TWERD ENERGO-PLUS

Renewable energy sources three-phase inverter **PS300** type

in variants:

PS300-PV
photovoltaic systems

PS300-WT
wind turbine systems

PS300-H
photovoltaic / wind turbine systems

3 kW, 5 kW, 8 kW, 10 kW
On-grid

12 kW, 20 kW, 30 kW
On-grid, off-grid

PS300-PV+BC

User manual

User manual ver.: 13.1,0 en

Contents

1. Device description

The family of three-phase, high-efficiency and transformerless inverters type PS300 is designed for cooperation with small photovoltaic power plants as well as wind and water based on synchronous generators with permanent magnets. These inverters enable the transmission of energy obtained from the power plant to the three-phase electrical network - the so-called "on-grid" systems.

These inverters allow the transmission of energy obtained from the power plant to the three-phase electricity grid - the so-called "on-grid" systems - or they can work in the so-called “off-grid” system and directly supply local electrical loads (inverters with charging module are marked "+BC"). The inverters can be made in the "auto on/off-grid" version - then in the event of a power grid failure, the inverter disconnects from the grid and operates in the "off-grid" island mode.

Inverters are working fully autonomously. After being installed by an authorized person, the user's role is only to systematically check the condition of the device (failure, flooding, etc.).

The PS300 inverters are available in following variants:

- **PS300-WT/3kW, PS300-WT/5kW, PS300-WT/8kW, PS300-WT/10kW, PS300-WT/20kW, PS300-WT/30kW**
  AC voltage inverters designed for small wind or water turbines with permanent magnet synchronous generators.
  Input on the inverter is marked as WT.
- **PS300-PV/3kW, PS300-PV/5kW, PS300-PV/8kW, PS300-PV/10kW, PS300-PV/12kW, PS300-PV/20kW, PS300-PV/30kW**
  Photovoltaic inverters with DC voltage inputs for installation with solar panels.
  Input on the inverter is marked as PV.
- **PS300-H/5kW, PS300-H/8kW, PS300-H/10kW, PS300-H/20kW, PS300-H/30kW**
  Hybrid inverters with one alternating voltage (WT) and one direct voltage (PV) input: they allow simultaneous connection of solar panels and a synchronous generator.
  Note: *The total power of the connected solar panels and the synchronous generator may not be greater than the nominal power of the inverter, and voltages and currents may not exceed the permissible values of the given input – table 3.1 page 10.*
- **PS300-PV+BC/...**
  Photovoltaic inverters equipped with a high-voltage battery charging module.
  For more information, see chapter 14. “Battery charger module“ on page 59.

Note:

When ordering an inverter equipped with a battery charging module (+BC), specify in what mode it is supposed to work: on-grid or off-grid. A later change of the operating mode requires service intervention in the hardware configuration of the inverter.

Photovoltaic panels are loaded on the basis of a follow-up MPPT (Maximum Power Point Tracking) algorithm, while for synchronous generators it is necessary to enter a 16-point characteristic of the generator input current as a function of its frequency. In addition, load control of a synchronous generator can be done by directly setting the load current via the MODBUS communication protocol (RTU, TCP / IP). Each of these algorithms is designed to optimally use a renewable source of electricity (RES).

Via the www.inverters.pl portal, MODBUS or Json communication protocol, you can read from the system information about:

- current inverter input and output voltages and currents,
- current output power (home appliances or electrical network),
- energy delivered in the last 24 hours,
- information on occurring failures.

The inverter is equipped with an extensive diagnostic system as well as blockades and protections protecting the inverter, and user. Has security:

- from the mains side:
  - protection against incorrect mains parameters: voltage, frequency,
  - protection against off-grid island operation (disconnection by relays from the mains in the event of its disappearance),
- from the generator side: overvoltage, overcurrent, before the generator runaway,
- from the PV side: overvoltage, overcurrent,
- against too high an inverter heat sink temperature.

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2. Conditions of safe operation

Before installing and working with the device, make sure you read the instructions with this description. Ignorance of the information contained therein may cause a threat to life, human health or irreversible damage to the device.

RISK OF ELECTRIC SHOCK!

HOT SURFACE!

2.1. Warnings

- Incorrect installation, using, and maintenance of the device can cause physical injury or death, or damage to the device and connected equipment.
- Some housing components, including a heat sink, can heat up to more than 80°C during normal operation - there is a risk of burns.
- Installation, using, and maintenance of the device must be performed only by qualified personnel.
- Before working on the device, disconnect all power sources and make sure that there is no dangerous voltage at the connection terminals.
- Before switching on the device, make sure the device has been correctly installed and all housing elements have been properly assembled.
- When the device is connected to the supply voltage, its internal components (except the control terminals – Fig. 11.1 on page 46) are on the power supply potential. Touching these components can cause an electric shock.
- Voltage on the capacitors of the device's internal intermediate DC-link circuit may cause electric shock. It remains for at least 5 minutes after disconnecting the power supply.

  Attention! The lack of the voltage at the connection terminals is not synonymous with the lack of dangerous voltage in the internal DC-link circuit of the device.
- Don’t make any connections changes when the device is connected to the power supply.
- Due to the use of a transformer-free topology of the charger, and thus connecting the negative pole of the battery bank to the inverter's intermediate circuit, there are dangerous voltage and life-threatening voltage on the terminals of the battery bank. It is forbidden to touch the terminals of the battery bank, because it may cause an electric shock!

2.2. Basic rules

Despite every effort, the inverter manufacturer does not guarantee the effectiveness of the protection devices protecting the turbine against achieving unintended rotational speed, i.e. correct operation of the relays switching the braking resistors and controlling the tail operation, in a situation in which they should be switched on (e.g. activation of storm protection, inverter failure, etc.).

For this reason, it is necessary to use an additional system, independent of the inverter, to protect the turbine against achieving unintended rotational speed or other factors that may cause damage to the turbine itself and other resulting consequences.

The manufacturer's liability towards the buyer is limited to the value of the product determined according to the manufacturer's suggested retail price on the date of purchase and does not cover damages resulting from its damage or faulty operation.

- Do not connect a wind turbine to an inverter intended to work with a synchronous generator (WT and H versions) without first connecting the load resistors, as this may result in the turbine reaching an unintended rotational speed and, consequently, damage for which the manufacturer is not responsible.
- The inverter manufacturer is not responsible for the correct choice of braking resistors. Damage to the inverter caused by incorrect choice is not covered by the warranty.
- Do not make any connections when the electrical voltage is supplied to the inverter: from the mains side, photovoltaic panels, wind/water turbine generator, battery bank, etc.
- Do not measure the voltage endurance of any unit devices.
- To measure the cables insulation it is necessary to disconnect them from the device.
- Don’t touch integrated circuits and any other parts on the device’s electronic board even when the device is switched off, as they can be damaged by electrostatic discharge..
- Make sure that no other passive components are connected to the cables, such as resistors, capacitors, coils.
- Do not repair the device by yourself. All repairs can only be carried out by the manufacturer's authorized service. Any modifications or self-repairs of the device can cause physical injury or death, or damage to the device and connected equipment. Any attempt at self-repair will void any warranty..
- After removing the front cover of the inverter, you gain access to the buttons on the operator panel and at the same time to elements that are under voltage that is dangerous to life and health.

  ATTENTION: Particular caution should be exercised due to the possibility of electric shock. Disassembly of the front cover of the inverter (when the device is supplied with voltage from both the mains and the generator) and changes in settings can only be made by a person with appropriate electrical qualifications.
- Periodically, you should check:
  - Connection of protective conductors,
  - Wiring (the connections, insulation),
  - Whether water did not got inside the system,
  - he degree of heat sink dirtiness.

2.3. Protection against electric shock

Protective conductor must be connected to inverter’s PE terminal on terminal strip.

The device has built-in protection against earth fault currents, but it only protects the device and does not protect a user against electric shock.

2.4. Operation list after receiving the device

- After unpacking the device, it is necessary to check up visually the presence of damages which could arise during the transport.
- Check up the correspondence between the delivered frequency converter and the order - check up the ratings plate on the case.
- Check up the correspondence between conditions in which the converter will be used and conditions of the environment for which it is designed.
- Installation of the frequency converter should be made according to principles of safety and EMC rules.

2.5. Environmental conditions

a. Degree of pollution

During design, the second degree of pollution has been assumed, at which there is normally only non-conducting pollution. However there is a probability of temporary conductivity caused by condensation, when the device is disconnected from the voltage source.

In case the environment in which the device will work contains pollution which can influence its safety, it is necessary to apply appropriate counteraction, using, for example, additional cases, air channels, filters etc.

b. Climatic conditions

Table 2.1. Installation, warehousing and transport conditions

	Installation site	During warehousing	During transport
Temperature	-10°C..+40°C	-25°C .. +55°C	-25°C .. +70°C
		In protective packing	
Relative humidity	5% .. 95%	5% .. 95%	Max 95%
	Short-term, insignificant condensation on the external side of the device case is permitted only when the device is disconnected from the voltage source.		
Air pressure	86kPa .. 106kPa	86kPa .. 106kPa	70kPa .. 106kPa

2.6. Recycle

Equipment containing electrical and electronic components may not be disposed of in municipal waste containers. Separate such equipment from other waste and attach it to electrical and electronic waste in accordance with applicable local regulations.

3. Specification

3.1. Technical data

Table 3.1. PS300 inverter technical data

No.	Description	Symbol	Nominal power						
			3 kW	**5 kW**	**8 kW**	**10 kW**	**12 kW**	**20 kW**	**30 kW**
1	WT input (alternating voltage): synchronous generator with permanent magnets *PS300-WT and PS300-H inverters*								
1.1	Working voltage range from the AC generator side	U_{GEN}	3 x 60..425 V_{AC} (Phase - Phase)						
1.2	Rated voltage from the AC generator side	U_{GEN-N} (N* nominal)	3 x 400 V_{AC}						
1.3	Maximum input current from the AC generator side								
	PS300-WT	$I_{GEN-MAX}$	13 A	13 A	13 A	20 A	--	40 A	50 A
	PS300-H	$I_{GEN-MAX}$	-	13 A	13 A	13 A	--	25 A	25 A
2	Inputs PV1, PV2 (direct voltage): solar panels *PS300-PV and PS300-H inverters*								
2.1	MPPT voltage range *inverter working voltage range*	U_{MPPT}	120 - 850 V_{DC}						
2.2	Feed-in start voltage	$U_{PV-START}$	120 V_{DC}						
2.3	Nominal PV input voltage	U_{PV-NOM}	650 V_{DC}						
2.4	Maximum input voltage *maximum allowable voltage from the PV side, exceeding the given value may damage the inverter*	U_{PV-MAX}	900 V_{DC}						
2.5	Maximum current of PV panels								
	PS300-PV	I_{PV-MAX}	13 A	13 A	2x13 A	2x13 A	2x15 A	2x25 A	2x25 A
	PS300-H	I_{PV-MAX}	--	13 A	13 A	13 A	--	25 A	25 A
2.6	Maximum short circuit current of PV panels								
	PS300-PV	I_{PV-SC}	20 A	20 A	2x20 A	2x20 A	2x20 A	2x40A	2x40A
	PS300-H	I_{PV-SC}	--	20 A	20 A	20 A	--	40 A	40 A
2.7	Type of PV connector	-	MC4						
3	The number and types of inputs depending on the power and variant of inverter								
3.1	PS300-PV								
	PV inputs		1		2			4	
	MPPT individual strings		1		2			2	
	WT inputs		0						
3.2	PS300-WT								
	PV inputs		0						
	MPPT individual strings		*not applicable*						
	WT inputs		1						
3.3	PS300-H								
	PV inputs		-	1				2	
	MPPT individual strings		-	1					
	WT inputs		-	1					

No.	Description	Symbol	Nominal power						
			3 kW	**5 kW**	**8 kW**	**10 kW**	**12 kW**	**20 kW**	**30 kW**
4	Nominal AC output power	P_N	3 kW	5 kW	8 kW	10 kW	12 kW	20 kW	30 kW
5	Output voltage (from the power grid side)	U_{OUT}	3 x 400 V, 50 Hz						
6	Maximum output current	I_{OUT}	4,5 A	7,5 A	12,0 A	14,5 A	18 A	30 A	45 A
7	Efficiency (at rated output power)	η	97 %						
8	Current THD	THDi	< 3%						
9	Working mode	-	on-grid				on-grid, off-grid		
10	Switching frequency	f_{SW}	16 kHz						
11	Maximum temperature of heatsink	$T_{RAD-MAX}$	85 °C						
12	Communication	-	Ethernet, RS-485, Wi-Fi (option)						
13	Digital inputs	DI1..DI5	5 digital inputs: 5 Vdc or 7 Vdc depending on implementation						
14	Relay outputs	K1, K4* K2, K3	K1, K4*: Switchable NO/NC 2A 230V AC K2, K3: NO, 2A 230V AC * K4 is present in 20 kW and 30 kW inverters						
15	*Internal relays controlling the operation of braking resistors PS300-WT and PS300-H inverters*	Resistor	Inverters 3 kW – 10 kW: 30 A, AC1 Inverters 20 kW and 30 kW: use an external contactor, the K4 relay is dedicated to control the operation of this contactor						
16	Protections	- Before the generator run-up - Before working in off-grid mode – in inverters dedicated to work only in on-grid mode - Electrical network parameters monitoring system - Before too high inverter temperature							
17	Algorithm of Maximum Power Point Tracking	• WT synchronous generator input (AC): characteristic *Igen=f(fgen)* defined by user. • PV input (DC): advanced MPPT global tracking system that guarantees finding the optimal operating point even with partially shaded or in series-connected panels.							
18	Power consumption in standby mode	-	20 W						
19	Humidity	-	85% for 40°C						
20	Ambient temperature range	-	-10°C..+40°C						
21	IP protection	-	IP65						
22	Weight	-	*Look at the chapter 3.2* on page *12*.						

Table 3.2. Battery charger module technical data – „+BC” option

No.	Description	Symbol	Value
1	Battery voltage range	U_{BAT-N}	48..640 V_{DC}
2	Rated charging/discharging current	$I_{BAT-MAX}$	50 A
3	Battery communication interface	-	RS-485, CAN

3.2. Mechanical dimensions and weight – 3 kW, 5 kW, 8 kW, 10kW on-grid inverters

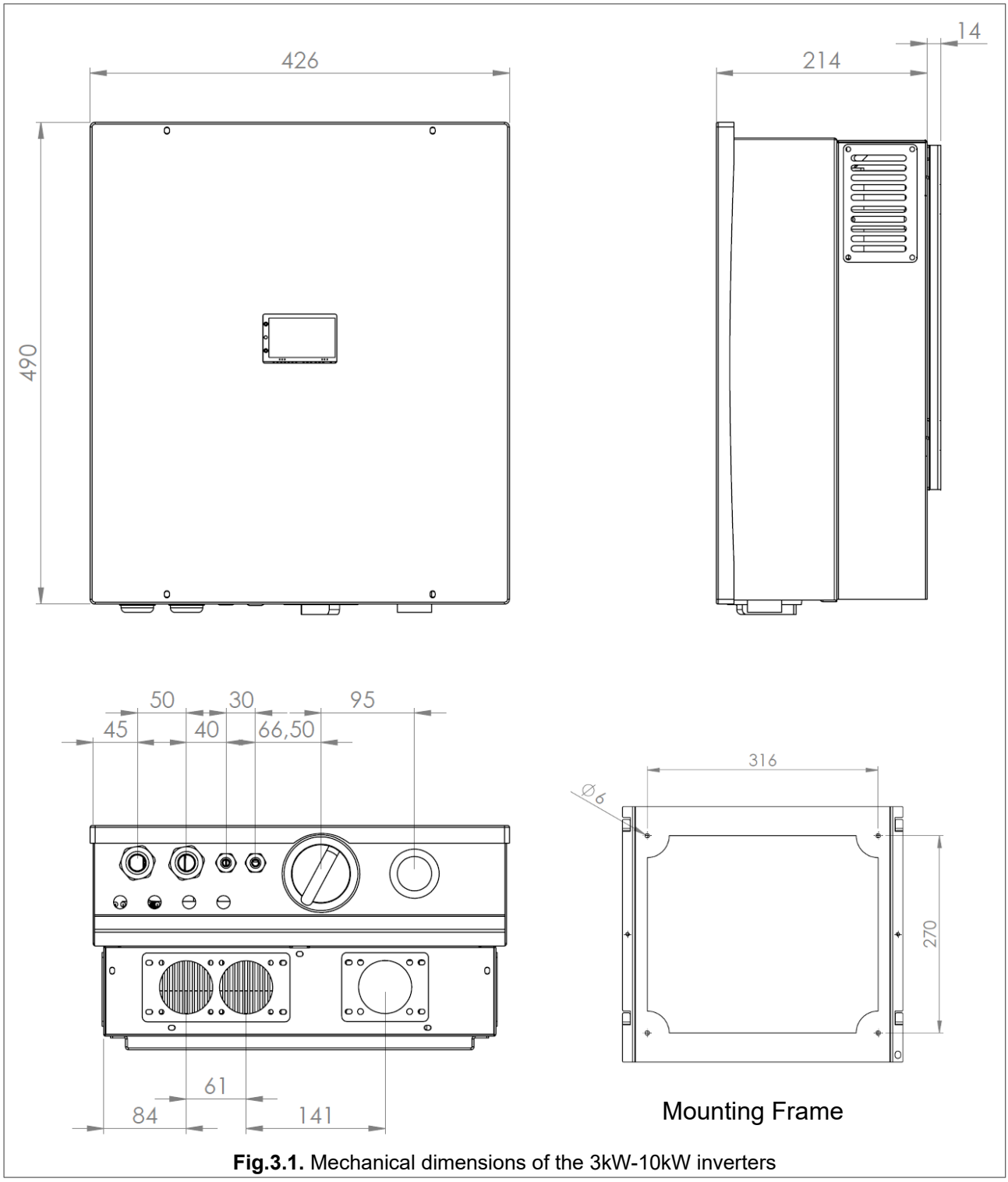


Fig.3.1. Mechanical dimensions of the 3kW-10kW inverters

Weight of the inverter with mounting frame: 33 kg.

3.3. Mechanical dimensions and weight – 12 kW, 20 kW and 30 kW on-grid/off-grid inverters

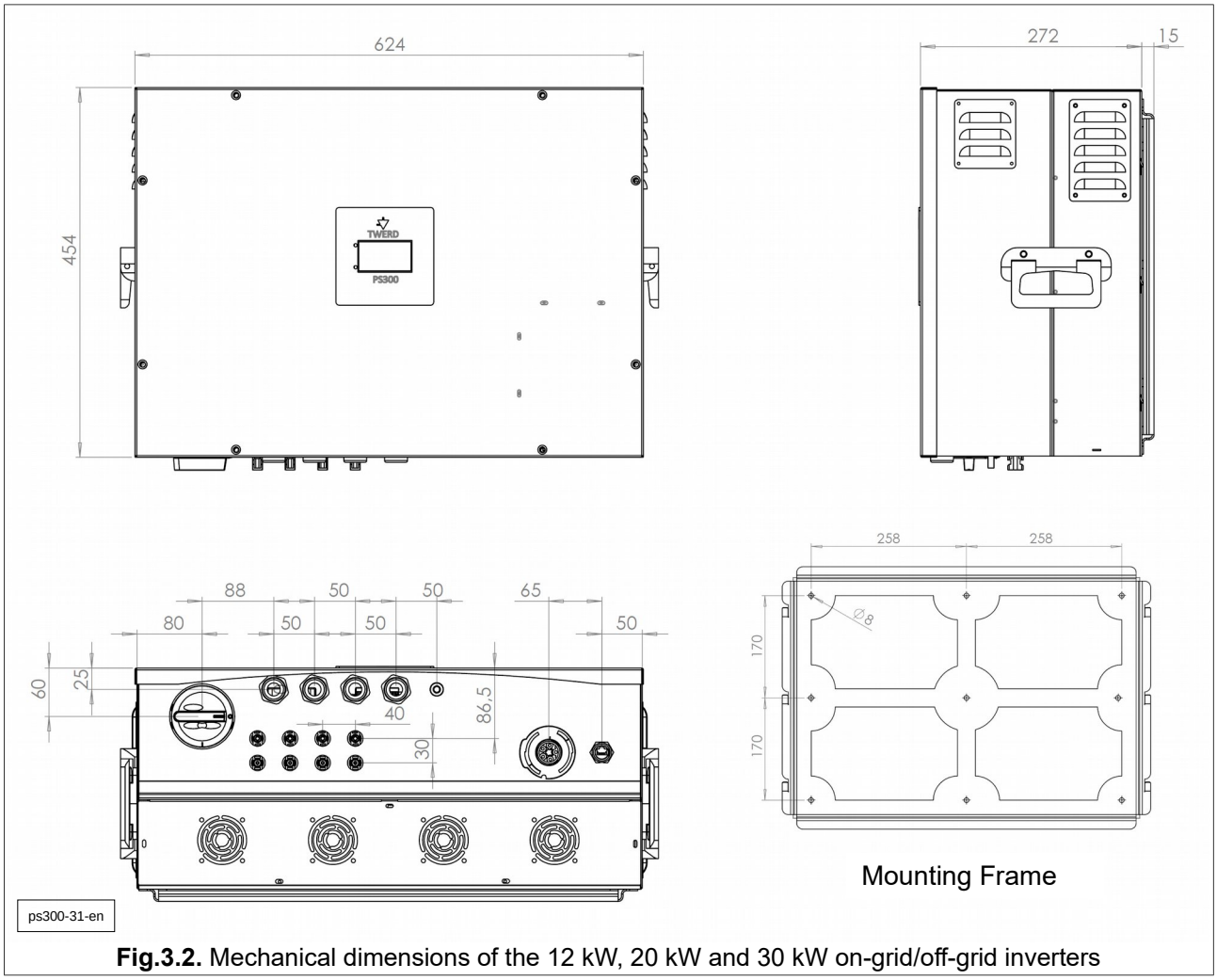


Fig.3.2. Mechanical dimensions of the 12 kW, 20 kW and 30 kW on-grid/off-grid inverters

Weight of the inverter with mounting frame: 58 kg.

3.4. View from the connectors side – 3kW, 5 kW, 8 kW, 10 kW on-grid inverters

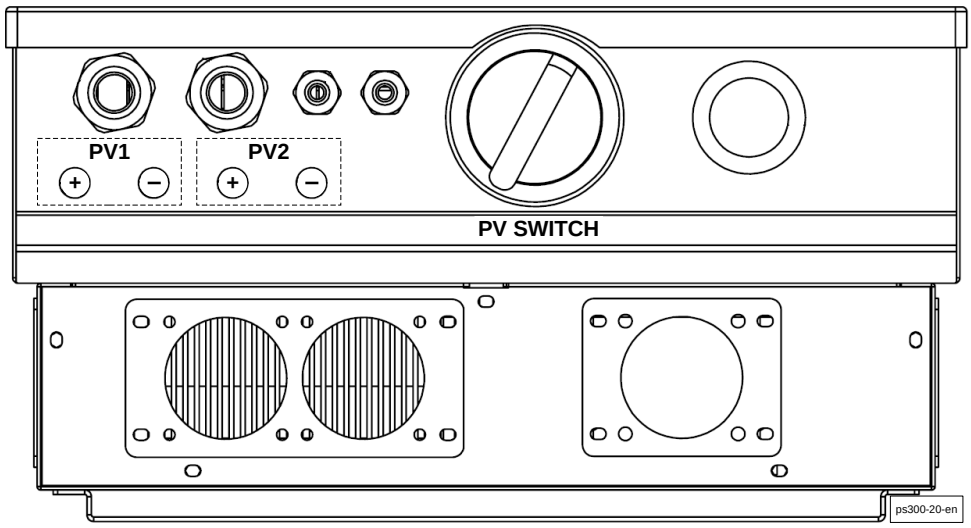


Fig.3.3. View from the connectors side – 3 kW, 5 kW, 8 kW, 10 kW inverters.

Note: PV connectors and a PV switch only exist in the PS300-PV and PS300-H inverters

3.5. View from the connectors side – 12 kW, 20 kW and 30 kW on-grid/off-grid inverters

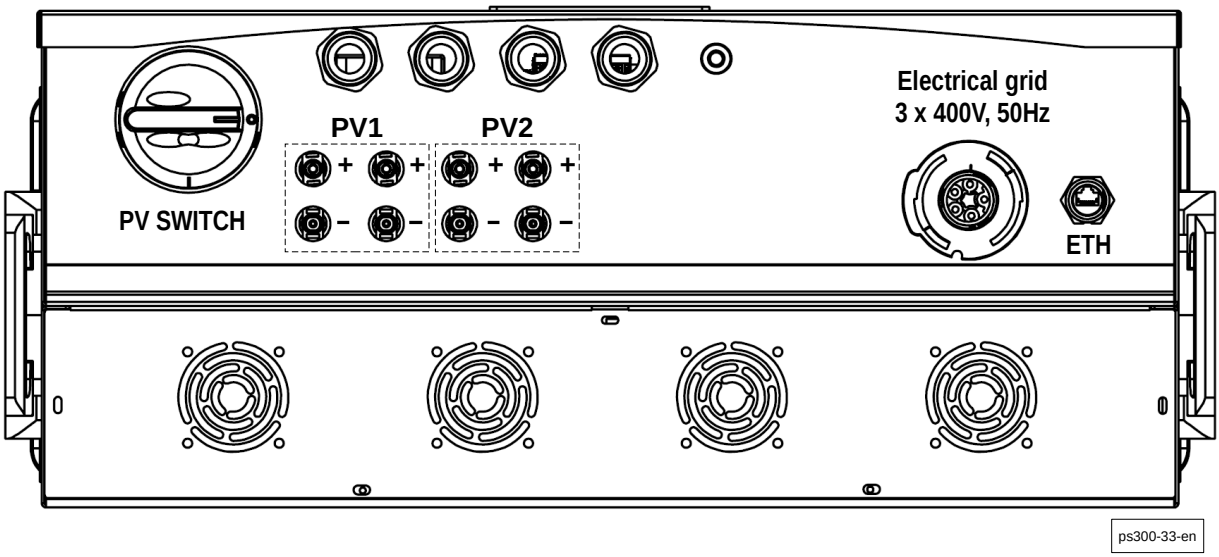


Fig. 3.4. View from the connectors side – 12 kW, 20 kW and 30 kW inverters.

Note: PV connectors and a PV switch only exist in the PS300-PV and PS300-H inverters

4. Preparing for installation

4.1. Inverter installation location

- The inverter is designed for installation both indoors and outdoors.
- The inverter has an IP65 protection rating and should be considered when choosing the mounting location.
- To keep the inverter temperature as low as possible, the inverter must not be exposed to direct sunlight. The inverter must be installed in a sheltered place.
- In general, the inverter has a dustproof construction. However, in areas with high dustiness, cooling surfaces can be dusted and the thermal performance may be significantly reduced. In this case, it is necessary to clean the heat sink regularly. Therefore installation is not recommended in rooms and areas with high dustiness.
- The inverter must not be installed in:
    - flammable and / or explosive environment as it may cause fire and / or explosion,
    - area of puffing ammonia, corrosive vapors, acidified or salty air (e.g. in fertilizer depots, barn ventilation holes, chemical installations, tanneries, etc.),
    - premises with an increased risk of accidents involving farm animals (horses, cattle, sheep, etc.)
    - stables and adjacent rooms,
    - warehouses and warehouses for hay, straw, sawdust, animal feed, fertilizers, etc.,
    - greenhouses,
    - rooms where fruit, vegetables and vines are stored and processed,
    - rooms for the preparation of cereals, green feed and feed additives.
- Due to the low noise generated by the inverter in certain operating conditions, staying for a long time may be slightly burdensome for some people, so installation in the immediate vicinity of living quarters is not recommended.

4.2. Environmental condition

The PS300 inverter should work in dry rooms with little dust. Ambient temperature should not exceed 40 °C and relative humidity 85% according to tab. 2.1 on page 9.

4.3. Cooling

In order to ensure the required air circulation, the inverter should be mounted so as to keep a free space of at least 20 cm from the top and bottom and 10 cm from both sides. When installing in a closed enclosure, use ventilation openings. It is advisable to use an additional fan. Prevent dust from settling on the heat sink surface. The radiator should be cleaned from time to time.

4.4. Power line connector – 3 kW, 5 kW, 8 kW, 10 kW on-grid inverters

Remember to carry out voltage-free installation work. Otherwise, there is a risk of electric shock that is dangerous to health and life.

The Wieland RST20I5S S1 M01V SW (96.052.5053.1) connector is installed in the inverter - Fig. 4.1. The **Wieland RST20I5S B1 ZR1 SW (96.051.4053.1)** connector (Fig. 4.2), which is included with the inverter, is used to connect the inverter to a 3-phase 400 V, 50 Hz mains. The terminals on the connector are respectively labelled: L1, L2, L3 and N. The PE protective conductor terminal is marked with the earthing symbol ⏚.

