



REFUsol – Solar Inverters

REFUsol 023K – 460 VAC

Operating Instructions

Version 02

REFU*sol*

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1 About these Operating Instructions

These operating instructions form part of the product

- ⇒ Read the operating instructions carefully before 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.

1.1 Symbols and Markup

☑	Pre-requisite
⇒	One-step operating instruction
1.	Multiple-step operating instruction
•	Bulleted list
Highlighting	Highlighting within a text
⇓	Result

1.2 Warning Notices

1.2.1 Layout of a Warning Notice

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

1.2.2 Categories of Warning Notices

There are three categories of warning notices.

 DANGER	“DANGER” designates a safety notice, disregarding which will lead directly to death or severe injury!
--	--

 WARNING	"WARNING" designates a safety notice, disregarding which can lead to death or severe injury!
 CAUTION	"CAUTION" designates a safety notice, disregarding which can lead to property damage or minor injury!

1.3 Information



Info:

Information which is important for the optimum and cost-effective operation of the equipment.

2 Safety Information

2.1 Proper Usage

The **REFUso/**, 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 into the public power supply network. The inverter has been constructed according to the current state of technology and in line with the rules of technical safety. Any use beyond this is not deemed to be proper. The manufacture will accept no liability for any damage resulting from this and the user alone will bear all responsibility.

2.2 Qualification of Personnel

Only suitably trained and qualified personnel are permitted 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.

Furthermore, they will have been trained, instructed, or authorized to switch electric circuits and devices on and off, and to earth these in accordance with the relevant safety rules, and to identify them appropriately in line with job requirements. They must be in possession of suitable safety equipment and be trained in first aid.

2.3 Dangers Arising from Misuse



DANGER

Danger to life from electric shock

⇒ Device may only be installed and serviced by qualified specialist technical personnel.



DANGER

Danger to life from electric shock

After the device has been switched off, the interior may still contain life-threatening voltage

⇒ Do not open inverter.



DANGER

Danger to life from electric shock

⇒ Carry out connections carefully.



DANGER

Danger to life from high discharge current

⇒ It is essential to ensure an earthing connection has been established prior to connection to the supply current circuit!



WARNING

Danger to health for persons with pace-makers, metallic implants, and hearing aids in direct proximity to electrical equipment

⇒ These people must consult their doctor beforehand.



WARNING

Danger of burns

Machine housing surfaces may be hot

⇒ Allow hot surfaces to cool down.



WARNING

Danger of injury due to crushing, shearing, cutting, striking

⇒ Assembly of the device requires two persons.

2.4 Protection against Contact with Electrical Parts



DANGER

Danger to life, danger of injury due to high electrical voltage

- ⇒ 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.
 - ⇒ Operation, maintenance and/or repair of the inverter must only be carried out by personnel trained and qualified to work with electrical devices.
 - ⇒ General assembly and safety stipulations relating to working on high current facilities must be followed.
 - ⇒ Before switching on, a check must be made to ensure that the plugs are firmly in place (locked).
 - ⇒ The plugs of the PV generator must only be pulled out once when the DC circuit breaker on the inverter is positioned at "OFF". The feeder must be isolated and secured against being switched on again before the power plug is pulled out.
-

2.5 Protection against Magnetic and Electromagnetic Fields during Operation and Assembly



WARNING

Danger to health for persons with pace-makers, metallic implants, and hearing aids in direct proximity to electrical equipment

- ⇒ In general, persons with pace-makers and metallic implants must not enter areas in which electrical devices and parts are being assembled, operated, or are being brought into service.
 - ⇒ Should people wearing pace-makers need to enter such areas, the decision as to whether this is permitted is to be made by a doctor beforehand. Immunity from interference of pace-makers which have already been implanted or will be in the future varies greatly, meaning that there is no rule of thumb in this respect.
 - ⇒ Persons with metal implants or metal splinters as well as those with hearing aids must ask a doctor before entering such areas, as impairments to health are to be expected.
-

2.6 Protection against Contact with Hot Parts



CAUTION

Danger of burns caused by hot surfaces on housings

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 75°C.

- ⇒ Do not touch the housing surface near to heat sources.
 - ⇒ Allow the device to cool down for 15 minutes before touching the surface of the device.
-

2.7 Protection during Handling and Assembly



WARNING

Danger of injury during improper handling caused by crushing, shearing, cutting, striking, and lifting

The inverter weighs 40 kg!

- ⇒ Follow the general instructions for assembly and safety during handling and set-up.
- ⇒ Use suitable assembly and transportation equipment.
- ⇒ Avoid trap and crush injuries by taking suitable precautions.
- ⇒ Only use suitable tools. Use special tools where this is prescribed.
- ⇒ Use lifting equipment and tools in a technically correct manner.
- ⇒ If necessary, use suitable protective equipment (for example, goggles, safety footwear, protective gloves).
- ⇒ Do not stand under hanging loads.
- ⇒ Remove any liquids escaping onto the floor immediately to avoid the danger of slipping.

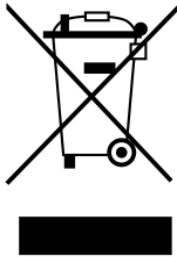
2.8 Please Note Before Starting Up

- Problem-free and safe operation of the inverter requires proper and specialized 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 safety rules and regulations that apply in the country where the inverter will 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 in compliance with the national EMC rules for the use case in question.
- The manufacturer of the equipment or machine is responsible for ensuring compliance with the thresholds required by the respective national regulations.

European countries: EU Directive 2004/108/EC (EMC Directive).

- The technical data, connection and installation conditions are to be taken from the product documentation and must be observed under all circumstances.
- The inverter must first be switched off on the AC side via the circuit breaker. Switch-off is then to be effected on the DC side via the DC circuit breaker, should maintenance work need to be carried out on the DC side.
This increases the service life of the DC circuit breaker.
- It is not necessary to switch off the inverter via the DC circuit breaker overnight, as the inverter switches off completely as soon as no DC voltage is present at the input.
If no switch-off is effected via the DC circuit breaker, the inverter switches on automatically in the morning when the PV generator supplies sufficiently high voltage. This ensures that the maximum output is generated.

2.9 Disposal



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

Do not dispose of the inverter with normal domestic waste.

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

REFUso/ GmbH will take back the inverter completely. Please contact the Service team!

3 REFUso/ 023K – 460 VAC Description

3.1 Description of Device

The REFUso/ is a three-phase solar inverter without a transformer, which has a particularly high efficiency at any operating point and is suitable for the connection of a PV generator with a power of 25.3 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 considerably 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 provides excellent and convenient control and navigation features. Due to its design in protection class IP65, the inverter can be installed in almost any outside location.



Fig No. 1 REFUso/ 023K – 460 VAC

3.2 Scope of Delivery

The scope of delivery includes a wall-mounting bracket and an enclosed bag 0030532 containing:

- 1 x 5-pin contact insert, IP67, VC-TFS5-PEA
- 1 x adapter housing, IP67, VC-K-T3-R-M25-PLOMB
- 3 x U-washer, shape B, M8, DIN125-8
- 1 x cable gland, Schlemmer-Tec, M25x1.5/21532
- 2 x cross-recessed flat-head screw, M5x20 => for mechanically securing the device in the wall bracket

The IP67 VC-K-T3-R-M25-PLOMB adapter housing allows sealing according to DK4940.

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.

3.3 External Dimensions

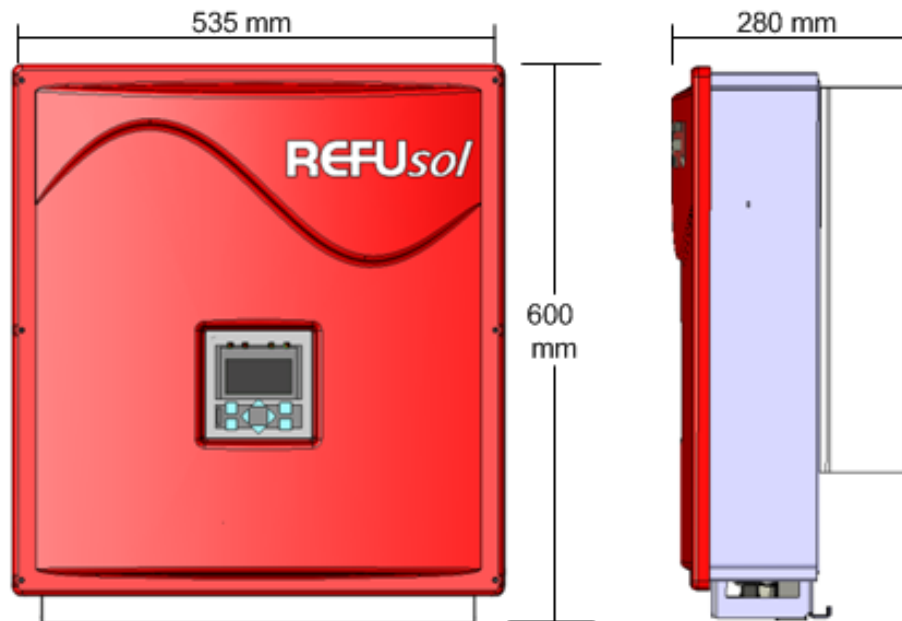


Fig No. 2 External dimensions

3.4 Block Diagram

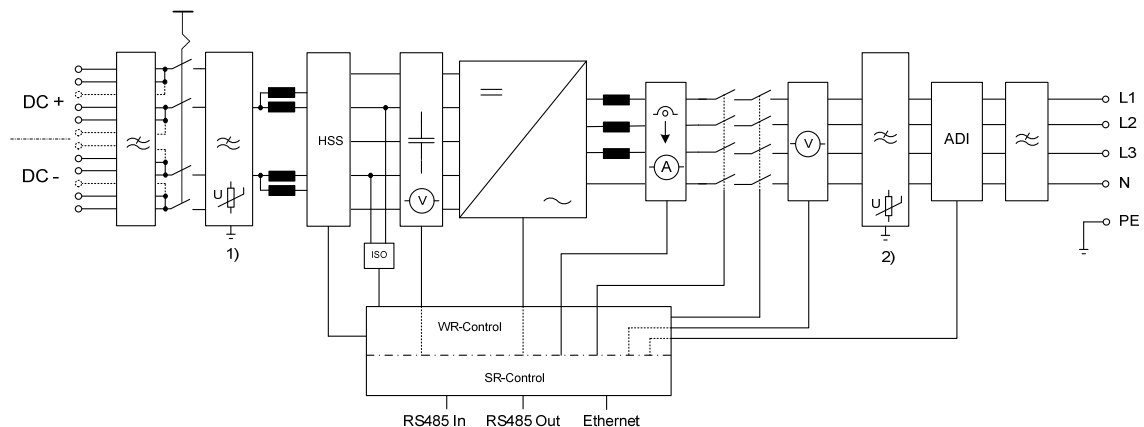


Fig No. 3 Block diagram

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

3.5 DC Connection

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

Max. DC voltage at each input	1000 V
Max. current per DC	25 A
Max. DC current at the input across all connections	41 A

To keep the maximum current of 25 A permitted at the DC circuit breaker contacts, observe the following input assignments.

The power of the PV generator must be uniformly distributed over all 6 inputs. The maximum DC current may not be exceeded.



Info: Failure to observe these requirements may result in malfunction and damage to the DC circuit breaker, thus voiding the warranty!



Info: If all DC inputs are not occupied, then the open inputs must be closed with MC4 closure caps. The IP65 protection class cannot be guaranteed if these requirements are not observed!
Both caps (+/-) can be ordered at any time under the part no. 0028991 and 0028992 from RefUsol GmbH.

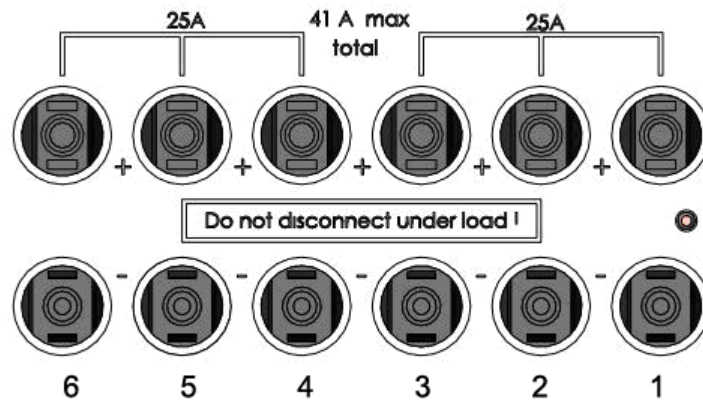


Fig No. 4 PV generator connection

3 PV connecting lines → e.g.: inputs 1, 2, 4 or inputs 1, 4, 5

4 PV connecting lines → e.g.: inputs 1, 2, 4, 5 or inputs 2, 3, 5, 6

If several PV connecting lines are available, the connections can be made as desired.



Info:

When using the solar inverter without transformer, do not ground the positive or negative pole of the PV generator. Otherwise, the modules may experience a loss of power.

3.6 Reverse Current through Defective Modules

Reverse currents are fault currents that only occur in PV systems comprising parallel strings. Given short circuits of individual modules or cells in a module, or a double ground fault, 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.

