Control panel with status LEDs, display and keys

<b>F1</b>	Menu display
<b>F2</b>	In basic display: Reboot of display "Yield normalised" on the display Input of standardized data.
<b>&lt;&gt;</b>	<u>Function in the menu:</u> Navigation within the menu level (previous menu, next menu). <u>Function while parameters are edited:</u> digit to the left, digit to the right (decade jump)
<b>^ v</b>	Selection within the menu.
<b>ESC</b>	<u>Acknowledge failures</u> and exit from menu level, exit from input menu without entering data
<b>OK</b>	confirm the selected menu (next menu level) and entered data.

## 5.5. BASIC SCREEN DISPLAY



Fig. 21: Operating mode display

PAC = Current feed power in watts (W)

Uac = Line voltage in volts (V)

UDC = Solar cell voltage in volts (V)

y day = yield of the day in kWh

## 5.6. GRAPHICAL DISPLAY

Press the ◀ arrow key once to display the development of the day's feed power.

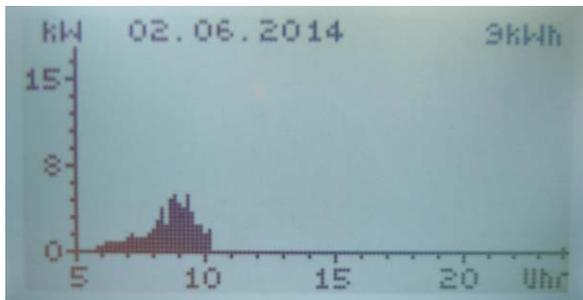


Fig. 22: "Today's" feed power display

Press the ▼ arrow key to display the development of the previous days.

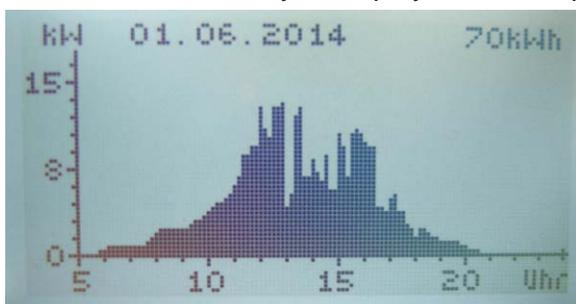


Fig. 23: "Yesterday's" feed power display

Press the **ESC** key to return to the basic screen display.

## 5.7. YIELD DATA DISPLAY

Press the ▶ arrow key to display the current yield data and the operating hours having currently elapsed.

<b>Energy absolute</b>	
Day :	10.1 kWh
Month :	80.1 kWh
Year :	738.1 kWh
Total :	3986.4 kWh
Oper. hr :	675.7 h

Fig. 24: Yield absolute display

## 5.8. STANDARDIZED YIELD DATA DISPLAY

Press the ▶ arrow key, then the ▼ arrow key to display the development of standardized yield data.

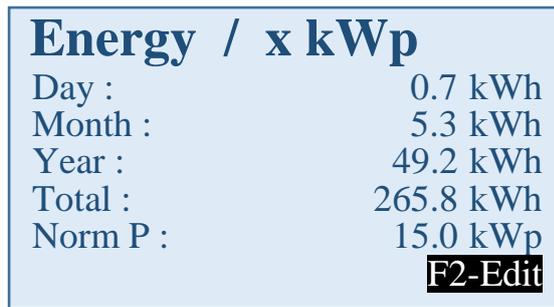


Fig. 25: Yield normalised on the display

Press the **ESC** key to return to the basic screen display.

## 5.9. INPUT OF STANDARDIZED DATA

To change the normalization, press the **F2** key and enter the currently connected PV generator power as follows:

- ◀▶ keys:            Pressing the ◀ key: Selection of the place before the point  
                          Pressing the ▶ key: Selection of the place after the point
- ▲ key:                Whenever you press this key, the number at the digit selected is incremented by 1.
- ▼ key:                Whenever you press this key, the number at the digit selected is decremented by 1.

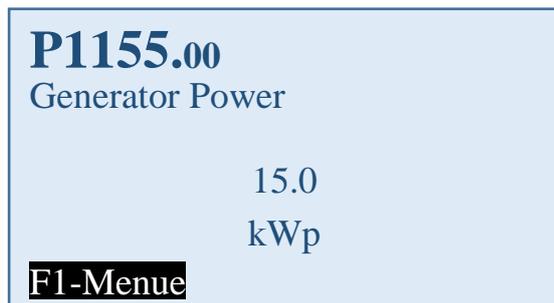


Fig. 26: Standardized data input display

Press the **"OK"** key to apply the set value.

Press the **ESC** key to discard the value and display the previous "normalized yield" level.

Press the **F1** key to display the menu.

## 5.10. MENU STRUCTURE

The menu structure serves as a support to change to the individual information displays and setting displays. For navigation, see "Control panel", p. 40.

Menu level 1	Menus level 2	Menus level 3	Menus level 4	Display without entry
--------------	---------------	---------------	---------------	-----------------------

Menu level 1	Menus level 2	Menus level 3	Menus level 4	Display without entry
Analysis	Absolute yield			Yield absolute Day: 41.7 kWh Month: 1322.0 kWh Year: 5083.4 kWh Total: 5083.4 kWh Oper. hr: 422.3 h F1-Menue
	Standardized yield			Yield / x kWp Day: 2.8 Month: 88.1 Year: 338.9 Total: 338.9 Norm P: 15.0 F1-Menue
Actual values	DC			DC power 6714.4 W DC voltage 504.2 V DC current 13.3 A F1-Menue
	AC			AC power 6521.4 W AC voltage 228.2 V AC current 23.3 A AC frequency 50.0 Hz F1-Menue
	Sensors			Heat sink 40.4°C Interior 46.4°C Irradiation 622.3W/qm Panel 37.4°C F1-Menue
Fault memory			Display of the fault memory, e.g. grid undervoltage. Using ◀ ▶ you can navigate between the display of the date and the fault number.	
Configuration	Languages	"List of languages"	See p. 45	
	RAC limit	See p. 45		RAC limit
	External switch off			Entry of sensor
	Communication	Ethernet (see p. 46)		DHCP
IP address				Entry of IP address
Subnet mask				Entry of subnet mask

