

Izradio (ili odgovoran) - Prepared (also subject responsible if other) ŽUM	Br - No. 1551 – INV2 1000VA48			
Odg.za dok/Odobrio - Doc respons/Approved VZD	Kontr - Checked	Datum - Date 15. 09. 2016.	Rev D	File ENG



Izradio (ili odgovoran) - Prepared (also subject responsible if other)	Br - No.		
ŽUM	1551 – INV2 1000VA48		
Odg.za dok/Odobrio - Doc respons/Approved	Kontr - Checked	Datum - Date	Rev
VZD		15. 09. 2016.	D
		File	ENG

DESCRIPTION OF INVERTER INV2 1000VA48

1. General

INV2 1000VA48 is a single phase DC/AC converter (Inverter) whose nominal input voltage is 48VDC and on its outputs gives a clean sine-wave voltage of 230VAC. It can run as an independent power unit or in parallel with other converters of the same type in order to increase the output power. Nominal output power is 1000VA. The maximum number of units that can be connected in parallel is 10 units, which gives the maximum nominal power of the energy plant of 10000VA. Converter performances are robust and allow a great strain on the current (2.5 times greater than the nominal power). Because of this, besides electronic equipment that need uninterrupted power supply, devices with the electric motor (household appliances, electric tools, electric equipment for ships and the like) can also be connected to it.

2. Basic technical features

- Sine wave form output voltage (THD \leq 2%)
- A high degree of efficiency (92%)
- Low consumption in idle (6W)
- Greatly allowed overload (2.5 x P nom)
- Parallel work **without signal synchronization connections**
- Connection and disconnection of parallel units during operation "HOT SWAP"
- Undervoltage battery protection
- Overload protection
- Short-circuit protection
- Overheating protection
- Local signaling state of the converter throughout luminous diodes
- Remote signaling by means of dry relay contacts
- Mounting in rack with 19" raster

3. Purpose

This converter is designed for uninterrupted power supply to sensitive electronic equipment in power systems with 48V batteries. Because of the low power consumption in idle and greatly allowed overload, it is ideal for use in solar power systems of universal purpose.

4. Mechanical construction

Inverter's casing is of the following dimensions: h = 120,5mm, w = 212mm d = 331,5mm. Inverter can run as an independent unit or as AC power source system with several units connected in parallel. Unit (units) have to be plugged in sub rack for achieving electrical connections. Cross-section and the length of the connecting cables must be designed in accordance with instructions for installation. Converters casing is mechanically customized for mounting in the 19" rack. For such installation a sub rack type BFLV 1002 is provided, which, except for mechanical fixation, has a function of inter-connecting the converter to 48VDC, 230VAC, and signal outputs. Sub rack is designed for a maximum of two converters, and for larger configurations more sub racks are connected in parallel.

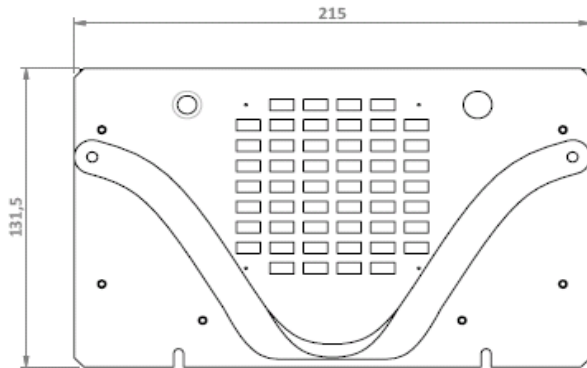
Izradio (ili odgovoran) - Prepared (also subject responsible if other) ŽUM	Br - No. 1551 – INV2 1000VA48
Odg.za dok/Odobrio - Doc respons/Approved VZD	Datum - Date Rev File 15. 09. 2016. D ENG

