

Operating manual

## REFUsol

### *REFUsol 20K-2T*

### *REFUsol 33K-2T*

## Solar Inverter

Product | **REFUsol 20K...33K-2T**

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# Contents

1	About this Manual .....	5	3.3	Connection Requirements.....	14
1.1	Scope of this Manual .....	5	3.4	Compatible Grid Types .....	15
1.2	Target Group of this Manual .....	5	3.5	Components and Dimensions .....	16
1.3	Presentation of Information.....	5	3.6	Communication Interfaces .....	19
1.3.1	Symbols .....	5	3.7	Display and Operating Elements.....	22
1.3.2	Warnings in this Manual.....	6	3.7.1	Keys .....	23
2	Safety and Responsibility.....	7	3.7.2	Status-LEDs.....	23
2.1	Safety Guidelines.....	7	3.7.3	Information of the LCD display.....	23
2.2	Rules for Safe Installation and Operation.....	7	3.7.4	Menu Display .....	26
2.3	Symbols and Warnings on the Product.....	7	3.8	LED Display of the Ethernet and WiFi Stick ...	27
2.4	Designated Use.....	8	3.8.1	LED Display Ethernet Stick LSE-3 .....	28
2.5	Improper Use.....	8	3.8.2	LED Display WiFi Stick LSW-3 (optional) .....	29
2.6	Requirements for Electricians .....	8	3.9	Efficiency and Power Diagrams .....	30
2.7	General Safety Instructions.....	8	4	Installation .....	31
2.8	Personal Protective Equipment .....	9	4.1	Installation Warnings .....	31
2.9	Five Safety Rules When Working on Electrical Systems .....	9	4.2	Auxiliary Means and Tools.....	31
3	Technical Description .....	10	4.3	Check Scope of Delivery .....	32
3.1	Functionality of the Inverter.....	10	4.4	Requirements for the Installation Site.....	34
3.2	Cooling Concept .....	12	4.5	Mounting the Inverter Bracket .....	35
			4.6	Remove the Inverter from the Packaging .....	36

4.7	Mount Inverter .....	36	7	Error Messages and Troubleshooting .....	53
4.8	Connect Earthing Conductor .....	37	7.1	Maintenance .....	67
4.9	Connect AC Cable .....	38	7.1.1	General Warnings .....	67
4.10	Assembling and Connecting DC Cables .....	40	7.1.2	Maintenance Intervals .....	67
4.10.1	Assemble DC Cable .....	40	8	Decommissioning .....	68
4.10.2	Connect DC Cable .....	41	8.1	Taking the Inverter Out of Operation .....	68
4.11	Connect Communication .....	41	8.2	Packing the Inverter .....	68
4.11.1	Connect RS485 Communication .....	42	8.3	Store Inverter .....	68
4.11.2	Connect Digital Inputs IN1 to IN4 .....	43	8.4	Dispose Inverter .....	69
4.11.3	Connecting the Ethernet Stick LSE-3 .....	43	9	Technical Data .....	69
4.11.4	Connect WiFi Stick LSW-3 (optional) .....	44	9.1	DC Data .....	69
4.11.5	REFUlog Monitoring Portal .....	45	9.2	AC Data .....	69
5	Commissioning .....	46	9.3	Performance .....	70
5.1	Testing the Electrical Safety .....	46	9.4	Protection .....	70
5.2	Commissioning the Inverter .....	46	9.5	Communication .....	71
6	Operation .....	46	9.6	General Data .....	71
6.1	Operation, Navigation and Key Functions .....	46			
6.2	Main Menu (v2.6) .....	47			
6.2.1	Main Menu > 1. Enter Setting .....	47			
6.2.2	Main Menu > 2. Event List .....	51			
6.2.3	Main Menu > 3. System Info .....	51			
6.2.4	Main Menu > 4. System Time .....	51			
6.2.5	Main Menu > 5. Software (firmware) Update .....	52			

# 1 About this Manual

## 1.1 Scope of this Manual

This manual applies to the following products:

- *REFUsol 20K-2T* Solar Inverter
- *REFUsol 33K-2T* Solar Inverter

## 1.2 Target Group of this Manual

This manual is intended for installers, operators, service technicians and plant operators.

This manual contains basic information, to assemble the product safely and properly, to transport, to put into operation and to operate.

- ▷ Read this manual completely and in particular the chapter "Safety and Responsibility", before you work with the product.







## 1.3 Presentation of Information

To enable you to handle your product safely and quickly with these instructions, uniform warnings, symbols, designations and abbreviations are used.

### 1.3.1 Symbols

The following symbols indicate instructions which are intended to make the instructions easier to understand.


Tab. 1: Symbols/signs

Symbol	Meaning
	Useful information on the optimal and most economical use of the product.
	Prerequisite for an action that must be completed/executed beforehand.
	Single action step that is to be executed.
	Sub-step of an action step that is to be executed.
	Alternative action that can also be executed. Partially conditioned by other prerequisites.
1. 2. 3.	Numbered action instruction that is to be executed in the order listed.
	Result of the action instruction.
... > ...	Menu sequence in a software that is to be clicked one after the other.

### 1.3.2 Warnings in this Manual

Warnings in this manual indicate an action where there is a risk of personal injury or property damage. Always observe the measures described to avert the danger.

The warnings in this manual are presented in a box that contains the following information:

 <b>SIGNAL WORD/WARNING CATEGORY</b>
<b>Type and source of danger</b> Consequences of ignoring the warnings. <ul style="list-style-type: none"><li>► Measures required to avoid the danger.</li></ul>

 <b>DANGER</b>
<b>Leads directly to death or serious personal injury if ignored.</b> <ul style="list-style-type: none"><li>► Follow the warnings to avoid death or serious injury!</li></ul>
 <b>WARNING</b>
<b>May result in death or serious personal injury if ignored.</b> <ul style="list-style-type: none"><li>► Follow the warnings to avoid serious injuries!</li></ul>
 <b>CAUTION</b>
<b>May cause minor personal injury if ignored.</b> <ul style="list-style-type: none"><li>► Follow the warnings to avoid injury!</li></ul>
<b>NOTICE</b>
<b>Can lead to property damage if ignored.</b> <ul style="list-style-type: none"><li>► Follow the warnings to avoid damage or destruction of the product!</li></ul>

## 2 Safety and Responsibility

The product has been manufactured in accordance with the generally accepted state of the art. Nevertheless, there is a risk of personal injury and property damage if you do not observe this chapter and the warnings in this manual.

- ▷ Read this manual thoroughly and completely before using the product.

### 2.1 Safety Guidelines

Installation, commissioning, and operation of the product must be carried out by (electrically) qualified personnel.

- ▷ Read all technical information and safety instructions before installing and using the product.

### 2.2 Rules for Safe Installation and Operation

- Do not attempt to install or operate the product without proper training.
- Ground the product properly.

- Ground the metal supporting frame of the PV modules using potential equalization.
- Only use PV modules of class A according to IEC 61730 and of the same type.
- Connect all cables properly.
- Before switching on, check the AC and DC voltages and polarity. Observe the information on the data sheet or type plate.
- Take appropriate precautions to protect against electrostatic discharge (ESD).
- Never remove the cover of the inverter.
- To ensure safe operation, carry out all work professionally, including transport, storage, assembly, installation and operation.

### 2.3 Symbols and Warnings on the Product

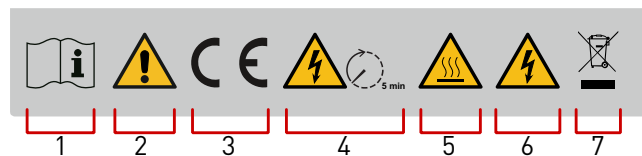


Fig. 1: Symbols on the product

- 1 Follow the instructions before use
- 2 General warning
- 3 CE marking
- 4 Discharge time 5 minutes
- 5 Warning of hot surface
- 6 Warning of electrical voltage
- 7 Proper disposal of waste electrical and electronic equipment

## 2.4 Designated Use

The **REFUsoI 20K...33K-2T**, is a solar inverter, which transforms the direct current generated by the PV generator (photovoltaic modules) into alternating current and can feed it into mains supply.

The **REFUsoI 20K...33K-2T** complies with protection class IP65 and can be used indoors and outdoors.

## 2.5 Improper Use

Only the use described in the "Designated Use" is permissible.

## 2.6 Requirements for Electricians

The activities described in this manual require basic knowledge of the electrical system, the associated technical terms and the relevant technical rules. To ensure safe use, these activities may therefore only be carried out by an appropriate specialist or a trained person under the supervision of a specialist.

A skilled person is a person who, on the basis of his professional training, his knowledge and experience as well as his knowledge of the relevant regulations, can assess the work assigned to him, recognize possible dangers and take suitable safety measures.

## 2.7 General Safety Instructions

- ▷ Observe the valid regulations for accident prevention and environmental protection.
- ▷ Observe the safety regulations and regulations of the country in which the product is used.
- ▷ Only use products in technically perfect condition.
- ▷ Observe all notes on the product.



- ▷ Persons installing, operating or maintaining products must not be under the influence of drugs or medication.
- ▷ Use only accessories and spare parts approved by REFU Elektronik GmbH in order to exclude a personal hazard due to unsuitable spare parts.
- ▷ Observe the technical data and the ambient conditions specified in the operating instructions.
- ▷ Observe safety notes and instructions in third-party documentation.
- ▷ Do not put the product into operation until it has been determined that it complies with country-specific rules, regulations, safety regulations/certificates and application regulations.

## 2.8 Personal Protective Equipment

REFU Elektronik GmbH recommends to wear the following personal protective equipment.

- Safety shoes
- Protective gloves
- If required: transport aid
- Safety goggles

- ✓ Observe the instructions of the respective manufacturer.
- ✓ All components of the personal protective equipment must be intact.

## 2.9 Five Safety Rules When Working on Electrical Systems

Disconnect electrical systems (lock and tag) according to the five safety rules:

- ▷ Unlock and disconnect completely.
- ▷ Secure against re-connection.
- ▷ Check that there is no voltage (DC and AC).
- ▷ Carry out earthing and short-circuiting.
- ▷ Provide protection against adjacent live parts.

## 3 Technical Description

### 3.1 Functionality of the Inverter

The *REFUsoI 20K...33K-2T* is a multi-string inverter with two MPP trackers that converts the DC voltage generated by the photovoltaic modules into AC voltage and can feed the power into the low or medium voltage grid.

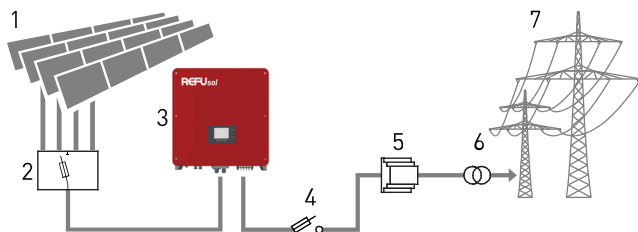


Fig. 2: Functional principle of a grid-connected PV system

- 1 Photovoltaik (PV) modules
- 2 Solar string combiner box
- 3 Photovoltaic inverter
- 4 AC protection (fuse switch disconnect or circuit breaker)
- 5 Grid protection
- 6 Isolation transformer is required for medium-voltage grid
- 7 Low or medium-voltage AC grid

A DC switch is integrated at the DC input of the inverter; this disconnects the inverter from the PV modules. The PV inverter has two independent MPP trackers on the input board. These can be operated in parallel mode or in independent mode.

The input board provides extensive functions, including insulation monitoring, DC voltage and current monitoring and reverse polarity protection. EMC filtering is also performed on this board to suppress unwanted noise levels at the DC input.

The DC-DC boost converter controls the level of the DC voltage, which is fed to the inverter board, where the DC current is converted into AC current. On the output board, EMC filtering of the AC current, fault current

monitoring and disconnection from the AC mains are carried out by redundant AC relays.

The control and regulation board centrally monitors, regulates and controls all unit functions. For this purpose, all sensor data are recorded, processed and the operating status of the inverter is displayed (LCD). This includes the current operating data, error messages and warnings (warning LED).

The communication board enables the connection of different adapters (RS485, Ethernet, WiFi) and the communication of the inverter with other IT devices (PC, smartphone) and web portals.

Depending on the design of the PV system and the wiring of the individual PV modules, the PV strings can be connected to two MPPT trackers and operated in "parallel mode" or "independent mode".