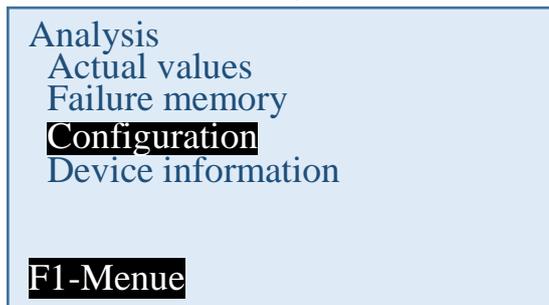
Menu level 1	Menus level 2	Menus level 3	Menus level 4	Display without entry	
			Standard gate-way	Standard gate-way entry	
			DNS	DNS entry	
		RS485 (see p. 47)	USS address	Entry USS address	
			Protocol	Entry Protocol	
			Baud rate	Entry Baud rate	
	Date/Time			Entry of Date/Time	
	Portal monitoring	Activation			Activation: 0 = off 1 = on
		Sending Config		0 = no activity 1 = configuration data is being sent	
		Portal Test function		With a "yes" entry the data package is sent to the webserver (portal). There is no feedback. To check, contact service.	
	Extended	Numerical list		Display of all internal parameters (only for service)	
	Device information	Version ID		Version recognition display	
Country of use			Country code display		
Current language			"Current language" display		
Device type			Device type display		
Serial number			Serial number display		
Ethernet			Active IP-adress display		

## 6. Configuration

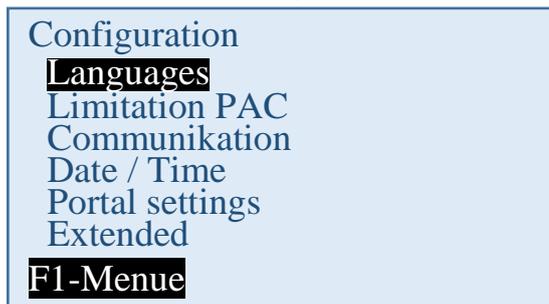
### 6.1. CHANGING THE MENU LANGUAGE

The language selection has no effect on the country code. Proceed as follows to change the menu language:

1. Press "**F1**" to open the menu.
2. Use the "▼" and "▲" keys to select the fourth menu item Configuration.



3. Press "OK" to confirm.
4. Use the "▼" and "▲" keys to select the first menu item Languages.



5. Press "**OK**" to confirm.
6. Use the "▼" and "▲" keys to select the desired menu language.
7. Press "OK" to confirm.
  - ↳ The menu switches to the selected language. The display is initially empty.
8. Press "ESC" to return to the menu.

### 6.2. REDUCTION OF THE POWER OUTPUT

Proceed as follows in order to limit the power output of the inverter:

1. Using the "**F1**" key, select the menu item Configurations and confirm with the "**OK**" key.
2. Select the sub-menu "PAC reduction" and confirm with the "**OK**" key.
3. Enter the invert power output desired and confirm with the "**OK**" key.  
An input of 70, for example, means that the inverter will only deliver 70% of its possible power output.

↳ The changed value is immediately used.

## 6.3. AE-SETUP - ÄNDERUNG UND ANPASSUNG LÄNDERSPEZIFISCHER PARAMETER

You can set the country-specific parameters of the inverter with the REFUset tool. This covers in detail:

- Feed-in conditions voltage and frequency.
- Ramp starting time in the event of a grid error
- Average voltage monitoring
- Phase conductor voltage monitoring
- Frequency-dependent power reduction
- Actual voltage monitoring (rapid disconnection)
- Actual frequency monitoring
- Reactive power ( $\cos \varphi$ )
- Power-up time
- K factor (fault ride through)

AE Setup (former REFUset) can be downloaded free under [www.advanced-energy.de/de/1TL\\_3TL\\_Downloads.html](http://www.advanced-energy.de/de/1TL_3TL_Downloads.html).

## 6.4. COMMUNICATION VIA ETHERNET

The settings for the Ethernet communication can take place either automatically (via DHCP) or manually.

### 6.4.1. Automatic setting via DHCP

1. Navigate to Configuration > Communication > Ethernet > DHCP.
2. Enter "1" in DHCP input field.
3. Press "**OK**" to confirm.
4. Restart inverter.

⇒ There is then an automatic integration of the inverter into the existing network. The necessary settings for IP address, subnet mask, standard gateway and DNS are automatically taken from the DHCP server, e.g. the superior router.

### 6.4.2. Manual setting

In order to ensure a trouble-free operation, all values must be given by the responsible network administrator and individually set in each inverter.

1. Navigate to Configuration > Communication > Ethernet > IP address.
2. Enter IPv4 address. The IPv4 address is arbitrary, but must be consistent throughout the subnet (default value: 192.168.1.99, unchangeable IP address for service purposes: 192.168.130.30).
3. Press "**OK**" to confirm.
4. Navigate to Configuration > Communication > Ethernet > Subnet mask.

5. Enter IPv4 mask. The IPv4 mask is arbitrary, but must be consistent throughout the subnet (default value: 255.255.0.0).
6. Press "**OK**" to confirm.
7. Navigate to Configuration > Communication > Ethernet > Standard gateway.
8. Enter the address of the router that allows connection to the internet (default value: 192.168.1.1).
9. Press "**OK**" to confirm.
10. Navigate to Configuration > Communication > Ethernet > DNS.
11. Enter arbitrary IPv4 address of the superior DNS server (default value: 0.0.0.0).
12. Press "**OK**" to confirm.
13. Restart inverter.

## 6.5. COMMUNICATION VIA RS485

USS address:

Input 1 – 31

This address is required for communicating with the inverter via RS485

⇒ After entering the address, restart the inverter. Only then is the new address activated.

Protocol polling via Ethernet:

Input 1

1: USS protocol

Baud rate: 57600 (preset), 115200 (only for short cable lengths)

Parity: straight

Handshake: no handshake

Data bits: 8

Stop bits: 1

Block check: CRC16

## 6.6. PORTAL MONITORING

Activation 0 or 1

0 = Portal monitoring not active

1 = Portal monitoring active

To ensure the inverter sends data to the AE SiteLink monitoring portal, the portal monitoring must be active.

## 6.7. SENDING CONFIG

The configuration data is required by AE-SiteLink in order to recognise the inverter. Of the sent data, the device type, Firmware version and country code are visible for the SiteLink user.

By setting the parameter to 1 the configuration data is first sent, then the parameter is automatically set back to 0.

## 6.8. PORTAL TEST FUNCTION

Input: "yes"

A data package is sent to the web server (portal).

There is no feedback!

Please contact the Service team to learn whether the data package was sent successfully.

