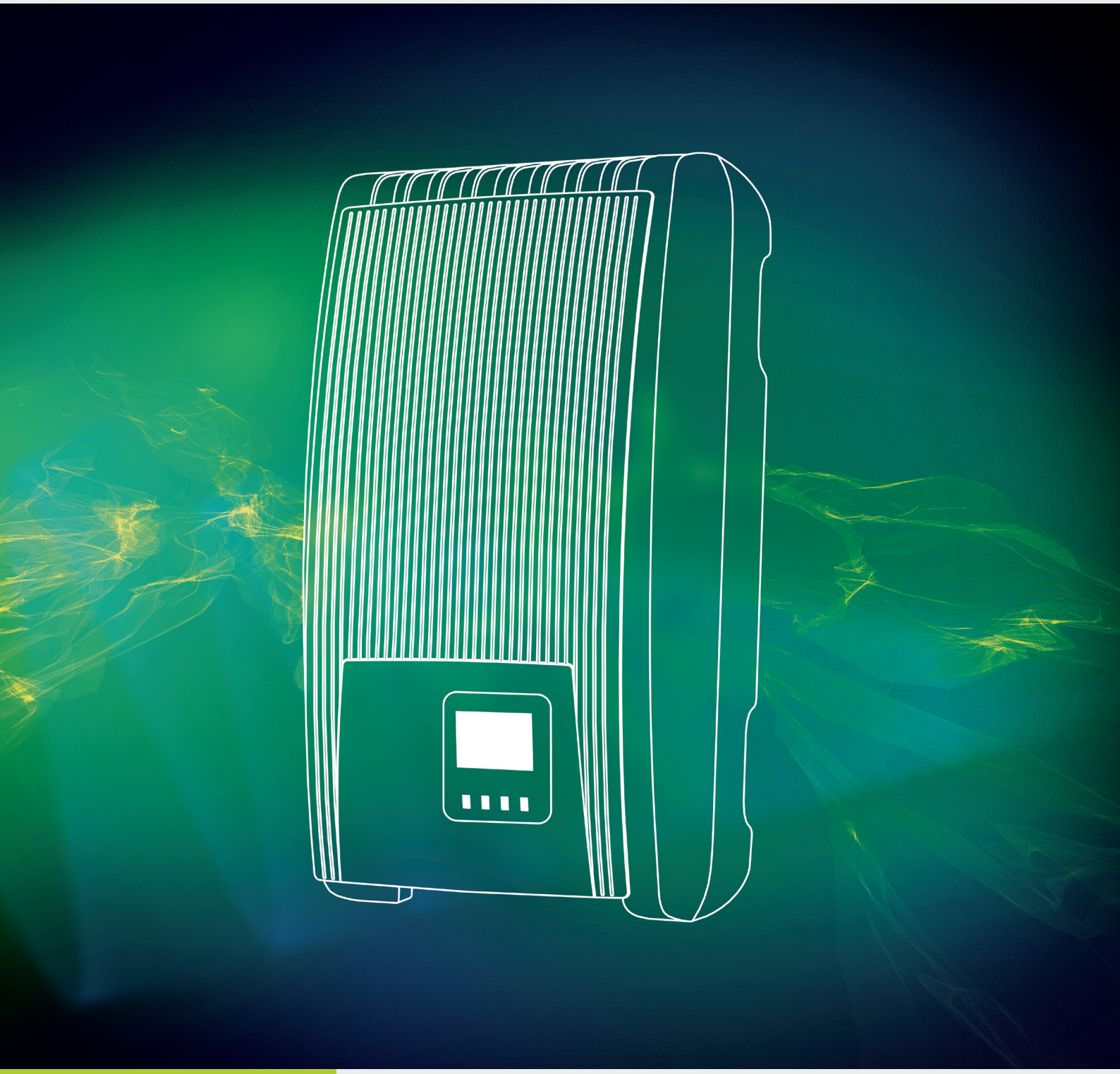
SOLAR ELECTRIC

KOSTAL



Smart connections.

Operating instructions

PIKO 1.5 - 4.2 MP

Legal notice

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General note on gender equality

KOSTAL Solar Electric GmbH is aware of the importance of language with regard to the equality of women and men and always makes an effort to reflect this in the documentation. Nevertheless, for the sake of readability we are unable to use non-gender-specific terms throughout and use the masculine form instead.

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Table of contents

1 Preface

Thank you for purchasing a PIKO inverter from KOSTAL Solar Electric GmbH. By using solar energy, you are making a significant contribution to environmental protection; by reducing the amount of carbon dioxide (CO_2) and other harmful gases that burden the atmosphere of the earth.

Maximum efficiency with a long service life

The innovative inverter topology is based on a single-stage transformer-less circuit concept. This unique technology allows peak efficiencies of 98,0 % or 98,6 % to be achieved. Depending on the type, the European efficiency of the devices is also significantly greater than 98 % and sets new standards in photovoltaic grid-feed systems.

A new, unique cooling concept in the interior of the inverter guarantees uniform distribution of heat and thus a long service life.

Designer casing and easy installation

For the first time, the very high efficiency allows the use of a designer housing made of plastic for the PIKO MP inverters. This offers many advantages. The surface temperatures of the devices overall remains extremely low. In addition, there are clear benefits for the installation.

The lightweight devices weigh only 9 or 12 kg and can be easily and safely mounted on a wall. The supplied wall bracket and practical recessed grips for right and left handed installers make mounting of the device simple and convenient. All connections and the DC circuit breaker are externally accessible.

Visualisation

The devices have a graphic display, with which the energy load values, actual capacities, and operating parameters of the photovoltaic system can be visualized. Its innovative menu allows individual selection of the various measurements.

For more information about our inverters, go to ***www.kostal-solar-electric.com***.

2 General information

2.1 General safety instructions

- This document is part of the product.
- Install and use the device only after reading and understanding this document.
- Always perform the measures described in this document in the sequence specified.
- Keep this document in a safe place for the entire service life of the device. Pass the document on to subsequent owners and operators of the device.
- The yield of the system can be reduced through improper operation.
- If the housing is damaged, do not connect the device to the DC or AC lines.
- If one of the following components is damaged, immediately take the device out of operation and disconnect it from the mains grid and PV generators.:
  - Device (not functioning, visible damage, smoke, penetration of liquid etc.)
  - Lines
  - PV generators

  Do not switch the system on again before
  - the device has been repaired by a dealer or the manufacturer,
  - Damaged cables or PV generators have been repaired by a technical specialist.
- Never cover the device
- Do not open the casing: Risk of death. Invalidation of the guarantee.
- Factory labels and markings must never be altered, removed or rendered unreadable.
- Comply with the instructions of the respective manufacturer when you connect an external component that is not described in this document (e.g. external data loggers). Components that are incorrectly connected can damage the device.

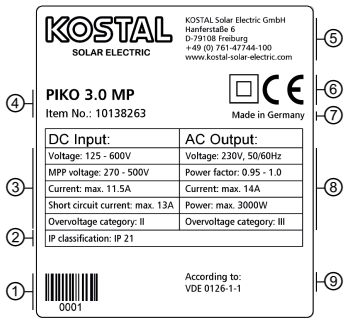
DANGER!

Dangerous voltages can remain present on the components up to 10minutes after switching off the DC circuit breaker **and** the line circuit breaker.

2.2 Identification

Feature	Description
Types	PIKO 1.5 MP, PIKO 2.0 MP, PIKO 2.5 MP, PIKO 3.0 MP, PIKO 3.6 MP, PIKO 4.2 MP
Version status of the manual	01/2016
Manufacturer's address	See *Chapter 11 'Contact' on page 72*
Certificates	For the certificates, refer to our website under ***www.kostal-solar-electric.com/Download/Zertifikate***

Rating plate



① Bar code for internal use
② Protection class
③ Technical data of the DC input
④ Article number and product designation
⑤ Manufacturer's address
⑥ Cover the *Protection class II* and CE mark
⑦ Country of manufacture
⑧ Technical data of the AC output
⑨ Standard for grid monitoring

- *For Australia only: Cover the Protection class IIsymbol on the type plate, as described on 'For Australia only: Cover the Protection class II symbol on the type plate.' on page 31.*
- *For the serial number, see Chapter 2.5.3 'Designations' on page 9*
- *For the position of the type plate, see Chapter 3.1 'Housing' on page 11.*

EU Declaration of Conformity/Certificates

The products described in this document comply with the applicable European Directives. For the certificates for the products, refer to our website under ***www.kostal-solar-electric.com/Download/Zertifikate***

2.3 Scope of delivery

- Inverter ①
- Mounting plate ②
- AC plug ③
- 1 pair SUNCLIX plug-in connectors ④
- Short Manual ⑤

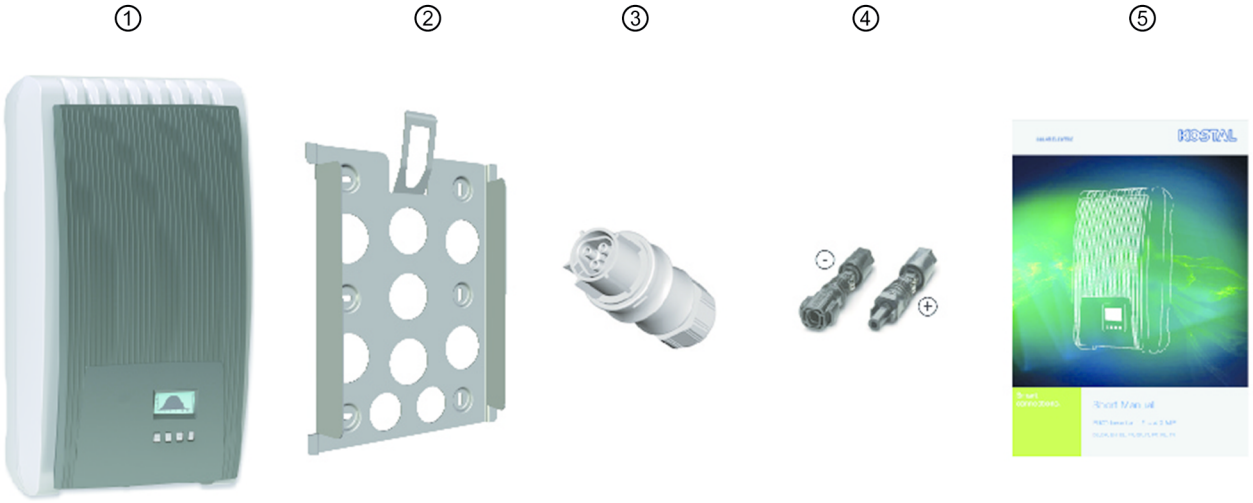


Fig. 1: Scope of delivery

2.4 Intended use

- The inverter must only be used in grid-coupled photovoltaic systems. The inverter is suitable for all PV generator with connections that do not need to be grounded.
- PV generator must be used that have an IEC 61730 class A rating because the inverter does not have electrical isolation.
- If the maximum AC operating voltage is higher than the maximum system voltage of the PV generator, then PV generators must be used that have a maximum system voltage that is higher than the AC grid voltage.

2.5 About this manual

2.5.1 Contents

This manual describes the inverters of the types PIKO 1.5 - 4.2 MP. The points at which the types differ are marked in the text.

This manual contains all information that a specialist needs to set up and operate the inverters. Follow the instructions of the respective manufacturers when installing other components (e.g. PV generator, cables).

2.5.2 Target group

Unless otherwise indicated, the target audiences of this manual are technical professionals and system operators. Technical professionals are, for example:

- Persons who have the knowledge of terminology and the skills necessary for setting up and operating photovoltaic systems.
- Persons who have the necessary training, knowledge and experience, and knowledge of the applicable regulations in order to evaluate and recognise the dangers inherent in the following work:
  - Installation of electrical equipment
  - Production and connection of data communication cables
  - Production and connection of mains grid power supply cables

2.5.3 Designations

Symbols

The following table contains the symbols used in this manual.

Warning signs	Type of danger
	Warning – high-voltage.
	Warning – danger zone.

Symbols used on the device

The following table contains the symbols used on the device.

Cover the	Description
	Danger from electricity.
	Read the manual before using the product.
	Bar code with serial number.

Signal words

Keywords used in conjunction with the symbols described:

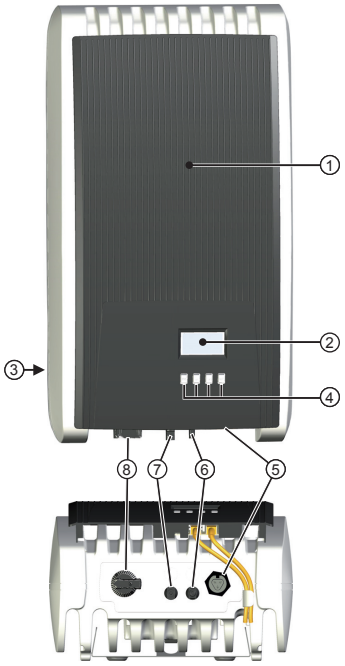
Signal word	Meaning
DANGER!	This combination of symbol and signal word indicates an immediate dangerous situation that will result in death or serious injury if it is not avoided.
NOTICE!	This combination of symbol and signal word indicates a possible dangerous situation that can result in material and environmental damage if it is not avoided.

Abbreviations

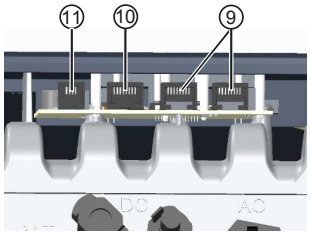
Abbreviation	Description
Derating	Power reduction
DHCP	DHCP automatically integrates the device in an existing network (acronym: **D**ynamic **H**ost **C**onfiguration **P**rotocol)
MSD	Internal grid monitoring of the inverter (English: **M**ains monitoring with allocated **S**witching **D**evices).
MPP	Working point producing the most power (English: **m**aximum **p**ower **p**oint)
MPP tracker	Controls the power of the connected module strings to match the MPP
SELV, TBTS, MBTS	Schutzkleinspannung (EN: **S**afety **E**xtra **L**ow **V**oltage; FR: **T**rès **B**asse **T**ension de **S**écurité; ES: **M**uy **B**aja **T**ensión de **S**eguridad)
V_{PV}	The PV generator voltage present at the DC connection (photovoltaic voltage)

3 Structure and function

3.1 Housing



① Hood
② Display (monochrome, 128 x 64 pixels)
③ Rating plate, serial number, warnings
④ Operating buttons: ESC, △, ▽, SET (from left to right)
⑤ 1x AC connection
⑥ 1x DC connection Minus(–) for PV generator (Phoenix Contact SUNCLIX, touch protection)
⑦ 1x DC connection Plus(+) for PV generator (Phoenix Contact SUNCLIX, touch protection)
⑧ DC load-break switch (disconnects plus and minus input simultaneously)



⑨ 2 x RJ45 sockets (RS485 bus)
⑩ 1 x RJ45 socket (TCP/IP Ethernet) for connection to an IP grid via LAN
⑪ 1 x RJ10 socket (Modbus RTU) for connection of an energy meter

The housing components are described in detail below.

