TWERD ENERGO-PLUS

Renewable energy sources one-phase inverter **PS100** type

in variants:

PS100-PV
photovoltaic systems

PS100-WT
wind turbine systems

PS100-H
photovoltaic / wind turbine systems

PS100-PV

1 kW, 3 kW, 5.5 kW
On-Grid / Off-Grid

User manual

User manual ver.: 13.12,0

Contents

1. Device description

The family of single-phase, high efficiency and transformerless PS100 inverters is designed for work with small wind turbines (equipped with permanent magnet synchronous generators) and PV installations, with an electric power of up to 5.5 kW. These inverters converts the energy obtained from the wind and/or solar power plant to a single-phase power grid (so-called "on-grid" systems). They operate fully autonomously.

After being installed by an authorized person, the user's role is limited to systematic monitoring of the device's condition (failure, flooding, etc.).

Presented PS100 products family includes the following types of inverters:

- **PS100-WT/1kW, PS100-WT/3kW, PS100-WT/5.5kW** - inverters with WT synchronous generators input (AC voltage input): designed for a small wind or water turbines.
- **PS100-PV/1kW, PS100-PV/3kW, PS100-PV/5.5kW** - inverters with PV input(s) (DC voltage input(s)): designed for a photovoltaic panels (PV).
- **PS100-H/3kW, PS100-H/5.5kW** - hybrid inverters with one WT input and one PV input enabling simultaneous connection of PV panels and a synchronous generator.

  Note: the inverter power determines the total input power obtained from both sources – PV panels and synchronous generator. Currents and voltages cannot exceed individual input values given in Table 3.1 on page 9.
- **PS100-x-BAT** - each of the above types of inverters (WT, PV, H) can be equipped with a battery charging module in the 48V DC voltage system. It enables building off-grid island systems and intelligent energy management in "on-grid" systems. See chapter *12. Battery charger module* on page 50 for more information.

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

Using the 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 system is equipped with an extensive diagnostic and protection tools for the inverter and user. The device is secured:

- from the mains side:
  - protection against improper mains parameters: voltage, frequency,
  - protection against off-grid island operation (disconnection by relays from the network in the event of its loss);
- from the generator side: overvoltage, overcurrent, before the generator runs away;
- from the PV side: overvoltage, overcurrent;
- against too high inverter’s heat sink temperature;
- against too deep discharge of the energy storage (applies to systems with a battery charging module marked "+ BAT").

Limitation of liability

Despite all efforts and due diligence, TWERD Power Electronics Limited does not guarantee that the published data is free of errors. The information in this document is subject to change without notice. The latest version of this document is available on our website www.twerd.pl. If you have any doubts or would like to receive additional information, please contact us.

All trademarks used are the property of their respective owners.

2. Conditions of safe operation

Before start to work with the PS100 inverter read carefully this User's manual. Not knowing or ignorance of the information contained in it can cause physical injury, death or damage to the inverter.

In the further part of this User manual, the PS100-WT inverter, to which this instruction applies, will also be referred to as the „PS100-WT or "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. 9.1 on page 41) 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 turbine generator, battery bank, etc.
- Don’t 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: Take particular care due to the possibility of electric shock. Removing the front cover of the inverter (when the electrical voltage is supplied to the device both from the network side and the generator) and changing the settings can only be made by a person with appropriate electrical qualifications.
- Periodically, you should check:
  - Connection of protective conductors,
  - Wiring (the connections, insulation),
  - Did not water get inside the system,
  - 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 the user against electric shock.

2.4. Operation list after receiving the device

- After unpacking the device, it is necessary to check up visually 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 an 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 second degree of pollution has been assumed, at which there are normally only non-conducting pollution. However there is a probability of temporary conductivity caused by a 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 ºC .. +40 ºC	-25 ºC .. +55 ºC	-25 ºC .. +70 ºC
		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	86 kPa .. 106 kPa	86 kPa .. 106 kPa	70 kPa .. 106 kPa

2.6. Recycle

Always return your used electronic products, batteries, and packaging materials to dedicated collection points. This way you help prevent uncontrolled waste disposal and promote the recycling of materials.

3. Specification

3.1. Technical data

Table 3.1. PS100 inverters technical data

No.	Type			PS100		
				1kW	3kW	5.5kW
	Description	**Name**	**Unit**			
1	WT input (AC voltage): permanent magnet synchronous generator *PS100-WT, PS100-H inverters*					
1.1	Working voltage range from the AC generator side	U_{GEN}	V	3 x 60..290 V_{AC} (Phase - Phase)		
1.2	Rated voltage from the AC generator side	U_{GEN-N} (n* nominal)	V	3 x 230 V_{AC}		
1.3	Maximum input current from the AC generator side					
	PS100-WT	$I_{GEN-MAX}$	A	7 A	13 A	24 A
	PS100-H	$I_{GEN-MAX}$	A	7 A	13 A	
2	PV inputs (DC voltage): photovoltaic panels *PS100-PV, PS100-H inverters*					
2.1	MPPT voltage range *inverter working voltage range*	U_{MPPT}	V	60..450 V_{DC}		
2.2	Feed-in start voltage	$U_{PV-START}$	V	60 V_{DC}		
2.3	Nominal PV input voltage	U_{PV-NOM}	V	300 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}	V	500 V_{DC}		
2.5	Maximum current of PV panels					
	PS100-PV	I_{PV-MAX}	A	9 A	13 A	2 x 13 A
	PS100-H	I_{PV-MAX}	A	9 A	13 A	
2.6	Maximum short circuit current of PV panels					
	PS100-PV	I_{PV-SC}	A	13 A	20 A	2 x 20 A
	PS100-H	I_{PV-SC}	A	13 A	20 A	
2.7	Type of PV connector	-	-	MC4		
3	The number and types of inputs depending on the power and type of inverter *each PV input is with individual MPPT*					
3.1	PS100-PV:					
	PV inputs	-	pcs.	1		2
	WT inputs	-	pcs.	0		
3.2	PS100-WT:					
	PV inputs	-	pcs.	0		
	WT inputs	-	pcs.	1		
3.3	PS100-H:					
	PV inputs	-	pcs.	1		
	WT inputs	-	pcs.	1		
4	Nominal AC output power	P_N	kW	1 kW	3 kW	5.5 kW
5	Output voltage (from the power grid side)	U_{OUT}	V	1 x 230V, 50Hz		
6	Maximum output current	I_{OUT}	A	4,5	13	25
7	Efficiency (at rated output power)	η	%	97%		
8	Current THD		%	< 3		
9	Work modes	-	-	On-Grid, Off-Grid		
10	Nominal voltage of DC-link circuit	U_{DC}	V	380 V		
11	Maximum voltage of DC-link circuit	U_{DC-MAX}	V	600 V		

No.	Type			PS100		
				1kW	3kW	5.5kW
	Description	**Name**	**Unit**			
12	Transistors switching frequency	f_{SW}	kHz	16		
13	Maximum temperature of heatsink	$T_{RAD-MAX}$	°C	85		
14	Communication	-	-	Ethernet, RS485		
15	Digital inputs	DI1..DI5	pcs.	5		
16	Relay outputs: 2A 230V AC	K1 K2, K3	pcs.	K1: Switchable, 2A 230V_{AC} K2, K3: Normally Open, 2A 230V_{AC}		
17	Internal relays controlling the operation of braking resistors Inverters PS 100-WT and PS100-H	Rezystory	-	30 A, AC1		
18	Protections	- before run-up the PMSG, - before too high device temperature, - the monitoring system of the power grid parameters				
19	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.				
20	Power consumption in standby mode	-	W	2		
21	Humidity	-	%	85% for 40°C		
22	Ambient temperature range	-	°C	-10°C..+40°C		
23	IP protection	-	-	IP65		
24	Weight	-	kg	Look at the chapter 3.2 *Mechanical dimensions and weight* on page 11.		
Devices with battery charger module „+BC”:						
25	Nominal voltage of battery	U_{BAT-N}	V	48 V_{DC}		
26	Nominal charging/discharging current	$I_{BAT-MAX}$	A	50 A_{DC}		

3.2. Mechanical dimensions and weight

3.2.1. PS100-WT/1kW, PS100-WT/3kW, PS100-PV/1kW, PS100-PV/3kW

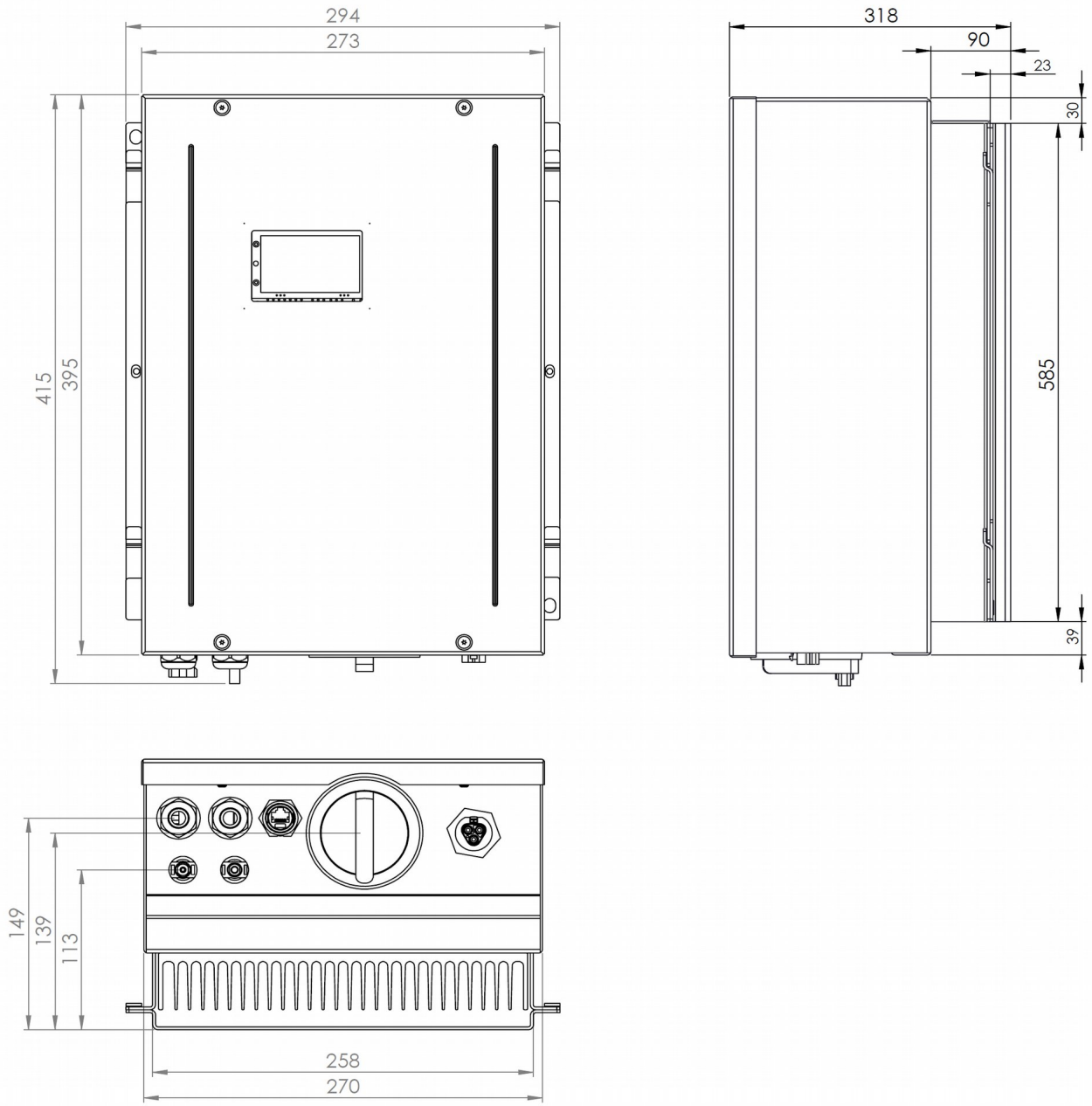
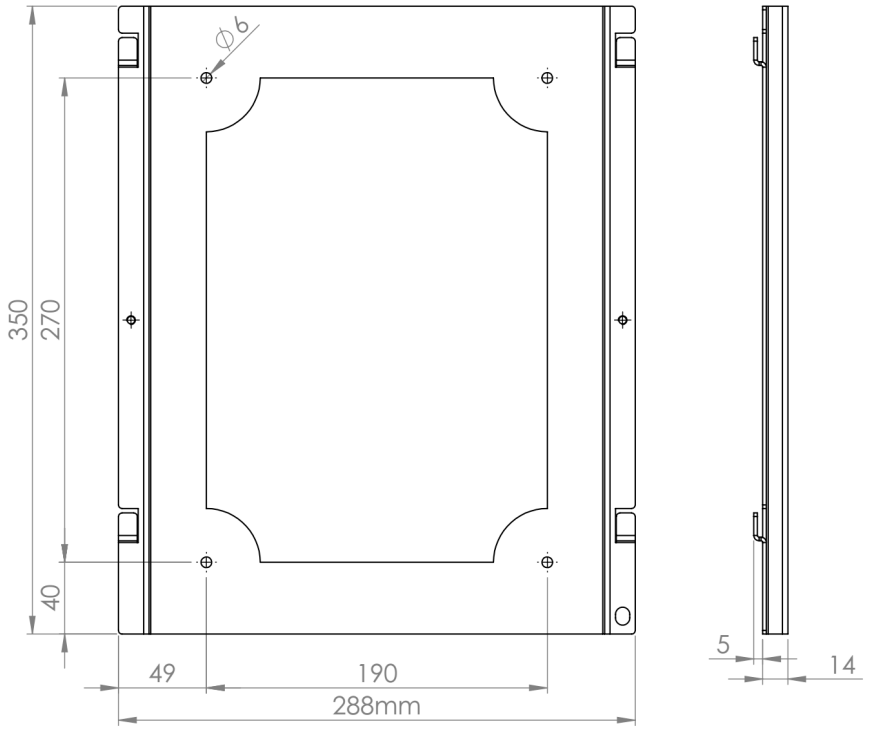


Fig. 3.1. Mechanical dimensions of the inverter

Weight of the inverter with mounting frame: 14 kg.



Rys.3.2. Mechanical dimensions of the mounting frame

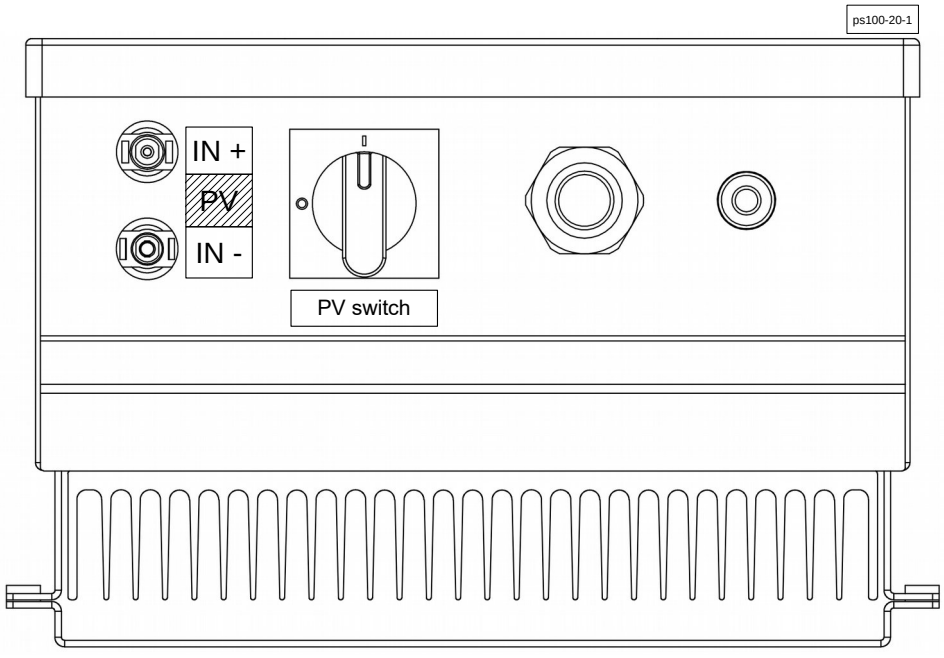


Fig. 3.3. Inverter view from the connectors side

Note: PS100-WT - no PV connectors and a PV switch.

3.2.2. PS100-PV/5.5kW, PS100-WT/5.5kW, PS100-H/3kW, PS100-H/5.5 kW

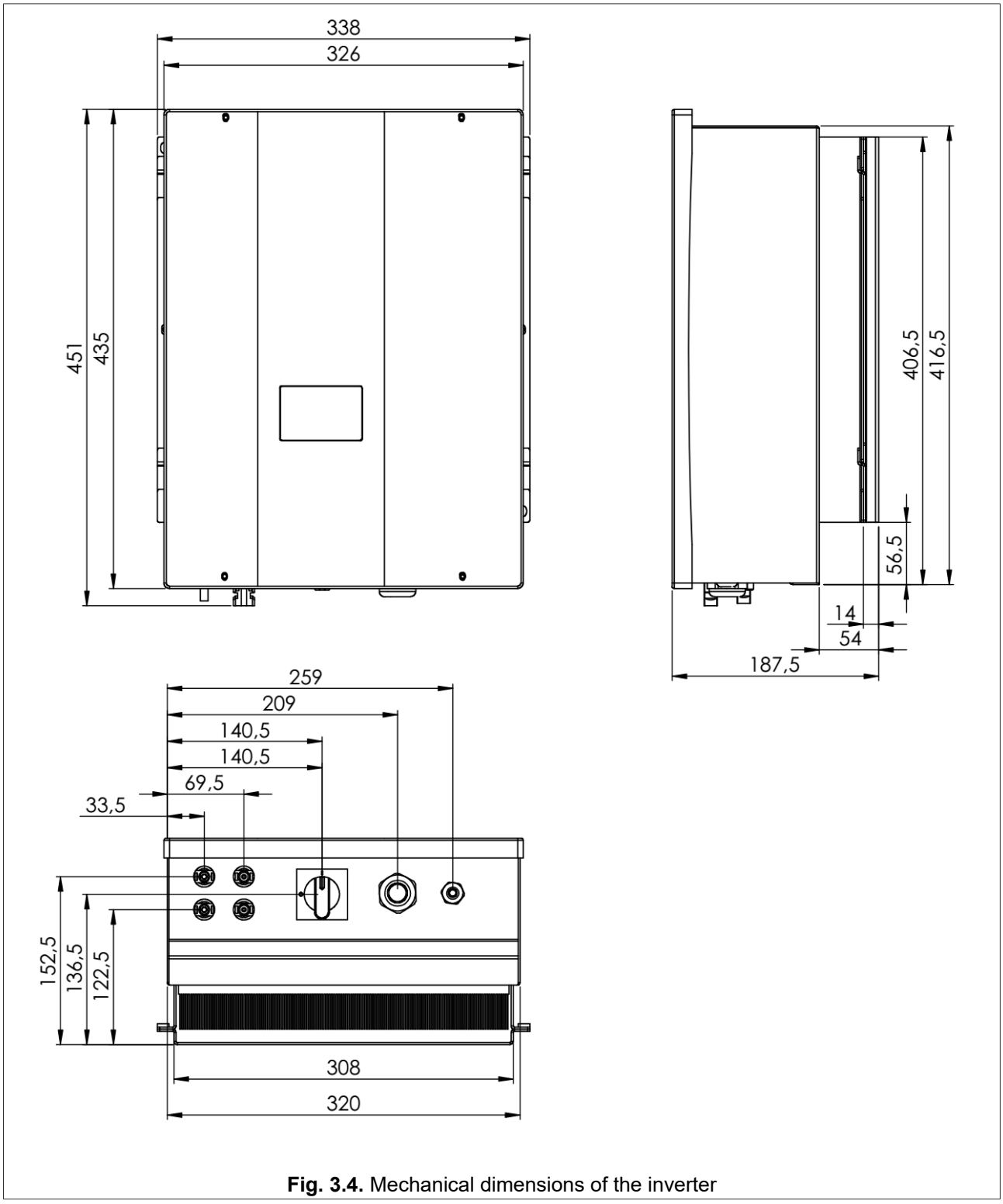


Fig. 3.4. Mechanical dimensions of the inverter

Weight of the inverter with mounting frame: 16 kg.