5. Inverter INV2 1000VA48 specifications

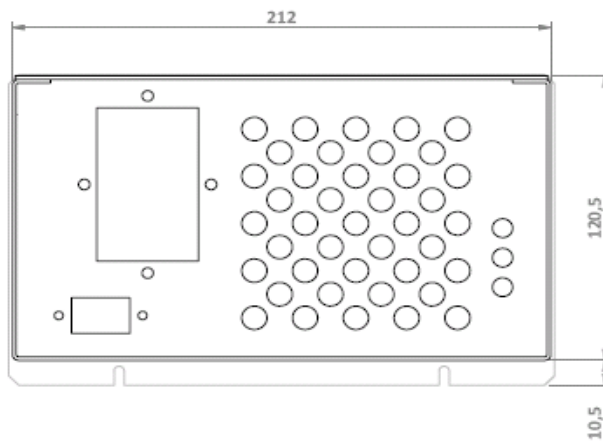
Nominal input voltage	48 Vdc
Allowed input voltage limit	42 Vdc-66 Vdc
Consumption in idle	6 W
Nominal input current	22 Adc
Nominal output power	1000 VA
Permitted overload (Tamb=25°C)	2000VA ; 30 min 2500VA ; 5 min
Maximum asymmetrical overload (half-wave)	500 VA
Output voltage	Sine Wave, 230Vac +/- 5%
Output voltage distortion at resistive load (THD)	≤ 2 %
Output voltage frequency	50Hz, +/- 0, 1 Hz
Nominal output current	4,35 A
Maximum output current in current limit	11,5 A
Peak output overload current (t = 1 sec)	20 A
Allowed power factor Cos φ	from – 0,0 capacitive to + 0.0 inductive
Power efficiency	92 %
Switch-on delay	5 sec
Battery undervoltage protection	42 Vdc - shutdown, 48 Vdc - re-engaging
Temperature protection	95 °C - shutdown 90 °C - re-engaging
Overload protection	Continuous current limit 11,5 A + Thermal protection
Short-circuit protection	Continuous current limit 11,5 A + Thermal protection
Operating temperature	from - 10°C, to + 40°C
Dimensions : h x w x d	120,5mm x 212mm x 331,5 mm
Weight	13 kg
Safety standards	HRN EN60950:2000
EMC - standards	HRN EN61000-6-2:2008 HRN EN 61000-6-4:2008

Izradio (ili odgovoran) - Prepared (also subject responsible if other)		Br - No.	
ŽUM		1551 – INV2 1000VA48	
Odg.za dok/Odobrio - Doc respons/Approved	Kontr - Checked	Datum - Date	Rev
VZD		15. 09. 2016.	D
			File
			ENG

