Magnetron Power Supply PPS1500U

User Manual

May 2025, Rev2.1

EXCECUTIVE SUMMARY

The document contains a detailed description of the start-up, configuration & interfacing of the power supply

EDFelectronics

EDFelectronics JRMM Sp. z o.o. s.k
Rybnicka 64, Radlin 44-310, Poland
http: www.edfelectronics.com ; e-mail: info@edfelectronics.eu tel.: +48 604 343 504

Document History

Version	Date	Sign	Comment
1.0	2021-12-18	JL	First version – continuity of PPS20 rev 1.9
2.0	2022-07-15	JL	Different power calculation for Pulse Mode
2.1	2025-05-26	JL	New version of PPS – max mower in PulseDC mode also 1500 W

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1.INTRODUCTION

Please read this manual carefully to ensure optimum operating conditions right from the start. This user manual handbook contains important information about the functionality, installation, start-up and operation of the Magnetron Power Supply PPS1500U.

1.1. INTENDED USE

Power Supply PPS1500U is a high voltage device which generates a high DC and PulseDC voltage of negative polarity. PPS1500U can be operated in three modes: Constant Power, Constant Voltage or Constant Current.
The main field of application is the formation of plasma processes. The concept and design of the power supply allows for safe and reliable integration of complex process control systems. The device is referred to as PPS1500U in the remainder of this manual.

1.2. LIABILITIES AND WARRANTY

EDFelectronics company is not liable for damages resulting from improper use of the device and the guarantee expires, if the user, or third party:

- ignores information contained in this manual,
- utilizes the product in a manner inconsistent with intended purpose,
- makes any modification or alteration of the product,
- unit should not be used with unauthorized accessories (compatible accessories, types and models can be found in the product documentation)

EDFelectronics JRMM company reserves the right to make changes without prior notice. Illustrations may vary depending on the version of the device.

1.4 SAFETY

1.4.1. PERSONNEL QUALIFICATIONS

All work described in this document may only be carried out by persons who have suitable technical training and the necessary experience or who have been instructed by the end user of the product.

1.4.2. ILLUSTRATION OF RESIDUAL DANGERS

This Operating Manual illustrates safety notes concerning residual dangers as follows:

Information on preventing any kind of physical injury.

Information on preventing extensive equipment and environmental damage.

Information on correct handling or use. Disregarding safety notes can lead to malfunctions or equipment damage.

Note: Indicates particularly important, but not safety-relevant information.

1.4.3. General Safety Instructions

For all work you are going to do, adhere to the applicable safety regulations. Also observe all safety notes given in this document and forward the information to all other users of the product. In particular, pay attention to the following safety notes:

Mains voltage.

Contact with live parts is extremely hazardous when any objects are introduced, or any liquids penetrate into the device.

Make sure that no objects enter through the louvers of the device. Keep the device dry.

Fig 1.0.1

Improper use.

Improper use can damage the PPS1500U.

Use the PPS1500U only as intended by the manufacturer.

Improper installation and operation data.

Improper installation and operation data may damage the PPS1500U.

Strictly adhere to the stipulated installation and operation data.

2. TECHNICAL DATA

2.1. GENERAL DATA

2.1.1. MECHANICAL DATA

Dimensions:	Width: 483 mm
	Height: 88,1 mm (2 HU)
	Depth: 395 mm
	See Fig . 2.1.1
Net Weight:	10.8 kg
Installation:	19” Rack standard or Bench Top unit