### Independent mode (default)

If different PV outputs are expected at the two MPPT inputs due to shading or different orientation (azimuth or tilt angle), independent mode should be used for the purpose of PV yield optimisation.

### Parallel mode

If all PV strings are connected in parallel via a "combiner box" or Y-cable, "Parallel mode" must be used.

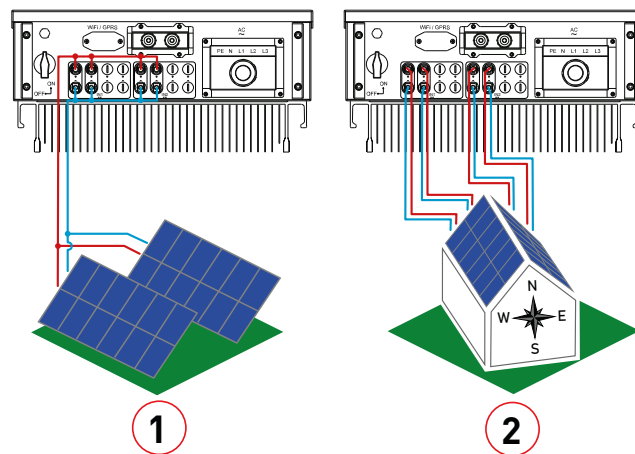


Fig. 3: Examples for MPPT operating modes

- |   |   |
|---|---|
| <p><b>1</b> Parallel mode<br/>(open area with the same orientation)</p> | <p><b>2</b> Independent mode<br/>(roof surfaces with different orientation)</p> |
|---|---|

## 3.2 Cooling Concept

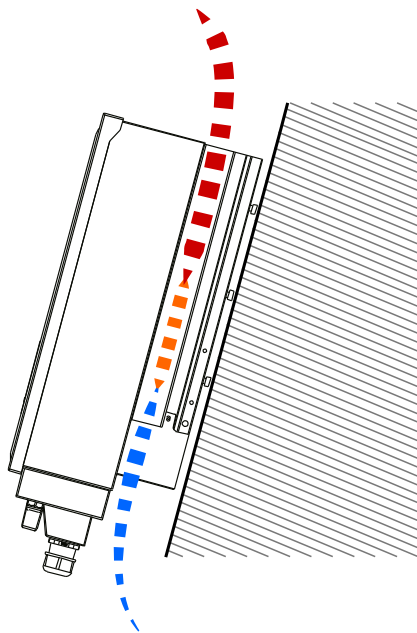


Fig. 4: Cooling of the inverter

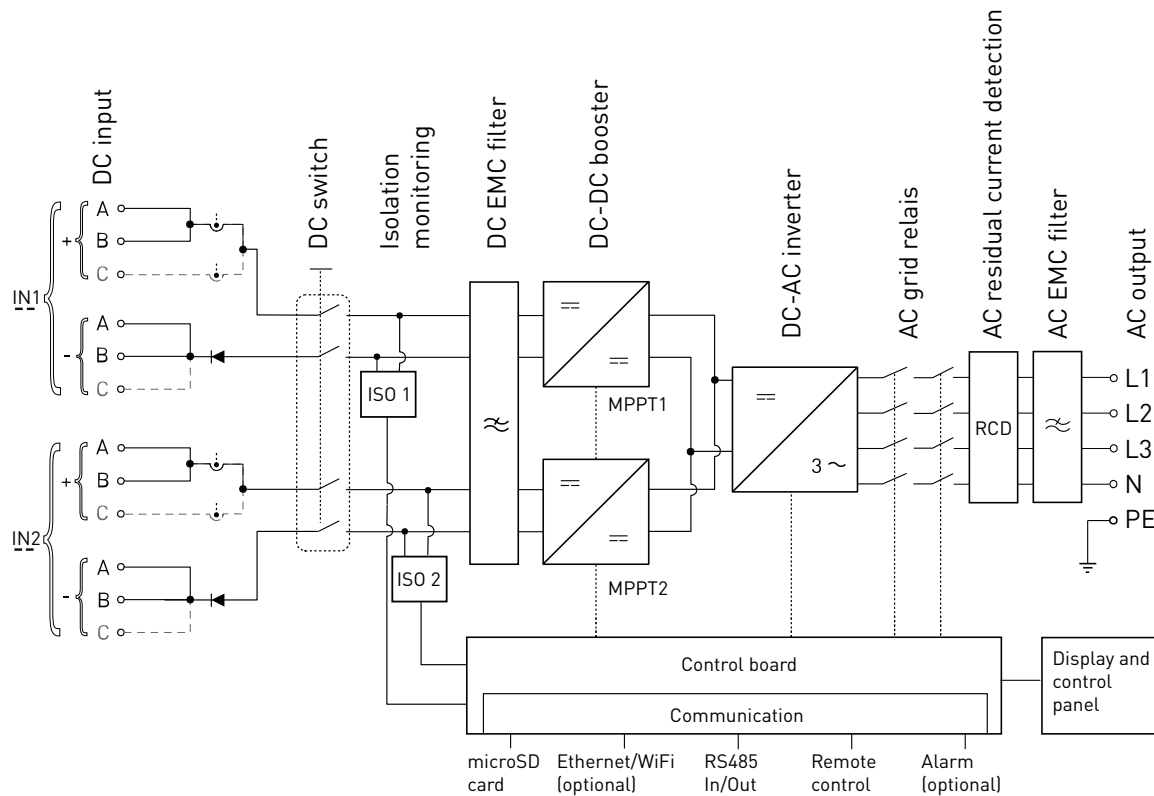


Fig. 5: Overview circuit diagram *REFUsol 20K...33K-2T* (for REFUsol 20K-2T: 2 x PV per MPPT input; for 33K-2T: 3 x PV/MPPT input)

### 3.3 Connection Requirements

Additional required equipment	at low voltage network	at medium voltage network
DC load break switch	integrated <sup>1)</sup>	integrated <sup>1)</sup>
AC load break switch	necessary	necessary
Central grid protection device with section switch (VDE-AR-N 4105, VDE-AR-N 4110)	necessary	necessary
LV-/MV-Transformer	not necessary	necessary

<sup>1)</sup> Local regulation might require an additional DC switch at a external DC combiner box.

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

- The **REFUsol 20K...33K-2T** can feed into the low-voltage grid and the medium-voltage grid.
- The power supply line must be equipped with an appropriate AC disconnecting device.

- The **REFUsol 20K...33K-2T** is not equipped with internal potential isolation.
- If connected with the medium-voltage-grid, it must be operated with electrically isolating transformers.
- The transformer must be selected according to the specific site of use and the relevant regulations must be taken into account: Hazardous substances ordinance, ordinance on installations for handling substances hazardous to water, chemicals prohibition ordinance, technical instructions for noise protection, and regional building regulations.

#### Specification of medium voltage transformer

Mains transformer according to EN 50588-1

Switching group          Dyn5 or Dyn11

- The **REFUsol 20K...33K-2T** has 2 independent MPP trackers. All PV modules connected to the same MPPT should be of the same type and have the same orientation.
- When planning the system, selecting operating equipment, installation, commissioning and com-

missioning testing, take into account and adhere to the specified rated data from the technical data sheet.

### 3.4 Compatible Grid Types

The *REFUsol 20K...33K-2T* are compatible with the TN-S, TN-C, TN-C-S and TT grid types. When using the TT mains, the voltage between the neutral conductor and earth should be less than 30 V.

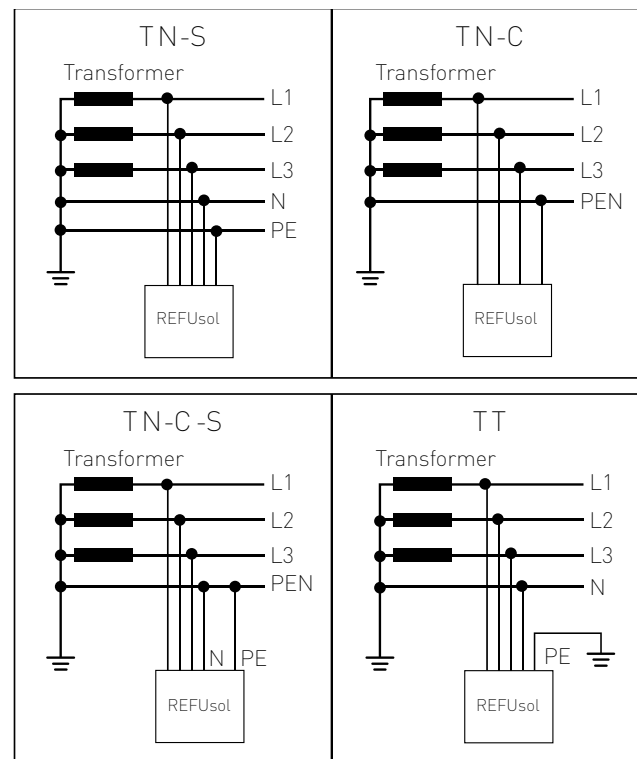


Fig. 6: Overview of the grid types

### 3.5 Components and Dimensions

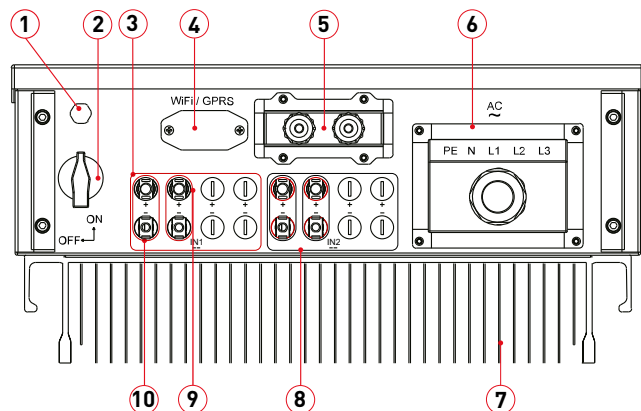


Fig. 7: Connection area REFUsol 20K-2T

- |                                  |                                  |
|----------------------------------|----------------------------------|
| 1 Pressure compensation membrane | 6 AC cover                       |
| 2 DC switch                      | 7 Heat sink (20K-2T only)        |
| 3 PV connection area IN1 (MPPT1) | 8 PV connection area IN2 (MPPT2) |
| 4 Ethernet or WiFi interface     | 9 DC positive connection         |
| 5 RS485 and digital input cover  | 10 DC minus connection           |

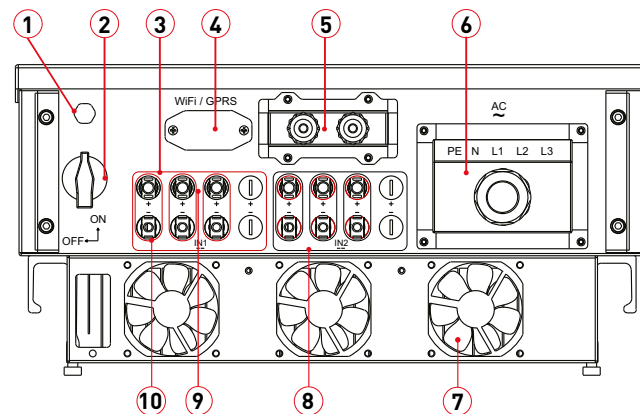


Fig. 8: Connection area REFUsol 33K-2T

- |                                  |                                  |
|----------------------------------|----------------------------------|
| 1 Pressure compensation membrane | 6 AC cover                       |
| 2 DC switch                      | 7 Heat sink with fans            |
| 3 PV connection area IN1 (MPPT1) | 8 PV connection area IN2 (MPPT2) |
| 4 Ethernet or WiFi interface     | 9 DC positive connection         |
| 5 RS485 and digital input cover  | 10 DC minus connection           |