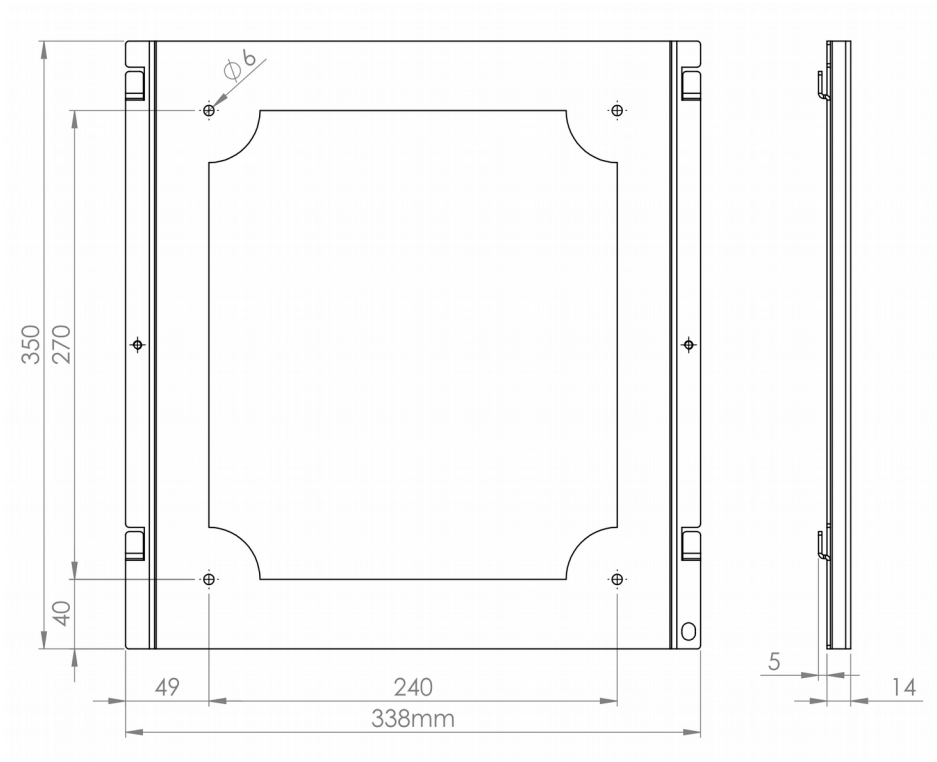


Fig. 3.5. Mechanical dimensions of the mounting frame

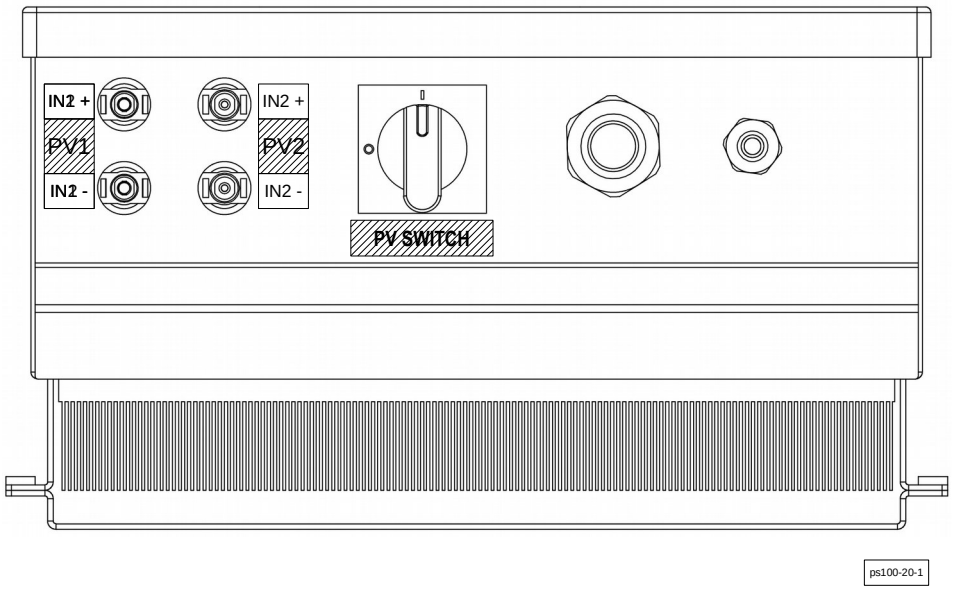


Fig. 3.6. Inverter view from the connectors side

Note: PS100-WT - no PV1, PV2 connectors and a PV switch;
PS100-H – no PV2 connector.

3.2.3. PS100-WT+BC/1kW, PS100-WT+BC/3kW, PS100-PV+BC/1kW, PS100-PV+BC/3kW

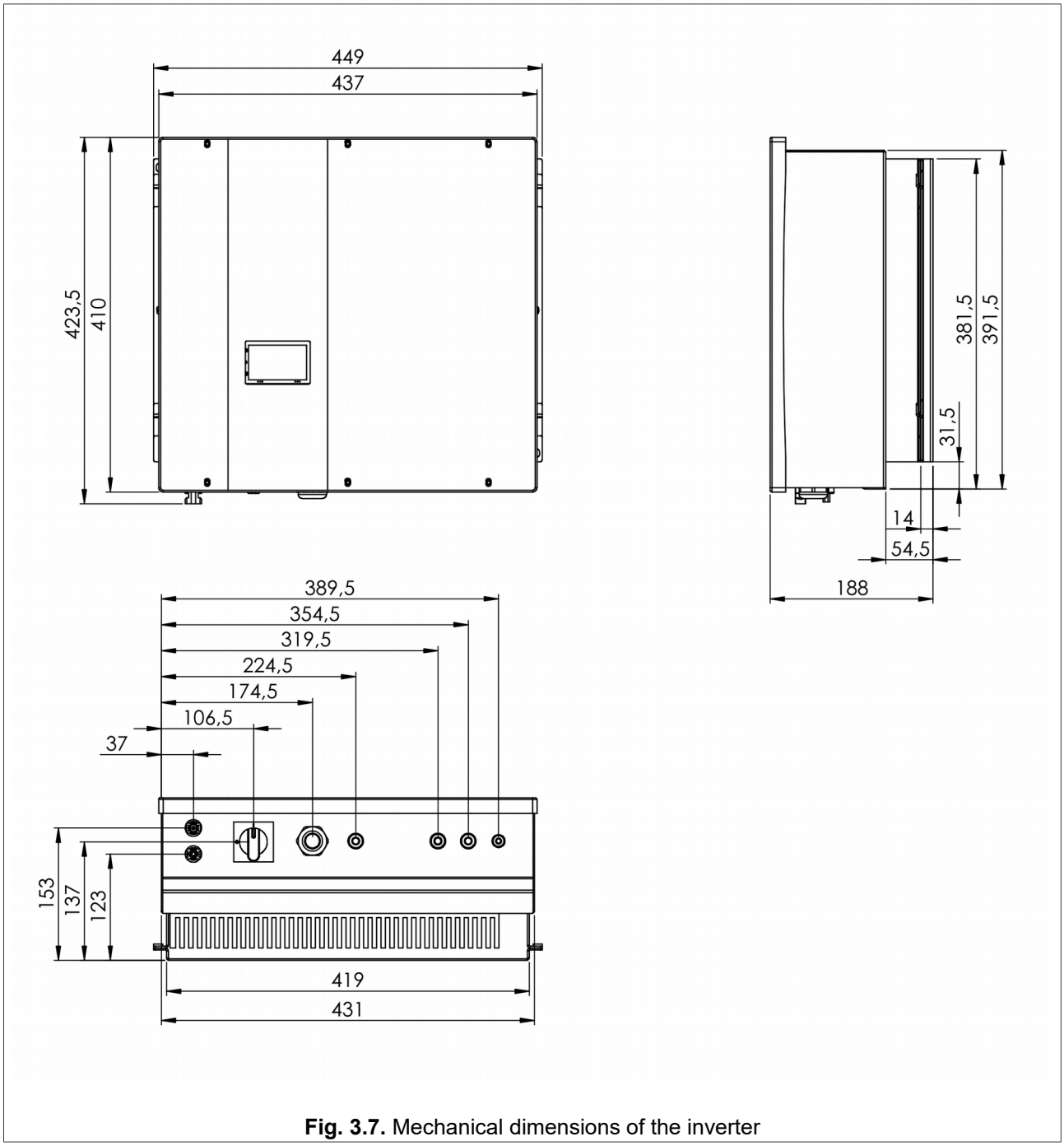


Fig. 3.7. Mechanical dimensions of the inverter

Weight of the inverter with mounting frame: 19 kg.

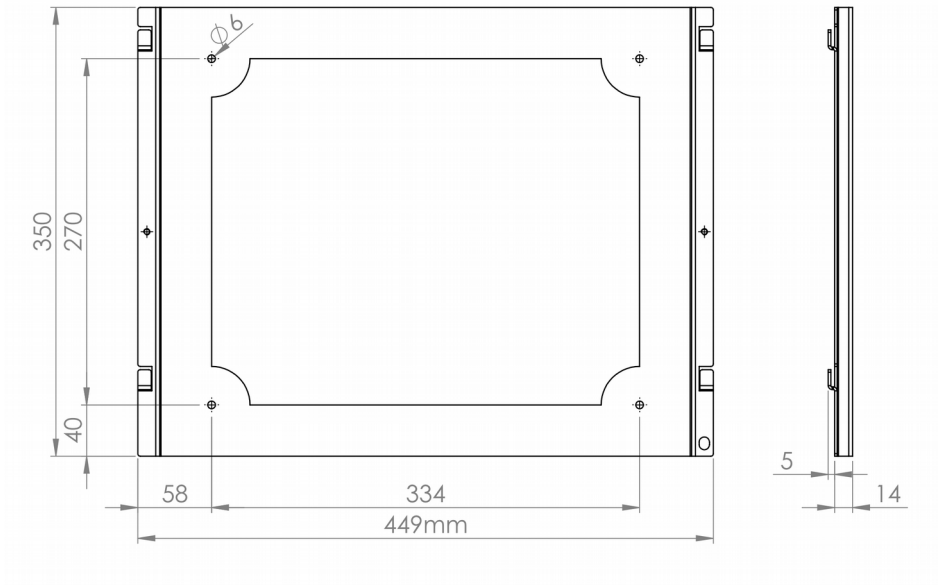


Fig. 3.8. Mechanical dimensions of the mounting frame

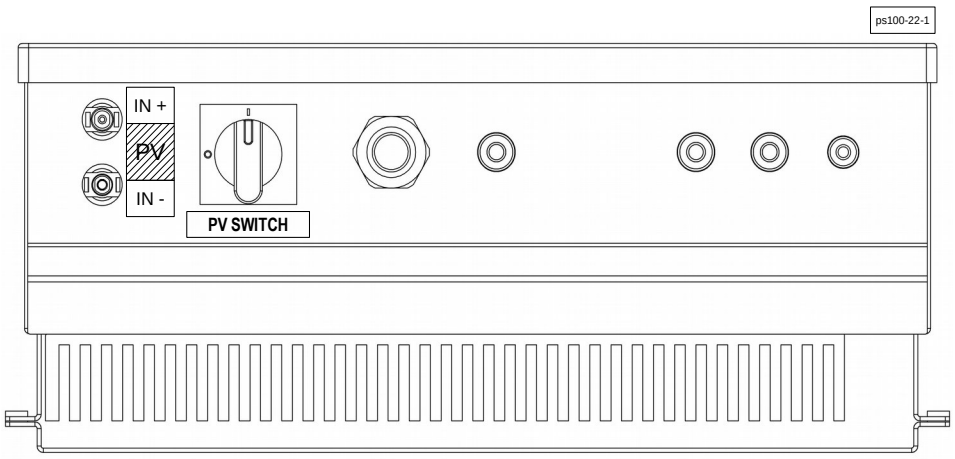


Fig. 3.9. Inverter view from the connectors side

Note: PSW100-WT+BC - no PV connectors and a PV switch.

3.2.4. PS100-WT+BC/5.5kW, PS100-PV+BC/5.5kW, PS100-H+BC/3kW, PS100-H+BC/5.5kW

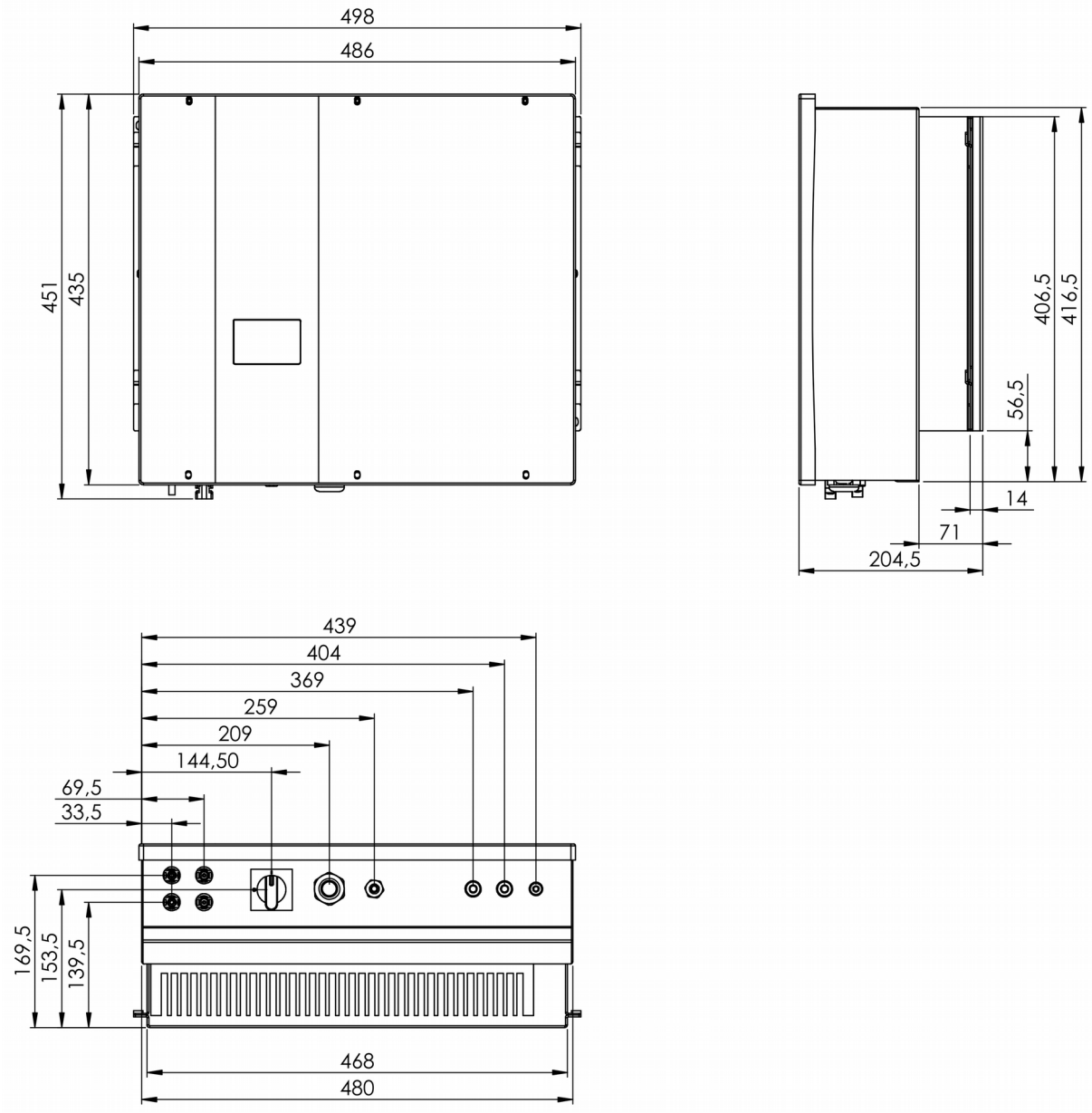


Fig. 3.10. Mechanical dimensions of the inverter

Weight of the inverter with mounting frame: 21 kg.

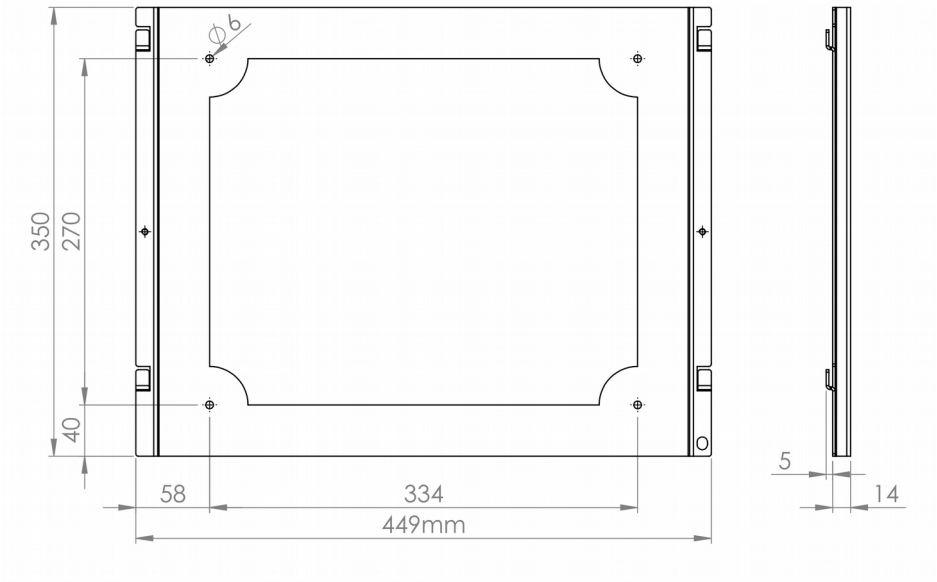


Fig. 3.11. Mechanical dimensions of the mounting frame

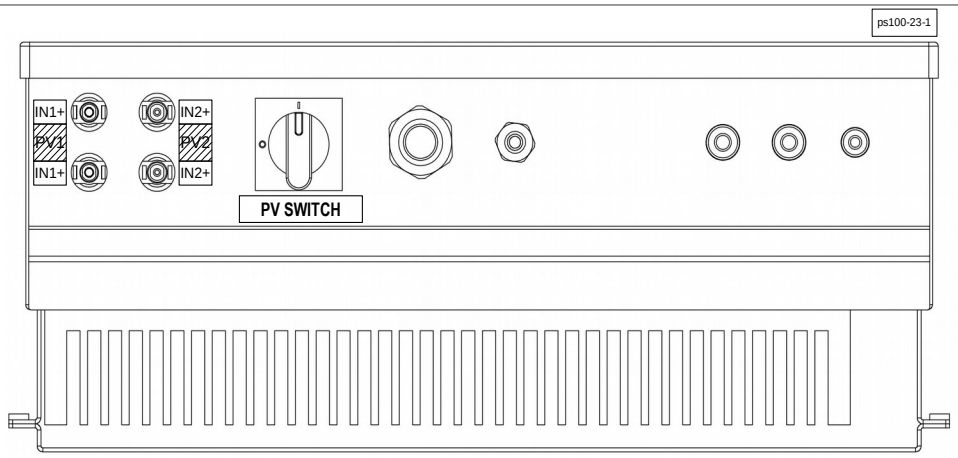


Fig. 3.12. Inverter view from the connectors side

Note: PS100-WT+BC - no PV1, PV2 connectors and a PV switch;
PS100-H+BC – no PV2 connectors.