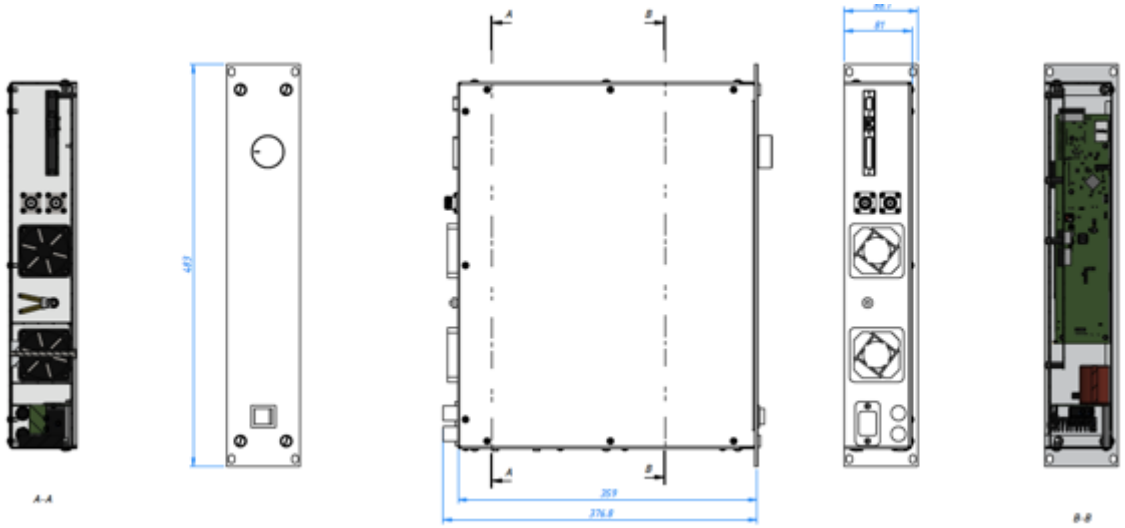


Fig. 2.1.1 Dimensions (mm)

Note: The image above is illustrative, rear panel connectors may differ depending on the version of the device.

2.1.2. AMBIENCE

Temperature Storage:	-10…+60 °C
Operation Temperature:	+5…+40 °C

Relative Humidity:	Max. 80 % (up to 31 °C), decreasing to max. 50 % (above 40 °C)
Use indoor only	
Altitude:	max. 2000 m n.p.m.
The degree of dust standard:	II
Humidity resistance:	IP20

2.1.3. USE AND OPERATING MODES

There are three common operation modes:

- manual control, with 5 buttons user interface on the front panel
- software remote control, with RS232/RS485 or Ethernet Interface
  (All **Read** commands are accessible all the time, **Write** commands are accessible only with activation of this function from the user menu – see remote control for use)
- hardware remote control with I/O interface – see *Tab. 3.3.0*
  This mode is active with external signal only. In this mode all of the front buttons are deactivated. To turn the High Voltage off use Main Power Switch on the front panel – *Fig.4.1.0*

2.1.4. STANDARDS

Conformity with the Directive relating to electrical equipment designed for use within certain voltage limits 73/23/EWG

Conformity with the Directive relating to electromagnetic compatibility 89/336/EWG

Harmonized and international/national standards and specifications:

EN 61010-1 (Safety requirements for electrical equipment for measurement, control and laboratory use)

EN 61000-6-2 (Electromagnetic compatibility generic immunity standard)

EN 61000-6-3 (Electromagnetic compatibility generic emission standard)

2.2. MAINS CONNECTION

Voltage:	195 to 250 VAC, 1 phase operation
Frequency:	43 - 63 Hz
Current consumption:	Max. 8 A at 230V,
Power consumption:	Max. 1800 W
Overvoltage category II	
Protection class 1	
Connection European appliance connector	IEC 320 C14
Fuse	T16A at 230V

2.3. SPECIFICATIONS

Electrical	
Input Supply Voltage	195 to 250 Vac (43 …. 63 Hz), 1 phase operation *
Input Current	Max 8A; Power factor = 0.87

Mode of operation	DC and Unipolar PulseDC
Frequency in PulseDC operation	10kHz ... 120 kHz, or 10kHz ... 300kHz **
Duty Cycle in PulseDC operation	2 ... 70% (shortes impuls time 1,5 us)
Output Voltage / Current / Power	0 – 1000 VDC negative (ignition voltage 1200V) 0 – 3000 mA (1 mA step) 0 - 1500W max in DC/PulseDC mode ***
Regulation mode	Power, Voltage or Current mode
Ripple Noise	Switching: 2% p-p (50kHz) Line: 1% p-p (100/120 Hz)
Ramp Up time	Programable
Communication Interface	RS232 or RS485** and Ethernet 10/100Mb
Methods of control	Local or remote through Communication Interface
Arc Detection	< 2 us Response Time
Dimensions	483 x 395 x 88 mm (W x D x H) - 2U Rack Mounting Standard
Weight	10.8 kg
* alternatively, operation is also possible from two hot wires 3 phase systems, providing the voltage between them does not exceed more than 250 VAC *** minimum power in Pulse mode strongly depends on cable length and output (magnetron) impedance	

I/O control	
Analog Interface	25 D-Sub male connector isolated (up to 2000 V RMS, 0...5V Analogue, 0/24 VDC Digital)
Serial Communication Options	RS232 or RS485 with ModBUS EDF's protocol ***; Ethernet IP, with ModBUS TSP EDF's protocol
*** configurable with order only	

2.4 FEATURES:

- Operating mode: DC, and PulseDC with variable frequency and duty cycle
- Two high-voltage outputs - the ability to support two independent magnetrons without having to use an external switch
- Fast response arc detection/suppression
- Switched control methods (I, V, P) for maximum performance,
- Transparent interface with OLED display and desk light identification parameters
- Built-in timer
- Stable power operation from just 2W (depends from cable length strongly)

