

REFU Power Quality REFUSOL – Solar Inverter

Operating Instruction

DOK-ReSOL-BA07-EN-WR0015k_ -NN-P.doc



Title	REFU Power Quality REFUSOL– Solar inverter
Kind of documentation	Operating instruction
Purpose of the documentation	This documentation shall explain the REFUSOL device. Information provided <ul style="list-style-type: none"> • on the commissioning of the equipment • on fault messages, with details about cause and remedy This description is applicable as from November 2008

History of revisions

State-related designation of the document	State	Remarks
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1 Safety instructions for REFUSOL

1.1 Introduction

Read the following instructions before putting the system into operation the first time, in order to avoid injuries and / or material damages. Observe these safety instructions any time.

You are urgently requested to read all supplied documents carefully prior to commissioning. This applies also to the safety instructions and any other advice for the user whenever any work at the inverter is started. If the user instructions for the device are not available to you, please refer to REFU Elektronik GmbH. Ask for the immediate delivery of these documents to the person(s) in charge of the safe operation of the device.

In case of sale, renting out and/or any other passing on of the device, these safety instructions are also to be handed over.



WARNING

Improper handling of these devices and disregard of the here mentioned warnings, as well as improper intervention in the protective equipment and the device, may cause material damage, injuries, electric shock or, in an extreme case, may cause fatal consequences.

1.2 Explanations

The safety instructions will describe the class of hazard according to ANSI:

Warning symbol with signal word	Class of hazard according to ANSI
 DANGER	The class of hazard describes the risk when the safety instructions are disregarded: Death or serious injuries will occur.
 WARNING	Death or serious injuries may occur.
 CAUTION	Injuries or material damage may occur.

Fig.: 1: Levels of danger (acc. to ANSI)

1.3 Dangers caused by improper use



DANGER

High electrical voltage and high operating current! Mortal danger or serious injuries by electric shock!



WARNING

High electrical voltage owing to wrong connection! Mortal danger or serious injuries by electric shock!



WARNING

Health hazard in the immediate vicinity of the electrical equipment for persons with pacemaker, metallic implants and hearing aid!



CAUTION

Hot surfaces possible on equipment casings! Risk of injury! Risk of burns!



CAUTION

Risk of injury owing to improper handling! Injuries caused by bruising, shearing, cutting, knocking against.

1.4 General remarks

- REFU Elektronik GmbH excludes any liability for any damages caused by non-compliance with the warnings included in this operating instruction.
- Read the operating, maintenance and safety instructions carefully prior to commissioning.
- The proper and safe operation of this device bases on appropriate transport, storage, mounting and installation, and on a careful operation and maintenance.
- Employ trained and qualified personnel only for the handling of the electrical systems.

Only adequately trained and qualified persons shall have access to this equipment. Qualified means, the persons should be familiar with mounting, installation and operation of the products and sufficiently familiar with all warnings and precautionary measures described in this operating instruction.

Further, the persons are be trained, instructed and authorized to switch on and off the electric circuits and devices, to connect them to earth, and to mark them adequately in accordance with the rules of safety engineering. The persons have to be provided with appropriate protective equipment and shall be trained in first aid.

- Use only accessories and spare parts approved by the manufacturer.
- Observe the safety regulations and legal requirements of the country where the device is installed.
- Meet the ambient operating conditions mentioned in the product documentation.
- Commissioning is prohibited until it has been verified that the system into which the products are integrated complies with the relevant national regulations and safety rules.
- Operation is allowed for the present case, provided the national EMC regulations have been complied with.
- The manufacturer of the system or machinery shall be liable for adherence to the limiting values required by the national regulations.

European countries: EC directive 2004/108/EG (EMC directive).

- The technical data, the conditions for connection and installation have to be taken from the product documentation and to be observed strictly.

1.5 Protection against accidental contact with electrical parts



Note: This section refers only to devices and components of devices under a voltage above 50 Volt.

Persons may be endangered and an electrical shock may occur if parts with a voltage higher than 50 Volt are touched. Upon operation of electrical devices are certain parts of these devices inevitably under hazardous voltage.

High electrical voltage! Mortal danger, risk of injury by electric shock or of serious injury!



WARNING

- ⇒ The REFUSOL device may be installed only by qualified personnel. Furthermore, the installer has to be approved by the relevant power supply company.
 - ⇒ Operation, maintenance and / or repair of this device may be carried out only by qualified persons, trained for work at or with electric devices.
 - ⇒ Observe the general regulations on installation and safety for working on power systems.
 - ⇒ Check the tight fit (arresting) of the connector plugs before switching on.
 - ⇒ Remove the connector plugs of the PV-generator only, when the DC-disconnect switch at the REFUSOL device is "OFF". Deactivate the power supply input and secure it against reactivation before removing the power plug.
 - ⇒ The user has to observe all the above mentioned clauses any time.
-

1.6 Protection against magnetic & electromagnetic fields upon operation and installation

Magnetic and electromagnetic fields existing in the immediate vicinity of live conductors can represent a serious hazard for persons with pacemaker, metallic implants and hearing aids.

Health hazard for persons with pacemaker, metallic implants and hearing aids in the immediate vicinity of electrical equipment!



WARNUNG

- ⇒ For persons with pacemaker and metallic implants access is prohibited to the following areas:
 - Areas where electrical devices and components are mounted, operated or put in operation.
 - ⇒ If for persons with pacemaker the necessity arises to enter such areas, decision has to be taken before by a doctor. The interference immunity of pacemakers already implanted or to be implanted in future is very different and there exist no generally applicable rules.
 - ⇒ Persons with metallic implants or metal splinters, as well as hearing aid shall consult a doctor before entering such an area since there is a risk for health to be expected.
-

1.7 Protection against contact with hot parts



VORSICHT

Hot surfaces on device casings are possible! Risk of injury! Risk of burns!

- ⇒ Don't touch device housings located close to a heat source! Risk of burns!
 - ⇒ Before touching have the device cooling down for 10 minutes after switch off.
 - ⇒ At an ambient temperature of 45°C the top of the housing and the heat sink element may take up a surface temperature of 75°C!
-

1.8 Protection upon handling and installation

Under unfavourable circumstances, handling and installation of particular parts and components in an improper way may cause injuries.



VORSICHT

Risk of injury owing to improper handling! Bodily harm by bruising, shearing, cutting, knocking against and lifting up!

- ⇒ Observe the general regulations on erection and safety during handling and installation.
 - ⇒ The weight of the REFUSOL device is 38 Kg!
 - ⇒ Use adequate installation and transport equipment.
 - ⇒ Take precautions against jamming and bruising by taking suitable measures.
 - ⇒ Use suitable tools only. Use special tools wherever prescribed.
 - ⇒ Use lifting equipment and tools in a professional way.
 - ⇒ If required, use suitable protective equipment (for instance: safety goggles, safety boots, protective gloves).
 - ⇒ Don't stay under suspended loads.
 - ⇒ Remove leaking liquids on the floor immediately because of the slipping risk.
-

1.9 Disposal



Note: The REFUSOL device is conform to RoHS. Therefore, the device can be delivered to the local authorities responsible for the disposal of electrical appliances.

2 Description of REFUSOL

2.1 Description of the device

The REFUSOL device is a three-phase solar inverter without transformer that works with an extremely high efficiency at any operating point, suitable for the connection of a PV-generator with a capacity of up to 17,5 KW. The heat discipation is performed by mere convection, an internal temperature monitoring feature protects the device when the admissible ambient temperature is exceeded. The REFUSOL device is designed so, that it has not to be opened for installation and connection. All electrical connections are performed exclusively with lockable plugs. In addition, the REFUSOL device includes an integrated DC-isolator switch according to EN 60947-3 which reduces considerably the expenditure and extent of work of the installer. For communication the REFUSOL offers the standard interfaces RS485, Ethernet and USB. By means of an illuminated graphics display the characteristics of the incoming power and of other data are clearly represented.

Additionally, an 8-key operating panel beneath the display provides an outstanding ease of operation and navigation. Owing to the degree of protection of IP65 the REFUSOL device is suitable for outdoor installation almost unrestricted.

If galvanic isolation should become necessary we offer an optional solution that is perfectly adjusted to this type of device. Owing to the high efficiency of about 98% this is scarcely reducing the device performance and the total efficiency. Therefore, the connection of thin-film modules, requiring the linking of the DC-voltage to a particular potential, is possible without problems. The space needed for that is minimized owing to the possibility of mounting it beneath the device. The connection of the REFUSOL device to the transformer is performed by a confusion-safe plug connector.



