



PSBEN 5012D/LCD

v.1.0

PSBEN 13,8V/5A/40Ah/EN/LCD **Buffer, switched mode power supply unit.**

EN

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BLACK POWER



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Features:

- PN-EN50131-6 compliance, grades 1÷3 and II environmental class
- mains supply of 230VAC
- uninterrupted voltage of 13,8VDC
- fitting battery: 40Ah/12V
- high efficiency 70%
- PSU current efficiency:
 - 2,8A – for grades 1 , 2 *
 - 1,33A – for grades 3 **
 - 5A – for general use ***
 (see: chapter 2.1)
- low level of voltage ripple
- microprocessor-based automation system
- intelligent management of PSU power's output stage
- 'SERIAL' communication port with implemented MODBUS RTU protocol
- remote monitoring (option: WiFi, Ethernet, RS485, USB)
- free program - 'PowerSecurity' for monitoring the PSU operation parameters
- load current control
- output voltage control
- output fuse status control
- dynamic battery test
- battery circuit continuity control
- battery voltages control
- battery fuse status control
- battery charge and maintenance control
- deep discharge battery protection (UVP)
- battery overcharge protection
- battery output protection against short circuit and reverse polarity connection
- jumper selectable battery charging current
0,6A/1,5A/2,2A/3A
- remote battery test (additional module required)
- START button for battery activation
- STOP button for disconnecting during battery-assisted operation
- optical indication – LCD panel
 - electrical parameters reading, e.g.: voltage, current
 - failure indication
 - PSU settings adjusted from the panel's level
 - 3 levels of access, password-protected
 - PSU's operation history
 - failure history
 - real-time clock, battery-backed
- optical indication of PSU overload OVL
- acoustic indication of failure
- adjustable times indicating AC power failure
- technical inputs/outputs with galvanic isolation
- collective failure input EXT IN
- EPS technical output indicating AC power loss
- PSU technical output indicating PSU failure
- APS technical output indicating battery failure
- internal memory of PSU operating status
- protections:
 - SCP short circuit protection
 - OLP overload protection
 - OHP overheat protection
 - OVP over voltage protection
 - surge protection
 - against tampering: unwanted opening of the enclosure or detachment from the mounting surface
- convectional cooling
- warranty – 5 year from the production date

1. Functional requirements of the PSU compliant with PN-EN 50131-6.

Functional requirements	Requirements of PN-EN 50131-6			PSBEN5012D/ LCD
	Grade 1	Grade 2	Grade 3	
EPS network absence	YES	YES	YES	YES
Battery low voltage	YES	YES	YES	YES
Protection against full battery discharge	-	-	YES	YES
Battery fault	-	-	YES	YES
No battery charge	-	-	YES	YES
Output low voltage	-	-	YES	YES
Output high voltage	-	-	YES	YES
PSU fault	-	-	YES	YES
Surge protection	-	-	YES	YES
Short circuit protection	YES	YES	YES	YES
Overload protection	YES	YES	YES	YES
Output fuse activation	-	-	-	YES
Battery fuse fault	-	-	-	YES
EPS technical output	YES	YES	YES	YES
APS technical output	YES	YES	YES	YES
PSU technical output	YES	YES	YES	YES
Collective failure input	-	-	-	YES
Remote battery test	-	-	-	YES
Tamper resistance – enclosure opening	YES	YES	YES	YES
Tamper resistance – detachment from the mounting surface	-	-	YES	YES

2. Technical description.

2.1. General description.

The buffer power supply has been designed in accordance with the requirements of the PN-EN 50131-6 standard, grade 1÷3 and II environmental class. It is intended for an uninterrupted supply to alarm system devices requiring stabilized voltage of 12V/DC (+/-15%).

Depending on a required protection level of the alarm system in the installation place, the PSU efficiency and the battery charging current ought to be measured as follows:

* Grade 1, 2 - standby time 12h

Output voltage 2,8A + 2,2A battery charge

** Grade 3 - standby time 30h if the faults of the main power source are reported to the Alarm Receiving Centre - ARC (in accordance with 9.2 – PN-EN 50131-1).

Output voltage 1,33A + 3A battery charge

- standby time 60h if the faults of the main power source are reported to the Alarm Receiving Centre - ARC (in accordance with 9.2 – PN-EN 50131-1).

Output voltage 0,66A + 3A battery charge

*** General use – if the PSU is not mounted within an installation which is PN-EN-50131 compliant, the acceptable current efficiency amounts to:

1. Output voltage 5A (without battery)

2. Output voltage 4,4A + 0,6A battery charge

3. Output voltage 3,5A + 1,5A battery charge

4. Output voltage 2,8A + 2,2A battery charge

5. Output voltage 2A + 3A battery charge

Total current of the receivers + battery: 5A max.

In case of power decay, a battery back-up is activated immediately. The PSU is housed in a metal enclosure (colour: RAL 9005 - black) which can accommodate a 40Ah/12V battery. It features a micro switch that indicates unwanted door opening (faceplate) and detaching from the mounting surface.

2.2. Block diagram.

The PSU has been manufactured based on a high-duty system of DC/DC converter. It features a microprocessor-based operation control, responsible for full diagnostics of the PSU and battery parameters.

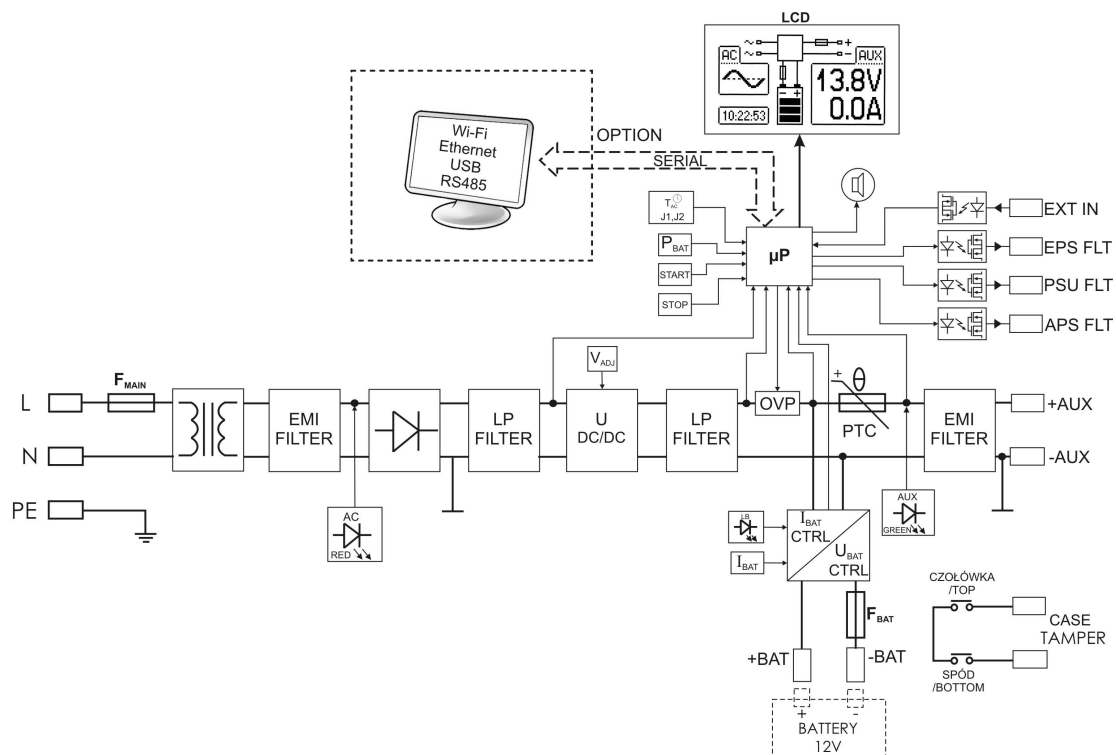




















Fig. 1. Block diagram of the PSU.

2.3 Description of PSU's components and connectors.

Table 1. Elements of the PSU pcb (see Fig. 2).

Element no.	Description
[1]	PANEL – optical indication connector
[2]	P_{BAT} – jumper; idle in this model T_{AC} – jumpers J1, J2; idle in this model <i>CAUTION. In this model, jumpers are operated from the LCD desktop's level (see: chapter 3.4.2).</i>
[3]	I_{BAT} – battery charging current selection J1=  , J2=  J3=  I _{BAT} =0,6 A J1=  , J2=  J3=  I _{BAT} =1,5 A J1=  , J2=  J3=  I _{BAT} =2,2 A J1=  , J2=  J3=  I _{BAT} =3,0 A Caption:  jumper on,  jumper off
[4]	START – button (launching the PSU from a battery) STOP – button (disconnection of the PSU during battery-assisted operation)
[5]	«)) – pin; activation of acoustic indication  - indication on  - indication off Caption:  jumper on,  jumper off
[6]	V_{ADJ} – potentiometer, DC voltage adjustment
[7]	BUZZER – acoustic indicator
[8]	F_{BAT} – fuse in the battery circuit
[9]	Connectors: ~AC~ – AC power input +BAT – DC power battery output +AUX – DC power output (+AUX= +U, -AUX=GND) EPS FLT – technical output of AC network absence indication open = AC power failure close = AC power - O.K. PSU FLT – technical output of PSU failure open = failure close = PSU working correctly - O.K. APS FLT – technical output of battery failure open = battery failure close = battery O.K. EXT IN – output of collective failure
[10]	V_{EXT} pin – polarisation of EXT IN circuit
[11]	Communication connector
[12]	LEDs – optical indication: AC – presence of the AC power AUX – DC output voltage OVL – PSU overload PSU – PSU failure APS – battery failure EXT – EXT IN output's status LB – battery charge
[13]	OVP – optical indication for activating the over voltage system