## 6.9. AE SETUP

AE Setup is a configuration tool that allows extensive configurations. AE Setup can be downloaded for free from [www.advanced-energy.de/de/1TL\\_3TL\\_Downloads.html](http://www.advanced-energy.de/de/1TL_3TL_Downloads.html).

## 7. Troubleshooting

### 7.1. SELF-TEST – ERROR MESSAGE

After the initialization routine, the system runs through a self-test. The individual parts of the system, such as firmware and dataset, are checked and data is read in from the power control board. If an error continues to be detected, possible remedial measures must be taken according to the type of error.

### 7.2. TRANSIENT FAILURE

In certain operating states the inverter goes temporarily offline.

Unlike malfunctions, “transient failures” are automatically acknowledged by the inverter which attempts to restart once the error no longer exists.

A transient failure is indicated by the red LED "ERROR" on the control panel flashing and remains stored in the fault memory even in the event of a power failure. Liste der Störmeldungen.

### 7.3. FAULTS

Permanently programmed and parameterizable limit values are continuously monitored during ongoing operation. In order to be protected, the inverter power section is isolated from voltage supply if a limit value is exceeded or if a failure occurs. However, the DC and AC voltages may still be available. The corresponding fault message appears in the display.

The fault is indicated on the control panel by the red "ERROR" LED emitting steady light.

Fault messages are stored in the fault memory, where they will remain even in the event of a power failure. The fault memory can be called up via the display. The last 100 faults are recorded in the fault memory. The latest fault is kept at memory location S0, the oldest at S100. A new fault is always stored to memory location S0. When this happens, any fault already at memory location S100 will be lost.

### 7.4. FAULT ACKNOWLEDGEMENT

After shutdown due to a fault, the device remains locked against reactivation until the fault is acknowledged. It is not possible to acknowledge the fault while the cause of the fault still exists. The fault can only be acknowledged after the cause of the fault has been eliminated.

⇒ To acknowledge the fault message, press the ESC key or turn the inverter off with the DC switch and wait min. 30 seconds to turn the inverter ON again.

### 7.5. LIST OF FAULT MESSAGES

Error code	Error message	Description	Action
090006	grid overvoltage	A grid overvoltage has been detected.	As long as the inverter is detecting a grid overvoltage: check line voltages (with a true RMS measurement device). As long as you consider the

Error code	Error message	Description	Action
			line voltages to be in order, contact Service.
090007	Grid undervoltage	Grid undervoltage detected Voltage dip	As long as the inverter is detecting a grid undervoltage: check line voltages (with a true RMS measurement device). As long as you consider the line voltages to be in order, contact Service.
090008	Overfrequency	The grid frequency has exceeded the limit value.	As long as the inverter is detecting an overfrequency: check the frequency of the phases. As long as you consider the frequencies to be in order, contact Service
090009	Underfrequency	The grid frequency has dropped below the limit value.	As long as the inverter is detecting underfrequency: check the frequency of the phases. As long as you consider the frequencies to be in order, contact Service
09000A	DC link 3	Regulation error in positive boost converter	Wait for the regulator to become stable again. If this takes more than 2-3h, please contact Service.
09000B	DC link 1	Asymmetry low: Difference between the two solar voltages is too high.	If problem occurs once only: wait for the regulator to become stable again. If problem occurs repeatedly: please contact Service.
09000C	DC link 2	Asymmetry high: Difference between the two boosted DC link voltages is too high	If problem occurs once only: wait for the regulator to become stable again. If problem occurs repeatedly: please contact Service.
09000D	DC link 4	The positively boosted DC link has dropped below the mains peak value	If problem occurs once only: wait for the regulator to become stable again. If problem occurs repeatedly: please contact Service.
090010	DC link 5	The positively boosted DC link voltage is too high.	If problem occurs once only: wait for the regulator to become stable again. If problem occurs repeatedly: please contact Service.
090011	DC link 6	The positive solar voltage is too high.	If problem occurs once only: wait for the regulator to become stable again. If problem occurs repeatedly: please contact Service.

Error code	Error message	Description	Action
090017	Communication PS	Communication malfunction between power section and control and regulation unit	Do nothing. The inverter will acknowledge the error automatically. If problem occurs repeatedly, contact Service
090018	Grid frequency PS	Power section has detected under/overfrequency	As long as the inverter is detecting a PS grid frequency: check the frequency of the phases. As long as you consider the frequencies to be in order, contact Service
090019	Grid overvoltage PS	The power section has detected a grid overvoltage.	As long as the inverter is detecting a grid overvoltage: check line voltages (with a true RMS measurement device). As long as you consider the line voltages to be in order, contact Service.
09001A	Grid undervoltage PS	The power section has detected a grid undervoltage.	As long as the inverter is detecting a grid undervoltage: check line voltages (with a true RMS measurement device). As long as you consider the line voltages to be in order, contact Service.
09001B	RCD fault	The power section has detected residual current. Isolation error during operation.	Check system isolation. As long as you consider the isolation impedance to be in order, contact Service.
09001D	RCD warning	The power section has detected residual current during operation.	Check system isolation. If you consider the system isolation to be in order, contact Service.
090020	Initialisation C1	Initialisation has failed.	Restart inverter. If this does not rectify the error, contact Service.
090021	Initialisation C0	Initialisation has failed.	Restart inverter. If this does not rectify the error, contact Service.
090023	Permanent fault	A critical fault has repeatedly occurred. The device has been permanently shut down.	please contact Service.
090024	SR parameter error	Error in parameter initialisation. The device has been permanently shut down.	Please contact Service.
090028	Update Start	Update start notification.	When starting an update this notification is entered. It shows that an update is currently running and that the device is not running.
090029	Update fault	Update failed	The update has failed. Contact Service. Warning, the device is stopping.