To prevent such damage to PV systems, appropriate precautionary measures should be taken. There are two different cases in this respect:

1. The PV system is designed such that the reverse current, which flows in the event of a failure and, in the worst case scenario, consists of the sum of the short-circuit currents of all intact strings, does not result in the destruction of the damaged string or therefore in secondary damage either. The decisive factor here is the current carrying capacity of the system components (connectors, lines) and the reverse current carrying capacity of the modules. The appropriate data can be found in the manufacturer's data sheet. In this case, it is not necessary to take any further measures.
2. The PV system is designed such that the reverse current which flows in the event of a failure exceeds the destruction limit. In this case, 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.

3.7 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.

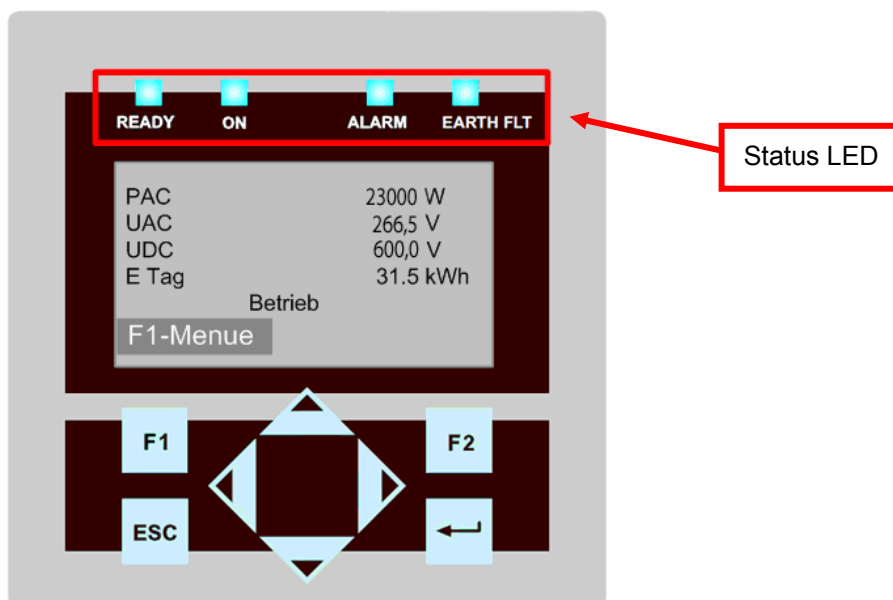


Fig No. 5 Control panel

F1: Display the menu

◀▶: Function in the menu: navigation through the menu level (previous menu, next menu)

Function while parameters are being edited: digit to the left, digit to the right (decade jump)

▲▼: select the menu level (level up, level down)

ESC: Acknowledge failures and exit from menu level, exit from input menu without entering data

↵: confirm the selected menu and entered data

3.8 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.

Recording cycle	Storage time
1 minute	6 months
2 minutes	12 months
5 minutes	2.5 years
10 minutes	5 years

4 Installation

4.1 Unpacking the Device

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.

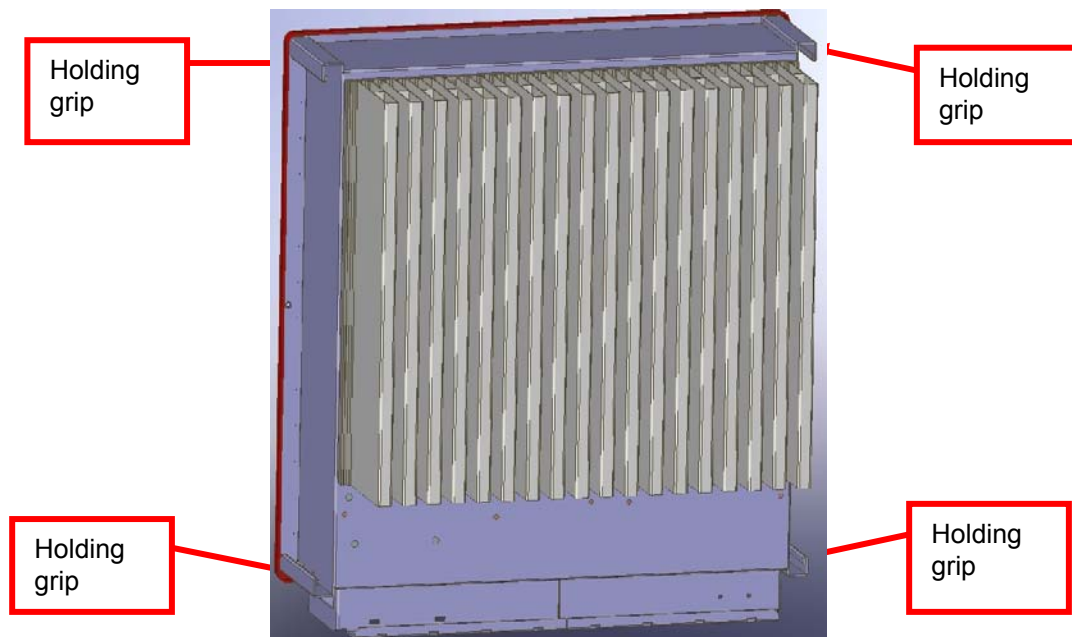


Fig No. 6 Rear panel

4.2 Assembly Site Requirements

The inverter is provided only with convection cooling and is therefore designed for attachment to a vertical wall. The device is attached by means of a wall-mounting plate, which is included in delivery.



WARNING

Danger of injury due to crushing, shearing, cutting, striking

⇒ To prevent accidents when installing and servicing, unrestricted and safe access to the devices must be ensured.

- The assembly site must be shaded.
- The device may only be mounted in a vertical position.

- For installation, choose a solid wall or metal construction, which complies with fire protection class F30 and has a load bearing capacity of 40 kg per unit. Relevant construction regulations must be observed!
- Mount the device at an appropriate distance from combustible materials.
- We recommend that you mount the device at eye level to ensure optimum user comfort.
- Owing to its protection type (IP65), the device can also be mounted in outside areas.



Info: 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!



Info: Do not cover the cooling ribs of the heat sink. Failure to do so could void your warranty.

- To allow for the heat dissipation required, keep the following minimum distances from the ceiling and wall as well as from neighboring devices:

Minimum distances	At the sides	50 mm	At the top	500 mm	At the bottom	500 mm
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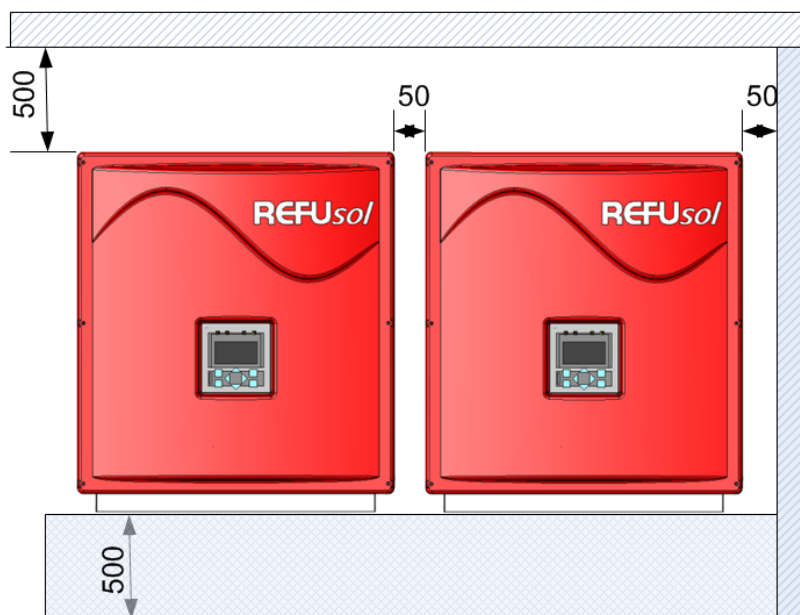


Fig No. 7 Minimum distances



Info: Inverters should never be mounted on top of each other without a REFUpowercap, otherwise the convection cooling will be affected!

4.3 Transport

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

4.4 Storage

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



Info:

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 one year has been exceeded, please contact the REFUsol Service team before connecting the inverter to your system!

4.5 Mounting

The inverter is mounted using the wall-mounting plate which is included in the scope of delivery.

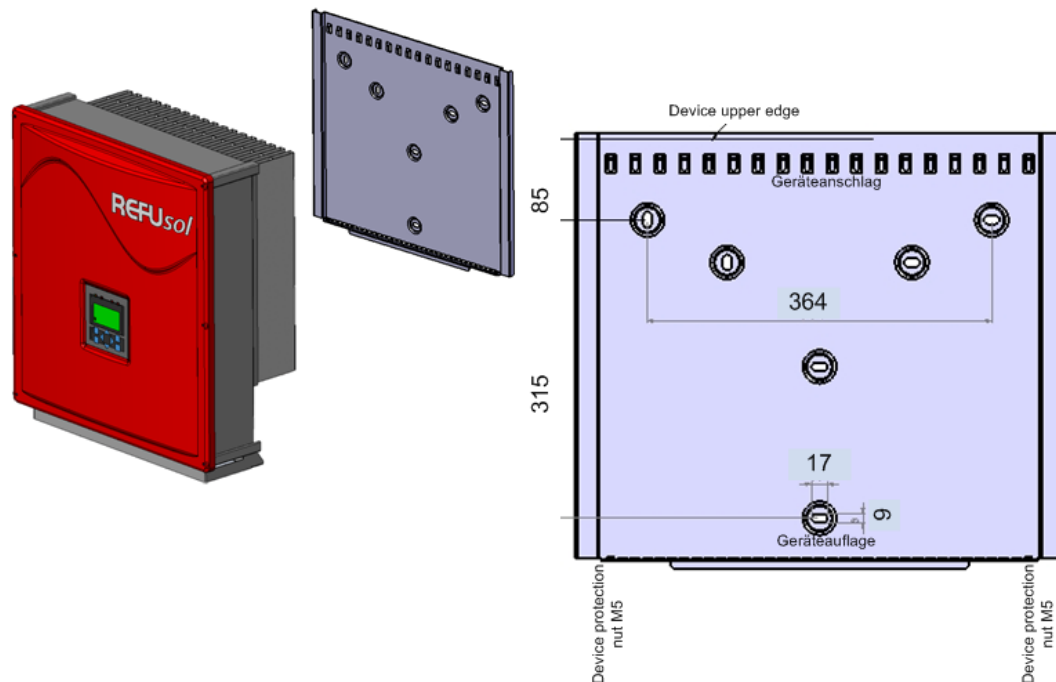


Fig No. 8 Mounting the inverter



Info: Opening the device is not permitted!

If this is not observed then dust, dirt, and also humidity can penetrate the device or components can be damaged by electro-static discharge. IP65 protection is no longer guaranteed.

There is subsequently no warranty for resulting damage!



Info: When selecting the place of assembly, clear and unobstructed access for servicing the inverter must be considered.

Otherwise the operator or installation engineer must provide suitable technical equipment for servicing.



WARNING

Severe injury possible due to crushing, shearing, cutting, striking, or fire

⇒ The following instructions must be always be observed:

When designing the attachment of the wall-mounting plate, take the 40 kg weight of the inverter into account.

**CAUTION****Damage to property or risk of injury**

- ⇒ Avoid any load on the edge of the cover while mounting the device.
- ⇒ Do not use the cover to hold the device.
- ⇒ Only use the four holding grips to move the device.

- **Mounting the wall bracket:** Use the wall bracket to mark the positions of the holes to be drilled. Attach the mounting plate to the wall with the outer holes.
- Insert the upper edge of the cooler into the recess of the device holder. Push the inverter upwards until it stops and place the lower edge of the cooler onto the wall holder. Ensure that the rib profile is locked behind the nuts. Then 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) as anti-theft protection. The design of the wall bracket ensures that the REFUsol inverter is automatically centered in this bracket.

4.6 Connectors on the Device

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

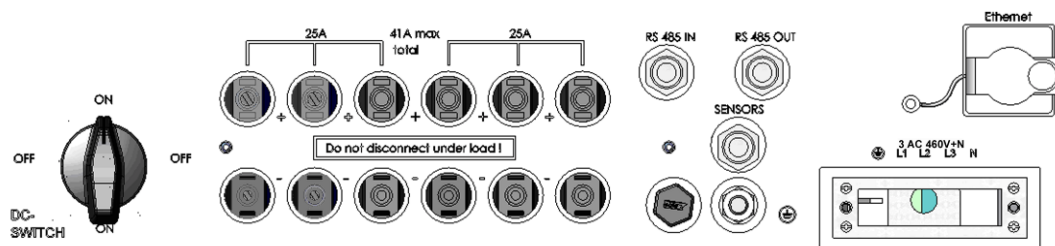


Fig No. 9 Device connectors

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

- 4/6 pairs of PV generator connectors
- SENSOR (connection: radiation and temperature sensor)
- RS485 connectors (IN and OUT)
- Ethernet interface port
- Power connection

4.7 Power Connection

**DANGER****Risk of electric shock and fire caused by high discharge current!**

- ⇒ Before connecting the device to the supply circuit, establish a ground connection by means of the labeled ground stud.