Fig. 4.1. View of Wieland RST20I5S S1 M01V SW (96.052.5053.1) connector installed in the inverter

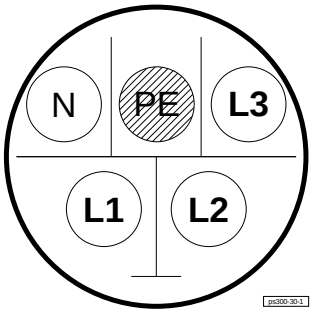


Fig. 4.2. View of the Wieland RST20I5S B1 ZR1 SW (96.051.4053.1) connector for connection electricity grid

Pictures 4.3 - 4.5 below show the subsequent stages of connector preparation.
Picture 4.6 shows how to disconnect the connector - remember about the latch (1) in Fig. 4.6.

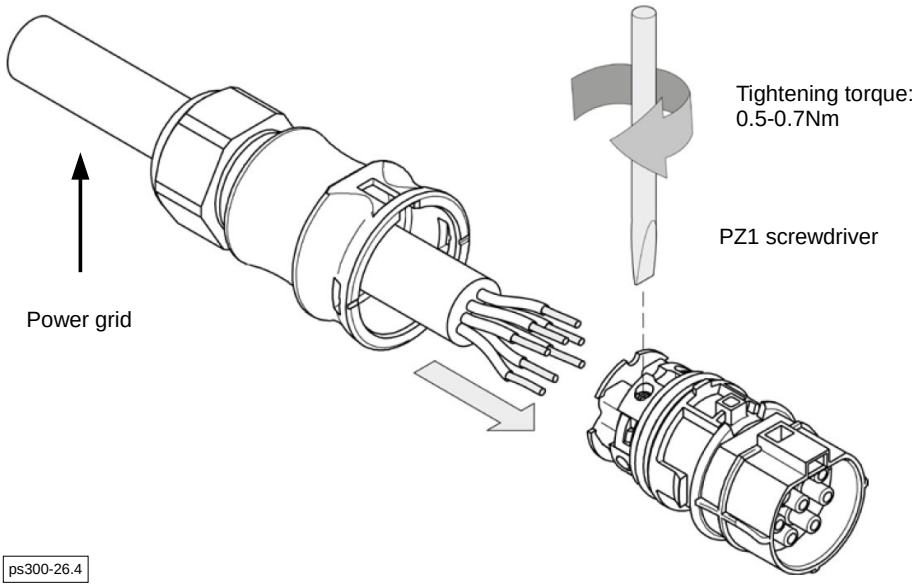


Fig.4.3. Connector preparation

Diameter of connection wires: 0.75-4 mm^2 (solid and stranded).
Tightening torque for electrical connection screws: 0.5-0.7 Nm. PZ1 screwdriver.

Full assembly instructions for the RST20I5S B1 ZR1 SW connector (96.051.4053.1) are available on the Wieland website.

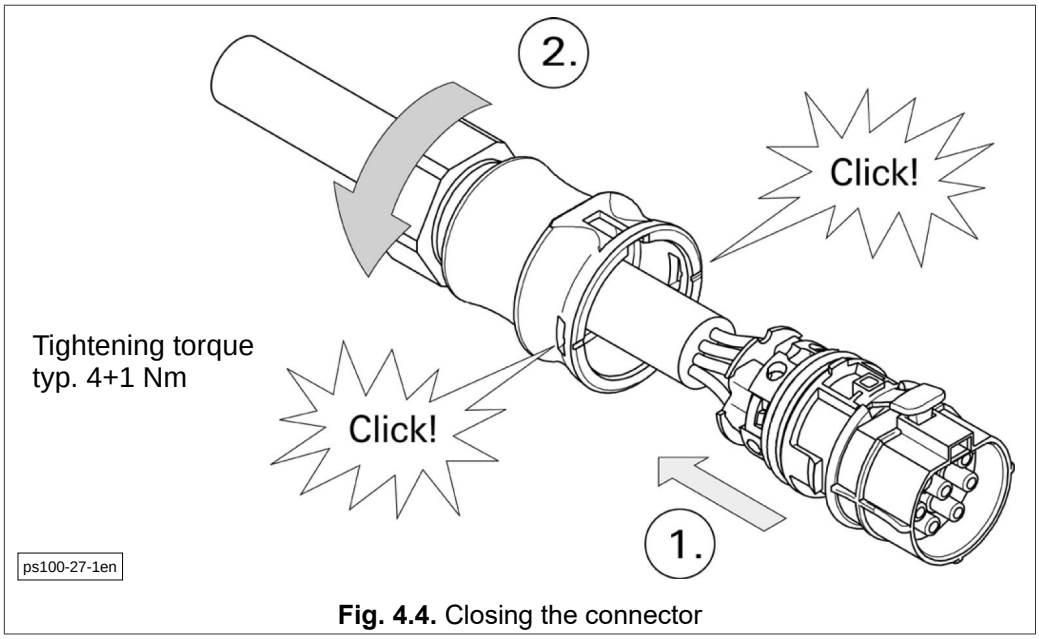


Fig. 4.4. Closing the connector

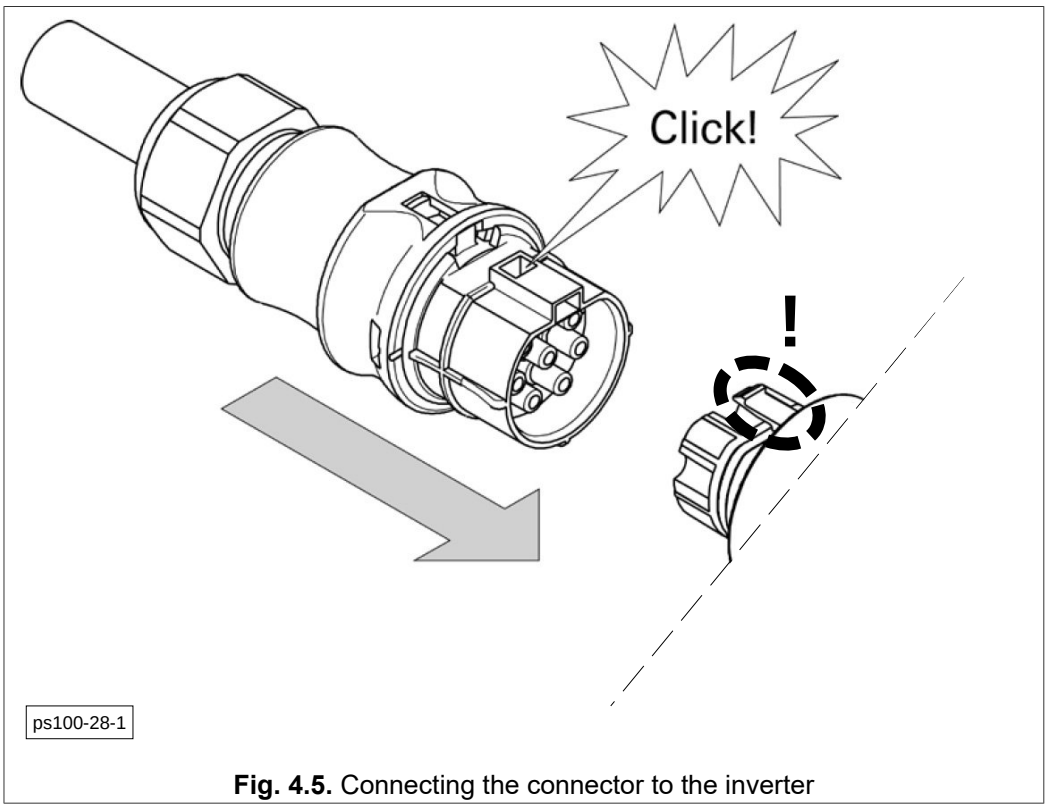


Fig. 4.5. Connecting the connector to the inverter

Note: If you need to disconnect the connector, remember to latch - 1. in Fig. 4.6.

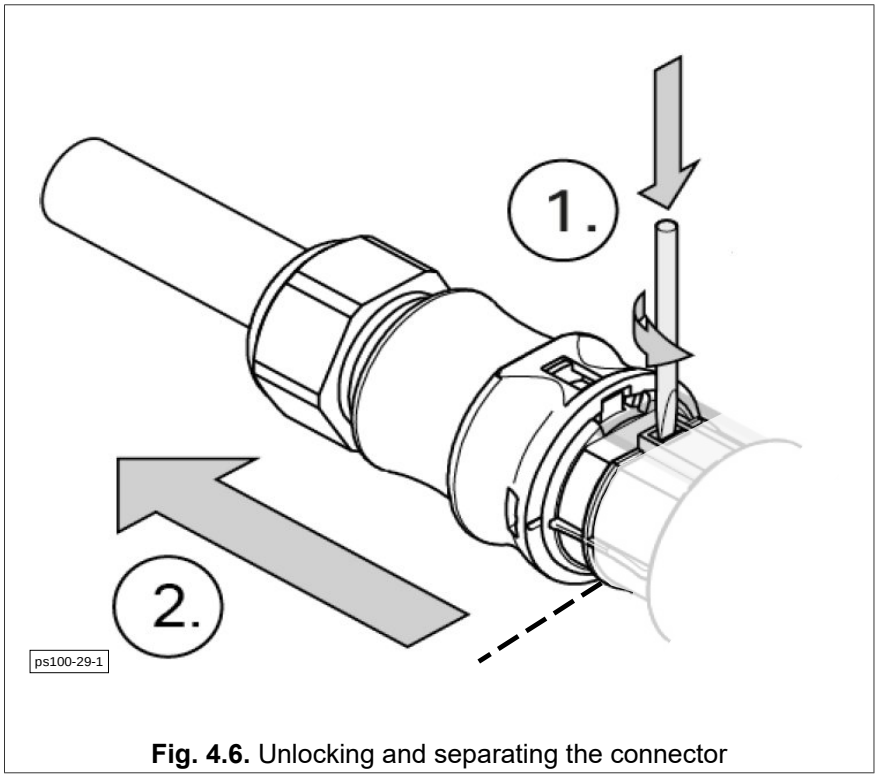


Fig. 4.6. Unlocking and separating the connector

4.5. Power line connector – 12 kW, 20 kW and 30 kW on-grid/off-grid inverters

Depending on the version, the inverter can be connected to the mains via a terminal strip or the Wieland RST50I5S B1 ZR7 S SW connector, product number 97.051.4253.1.

Figure 4.7 shows the view of the Wieland RST50I5S B1 ZR7 S SW connector.

Fig. 4.7. View of the Wieland RST50I5S B1 ZR7 S SW connector

During preparing the connector, pay attention to correct assembly– Fig. 4.8.

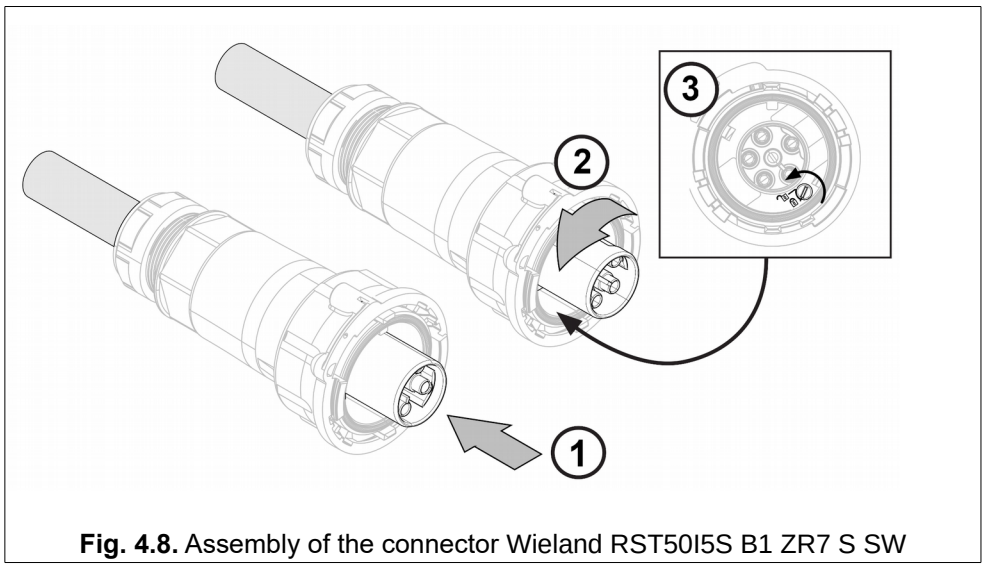


Fig. 4.8. Assembly of the connector Wieland RST50I5S B1 ZR7 S SW

Diameter of connecting wires: 4.0-6 mm^2 (solid), 4.0-16 mm^2 (stranded). For 4 mm^2 stranded wire, use a cable ferrule. Tightening torque for electrical connection screws: 2 Nm.
Full assembly instructions for the RST50I5S B1 ZR7 S SW connector are available on the Wieland website.

If the connection is made via the Wieland RST50I5S B1 ZR7 S SW connector, the Wieland RST50I5S S1 ZM02V SW socket, product number 97.052.5553.1, is installed in the inverter.

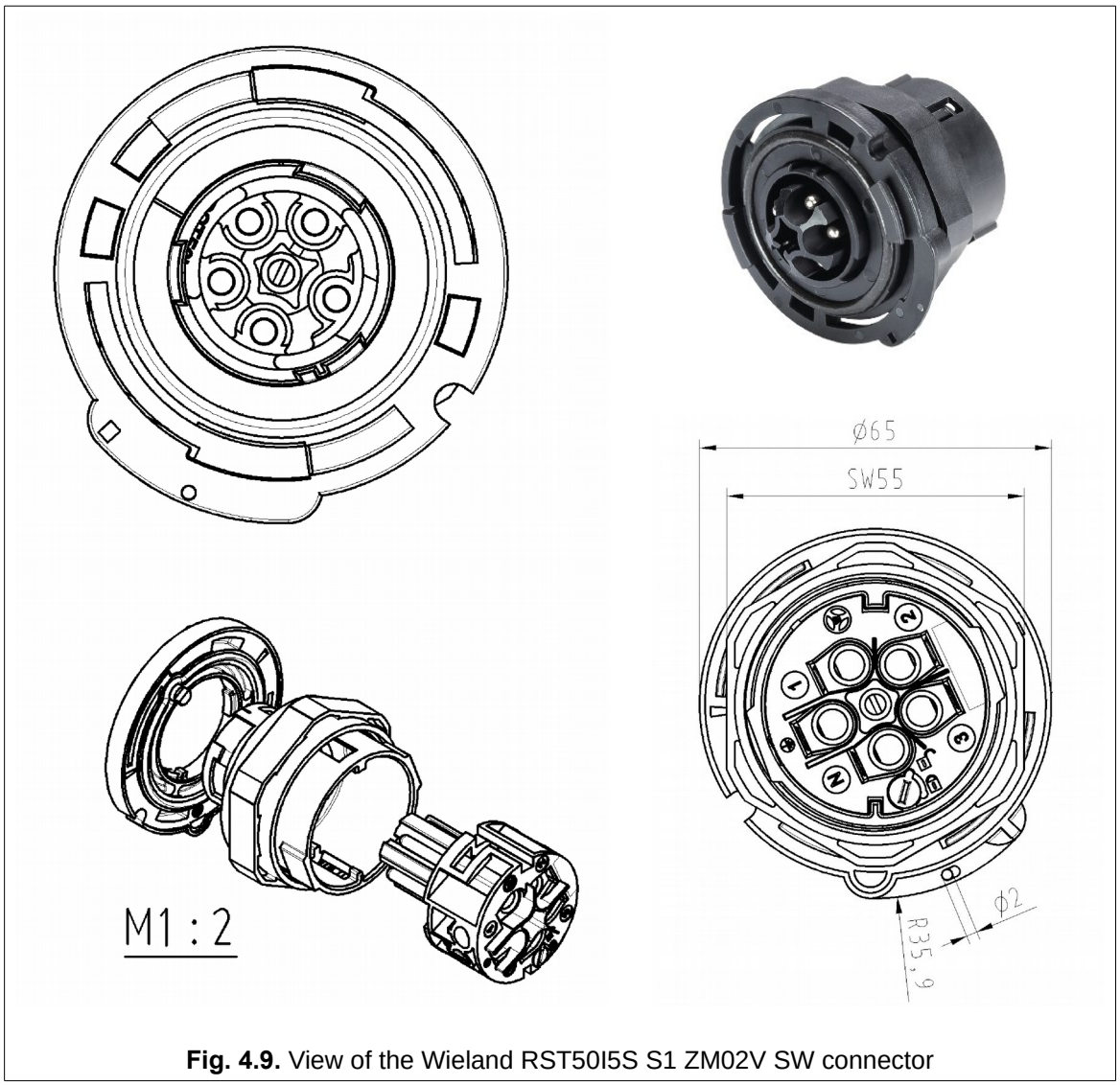


Fig. 4.9. View of the Wieland RST50I5S S1 ZM02V SW connector

4.6. Installation position

The inverter is designed to be installed vertically on a vertical wall (±15 degree) with connectors facing downwards. The inverter is not designed to be installed in any others positions, especially:

- in horizontal position,
- on sloping surface,
- when connectors facing downwards,
- on the ceiling,
- overhangs with its connection sockets facing upwards.

Inverters: 3 kW, 5 kW, 8 kW, 10 kW

1. Fasten the mounting frame with 4 screws.

2. Hang the inverter on the mounting frame and secure it with two screws and optionally with a padlock.

ATTENTION: The assembly should be performed by at least two people with appropriate protection measures.

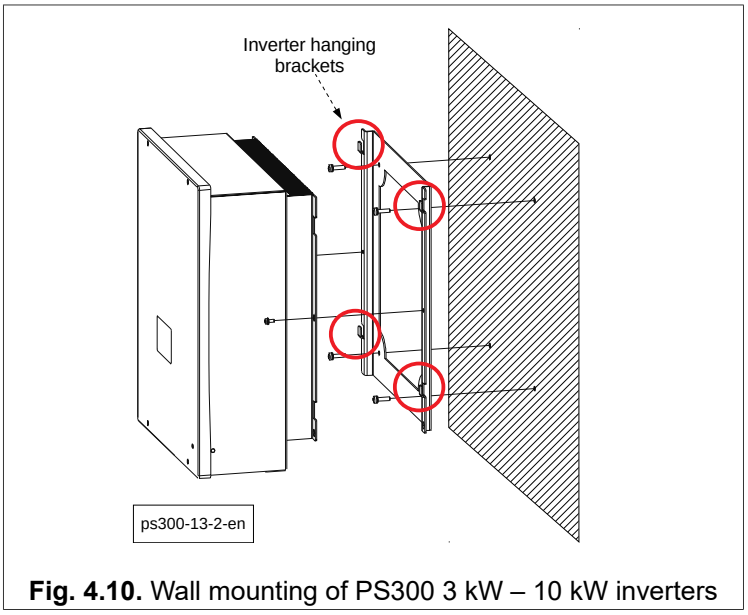


Fig. 4.10. Wall mounting of PS300 3 kW – 10 kW inverters

Inverters: 12 kW, 20 kW and 30 kW

1. Fasten the inverter mounting frame with 9 screws.

2. Hang the inverter on the mounting frame, making sure that it is securely seated on the 9 holders.

ATTENTION: Due to the high weight of the inverter, its assembly should be carried out by at least two people (recommended three) with appropriate protection measures.

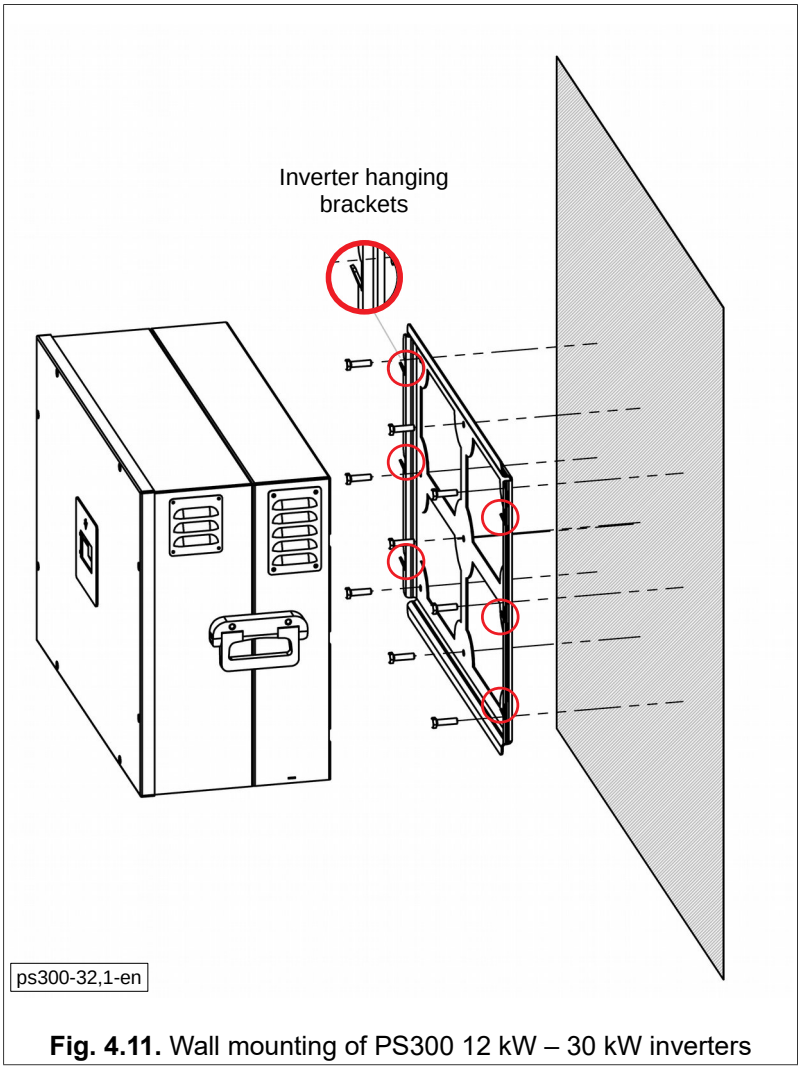


Fig. 4.11. Wall mounting of PS300 12 kW – 30 kW inverters

4.7. Power circuit terminals

The following figures show electrical diagrams of power cable connections. The power electric circuit is connected to the terminal strip, which is located on the bottom plate of the device. On it there are also fuses of a value depending on the inverter power - Table 4.1.

Table 4.1. Internal DC and power supply lines fuses values

PS300	Internal DC protection fuse (RESs side)	Fuse protection from electrical grid side
3 kW	16A DC	B10
5 kW	2 x 16A DC	B10
8 kW	2 x 16A DC	B16
10 kW	2 x 16A DC	B20
12 kW	2 x 16A DC	B20
20 kW	2 x 30A DC	B40
30 kW	2 x 30A DC	B50

Blow of fuse can be caused by incorrect operation of the inverter or connected to it electric circuits. Replacing the fuse without analysing the cause of the failure may result in more severe damage to the inverter that is not covered by the warranty. For this reason, the replacement of fuse can only be done by the manufacturer's service.

4.8. Usage of residual current devices

Due to the built-in RFI filter, the residual current must be at least 200 mA.

5. ON-GRID installation

Applies to:

- PS300-WT,
- PS300-PV,
- PS300-H.

DO NOT MAKE ANY CONNECTIONS WHEN AN ELECTRICAL VOLTAGE IS PROVIDED TO THE INVERTER!

THE VOLTAGE SOURCE MAY BE BETWEEN OTHER:
PV PANELS, GENERATOR, ELECTRIC NETWORK, BATTERIES, EXTERNAL CONTROL CIRCUITS.

INSTALLATION, MAINTENANCE AND MAINTENANCE OF INVERTER TECHNICAL PERFORMANCE MAY ONLY BE CARRIED OUT BY A PERSON WHO HAVE APPROPRIATE QUALIFICATIONS AND HAVE SUFFICIENT KNOWLEDGE IN THE OPERATION OF ELECTRICAL INSTALLATIONS.

INCORRECT INSTALLATION AND MAINTENANCE OF THE TECHNICAL PERFORMANCE OF THE APPLIANCE MAY CAUSE DANGER TO LIFE, HUMAN HEALTH, LOSS OF PROPERTY, OR IRREVERSIBLE DAMAGE TO THE APPLIANCE.

There are two kind of inputs from the Renewable Energy Sources side:

- **WT input (AC voltage input):** permanent magnet synchronous generator input – used for **PS300-WT** and **PS300-H** inverters;
- **PV inputs (DC voltage inputs)**: photovoltaic panels input – used for **PS300-PV** and **PS300-H** inverters.

Installation operations must be carried out in accordance with following chapters.

After their execution, the inverter will be ready for autonomous operation without user intervention.

The user via the inverter control panel and the dedicated website www.inverters.pl (the inverter must be connected to the Internet) described in chapter 13. “Inverter Monitoring System via www.inverters.pl“ on page 55 has access to information about the current operating status of the device and historical data.

By connecting directly to the inverter via the RS-485 Modbus RTU or Ethernet Modbus TCP/IP communication link, the user can access the inverter configuration parameters.

A detailed description of the configuration of communication with the inverter can be found in chapter 12. “Communication parameters setting“ on page 50.

ATTENTION:

When installing the inverter, it should be remembered that the electric circuit on the generator or PV panel side must be galvanically separated from the power line supply. Additional measurement circuits between the generator and the inverter must also comply with this principle. Otherwise, the inverter it can work incorrectly or even damage that will not be covered by the warranty.

5.1. Wind turbine WT inverter with AC input – 3 kW, 5 kW, 8 kW, 10 kW

Wind turbine WT inverter is dedicated to use with with permanent magnet synchronous AC generators.

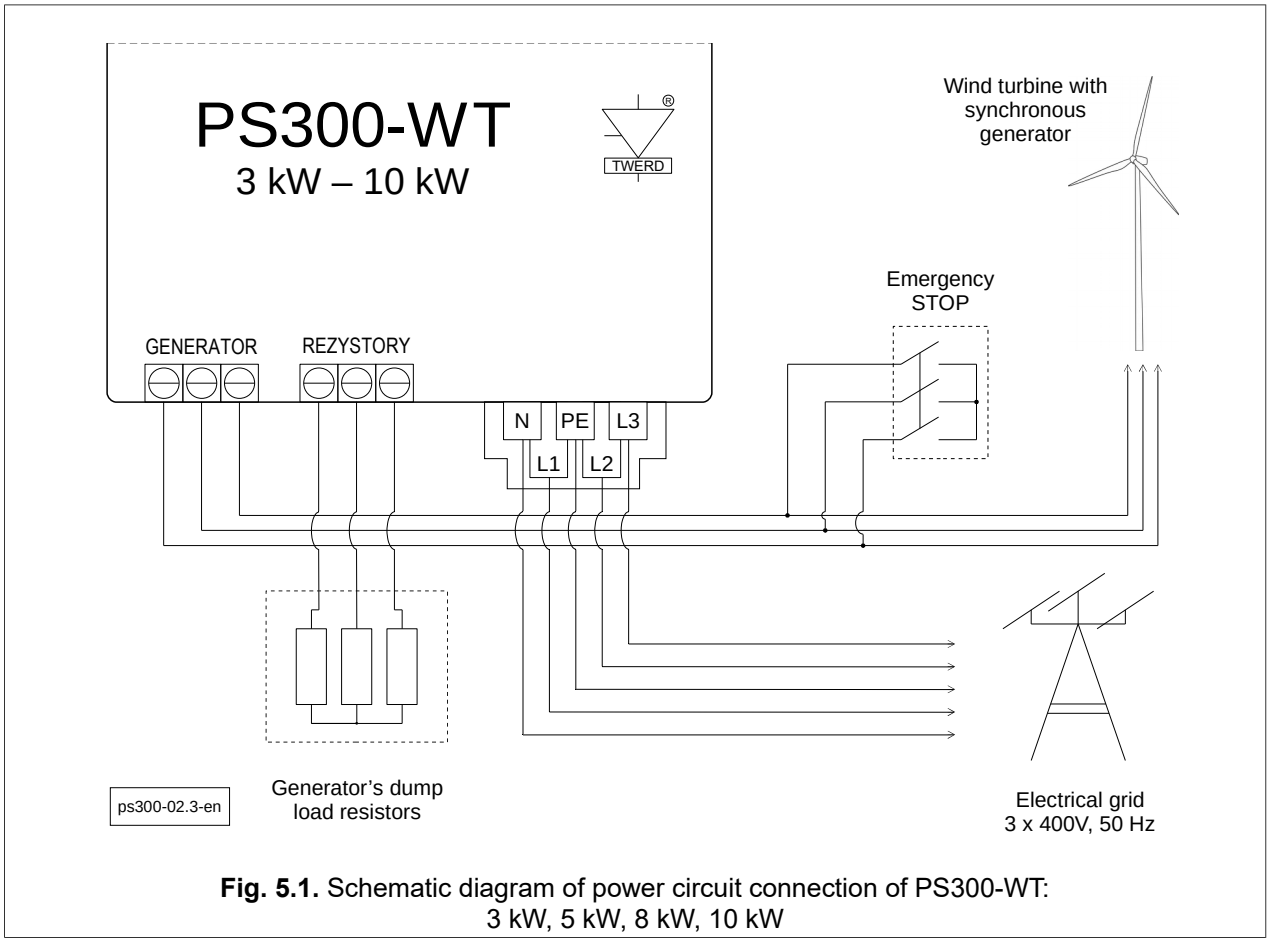


Fig. 5.1. Schematic diagram of power circuit connection of PS300-WT: 3 kW, 5 kW, 8 kW, 10 kW

The order of installation operations:

1. **Switch On the Emergency STOP.**
2. Unscrew the inverter cover by 4 screws.
3. Connect the generator wires to GENERATOR terminal strip.
4. Connect the generator load resistors to REZYSTORY terminal strip.
5. Be sure that there is no dangerous voltage on wires(!) and then connect to L1, L2, L3, N, PE terminal strip the electrical line.
6. **Switch On the power** from public electric side.
7. Set the inverter parameters: load characteristic in group 3, breaking parameters in group 10, the point of start and stop of generator in parameters: 2.1, 1.20 and 1.21. Detailed description is placed in chapter 9.
8. Refasten the inverter cover by four screws.
9. **Switch OFF the Emergency STOP.**
10. Wait a moment to ensure that the inverter did not signal the fault.