Error code	Error message	Description	Action
09002B	Update End	Update successful notification.	An update was successfully completed. The device will resume normal operation.
090052	User lock active	User lock is active	Deactivate user lock
090053	Communication SR	Internal communication problems	Fault is independently resolved after a few minutes. If not, switch device off and on again. If this does not resolve the problem, contact Service.
090054	Overvoltage 2	The nominal grid voltage was below the limit value of the voltage average monitor for too long.	As long as the inverter is detecting the voltage error: monitor line voltages (analyse grid). As long as you consider the line voltages to be in order, contact Service.
090057	Watchdog C0	Internal protection function is triggered.	Contact Service.
090058	Watchdog C1	Internal protection function is triggered.	Contact Service.
090059	PS Firmware	The software of the PS is defective.	Contact Service.
0A0013	PM isolation AFISR	Control and regulation unit has detected residual current.	Check system isolation. If you consider the system isolation to be in order, contact Service.
0A0102	Overtemperature PS 1	Cooler overtemperature (right)	Check temperature of direct surroundings and reduce this as required.
0A0103	Overtemperature PS 2	Interior overtemperature (left)	Check temperature of direct surroundings and reduce this as required.
0A0104	Overtemperature PS 3	Interior overtemperature (right)	Check temperature of direct surroundings and reduce this as required.
0A0105	Overtemperature PS 4	Cooler overtemperature (left)	Check temperature of direct surroundings and reduce this as required.
0A0106	Supply voltage PS	Supply voltage at the power section is too low.	Please contact Service.
0A010C	PM isolation PS	The power section has detected a grid undervoltage.	Check system isolation. If you consider the isolation resistance to be in order, contact Service.
0A010E	Device fault PS	Power section hardware shutdown	Note: When did the error occur (precisely: day, kW output, time).
0A0110	Solar voltage PS 1	Power section overvoltage shutdown in positive DC link	Do nothing. The inverter will acknowledge the error automatically. If problem occurs repeatedly,

Error code	Error message	Description	Action
			contact Service
0A0111	Solar voltage PS 2	Power section overvoltage shutdown in negative DC link	Do nothing.The inverter will acknowledge the error automatically. If problem occurs repeatedly, contact Service
0A0114	PM isolation RCD PS	The isolation impedance of the photovoltaic module is too low	Check system isolation. If you consider the system isolation to be in order, contact Service.
0A0116	R-detect	Separator defective.	Please contact Service in order to arrange an inverter replacement.
0A0117	Isolation test unit	DC discharge is taking too long.	Please contact Service.
0A0118	Voltage offset PS	Offset adjustment values between power section and control and regulation unit divergent	Please contact Service.
0A011A	Activation PS 1	DC discharge is taking too long.	Do nothing.The inverter will acknowledge the error automatically. If problem occurs repeatedly, contact Service
0A011B	Activation PS 2	DC link voltage drop during activation	Do nothing.The inverter will acknowledge the error automatically. If problem occurs repeatedly, contact Service
0A011C	Activation PS 3	Target value for balancing is invalid.	Do nothing.The inverter will acknowledge the error automatically. If problem occurs repeatedly, contact Service
0A011D	Activation PS 4	Balancing has failed	Please contact Service.
0A011E	Activation PS 5	Uploading of DC links has failed.	Please contact Service.
0A011F	PS parameter error	Faulty reading or writing process in power section memory	1.) Switch off device with DC disconnecter. 2.) Wait until the display has turned off completely. 3.) Switch on device with DC disconnecter. If this does not rectify the error, contact Service.
0A0130	Comb. relay config	Faulty configuration of elements for the power section	Please contact Service.
0A0131	Combine relay	Switching the combine relay has failed.	Please contact Service.
0A0172	P24V aux. supply PS	P24V supply voltage at the power section is too low.	Please contact Service.

<b>Error code</b>	<b>Error message</b>	<b>Description</b>	<b>Action</b>
0A0173	P5V aux. supply PS	P5V supply voltage at the power section is too low.	Please contact Service.
0A0174	P15V aux. supply PS	P15V supply voltage at the power section is too low.	Please contact Service.

## 8. Options

### 8.1. IRRADIATION AND TEMPERATURE SENSOR

An irradiation and temperature sensor can be optionally connected for recording the irradiation and the module temperature. Type Si-13TC-T-K is recommended. AE item no. 0030628. The sensor plug is included in the scope of delivery for the irradiation and temperature sensor. The sensor plug can also be separately ordered from AE under item no. 0030616.

The sensor comes with a 3 meter UV-resistant connecting line (5 x 0.14 mm<sup>2</sup>). The line can be extended with a 5 x 0.25 mm<sup>2</sup> shielded line, max. 100 m.

More information about the technical data of the sensor you will find in p. 66.

Pin assignment					
Si-13TC-T-K			Sensor	Plug	
Red RD	Supply voltage (12-28 VDC)		Pin 1	Brown	BN
Black BK	GND		Pin 2	White	WH
Orange OG	Measurement signal for irradiation (0–10 V)		Pin 3	Blue	BU
Brown BN	Measurement signal for temperature (0–10 V)		Pin 4	Black	BK
Grey GY	Shielding		Pin 5	Grey	GY



#### Note:

The shield of the sensor line must be applied to PIN 2 and PIN 5! The outer diameter of the connecting cable can be max. 8mm.

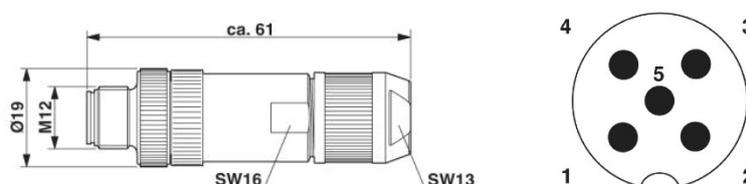
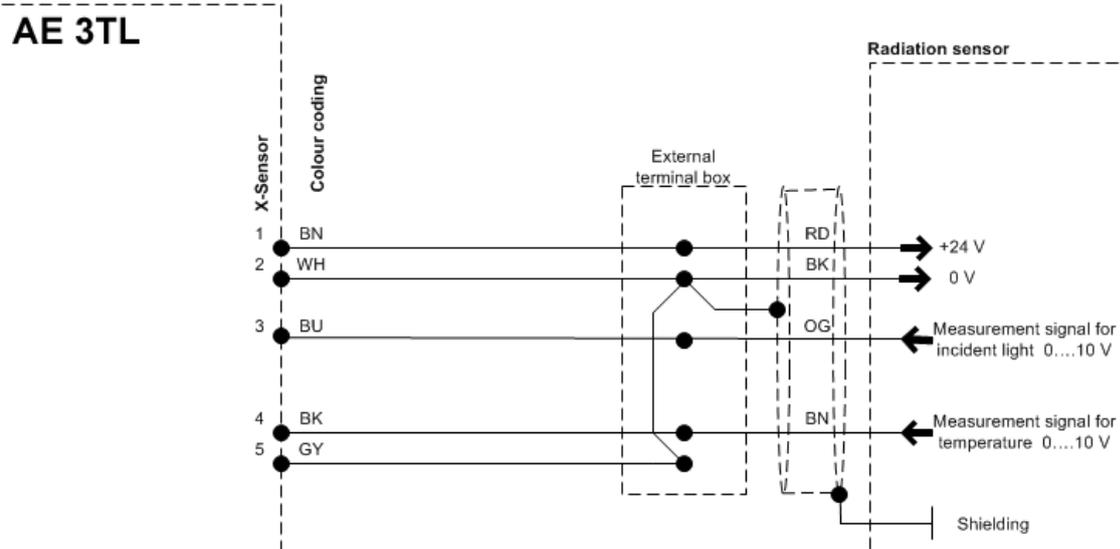


Fig. 27: Connector M12 x 1 straight, shielded; pole arrangement: male M12, 5 pins, A-coded, view of male connector side

PHOENIX CONTACT designation: SACC-M12MS-5SC SH



**Note:** If you do not use the temperature input, wire a jumper across PIN 4 and PIN 5. Alternatively, you can also wire the jumper to the intermediate terminal point (cable extension).