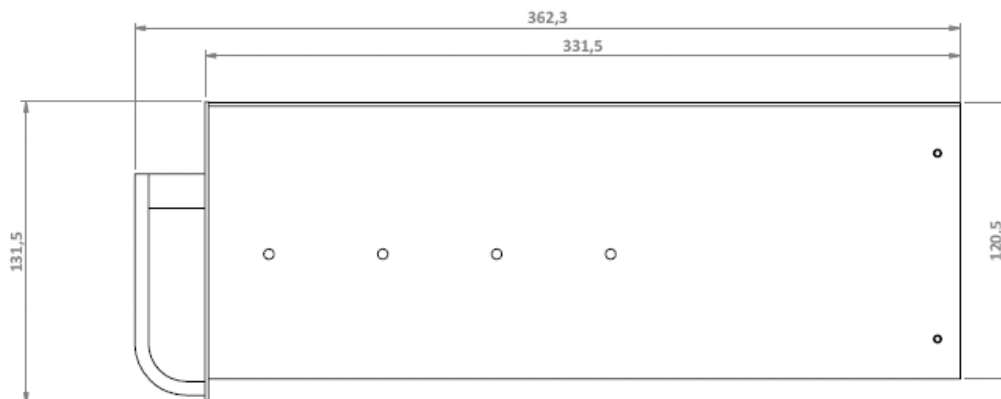
5.1 Front panel



5.2. Back panel



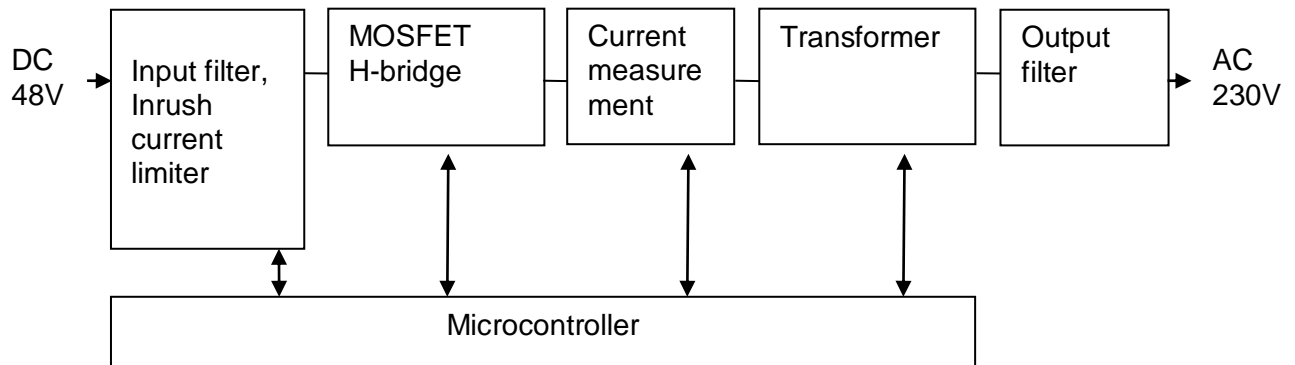
5.3. Side panel



Izradio (ili odgovoran) - Prepared (also subject responsible if other)		Br - No.	
ŽUM		1551 – INV2 1000VA48	
Odg.za dok/Odobrio - Doc respons/Approved	Kontr - Checked	Datum - Date	Rev
VZD		15. 09. 2016.	D
		File	ENG

6. Operation description of inverter

INV2 1000VA48 is a high frequency-processor-controlled DC / AC converter whose block scheme is shown in the picture below.



On the input stage of the inverter there is a capacitive filter and MOSFET for inrush current limiting. With MOSFET H-bridge, dc voltage 48V is PWM modulated and commuted to get sine curve shape. Transformer galvanically separates battery voltage from output voltage and transforms it into 230Vac. It is also used for current and voltage measurements, for regulation purposes. Regulation of the parameters is done through the microprocessor which compares all measured parameters with the reference parameters. Output filter "cleans" the sine curve from voltage higher harmonics so we would get a clean sinus on the inverter output. Input voltage is galvanically separated from output, and from device housing. Output voltage is floating, which means that the phase and neutral are separated from the bonding potential. Connector for the 230Vac is three-pined and has a protective bonding connection which is connected to device housing, so it should be connected to the main bonding of the building.