The following mains systems are suitable:

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

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 on this can be found under Technical Data in section 10.1. 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 in the event of over-current
DIN VDE 0100; Part 410	Protective measures: protection against electric shock

Also observe the following requirements specified by the local network operator:

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



DANGER

Danger to life from electric shock

⇒ 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, which may not exceed 305 V (phase against neutral conductor). If the line voltage is higher, contact your local network operator.
- Apply the power cable to the supplied connector as illustrated, connect the power cable to the inverter, and fasten the connector.



Info:

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.

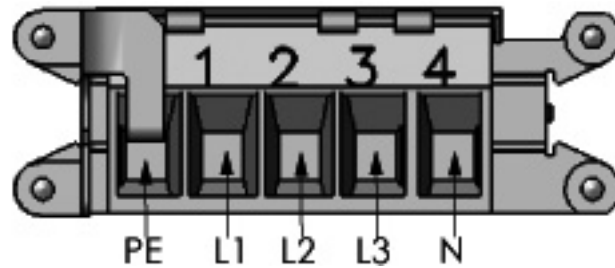


Fig No. 10 Power connection

4.8 Power Supply Line

Select the cross-section of the power supply line such that line losses are as low as possible.

- However, observe the following points:
 - o Due to the construction, the recommended feed line for all cross-sections is a fine-strand line.
 - o The cable fitting of the standard connector housing supplied allows a 5 x 6 mm² cable to be connected. The maximum outside diameter of the power supply line may be 18 mm (e.g. Lapptherm 145, 5 x 6 mm²).
 - o Optionally, you can also order a larger connector housing allowing connection of a 5 x 10 mm² power supply line.

The table below shows the maximum line lengths in relation to the conductor cross-section with a voltage drop of $\leq 1\%$.

Line cross section	4.0 mm ²	6.0 mm ²	10.0 mm ²
Max. line length	20 m	30 m	50 m



Info: In order to ensure IP65 protection, the power plug supplied must be used.

4.9 Grid Line Inductance

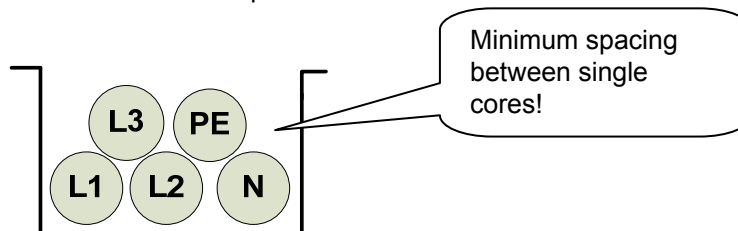
For better efficiency, large line cross-sections in single cables are increasingly used for power supply lines, especially if local conditions require long supply lines.

The considerable line lengths between the 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
- line frequency
- grid overvoltage
- sometimes increased operating noise of the transformers

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 permitted 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.



Info:

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. It must be ensured that the line inductance remains $< 30 \mu\text{H}$.

4.10 Grounding



DANGER

Danger to life from electric shock

⇒ The inverter must be connected to the ground stud. Otherwise, a voltage gradient may develop, which may result in electric shock!

The inverter features a threaded bolt below the power supply port on the connection side for additional grounding. Grounding is intended to ensure optimum overvoltage protection. That is why the ground wire cross-section must be chosen in excess of the cross-section of the power supply

line by a factor of one (at least 10 mm²). In addition, ensure that the ground wire is placed as far away from and not directly in parallel to the power supply line.

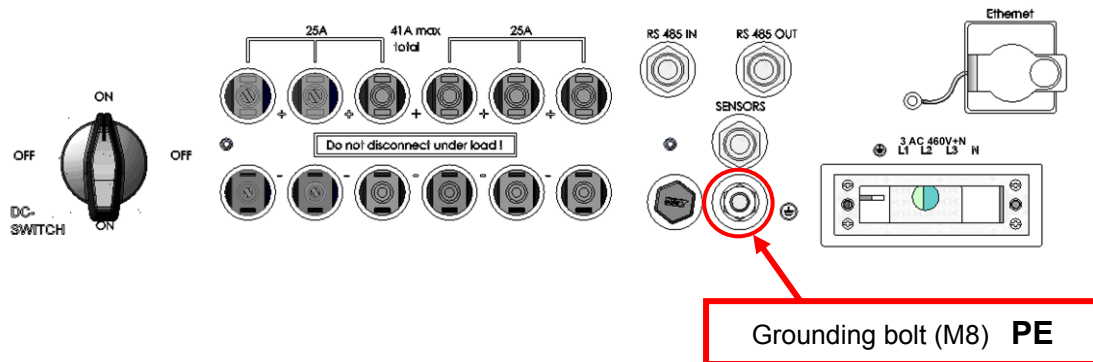


Fig No. 11 Grounding bolt

4.11 Residual Current Protective Device

Since February 2009, 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.



Info: 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.

4.12 PV Generator DC Connection



DANGER

Danger to life due to high voltages from active PV strings

- ⇒ Before connecting the PV strings, connect the inverter to the power supply network and to the grounding bolt to ensure that the device is **safely connected to the protective conductor.**
Connect the PV strings to the inverter **only in a de-energized state**
Live PV strings can be under lethal voltages!

- The DC connection is effected with MC4 plugs and sockets. More information is given in the table below.
- Before connecting the PV strings an isolation measurement must be taken. Whenever it is switched on, the inverter automatically checks the isolation 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 inverter is protected by an integrated polarity reversal protection diode.
- The connection has to be strictly done according to section 4.5 of the operating instructions. Failure to do so may destroy the DC circuit breaker and void the warranty!

4.13 DC Connecting Line

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

Designation	Type	Item No. MultiContact	Diameter wire insulation in mm	Cable cross section in mm ²
Connector plug	PV-KST4/6I-UR	32.0015P0001	3 - 6	4 - 6
Connector plug	PV-KST4/6II-UR	32.0017P0001	5.5 - 9	4 - 6
Connector socket	PV-KBT4/6I-UR	32.0014P0001	3 - 6	4 - 6
Connector socket	PV-KBT4/6II-UR	32.0016P0001	5.5 - 9	4 - 6



Info:

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. Failure to do so could void your warranty!

We suggest you use only original MultiContact components! Please take note of the MultiContact installation instructions!

To attach the crimp contacts on the site, you might acquire pliers, type PV-CZM-9100, from MultiContact.

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.

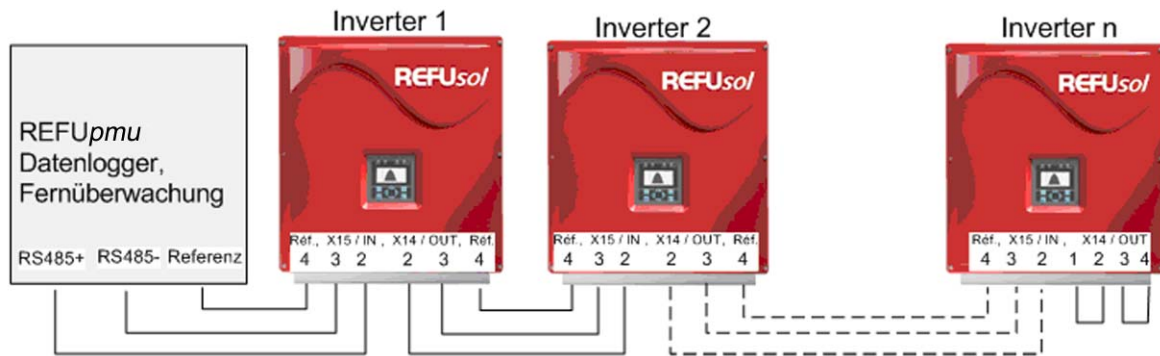


Fig No. 12 Standard interface connection

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”).

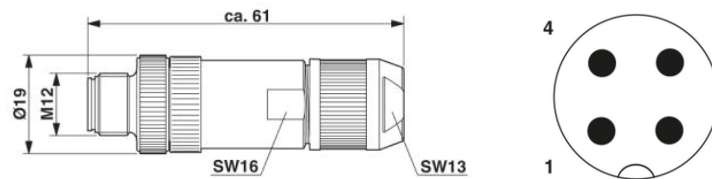


Fig No. 13 Connector M12 x 1 straight, shielded; pole arrangement: male M12, 4 pins, A-coded, view of male connector side

**Info:**

In order to ensure IP65 protection and the required and declared conformity with the domestic EMC standard a PhoenixContact 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 these requirements may lead to the inverter being damaged and the warranty being voided!

The plug can be ordered from REFUso/ GmbH under item number 0030615.

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.

**Info:**

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

Failure to observe these requirements may lead to the inverter being damaged and the warranty being voided!

The plug can be ordered from REFUso/ GmbH under item number 0028943.

5 Commissioning

Before commissioning the inverter make 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

Danger to life from electric shock



DANGER

- ⇒ Before switching on the device, check whether the connectors are securely fitted (locked).

Do not pull off the connectors of the PV generator before you have met the following requirements:

- ⇒ Set the DC isolator on the inverter to “OFF”
- ⇒ Check that the DC cables of the PV generator are de-energized
- ⇒ Isolate the power supply line
- ⇒ Protect the voltage supply from being reactivated



DANGER

Risk of electric shock and fire caused by high discharge current!

- ⇒ Before connecting the device to the supply circuit, establish a ground connection.

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. Set the DC isolating switch on the inverter to the ON position. The inverter will not start running with connected PV field before the DC isolator is switched on.



Info:

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

5.2 Setting the Country Code and the Menu Language

The country code defines the country-specific network monitoring parameters. The menu language is automatically set when the country code is selected. Thereafter, the menu language can be selected as desired at any time, independent of the country code set in the menu.

The country code is not set on delivery.



Info:

The selected country code can only be changed by Service personnel

After having set and confirmed the country code, you cannot change it yourself any longer.

This also applies to devices that are or were in operation. According to a new rule, the country code can now only be changed by Service personnel.



Info:

Cancellation of the operating license!

If the inverter is operated with the wrong country code the utility company may cancel the operating license. The inverter must not be put into operation before the overall system complies with the applicable national rules and safety regulations.



Info:

We assume no liability for negative consequences resulting from an incorrectly set country code!

Setting the Country Code

Immediately after the DC isolator has been set to "ON" and the PV generator voltage is sufficiently high, the following window appears on the screen. A country code is stored for the countries displayed in the list. You can select the desired country from the list as described below. The term "country code" as such is not displayed in the menu. The display will be illuminated after you have pressed the first key.

Belgie
Česko
Deutschland ENS
Deutschland MSR
España RD1663
España RD661
France

ENS => Setting for systems that feed into the low voltage grid

MSR => Setting for systems that feed into the medium voltage grid

In case of ambiguity, contact the local utility.

Greece (Continent)
 Greek Islands
 Italia
 Italien Option
 South Korea
 Portugal
 Slovenija

1. Use the “▲” and “▼” keys to select the country code which is specific for your country and your location.
 - When you select the country code, you automatically select the menu language at the same time.
 - The menu language can be changed in the menu at any time.
2. Press “↵” to confirm.



Info: If network conditions are difficult at a location in Italy, you can select the “Italia Option” setting, provided this has been specifically approved by ENEL.

Accepting the Country Code

The display will show a safety prompt asking you whether you wish to accept the country code. After having accepted the country code, it is no longer possible to change it.

Accept ?
 Yes = Enter
 No = Esc

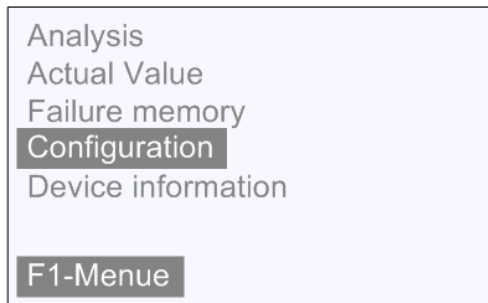
Confirm the country code only if you are absolutely sure. If you are not sure, press “ESC” to cancel your selection. In this case, you cannot put the device into operation and using the menu is not possible any longer.

⇒ If you wish to accept the country code, press “↵” to confirm.

Changing the Menu Language

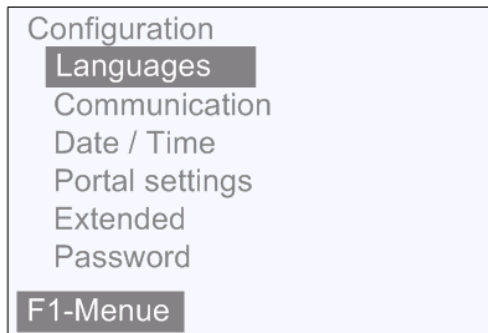
The language selected does not affect the country code in any way. Proceed as follows to change the menu language:

1. Press “F1” to open the menu.
2. Use the “▼” and “▲” keys to select the menu item Configuration.



3. Press “” to confirm.

4. Use the “▼” and “▲” keys to select the menu item Languages.



5. Press “” to confirm.

6. Use the “▼” and “▲” keys to select the desired menu language.

7. Press “” to confirm.

The menu switches to the language selected.

The display will be empty at first.