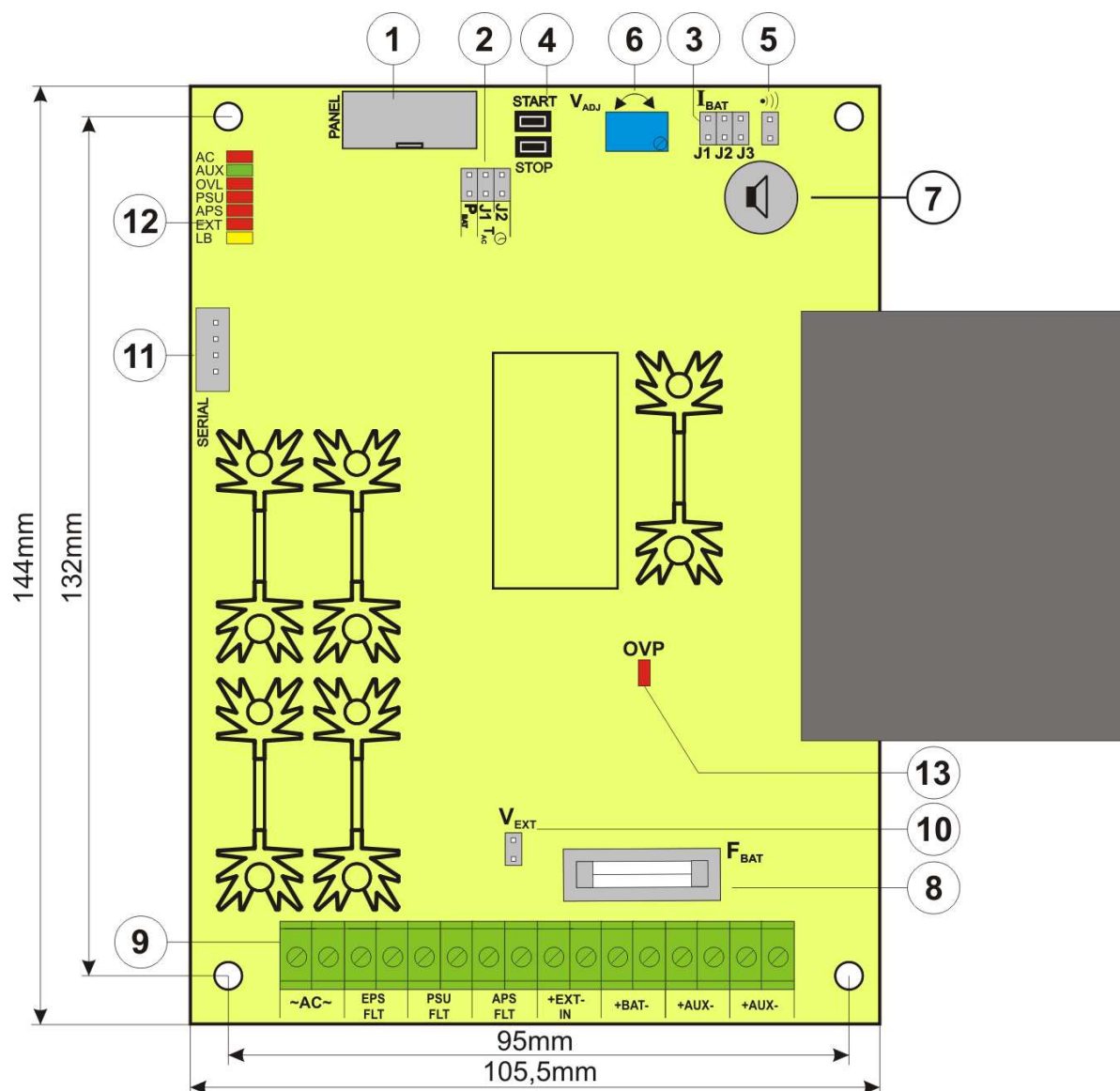



Fig. 2. The view of the PSU's pcb.

Table 2. PSU elements (see fig. 3).

Element no.	Description
[1]	Insolation transformer
[2]	PSU board (tab.1, fig.2)
[3]	TAMPER ; micro-switch (contacts) of tamper resistance (NC)
[4]	F_{MAIN} fuse in the supply circuit (230 V AC)
[5]	L-N 230V/AC power connector,  PE connector
[6]	Battery connectors: positive: +BAT = red, negative: - BAT = black
[7]	Grip of tamper resistance

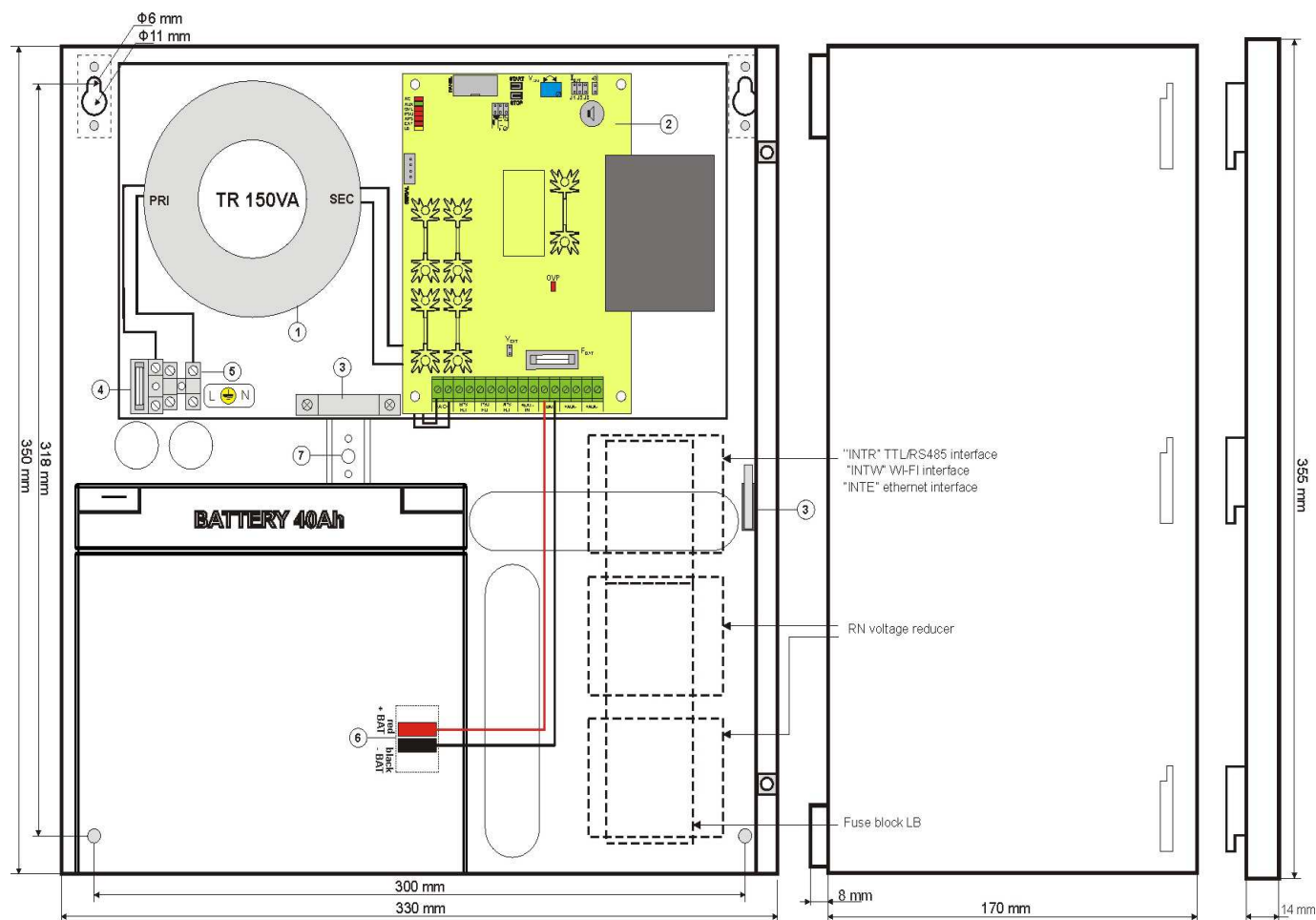


Fig.3. The view of the PSU.

3. Operating status indication.

3.1. Control panel.

The PSU is equipped with a panel with buttons and an LCD display which enables reading all available parameters of the device. The buttons are for selecting and approving a certain parameter that is to be displayed.

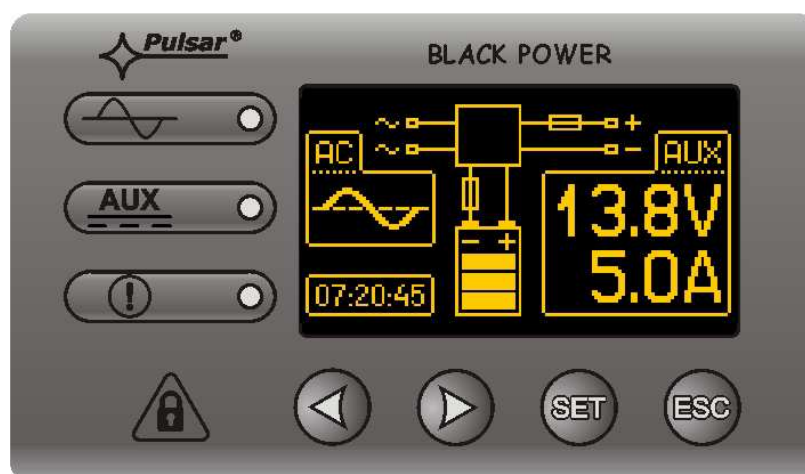
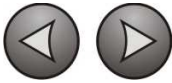







Fig. 4. The control panel.

Table 3. A description of buttons and LEDs of the LCD panel.

	- move the cursor on the display
	- selection approval
	- leaving the editing mode without changing the values - entering the overview menu mode
	- red LED indicating the presence of AC voltage
	- green LED indicating power at the AUX output of the PSU
	- red LED indicating the PSU failure



The resolution for voltage measurement amounts to 0.1V, for current measurement: 0.1A. Displayed voltage and current rate is only approximate. For higher accuracy, a multimeter shall be used.

3.2. Main screen of the LCD display.

The main screen of the LCD display shows basic electrical parameters and informs about the current PSU state.

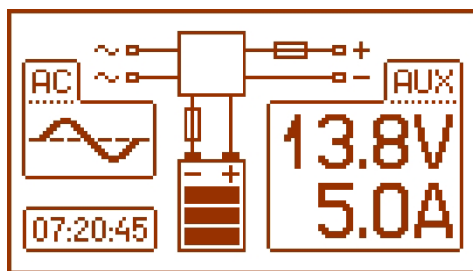










Fig. 5. The main screen.

Table 4. Description of the symbols on the main screen.