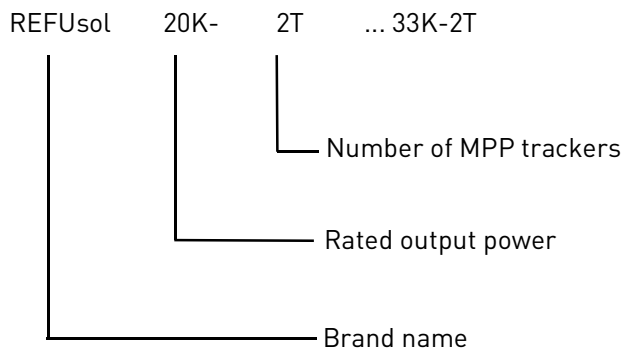


Fig. 9: Structure of the type code

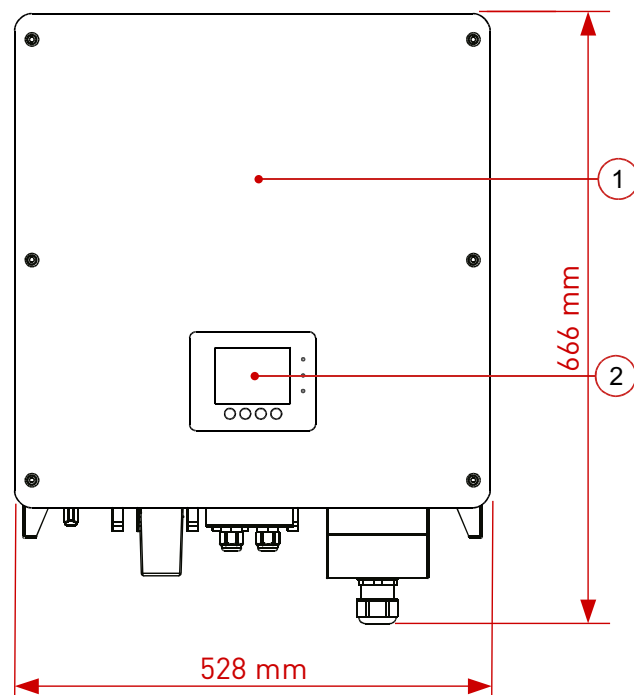


Fig. 10: Dimensions front view

- 1 Housing cover
- 2 LED display with membrane keys and status LEDs

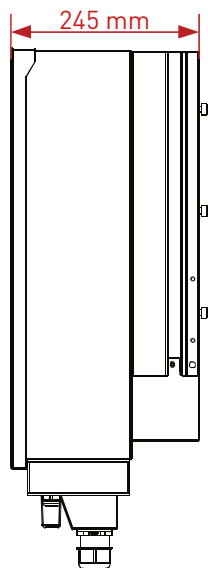


Fig. 11: Dimensions side view

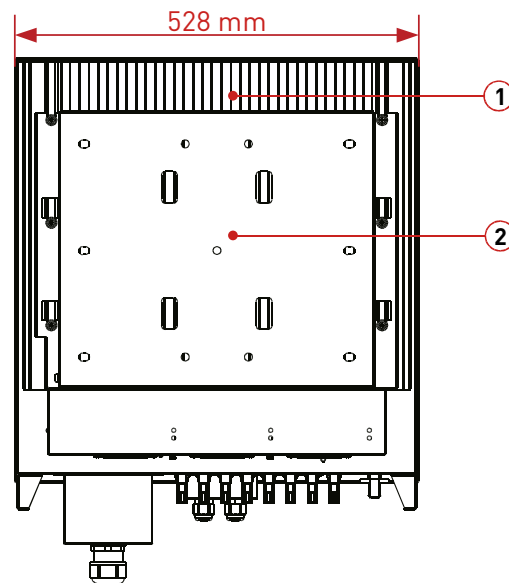


Fig. 12: Dimensions rear view

- 1 Heat sink
- 2 Inverter bracket

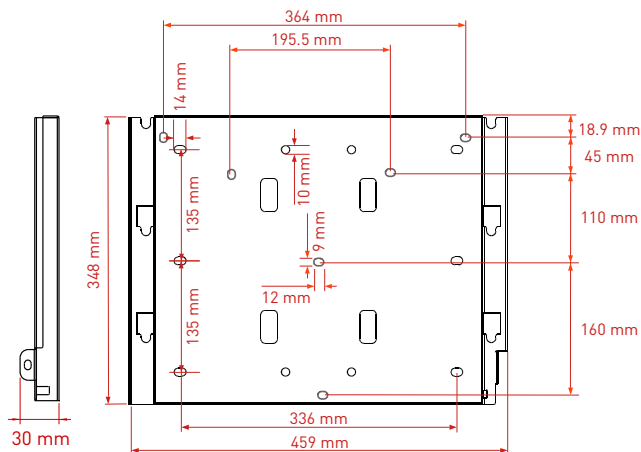


Fig. 13: Dimensions of the inverter bracket

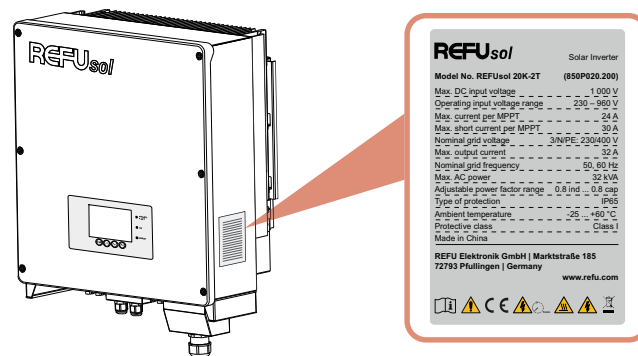


Fig. 14: Type plate of the inverter

### 3.6 Communication Interfaces

The **REFUsol 20K...33K-2T** have 3 communication ports: two RS485 interfaces and one Ethernet/WiFi interface.

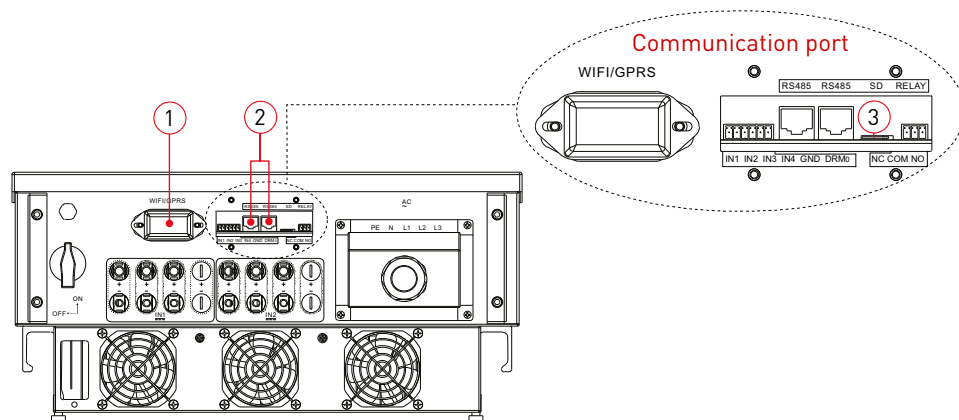


Fig. 15: Communication interfaces

1 Ethernet/WiFi interface

2 RS485 interface(s)

3 microSD card slot

Tab. 2: Communication ports, digital inputs

Terminal connection						
Designation		IN1	IN2	IN3	IN4	
Function/circuit for power reduction		IN1 $\Leftrightarrow$ GND $P_N = 0 \%$	IN2 $\Leftrightarrow$ GND $P_N = 30 \%$	IN3 $\Leftrightarrow$ GND $P_N = 60 \%$	IN4 $\Leftrightarrow$ GND $P_N = 100 \%$	Logic-GND -

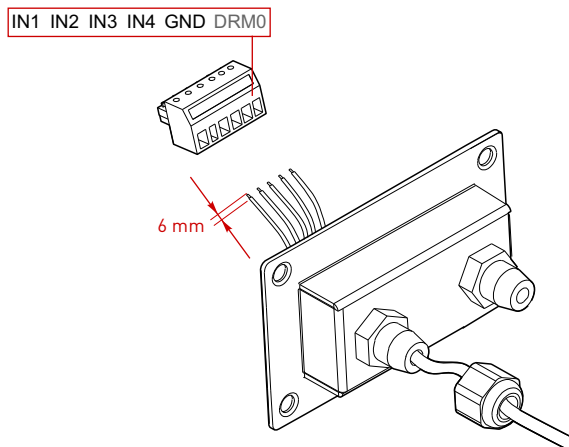


Fig. 16: Pin assignment terminal connection digital inputs

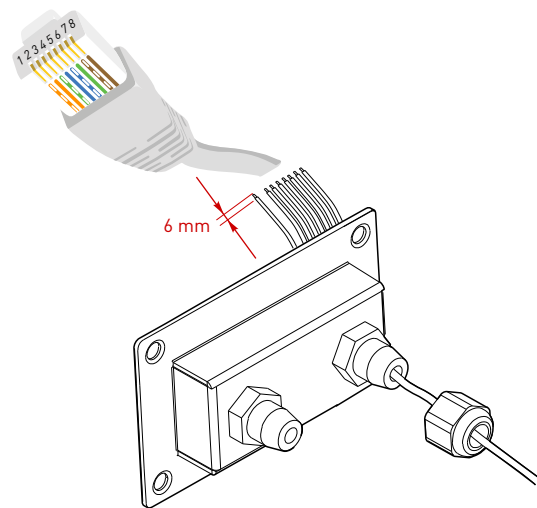


Fig. 17: Pin assignment RJ45 for RS485 communication

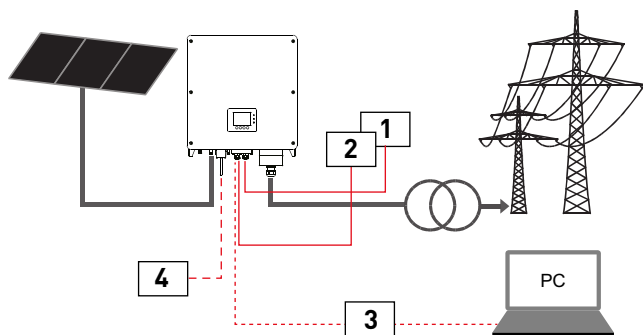


Fig. 18: RS485 and radio ripple control

- 1 Radio ripple control receiver connected to RS485
- 2 Power reduction (0 % 30 %, 60 % und 100 %)
- 3 RS485/USB adapter for service to a PC
- 4 Ethernet or WiFi interface for data logging

### 3.7 Display and Operating Elements

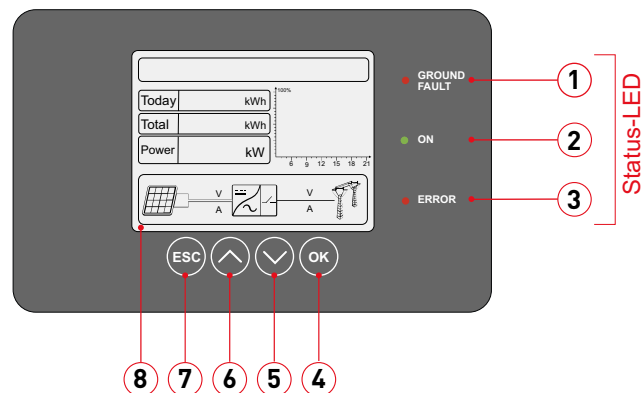


Fig. 19: LCD display with keys and status-LED

- 1 Ground-fault detection
- 2 Normal operation (On)
- 3 Alarm/fault
- 4 OK key: Confirm selection or value
- 5 √ key: Menu level downwards
- 6 ∧ key: Menu level upwards
- 7 ESC key: Cancel or return
- 8 LCD display

### 3.7.1 Keys

Key	Description
OK	Return to the previous menu or open up the main menu via the standard display
∧	One menu level up
∨	One menu level down
ESC	Select or confirm the value

### 3.7.2 Status-LEDs

Status-LED	Operating status	Description
GROUND FAULT, red	on	GFI error, ground fault detected
	off	no GFI error
ON, green	flashing	Waiting or test state
	on	Normal operation (inverter in feed mode)
	off	Fault or permanent fault condition

Status-LED	Operating status	Description
ERROR, red	flashing	Fan error
	on	Inverter in fault state
	off	Normal operation (inverter in feed-in operation)

### 3.7.3 Information of the LCD display

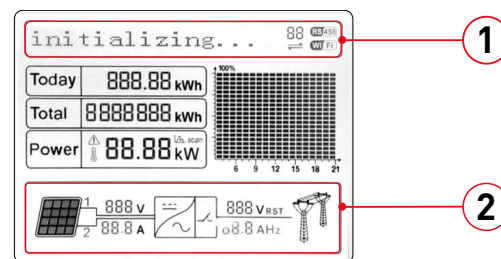


Fig. 20: Menu display and status information

- 1 Operating status and communication status
- 2 Real-time measured values AC and DC mains