Figure No.1 REFUSOL 010 bis 015k

2.2 Outer dimensions of REFUSOL 10k - 15K

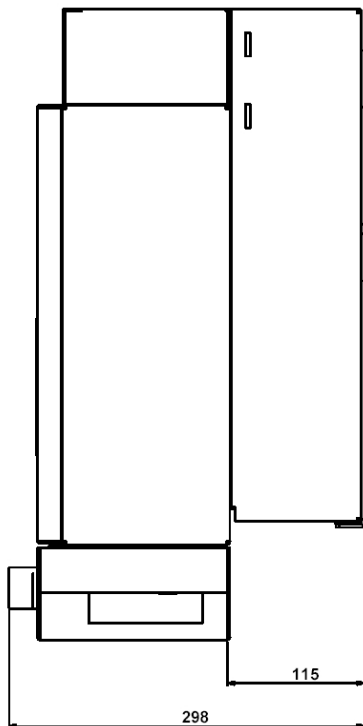
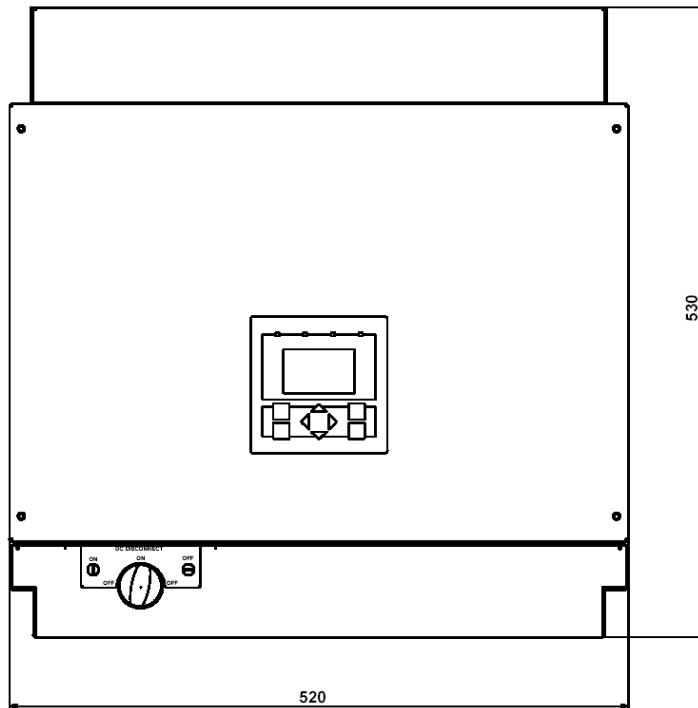


Figure No.2 Overall dimensions

2.3 Block diagram of REFUSOL 10 to 15K

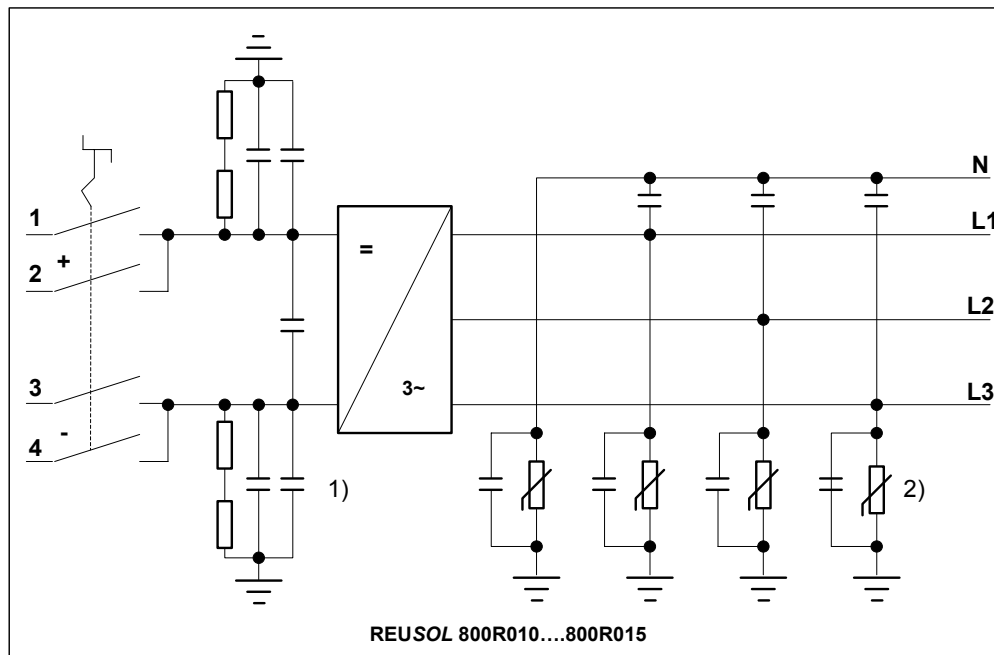


Figure No.3 Block diagram

- 1) Overvoltage protection DC type 3
- 2) Overvoltage protection AC type 3

2.4 Demands on the PV-generator

Under no circumstances the PV-generator may not exceed the following operating data!

Device type	10k	11k	12k	15k
Max. DC voltage per input	900V			
Max. current per DC input	25A			
Max. DC current at the input over all connections	36 A			

The power of the PV-generator must be evenly distributed over all four inputs. If necessary, the connections can also be distributed over two inputs:

Input 1 and 3 or input 2 and 4 !



Figure No.4 Connection PV-generator

**WARNING**

Beim traflosen Solarwechselrichter darf der Plus- oder Minuspol des PV-Generator in keinem Fall geerdet werden !

2.4.1 Reverse current

Reverse currents are fault currents occurring only in PV-systems consisting of in-parallel connected strings. Owing to short-circuits of individual modules or of cells in one module, or a double fault to earth, the no-load voltage of the respective string (e.g. caused by defective modules or parts of modules) may decrease so much that the intact in-parallel connected strings will drive a reverse current through the defective string. In the worst case this may result in the damage of the string.

Moreover, because of the partially high heating-up of the defective string, secondary damages may occur caused by the reverse current.

In order to avoid such damages in PV-systems appropriate precautions should be taken, distinguishing between two different cases:

1. The PV-system is designed so that the reverse current in case of a fault, in the worst case consisting of the sum of the short circuit currents of all intact strings, will not cause the destruction of the defective string, neither will be causing secondary damages. The important criterion for that is the current load rating of the system components (plug connectors, conductors) and the reverse current resistance of the modules. This can be taken from manufacturer's specification!
2. The PV-system is designed so that the reverse current, occurring in case of a fault, exceeds the destruction limit. In this case, every string has to be fused individually by a string fuse connected in series. In case of a fault the string is separated from the intact strings so that the destruction is prevented.

2.5 Control panel

Using the graphic display integrated into the front side and having 128x64 pixels, you are able to represent the course of interesting data, such as supply power.... The required parameters are selected and entered by means of the 8-key control panel. The control panel will be illuminated upon pressing the first key and returns to being dark after a time of 5 minutes.

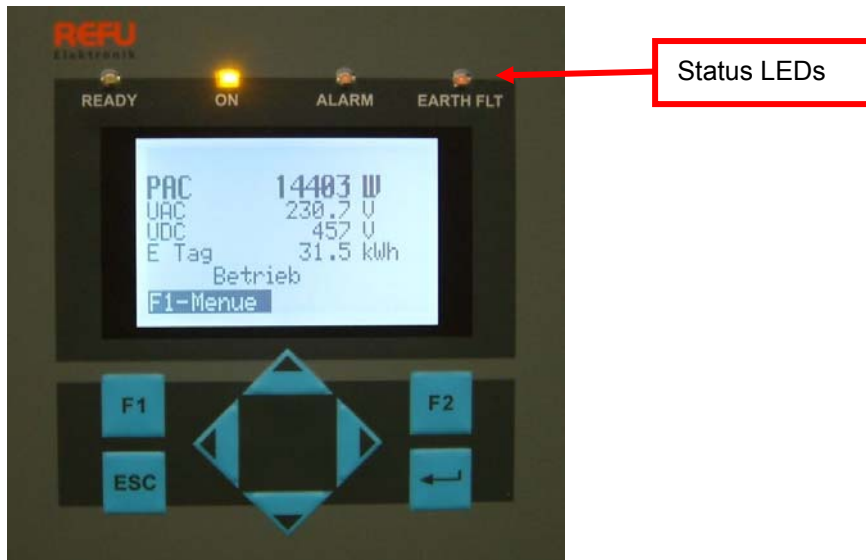


Figure No.5 Control panel

- F1: Menu display
- F2: Select input of standardized yield data
- Auf / Ab: Menu selection
- Links / rechts: Function in the menu: jump to the first or last menu item.
Function during editing of parameters: digit to the left, digit to the right (decade jump)
- ESC: Failure acknowledgement, deleting the entry
- Enter: Confirmation of the menu selection and of the entry

2.6 Internal data logger

The REFUSOL includes an internal data logger that allows 40 measured values to be recorded in parallel in the form of parameters. Depending on the recording cycle selected, the values can be stored for up to approx. 14 years.

Recording cycle	Storage time
every minute	approx. 8.5 months
every 10 minutes	approx. 7 years
every 20 minutes	approx. 14 years

3 Installation

3.1 Requirements concerning the installation site

The REFUSOL device is provided with mere convection cooling which means that it is designed for mounting to a vertical wall. The installation is carried out by means of a self-centering wall mounting plate.



Note: To prevent accidents when installing and servicing, free and safe access to the equipment must be ensured.

- Shaded site
- Only vertical mounting is permitted
- Solid wall or metal structure. **No wood, no gypsum plaster board or similar!** Please take the load capacity of the wall into account! Per each unit a minimum of 38kg is required!
- Sufficient distance to combustible materials.
- The best ease of application will be achieved when the device is mounted at eye level.
- The IP65 degree of protection allows outdoor installation also.



Note: In order to ensure Protection Class IP 65, use only the supplied plugs and sockets for connecting the REFUSOL. To protect against penetrating moisture and dirt, unused inputs and outputs must be properly closed. Failure to observe this specification could void your warranty!

- If you assemble REFUSOL inverters one on top of the other, you require the additional PowerCap cooling unit.



Note: Do not cover the cooling ribs of the heatsink. Failure to observe this specification could void your warranty.

- In order to ensure the required heat discipation the following minimum distances from ceiling and wall or between adjacent units have to be observed. To the optional galvanic isolation a downward distance of 300 mm is required.

Minimum distancies	side	50 mm	above	500 mm	belpow	500 mm
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3.2 Storage and mounting

3.2.1 Transport

The units must be transported under clean and dry conditions, preferably in the original packing. The transport temperature shall be between -25 °C and $+70\text{ °C}$. Temperature fluctuations of more than 20 K per hour are inadmissible.

3.2.2 Storage

The units must be stored in clean and dry locations, preferably in the original packing. The storage temperature shall be between -25 °C and $+55\text{ °C}$. Temperature fluctuations of more than 20 K per hour are inadmissible.