Note: The above schematic diagram does not take include the safety devices that must be used in accordance with the applicable regulations.

5.2. Wind turbine WT inverter with AC input: 20 kW and 30 kW

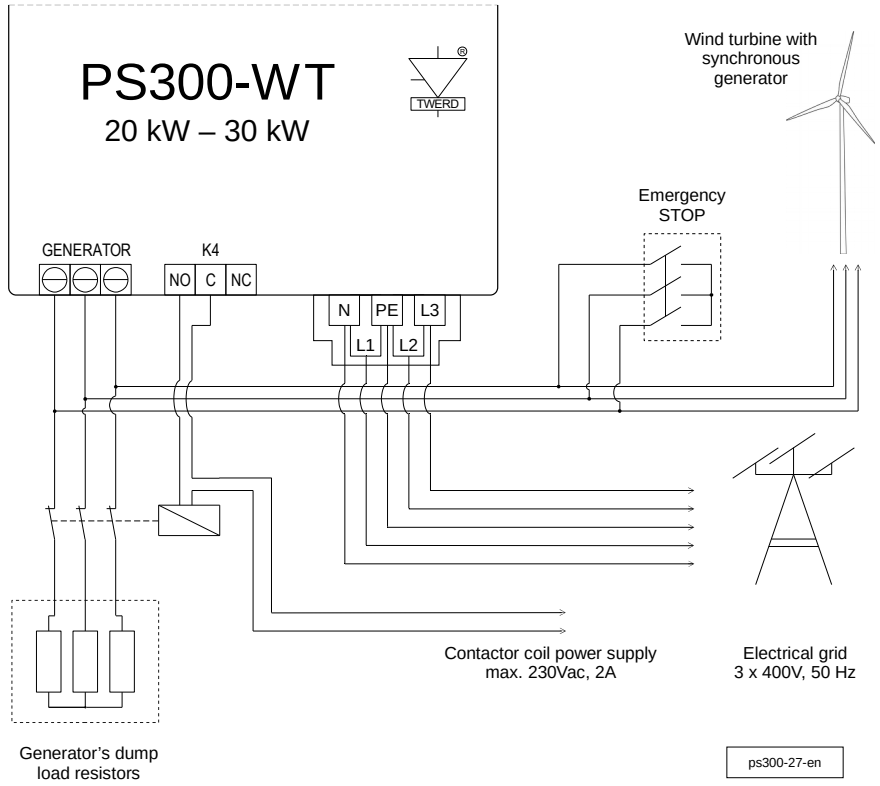


Fig. 5.2. Schematic diagram of power circuit connection of PS300-WT: 20 kW i 30 kW

The order of installation operations:

1. **Switch On the Emergency STOP.**
2. Unscrew the inverter cover.
3. Connect the generator wires to GENERATOR terminal strip.
4. Connect the coil leads of the NC contactor that switches the generator load resistors to the NO and C terminals of the K4 relay.
5. Be sure that there is no dangerous voltage on wires(!) and then connect to L1, L2, L3, N, PE terminal strip the electrical line.
6. **Switch On the power** from public electric side.
7. Set the inverter parameters: load characteristic in group 3, breaking parameters in group 10, the point of start and stop of generator in parameters: 2.1, 1.20 and 1.21. Detailed description is placed in chapter 9.
8. Refasten the inverter cover.
9. **Switch OFF the Emergency STOP.**
10. Wait a while to ensure that the inverter did not signal the fault.

Note:

1. The above schematic diagram does not take into account the safety devices which should be selected accordingly with applicable regulations.

2. The contactor and load resistors should be selected in accordance with the guidelines of the turbine manufacturer. These items are not included with the inverter.

3. Do not ground the star point of the generator load resistors.

5.3. Photovoltaic panels PV inverter with DC inputs: 3 kW, 5 kW, 8 kW, 10 kW, 12 kW, 20 kW, 30 kW

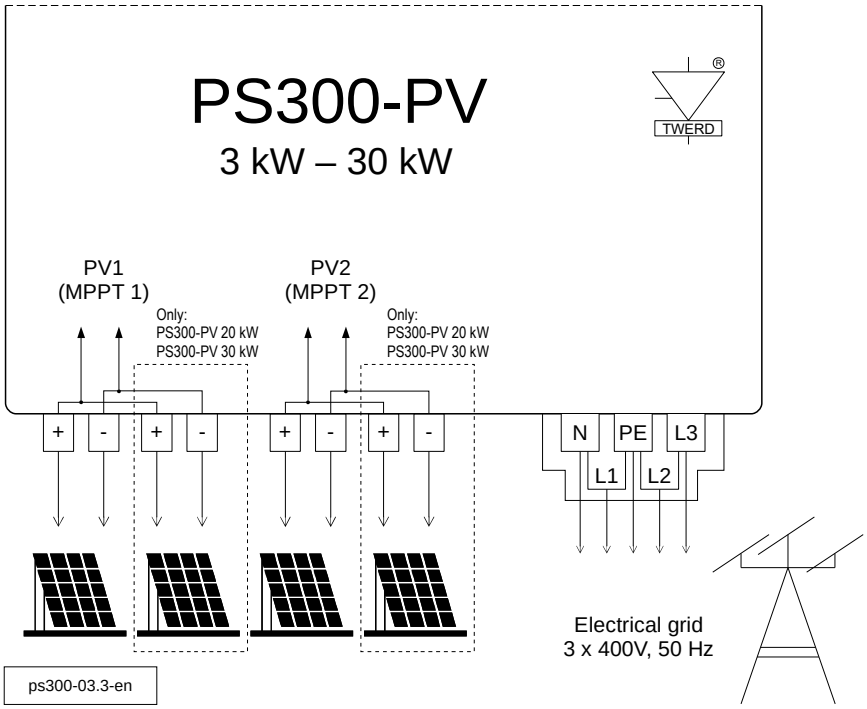


Fig. 5.3. Schematic diagram of PS300-PV (3 kW – 30 kW) power circuit connection

The order of installation operations:

1. **Switch OFF** the PV switch.
2. Be sure that there is no dangerous voltage on wires(!) and then connect to L1, L2, L3, N, PE terminal strip the electrical line.
3. Measure the voltage of solar panels and check their polarization.
4. Connect solar panels to dedicated PV connectors.
5. **Switch On the power** from public electric line.
6. **Switch ON** the PV switch.
7. Wait a while to ensure that the inverter did not signal the fault.

Note: The above schematic diagram does not take include the safety devices that must be used in accordance with the applicable regulations.

5.4. Hybrid inverter: 3 kW, 5 kW, 8 kW, 10 kW

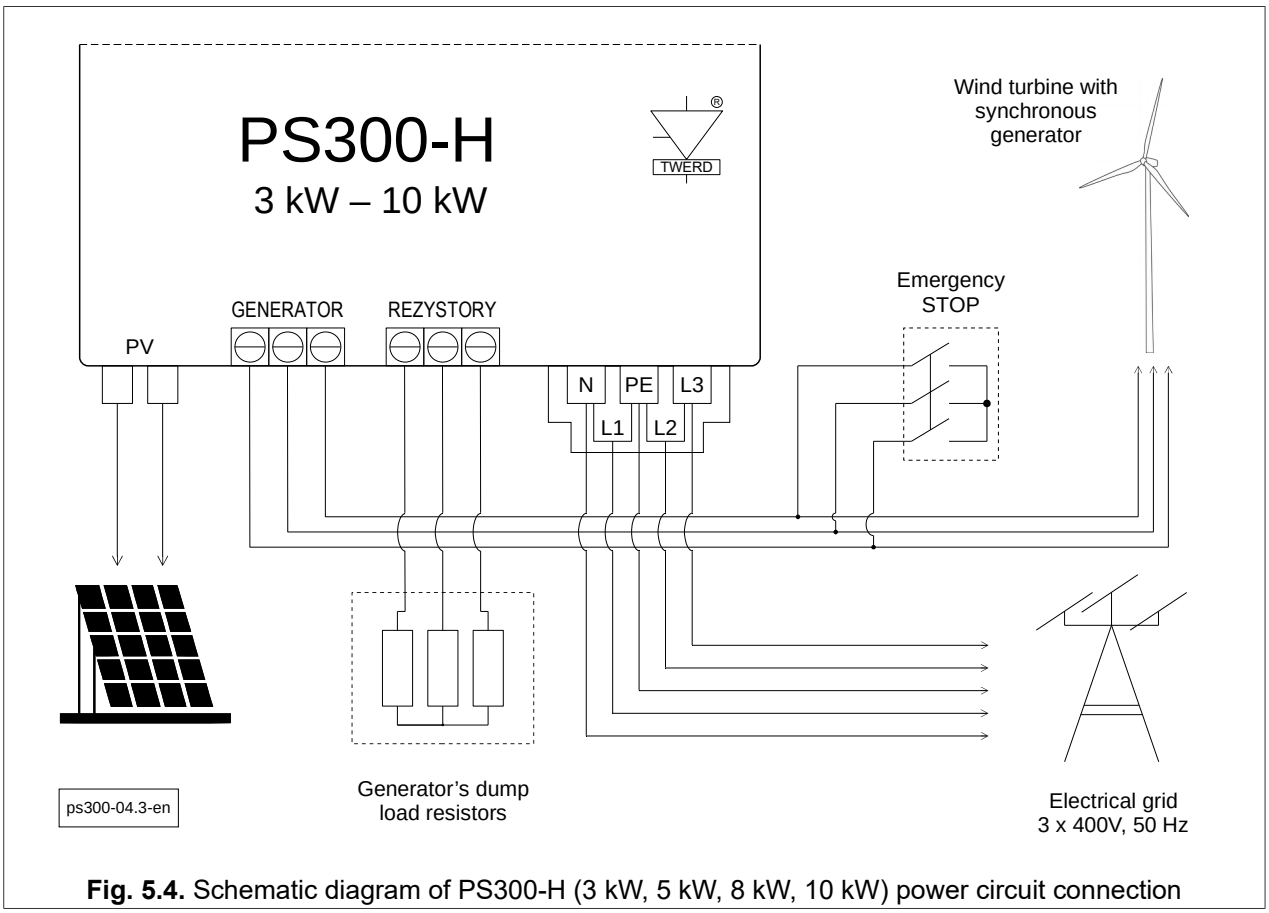


Fig. 5.4. Schematic diagram of PS300-H (3 kW, 5 kW, 8 kW, 10 kW) power circuit connection

The order of installation operations:

1. **Switch On the Emergency STOP.**
2. **Switch OFF the PV switch**.
3. Unscrew the inverter cover by 4 screws.
4. Connect the generator wires to GENERATOR terminal strip.
5. Connect the generator load resistors to REZYSTORY terminal strip.
6. Be sure that there is no dangerous voltage on wires(!) and then connect to L1, L2, L3, N, PE terminal strip the electrical line.
7. **Switch On the power** from grid side.
8. Set the inverter parameters: load characteristic in group 3, breaking parameters in group 10, the point of start and stop of generator in parameters: 2.1, 1.20 and 1.21. Detailed description can be found in chapter 9.
9. Refasten the inverter cover.
10. Measure the voltage of solar panels and check their polarization.
11. Connect solar panels to dedicated PV connectors.
12. **Switch OFF** the Emergency STOP.
13. **Switch ON** the **PV switch.**
14. Wait a while to ensure that the inverter did not signal the fault.

Note: The above schematic diagram does not take include the safety devices that must be used in accordance with the applicable regulations.

5.5. Hybrid inverter: 20 kW, 30 kW

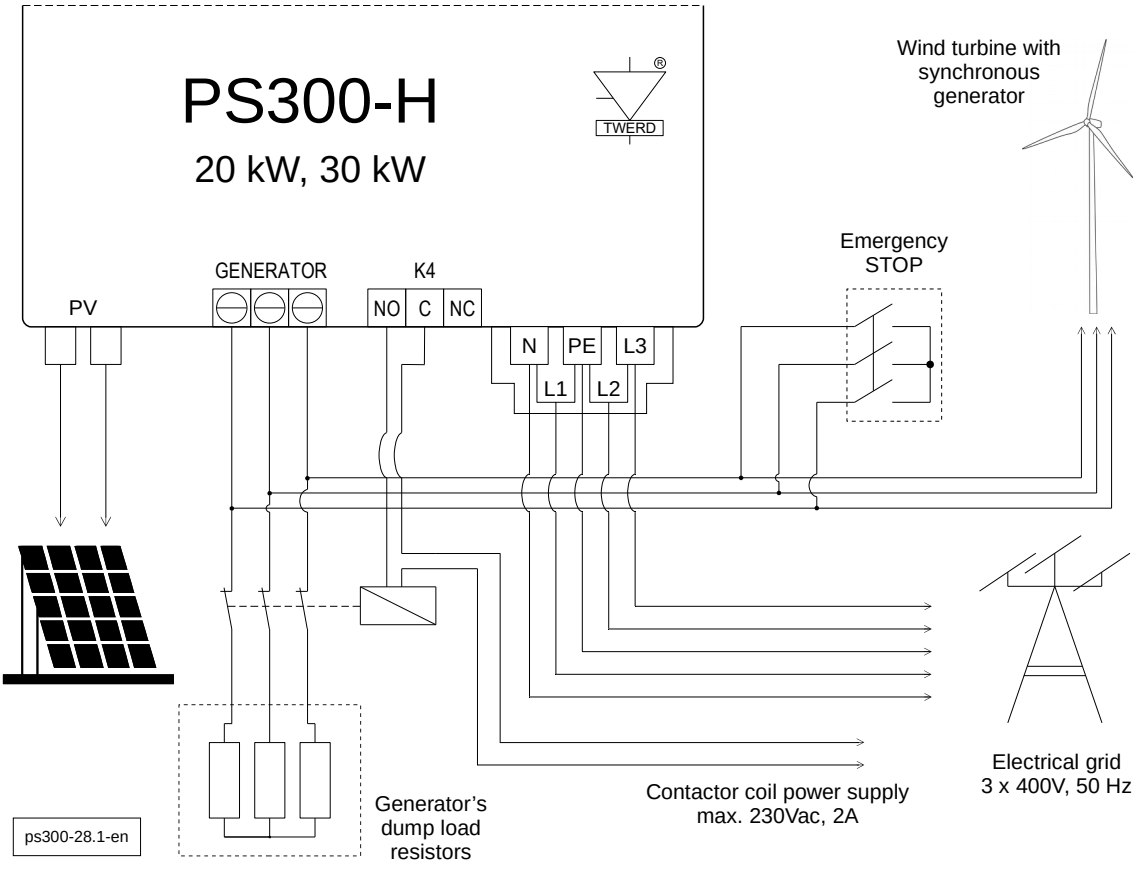


Fig. 5.5. Schematic diagram of PS300-H 20 kW and 30 kW power circuit connection

The order of installation operations:

1. **Switch On the Emergency STOP.**
2. **Switch OFF the PV switch.**
3. Unscrew the inverter cover.
4. Connect the generator wires to GENERATOR terminal strip.
5. Connect the coil leads of the NC contactor that switches the generator load resistors to the NO and C terminals of the K4 relay.
6. Be sure that there is no dangerous voltage on wires(!) and then connect to L1, L2, L3, N, PE terminal strip the electrical line.
7. **Switch On the power** from grid side.
8. Set the inverter parameters: load characteristic in group 3, breaking parameters in group 10, the point of start and stop of generator in parameters: 2.1, 1.20 and 1.21. Detailed description can be found in chapter 9.
9. Refasten the inverter cover.
10. Measure the voltage of solar panels and check their polarization.
11. Connect solar panels to dedicated PV connectors.
12. **Switch OFF the Emergency STOP.**
13. **Switch ON** the **PV switch.**
14. Wait a while to ensure that the inverter did not signal the fault.

Note:

1. The above schematic diagram does not take into account the safety devices which should be selected accordingly with applicable regulations.

2. The contactor and load resistors should be selected in accordance with the guidelines of the turbine manufacturer. These items are not included with the inverter.

3. Do not ground the star point of the generator load resistors.

6. Off-grid inverter installation

6.1. Off-grid inverter with input of photovoltaic panels - powers: 12 kW, 20 kW, 30 kW

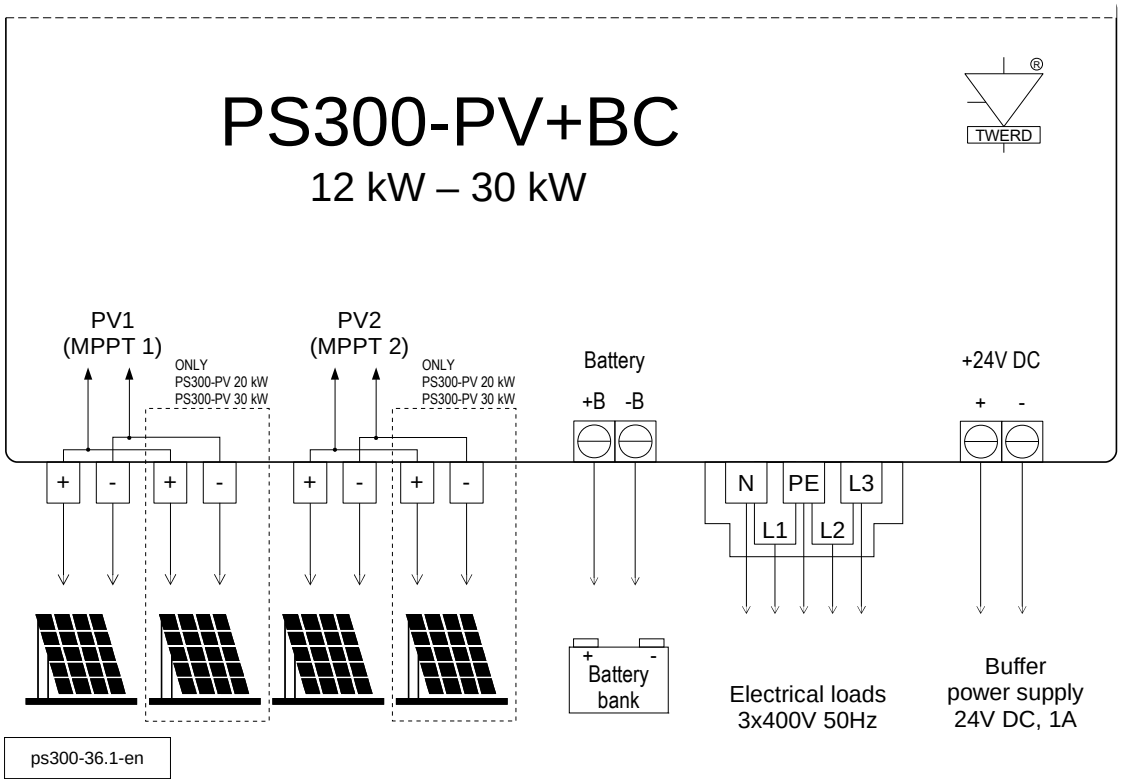


Fig. 6.1. Schematic diagram of connecting the power circuit of the PS300-PV+BC inverter with a power of 12 kW - 30 kW

The order of installation operations:

1. **Switch OFF** the **PV switch**.
2. Be sure that there is no dangerous voltage on wires(!) and then connect to L1, L2, L3, N, PE terminal strip the electrical line.
3. Connect the earth electrode to the PE terminal and connect the N and PE terminals together.
4. Measure the voltage of solar panels and check their polarization.
5. Connect solar panels to dedicated PV connectors.
6. Connect the battery pack in accordance with the safety rules described in chapter 14 describing the charger module - page 59.
7. Connect the communication wires of the battery module - if present.
8. Connect the 24 VDC 1 A buffer power supply
9. Install the inverter cover.
10. **Switch ON** the **PV switch**.
11. Wait a while to ensure that the inverter did not signal the fault.

Note: The above schematic diagram does not take include the safety devices that must be used in accordance with the applicable regulations.

6.2. Off-grid inverter with WT input of a 6-phase synchronous generator - 20 kW power

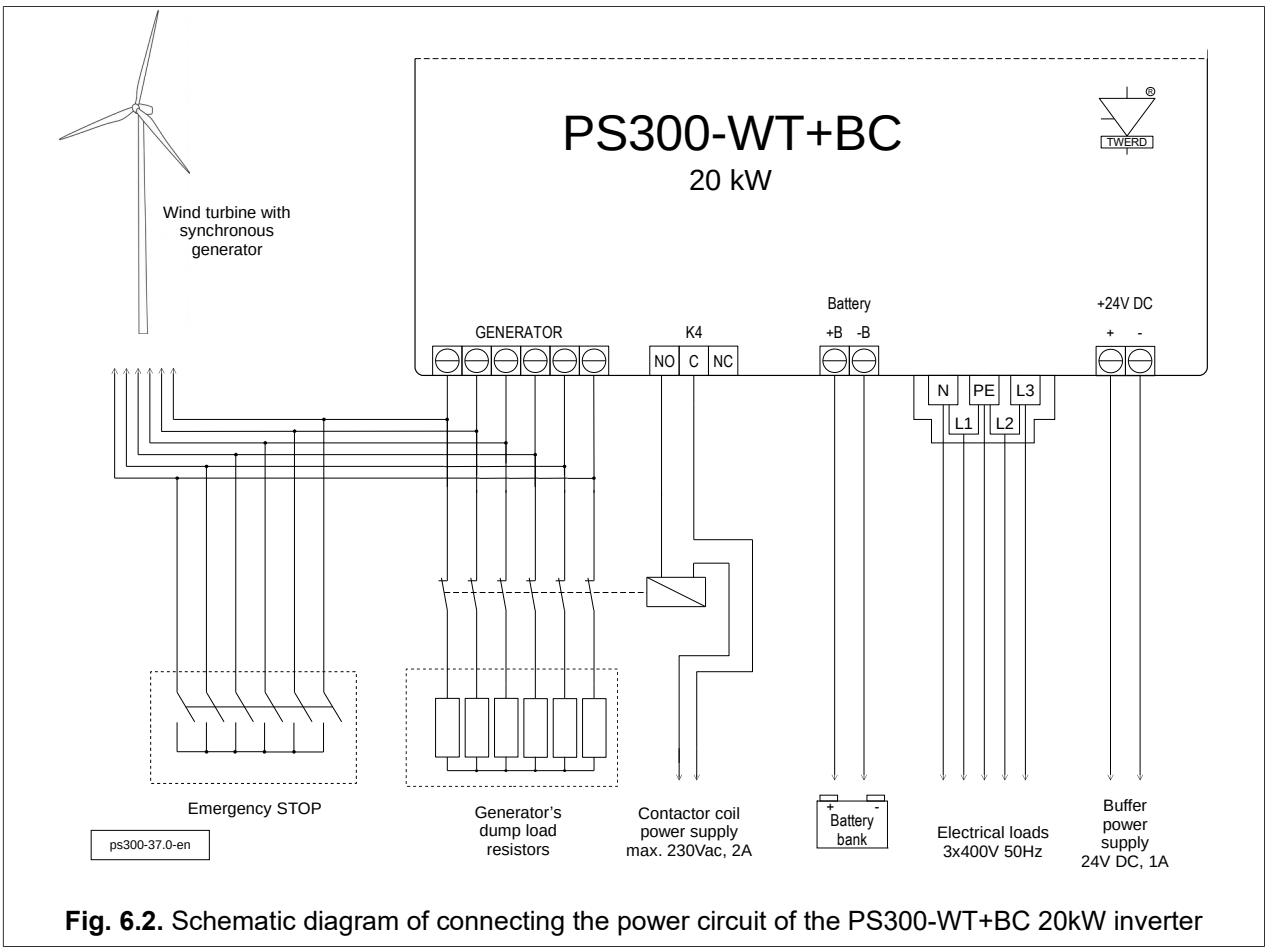


Fig. 6.2. Schematic diagram of connecting the power circuit of the PS300-WT+BC 20kW inverter

The order of installation operations:

1. **Switch On** the **Emergency STOP** of wind generator.
2. Unscrew the inverter cover and remove it.
3. Connect the generator wires to GENERATOR terminal strip.
4. Connect the coil leads of the NC contactor that switches the generator load resistors to the NO and C terminals of the K4 relay.
5. Be sure that there is no dangerous voltage on wires(!) and then connect to L1, L2, L3, N, PE terminal strip the electrical line.
6. Connect the earth electrode to the PE terminal and connect the N and PE terminals together.
7. Connect the battery pack in accordance with the safety rules described in chapter 14 describing the charger module - page 59.
8. Connect the communication wires of the battery module - if present.
9. Connect the 24 VDC 1 A buffer power supply.
10. Install the inverter cover.
11. **Switch OFF** the **Emergency STOP** of wind generator.
12. Wait a while to ensure that the inverter did not signal the fault.

Note:

1. The above schematic diagram does not take include the safety devices that must be used in accordance with the applicable regulations.
2. The contactor and load resistors should be selected in accordance with the turbine manufacturer's guidelines, these elements are not included with the inverter.
3. Do not ground the generator load resistors star point.

7. Installation of the inverter for operation in "auto on/off-grid" mode

This chapter applies to inverters:

- PS300-PV+BC: 12 kW, 20 kW, 30 kW.

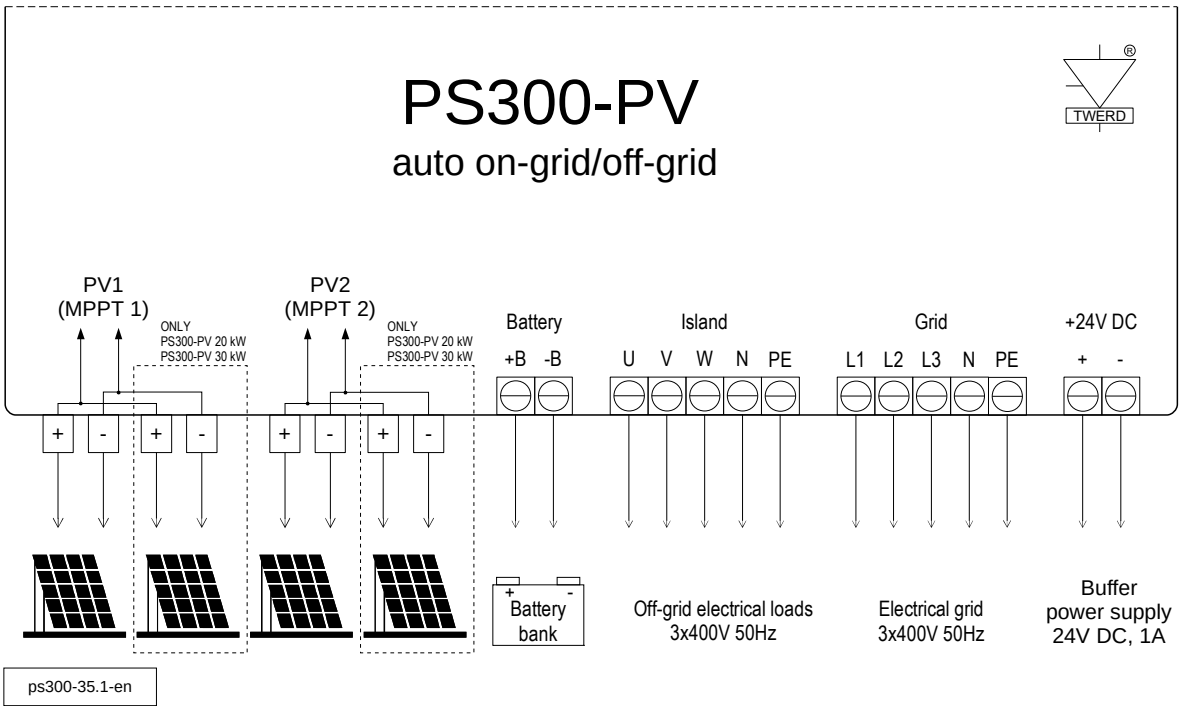


Fig. 7.1. Schematic diagram of connecting the power circuit of the PS300-PV inverter with a power of 12 kW - 30 kW

The order of installation operations:

1. **Switch OFF** the **PV switch.**
2. Be sure that there is no dangerous voltage on wires(!) and then connect to L1, L2, L3, N, PE terminal strip the electrical line.
3. Be sure that there is no dangerous voltage on wires(!) and then connect to U, V, W, N, PE terminal strip the off-grid electrical loads.
4. Measure the voltage of solar panels and check their polarization.
5. Connect solar panels to dedicated PV connectors.
6. Connect the battery pack in accordance with the safety rules described in chapter 14 describing the charger module - page 59.
7. Connect the communication wires of the battery module - if present.
8. Connect the 24 VDC 1 A buffer power supply.
9. Install the inverter cover.
10. **Switch ON** the **PV switch**.
11. Wait a while to ensure that the inverter did not signal the fault.