Screen field	Description
	Information about the current AC power status. - AC power present
	- no AC power
	Information about the present voltage at the AUX output and the current consumption. In case of a failure tripped by incorrect output voltage or exceeding the load current, an appropriate parameter twinkles on the display.
	Information about the battery charging level. In case of a failure, the battery symbol twinkles.
	A field symbolising the PSU.
	In case of a PSU failure, a twinkling symbol with an exclamation mark appears.
	Fuse symbol. Twinkling symbol informs about activation of the fuse.
	Clock

3.3 Information displayed on the panel.

3.3.1. Overview menu.

After pressing the 'ESC' button, an overview menu appears at the bottom of the display. It enables choosing one of three available PSU screens:



- parameters of the PSU



- history of the PSU's parameters



- history of events

In order to choose a proper screen, select a dedicated field by pressing the arrow buttons: '<' or '>'. Then, approve by pressing the SET button.



Fig. 6. Overview menu.

3.3.2 Screen – parameters of the PSU.

The screen displays electrical parameters and the technical outputs' status during operation. Highlighting of an element informs about an active state and reflects the status of LEDs on the pcb of the PSU. (see table 1, [12]).

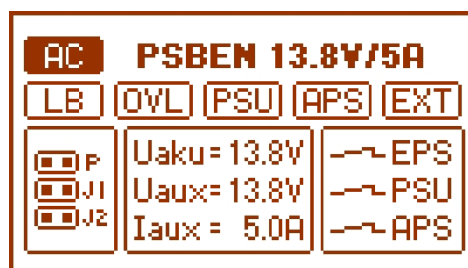



Fig. 7. Screen – parameters of the PSU.

Table 5. Description of the symbols on the screen – parameters of the PSU.

Screen field	Description
AC	- Indicates presence of AC power (highlighted = AC power present)
LB	- Indicates battery charging process (highlighted = charging in process)
OVL	- Indicates the PSU's overload (highlighted = PSU overloaded)
PSU	- Indicates the PSU's failure (highlighted = failure of the PSU)
APS	- Indicates the battery failure (highlighted = failure of the battery)
EXT	- Indicates the EXT IN input status (highlighted = EXT IN input is active)
Uaku = 13.8V Uaux = 13.8V Iaux = 5.0A	Current electrical parameters of the PSU: Uaku – battery voltage Uaux – output voltage Iaux – output current

	PSU technical outputs' status: EPS – AC network presence indication open = AC power failure close = AC power - O.K. PSU – PSU failure indication open = failure close = PSU working correctly - O.K. APS – battery failure indication open = battery failure close = battery O.K.
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3.3.3 Screen – history of the PSU's parameters.

During normal operation the PSU records the electrical parameters delivered to the AUX output and saves them in its non-volatile memory. The saving occurs every 5 minutes and the internal memory can store up to about 6100 values. The memory works in a circular cycle. When the memory becomes fulfilled, the oldest entries get replaced with the newest ones.

The screen of the parameters history enables reading of the stored parameters and scanning the values on a chart. The screen features a time axis, located horizontally in the bottom part of the chart, and the axis of a selected parameter – located vertically in the left part. The cursor can be moved into various time points via '<' and '>' buttons. For each time point, the corresponding value in can be read.

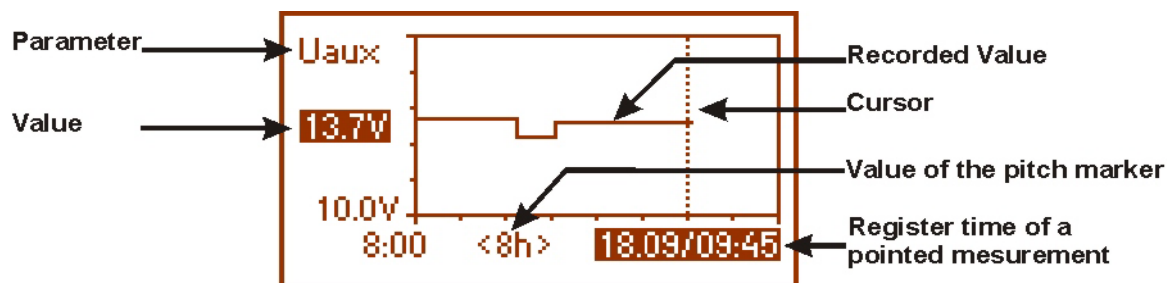


Fig. 8. Screen of the history of PSU's parameters.

From the given chart entries, the values of the following parameters can be read:

- **Uaux** - output voltage (approximate value within 5 minute period)
- **Uaux max** - maximum output voltage
- **Uaux min** - minimum output voltage
- **Iaux** - output current (approximate value within 5 minute period)
- **Iaux max** - maximum output current
- **Iaux min** - minimum output current

For optimal reading and analysis of the values shown on the chart, the time range of the chart screen can be adjusted in the bottom axis. Here are the available ranges:

<8h>

<24h>

<2days>

<week> (weekly)

In order to change the displayed parameter, highlight its name by pressing the 'SET' button. Then, with the '<' and '>' buttons choose the requested measurement. Pressing the 'SET' button again will highlight the time range of the chart, which can be changed with the '<' and '>' buttons. Another pressing of the 'SET' button will enable moving the cursor (vertical dotted line on the chart) along the time line with the '<' and '>' buttons. The values of currently chosen parameter and the register time pointed by the cursor will also be highlighted,

3.3.4 Screen – failure history.

If any incorrect electrical parameters appear during the operation, the PSU will begin indicating the failure by cyclical switching on and off the LCD display illumination, illuminating the failure LED on the panel and activating the acoustic indication (provided, it has not been switched off).

The screen of the PSU failure history enables overviewing the events recorded by the internal diagnostic system. The memo can store over 2000 events carrying information about the fault type, time of occurrence and values of the voltages or load current. Additionally, on the basis of the stored parameters, the diagnostic system assigns the fault code characteristic for a particular event.

The operation history can be previewed by pressing '<' or '>'. It can be done in two modes: short (date, time, code, fault description) or full - with additional information about values of voltages and current, and status of inputs and outputs. Switching between the modes is to be done by the 'SET' button.

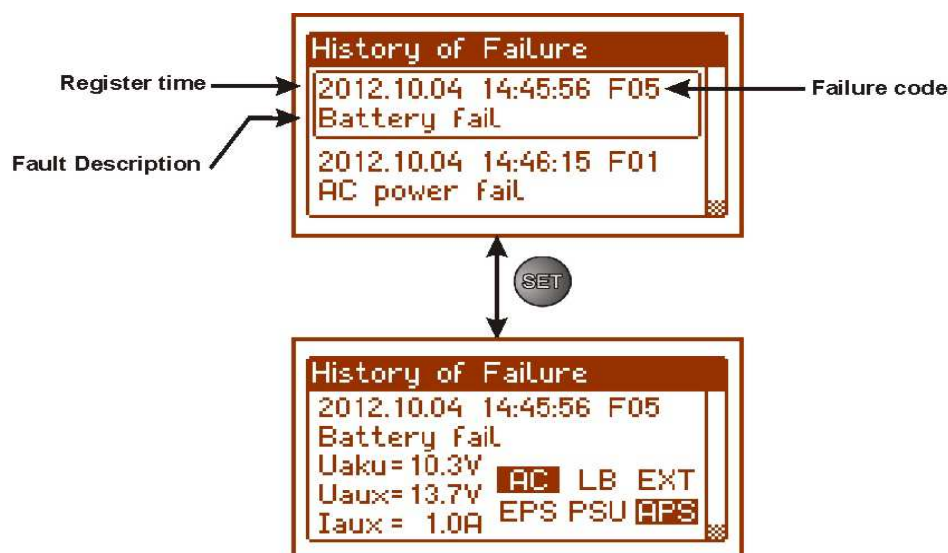


Fig. 9. Failure history screen.

In chapter 9, there have been listed codes of all possible failures that may occur during the PSU operation. Each code is accompanied by appropriate optical indication on the panel, acoustic indication and activation of a dedicated technical output.

3.4 PSU settings.

From the desktop's level, the configuration of the PSU settings is possible. To enter the adjustment mode, press the 'SET' button from the main screen's level.



Fig .10. Window of the PSU settings.

3.4.1 Password of access.

The PSU operates 3 levels of access to configuration which limit the possibility of changing the PSU's settings from the level of the LCD desktop. They are protected with separate passwords.

- Keypad password** – locks the access to buttons of the LCD desktop, only an idle screen is visible. In this mode, pressing any button causes a password demand.
- User password** – allows access to the desktop's settings
- Installer password** – full access to the PSU's settings

The option with the keypad password appears on the screen only after entering the correct user or installer password.

Table 6. Ranges of access.

	Access range		
	Buttons	'Desktop' Settings	'PSU' Settings
PASSWORD			
KEYPAD	•	-	-
USER	•	•	-
INSTALLER	•	•	•



Preset passwords:

- keypad password – ____ (none)
- user password – 1111
- installer password – 1234

Entering the password.

- set menu with '>' or '<' **Password (enter/change)**

Settings	
Password (Enter/Change)	
About Manufacturer	



- press the 'SET' button,
another window with available levels of passwords will appear

Password (Enter/Change)	
User	Enter
Service	Enter



- with '>' or '<' choose the right level of the password

Password (Enter/Change)	
User	Enter
Service	Enter



- confirm your choice with the 'SET' button

- with '>' or '<' enter the first digit

Service	0***<	▶	0...9	◀
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- confirm your choice with the 'SET' button



- with '>' or '<' enter the second digit

Service	*0***<	▶	0...9	◀
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- confirm your choice with the 'SET' button



- with '>' or '<' enter the third digit

Service	**0***<	▶	0...9	◀
---------	---------	---	-------	---

- confirm your choice with the 'SET' button



- with '>' or '<' enter the fourth digit

Service	***0***<	▶	0...9	◀
---------	----------	---	-------	---

- confirm your choice with the 'SET' button



Password (Enter/Change)	
Keyboard	Change
User	Enter
Service	Change

If the typed password is incorrect, the following message will appear:



Fig. 11. The message after entering a wrong keypad password.



If none of the buttons is pressed within the next 30 seconds, the PSU settings will be locked automatically.

Password change.

After entering the correct password, it is a possibility to change it. Choose the password that will be altered and enter the new one.

Skipping the access password.

If the password of access to the PSU's settings is not required, it can be skipped by typing '0000' as a new password.

Keypad password "0000" unlocks the access to the keypad.

User password "0000" unlocks the access from the user's level.

Installer password "0000" unlocks the access from the installer's level.

Erasing passwords.