3.2 Operating buttons

The operating buttons ④ in ↳ *Chapter 3.1 'Housing' on page 11* have the following functions:

Button	Action	Function	
		General information	**Guided operation**
ESC	Press briefly	Goes to the next higher menu level	Navigates 1 step back
		Discards any changes	
	Press longer (≥ 1 second)	Goes to the status display	Jumps to the start of the guided configuration process
△	Press briefly	■ Moves the marking bar or the display content upward ■ In a numeric setting, moves the marking 1 position to the left ■ Increases an adjustment value by 1 increment	
▽	Press briefly	■ Moves the marking bar or the display content downward ■ In a numeric setting, moves the marking 1 position to the left ■ Increases an adjustment value by 1 increment	
SET	Press briefly	Goes to the next lower menu level	—
		■ a selected numerical value starts flashing and can be changed ■ Applies a change ■ Changes the status of a control element (check box/option box)	
	Press longer (≥ 1 second)	Answers a query dialog with *Yes*	Goes 1 step back

3.3 Display

3.3.1 General information

For the presentation on the display ② in ↳ *Chapter 3.1 'Housing' on page 11*, the following applies in general:

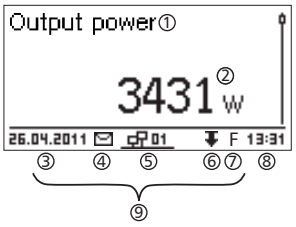
- Symbol ✳: While the inverter is processing large volumes of data, it cannot process any user inputs. The resulting waiting time is indicated by the animated sun symbol.
- Errors are indicated by a red flashing backlighting. An event message is also displayed at the same time.

The display reacts slower at very low temperatures.

3.3.2 Information

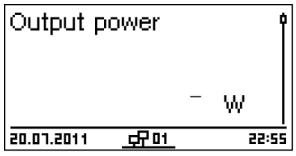
The information shown on the display is described below using illustrative examples.

Status display



The status display shows the following values:

① Measurement name
② Measurement with units
③ Date is displayed alternatingly with IP address
④ Cover the *Non-confirmed event messages*; for more information, see *Chapter 7 'Event messages' on page 53*.
⑤ Animated symbol *Connect* symbol with 2-digit inverter address; indicates data traffic on the RS485 bus.
⑥ Cover the *Power reduction* (Derating)
⑦ Cover the *Fixed voltage mode activated*
⑧ Time
⑨ IP address of the device when a network connection has been established, display alternates with ③ – ⑦

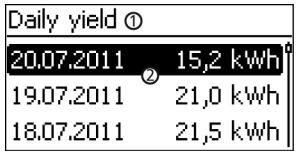


The following applies to the status display:

- The measurements shown in the status display are defined under `Settings` ▸ `Meas. values`. Some measurements are always displayed (default setting).
- Current values are not displayed at night (solar irradiation too low; example in Fig. left).

Numeric yield (day, month, year)

Daily, monthly and annual yields can be displayed numerically in a list.



① Yield period (day/month/year)
② Individual yields with period and value (1 per row)

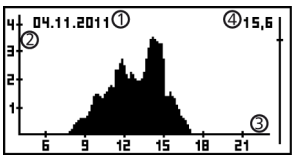
The yield periods contain the following numbers of individual entries:

- Day yield: last 31 days[1)]
- Monthly yield: last 13 months[1)]
- Annual yield: last 30 years[1)]

[1)] A yield value of 0 is shown when the inverter was not yet installed at that time.

Graphical yield (day, month, year)

Daily, monthly and annual yields can be displayed graphically in a chart.



① Period on an individual yield (here: day yield)
② Y axis [1) 2) 3)]
③ X axis: Time in hours/days/months/years
④ Total of all individual yields shown in the diagram, in kWh

The graphical representation can show annual yields for the last 20 years.

[1)] Yield in kWh

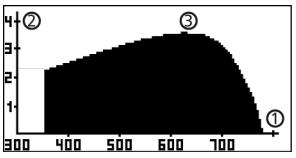
[2)] With addition of *'M'*: : yield in MWh

[3)] The scaling changes depending on the maximum value.

Event messages

↳ *Chapter 7 'Event messages' on page 53*

PV generator characteristic curve

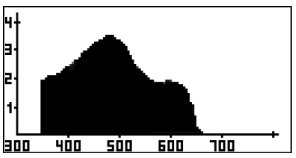


① X axis: input voltage in V
② Y axis: power in kW
③ Peak = MPP

If the *'Ch. Curve'* menu item is called, the inverter records the PV generator characteristic curve and then displays it (Fig. upper left).

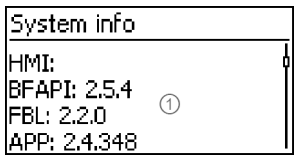
The following applies:

- The inverter traverses the input voltage range and records the power generated over this range. Duration: a few seconds; ✳ is displayed.
- The MPP is at the peak of the PV generator characteristic curve.
- This peak and the PV generator characteristic curve change with the level of solar irradiation.



- Multiple peaks are a sign of partial shadowing (Fig. left).
- If the top of the curve is flat, the inverter can possibly no longer feed power into the grid.

Information

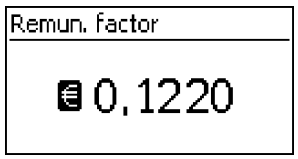


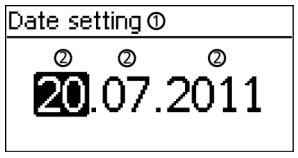
The menu item `Information` contains the following sub-menu items.

- `Contact info`
- `System info`: (see Fig. left)
  - Product designation
  - Serial number of the inverter
  - Information concerning the software and hardware version of the inverter (see sample ① in Fig. left)
  - Inverter address
  - Version of the manual that belongs with the inverter
- `Reactive power characteristic curve`: Diagram of the reactive power characteristic curve (only if prescribed for the set country)
- `Network`: Network parameters, partially configurable under `Settings` ▸ `Network`
  - `Host name`: Unique name in the network
  - `DHCP status`: DHCP on/off
  - `Link status`: Status of the network connection
  - `IP address`: IP address of the inverter
  - `Subnet mask`: Subnet mask of the inverter
  - `Gateway`: IP address of the network gateway
  - `DNS address`: IP address of the DNS server
  - `MAC address`: Hardware address of the inverter
- Results of the last self-test (only if in the country setting *Italy* is set)

3.3.3 Settings

Numerical settings





When performing numerical settings of remuneration and dates, the following applies:

Remuneration

- Possible currencies: £ (Pounds), € (Euros), kr (Krones), *none.*
- The maximum value that can be set for remuneration is limited for technical reasons. The remuneration must be set using different units as required. Example: Dollars instead of Cents (set currency to *none*).

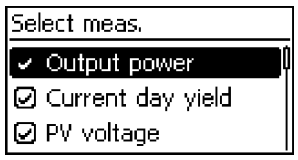
① Designation of the numerical setting
② Value to be set; the selected value to be set is highlighted in black.

Date

When setting the month/year, a check is performed to ensure that the selected day is valid. If not, then the day is automatically corrected.

Example: 31.02.2011 is corrected to 28.02.2011.

Selection of the measurements



Selection of the measurements to be shown in the status display. The following measurements can be selected:

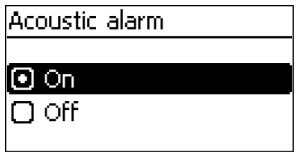
- `Output power`: Inverter output power[1)]
- `Current day yield`: Day yield since 0:00
- `PV voltage`: The voltage supplied by the PV generators
- `PV current`: The current supplied by the PV generators
- `Grid voltage`: Voltage at the inverter connection[1)]
- `Grid current`: The current fed into the mains grid
- `Grid frequency`: The frequency of the public grid
- `Internal temperature`: Internal temperature of the inverter
- `Derating` Reason for derating[2)]
- `Max. daily power`: The maximum power supplied in the current day[3)]
- `Abs. max. power`: The maximum power ever fed into the grid[3)]
- `Max. daily yield`: The maximum daily yield achieved[3)]
- `Operating hours`: The operating hours during which the device has been connected to the grid (including night-time hours).
- `Total yield`: Yield since commissioning
- CO_2 `savings`: CO_2 savings achieved since commissioning

[1)] Measurement is always displayed (cannot be switched off)

[2)] Possible causes:
- Internal temperature too high
- User default *Power limiter*
- Frequency too high
- Controlled by grid operator (feed-in management)
- Delayed increase in power after starting

[3)] Can be reset to 0 via `Settings` ▸ `Reset max. vals.`

Acoustic alarm

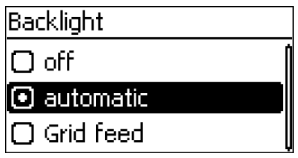


An acoustic alarm sounds (approx. 4.5 kHz) when an event message is displayed.

- 2 Sounds: Warning
- 3 Sounds: Error

The acoustic alarm is switched off with the factory default settings.

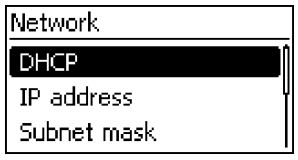
Backlight



- `off`
- `automatic`: Switches on for 30 seconds when a button is pushed
- `Grid feed`: (factory setting)
  - *Not feeding*: Switches on for 30 seconds when a button is pushed; then switches off
  - *Feeding*: Switches on for 30 seconds when a button is pushed; then dims

TCP/IP network

- *A prerequisite for this is that you know the parameters required for setting up the TCP/IP network connection. Consult (further) technical professionals if required.*
- *DHCP is activated in the device ex-works. This allows automatic integration of the device in most networks.*



Network settings, required for network communication, e. g. with an Internet portal:

- `DHCP`: Switch DHCP on/off
- `IP address`: IP address of the inverter
- `Subnet mask`: Subnet mask of the inverter
- `Gateway`: IP address of the network gateway
- `DNS address`: IP address of the DNS server
- `web-portal`: Settings at the web portal
  - `Web portal setting`: Disabling of data transmission and selection of a web portal
  - `Connection check`: Checks the internet connection and indicates the result

3.3.4 Service menu

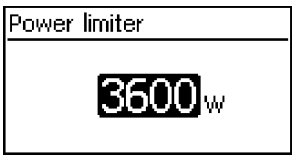
The service menu items are described below. Some items are password protected; see *further information on page 45* (menu structure)

You can obtain the password from technical support; see *Chapter 11 'Contact' on page 72*.

NOTICE!

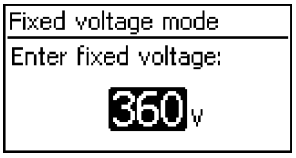
Risk of reduced yields. In the service menu, inverter and grid parameters can be changed. The service menu must only be operated by a specialist, who ensures that the change does not violate applicable regulations and standards!

Power limiter



The inverter output power can be manually limited to a minimum of 500 W. When the power is manually limited, the *Power reduction* symbol is shown in the status display and the *'Derating'*/ *'Cause: User default'* measurement is displayed.

Fixed voltage

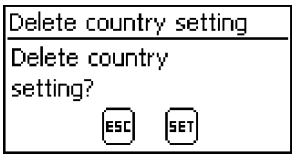


The device can regulate the input voltage to a manually adjustable value. This switches off the automatic setting of the MPP (MPP tracking). The input voltage can be adjusted over a range between the maximum and minimum input voltage and the minimum input voltage in 1V steps.

Exemplary application: Hydroelectric installation

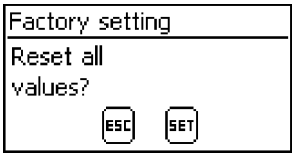
NOTICE!
Before setting a fixed input voltage, make sure that the PV generator is suitable for this. Otherwise, this may result in yield losses or damage to the system.

Delete country setting



After the country setting has been deleted the device restarts anew and displays the guided 1st commissioning menu.

Factory setting

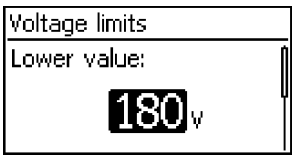


Resetting the device to the factory setting deletes the following data:

- Yield data
- Event messages
- Date and time
- Country setting
- Display language
- Network settings

After the factory setting has been deleted, the device restarts anew and displays the guided 1st commissioning menu.

Voltage limits (peak value)

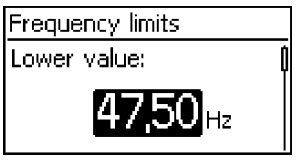


The following voltage limits can be changed:

- Upper disconnection value[1)]
- Lower disconnection value[1)] (Fig. left)

[1)] The disconnection value relates to the peak value of the voltage.

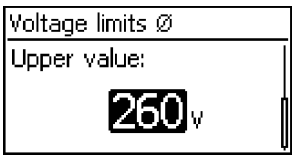
Frequency limits



The following frequency limits can be changed:

- Upper disconnection value
- Lower disconnection value (Fig. left)
- Derating switch-on threshold (because frequency is too high)
- Frequency threshold when switching on again

Voltage limits ø (average value)

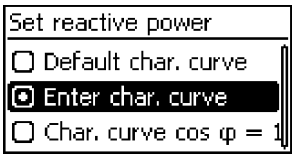


The following voltage limits can be changed:

- Upper disconnection value[1)] (Fig. left)
- Lower disconnection value[1)]

[1)] The disconnection value relates to the average value of the voltage.

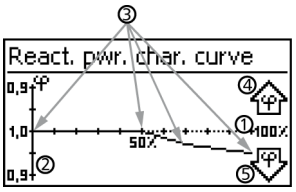
Reactive power characteristic curve



Overview:

The reactive power characteristic curve must be set during 1st commissioning if this is prescribed for the previously selected country. The following applies:

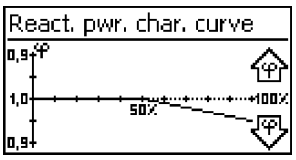
- 3 characteristic curves are available for selection (Fig. left):
  - `Default. char. curve` (pre-defined)
  - `Enter char. curve` (manually adjustable)
  - `Char. curve cos φ = 1` (pre-defined)



- After configuration, the characteristic curve is displayed as a graph (example in Fig. left).
  ① x-axis, output power P in %
  ② y-axis, phase shift cos ϕ
  ③ Nodes (in example: 4 nodes)
  ④ Arrow symbol *Overexcitation*
  ⑤ Arrow symbol *Underexcitation*

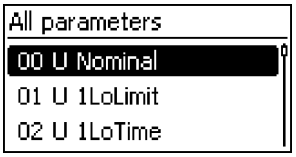
Technical details

- Each characteristic curve is defined by 2 to 8 nodes.
- A node is defined by the output power P of the inverter (x-axis) and the associated phase shift (y-axis).
- The phase shift can be set over a range of 0.95 (overexcitation) through 1.00 (no phase shift) to 0.95 (underexcitation).
- The type of phase shift is shown in the graph using arrow symbols defined as follows (defined from the point of view of the inverter):
  Overexcitation, inductive
  Underexcitation, capacitive



- The 3 characteristic curves available for selection have the following properties:
  `Default char. curve`: pre-defined according to the selected country (example in Fig. left).
  `Char. curve φ = 1`: pre-defined with cos ϕ = constantly 1.00. This characteristic curve must be selected if no reactive power control is to be performed on the device.
  `Enter char. curve`: The number of nodes and their x/y values can be configured. Exceptions: The first node is always at x (P %) = 0 %, the last always at x (P %) = 100 %.