4. Preparing for installation

4.1. Inverter installation location

- The inverter is suitable for installation indoors and outdoors.
- The inverter has an IP65 protection rating and this should be taken into account when selecting the mounting location.
- In order to minimise the heating up of the inverter, do not expose it to direct sunlight. Install the inverter in a protected location.
- All inverters are design to be dust-tight. However, in areas with a heavy build-up of dust, the thermal efficiency may still be impaired by dust forming on the cooling surfaces. Regular cleaning is necessary in such situations. It is therefore not recommended to mount the device in rooms or areas in which a strong formation of dust is expected.
- Do not install the inverter in:
  - flammable or explosive atmosphere because it could cause fire or explosion,
  - areas where ammonia, corrosive vapours, acids or salts are present (e.g. fertiliser stores, ventilation openings from cattle sheds, chemical plants, tanneries, etc.),
  - places where there is an increased risk of damage from farm animals (horses, cattle, sheep, pigs, etc.),
  - stables or adjoining areas,
  - storage areas for hay, straw, chaff, animal feed, fertilisers, etc.,
  - greenhouses,
  - storage or processing areas for fruit, vegetables or winegrowing products,
  - places used to prepare grain, green fodder or animal feeds.
- Due to the low noise generated by the inverter in certain operating conditions, staying for a long time can be slightly burdensome for some people, so installation in the immediate vicinity of living quarters is not recommended.

4.2. Environmental condition

The PS100 inverter should work in dry rooms with little dust. Ambient temperature should not exceed 40 °C and relative humidity 85% according to Table 2.1 on page 8.

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

The inverter contains a connector for connecting the inverter to an 230 V, 50 Hz electricity network.
The terminals on the connector are marked as follows: L and N. The PE terminal is marked with the earth symbol  .

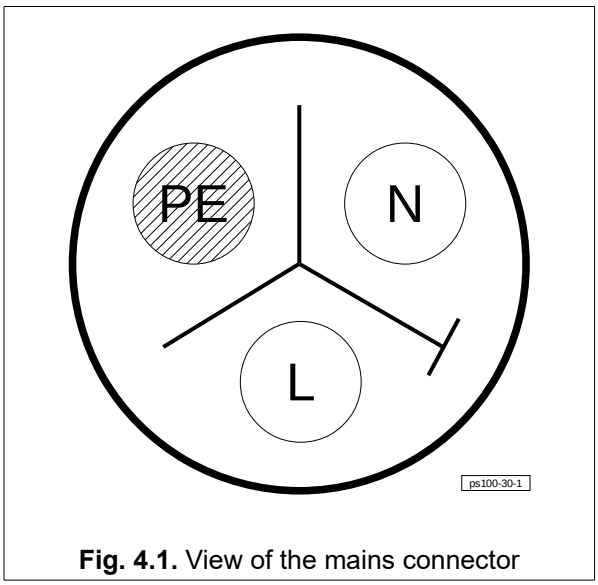


Fig. 4.1. View of the mains connector

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

Pictures 4.2 - 4.4 below show the subsequent stages of connector preparation. Picture 4.5 shows how to disconnect the connector.

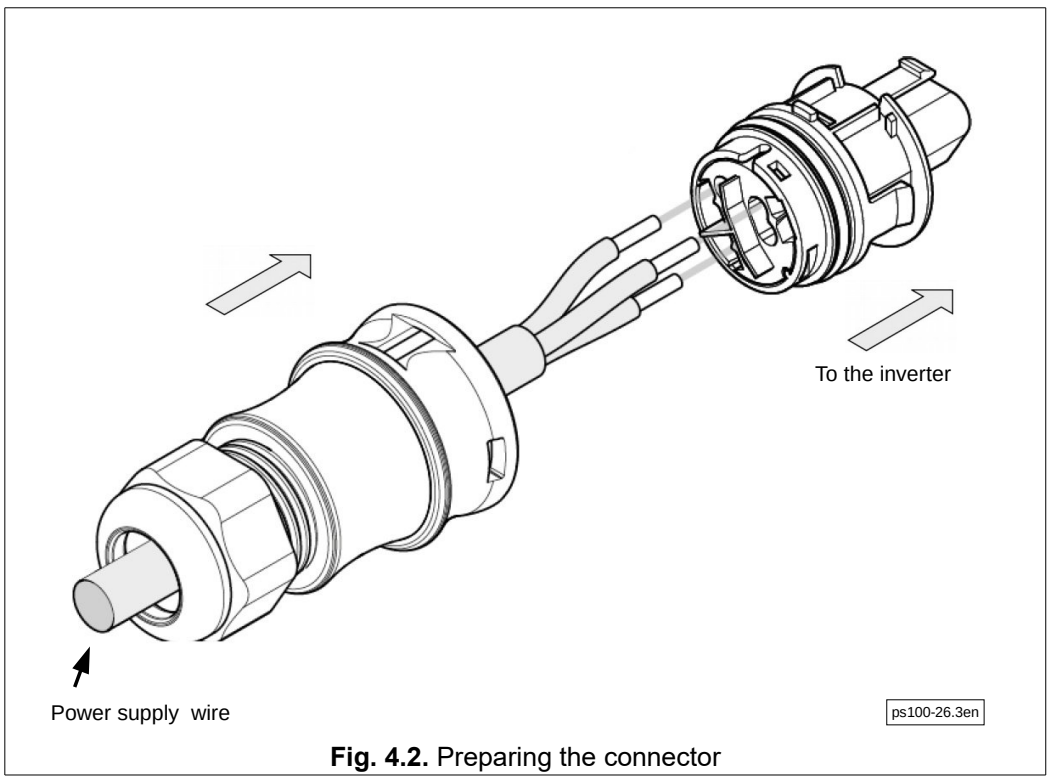


Fig. 4.2. Preparing the connector

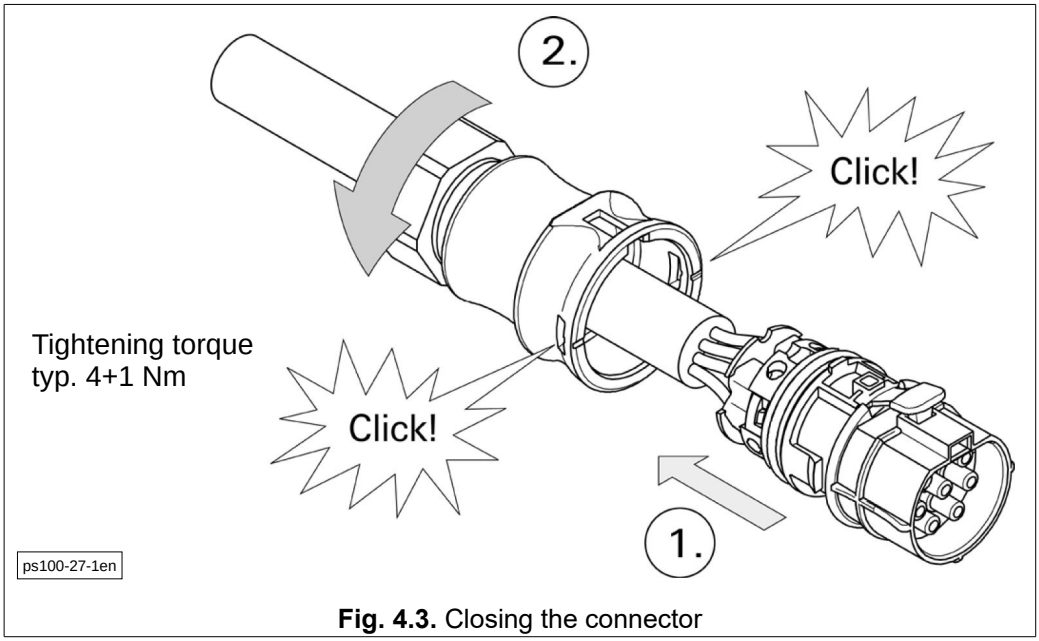


Fig. 4.3. Closing the connector

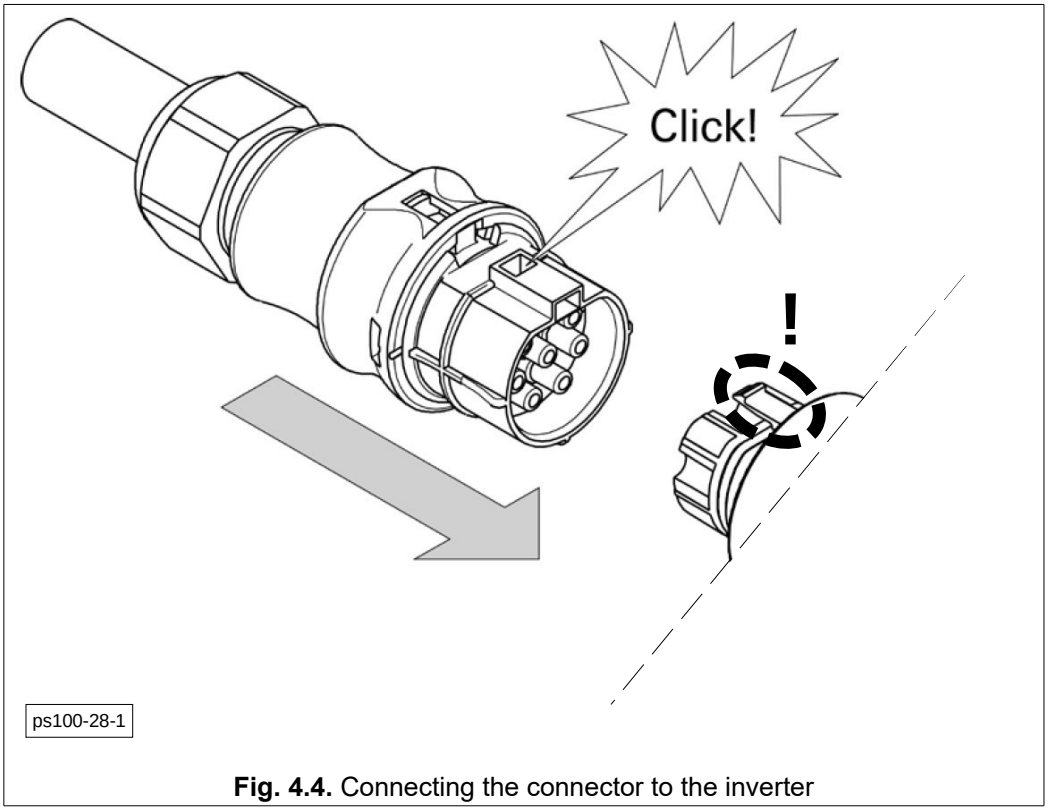


Fig. 4.4. Connecting the connector to the inverter

Attention: Fig. 4.3 and 4.4 show connectors for a 3-phase network. However, the principle of mounting connectors for the network 1-phase is the same.

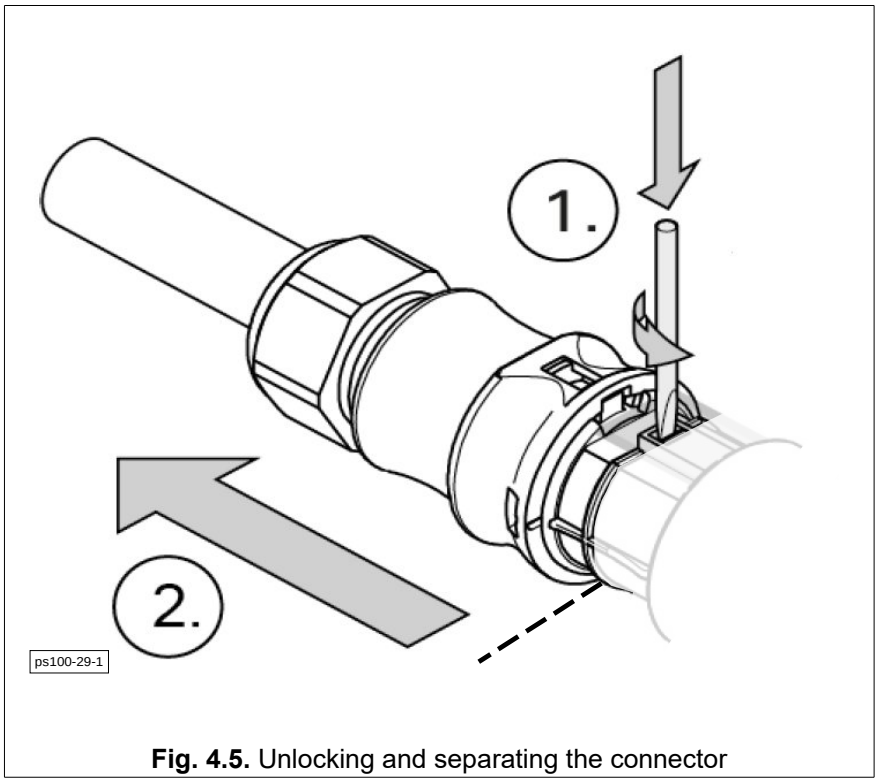


Fig. 4.5. Unlocking and separating the connector

Note: if you need to disconnect the connector, remember to latch - 1. in Fig. 4.5.

4.5. 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.

First, fix the mounting plate with 4 screws. Then hang the inverter on this board and secure it with two screws and an optional padlock.

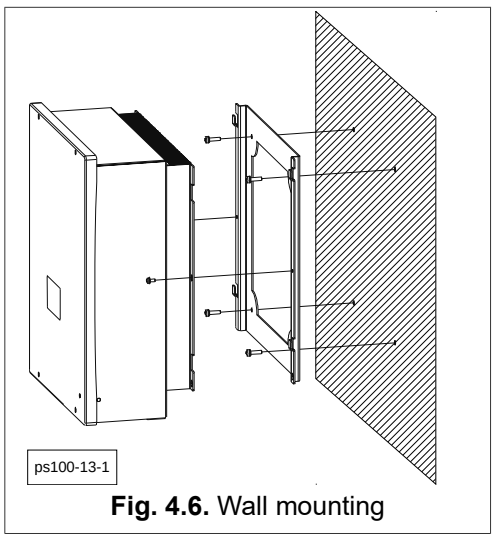


Fig. 4.6. Wall mounting

4.6. Power circuit terminals

Figures 5.1 - 6.2 show an electrical diagram of power cables 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.

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.

Access to the power circuit terminals is obtained by removing the front cover of the inverter.

Table 4.1. Internal DC and power supply lines fuses values

PS100	Internal DC protection fuse (RESs side)	Fuse protection from electrical grid side
1 kW	12A DC	B16
3 kW	16A DC	B20
5.5 kW	2 x 16A DC	B32

4.7. Use 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:

- PS100-WT,
- PS100-PV,
- PS100-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 PS100-WT and PS100-H inverters;
- **PV1, PV2 inputs (DC voltage inputs)**: photovoltaic panels input – used for PS100-PV and PS100-H inverters.

Installation operations must be carried out in accordance with chapter 5.1, 5.2, 5.3. After their execution, the inverter will be ready for autonomous operation without user intervention.

The user can obtain information about the current state of the device by website www.inverters.pl (see chapter 11 *Inverter Monitoring System via "www.inverters.pl"* on page 46), using the communication bus (RS-485, Ethernet) or directly from the control panel. Detailed description of communication configuration with the inverter can be found in chapter 10 *Communication parameters setting* on page 44.

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. Inverter with WT generator input

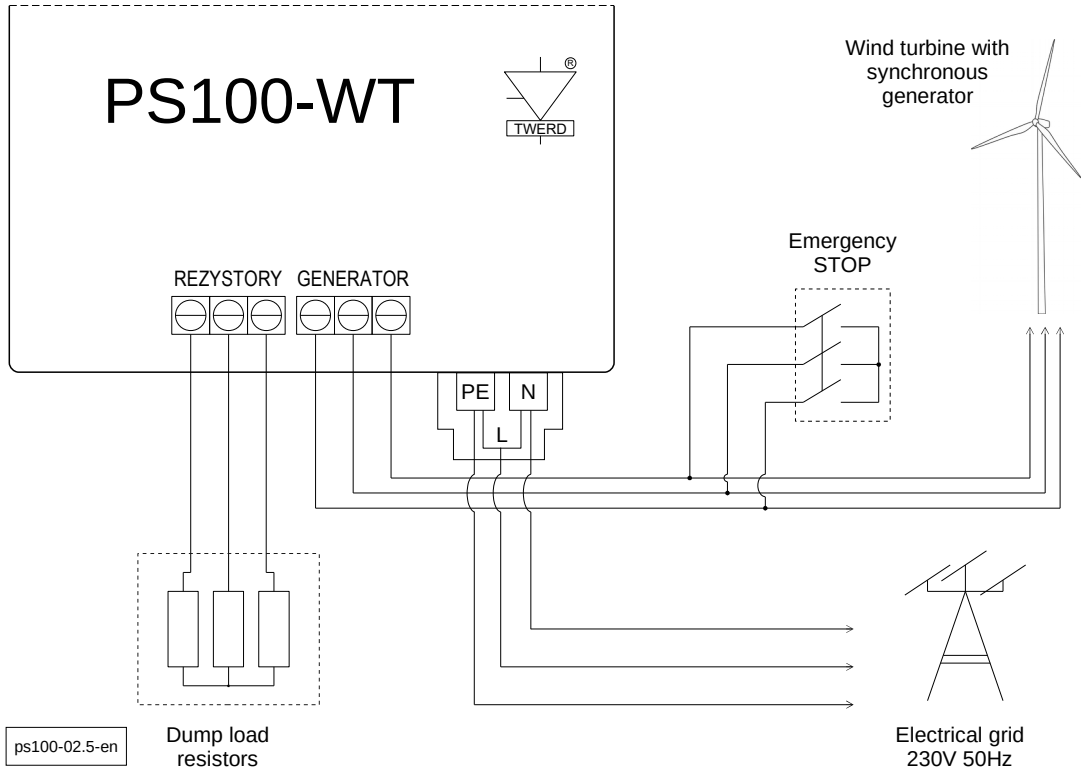


Fig. 5.1. Schematic diagram of PS100-WT power circuit connection

When connecting a three-phase permanent magnet generator, the following sequence should be followed:

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 RESISTOR terminal strip.
5. Be sure that there is no dangerous voltage on wires(!) and then connect to L,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 i 1.21. Detailed description is placed in chapter 8.
8. Refasten the inverter cover by four screws.
9. Switch OFF the Emergency STOP.
10. Wait a while to ensure that 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. Inverter with PV input