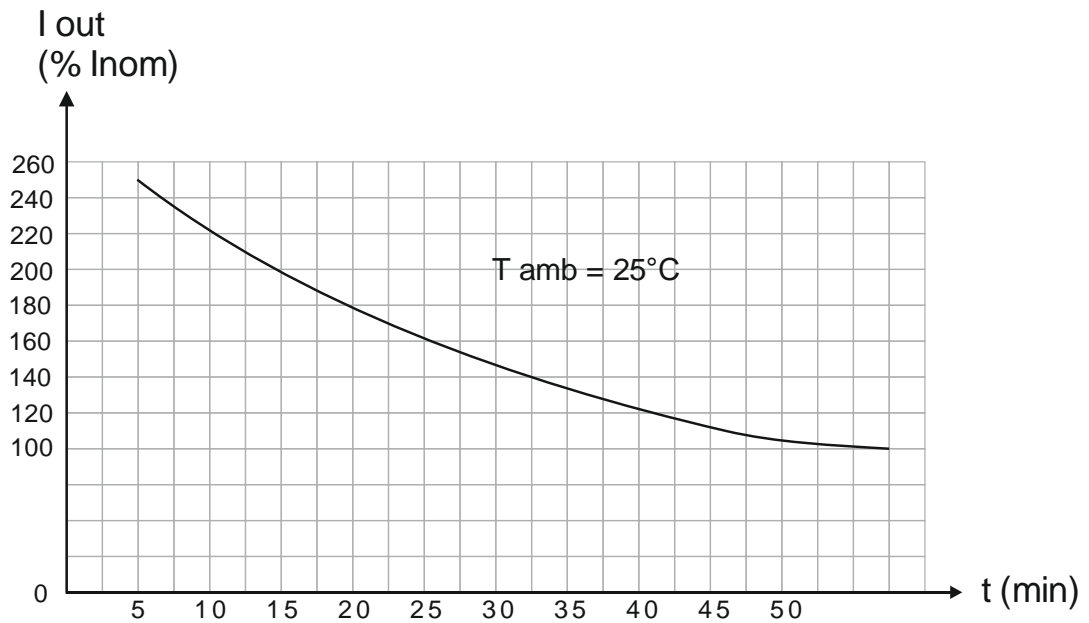
Parallel work of several converters is achieved without synchronization connections (synchronization BUS). Sharing of the output current (load) parallel-connected inverters is due to U - I characteristic slope, thanks to which the power is shared with an accuracy of 10 % of difference between the individual inverters. Additional regulation of load sharing at higher output current is achieved with output voltage regulation according to the temperature inside the inverter (U - T feature). In this way we get a uniform thermal load of all the converters connected in parallel. Frequency synchronization is performed physical in the same way as the synchronization of electromechanical generator of the parallel-connected power system. The occurrence of phase shift causes the appearance of reactive power which equalizes them by frequency.

6.1. Methods of protection

- a) Reverse input polarity protection;
It is derived with the internal fuse which in the case of the swaped polarity burns out and the converter must be returned for repair to the manufacturer.
- b) Input protection from inrush current switching;
Semiconductor valve at the entrance of the inverter limits the inrush current to 20 A.

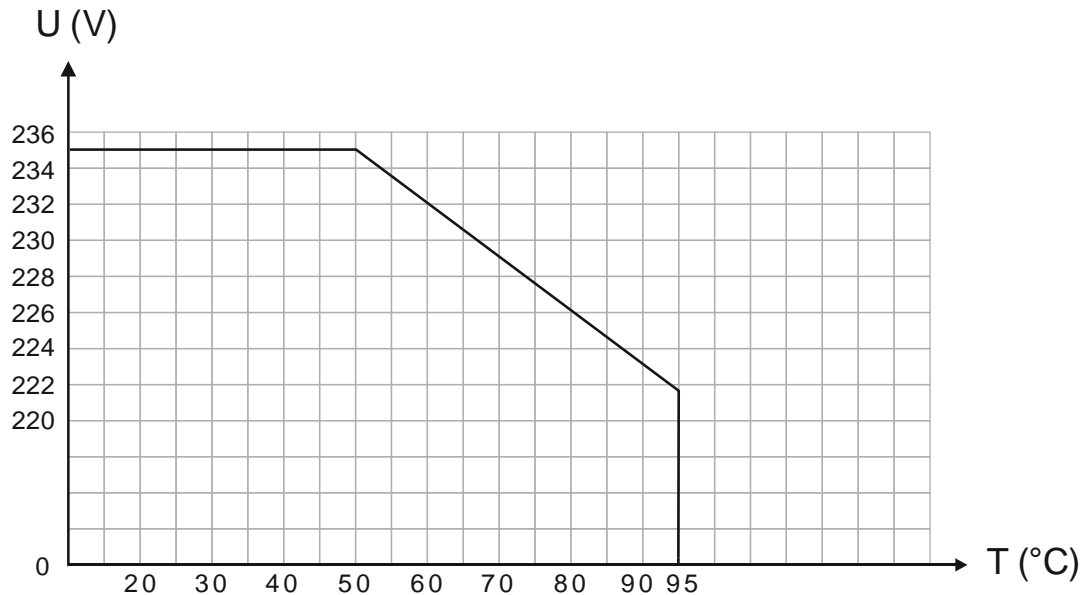
Izradio (ili odgovoran) - Prepared (also subject responsible if other)		Br - No.	
ŽUM		1551 – INV2 1000VA48	
Odg.za dok/Odobrio - Doc respons/Approved	Kontr - Checked	Datum - Date	Rev
VZD		15. 09. 2016.	D
		File	ENG