- High acceptance output impedance - ability to work with magnetrons of different sizes
- Suitable for working with one or two magnetrons
- User-friendly interface with OLED display, keypad and rotary encoder

2.5. INTERFACES

2.5.1. I/O INTERFACE

Connector:	D-Sub 25 female connector
	Refer to chapter 3.3.5 for details
No of Digital Inputs:	6 – opto-isolated; 24VDC
No of Digital Outputs:	6 – OC type, opto-isolated; 24 VDC
No of Analog Inputs:	3 – voltage input type, opto-isolated (0 ... 5VDC)
No of Analog Outputs:	3 – voltage output type, opto-isolated (0 ... 5VDC)
Response time:	100 ms max

2.5.2. UART (RS232/RS485)

Connector:	D-Sub 9; female connector
Transmission mode:	2400, 4800, 9600, 19200, 38400, 57600, 115200 bits/s
Data Length:	8 bit
Parity Control:	none
Stop Bit:	1
Transmission Control:	none

2.5.3 ETHERNET/IP

Connector:	RJ45
Transmission mode:	100 MB/s
	TCP/IP stack, IPv4

NOTE: The communication protocol is described in separate document

3. INSTALLATION

3.1. UNPACKING

1. Visually inspect the transport packaging for signs of external damage

2. Unpack the PPS1500U and put the packaging material aside

Note: Keep the packaging material for later use. The PPS1500U must be stored and transported in the original packaging material only.

3. Examine the PPS1500U for completeness

4. Visually inspect the PPS1500U for signs of damage

Damaged product.

Putting a damaged product into operation can be extremely dangerous.

Never attempt to put a damaged product into operation. Secure the damaged product from unintended operation. Send a damage report to the haulage company or the insurer.

3.2. MECHANICAL INSTALLATION

PPS1500U can be used in the following ways: as a bench top device, mounted in a control panel or mounted in a 19 "rack. In each case, consider the following important safety information:

The temperature of the environment.
Exceeding the allowable temperature of the device may damage the unit.

Make sure that the maximum permissible ambient temperature is not

exceeded, and the air can circulate freely through the ventilation slots. Do not expose the device to direct sunlight.

3.2.1. RACK INSTALLATION

The PPS1500U is designed for installation into a rack according to DIN 41 494 (19", 2 HU).

Ambient temperature.

Exceeding the maximum permitted ambient temperature may damage the device. Make sure that the maximum permitted ambient temperature is not exceeded and that the air can flow freely through the louvers. Do not expose the device to direct sunlight.

Protection class of the rack.

If the product is installed in a rack, it is likely to lower the protection class of the rack (protection from foreign bodies and water) e.g. according to the EN 60204-1 regulations for switching cabinets.
Take appropriate measures to restore the required protection class of the rack.

NOTE: To reduce the stress on the front panel, the device must be supported with rack rails.

