REFU*connect*

Operating instructions

Version 01.1

Title	**REFU**connect
Type of documentation	Operating instructions
Purpose of documentation	The REFU*connect* product is explained in this documentation.
	It provides information about
	• Operating the product
	• Error reports with indications as to their cause and how to deal with them
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1. Safety instructions for REFU*connect*

- It is essential to read the installation instructions before connecting the device to the mains.

WARNING	**The voltage of the device is 24 Volts.** **This device does not possess any mains switch. It is turned on and off through connection to the power supply or through connection of the power supply cable.** **The power supply must be disconnected before opening the device.** **Only use a power supply with the output voltage and polarity stated and which corresponds with the safety provisions of the respective country.**
WARNING	**The device emits low-level electro-magnetic radiation.** **This electro-magnetic radiation is within the legally permissible limit.** **When operating the device, ensure that a distance of at least 20 cm is maintained between it and your body!**

2. REFU*connect*

2.1. Description of device

The REFU*connect* allows for safe wireless connection of all inverters of a photovoltaic park via a self-regulating multi-hop network. REFU*connect* allows the costs of planning and the resources required for cabling when installing PV components to be reduced to a minimum.
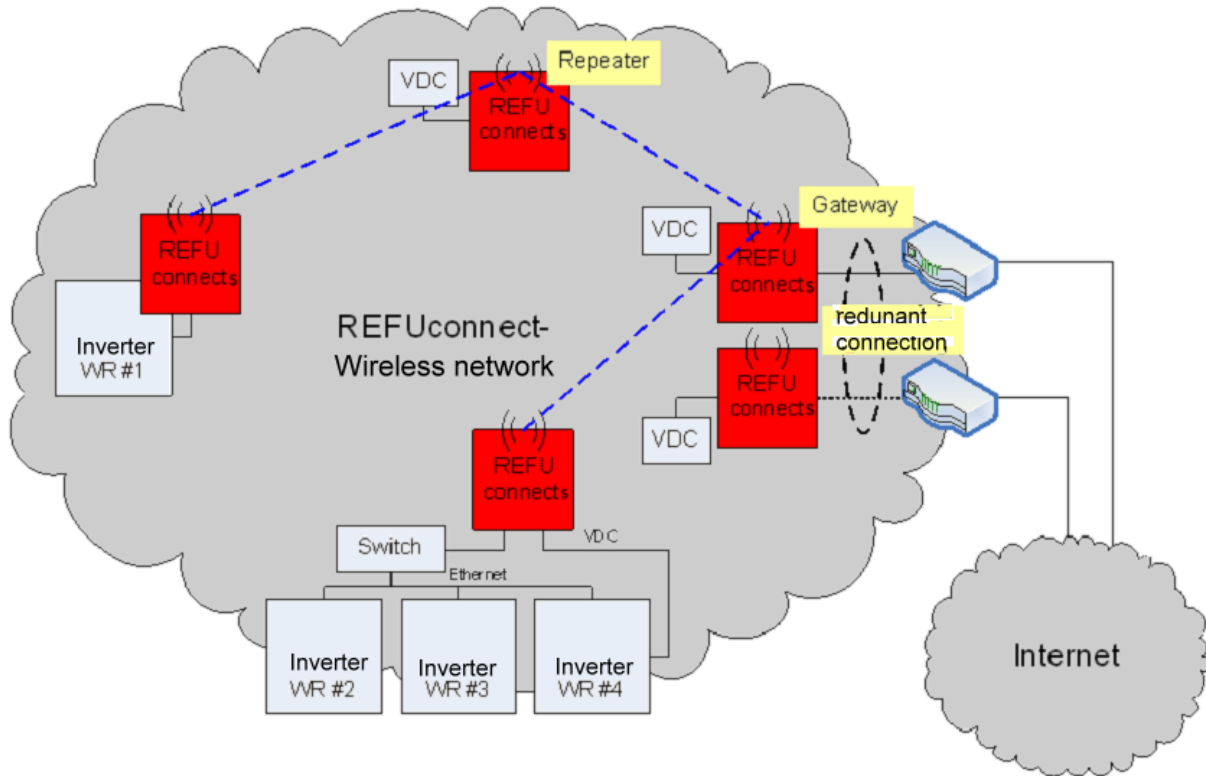
Illustration 1: Network structure with REFU*connects*

2.2. Proper usage

REFU*connect* is a self-regulating multi-hop network for photovoltaic installations. Any use beyond this is not deemed to be proper.