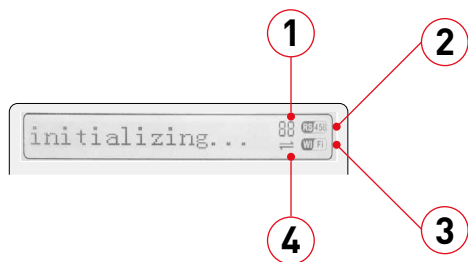


Fig. 21: Operating status, communication, communication status and menu display

- |                                 |   |
|---------------------------------|---|
| <b>1</b> Modbus address         | <b>3</b> Ethernet/WiFi interface active |
| <b>2</b> RS485 interface active | <b>4</b> Activity on RS485 bus          |

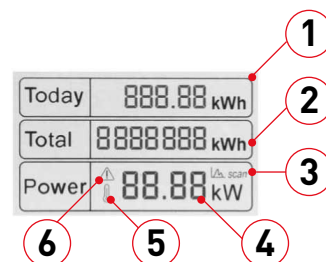


Fig. 22: Performance data

- |   |  |
|---|--|
| <b>1</b> Daily PV yield                     | <b>6</b> Flashes during frequency and power derating; Lights up during remote shutdown |
| <b>2</b> Total PV yield                     |  |
| <b>3</b> MPPT scan function                 |  |
| <b>4</b> Real-time power                    |  |
| <b>5</b> High inverter internal temperature |  |



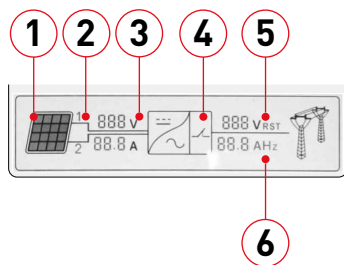


Fig. 23: Real-time measured values DC/AC

- |   |   |
|---|---|
| <b>1</b> Lights up when DC voltage exceeds 250 V                                    | <b>4</b> Lights up in feed-in operation ("normal")  |
| <b>2</b> Measuring channel MPPT1/MPPT2 (IN1/IN2)                                    | <b>5</b> AC voltage of phases L1, L2 and L3 (changes every three seconds)                 |
| <b>3</b> DC voltage and current per measuring channel (changes every three seconds) | <b>6</b> AC current of phases L1, L2 and L3 or AC frequency (changes every three seconds) |

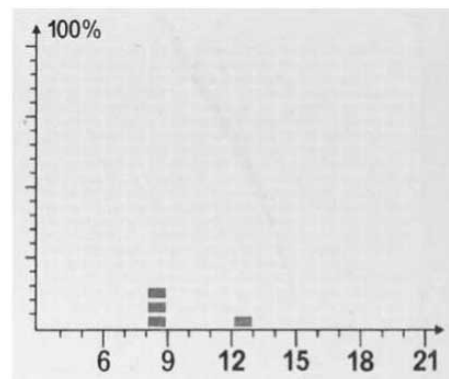


Fig. 24: PV yield from 3 a.m. to 9 p.m.

### 3.7.4 Menu Display

When the DC voltage exceeds 250 V, the inverter starts and the LCD display shows Initializing... is displayed.

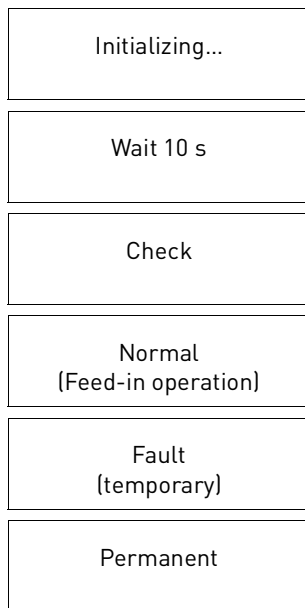


Fig. 25: Starting the inverter

Tab. 3: Operating states

<b>Wait</b>	The DC voltage is more than 250 V, the values of the AC voltages are within the permissible range. If this is not the case, the inverter switches to the temporary or permanent error state. In this operating state, the inverter waits for the next initialisation step "Check".
<b>Check</b>	The inverter checks the insulation resistance of the PV system, the status of the AC grid relays and other safety functions. It also carries out a self-test to ensure that the software and hardware of the inverter are functioning without errors. The inverter enters the temporary or permanent error state when an error or fault has been detected.
<b>Normal</b>	The inverter is in the "Normal" operating state, feeding into the grid is taking place, when an error or fault occurs, the inverter goes into the temporary or permanent error state.

Tab. 3: Operating states

<b>Fault</b>	The inverter has detected a temporary error or malfunction and is in the operating state temporary error state. As soon as the error no longer exists, the inverter automatically returns to the operating state "Normal". If the error condition still exists, check the inverter using the error code displayed.
<b>Permanent</b>	The inverter has detected a permanent error that cannot be acknowledged. The fault is rectified by a qualified electrician and by evaluating the displayed error code.

### 3.8 LED Display of the Ethernet and WiFi Stick

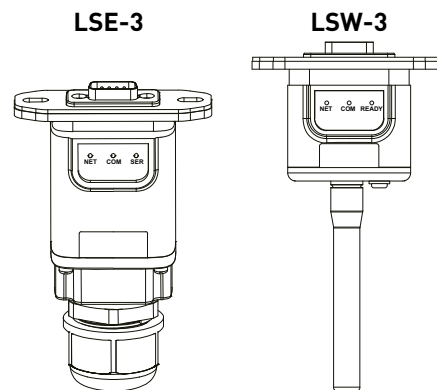


Fig. 26: Ethernet stick (LSE-3) and WiFi stick (LSW-3)

### 3.8.1 LED Display Ethernet Stick LSE-3 (optional)

LED	Communication	Status	Description
NET	Network	On	Connection to the network successful
		Off	Connection to network failed
COM	Solar inverter	On	Communication with solar inverter successful
		Off	Communication with solar inverter failed
SER	Server	Flashing interval 1 s	Connection to server successful
		Flashing interval 6 s	Connection to server failed

#### **Operating Status of the Ethernet stick:**

Initialisation: NET LED lights up for 1 s and switches off.

Server connection: SER LED flashes slowly for 2 s.

Communication with solar inverter successful: COM LED lights up for approx. 5 s.

Server connection successful: SER LED flashes quickly and NET LED lights up for approx. 7 s.

⇒ Start of normal operation.

### 3.8.2 LED Display WiFi Stick LSW-3 (optional)

LED	Communication	Status	Description
NET	Router	On	Connection to server successful
		Flashing interval 1 s	Connection to router successful
		Flashing interval 100 ms	Quick setting network active
		Off	Connection to router failed
COM	Solar inverter	On	Logger is connected to the solar inverter
		Flashing interval 1 s	Communication with solar inverter active
		Off	Communication with solar inverter failed
READY	Logger status	Flashing interval 1 s	Logger active
		Flashing interval 100 ms	Restore factory settings
		Off	Logger not active

### 3.9 Efficiency and Power Diagrams

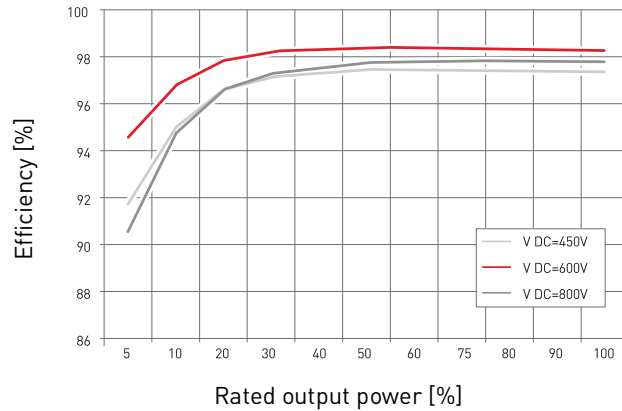


Fig. 27: Efficiency diagram

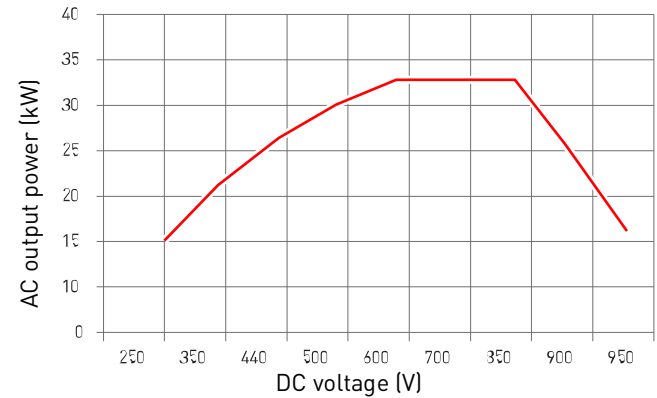


Fig. 28: DC voltage power diagram

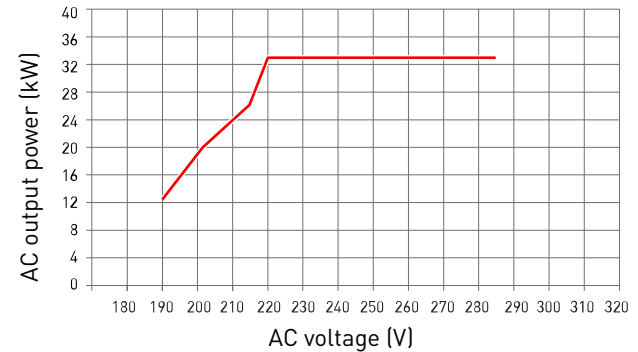


Fig. 29: AC voltage power diagram

## 4 Installation

### 4.1 Installation Warnings

#### **DANGER**

##### **High voltage**

Danger to life due to high voltages in the live components of the inverter, which can cause fatal electric shocks.

- ▶ All work on the product must be carried out by qualified electricians only.
- ▶ Always disconnect the inverter before working on it and observe the five safety rules (see chapter 2.9).
- ▶ Observe the discharge time of 5 minutes.



#### **CAUTION**

##### **Hot surfaces**

Risk of burns due to hot surfaces.

The product can get hot during operation.

- ▶ Avoid contact during operation.
- ▶ Allow the product to cool down sufficiently before carrying out any work.



### 4.2 Auxiliary Means and Tools

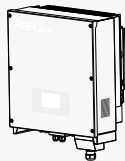
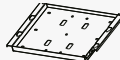



- Drill with Ø 8 mm drill bit
- RJ45 crimping pliers
- Open-ended spanner (at least 13 mm)
- Slotted screwdriver
- Phillips screwdriver
- Allen key for M6
- Hammer
- Assembly tool for MC4 connectors
- Combination pliers
- Wire stripper
- Stripping tool
- Cable cutter
- Crimping tool(s)

- Hoover
- Voltage tester
- Marker pen
- Measuring tape
- Spirit level with protractor
- Warning sign for maintenance work

### 4.3 Check Scope of Delivery

1. Check the packaging for damage.  
If damage is found, do not unpack the inverter and contact the supplier immediately.
2. Check the scope of delivery.  
If the scope of delivery is incomplete or damage is detected, contact the supplier.