## 8.2. EXTERNAL TURN OFF SIGNAL

### 8.2.1. Overview

AE String inverters have an internal NS protection and section switch.

Depending on local connection, installation instructions and the selected line voltage level either the internal NA-protection can be used with section switch, or an external NS protection must be used with section switch also.

It is also possible to combine the internal to the external NA protection.

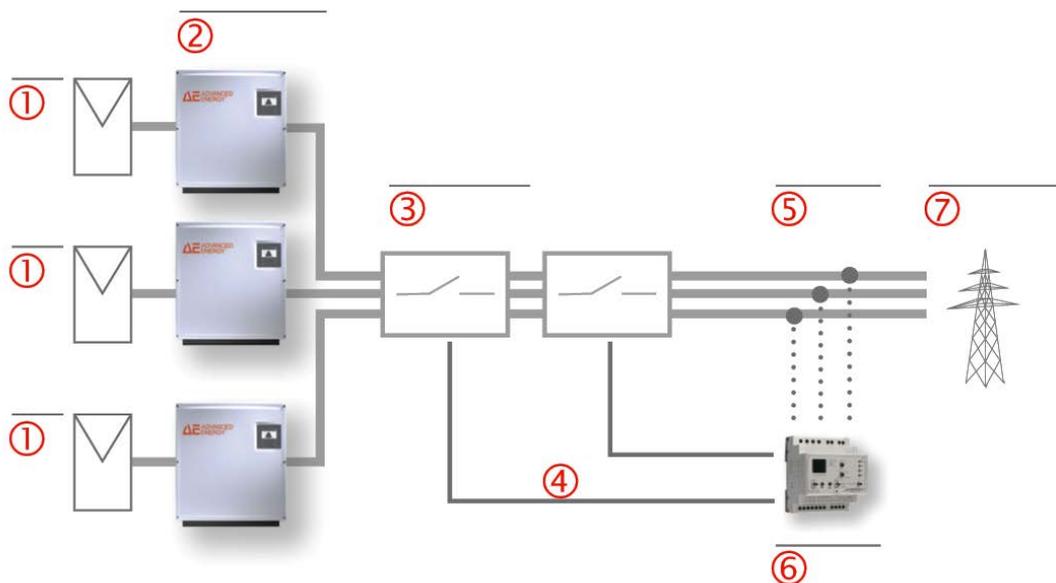


Fig. 29: Central grid and plant protection with external section switches

①	Photovoltaic modules
②	AE 3TL 40/46 kW
③	Section switch
④	Control line
⑤	AC
⑥	AE GridProtect
⑦	Low or medium voltage grid

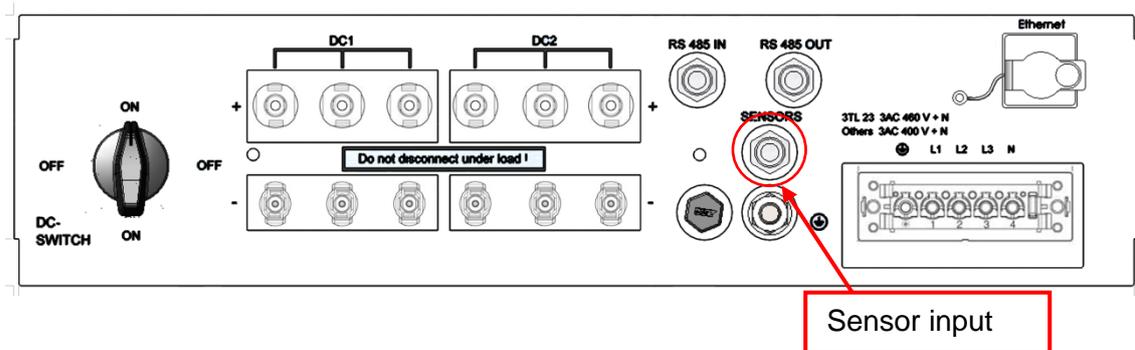
### 8.2.2. Specification

Rated input voltage	10 V DC
Input voltage (operation)	7.5... 10 V DC
Input voltage (stop)	0... 7.5 V DC
Standard inverter switch off time	50 ms
Switch off time setting area	50 ms ... 100 ms

If there is a logical 1 at the sensor output, then the inverter stays in operation. If the connected voltage drops below 7.5 V, then a fault is triggered and the inverter stops its operation within the configurable switch off time.

### 8.2.3. Configuration via sensor input

The external switch off signal takes place via the sensor input of the inverter.



The sensor plug can be separately ordered from AE under item no. 0030616.

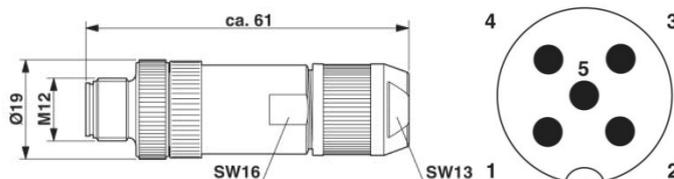


Fig. 30: Sensor plug M12 x 1 straight, shielded; pole arrangement: male M12, 5 pins, A-coded, view of

male connector side, Phoenix designation: SACC-M12MS-5SC SH

In the following, the possible allocations of the sensors are described:

**Standard configuration**

Switch off signal	0...10 VDC	Shielding				
-------------------	------------	-----------	--	--	--	--

Connection Sensor		Pin1	Pin2	Pin3	Pin4	Pin5	Sensor selection
Inverter	1	NC	Shielding	NC	Signal (0...10 VDC)	GND	3
	2						
	3						
	n						