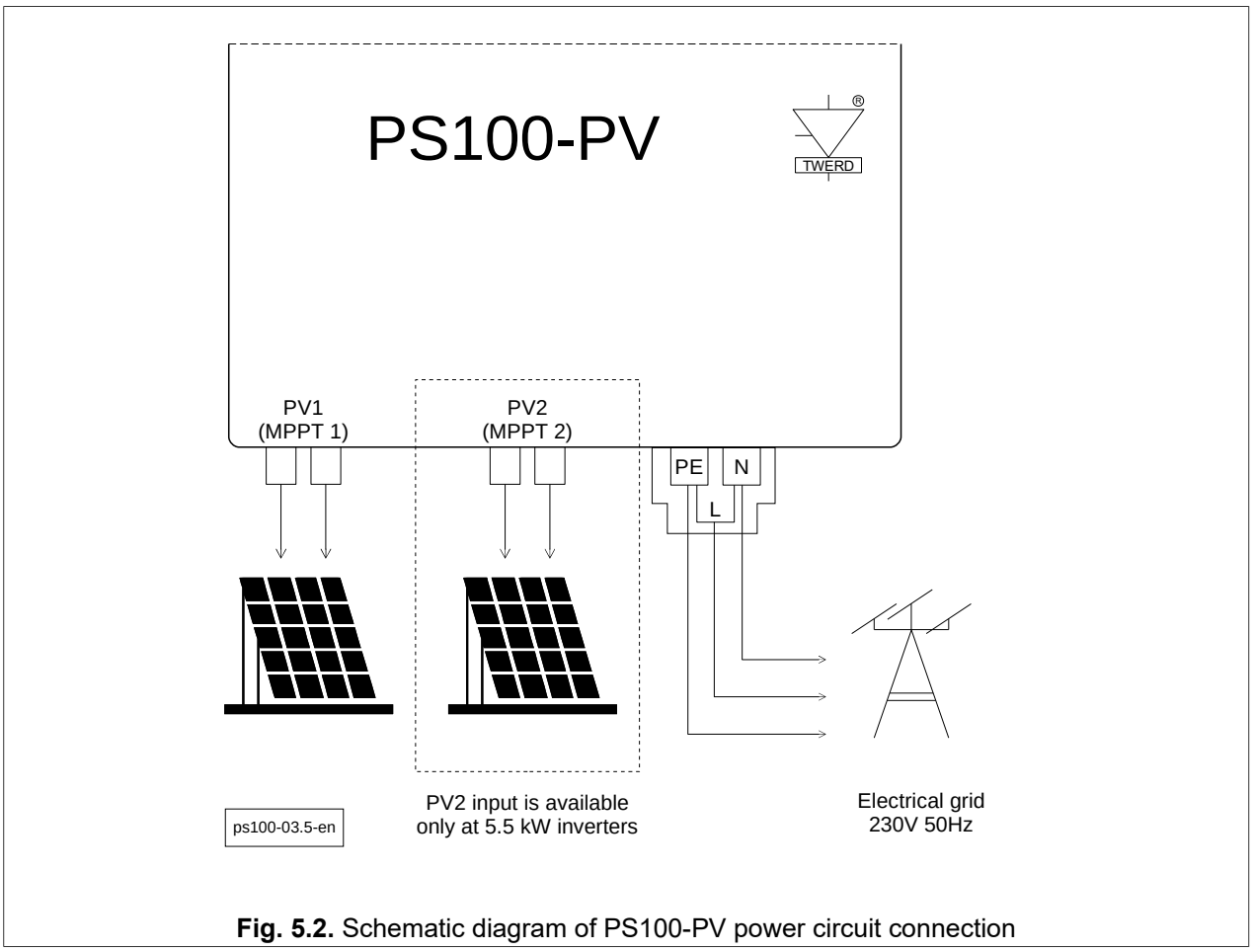


Fig. 5.2. Schematic diagram of PS100-PV power circuit connection

When connecting photovoltaic panels, follow the order of steps below:

1. Set the PV switch to OFF.
2. Connect the power supply cables to the terminals L, N, PE (potential free).
3. Measure the voltage of solar panels and their polarization.
4. Connect the solar panels to the dedicated PV connectors.
5. Switch on the inverter power supply from the mains side.
6. Set the PV switch to ON.
7. Wait a moment to check that the device is not detecting a failure.

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

5.3. Hybrid inverter with AC (PMSG) and DC (PV) inputs

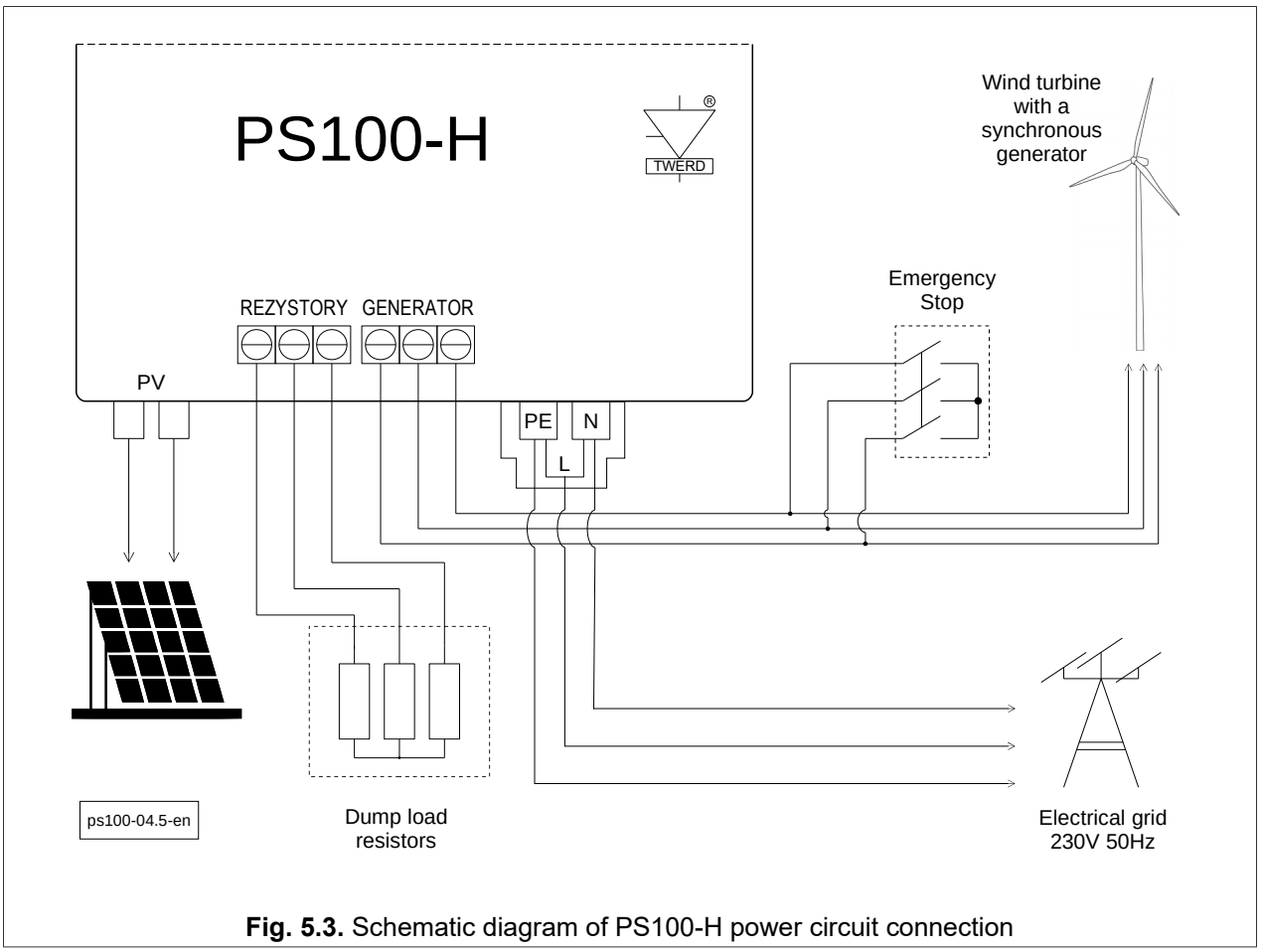


Fig. 5.3. Schematic diagram of PS100-H power circuit connection

When connecting photovoltaic panels and a synchronous generator to a hybrid inverter follow the order of steps below:

1. Short the generator windings through an external emergency stop.
2. Set the PV switch to OFF.
3. Remove the 4 screws securing the inverter cover.
4. Connect the generator cables to the terminals described GENERATOR.
5. Connect the leads of the generator braking resistors to the terminals described RESISTORS in emergency situations.
6. Connect the electric network cables (voltage free) to the L, N, PE terminals.
7. Switch on the inverter power supply from the mains side.
8. Set the system parameters: load characteristics in group 3, braking parameters in group 10 and specify the generator's starting and stopping load in parameters: 2.1, 1.20 and 1.21. A detailed description of the inverter operation can be found in chapter 8.
9. Screw in the inverter cover.
10. Measure the voltage of solar panels and their polarization.
11. Connect the solar panels to the dedicated PV connectors.
12. Turn off the emergency stop on the generator.
13. Set the PV switch to ON.
14. Wait two minutes to check if the device is detecting a failure.

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

6. OFF-GRID installation

This chapter applies to the following systems:

- PS100-WT + BAT
- PS100-PV + BAT
- PS100-H + BAT

The above inverters, after retrofitting with the PS100-INT module, can additionally work in mode 2: auto on-off-grid.

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 types of entries from the side of the renewable electricity source:

- AC input: synchronous generator input (wind farm, hydro power plant), used in PS100-WT + BAT, PS100-H + BAT systems;
- DC input: PV solar panel input used in PS100-PV + BAT, PS100-H + BAT systems.

Depending on the type of inverter you have, installation and commissioning should be carried out in accordance with the following sections (6.1, 6.2, 6.3).

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

The user can only obtain information on the current status of the device via communication buses (RS-485, Ethernet) or directly from the panel. Detailed description of communication configuration with inverter is in chapter 11.

ATTENTION:

1. When installing the inverter, remember that the electrical circuit from the generator or PV panel side must be galvanically separated from the grid. Additional measuring circuits connected between the generator and inverter must also comply with this principle. Otherwise, the system may malfunction and even damage, which will not be covered by the warranty.
2. In off-grid mode, consider the need to connect the PE conductor to the N terminal of the inverter - to provide protection against electric shock.

6.1. Inverter with the WT generator input

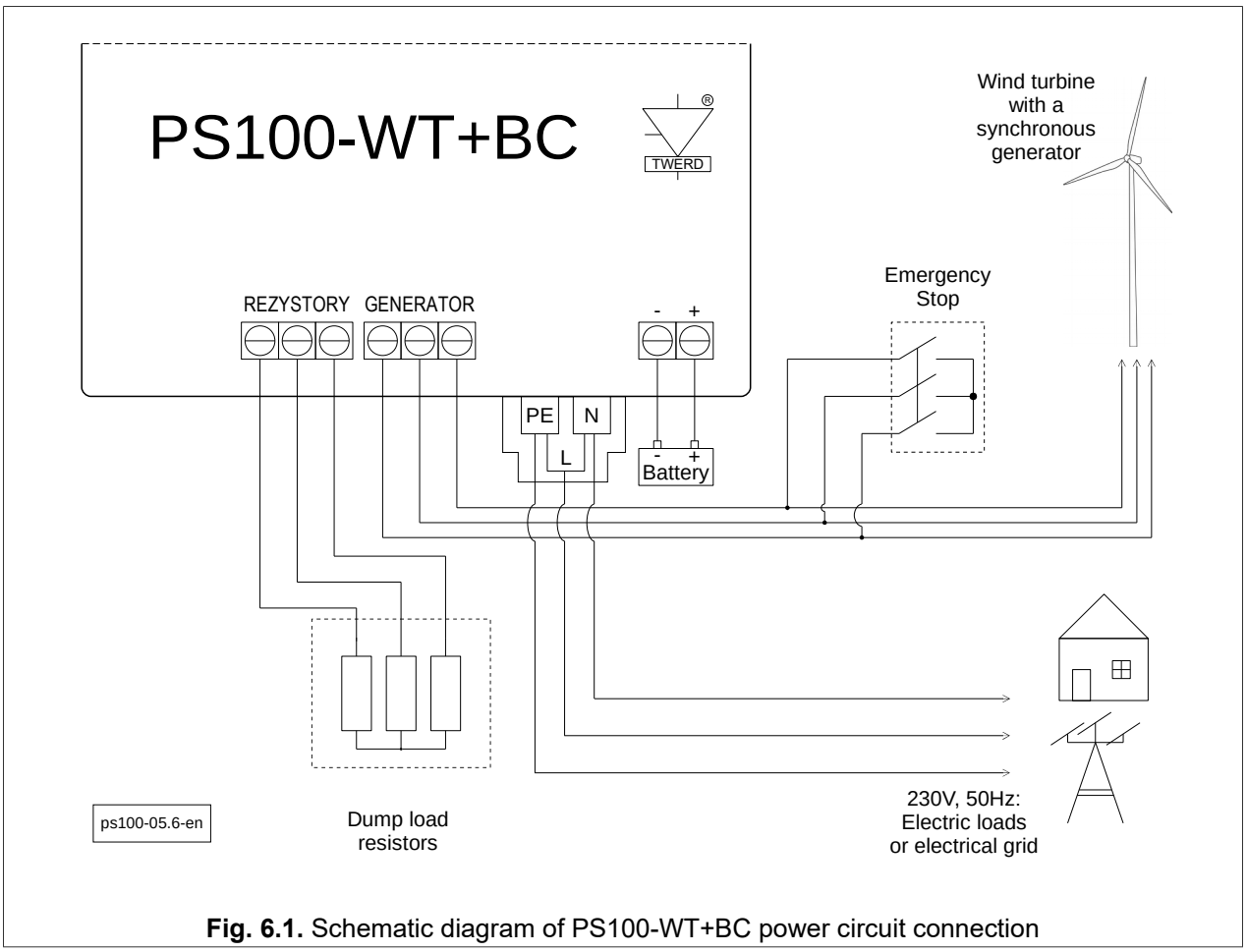


Fig. 6.1. Schematic diagram of PS100-WT+BC power circuit connection

When connecting a three-phase permanent magnet generator, the following sequence should be followed:

1. Short the generator windings through an external emergency stop.
2. Remove the 4 screws securing the inverter cover.
3. Connect the generator cables to the terminals described GENERATOR.
4. Connect the leads of the generator braking resistors to the terminals described RESISTORS in emergency situations.
5. Connect electrical loads to terminals L, N, PE.
6. Connect the earth electrode to the PE terminal and connect the N and PE terminals together.
7. Connect the battery observing the safety rules described in section 12 *Battery charger module* on page 50.
8. Set operating mode 0: "*Off-grid*" or 2: "*auto on-off-grid*" in parameter 1.1.
   Note: for operation in mode 2: "*auto on-off-grid*" it is required to connect the PS100-INT module.
9. Set the system parameters: load characteristics in group 3, braking parameters in group 10 and specify the generator's starting and stopping load in parameters: 2.1, 1.20 and 1.21. A detailed description of the inverter operation can be found in chapter 8.
10. Screw the inverter cover.
11. Turn off the generator emergency stop.
12. Wait a moment to check that the device is not detecting a failure.

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

6.2. Inverter with PV photovoltaic panels input

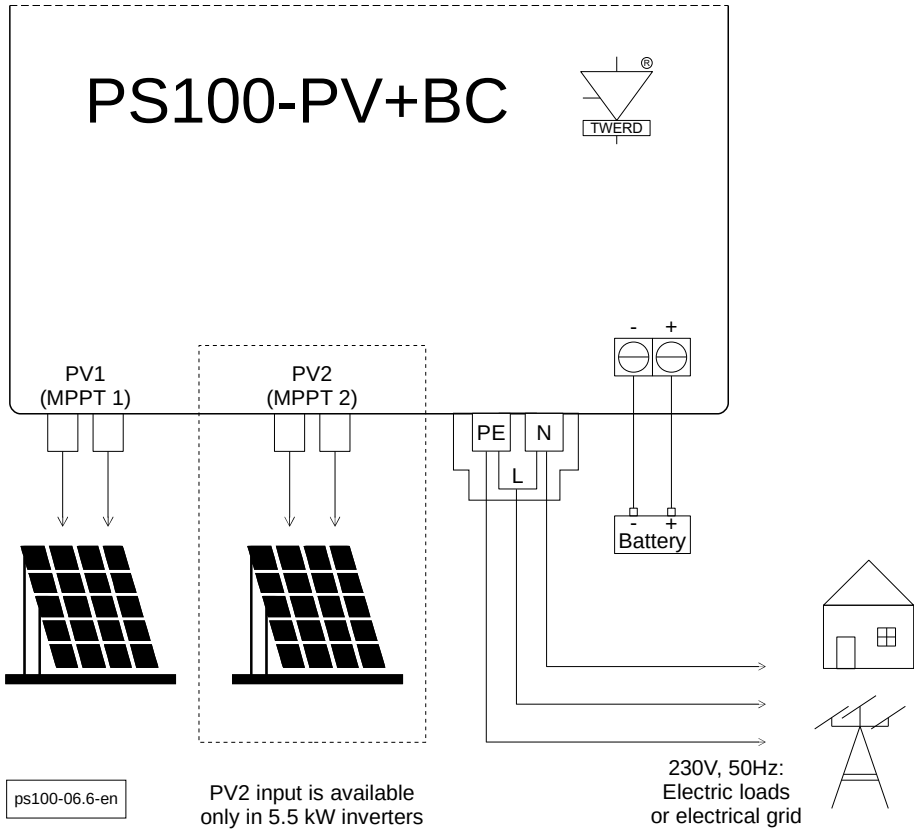


Fig. 6.2. Schematic diagram of PS100-PV+BC power circuit connection

When connecting photovoltaic panels, follow the order of steps below:

1. Set the PV switch to OFF.
2. Remove the 4 screws securing the inverter cover.
3. Connect electrical loads to terminals L, N, PE.
4. Connect the earth electrode to the PE terminal and connect the N and PE terminals together.
5. Measure the voltage of solar panels and their polarization.
6. Connect the solar panels to the dedicated PV connectors.
7. Connect the battery observing the safety rules described in section 13…. describing the charger module.
8. Set operating mode 0: "*Off-grid*" or 2: "*auto on-off-grid*" in parameter 1.1.

   Note: for operation in mode 2: "*auto on-off-grid*" it is required to connect the PS100-INT module.
9. Screw in the inverter cover.
10. Set the PV switch to ON.
11. Wait a moment to check if the device is detecting a failure.