8. Press “ESC” to return to the menu.

5.3 Activating the Device

- Verify that the inverter is connected to the line voltage.
- Provided the PV generator is supplying sufficiently high voltage, the inverter is connected to the line voltage, and there no errors or failures, the device undergoes the following sequence of operations which you can follow on the control panel display:
- Self-test:
 - ⇒ All status LEDs are lit for approx. 6 seconds
- The initialization cycle is started:
 - ⇒ The “Ready” status LED flashes
 - Display:
 - ⇒ Pac Feed power in watts (W)
 - ⇒ Uac Line voltage in volts (V)
 - ⇒ Udc Solar cell voltage in volts (V)
 - ⇒ State Initialization



Fig No. 14 Initialization display

- Initializing has been completed:
 - ⇒ The “READY” status LED remains illuminated
 - Display:
 - ⇒ Pac Feed power in watts (W)
 - ⇒ Uac Line voltage in volts (V)
 - ⇒ Udc Solar cell voltage in volts (V)
 - ⇒ Switched off

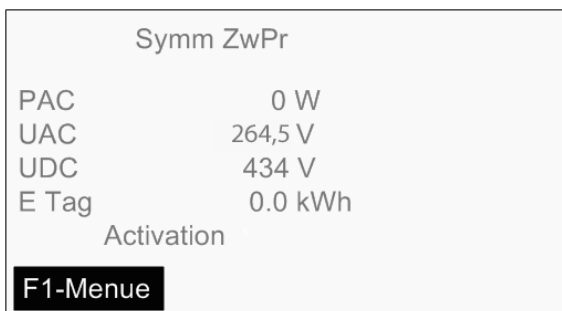


Fig No. 15 Device activation display

- Power-up starts if the solar cell voltage is >350 volts:
 - ⇒ The “READY” status LED is illuminated, the “ON” status LED flashes
- Display:
 - ⇒ Pac Feed power in watts (W)
 - ⇒ Uac Line voltage in volts (V)
 - ⇒ Udc Solar cell voltage in volts (V)
 - ⇒ Activating
 - ⇒ This process can take up to one hour when the device is being started up for the first time; during normal operation, it takes up to 3 minutes.
- Feed mode:
 - ⇒ The “ON” status LED remains illuminated; the “READY” status LED goes off.
 - 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 in kWh
- ⇒ Operation
- Check time:
 - o If the electronic system is disconnected from the supply voltage for a longer period (approx. 2 weeks) an incorrect time setting is possible. Therefore, before switching on the inverter and if the PV generator has been covered with snow for a long period of time, you have to check the time and readjust if necessary as follows:
 - o Press F1 key to open menu.
 - o Use ▼ to choose the Configuration menu item and select using ◀ / ▶.
 - o Use ▼ to choose the Date/Time menu item and select using ◀ / ▶.
 - o Use ▶ ◀ arrow keys for successive setting of day, month, year, hour, minute, and second.
 - o Press ◀ key to confirm.

5.4 Navigation using the Control Panel

Navigation display:

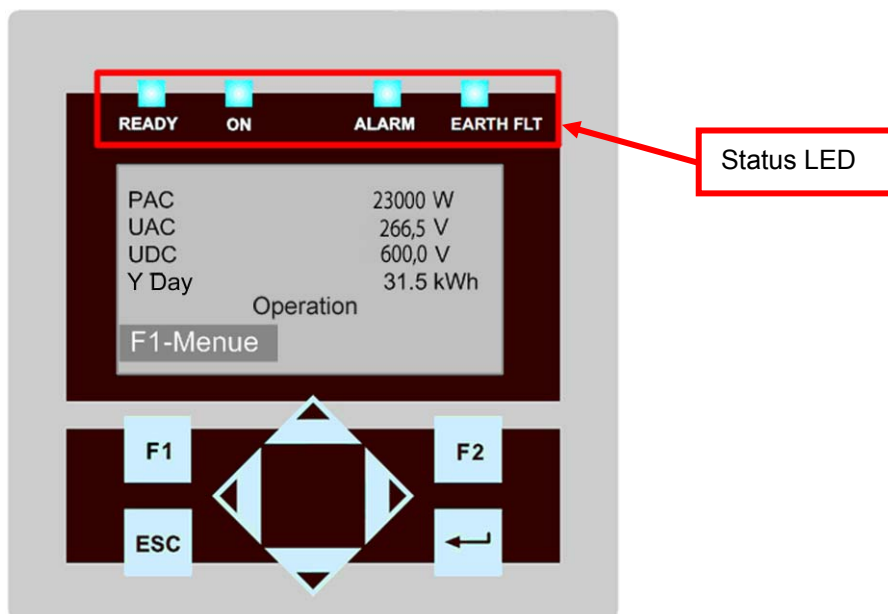


Fig No. 16 Navigation display

F1: Display the menu

◀ ▶: Function in the menu: navigation through the menu level (previous menu, next menu)

Function while parameters are being edited: digit to the left, digit to the right (decade jump)

▲ ▼: select the menu level (level up, level down)

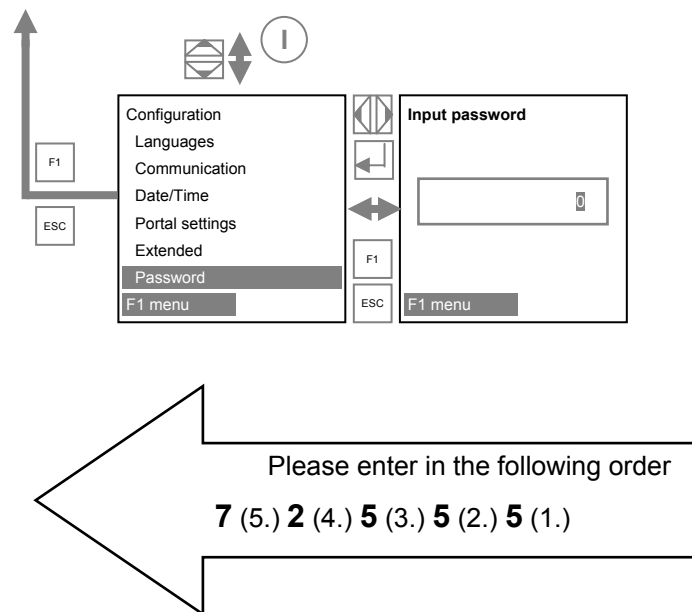
ESC: Acknowledge failures and exit from menu level, exit from input level without entering data

↵: Confirm the selected menu and entered data

5.5 Password Entry

For the configuration and parameterization the customer password 72555 is often required!

Password entry as follows:



Basic screen display:

PAC	23000 W
UAC	266,5 V
UDC	600 V
y day	31.5 kWh
Operation	
F1-Menue	

Fig No. 17 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

Graphical display:

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

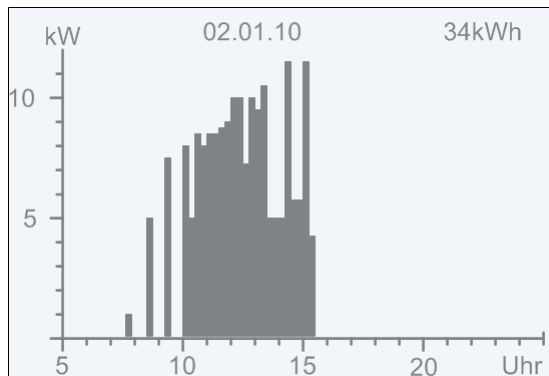


Fig No. 18 "Today's" feed power display

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

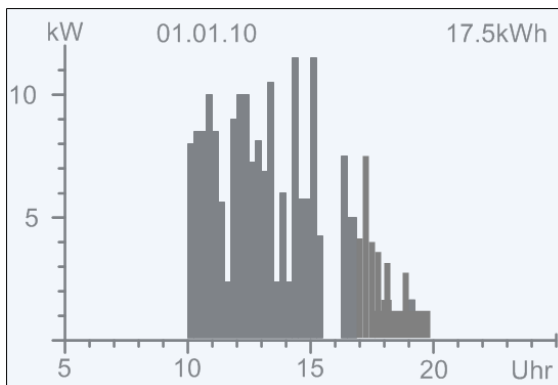


Fig No. 19 "Yesterday's" feed power display

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

Yield data display:

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

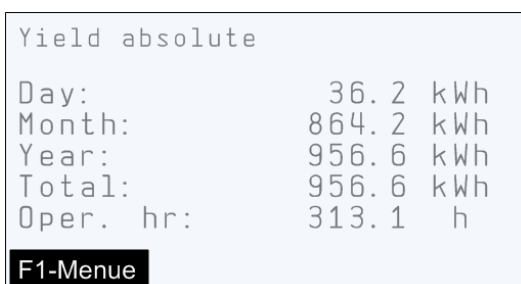


Fig No. 20 Yield data absolute display

Standardized yield data display:

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

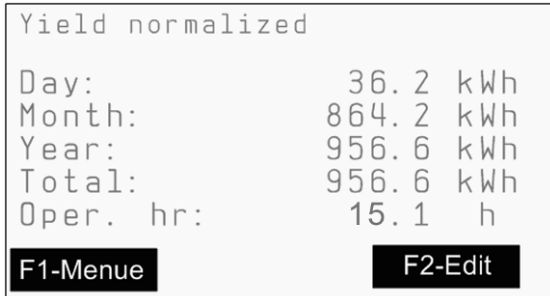


Fig No. 21 Standardized yield data display

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

Input of standardized data:

To obtain the standardized yield data, press the F2 key and enter the connected PV generator power under parameter P1155 as follows:

- ◀▶ keys: Pressing the ◀ key => selects the digit to the left of the decimal point
 Pressing the ▶ key => selects the digit to the right of the decimal 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.

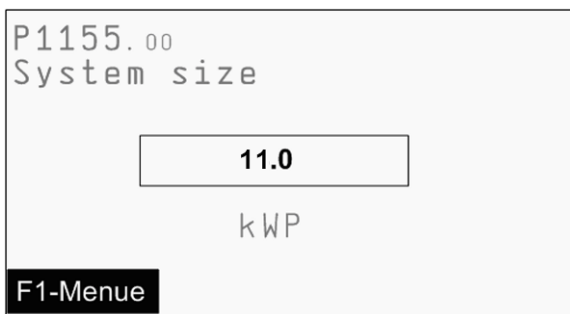


Fig No. 22 Standardized data input display

Press the ESC key to display the previous “normalized yield” level.

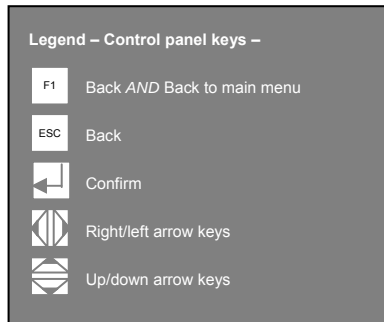
Press the F1 key to display the menu.

Press the ⏮ key to apply the value set. However, this requires that the password is correct.