Note 1: The above schematic diagram does not take include the safety devices that must be used in accordance with the applicable regulations.

Note 2: Phase sequence is important. The "Zła kolejność faz" error means that two phases must be swapped on the mains side. The phase numbering must match the phase numbering in the Energy Guard module.

8. Built-in control panel

After turning the system on, it will initialize and the screen will take its initial state: *basic view*. Access to the keys is obtained after removing the front cover of the inverter. The <OK>, <ESC>, <up>, <down>, <right> and <left> keys are used to navigate the menu and to change parameter settings – see chapter 8.2.

Warning! Be especially careful due to the possibility of electric shock!

Access to the control panel is obtained after removing the front cover of the inverter. After disassembling the front cover of the inverter, at the same time, access to elements that are, under the conditions of normal inverter operation, under the electrical voltage dangerous to life and health (active parts) is obtained.

Removing the front cover of the inverter (when the electric voltage is supplied to the device both from the network side and the generator side) and changing the settings can only be made by a person with appropriate electrical qualifications.

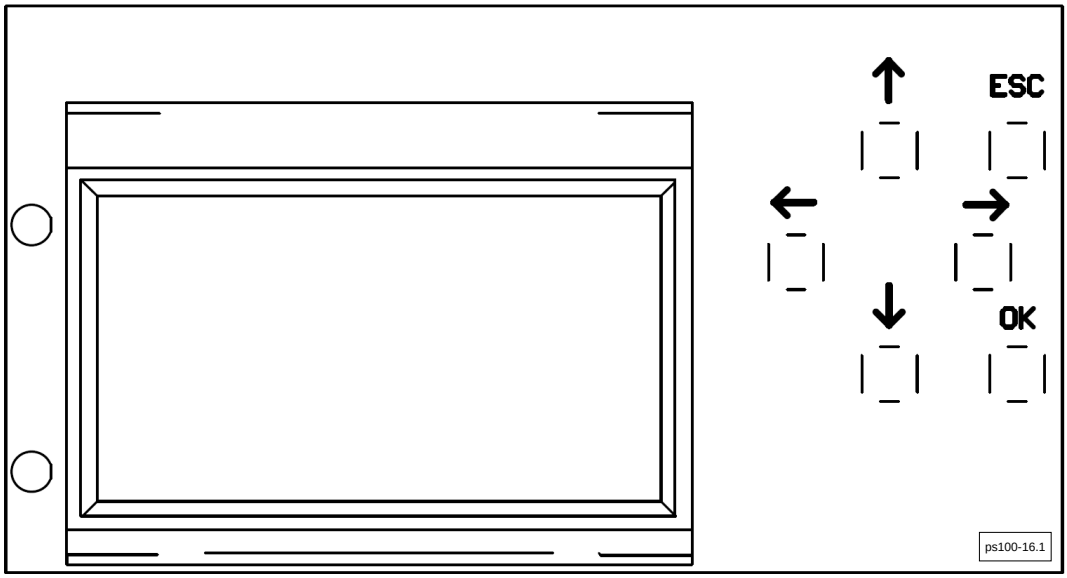


Fig. 8.1. Control panel

Table 8.1. Status diodes

Diode colour	Type of light	Description
All LEDs are off, the display is off		No power supply
Green	Flashing light	Inverter is ready to work
	Continuous light	Inverter is working
	The LED is off, the display is on	The device is not working, the state of failure when the red diode is lit at the same time
Red	Continuous light	Fault
	Flashing light	The contactor of the braking resistors is switched on - applies to WT and H inverters only

8.1. Information displayed on the operator panel without removing the inverter cover

The information displayed on the Operator Panel changes cyclically (screens 1 - 7) without user intervention. Pressing the ESC key for 2 seconds stops cyclic switching between the displayed screens.

- **Screen 1**: inverter type, version and serial number; current date and time.
- **Screen 2**: daily generated electrical energy graph.

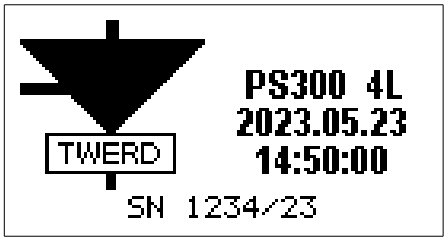


Fig. 8.2. Screen 1

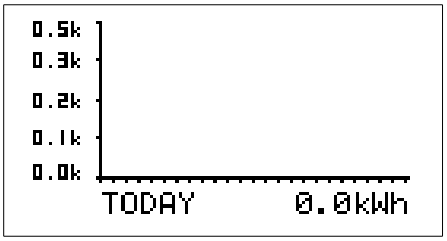


Fig. 8.3. Screen 2

- **Screen 3**: inverter operating status:
  - status of PV/WT/BAT inputs (depending on the inverter type)
    - voltages, currents and instantaneous powers
    - for the WT/H version: turbine frequency, wind speed, turbine RMS voltage,
  - output status: voltages, currents and instantaneous powers on each phase,
  - inverter operating status: "Stopped", "On-grid", "Off-grid", "Fault".
    The values described above are displayed alternately.

- **Screen 4**: charger operating status
  - SoC – battery charge status (BMS module required),
  - SoH – battery life status (BMS module required)
  - T_{bat} – charger module temperature,
  - current battery/power bank operating parameters (voltage, current, power),
  - battery status: "Charging" / "Discharging".

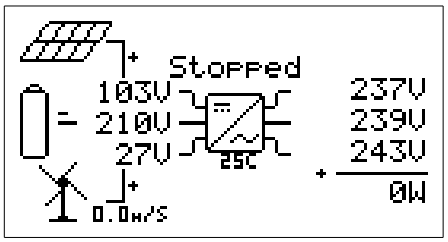


Fig. 8.4. Screen 3

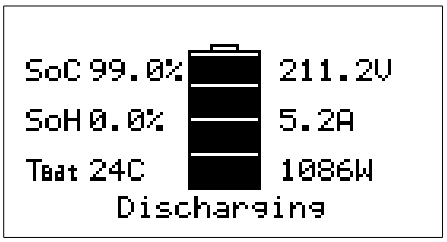


Fig. 8.5. Screen 4

- **Screen 5, 6 and 7: controller, inverter and charger failures**

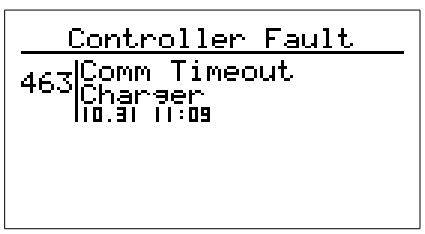


Fig. 8.6. Screen 5

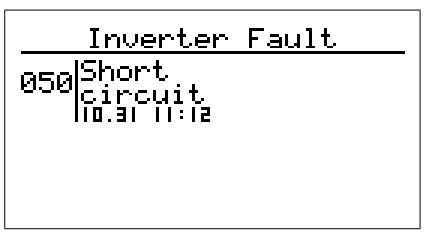


Fig. 8.7. Screen 6

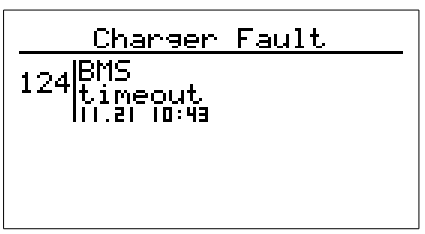


Fig. 8.8. Screen 7

8.2. Operating the control panel using buttons

After removing the cover, the buttons are accessed.

To enter the „Main menu”, press the <OK> key. To navigate in the „main menu”, use the <up> <down> and <right> <left> keys. The highlighted option is selected by pressing the <OK> key, the return to the „main menu” is done by pressing the <ESC> key.

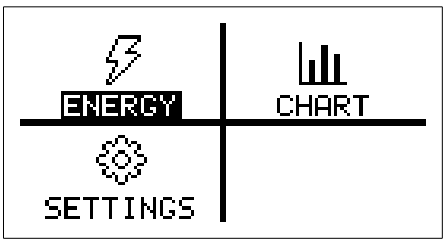


Fig. 8.9. Main menu

- **Energy** menu
  - "Total" - total energy generated since the inverter was connected to the grid
  - "Now" - instantaneous power generated

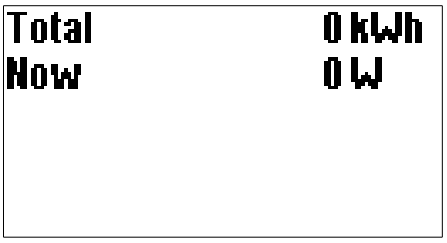


Fig. 8.10. „Energy” menu

- **Chart** menu - users could enter any specific date than check on the graphics input and output power values for that day. Use the <up><down> keys to select the interesting parameter to preview on the chart:
  - Total power – total power at the inverter output
  - PV1 power – power from the first solar input
  - PV2 / WT power – power from the second solar input or turbine power (depending on the inverter type)
  - EG power – power absorbed/delivered to the grid connection (Energy Guard module required)
  - Average wind speed
  - Battery power
  - Battery voltage

  Each bar on the chart corresponds to a 15-minute time frame.

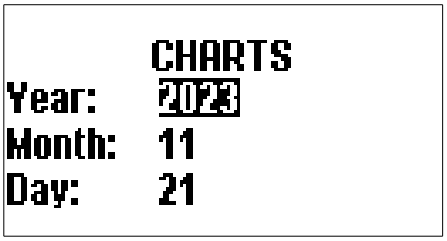


Fig. 8.11. Menu „Charts”

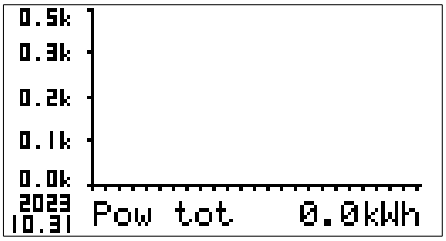


Fig. 8.12. Menu „Charts”

- **Settings** menu - there is a four submenus: PARAMETERS, CLOCK, COMMUNICATION, SERVICE.

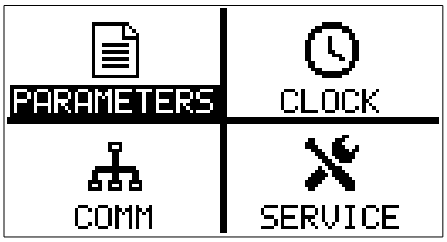


Fig. 8.13. Menu „Settings”

- **PARAMETERS** - parameters configuring the operation of the inverter. Access to them is protected by an access code, except for read-only parameters from group 0. To access code-protected parameters select *Service* in the *Settings* menu, enter the access code **123321**, press OK and then in the *Settings* menu, select *Parameters*. Then, use the <up> and <down> buttons to select previously blocked groups. A full list of parameters is listed in chapter 15. Configuration of Parameters on page 62.
- Viewing the last 10 failures is possible from the parameters 00.70 - 00.79. Pressing the <OK> key displays detailed operating data of the device during a failure. Data is presented on 2 screens, transitions between screens occur after pressing the <left> or <right> keys. To return to the parameter viewing menu, press the <ESC> key.

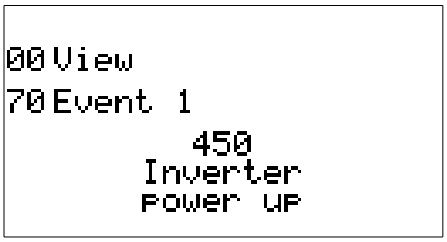


Fig. 8.14. Failure menu

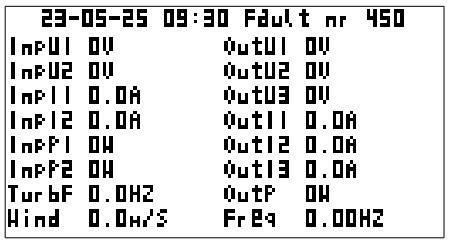


Fig. 8.15. Failure data

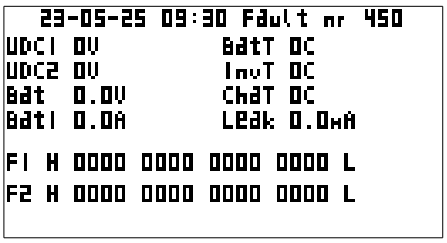


Fig. 8.16. Failure data

- **CLOCK** menu - settings related to date and time settings:
  - **Manual / ntp**: set time and date manually "Manual" or automatically "ntp".
    The "ntp" automatic setting requires access to the Internet.
  - **Time zone**
  - **Summer time**: EU – automatic summer / winter time change
    none – no summer / winter time change
  - **Ntp update h**: time of the day at which inverter will synchronize once a day the date and time with the Ntp server
  - **Set clock**: available when the Manual/ntp setting is set to Manual
  - **Ntp server** – allows to enter the Ntp server address
  - **Ntp force** - immediate force synchronization of date and time

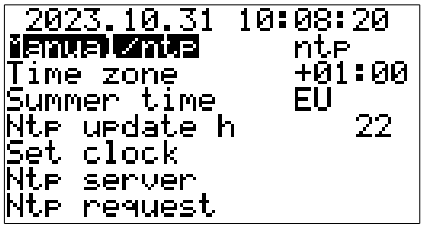


Fig. 8.17. CLOCK Menu

Fig. 8.18. Setting time and date

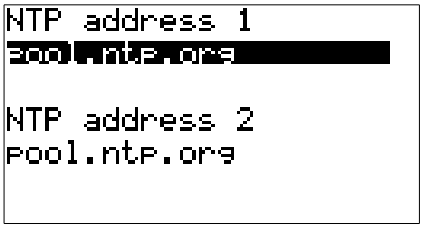


Fig. 8.19. NTP server address

- **COMMUNICATION** menu

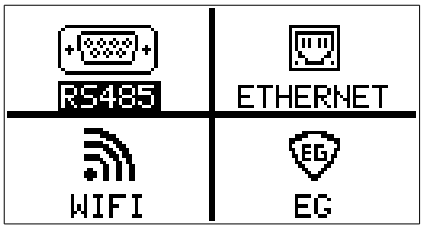


Fig. 8.20. Communication menu

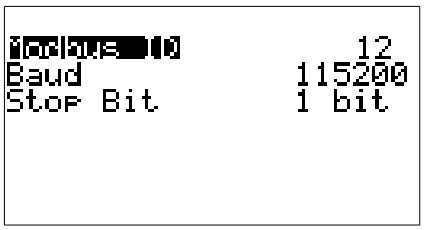


Fig. 8.21. RS485 menu

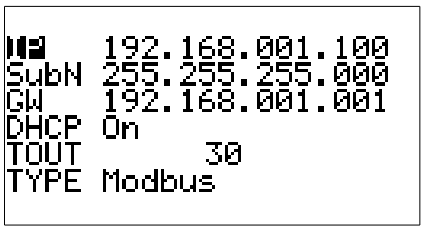


Fig. 8.22. Ethernet menu

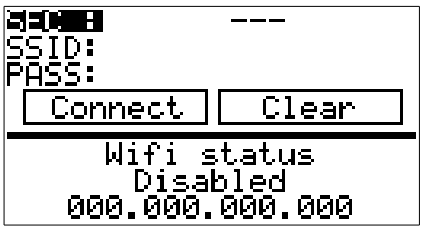


Fig. 8.23. Wi-Fi menu

- **SERVICE** menu - users and authorized technical service members could enter access codes and get access to related secured levels.
  The randomly generated code below the access code you enter is for service purposes.

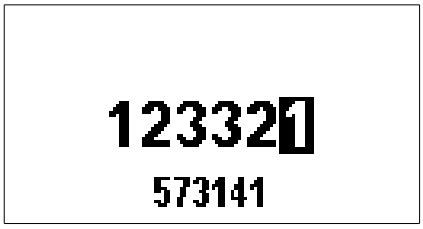


Fig. 8.24. Service menu

8.3. Updating the Control panel software

In order to update the inverter firmware:

1. Disconnect the inverter from the renewable energy source (photovoltaic panels, wind generator).
2. Connect the USB micro cable to the J2 USB micro connector. Connect the other end of the cable to your computer.
3. Supply the inverter from the AC grid 3x400V 50 Hz via terminals L1, L2, L3, N, PE.

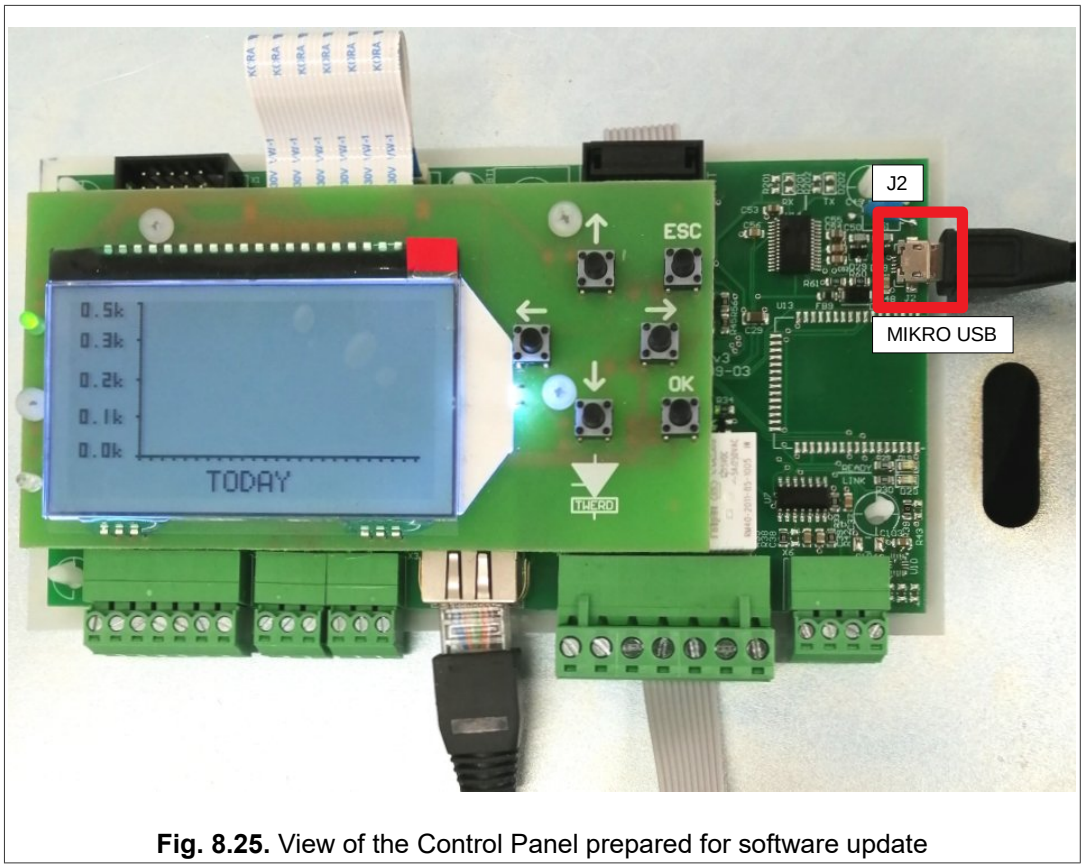


Fig. 8.25. View of the Control Panel prepared for software update

4. In the menu follow the **Settings** → **Communication** → **RS485** than:

   - Set modbus address to: 12
   - Set baud rate to: 38400

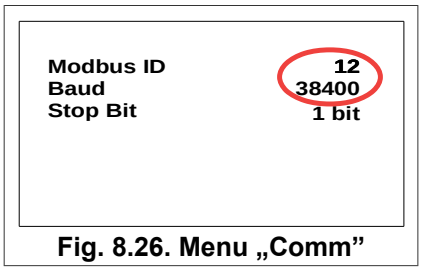


Fig. 8.26. Menu „Comm”

5. Start the PS100 program. COM ports will be automatically detected.
6. The program will search for the connected inverter and display its ID number.
7. Select the "Start updating application" button - the new software upload process will start.
8. The software update process takes about 3 minutes. After it finishes, it will restart.
   If the program stops responding, close the program and restart it.

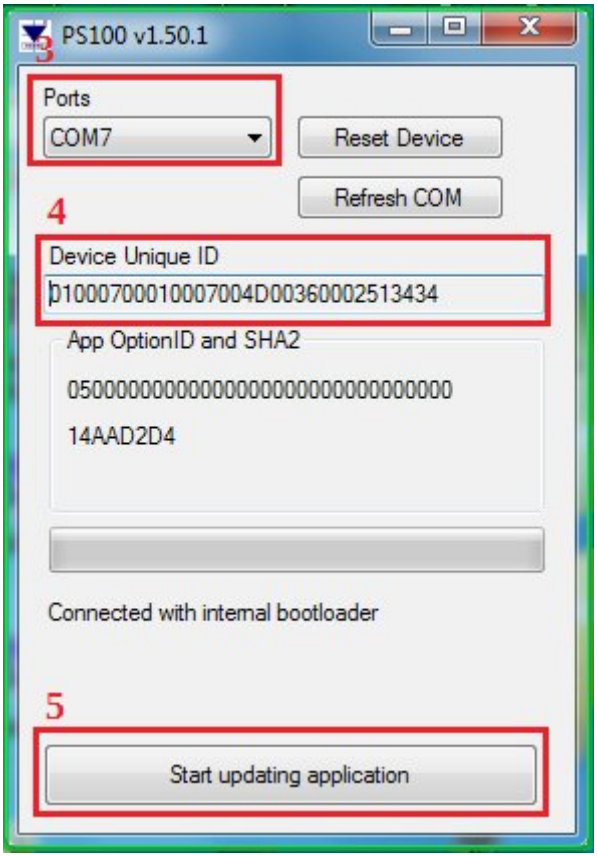


Fig. 8.27. View of the PS100 program window

9. The first run

The device is intended for loading solar panels or / and a permanent magnet synchronous generator. The system is equipped with the following energy conversion blocks:

- **AC/DC/DC**: diode rectifier with BOOST converter from the generator side,
- **DC/DC**: BOOST converter from the side of PV panels,
- **DC/AC**: active rectifier AcR (active rectifier) working from the side of the power grid (on-grid mode) or local electrical loads (off-grid mode).

The BOOST converter enables obtaining electricity in a wide range of voltages: from 60 to 450 Vdc. The start voltage is specified in the service parameter 1.20 The load for photovoltaic panels is based on the maximum power point tracking algorithm (MPPT) implemented in the device, inverters with two PV inputs have two independent tracking algorithms.

9.1. Maximum Power Point Tracking (MPPT) and Global Maximum Power Point Tracking (GMPPT)

PS300-PV and PS300-H inverters with PV input (DC voltage input) are using Maximum Power Point Tracking (MPPT) algorithm. This algorithm constantly analyzes the voltage-current characteristic of a PV panels and adjusting the load current in such a way as to obtain the greatest possible power from the system - Fig. 9.1.

Under the partial-shading condition, the voltage-current characteristic of a PV panels is different - instead of having a single maximum power point (MPP), they exhibit multiple MPPs - Fig. 9.2. For this reason, in order to work at the global maximum point, it may be necessary to enable the global maximum power point tracking (GMPPT) algorithm, which will allow for greater efficiency of the system.

The user can set the GMPPT scan time in parameter 10.14. The optimal setting is 5 minutes.
Default the GMMPT is switched OFF.

It is recommended to use the GMPPT algorithm only under conditions of possible partial shading. If partial shading does not occur, using the GMPPT algorithm will decrease overall system efficiency by up to 2%.

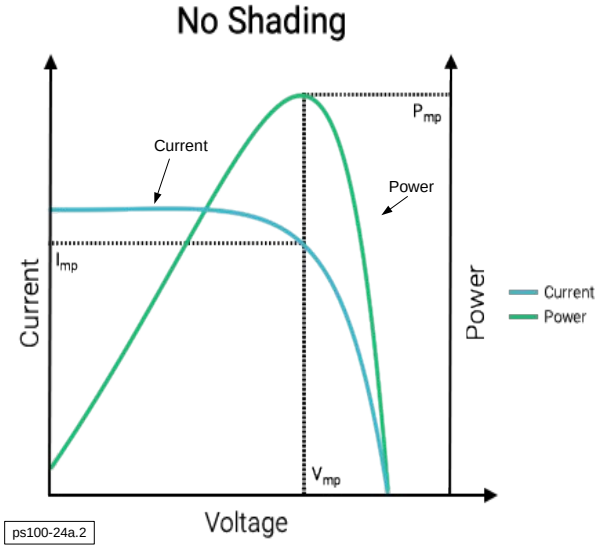


Fig. 9.1. Voltage-current characteristic – no shading conditions

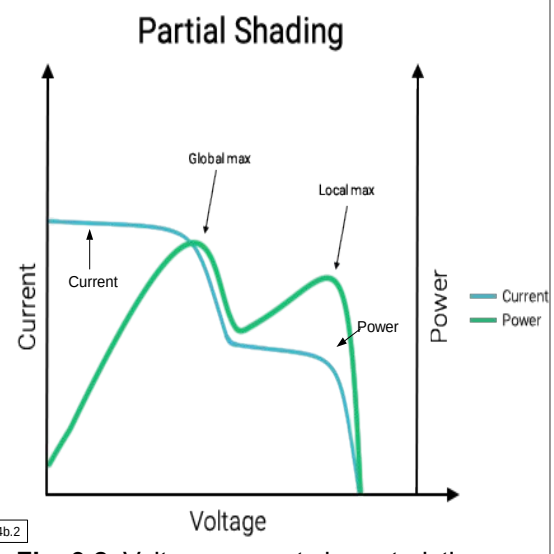


Fig. 9.2. Voltage-current characteristic – partial shading conditions

9.2. 16 point load characteristic of a synchronous generator

Converters for synchronous generators have the 16-point load characteristic:

$$I = f(\omega)$$

where: ω – generator frequency,

I – current limit [%] in relation to nominal current set in par. 3.30.

Points (ω,I) are set by user using the “control panel” in the group 3. A superior current limit is imposed on the characteristic curve (**par. 3.9 „DC curr limit [A]”**), the maximum value of which results from the technical capabilities of the device. However, you can set the lower values by trimming the characteristics as in the figure below.

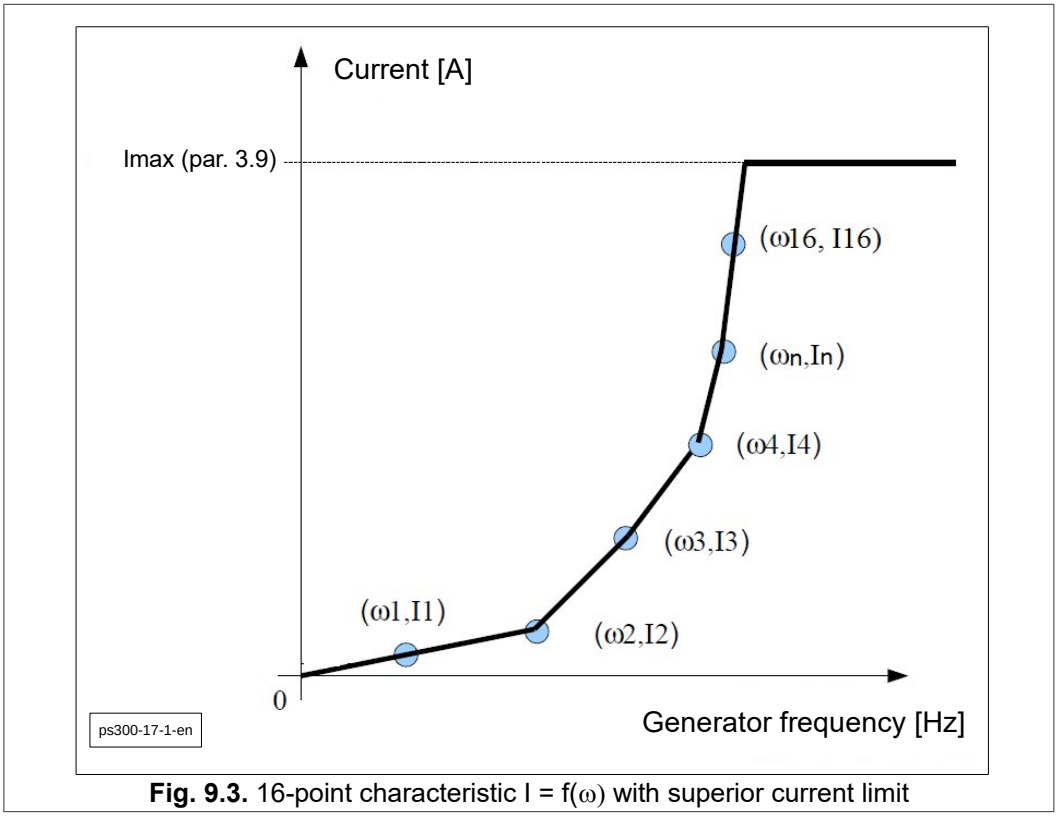


Fig. 9.3. 16-point characteristic I = f(ω) with superior current limit

9.3. Start/Stop command

The START / STOP command is executed automatically when the DC input voltage exceeds voltage thresholds responsible for it:

a) **Par. 1.20 (group 1, parameter 20) "Autostart volt. [V]"** – rectified voltage from the input side (renewable source of electricity: wind / water generator, PV panels) above which the inverter will start work (if it was in the STOP state) and begin to transfer energy to the electrical grid.

b) **Par. 1.21 (group 1, parameter 21) "Autostop volt. [V]”** - rectified voltage from the input side (renewable energy source) below which the inverter ceases to transfer energy to the mains and goes into the *sleep mode*. If the input voltage remains below this level for the time specified in par. 1.11 this inverter will go into the *deep sleep* state.