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

6.3. Hybrid inverter with WT generator and PV photovoltaic panels inputs

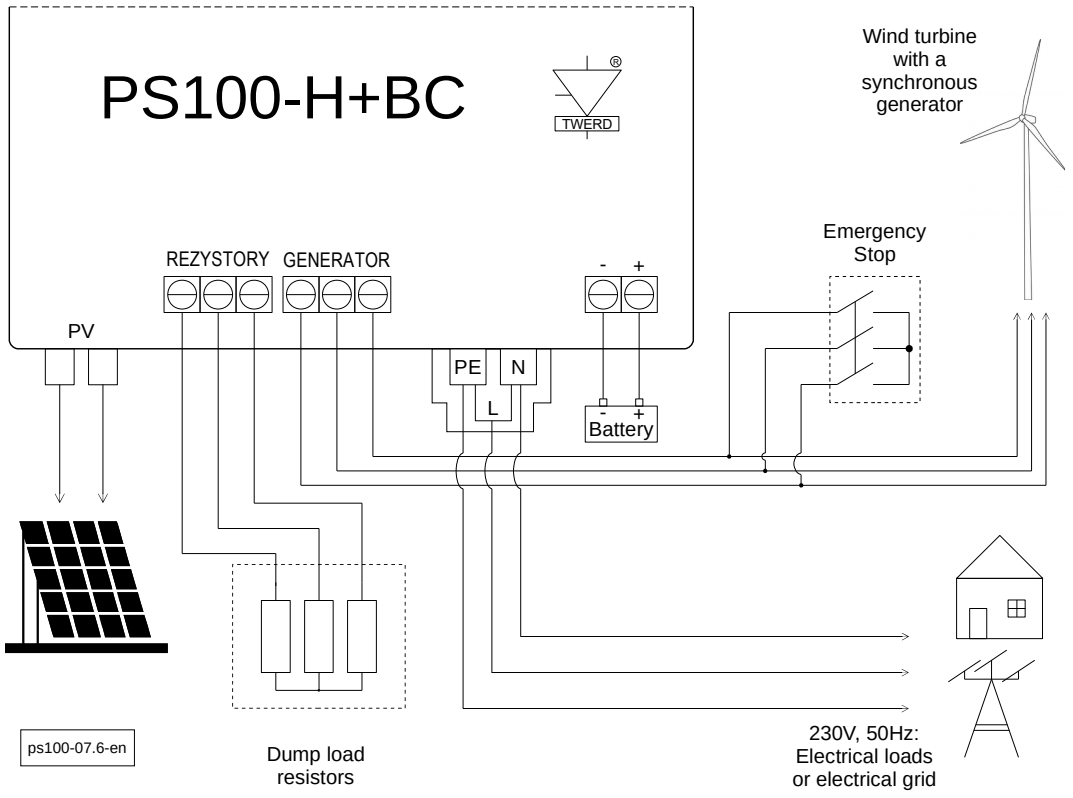


Fig. 6.3. Schematic diagram of PS100-H+BC power circuit connection

When connecting solar panels and a synchronous generator, the following sequence should be followed:

1. Short the generator windings through an external emergency stop.
2. Set the PV switch to OFF.
3. Remove the 4 screws securing the inverter cover.
4. Connect the generator cables to the terminals described GENERATOR.
5. Connect the leads of the generator braking resistors to the terminals described RESISTORS in emergency situations.
6. Connect electrical loads to terminals L, N, PE.
7. Connect the earth electrode to the PE terminal and connect the N and PE terminals together.
8. Connect the battery observing the safety rules described in section 12 describing the charger module.
9. Set operating mode 0: "*Off-grid*" or 2: "*auto on-off-grid*" in parameter 1.1.
   Note: for operation in mode 2: "*auto on-off-grid*" it is required to connect the PS100-INT module.
10. Set the system parameters: load characteristics in group 3, braking parameters in group 10 and specify the generator's starting and stopping load in parameters: 2.1, 1.20 and 1.21. A detailed description of the inverter operation is in chapter 8.
11. Screw the cover of the inverter.
12. Measure the voltage of solar panels and their polarization.
13. Connect the solar panels to the dedicated PV connectors.
14. Turn off the generator emergency stop.
15. Set the PV switch to ON.
16. Wait a moment to check that the device is not detecting a failure.

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

7. 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 7.2.

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.

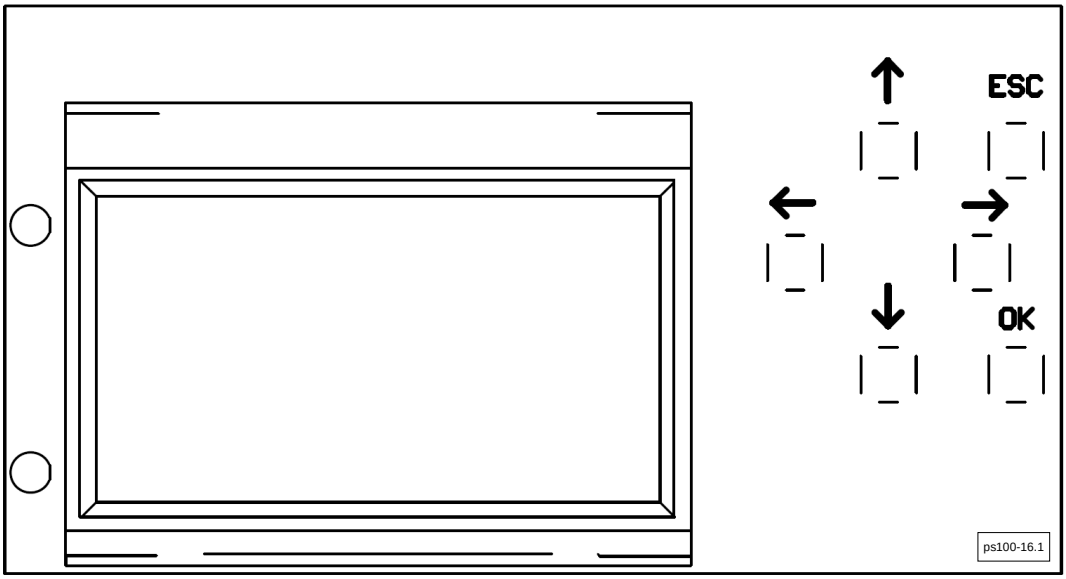


Fig. 7.1. Control panel

Table 7.1. Status diodes

Diode colour	Type of light	Description
None	LEDs off, the display shows basic information	Too low inverter input power, inverter in energy saving mode
Green	Flashing light	Inverter is ready to work
	Continuous light	Inverter is working
Red	Continuous light	Fault

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

The information displayed on the Operator Panel changes cyclically (screens 1 - 6) without user intervention. Those screened parameters are:

- **Screen 1**: producer logo, date and time.
- **Screen 2**:daily generated electrical energy graph.

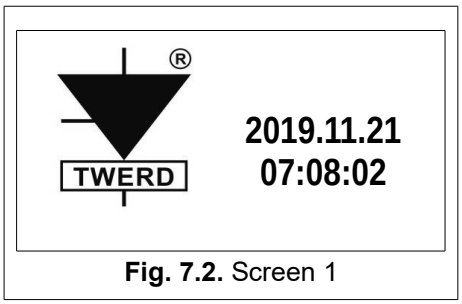


Fig. 7.2. Screen 1

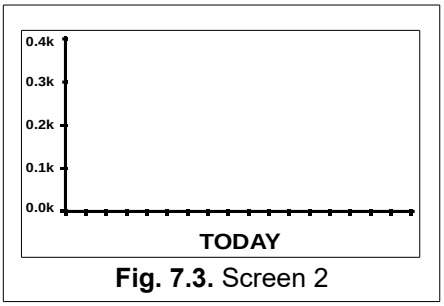


Fig. 7.3. Screen 2

- **Screen 3**: if inverter detects any fault, failure screen will appear and display present failure “Fault the previous fault “Previous Fault”
- **Screen 4:** the input voltages and currents values of the inverter.

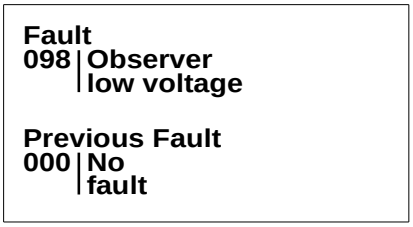


Fig. 7.4. Screen 3

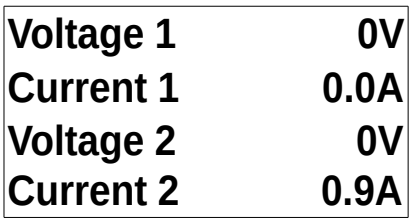


Fig. 7.5. Screen 4

- **Screen 5:**
  - Total generated energy from first run-up to present.
  - Present output power.
  - Present output current.
  - Temperature of inverter.
  - Velocity of wind.

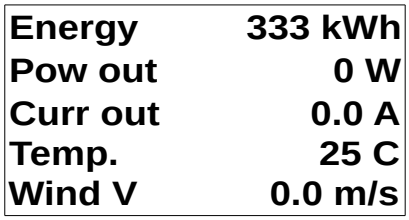


Fig. 7.6. Screen 5

- **Screen 6 – inverters with build-in battery charger module:**
    - Battery voltage.
    - Battery current.
    - Temperature of battery charging module.

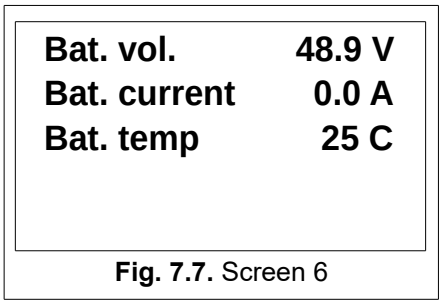


Fig. 7.7. Screen 6

7.2. 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.

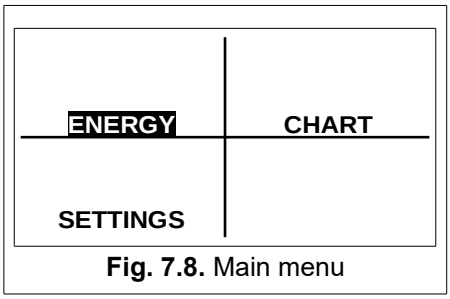


Fig. 7.8. Main menu

If it is necessary to change the parameter settings from password protected groups, first select: Settings → Service and enter the code: 123321.

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

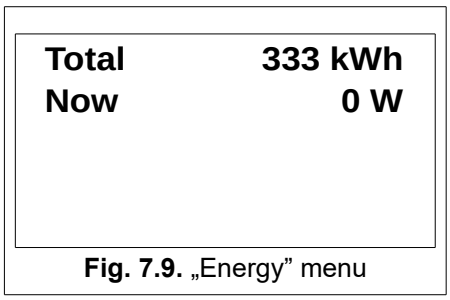


Fig. 7.9. „Energy” menu

- **Chart** menu - users could enter any specific date than check on the graphics input and output power values for that day.
- **Settings** menu - there is a four submenus: PARAMETERS, CLOCK, COMMUNICATION, SERVICE.

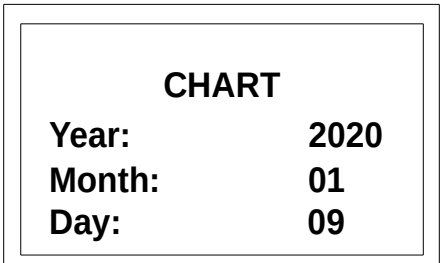


Fig. 7.10. Menu „Chart”

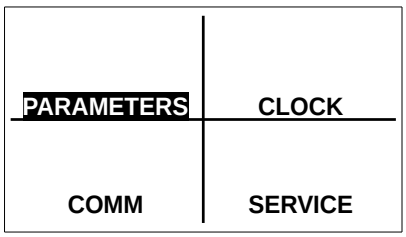


Fig. 7.11. Menu „Settings”

- **PARAMETERS** - users are able to see and set value of parameters - except group 0 which shows read-only parameters. Rest of the parameters are secured by access code. To access these protected parameters enter the **123321** access code in SETTINGS → SERVICEmenu, than choose again SETTINGS → PARAMETERS menu.
  A full list of parameters is listed in chapter 13. *Groups of parameters* on page 54.

- **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

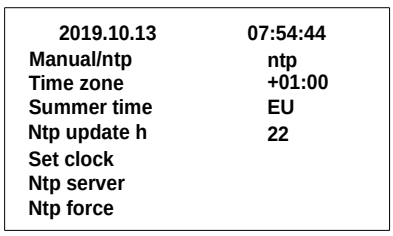


Fig. 7.12. CLOCK Menu

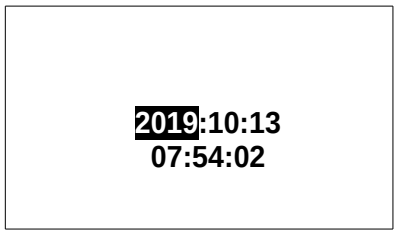


Fig. 7.13. Setting time and date

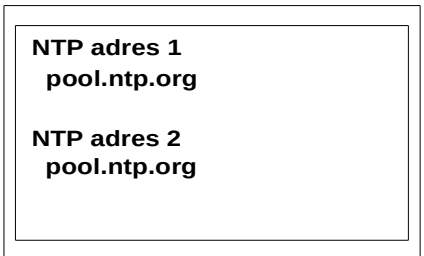


Fig. 7.14. Ntp server address

- **COMMUNICATION** menu - users able to set RS485 and Ethernet communication settings

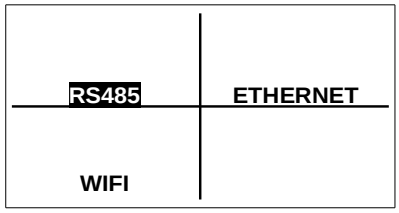


Fig. 7.15. COMM menu

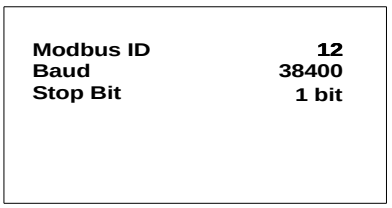


Fig. 7.16. RS485 menu

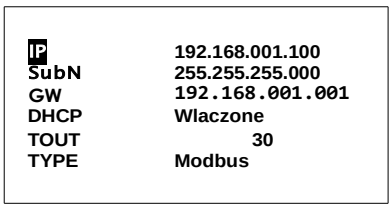


Fig. 7.17. ETHERNET menu

- **SERVICE** menu - users and authorized technical service members could enter access codes and get access to related secured levels.

7.3. Updating the Control panel software

1. Disconnect the inverter from the renewable energy source (photovoltaic panels, wind generator). Connect the USB micro cable to the J2 USB micro connector. Connect the other end of the cable to your computer. Supply the inverter from the 230V 50 Hz network via terminals L, N, PE

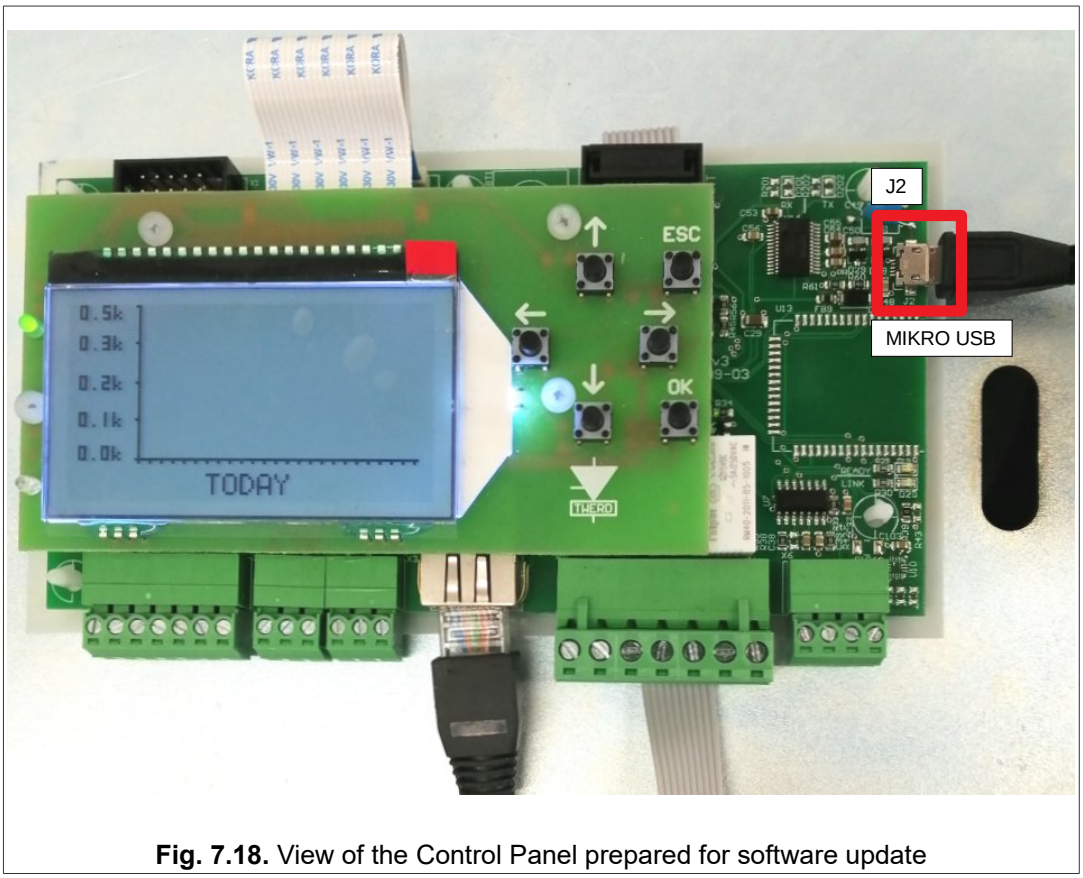


Fig. 7.18. View of the Control Panel prepared for software update

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

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

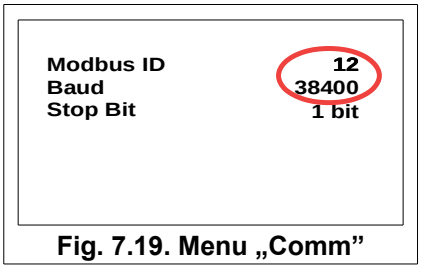


Fig. 7.19. Menu „Comm”

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

Note: If the program stops responding, close the program and restart it.

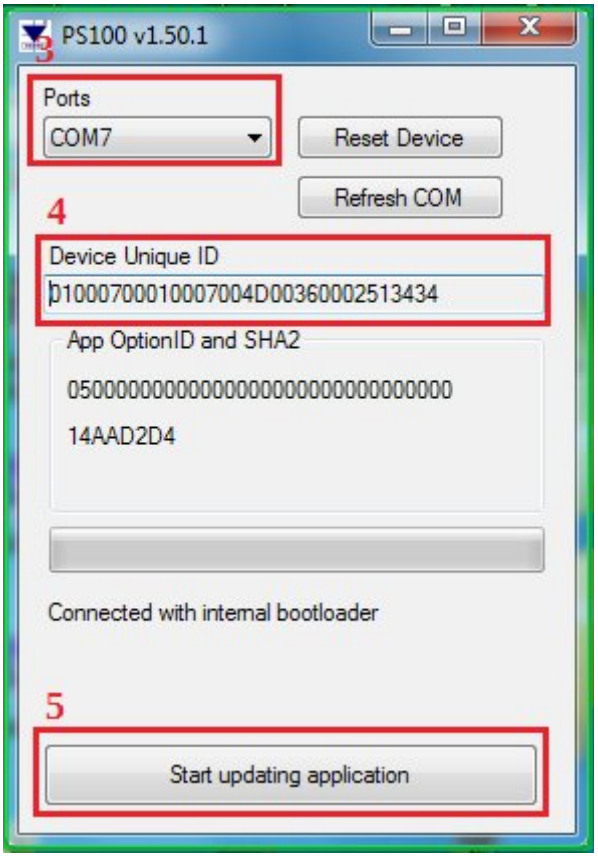


Fig. 7.20. View of the PS100 program window

8. 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.

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

PS100-PV and PS100-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. 8.1

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. 8.2. 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%.