2.3. Performance features

REFU*connect* offers the following advantages:

- Redundant, wireless networking of the components and wireless access to the network for servicing, transparent forwarding of all data at the Ethernet interface through the multi-hop wireless network.

- Automatic network formation, network optimisation and network management with automated path search and use of redundant connections in the event of failure of individual REFU*connect* devices.

- The range of connectivity between two REFU*connect* devices reaches up to 300 metres.

- Every REFUconnect device provides the access point to the wireless network as well as a repeater within the wireless network for every other REFU*connect* device. Access is provided via an Ethernet interface.

- When used as a repeater, the device helps to increase the connectivity range and under critical propagation conditions.

- Scalable networks with up to 2,000 REFU*connect* exchange points and five active connections per exchange point.

- Adaptive emitting performance regulations to minimise errors in dense networks.

- Transmission guarantee through 128 bit encryption with customised password and logical network separation by means of network names.

3. Assembly and dimensions

3.1. Contents of delivery

- REFU*connect*
- Plugs for PG9 cable fitting
- Operating instructions
- Universal holder
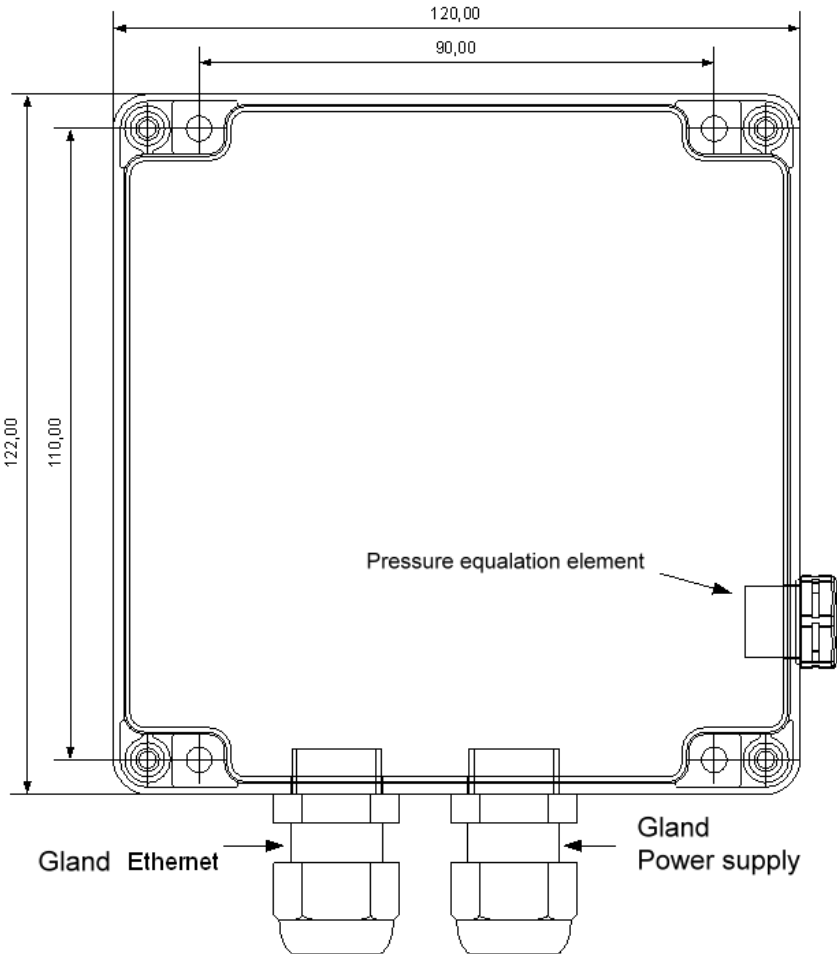- Fixing screws for the REFU*connect*