If by any chance, the passwords have been lost, there is a procedure that will allow reassigning the passwords.

Please, do as follows:

- unplug the PSU from the AC network and the battery for at least 10 seconds
- press the STOP button on the pcb of the PSU
- plug in the PSU to the AC power and the battery while having the button pressed for another 10 seconds
- the PSU will display the message: "Access unlocked"
- confirm by pressing the 'SET' button
- go to menu "Settings -> Password" and change the passwords into new ones



If none of the buttons is pressed within the next 30 seconds, the PSU settings will be locked automatically.

Keypad password.

If the keypad has been locked due to the access password, the activation of the keypad access will occur after minimum 30 seconds of not pressing any buttons on the desktop. After this time, pressing any button on the desktop will display a window with a password demand. The password is to be entered using '<' or '>' as it has been explained above.

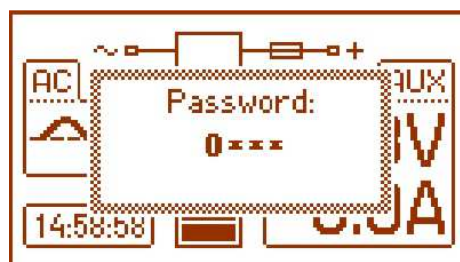


Fig. 12. Keypad password demand.

3.4.2 PSU.



The facility is only available after entering the correct installer's password.

Selecting the "PSU" entry in the setting menu enables entering another menu from which the full PSU's settings configuration is possible. After entering the right settings, they are stored in non-volatile memo which protects the PSU against data loss in case of a failure of mains power decay.

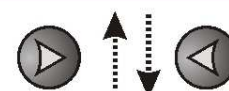


Fig. 13. 'PSU' screen

Table 7. Description of the 'PSU' screen.

Entry	Description
Battery present	YES – battery connected to the PSU NO – battery not connected to the PSU (see chapter 4.6)
Battery test	YES – battery test on NO – battery test off (see chapter 4.3)
Battery protection	YES – battery protection function (disconnection) on NO – battery protection function (disconnection) off (see chapter 4.2)
EPS output lag	Adjustable time lag of AC power failure indication: 5s/2min 20s/17min/2h20min
Communication address	1÷ 247 PSU address required during the communication with the computer
Transmission	Defines the speed and protocol of communication 9.6k 8N2 9.6k 8E1 9.6k 8O1 19.2k 8N2 19.2k 8E1 (factory settings) 19.2k 8O1

Setting the battery presence.



- with '>' or '<' choose the **Battery presence** menu

- press the "SET" button, you will see the prompt at the end of the line

- with '>' or '<' set 'YES' or 'NO'
YES – if the battery is connected to the PSU
NO – if the battery is not connected to the PSU

- confirm your choice with the 'SET' button

Setting the battery test.

- with '>' or '<' choose the **Battery test** menu

- press the "SET" button, you will see the prompt at the end of the line

- with '>' or '<' set 'YES' or 'NO'
YES – battery test on
NO – battery test off

- confirm your choice with the 'SET' button

Setting the battery protection.

- with '>' or '<' choose the **Battery protection** menu

Battery Present **NO**<

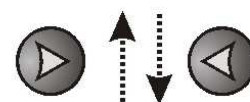


Battery Present **YES**<



Battery Present **YES**

Power Supply
 Battery Present **YES**
 Battery Test **YES**
 Battery Protect. **NO**
 EPS Output Delay



Power Supply
 Battery Present **YES**
 Battery Test **YES**
 Battery Protect. **NO**
 EPS Output Delay



Battery Test **YES**<



Battery Test **NO**<



Battery Test **NO**

Power Supply
 Battery Present **YES**
 Battery Test **YES**
 Battery Protect. **YES**
 EPS Output Delay



- press the "SET" button, you will see the prompt at the end of the line

- with '>' or '<' set 'YES' or 'NO'

YES – battery protection function (disconnection) on

NO – battery protection function (disconnection) off

- confirm your choice with the 'SET' button

Power Supply	
Battery Present	YES
Battery Test	YES
Battery Protect.	YES
EPS Output Delay	

SET

Battery Protect.	YES<
------------------	------

YES
NO

Battery Protect.	NO<
------------------	-----

SET

Battery Protect.	NO
------------------	----

Setting the EPS output lag.

- with '>' or '<' choose the **EPS output lag** menu

Power Supply	
Battery Protect.	NO
EPS Output Delay	17 min
Comm. Address	1

↑
↓

Power Supply	
Battery Protect.	NO
EPS Output Delay	17 min
Comm. Address	1

- press the "SET" button, you will see the prompt at the end of the line below

SET

EPS Output Delay	17 min<
------------------	---------

- with '>' or '<' choose the time lag

- **5s**

- **2min 20s**

- **17min**

- **2h 20min**

5s
2min 20s
17min
2h 20min

EPS Output Delay	2 h 20 min<
------------------	-------------

- confirm your choice with the 'SET' button

SET

EPS Output Delay	2 h 20 min
------------------	------------

Setting the communication address.

- with '>' or '<' choose the **Communication address** menu



- press the "SET" button, you will see the prompt at the end of the line



- change the setting with '>' or '<'

1 ÷ 247 – PSU's address during communication with the computer



- confirm your choice with the 'SET' button



3.4.3 Desktop.



The facility is only available after entering the correct user's or installer's password.

The 'Desktop' menu enables setting the current date, time, brightness, contrast and the language of messages. Setting the correct date and time is important for keeping chronology of events stored in the memo. Setting the brightness and contrast guarantees the quality of the displayed messages.

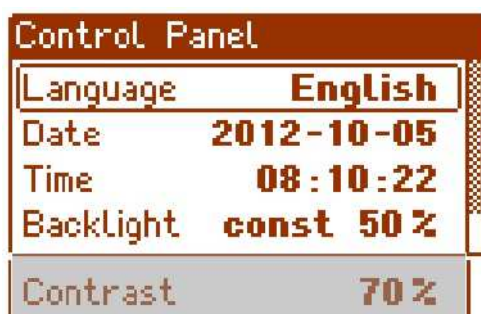
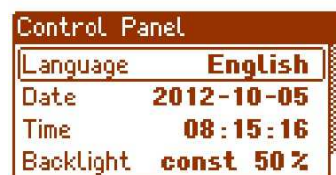
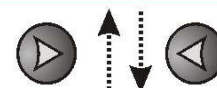
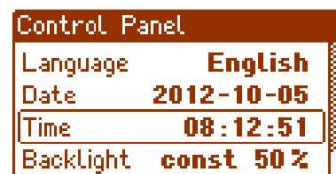


Fig. 14. 'Desktop' screen.

Setting the language of messages.

- with '>' or '<' choose the **Language** menu



- press the "SET" button, you will see the prompt at the end of the line



- with '>' or '<' choose the language of messages

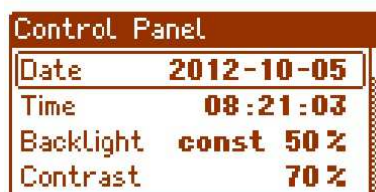
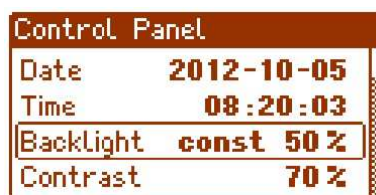


- confirm your choice with the 'SET' button



Setting the date.

- with '>' or '<' choose the **Date** menu



- press the 'SET' button,
the prompt will appear at the year digits

- with '>' or '<' set the year



- press the 'SET' button,
the prompt will move to the month section

Date 2012-10<05 (set the month)

- with '>' or '<' set the current month

SET

Date 2012-10-05< (set the day)

SET

- press the 'SET' button,
the prompt will move to the day section

- with '>' or '<' set the current day

Date 2012-10-05

- approve the settings with the 'SET' button

Setting the time.

Control Panel
Date 2012-10-05
Time 08:21:22
Backlight const 50 %
Contrast 70 %

- with '>' or '<' choose the **Time** menu



Control Panel
Date 2012-10-05
Time 08:21:39
Backlight const 50 %
Contrast 70 %

- press the 'SET' button,
the prompt will appear at the digits of hours

SET

- with '>' or '<' set the hour

Time 08<21:47 (set hours)

- press the 'SET' button,
the prompt will move to the minute section

SET

- with '>' or '<' set the minutes

Time 08:21<47 (set minutes)

- press the 'SET' button,
the prompt will move to the second section

SET

- with '>' or '<' set the seconds

Time 08:21:47< (set the second)

- approve the settings with the 'SET' button

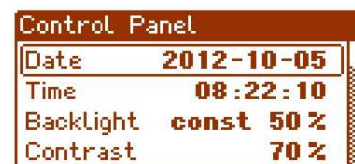
SET

Time 08:21:68

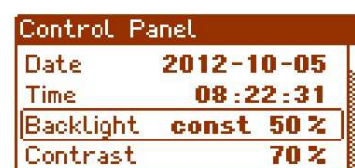
Setting the highlighting.

Intensity of the LCD highlighting (brightness) can be adjusted within the range of 0 to 100% with a 10% step. The display features a function of constant or temporary highlighting. In the mode of time highlighting the screen blanking is on after 60 seconds counting from the last pressing of the button on the panel. To set the intensity with the screen blanking, the following procedure is to be followed:

- with '>' or '<' choose the **Highlight.** menu (abbr. Highlighting)



- press the 'SET' button, the prompt will appear next to the **constant<** option



- with '>' or '<' change the setting into **60 s**



- press the 'SET' button, the prompt will move to the end of the line



- with '>' or '<' set the demanded screen brightness

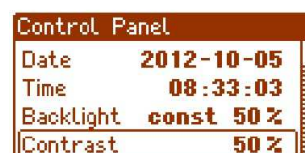
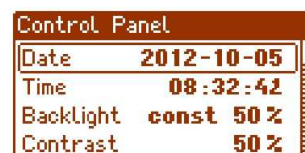


- approve your choice with the 'SET' button



Setting the contrast.

- with '>' or '<' choose the **Contrast** menu



- press the 'SET' button, the prompt will appear at the end of the line

Contrast 50 %



Contrast 70 %



Contrast 70 %

- with '>' or '<' set the contrast

- approve your choice with the 'SET' button

3.5 Acoustic indication.

Emergency situations are acoustically indicated. The frequency and the number of signals depend on an event type (see chapter 9). The acoustic indication is off after removing an appropriate jumper (fig. 2, [5]).