All parameters



Service technicians can use this menu item for changing additional MSD parameters.

3.4 Cooling

The internal temperature control system prevents excessive operating temperatures. When the internal temperature is too high, the inverter adjusts the power consumption from the PV generators to reduce the heat dissipation and operating temperature.

The inverter is convection cooled via fins on the front and rear side. A maintenance-free fan circulates the heat within the closed housing evenly over the entire surface of the housing.

3.5 Grid monitoring

The inverter constantly monitors the mains grid parameters while feeding the grid. If the grid deviates from the legally prescribed specifications then the inverter automatically switches off. When the grid conforms to the legally prescribed specifications then the inverter automatically switches on again.

3.6 Data communication

The device has the following communication interfaces:

- 1x RJ45 socket (Ethernet for TCP/IP grid) for communication, e.g. for connection to the PIKO Solar Portal via your network.
- 2x RJ45 sockets (RS485 bus) for communication with external devices, e.g. a data logger
- 1x RJ10 socket (Modbus RTU) for communication e. g. with an external energy counter

3.6.1 Data

The inverter can transmit a wide range of data to other devices. Some of this data is shown on the display and certain data is stored in the internal memory (EEPROM) as described below.

Displayed data

- Voltage and current of the PV generator
- Power and current fed into the grid
- Voltage and frequency of the power grid
- Energy yields on a daily, monthly and annual basis
- Error conditions, notes
- Version information

Logged data (EEPROM)

- Event messages with date
- Energy yields on a daily, monthly and annual basis

The storage resolution of the energy yield data is as follows:

Energy yield data	Storage resolution/period
10-minute values	31 days
Daily values	13 months
Monthly values	30 years
Annual values	30 years
Total yield	permanent

3.6.2 Network (TCP/IP)

Using the TCP/IP interface, the device can transmit yield data and event messages to the PIKO Solar Portal ***www.piko-solar-portal.com***. In the free-of-charge Solar Portal, the yield data can be displayed graphically.

- Before you can use the Solar Portal, the inverter must send its data to the PIKO Solar Portal. Once the 1st commissioning communication between the inverter and the Solar Portal has been established, the user can carry out the registration process and then add the inverter to the user's system.
- The local network settings must be set at the inverter in order to establish a connection to the Internet portal server. This can be performed automatically or manually:
  Automatically: If IP addresses are automatically assigned in your network (DHCP), then no settings need to be made at the inverter.
  Manually: If IP addresses are not automatically assigned in your network, then you must manually set the inverter network settings via `Settings` ▸ `Network`; see *'TCP/IP network' on page 17*

- The address of the PIKO Solar Portal is permanently stored in the inverter and cannot be changed.
- Once the network connection is established, the inverter automatically starts non-encrypted transmission of data to the server.

The network cable must be disconnected in order to prevent transmission of the data, or data transmission must be disabled according to ‘TCP/IP network’ on page 17.

Furthermore, you can use the inverter interface to display yield data and other information as HTML pages via the internal web server. You need a PC connection to indicate the data. The web server can be called up via a browser (e.g. Mozilla Firefox or Internet Explorer). To enable the connection, enter the IP address of the inverter (see inverter status indication) in the input line of the browser (e.g. http://192.168.103.168). To enable the connection, enter the IP address of the inverter (see inverter status indication) in the browser.

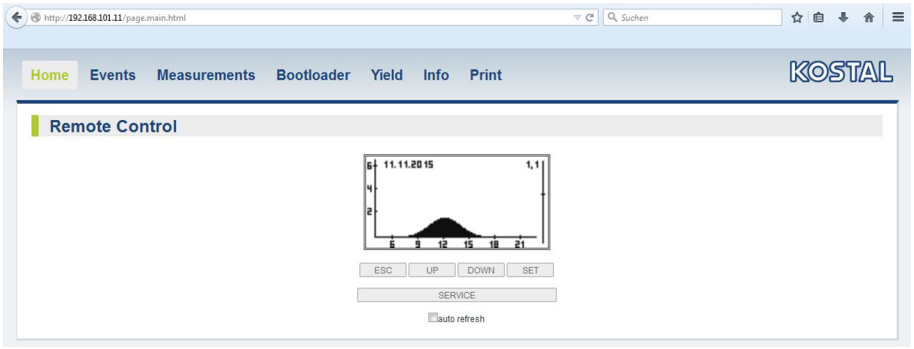


Fig. 2: *Example 1 of an HTML page*

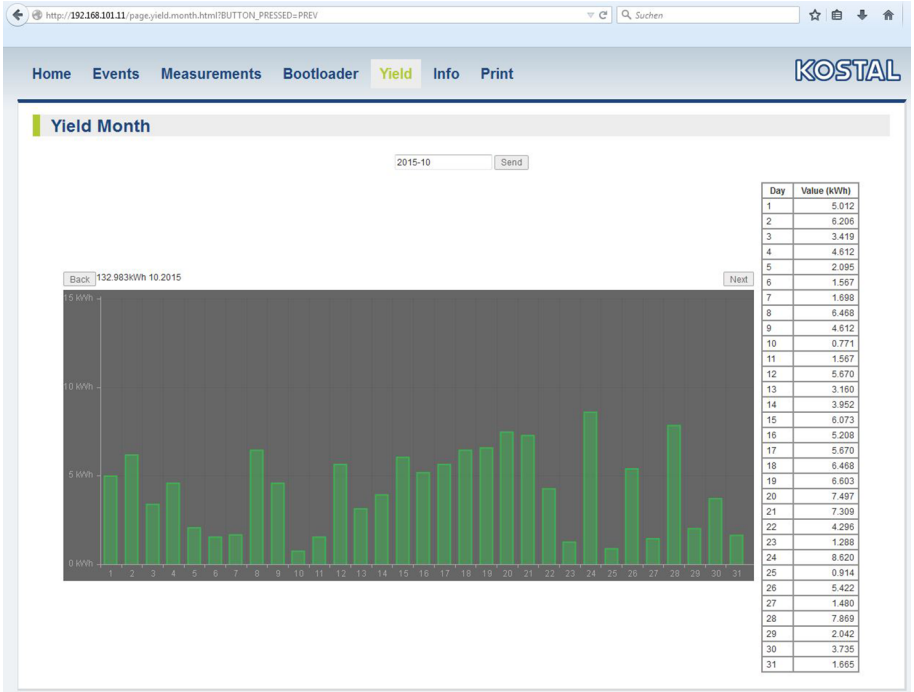


Fig. 3: Example 2 of an HTML page

3.6.3 RS485 bus

The inverter communicates with other devices via an RS485 bus. The following applies:

The following applies:

- The inverter has two RS485 interfaces (RJ45 sockets) on the lower side of the casing.
- The beginning and end of the RS485 bus must be terminated; see *Chapter 3.6.5 'RS485 termination' on page 26*.
- Standard RJ45 cables can be used as bus cables (Cat-5 patch cables, not supplied). Use an alternative data connection cable for longer connections; see *Chapter 3.6.4 'Alternative RS485 data connection cable' on page 26*.
- The inverters connected to the RS485 bus operate as *slaves.*

The following inverters have compatible data interfaces and can be connected to the RS485 bus as slaves:

- *PIKO 1.5 MP*
- *PIKO 2.0 MP*
- *PIKO 2.5 MP*
- *PIKO 3.0 MP*
- *PIKO 3.6 MP*
- *PIKO 4.2 MP*

Comply with the instructions in the manuals of these devices relative to addressing, termination, and approved data cables.

If in the country setting Italy is set, then the RS485 bus must be connected as follows to enable control through an external device in accordance with CEI 0-21.

- *External fast switch-off (Italian: Teledistacco): If the lines 3[1)] and 8[1)] of the RS485 bus[2)] are connected, e. g. via an external relay, the following applies:*
  ***Relay closes**: The inverters on the bus disconnect themselves from the network.*
  ***Relay opens**: The inverters connected on the network connect themselves to the network (regular operation).*
- *Switch-over of the grid frequency disconnection thresholds (Ital.: Modalità definitiva di funzionamento del sistema di protezione di interfaccia (impiego del SPI sulla base di letture locali e di informazioni/comandi esterni)): If the lines 5[1)] and 8[1)] of the RS485 bus[2)] are connected, e. g. via an external relay, the following applies:*
  ***Relay closes**: The inverters connected on the bus set the switch-off thresholds in accordance with CEI 0-21 to 47.5 Hz and 51.5 Hz.*
  ***Relay opens**: The inverters connected on the bus set the switch-off thresholds in accordance with the country setting Italy ; ↳ Chapter 9 'Technical data' on page 60*

We recommend that you integrate the wiring of lines 3, 5, and 8 in the bus termination.

[1)] Contact assignment of the RJ45 plug for the RS485 bus: Fig. 4.

[2)] See ↳ Chapter 3.1 'Housing' on page 11 ⑥ and ⑦.

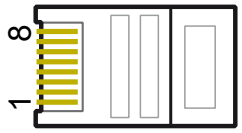


***Fig. 4:** Contact assignment (= line number) of the RJ45 plug*

Optionally *one* (!) of the following *master*devices can be connected to the RS485 bus. The devices support the transfer protocol used by the inverter. The devices support the transfer protocol used by the inverter.

External system monitoring which can be connected additionally, e.g.:

- WEB'log (Meteocontrol)
- Solar-Log (Solare Datensysteme)
- Energy-Manager (Kiwigrid GmbH)

As a free-of-charge alternative to external system monitoring, the PIKO Solar Portal can be used.

NOTICE!
The settings must be made on the external data loggers as specified by the manufacturer, before connecting.

The wiring diagram of the RS485 bus is shown below.

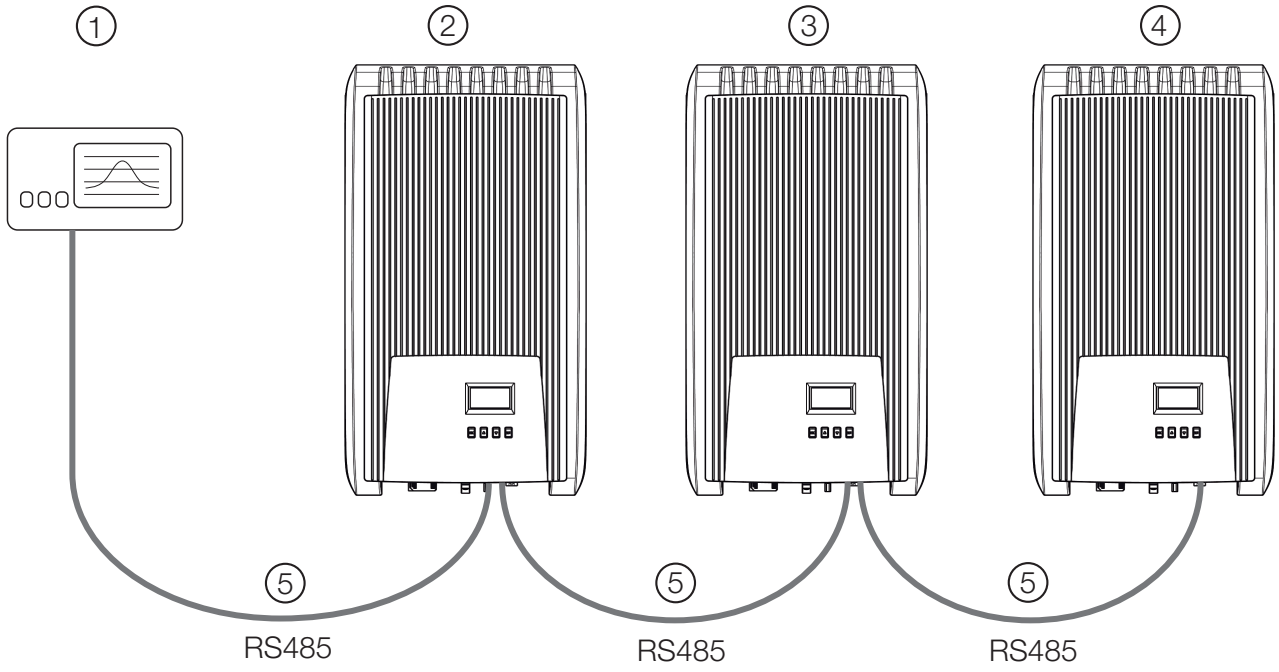


Fig. 5: *Wiring diagram*

① External data logger
② First inverter
③ Inverter
④ Last inverter, terminated
⑤ RJ45 standard cable (patch cable)

3.6.4 Alternative RS485 data connection cable

NOTICE!
Material damage caused by electrical voltage! The alternative data connection cable may only be manufactured by professional personnel.

The alternative data connection cable is a Cat-5 cable for long data connections. The following applies to the alternative data connection cable:

- The total length of the RS485 bus must not exceed 1,000 m (Master/ first inverter to last inverter).
- Use the pin assignment according to the table below if the alternative data connection cable is connected to the RJ45 socket of the first inverter or to the connector of an external data logger.

Pin assignment of the alternative RS485 data cable

Device	Inverter	Solar-Log	WEB‘log[1)]	Kiwigrid	
Connection	RJ45	Terminal strip	RJ12	Terminal strip	Signal ↓
Contact	1	1	2	A	Data A
	2	4	4	B	Data B
	3	—	—	—	—
	4	—	—	—	—
	5	—	—	—	—
	6	—	—	—	—
	7	—	—	—	—
	8	3	6	GND	Ground

NOTICE!
[1] Danger of destroying the inverter's RS485 input. Pin 1 of the RJ12 socket of the Web‘log data logger carries 24 V DC. Never connect the alternative data connection cable to pin 1!

3.6.5 RS485 termination

To prevent data transmission errors, the start and end of the RS485 bus should be terminated:

- The external data logger (at the start of the data connection) must be terminated according to the manufacturer's specifications.
- The last inverter (at the end of the data connection) is terminated by plugging the optionally available termination plug into the free RJ45 socket (for RS485 bus) (see table in ↳ *Chapter 2.2 'Identification' on page 7* under 'Optional accessories').

3.6.6 RS485 addressing

Every inverter must be assigned its own unique address for communication between the bus master and the slaves.