- c) Deep discharge battery protection;
At the input of the inverter there is a monitor for battery voltage supervision, which when the voltage drops to 42VDC turns off the device and starts it up again when the input voltage exceeds 48VDC .
- d) Overvoltage protection on input;
The built-in voltage monitor switches off the drive when the input voltage exceeds 66VDC and turns it on again when the voltage is reduced to 60VDC .
- e) Over-temperature protection;
Temperature monitor measures the temperatures of the power components in the inverter. When one of the measured temperatures exceeds 95°C the inverter switches off and turns back on automatically when the temperature drops below 90°C. Allowed overload duration is determined by over-temperature protection and the current ambient temperature. Dependence of allowed current overload and time is shown by curve (S - t characteristics) .

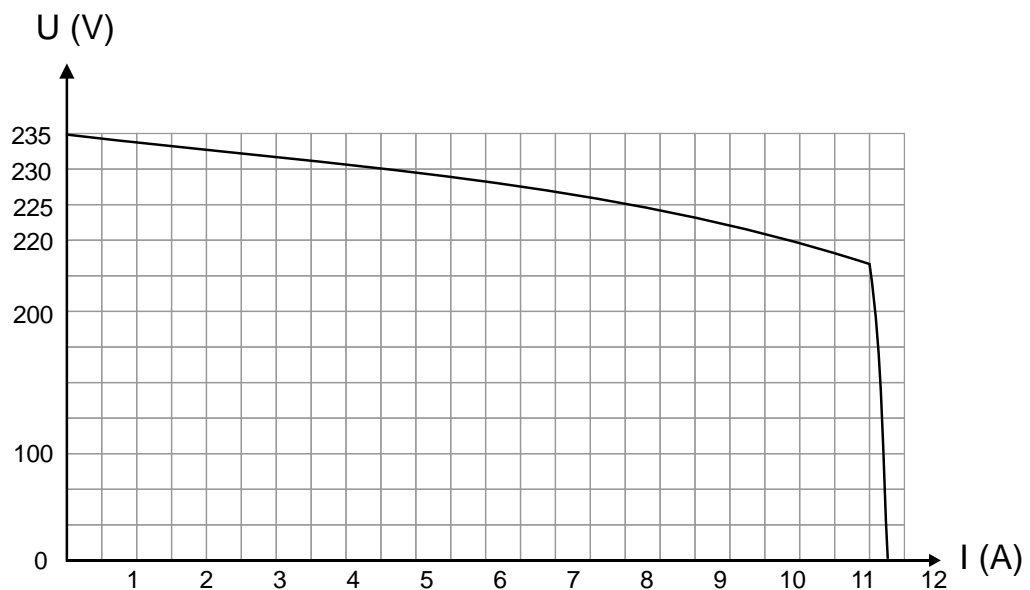


Izradio (ili odgovoran) - Prepared (also subject responsible if other)		Br - No.	
ŽUM		1551 – INV2 1000VA48	
Odg.za dok/Odobrio - Doc respons/Approved	Kontr - Checked	Datum - Date	Rev
VZD		15. 09. 2016.	D
		File	ENG

In addition to overload protection, the temperature sensor also has a role of regulating the voltage in parallel operation of several inverters . With temperature increase the output voltage is reduced and current is taken over by other parallel connected inverters so that the load is symmetrically divided . The dependence of the output voltage of the temperature is shown in the curve (U - T characteristics) .