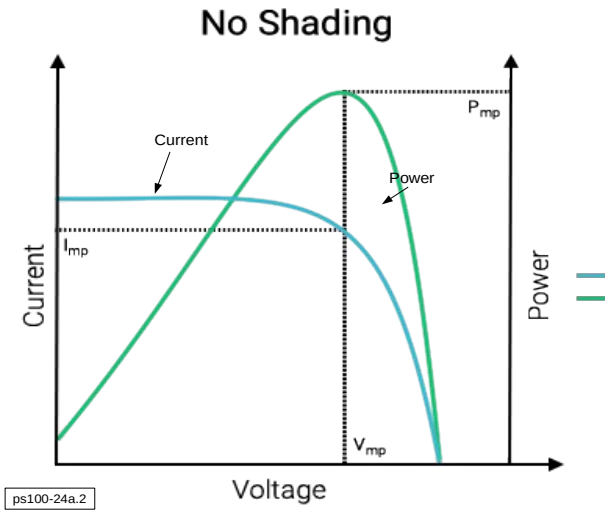


Fig. 8.1. Voltage-current characteristic – no shading conditions

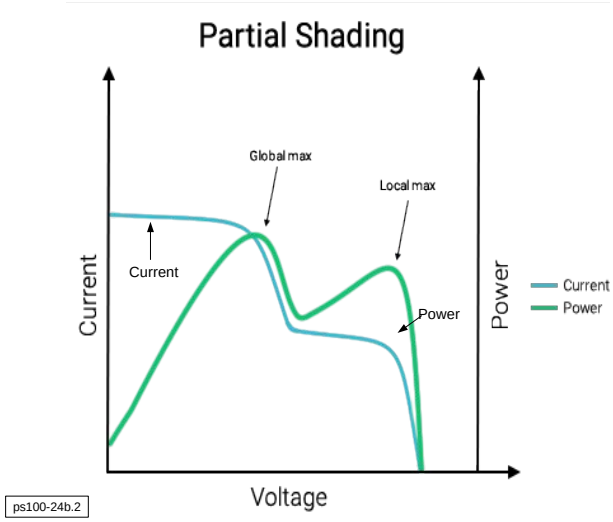


Fig. 8.2. Voltage-current characteristic – partial shading conditions

8.2. 16 point load characteristic of a synchronous generator

PS100-WT and PS100-H inverters with WT input (AC voltage input) inverters set the load based on 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 2”**), 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.

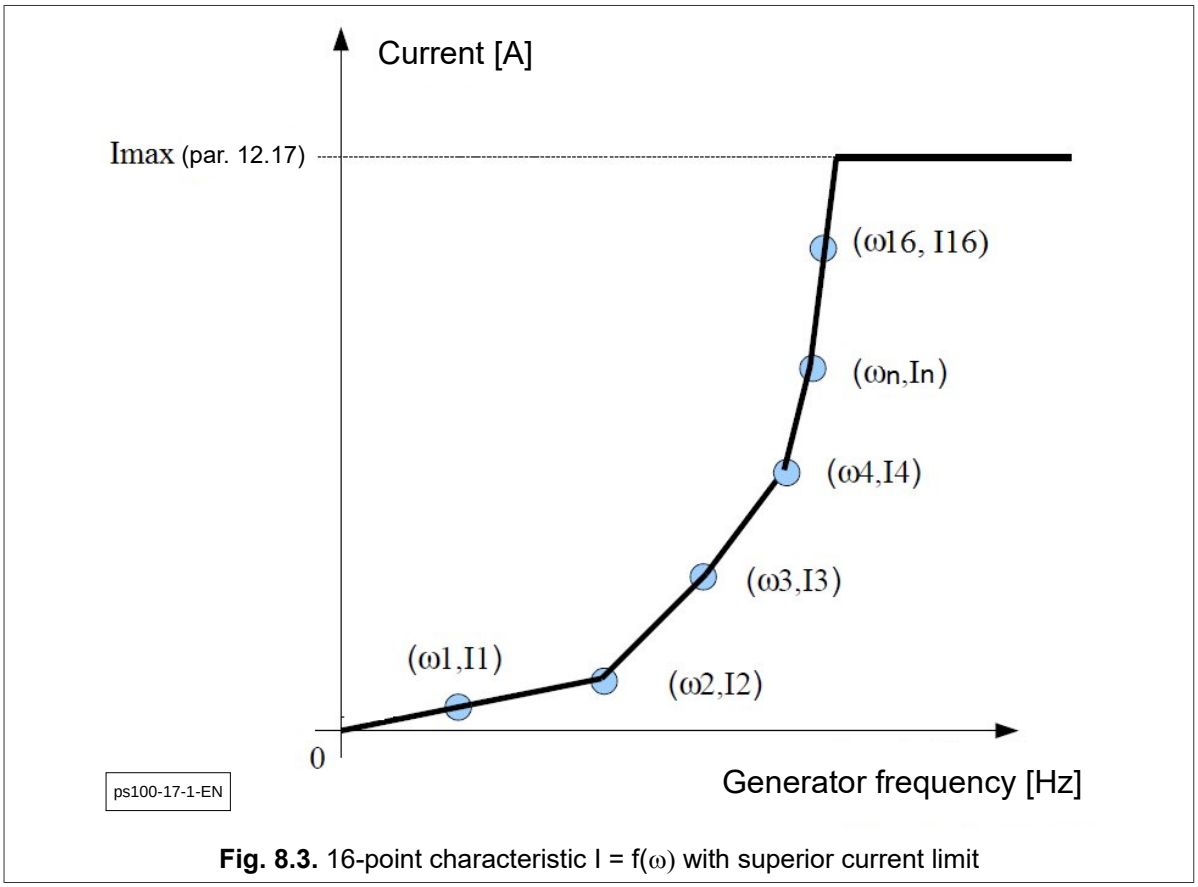


Fig. 8.3. 16-point characteristic I = f(ω) with superior current limit

8.3. Start/Stop command

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

a) **Par. 1.20 (group 1, parameter 20) "Autostart Volt"** – rectified voltage from the RES input side (renewable energy source side: synchronous generators or PV panels) above which the inverter will start operation (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”** – rectified voltage from the RES input side below which the inverter ceases to transfer energy to the mains and goes into *sleep mode*. If the input voltage remains below this level for the time specified in par. 1.11 this inverter will go into a *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 *sleep* mode.

8.4. Dump load resistors

Dump load resistors (not supplied) should be connected to proper terminals – see suitable Fig. from section 5 or 6.The dump load resistors relays have switching capacity in the category AC1: 30A.

Dump load resistors resistors will be switch on in four cases:

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

8.5. 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.

8.6. The internal process of switching the inverter off-grid

The device works autonomously, requires no maintenance.
The internal switching process is as follows:

- After connecting the batteries, the system increases the voltage in the DC circuit to a value that allows the generation of 230V AC RMS voltage.
- In the case of a photovoltaic input, it monitors the voltage of the panels, while in the case of a generator input it disconnects the load resistors and begins to monitor the voltage and frequency of the generator.
- Taking energy from renewable sources, the inverter directs it to electrical loads first. When the available electrical power exceeds the demand for electrical loads, the process of charging the batteries connected to the inverter occurs.

  In a situation where the demand for electric power by the load exceeds the power generated by renewable sources, the inverter turns into the battery discharge mode.

9. Digital inputs and outputs

The inverter has 5 digital inputs 7 Vdc, R_{IN} > 300Ω 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. 9.1 shows the view of the terminal blocks on the PS100-WT inverter. To view the status of digital inputs and outputs enter the I/O PREVIEW in the MAIN MENU of the inverter.

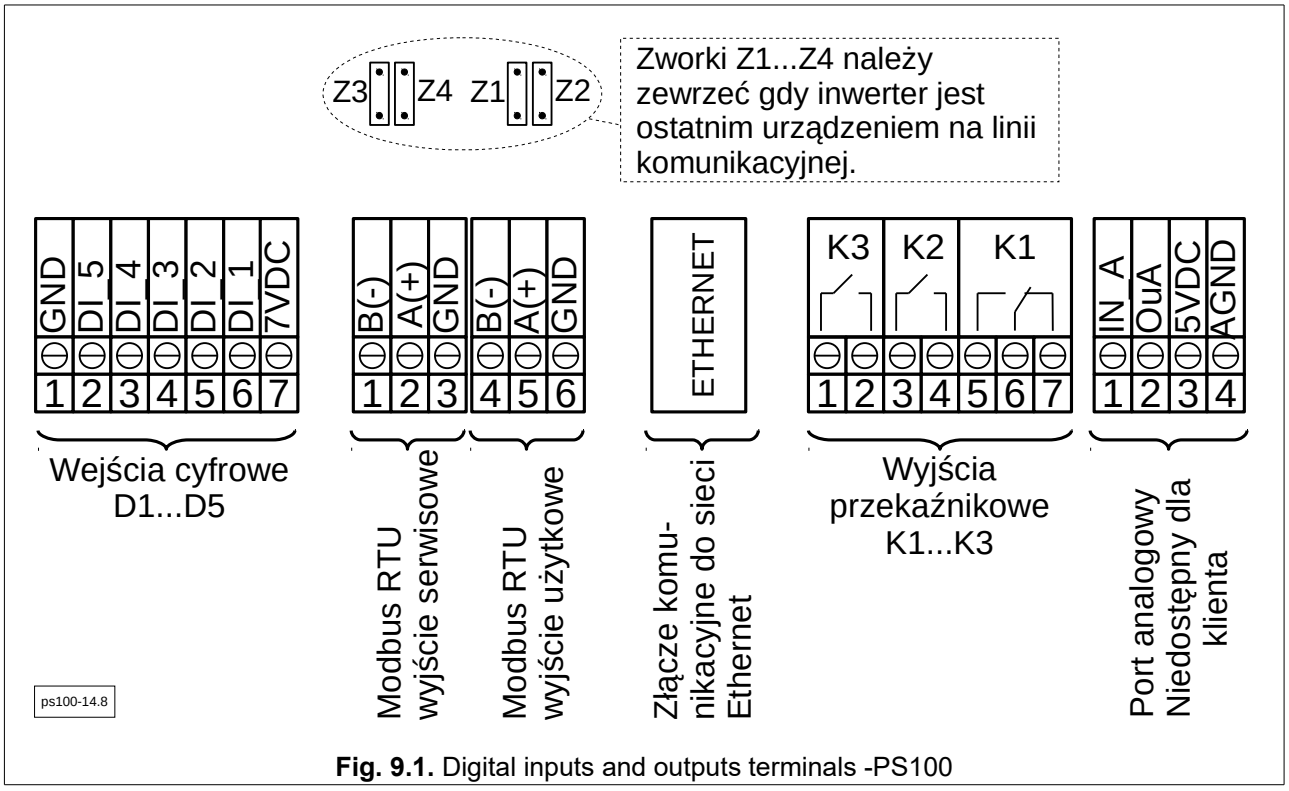


Fig. 9.1. Digital inputs and outputs terminals -PS100

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 and digital input DI_2 for operating an optional anemometer (anemometer) - see chapter *9.2 Anemometer* on page 43.

9.1. Generator load control

The PS100 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. 9.2. The principle of controlling the dump load resistors shows the principle of controlling the dump load resistors.

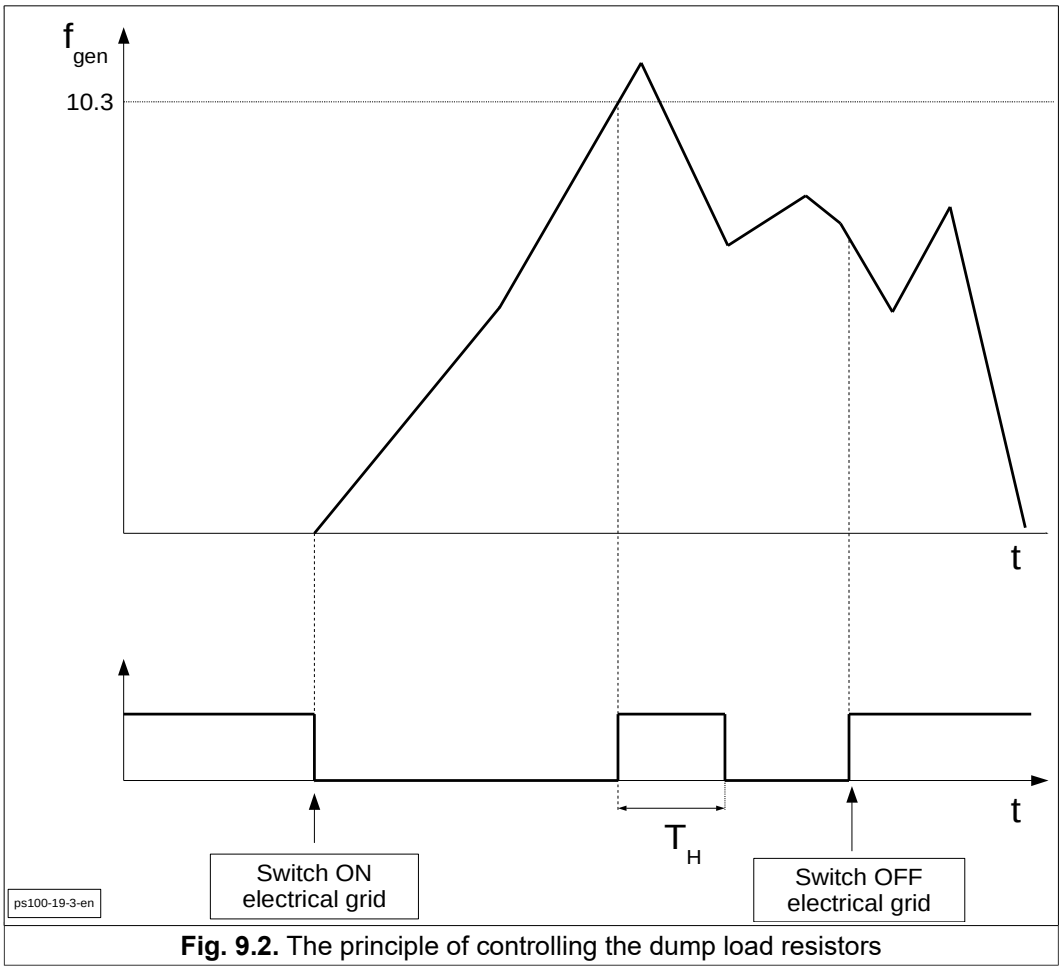


Fig. 9.2. The principle of controlling the dump load resistors

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

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

9.2. 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. 9.3 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. 9.4.

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**.

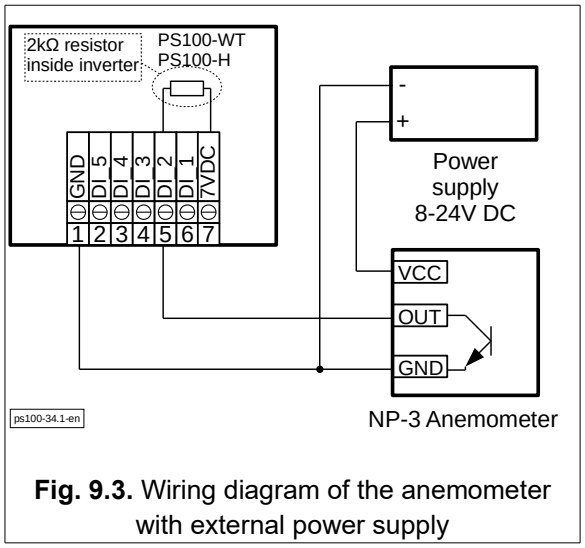


Fig. 9.3. Wiring diagram of the anemometer with external power supply

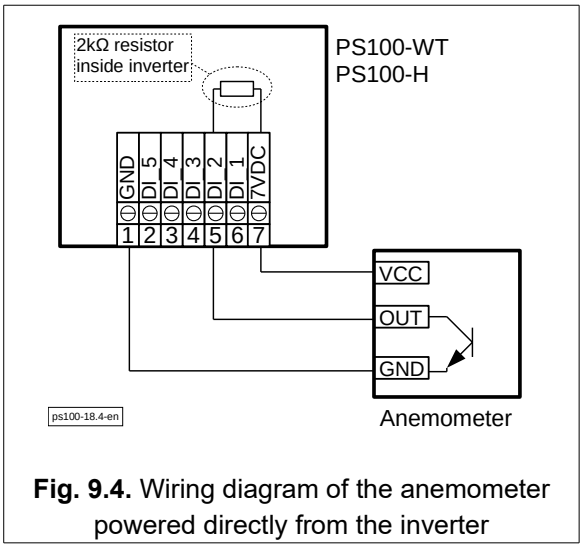


Fig. 9.4. Wiring diagram of the anemometer powered directly from the inverter

9.3. Storm Protection

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

- **P. 10.48** In this parameter users could set maximum velocity of wind for the storm protection threshold.
- **P. 10.49** In this parameter users could set time of storm protection threshold.

When the system detect above velocity than set, K3 contactor turning off and dump load is turning on. When the set time up, storm protection getting deactivated and process repeats to check wind velocity. If wind velocity still above of the storm protection threshold, system repeats same process.

9.4. Remote Output Stop Order

User could connect and use an external switch to control inverter. Switch must be connected to DI_1(6) – Fig. 9.5.

- When the switch is open; inverter works.
- When the switch is close; inverter stops, K3 contactor switching off, output relays switching off and if the inverter is for the wind turbine, dump load is switching on.

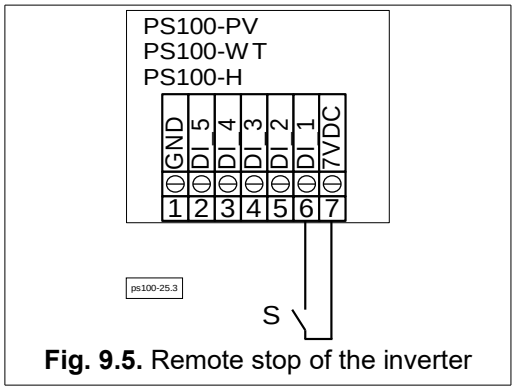


Fig. 9.5. Remote stop of the inverter

10. Communication parameters setting

The PS100 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 mode 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,
- 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 7.2 *Operating the control panel using buttons* on page 34

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.

10.1. Connecting the inverter to the Internet

Parameters configuring the connection of the inverter to the Internet are presented in Table 10.1. 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 10.1.

Table 10.1. Control of the dump load resistors - group 10 (service group, password protected)

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

10.2. 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 – realtime 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 **10.1 Connecting the inverter to the Internet page 45.**

11. Inverter Monitoring System via “www.inverters.pl”

11.1. Creating an 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.

11.2. Login

1-Enter user name.

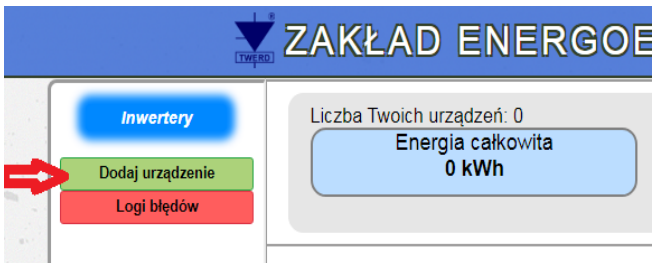
2-Enter password.