Every inverter is set with an address of 1 at the factory. This means that the addresses must be adjusted in systems having more than 1 inverter. The following applies:

- The address is changed at the inverter via the menu items *'Settings'* ▸ *'Address'*.
- Only addresses ranging from 1 – 99 may be set.
- The bus master devices usually support less than 99 addresses. Consult the respective operating instructions for these devices before setting the addresses of the inverters.
- We recommend starting with address 1 for the first inverter on the bus and then incrementing the address by 1 for each subsequent inverter on the bus, in the same order as they are physically installed. This makes it easier to identify the relevant inverters when their address is displayed in messages shown on the remote display.

3.6.7 Modbus RTU

The inverter communicates via Modbus RTU with energy meters ↳ *'Feed-in management' on page 41*. The following applies:

- Only energy meter pre-programmed in the inverter can be used.
- The energy meter must measure the supply from the grid in positive direction. Follow the manufacturer's instructions.

3.6.8 Modbus RTU data connection cable

NOTICE!
Material damage from electrical current! The alternative data connection cable may only be manufactured by technical professionals.

On the inverter side, a 4-pole telephone cable with RJ10 connector may be used as data connection cable.

Fig. 6: Contact assignment (= line number) of the RJ10 plug

Device Connection	Inverter RJ10	Signal
Contact	1	Data A
	2	Data B
	3	Ground
	4	—

NOTICE!
Danger of destroying the Modbus RTU input of the inverter. Contact 4 of the RJ10 socket of the inverter carries voltage <20V. Do not use this contact.

4 Installation

4.1 Safety measures during installation

Observe the following safety notes when performing the work described in Section *Installation* .

DANGER!

Risk of death by electrocution!

- Only technical professionals may perform the work described in Section *Installation* .
- Do not connect cables to the inverter until explicitly asked to do so in the manual.
- Do not open the housing of the inverter.
- Connect only SELV circuits to the RJ45 sockets.
- Lay the cables such that the connection cannot come loose accidentally.
- When laying cables, ensure that no damage occurs to any of the constructional fire safety measures in the building.
- Make sure that no inflammable gases are present.
- Observe all applicable installation regulations and standards, national laws and connection values specified by the regional power supply company.

DANGER!

Danger from electrical current

ELECTRICAL SHOCK AND DISCHARGE!

The PV generators/lines may be energised as soon as the PV generators are exposed to light.

Always disconnect all DC and AC cables as follows before starting work on the inverter:

1. Set the DC circuit breaker on the inverter to position `0`. Take measures to prevent the system from being unintentionally switched on again.
2. Turn the AC circuit breaker to off. Take measures to prevent the system from being unintentionally switched on again.
3. Wait for at least 10 minutes before disconnecting the plug-in connectors of the DC cables.
4. Disconnect the DC cable plug connectors according to the manufacturer's instructions.
5. Disconnecting the AC plug from the inverter ⇒ Release safety clip at the front of the AC plug by depressing it with a suitable object, then pull the plug out.

6. Check that all pins of the AC plug are free of voltage. Use a suitable voltmeter for this (do not use a simple neon phase checker).

NOTICE!

Risk of damage to the inverter or derating!

- The mounting location must satisfy the following conditions:
  - The mounting location and immediate environment are permanently fixed, vertical, flat, non-inflammable and not subject to constant vibration.
  - The permissible ambient conditions are complied with; *Chapter 9 'Technical data' on page 60*.
  - The following free spaces must be present around the inverter:

    Above/below: at least 200 mm

    At the sides/in front: at least 60 mm
- Do not install the inverter in areas where animals are kept.
- Observe the connection ratings specified on the type plate.
- The DC cables must not be connected to an earth potential (DC inputs and AC output are not galvanically isolated).

NOTICE!

When transmitting data over a public network:

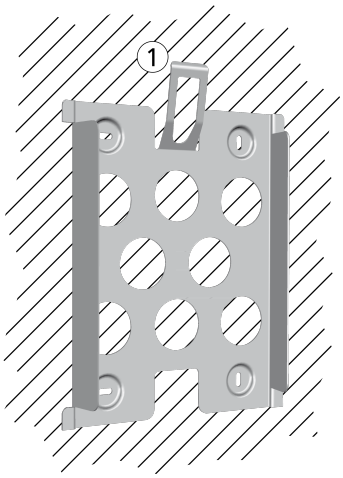
- Transmitting data over a public network may result in additional costs.
- Data transmitted over a public network is not protected from unauthorised access by third-parties.

NOTICE!

- Avoid exposing the inverter to direct sunlight.
- The display must be readable on the installed device.

4.2 Mounting the inverter

Fastening the mounting plate



▶ Screw the mounting plate to the mounting surface using 4 screws:

- Use screws (and dowels etc.) appropriate for the weight of the inverter.
- The mounting plate must lie flat on the mounting surface and the metal strips at the sides must point forwards (Fig. left).
- Install the mounting plate vertically with the retaining plate ① at the top (example in Fig. left).

NOTICE!

For more information on determining the optimum position for the mounting plate, refer to the Brief Installation Instructions comprised in the delivery, and to the Appendix of this manual
↳ *Appendix 'Bore dimension drawing' on page 74*.

For Australia only: Cover the *Protection class II* symbol on the type plate.

When the inverter is used in Australia, the national regulations do not permit the Protection class II symbol to be displayed on the type plate.

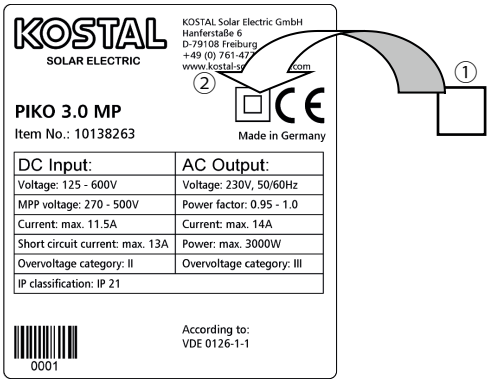
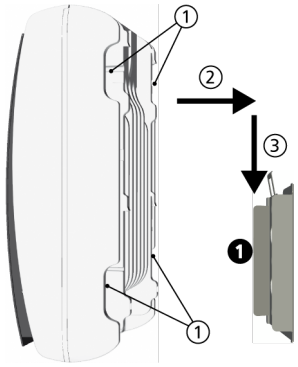


Fig. 7: *Position of the sticker for covering the Protection Class II symbol*

→ Completely cover the *Protection class II* symbol using the small sticker provided, as shown in Fig. 7.

Attaching the inverter on the mounting plate



1. Grasp the inverter by the recesses ① position it ② in the middle of the mounting plate ❶ and press lightly (example in Fig. left).
2. Lower the inverter ③ until the securing sheet metal element of the mounting plate audibly locks in place. In this process, the hooks on the rear of the inverter must be guided above the catches on the mounting plate.
3. The inverter must now be firmly seated on the mounting plate and it can no longer be lifted (upwards).

NOTICE!
How to remove the inverter from the mounting plate is described under *Chapter 4.11 'Deinstalling the inverter' on page 43*.

4.3 Prepare AC connection

4.3.1 Miniature circuit breaker

Information on the required line circuit breaker and the cables to be used between the inverter and the line circuit breaker is provided in *Chapter 9.2 'AC cables and line circuit breakers' on page 70*.

4.3.2 Fault current circuit breaker

If the local installation regulations require the installation of an external residual current circuit breaker, then a Type A residual current circuit breaker as per IEC 62109-1, § 7.3.8. is sufficient.

4.3.3 Assemble AC plug

Grid voltage 220 V ... 240 V

DANGER!
Risk of death by electrocution! Observe the hazard warnings under *Chapter 4.1 'Safety measures during installation' on page 29*.

Wire the supplied AC plug.

For detailed information on mounting the plug, refer to the website of the plug manufacturer.

Grid voltage 100 V ... 127 V

DANGER!
Risk of death by electrocution! Never connect one of the phases L1, L2 or L3 to PE or N on the mains grid side.

Notice
With a mains grid voltage of 100 V ... 127 V, the inverter can be connected between the L1, L2 and L3 external conductors as follows:

2-phase mains grids

- N and L are connected between the L1 – L2 external conductors at the inverter side. See ② and ③ in Fig. 8.
- *One* of the two connected external conductors is connected to PE at the inverter side. This connection can be made within the AC plug or in an external junction box.
  Fig. 8 shows an example of an inverter-side connection between L1 and PE:
  Top: Connection ① in the AC plug ⑤
  Bottom: Connection ④ in an external junction box ⑥)

3-phase mains grids

- N and L are connected between the L1 – L2 or L1 – L3 or L2 – L3 external conductors at the inverter side.
- *One* of the two connected external conductors is connected to PE at the inverter side. This connection can be made within the AC plug or in an external junction box.
  Fig. 8 shows an example of an inverter-side connection between L1 and PE:
  Top: Connection ① in the AC plug ⑤
  Bottom: Connection ④ in an external junction box ⑥)

The external conductor voltages are shown in Fig. 9.

1. Wire the AC plug supplied for the selected external conductors. For more detailed information, refer to the website of the plug manufacturer under ***www.wieland-electric.com***. Do not yet close the AC plug.
2. Connect one of the two connected phases to PE at the inverter side. Make this connection inside the AC plug or use an external junction box, as shown in Fig. 8.
3. Close the AC plug.

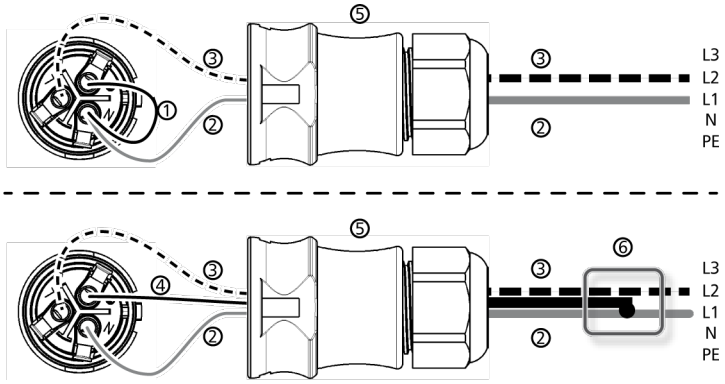


Fig. 8: *Connection of N and PE in the AC plug (above) or junction box (below)*

① Connection cable between N and PE with the connection point inside the AC plug
② External conductor L1
③ External conductor L2
④ Connection cable between N and PE with the connection point inside the junction box
⑤ Casing of the AC plug
⑥ Junction box

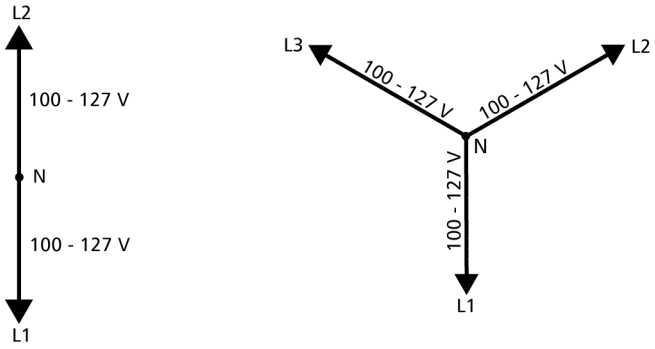


Fig. 9: *External conductor voltages in 2- and 3-phase grids with 100 V ... 127 V*

4.4 Prepare DC connections

DANGER!
Risk of death by electrocution!

- Observe the hazard warnings under *Chapter 4.1 'Safety measures during installation' on page 29*.
- Use the provided SUNCLIX plugs so that the specified protection class is maintained.

NOTICE!
Risk of damage to the inverter and the modules. Connect the opposing connectors for the DC connections to the DC cable, observing the correct polarity.

→ Attach the connector plug counterparts to the DC cable according to the manufacturer's instructions.

4.5 Preparing the data connection cable

→ If a data connection is required, use a standard RJ45 cable (patch cable, Cat5) or construct an alternative data connection cable(see *further information on page 26*).

4.6 Connecting the inverter and switching the AC on

DANGER!
Risk of death by electrocution! Observe the hazard warnings under *Chapter 4.1 'Safety measures during installation' on page 29*.

NOTICE!
Between the data connection cables (RS485/Ethernet) and the DC/AC lines, maintain a distance of 200 mm, to avoid interference in the data transmission.

1. If necessary, establish the data connection:
   - Connect the inverters and the master with data connection cables.
   - On the last inverter, switch on the termination (slide switch).
2. Seal open RJ45 sockets with sealing caps.
3. Forcefully press the plug connector mating piece (DC cable) into the DC connection on the inverter until it audibly locks in place.
4. Plug the AC connector onto the coupling on the inverter, until the plug audibly locks in place.
5. Switch on the AC miniature circuit breaker. The start page for 1st commissioning is shown on the display.
6. Perform initial commissioning and switch on the DC supply, as described in the following.

4.7 Initial commissioning of the inverter

4.7.1 Function

Conditions for starting initial commissioning

Initial commissioning starts automatically when at least the AC connector has been installed and switched on as described previously. If initial commissioning is not fully completed then it starts again anew the next time the device is switched on.

Guided initial commissioning

Initial commissioning is a guided procedure that sets the following information:

- Display language
- Date / Time
- Country
- Reactive power characteristic curve (if prescribed for the selected country)

Setting the country

The following applies when setting the country:

- The country set must always be the same as the country where the inverter is installed. This causes the inverter to load the prescribed grid parameters for the selected country. For a list of country settings, refer to our website under ***www.kostal-solar-electric.com/Download/PIKO_MP***.
- **The country can only be set once!**
  If you have mistakenly selected the wrong country, reset the country setting in the Service menu (*Chapter 3.3.4 'Service menu' on page 17*).
- If the Countries table does not list your country, select a country with stricter specifications.
- The country setting does not affect the language used on the display. The display language is set separately.

4.7.2 Operation

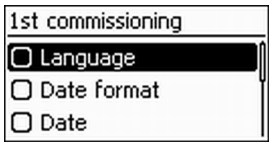
Starting 1st commissioning

NOTICE!

- When a check list item is called up, the corresponding check box is automatically selected.
- Initial commissioning is completed by calling up the `Finish` item.
- `Finish` can only be performed when *all other* check boxes are selected.

The check list for 1st commissioning is displayed:

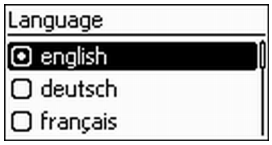
- The default display language is English.
- The Language entry is selected.
- The check boxes are not selected.



1. Press △▽ to select a check list item.
2. Press SET to call up the item.

   The items are described in detail below.

Language

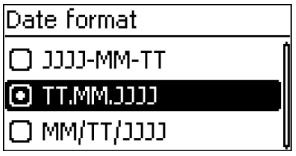


1. Press △▽ to select a display language.
2. Press SET.

   ⇨ The language is adopted.
3. Press ESC.