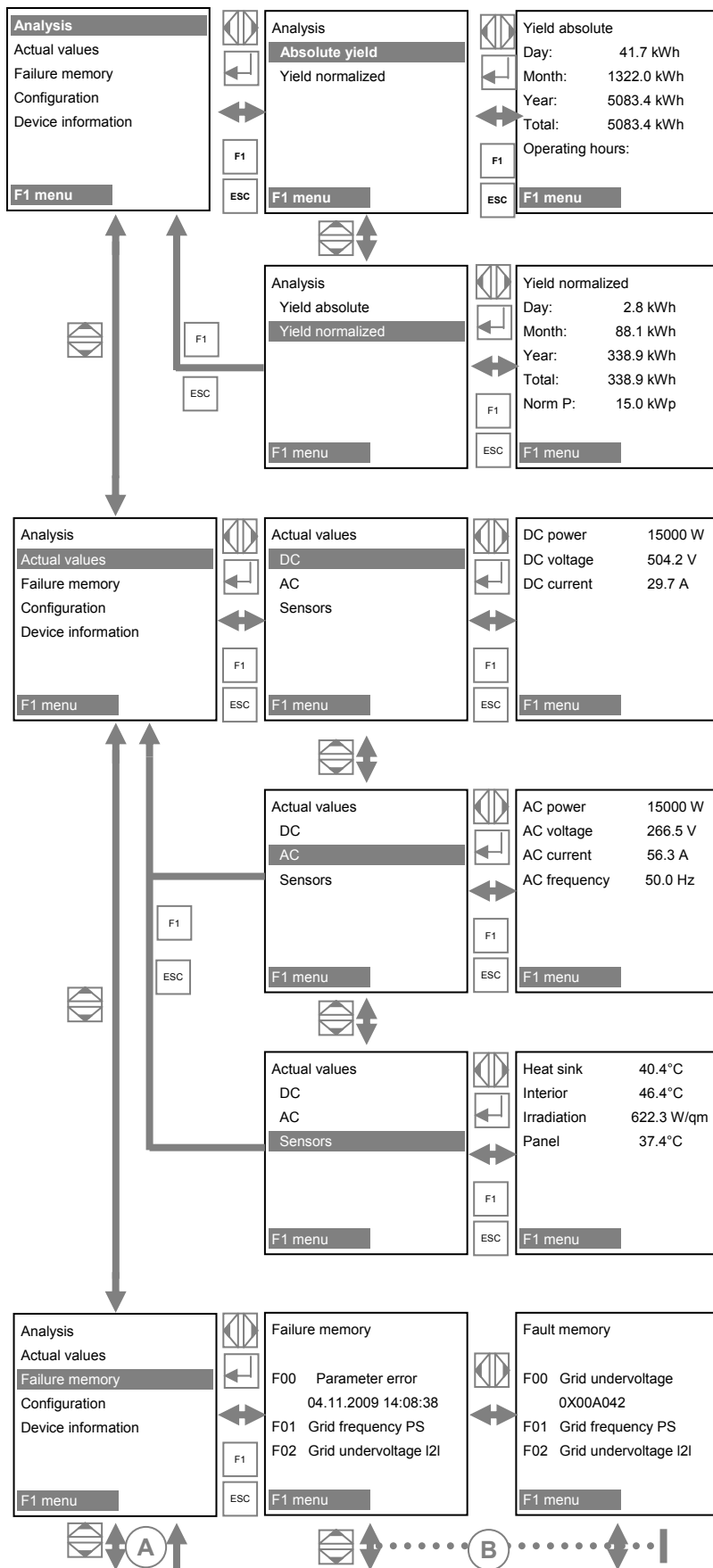
5.6 Menu Structure

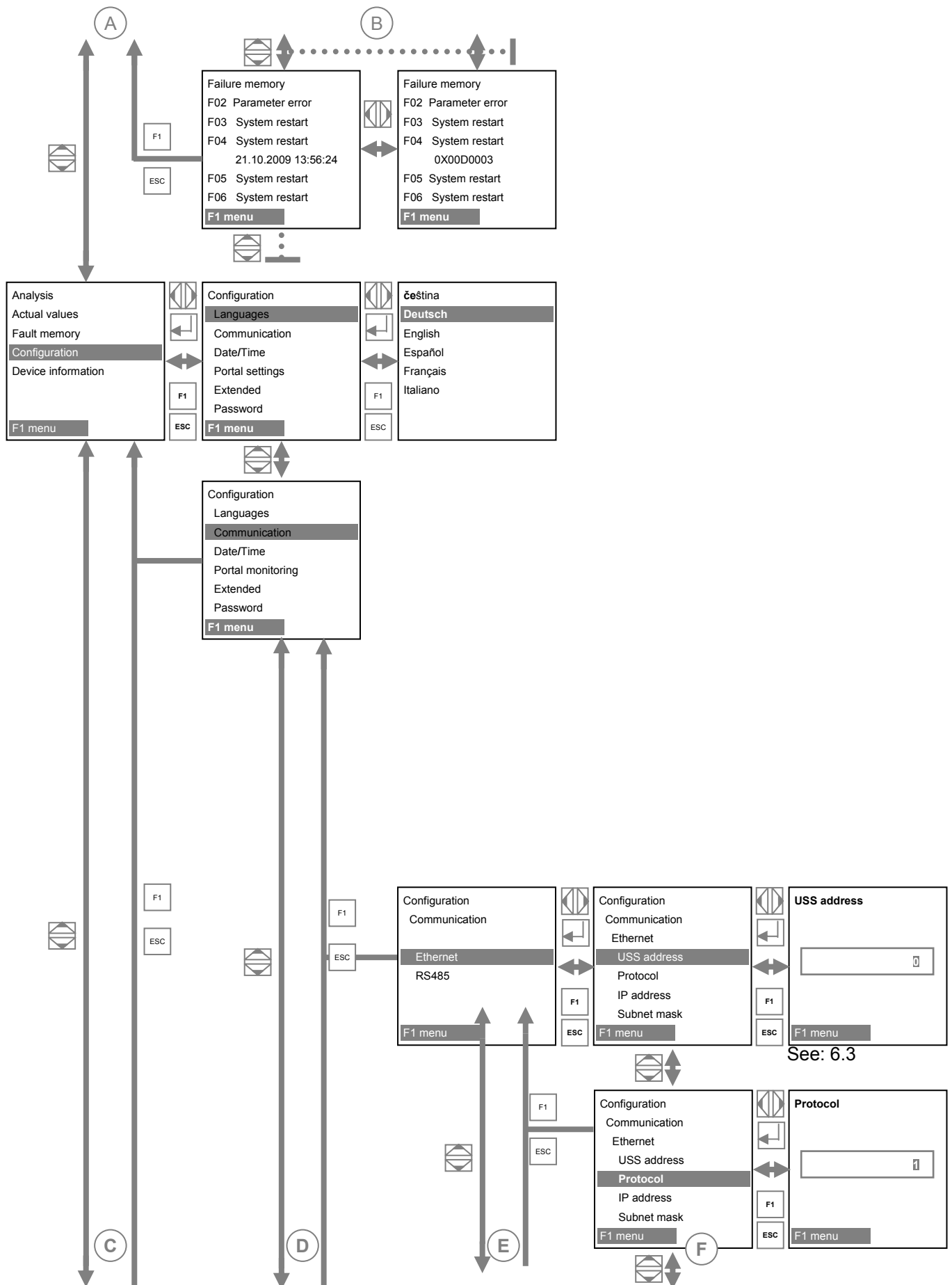
The menu structure aids switching to the individual information displays and the setting displays.

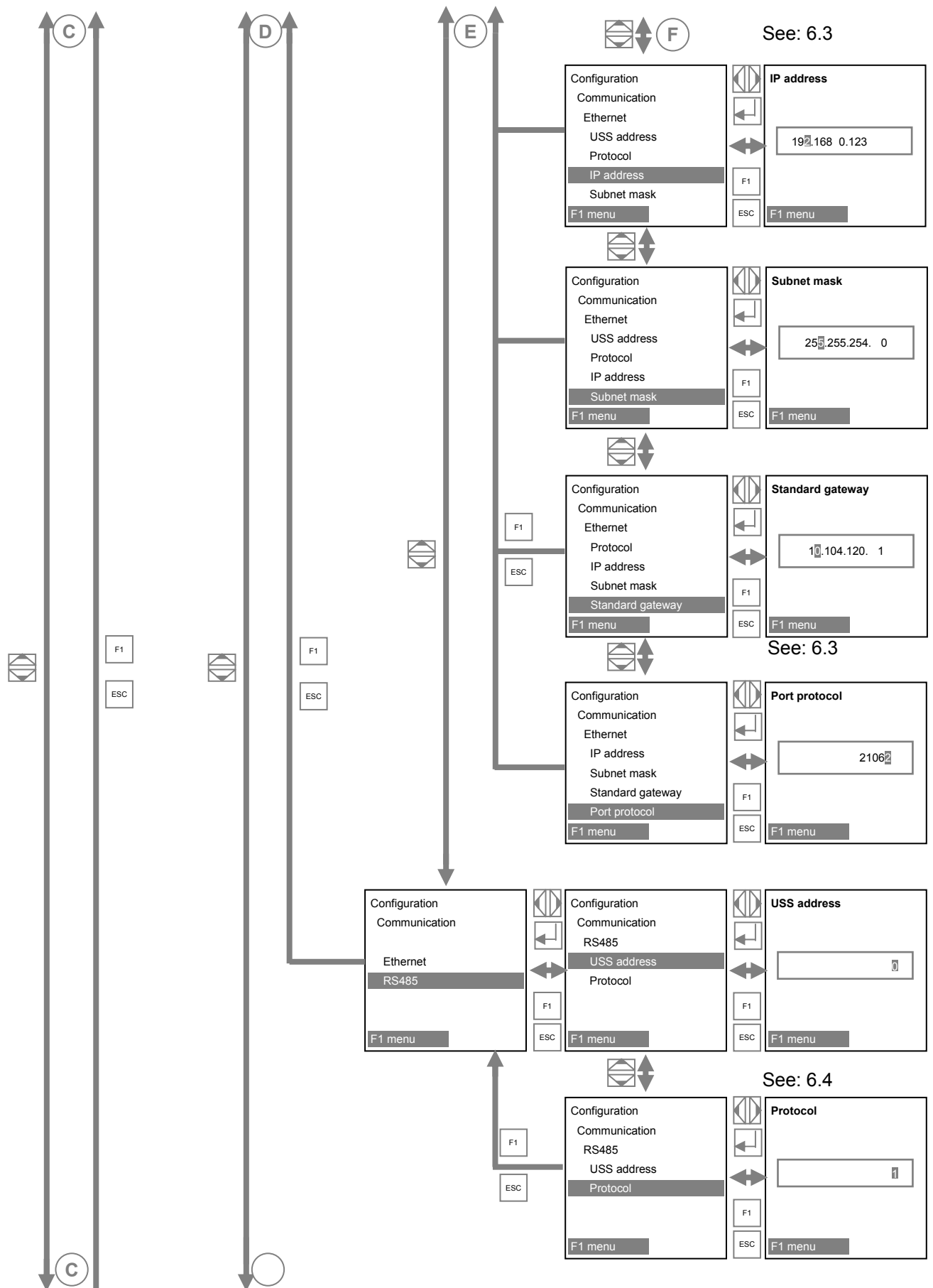
Legend:

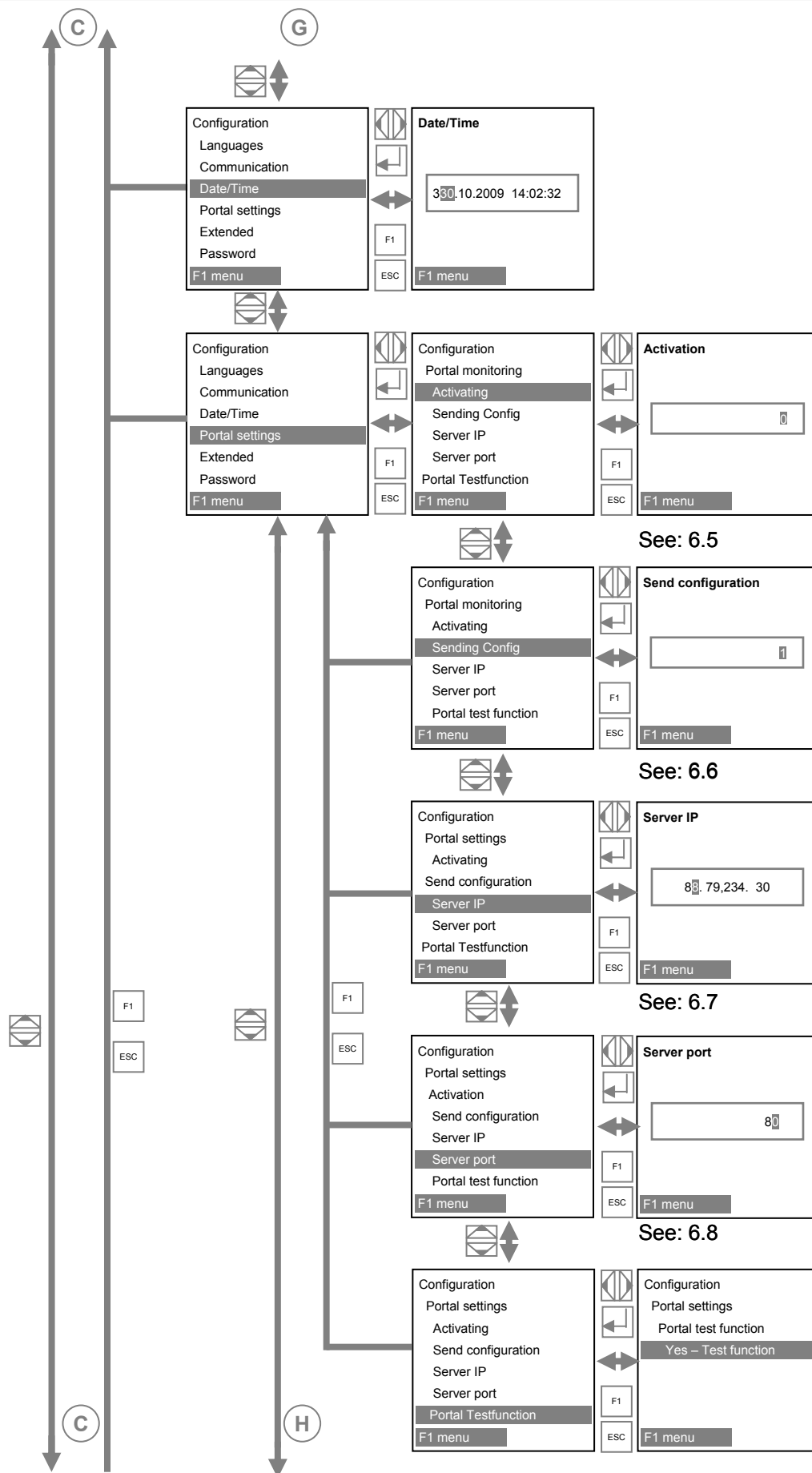


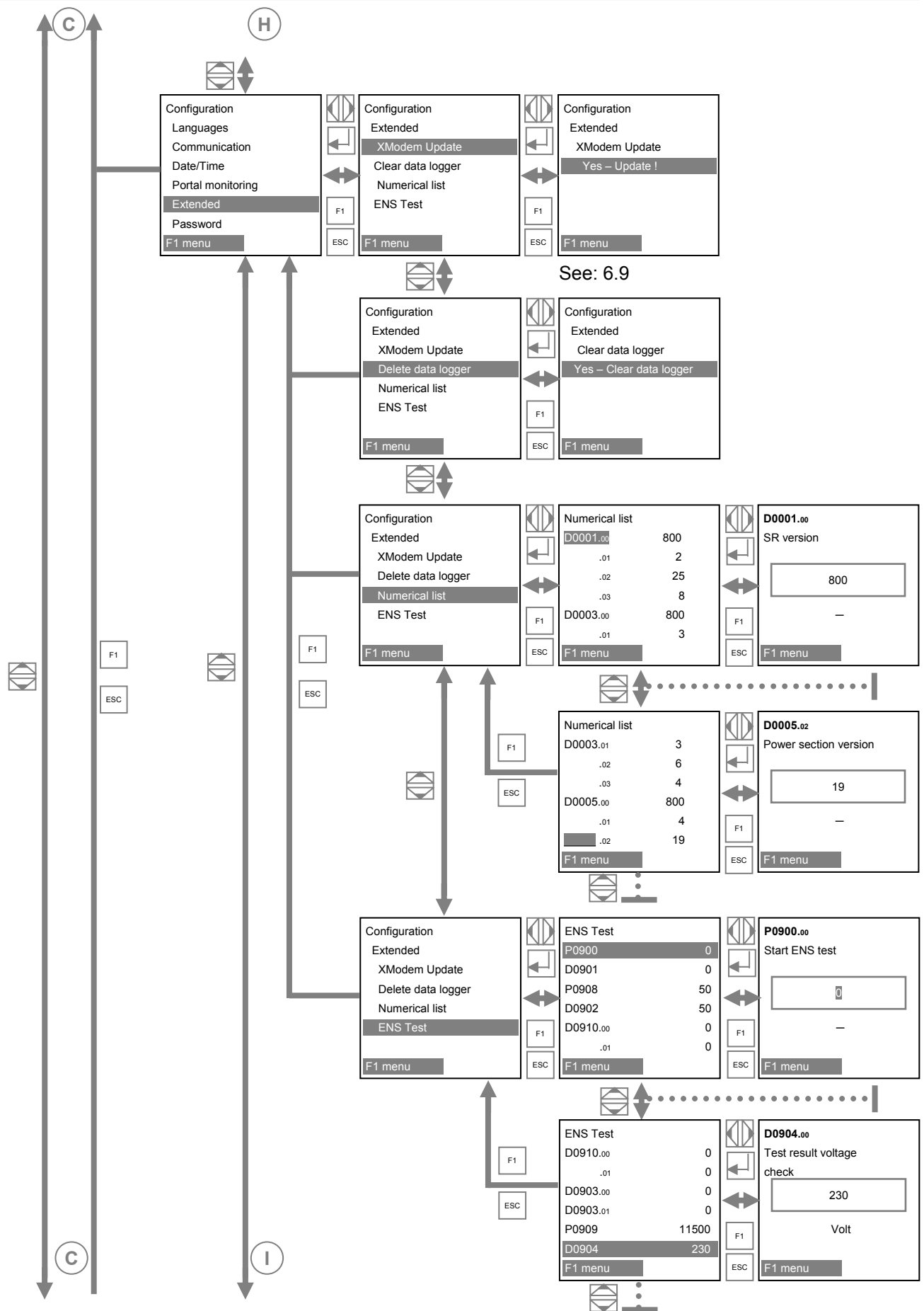
Menu guide

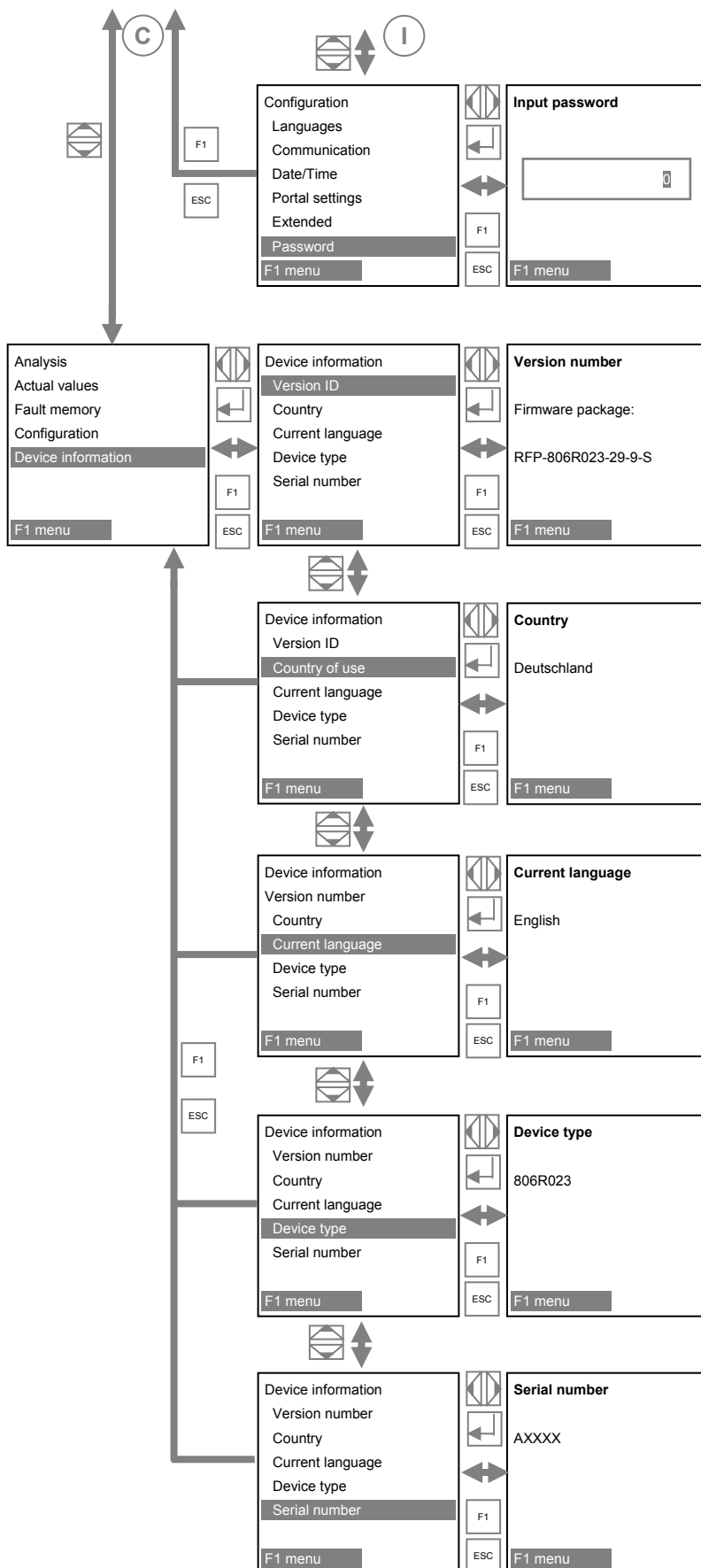




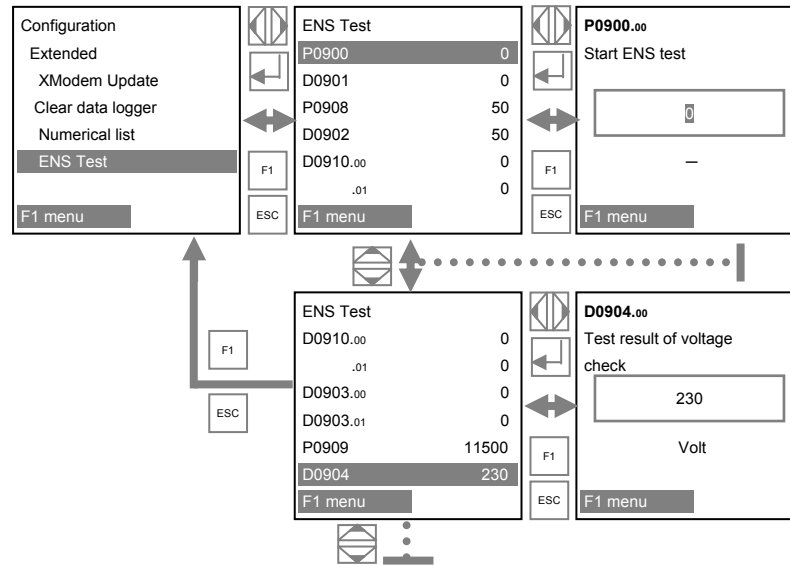








5.7 ENS Test



Info: If the ENS test is carried out while the device is disconnected from power supply, there will be no result. First restart the device.

Carrying out the ENS Test:

- Setting P0900 to "1" → starts the ENS test
- P0901 shows the progress of the ENS test
- P0908 informs about the frequency ramp (in mHz/s) and can be set
- P0902 shows the development of the simulated frequency
- P0910.00 shows the time measured until the lower frequency limit is reached
- P0910.01 shows the time measured until the upper frequency limit is reached
- P0903.00 shows the frequency value having caused turnoff at the lower limit
- P0903.01 shows the frequency value having caused turnoff at the upper limit
- P0909 informs about the voltage ramp (in mV/s) and can be set
- P0904 shows the development of the simulated voltage
- P0910.02 shows the time measured until the lower voltage limit is reached
- P0910.03 shows the time measured until the upper voltage limit is reached
- P0905.00 shows the voltage value having caused turnoff at the lower limit
- P0905.01 shows the voltage value having caused turnoff at the upper limit

ENS test status list:

- 0 Initializing / ready for start
- 1 ... 3 Frequency test at the lower frequency limit
- 4 ... 6 Frequency test at the upper frequency limit
- 7 ... 9 Voltage test at the lower voltage limit
- 10 ... 12 Voltage test at the upper voltage limit
- 13 ENS Test completed

6 Configuration

6.1 Reduction of the power output

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

1. Enter the customer password "72555".
2. Using the F1 key, select the menu item Configuration and confirm with the  key.
3. Select the sub-menu "PAC reduction" and confirm with the  key.
4. Enter the invert power output desired and confirm with the  key.
An input of 70, for example, means that the inverter will only deliver 70% of its possible power output.
5. Switch off inverter with DC circuit breaker for 30-60 seconds.
6. The amended input value will be adopted when the device is switched back on again

6.2 Input of $\cos \varphi$

The specification of $\cos \varphi$ can be entered in the following ways:

- ⇒ Using the F1 key, select the menu item Configuration and confirm with the  key.
- ⇒ From the Configuration menu, select the "Extended" submenu and confirm with the  key.
- ⇒ Within the menu item "Extended", select the sub-item "New list" and confirm with the  key.
- ⇒ Enter parameter "1164" using the arrow keys and confirm with the  key.
- ⇒ The list of input options for $\cos \varphi$ will be displayed.
 - Parameter 1166: Input of the fixed value for $\cos \varphi$ as angle.
 - Parameter 1167: Squint angle variable. The function requires the REFUpmu option.
 - Parameter 1168: Squint angle via P characteristic curve by means of 10 values in degree specification.
Parameters 1168.00 to 1168.10.
 - Parameter 1169: Squint angle via U characteristic curve by means of 10 values in degree specification parameters 1169.00 to 1169.10

6.3 Communication via Ethernet

USS address:

Is factory-set and cannot be changed.

Protocol:

Activation 0 or 1

0 = RTP protocol

1 = USS and RTP protocol

Protocol port:

Input 1024....65535; default setting 21062.

The port number is required for communication via Ethernet.

6.4 Communication via RS485

USS address:

Input 1 – 31

This address is required for communicating with the inverter via RS485.

Note:

if you change this parameter (address) and wish to save it, you must restart the inverter!
The new address will only be active thereafter.

Protocol polling via Ethernet:

Input 1, 2 and 3

1: USS and RTP protocol

2: Solar data systems (old SolarLog® firmware)

3: MeteoControl©

Baud rate:

Set 9600, 19200, 57600 or 115200

6.5 Portal monitoring

Activation 0 or 1

0 = Portal monitoring not active

1 = Portal monitoring active

For using the REFUlog monitoring portal, portal monitoring must be set as active.

6.6 Sending Config

Activation 0 or 1

0 = no Config data in the waiting queue

1 = Config is sent.

6.7 Server IP

Display of IP address

6.8 Server port

Display of the port number of the web server.

6.9 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.

7 Troubleshooting

7.1 Self-Test Error Messages

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 alarm on the control panel flashing and remains stored in the fault memory even in the event of a power failure. See the Faults section.

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 “Alarm” LED remaining illuminated.

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 at least 30 seconds.

7.5 List of Fault Messages

Error code	Error message	Description	Action
0A0001	Regulator voltage 1	Boost converter of the positive DC link could not be regulated sufficiently	Wait for the regulator to become stable again.
0A0002	Regulator voltage 2		
0A0003	Regulator voltage 3	Asymmetry in the DC link low	
0A0004	Regulator voltage 4		
0A0005	Regulator voltage 5	The positively boosted DC link has dropped below the mains peak value	
0A0006	Regulator voltage 6		
0A0007	Regulator voltage 7	The positive DC link voltage has dropped below the limit value P0024.0	
0A0008	Regulator voltage 8	The positive DC link voltage has exceeded the limit value P0024.1	
0A0009	Regulator voltage 9	The negative DC link voltage has dropped below the limit value P0024.0	
0A000A	Regulator voltage 10	The negative DC link voltage has exceeded the limit value P0024.1	
0A000B	Regulator voltage 11	The positively boosted DC link voltage has exceeded the limit value P0024.1	
0A000C	Regulator voltage 12	The negatively boosted DC link voltage has exceeded the limit value P0024.1	
0A000D	Grid overvoltage	Grid overvoltage detected (ENS, control section)	May have been triggered by switching operations on the grid. 1. Wait until the situation has settled down or measure grid voltage again. 2. Contact the grid operator if the grid voltage is not in the normal range. 3. Contact the Service team if the grid voltage is in the normal range.
0A000E	Grid undervoltage	Grid undervoltage detected (ENS, control section)	
0A000F	Grid overvlt. 2I	Grid line-to-line overvoltage detected (ENS, control section)	
0A0010	Grid undervlt. 2I	Grid line-to-line undervoltage detected (ENS, control section)	
0A0011	Grid frequency FLL	A grid error has been detected (ENS, control section).	