- f) Overload and short-circuit protection on the output;
 The converter can be current overloaded according to data from the table of technical data , and that means with a maximum of $2,5 \times P_{nom}$ (2500VA) , for 5 minutes . Output current protection is set to 11.5 A , with the possibility of short-term overload of 20 A for 1 second. After 1 second current is reduced to 11,5 A and remains at that value until the termination of the overload or short circuit. The dependence of the output voltage and the output current is shown in the curve (U - I characteristics) .

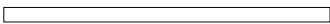







Izradio (ili odgovoran) - Prepared (also subject responsible if other) ŽUM		Br - No. 1551 – INV2 1000VA48	
Odg.za dok/Odobrio - Doc respons/Approved VZD	Kontr - Checked	Datum - Date 15. 09. 2016.	Rev D
		File ENG	


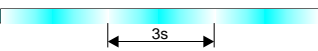

6.2. Signalling

- a) Local signalling, visible on the front panel of the inverter, is derived using two light diodes whose functions are shown in tables below:

LED INDICATOR D1

STATE OF LED INDICATOR		STATE OF INVERTOR
indicator «off»		inverter «off»
indicator «on» constant - green		normal operation
indicator flickers: - 0,5 sec green - 0,5 sec «off»		I_{out} > 4,35 A I_{out} < 11,5 A
indicator flickers: - 0,5 sec green, - 0,5 sec red		I_{out} ≥ 11,5 A
indicator flickers: - 0,9 sec green - 0,1 sec red		input voltage outside nominal range U_{in} > 66 V U_{in} < 42V
indicator «on» constant - red		over-temperature protection T > 95°C

LED BUTTON







STATE OF LED INDICATOR 		STATE OF INVERTER
indicator gradually turns «on» and «off»		inverter «off»
indicator is constantly «on»		inverter «on»

Izradio (ili odgovoran) - Prepared (also subject responsible if other)		Br - No.	
ŽUM		1551 – INV2 1000VA48	
Odg.za dok/Odobrio - Doc respons/Approved	Kontr - Checked	Datum - Date	Rev
VZD		15. 09. 2016.	D
		File	ENG

b) Remote signalling of inverter faults:

The inverter has a built-in relay for signalling errors . Its contacts are connected via a connector to the magazine onto the terminal blocks labeled : NC - C - NO . These contacts are potential-free and galvanically isolated from the input and output voltage , and are sized for the maximum voltage of 60 V and a current of 100 mA . Its function are shown in the table below:

RELAY OUTPUT (EXTERNAL FAULT SIGNALLING)

STATE OF RELAY OUTPUT		STATE OF INVERTOR
NC  C  NO 	C - NC = 1 C - NO = 0	normal operation
NC  C  NO 	C - NC = 0 C - NO = 1	fault <ul style="list-style-type: none"> * $I_{out} \geq 11,5 A$ * input voltage outside nominal range $U_{out} > 66 V$ $U_{out} < 42V$ * over-temperature protection $T > 95^{\circ}C$

7. Assembly, connection and commissioning
7.1 Safety guidelines

- When handling the device there is a risk of electric shock, so installation and connecting must be carried out only by qualified personnel.
- The device is not to be installed in locations with high humidity (more then 90%).
- The device is not to be installed in locations exposed to high temperatures ($\geq 45^{\circ}C$), direct sunlight and open flames.
- When installing the device, leave minimum of 5 cm of space in front and in the back of the device for the ventilation purposes.
- Output connector (230VAC) is three-poled, has a protective grounding connected to the chassis of the inverter and must be connected to the main earthing point of the facility.