3.2. Dimensions of device

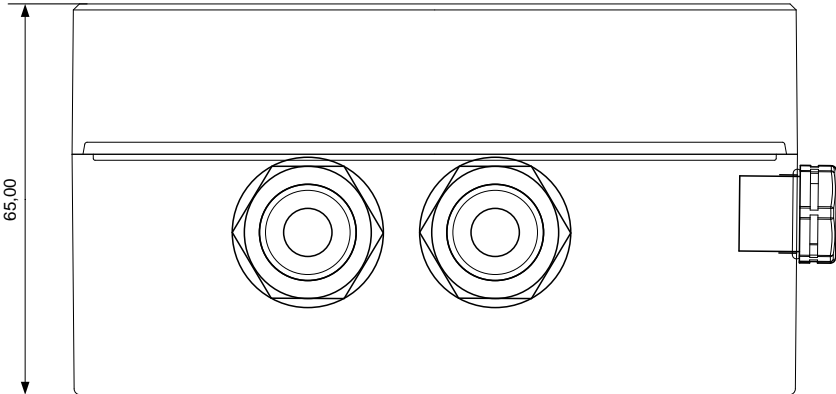
Illustration 2: REFU*connect* dimensions

Illustration 3: REFU*connect* dimensions (2)

3.3.   Notes for setting up the devices

The following installation instructions are designed for optimum power REFU*connect* to education and a data transfer between devices.

For trouble-free operation, the following guidelines be followed.

- Like other wireless technologies, REFU*connect* uses the licence-free 2.4 GHz ISM band. As the frequency band is shared with other devices or wireless technologies, sufficient distance must be ensured to other wireless technologies such as WLAN; Bluetooth®, mobile communications and DECT, so as to avoid interference.
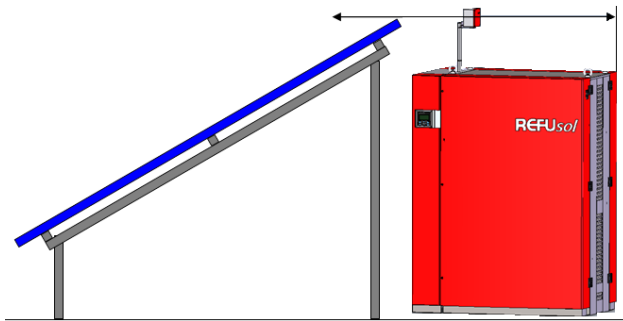
Illustration 4: Installation example of REFU*connect* about other objects

- The REFU*connect* device should be mounted as high as possible off the floor and above all other objects.
- In order to achieve the maximum connectivity range, adjoining REFU*connect* devices must be in sight of each other. Objects beyond the range of sight can nevertheless still interfere with the wireless connection.

- The maximum range of connectivity in the open air is up to 300 m, depending on the propagation conditions.

- Assembling the device without distance between it and the wall.

Illustration 5: Universal bracket

- The minimal distance between the devices of 0.5 m must be adhered to.

- If necessary, further REFU*connect* devices can be used as repeaters to extend the connectivity range or to bypass obstacles.

- **Note**: shadowing by metallic or conductive objects, concrete, etc. should be avoided.

4. Short Guide to getting started

4.1. Hardware installation

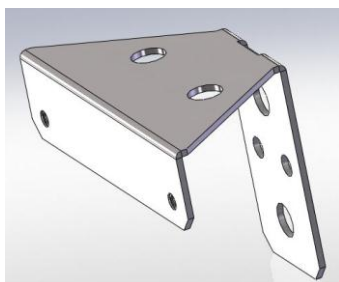| ⚠️ **WARNING**	**The power supply must be disconnected before opening the device. Disconnect the device from the mains!**

- Open the cover of the housing by loosening 4 screws.

- Lead the cables (diameter of 4...8 mm) for Ethernet and power supply through the cable glands (PG9).