   ✓ The check list is shown.

Date format



1. Press △▽ to select a date format.
2. Press SET.

   ⇨ The date format is adopted.
3. Press ESC.

   ✓ The check list is shown.

Date

1. Press SET.

   ⇨ The day flashes.
2. Press △▽ to change the day.
3. Press SET.

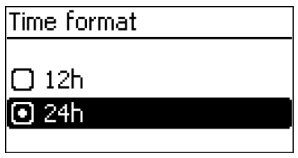
   ⇨ The change is adopted.
4. Press ▽.

   ⇨ The month is selected.
5. Repeat steps 1 to 3 for the month.
6. Press ▽.

   ⇨ The year is selected.
7. Repeat steps 1 to 3 for the year.
8. Press ESC.

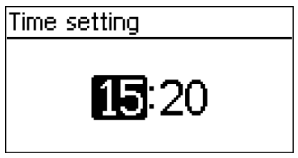
   ✓ The check list is shown.

Time format



1. Press △▽ to select a time format.
2. Press SET.
   ⇨ The time format is adopted.
3. Press ESC.
   ✓ The check list is shown.

Time



1. Press SET.
   ⇨ The hours display flashes.
2. Press △▽ to change the hour.
3. Press SET.
   ⇨ The change is adopted.
4. Press ▽.
   ⇨ The minutes are selected.
5. Repeat steps 1 to 3 for the minutes.
6. Press ESC.
   ✓ The check list is shown.

Country selection

NOTICE!
The country can only be set once!
If you have mistakenly selected the wrong country, reset the country setting in the Service menu (*Chapter 3.3.4 'Service menu' on page 17*).

1. Press △▽ to select a country.
2. Press SET.
   ⇨ The dialog shown on the left is displayed.

3. Press ESC.
4. Press ESC to select a different country by performing step 1 and step 2, or
   Press SET for a longer period of time (> 1 s) to confirm the currently selected country.
   ✓ The check list is shown.

Reactive power

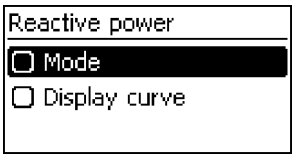
NOTICE!

The following items are only displayed when the use of a reactive power characteristic curve is prescribed for the country currently selected in the Country item:

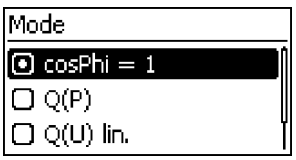
- `Mode`: Type of characteristic curve
  Select one of the following types:
  – cos phi = 1
  – Q(P)
  – Q(U) linear
  – Q(U) hysteresis
- `Loading defaults`[1]: A default characteristic curve can be selected here.
- `Node 1`[1]
  `No. of nodes`[1] The nodes provide for free programming of a characteristic curve.
- `Node 2`[1]
- `Node n`[1] [2]
- `Display char. curve`

[1]: Not indicated with mode cos phi = 1.

[2]: Is only displayed when `no. of nodes` has been set to a value > 2.



1. Press `SET` to call up the item.

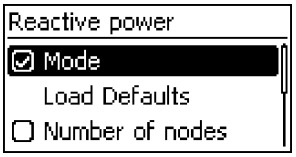


2. Press △▽ to select a type of reactive power characteristic curve.
3. Press `SET`.
   ⇨ The reactive power characteristic curve type is adopted.
4. Press `ESC`.
   ✓ The check list is shown.

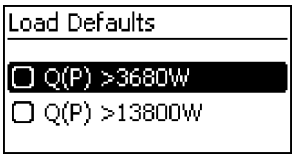
Loading defaults

NOTICE!

If cosPhi = 1 was not selected, an additional menu item *'Load defaults'* is indicated.

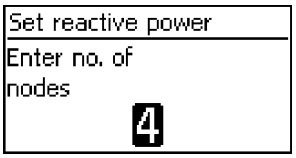


1. Press ▽ to select "Load defaults".
2. Press SET.



3. Press △▽ to select a default characteristic line.
4. Press SET.
   ⇨ The default characteristic line is adopted.
5. Press ESC.
   ✓ The check list is shown.

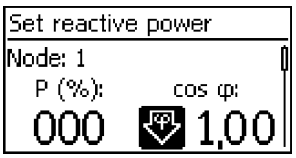
Number of nodes



1. Press SET.
   ⇨ The value flashes.
2. Press △▽ to change the number of nodes.
3. Press SET.
   ⇨ The value is adopted.
4. Press ESC.
   ✓ The check list is shown.

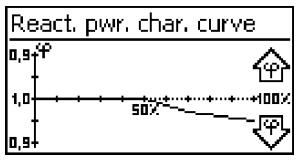
Node *n*

NOTICE!
P % cannot be changed at the first and last nodes (000 %, 100 %).



1. Press △▽ to select a parameter for the node.
2. Press SET.
   ⇨ The parameter value flashes.
3. Press △▽ to change the value.
4. Press SET.
   ⇨ The change is adopted.
5. Repeat steps 1 to 4 for the other parameters.
6. Press ESC.
   ✓ The check list is shown.

Display char. curve

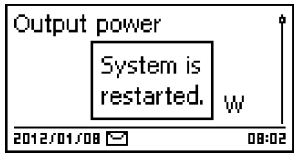


1. The previously set reactive power characteristic curve is displayed graphically (example in Fig. left).
2. Press ESC
   ✓ The check list is shown.

Finishing initial commissioning

Finish has been selected in the check list and SET has been pressed. One of 2 possible dialogues is displayed.

1. Proceed as follows, depending on the respective dialogue:
   - Dialogue Settings are incomplete: Press SET and work through the open items in the check list.
   - Dialogue Are all settings correct?: Press ESC to correct settings or



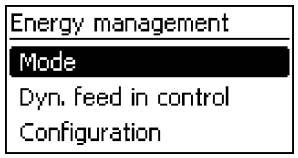
2. Press and hold SET (> 1 s) to finish 1st commissioning.
   ✓ If SET was pressed for a longer time then the inverter starts anew and synchronises itself with the grid (Fig. left).
   You have completed the initial commissioning of the inverter.

4.8 Feed-in management

Depending on the country, photovoltaic systems must have the possibility of being reduced in the fed-in effective power by the network operator. The following products are recommended for implementing this legally prescribed specification:

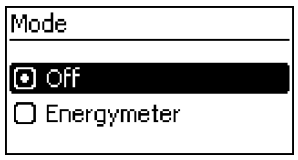
- Energy meters (B+G SDM630, Herholdt ECS3-80B, Carlo Gavazzi EM24-DI, Janitza ECS3)
- WEB'log from Meteocontrol
- Solar-Log from Solare Datensysteme
- Energy-Manager from Kiwigrid

The energy meter for the feed-in management is connected to the Modbus RTU interface (RJ10) and must meet the preconditions described in *Chapter 3.6.7 'Modbus RTU' on page 27* and *Chapter 3.6.8 'Modbus RTU data connection cable' on page 27*.



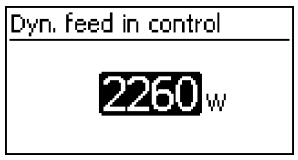
NOTICE!
The settings for feed-in management must be made in the sub-menu *'Energy management'*.

Mode



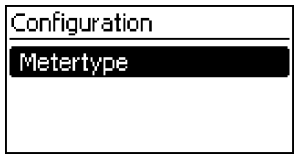
1. Press SET to call up the item.
2. Press ▽ to select "Energy meter".
3. Press SET.
4. Press ESC to go one level higher to Energy management.

Dynamic feed-in regulation



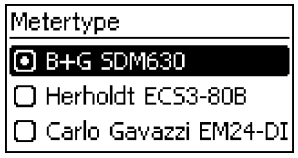
NOTICE!
The power fed into the grid is adjusted in 10 W steps. It can be limited to a minimum of 0 W.

Configuration of the energy meter



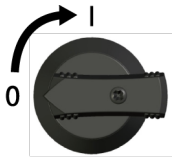
1. Press SET to call up the item.

NOTICE!
The inverter can only work with energy meters that have been pre-programmed in the inverter. The pre-programmed energy meters are listed under Meter type.



2. Press △▽ to select a meter type.
3. Press SET.
4. Press ESC to quit the sub-menu.

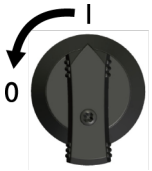
4.9 Switching the inverter on



Place DC load-break switch on the inverter on position I (Fig. left). After testing via the internal MSD (approx. 2 minutes), the power fed into the grid can be shown on the display (assuming that sunlight is present).

4.10 Switching the inverter off

Switching off the AC and DC supplies



1. Set the DC circuit breaker on the inverter to position 0 (Fig. left).
2. Turn the AC circuit breaker to off.
3. Wait for at least 10 minutes before disconnecting the plug-in connectors of the DC cable.

4.11 Deinstalling the inverter

DANGER!
Risk of death by electrocution! Only technical professionals may perform the work described in this section. Follow the safety instructions at the beginning of the Section "Installation".

Disconnecting the DC connections from the inverter

Switch the inverter off *'Switching the inverter off' on page 43*.

→ Disconnect the DC cable plug connectors according to the manufacturer's instructions.

DANGER!
DC cables carry voltage when the PV generators are subjected to sunlight.

Disconnecting the AC plug from the inverter

1. Disconnecting the AC plug from the inverter

   Release the safety clip at the front of the AC plug by depressing it with a suitable object, then pull the plug out.
2. Check that all pins of the AC plug are free of voltage:

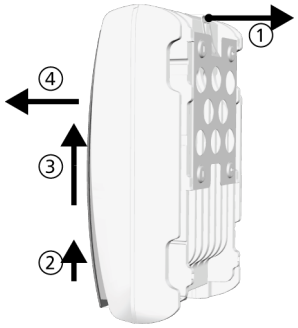
   Use a suitable voltmeter for this (do not use a simple neon phase checker).

Opening the AC plug (only if required)

→ Opening the AC plug:

First, unscrew the rear cable connection. Next, release the safety clips at the left and right of the plug housing by depressing them simultaneously with a suitable object. Now, pull the top part of the housing off the contact element.

Removing the inverter from the mounting surface



1. → Use one hand to press the retaining plate on the mounting plate approx. 5 mm towards the mounting surface ① (Fig. left).

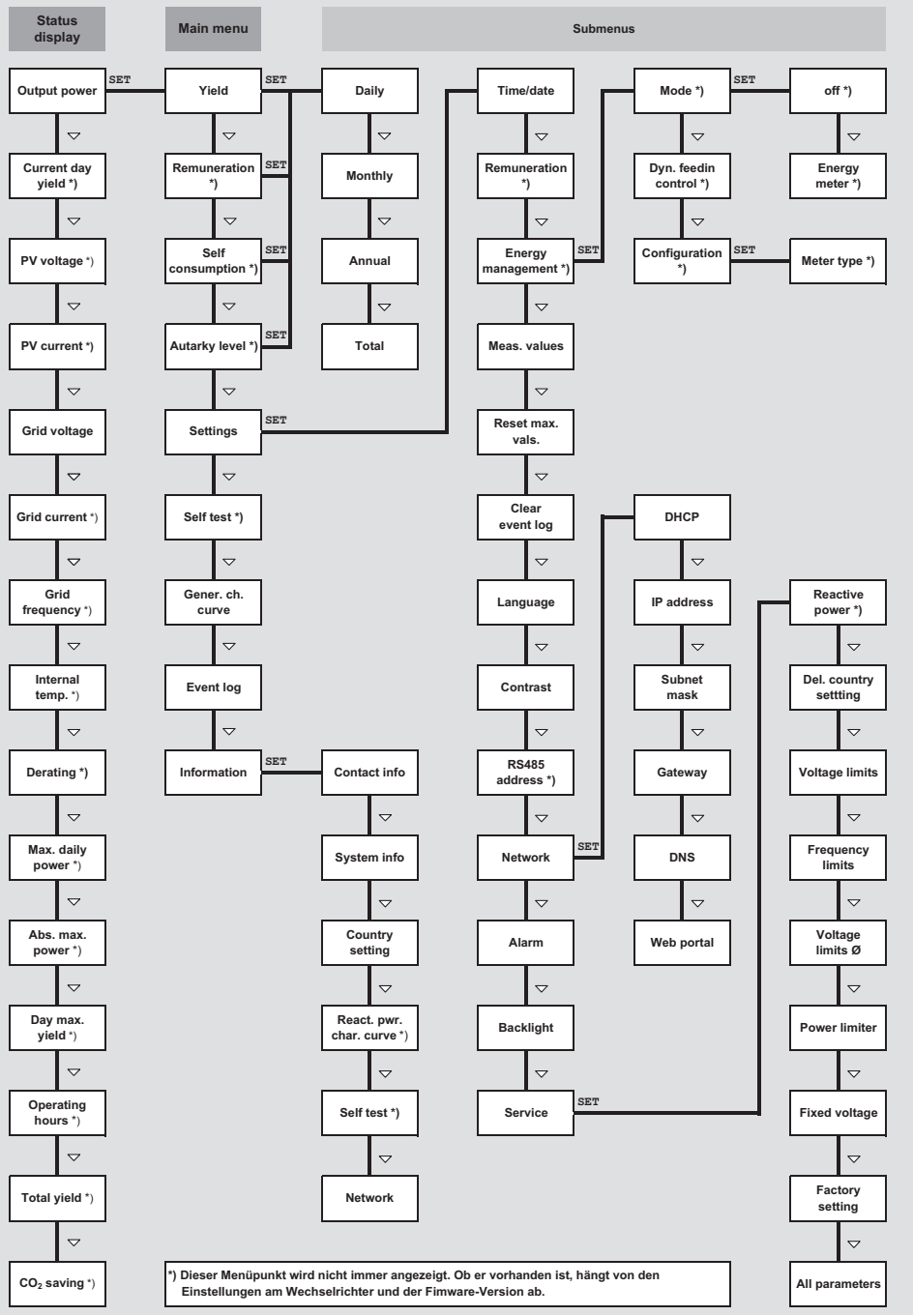
2. → Use the other hand to push the inverter upwards, far enough so that the retaining plate no longer latches ②. Release the retaining plate.

3. → Lift the inverter with both hands until the hooks on the rear side of the inverter are free ③.

4. → Remove the inverter from the mounting surface ④.

5 Operation

5.1 Overview of operating functions



Only the ▽ and SET operating buttons are illustrated (for the sake of clarity).

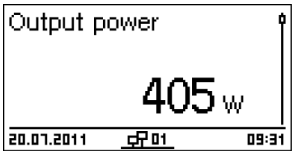
5.2 General operating functions

- Hidden content is shown using the △ and ▽ buttons.
- Repeated button presses: If △▽ need to be pressed repeatedly, you can alternatively hold these buttons pressed for a *long* time. The rate of repetition increases the longer the button is held.
- Pressing any button switches on the display backlighting

5.3 Important operating functions

The figures in this section show examples.