Tab. 4: Scope of delivery

Description		Quantity 20K-2T	Quantity 33K-2T
	REFUsoL 20K-2T or REFUsoL 33K-2T	1	1
	Inverter bracket	1	1
	MC4 connector (DC+)	4	6
	MC4 connector (DC-)	4	6
	Terminal connection digital input	1 (plugged in)	1 (plugged in)



Tab. 4: Scope of delivery

Description	Quantity 20K-2T	Quantity 33K-2T
 MC4 crimp contacts (DC+)	4	6
 MC4 crimp contacts (DC-)	4	6
 Hexagon socket screw M6	2	2
 M8x80 heavy duty anchor for inverter bracket	6	6
 Operating Manual	1	1

## 4.4 Requirements for the Installation Site

▷ The following requirements must be met for the installation site:

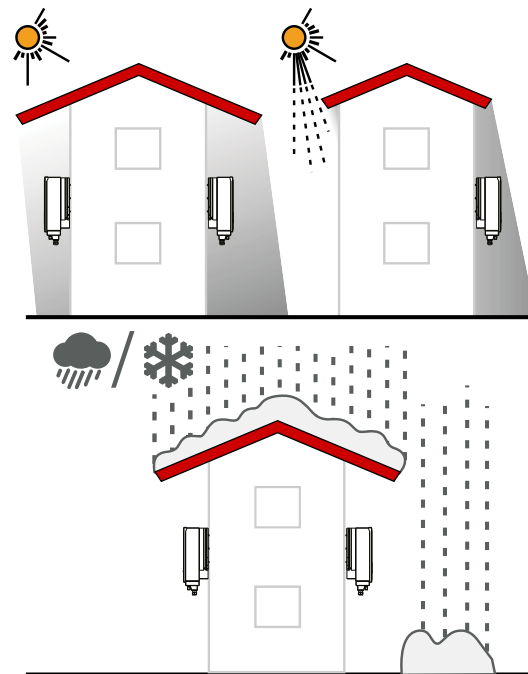


Fig. 30: Requirement for the installation site

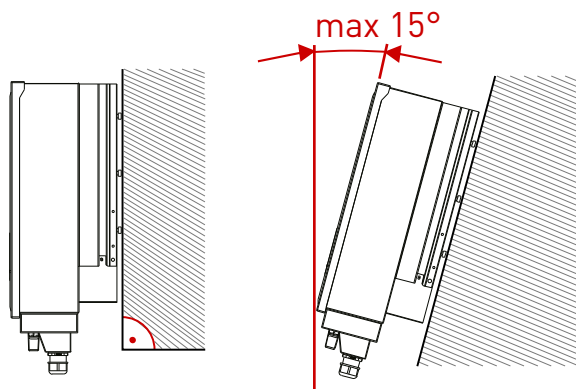


Fig. 31: Vertical installation

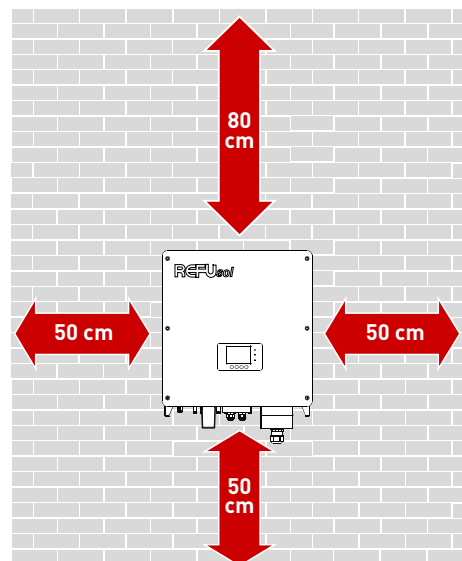


Fig. 32: Distances and clearances

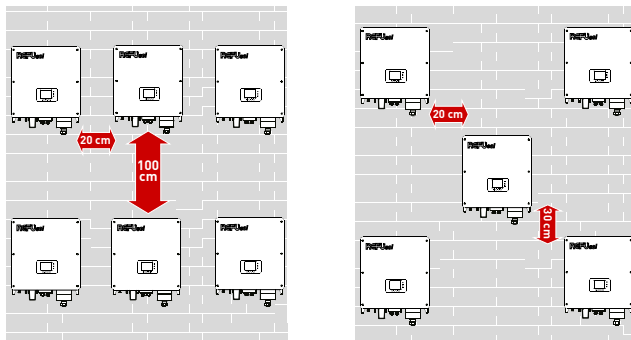


Fig. 33: Minimum installation distance and arrangement of several **REFUsol 20K...33K-2T**

## 4.5 Mounting the Inverter Bracket

There are two options for mounting the inverter bracket. Vertical wall mounting or wall mounting with a maximum inclination angle of 15°.

- ✓ Requirements for the installation location according to IEC 60364-7-712 for photovoltaic power supply systems are taken into account during planning.

1. Position the inverter bracket, align it with a spirit level and mark the drill holes.
2. Drill holes according to the markings.
3. Insert heavy-duty anchors into the drilled holes and hammer them in with a hammer.
4. Fasten the inverter bracket with the heavy-duty anchors – or select equivalent fastening material.
5. Tighten all screws of the heavy-duty anchors cross-wise

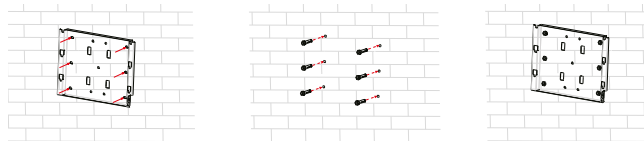


Fig. 34: Mounting the inverter bracket

## 4.6 Remove the Inverter from the Packaging

- ✓ Inverter packaging is ready at the installation site.
- ▷ With two people, grasp the inverter at the following positions and lift it out of the packaging.

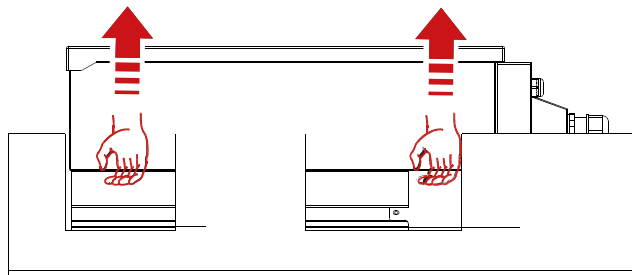


Fig. 35: Handle options on the inverter

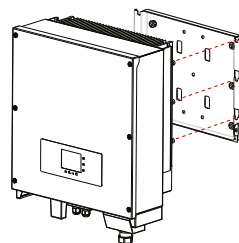
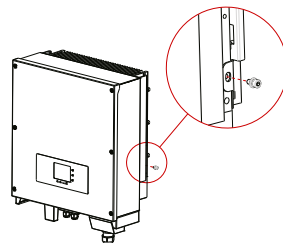


Fig. 36: Wall mounting



## 4.7 Mount Inverter

1. With two people, align the inverter on the inverter bracket with the recesses and hook it in.
2. To secure the inverter, tighten the M6 hexagon socket screw on the inverter bracket.
3. If necessary, use a lock to prevent theft.

## 4.8 Connect Earthing Conductor

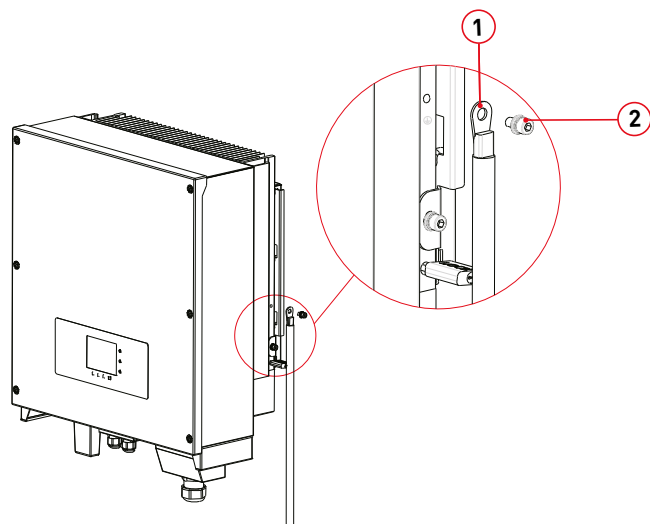


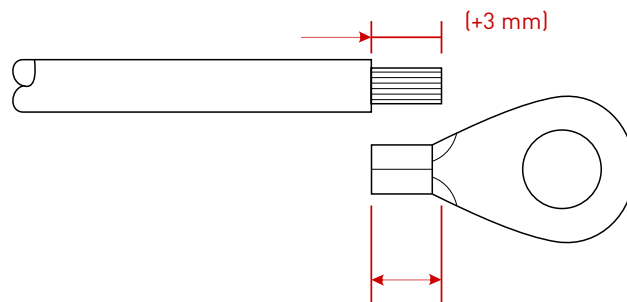
Fig. 37: Potential equalisation connection

1 Potential equalisation conductor with crimp cable lug

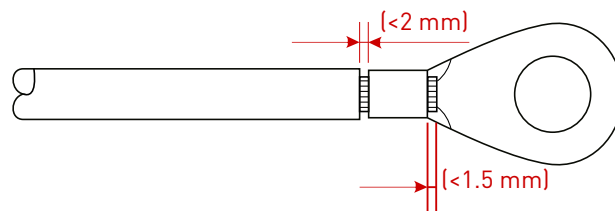
2 Hexagon socket screw M5

✓ The potential equalisation conductor with a cross-section of  $16 \text{ mm}^2$  is prepared.

1. Strip the potential equalisation conductor to a suitable length using a pair of wire strippers.



2. Insert the bare conductor into the crimping cable lug and crimp it with a crimping tool..



3. Tighten the crimp cable lug and the hexagon socket screw M5 at the marked potential equalisation connection with a tightening torque of 4.5 Nm.

- If necessary, protect the potential equalisation connection against corrosion.

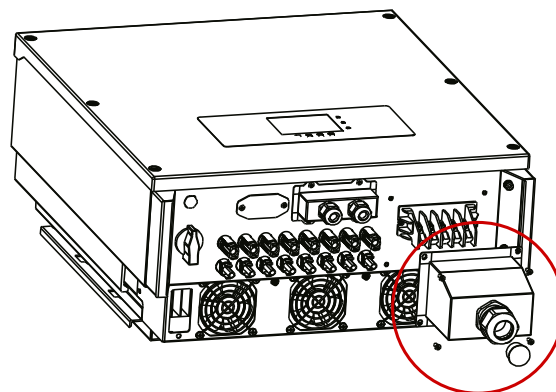
## 4.9 Connect AC Cable

Tab. 5: AC fuse and minimum cross-sections of the AC cables

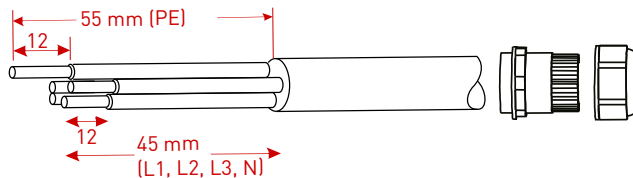
Type	REFUol 20K-2T	REFUol 33K-2T
Conductor cross section*	$\geq 10 \text{ mm}^2$	$\geq 16 \text{ mm}^2$
Fuse	40 A	63 A

\* The conductor cross-sections shown in the table are minimum requirements. For longer cable lengths, the conductor cross-sections must be designed accordingly.

- Remove the AC cover with a Phillips screwdriver.
- Loosen the union nut and remove the blind plug of the cable gland.

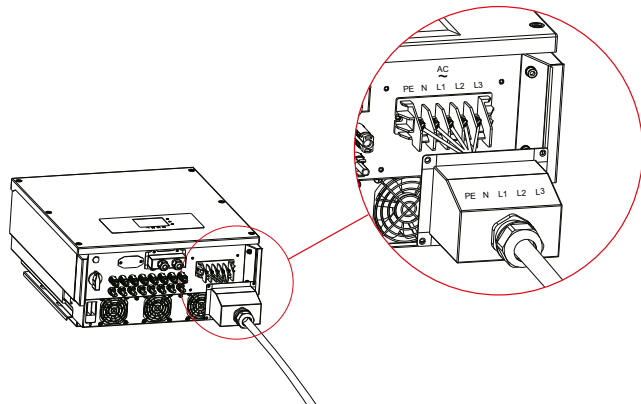


- Strip the conductors of the AC cable according to the following illustration.



- Attach the union nut to the PG cable gland.
- Feed AC cable through PG cable gland and AC cover.
- Insert the conductor into the M6 crimping cable lug and crimp it with a crimping tool.

7. Connect AC conductors in the order "PE, N, L1, L2, and L3" with M6 Phillips screwdriver.



8. Mount the AC cover on the inverter housing using a Phillips screwdriver.
9. Tighten the union nut of the PG cable gland.
10. Check proper installation of the AC cable and tightness of the AC cover.

## 4.10 Assembling and Connecting DC Cables

### 4.10.1 Assemble DC Cable

- ✓ The polarity of the DC cables are checked and marked.
  - ✓ The electrical system is secured and disconnected in accordance with the 5 safety rules.
1. Strip 10 mm of insulation from the DC conductor (4 – 6 mm<sup>2</sup>) using a suitable tool.  
Make sure that no individual strands are cut off.
  2. Insert stripped conductors into the corresponding crimp contact sleeve up to the stop. The conductor ends must be visible in the crimp contact sleeve.
  3. Crimp conductor and crimp contact sleeve with crimping pliers.
  4. Check that the ladder is firmly seated.