Sleep state: the mains voltage maintains the voltage in the batteries of the intermediate circuit capacitors, the inverter is ready to start working in a few seconds.
Deep sleep state: the inverter's intermediary circuit is disconnected from the mains, it may take about 1 ÷ 2 min to start working. In this mode, energy consumption is less than in the *sleep* mode.

9.4. Dump load resistors

Dump load resistors (not supplied) should be connected to proper terminals – see chapter 5. Depending on the type of inverter, the resistors are connected:

- directly to the terminals marked "Rezystory". In this configuration, the operation of the resistors is controlled by internal relays

or

- to the "Generator" terminals. In this configuration, an external contactor must be used to switch on the resistors. To control the operation of this contactor, use the K4 relay output.

In order to select the value of the resistors, contact the manufacturer of the wind turbine.
Dump load resistors will be switched on in four cases:

a) generator's RMS voltage will exceed the value from the parameter **10.2 (U RMS gen. Ham [V]),**
b) generator's frequency will exceed the value set in the parameter **10.3 (Czest. Gen. ham [Hz]),**
c) the lack of the electrical grid,
d) during a failure.

9.5. The internal process of switching ON the inverter in ON-GRID mode

- After connecting to the electrical grid, the inverter with PV inputs monitors the panel voltage; the inverter with generator input first disconnects the load dump resistors and starts to monitor the generator voltage and frequency.
- The inverter checks whether the voltage and frequency of the network is correct.
- By collecting energy from a source connected to the input, it increases the voltage in the DC circuit to the level suitable for switching on the power network.
- Performs synchronization with the electrical grid.
- If the voltage received from the renewable source is high enough (threshold defined by parameter **1.20**), the MPPT algorithm starts and the solar panels load according to the MPPT algorithm or generator according to the curve introduced in group 3. The obtained electricity is sent to the electrical grid.

10. Inverter reactive power control

The inverter has four modes of reactive power generation control that can be configured by the installer. All configuration parameters are available in the password protected access menu. The operating mode is set by changing the setting of parameter **12.36**.

Table 10.1. Inverter reactive power control

Options of parameter 12.36	Operating mode
0	Q set
1	Cosφ set
2	Q(U)
3	Cosφ (P)

10.1. Q mode

The inverter generates reactive power with a value proportional to the **nominal value of the inverter's active power**. The percentage value of reactive power is determined by changing the setting of parameter **12.37**, whereby a positive value means over-excitation (reactive power generation), while a negative under-excitation (reactive power consumption).

10.2. Cosφ mode

The inverter generates reactive power by changing the value of the power factor cosφ. The size of the power factor is determined by changing the setting of parameter **12.38**, whereby a positive value means over-excitation (reactive power generation), while a negative under-excitation (reactive power consumption).

10.3. Q(U) mode

The inverter generates reactive power as a function of the mains voltage value Q (U). In the Q (U) operating mode, the control takes place according to the entered curve - Fig. 10.1. Control curve Q(U)

The inverter can be configured to start Q (U) control when the output power level exceeds the threshold of parameter **12.48**, and end when the output power drops below the threshold from parameter **12.49**. When **12.49 <12.48** then the control switching system Q (U) shows hysteresis. Below the threshold, the inverter does not generate reactive power.

The dynamics of reactive power value adjustment as a function of network voltage changes is determined by the value of parameter **12.47**. The inverter will regulate the value of reactive power with dynamics such as the first order filter with a time constant of the value set in parameter **12.47**. The individual points of the curve are described in Table 10.2. Table of curve points Q (U).

When the possibility of regulating the mains voltage by controlling the reactive power consumption in the Q (U) operating mode reaches its limit, it is possible to limit the active power of the inverter along with a further voltage increase. The active power limitation function is enabled by setting parameter **12.70** to 1. In case of a reactive power control mode other than Q (U), the active power generation limitation is inactive.

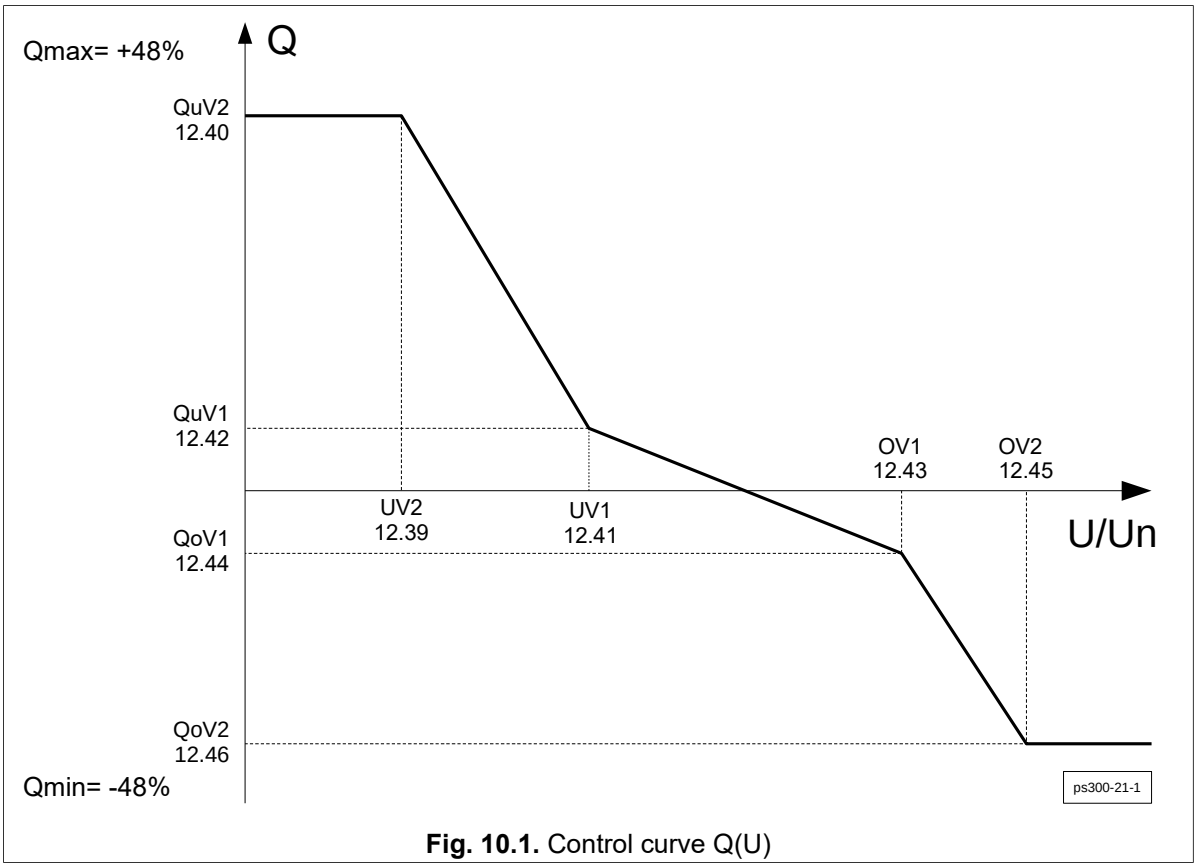


Fig. 10.1. Control curve Q(U)

Table 10.2. Table of curve points Q (U)

Parameter No	Parameter name	Description
12.39	uV2	Voltage value for QuV2
12.40	QuV2	Reactive power at voltage uV2
12.41	uV1	Voltage value for QuV1
12.42	QuV1	Reactive power at voltage uV1
12.43	oV1	Voltage value for QoV1
12.44	QoV1	Reactive power at voltage oV1
12.45	oV2	Voltage value for QoV2
12.46	QoV2	Reactive power at oV2 voltage
12.47	Time filter	A time constant value that specifies the rate of adjustment
12.48	Lock in power	Power level for switching on the Q (U) control
12.49	Lock out power	Power level to deactivate the Q (U) control

10.4. Cosφ(P) mode

The inverter generates reactive power by changing the value of the power factor cosφ as a function of the output power value P. In the cosφ (P) operating mode, the control is carried out in accordance with the introduced curve Fig. 10.2.

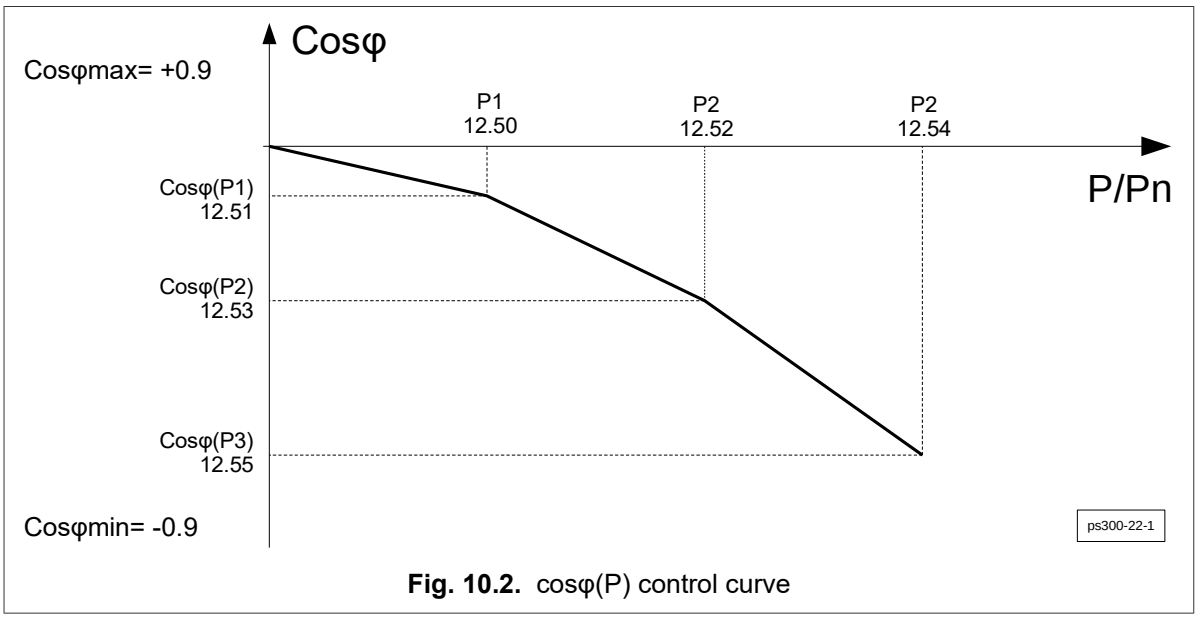


Fig. 10.2. cosφ(P) control curve

The individual points of the curve are in Table 10.2.

Table 10.3. Table of points of the cosφ curve (P)

Parameter No	Parameter name	Description
12.50	P1	P1 power value
12.51	cosfi(P1)	Setting cosφ for power P1
12.52	P2	P2 power value
12.53	cosfi(P2)	Setting cosφ for power P2
12.54	P3	P3 power value
12.55	cosfi(P3)	Setting cosφ for power P3

10.5. Reactive power compensation mode

The inverter can compensate the reactive power in the user's installation. To work in this mode, it is necessary to use the PS Energy Guard measuring device. PS Energy Guard calculates the current reactive power consumption in the user's installation and sends this information to the PS300 inverter, which on this basis generates the required reactive power value locally.

The inverter is able to generate reactive power in the range of ± 48% of the nominal power of the device. If the connection with PS Energy Guard is lost, the inverter stops producing reactive power and works with cosφ = 1.

In order to switch on the reactive power compensation mode, set the following parameter values:

Table 10.4. Setting up the inverter to work in the reactive power compensation mode

Parameter No	Parameter name	Description
12.36	Control Mode	0- Qset
12.37	Q set	0%
12.70	Rea. Power Comp.	1

11. Digital inputs and outputs

The inverter has 5 digital inputs 7 Vdc, R_{IN} > 300 Ω and 3 relay outputs with 2 A switching power 230 Vac. On the digital inputs terminal block there is also 7 Vdc voltage terminal available to operate digital inputs and any external devices with a maximum current consumption of 50 mA.

Fig. 11.1 shows the view of the terminal blocks on the PS300 inverter series. To view the status of digital inputs and outputs enter the I/O PREVIEW in the MAIN MENU of the inverter.

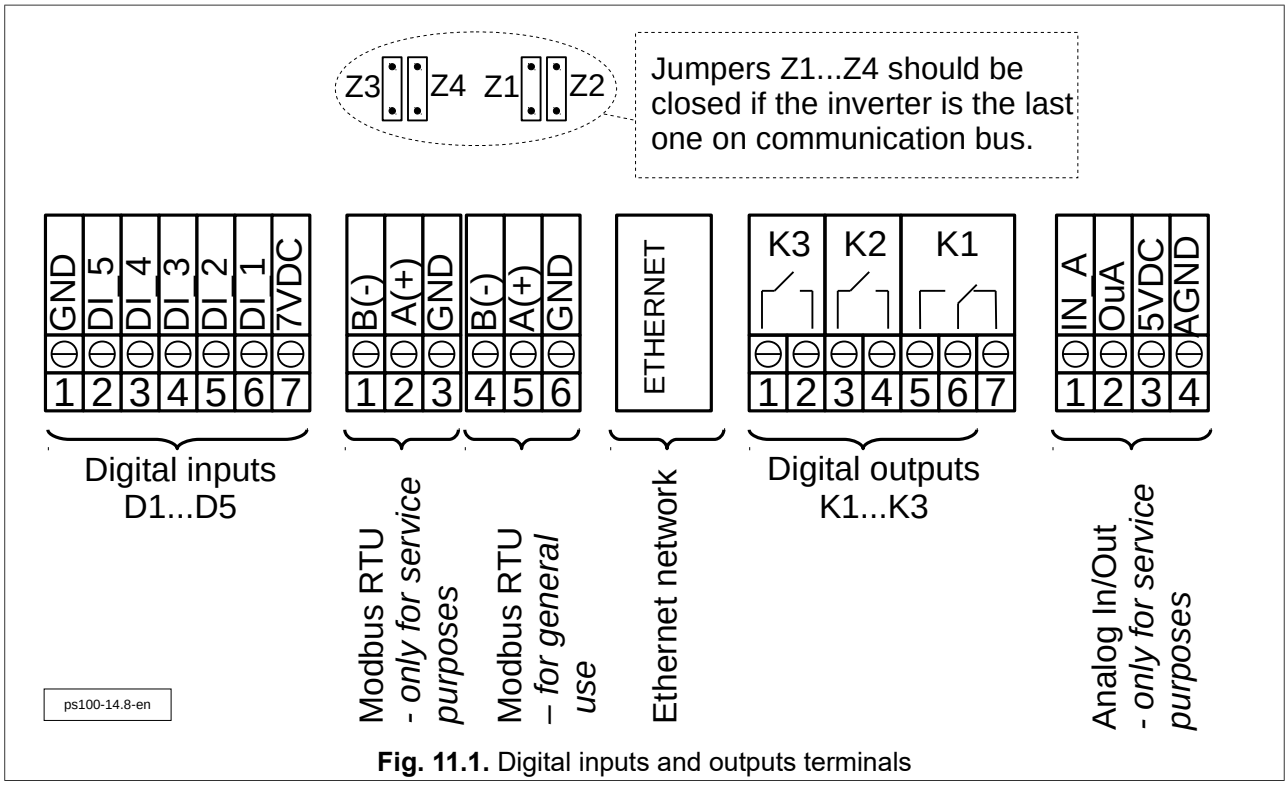


Fig. 11.1. Digital inputs and outputs terminals

By default the inverter uses three relay outputs K1, K2, K3 to adjust the frequency of the generator if the wind turbine is equipped with a tail (see chapter 11.1 “Generator load control“ on page 47) and digital input DI_2 for operating an optional anemometer (see chapter 11.2 “Anemometer“ on page 48).

Maximum cross-section of the connecting wires:

- solid: 1.5 mm^2,
- stranded: 1.0 mm^2.

Relay functions in wind turbine tail control mode:

- K1 – opening the tail,
- K2 – closing the tail,
- K3 – readiness to work.

Digital input functions:

- DI_1 – remote stop of the inverter,
- DI_2 – anemometer,
- DI_3 – remote stop of the charger
- DI_4 and DI_5 – reserve.

11.1. Generator load control

The PS300 inverter, in addition to the turbine run-out protection, is adapted to regulate the frequency of the generator (and thus the power generated) by switching ON the dump load resistors.

Fig. 11.2. The principle of controlling the dump load resistors shows the principle of controlling the dump load resistors.

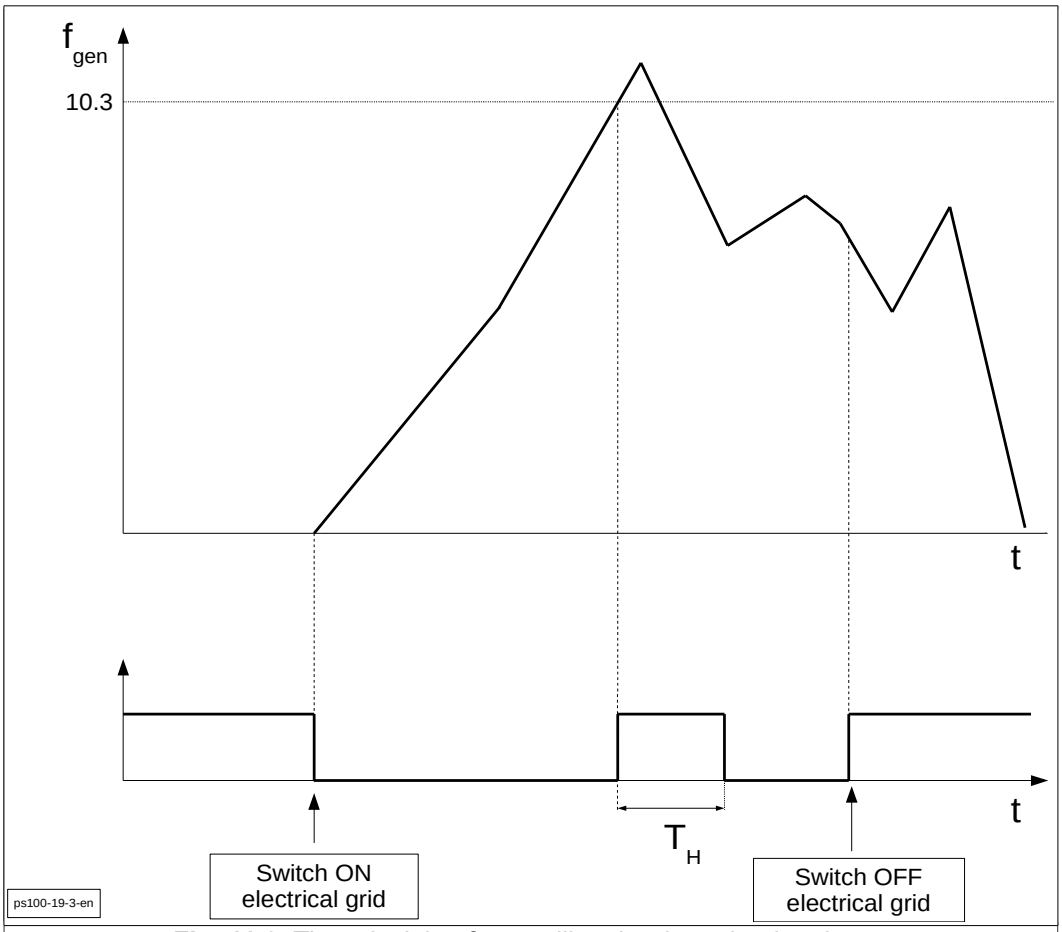


Fig. 11.2. The principle of controlling the dump load resistors

The inverter continuously measures the frequency and voltage of the generator, and compares them to the saved settings in the inverter's memory (group 10).

To prevent the generator from detaching, use dump load resistors. Parameter 10.3 determines the frequency threshold of the generator above which the resistors are switched ON for the braking time T_H, in which the frequency of the generator drops below the threshold value reduced o hysteresis specified in parameter 10.5, however not shorter than the time set in parameter 10.4.

Additionally the inverter can react to exceeding the voltage thresholds. Parameter 10.2 is used to determine the voltage level that triggers the activation of load resistors.

In the event of any failure, the system switch ON the dump load resistors.

Table 11.1. Control of the dump load resistors - group 10 (service group, password protected)

Param. No.	Name	Description
10.2	"U RMS gen. hamt. [V]	Generator RMS voltage from which the "Resistors" load is connected
10.3	Gen. break. freq. [Hz]	Generator frequency from which the "Resistors" load is attached
10.4	Min. gen. break [s]	Minimum switching ON time of a dump load resistors
10.5	Break hist. off [%]	Hysteresis specified in % in relation to the values given in parameters 10.1 and 10.2

11.2. Anemometer

The inverter works with anemometer with open collector type (OC) output or reed relay output. The maximum frequency must be less than 1 kHz.
Fig. 11.3 shows a connection diagram on the example of the Fardata NP-3 anemometer, where it is necessary to use an external power supply. Anemometers supplied with a voltage of 7 Vdc and a load current of up to 50 mA can be supplied directly from the inverter - Fig. 11.4.

In order to correctly measure the wind speed, it is necessary to enter wind speed [m/s] corresponding to 10 pulses / second in parameter **10.6**. This value is given by the manufacturer of the anemometer (ex. 1.5). The current wind speed is showed in par. **0.31**.

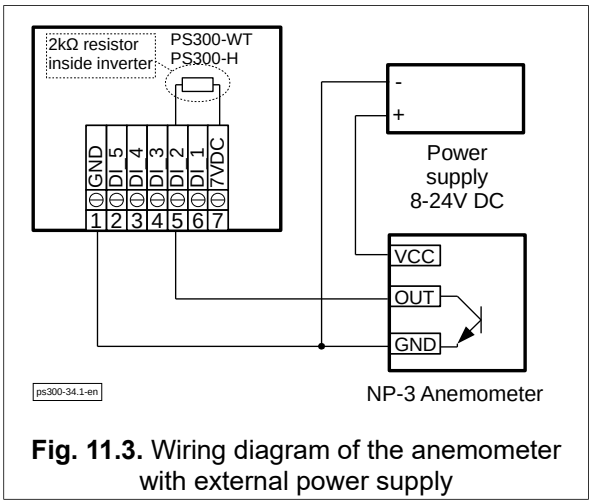


Fig. 11.3. Wiring diagram of the anemometer with external power supply

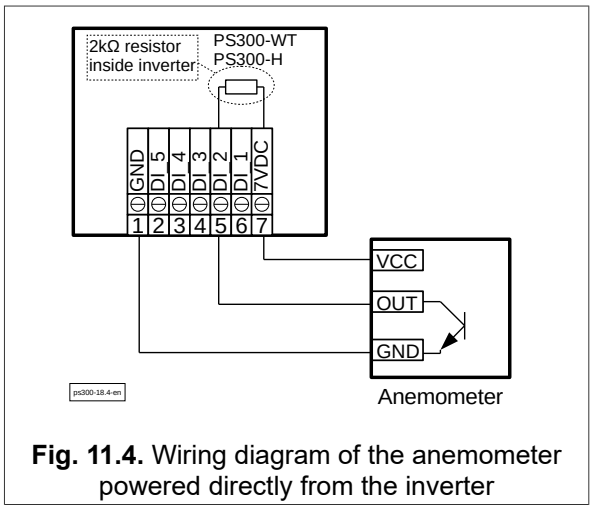


Fig. 11.4. Wiring diagram of the anemometer powered directly from the inverter

The anemometer should be installed in the immediate vicinity of the generator.

In case the wind turbine generates voltage to the inverter and the inverter does not receive pulses from the anemometer, a failure will occur after 10 seconds. Then the inverter will turn on the relays from the braking resistors and windmill tail folding.

11.3. Storm Protection

In our inverter we have a storm protection feature. Users are able to set dedicated parameters for the storm protection. Storm protection system works through these parameters:

Par. 10.48 – Wind speed that activates storm protection.
Par. 10.49 – Switch-on duration of storm protection from par. 10.48.
The value "0" disables the protection.
Par. 10.71 – Turbine frequency that activates storm protection.
Par. 10.72 – Switch-on duration of storm protection from par. 10.71.
The value "0" disables the protection.
Par. 10.73 – Duration of exceeding the set storm protection values in parameters 10.48 and 10.71, after which storm protection will be activated.

If

- the wind speed is higher than set in par. **10.48**

or

- the frequency of the generator voltage is higher than set in par. **10.71**

and

- the duration of any of these events will exceed the time set in par. **10.73**

then storm protection will be activated - the internal K3 relay will be disconnected and switching on the load resistors. The duration of storm protection is determined by parameters **10.49** and **10.72**.

11.4. Remote stop of the inverter operation

User could connect and use an external switch to control inverter. Switch must be connected to DI_1(6) and 5VDC sockets(7).
Digital input DI1 (6) can be used to remotely stop the inverter - Fig. 11.5. Closing switch S will cause:

- stopping the inverter operation,
- K3 relay opening,
- opening of output relays,
- activation of the generator load resistors – inverters with WT input.

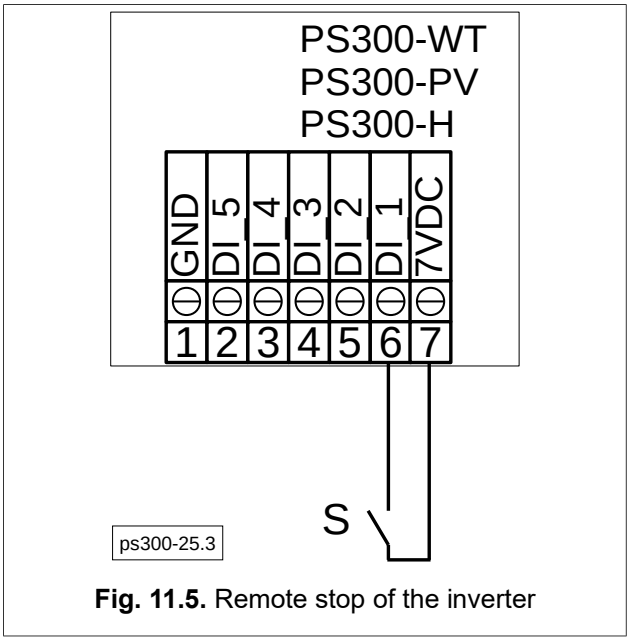


Fig. 11.5. Remote stop of the inverter

12. Communication parameters setting

The PS300 inverter is equipped with the RS-485 communication interface and the Ethernet port. This allows the inverter to be controlled by a computer or an external controller. Basic features and the possibilities are:

RS-485:

- communication speed: 2400, 4800, 9600, 19200, 38400, 57600, 115200 bit/s,
- 8 data bits, lack of parity control; 1 or 2 stop bits,
- transfer protocol: MODBUS RTU,
- checking of transfer validity by CRC,
- ModBus address (default 1),
- support of MODBUS commands: command 3 - “read the register” - allows to read individual registers from the inverter or block of up to 123 registers. Command 6 - “register write” - allow to write to individual register in the inverter. Command 16 - “n register write” - allow to write block of up to 123 register to inverter.

Ethernet:

- transmission protocol: MODBUS TCP/IP,
- default port of communication: 502,
- ModBus address (default 1),
- support of MODBUS commands: command 3 - “read the register” - allows to read individual registers from the converter or block of up to 123 registers. Command 6 - “register write” - allow to write to individual register in the converter. Command 16 - “n register write” - allow to write block of up to 123 register to inverter.

All operations are based on the MODBUS RTU / TCP protocol commands 3 and 6 and they are described in publications on MODBUS protocol.

Addressing is done by querying the 4xxyy parameter, where xx - group number, yy - parameter number. For example, if you want to read parameter 0.3 - the frequency of the network, you should inquire about the address 40003. Modification of the parameter using command 6 is only possible after unlocking access to password protected groups – see chapter 8.2. “Operating the control panel using buttons“ on page 35.

Remote unlocking of configuration parameters occurs by sending the password "12321" to the Modbus address 41053.

Network cable requirements:

The cable length and quality affect the quality of the signal. Observe the following cable requirements.

- Cable type: 100BaseTx
- Cable category: minimum CAT5e
- Plug type: RJ45 of Cat5, Cat5e or higher
- Shielding: SF/UTP, S/UTP, SF/FTP or S/FTP
- Number of insulated conductor pairs and insulated conductor cross-section: at least 2 x 2 x 0.22mm²
- Maximum cable length between two nodes when using patch cables: 50 m (164 ft)
- Maximum cable length between two nodes when using installation cables: 100 m (328 ft)
- UV-resistant for outdoor use.