1. Insert PPS1500U guides.
2. Screw the PPS1500U using the supplied screws and plastic sleeves.

3.3. CONNECTING

3.3.1. REAR PANEL

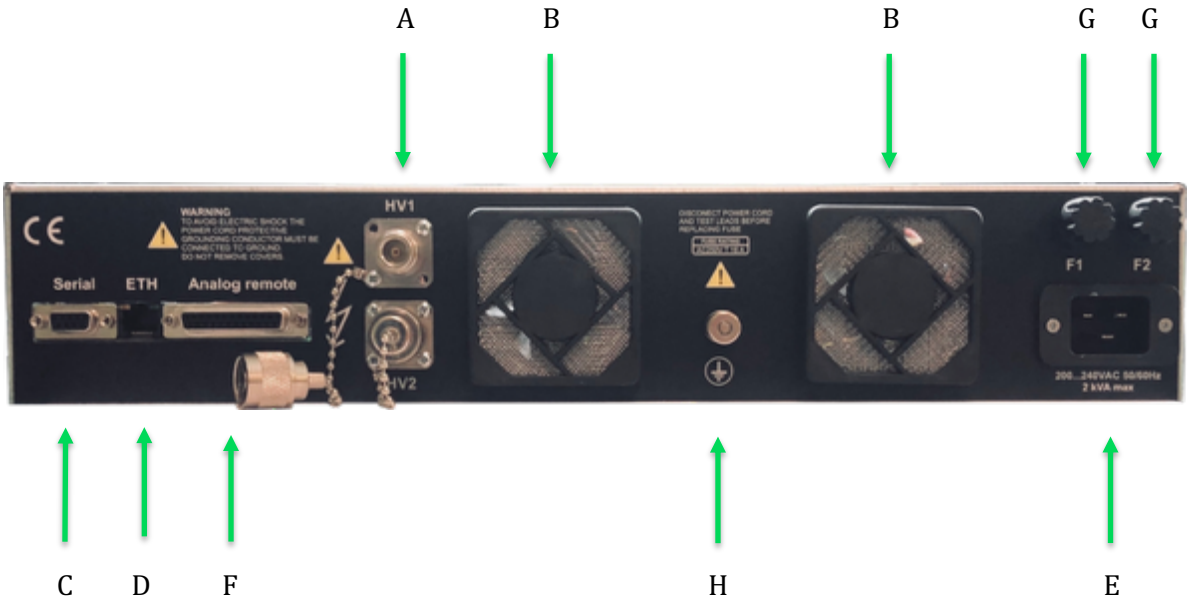


Fig. 3.3.0 Rear panel PPS1500U

A – HV1 and HV2 output connectors type N-50/2-0/G1.07

B –fans and filters

C - RS232 interface Dsub 9 female (RS485 optionally)

D – Ethernet interface RJ45

E – main power socket IEC C13

F – I/O interface connector Dsub 25 female (see chapter 3.3.5 for details)

G – Fuses

H – grounding pin

Screw for internal protective conductor.

The internal protective conductor is connected to the casing with a screw.

Do not turn or loosen this screw.

The configuration of the available connections and photographs of cables is described in the following sections.

3.3.2. MAINS CONNECTION

The mains connection is designed for a mains cable which contains IEC 320 C19 connector on the device side. A mains cable is supplied with the device. If the plug is not compatible with your wall socket, you should replace it with a suitable mains cable:

- Three-conductor cable with protective ground
- Conductor cross-section 3x1.5 mm^2 or larger

Fig. 3.3.1 Three-conductor cable with protective ground (example)

Mains power.

Improperly grounded devices can be extremely dangerous in the event of a fault. Use three-wire mains or extension cables with protective ground only. Plug the mains cable into wall sockets with protective ground only.

1. Connect the European appliance connector of the mains cord with the mains connection of the device
2. Connect the plug of the mains cable with the wall socket

Note:

If the device is installed in a switching cabinet, the mains power can be supplied via a switchable central power distributor.

3.3.3. GROUNDING

Grounding screw (Fig. 3.3.0, the reference H) should be used to connect the PPS1500U with the main grounding system in which it operates. It is recommended to use a cable with a minimum section of 2.5 mm2

If required, connect the vacuum system ground from the earthing screw using the protective conductor.

3.3.4. HIGH VOLTAGE CONNECTORS HV1 AND HV2

The power supply is equipped with two HV outputs of N-50/2-0/G1.07 type. Output configuration is set by the software user interface. Please refer to chapter 4.3.0

Fig. 3.3.2 HV connector , N-50/2-0/G1.07 type

1 – HV1 (- 1000 VDC)

2 – HV2 (- 1000 VDC)

Hazardous voltage.

After entering "Operate" mode (HV LED indicator on the front panel is lit), the connector develops voltage levels dangerous to life and health. The device must be turned off and completely isolated before any work associated with connecting or disconnecting the high voltage cable. When turned off, you must wait at least 15 seconds before attempting to connect / disconnect the HV cable.