Note: The REFUSOL device contains electrolytic capacitors in the intermediate circuits. Storage in voltage-free condition is possible for maximum two years at a temperature of maximum $+40\text{ °C}$.

If the storage time of two years is exceeded please contact the service dept. of REFU Elektronik before connecting the REFUSOL unit!

3.3 Mounting of REFUSOL 10k - 15K

Mounting is carried out with the aid of a self-centering wall mounting plate which is included in the supply.

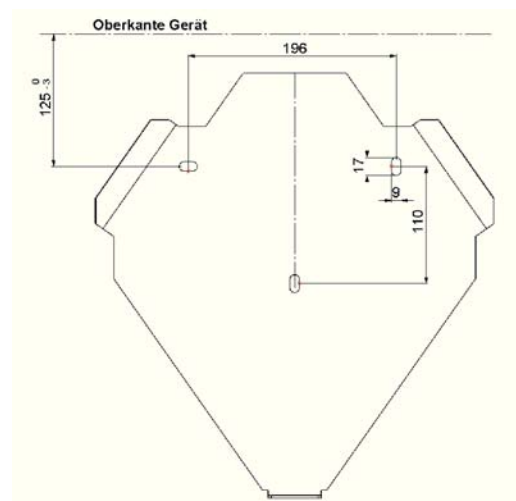
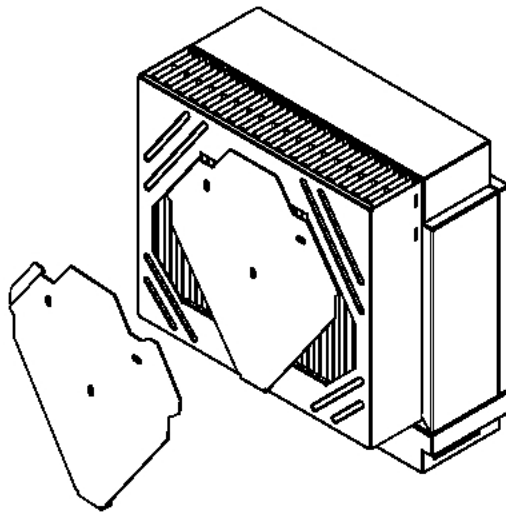


Figure No.6 Mounting



CAUTION

Disregard of these requirements may result in malfunctioning of the device or even in serious injuries by bruising, shearing, cutting, knocking against and fire!

Upon fixation of the wall mounting plate the weight of the REFUSOL device of 38 kg has to be taken into account.

- Mounting of the wall mounting plate. For marking the bore hole positions the wall mounting plate can be used as a template.
- Now hold the REFUSOL to the wall mounting plate so, that the backside is tightly at the wall, then have the REFUSOL unit sliding downward. Because of the design of the wall mounting plate the REFUSOL unit will self-center on the plate.
- Secure the REFUSOL unit against displacement at the bottom of the device by means of the supplied safety screw M8 x 16.
- The accessories pack includes:
 - 1 x Contact insert IP67 5-pole VC-TFS5-PEA
 - 1 x Grommet housing IP67 VC-K-T3-R-M25
 - 2 x Plug 4-pole SACC-M12MS-4SC => RS485
 - 1 x Plug 5-pole SACC-M12MS-5SC => Sensor
 - 1 x Sleeve 4-pole SACC-M12FS-4SC => Relais
 - 1 x Ethernet-plug Phoenix Contact VS-08-RJ45-5-Q / IP67
 - 1 x Cylinder head screw IKT M8x16 DIN912
 - 4 x Washer Form B M8 DIN125-8
 - 1 x Cable fitting Schlemmer-Tec M25x1,5/21
 - 4 x Male DC connectors LC3, Lumberg 4730...
 - 4 x Female DC connectors LC3, Lumberg 4731...

3.4 Elektrical connection

3.4.1 Connection of the device

The following picture shows the connections of the REFUSOL unit at the underside of the device.



Figure No.7 Connection of device

Seen from the left to the right side are the following connectors at the REFUSOL device:

- 4 pairs of PV-generator connectors
- USB and Ethernet interface connectors

- Sensor connector (irradiation and temperature sensor)
- Relay connector
- RS485 connectors (IN and OUT)
- Power connector

3.4.2 Mains connection

The mains connecting cable has to be provided with a suitable line protection, the maximum rated device current is 25 A per each phase (REFUSOL 11K: 18A). Consider the derating factors in case of power circuit-breakers are strung together. Here, the following basic standards have to be observed:

DIN VDE 0298-4	Modes of cable laying and permissible current loading
DIN VDE 0100; Teil 430	Measures for the protection of cables and conductors against overcurrent
DIN VDE 0100; Teil 410	Measures for protection against electric shock

Additionally, the following requirements of the local power supplier have to be observed:

- The relevant technical and special regulations
- Permission for the installation must be available



CAUTION

Before connecting the REFUSOL device to the AC network the connection to the mains has to be enabled, the no-load condition has to be verified and the power circuit-breaker must be secured against reactivation.

- Recheck the line voltage, it shall not be higher than 265 V_{AC}. In case the line voltage is higher the local power supplier has to arrange for a solution.
- Connect the REFUSOL device to PE at the appropriately marked earthing stud.
- Now attach the power cables to the supplied connector plugs according to the picture, plug it to the REFUSOL unit and screw on the plug tightly.

If insulated wire end sleeves are used you have to see that the insulation of the end sleeves will not be squeezed!

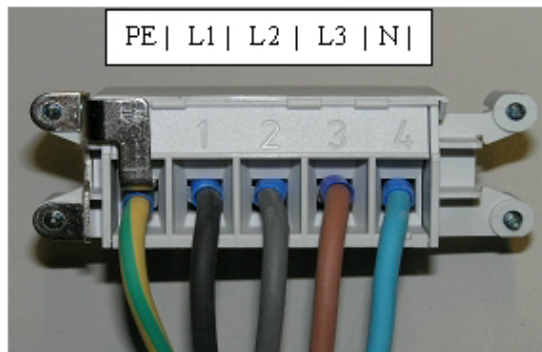


Figure No.8 Mains connection

3.4.3 Selection of connecting cable

Select the cross section of the mains connection cable so, that the line losses will be as low as possible.

- The power plug allows for a cable cross-section of up to 10 mm².
- However, the following points must be observed:
 - Due to the construction, the recommended feed line for all cross-sections is a fine-strand line.
 - The cable fitting of the standard plug hood supplied allows a 5 x 6 mm² cable to be connected. The maximum outer diameter of the connection line is 18 mm. (e.g. Lapptherm 145, 5 x 6 mm²)
 - Optionally, under REFU item No.: 0029939, you can order a larger plug hood that allows you to connect a 5 x 10 mm² connector line.

The maximum cable lengths dependent from the cable cross section are shown in the following table, considering a voltage drop of $\leq 1\%$.

Cable cross section	4,0 qmm	6,0 qmm	10,0 qmm
Max. cable length	20 m	30 m	50 m



Note: In order to ensure the degree of protection IP65, plug connectors and power supply connection cable must be matched to each other and all unused connectors shall be fitted with blanking plugs.

3.4.4 Grounding

The REFUSOL features a threaded bolt below the power supply port on the connection side for additional grounding. Since grounding is considered to be a lightning protection measure, the ground wire cross-section must be chosen bigger than 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 laid as far away from and not directly in parallel to the power supply line.

3.4.5 DC-connection PV-string

Attention !

The PV-string may be connected to the REFUSOL unit only in de-energized condition, at best in darkness when the PV-strings are not active.

Before the PV-strings are connected the device has to be connected to the power mains to connect the unit **safely to PE**.



WARNING

At active PV-strings life-threatening voltages may apply!

=> Recheck the no-load voltage before connecting the PV-string, it must not exceed 50 V.

- The PV-strings which are to be connected must be checked before for a possible earth fault by measuring the DC-voltage between the positive connection of the string and the potential to earth and between the negative connection and the potential to earth. If these voltages are constant and if the sum corresponds to about the no-load voltage of the string, it can be assumed that there has an earth fault occurred. The earth fault has to be settled first before the PV-string is connected to the REFUSOL unit.
- Pay strict attention to the correct polarity when connecting the PV-string. In case of wrong connection of individual strings the modul strings may be damaged. The REFUSOL device is protected by an integrated reverse polarity protection diode. Secure the connections against inadvertent removal.
- Cover unutilized connections by means of stoppers! Otherwise the degree of protection of the device (IP65) might be not be kept!
- Pay strict attention upon using the correct DC-connector plugs, fitting the cable cross-section! If connector plugs are used that are not suitable for the cable cross-section the degree of protection of IP65 is not guaranteed!

3.4.6 Selection of the DC connecting cable

Connect the PV-generator via the LC3 male and female connectors (Lumberg) installed in the housing. Line cross-sections up to 6 mm² are possible.

3.4.7 Interface connection

- RS485: plug included in the accessories pack.

X14B: RS485 out		X15B: RS485 in	
Pin 1	Bus termination +	Pin 1	
Pin 2	RS485+ out	Pin 2	RS485+ in
Pin 3	RS485- out	Pin 3	RS485- in
Pin 4	Bus termination -	Pin 4	Reference -

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.