12.1. Connecting the inverter to the Internet

Parameters configuring the connection of the inverter to the Internet are presented in Table 12.1. The inverter can work with dynamic DHCP address assignment enabled or disabled. The changes are made in the *Settings → Communication → Ethernet menu*:

a. DHCP enabled: configuration parameters (IP address, subnet mask and gateway address) will be assigned automatically by an external DHCP server.

b. DHCP disabled: parameters configuring the inverter to work on the Internet must be entered manually:
   IP: IP address
   SubN: subnet mask address
   GW: gateway address.

Current settings of the parameters configuring the inverter's work in the Internet are also available for reading in 0 group of parameters (menu: SETTINGS → PARAMETERS) - Table 12.1.

Table 12.1. Parameters from group 0 regarding the configuration of the inverter in the Internet

Parameter No	Parameter name	Access level	Description
0.80	Eth. IP 1	O	IP Address
0.81	Eth. IP 2	O	IP Address
0.82	Eth. IP 3	O	IP Address
0.83	Eth. IP 4	O	IP Address
0.84	Eth. MASK 1	O	Subnet Mask
0.85	Eth. MASK 2	O	Subnet Mask
0.86	Eth. MASK 3	O	Subnet Mask
0.87	Eth. MASK 4	O	Subnet Mask
0.88	Eth. GW 1	O	Gateway
0.89	Eth. GW 2	O	Gateway
0.90	Eth. GW 3	O	Gateway
0.91	Eth. GW 4	O	Gateway
0.92	Eth. stan	O	xx0: not connected xx1: DHCP waiting xx2: connected

12.2. Communication via Json file

Inverter parameters can be presented in JSON file format and used for data presentation in other monitoring systems. To obtain data in JSON format, send a request to the inverter in the form: htttp://Inverter_ip_address/command.

Below is a list of available commands:

http://IP_Address/dataNow – real-time inverter parameter values read from group 0,
http://IP_Address/plotNow – data for the chart from today,
http://IP_Address/plotPrev – data for the chart from the previous day.

Data available on the charts are recorded at 15-minute intervals.

Due to the necessity of querying the inverter's IP address, it is recommended to set a static IP address (see chapter 12.1. “Connecting the inverter to the Internet“ on page 51.

12.3. Configuring the Wi-Fi connection

Configuring the Wi-Fi connection can be done in two ways:

1. Using a device with a Wi-Fi (smartphone, computer, etc.),
2. Directly from the inverter menu.

To configure the Wi-Fi connection, remove the front cover of the inverter to gain access to the buttons located on the right side of the display. The "Wi-Fi" connection is configured in the **"08 Wi-Fi" parameter group: SETTINGS→PARAMETERS**.

You can enter the menu by pressing the OK button.

*In order to gain access to the **"08 Wi-Fi"** group, you must first enter the code **123321** in the **SETTINGS→SERVICE** menu.*

Configuration via smartphone or other Wi-Fi device

The inverter can operate in "client" or "Access Point" (AP) mode. "Client" mode is the default operating mode. AP mode is used to configure the inverter to work in a Wi-Fi network.

After power on the inverter, the Wi-Fi network is inactive for 2 minutes. After this time, the inverter starts working in "client" mode and tries to connect to the last known Wi-Fi network for another 2 minutes. If the network is not found within this time, the inverter switches to AP mode and starts broadcasting the "PS100/PS300" network for 5 minutes. After this time, it will return to the "client" mode again for 2 minutes and the cycle will repeat. Network broadcasting can be forced in parameter **08.05 "Force AP"**.

To connect the inverter to the Wi-Fi network:

1. Make sure the inverter's Wi-Fi module is turned on and the network is broadcast:
   par. 08.01 „**Wifi enabled**” = „**001 YES**”
   par. 08.02 „**Hide SSID**” = „**000 NO**”.
2. Connect to the „**PS 100/300**” Wi-Fi network using a device with Wi-Fi access.
   If the „**PS 100/300**” Wi-Fi network is not visible, force the AP mode by changing the **par. 08.05** „**Force AP**” to „**001 YES**”.
   Note: *AP mode is active for 5 minutes after setting par. **08.05 „Force AP”** to **„001 YES”**.*
3. Enter the address **192.168.1.1** in a web browser. On the configuration page (Fig. 12.1.) enter the parameters of the Wi-Fi network to which the inverter is to connect:
   SSID: Wi-Fi name,
   Tryb zabezpieczen: Wi-Fi security mode,
   Haslo: Wi-Fi password.

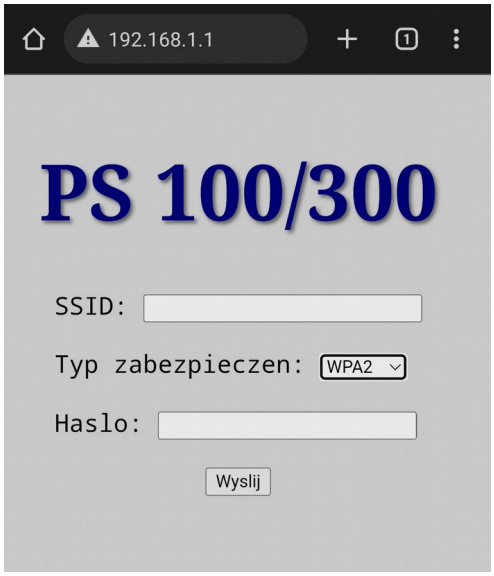


Fig. 12.1. View of the Wi-Fi inverter configuration page

In case of a failed connection (or other Wi-Fi problems), please **par. 08.04** „**Service mode**” to „**001 YES**”, accept with OK button and set again to "**000 NO**".

Configuration from the inverter menu

To configure the Wi-Fi connection from the inverter menu:

1. In the inverter menu, select: SETTINGS → COMM → WIFI

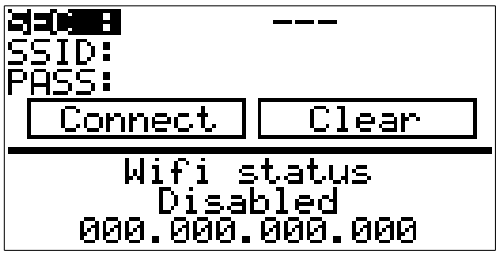


Fig. 12.2. View of the Wi-Fi configuration menu

2. Configure the connection parameters

   - **SEC**: Select the security mode used in the Wi-Fi network to which the inverter is to connect. Possible options are:

     OPEN: open network, not password.
     WPA-PSK: a network secured with the WPA-PSK (WPA2) standard.
     WEP: a network secured with the WEP standard.
     802_1x: a network secured with the 802_1x standard.
     If you select a security mode other than OPEN, it will be necessary entering *a password and possibly other authentication data.*

   - **SSID**: Select the Wi-Fi network to which the inverter should connect. Possible options are:
     Input: manually enter the network name.
     Scan: selection of Wi-Fi networks from the list scanned by the inverter.

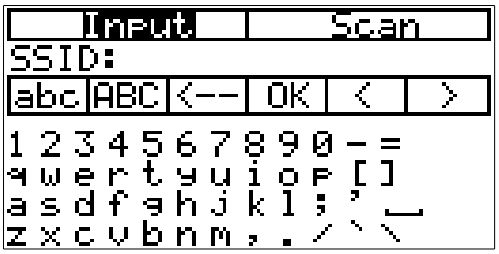


Fig. 12.3. Manually entering the Wi-Fi network name

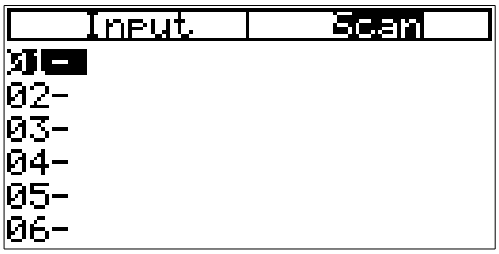


Fig. 12.4. Select a Wi-Fi network from the list of available networks

After selecting the network, press ESC on the keyboard to return to the menu in Fig. 12.2.

   - **PASS**: Enter authentication data. Depending on the selected **SEC** security mode, it may be only a password or also other data.

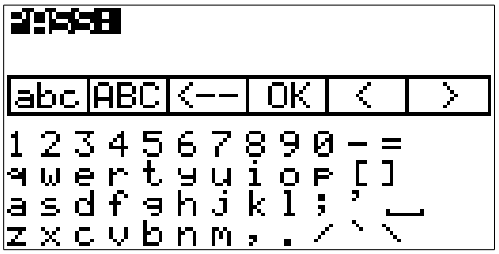


Fig. 12.5. Entering Wi-Fi password

After entering the authentication data, press ESC on the keyboard to return to the network configuration menu showed in Fig. 12.2.

List of all parameters from group 08 that configure the Wi-Fi network

- **Par. 08.01**: **Wifi enabled** – switching on the Wi-Fi module built into the inverter.
- **Par. 08.02**: **Hide SSID** – the inverter SSID is not broadcast – AP mode.
- **Par. 08.03**: **Pass require** – password protection of the inverter connection in AP mode; the password is permanent and linked to the inverter's serial number (e.g. PS-000743/22 is the password for the inverter with serial number 743/22/xx).
- **Par. 08.04: Service mode.**
- **Par. 08.05**: **Force AP** – forcing operation in "Access Point" mode. AP mode is active for 5 minutes from the time it is activated.

13. Inverter Monitoring System via www.inverters.pl

13.1. Creating a user account

When you enter the **www.inverters.pl** web site, on the main page click to **"Zarejestruj sie"** and:

1-Define an username.
2-Enter e-mail address.
3-Define a password.
4-Re-enter password.
5-Click to **"załóż konto"**

After creating an account go back to main page for signing in.

13.2. Login

1-Enter user name.

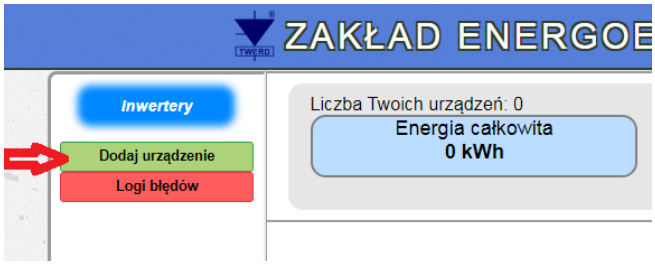
2-Enter password.

3-For log-in click to **"zaloguj"**

13.3. Adding the inverter to the system to monitor its operation

Adding inverters to the system for remote monitoring;

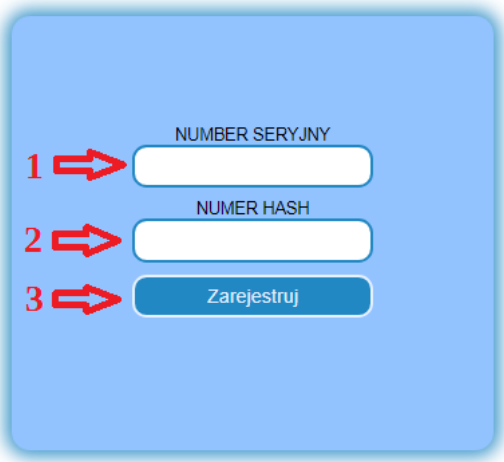
Click to **"dodaj urzadzenie"**



1 - Enter the serial number**(Nr seryjny)** of the device.

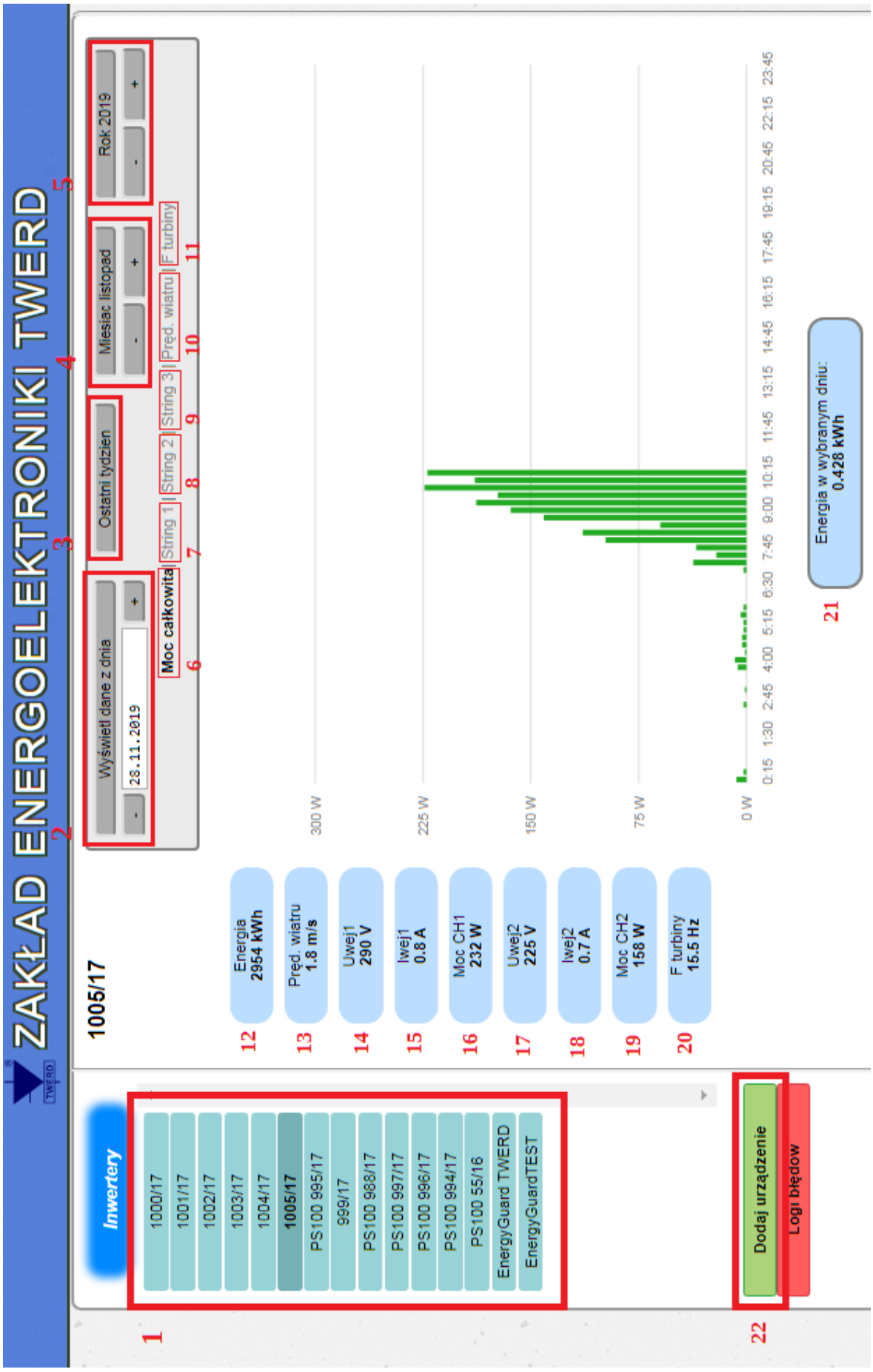
2 - Enter the **hash admin** numbers.

3 - For register click to **"Zarejestruj"**



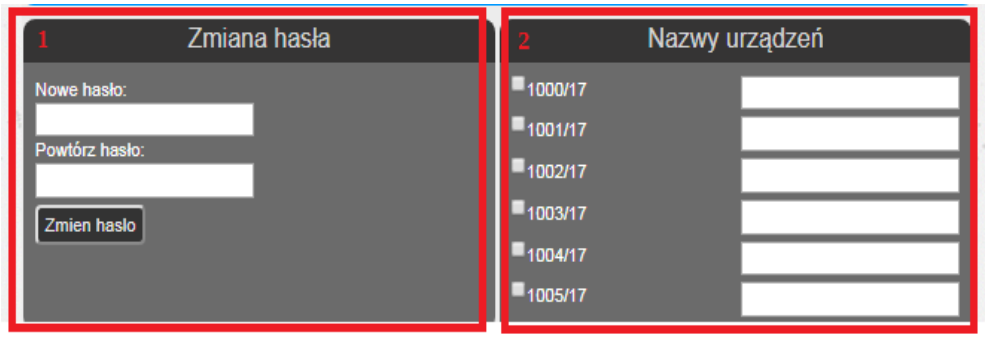
Note: Serial number and hash admin numbers will be attached on the user manual.

After whole processes users are able to monitoring their devices via **www.inverters.pl** web site.


ZAKŁAD ENERGOELEKTRONIKI TWERD
TWERD
1
2
3
4
5
Inwertery
1000/17
1001/17
1002/17
1003/17
1004/17
1005/17
PS100 995/17
999/17
PS100 988/17
PS100 997/17
PS100 996/17
PS100 994/17
PS100 55/16
EnergyGuard TWERD
EnergyGuardTEST
1005/17
Wyświetl dane z dnia
28.11.2019
Ostatni tydzien
Miesiac listopad
Rok 2019
Moc całkowita
String 1
String 2
String 3
Pręd. wiatru
F turbiny
6
7
8
9
10
11
300 W
225 W
150 W
75 W
0 W
0:15 1:30 2:45 4:00 5:15 6:30 7:45 9:00 10:15 11:45 13:15 14:45 16:15 17:45 19:15 20:45 22:15 23:45
Energia
2954 kWh
12
Pręd. wiatru
1.8 m/s
13
Uwej1
290 V
14
Iwej1
0.8 A
15
Moc CH1
232 W
16
Uwej2
225 V
17
Iwej2
0.7 A
18
Moc CH2
158 W
19
F turbiny
15.5 Hz
20
Energia w wybranym dniu:
0.428 kWh
21
Dodaj urządzenie
Logi błędow
22

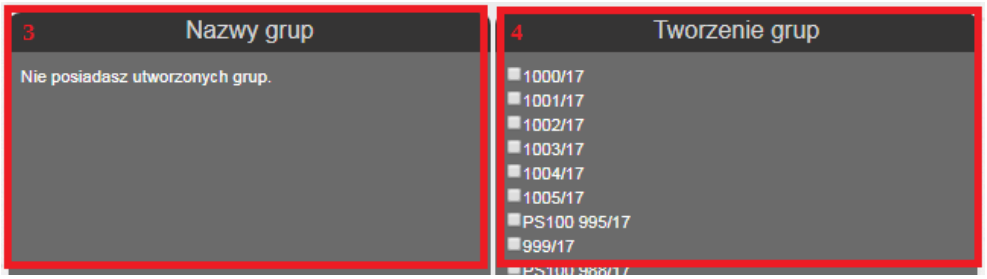
1. On this label users can see registered inverters and when you click one of them you can see details of inverter on the main screen.
2. Users can check any previous specific date parameters by entering date and clicking to “wyswietl dane z dnia”.
3. Users can check last week parameter chart by clicking to “ostatni tydzien”.
4. Users can check any monthly chartered datas. To see montly chart by “+” and “-“ buttons can set month and click to upper button “miesiac …”.
5. Users can check any yearly chartered datas. To see yearly chart by “+” and “-“ buttons can set month and click to upper button “rok …”.
6. Clicking by “moc calkowita” users could see total power chart.
7. Clicking by “string 1” users could see power chart of string 1.
8. Clicking by “string 2” users could see power chart of string 2.
9. Clicking by “string 3” users could see power chart of string 3.
10. Clicking by “pred. wiatru” users could see wind speed chart.
11. Clicking by “F turbiny” users could see frequency of wind turbine chart.
12. From first run-up to present total energy generation.
13. Present wind speed.
14. Present voltage value of input 1.
15. Present current value of input 1.
16. Present power value of input 1.
17. Present voltage value of input 2.
18. Present current value of input 2.
19. Present power value of input 2.
20. Present frequency of wind turbine.
21. Energy on a selected day.
22. To register new inverter.

13.4. Account settings



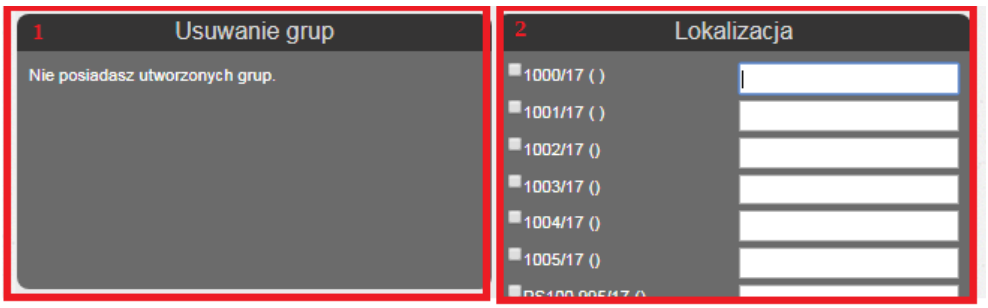
1 - In this menu users can change account password.

2 - In this menu users replace name of inverter. To change the name of inverter user should choose related inverter and insert the box new name than click to save button **“zmien zaznaczone”.**



3 - Nazwy grup - users can see and manage created inverter groups.

4 - Tworzenie grup: users can create a group and add inverters to the group. To create a group of inverters user should choose related inverters and insert the box group name than click to save button **“utworz grupe”.**



1-Here (usuwanie grup) users could delete group.
2-Here (lokalizacja) users could change the localization details of inverters. To change the localization of inverter user should choose related inverter and insert the box new localization than click to save button **“zmien zaznaczone”.**

14. Battery charger module

14.1. General information

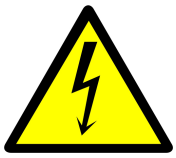
The following inverters are equipped with the battery charging module:

- **PS300-PV+BC.**

Table 14.1. Charger module specifications

Lp.	Name of the parameter	Value
1	Nominal battery voltage	48 Vdc – 640 Vdc
2	Nominal charging/discharging current	50 A
3	Charger topology	transformerless

!!! ATTENTION. RISK OF ELECTRIC SHOCK !!!



Due to the use of transformerless topology of the charger, and thus the connection of the negative pole of the battery to the DC circuit of the inverter, the battery terminals on the batteries are life-threatening and health electrical voltage.

It is forbidden to touch the battery terminals because it may endanger you electric shock!

Caution:

1. The battery charger module does not have a pre-charger circuit. This means that an external pre-charger circuit must be installed to limit the current drawn from the battery to 40 A.

   Otherwise, the battery and charging module may be damaged. This current can also cause fire, explosion and pose a threat to life and health.
2. The energy storage module must contain a short-circuit protection with a breaking capacity specified by the battery manufacturer.
3. It is recommended to use a safety switch disconnecting the battery from the charging module in emergency situations.

Moreover:

1. It is forbidden to ground the battery poles. This may result in irreversible damage to the inverter and will void the warranty.
2. Additional measuring circuits connected to the accumulator battery must be galvanically separated from the power grid and the inverter's I/O. Otherwise, the system may malfunction and even damage, which will not be covered by the warranty.

Charging and discharging of the attached battery takes place in two stages: initially it is work at constant current, then work at constant voltage. The process of charging and discharging the battery is shown in Fig. 14.1. It also indicates the parameters determining the maximum battery charging and discharging current and voltage thresholds at their terminals.

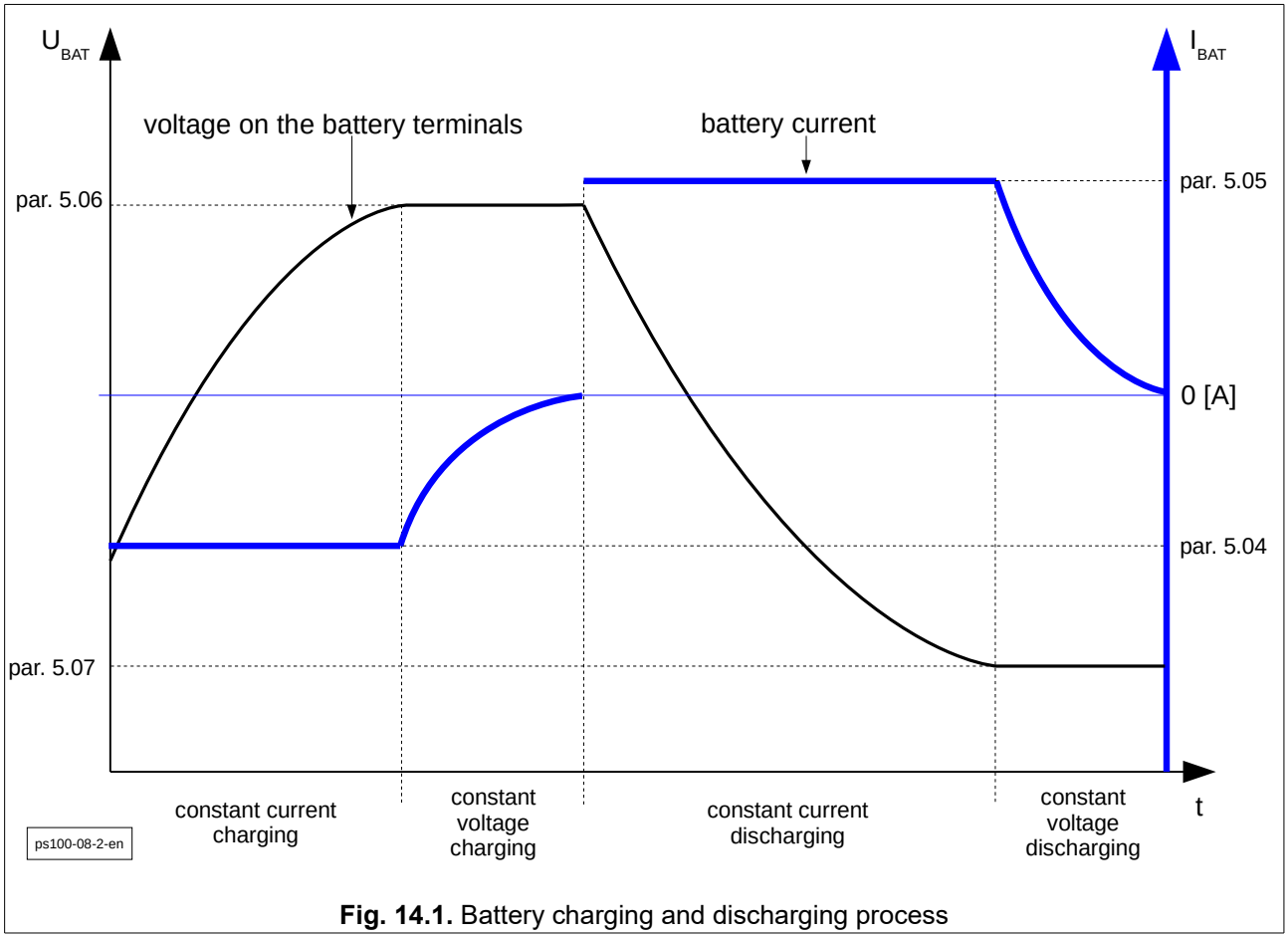


Fig. 14.1. Battery charging and discharging process

Note:

1. It was assumed that during the battery charging process the current value is negative. This is shown in Fig. 14.1, where during the charging process the current curve is below 0A. Also on the display, in the parameter 0.41 a negative value of the charger current means the battery charging process, and a positive value means the discharge process.

14.2. Possible operation scenarios

The inverter equipped with the battery charging module can work in one of the following scenarios (or their combinations) previously programmed at the manufacturer's:

1. The "**on-grid**" system with the "**Energy guard**" module

The system synchronizes with the electrical grid, but manages the energy in such a way as to avoid its transmission further than the connection point to the electrical grid. The system is intended for customers who do not plan to sell electricity to the mains, but only use it for their own needs.

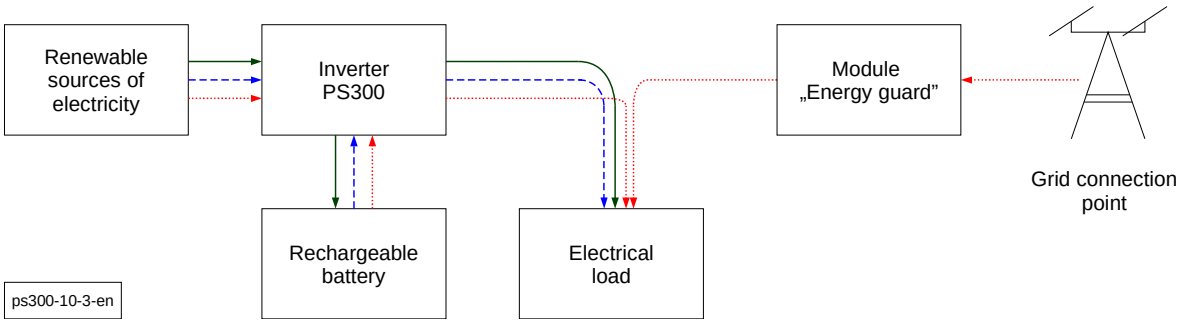


Fig. 14.2. Energy transfer scenario with „*on-grid*” operation with „*Energy guard*” module

Operation principle: inverter based on data received from the Energy guard module about the power demand through electrical loads, controls the flow of energy as follows:

- Electricity obtained from renewable energy supplies electrical loads and excess energy is stored in batteries - a solid green line.
- When the demand for electricity exceeds the renewable energy source's capacity, the shortage is balanced by the use of energy stored in the battery - the blue dotted line.
- When the demand for electrical power exceeds the capacity of the renewable energy source and energy supplied from the battery, the power shortage is taken from the electricity grid - a red dotted line.