Typical discharge voltage without the load is presented at Fig. 3.3.3

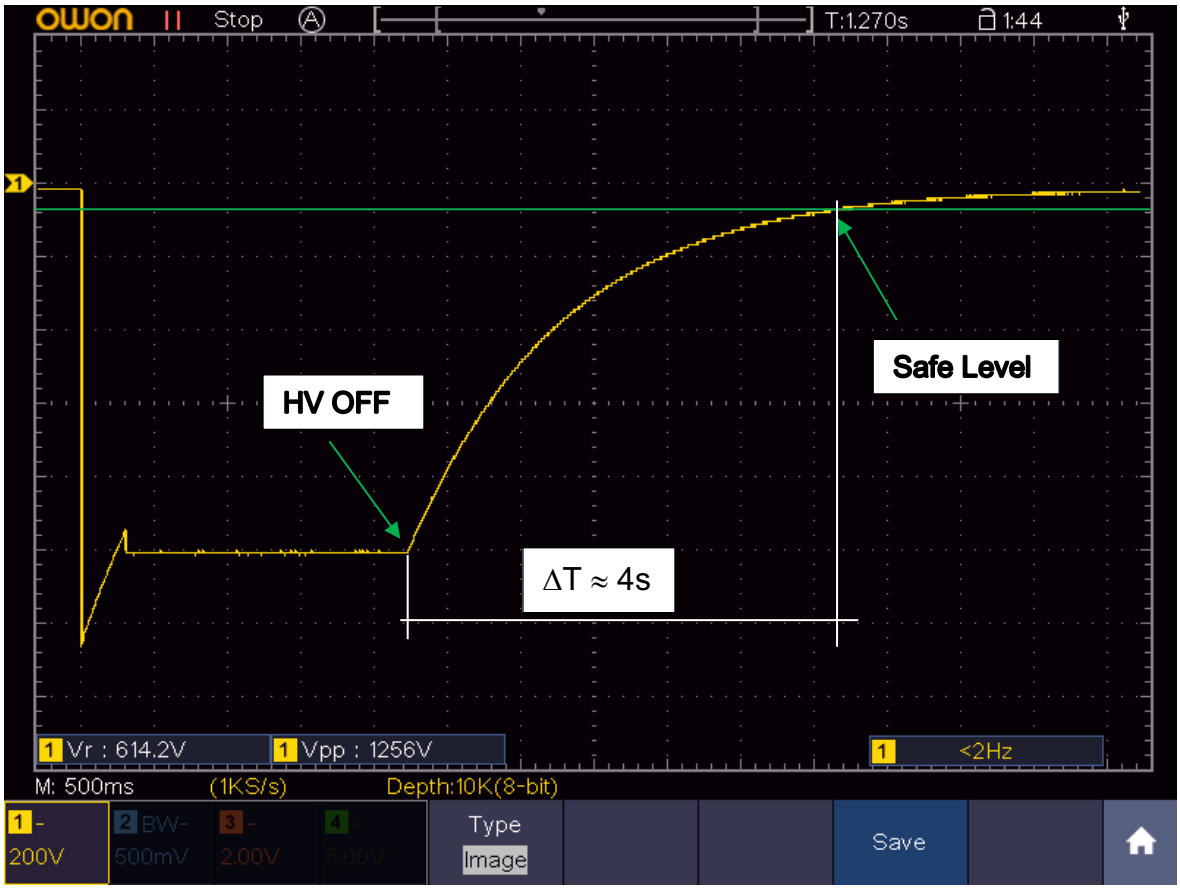


Fig.3.3.3

CAUTION

Improper usage of the power supply (See Chapter 1.1) can cause power supply to be damage and brings risk of HV hazard.

Power Supply has to be interlocked with vacuum threshold system to prevent HV present at the accessible parts – see *Fig.3.3.5.*

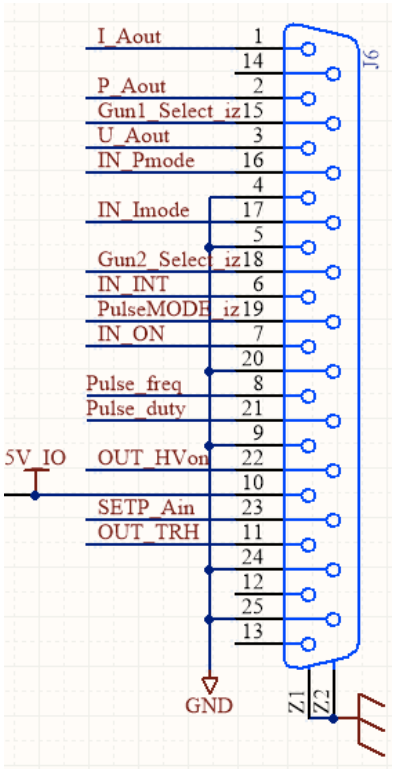
3.3.5. INTERFACE CONNECTOR *ANALOG REMOTE*

Connector Interface "Analog remote" (Fig.3.3.4, a reference F) used to connect external protection interlock and to control I/O of the power supply. Standard Dsub25 female type connector type.

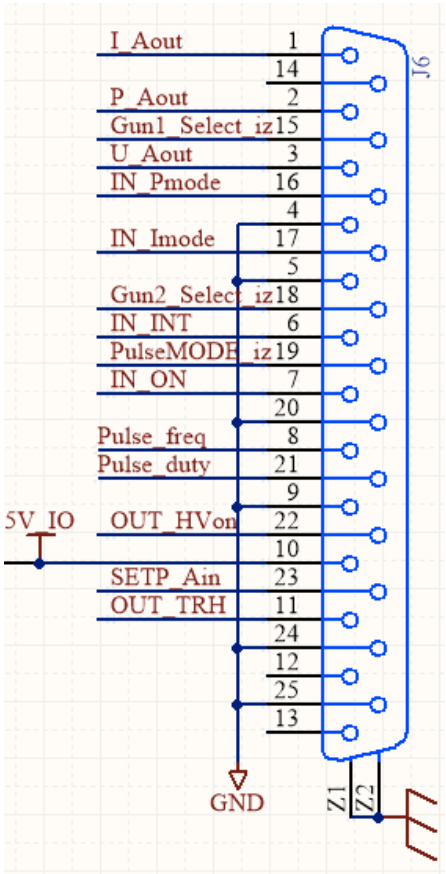
Pin outs and functions description:

Fig. 3.3.4 I/O Dsub25 pinouts

Pin No	
1	**AO** Analogue Output for output current measurement *I_OUT*; 0…5V (0…3000 mA); Max load: 50mA
2	**AO** Analogue Output for output power measurement *P_OUT*; 0…5V (0…1500W); Max load: 50mA
3	**AO** Analogue Output for output voltage measurement *V_OUT*; 0…5V (0…1000 V); Max load: 50mA
4	Main common **GND** signal for all of the Analogue signals
5	Main common **GND** signal for all of the Analogue signals
6	**DI** Digital Input signal for external interlock – bridge this signal with pin 5 or 20 or 25 to set the device to active operation. Iin max: 5mA at 5V
7	**DI** Digital Input – optocoupler type. This pin has to be active to set HV ON. Input Voltage range: 0…5VDC. Input active from 1,8…5VDC; max current consumption 5mA at 5 VDC **IMPORTANT:** this input change the state on rising slop of the signal only, to prevent automatic activation after powering on. To set this pin active, Analog Control has to be set in the user menu – ref. to chapter 4.3.1
8	**AI** Analogue Input - set frequency in PulseDC mode operation. 0..5V (10…120 kHz or 10…300kHz – up to the version), I_{in}: 20mA max
9	Main common **GND** signal for all of the Digital signals



10	**5VDC** source, max 500 mA. This signal should be applied according to the digital ground – pin.4,5
11	**DO** Digital Output - Toggle between +5V & 0V to indicate that target usage is below the threshold
12	**Not used**
13	**Not used**
14	**Not used**
15	**DI** Digital Input – HV1 output selection; activated on raising edge 5V **IMPORTANT:** other output HV2 needs to remain on 0 level (0V, Pin 18). Otherwise rising edge on this input will not take any effect. Whatever is set on HV1 or HV2 pin during powering on, unit always remains in previous/last output selection state. To set this pin active, Analog Control has to be set in the user menu as well – ref. to chapter 4.3.1
16	**DI** Digital Input – optocoupler type. This pin has to be active to set device into the Constant Power Mode. Input Voltage range: 0…5VDC. Input active from 1,8…5VDC; max current consumption 5mA at 5 VDC. **IMPORTANT:** If this input stays in non active mode (0VDC) together with the DI pin no. 17, unit will be switched into the Constant Voltage Mode. To set this pin active, Analog Control has to be set in the user menu – ref. to chapter 4.3.1
17	**DI** Digital Input – optocoupler type. This pin has to be active to set device into the Constant Current Mode. Input Voltage range: 0…5VDC. Input active from 1,8…5VDC; max current consumption 5mA at 5 VDC **IMPORTANT:** If this input stays in non active mode (0VDC) together with the DI pin no. 16, unit will be switched into the Constant Voltage Mode. To set this pin active, Analog Control has to be set in the user menu – ref. to chapter 4.3.1
18	**DI** Digital Input – HV2 output selection; activated on raising edge 5V **IMPORTANT:** other output HV1 needs to remain on 0 level (0V, Pin 15). Otherwise rising edge on this input will not take any effect. Whatever is set on HV1 or HV2 pin during powering on, unit always remains in previous/last output selection state. To set this pin active, Analog Control has to be set in the user menu as well – ref. to chapter 4.3.1
19	**DI** Digital Input – operating mode selection: 0V = DC operation mode; 5V = PulseDC operation mode **IMPORTANT:** To set this pin active, Analog Control has to be set in the user menu – ref. to chapter 4.3.1
20	Main common **GND** signal for all of the Analogue signals
21	**AI** Analogue Input - set duty cycle in PulseDC mode operation. 0..5V (2 .. 70%), I_{in}: 20mA max
22	**DO** Digital Output – this output stays in the high state (+5V), when High Voltage is activated
23	**AI** Analogue Input - set output voltage, current or power; up to selected mode at pin 16 and 17. I_{in}: 20mA max



Logic of Modes Operations controlled via I/O interface		
	I/O D-Sub 25 connector	
Mode of operation	Pin 16 – "In_Pmode"	Pin 17 – "In_Imode"
Constant U	0	0
Constant U	1	1
Constant I	0	1
Constant P	1	0