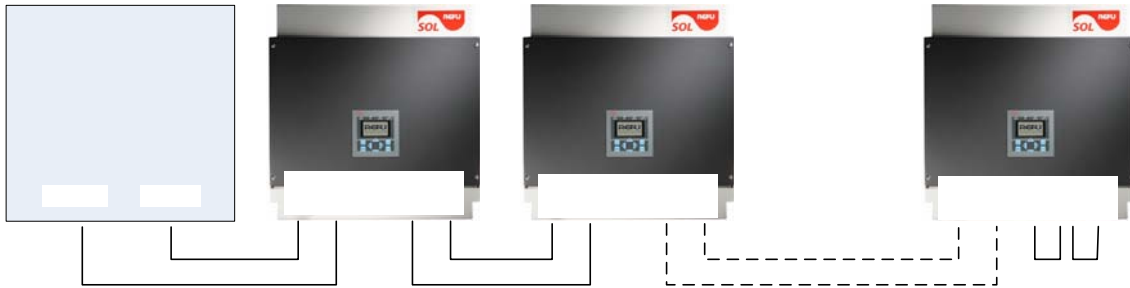


Figure No.9 Connection standard interface

For operation of this interface ensure that the same interface configuration is set for every bus user.

Bus termination is made by means of wire bridges on X14 to the last bus user (Inverter “n”).

- USB

Prefabricated cable IP20 on plug IP67:

Phoenix Contact VS-04-2X2X26C7/7-67B/SDA, Serial no. 1653922 for 5 m

Phoenix Contact VS-04-2X2X26C7/7-67B/SDA, Serial no. 653922 for 2 m

- Ethernet: Plug included in the accessories pack

Datenlogger
Fernüberwachung

3.4.8 Relay connection

X61	RS485+	RS485-
Pin 1	n.c.	
Pin 2	Contact rating 4A/230V AC-3	
Pin 3	n.c.	
Pin 4	Contact rating 4A/230V AC-3	

- Plug included in the accessories pack
- The relay is programmed for fault signalling (standard).

X1
3

4 Commissioning

Prior to commissioning of the REFUSOL device the following activities have to be terminated:

- Correct connection to the mains
- Correct connection of the PV-strings
- Protection of the connections against inadvertent removing

4.1 Activation of the device

- The line voltage is applied to the REFUSOL device by operating the power circuit-breaker.
- Now set the DC-disconnector switch of the REFUSOL unit into ON-position.

Provided that the solar modules are exposed to sufficient sunlight and that there are no errors or failures, the device undergoes the following sequence of operations which you can follow on the display of the operator panel:

- 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 Initializing



Figure No.10 Device activation display

- Initializing has been completed
 - ⇒ The Ready status LED emits steady light
 - Display
 - ⇒ Switched off
 - ⇒ PAC Feed power in watts (W)
 - ⇒ UAC Line voltage in volts (V)

⇒ UDC Solar cell voltage in volts (V)

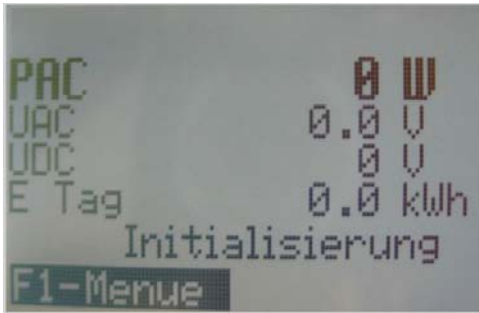


Figure No.11 Initializing display

- Power-up starts if the solar cell voltage is >350 volts
 - ⇒ The Ready status LED emits steady light; the On status LED flashes
 - Display
 - ⇒ Activating
 - ⇒ On
 - ⇒ UDC Solar cell voltage in volts (V)
 - ⇒ This process can take up to one hour if the device is commissioned; during normal operation, it takes up to 3 minutes.

- Feed mode
 - ⇒ The On status LED emits steady light; the Ready status LED turns dark.
 - Display
 - ⇒ PAC Feed power in watts (W)
 - ⇒ UAC Line voltage in volts (V)
 - ⇒ UDC Solar cell voltage in volts (V)
 - ⇒ E TAG Yield of the day

4.1.1 Check time

During the activation procedure it is imperative to check date and time on the REFUSOL and to set the same properly, if required. Please follow the following steps:

- Press F1 key to open menu
- Use arrow key “down“ to select menu item “set time”
- Use arrow keys “up/down” for successive setting of day, month, year hour, minute, and second.
- Press “Enter“ to confirm.

4.2 Control panel



Figure No.12 Display navigation

- F1: Menu display
- F2: Select input of standardized yield data
- Up / Down: Menu selection
- Left / right: Function in the menu: jump to the first or last menu item.
Function during editing of parameters: digit to the left, digit to the right
 (decade jump)
- ESC: Failure acknowledgement, deleting the entry
- Enter: Confirmation of the menu selection and of the entry

Display basic image



Figure No.13 Operating mode display

Pac = current supply power

Uac = mains voltage

Udc = voltage at the solar generator

E-Tag = daily yield

Graphic display

Press the arrow key "Left" once the course of the supply power of the day.

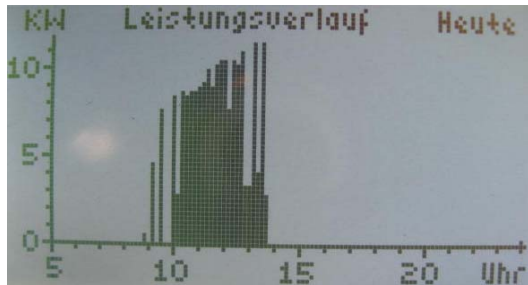


Figure No.14 Display graphic

Press the arrow key "Down" to display the course of the supply power of the previous day.

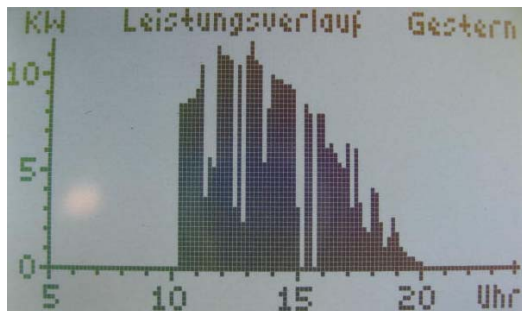


Figure No.15 Feed power display

Return to the basic image => ESC key

Display yield data

Press the arrow key "Right" once to display the current yield data, as well as the operating hours accrued up to this point in time



Figure No.16 Display yield data

Display standardized yield data

Press the arrow key "Right" twice to display the course of the standardized yield data.

The actually connected generator power ("Standard P") may be entered in menu item "Numerical list" at parameter P1155.

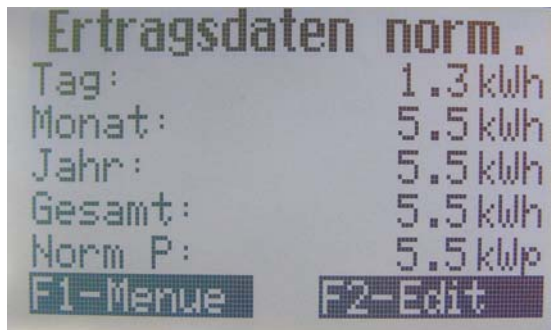


Figure No.17 Display standardized yield data

Return to the basic image => ESC key

Input for standardized data

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

- "Left/Right" keys: Press the "Left" key => selects the digit to the left of the decimal point
 Press the "Right" key => selects the digit to the right of the decimal point
- "Up" key: Whenever you press this key, the number at the digit selected is incremented by 1.
- "Down" key: Whenever you press this key, the number at the digit selected is decremented by 1.



Figure No.18 Standardized data input display

Return to the basic image => ESC key

Menu

Press the F1 key to display the menu The following menu items are listed:

- Version identification
- Communication (1. General, 2. Ethernet)

- Actual values
- Errors
- SOL (operation, MPPT, control, FLL)
- Numerical list
- Failure memory
- Set time
- SR firmware update

Version identification

Designation current firmware version

Communication

General: P2000

Entry of the password required for the modification of parameters. The customer password is 72555.

Password entry:

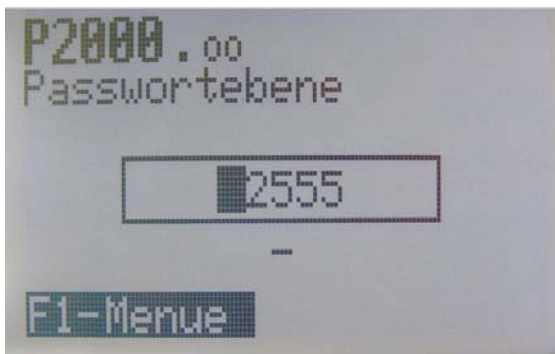
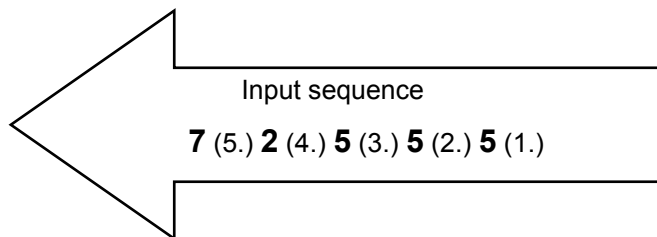


Figure No.19 Password entry display



- P0405.00 - .05 Service level
- P0406.00 - .05 RS485-address 0-31. The address can be selected as desired. Each device requires its own addresses. **Double addresses are not allowed!**
Otherwise, RefuLog, SolarLog and MeteoControl cannot be allocated.
- P0407.00 - .05 RS485 protocol (2= SolarLog, 3= MeteoControl)

Ethernet: P0410.00 - .03 IP address

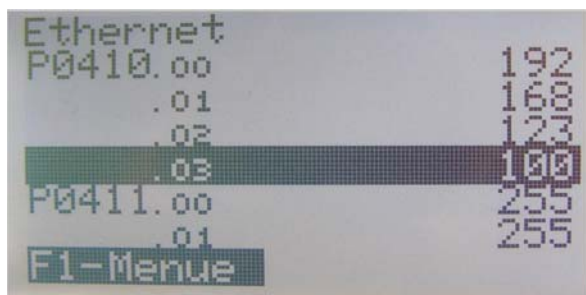


Figure No.20 Display Ethernet IP address

P0410.00	P0410.01	P0410.02	P0410.03
192	168	123	100

P0411 Subnet mask

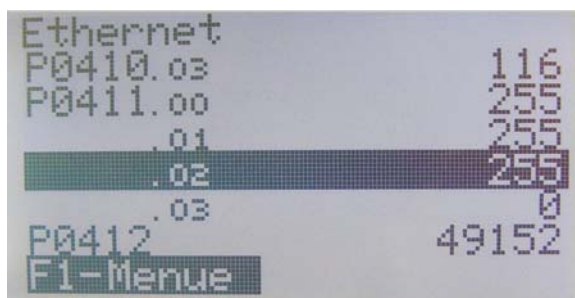


Figure No.21 Display Ethernet IP address

P0411.00	P0411.01	P0411.02	P0411.03
255	255	255	0

P0412.00 The port number 0-65535 (preferably > 49152) can be selected as desired. Caution! Double assignment is unallowed and must be avoided!