3-For log-in click to **“zaloguj”**

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

Adding inverters to the system for remote monitoring;

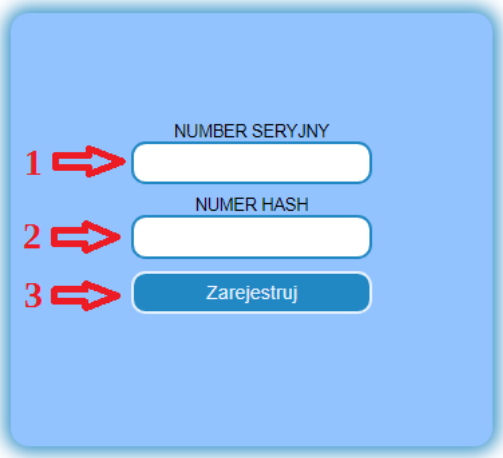
Click to **“dodaj urzadzenie”**



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

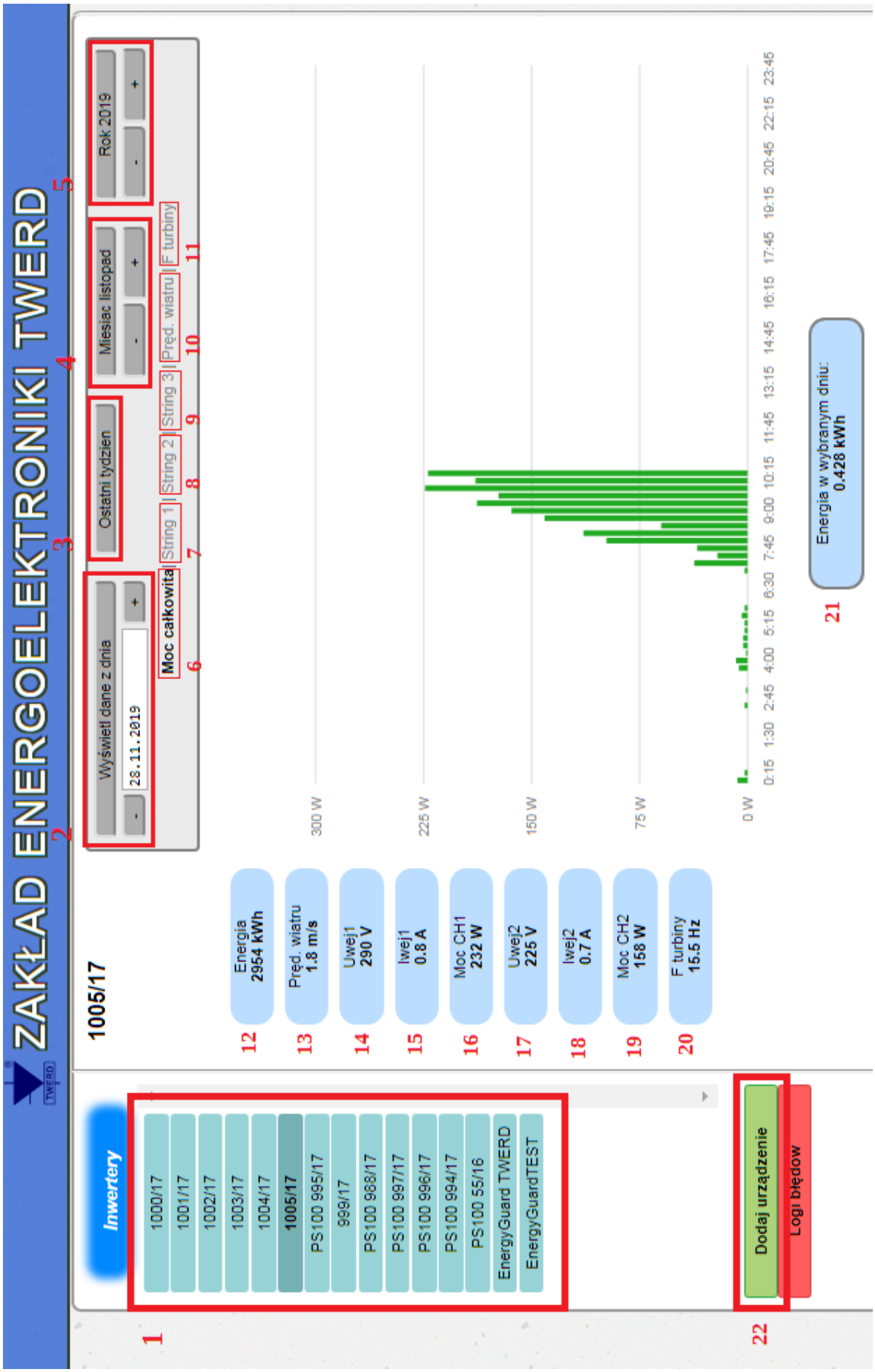
2 - Enter the **hash admin** numbers.

3 - For register click to **“Zarejestruj”**



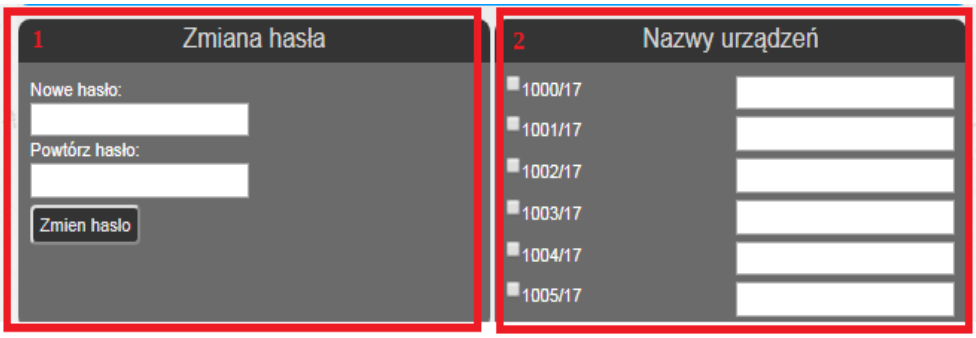
Note: Serial number and hash admin numbers will be attached on the user manual.

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


ZAKŁAD ENERGOELEKTRONIKI TWERD
1005/17
Wyświetl dane z dnia
28.11.2019
Ostatni tydzień
Miesiąc listopad
Rok 2019
Moc całkowita
String 1
String 2
String 3
Pręd. wiatru
F turbiny
Energia 2954 kWh
Pręd. wiatru 1.8 m/s
Uwej1 290 V
Iwej1 0.8 A
Moc CH1 232 W
Uwej2 225 V
Iwej2 0.7 A
Moc CH2 158 W
F turbiny 15.5 Hz
Energia w wybranym dniu: 0.428 kWh
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
Dodaj urządzenie
Logi błędów
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22

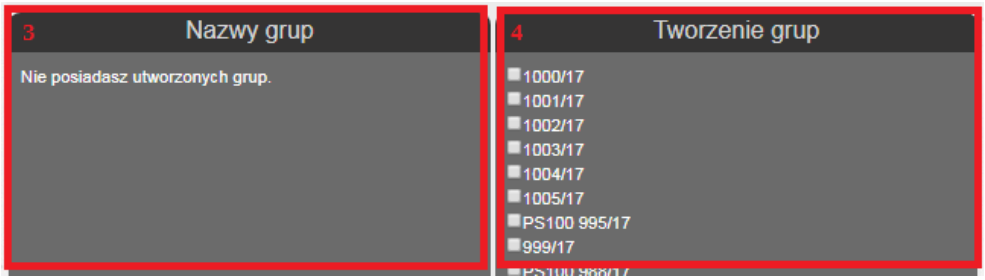
1 On this label users can see registered inverters and when you click one of them you can see details of inverter on the main screen.
2 Users can check any previous specific date parameters by entering date and clicking to “wyswietl dane z dnia”
3 Users can check last week parameter chart by clicking 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

11.4. Account Settings

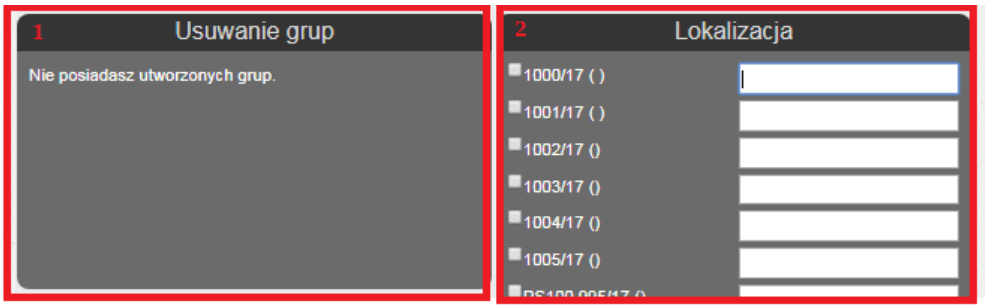


1 - In this menu users can change account password.

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”.**

12. Battery charger module

12.1. General information

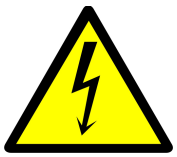
The following systems are equipped with the battery charging module:

- **PS100-WT+BC**,
- **PS100-PV+BC**,
- **PS100-H+BC**.

Table 12.1. Charger module specifications

No.	Name of the parameter	Value
1	Nominal battery voltage	48 V dc
2	Nominal charging/discharging current	50 A dc
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!

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.
3. 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. 12.1. It also indicates the parameters determining the maximum battery charging and discharging current and voltage thresholds at their terminals.

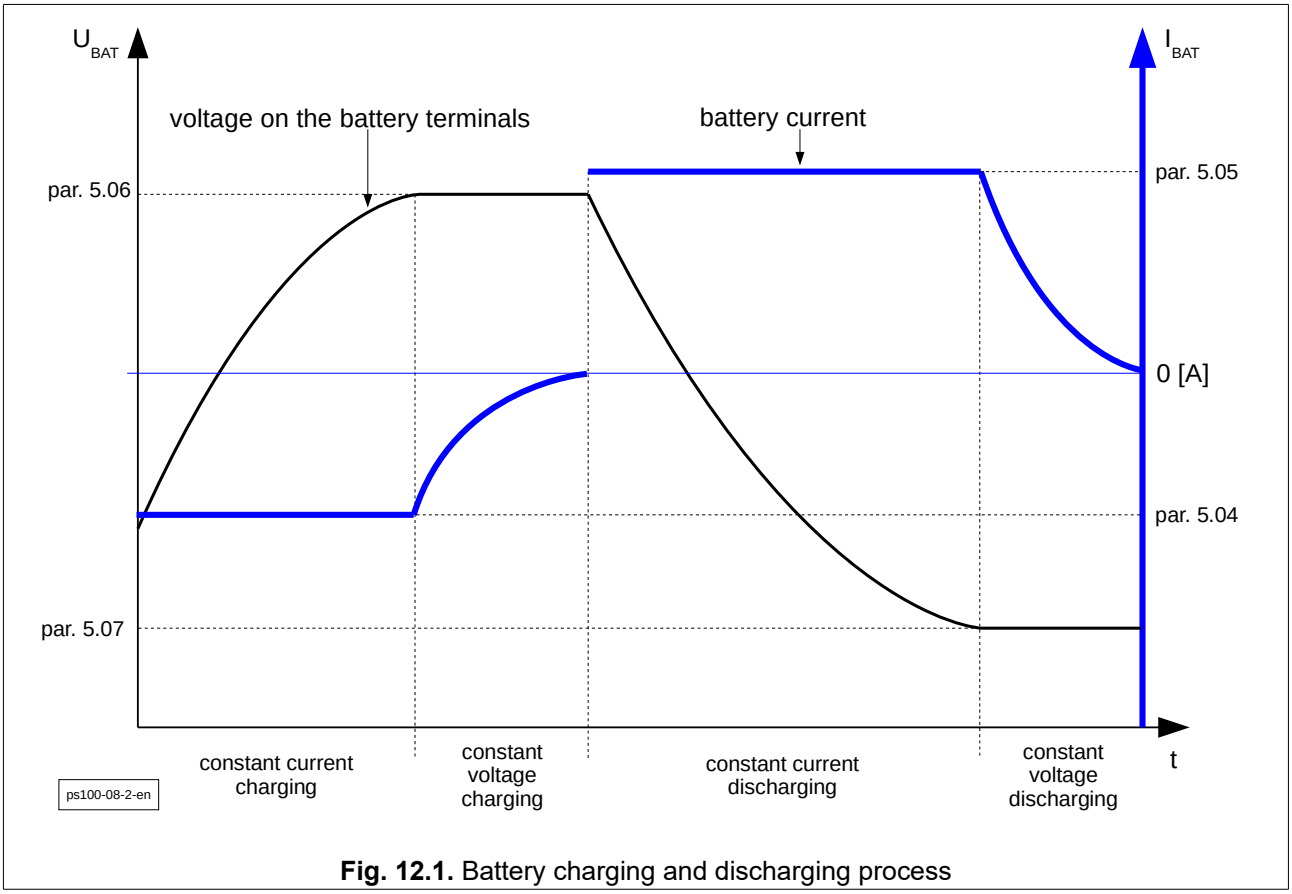


Fig. 12.1. Battery charging and discharging process

Note:

1. It was assumed that during the battery charging process the current value is negative. This is shown in Fig. 12.1, 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.
2. The module also allows you to connect a resistor in the DC circuit as an additional electricity receiver for the PS100-WT + BAT and PS100H + BAT systems, in which the wind energy is the source of electricity. This resistor is activated when the batteries are fully charged in order to load the generator and to avoid excessive speed and damage. The DC voltage level above which the resistor will switch on is set by the parameter. 5.1.
3. The system is equipped with a hardware protection that protects connected battery banks against deep discharge. The principle of the system consists in monitoring the voltage at the battery terminals and turning off the charger module when the voltage drops below 39V. The power consumption will be limited to 50μA.
4. In the situation when the charger module is not operating, check the voltage at the terminals of the connected battery. If the voltage is lower than 40V, it means that the inverter turned into mode for battery protection against deep discharge. In this situation, disconnect the battery from the inverter and charge it using external charger or replace it with a new one.

12.2. 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 bat**" system

The inverter is connected to the mains. Charging the connected battery is a priority. Energy electric power is transferred first from the Renewable Energy Sources (RES) to the connected batteries. Transmission of energy to the grid begins only when the power from RES is greater than what can be recharged or when the batteries are fully recharged.

This mode of operation is recommended for consumers who want to use energy accumulated in batteries.

2. 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.

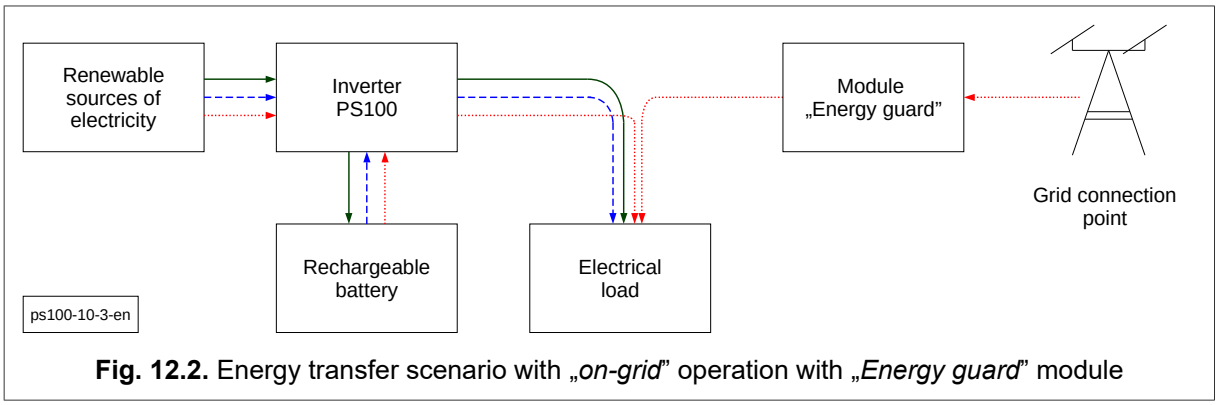


Fig. 12.2. Energy transfer scenario with „*on-grid*” operation with „*Energy guard*” module

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.

3. 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).

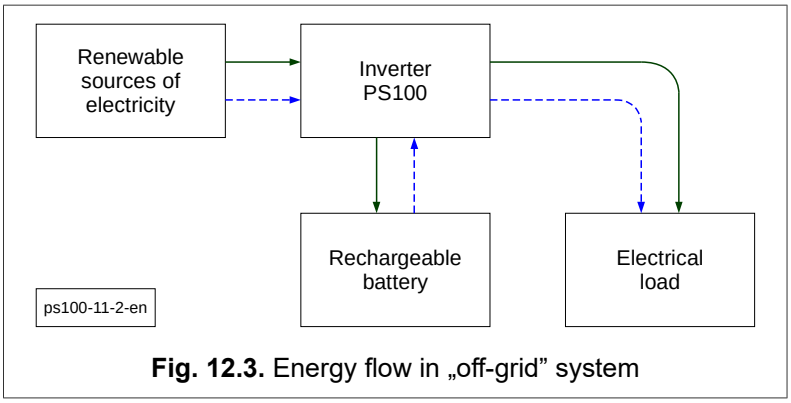


Fig. 12.3. Energy flow in „off-grid” system

4. System „**auto-on-off-grid**”

The priority is to send all energy obtained from renewable sources to the electricity grid. Only in a situation where, for some reasons, the electrical grid is turned off, the system through the PS100-INT module immediately disconnects from the electrical network and turns into “Off-grid” operation mode (see point 3 above). Only at this moment the cooperation with batteries takes place.

In the situation when the electric network is switched on again, the PS100-INT module sends information about it to the inverter and the electrical loads are switched to the mains supply. Then the inverter synchronizes again with the grid and goes into "*on grid*" mode.

NOTE: in this mode, if the battery voltage drops below the U_{LL} level (par. 5.7) the system will start charging the batteries from the mains and from renewable sources until the voltage will increase to the value from parameter 5.6.

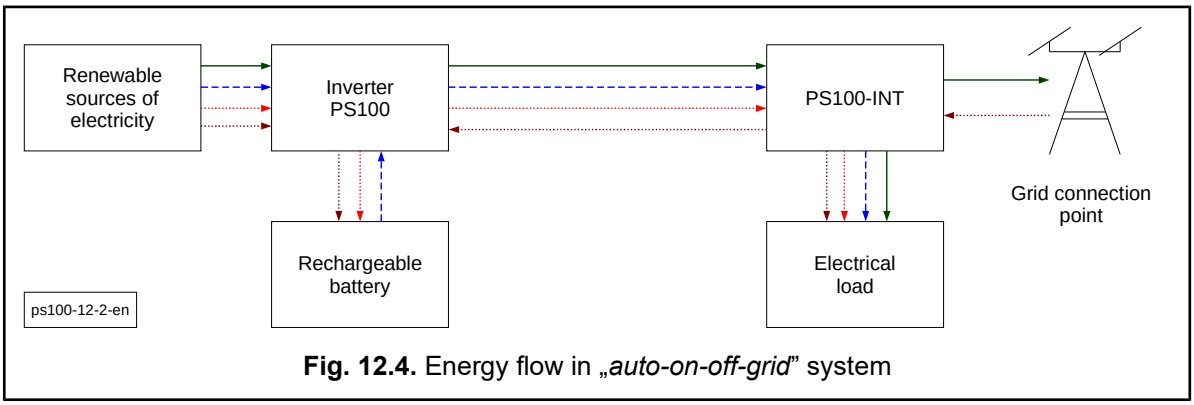


Fig. 12.4. Energy flow in „*auto-on-off-grid*” system

Fig. 12.4 shows the flow of electricity in the "auto-on-off-grid" system:

- The solid green line shows the situation in which the electrical grid is connected; renewable energy is supplied to electrical consumers and the surplus is sent to the electricity grid.
- The dashed blue and dotted red lines represent the "off-grid" system (described above in item 3), into which the system will switch after the power outage.
- The dotted-dotted brown line corresponds to the situation in which the batteries have reached the minimum permissible U_{LL} voltage and are charged from RES and from the electricity grid.