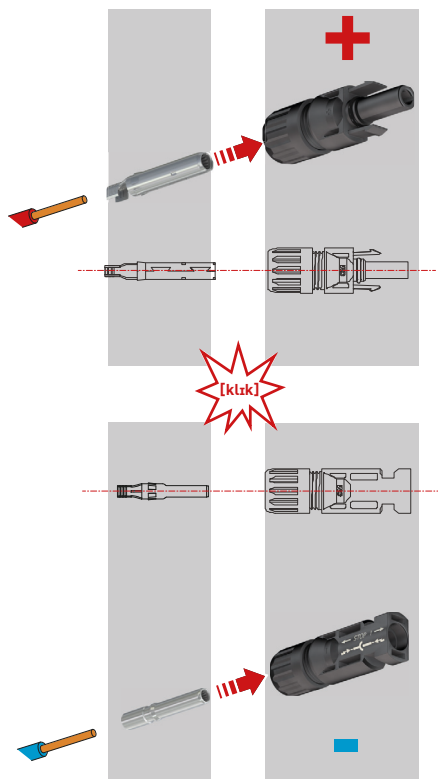
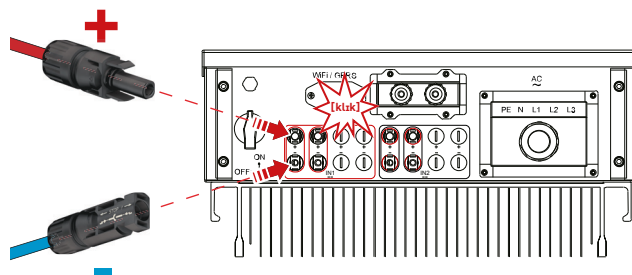


Fig. 38: DC cable assembly with MC4 connector

- ✓ Depending on the MPPT operating mode set, ensure that the DC cables are correctly assigned.
- 5. Slightly loosen the union nut of the MC4 connectors.
- 6. Push the crimped conductor into the MC4 connector until it audibly clicks into place.
- 7. Tighten the union nut and check for tightness and strain relief.

#### 4.10.2 Connect DC Cable



1. Insert MC4 connectors DC+ and DC- into the corresponding housing sockets/plugs until the MC4 connectors snap into place.
2. Check safe contacting.



## 4.11 Connect Communication

**REFU<sub>sol</sub> 20K...33K-2T** are equipped with an Ethernet interface as standard.

Device information (yield data, error messages, alarms, operating status) of the inverter is transmitted to the REFUlog monitoring portal via Ethernet or optionally via WiFi.

- ▷ For a communication connection (Ethernet, RS485 and digital inputs) use a shielded network cable with an outer diameter of 4.5 mm to 7.5 mm.
- ▷ To avoid communication interference, lay communication cables away from live lines and sources of interference.
- ▷ The length of the communication cable should be less than 1000 m.

### 4.11.1 Connect RS485 Communication

1. Remove the RS485 and digital input cover on the inverter.
2. Slightly loosen the union nut of the PG screw connection.
3. Remove the blind plug from the PG gland and feed the shielded network cable through the cable gland and seal.
4. Use a crimping tool to assemble the network cable with an RJ45 plug. Make sure that the PIN assignment is correct.

Pin	Colour	RS485 function
1	white and orange	RS485 <b>B-</b> , RS485 differential signal-
2	orange	RS485 A-, RS485 differential signal+
3	white and green	RS485 A-, RS485 differential signal+
4	blue	RS485 A-, RS485 differential signal+
5	white and blue	RS485 <b>B-</b> , RS485 differential signal-
6	green	RS485 <b>B-</b> , RS485 differential signal-
7	white and brown	NC
8	brown	NC

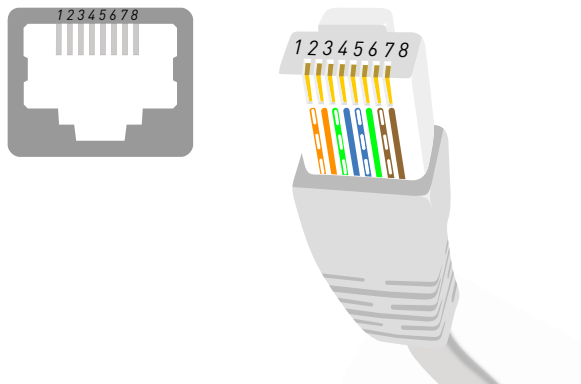
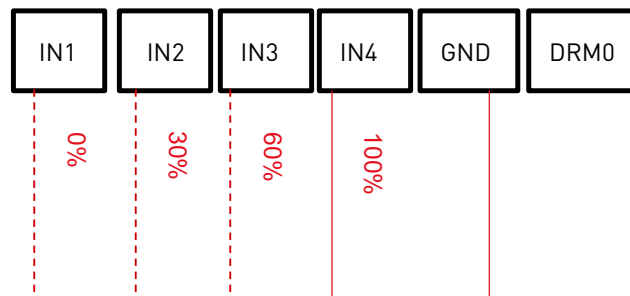


Fig. 39: Pin assignment RJ45 plug

5. Insert the RJ45 connector into the RS485 port of the inverter until it locks securely.
6. Check secure connection of the RJ45 plug.
7. Fit the RS485 and digital input cover.
8. Tighten the union nut of the PG screw connection.
9. Check the tightness and the strain relief of the PG screw connection and cover.

#### 4.11.2 Connect Digital Inputs IN1 to IN4

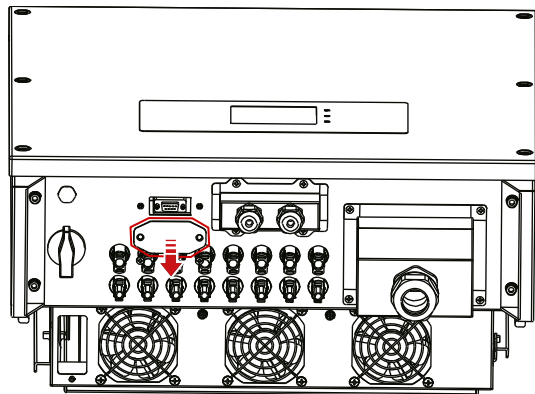
1. Remove the RS485 and digital input cover on the inverter.
2. Slightly loosen the union nut of the PG screw connection.
3. Remove the blind plug from the PG gland and feed the shielded network cable through the cable gland and seal.
4. Plug in the terminal strip for the digital inputs.
5. Assemble the network cable and connect the wires to the digital inputs of the terminal strip IN1, IN2, IN3, IN4 and GND.



6. Fit the RS485 and digital input cover.

7. Tighten the union nut of the PG screw connection.
8. Check the tightness and the strain relief of the PG screw connection and cover.

#### 4.11.3 Connecting the Ethernet Stick LSE-3 (optional)

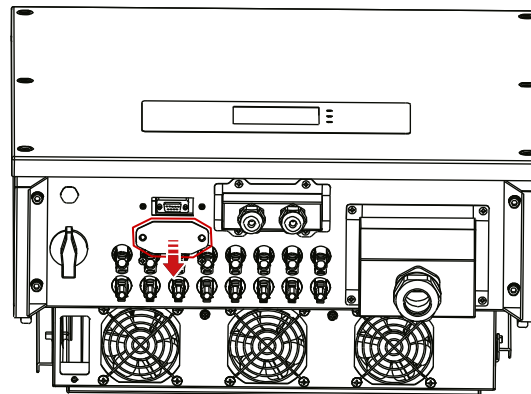


1. Remove the WiFi/GPRS cover of the connection area with a Phillips screwdriver.
2. Slightly loosen the cable gland of the Ethernet adapter.
3. Plug the shielded RJ45 Ethernet cable into the Ethernet stick.

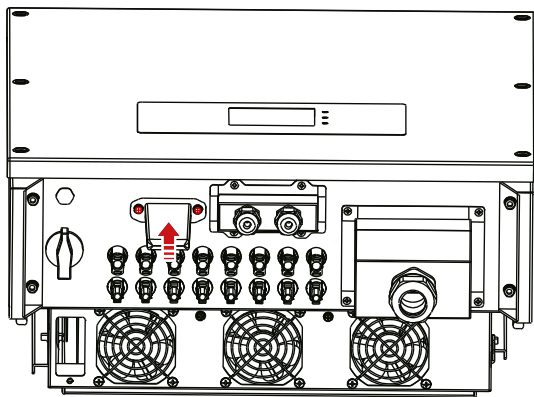
4. Tighten the cable gland and check for tightness and strain relief.
5. Plug the Ethernet stick into the "WiFi/GPRS" connection.
6. Fasten the Ethernet stick with two screws.

#### 4.11.4 Connect WiFi Stick LSW-3 (optional)

1. Remove the WiFi/GPRS cover of the connection area with a Phillips screwdriver.



2. Plug in the WiFi stick.
3. Fasten the WiFi stick with two screws.



### Configure WiFi Stick with PC

- ✓ The WiFi stick is mounted.
- ✓ Inverter is in operation.
- ✓ Computer (PC, tablet, smartphone) is prepared.

1. Connect the computer to the access point of the WiFi stick.

The name of the access point is "AP" followed by the serial number of the WiFi stick (see WiFi stick type plate).

2. Enter the password of the WiFi stick (see WiFi stick type plate).
  3. Open the Internet browser and enter the address 10.10.100.254.
  4. Enter user name "admin" and password "admin".
    - ⇒ The status page opens.
  5. Click the "Wizard" button to configure the settings of the WiFi stick.
    - ⇒ If configured correctly, the WiFi stick is recognised in the network and starts sending monitoring data to REFUlog.
- ✓ To start the configuration wizard directly, scan the QR code stuck on the Wifi stick and follow the instructions shown.

### 4.11.5 REFUlog Monitoring Portal

As soon as an Internet connection is established via WiFi or Ethernet, the **REFUsoI 20K...33K-2T** automatically send their operating data to the REFUlog monitoring portal every 5 minutes.

The Ethernet and WiFi stick have an internal flash memory that temporarily stores the most important data in case of communication interruption. As soon as communication is available again, the stored data is automatically sent to the REFUlog monitoring portal.

- ▷ To view the inverter data, open the website [www.refu-log.com](http://www.refu-log.com) with a browser and register as a new user.



## 5 Commissioning

### 5.1 Testing the Electrical Safety

- ▷ Carry out initial commissioning test according to IEC 62446-1.

### 5.2 Commissioning the Inverter

1. Switch on the DC switch.
  - ⇨ The inverter starts and after a short waiting time it is ready for setting and parametrising the inverter.
2. Set the menu language.
3. Set the date and time.
4. Set country code.
5. Switch off the DC switch and wait 5 minutes.
6. Switch on the DC switch.
7. Switch on the AC switch.
  - ⇨ The inverter goes into feed-in operation (normal).
8. Check and document the correct settings of all safety-related parameters.

## 6 Operation

### 6.1 Operation, Navigation and Key Functions

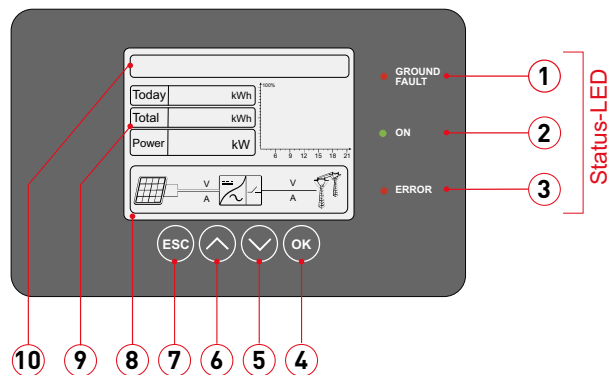


Fig. 40: LCD display with keys and status LED

- |                                      |   |
|--------------------------------------|---|
| 1 Ground fault detection             | 6 $\wedge$ key: Menu level upwards          |
| 2 Normal operation (On)              | 7 ESC key: Cancel or back                   |
| 3 Alarm/Fault                        | 8 Real-time measured values AC and DC mains |
| 4 OK key: Confirm selection or value | 9 Performance data                          |
| 5 $\vee$ key: Menu level downwards   | 10 Menu display                             |

- ▷ Press the  $\vee$  or  $\wedge$  key to select a menu item.
- ▷ Use the  $\vee$  or  $\wedge$  key to count up or down the value of a digit or element by one unit.
- ▷ Press the ESC key to go back one step or to call up the main menu.
- ▷ If a setting is password protected, press the OK key to enter the password.
- ▷ Press the OK key to confirm the selection.
- ⇒ After a successful setting change, "Success" is shown in the menu display.
- ▷ The default password is "0001".
- ▷ For the software update and ON-OFF control, the password is "0715".