- The connections of the REFU*connect* for Ethernet and power supply are effected via the X302 (Ethernet) and X602 (power supply) marshalling panels located on the circuit board. The arrangement of the marshalling panels is shown in illustration 7. The connection configuration of the marshalling boards is effected in accordance with the details in table1 and table2. The Ethernet cable shield must be placed on the contact foreseen and electrically conductible.

- The Ethernet connection is established through a CAT.5 cable to X302 on the inverter or via an external switch (in the event of several inverters being connected). In the event of using REFU*connect* as a pure repeater, X302 remains unconfigured and the cable gland provided for Ethernet must be sealed up using the plug supplied. REFU*connect* devices configured as Gateways are connected via the Ethernet connection using the internet access point.

- The power supply to X602 can be effected directly from the inverter or by using a wall plug transformer which can be obtained separately.

- After connecting the cables, the cable glands must be drawn sufficiently tightly and the cover of the device must be closed again, using 4 screws.

Illustration 6: Housing cover with 4 screws
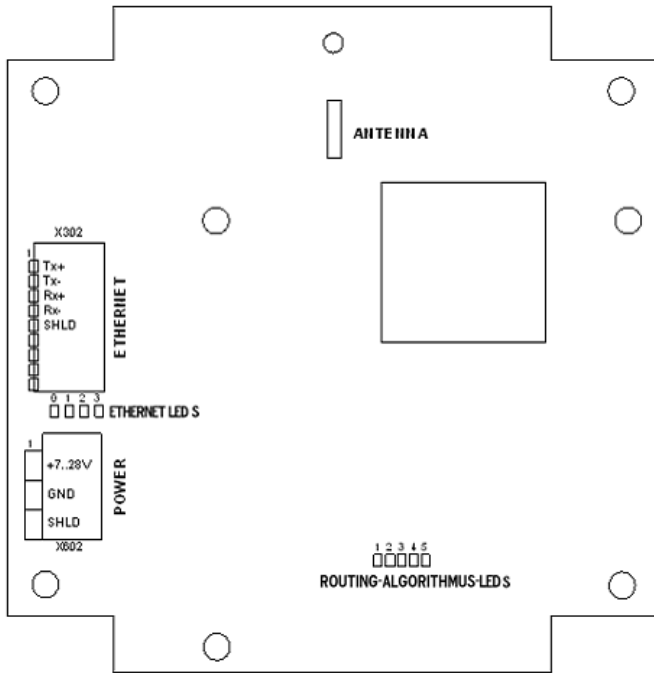
Illustration 7: Arrangement of interfaces

4.1.1. Wiring terminal block

	Wiring terminal block X302
Contact	EIA/TIA 568B (258A)
1	white/ orange
2	orange or orange / white
3	white/ green
4	green or green / white
5	Shielding
6	Not configured
7	Not configured
8	Not configured
9	Not configured

Contact	**Wiring terminal block X602**
1	+7 … +28 VDC
2	GND

4.1.2. LED Indication

	Indication for Ethernet-LEDs		
LED	**On**	**Off**	**Flashing**
0	Full duplex	Semi-duplex	-
1	100 Mbit/s	10 Mbit/s	-
2	-	Not active	Active
3	Link established	No link	-

	Indication for routing-algorithmus-LEDs
LED	
1	Nodes in the tree in a gateway
2	REFU*connect* is root of a(Sub-)trees
3	REFU*connect* has slaves / children
4	Existing network connection
5	Inquiry phase flashing, otherwise continuously active