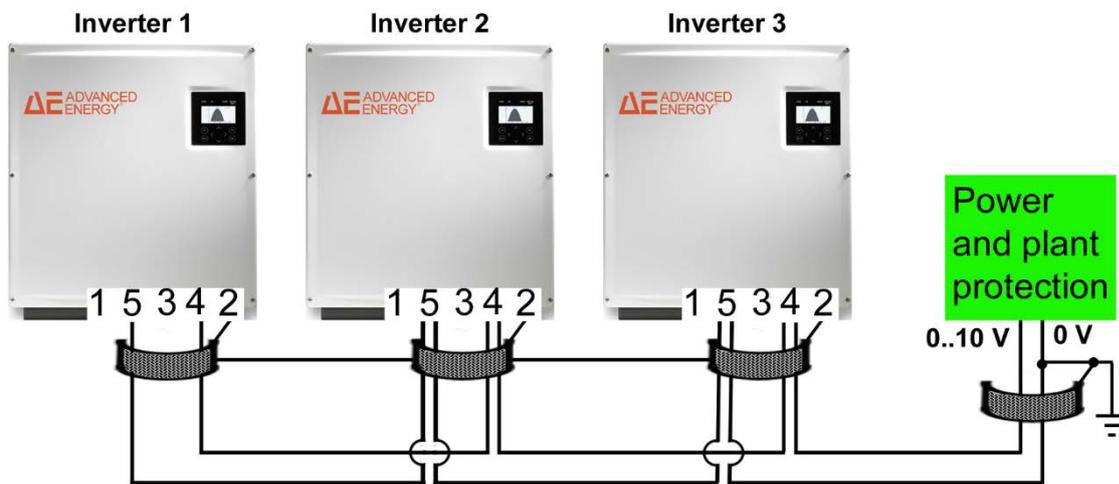


Fig. 31: Diagrammatic explanation of the standard configuration

**Standard configuration with connected irradiation and temperature sensor**

Switch off signal	0...10 VDC	GND				
-------------------	------------	-----	--	--	--	--

Si-13TC-T-K connection		Red RD	Black BK	Orange OG	Braun BN	Gray GY	
		Voltage (12-28 VDC)	Shielding	Measurement signal for irradiation (0-10 V)	Measurement signal for temperature (0-10 V)	GND	
Connection Sensor		Pin1	Pin2	Pin3	Pin4	Pin5	Sensor selection
			← Bridge →				
Inverter	1	Voltage (12-28 VDC)	Shielding	Signal (0...10 VDC)	Measurement signal for temperature (0-10 V)	GND	2
	2	NC	Shielding	Measurement signal for irradiation	Signal (0...10 VDC)	GND	1

				tion (0–10 V)			
	3	NC	Shielding	NC	Signal (0...10 VDC)	GND	1
	n						

### Redundant monitored switch off signal

Switch off signal	0...10 VDC	GND				
-------------------	------------	-----	--	--	--	--

Connection Sensor		Pin1	Pin2	Pin3	Pin4	Pin5	Sensor selection
Inverter	1	NC	Shielding	Signal (0...10 VDC)	Signal (0...10 VDC)	GND	3
	2						
	3						
	n						

### Monitoring of two different switch off signals

Switch off signal	Signal 1 0...10 VDC	GND		Signal 2 0...10 VDC	GND	
-------------------	------------------------	-----	--	------------------------	-----	--

Connection Sensor		Pin1	Pin2	Pin3	Pin4	Pin5	Sensor selection
Inverter	1	NC	Shielding	Signal 1 (0...10 VDC)	Signal 2 (0...10 VDC)	GND	3
	2						
	3						
	n						



#### Note:

In order to ensure the function of the switch off signal, the sensor selection must be correctly set in the inverters.

The sensor function can be entered on the display of the inverter via Configuration > External switch off.

The configuration of the inverter continues to be possible using the AE Setup tool. Other switch off times required by the EVU, for example, or other voltage ranges can be configured here. It is also possible to deactivate the internal NA protective function of the inverter if an external NA protective relay is connected and your grid supplier allows it.

 <b>DANGER</b>	<p><b>Risk of electric shock and fire caused by high discharge current.</b></p> <p>⇒ Before connecting the device to the supply circuit, establish a ground connection.</p>
--	---

## 8.3. REMOTE MONITORING SYSTEM

The following options are available for remote monitoring:

- AE SiteLink: A monitoring portal for the purpose of monitoring and recording solar system data. For more information and details, please refer to the AE SiteLink (formerly REFUlog) manual, available for download at [www.advanced-energy.de/de/1TL\\_3TL\\_Downloads.html](http://www.advanced-energy.de/de/1TL_3TL_Downloads.html).

For information about the configuration, please refer to the Operating Instructions of AE SiteLink.

## 8.4. DATA LOGGER PARAMETERS

The data loggers can be configured in AE Setup.