Error code	Error message	Description	Action
0A0012	Grid frequency	A grid frequency error has been detected (ENS, control section).	See above
0A0013	Gen. isolation RCD CR	An isolation error was detected during the automatic system isolation check (ENS, control section)	Check and repair system isolation
0A0014	No country code	Country code has not been set	Please contact the Service team
0A0102	Overtemperature PS 1	Cooler overtemperature (right) above limit value P0027.3	Leave the device the cool down. Acknowledge fault
0A0103	Overtemperature PS 2	Interior overtemperature (top left interior sensor) above limit value P0027.3	
0A0104	Overtemperature PS 3	Interior overtemperature (bottom right interior sensor) above limit value P0027.3	
0A0105	Overtemperature PS 4	Cooler overtemperature (left) above limit value P0027.3	
0A0106	Supply voltage PS	Control voltage is faulty in the power section	Please contact the Service team.
0A0108	Grid frequency PS	A grid frequency error has been detected (ENS, power section).	May have been triggered by switching operations on the grid. 1. Wait until the situation has settled down or measure grid frequency and voltage again. 2. Contact the grid operator if the grid voltage is not in the normal range. 3. Contact the Service team if the grid voltage is in the normal range.
0A0109	Grid overvoltage PS	Grid overvoltage detected (ENS, power section)	
0A010A	Grid undervoltage PS	Grid overvoltage detected (ENS, power section)	
0A010C	Gen. isolation PS	An isolation error was detected during the automatic system isolation check (ENS, power section)	Check and repair system isolation
0A010D	RCD fault	Residual current detected (ENS, power section)	RCD sensor failed, check circuit board contacts, have replaced by Service team is required
0A010E	Device fault PS	Shutdown due to overloading in the power section	Acknowledge fault
0A0110	Solar voltage PS 1	Overvoltage shutdown in the positive DC link (power section)	Check solar cell voltage
0A0111	Solar voltage PS 2	Overvoltage shutdown in the negative DC link (power section)	

Error code	Error message	Description	Action
0A0113	Country code incon. PS	Country of use code and country of use subcode do not match	Please contact the Service team.
0A0114	Gen. isolation RCD PS	An isolation error was detected during the automatic system isolation check (ENS, power section)	Check and repair system isolation
0A0115	RCD warning	An isolation error was detected during the automatic system isolation check (ENS, power section)	
0A0117	Iso. test unit def.	Isolation test unit defective	Please contact the Service team.
0A0118	Voltage offset PS	Offset adjustment values of the power section are outside the limits	Acknowledge fault
0A0119	Current transdcr.PS	Failure detected in current sensors in the power section	1. Acknowledge fault 2. If fault occurs repeatedly contact the Service team
0A011A	Activation PS 1	Failure of a power branch detected in the boost converter	
0A011B	Activation PS 2	DC link voltage has dropped below the limit value P0024.0 (power section)	
0A011C	Activation PS 3	Target value for DC link symmetry is defective	
0A011D	Activation PS 4	Time exceeded for DC link symmetry	
0A011E	Activation PS	Time exceeded for DC link pre-charging	
0A0120	Communication PS	Communication problem between control and power section	Acknowledge fault Contact Service team if fault occurs repeatedly
0x0A0121	Offset DC	DC current in AC feed-in	
0A200D	Overtemperature 6	Temperature in the device is too high	Overtemperature shutdown of SR or cooler temperature has exceeded 80°C or interior temperature has exceeded 75°C; Leave device to cool
100001	Ethernet connection 1	Ethernet connection failed to establish	Check Ethernet connection
100002	Ethernet connection 2	Loss of Ethernet connection	
100003	Ethernet connection 3	The Ethernet connection is not 100Mbit/s	Establish Ethernet connection with 100Mbit/s.

8 Options

8.1 Power Plug

Optionally, you can also order a larger connector housing with M32 cable gland that allows you to connect a 5 x 10 mm² flexible power supply line with a maximum external diameter of 26.5 mm. The connector housing can be ordered from REFUsol GmbH under the following item number.

Designation	REFUsol GmbH part no.
VC-AL-T3-Z-M32-S-PLOMB	0029939

8.2 Radiation and Temperature Sensor

A radiation and temperature sensor can be optionally connected for recording the solar radiation incidence and the module temperature. Type Si-13TC-T-K. REFU item no. 0030628 is recommended. The sensor plug is included in the scope of delivery for the radiation and temperature sensor. The sensor plug can also be separately ordered from REFUsol GmbH under part no. 0030616.

The sensor comes with a 3 meter UV-resistant connecting line (5 x 0.14 mm²). The line can be extended with a 5 x 0.25 mm² shielded line, max. 100m.

More information on this can be found under Technical Data in section 10.2.

Si-13TC-T-K pin assignment			REFUSOL pin assignment: Sensor
Red	RD	Supply voltage (12–24 VDC)	Pin 1
Black	BK	GND	Pin 2
Orange	OG	Measurement signal for incident light (0–10 V)	Pin 3
Brown	BN	Measurement signal for temperature (0–10 V)	Pin 4
Gray	GY	Shielding	Pin 5



Info: 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. 8 mm.

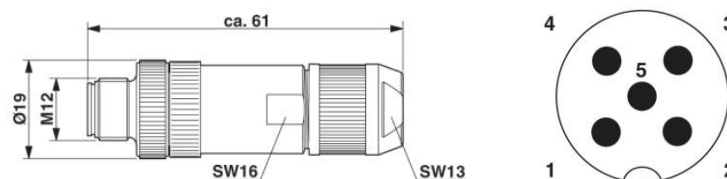


Fig No. 23 Connector M12 x 1 straight, shielded; pole arrangement: male M12, 5 pins, A-coded, view of male connector side,

Phoenix name: SACC-M12MS-5SC SH

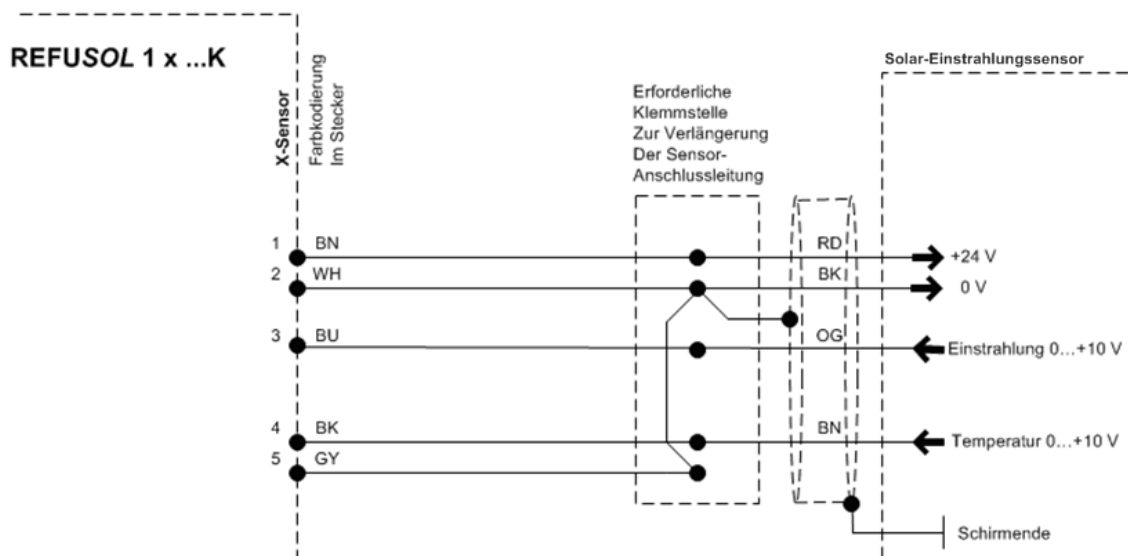


Fig No. 24 Connection of the solar radiation sensor

The data of the Si-13TC-T-K can be called up with the following parameters:

- D 1191.00 => incidence
 - 0–10 V => 0–1300 W/m²
- D 1193.00 => temperature
 - 0–10 V => –26.1°C to 90°C

This data can also be recorded in the data logger.



Info: 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).

8.3 Remote Monitoring System

The following options are available for remote monitoring:

- REFUlog: A portal that has been developed by REFUso/ for the purpose of monitoring and recording solar system data. For more information and details, please refer to the REFUlog operating instructions. These are available to download from our website www.refusol.com.
- Web Log: Data logger from MeteoControl. Connection via RS485.
- SolarLog®: Data logger from Solare Datensysteme. Connection via RS485.

Where MeteoControl® and Solarlog® are concerned, data is imported from the inverters via an RS485 interface.

For information about the configuration, please refer to the Operating Instructions of the particular data logger.

8.4 Instrument Settings for Monitoring with SolarLog® or MeteoControl®

All inverters must be equipped with the firmware version **RTF-80xR0xx-25-x-S or higher** (available at: Menu F1/Device information/Version ID/RFP ...).

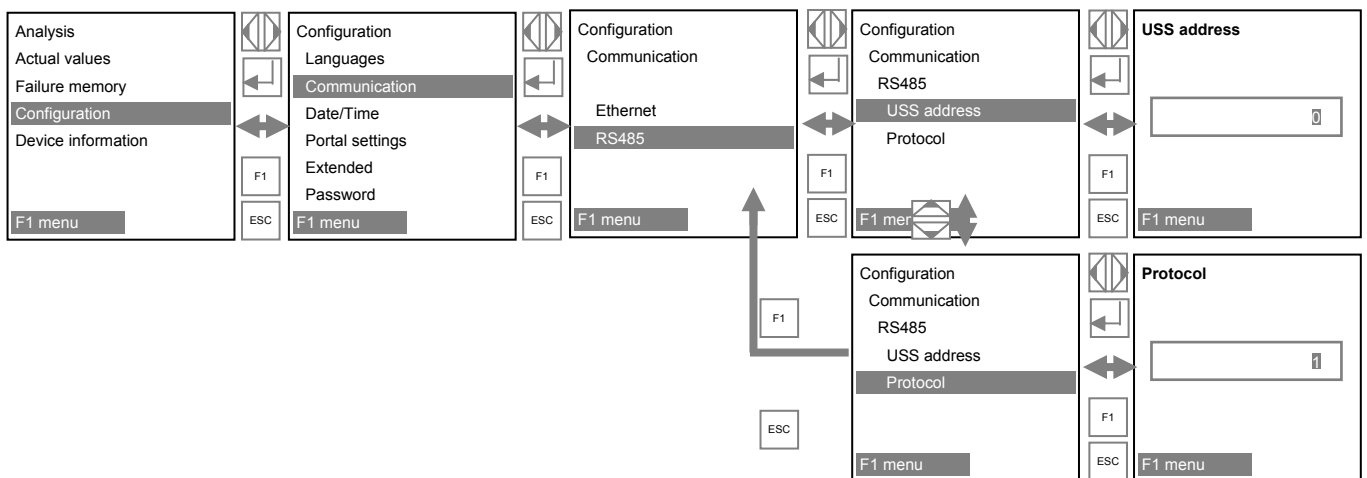
The RS485 interface (RS485 IN/OUT) is standard on all inverters.

For communication via SolarLog® or MeteoControl® each REFUsol must be given a communications address. Predefining the addresses continuously starting with 1 (then 2, 3, etc. to max. 31) is recommended.



Info: The maximum number of inverters that can be operated at one bus is 31.

These settings are made as follows on the inverter's control panel after the customer password 72555 has been entered (see section 5.5):



Protocol: for SolarLog® enter “2” and ,
or for MeteoControl® enter “3” and 



Info: After entry has been made turn the inverter off for at least 30 seconds before turning it back on again!

8.5 Data Logger Parameters

These parameters serve as settings for the internal data logger.

Parameter number	Parameter name	Description
P450.00	Data logger enabled	- Enables or disables the data logger. 0 = disabled. 1 = enabled. Data will be recorded at regular intervals.
P451.00	Data logger interval	Contains the time interval (60 / 300 / 600 sec) for which the data logger stores values.
P452.00 - 39	Parameter no. data logger	Contains a list of all parameter numbers to be recorded. This only works in conjunction with indices (P453.x). Nonexistent parameter numbers will be ignored.
P453.00 - 39	Data logger indices	Contains a list of all indices assigned to the parameter numbers to be recorded. This only works in conjunction with parameter numbers (P452.x). Nonexistent parameter numbers will be ignored.