2. The "**off-grid**" system

The inverter supplies the local loads and collects the surplus energy in batteries (solid green line). If the power from renewable sources is not enough to cover the demand of loads, the batteries will be discharged (blue dotted line).

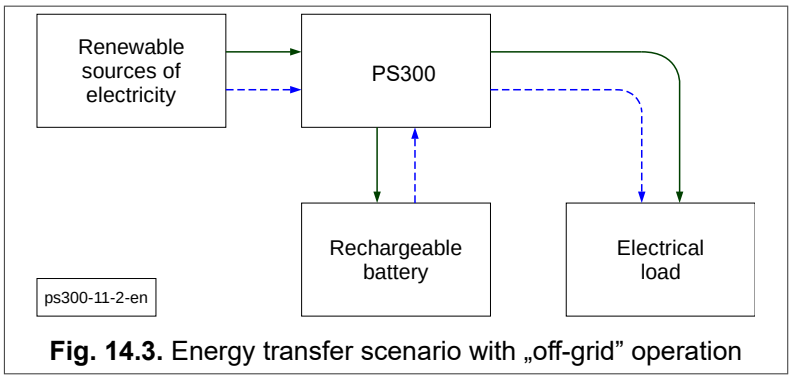


Fig. 14.3. Energy transfer scenario with „off-grid” operation

3. The „**auto-on-off-grid**” system

When the electrical grid is turned off, the system immediately disconnects from the electrical grid and turns into „Off-grid” operation mode (see point 1 above: The "on-grid" system with the "Energy guard" module).

When the electrical grid is switched on again the inverter synchronizes again with the grid and goes into "on grid" mode (see point 2 above: The "off-grid" system).

The separated off-grid network is connected to the supply power network by means of a contactor located inside the inverter.

15. Configuration of Parameters

The following parameter tables are common to the PS100 and PS300 series inverters.
Parameters marked in gray apply only to PS300 inverters.

15.1. Inverter status parameters – group 0

Group 0 contains parameters that inform about the current state of the device (acces level „O” - read-only). These are public parameters - access to them is not password protected.

Parameter No.	Name	Access level	Description
00.01	Produced energy [kWh]	O	Total produced energy
00.02	Run time [h]	O	Total working time
00.03	Grid power L1 [W]	O	Active power from the grid side in phase L1 [1)]
00.04	Grid power L2 [W]	O	Active power from the grid side in phase L2 [1)]
00.05	Grid power L3 [W]	O	Active power from the grid side in phase L3 [1)]
00.06	Grid freq [Hz]	O	Grid frequency
00.09	Grid volt. L1 [V]	O	L1 phase grid voltage
00.10	Grid volt. L2 [V]	O	L2 phase grid voltage
00.11	Grid volt. L3 [V]	O	L3 phase grid voltage
00.12	Grid curr. L1 [A]	O	L1 phase grid current
00.13	Grid curr. L2 [A]	O	L2 phase grid current
00.14	Grid curr. L3 [A]	O	L3 phase grid current
00.15	Grid r. power L1	O	Reactive power from the electrical grid side in phase L1 [1)]
00.16	Grid r. power L2	O	Reactive power from the electrical grid side in phase L2 [1)]
00.17	Grid r. power L3	O	Reactive power from the electrical grid side in phase L3 [1)]
00.18	Grid power sum [W]	O	Total active power from the grid side (sum of phases L1, L2, L3) [1)]
00.19	Grid r. power sum [var]	O	Total reactive power from the grid side (sum of phases L1, L2, L3) [1)]
00.20	Input 1 power [W]	O	Input 1 power
00.21	Input 1 volt [V]	O	Input 1 DC voltage
00.22	Input 1 curr [A]	O	Input 1 DC current
00.23	Input 2 power [W]	O	Input 2 power
00.24	Input 2 volt [V]	O	Input 2 DC voltage (in inverters with synchronous generator input the AC input voltage first is rectified and the measurement is done after it)
00.25	Input 2 curr [A]	O	Input 2 DC current (in inverters with synchronous generator input the AC input current first is rectified and the measurement is done after it)
00.26	Input 3 power [W]	O	Instantaneous power at input 3
00.27	Input 3 volt [V]	O	DC voltage at input 3
00.28	Input 3 curr [A]	O	DC current at input 3
00.29	Turbine RMS	O	Wind turbine RMS voltage
00.30	Turbine freq [Hz]	O	Turbine generator frequency

1 The sign "-" means energy consumption from the electricity grid.

Parameter No.	Name	Access level	Description
00.31	Wind speed [m/s]	O	Wind speed
00.32	Resistance [kΩ]	O	Insulation resistance
00.33	Leakage current [mA]	O	Leakage current
00.34	Digital out.	O	Digital outputs state (Brake, K3, K2, K1)
00.35	Digital inp.	O	Digital inputs state
00.40	Charger volt. [V]	O	Charger voltage input
00.41	Charger curr. [A]	O	Charger DC current input
00.42	Charger temp. [°C]	O	Battery temperature
00.43	Charger t. mod [°C]	O	Charger internal transistor module temperature
00.44	Charger fault	O	Battery charger fault code
00.45	Charger UDC	O	DC voltage value in the charger intermediate circuit
00.46	SoC	O	The level of charge of an electric battery
00.47	Charger power	O	
00.50	UDC [V]	O	DC link circuit voltage
00.51	UDC 1 [V]	O	DC link 1 circuit voltage
00.52	UDC 2 [V]	O	DC link 2 circuit voltage
00.53	Radiator temp. [°C]	O	Heatsink temperature
00.54	Module temp. [°C]	O	Module temperature
00.56	Out grid freq	O	Power grid frequency
00.57	Out grid volt L1	O	Power grid voltage – phase L1
00.58	Out grid volt L2	O	Power grid voltage – phase L2
00.59	Out grid volt L3	O	Power grid voltage – phase L3
00.60	Status	O	Inverter status: b_0 – inverter run, b_1 – inverter input 1 boost 1 run, b_2 – inverter input 2 boost run, b_3 – power grid line contactor switched on, b_4 – input 1 and input 2 ready to work, b_5 – string 1 voltage is correct, b_6 – string 2 voltage is correct, b_7 – UDC voltage is correct, b_8 – OnGrid mode, b_9 – power grid parameters are correct, b_{10} – phase power line voltages are correct, b_{11} – configuration parameters received, b_{12} – low input power, b_{13} – permission to discharge the battery, b_{14} – braking resistor contactor switched on, b_{15} – AC pre-charging contactor on
00.61	Version ctr1	O	Software version (communication)
00.62	Version output	O	Software version (control)
00.63	Version charger	O	Software version (charger module)
00.64	Revision ctrl.	O	Software revision (communication)
00.70	Event 1	O	Last event code
00.71	Event 2	O	Previous event code
00.72	Event 3	O	Previous event code

Parameter No.	Name	Access level	Description
00.73	Event 4	O	Previous event code
00.74	Event 5	O	Previous event code
00.75	Event 6	O	Previous event code
00.76	Event 7	O	Previous event code
00.77	Event 8	O	Previous event code
00.78	Event 9	O	Previous event code
00.79	Event 10	O	Oldest event code
00.80	Eth. IP 1	O	IP address
00.81	Eth. IP 2	O	IP address
00.82	Eth. IP 3	O	IP address
00.83	Eth. IP 4	O	IP address
00.84	Eth. MASK 1	O	Subnet mask
00.85	Eth. MASK 2	O	Subnet mask
00.86	Eth. MASK 3	O	Subnet mask
00.87	Eth. MASK 4	O	Subnet mask
00.88	Eth. GW 1	O	Default gateway
00.89	Eth. GW 2	O	Default gateway
00.90	Eth. GW 3	O	Default gateway
00.91	Eth. GW 4	O	Default gateway
00.92	Eth. State	O	Ethernet connection state
00.97	EG L1 [kW]	O	Instantaneous power in the phase L1 measured by the Energy Guard module
00.98	EG L2 [kW]	O	Instantaneous power in the phase L2 measured by the Energy Guard module
00.99	EG L3 [kW]	O	Instantaneous power in the phase L3 measured by the Energy Guard module

15.2. Inverter configuration parameters

Each parameter has an assigned access level. The access level codes differ depending on whether the code is entered on the inverter display or via the Modbus TCP/IP protocol.

Access level "1" - display: code **123321**; Modbus TCP/IP protocol: code **12321**.

Access level "2" (service) - display: code **136064**; Modbus TCP/IP protocol: code **13664**.

Higher access levels are reserved for the device manufacturer and the user is not authorized to change them.

Attention! Changes to parameter settings should be made consciously. Incorrect changes to parameter settings may cause incorrect operation of the inverter and, as a result, damage it. Devices connected to the same electrical network or directly to the inverter may also be damaged. The inverter manufacturer is not responsible for any of these damages.

GROUP 1 – Grid module

Parameter No.	Name	Access level	Description
01.02	Output volt. [V]	1	Output voltage

Parameter No.	Name	Access level	Description
01.03	Output freq. [Hz]	1	Output frequency
01.10	Disconnect volt. [V]	1	DC input PV voltage or rectified AC input generator voltage, below which the countdown time will start (time is set in par. 1.11). This feature is used to reduce energy consumption in "On-grid" mode.
01.11	Disconnect time [V]	1	Time after which the inverter will be disconnected from the power supply to reduce power consumption, in case where the DC input voltage falls below the level set in par. 1.10
01.20	Autostart volt. [V]	1	DC input PV voltage or rectified AC input generator voltage over which you can start to load the generator and execute the START command.
01.21	Autostop volt. [V]	1	DC input PV voltage or rectified AC input generator voltage, below which the inverter will stop.
01.22	Autostart	2	Selection of the method of giving the START command 0 : manual - for giving the START/STOP command parameter 1.23 corresponds then 1 : automatic
01.25	Autorestart	2	Enable (1) / Disable (0): automatic deletion of the failure code if it occurs
01.26	Fault reset	2	Manual fault reset, specify the sequence: 0 → (wait 3 sec.) → 1 → (3 sec.) → 0
01.43	Batt. work time [min]	2	Battery life

GROUP 2 – Input 1: PV1

Parameter No.	Name	Access level	Description
02.01	Uin autostop [V]	1	Voltage at which Input 1 boost switches Off

GROUP 3 – Input 2: PV2 / WT

Parameter No.	Name	Access level	Description
03.01	Uin autostop [V]	1	Voltage at which Input 2 boost switches Off
03.29	Turb freq div	2	Turbine frequency divider
03.30	Turbine current [A]	1	Nominal generator DC current
03.31	Frequency 1 [Hz]	1	Frequency of point 1of the load characteristic
03.32	Curent 1 [%]	1	Value of load current in point 1 given as % of nominal current
...	...	1	...
03.61	Frequency 16 [Hz]	1	Frequency of point 16 of the load characteristic
03.62	Current 16 [%]	1	Value of load current in point 16 given as % of nominal current

GROUP 5 – Battery charger module

Parameter No.	Name	Access level	Description
05.01	UDC on break [V]	1	DC link voltage at which the charger brake turns on
05.04	Curr. Limit char [A]	1	Charging current limit
05.05	Curr. Limit dos [A]	1	Charging current limit
05.06	Umax battery [V]	1	Maximum battery voltage
05.07	Umin battery [V]	1	Minimal battery voltage
05.08	Tmax battery [°C]	1	Maximum battery temperature
05.09	Block run	1	Module charger operation lock 0 → charger module is working 1 → charger module is not working
05.10	Un	1	Nominal battery voltage
05.11	Delta Ibat	1	In order to protect against excessive discharge of the connected batteries, the inverter monitors the voltage and the current consumed. When the voltage value drops below the value specified in parameter 5.7 "Umin battery" and the obtainable current value is lower than the value specified in parameter 5.11 "Delta Ibat", the inverter will stop further discharging the battery. In order to recharge them, the inverter will first try to get energy from a renewable energy source (photovoltaic panels, wind generator), but if the amount of generated electricity is too small, depending on the operating mode: a. on-grid: for charging the battery inverter will draw energy from the power grid, b. off-grid: inverter will block the possibility of further discharge of the connected battery, 0 - battery protection disabled.
05.12	Power limit EG	1	Load limit for operation with Energy Guard. Minus sign means the possibility of giving the electric energy to the grid.
05.13	UDC Scale	1	A scale to calibrate the voltage measurement in the charger DC circuit
05.14	Power limit EG rec	1	Load power limit when operating with PS Energy Guard, at which the system will be supported with energy from the battery
05.15	EGBatChargePriority	1	Forcing battery charge/discharge priority in On-Grid mode. *The parameter is active only for EG modes 1, 2, 3 of EG (Par. 10.29).*
05.17	Ubat crit.	2	Critically low battery voltage. When the battery voltage drops to this level, it is recharged with energy from the power grid (in on-grid mode)
05.18	U bat min on-grid	1	Minimum battery voltage during on-grid operation
05.21	Fault Reset	2	Charger failure reset
05.22	kp UDC	2	Setting of the proportional part of the voltage regulator in the DC circuit
05.23	ti UDC	2	Setting of the integral part of the voltage regulator in the DC circuit

Parameter No.	Name	Access level	Description
05.24	kp Ubat	1	Setting of the proportional part of the battery voltage regulator
05.25	ti Ubat	1	Setting the integral part of the battery voltage regulator
05.26	kp I	2	Setting of the proportional part of the battery current regulator
05.27	ti I	2	Setting the integral part of the battery current regulator
05.28	Force Charge	1	Forcing battery charging from the grid. 'Yes' will start charging the battery with the energy from the grid.
05.29	BMS Type	1	Type of BMS used. 0 - no BMS system (lead battery) 1 - Nilar BMS 2 - Orion BMS
05.30	Test mode	2	Switching to test mode
05.31	High charge curr.	2	Service parameter
05.32	High disch. curr.	2	Service parameter
05.33	Remote blockade	1	Permission for external work blocking
05.34	Built-in charger	2	Parameter that sets information about the built-in charger
05.35	Ubat hysteresis	1	Battery voltage hysteresis The inverter will start working after exceeding the minimum voltage Ubat stop + Ubat Histereza, the system will be turned off after discharging to the voltage Ubat stop
05.36	Ubat stop	1	Minimum battery voltage at which the charger will be switched off, this value must be greater than value of par. 05.07
05.37	Precharge Contactor	2	Activation of the precharge contactor
05.38	Offset ADC Curr. Bat.	2	Battery current measurement offset
05.39	Scale ADC Curr. Bat.	2	Battery current measurement scale
05.40	Offset ADC Volt. Bat	2	Battery voltage measurement offset
05.41	Scale ADC Volt. Bat	2	Battery voltage measurement scale
05.42	BMS Timeout	2	Maximum interval time between data sent by the BMS module
05.43	Load Symmetrization	2	*Four-branch inverters only (4L)* Default value: 0. Range: 0..3 0 - no load symmetrization between phases; 1 - load symmetrization only for the system operating in the power range between the limits specified in parameters 5.12 and 5.14; 2 - load symmetrization only for the system operating outside the power range specified in parameters 5.12 and 5.14; 3 - load symmetrization throughout the entire operating range of the inverter, regardless of the system operating point.

GROUP 8 – Wi-Fi configuration

Parameter No.	Name	Access level	Description
8.01	Wifi enabled	1	Switching on the Wi-Fi module built into the inverter
8.02	Hide SSID	1	The inverter SSID is not broadcast - AP mode
8.03	Pass require	1	Password protection of the inverter connection in AP mode. The password is permanent and linked to the inverter's serial number (e.g. PS-000743/22 is the password for the inverter with serial number 743/22/xx)
8.04	Service mode	1	Service mode
8.05	Force AP	1	Forcing operation in "Access Point" mode. AP mode is active for 5 minutes from the time it is activated.

GROUP 10 – Service parameters

Parameter No.	Name	Access level	Description
10.03	Czest. gen. ham. [Hz]	2	Generator frequency at which the "Resistors" load is turned on
10.04	Min. czas ham. [s]	2	Minimum "Resistors" load turn-on time
10.05	Hist. ham. off [%]	2	Hysteresis specified in % in relation to the values given in parameters 10.2 and 10.3, giving the load release thresholds
10.06	Metro / 10imp [m/s]	2	Wind speed corresponding to 10 pulses from the anemometer
10.07	Ogon freq max [Hz]	2	Generator frequency above which the K2 relay is switched on
10.08	Ogon freq min [Hz]	2	Generator frequency below which the K1 relay is switched on
10.09	Ogon freq opt [Hz]	2	Generator frequency beyond which the K1 or K2 relay is switched off
10.10	Ogon Urms max [V]	2	Voltage above which the K2 relay is switched on and possibly the K1 relay is switched off
10.11	Ogon t1 [s]	2	The minimum activation time of the K2 relay
10.13	powerHysteresis	2	MPPT parameter
10.14	Global mppt scan	1	Time between global MPPT scans; 0 min. means disabling global MPPT
10.16	antiIsland	2	Anti-island protection
10.17	Ugadna start b	2	Energy Guard parameter
10.18	Reac. Power Comp.	2	Reactive power compensation permission
10.20	Erase all plot	2	Delete all plots
10.21	Set 0-999W	2	Manual setting the value of the generated energy - W
10.22	Set 0-999kW	2	Manual setting the value of the generated energy - kW
10.23	Set 0-999MW	2	Manual setting the value of the generated energy - MW
10.24	Erase power	2	Resetting the value of the generated energy
10.25	Set run day	2	Manual setting of working time - days
10.26	Set run hour	2	Manual setting of working time - hours

Parameter No.	Name	Access level	Description
10.27	Erase run time	2	Resetting the working time value
10.29	EG Mode	1	PS Energy Guard module operating mode: 0 – Power limitation disabled; in inverters with the battery connected, first the battery is charged and the surplus is returned to grid. 1 - The inverter limits the power according to the power from the least loaded phase. 2 - The inverter limits the power based on the sum active power from three phases. 3 - The inverter limits the power based on the average active power from three phases. 4 - The inverter limits the maximum output power to values from par. 5.12. PS Energy Guard module is not required.
10.45	Ogon fmax stop	2	Generator frequency above which the K2 relay is switched on
10.46	Ogon fmin stop	2	Generator frequency below which the K1 relay is switched on
10.47	Ogon fopt stop	2	Generator frequency beyond which the K1 or K2 relay is switched off
10.48	High wind speed	1	Wind speed that activates storm protection
10.49	High wind timer	1	Switch-on duration of storm protection from par. 10.48. *Value "0" disables protection*
10.50	Language	1	Language selection
10.51	Contrast	1	LCD screen contrast
10.52	Remote par. edit	1	Permission to remotely change parameter settings in flash memory via the Modbus RTU / TCP/IP protocol 0 – save parameter settings to flash memory, 1 – change of settings without saving to the flash memory - after restarting the power supply, the last setting saved in the flash memory will be read
10.53	Remote login	1	Service parameter
10.54	Min ground res.	2	Permits to carry out an insulation resistance test
10.62	Relay function	2	0 – wind generator tail control 1 – DSP (control forced by the inverter module) 2 – load control
10.63	K1 On EG power	1	Power threshold measured by the PS Energy Guard module, beyond which the K1 and K2 relays will be switched on/off.
10.64	K1 Off EG power	1	
10.65	K2 On EG power	1	
10.66	K2 Off EG power	1	
10.71	High wind freq	1	Turbine frequency that activates storm protection
10.72	High wind timer	1	Switch-on duration of storm protection from par. 10.71. *Value "0" disables protection*
10.73	High wind duration	1	Duration of exceeding the storm protection value set in parameters 10.48 and 10.71, after which storm protection will be activated.
10.74	Load res. on fault	1	Forcing the braking resistor to turn on in the event of a failure.

GROUP 11 – Grid parameters

Parameter No.	Name	Access level	Description
11.01	OverVoltageSt2	2	Overvoltage protection threshold - level 2 instantaneous
11.02	OverVoltageSt1	2	Overvoltage protection threshold - level 1 time delay
11.03	UnderVoltage	2	Undervoltage protection threshold
11.04	OverFreq	2	Overfrequency protection threshold
11.05	UnderFreq	2	Underfrequency protection threshold
11.06	OverFreqTime	2	Delay time of overfrequency protection operation
11.07	UnderFreqTime	2	Underfrequency protection trip delay time
11.08	OverVoltageSt2Time	2	Overvoltage protection activation delay time - level 2
11.09	OverVoltageSt1Time	2	Overvoltage protection activation delay time - level 1
11.10	UnderVoltageTime	2	Delay time of undervoltage protection operation
11.11	MinFReconnect	2	Minimum grid frequency when reconnected
11.12	MaxFReconnect	2	Maximum network frequency when reconnected
11.13	MinUReconnect	2	Minimum mains voltage when reconnected
11.14	MaxUReconnect	2	Maximum mains voltage when reconnected
11.15	MinFStart	2	Minimum grid frequency at start-up
11.16	MaxFStart	2	Maximum grid frequency at start-up
11.17	MinUStart	2	Minimum mains voltage at start-up
11.18	MaxUStart	2	Maximum mains voltage at start-up
11.19	GridObservationTime	2	Time to recognize the grid before starting work
11.20	Reconn.PowerRamp	2	Time after reconnection in which the inverter output power limit increases from 0 to nominal power
11.21	StartingPowerRamp	2	The time after the start of operation in which the power limit at the output of the inverter increases from 0 to the nominal power.
11.22	ReducePowerFreq	2	Grid frequency threshold from which the inverter output power limit starts to be limited
11.23	OverFreqDroop	2	Percentage decrease of the inverter output power limit as the grid frequency increases above the tripping threshold
11.24	CosPhi	2	Defines the cosφ of the output current and the type of reactive power of the inverter (capacitive/inductive)
11.25	Rocof Ramp	2	Collateral value Rocof

GROUP 12 – Grid parameters EN50549

Parameter No.	Name	Access level	Description	Default value	Setting range
12.01	Napiecie znamionowe sieci	2	Rated voltage	230 V	100-400V
12.02	Czestotliwosc znamionowa	2	Rated frequency	50 Hz	50Hz, 60Hz
12.03	Nominal Power		Rated power	Pn	-

Parameter No.	Name	Access level	Description	Default value	Setting range
12.04	UnderVoltage St1	2	Undervoltage protection threshold threshold 1	0.85	0.2..1.00
12.05	UnderVoltage St1 Time	2	Undervoltage protection threshold threshold 1 – time	1.2 s	0.1..100.0 s
12.06	UnderVoltage St2	2	Undervoltage protection threshold threshold 2	0.4	0.20..1.00
12.07	UnderVoltage St2 Time	2	Undervoltage protection threshold threshold 2 - time	0.20 s	0.10..5.00 s (rozdz:0.05s)
12.08	OverVoltageSt1	2	Overvoltage protection threshold - level 1 (instantaneous)	1.15	1.00..1.20
12.09	OverVoltageSt1Time	2	Overvoltage protection activation delay time - level 1	0.1 s	0.1..100.0 s
12.10	OverVoltageSt2	2	Overvoltage protection threshold - level 2 (instantaneous)	1.15	1.00..1.30
12.11	OverVoltageSt2Time	2	Overvoltage protection activation delay time - level 2	0.10 s	0.10..5.00 s (rozdz.: 0.05s)
12.12	OverVoltage10min	2	Overvoltage protection threshold 10 minutes (delayed)	1.10	1.00..1.15
12.13	Enable ST1 Under/Over Freq		Selection of active security thresholds: 0 - St2 1 - St1 2 - DI4 3 - Remote	0	0, 1, 2, 3
12.14	UnderFreqSt1A	2	Underfrequency protection threshold	47.5 Hz	47.0..50.0 Hz
12.15	UnderFreqTimeSt1A	2	Underfrequency protection activation delay time	0.1 s	0.1..100.0 s
12.16	UnderFreqSt2A	2	Underfrequency protection threshold	47.5 Hz	47.0..50.0 Hz
12.17	UnderFreqTimeSt2A	2	Underfrequency protection trip delay time	0.10 s	0.10..5.00 s (rozdz.: 0.05s)
...					
12.22	OverFreq St1	2	Overfrequency protection threshold St1	52.0 Hz	50.0..52.0 Hz
12.23	OverFreqTimeSt1	2	St1 overfrequency protection activation delay time	0.1 s	0.1..100.0 s
12.24	OverFreq St2	2	Overfrequency protection threshold St2	52.0 Hz	50.0..52.0 Hz
12.25	OverFreqTimeSt2	2	St2 overfrequency protection activation delay time	0.10 s	0.10..5.00 s (rozdz.: 0.05s)
LFSM-U					

Parameter No.	Name	Access level	Description	Default value	Setting range
12.26	Under Treshold freq f1	2	The grid frequency threshold below which the output power starts to be increased 46.0 - Disables features	49.8 Hz	46.0..49.8 Hz
12.27	UnderFreqDroop	2	Percentage increase of the inverter output power limit as the grid frequency falls below the tripping threshold	5%	2..12%
12.28	UnderFreq PowerRef	2	Reference when threshold is exceeded PM - power at the time of exceeding Pmax - nominal power of the device	Pmax	0 - Pmax 1 - Pm
12.29	UnderFreq IntentDelay	2	LFSM-U mode activation delay	0	0.0...2.0s
			LFSM-O		
12.30	OverFreq Treshold freq f1	2	Grid frequency threshold above which the inverter output power starts to be limited. 52.0-Disables features	50.2 Hz	50.2..52.0 Hz
12.31	OverFreqDroop	2	Percentage decrease of the inverter output power limit as the grid frequency increases above the tripping threshold	5%	2..12%
12.32	Over Freq PowerRef	2	Reference when threshold is exceeded PM - power at the time of exceeding Pmax - nominal power of the device	PM	0 – Pmax 1 – Pm
12.33	OverFreq IntentDelay	2	LFSM-O mode activation delay	0 s	0.0..2.0 s
12.34	Fstop	2	Latched limit deactivation threshold in mode LFSM-O. Fstop ≥ par.12.30 disables freeze limit.	52.0 Hz	50.0.. 52.0 Hz
12.35	UF-Deactivation Time Fstop	2	Limit reset function delay	0 s	0.0..2.0 s
			Control		
12.36	Control Mode	2	Reactive power generation control mode		0 - Qset 1 - cos φ set 2 - Q(U) 3 - cosφ(P)
12.37	Q set	2	Reactive power setting as a percentage of the active power of the device for Par. 12.36 = 0	0	-48..+48 %
12.38	Cosfi set	2	Cos φ setting for par. 12.36 = 1	0	-0.9..0.9
12.39	uV2	2	QuV1 setting dor par. 12.36 = 2	0.92	0.80..1.00
12.40	QuV2	2	Q for uV1 Par. 12.36 = 2	48%	-48..48 %

Parameter No.	Name	Access level	Description	Default value	Setting range
12.41	uV1	2	Voltage for QuV1 par. 12.36 = 2	0.94	0.90..1.00
12.42	QuV1	2	Q for uV1 par. 12.36 = 2	0	-48..48 %
12.43	oV1	2	Voltage for QoV1 par. 12.36 = 2	1.06	1.00..1.15
12.44	QoV1	2	Q for oV1 Par. 12.36 = 2	0	-48..48 %
12.45	oV2	2	Voltage for QoV2 par. 12.36 = 2	1.08	1.00..1.15
12.46	QoV2	2	Q for oV2 par. 12.36 = 2	-48%	-48..48 %
12.47	Time filter	2	Q(U) control filter time constant par. 12.36 = 2	10 s	3..60 s
12.48	Lock in power	2	Power level to enable Q(U) regulation par. 12.36 = 2	0	0..20 %
12.49	Lock out power	2	Power level to disable Q(U) regulation par. 12.36 = 2	0	0..20 %
12.50	P1	2	Power value P1 of the cosφ(P) characteristic par. 12.36 = 3	0.20	0.01..1.00
12.51	cosfi(P1)	2	Cosφ setting for power P1 of the cosφ(P) characteristic par. 12.36 = 3	1.00	-0.9..0.9
12.52	P2	2	Power value P2 of the cosφ(P) characteristic par. 12.36 = 3	0.50	0.01..1.00
12.53	cosfi(P2)	2	Cosφ setting for power P2 of the cosφ(P) characteristic par. 12.36 = 3	1.00	-0.9..0.9
12.54	P3	2	Power value P3 of the cosφ(P) characteristic par. 12.36 = 3	1.0	0.01..1.00
12.55	Cosfi (P3)	2	Cosφ setting for power P3 of the cosφ(P) characteristic par. 12.36 = 3	-0.9	-0.9..0.9
12.56	Min F Reconnect	2	Minimum grid frequency when reconnected	49.5 Hz	47.0..50.0 Hz
12.57	MaxFReconnect	2	Maximum network frequency when reconnected	50.2 Hz	50.0..52.0 Hz
12.58	MinUReconnect	2	Minimum mains voltage when reconnected	85%	50..100 %
12.59	MaxUReconnect	2	Maximum mains voltage when reconnected	110%	100..120 %
12.60	Grid Observation time Reconnect	2	Observation time before reconnecting to the network	60 s	10..600 s
12.61	Reconn.PowerRamp	2	Power limit ramp rate after reconnection	10 %/min	6..6000 %/min

Parameter No.	Name	Access level	Description	Default value	Setting range
12.62	MinFStart	2	The minimum frequency of the network at start-up	49.5 Hz	47.0..50.0 Hz
12.63	MaxFStart	2	Maximum grid frequency	50.1 Hz	50.0..52.0 Hz
12.64	MinUStart	2	Minimum mains voltage at start-up	85%	50..100 %
12.65	MaxUStart	2	Maximum mains voltage at start-up	110%	100..120 %
12.66	GridObservationTime	2	The time of measuring the parameters of the electrical network before starting work	60 s	10..600 s
12.67	Start.PowerRamp	2	The steepness of the power limit increase after system start	Disable	6..6000 %/min
12.68	Rocof Ramp	2	Rocof protection value	2.5 Hz/s	0.0..3.0 Hz/s
12.69	Rocof Time	2	Rocof protection time constant	0.10 s	0.10..1.00 s (rozdz.:0.05s)
12.70	Enable power limitation	2	Permission to limit active power after reaching the voltage limit under control mode Q(U) par.12.36 = 2	0	0..1

GROUP 13 – Remote control

Parameter No.	Name	Access level	Description
13.01	Autostart enable	1	Selection of the method of giving the START command 0 : manual - parameter 1.23 is responsible for giving the START/STOP command 1 : automatic
13.02	Wymuś off-grid	1	Switching to off-grid mode
13.03	Blokuj auto off-grid	1	Block the switching to off-grid mode when the network is lost
13.06	Wymuś P sum	1	Forcing active power at the inverter output as a sum of 3 phases (symmetric) or a single phase (asymmetric) '+' network download '-' sending to the network Parameters 13.06 and 13.07-09 add up. *Forcing power on individual phases is only available for four-leg systems
13.07	Wymuś P L1	1	
13.08	Wymuś P L2	1	
13.09	Wymuś P L3	1	
13.10	Wymuś Q sum	1	Forcing reactive power at the inverter output as a sum of 3 phases (symmetric) or a single phase (asymmetric) '-' capacitive reactive power '+' inductive reactive power Parameters 13.06 and 13.07-09 add up. *Forcing power on individual phases is only available for four-leg systems
13.11	Wymuś Q L1	1	
13.12	Wymuś Q L2	1	
13.13	Wymuś Q L3	1	
13.14	Tryb EG	1	Repeating parameter 10.29. The parameter value is not saved to the inverter memory and after restarting the inverter it assumes the value from param. 10.29.