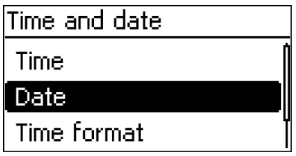
Status display



1. If necessary, press ESC for 1 second to call up the status display (Fig. left).
2. Press △▽ to display a different parameter.

Menu navigation

1. Press ESC for 1 second to call up the status display as required.
2. Press SET.
   ⇨ The main menu is displayed with the top item selected.



3. Press △▽ to select a menu item.
4. Press SET to call up the submenu (Fig. left).
5. Repeat steps 3 and 4 for further submenus as required.

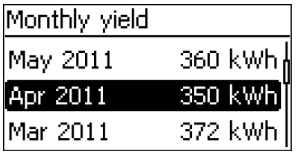
Event messages

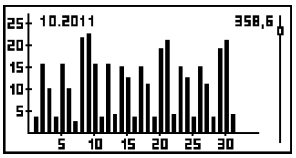
See ↳ *Chapter 7 'Event messages' on page 53*

Displaying entries numerically (list) and graphically (diagram)

The status display is shown.

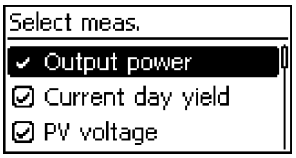
1. Press SET.
   ⇨ The main menu is displayed with Yield selected.
2. Press SET.
   ⇨ The list with yield time periods is shown.





3. Press △▽ to select a yield time period.
4. Press SET.
   ⇨ The individual yields for the yield time period are shown in a list (Fig. left).
5. Press △▽ to select an individual yield value.
6. Press SET.
   ⇨ The selected individual yield is shown in a chart (Fig. left).
7. Press △▽ to page through the charts.
8. Press SET to return to the list.

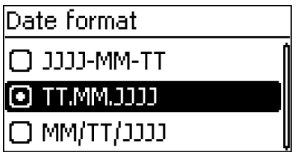
Editing selection lists containing check boxes



A selection list with check boxes is displayed (Fig. left).

1. Press △▽ to select a check box.
2. Press SET.
   ⇨ The state of the check box changes from *on* to *off* and vice-versa (preset check boxes cannot be changed).
3. Repeat steps 1 and 2 for further check boxes as required.
4. Press ESC.
   ✓ The changes are adopted and the next higher menu level is displayed.

Editing selection lists containing radio buttons



A selection list with radio buttons is displayed (Fig. left).

1. Press △▽ to select a radio button that is currently switched off.
2. Press SET.
   ⇨ The selected radio button is switched on and the previously switched on radio button is switched off.
3. Press ESC.
   ✓ The changes are adopted and the next higher menu level is displayed.

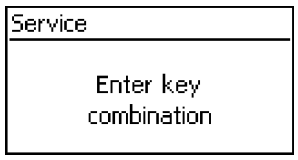
Changing numeric settings

A numeric setting is displayed (example *Date* in Fig. left).

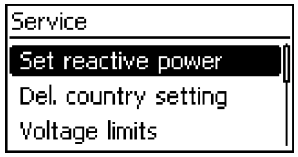
1. Press SET.
   ⇨ The selected value flashes (*Day* in Fig. left).
2. Press △▽ to change the value.
3. Press SET.
   ⇨ The change is adopted (value no longer flashes) *or*
4. Press ESC to cancel the change (value no longer flashes).
5. Press ▽.
   ⇨ The next value is selected.
6. Repeat steps 1 to 4 for the remaining values.
7. Press ESC.
   ✓ The next higher menu level is displayed.

Calling up the service menu and editing the values

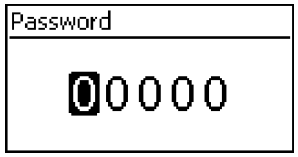
NOTICE!
Risk of yield losses and contravention of regulations and standards. Inverter and grid parameters can be changed in the service menu. The service menu must therefore only be used by technical professionals who know the applicable regulations and standards.



1. Select the Service menu item.
2. Press SET.
   ⇨ The fig. shown at the left appears.



3. Press △▽ simultaneously for 3 seconds.
   ⇨ The service menu is displayed (Fig. left).
4. Press △▽ to select a menu item.



5. Press SET to edit the menu item. The following applies:
   - Enter the password if required (Fig. left); and
     ↳ *Chapter 3.3.4 'Service menu' on page 17*
   - If necessary, press △▽ within a menu item to display and edit other settings (e.g. Voltage limits).
   - The menu items are described in
     ↳ *Chapter 3.3.4 'Service menu' on page 17*.

5.4 PIKO Solar Portal

5.4.1 Registration in the PIKO Solar Portal

Calling up the Internet portal, entering the language and serial number

To allow for finding the inverter in the Solar Portal and its assignment to a system, the inverter must have connected to the Solar Portal at least once.

1. Enter the following address in your Internet browser: ***www.piko-solar-portal.com***. Ensure that your browser permits scripts and cookies for ***www.piko-solar-portal.com***.
2. Click on the button *'Join now'*.
   ⇨ The website "PIKO Solar Portal | Registration" appears.
3. Fill in all fields in the registration form.

NOTICE!
- Enter the item and serial numbers in the respective fields.
- Note the fields marked with * in the entry screens: These fields are mandatory and must be filled in.
- The serial number always consists of a sequence with *6 numbers – 2 letters – 12 numbers*, e. g. *123456AB123456789012*.
- If you enter an invalid serial number or if the inverter has not yet logged in with the Solar Portal, an alarm message is displayed, and the registration process is aborted.
- Press the green button "+" at the left next to the field ② to enter the serial numbers of further inverters (a maximum of 5 inverters is possible).

4. Click on the button *'Submit registration'*.
   ⇨ You will receive an email with a log-in confirmation.
5. Open this email and click on the link.
   ✓ The website "PIKO Solar Portal | Registration" appears with the message "Registration completed".
   You have completed the registration with the PIKO Solar Portal.

6 Self test

The self test is mandatory for operation of inverters in Italy.

Function

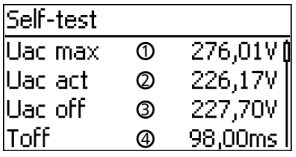
The prerequisites for performing the self test are as follows:

- The country *Italy* was selected during initial commissioning.
- The level of solar irradiation is high enough to ensure that the inverter can feed the grid.

During the self test, the inverter checks its switch-off behaviour with regard to too high / too low grid voltage and frequency (7 test phases, duration of approx. 40 minutes). The following applies:

- In each phase of the self test, the inverter changes its switch-off threshold, step-by-step upwards/downwards from the set lower/upper limit values.
- When the switch-off threshold reaches the actual grid voltage/ frequency then the inverter stores this information.
- The data is shown on the display as follows:
  - The current values of the *first* test phase are displayed first; see the following illustration.
  - The values of the subsequent test phases are added below (initially hidden).
  - If the self test succeeded then the message `Self test passed` is added below. The message must be displayed and confirmed.
- If the self test conditions are not satisfied, one of the following messages will be displayed: *'Messages of errors that prevent the self test from running' on page 52*.
- If a measurement lies outside the required tolerance during the self test then the self test is cancelled and the inverter displays the message `Self test failed`. The inverter remains disconnected from the grid (relay open, no feeding) until the self test is passed successfully.

> *To see the results of the self test saved in the inverter, press Information ⇒ Self test.*



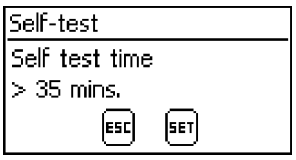
① Lower / upper limit value according to the country setting
② Measured actual grid voltage / frequency
③ Switch-off threshold (changed in steps)
④ Switch-off time [1)]

[1)] time between following events:

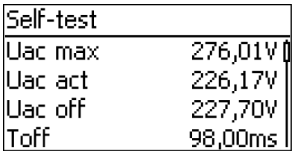
- Switch-off threshold reaches the actual grid voltage / frequency
- The inverter disconnects itself from the grid

Operation

At the inverter you wish to test, *Italy* is selected as country setting.

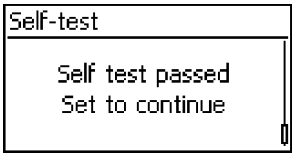


1. Check the country setting via `Information` ▸ `System info` in the main menu as required.
2. Select `Self test` in the main menu.
   ⇨ The dialog shown on the left is displayed.



3. Press and hold `SET` for 1 second.
   ⇨ The self test starts.
   The values for the first test phase are displayed (Fig. left).
4. Press ▽ to display the values for the subsequent test phases (if available).
5. Only when `Self test failed` is displayed: Press `SET` to confirm the message.
   ✓ The status display appears.

When the self test has finished, proceed as follows:



1. Press ▽ several times until the message `Self test passed` is displayed (Fig. left).
2. Press `SET` to confirm the result of the self test.
   ✓ The status display appears.

NOTICE!
If `Self test failed` is displayed, repeat the self test as soon as possible so that the inverter can resume feeding.

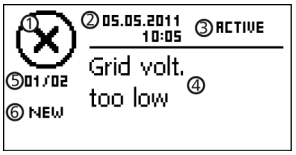
Messages of errors that prevent the self test from running

Message	Description	Remedy
`An error was detected`	An internal error prevented the self test from starting.	Contact your installer if this error occurs frequently.
`Invalid grid conditions`	The self test was cancelled due to invalid grid conditions, e.g. due to insufficient AC voltage.	Repeat the self test later.
`MSD not ready`	The self test was not started because the inverter was not ready for operation.	Repeat the self test a few minutes later when the inverter is ready for operation and is feeding.
`Not enough sunlight`	The self test was not started or was cancelled due to insufficient sunlight, especially in the evening / at night.	Repeat the self test during the day when the inverter is feeding the grid.

7 Event messages

Events are indicated by messages as described below. The display flashes red. The *list of event messages* below contains information on troubleshooting and fault correction.

Structure



Event messages contain the following information:

① Symbol for the type of event message
② Date/time when the event occurred
③ `ACTIVE` = cause of the event message is still present *or* `Date/time` at which the cause of the event message was corrected.
④ Cause of the event message
⑤ Counter: *No. of the displayed event messages* / *Total number of event messages*; max number of all event messages = 30
⑥ `NEW` is displayed until the event message has been manually confirmed via the `ESC` or △▽ button.

Function

Event message types

- Type **Information** (symbol ⓘ)
  The inverter has detected an event that does not affect the feed-in process. The user does not need to intervene.
- Type **Warning** (symbol ⚠)
  The inverter has detected an event that may result in reduced yields. It is recommended that you correct the cause of the error.
- Type **Error** (symbol ⊗)
  The inverter has detected a serious error. The inverter will not feed into the grid while this error is present. Please contact your installer. More information is provided in the table below.

Display behaviour

New event messages are displayed immediately. The messages disappear after they have been confirmed or their causes have been corrected.

When an event message is acknowledged, the user thereby simply confirms that he/she has seen the message. This does not correct the error that caused the event message to be shown!

If messages exist whose cause has been corrected but have not been confirmed then ✉ is shown in the status display. If an already confirmed error recurs then it is displayed again.

Operation

Confirming event messages

✓	An event message with the comment NEW is displayed.
▶	Press ESC/△/▽. The event message is confirmed.

Displaying event messages

1. Select Event log in the main menu.
2. Press SET.
   ⇨ The event messages are displayed in chronological order (latest message first).
3. Press △▽ to page through the event messages.

Event messages

Event message	Description	Type
Boost converter defective	The boost converter is defective, the inverter is not injecting into the grid or is injecting at reduced power. ▶ Notify your installer.	⊗
Boost converter has wrong HW version	The inverter cannot identify an internal component, or it does not match the other components. The inverter cannot inject into the grid. ▶ Notify your installer.	⊗
Boost converter malfunction	An internal component of the inverter is defective. It is possible that the inverter injects into the grid not at all, or with reduced capacity. ▶ Notify your installer.	⊗
Boost converter not connected	The connection of the internal components is interrupted. The inverter is not injecting into the grid. ▶ Notify your installer.	⊗
Boost converter not recognised	▶ Notify your installer.	⊗
CountryCode failed	There is an inconsistency between the selected country setting and the country setting stored in memory. ▶ Notify your installer.	⊗
Country parameters invalid	The inverter cannot inject into the grid because it has no valid parameters. ▶ Notify your installer.	⊗

Event message	Description	Type
Device overheated	In spite of capacity reduction, the maximum permissible temperature is exceeded. The inverter does not inject into the grid until the permissible temperature range is reached. 1. Check whether the installation conditions are fulfilled. 2. Contact your installer if this alarm occurs frequently.	⊗
Data transfer failed	A setting failed, for example during initial commissioning, because it has not been properly adopted. ▶ Repeat the setting. ▶ Contact your installer if this error occurs frequently.	⊗
Fan faulty	The internal fan of the inverter is defective. It is possible that the inverter injects into the grid with reduced capacity. ▶ Notify your installer.	⚠
FE not connected	The protective earth is not connected. For safety reasons the inverter is not allowed to inject into the grid. ▶ Notify your installer.	⊗
Grid current DC offset too high	The DC current power share that is injected by the inverter into the grid, exceeds the permissible value. Pursuant to statutory regulations, the inverter switches off automatically as long as this fault is pending. ▶ Notify your installer.	⊗
Grid frequency too high	The grid frequency applied on the inverter exceeds the permissible value. Pursuant to statutory regulations, the inverter switches off automatically as long as this fault is pending. ▶ Contact your installer if this error occurs frequently.	⊗
Grid frequency too high for reactivation	After switch-off, the inverter cannot inject again because the grid voltage exceeds the legally prescribed switch-on value. ▶ Contact your installer if this error occurs frequently.	⊗
Grid frequency too low	The grid frequency applied on the inverter is below the permissible value. Pursuant to statutory regulations, the inverter switches off automatically as long as this fault is pending. ▶ Contact your installer if this error occurs frequently.	⊗