P0413 Service level

P0414.00 – 03 IP standard gateway

Actual values

D1100 Actual value Uzk voltage
 D1104 Voltage of the solar generator
 D1105 Current PV generator
 D1106 AC power (Watt)
 D1107 DC power (Watt)
 D1108 Service level

Errors

Fault evaluation: Control/power

Display if occurrence of faults in the power section or control.

SOL

Service level

FLL

D1120.00	Phase angle L1
D1121.00	Amplitude L1
D1122.00	Frequency L1
D1120.01	Phase angle L2
D1121.01	Amplitude L2
D1122.01	Frequency L2
D1120.02	Phase angle L3
D1121.02	Amplitude L3
D1122.02	Frequency L3

Monitoring parameters

Parameter number	Parameter name	Unit
1107.0	DC power	Watt
1104.0	DC voltage	Volt
1105.0	DC intensity	Ampere
1106.0	AC power	Watt
$(1121.0 * \text{root } 2) / 2$	Effective AC voltage phase 1	Volt
$(1121.0 * \text{root } 2) / 2$	Effective AC voltage phase 2	Volt
$(1121.0 * \text{root } 2) / 2$	Effective AC voltage phase 3	Volt
$(\text{Total of phases 1, 2, 3})/3$	Mean value of effective AC voltage	Volt
1141.0	AC intensity phase 1	Ampere
1141.1	AC intensity phase 2	Ampere
1141.2	AC intensity phase 3	Ampere
$(1140.0 / 3)$	Mean value of AC intensity phase	Ampere
1122.0	AC frequency 1	Hertz
1122.1	AC frequency 2	Hertz
1122.2	AC frequency 3	Hertz
92.0	Device temperature 1	°C
92.1	Device temperature 2	°C
92.2	Device temperature 3	°C
92.3	Device temperature 4	°C
$(92.0 + 92.1) / 2$	Mean value of device temperature	°C
1191.0	Radiation sensor	Watt / m ²
1193.0	Temperature sensor	°C
501.0	Current state	-
500.0	Error code	-
1150.0	Yield of the day	kWh
1153.0	Yield of the month	kWh
1154.0	Yield of the year	kWh
1151.0	Total yield	kWh
$1150.0 / 1155.0$	Standardized yield of the day	kWh/kWp
$1153.0 / 1155.0$	Standardized yield of the month	kWh/kWp
$1154.0 / 1155.0$	Standardized yield of the year	kWh/kWp

1151.0 / 1155.0	Standardized total yield	kWh / kWp
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memory

Use arrow key "down" to select menu item "set time"

Set time

Selection of day, month, year, hours, minutes, seconds using the keys "Right/Left"

Modifications with keys "Up/Down" and confirmation with the "Enter" key

Special functions**SR firmware update**

Used for firmware update by authorized service.

**Note:****If you exchange the SR card, do not forget to read and write down the parameters!****Reactivation requires a password!****Make a restart!**

5 Trouble shooting

5.1 Selftesting routine – fault messages

After the initialisation routine the system carries out a self-test. About this, the individual parts of the micro-computer systems like firmware and data record are checked, and data from the power control board are read-in. Possible remedies are depending on the nature of the fault.

5.2 Short failure

Upon occurrence of particular faults the inverter disconnects temporarily from the mains.

Unlike as with common faults, the “short failure“ is automatically acknowledged by the inverter and another attempt to reactivate the device is started when the fault signal is canceled.

“short failures“ are signaled by blinking of the red LED and are stored powerfail-proof in the fault memory. See paragraph “Faults“.

5.3 Faults

During operation the fixed-programmed and parameterized limiting values are continuously monitored. In order to protect the power section from damages the REFUSOL unit is disconnected when the limiting value is exceeded or a failure has occurred. On the display, the respective fault message will be shown.

The fault is indicated by the red "Alarm" -LED (permanently lit) on the front side of the device (control panel).

Fault messages are stored powerfail-proof in the fault memory. The fault memory is called up via the display. In the fault memory the last 120 faults are registered. The most recent fault is on location S0 in the memory, the oldest one in S120. A new fault is always stored in location S0. All previous faults are shifted upward in the memory by one level. Consequently, the fault stored on location S120 will be canceled.

5.3.1 Fault acknowledgement

After the switch-off resulting from a fault the reactivation of the device remains blocked until the fault is acknowledged. As long as the source of the fault still exists, no acknowledgement is possible. When the source of the fault is eliminated, the fault can be acknowledged.

- ⇒ to acknowledge the fault message the REFUSOL device press the ESC key or it has to be switched ON and OFF by the DC-switch.

5.4 List of fault messages

Fault number	Designation of fault	Message / Remedy
40030001	No functioning file system	<ul style="list-style-type: none"> The processor cannot process the current firmware. Please contact the service department!
40030002	Invalid parameter file	<ul style="list-style-type: none"> Caused by a change of the firmware the current data set can no longer be processed. Please contact the service department!
40040001	WS it disconnected	<ul style="list-style-type: none"> There exists a communication problem between control board and controller board and the WS/WR-board (the power section). This may be caused by a defect in the SR-board or WS/WR-board and the data cable between these components! Please contact the service department!
4005039E	Initializing (wrong WS-version)	<ul style="list-style-type: none"> Firmware of control board, controller board and WS-board are not compatible, communication not possible. Carry out a firmware update. For that, please contact the service department
40050A8C	Initializing (Real time clock) Use REFU.SetTime	<ul style="list-style-type: none"> The device was off-voltage for a too long time (about 2-3 weeks) therefore the real time setting is no longer up to date. Operating panel: Push F1 > menue, scroll down until "set time" > enter, now set time and date > enter or Please adjust the device-time by means of REFUVis!
40050001 00050000 000503B7	Initializing	<ul style="list-style-type: none"> Cumulative error of the initialization routine Can occur during a firmware update Please contact the service department!
000A0000	FPGA Firmware is incompatible with REFUSOL	<ul style="list-style-type: none"> FPGA firmware is incompatible to REFUSOL Please contact the service department!
000A0001	Uzkhp < Uzklp	<ul style="list-style-type: none"> Reference to hardware defect. Please contact the service department!
000A0002	Uzkhn < Uzkln	<ul style="list-style-type: none"> Reference to hardware defect. Please contact the service department!
000A0003	Asymmetry low	<ul style="list-style-type: none"> Low intermediate circuit is asymmetrically loaded; normally, this is automatically corrected. If this recurs repeatedly, please refer to Service!
000A0004	Asymmetry high	<ul style="list-style-type: none"> High intermediate circuit is asymmetrically loaded; normally, this is automatically corrected. If this recurs repeatedly, please refer to Service!
000A0005	Mains > hp	<ul style="list-style-type: none"> High intermediate circuit was discharged to a level below the mains threshold value; will normally be automatically corrected. If this recurs repeatedly, please refer to Service!
000A0006	Mains > hn	<ul style="list-style-type: none"> High intermediate circuit was discharged to a level below the mains threshold value; will normally be automatically corrected. If this recurs repeatedly, please refer to Service!
000A0007	Uzklp < 90	<ul style="list-style-type: none"> Low intermediate circuit discharged too much; Charging by solar generator to be expected. If this recurs repeatedly, please refer to Service!
000A0008	Uzklp > 450	<ul style="list-style-type: none"> Voltage limit in the low intermediate circuit is reached. Can normally be automatically corrected.
000A0009	uzkln < 90	<ul style="list-style-type: none"> Low intermediate circuit discharged too much; Charging by solar generator to be expected. Wait until charged by solar generator