Parameter No.	Name	Access level	Description
13.15	Limit Mocy EG	1	Repeating parameter 5.12. The parameter value is not saved to the inverter memory and after restarting the inverter it assumes the value from param. 5.12.
13.16	Limit Mocy EG pob.	1	Repeating parameter 5.14. The parameter value is not saved to the inverter memory and after restarting the inverter it assumes the value from param. 5.14.

GROUP 97 – BMS service data

Parameter No.	Name	Access level	Description
97.01	Status BMS	1	BMS controller status flags
97.02	Kod bledu BMS	1	BMS controller error code
97.03	Umin baterii [V]	1	Minimum battery voltage
97.04	Umax baterii [V]	1	Maximum battery voltage
97.05	Limit pradu ladow. [A]	1	Charging current limit
97.06	Limit pradu rozlad. [A]	1	Discharge current limit
97.07	Temp. Baterii [°C]	1	The highest temperature of all battery cells
97.08	SoC [%]	1	Battery charge status
97.09	SoH [%]	1	Battery health status
97.10	BM TO Time	1	*Service parameter*

GROUP 99 – Service statistics

Parameter No.	Name	Access level	Description
99.00	Service stats	1	Service parameter
99.01	Service stats	1	Service parameter

16. Faults and events

The occurrence of the fault is indicated by the red diode lighting up (pic. 8.1). The fault or event number can be read in parameters 0.70÷0.79. Table 16.1 lists the numbers of failures and events with their descriptions.

After a cause that could damage the inverter, the inverter goes into a state of failure. Depending on the parameter setting 1.25:

a) par. 1.25 **„Autorestart" = 0 (disabled)**: the red LED will light up and the inverter will remain in a fault state until it is erased by a user,

b) par. 1.25 **„Autorestart" = 1 (enabled)**: the inverter will try to resume itself.

If parameter 1.25 "Autorestart" is set to 1, the system will automatically delete the failure message after 10 seconds and will try to resume operation on its own. If the same failure occurs three times, the system will go into failure mode. The red LED will light up continuously on the display.

Table 16.1. List of fault and events codes

No.	Fault / event	Fault description	How to fix it
0	No fault	The system is working properly.	-
1	Too high temperature	The heat sink temperature exceeded 85 ºC.	Wait for the device to cool down.
2	Damaged temperature sensor	Indications from the temperature sensor are incorrect	Contact the service.
9	No ADC measurement	No measurement from the Analog/Digital converter	1. In the case of power supply via the USB port, this is a normal situation and does not mean a failure. 2. In any other situation, please contact the service.
10	CRC Error	Invalid internal memory checksum.	Upload default parameters, contact with service.
11	Write error	Writing error to FLASH memory	1. Delete the stored amount of energy produced by the inverter - par. 10.20. 2. Contact the service.
12	Storm protection	The measured wind speed is higher than the limit set in par. 10.48.	In case of false failures, check the correctness of the anemometer connection and the value of the speed scale - par. 10.06.
13	Watchdog 1	Keyboard program auto-reset	Contact the service.
14	Watchdog 2		
15	Chart data reading error	Data reading error. Possible memory failure.	1. Delete saved charts, events - par. 10.20, 10.24, 10.27, 10.28. 2. Restore parameters to factory defaults. 3. Contact the service.
16	Data reading error		
17	Memory reading error		
18	Iterator reading error		
19	Memory corruption		
20	Earthing	Leakage current is too high.	1. Check if the inverter is connected correctly. 2. Check the value of the insulation resistance.
21	Earthing	Sudden change the value of the leakage current.	

No.	Fault / event	Fault description	How to fix it
30	High Udc	Too high voltage on the DC link capacitors.	1. Check the electrical connection configuration of the solar panels for output voltage (number of panels in series) 2. Check the connection of the braking resistor when using a synchronous generator.
31	High U_IN1	Too high voltage at input 1.	1.Check the electrical connection configuration of the solar panels for output voltage (number of panels in series).
32	High U_IN2	Too high voltage at input 2.	1. Check the electrical connection configuration of the solar panels for output voltage (number of panels in series) 2. Check the connection of the braking resistor when using a synchronous generator.
36	Input voltage ripples	Too big ripples in the input voltage	1.Check the correct connection of the installation. 2.Check the value of phase-to-phase voltages in the generator.
37	Low Udc	Too low voltage on the DC-link capacitors.	Check if the power of the energy sources is sufficient or higher than the power of loads connected to the inverter.
38	High Udc - hardware failure	Too high voltage on the DC link capacitors.	1. Check the configuration of electrical connection of photovoltaic panels (too many PV panels in series connection) 2. Check the connection of the dump load resistor when using a synchronous generator.
39	No symmetry of Udc voltage	Incorrect DC link voltages	1. Check the installation for earth faults. 2. Check the generator for a short circuit.
40	Low resistance	The inverter has detected that the resistance of the PV panels is too low	1. Check the installation for earthing failure. 2. Measure the resistance of the poles of the installation to PE conductor.
50	Short circuit - hardware failure	Hardware protection has recorded the occurrence of transistor short-circuits.	Check the connection of the power wires.
60	High current - hardware failure	The amplitude of current drawn from sources or mains current has reached a value exceeding the limit.	1. Check the input current measurement and the voltage measurement in the DC-link circuit. 2. Check the reference voltage in the DC-link circuit.
61	High current on input 1	The amplitude of the input current at input 1 has exceeded the limit.	1. Check the input current measurement and the voltage measurement in the DC-link circuit. 2. Check the reference voltage in the DC-link circuit.
62	High current on input 2	The amplitude of the input current at input 2 has exceeded the limit.	1. Check the input current measurement and the voltage measurement in the DC-link circuit. 2. Check the reference voltage in the DC-link circuit.
65	Too high output current	The amplitude of the current fed into the network has reached a value exceeding the limit.	1. Check the input current measurement and the voltage measurement in the DC-link circuit. 2. Check the reference voltage in the DC-link circuit.

No.	Fault / event	Fault description	How to fix it
66	Overload	Long-term output current above nominal current.	1. Check if the power of the connected loads does not exceed the inverter power. 2. Check the cosφ of the installed loads.
67	Output voltage dip	The value of the generated voltage has dropped below the threshold.	1. Check that the power of the loads during their start-up is not greater than 150% of the inverter's rated power.
70	Varistor failure	Failure of the varistor has been detected.	Contact the service.
71	Low input 1 resistance	Too low resistance was detected between input 1 and PE.	1. Check the installation wires. 2. Measure the resistance of the installation poles relative to PE.
72	Low input 2 resistance	Too low resistance was detected between input 2 and PE.	1. Check the installation wires. 2. Measure the resistance of the installation poles relative to PE.
73	Low -DC resistance	Too low resistance was detected between i-DC and PE.	1. Check the installation wires. 2. Measure the resistance of the installation poles relative to PE.
80	Timeout	Exceeding the response time in the internal communication bus of the inverter.	1. Check the connection of communication wires inside the inverter. 2. In case of frequent failures contact the service.
81	Communication error	Incorrect data in the internal communication bus of the inverter.	1. Check the connection of communication wires inside the inverter. 2. In case of frequent failures contact the service.
82	System reset	Internal processor reset.	In the event of frequent malfunctions, contact the service.
89	ROCOF error	The electric network is not connected to the device - anti-spy protection.	1. Make sure that the electrical grid is connected. 2. In the event of frequent false failures of ROCOF, the quality of the electricity at the connection point should be checked.
90	Anti-islanding	The electric grid is not connected to the inverter - anti-islanding protection.	1. Make sure that the inverter is connected to an electrical grid. 2. In the event of frequent false failures of, the quality of the electricity at the connection point should be checked.
91	Low electric grid frequency – work state	The electric grid frequency is too low or inverter measurement module is damaged	1. Check the electrical grid frequency. 2. In case of frequent failures contact the service.
92	High electric grid frequency – work state	The electric grid frequency is too high or inverter measurement module is damaged	1. Check the electrical grid frequency. 2. In case of frequent failures contact the service.
93	Low electric grid voltage – work state	The electric grid RMS voltage is too low or inverter measurement module is damaged.	1. Check the electrical grid frequency. 2. In case of frequent failures contact the service.
94	High electric grid voltage – work state	The electric grid RMS voltage is too high or inverter measurement module is damaged.	

No.	Fault / event	Fault description	How to fix it
95	Uref limit	Electrical grid is no connected to the inverter – anti-islanding protection	1. Check the electrical grid wires, protection fuses, and be be sure main switch power is ON.
96	Low electrical grid frequency – monitoring state	The frequency of the electrical grid measured before the inverter starts working is too low or the inverter measuring module is damaged.	1. Check the electrical grid frequency. 2. In case of frequent failures contact the service.
97	High electrical grid frequency – monitoring state	The frequency of the electrical grid measured before the inverter starts working is too high or the inverter measuring module is damaged.	
98	Low electric grid voltage – monitoring state	The electric grid RMS voltage is too low or inverter measurement module is damaged.	1. Check the electrical grid voltage. 2. In case of frequent failures contact the service.
99	High electric grid voltage – monitoring state	The electric grid RMS voltage is too high or inverter measurement module is damaged.	
103	High volt. battery	Battery voltage too high	Check the battery parameter settings, in particular the charging current value.
104	Low volt. battery	Battery voltage too low	
115	Short circ. charger	Short circuit in the charger module.	Contact the service.
117	High curr. charging	Battery charging current too high.	In case of repeated failure, please contact the service.
118	High curr. discharg.	Battery discharge current too high.	In case of repeated failure, please contact the service.
123	BMS fault	The battery management system reported an error.	1. Reset the BMS and inverter by disconnecting the power supply. 2. If the error persists, contact the BMS manufacturer.
124	BMS timeout	BMS response time exceeded.	1. Check the connection of the BMS wires. 2. In case of repeated failure, contact the service.
125	Charger precharge err.	Pre-charge error, no battery voltage at the input terminals.	1. Check the connection and continuity of wires between the energy storage batteries and the inverter. 2. In case of repeated failure, contact the service.
400	SYSTEM_CRASH	Ethernet communication problem	1. Check the correctness of the internet connection. 2. Check the correctness of the Wi-Fi module settings. 3. Check if the Ethernet cable is connected properly. 4. Contact the service.
401	PARTIAL_CRC_ERRO		
402	ETHERNET_RESTART		
403	ETHERNET_PHY_RESTART		

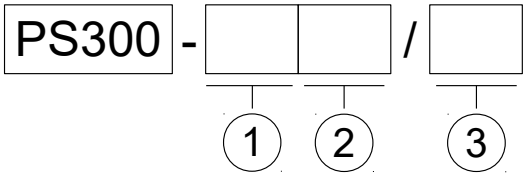
No.	Fault / event	Fault description	How to fix it
404	RTC_CLOCK_BROKEN		
405	ETHERNET_DMA_STUCK		
406	PLOT_OK		
407	PLOT_REPEAT		
408	PLOT_ERROR_ELSE		
409	PLOT_ERROR		
410	PLOT_NO_DATA		
411	PLOT_SN_ERROR		
412	PLOT_ERROR_X		
413	ETHERNET_TCP_SEND_ERROR		
414	ETHERNET_TCP_MEMP_FREE		
420	ETHERNET_PHY_RESTART_LONG		
450	Power grid *- event*	Connecting the inverter to the power grid	*Does not apply*
451	*Access level changing* *- event*	User level	*Does not apply*
452		Installer level	*Does not apply*
453		Service level	*Does not apply*
454	Parameter’s value error *- event*	Value of parameter outside the allowed range	*Does not apply*
460	No communication with the Energy Guard module	Response timeout with Energy Guard module	1. Check the continuity of the connection between the Energy Guard module and the inverter. 2. Use terminating resistors at the ends of the RS bus. 3. Use shielded twisted pair cable. 4. Contact the service.
461	Anemometer	No signal from the anemometer	1. Check the continuity of the anemometer connection with the inverter. 2. Check whether the cable used meets the recommendations of the anemometer manufacturer.
462	Internal connection failure – inverter module	Response timeout on the device's internal communication bus	In case of repeated failure, contact the service.
463	Internal connection failure – charger module		
911	Low network frequency - ST2 operation	The grid quality during inverter operation does not meet standards or the inverter	Check mains voltage frequency. In case of repeated failure please contact the

No.	Fault / event	Fault description	How to fix it
921	High network frequency - ST2 operation	measuring system has been damaged. ST2 range.	service.
931	Low network voltage phase U ST1	Low RMS network voltage during inverter operation -phase U	Check the network voltage. In case of repeated failure please contact the service.
932	Low network voltage phase V ST1	Low RMS network voltage during inverter operation -phase V	
933	Low network voltage phase W ST1	Low RMS network voltage during inverter operation -phase W	
930	Low ST2 network voltage	Low RMS network voltage during inverter operation	Check the network voltage. In case of repeated failure please contact the service.
934	Low network voltage phase U ST2	Low RMS network voltage during inverter operation -phase U	
935	Low network voltage phase V ST2	Low RMS network voltage during inverter operation -phase V	Check the network voltage. In case of repeated failure please contact the service.
936	Low network voltage phase W ST2	Low RMS network voltage during inverter operation -phase W	
941	High network voltage phase U ST1	High RMS network voltage during inverter operation -phase U	Check the network voltage. In case of repeated failure please contact the service.
942	High network voltage phase V ST1	High RMS network voltage during inverter operation -phase V	
943	High network voltage phase W ST1	High RMS network voltage during inverter operation -phase W	
944	High mains voltage 10 minutes phase U	High RMS grid voltage with an average of 10 minutes during inverter operation - U phase	Check the network voltage. In case of repeated failure please contact the service.
945	High mains voltage 10 minutes phase V	High RMS grid voltage with an average of 10 minutes during inverter operation - V phase	
946	High mains voltage 10 minutes phase W	High RMS grid voltage with an average of 10 minutes during inverter operation - W phase	
950	High voltage of network ST2	High RMS network voltage during inverter operation	Check the network voltage. In case of repeated failure please contact the service.
951	High voltage network phase U ST2	High RMS network voltage during inverter operation -phase U	
952	High voltage network phase V ST2	High RMS network voltage during inverter operation -phase V	

No.	Fault / event	Fault description	How to fix it
953	High voltage network phase W ST2	High RMS network voltage during inverter operation -phase W	Check the network voltage. In case of repeated failure please contact the service.

Note: The inverter monitors the electrical grid for 60 seconds before starting work. After a failure with incorrect electrical parameters in the grid (fault 91 ÷ 94) or failure of the grid current controller (fault 95), the inverter also monitors the electrical grid for 60 seconds before restarting.

17. Ordering information



1. Input type:
   PV – photovoltaic
   WT – permanent magnet generator: one AC input
   H – hybrid
2. Built-in battery charger module:
   PS300 inverter does not have an implementation with a charger module.
3. Power of the inverter:
   3 kW, 5 kW, 8 kW, 10 kW,
   12 kW, 20 kW, 30 kW

18. Warranty conditions

The system is covered by the warranty in accordance with the information contained in the Warranty Card.

dtr-ps300-en-v13.1,0, 08/10/24

Appendix A: EU Declaration Of Conformity

EU DECLARATION OF CONFORMITY CE

We:

Manufacturer's name:	**TWERD ENERGO-PLUS Sp. z o.o.**
Manufacturer's address:	**Aleksandrowska 28-30** **87-100 Toruń, Poland**
Phone:	**+48 56 654-60-91**
WWW, e-mail:	**www.twerd.pl twerd@twerd.pl**

Declare at our own responsibility, that product:

Product name:	**Renewable energy source Inverter**
Type:	**PS300**
Power range:	**3,0 kW ÷ 30,0 kW**

installed and used according to the User Manual for the device, to which this declaration relates, meets the requirements of Polish Standards:

Safety:

PN-EN 50549-1:2019-02
PN-EN 62109-1:2010
PN-EN 62109-2:2011

Electromagnetic Compatibility (EMC):

PN-EN IEC 61000-3-2:2019-04
PN-EN 61000-3-3:2013-10
PN-EN IEC 61000-3-11:2020-01
PN-EN 61000-3-12:2012
PN-EN IEC 61000-6-1:2019-03
PN-EN IEC 61000-6-2:2019-04
PN-EN 61000-6-3:2021-08
PN-EN IEC 61000-6-4:2019-12

which are equivalent to European Standards, harmonized with directives:

2014/35/EU Low Voltage Devices (LVD)
2014/30/EU Electromagnetic Compatibility (EMC)

TWERD ENERGO-PLUS Sp. z o.o.

Justyna Jątczak
Dyrektor Zarządzający/Członek Zarządu

Justyna Jątczak
Managing director / Member of the Board

TWERD ENERGO-PLUS
Spółka z ograniczoną odpowiedzialnością
87-100 Toruń, ul. Aleksandrowska 28-30
tel. 56 654 60 91
NIP 9562337873, REGON 380968365
KRS 0000743645

Date: 2024-01-30

Appendix B: NC RfG Certificate Of Conformity

INSTYTUT TECHNIKI GÓRNICZEJ KOMAG
Zakład Badań Atestacyjnych Jednostka Certyfikująca
ul. Pszczyńska 37, 44-101 Gliwice

PCA Polskie Centrum Akredytacji – Certyfikacja Wyrobów AC 023

CERTYFIKAT ZGODNOŚCI
Nr KOMAG/20/0232

Program typu 1a wg PN-EN ISO/IEC 17067

Program certyfikacji PC-DBA/05 wyd. nr 2 z dnia 20.05.2022 r.

Nazwa wyrobu:	**Trójfazowy inwerter PS300**
Typ (odmiany):	**PS300-PV (PS300-PV+BC) inwerter fotowoltaiczny** **PS300-WT (PS300-WT+BC) inwerter wiatrowy** **PS300-H (PS300-H+BC) inwerter hybrydowy**
Nazwa i adres posiadacza certyfikatu:	**Zakład Energoelektroniki TWERD Sp. z o.o.** ul. Aleksandrowska 28-30, 87 - 100 Toruń
Nazwa i adres producenta wyrobu:	**Zakład Energoelektroniki TWERD Sp. z o.o.** ul. Aleksandrowska 28-30, 87 - 100 Toruń
Identyfikacja wyrobu:	zgodnie z załącznikiem do certyfikatu, zawierającym parametry techniczne i specyfikację dokumentacji

Potwierdzenie zgodności z:

– Rozporządzeniem Komisji (UE) 2016/631 z dnia 14 kwietnia 2016 r. ustanawiającym kodeks sieci dotyczący wymogów w zakresie przyłączenia jednostek wytwórczych do sieci (Dz. Urz. UE L 112/1 z 27.04.2016) - NC RfG.

Potwierdzenie spełniania wymagań dla producenta wyrobu, zawartych w niżej wymienionych dokumentach:

– Wymogi Ogólnego Stosowania wynikające z rozporządzenia komisji UE 2016/631 z dnia 14 kwietnia 2016 r. ustanawiającego kodeks sieci dotyczący wymogów w zakresie przyłączenia jednostek wytwórczych do sieci - zatwierdzone decyzją Prezesa Urzędu Regulacji Energetyki DRE.WOSE.7128.550.2.2018.ZJ z dnia 2 stycznia 2019 r.

– Warunki i procedury wykorzystania certyfikatów w procesie przyłączenia modułów wytwarzania energii do sieci elektroenergetycznych – opracowanie Polskiego Towarzystwa Przesyłu i Rozdziału Energii Elektrycznej z dnia 26.04.2021 r. (aktualizacja 4.05.2021 r.)

Niniejszy certyfikat zastępuje certyfikat nr KOMAG/20/0232 wydany w dniu 15 lipca 2021 r.

Certyfikat jest ważny od **15 listopada 2022 r.** do **20 grudnia 2025 r.** Dotyczy wyłącznie egzemplarzy wyrobów posiadających identyczne właściwości (parametry) jak przedstawiony do oceny wzór (wzory) i odpowiadających wymaganiom określonym powyżej.

INSTYTUT TECHNIKI GÓRNICZEJ KOMAG GLIWICE

Kierownik Zakładu Badań Atestacyjnych Jednostki Certyfikującej

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dr inż. Andrzej Figiel

Gliwice, dnia **15 listopada 2022 r.**

Druk: PC-DBA/05-Z2 wyd. z dn. 20.05.2022 r.

INSTYTUT TECHNIKI GÓRNICZEJ KOMAG
Zakład Badań Atestacyjnych Jednostka Certyfikująca

Załącznik

do CERTYFIKATU ZGODNOŚCI Nr KOMAG/20/0232

(strona 1/2)

(A1) PRZEZNACZENIE WYROBU

Trójfazowe inwertery PS300 w odmianach: PS300-PV (PS300-PV+BC) - inwertery fotowoltaiczne, PS300-WT (PS300-WT+BC) - inwertery wiatrowe i wodne oraz PS300-H (PS300-H+BC) - inwertery hybrydowe, stanowią wyposażenie małych elektrowni fotowoltaicznych, wiatrowych i wodnych.

Inwertery umożliwiają przesyłanie energii uzyskanej z elektrowni do trójfazowej sieci elektroenergetycznej (układy „on-grid"). Urządzenia z modułem ładowania (wykonanie +BC) są dedykowane do pracy z magazynami energii. Posiadają one funkcję bezpośredniego zasilania odbiorów elektrycznych i równoczesnego ładowania magazynu energii. Urządzenia działają w pełni autonomicznie.

Dane techniczne

– znamionowa moc wyjściowa po stronie AC	3 kW, 5 kW, 8 kW, 10 kW, 20 kW, 30 kW
– zakres napięcia roboczego (strona generatora)	3 × 60...425 V_{AC}
– napięcie znamionowe (strona generatora)	3 × 400 V_{AC}
– maksymalny prąd wejściowy (strona generatora)	13 A, 20 A, 40 A, 50 A
– zakres napięcia (strona paneli PV)	120 ÷ 850 V_{DC}
– maksymalny prąd paneli PV	13 A, 2 × 13 A, 2 × 25 A,
– sprawność	97%
– wyższe harmoniczne prądu THDi	< 3%
– temperatura otoczenia	-10°C ÷ +40°C
– stopień ochrony IP	IP65
– komunikacja	Ethernet, Modbus RTU (RS-485)

Wersja oprogramowania

– inwerter o mocy od 3 kW do 10 kW bez układu bateryjnego	3.65 – inwerter, 1.59 – sterownik
– inwerter o mocy od 10 kW do 30 kW z układem bateryjnym (+BC)	4.03 – inwerter, 1.59 – sterownik

(A2) ZAKRES BADAŃ I OCENA WYNIKÓW

Ze względu na zakres oceny badaniom poddano inwerter trójazowy typu PS300-WT o mocy 10 kW, prod. Zakład Energoelektroniki TWERD Sp. z o.o. Szczegółowe wyniki badań są zawarte w sprawozdaniach z badań nr 110/BT/2020 oraz 96/BT/2022 wydanych przez Laboratorium Badań Stosowanych ITG KOMAG. Zbiorcze zestawienie badań i ocena ich zgodności z odpowiednimi wymaganiami kodeksu sieci NC RfG dla jednostek wytwórczych typu A przedstawiono w poniższej tabeli.

WYMAGANIE (funkcja, parametr)	Kodeks sieci NC RfG	Sprawozdanie		Wynik oceny
		110/BT/2020	96/BT/2022	
Zakres częstotliwości	art. 13.1 (a)	pkt 5.2.1	-	spełnione
Odporność na szybką zmianę częstotliwości (RoCoF), df/dt	art. 13.1 (b)	pkt 5.1.7	-	spełnione
Odpowiedź mocą czynną na podwyższoną częstotliwość (LFSM-O)	art. 13.2	pkt 5.2.4	-	spełnione
Dostarczanie mocy przy obniżonej częstotliwości	art. 13.4	pkt 5.2.5	-	spełnione
Zaprzestanie generacji mocy czynnej	art. 13.6	-	pkt 4.1	spełnione
Rozpoczęcie wytwarzania energii elektrycznej dla samoczynnego ponownego załączenia po wyzwoleniu zabezpieczenia przyłącza	art. 13.7	pkt 5.2.7.1	-	spełnione
Rozpoczęcie wytwarzania energii elektrycznej (normalne uruchomienie operacyjne)		pkt 5.2.7.2	-	

INSTYTUT TECHNIKI GÓRNICZEJ KOMAG GLIWICE

Kierownik Zakładu Badań Atestacyjnych
Jednostki Certyfikującej

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dr inż. Andrzej Figiel

Gliwice, dnia **15 listopada 2022 r.**

Druk: PC-DBA/05-Z2 wyd. z dn. 20.05.2022 r.

INSTYTUT TECHNIKI GÓRNICZEJ KOMAG
Zakład Badań Atestacyjnych Jednostka Certyfikująca

Załącznik

do CERTYFIKATU ZGODNOŚCI Nr KOMAG/20/0232

(strona 2/2)

Szczególne warunki stosowania:

1. Zmiany wprowadzone w projekcie systemu, wyposażeniu lub oprogramowaniu certyfikowanego urządzenia muszą być zatwierdzone przez Zakład Badań Atestacyjnych Jednostkę Certyfikującą.
2. Nastawy inwertera muszą być uzgodnione i sprawdzone tak, aby zapewniały pełną zgodność z kodeksem sieci NC RfG, w oparciu o wymagania właściwego operatora systemu (OS).

(A3) PRZEDSTAWIONE DOKUMENTY

a) dokumenty opisowe

- Rodzina inwerterów typu PS300 przeznaczonych dla odnawialnych źródeł energii elektrycznej (elektrownie wiatrowe, wodne i słoneczne). Moce: 3 kW; 5 kW; 8 kW; 10 kW; 20 kW; 30 kW. Instrukcja obsługi.

b) schematy

- 04-050100-10 WT 10 kW
- 04-050100-30 H 10 kW
- 04-050100-20 PV 10 kW
- 04-050050-20 PV 5 kW
- PS300-PV+BC 10-30 kW
- PS300-PV+BC 10-30 kW AUTO

c) wyniki badań

- Sprawozdanie z badań Nr 110/BT/2020. Badania trójfazowego inwertera PS300-WT o mocy 10 kW. Laboratorium Badań Stosowanych, ITG KOMAG. Gliwice, 1.12.2020 r.
- Sprawozdanie z badań Nr 96/BT/2022. Badania inwertera trójfazowego OZE typu PS300-WT o mocy 10 kW. Laboratorium Badań Stosowanych, ITG KOMAG. Gliwice, 22.09.2022 r.

INSTYTUT TECHNIKI GÓRNICZEJ KOMAG GLIWICE

Kierownik Zakładu Badań Atestacyjnych
Jednostki Certyfikującej

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dr inż. Andrzej Figiel

Gliwice, dnia **15 listopada 2022 r.**

Druk: PC-DBA/05-Z2 wyd. z dn. 20.05.2022 r.

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