## 8.5. AE POWERCAP

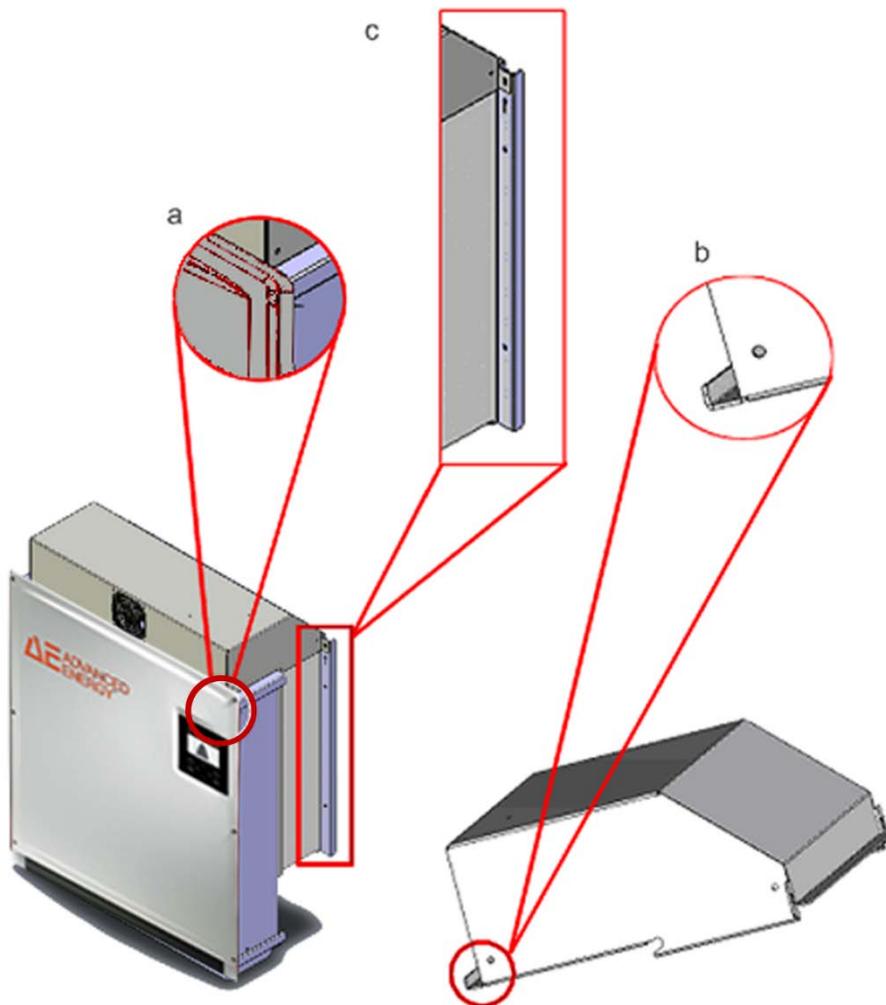


Fig. 32: AE Powercap

AE Powercap is an additional fan module, which is used if the available space requires that the inverters be mounted one on top of the other. AE *powercap* raises the permissible ambient temperature range by 5°C. The ventilation module mounts directly on to the inverter. The fold (b) must be hung into the upper edge of the front cover (a) and secured to the inverter wall-mounting bracket by means of 2 M5 screws (included in scope of delivery).

The fan inside it is powered by the inverter's sensor connector. The power supply line for the AE Powercap must be attached to the wall-mounting bracket (c) by means of the enclosed 6.5 mm polyamide mounting clips and the mounting tie.

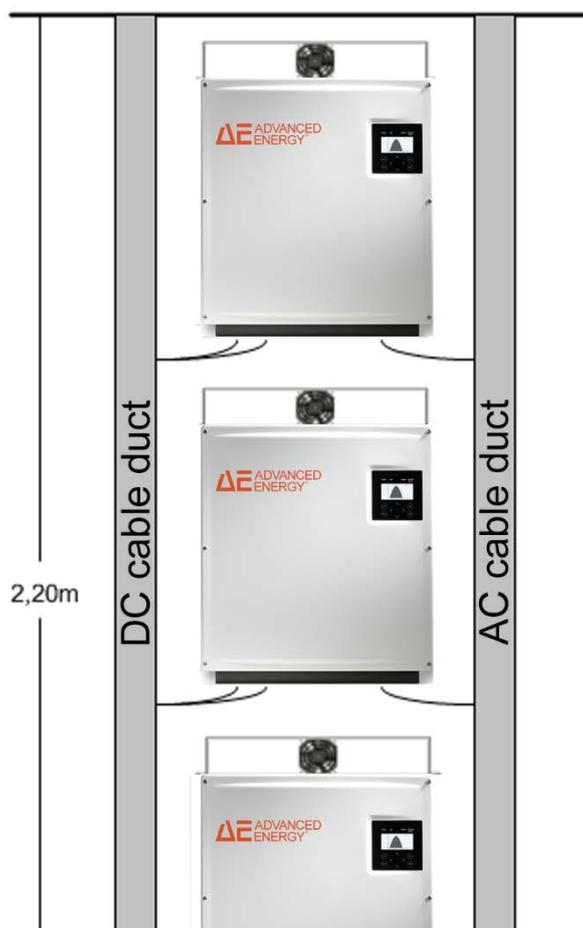
The fan motor is enclosed according to IP54 protection class.



**CAUTION**

**Damage to property caused by impairment of convection cooling and possible overheating**

⇒ Always mount inverters on top of one another with AE Powercap.



**Note:**



If a temperature and radiation sensor is connected, a 24-V-DC power supply unit (e.g. AE item no.: 0030449; 230 VAC / 24 VDC, 18 W) must be provided to supply the AE Powercap fan motor. We recommend that the power supply unit be turned on during ongoing operation of the inverter only. Implement a 230-V-AC timer switch to turn the power supply unit on and off.

### 8.5.1. Connecting the AC Adaptor to the AE Powercap

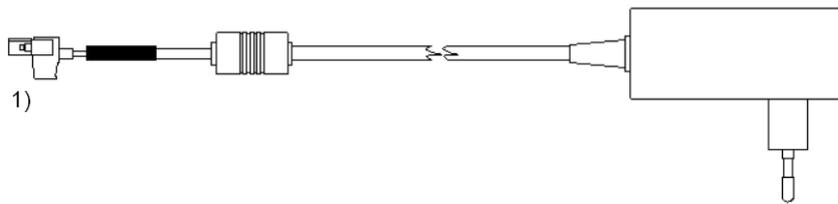


Fig. 34: AC adaptor

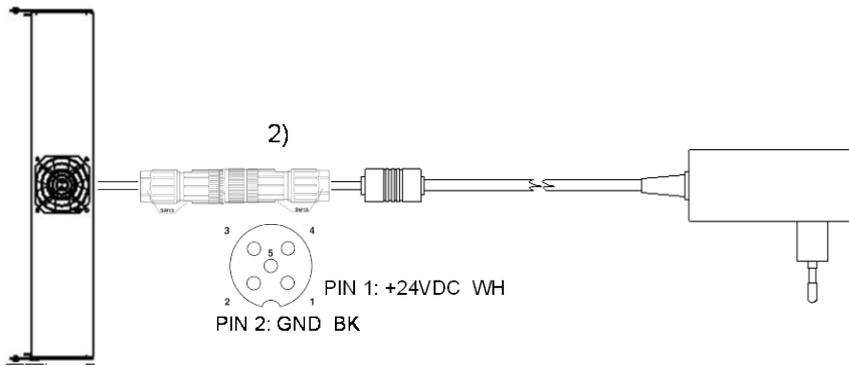


Fig. 35: AE Powercap with adaptor

1. Disconnect the plug.
2. Sensor/actuator socket:  
To ensure IP65 protection sensor/actuator socket type SACC-M12MS-5SC SH from PheonixContact should be used.

**Failure to do so may damage the inverter and void the warranty!**

The socket can be ordered from AE under item number 0030626.