5. „**Off-grid MPPT**”

The inverter works in off-grid mode, but without a battery charger. An electric boiler may be connected at the inverter output. The system will automatically adjust the output voltage to the heater resistance in such a way as to transmit the maximum power resulting from the MPPT algorithm.

NOTE: the maximum voltage at the inverter output is 230VAC. Therefore, heaters with adequate power for 230VAC should be used.

13. Groups of parameters

The following parameter tables are common to the PS100 and PS300 series inverters.
Parameters marked in gray do not apply to PS100 inverters.

13.1. Inverter status parameters – group 0

This group contains „read only” inverter status parameters with access without any password.

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
00.31	Wind speed [m/s]	O	Wind speed

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

Parameter No.	Name	Access level	Description
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
00.73	Event 4	O	Previous event code

Parameter No.	Name	Access level	Description
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

13.2. 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 input

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 input

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]	1	Generator frequency at which the "Resistors" load is turned On (break contacts 8A / 250 Vac)
10.04	Min czas ham. [s]	1	Minimum "Resistors" load turn On time
10.05	Hist. ham. Off [%]	1	Hysteresis specified in% in relation to the values given in parameters 2 and 3, giving the load release thresholds
10.06	Metro / 10imp [m/s]	1	Wind speed corresponding to 10 pulses from the anemometer
10.14	Global mppt scan	1	Time between global MPPT scans; 0 min. means disable global MPPT
10.29	Phase guard	1	Phase determination when using Energy guard
10.48	High wind speed	1	Wind speed that turns On the storm protection
10.49	High wind timer	1	Time duration of storm protection
10.50	Language	1	Language selection
10.51	Contrast	1	
10.52	Remote par. edit	1	
10.53	Remote login	1	
10.54	Min ground res.	1	Permits to carry out an insulation resistance test

GROUP 11 – Grid parameters

Parameter No.	Name	Access level	Description
11.01	OverVoltageSt2	3	Overvoltage protection threshold - level 2 instantaneous
11.02	OverVoltageSt1	3	Overvoltage protection threshold - level 1 time delay
11.03	UnderVoltage	3	Undervoltage protection threshold
11.04	OverFreq	3	Overfrequency protection threshold
11.05	UnderFreq	3	Underfrequency protection threshold

Parameter No.	Name	Access level	Description
11.06	OverFreqTime	3	Delay time of overfrequency protection operation
11.07	UnderFreqTime	3	Underfrequency protection trip delay time
11.08	OverVoltageSt2Time	3	Overvoltage protection activation delay time - level 2
11.09	OverVoltageSt1Time	3	Overvoltage protection activation delay time - level 1
11.10	UnderVoltageTime	3	Delay time of undervoltage protection operation
11.11	MinFReconnect	3	Minimum grid frequency when reconnected
11.12	MaxFReconnect	3	Maximum network frequency when reconnected
11.13	MinUReconnect	3	Minimum mains voltage when reconnected
11.14	MaxUReconnect	3	Maximum mains voltage when reconnected
11.15	MinFStart	3	Minimum grid frequency at start-up
11.16	MaxFStart	3	Maximum grid frequency at start-up
11.17	MinUStart	3	Minimum mains voltage at start-up
11.18	MaxUStart	3	Maximum mains voltage at start-up
11.19	GridObservationTime	3	Time to recognize the grid before starting work
11.20	Reconn.PowerRamp	3	Time after reconnection in which the inverter output power limit increases from 0 to nominal power
11.21	StartingPowerRamp	3	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	3	Grid frequency threshold from which the inverter output power limit starts to be limited
11.23	OverFreqDroop	3	Percentage decrease of the inverter output power limit as the grid frequency increases above the tripping threshold
11.24	CosPhi	3	Defines the cosφ of the output current and the type of reactive power of the inverter (capacitive/inductive)
11.25	Rocof Ramp	3	Collateral value Rocof

GROUP 12 – Grid parameters EN50549

Parameter No.	Name	Access level	Description	Default value	Setting range
12.01	Napiecie znamionowe sieci	3	Rated voltage	230 V	100-400V
12.02	Czestotliwosc znamionowa	3	Rated frequency	50 Hz	50Hz, 60Hz
12.03	Nominal Power	3	Rated power	Pn	-
12.04	UnderVoltage St1	3	Undervoltage protection threshold threshold 1	0.85	0.2..1.00
12.05	UnderVoltage St1 Time	3	Undervoltage protection threshold threshold 1 – time	1.2 s	0.1..100.0 s

Parameter No.	Name	Access level	Description	Default value	Setting range
12.06	UnderVoltage St2	3	Undervoltage protection threshold threshold 2	0.4	0.20..1.00
12.07	UnderVoltage St2 Time	3	Undervoltage protection threshold threshold 2 - time	0.20 s	0.10..5.00 s (rozdz:0.05s)
12.08	OverVoltageSt1	3	Overvoltage protection threshold - level 1 (instantaneous)	1.15	1.00..1.20
12.09	OverVoltageSt1Time	3	Overvoltage protection activation delay time - level 1	0.1 s	0.1..100.0 s
12.10	OverVoltageSt2	3	Overvoltage protection threshold - level 2 (instantaneous)	1.15	1.00..1.30
12.11	OverVoltageSt2Time	3	Overvoltage protection activation delay time - level 2	0.10 s	0.10..5.00 s (rozdz.: 0.05s)
12.12	OverVoltage10min	3	Overvoltage protection threshold 10 minutes (delayed)	1.10	1.00..1.15
12.13	Enable ST1 Under/Over Freq	3	Selection of active security thresholds: 0 - St2 1 - St1 2 - DI4 3 - Remote	0	0, 1, 2, 3
12.14	UnderFreqSt1A	3	Underfrequency protection threshold	47.5 Hz	47.0..50.0 Hz
12.15	UnderFreqTimeSt1A	3	Underfrequency protection activation delay time	0.1 s	0.1..100.0 s
12.16	UnderFreqSt2A	3	Underfrequency protection threshold	47.5 Hz	47.0..50.0 Hz
12.17	UnderFreqTimeSt2A	3	Underfrequency protection trip delay time	0.10 s	0.10..5.00 s (rozdz.: 0.05s)
...					
12.22	OverFreq St1	3	Overfrequency protection threshold St1	52.0 Hz	50.0..52.0 Hz
12.23	OverFreqTimeSt1	3	St1 overfrequency protection activation delay time	0.1 s	0.1..100.0 s
12.24	OverFreq St2	3	Overfrequency protection threshold St2	52.0 Hz	50.0..52.0 Hz
12.25	OverFreqTimeSt2	3	St2 overfrequency protection activation delay time	0.10 s	0.10..5.00 s (rozdz.: 0.05s)
LFSM-U					
12.26	Under Treshold freq f1	3	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	3	Percentage increase of the inverter output power limit as the grid frequency falls below the tripping threshold	5%	2..12%

Parameter No.	Name	Access level	Description	Default value	Setting range
12.28	UnderFreq PowerRef	3	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	3	LFSM-U mode activation delay	0	0.0...2.0s
			LFSM-O		
12.30	OverFreq Treshold freq f1	3	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	3	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	3	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	3	LFSM-O mode activation delay	0 s	0.0..2.0 s
12.34	Fstop	3	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	3	Limit reset function delay	0 s	0.0..2.0 s
			Control		
12.36	Control Mode	3	Reactive power generation control mode		0 - Qset 1 - cos φ set 2 - Q(U) 3 - cosφ(P)
12.37	Q set	3	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	3	Cos φ setting for par. 12.36 = 1	0	-0.9..0.9
12.39	uV2	3	Voltage for QuV2 par. 12.36 = 2	0.92	0.80..1.00
12.40	QuV2	3	Q for uV2 Par. 12.36 = 2	48%	-48..48 %
12.41	uV1	3	Voltage for QuV1 par. 12.36 = 2	0.94	0.90..1.00
12.42	QuV1	3	Q for uV1 par. 12.36 = 2	0	-48..48 %
12.43	oV1	3	Voltage for QoV1 par. 12.36 = 2	1.06	1.00..1.15

Parameter No.	Name	Access level	Description	Default value	Setting range
12.44	QoV1	3	Q for oV1 Par. 12.36 = 2	0	-48..48 %
12.45	oV2	3	Voltage for QoV2 par. 12.36 = 2	1.08	1.00..1.15
12.46	QoV2	3	Q for oV2 par. 12.36 = 2	-48%	-48..48 %
12.47	Time filter	3	Q(U) control filter time constant par. 12.36 = 2	10 s	3..60 s
12.48	Lock in power	3	Power level to enable Q(U) regulation par. 12.36 = 2	0	0..20 %
12.49	Lock out power	3	Power level to disable Q(U) regulation par. 12.36 = 2	0	0..20 %
12.50	P1	3	Power value P1 of the cosφ(P) characteristic par. 12.36 = 3	0.20	0.01..1.00
12.51	cosfi(P1)	3	Cosφ setting for power P1 of the cosφ(P) characteristic par. 12.36 = 3	1.00	-0.9..0.9
12.52	P2	3	Power value P2 of the cosφ(P) characteristic par. 12.36 = 3	0.50	0.01..1.00
12.53	cosfi(P2)	3	Cosφ setting for power P2 of the cosφ(P) characteristic par. 12.36 = 3	1.00	-0.9..0.9
12.54	P3	3	Power value P3 of the cosφ(P) characteristic par. 12.36 = 3	1.0	0.01..1.00
12.55	Cosfi (P3)	3	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	3	Minimum grid frequency when reconnected	49.5 Hz	47.0..50.0 Hz
12.57	MaxFReconnect	3	Maximum network frequency when reconnected	50.2 Hz	50.0..52.0 Hz
12.58	MinUReconnect	3	Minimum mains voltage when reconnected	85%	50..100 %
12.59	MaxUReconnect	3	Maximum mains voltage when reconnected	110%	100..120 %
12.60	Grid Observation time Reconnect	3	Observation time before reconnecting to the network	60 s	10..600 s
12.61	Reconn.PowerRamp	3	Power limit ramp rate after reconnection	10 %/min	6..6000 %/min
12.62	MinFStart	3	The minimum frequency of the network at start-up	49.5 Hz	47.0..50.0 Hz
12.63	MaxFStart	3	Maximum grid frequency	50.1 Hz	50.0..52.0 Hz
12.64	MinUStart	3	Minimum mains voltage at start-up	85%	50..100 %

Parameter No.	Name	Access level	Description	Default value	Setting range
12.65	MaxUStart	3	Maximum mains voltage at start-up	110%	100..120 %
12.66	GridObservationTime	3	The time of measuring the parameters of the electrical network before starting work	60 s	10..600 s
12.67	Start.PowerRamp	3	The steepness of the power limit increase after system start	Disable	6..6000 %/min
12.68	Rocof Ramp	3	Rocof protection value	2.5 Hz/s	0.0..3.0 Hz/s
12.69	Rocof Time	3	Rocof protection time constant	0.10 s	0.10..1.00 s (rozdz.:0.05s)
12.70	Enable power limitation	3	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.
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.

Parameter No.	Name	Access level	Description
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

14. Faults and events

The occurrence of the fault is indicated by the red diode lighting up (Fig. 7.1). In the parameters from 0.70 to 0.79 you can read the history of recent failures. Table 14.1 lists the numbers of failures and events with their descriptions.

The faults reported by the battery charging module (inverters with the + BAT symbol) are separated from other failures - their description is presented in Table 14.2.

After a cause that could damage the inverter, the system goes into fault state. Depending on the setting of the par. 1.25:

a) par. 1.25 **„On/Off Restart" = 0** (turn off): the red LED will lighting up and the inverter will remain in a fault state until it is erased by the user,

b) par. 1.25 **„On/Off Restart" = 1** (turn on): the inverter will try to resume itself.
Explanation: the inverter after 10 seconds will automatically delete the error message and try to resume operation. In the situation when the same failure repeats three times, the inverter will go into fault state, remain in it until it is erased by the user and the red LED will be lighting up continuously on the display.

Table 14.1. List of fault and event codes of inverter

Fault No.	Fault / Event	Fault Description	How to fix it
0	No fault	Systems operate properly	-
1	Over-temperature	The heat sink temperature exceeded 85 ºC.	Check efficiency of ventilation. Wait until the device has cooled down.
2	Temperature sensor failure	Indications from the temperature sensor are incorrect	Contact the service.
10	CRC error	Invalid internal storage checksum.	Load default parameters, contact the 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	Grounding	Too high leakage current.	1. Check if the inverter is connected correctly. 2. Check the value of the insulation resistance.
21	Grounding	Sudden change the value of the leakage current.	

Fault No.	Fault / Event	Fault Description	How to fix it
30	High Udc voltage	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.
31	Too high U_IN1	Input 1 voltage too high	1. Check the configuration of electrical connection of photovoltaic panels (too many PV panels in series connection)
32	Too high U_IN2	Input 2 voltage too high	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.
36	Voltage ripples in the input voltage	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 source is sufficient or higher than the power of the 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	Check the installation for earth faults.
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 connecting the power wires.
60	High current - hardware failure	The amplitude of the current from the RESs or electrical grid has reached a value in excess of 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.	
62	High current on input 2	The amplitude of the input current at input 2 has exceeded the limit.	
65	Too high output current	The amplitude of the current send to the electric grid reaches a value exceeding the limit.	
66	Overload	Long-term value of the output current exceed the nominal current.	1. Check that 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 varistors has been detected.	Contact the service.

Fault No.	Fault / Event	Fault Description	How to fix it
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.	
73	Low -DC resistance	Too low resistance was detected between i-DC and 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	Erroneous data in the inverter's internal communication bus.	
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.
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	
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 voltage. 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.	
95	Uref limit	Electrical grid is no connected to the inverter – anty-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.	
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		

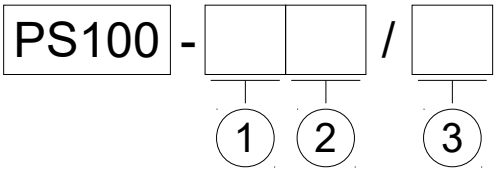
Fault No.	Fault / Event	Fault Description	How to fix it
403	ETHERNET_PHY_RESTART	Ethernet communication problem	1. Check the correctness of the internet connection. 2. Check the correctness of the Wi-Fi module settings. 3. Check if the Ethernet cable is connected properly. 4. Contact the service.
404	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		

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.

Table 14.2. List of fault codes of battery charger module

Fault No.	Fault type	Fault Description	How to fix it
1	High battery temperature	The battery temperature is higher than the value set in parameter 10.8.	1. Check the correct connection of the Pt100 sensor. 2. Check that the voltage at the battery terminals is correct.
3	High UDC	High voltage in the DC-link	Check the correct connection of renewable energy sources. *See failure No. 30 in Table 14.1 on page 43*.
4	Low battery voltage	Too low voltage at the battery terminals.	1. Check the battery connections are correct. 2. Check and compare the param setting. 10.7 with the minimum permissible voltage of the batteries used. 3. Charge the excessively discharged battery.
5	Short circuit	The hardware protection has registered a short circuit of transistors.	In case of repeated failure contact the device manufacturer.
6	High charging current	The current value is too high in battery charging mode.	1. Check the battery connections are correct. 2. Make sure the battery is functional. 3. In case of repeated failure, contact the device manufacturer.
7	High module temperature	Too high transistors temperature.	1. Check the heat sink for dirt, clean the heat sink if necessary. 2. Check the ambient temperature.
13	High battery voltage	Too high voltage at the battery terminals.	1. Check the battery connections are correct. 2. Check and compare the setting of par. 10.6 with the maximum permissible voltage of the batteries used
16	High discharging current	The current value is too high in battery discharge mode.	1. Check the battery connections are correct. 2. Pay attention to the type of electrical loads in terms of high power consumption.
23	High UDC: hardware failure	To high voltage in the DC-link.	Check the correct connection of renewable energy sources. *See failure No. 30 in Table 14.1 on page 43.*
26	High current: hardware failure	Output current too high.	1. Check the battery connections are correct. 2. Make sure the battery is functional. 3. In case of repeated failure, contact the device manufacturer.

15. Ordering information



1. Input type:
   - **PV** – photovoltaic:
     - 1 kW inverters has one MPPT input
     - 3 kW and 5.5 kW inverters have two MPPT inputs
   - **WT** – permanent magnet generator: one AC input
   - **H** – hybrid:
     - one photovoltaic input, max. 3 kW,
     - one permanent magnet generator input, max. 3 kW.

   Note: the total power of the connected sources must not exceed the rated power inverter
2. Built-in battery charger module:
   - „**without sign"** – not present
   - **+BC** - present
3. Power of inverter:
   - **1 kW**
   - **3 kW**
   - **5.5 kW**

Ordering examples:

PS100-PV/5,5kW: photovoltaic inverter 5,5 kW.
PS100-PV+BC/5.5kW: photovoltaic inverter 5.5 kW with built-in battery charger.
PS100-WT/5,5kW: wind/water turbine inverter 5,5 kW.
PS100-WT+BC/5,5kW: wind/water turbine inverter 5,5 kW with built-in battery charger.
PS100-H/5,5kW: hybrid inverter 5,5 kW with one 3 kW photovoltaic input and one 3kW generator input; total input power must not exceed 5,5 kW.
PS100-H+BC/5,5kW: hybrid inverter 5,5 kW (as above) with battery charger.

16. Warranty conditions

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

dtr-ps100-en-v13.12,0, 6/06/25

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:	**PS100**
Power range:	**1 kW ÷ 5,5 kW**

installed and used according to the User manual is conformity with the following directives and standards:

Directive 2014/35/UE: Low Voltage Directive (LVD)
Safety of power converters for use in photovoltaic power systems:

- **PN-EN 62109-1:2010**(1)
- **PN-EN 62109-2:2011**(1)

(1) Applicable for solar and hybrid (solar-wind) models only.

Directive 2014/30/UE: Electromagnetic Compatibility (EMC) Directive
Electromagnetic Compatibility (EMC) – Limits

- **PN-EN 61000-3-2:2014-10**
- **PN-EN 61000-3-3:2013-10**
- **PN-EN 61000-3-12:2012**

Electromagnetic Compatibility (EMC) – Generic standards

- **PN-EN 61000-6-1:2008**
- **PN-EN 61000-6-2:2008**
- **PN-EN IEC 61000-6-3:2008+A1:2012**
- **PN-EN IEC 61000-6-4:2008+A1:2012**

Directive 2011/65/EU: Restriction of the use of certain hazardous substances in electrical and electronic equipment (RoHS)

- **PN-EN IEC 63000:2019-01**

Standard PN-EN 50549-1:2019-02 for type A generating modules.

TWERD ENERGO-PLUS Sp. z o.o.
Oleksandr Skliar
Dyrektor ds. rozwoju i
stosunków międzynarodowych
Prokurent

Oleksandr Skliar
Director of Development and International Relations / Commercial Proxy

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: 2025-06-05

TWERD ENERGO-PLUS Sp. z o.o.

ul. Aleksandrowska 28-30
87-100 Toruń, Poland

tel: +48 56 654 60 91
e-mail: twerd@twerd.pl

www.twerd.pl

DESIGN – PRODUCTION – SERVICE