4.2. Cable assembly

The assembly of the cables for Ethernet and power supply for connection to the marshalling panels is described in the following illustrations. A permissible cable diameter of 4...8 mm must be adhered to for the cable glands (PG9).
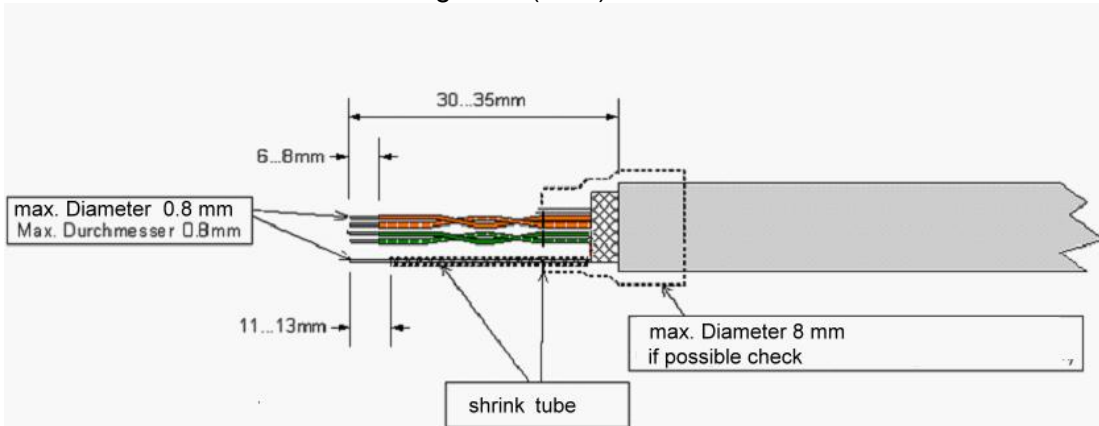
Illustration 8: Possible assembly of the Ethernet cable

REFU*connect* is approved for use with shielded Ethernet cable up to a maximum length of < 5 m.
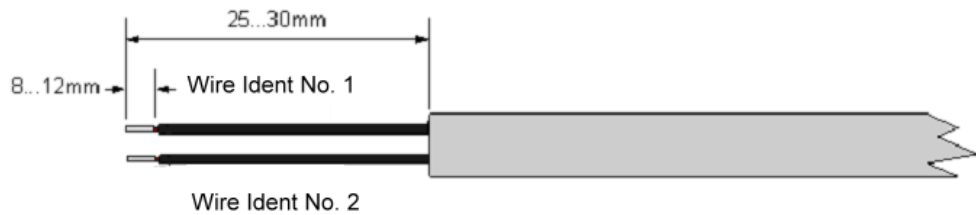
Illustration 9: Possible assembly of the power supply cable

Wire Ident. No.	Configuration
1	+24 V
2	0 V

REFU*connect* external power supply

Illustration 9: Possible assembly of the power supply cable

Ferrrule	Configuration
red	+24 V
blue	0 V

4.3. Configuration

Configuration of the REFU*connect* is not required.
For safety reasons, however, the pre-set password for encrypting wireless connections should be changed for all REFU*connect* devices belonging to the network and set to an identical value which differs from the standard setting.
The following Table provides an overview of the most important configuration parameters for REFU*connect*:

Configuration parameters	Description
Password	Password for the encryption of the wireless connections between the REFU*connect* devices. All devices belonging to a network must use the same password.
Network name	Logical compartmentations of the devices can be undertaken via the network names. When developing the network, only REFU*connect* devices with identical network names are connected.
Gateway	The REFU*connect* devices are identified which provide the transfer to the internet or other subordinated networks via the Gateway parameter. Through setting this parameter for a REFU*connect* device, the wireless network tries to optimise the range of all exchange points in the network to this device. Through the configuration of two REFU*connect* devices as a Gateway, the redundant second Gateway can assume the function of the primary gateway in the event of the latter failing.

5. Check-list

If the facility or individual devices do not transmit any data, the following check-list can help you to determine the cause of this.

Symptom	Possible cause	Removal of cause
Device does not switch off.	Power supply not active or wrongly connected.	Check the power supply cable has been correctly connected.
No Ethernet connection; Link-LED is not illuminated. (Only visible if the device has been opened).	Ethernet cable wrongly connected.	Check the Ethernet cable has been correctly connected.
No wireless connection.	Unfavourable positioning of the devices, to great distance or shadowing of the wireless signal or disturbances caused by multi-channel expansion.	Secure the device as high as possible above the ground or change its position so that one device is as far as possible in sight of another device. Should the device still not be connected wirelessly, repeaters can be set up to bridge larger distances.