Table 8. Acoustic indication.

No.	Description	Event
1	1 signal per 10s, battery-assisted operation	No 230V AC supply
2	1 signal per 10s, mains operation	Battery fault, undercharged battery
3	2 signals per 10s, battery-assisted operation	Low level of battery charge
4	Fast signals, battery-assisted operation	The PSU will be disconnected due to the battery discharge
5	Continuous indication	PSU failure [see chapter 9]
6	1 signal	Breaking the battery test
7	2 signals	Activation of the battery test

3.6 Technical outputs.

The PSU feature indication outputs, with galvanic isolation, which change state if any of the following event occur:

- **EPS FLT – output indicating AC power loss.**

The output indicates AC power loss. Under normal status – with the 230V AC supply, the output is close. In case of a power failure the PSU will switch the output into the open state after a period of time determined by the 'EPS output lag' facility (see 3.4.2, table 7).

- **APS FLT - output indicating battery failure.**

The output indicates a failure in the battery circuit. Under normal status (during correct operation) the output is close. In case of a failure the PSU will switch the output into the open state. Any failures can be triggered by the following events:

- a faulty or undercharged battery
- battery voltage below 11,5V during battery-assisted operation
- battery fuse fault
- no continuity in the battery circuit

- **PSU FLT - output indicating PSU failure.**

The output indicates the PSU failure. Under normal status (during correct operation) the output is close. In case of a failure the PSU will switch the output into the open state. Any failures can be triggered by the following events:

- low output voltage $U_{aux} < 11,8V$
- high output voltage $U_{aux} > 14,7V$
- high battery voltage $U_{aku} > 14V$ (during battery test)
- polymer fuse PTC activation
- exceeding the PSU nominal current

- failure in the battery charging circuit
- activation of the over voltage protection OVP

The technical outputs have been implemented with galvanic isolation between the PSU's systems and the attached devices.

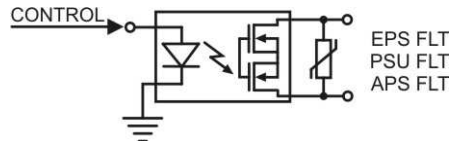


Fig. 15. Electrical diagram of the technical outputs.

- **TAMPER - output that indicates tampering with the PSU enclosure:** output with volt-free (potential-free) contacts indicating the door status and PSU detachment from the mounting surface. NC contacts: the PSU is locked and fixed to the dedicated surface.

3.7 Input of collective failure: EXT IN.

The EXT IN (external input) technical input indicating a collective failure is intended for additional, external devices that generate the failure signal. If voltage appears at the EXT IN input, it will cause generating a PSU failure, storing the information about the event in the internal memo and sending the signal about the failure to the PSU FLT output.

The EXT IN technical input has been implemented with galvanic isolation between the PSU's systems and the devices attached.

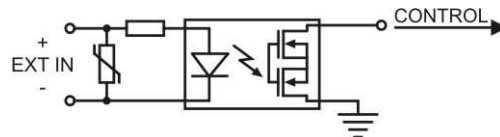


Fig. 16. Electrical diagram of the EXT IN input.

The electrical diagram below shows the way of connecting external devices to the EXT IN input. Outputs such as: OC (open collector), relay type or tamper may be used as a source of the signal.

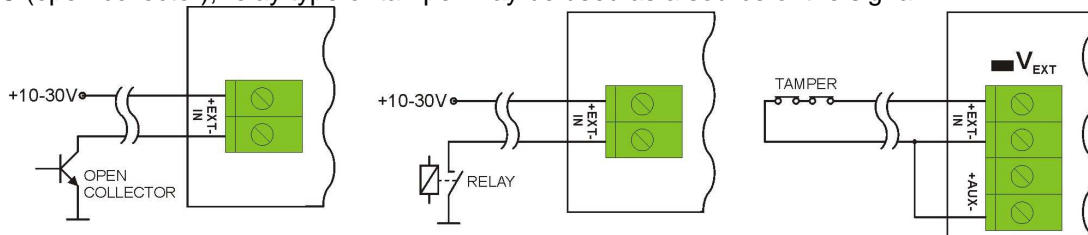


Fig. 17. Examples of connections.

In the option with tamper switches, the V_{EXT} jumper must be on. It polarises the EXT IN input circuit therefore is required in such configuration.

The EXT IN input has been adjusted to cooperate with fuse modules that generate a failure signal in case of a fuse fault in any of output sections (e.g. AWZ535, AWZ536). To guarantee a correct cooperation between the module and the EXT IN input, the V_{EXT} jumper must be on and the connections are to be made accordingly to the diagram below.

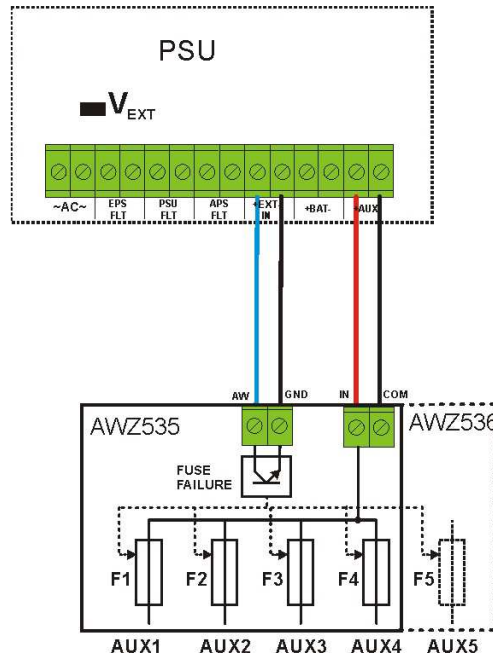


Fig. 18. Example of a connection with the fuse module AWZ535 or AWZ536.

4. Battery-assisted operation.

4.1. Running the PSU from the battery.

The PSU has been equipped with two buttons on the pcb board which enable running or disconnecting the PSU during battery-assisted operation.

- **Running the PSU from the battery:** press the **START** button on the main board and hold for 1s.
- **Disconnecting the PSU from the battery:** press the **STOP** button on the main board and hold for 5s.

4.2. Deep discharge battery protection UVP.

The PSU is equipped with the disconnection system and the discharged battery indication. If the voltage at the battery terminals drops below $10V \pm 0.2V$ during battery-assisted operation, the battery will be disconnected after appr. 15s.

Switching off/on the function of the battery protection:

Press the 'SET' button from the level of the LCD desktop and then choose:

"PSU -> Battery protection: YES/NO" (see chapter 3.4.2, table 7).



Caution.

Deactivating of the UVP function is not recommended since a deep discharge of the battery limits its capability of storing energy, lowers its capacity and shortens its durability.

4.3 Dynamic battery test.

The PSU runs a battery test every 10 minutes. It is done by a momentary switching into a battery-assisted operation. A failure is indicated when voltage drops below 12V. The battery test facility can be switched off.

Deactivating/activating the test:

- enter the PSU settings from the level of the LCD desktop by pressing the 'SET' button. Then choose:

"PSU -> Battery protection: YES/NO" (see chapter 3.4.2, table 7) or

- from the pcb level: during mains-powered PSU operation press the STOP button on the main board and hold it for 3 seconds.

The device will confirm the activation/deactivation of the test (see tab.8 [6, 7]) and show an appropriate message on the display: **"TEST ON/ TEST OFF"**.



Deactivating/activating the test is stored in the memory even after unplugging the device from mains. The battery failure indication at the APS FLT output is automatically switched off. The battery protection system against deep discharged remains on, though.

4.4. Standby time.

The standby time during batter-assisted operation depends on: battery capacity, battery charge level and load current. In order to keep the standby time, the current drawn from the PSU during battery-assisted operation should be limited. Characteristics for a 40Ah/12V SLA:

Grade 1, 2 - standby time 12h

Output current 2,8A + 2,2A battery charge

Grade 3 - standby time 30h if the faults of the main power source are reported to the Alarm Receiving Centre - ARC (in accordance with 9.2 – PN-EN 50131-1).

Output current 1,33A + 3A battery charge













- standby time 60h if the faults of the main power source are reported to the Alarm Receiving Centre - ARC (in accordance with 9.2 – PN-EN 50131-1).

Output current 0,66A + 3A battery charge

4.5. Battery charging time.

The PSU has a battery circuit charged with direct current. The current selection is done via I_{BAT} jumpers. The table below shows how long it takes to charge a (fully discharged) battery up to min. 80% of its nominal capacity.

Table 9. Battery charging time.

40Ah battery charging time up to capacity of 0,8°C	Charging current [A]	Configuration of I_{BAT} jumper
12h	3	J1=  , J2=  , J3= 
16h24m	2,2	J1=  , J2=  , J3= 
24h	1,5	J1=  , J2=  , J3= 
-	0,6	J1=  , J2=  , J3= 

4.6 Operation without a battery.

In case of an expected PSU operation without an attached battery, make a necessary configuration setting from the level of the LCD desktop (see chapter 3.4.2, table 7).

"Settings -> PSU -> Battery present: YES/NO"

In this mode the automation system allows adjustments of PSU's output voltage without indicating a failure connected with working of the battery.



CAUTION. During operation without battery assistance the PSU does not perform any parameter control that monitors its proper operation. Therefore, this mode ought to be chosen thoughtfully.

5. Remote monitoring (option: Wi-Fi, Ethernet, RS485, USB).

The PSU has been adjusted to operate in a system that requires a remote control of the parameters in a monitoring centre. Transmitting data concerning PSU status is possible due to an additional, external communication module that is responsible for communication in Wi-Fi, Ethernet or RS485 standard. A USB-TTL interface enables connection between the PSU and a computer.

In the further part of the chapter, there are presented different connection topologies which serve as examples since more communication variations are possible. For more examples, study the manuals of particular interfaces.

5.1 Communication in the wi-fi wireless network.

The Wi-Fi wireless communication is to be implemented on the basis of additional interfaces: WI-Fi 'INTW' and RS485-WiFi operating within 2,4GHz frequency band, accordingly to the IDEE 802.11b standard.

The WiFi 'INTW' interface shall be mounted in a selected location inside the enclosure so that the serial protrudes outwards.