Fault number	Designation of fault	Message / Remedy
000A000A	uzkln > 450	<ul style="list-style-type: none"> Voltage limit in the low intermediate circuit is reached. Can normally be automatically corrected. If this recurs repeatedly, please refer to Service!
000A000B	uzkhp > 450	<ul style="list-style-type: none"> Voltage limit in the high intermediate circuit is reached. Can normally be automatically corrected. If this recurs repeatedly, please refer to Service!
000A000C	uzkhn > 450	<ul style="list-style-type: none"> Voltage limit in the high intermediate circuit is reached. Can normally be automatically corrected.
000A000D	Stoer_ENS_UeS	<ul style="list-style-type: none"> Overvoltage (slow) acc. to ENS-directives Contact responsible power supply company.
000A000E	Stoer_ENS_UntS	<ul style="list-style-type: none"> Undervoltage (slow) acc. to ENS-directives Contact responsible power supply company.
000A000F	Stoer_ENS_UeS_AL	<ul style="list-style-type: none"> Overvoltage (outer conductor) acc. to ENS-directives Contact responsible power supply company.
000A0010	Stoer_ENS_UntS_AL	<ul style="list-style-type: none"> Undervoltage (outer conductor) acc. to ENS-directives Contact responsible power supply company.
000A0011	Stoer_FLL	<ul style="list-style-type: none"> One or more of the FLLs are asynchronous Contact responsible power supply company.
000A0012	Stoer_Netzfrequenz	<ul style="list-style-type: none"> Measured value (SR) of mains frequency is outside tolerance Contact responsible power supply company.
A0100	WR: Sammelstörmeldung	<ul style="list-style-type: none"> Message that a fault is signalled by the inverter. Normally, a detailed message with expressive code will follow.
A0101	WR:Stoer_WD	<ul style="list-style-type: none"> Fault: Processor internal Please contact the service department!
A0102	WR:Übertemp KL	<ul style="list-style-type: none"> Temperature of lefthand cooler above limit Allow the unit to cool down.
A0103	WR:Übertemp KR	<ul style="list-style-type: none"> Temperature of righthand cooler above limit Allow the unit to cool down.
A0104	WR:Übertemp IOL	<ul style="list-style-type: none"> Temperature internally lefthand on top above limit Allow the unit to cool down.
A0105	WR:Übertemp IUR	<ul style="list-style-type: none"> Temperatur: internally righthand below above limit Allow the unit to cool down.
A0106	WR: Stor_Hilfsvers	<ul style="list-style-type: none"> One of the internal auxiliary power sources is outside the limit Please contact the service department!
A0108	WR: ENS_FREQ	<ul style="list-style-type: none"> Measured value (inv.) for mains frequency outside tolerance Contact responsible power supply company.
A0109	WR: ENS_UES	<ul style="list-style-type: none"> Measured value (inv.) for mains voltage above limit Measure mains voltage. Contact responsible power supply company.
A010A	WR: ENS_US	<ul style="list-style-type: none"> Measured value (inv.) for mains voltage below limit Check mains fuses. Contact responsible power supply company.
A010C	WR: ENS_ISO	<ul style="list-style-type: none"> Sudden fault current above limit detected. Check of insulation ! Check isolation
A010D	WR: ENS:PEFAIL	<ul style="list-style-type: none"> Fault current sensor board shows hardware failure Please contact the service department!
A010E	WR: WR	<ul style="list-style-type: none"> Hardware cutout on inverter has tripped. Is normally acknowledged automatically. If this occurs repeatedly, please contact the service department

Fault number	Designation of fault	Message / Remedy
		<ul style="list-style-type: none"> • If this recurs repeatedly, please refer to Service!
A0110	WR: uerspg_PZKHI	<ul style="list-style-type: none"> • Measured voltage (inv.) too high for pos. intermediate circuit • If this recurs repeatedly, please refer to Service!
A0111	WR: uerspg_NZKHI	<ul style="list-style-type: none"> • Measured voltage (inv.) too high for neg. intermediate circuit • If this recurs repeatedly, please refer to Service!
A0112	WR: unterspg_PZKHI	<ul style="list-style-type: none"> • Measured voltage (inv.) too low for pos. intermediate circuit • If this recurs repeatedly, please refer to Service!
A0113	WR: unterspg_NZKHI	<ul style="list-style-type: none"> • Measured voltage (inv.) too low for neg. intermediate circuit • If this recurs repeatedly, please refer to Service!
A0114	WR: ENS_FS	<ul style="list-style-type: none"> • Fault current detected. Check of installation! • Check installation.
A0115	WR: ENS_PEWARN	<ul style="list-style-type: none"> • Fault current sensor board is operated at limit • Please contact the service department!
A011F	WR: EEPROM_LESEN	<ul style="list-style-type: none"> • Fault upon reading of the EEPROM. Please contact the service department! • Please contact the service department!
A0120	WR: Timeout_WR_SR	<ul style="list-style-type: none"> • Communication SR-WR interrupted • If this recurs repeatedly, please refer to Service!

6 Options

6.1 Connector plugs

6.1.1 PV Generator



Note: Please be absolutely sure to read the package leaflet when connecting the PV-generator!

If the package leaflet is not available, download it from our website:

www.refu-elektronik.de

6.2 Power plug

Optional ist ein größeres Steckergehäuse, das den Anschluss einer 5x10mm² Anschlussleitung zulässt lieferbar.

Designation	Art.-Nr. Multi-Contact	Art.-Nr. REFU Elektronik GmbH
VC-AL-T3-Z-M32-S	1583657	0029939

6.3 Radiation sensor

A radiation sensor can be connected optionally for recording the solar radiation incidence and the module temperature. We recommend using the type Si-13TC-T-K. REFU item No. 0029667

The sensor is supplied with a 3 meter UV-stable connection cable (4x0,14mm²). If an extension is needed, use a shielded cable 4x0,25 mm².

Connector assignment Si-13TC-T-K		Connector assignment REFUSOL: sensors
Red	Supply voltage (12-24VDC)	Pin 1
Black	GND	Pin 2
Orange	Measuring signal of irradiation (0-10V)	Pin 3
Brown	Measuring signal of temperature (0-10V)	Pin 4
	Shielding	Pin 5

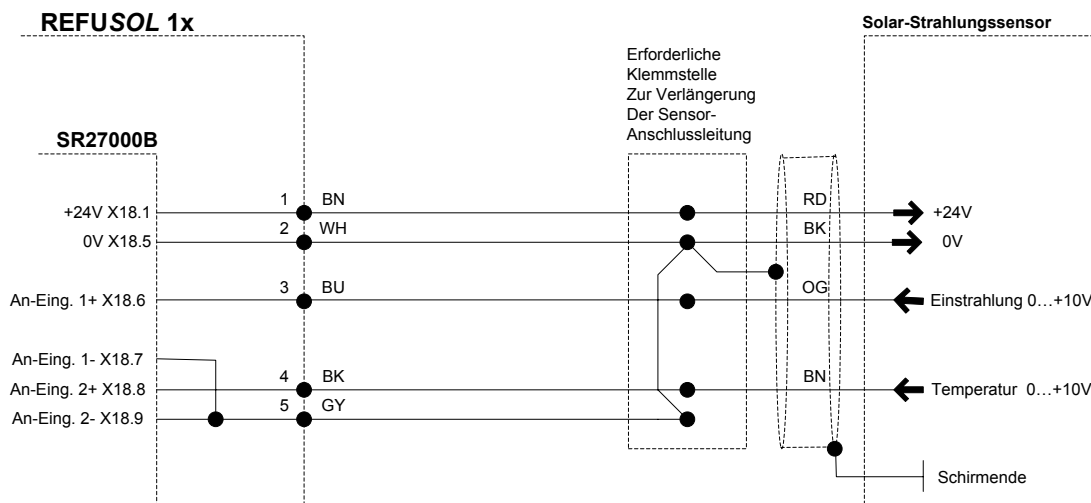


Figure No.22 Connection radiation sensor

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

- D 1191.00 => incidence
 - 0 – 10V => 0 – 1300 W/m²
- D 1193.00 => temperature
 - 0 – 10V => -26,1°C – 90°C

These data may be recorded in the data logger as well.

6.3.1 Internet communication

Communication between the PV-system and the user via the Internet can be established in the following ways:

- REFUlog: RefuLog is a system developed by REFU
- WebLog: Weblogger by MeteoControl
- SolarLog: Weblogger by Solare Datensysteme

Data is imported from the inverters via an RS485 interface.

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

6.3.2 Parameter setting

SolarLog:	P0406.03	Address 1–31
	P0407.03	2
	P0420.03	Baud rate 9600

MeteoControl:	P0406.03	Address 0–31
	P0407.03	3
	P0420.03	Baud rate 57600
	P0421.03	1 parity bit

6.4 List of Parameters

6.4.1 Interface Parameters

Parameter number	Parameter name	Description
P 404.02	Timeout configuration	<ul style="list-style-type: none"> Control unit If this is set to 1, then the interface responds when communication drops out. If this is set to 0, then lapses in communication are ignored.
P 404.03	Timeout configuration	<ul style="list-style-type: none"> RS 485 If this is set to 1, then the interface responds when communication drops out. If this is set to 0, then lapses in communication are ignored.
P 404.04	Timeout configuration	<ul style="list-style-type: none"> USB If this is set to 1, then the interface responds when communication drops out. If this is set to 0, then lapses in communication are ignored.
P 405.02	Configuration of the control word behavior	<ul style="list-style-type: none"> Control unit If this is set to 0, then the interface will be completely ignored. If this is set to 1, then the interface can control directly. If this is set to 2, then the interface can only control when the same signal logically exists on the terminal strip. If this is set to 3, then the interface switches to "permanently on". The REFUsol will therefore be switched on immediately upon start. It makes sense to deactivate the timeout for this particular interface.
P 405.03	Configuration of the control word behavior	<ul style="list-style-type: none"> RS 485 If this is set to 0, then the interface will be completely ignored. If this is set to 1, then the interface can control directly. If this is set to 2, then the interface can only control when the same signal logically exists on the terminal strip. If this is set to 3, then the interface switches to "permanently on". The REFUsol will therefore be switched on immediately upon start. It makes sense to deactivate the timeout for this particular interface.
P 405.04	Configuration of the control word behavior	<ul style="list-style-type: none"> USB If this is set to 0, then the interface will be completely ignored. If this is set to 1, then the interface can control directly. If this is set to 2, then the interface can only control when the same signal logically exists on the terminal strip. If this is set to 3, then the interface switches to "permanently on". The REFUsol will therefore be switched on immediately upon start. It makes sense to deactivate the timeout for this particular interface.