24	Main common **GND** signal for all of the Digital signals	
25	Main common **GND** signal for all of the Digital signals	

Tab. 3.3.0 "Analog remote" connector description

The minimum required wiring is external interlock mode configuration – see *Fig. 3.3.5*

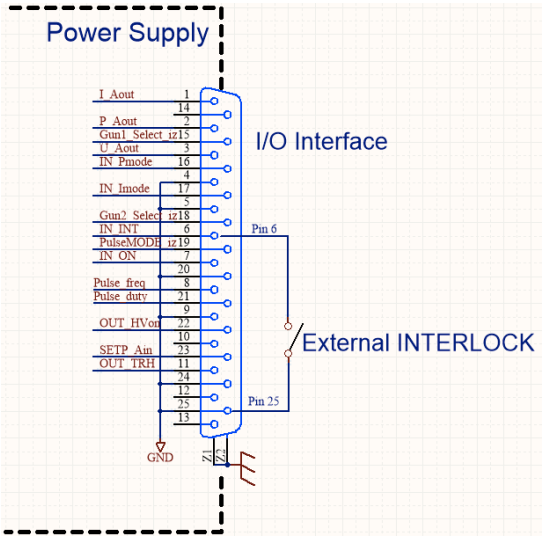


Fig. 3.3.5 Minimum required wiring

CAUTION

Improper connection.

In the case of incorrect connection - in accordance with Tab. 3.3.0 and Fig. 3.3.5, there is a danger of damage to the power supply

3.3.6 SERIAL INTERFACE CONNECTOR

PPS1500U can be controlled via RS232 or RS485 interface.

NOTE: only one interface is available and has to be configured with order

The RS485 interface is Half-Duplex type and requires a terminal resistor – please refer to *Fig.3.3.5 and Tab. 3.3.1*

The transmission protocol is described in separate document – contact supplier for details if needed

Pin 1

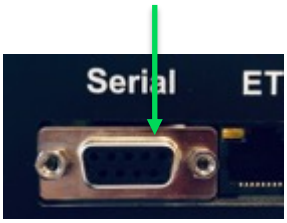


Fig. 3.3.5 Serial connector

Serial Interface	
RS 232	**RS485**
1. Not Used *2. RxT* *3. TxT* *4. Not Used* *5. GND* *6.,7.,8.,9. Not Used*	*1. Not Used* *2. B (-)* *3. A (+)* *4. Not Used* *5. GND* *6.,7.,8.,9. Not Used*

Tab. 3.3.1

Note: If unit is the last one on the line the 150 ohm terminal resistor is recommended to be connected in the plug in case of wiring between A and B pin

3.3.7 ETHERNET INTERFACE

The Ethernet interface allows to communicate with PPS1500U based on IEEE 802.2 standard with 100 MB/s speed.

Note: to achieve best performance and speed, the LAN cable has to be shielded and Cat-6 or higher. Both crossover/non crossover types are equally permissible.

Please refer to *Fig. 3.3.6* for hardware connections in T568A standard. Ethernet interface settings are described in chapter 4.3.1

Fig. 3.3.6 Ethernet RJ45 connector (T568A standard)

1 – Receive +
2 – Receive –
3 – Transmit +
4 – Not Used
5 – Not Used
6 – Transmit –
7 – Not Used
8 – Not Used

4. USING THE POWER SUPPLY PPS1500U

4.1. FRONT PANEL

Please refer to *Fig. 4.1.0* for front panel details

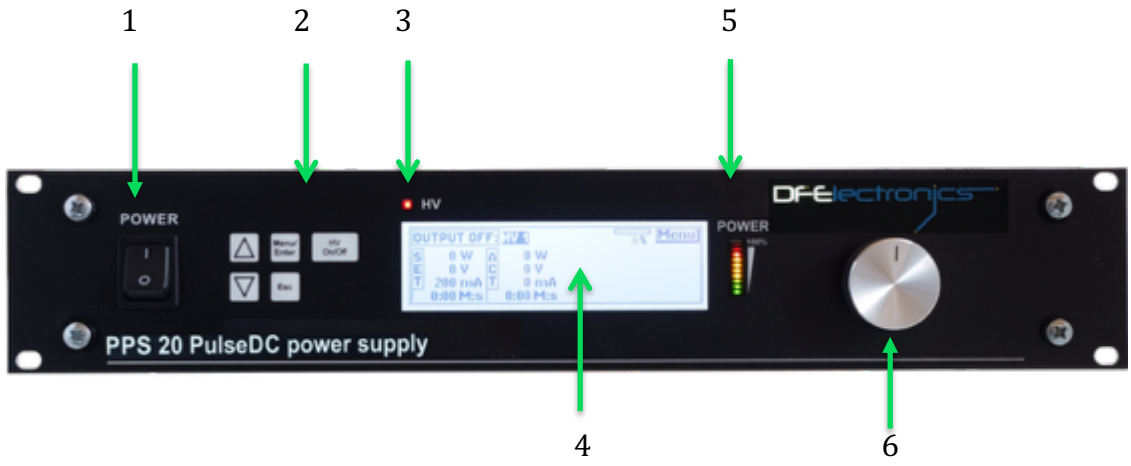


Fig. 4.1.0 Front Panel of PPS1500U

1 – main power switch – Rocker type

2 – membrane press keyboard

3 – high voltage indicator (HV)