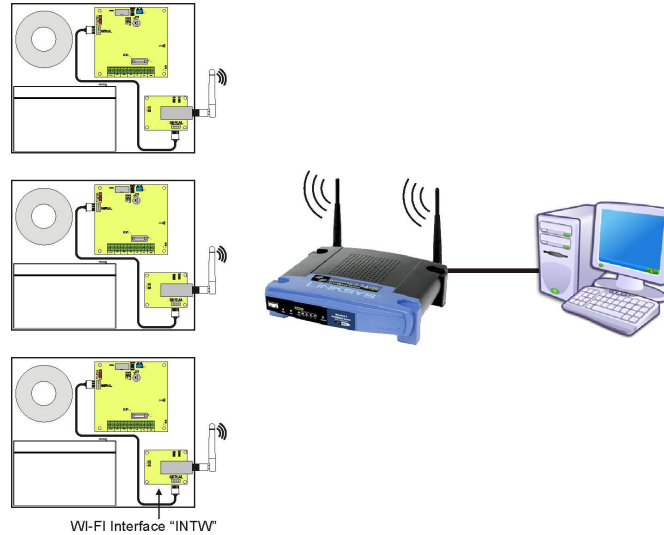


Fig.19. WI-FI communication with the use of the WI-FI "INTW" interface".

The RS485-WiFi 'INTRW' interface is a device intended for converting signals between the RS485 bus and the Wi-Fi network. To work correctly, the device requires external power supply within the range of 10÷30V DC e.g. drawn from a PSU of the PSBEN series. The device is mounted in a hermetic enclosure that protects it against adverse environmental conditions.

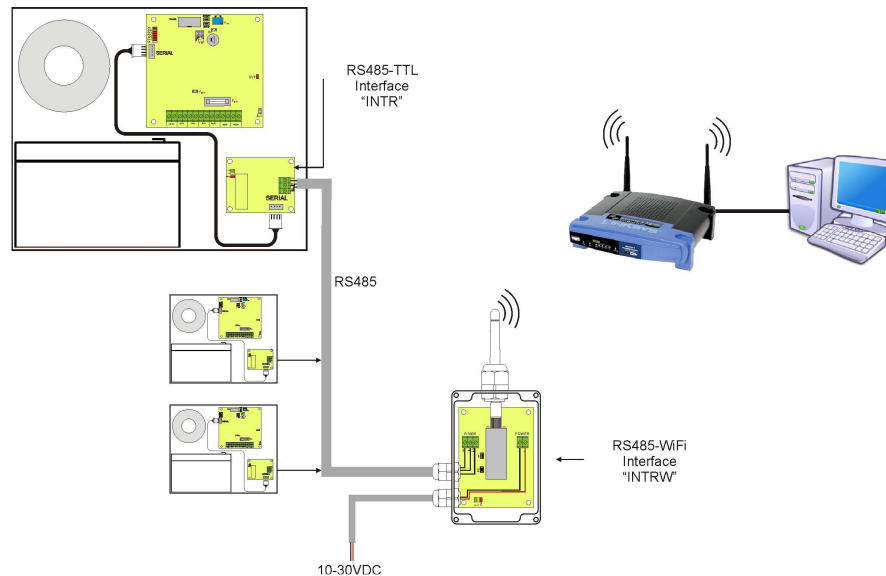


Fig. 20. WI-FI communication with the use of the RS485-WIFI 'INTRW' interface.

5.2 Communication in the ETHERNET network.

Communication in the Ethernet network is possible due to the additional interfaces: Ethernet 'INTE' and RS485-ETH, compliant with the IEEE802.3 standard.

The Ethernet 'INTE' interface feature full galvanic isolation and protection against surges. It shall be mounted inside the PSU enclosure.

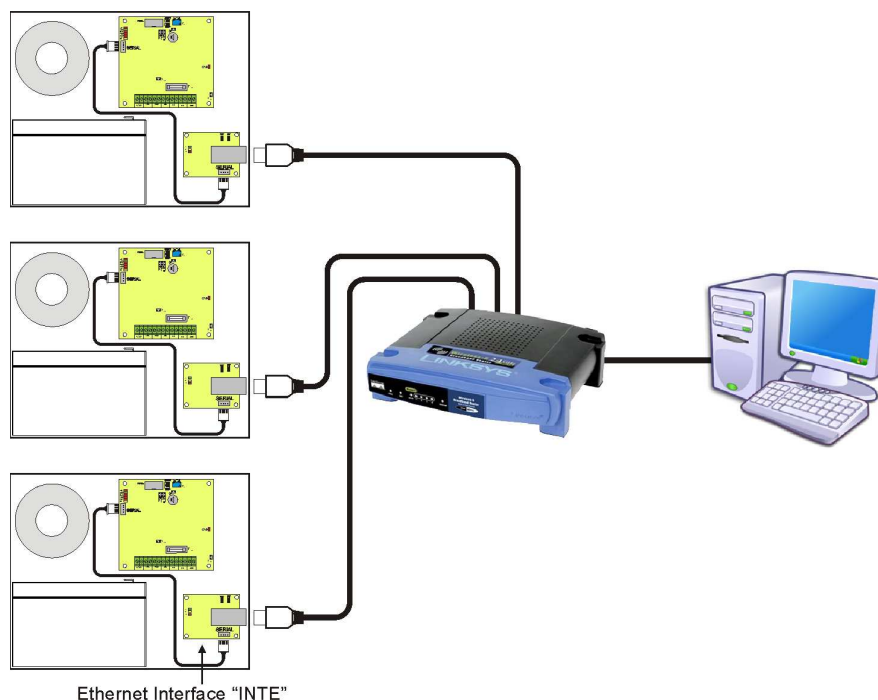


Fig. 21. Ethernet communication with the use of the 'INTE' interface.

The RS485-ETHERNET 'INTRE' interface is a device intended for converting signals between the RS485 bus and the Ethernet network. To work correctly, the device requires external power supply within the range of 10÷30V DC e.g. drawn from a PSU of the PSBEN series. The physical connection is safe due to embed galvanic isolation. The device is mounted in a hermetic enclosure that protects it against adverse environmental conditions.

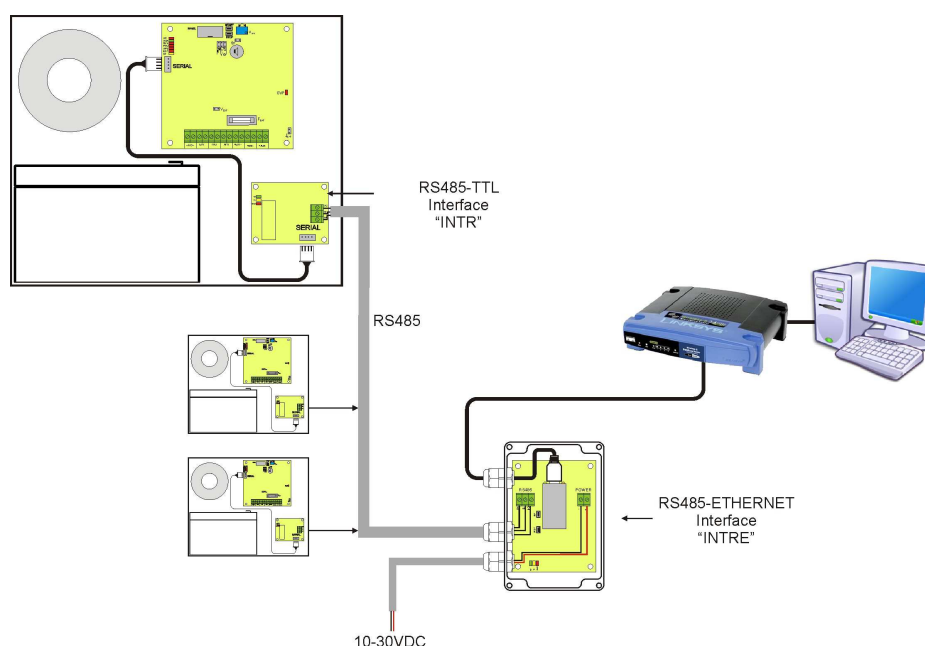


Fig. 22. Ethernet communication with the use of the RS485-Ethernet 'INTRE' interface.

5.3 Communication in RS485 network.

Another kind of network communication is the RS485 that uses a two-wire transmission line. To implement this kind of data exchange, the PSU needs to be equipped with the additional RS485-TTL "INTR" interface which converts data from the PSU into the RS485 standard and the USB-RS485 "INTUR" one that converts data from the RS485 network into a USB. These interfaces feature full galvanic isolation and protection against surges.

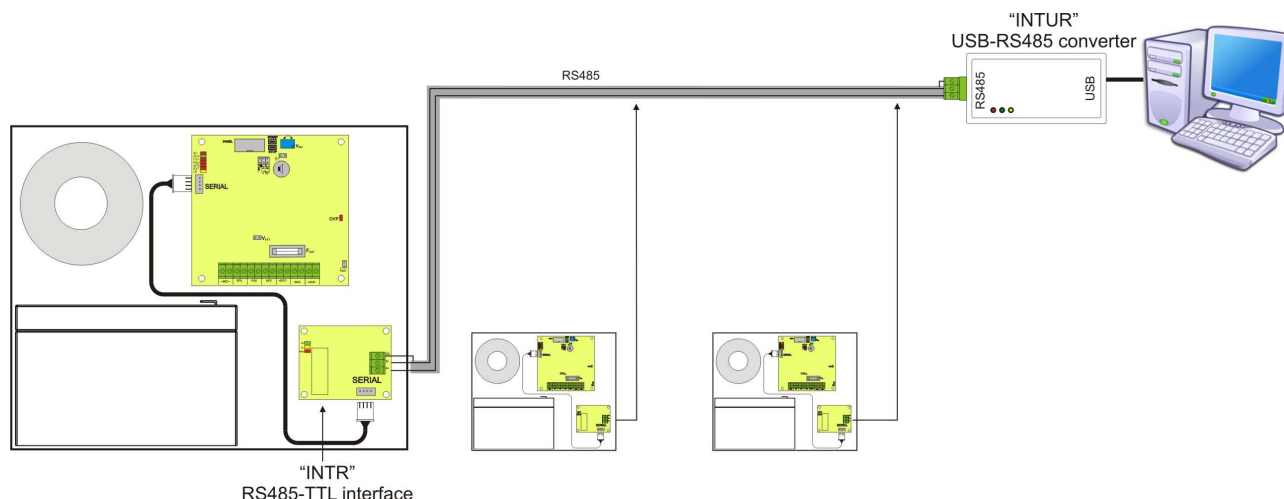


Fig. 23. RS485 communication with the use of the interfaces: "INTR" and "INTUR".