6. Technical Data

Type	REFU*connect*
Wireless technology	
Frequency range	2.4...2.5 GHz (ISM band)
Transmission capacity	max. 20 dBm
Input sensitivity	-99 dBm at 0.1% BER
Transfer rate	up to 2.1 Mbit/s per hop, or between adjoining REFUconnects
Range	up to 300 m per hop
Network size	up to 2,000 exchange points
Connections	Up to 4 + 1
Security	128 bit encryption
Aerial:	external aerial
External interfaces	
Aerial:	7… 28 V/DC
Performance capacity	1.6 W typical / 2.8 W max.
Ethernet:	IEEE 802.3u (Fast Ethernet), 10/100 Base-T
Outline dimension / weight	
Dimensions without aerial (width/ height/ depth) Dimensions aerial (height/diameter)	120 mm x 122 mm x 65 mm 200 mm / Ø16 mm
Weight:	approx. 400 g
Environmental conditions	
Permissible temperature range	-25…+60 °C (in operation, for storage and transport)
Protection category	IP65 (suited for outdoor use)

7. Explanation of terminology

Term	Explanation
Gateway	A Gateway (also referred to in German as a "protocol implementer") allows networks based on completely different protocols to communicate with one another.
Multi-hop	In the case of Multi-*hop* connections, several wireless links can be switched, one after another. Every REFUconnect operates as an end-point, but also as a repeater for the others.
redundant	Available several times over
Repeater	A Repeater is an electronic signal reinforcer and serves to extend the connectivity range of the wireless signal.

8. Parts list

REFUsol name	Part No.	Comment
REFU*connect* basic assembly	911R002.000	Basic assembly with PG blind plug for repeater. Remark: Without options like cabling, external power supply or mounting parts
Accessories (Cabling, external power supply, mounting)		
Cabling not for US! Here: **Standard Ethernet-Cable** and **Sensor-Interface plug 0032103** (MC STT 5pol.)		
		Pigtail with Ethernet plug fitting to the inverter and cable end sleeves
REFU*connect* Ethernet pigtail 2m	0032544	
REFU*connect* Ethernet pigtail 5m	0032545	
RJ45 plug QUICKON VS-08-RJ45-5-Q/IP67	0028943	Ethernet plug for inverter (Phoenix contact No. 1656990)
"Proposed Ethernet cable"		Lapp cable: #CE217489; ETHERLINE FD P CAT.5 4x2xAWG 26/19 BK
REFU*connect* power supply pigtail 1m	0032546	Pigtail with plug fitting to the inverters' sensor interface and cable end sleeves
REFU*connect* power supply pigtail 2m	0032547	(Not for US!)
REFU*connect* power supply pigtail 5m	0032548	
Sensor/actuator plug 5p SACC-M12MS-5SC SH	0030616	Temperature and insulation sensor plug for inverter (Phoenix contact No. 1512555)
"Proposed power supply cable"		Lapp cable: #0022700 2X0,5; ÖLFLEX® ROBUST 215 C
External power supply		
REFU*connect* external power supply	0032613	For applications like gateway, repeater or in comb. with switch, w/o country specific adaptation. Including cable end sleeves for easy mounting.
PSA15R-AC-Adapter for Europe	0032644	Country specific adapter for EU
PSA15R-AC-Adapter for UK	0032645	Country specific for United Kingdom
Mounting bracket		
For REFU*sol* 333k	0032480	Brackets with variable height adjustment screws, cable clamps

	Basic kit	Optional parts		
		Ext. power supply	Ethernet	Others
Gateway	X	Ext. power supplyl	X	-
Repeater (for inverter)	X	Cable	X	(333 mounting kit)
Repeater (stand-alone)	X	Ext. power supply	-	-

9. Environmental protection

9.1. Disposal

Dispose of packaging and replaced parts in accordance with the provisions of the country in which the device has been installed.
The REFU*connect* conforms to RoHS, meaning the device can be surrendered at communal sites for the disposal of household devices.
Do not dispose of with household waste!

10. Declaration of conformity

It is herewith declared by REFGU*sol* GmbH that the REFU*connect* product corresponds to the provisions of Directive 1999/5/EG of the Council of the European Union.
The complete text of the Declaration of Conformity and all documentation are deposited with the manufacturer.

11. Notices

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