Event message	Description	Type
Grid frequency too low reactivation	After switch-off, the inverter cannot inject again because the grid voltage is below the legally prescribed switch-on value. ▶ Contact your installer if this error occurs frequently.	⊗
Grid islanding detected	The grid is not carrying any voltage (self-run of the inverter). For safety reasons the inverter is not allowed to inject into the grid. It switches itself off as long as the error is present (display dark). ▶ Contact your installer if this error occurs frequently.	⊗
Grid relay defective	The inverter has detected that a grid relay is defective; for this reason, it is not injecting into the grid. ▶ Notify your installer.	⊗
Grid voltage too high	The grid voltage applied on the inverter exceeds the permissible value. Pursuant to statutory regulations, the inverter switches off automatically as long as this fault is pending. ▶ Contact your installer if this error occurs frequently.	⊗
Grid voltage ∅ too high	The output voltage averaged over the legally prescribed time period exceeds the permissible tolerance range. The inverter switches off automatically as long as this fault is pending. ▶ Contact your installer if this error occurs frequently.	⊗
Grid voltage too low	The grid voltage applied on the inverter is below the permissible value. Pursuant to statutory regulations, the inverter switches off automatically as long as this fault is pending. ▶ Contact your installer if this error occurs frequently.	⊗
Grid voltage ∅ too low	The output voltage averaged over the legally prescribed time period is below the permissible tolerance range. The inverter switches off automatically as long as this fault is pending. ▶ Contact your installer if this error occurs frequently.	⊗
Grid voltage too high for reactivation	After switching off, the inverter cannot resume feeding because the grid voltage exceeds the legally prescribed switch-on value. ▶ Contact your installer if this error occurs frequently.	⊗
Grid voltage too low for reactivation	After switch-off, the inverter cannot inject again because the grid voltage is below the legally prescribed switch-on value. ▶ Contact your installer if this error occurs frequently.	⊗
Intern.error	▶ Contact your installer if this alarm occurs frequently.	⊗

Event message	Description	Type
Intern. info	▶ Contact your installer if this alarm occurs frequently.	
Intern. warning	▶ Contact your installer if this alarm occurs frequently.	
Isolation error	The insulating resistor between plus and minus input and ground underranges the permissible value. For safety reasons the inverter is not allowed to inject into the grid. ▶ Notify your installer.	
L and N swapped	Outer conductor and neutral conductor are connected swapped out. For safety reasons the inverter is not allowed to inject into the grid. ▶ Notify your installer.	
No branding	The inverter has incorrect or faulty device data. For this reason, the inverter cannot inject into the grid. ▶ Notify your installer.	
No connection to the energy meter	The communication connection between the inverter and the energy meter does not exist or is defective. ▶ Please ask your installer to check the connection.	
Overtemperature HSS	The maximum permissible boost converter temperature has been exceeded. The inverter does not inject into the grid until the permissible temperature range is reached. 1. Check whether the installation conditions are fulfilled. 2. Contact your installer if this alarm occurs frequently.	
Power reduction due to temperature	The inverter reduces it output power because the maximum permissible temperature has been reached. 1. Check whether the installation conditions are fulfilled. 2. Contact your installer if this error occurs frequently.	
PV current too high	The input current at the inverter exceeds the permissible value. The inverter limits the current to the permissible value. ▶ Contact your installer if this alarm occurs frequently.	
PV voltage too high	The input voltage applied on the inverter exceeds the permissible value. ▶ Switch off the DC load-break switch of the inverter and notify your installer.	

Event message	Description	Type
`Reading CountryCode failed`	The inverter could not correctly read out the country setting from the memory. ▶ Notify your installer.	
`Residual current too high`	The fault current that flows from the plus or minus input via the PV generators exceeds the permissible value. Pursuant to statutory regulations, the inverter switches off automatically as long as this fault is pending. ▶ Notify your installer.	
`RS485 Gateway activated`	No communication with the inverter possible via the RS485 interface. ▶ Disconnect the inverter from the grid and reset it (AC reset). ▶ Have your installer carry out this operation.	
`Self test failed`	An error occurred during the self-test, the self-test has been aborted. ▶ Notify your installer if ■ the self-test has been aborted repeatedly at different times a day due to an error and ■ grid voltage and frequency were definitely within the limit values of the country setting.	
`Software incompatible`	"After a firmware update, the different software statuses in the inverter do not match any more. 1. Repeat the firmware update using a valid update file. 2. Contact your installer if this error occurs frequently.	
`Time/date lost`	The inverter lost the time because it remained unconnected from the grid for too long a time. Yield data cannot be stored, event messages only with incorrect date. ▶ Correct the time settings under `Settings` ▶`Time/date`.	

8 Maintenance and disposal

8.1 Maintenance

The inverter is virtually maintenance-free. Nevertheless, we recommend that you inspect it regularly to ensure that the cooling fins on the front and rear of the device are free of dust. Clean the device as needed, as described below.

NOTICE!
Risk of destruction of components.

- **Do not** allow cleaning agents and devices to penetrate between the cooling fins at the front of the inverter (under the grey hood).
- **Do not** use especially the following cleaning agents:
  - Solvent-based cleaning agents
  - Disinfection agents
  - Coarse or sharp-edged cleaning agents

Removing dust

→ Dust should be removed using compressed air (max. 2 bar).

Removing heavy soiling

DANGER!
Risk of death by electrocution! Use cleaning agents only with a slightly damp cloth.

1. → Remove heavy soiling with a slightly damp cloth (use clear water). If necessary, use a 2 % hard soap solution instead of water.
2. → After cleaning, remove any soap residue using a slightly damp cloth.

8.2 Disposal

Inverters, packaging, and replaced parts must be disposed of pursuant to the regulations of the country in which the device has been installed. Never dispose of the inverter with the regular household garbage.

9 Technical data

9.1 Inverter

9.1.1 PIKO 1.5 MP/PIKO 2.0 MP

	PIKO 1.5 MP	PIKO 2.0 MP
DC input side (PV generator connection)		
Number of DC inputs	1	
Maximum start voltage	420 V	
Maximum input voltage (VDCmax)	420 V	
Minimum input voltage (VDCmin)	75 V	
Start input voltage (VDCstart)	90 V	
Rated input voltage(VDC,r)	195 V	255 V
Minimum input voltage for DC rated output (VMPPmin)	135 V	180 V
Number of MPP trackers	1	
Operating input voltage range (VMPP)	75 ... 350 V	
Maximum input current (IDCmax)	11.5 A	
Rated input current	8 A	
Maximum backfeed current into the PV generator	0 A	
Maximum input capacity at maximum active output power	1,540 W	2,050 W
Rated input power (cos ϕ = 1)	1,540 W	2,050 W
Max. PV power (cos ϕ = 1)	1,800 Wp	2,500 Wp
Derating / power limiting	occurs automatically when: ■ input power > max. recommended PV power ■ Cooling is inadequate ■ Input current too high ■ Grid current too high ■ Internal or external power reduction ■ Grid frequency too high (in accordance with country setting) ■ Limiting signal on external interface ■ Output power limited (set on the inverter)	
AC output side (grid connection)		
Output voltage (UAC)	185 V ... 276 V (depending on the country settings)	
Rated output voltage	230 V	

	PIKO 1.5 MP	PIKO 2.0 MP
Maximum output current (IACmax)	12 A	
Rated output current	6.5 A	8.7 A
Maximum active power (cos ϕ=1)	1,500 W	2,000 W
Maximum active power (cos ϕ=0.95)	1,500 W	2,000 W
Maximum apparent power (cos ϕ=0.95)	1,580 VA	2,100 VA
Rated output, cos ϕ=1 (PAC, r)	1,500 W	2,000 W
Rated frequency (fr)	50 Hz and 60 Hz	
Grid type	L / N / PE (protective earth)	
Grid frequency	45 Hz ... 65 Hz (depending on the country settings)	
Power losses in nighttime operation	< 2 W	
Feeding phases	single-phase	
Distortion factor (cos ϕ = 1)	< 2 %	
Power factor cos ϕ	0.95 capacitive ... 0.95 inductive	
Characterization of the operating behaviour		
Maximum efficiency	98.0 %	
European efficiency	97.4 %	97.5%
CEC efficiency	97.6%	97.6%
MPP efficiency	> 99.7 % (static), > 99 % (dynamic)	
Efficiency values (at 5 %, 10 %, 20 %, 25 %, 30 %, 50 %, 75 %, 100 % of the rated output power) at rated voltage	90.7 %, 94.7 %, 96.6 %, 97.0 %, 97.3 %, 97.7 %, 97.7 %, 97.5 %	92.8 %, 95.8 %, 97.3 %, 97.5 %, 97.7 %, 97.8 %, 97.7 %, 97.4 %
Efficiency values (at 5 %, 10 %, 20 %, 25 %, 30 %, 50 %, 75 %, 100 % of the rated output power) at minimum MPP voltage	89.9 %, 94.2 %, 96.2 %, 96.6 %, 96.8 %, 97.1 %, 96.7 %, 96.1 %	91.4 %, 94.5 %, 96.2 %, 96.8 %, 97.0 %, 97.2 %, 97.1 %, 96.2 %
Efficiency values (at 5 %, 10 %, 20 %, 25 %, 30 %, 50 %, 75 %, 100 % of the rated output power) at maximum MPP voltage	90.7 %, 94.7 %, 96.7 %, 97.1 %, 97.4 %, 97.7 %, 97.8 %, 97.7 %	92.3 %, 95.7 %, 97.1 %, 97.4 %, 97.6 %, 97.8 %, 97.7 %, 97.5 %
Efficiency reduction in the case of a rise in ambient temperature (at temperatures > 40°C)	0.005 %/°C	
Efficiency change in the case of deviation from the DC rated voltage	0.002 %/V	
Own consumption	< 4 W	

	PIKO 1.5 MP	PIKO 2.0 MP
Derating at full power	from 50 °C (T_{amb})	
Switch-on power	10 W	
Switch-off power	5 W	
Safety		
Protection class according to IEC 62103	II	
Isolation principle	No electrical isolation, transformer-less	
Grid monitoring	yes, integrated	
Insulation monitoring	yes, integrated	
Residual current monitoring	yes, integrated[1)]	
Overvoltage protection version	Varistors	
Reverse polarity protection	yes	
Operating conditions		
Area of application	Indoor rooms, with or without air conditioning	
Climate protection class as per IEC 60721-3-3	3K3	
Ambient temperature range	–15 °C ... +60 °C	
Storage temperature	-30 °C ... +80 °C	
Relative humidity	0 % ... 95 %, non-condensing	
Operating altitude above sea level	≤ 2000 m above sea level	
Pollution degree	PD3	
Noise emission (typical)	31 dBA	
Improper ambient gases	Ammonia, solvents	
Fittung and construction		
Protection class	IP21 (housing: IP51; display: IP21)	
Overvoltage category	III (AC), II (DC)	
DC connection		
Type	Phoenix Contact SUNCLIX (1 pair)	
Connection conductor cross-section	Conductor cross-section 2.5 … 6 mm^2	
Opposing connector	Opposing connector included in delivery	
AC connection		
Type	Wieland RST25i3 plug	
Connection conductor cross-section	Cable diameter 10 ... 14 mm^2, conductor cross-section ≤ 4 mm^2	

	PIKO 1.5 MP	PIKO 2.0 MP
Opposing connector	Opposing connector included in delivery	
Dimensions (X x Y x Z)	340 x 608 x 222 mm	
Weight	8.3 kg	
Display	Graphical display, 128 x 64 pixels	
Communication interfaces	RS485 (2 x RJ45 sockets: Anschluss an Meteocontrol WEB'log oder Solar-Log™, 1 x RJ10 Buchse: Connection to Modbus RTU counter), Ethernet interface (1 x RJ45)	
Feed-in management as per EEG 2012	EinsMan-ready, via RS485 interface	
Integrated DC circuit breaker	yes, compliant with VDE 0100-712	
Cooling principle	Temperature-controlled fan, speed variable, internal (dust-protected)	
Test certificate	Certificates download see the product page on our homepage.	

Technical data at 25 °C/77 °F

[1] Due to its design the inverter cannot cause any DC fault currents.

9.1.2 PIKO 2.5 MP/PIKO 3.0 MP

	PIKO 2.5 MP	PIKO 3.0 MP
DC input side (PV generator connection)		
Number of DC inputs	1	
Maximum start voltage	600 V	
Maximum input voltage (VDCmax)	600 V	
Minimum input voltage (VDCmin)	125 V	
Start input voltage (VDCstart)	150 V	
Rated input voltage(VDC,r)	320 V	380 V
Minimum input voltage for DC rated output (VMPPmin)	225 V	270 V
Number of MPP trackers	1	
Operating input voltage range (VMPP)	125 ... 500 V	
Maximum input current (IDCmax)	11.5 A	
Rated input current	8 A	
Maximum backfeed current into the PV generator	0 A	
Maximum input capacity at maximum active output power	2,560 W	3,070 W

	PIKO 2.5 MP	PIKO 3.0 MP
Rated input power (cos ϕ = 1)	2,560 W	3,070 W
Max. PV power (cos ϕ = 1)	3,100 Wp	3,800 Wp
Derating / power limiting	occurs automatically when: ■ input power > max. recommended PV power ■ Cooling is inadequate ■ Input current too high ■ Grid current too high ■ Internal or external power reduction ■ Grid frequency too high (in accordance with country setting) ■ Limiting signal on external interface ■ Output power limited (set on the inverter)	
AC output side (grid connection)		
Output voltage (UAC)	185 V ... 276 V (depending on the country settings)	
Rated output voltage	230 V	
Maximum output current (IACmax)	14 A	
Rated output current	11 A	13 A
Maximum active power (cos ϕ=1)	2,500 W	3,000 W
Maximum active power (cos ϕ=0.95)	2,500 W	3,000 W
Maximum apparent power (cos ϕ=0.95)	2,630 VA	3,160 VA
Rated output, cos ϕ=1 (PAC, r)	2,500 W	3,000 W
Rated frequency (fr)	50 Hz and 60 Hz	
Grid type	L / N / PE (protective earth)	
Grid frequency	45 Hz ... 65 Hz (depending on the country settings)	
Power losses in nighttime operation	< 2 W	
Feeding phases	single-phase	
Distortion factor (cos ϕ = 1)	< 2 %	
Power factor cos ϕ	0.95 capacitive ... 0.95 inductive	
Characterization of the operating behaviour		
Maximum efficiency	98.0 %	
European efficiency	97.6 %	97.7 %
CEC efficiency	97.7 %	97.8 %
MPP efficiency	> 99.7 % (static), > 99 % (dynamic)	
Efficiency values (at 5 %, 10 %, 20 %, 25 %, 30 %, 50 %, 75 %, 100 % of the rated output power) at rated voltage	92.9 %, 95.5 %, 97.2 %, 97.3 %, 97.6 %, 97.7 %, 97.5 %, 97.1 %	94.6 %, 96.9 %, 97.9 %, 98.0 %, 98.1 %, 98.0 %, 97.6 %, 97.2 %