## 9. Maintenance

### 9.1. INVERTER

The cooling of the inverters is done exclusively through the natural convection. For safe operation according to the environment the cooling fins on the heat sink should be checked against dirt and if necessary clean up of dust / dirt.

Cleaning with high-pressure cleaners is prohibited.

## 10. Technical data

### 10.1. INVERTER

	3TL 8	3TL 10	3TL 13	3TL 17	3TL 20	3TL 23-MV
Item no.	867R008 867C008	867R010 867C010	867R013 867C013	867R017 867C017	867R020 867C020	867R023
<b>DC data</b>						
Recommended max. PV power (kW)	9.9	12	15.6	20.4	24	27.6
MPPT range (V)	370-850	410-850	480-850	460-850	490-850	575-850
DC start voltage (V)	350					
Max. DC voltage (V) ( $U_{SC\_PV}$ )	1000*					
Max. DC current (A)	23	25	31.1	38.3	41.8	41
MPP tracker	1					
Number of DC connections	3		4	6		
DC disconnection switch	Yes					
Max. total short circuit current of the PV plant ( $I_{SC\_PV}$ ) (A)	50					
<b>AC data</b>						
Rated AC power (kW)	8.25	10	13	17	20	23
Max. AC apparent output (kVA)	8.25	10	13	17	20	23
AC grid connection	L1, L2, L3, N, PE					
Rated power factor/range	1 / 0.8i ... 0/8c					
Rated voltage AC (V)	400					460
Voltage range AC (V)	320-460					368-529
Rated frequency/frequency range (Hz)	50, 60 / 45...65					
Max. AC current (A)	3 x 12	3 x 16	3 x 21	3 x 29.2		
Max. distortion factor THD	2.5%			1.8%		
Max. efficiency	98.1%			98.2%		98.3%
Feed-in starting at (W)	50					
Internal consumption in night operation (W)	< 0.5*					
Max. AC fall protection (A)	35					
Switch on current (A) / duration (ms)	< 5 / < 40					
<b>PROTECTION, ENVIRONMENTAL CONDITIONS</b>						

	3TL 8	3TL 10	3TL 13	3TL 17	3TL 20	3TL 23-MV
Item no.	867R008 867C008	867R010 867C010	867R013 867C013	867R017 867C017	867R020 867C020	867R023
Cooling	Natural convection					
Ambient temperature (°C)	-25 ... +55					
Storage temperature (°C)	-25 ... +55 (according to IEC 60721-3-1 1K4)					
Transport temperature (°C)	-25 ... +70 (according to IEC 60721-3-2 2K3)					
Relative ambient humidity (%)	0 ... 100					
Site altitude (m above NN)	4000**					
Noise level (dBA)	< 45					
Internal overvoltage protection (EN 61643-11)	Type 3					
Protection class (IEC 62103)	I					
Overvoltage protection (EN 60664-1)	DC: II, AC: III					
Environmental classes (IEC 721-3-4)	4K4H					
Degree of pollution (IEC 72162109-1)	III					
Certification	Current certificates can be found at <a href="http://advanced-energy.com/3TLCerts">advanced-energy.com/3TLCerts</a>					
SZS or grid protection	according to DIN VDE V 0126-1-1					
<b>GENERAL DATA</b>						
Interfaces	Ethernet, RS485, irradiation and temperature sensor					
Protection class (IEC 60529)	IP65					
Dimensions W x H x D (mm)	535 x 601 x 277					
Dimensions with packaging W x H x D (mm)	595 x 636 x 292					
Device weight (kg)	38.4					
Weight with packaging (kg)	43.5***					

\* In Concentrator devices due to the constant availability <20 W

\*\* Note derating of max. DC voltage:

Amount over NN.	Max. DC voltage
Up to 2600 m	1000 V
Up to 3000 m	950 V
Up to 3500 m	900 V
Up to 4000 m	850 V

\*\*\* +0.3 Kg at 867C ...

## 10.2. SENSOR

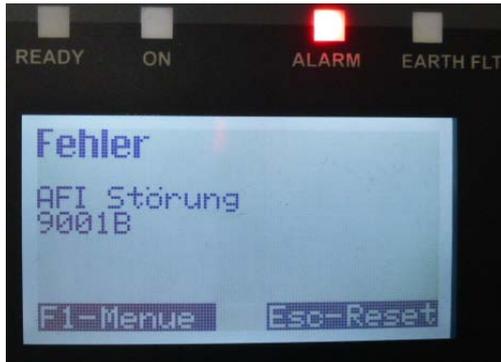
<b>TYPE</b>	<b>Si-13TC-T-K</b>
<b>GENERAL</b>	
Shunt resistor	0.10 $\Omega$ (TK = 22 ppm/K)
Working temperature	-20 °C to +70 °C
Power supply	12 to 24 VDC
Current draw	0.3 mA
Connecting cable	4 x 0.14 mm <sup>2</sup> , 3 m (UV-resistant)
Cell dimension	50 mm x 34 mm
Exterior Dimensions Length / Width / Height	145 mm x 81 mm x 40 mm
Weight	340 g
<b>INSOLATION</b>	
Measuring range	0 to 1,300 W/m <sup>2</sup>
Output signal	0 to 10 V
Measuring accuracy	±5% of final value
<b>MODULE TEMPERATURE</b>	
Measuring range	-20° C to +90° C
Output signal	2.268V + T [°C]* 86.9 mV/°C
Measuring accuracy	±1.5% at 25 °C
Non-linearity	0.5 °C
Max. deviation	2 °C
<b>PIN ASSIGNMENT</b>	
Orange	Measurement signal for insolation (0 to 10 V)
Red	Supply voltage (12 - 24 VDC)
Black	GND
Brown	Measurement signal for temperature (0 - 10 V)
Power supply	Temperature and radiation sensor or Power cap

# 11. Contact

Please address any questions on malfunctions or technical problems to:  
Service hotline: +49 (0)7123 / 969 – 202 (Monday – Friday, 8 a.m. to 5 p.m)  
E-mail: service.aei-power@aei.com

**You should have the following data at hand:**

- Exact description of the error with error code.



- Data from the type plate, particularly the device type on the top left of the type plate.

## 12. Certification

The following certificates

- EU Declaration of Conformity
- Clearance certificates after:
  - VDE-AR-N-4105 EZE
  - VDE-AR-N-4105 NA
  - CEI 0-16
  - CEI 0-21
- Country certifications

can be downloaded from [advanced-energy.com/3TLCerts](https://advanced-energy.com/3TLCerts).

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