### 6.2 Main Menu (v2.6)

Normal >	1. Enter Setting
	2. Event List
	3. System Info
	4. System Time
	5. Software Update

## 6.2.1 Main Menu > 1. Enter Setting

### Normal > 1. Enter Setting

1. Set Time
2. Clear Energy
3. Clear Events
4. Set Country Code
5. On-Off Control
6. Relay Command<sup>1)</sup>
7. Enable Set Country
8. Set Total Energy (input in kWh = feed-in limit)
9. Set Modbus Address
10. Set Inputmode (parallel or independent mode)
11. Set Language
12. Set Start Parameter<sup>1)</sup>
13. Set Safety Voltage<sup>1)</sup>
14. Set Safety Frequency<sup>1)</sup>
15. Set Insulation<sup>1)</sup>
16. Relay Test<sup>1)</sup>
17. Set Reactive Power

### Normal > 1. Enter Setting

18. Set Power Derating
19. PE Line Control<sup>1)</sup>
20. Set Reflux Power<sup>j</sup>
21. MPPT Scan<sup>1)</sup>
22. Set Election Meter<sup>1)</sup>
23. Logic Interface (digital inputs)
24. DRMs0
25. Protocol (1. Modbus = 9600N / 2. USS 57600E)

<sup>1)</sup> Function not available

#### 1. Set Time

- ▷ Set the current date and time.

#### 2. Clear Energy

- ▷ Reset internal energy meter.

#### 3. Clear Events

- ▷ Delete internal event list.

#### 4. Set Country Code

- Select the country code according to Table 6.
- Check the active country code under System Info > 5. Country.

Note: A new country code only becomes effective after the inverter has been restarted.

Tab. 6: Overview of the available country codes

Code	Country
000	Germany VDE AR-N4105
001	CEI 0-21 Italy
002	Australia
003	Spain RD1699
004	Turkey
005	Denmark
006	Greece Continent
007	Netherlands
008	Belgium
009	UK-G59
010	China
011	France
012	Poland

Tab. 6: Overview of the available country codes

Code	Country
013	Germany BDEW (VDE-AR-N 4110)
014	Germany VDE 0126
015	Italy CEI 0-16
016	UK-G83
017	Greece Island
018	EU EN50438
019	IEC EN61727
020	Korea
021	Sweden
022	Europe General
023	Customer VDE0126
024	Cyprus
025	India
026	Philippines
027	New Zealand
028	Brazil (380V)
029	Slovakia VSD
030	Slovakia SSE
031	Slovakia ZSD



Tab. 6: Overview of the available country codes

Code	Country
032	CEI0-21 In Areti
033	Ukraine
034	Brazil (208, 220V)
038	Wide Range 60 Hz

### 5. On-Off Control

- ▷ Select Inverter = OFF to set the time period until switch-off in days.
- ▷ Select Inverter = ON to switch the inverter back on. Contact REFU Service to obtain a password for activation.

### 6. Relay Command

(Function not available.)

### 7. Enable Set Country (change country code)

- ▷ If the inverter has been producing energy for more than 24 hours, the country code can only be changed after entering a password. Contact REFU

Service to obtain a password for activation.

The activation password is only valid for 24 hours.

### 8. Set Total Energy

- ▷ Limit the amount of energy fed into the grid. The information is given in kWh.

### 9. Set Modbus Address

- ▷ Change the Modbus address of the inverter for the RS485 connection. The values can be set in the range between 01 and 31.

### 10. Set Input Mode (parallel or independent mode)

- ▷ Set parallel or independent mode of the MPP trackers.

### 11. Set Language

- ▷ Change the language of the user interface of the LCD display.

### 12. Set Start Parameter – 16. Relay Test

(Function not available.)

## 17. Set Reactive Power

- ▷ Set the reactive power value.

## 18. Set Power Derating (active power reduction)

- ▷ Set active power reduction in %.

## 19. PE Line Control – 22. Set Election Meter

[Function not available.]

## 23. Logic Interface

- ▷ Activate or deactivate digital inputs.

## 24. DRMs0

[Function not available.]

## 25. Protocol (Modbus or REFU-USS)

- ▷ Switch between Modbus-9600N or REFU-USS-57600E.

Tab. 7: RS485 interface settings REFU-USS

Parameter	Value
Baud rate	57600
Parity	even

Tab. 7: RS485 interface settings REFU-USS

Parameter	Value
Handshake	no
Data bits	8
Stop bit	1

### 6.2.2 Main Menu > 2. Event List

The event list stores events in real time, with their specific ID numbers and time of occurrence in descending order.

1. Press the ESC key and the v key until the menu display shows "2. Event List".
2. Press the OK key to call up the total event list.
3. Press the OK key to display a single event ID number with event time.

### 6.2.3 Main Menu > 3. System Info

The system information interface displays the unit information and important settings.

### Main Menu > 3. System Info

- 1 Inverter Type
- 2 Serial Number
- 3 SoftVersion (software)
- 4 HardVersion (hardware)
- 5 Country
- 6 Input Mode (MPPT mode)
- 7 Relay Command<sup>1)</sup>
- 8 Safety Paras (parameters: OV1, OV2, UV1, UV2, OF1, OF2, UF1, UF2, Vtenmin)
- 9 Power Factor (cos phi = 1 <-> 0,8 i/c )
- 10 Reflux Power<sup>1)</sup>
- 11 MPPT Scan (OFF / ON)
- 12 Communication Protocol
- 13 Load Use Total (total energy generated)

<sup>1)</sup> Function not available

### 6.2.4 Main Menu > 4. System Time

- ▷ Display current system time.

### 6.2.5 Main Menu > 5. Software (firmware) Update

The firmware of the inverters can be updated with the files stored on a microSD card.

1. Remove the cover (RS485 and digital inputs) on the inverter.
2. Press the microSD card and remove it from the microSD card slot.
3. Insert microSD card into microSD card reader of your computer. If necessary, use adapters to use them in normal SD slots.
4. Download the appropriate inverter firmware from the website [refu.com/en/solar-solutions/](http://refu.com/en/solar-solutions/).
5. Unzip the firmware folder and copy the entire firmware folder to the microSD card directory.
6. Insert the microSD card into the microSD card slot of the unit.
7. Select the "Software update" menu in the LCD display of the inverter and confirm with OK key.
8. Enter password "0715".
  - ⇨ The system updates the processors (DSP1/DSP2). For each processor, it displays an "OK" message after success.

- ▷ If it indicates "Fail", switch off the inverter via the DC switch.
  - ▷ Wait until the LCD display switches off.
  - ▷ Switch the DC switch on again and repeat the firmware update from step 6.
9. After the update has been carried out successfully, switch off the DC switch.
10. After five minutes, fit the cover (RS485 and digital inputs) and switch on the DC isolator.
- ⇔ The inverter starts up.
- 
- ▷ If necessary, check the current software version under SystemInfo > 3. SoftVersion.

## 7 Error Messages and Troubleshooting

If the inverter does not work properly or is in a fault state, carry out the following steps:

- ▷ Check status LEDs.
- ▷ Check the AC and DC values shown in the LCD display.
- ▷ Note the warnings, error messages or error codes shown in the inverter display.



### **DSP communication fail**

If the connection between the control board and the communication board fails, the LDC display will show the error "DSP communicate fail".

- ▷ To display recorded events, press the ESC key > go to "3. Event List" > press the OK key.

Tab. 8: **Event list** with error and information messages

ID	Event name	Event description	Measure
ID01	Grid0VP	AC voltage in the mains is too high.	The inverter automatically returns to normal operating status when the AC voltage is again within the permitted limits.
ID02	GridUVP	AC voltage in the mains is too low.	The inverter automatically returns to normal operating status when the AC voltage is again within the permitted limits. If the event still occurs, check the AC supply to the inverter.
ID03	Grid0FP	The frequency of the AC power grid is too high.	The inverter automatically returns to normal operating status when the frequency is again within the permitted limits.
ID04	GridUFP	The frequency of the AC mains is too low.	
ID05	PVUVP	DC voltage is too low.	Check the wiring of the connected PV modules for damage, insulation damage and correct connection.
ID09	PvOVP	DC voltage is too high.	The inverter automatically returns to normal operating status after the cause of the fault has been rectified.
ID06	VLvrtlow	AC voltage is too low.	Check the applied AC voltages; if critical voltage conditions persist, contact your power supply company.

Tab. 8: **Event list** with error and information messages

ID	Event name	Event description	Measure
ID07- ID08	–	(Reserved)	–
ID10	IpvUnbalance	DC current is distributed asymmetrically to the MPPT inputs.	Check that the PV strings are correctly assigned and connected at both MPPT inputs. The maximum DC currents should be almost symmetrical at both inputs.
ID11	PvConfigSet- Wrong	Wrong input mode.	Check if the MPPT mode (Parallel or Independent) is set correctly according to the PV system configuration, change if necessary.
ID12	GFCIFault	GFCI error	If the insulation fault occurs frequently and lasts for a long time, the insulation resistance of the PV system must be checked; possible causes of the fault could be defective PV cables or MC4 connections.
ID13	GridFault	AC mains error	If this error occurs frequently, check the measured values of the AC network (frequency, voltage, current) on the display.
ID14	HwBoos- tOCP	The DC current is too high, the hardware protection is active.	Check that the DC current is within the maximum limits and check the connection to the MPPT inputs. If no troubleshooting is possible, contact REFU Service.

Tab. 8: **Event list** with error and information messages

ID	Event name	Event description	Measure
ID15	HwAcOCP	The AC current is too high, the hardware protection is active.	ID15-ID24 are internal faults of the inverter, in this case switch off the DC switch, wait 5 minutes and switch on the DC switch again. If no troubleshooting is possible, contact REFU Service.
ID16	AcRmsOCP	The AC current is too high.	
ID17	HwADFaultl-Grid	Error in AC current measurement.	
ID18	HwADFault-DCI	Error in DC current measurement.	
ID19	HwADFault-VGrid	Error in AC voltage measurement.	
ID20	GFCIDevice-Fault	Error in DC voltage measurement.	
ID21	MChip_Fault	Master chip (DSP) error.	
ID22	HwAuxPowerFault	Auxiliary voltage error.	
ID23	BusVoltZeroFault	Measurement error - DC bus voltage.	

REFU<sub>sol</sub> 20K...33K-2T

982079 | 05 | 2021-03

Tab. 8: **Event list** with error and information messages

ID	Event name	Event description	Measure
ID25	BusUVP	DC bus voltage is too low.	If the PV system configuration is correct (no ID05 error), the possible cause is insufficient solar irradiation. The inverter automatically returns to normal operating status after the solar irradiation returns to a normal level.
ID26	BusOVP	DC bus voltage is too high.	ID26-ID27 are internal faults of the inverter, switch off the DC switch, wait 5 minutes and switch on the DC switch again.
ID27	VbusUnbalance	DC bus voltage is unbalanced.	Check the DC voltages on both MPPT inputs and on the display. If no troubleshooting is possible, contact REFU Service.
ID28	DciOCP	DC current is too high.	Check if the MPPT mode (parallel or independent) is set correctly according to the PV system configuration, change if necessary. When the correct MPPT mode is set, switch off the DC switch, wait 5 minutes and switch on the DC switch again. If no troubleshooting is possible, contact REFU Service.
ID29	SwOCPInstant	AC current is too high.	Internal error of the inverter. Switch off the DC switch, wait 5 minutes and switch the DC switch on again. If no troubleshooting is possible, contact REFU Service.



Tab. 8: **Event list** with error and information messages

ID	Event name	Event description	Measure
ID30	SwBOCPIn- stant	DC current is too high.	Check that the PV strings are correctly assigned and connected at both MPPT inputs. The maximum DC currents should be almost symmetrical at both inputs. If no troubleshooting is possible, contact REFU Service.
ID31- ID48	–	(Reserved)	–

Tab. 8: **Event list** with error and information messages

ID	Event name	Event description	Measure
ID49	Consistent-Fault_VGrid	The comparison of the AC voltage readings between the master DSP and slave DSP is not consistent - failed.	ID49-ID55 are internal faults of the inverter, switch off the DC switch, wait 5 minutes and switch on the DC switch again. If no troubleshooting is possible, contact REFU Service.
ID50	ConsistentFault_F-Grid	Comparison of AC frequency readings between master DSP and slave DSP is not consistent - failed.	
ID51	ConsistentFault_DC	Comparison of DC current readings between master DSP and slave DSP is not consistent - failed.	