8.6 REFUpowercap

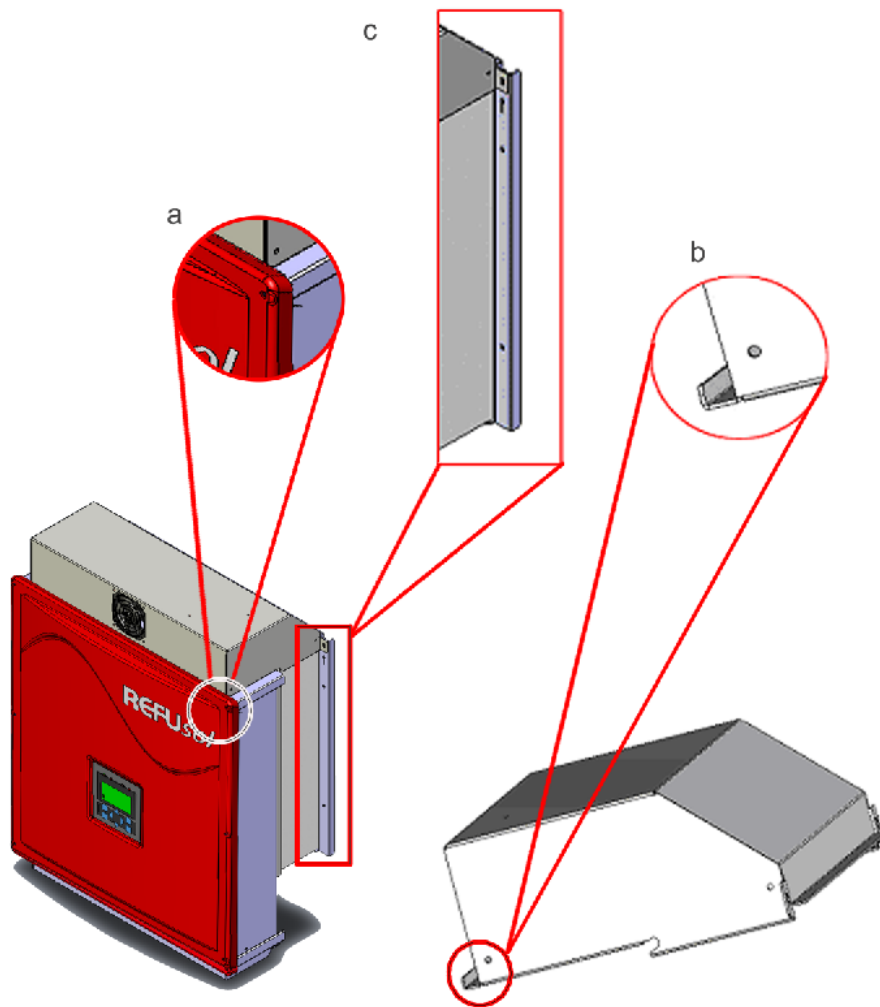


Fig No. 25 REFUpowercap

REFUpowercap is an additional fan module, which is used if the available space requires that the inverters be mounted one on top of the other. REFUpowercap 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 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 REFUpowercap must be attached to the wall-mounting bracket (c) by means of the enclosed 6.5 mm polyamide mounting clips and the mounting tie.

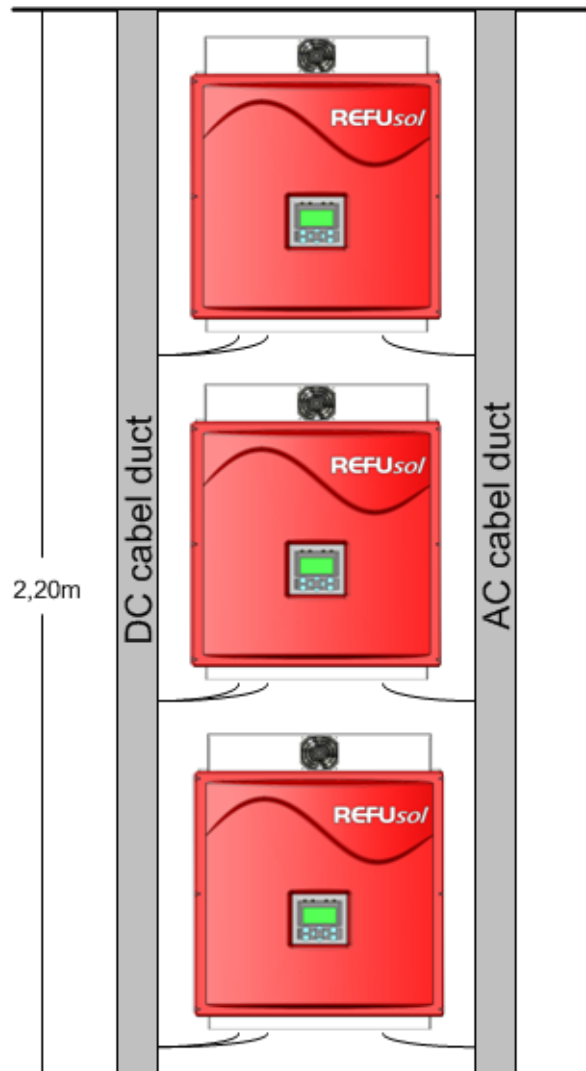
The fan motor is enclosed according to Protection Class IP54 and has a service life of approx. 10 years.



CAUTION

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

⇒ Always mount inverters on top of one another with REFUpowercap.



Info:

Because the power supply for the inverter's sensor connection is occupied by the REFUpowercap fan motor, no temperature and radiation sensor can be connected in this case.

8.7 Connecting the AC Adaptor to the REFUpowercap

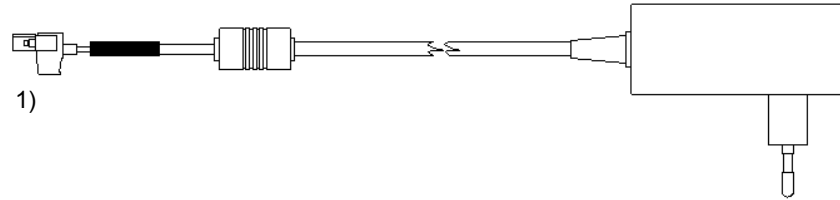


Fig No. 26 AC adaptor

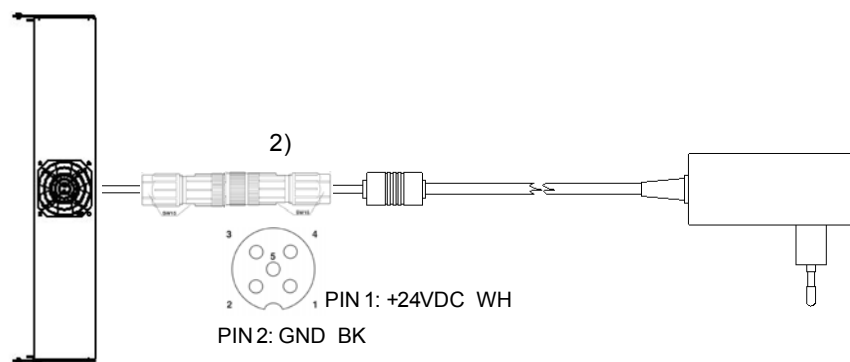


Fig No. 27 REFUpowercap with AC adaptor

1) Disconnect the plug.

2) Connect the 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 REFUso/ GmbH under item number 0030626.

9 Maintenance

The inverters are cooled exclusively through natural convection. For safe operation according to the ambient conditions, the cooling fins on the heat sink should be checked for dirt and any dust or dirt deposits cleaned away.

The DC switch is designed for a very long life but simple yearly maintenance is recommended. By operating the switch a few times (5x) the contacts will clean themselves and the switch will have a longer life.

Other maintenance work is not required.

10 Technical Data

10.1 Inverter

Type	REFUsol 023K - 460 VAC
DC data	
Max. PV power	25.3 kW $P_{rated} + 10\%$
MPPT range	575 to 900 V
Max. DC voltage	1000 V
Max. DC current	41 A
MPP tracking	One fast, precise MPP tracker
Number of DC connections	6 x MC4
DC isolator	Yes
Internal overvoltage protection	Type 3
AC data	
Rated AC power	23 kVA
Max. AC power	23 kW
AC grid connection	3 AC 460 V + N, 50 - 60 Hz
Rated power factor	1
Variable displacement factor	0.9i..1..0.9c
Max. AC current	29.2 A
Distortion factor THD	<1.8 %
Max. efficiency	98.34 %
European efficiency	98.1 %
Infeed from	20 W
Internal consumption in night operation	<0.5 W
Internal overvoltage protection	Type 3
Cooling, ambient conditions, EMC	
Cooling	Natural convection
Ambient temperature	-25°C to 55°C
Site altitude	Up to 2000 m above sea level
Noise	<45 dBa
Emitted interference	EN 61000-6-4; 2007
Certificate	CE (UL and CSA in preparation)
Interference immunity	EN 61000-6-2; 2005
Environmental classification	4K4H according to DIN IEC 721-3-4

Type	REFUso/ 023K - 460 VAC
Certificates	CE, VDE0126-1-1, VDEW compliance, Belgium C10/C11, Italy ENEL, Spain RD1663 RD 661, Austria ONORM, EN 50348:2007: Cyprus, Portugal
Grid code	Complies with all of the German low and medium voltage grid regulations (VDEW, BDEW, VDE-AR-N 4105 ⁴), EEG2012
Automatic disconnection	According to VDE 0126-1-1
Interfaces	Ethernet & RS485
General data	
Type of protection	IP65 as per EN 60529
Dimensions Width/Height/Depth	535 mm / 601 mm / 277 mm
Weight	41.5 kg

* Please observe the derating conditions in case automatic circuit-breakers are mounted side by side

10.2 Radiation and temperature sensor Si-13TC-T-K

Type	Radiation and temperature sensor Si-13TC-T-K
General	
Shunt resistor	0.10 Ω (TK = 22 ppm/K)
Ambient temperature	-20°C to +70°C
Supply voltage	12 to 24 VDC
Current draw	0.3 mA
Connecting cable	4 x 0.14 mm ² , 3 m (UV-resistant)
Cell dimension	50 mm x 34 mm
Dimensions Length / Width / Height	145 mm x 81 mm x 40 mm
Weight	340 g
Solar radiation	
Measuring range	0 to 1300 W/m ²
Output signal	0 to 10 V
Measuring accuracy	±5% of final value
Module temperature	
Measuring range	-20°C to +90°C
Output signal	2.268V + T [°C] * 86.9 mV/°C
Measuring accuracy	±1.5% at 25°C
Nonlinearity	0.5°C
Max. deviation	2°C
Pin assignment	
Orange	Output signal radiation (0 - 10 V)

Type	Radiation and temperature sensor Si-13TC-T-K
Red	Supply voltage (12 - 24 VDC)
Black	GND
Brown	Output signal temperature (0 - 10 V)
Supply voltage	Temperature and radiation sensor or Power cap

10.3 REFUpowerCap

Type	REFUSOL Power Cap
Electrical data	
Supply voltage	24 VDC
Connection supply voltage	Sensor connector
Internal consumption	2.4 W
Cooling, ambient conditions	
Free space in front of the unit	1000 mm
General data	
Type of protection	IP54 as per EN 60529
Dimensions Width/Height/Depth	488 mm / 90 mm / 250 mm
Weight	1.4 kg

11 Contact

Please address any questions on the configuration of [your inverter](#) to:

REFUsol/ GmbH

Uracherstr. 91

D-72555 Metzingen, Germany

Tel. +49 7123 969-102

Fax +49 7123 969-333

info@refusol.com

www.refusol.com

Please address any questions on failures or technical problems to:

Service hotline: +49 (0)7123 / 969 – 202 (Monday – Friday, 8 a.m. to 5 p.m)

Fax: +49 (0)7123 969 – 235

E-mail: service@refusol.com

You should have the following data at hand:

- Exact description of the error and if possible HEX code of the error (P0017.00).
- Data from the type plate:



REFUsol GmbH
Uracher Str. 91
72555 Metzingen / Germany
service@refusol.com
Hotline: +49 7123969-202




Photovoltaic String Inverter
Typ: 806R023 .000 REFUSOL 023K HW05

DC Max. Eingangsspannung DC max. input voltage	1000 V	AC Nenn-Betriebsspannung AC nominal operating voltage	3AC460V + N
DC MPP Bereich DC MPP range	575 - 900 V	AC Nenn-Betriebsfrequenz AC nominal operating frequency	50/60 Hz
DC Max. Eingangsstrom gesamt DC max. input current total	41,0 A	AC Nennleistung AC rated power	23.000 VA
DC Max. Strom pro Anschlusspaar/-tripel DC max. input current per input pair/-triplet	25 A	AC Max. Wirkleistung AC max. active power	23.000 W
Betriebstemperaturbereich Operating temperature range	-25...+55 °C	AC Max. Ausgangsstrom AC max. output current	3 x 29,2 A
Gehäuseschutzart Enclosure	IP65	Überspannungskategorie DC/AC Overvoltage category DC/AC	II / III



Serien-Nummer: 010025993

Made in Germany


 806R023.000
 010025993

12 Certificates

The following certificates

- EC Declaration of Conformity
- VDEW Declaration of Conformity
- Clearance certificate
- Unit certificate

can be downloaded from the REFUso/ GmbH website www.refusol.com.

13 Notes

No responsibility is taken for the
correctness of this information.
Subject to modification.

REFUso/ GmbH
Uracherstr. 91
D-72555 Metzingen / Germany

Tel.: +49 7123 969-102

Fax: +49 7123 969-333

info@refusol.com

www.refusol.com

Item No.: 0033533