	PIKO 2.5 MP	PIKO 3.0 MP
Efficiency values (at 5 %, 10 %, 20 %, 25 %, 30 %, 50 %, 75 %, 100 % of the rated output power) at minimum MPP voltage	92.1 %, 95.3 %, 96.6 %, 96.9 %, 97.0 %, 97.1 %, 96.7 %, 96.2 %	93.6 %, 95.8 %, 97.2 %, 97.3 %, 97.4 %, 97.2 %, 96.8 %, 96.1 %
Efficiency values (at 5 %, 10 %, 20 %, 25 %, 30 %, 50 %, 75 %, 100 % of the rated output power) at maximum MPP voltage	93.3 %, 96.1 %, 97.5 %, 97.6 %, 97.8 %, 98.0 %, 97.7 %, 97.5 %	94.4 %, 96.6 %, 97.7 %, 97.8 %, 97.9 %, 97.9 %, 97.5 %, 97.1 %
Efficiency reduction in the case of a rise in ambient temperature (at temperatures > 40°C)	0.005 %/°C	
Efficiency change in the case of deviation from the DC rated voltage	0.002 %/V	
Own consumption	< 4 W	
Derating at full power	from 50 °C (T_{amb})	from 45 °C (T_{amb})
Switch-on power	10 W	
Switch-off power	5 W	
Safety		
Protection class according to IEC 62103	II	
Isolation principle	No electrical isolation, transformer-less	
Grid monitoring	yes, integrated	
Insulation monitoring	yes, integrated	
Residual current monitoring	yes, integrated[1)]	
Overvoltage protection version	Varistors	
Reverse polarity protection	yes	
Operating conditions		
Area of application	Indoor rooms, with or without air conditioning	
Climate protection class as per IEC 60721-3-3	3K3	
Ambient temperature range	–15 °C ... +60 °C	
Storage temperature	-30 °C ... +80 °C	
Relative humidity	0 % ... 95 %, non-condensing	
Operating altitude above sea level	≤ 2000 m above sea level	
Pollution degree	PD3	
Noise emission (typical)	31 dBA	
Improper ambient gases	Ammonia, solvents	
Fittung and construction		

	PIKO 2.5 MP	PIKO 3.0 MP
Protection class	IP21 (housing: IP51; display: IP21)	
Overvoltage category	III (AC), II (DC)	
DC connection		
Type	Phoenix Contact SUNCLIX (1 pair)	
Connection conductor cross-section	Conductor cross-section 2.5 … 6 mm²	
Opposing connector	Opposing connector included in delivery	
AC connection		
Type	Wieland RST25i3 plug	
Connection conductor cross-section	Cable diameter 10 ... 14 mm², conductor cross-section ≤ 4 mm²	
Opposing connector	Opposing connector included in delivery	
Dimensions (X x Y x Z)	340 x 608 x 222 mm	
Weight	9.6 kg	
Display	Graphical display, 128 x 64 pixels	
Communication interfaces	RS485 (2 x RJ45 sockets: Anschluss an Meteocontrol WEB'log oder Solar-Log™, 1 x RJ10 Buchse: Connection to Modbus RTU counter), Ethernet interface (1 x RJ45)	
Feed-in management as per EEG 2012	EinsMan-ready, via RS485 interface	
Integrated DC circuit breaker	yes, compliant with VDE 0100-712	
Cooling principle	Temperature-controlled fan, speed variable, internal (dust-protected)	
Test certificate	Certificates download see the product page on our homepage.	

Technical data at 25 °C/77 °F

[1] Due to its design the inverter cannot cause any DC fault currents.

9.1.3 PIKO 3.6 MP / PIKO 4.2 MP

	PIKO 3.6 MP	PIKO 4.2 MP
DC input side (PV generator connection)		
Number of DC inputs	1	
Maximum start voltage	845 V	
Maximum input voltage (VDCmax)	845 V	
Minimum input voltage (VDCmin)	350 V	
Start input voltage (VDCstart)	350 V	

	PIKO 3.6 MP	PIKO 4.2 MP
Rated input voltage(VDC,r)	455 V	540 V
Minimum input voltage for DC rated output (VMPPmin)	350 V	
Number of MPP trackers	1	
Operating input voltage range (VMPP)	350 V … 700 V	
Maximum input current (IDCmax)	12 A	
Rated input current	8 A	
Maximum backfeed current into the PV generator	0 A	
Maximum input capacity at maximum active output power	3770 W	4310 W
Rated input power (cos ϕ = 1)	3770 W	4310 W
Max. PV power (cos ϕ = 1)	4500 Wp	5200 Wp
Derating / power limiting	occurs automatically when: ■ input power > max. recommended PV power ■ Cooling is inadequate ■ Input current too high ■ Grid current too high ■ Internal or external power reduction ■ Grid frequency too high (in accordance with country setting) ■ Limiting signal on external interface ■ Output power limited (set on the inverter)	
AC output side (grid connection)		
Output voltage (UAC)	185 V ... 276 V (depending on the country settings)	
Rated output voltage	230 V	
Maximum output current (IACmax)	16 A	18.5 A
Rated output current	16 A	18.3 A
Maximum active power (cos ϕ=1)	3680 W (Belgium 3330 W)	4200 W (Belgium: 3330 W)
Maximum active power (cos ϕ=0.95)	3500 W	3990 W
Maximum apparent power (cos ϕ=0.95)	3680 VA	4200 VA
Rated output, cos ϕ=1 (PAC, r)	3680 W (Portugal: 3450 W)	4200 W (Portugal: 3680 W)
Rated frequency (fr)	50 Hz and 60 Hz	
Grid type	L / N / PE (protective earth)	
Grid frequency	45 Hz ... 65 Hz (depending on the country settings)	
Power losses in nighttime operation	< 2 W	
Feeding phases	single-phase	

	PIKO 3.6 MP	PIKO 4.2 MP
Distortion factor (cos ϕ = 1)	< 2 %	
Power factor cos ϕ	0.95 capacitive ... 0.95 inductive	
Characterization of the operating behaviour		
Maximum efficiency	98.6 %	
European efficiency	98.3 %	98.2 %
CEC efficiency	98.3 %	98.2 %
MPP efficiency	> 99.7 % (static), > 99 % (dynamic)	
Efficiency values (at 5 %, 10 %, 20 %, 25 %, 30 %, 50 %, 75 %, 100 % of the rated output power) at rated voltage	95.8 %, 97.4 %, 98.2 %, 98.3 %, 98.4 %, 98.4 %, 98.1 %, 97.7 %	96.2 %, 97.6 %, 98.3 %, 98.3 %, 98.3 %, 98.2 %, 97.9 %, 97.4 %
Efficiency values (at 5 %, 10 %, 20 %, 25 %, 30 %, 50 %, 75 %, 100 % of the rated output power) at minimum MPP voltage	96.3 %, 97.7 %, 98.5 %, 98.6 %, 98.6 %, 98.5 %, 98.3 %, 97.9 %	96.7 %, 98.0 %, 98.5 %, 98.6 %, 98.6 %, 98.4 %, 98.1 %, 97.6 %
Efficiency values (at 5 %, 10 %, 20 %, 25 %, 30 %, 50 %, 75 %, 100 % of the rated output power) at maximum MPP voltage	95.2 %, 97.0 %, 97.8 %, 98.0 %, 98.1 %, 98.0 %, 97.8 %, 97.5 %	95.7 %, 97.0 %, 98.0 %, 98.1 %, 98.2 %, 97.9 %, 97.6 %, 97.2 %
Efficiency reduction in the case of a rise in ambient temperature (at temperatures > 40°C)	0.005 %/°C	
Efficiency change in the case of deviation from the DC rated voltage	0.002 %/V	
Own consumption	< 4 W	
Derating at full power	from 50 °C (T_{amb})	from 45 °C (T_{amb})
Switch-on power	10 W	
Switch-off power	5 W	
Safety		
Protection class according to IEC 62103	II	
Isolation principle	No electrical isolation, transformer-less	
Grid monitoring	yes, integrated	
Insulation monitoring	yes, integrated	
Residual current monitoring	yes, integrated[1)]	
Overvoltage protection version	Varistors	
Reverse polarity protection	yes	
Operating conditions		
Area of application	Indoor rooms, with or without air conditioning	

	PIKO 3.6 MP	PIKO 4.2 MP
Climate protection class as per IEC 60721-3-3	3K3	
Ambient temperature range	–15 °C ... +60 °C	
Storage temperature	-30 °C ... +80 °C	
Relative humidity	0 % ... 95 %, non-condensing	
Operating altitude above sea level	≤ 2000 m above sea level	
Pollution degree	PD3	
Noise emission (typical)	31 dBA	
Improper ambient gases	Ammonia, solvents	
Fittung and construction		
Protection class	IP21 (housing: IP51; display: IP21)	
Overvoltage category	III (AC), II (DC)	
DC connection		
Type	Phoenix Contact SUNCLIX (1 pair)	
Connection conductor cross-section	Conductor cross-section 2.5 … 6 mm^2	
Opposing connector	Opposing connector included in delivery	
AC connection		
Type	Wieland RST25i3 plug	
Connection conductor cross-section	Cable diameter 10 ... 14 mm^2, conductor cross-section ≤ 4 mm^2	
Opposing connector	Opposing connector included in delivery	
Dimensions (X x Y x Z)	340 x 608 x 222 mm	
Weight	9.1 kg	
Display	Graphical display, 128 x 64 pixels	
Communication interfaces	RS485 (2 x RJ45 sockets: Anschluss an Meteocontrol WEB'log oder Solar-Log™, 1 x RJ10 Buchse: Connection to Modbus RTU counter), Ethernet interface (1 x RJ45)	
Feed-in management as per EEG 2012	EinsMan-ready, via RS485 interface	
Integrated DC circuit breaker	yes, compliant with VDE 0100-712	
Cooling principle	Temperature-controlled fan, speed variable, internal (dust-protected)	
Test certificate	Certificates download see the product page on our homepage.	

Technical data at 25 °C/77 °F

[1] Due to its design the inverter cannot cause any DC fault currents.

9.2 AC cables and line circuit breakers

Conductor cross-sections of the AC cables and suitable line circuit breakers

Inverter	AC cable conductor cross-section	Power loss[1)]	Miniature circuit breaker
PIKO 1.5 MP	1.5 mm²	10 W	B16
	2.5 mm²	6 W	B16
	4.0 mm²	4 W	B16
PIKO 2.0 MP	1.5 mm²	18 W	B16
	2.5 mm²	11 W	B16
	4.0 mm²	6 W	B16
PIKO 2.5 MP	2.5 mm²	16 W	B16
	4.0 mm²	11 W	B16
PIKO 3.0 MP	2.5 mm²	25 W	B16 or B25
	4.0 mm²	15 W	B16 or B25
PIKO 3.6 MP	2.5 mm²	35 W	B25
	4.0 mm²	22 W	B25
PIKO 4.2 MP	2.5 mm²	48 W	B25
	4.0 mm²	30 W	B25

[1)] Power loss of the AC cables at the rated power of the inverter and a cable length of 10 m

10 Liability, commercial guarantee, legal guarantee

For warranty information, refer to the separate Service and Warranty Terms under ***www.kostal-solar-electric.com/Download/Service***

11 Contact

For service information and, if applicable, delivery of parts, we will need to know the type of your device and the serial number. You'll find this information on the rating plate at the outside of the housing.

Always use original spare parts for any replacements.

If you have technical questions, please call our service hotline:

Country	Telephone number
Germany and other countries [1]	+49 761 477 44 222
France, Belgium, Luxembourg	+33 16138 4117
Greece	+30 2310 477 555
Italy	+39 011 97 82 420
Spain, Portugal [2]	+34 961 824 927
Turkey [3]	+90 212 803 06 26

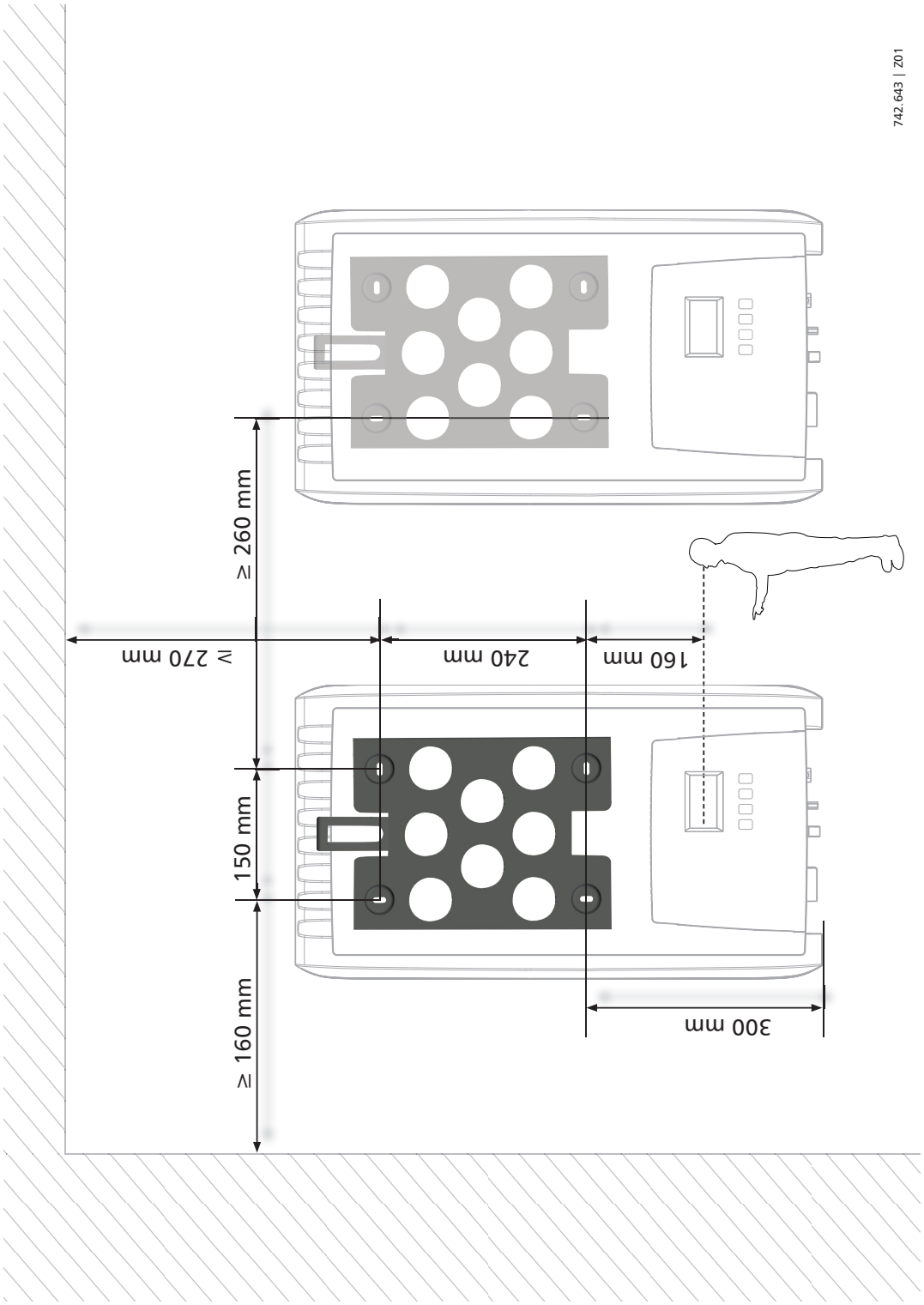
[1] Language: German, English

[2] Language: Spain, English

[3] Language: English, Turkish

Appendix

A Bore dimension drawing



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