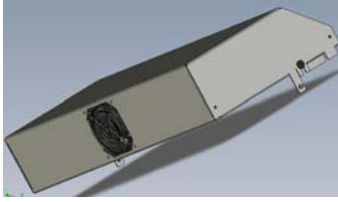
Parameter number	Parameter name	Description
P 405.05	Configuration of the control word behavior	<ul style="list-style-type: none"> Ethernet If this is set to 0, then the interface will be completely ignored. If this is set to 1, then the interface can control directly. If this is set to 2, then the interface can only control when the same signal logically exists on the terminal strip. If this is set to 3, then the interface switches to "permanently on". The REFUSol will therefore be switched on immediately upon start. It makes sense to deactivate the timeout for this particular interface.
P 406.00	Port number	<ul style="list-style-type: none"> Defines the address of the USS protocol. If several units are connected to one interface (e.g. RS 485), then this unit only responds when the address is correct.
P 407.00	Timeout IP communication	<ul style="list-style-type: none"> Parameter defines the USS protocol 0 = without real time, 1 = USS, 2 = Solarlog,
P 410.00	IP address	<ul style="list-style-type: none"> Index 0
P 410.01	IP address	<ul style="list-style-type: none"> Index 1
P 410.02	IP address	<ul style="list-style-type: none"> Index 2
P 410.03	IP address	<ul style="list-style-type: none"> Index 3
P 411.00	Subnet mask	<ul style="list-style-type: none"> Index 0
P 411.01	Subnet mask	<ul style="list-style-type: none"> Index 1
P 411.02	Subnet mask	<ul style="list-style-type: none"> Index 2
P 411.03	Subnet mask	<ul style="list-style-type: none"> Index 3
P 412.00	Port number	<ul style="list-style-type: none"> Port number
P 413.00	Timeout IP communication	<ul style="list-style-type: none"> Timeout IP communication
P 414.00	IP standard gateway	<ul style="list-style-type: none"> Defines the standard gateway. If the REFUSOL is only used in a local network, the standard gateway does not need to be specified. If the unit is addressed over a router, on the other hand, then the Internet address of the router must be entered here.
P 414.01	IP standard gateway	<ul style="list-style-type: none"> Defines the standard gateway. If the REFUSOL is only used in a local network, the standard gateway does not need to be specified. If the unit is addressed over a router, on the other hand, then the Internet address of the router must be entered here.
P 414.02	IP standard gateway	<ul style="list-style-type: none"> Defines the standard gateway. If the REFUSOL is only used in a local network, the standard gateway does not need to be specified. If the unit is addressed over a router, on the other hand, then the Internet address of the router must be entered here.
P 414.03	IP standard gateway	<ul style="list-style-type: none"> Defines the standard gateway. If the REFUSOL is only used in a local network, the standard gateway does not need to be specified. If the unit is addressed over a router, on the other hand, then the Internet address of the router must be entered here.

6.5 Data Logger Parameters

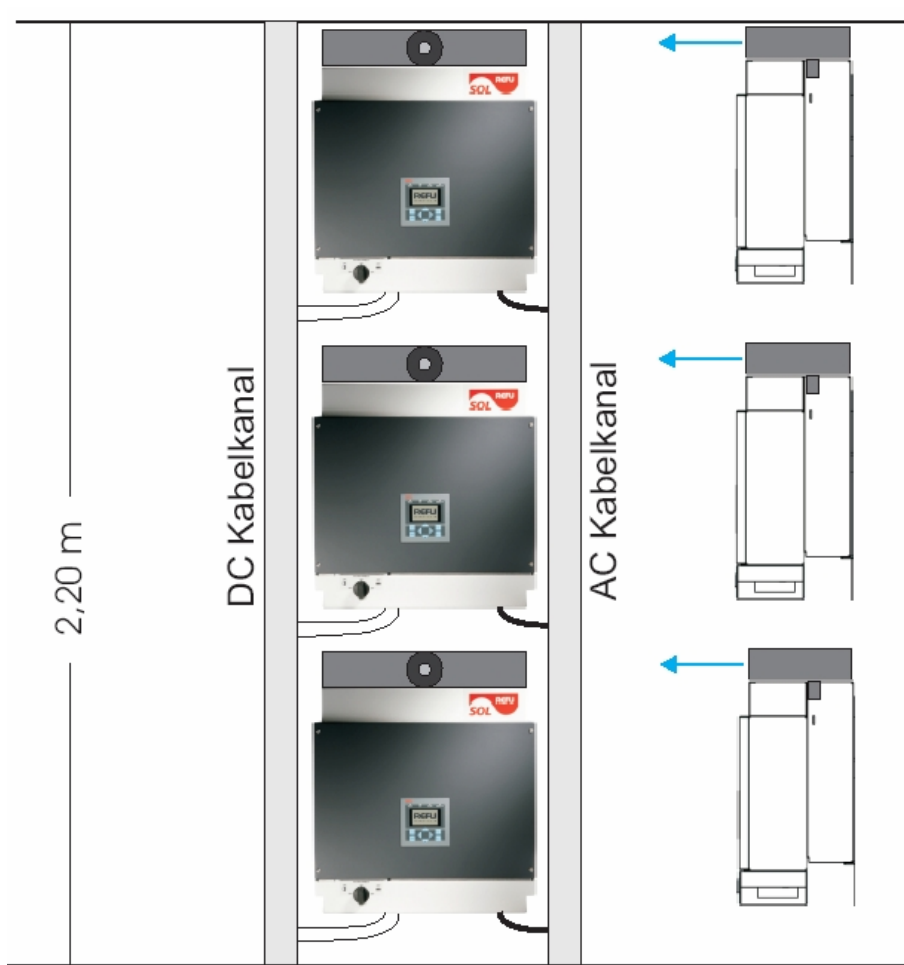
These parameters serve as settings for the internal data logger

P 450.00	Data logger enabled	<ul style="list-style-type: none"> Enables or disables the data logger. 0 = disabled 1 = enabled. Data will then be recorded at regular intervals
P 451.00	Data logger interval	<ul style="list-style-type: none"> Refers to the intervals at which the data logger will store data
P 452.00 – 39	Data logger parameter numbers	<ul style="list-style-type: none"> This contains a list of all parameter numbers to be recorded. This only works in conjunction with indices. Nonexistent parameter numbers will be ignored.
P 453.00 - 39	Data logger indices	<ul style="list-style-type: none"> This contains a list of all indices to the parameter numbers to be recorded. This only works in conjunction with parameter numbers. Nonexistent parameter numbers will be ignored.
D 1104.00	Actual value of the voltage on the PV generator	<ul style="list-style-type: none"> Actual value of the voltage on the PV generator, i.e. the voltage applied to the DC input of the REFU_{sol}.
D 1105.00	Actual value of the current from the PV generator	<ul style="list-style-type: none"> Actual value of the current from the PV generator.
D 1106.00	AC power	<ul style="list-style-type: none"> Current value of the total power fed into the mains
D 1107.00	DC power	<ul style="list-style-type: none"> Current value of the power consumption measured on the DC-side (solar generator)
D1150.00	Daily yield	<ul style="list-style-type: none"> Display daily yield / standardized daily yield Depending on Parameter P1155
D1151.00	Total yield	<ul style="list-style-type: none"> Display total yield / standardized total yield Depending on Parameter P1155
D1153.00	Monthly yield	<ul style="list-style-type: none"> Display monthly yield / standardized monthly yield Depending on Parameter P1155
D1154.00	Annual yield	<ul style="list-style-type: none"> Display annual yield / standardized annual yield Depending on Parameter P1155
P1155.00	Standardization yield	<ul style="list-style-type: none"> Here, the power of the PV generator may be entered. This results in the display parameters D1150 to D1154 displaying the standardized yields.
D1191.00	Incident light	<ul style="list-style-type: none"> Displays the value of the incidence sensor
D1193.00	Module temperature	<ul style="list-style-type: none"> Displays the module temperature provided by the sensor

6.6 Power Cap



REFUSOL Power Cap is an additional ventilation module for REFUSOL 10k – 15k. This ventilation module allows you to install up to three inverters on top of one another, and raises the permissible ambient temperature range by +5°C. The ventilation module mounts directly onto the inverter. The fan inside it is powered and monitored by the inverter's sensor connector (overspeed sensing). The fan motor is enclosed according to Protection Class IP 54 and has a service life of approx. 10 years.



7 Technical data

7.1 Solar inverter REFUSOL 10k and 11k

Type	REFUSOL 10k	REFUSOL 11k
DC Daten / DC data		
Max. PV-Leistung / <i>Max. PV-Power</i>	11,7 kW	13 kW
Nom. MPPT-Bereich / <i>Nom. MPPT-Range</i>	380...800V	460 – 800V
Max. DC Spannung / <i>Max. DC voltage</i>	900V	
Max. DC Strom / <i>Max. DC current</i>	29A	29
MPP-Tracking / <i>MPP-tracking</i>	Schnelles, präzises MPP-Tracking / <i>fast, precise MPP-tracking</i>	
Überspannungsschutz/ <i>Overvoltage protection</i>	Geräteschutz Typ 3 / <i>Device protection type 3</i>	
AC Daten / AC data		
AC Bemessungsleistung / <i>Rated AC-Power</i>	10 kW	11 kW
AC max. Leistung / <i>Max. AC-Power</i>	11 kW	12,1 kW
AC Netzanschluss / <i>AC grid connection</i>	3AC400V+N, 50 -60Hz	
Cos phi	1	
Max. AC Strom / <i>Max. AC current</i>	18 A	18 A
LS-Schalter / <i>MCB (Characteristic: B)</i>	20 A	20 A
Klirrfaktor THD / <i>Distortion factor THD</i>	<2,5 %	
Max. Wirkungsgrad / <i>Max. efficiency</i>	97,8 %	98 %
Europ. Wirkungsgrad / <i>Efficiency</i>	97,4 %	97,5 %
Einspeisung ab / <i>Infeed as from</i>	20W	
Eigenverbrauch Nacht / <i>Internal consumption in night operation</i>	<0,2W	
Überspannungsschutz/ <i>Overvoltage protection</i>	Geräteschutz Typ 3 / <i>Device protection type 3</i>	
Kühlung, Umgebungsbedingungen, EMV / <i>Cooling, ambient conditions, EMC</i>		
Kühlung / <i>Cooling</i>	Natürliche Konvektion / <i>Natural convection</i>	
Umgebungstemperatur Ambient temperature	-25...+55°C	
Aufstellhöhe <i>Site altitude</i>	Bis 2000m ü. NN <i>Up to 2000m above sea level</i>	
Geräusch / <i>Noise</i>	<45dBa	
Funkentstörgrad <i>Radio interference suppression</i>	EN55011, Gruppe 1, Klasse B <i>EN55011, group 1, class B</i>	
Zertifikat / <i>Certificate</i>	CE (UL und CSA in Vorbereitung) / <i>CE (UL and CSA in preparation)</i>	