5.4 USB-TTL communication.

If the PSU does not cooperate with any of previously mentioned network and the access to the parameters' adjustment and memo readings are necessary, the USB-TTL "INTU" needs to be used. This interface allows direct connection between the computer and the PSU and it is recognisable by the operating system as a virtual COM port.

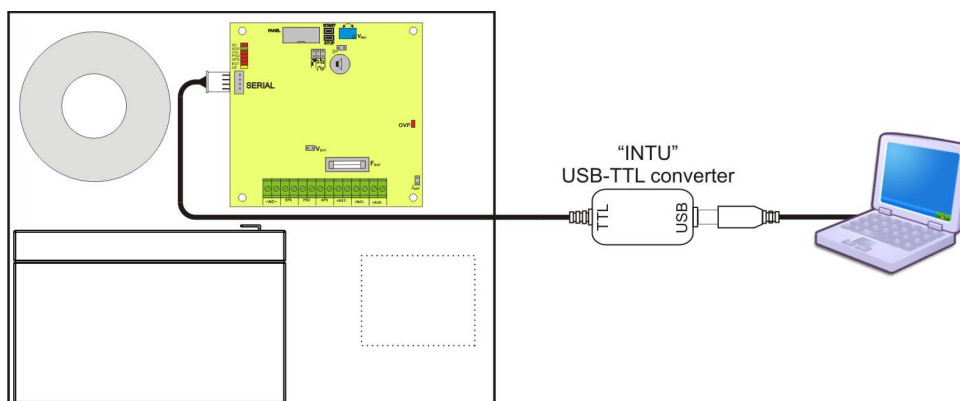


Fig. 24. USB-TTL communication with the use of the USB-TTL "INTU" interface.

5.5 "Power Security" program.

"Power Security" is a computer program that has been created for displaying and analysing the information sent from the PSU installation spots. Here is its front panel:

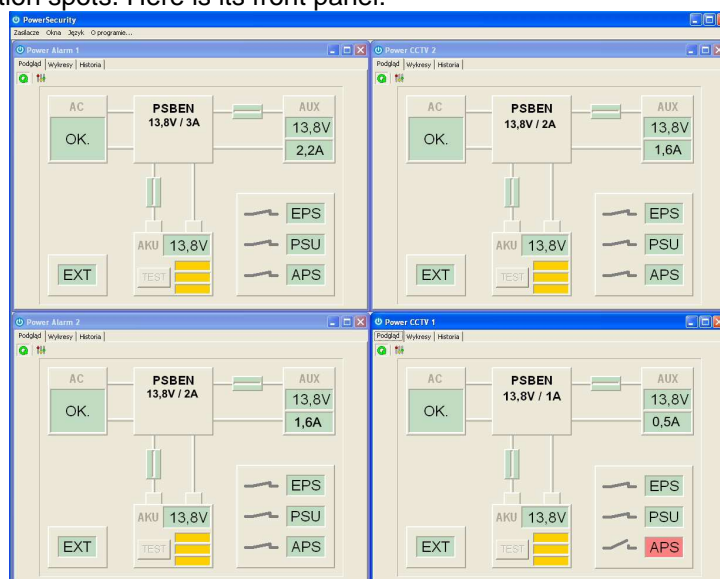


Fig. 25. Front panel of "Power security" program.

The main panel of the program has been formulated in such a way that it is possible to divide it into smaller areas, depending on the number of power supplies.

The program enables both a visualisation and an analysis of the received data. Exceeding of the acceptable parameters is indicated by highlighting in red the appropriate area or by twinkling of the indicator. Particular tabs

contain a chart with an overview of the PSU parameters and failure memo along with the information about status and the electrical specifications of the technical outputs.

*The "Power Security" program is available on our website: www.pulsar.pl
Its detailed description can be found in the manual of the program.*

6. Technical specifications.

Electrical specifications (tab.10).
Mechanical specifications (tab.11).
Operation safety (tab.12).
Operating specifications (tab.13).
Factory settings (tab. 14).

Table 10. Electrical specifications.

PSU type	A, protection grade 1÷3, II environmental class
Mains supply	230V/AC (-15%/+10%)
Current consumption	0,6 A
Power frequency	50Hz
PSU's power	78 W
Efficiency	70%
Output voltage	11,0V÷13,8 V DC – buffer operation 10,0V÷13,8 V DC – battery-assisted operation
Output current	- for grades 1, 2: $I_o = 2,8A + 2,2A$ battery charge - for grade 3: $I_o = 1,33A + 3A$ battery charge - (connection with ARC required, compliant with 9.2 – PN-EN 50131-1) $I_o = 0,66A + 3A$ battery charge - for general use: $I_o = 5A$ (without battery) $I_o = 4,4A + 0,6A$ battery charge $I_o = 3,5A + 1,5A$ battery charge $I_o = 2,8A + 2,2A$ battery charge $I_o = 2A + 3A$ battery charge
Output voltage setting, escalation and keeping time	5ms / 40ms / 18ms
Output voltage adjustment range	12 V ÷ 14,5 V
Ripple voltage	30 mV p-p max.
Current consumption by the PSU systems during batter-assisted operation	$I = 26mA$ $I = 17 mA$ – highlighting of the LCD desktop is off
Battery charging current	0,6A/ 1,5A/ 2,2A/ 3A – I_{BAT} jumper selectable
Low battery voltage indication	$U_{bat} < 11,5V$, during battery-assisted operation
Over voltage protection OVP	$U > 15,5V$, disconnection of the output voltage, automatic return (AUX+ disconnection)
Short circuit protection SCP	200% ÷ 250% of the PSU power - current limiting and/or fuse fault in the battery circuit (fuse-element replacement required)
Overload protection OLP	Program - equipment
Battery circuit protection SCP and reverse polarity connection	T6,3 A- current limiting, F_{BAT} fuse (failure requires fuse-element replacement)
Deep discharge battery protection UVP	$U < 10,0 V (\pm 2\%)$ – disconnection (-BAT) of the battery, adjustment from the LCD desktop's level
Technical outputs:	- type – electronic, max 50mA/30V DC, galvanic isolation 1500V _{RMS}
- EPS FLT; output indicating AC power failure	- time lag, approx. 5s/140s/17m/2h 20m (+/-5%)
- APS FLT; output indicating battery failure	- type – electronic, max 50mA/30V DC, galvanic isolation 1500V _{RMS}
- PSU FLT; output indicating PSU failure	- type – electronic, max 50mA/30V DC, galvanic isolation 1500V _{RMS}
- TAMPER output indicating enclosure opening and detachment from the mounting surface	- microswitches x2, NC contacts (enclosure closed and fixed to the mounting surface), 0,5A@50V DC (max.)
EXT IN technical input	Voltage 'on' – 10÷30V DC Voltage 'off' – 0÷2V DC Level of galvanic isolation: 1500V _{RMS}
Optical indication:	- LEDs on the PSU's pcb, - LCD panel

	<ul style="list-style-type: none"> • electrical parameters reading • failure indication • PSU settings adjusted from the panel's level • 3 levels of access, password-protected • PSU operation history – 6144 values • failure history - 2048 events • real-time clock, battery-backed
Acoustic indication:	- piezoelectric indicator ~75dB /0,3m, switched via jumper
LCD display's battery	3V, lithium, CR2032
F_{BAT} fuse F_{MAIN} fuse	T 6,3A / 250V T 3,15A / 250V
Additional accessories (not included)	<ul style="list-style-type: none"> - interface USB-TTL 'INTU'; communication: USB-TTL - interface RS485 'INTR'; communication: RS485 - interface USB-RS485 'INTUR'; communication: USB-RS485 - interface Ethernet 'INTE'; communication: Ethernet - interface WiFi "INTW"; wireless communication: Wi-Fi - interface RS485-Ethernet "INTRE"; communication: RS485-Ethernet - interface RS485-WiFi "INTRW"; wireless communication: RS485-WiFi

Table 11. Mechanical specifications.

Enclosure dimensions	330 x 350 x 178 (335 x 355 x 170+8) (WxHxD) [mm] (+/- 2)
Fixing	300 x 318 x Φ 6 x4 (WxH)
Fitting battery	40Ah/12V (SLA) max.
Net/gross weight	7,5/8,0 kg
Enclosure	Steel plate DC01 1,2mm, colour RAL 9005 (black)
Closing	Cheese head screw x2 (at the front), lock assembly possible
Connectors	Supply: Φ 0,63÷2,50 (AWG 22-10) Outputs : Φ 0,51÷2 (AWG 24-12) Battery outputs BAT: Φ 6 (M6-0-2,5) 56cm TAMPER output: wires, 25cm
Notes	The enclosure does not adjoin the assembly surface so that cables can be led. Convectional cooling.

Table 12. Operation safety.

Protection class PN-EN 60950-1:2007	I (first)
Protection grade PN-EN 60529: 2002 (U)	IP20
Electrical strength of insulation: - between input (network) circuit and output circuits of the PSU (I/P-O/P) - between input circuit and PE protection circuit (I/P-FG) - between output circuit and PE protection circuit (O/P-FG)	3000 V/AC min. 1500 V/AC min. 500 V/AC min.
Insulation resistance: - between input circuit and output or protection circuit	100 M Ω , 500V/DC

Table 13. Operating specifications.

Operating temperature	-10°C...+40°C
Storage temperature	-20°C...+60°C
Relative humidity	20%...90%, without condensation
Vibrations during operation	unacceptable
Impulse waves during operation	unacceptable
Direct insolation	unacceptable
Vibrations and impulse waves during transport	PN-83/T-42106

Table 14. PSU's factory settings.

Indication time of EPS network loss	5s
Battery charging current	2,2A
Battery presence	YES (battery present)
Battery test	YES (activated)
Deep discharge battery protection UVP	YES (battery protected)
Communication address	1
Transmission	19.2k 8E1
Highlighting	Constant – 50%

Passwords: - keypad's - user's - installer's	(n/a) 1111 1234
---	-----------------------

7. Installation.

7.1 Requirements.

The buffer PSU is to be mounted by a qualified installer, holding relevant permits and licenses (applicable and required for a given country) for 230V/AC interference and low-voltage installations. The unit should be mounted in confined spaces, in accordance with the II environmental class, with normal relative humidity (RH=90% maximum, without condensation) and temperature from -10°C to +40°C. The PSU shall work in a vertical position that guarantees sufficient convectional air-flow through ventilating holes of the enclosure.