Izradio (ili odgovoran) - Prepared (also subject responsible if other)		Br - No.	
ŽUM		1551 – INV2 1000VA48	
Odg.za dok/Odobrio - Doc respons/Approved	Kontr - Checked	Datum - Date	Rev
VZD		15. 09. 2016.	D
		File	ENG

7.2 The process of connecting and switching on and off the inverter

7.2.1 Fit magazines BFLV 1002 in a cabinet with 19" grid.

7.2.2 Perform wiring of the magazine: 48 Vdc, 230Vac and signalling if necessary.

Dimensions of connecting cables:

48 Vdc = 35 mm² (AWG 2), with a protective element (circuit breaker) of 125 A

230 Vac = 2,5 mm² (AWG 14)

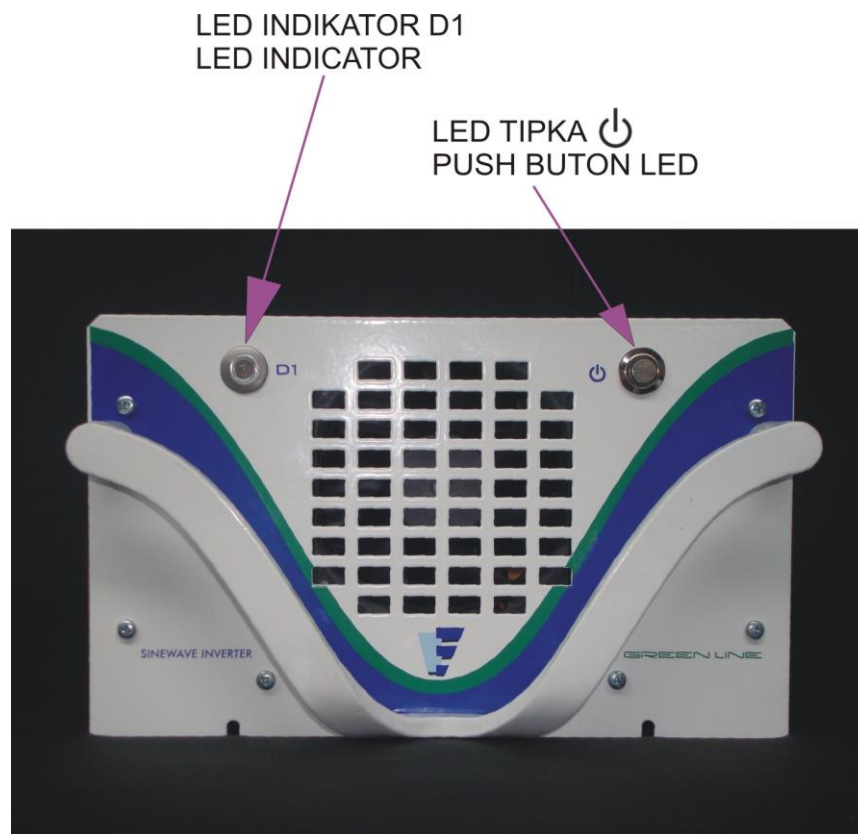
7.2.3 Turn on the input circuit breaker

7.2.4 Insert the inverter into the magazine, the inverter turns on automatically after a time delay of 5 seconds.

7.2.5 Turning off is preformed by holding the "⏻" button for 3 seconds.

7.2.6 Re-activating is preformed by holding the "⏻" button for 1 second.

Front side of the inverter



Izradio (ili odgovoran) - Prepared (also subject responsible if other)		Br - No.	
ŽUM		1551 – INV2 1000VA48	
Odg.za dok/Odobrio - Doc respons/Approved	Kontr - Checked	Datum - Date	Rev
VZD		15. 09. 2016.	D
		File	ENG

Back side of the inverter