Störfestigkeit / <i>Interference immunity</i>	EN 61000-6-2	
Umweltklassen / <i>Environmental classif.</i>	4K4H nach DIN IEC 721-3-3	
ENS / SZS	Nach VDE0126-1-1 / <i>acc. to VDE0126-1-1</i>	
Mechanik / Mechanics		
Schutzart / <i>Type of protection</i>	IP65 nach EN 60529 / <i>IP65 as per EN 60529</i>	
Abmessungen / <i>Dimensions</i>	520 mm / 530 mm / 270 mm	
Breite <i>Width</i> / Höhe <i>Height</i> / Tiefe <i>Depth</i>		
Gewicht / <i>Weight</i>	35kg	38kg

7.2 Solar inverter REFUSOL 12k and 15k

Typ	REFUSOL 12 K	REFUSOL 15 K
DC Daten / DC data		
Max. PV-Leistung / <i>Max. PV-Power</i>	13,8 kW	17,5 kW
Nom. MPPT-Bereich / <i>Nom. MPPT-Range</i>	410...800V	460 – 800V
Max. DC Spannung / <i>Max. DC voltage</i>	900V	
Max. DC Strom / <i>Max. DC current</i>	30A	36A
MPP-Tracking / <i>MPP- tracking</i>	Schnelles, präzises MPP-Tracking / <i>fast, precise MPP-tracking</i>	
Überspannungsschutz/ <i>Overvoltage protection</i>	Geräteschutz Typ 3 / <i>Device protection type 3</i>	
AC Daten / AC data		
AC Bemessungsleistung / <i>Rated AC-Power</i>	12 kW	15 kW
AC max. Leistung / <i>Max. AC-Power</i>	12,4 kW	16,5 kW
AC Netzanschluss / <i>AC grid connection</i>	3AC400V+N, 50 -60Hz	
Cos phi	1	
Max. AC Strom / <i>Max. AC current</i>	18 A	25 A
LS-Schalter / <i>MCB (Characteristic: B)</i>	20 A	32 A
Klirrfaktor THD / <i>Distortion factor THD</i>	<2,5 %	
Max. Wirkungsgrad / <i>Max. efficiency</i>	98 %	>98 %
Europ. Wirkungsgrad / <i>Efficiency</i>	97,5 %	97,7 %
Einspeisung ab / <i>Infeed as from</i>	20W	
Eigenverbrauch Nacht/ <i>Internal consumption in night operation</i>	<0,2W	
Überspannungsschutz/ <i>Overvoltage protection</i>	Geräteschutz Typ 3 / <i>Device protection type 3</i>	
Kühlung, Umgebungsbedingungen, EMV / <i>Cooling, ambient conditions, EMC</i>		
Kühlung / <i>Cooling</i>	Natürliche Konvektion / <i>Natural convection</i>	
Umgebungstemperatur/ Ambient temperature	-25...+55°C	
Aufstellhöhe/ <i>Site altitude</i>	Bis 2000m ü. NN <i>Up to 2000m above sea level</i>	
Geräusch / <i>Noise</i>	<45dBa	
Funkentstörgrad/ <i>Radio interference suppression</i>	EN55011, Gruppe 1, Klasse B <i>EN55011, group 1, class B</i>	
Zertifikat / <i>Certificate</i>	CE (UL und CSA in Vorbereitung) / <i>CE (UL and CSA in preparation)</i>	
Störfestigkeit / <i>Interference immunity</i>	EN 61000-6-2	
Umweltklassen / <i>Environmental classif.</i>	4K4H nach DIN IEC 721-3-3	
ENS / SZS	Nach VDE0126-1-1 / <i>acc. to VDE0126-1-1</i>	

Mechanik / Mechanics		
Schutzart / <i>Type of protection</i>	IP65 nach EN 60529 / <i>IP65 as per EN 60529</i>	
Abmessungen / <i>Dimensions/</i> Breite <i>Wide</i> / Höhe <i>Height</i> / Tiefe <i>Depth</i>	520 mm / 530 mm / 270 mm	
Gewicht / <i>Weight</i>	38kg	38kg

7.3 Radiation Sensor

Typ / Type	Si-13TC-T-K	
Allgemein / general		
Strommessshunt / <i>shunt resistor</i>	0,10 Ohm (TK = 22 ppm/K)	
Umgebungstemperatur / <i>ambient temperature</i>	-20 °C bis +70 °C	
Versorgungsspannung / <i>supply voltage</i>	12 – 24 VDC	
Stromaufnahme / <i>current draw</i>	0,3 mA	
Anschlusskabel / <i>connecting cable</i>	4 x 0,14 mm ² , 3 m (UV-stabil / <i>uv resistant</i>)	
Zellengröße / <i>cell dimension</i>	50 x 34 mm	
Abmessungen / <i>Dimensions</i> Länge <i>length</i> / Breite <i>width</i> / Höhe <i>height</i>	145 x 81 x 40 mm	
Gewicht / <i>weight</i>	340 g	
Solareinstrahlung / radiation		
Messbereich / <i>measuring range</i>	0 bis 1300 W/m ²	
Ausgangssignal / <i>output signal</i>	0 bis 10 V	
Messgenauigkeit / <i>measuring accuracy</i>	+/- 5 % v. Endwert / <i>of full scale</i>	
Modultemperatur / modul temperature		
Messbereich / <i>measuring range</i>	-20 °C bis +90 °C	
Ausgangssignal / <i>output signal</i>	2,268V + T [°C] * 86,9 mV/°C	
Messgenauigkeit / <i>measuring accuracy</i>	+/- 1,5 % bei 25 °C	
Nichtlinearität / <i>nonlinearity</i>	0,5 °C	
Max. Abweichung / <i>max. deviation</i>	2 °C	
Anschlussbelegung / terminal assignment		
Orange / orange	Messsignal Einstrahlung / <i>output signal radiation</i> (0-10V)	
Rot / red	Versorgungsspannung / <i>supply voltage</i> (12-24VDC)	
Schwarz / black	GND	
Braun / brown	Messsignal Temperatur / <i>output signal temperature</i> (0-10V)	

7.4 Power Cap

Typ / Type	REFUSOL Power Cap
Elektrische Daten / Electrical data	
Versorgungsspannung / supply voltage	24VDC
Anschluss Versorgungsspannung / connection supply voltage	Sensors-Stecker / sensors connector
Eigenverbrauch / Internal consumption	2,4W
Überwachung / control	Unterdrehzahlerkennung / underspeed control
Kühlung, Umgebungsbedingungen / Cooling, ambient conditions	
Freiraum vor dem Gerät / free space in front of the unit	1000 mm
Mechanik / Mechanics	
Schutzart / Type of protection	IP54 nach EN 60529 / IP54 as per EN 60529
Abmessungen / Dimensions Breite Wide / Höhe Height / Tiefe Depth	488 mm / 90 mm / 250 mm
Gewicht / Weight	1,4 kg

8 Contact

For questions regarding the REFUSOL device please contact:

REFU Elektronik GmbH
 Uracher Straße 91
 72555 Metzingen, Germany
 Phone +49 7123.969-102
 Fax +49 7123.969-140
Refusol@refu-elektronik.de
www.refu-elektronik.de

For questions regarding error messages or in case of technical problems please contact:

Service hotline: +49-7123-969-202 (on workdays from 8:00 am – 5:00 pm, CET)
Fax: +49-7123-969-220
E-mail: service@refu-elektronik.de

The following data should be at hand:

- Exact description of the fault, if possible the HEX-Code of the fault (P0017.00)
- For the acquisition of the data we recommend to use the failure log attached to the REFUSOL device, possibly download from www.refu-elektronik.de.
- Nameplate data



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Photovoltaic Central Inverter

TYP:800R015 REFUSOL 15kW AI -03

DC Max. Eingangsspannung Max. Input Voltage	900V	AC Nenn Betriebsspannung Nominal operating Voltage	3AC400V + N
DC MPP Bereich DC MPP Range	460 - 800V	AC Nenn Betriebsfrequenz Nominal operating frequency	50 Hz
DC Max. Eingangsstrom gesamt Max. Input current total	36A	AC Nenn-Ausgangsleistung Nominal output power	15.000 W
DC Max. Eingangsstrom pro Anschluss Max. input Current per connector	25A	AC Max. Ausgangsleistung Max. output power	16.500 W
Betriebstemperaturbereich Operating temperature range	-25...+55°C	AC Max. Ausgangsstrom Max output current	3 x 25A
Gehäuseschutzart Enclosure	IP65	AC Netzüberwachung mit ENS Grid monitoring with ENS	VDE0126-1 (2006)



Serien-Nummer: 800R015-A2589

9 Certificates

The certificates

- EC declaration of conformity
- VDEW declaration of conformity
- Certificate of non-objection
- .

are available on the homepage of REFU Elektronik GmbH www.refu-elektronik.de for downloading.

10 Notice

REFU
Elektronik

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