As the PSU is designed for a continuous operation and is not equipped with a power-switch, therefore an appropriate overload protection shall be guaranteed in the power supply circuit. Moreover, the user shall be informed about the method of unplugging (most frequently through separating and assigning an appropriate fuse in the fuse-box). The electrical system shall follow valid standards and regulations.

7.2 Installation procedure.



CAUTION!

Before installation, cut off the voltage in the 230V power-supply circuit.

To switch off power use an external switch in which the distance between the contacts of all poles in the disconnection state is not less than 3mm.

1. Mount the PSU in a selected location. It is crucial to bolt the tamper grip to the mounting surface. The grip is located in the central part of the enclosure (see fig. 3 [7]) and guarantees indication in case of any attempts of detaching the device from the mounting surface. Proper installation is one of the requirements of the PN-EN 50131-6 standard.

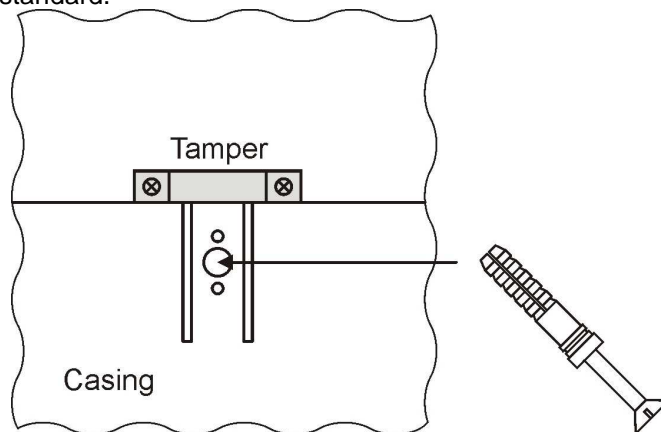


Fig. 26. Fixing a tamper grip.

2. Connect the power cables (~230Vac) to L-N terminals of the PSU. Connect the ground wire to the terminal marked by the earth symbol: PE. Use a three-core cable (with a yellow and green PE protection wire) to make the connection. Lead the cables to the appropriate terminals through the insulating bushing.



The shock protection circuit shall be performed with a particular care, i.e. the yellow and green wire coat of the power cable shall stick to one side of the terminal - marked with the PE symbol on the PSU enclosure. Operation of the PSU without the properly made and fully operational shock protection circuit is UNACCEPTABLE! It can cause a device failure or an electric shock.

3. Connect the receivers' cables to the +AUX, -AUX connectors of the terminal block on the PSU board.
4. If necessary, connect the device's leads to the technical inputs and outputs:
 - EPS FLT; technical output of AC power loss indication (alarm panel, controller, indicator, etc.)
 - PSU FLT; technical output of the PSU failure.
 - APS FLT; technical output of the battery failure.
 - TAMPER; output indicating enclosure opening or detaching from the assembly surface.
 - EXT IN; collective failure output
5. With the I_{BAT} jumper determine the maximum battery charging current, in accordance with the battery

parameters.

6. From the level of the LCD panel decide whether the function of discharged battery disconnection $U < 10V$ (+/-5%) is to be on or off (see chapter 3.4.2).

7. Switch on the ~230V AC supply (red AC diode and green AUX diode should be lit).

8. Check the output voltage (the PSU voltage without load and without a battery should amount to $13,7V \div 13,9V$, with a battery or during battery charging process: $11,0V \div 13,8V$). If the value of the voltage requires adjustment, it should be set by the V_{ADJ} potentiometer, monitoring the voltage at the AUX output of the PSU.

9. Connect the batteries in accordance with the markings: +BAT red to 'plus', -BAT black to 'minus'. The LB diode should be on during battery charging process.

10. With the STOP button, activate or deactivate a dynamic battery test. Deactivating the test turns out the PSU failure indication at the APS FLT output, but it does not affect the protection system against complete battery discharge.

11. Check the current consumption of the receivers allowing of the battery charging current no to exceed the total current efficiency of the PSU.

12. Once the tests and operation control have been completed, the enclosure can be locked.

8. Operation and use.

8.1. Over voltage protection OVP at the PSU output.

In case of voltage exceeding $15.5V \pm 0.5V$ at the regulator's output, the system cuts off the power at the outputs to protect the battery and the receivers from damage. The outputs will be battery-powered. The protection system is indicated by illuminating of the OVP red LED on the pcb board, PSU FLT output status change opening state, acoustic and appropriate message on the PSU front panel.

8.2 Overload of the PSU.

The PSU has been equipped with a LED OVL (overload) indicator light on the pcb. It informs about the output overload status. If the nominal current of the PSU is exceeded, the indicator light will be lit and the microprocessor will proceed to a specially implemented procedure. If the overload threatens the PSU's power grade, the control system will decide about a disconnection of the AUX output. Restart will occur after 1 minute.

8.3 Short circuit at the PSU output.

In the case of a short circuit at the AUX, BAT output (load $200\% \div 250\%$ of the PSU power) or a reverse polarity connection, the F_{BAT} fuse in the battery circuit becomes permanently damaged and the restoration of the voltage at the BAT output requires replacement of the fuse.

8.4 Battery replacement.

The battery replacement of the LCD panel should be done when the PSU is supplied from mains or a battery. This will prevent the time settings from erasing



CAUTION!

The removed batteries ought to be stored in a dedicated place. The poles should not be reversed. The use of the batteries of a different kind is forbidden. Tampering with the battery may lead to its explosion.

8.5. Maintenance.

Any and all maintenance operations may be performed following the disconnection of the PSU from the power supply network. The PSU does not require performing any specific maintenance measures. However, in the case of significant dust level, clean its interior with compressed air. In the case of a fuse replacement, use a replacement of the same parameters.

9. PSU FAILURE CODES.

Failure code	LED indication					Acoustic indication	Technical outputs activation	Fault description	Causes
	EXT	OVL	AC	PSU	APS				
F01	-	-	-	-	-	1 beep per 10s	EPS FLT	Battery-assisted operation	- No AC mains supply - Faulty main fuse F_{MAIN}
F02	-	-	ON	twinkles	-	ON	PSU FLT	PTC polyswitch activation at the AUX output	- Overloaded AUX output
F03	-	-	ON	-	twinkles	ON	APS FLT	Blown fuse of the battery F_{BAT}	- Short circuit in the battery circuit - Short circuit in the AUX output circuit - Overloaded AUX output
F04	-	ON	ON	ON	-	ON	PSU FLT	-	- Overloaded AUX output
F05	-	-	ON	-	ON	1 beep per 10s	APS FLT	Faulty battery*	- Drained battery - Undercharged battery - Unplugged battery
F06	-	-	ON	1 flash	-	ON	PSU FLT	Too high output voltage	- Output voltage $>14.7V$
F07	-	-	ON	2 flashes	-	ON	PSU FLT	Too high battery voltage*	- Battery voltage $> 14V$
F08	-	-	ON	3 flashes	-	ON	PSU FLT	Battery charging circuit failure	- Too low output voltage of the PSU, set $<13V$ - Fault in the battery charging circuit
F09	-	-	ON	4 flashes	-	ON	PSU FLT	Too low output voltage	- Output voltage $<11.8V$ (during buffer operation)
F10	-	-	-	-	ON	2 signals per 10s	APS FLT	Too low battery voltage	- Battery voltage drops below $11.5V$ (during battery-assisted operation)
F11	-	-	-	-	ON	Fast audible signals	APS FLT	PSU disconnection caused by battery discharge	- Battery voltage drops below $10V$ (during battery-assisted operation)
F12	ON	-	-	ON	-	ON	PSU FLT	Activation of the EXT IN collective failure input	-
F50	-	-	-	ON	-	ON	PSU FLT	Internal damage of the PSU	-
F51	-	-	-	ON	-	ON	PSU FLT	Error in setting memo	-
F60	-	-	-	-	-	-	-	No communication	Broken cord between the PSU and the display
F61-64	-	-	-	-	-	-	-	Desktop fault	-
F65	-	-	-	-	-	-	-	-	Password unblocking procedure

**WEEE MARKING**

According to the EU WEE Directive – It is required not to dispose of electric or electronic waste as unsorted municipal waste and to collect such WEEE separately.

CAUTION! The power supply unit is adapted for a sealed lead-acid battery (SLA). After the operation period it must not be disposed of but recycled according to the applicable law.

GENERAL WARRANTY CONDITIONS

1. Pulsar K. Bogusz Sp.j. (the manufacturer) grants a five-year warranty for the equipment, counted from the device's production date.
2. The warranty includes free-of-charge repair or replacement with an appropriate equivalent (the selection is at the manufacturer's discretion) if the malfunction is due to the manufacturer, includes manufacturing or material defects, unless such defects have been reported within the warranty period (item 1).
3. The equipment subject to warranty is to be brought to the place where it was purchased, or directly to the main office of the manufacturer.
4. The warranty applies to complete equipment, accompanied by a properly filled warranty claim with a description of the defect.
5. Should the claim be accepted, the manufacturer is obliged to provide warranty repairs, at the earliest convenience, however not later than within 14 days from the delivery to the service centre of the manufacturer.
6. The repair period mentioned in item 5 may be prolonged, if there are no technical possibilities to carry out the repairs, or if the equipment has been conditionally accepted, due to the breaking warranty terms by the claimant.
7. All the services rendered by force of the warranty are carried out at the service centre of the manufacturer, exclusively.
8. The warranty does not cover the defects of the equipment, resulting from:
 - reasons beyond the manufacturer's control,
 - mechanical damage,
 - improper storage and transport,
 - use that violates the operation manual or equipment's intended use
- fortuitous events, including lightning discharges, power failures, fire, flood, high temperatures and chemical agents,
- improper installation and configuration (in defiance with the manual),
9. The warranty is void in any of the following circumstances:
 - construction changes
 - repairs carried out by any unauthorized service center
 - damage or removal of warranty labels
 - modifications of the serial number
10. The liability of the manufacturer towards the buyer is limited to the value of the equipment, determined according to the wholesale prices suggested by the manufacturer on the day of purchase.
11. The manufacturer takes no responsibility for the defects that result from:
 - the damaging, malfunctioning or inability to operate the equipment
 - defects that result from using the equipment outside its stated specifications and operating parameters failing to abide by the recommendations and requirements contained in the manual, or the use of the equipment.

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