Tab. 8: **Event list** with error and information messages

ID	Event name	Event description	Measure
ID52	ConsistentFault_GF-FCI	The comparison of the insulation measurement values (GFCI) between master DSP and slave DSP is not consistent - failed.	ID49-ID55 are internal faults of the inverter, switch off the DC switch, wait 5 minutes and switch on the DC switch again. If no troubleshooting is possible, contact REFU Service.
ID53	Spi-CommLose	SPI communication between the master DSP and the slave DSP is faulty.	
ID54	Sci-CommLose	SCI communication between the master DSP and the slave DSP is faulty.	
ID55	RelayTest-Fail	Faulty AC relay detected.	
ID56	PvIsoFault	The insulation resistance is too low.	If the insulation fault occurs frequently and lasts for a long time, the insulation resistance of the PV system must be checked; possible causes of the fault could be defective PV cables or MC4 connections.

Tab. 8: **Event list** with error and information messages

ID	Event name	Event description	Measure
ID57	OverTemp-Fault_Inv	The temperature of the inverter is too high.	Check that the inverter has been assembled and installed according to the specifications in this manual. Check the solar radiation conditions and the ambient temperature at the inverter. Check the proper function of the cooler (dirt) and the function of the fans.
ID58	OverTemp-Fault_Boost	The boost temp is too high.	
ID59	OverTemp-Fault_Env	The ambient temperature is too high.	
ID60	PE Connect Fault	Connection error PE conductor.	
ID61-ID64	–	(Reserved)	–

Tab. 8: **Event list** with error and information messages

ID	Event name	Event description	Measure
ID65	Unrecover-HwAcOCP	AC current is too high, hardware error cannot be reset.	ID65-ID70 are internal faults of the inverter, switch off the DC switch, wait 5 minutes and switch on the DC switch again. If no troubleshooting is possible, contact REFU Service.
ID66	Unrecover-BusOVP	DC bus voltage, an error cannot be reset.	
ID67	Unrecoverla-cRmsUnbalance	AC current is too high, a fault cannot be reset.	
ID68	Unrecover-lpvUnbalance	DC current is asymmetrical, a fault cannot be reset.	
ID69	UnrecoverVbusUnbalance	DC bus voltage is unbalanced, an error cannot be reset.	
ID70	UnrecoverO-CPIinstantDC	AC current is too high, a fault cannot be reset.	

Tab. 8: **Event list** with error and information messages

ID	Event name	Event description	Measure
ID71	Unrecover-PvConfigSet-Wrong	Incorrect MPPT mode set.	Check if the MPPT mode (Parallel or Independent) is set correctly according to the PV system configuration, change if necessary.
ID72-ID73	–	(Reserved)	–
ID74	Unrecover-IPVInstant	The DC current is too high, an error cannot be reset.	ID74-ID77 are internal faults of the inverter, switch off the DC switch, wait 5 minutes and switch on the DC switch again. If no troubleshooting is possible, contact REFU Service.
ID75	Unrecover-WRITEEEPROM	The EEPROM is not recoverable.	
ID76	Unrecover-READEEPROM	The EEPROM is not recoverable.	
ID77	Unrecover-RelayFail	The relay has a permanent fault.	
ID78-ID80	–	(Reserved)	–

Tab. 8: **Event list** with error and information messages

ID	Event name	Event description	Measure
ID81	OverTemp-Derating	The inverter is in derating (power reduction) due to a too high ambient temperature.	Check that the inverter has been assembled and installed according to the specifications in this manual. Check that the inverter has been assembled and installed according to the specifications in this manual. Check the solar radiation conditions and the ambient temperature at the inverter. Check the proper function of the cooler (dirt) and the function of the fans.
ID82	OverFreqDerating	The inverter is derating (reducing power) because the grid frequency is too high.	The inverter automatically reduces the output power if the grid frequency is too high. As soon as the grid frequency is back in the regular range, derating is inactive again.
ID83	RemoteDerating	The inverter is in derating (power reduction) due to external power specification by the utility company.	The inverter records ID83 in case of remote power derating operation. Check the wiring of the remote power input and output signal connector on the communication board according to this manual.
ID84	RemoteOff	The inverter was switched off by remote disconnection.	The inverter records ID84 in the event of a remote shutdown. Check the wiring of the remote control input and output signal connector on the communication board according to this manual.

Tab. 8: **Event list** with error and information messages

ID	Event name	Event description	Measure
ID85	UnderFrequencyDerating	The inverter is derating (reducing power) because the grid frequency is too low.	The inverter automatically reduces the output power if the grid frequency is too low. As soon as the grid frequency is back in the regular range, derating is inactive again.
ID86	Fan4 Alarm	The fan 4 reports an error.	Check acoustically whether the internal fan is working properly. If no troubleshooting is possible, contact REFU Service.
ID87- ID89	–	(Reserved)	–
ID90	Fan3 alarm	The fan 3 reports an error.	Check acoustically and visually that the fan in question is functioning correctly. If no troubleshooting is possible, contact REFU Service.
ID91	Fan1 alarm	Fan 1 reports an error.	
ID92	Fan2 alarm	Fan 2 reports an error.	
ID93	Lightning protection alarm	Overvoltage protection modules (SPD's) have been triggered.	Check the surge protection modules (SPD's), if no troubleshooting is possible, contact REFU Service.



Tab. 8: **Event list** with error and information messages

ID	Event name	Event description	Measure
ID94	Software version is not consistent	Software version of the control board and the communication board do not match.	Update the software (firmware).
ID95	Communication board EEPROM fault	The EEPROM on the communication board is defective.	ID95-ID96 are internal faults of the inverter, switch off the DC switch, wait 5 minutes and switch on the DC switch. If no troubleshooting is possible, contact REFU Service.
ID96	RTC clock chip anomaly	The internal RTC clock is in error state.	
ID97	Invalid Country	The set country code is invalid.	Check if the correct country code is set, if not, enter the correct country code and restart the inverter. Switch off the DC switch, wait 5 minutes and switch on the DC switch. If no troubleshooting is possible, contact REFU Service.
ID98	SD fault	The microSD card is faulty.	Replace the microSD card.
ID99-100	–	(Reserved)	–

## 7.1 Maintenance

- i** The maintenance intervals are manufacturer recommendations and may need to be shortened in extreme environmental conditions.

### 7.1.1 General Warnings

#### **DANGER**

##### **High voltage**

Danger to life due to high voltages in the live components of the inverter, which can cause fatal electric shocks.

- ▶ All work on the product must be carried out by qualified electricians only.
- ▶ Always disconnect the inverter before working on it and observe the five safety rules (see chapter 2.9).
- ▶ Observe the discharge time of 5 minutes.



#### **CAUTION**

##### **Hot surfaces**

Risk of burns due to hot surfaces.

The product can get hot during operation.

- ▶ Avoid contact during operation.
- ▶ Allow the product to cool down sufficiently before carrying out any work.



### 7.1.2 Maintenance Intervals

\* Shorter maintenance intervals may be required (depending on location and environmental conditions).

Measures to be implemented	Interval
Cleaning the fan grilles (33K-2T only).	12 months*
Check the fans for function and operating noise.	12 months
Visual inspection of the inverter housing, all rubber seals and cable glands.	12 months
If necessary, clean the inverter with a dry or slightly damp cloth.	12 months
Visual inspection and, if necessary, cleaning of the heat sink.	12 months

Measures to be implemented	Interval
Visual inspection and check of all electrical connections.	12 months
Function test of the insulation monitoring.	12 months
Checking AC and DC voltages.	12 months
Checking the starting behaviour.	12 months
Function test of the display, the status LEDs and the membrane keys.	12 months
Visual inspection of the unit labelling (sticker, type plate and warning notices) and replace if necessary.	12 months
Documentation of the operating environment and the unit with a camera.	12 months

## 8 Decommissioning

### 8.1 Taking the Inverter Out of Operation

1. Release AC disconnecter and DC switch.
2. Wait 5 minutes until the inverter is discharged.
3. Dismantle electrical connections.
4. Dismantle communication lines and accessories if necessary.
5. Loosen the hexagon socket screw on the inverter bracket.
6. Using two people, carefully lift the inverter out of the inverter bracket.

### 8.2 Packing the Inverter

- ▷ If possible, pack the inverter in the original carton or use an equivalent carton that is suitable for loads of more than 50 kg.

### 8.3 Store Inverter

- ▷ Store inverters in a dry place with an ambient temperature between -25 and +70 °C.

## 8.4 Dispose Inverter

The packaging and the replaced parts must be disposed of in accordance with the regulations of the country in which the product is installed. The **REFUsoI 20K...33K-2T** must not be disposed of together with normal household waste. The **REFUsoI 20K...33K-2T** is RoHS-compliant.

For a complete return of the product, contact REFU Service.

# 9 Technical Data

## 9.1 DC Data

REFUsoI Inverter Type Art.-No.	20K-2T 850P020.200	33K-2T 850P033.200
Max. recommended PV power	26.6 kWp	44 kWp
Max. input voltage	1 000 V	
Operating input voltage range	230 V – 960 V	
Start-up input voltage	250 V	
Rated input voltage	620 V	

REFUsoI Inverter Type Art.-No.	20K-2T 850P020.200	33K-2T 850P033.200
Number of independent MPPT	2	
Number of DC inputs per MPPT	2	3
Rated power MPPT voltage range	480 V – 850 V	580 V – 850 V
Max. power per MPPT input	13 kW	20 kW
Max. current per MPPT	24 A	30 A
Max. short circuit current per MPPT	30 A	37.5 A
DC connection	MC4	

## 9.2 AC Data

REFUsoI Inverter Type Art.-No.	20K-2T 850P020.200	33K-2T 850P033.200
Rated power	20 kW	33 kW
Max. AC power	22 kVA	36.3 kVA
Nominal grid voltage	3/N/PE: 220/380 V, 230/400 V	

REFU <sub>sol</sub> Inverter Type Art.-No.	20K-2T 850P020.200	33K-2T 850P033.200
Nominal grid frequency	50, 60 Hz	
Max. output current	32 A	53 A
Total harmonic distortion (THD)	<3 %	
Adjustable power factor range	1/0.8 inductive – 0.8 capacitive	
AC connection	Ring cable lugs (M6)	

### 9.3 Performance

REFU <sub>sol</sub> Inverter Type Art.-No.	20K-2T 850P020.200	33K-2T 850P033.200
Max. efficiency	98.2 %	98.6 %
Weighted European efficiency (EU/CEC)	98 %	98.2 %
MPPT efficiency	>99.9 %	
Self-consumption at night	<1 W	
Feed-in start power	45 W	

### 9.4 Protection

REFU <sub>sol</sub> Inverter Type Art.-No.	20K-2T 850P020.200	33K-2T 850P033.200
DC switch	Integrated	
Safety protection	Anti-Islanding, DC reverse polarity, overtemperature, overvoltage, overcurrent, RCD, and insulation monitoring	
String monitoring	Each MPPT	
String fuses	–	
Protection class	Class I	
Overvoltage category (OVC)	DC: II AC: III	
External environment pollution degree	3	
Max. inverter back-feed current to the array	0 A	
Output short circuit current	85 A	105 A
Output inrush current	48 A	77 A

## 9.5 Communication

REFUsoI Inverter Type Art.-No.	20K-2T 850P020.200	33K-2T 850P033.200
Digital inputs	4 (P <sub>N</sub> : 0%, 30%, 60%, 100%)	
RS485	2	
microSD card slot	Yes	
Ethernet	Yes (Art.-Nr. 924023)	
WiFi	Optional (Art.-Nr. 924022)	

## 9.6 General Data

REFUsoI Inverter Type Art.-No.	20K-2T 850P020.200	33K-2T 850P033.200
Ambient temperature	-25 to +60 °C (>45° derating)	
Topology	Transformerless	
Type of protection (IEC 60529)	IP65	
Permissible range of relative humidity	0 – 100%	
Max. installation height	2 000 m above sea level	
Noise level	<30 dBA	<45 dBA

REFUsoI Inverter Type Art.-No.	20K-2T 850P020.200	33K-2T 850P033.200
Cooling	Natural con- vection	Fan
Dimensions (H × W × D)	666 × 528 × 254 mm	
Weight	37 kg	39,5 kg
Display and control panel	LCD display with keys and status LED	
Certificates	EN 61000-6-2, EN 61000-6- 4, EN 61000-3-11, EN 61000-3-12, IEC 62109- 1/2, IEC 62116, IEC 61727, IEC 61683, IEC 60068(1,2,14,30), VDE 0126, EN 50549-1, VDE AR-N 4105:2018-11, VDE AR-N 4110:2018-11	



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