4 – alphanumeric display LCD

5 – power meter bar

6 – rotary encoder with press button

4.1.1. MAIN POWER SWITCH

Switching On the power button (position 'I') activates the main power circuit of the device. There is no possibility that high voltages can appear on the output connectors before transition to 'Operate' mode (see Chap. 4.2.1).

Switching off the unit (position 'O' switch) completely cuts the power to the internal circuits - power supply is safe to make rear panel connections.

Risk of the electric shock !

All connection to the devices may only be carried out with the unit is turned off - the main power switch in 'O' position.
Failure to do so may cause electric shock

4.1.2. MEMBRANE KEYBOARD

Please refer to *Fig. 4.1.2* for keyboard details

USER INTERFACE

KEYBOARD:

Operations on the keys refer to interaction with the LCD display, and switches the power supply into the OPERATE or STAND BY mode

HV On/Off – turn the high voltage ON/OFF – switch to OPERATE/ STANDBY mode
Up, Down – user interface menu positions change
ESC – cancel the operation – move one menu level up
MENU/ENTER – this button has two functions:

a) go to the Main menu

b) confirm current setting

Fig 4.1.2 Press buttons description

4.1.3. HIGH VOLTAGE INDICATOR

Yellow HV LED color indicates the presence of high voltage on the output of the power supply. If the power supply is in the OPERATE mode then high voltage is ON. If the indicator remains blank, power supply remains in the STAND BY mode – high Voltage OFF.

High Voltage presence

An active HV indicator indicates the presence of high voltage output of the power supply and all circuits connected to the HV1 or HV2 outputs. Pay special attention to the operation of the power supply and comply with all the rules of use described in this manual. Improper use of the device may cause electric shock.

4.1.4. ALPHANUMERIC LCD DISPLAY

Interaction with the user takes place by means of a multiline alphanumeric LCD display with character height of 12.9 mm. The display has adjustable brightness and contrast - see Chap. 4.4.1

4.1.5. POWER BAR IDENTIFIER

Maximum output power of the device is 1500W in DC mode, and 900W in PulseDC mode. This value is proportionally presented by the LED power bar identifier. Three different colours (green, yellow and red) additionally identify the power level.

4.1.6. Rotary Encoder with Press Button

Multi-turn encoder provides a user interface for changing values/options selected with the keyboard.

4.1.7 Main Screen Description

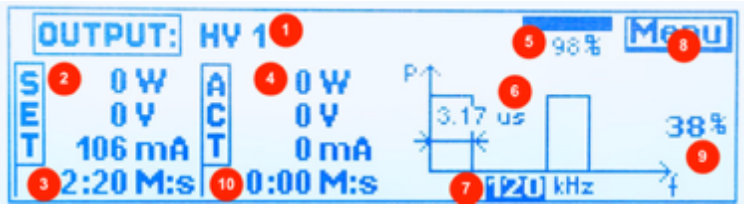


Fig. 4.1.1

No	Description	No	Description
1	Actual output selection	**6**	PulseDC indicator
2	Set point	**7**	PulseDC frequency
3	Deposition time indication	**8**	Main Menu tab
4	Actual measurements	**9**	PulseDC duty cycle
5	TG indicator	**10**	Deposition remaining time

The currently selected option is highlighted by selection mask. Turn rotary encoder or use arrow buttons ▲ or▼ to select required tab; press **ENTER** button or rotary knob to edit. Press **ENTER** button or rotary knob again to confirm the settings

4.2. MENU OPERATION

Selecting and setting the operation parameters can be done in two ways: by selecting **ENTER / MENU** button and navigate between the options of a menu using the arrow keys ▲or ▼. To enter the selected sub-menu, again press **ENTER / MENU** button. The current operation can be canceled at any time by pressing the **ESC** key. Pressing this this key also goes back to the previous menu.

If there is no reaction/further keypress for 30 s, the display returns to the main menu. The same interaction can be done using rotary encoder with integrated press button option. Menu structure is shown in Fig.4.2.0

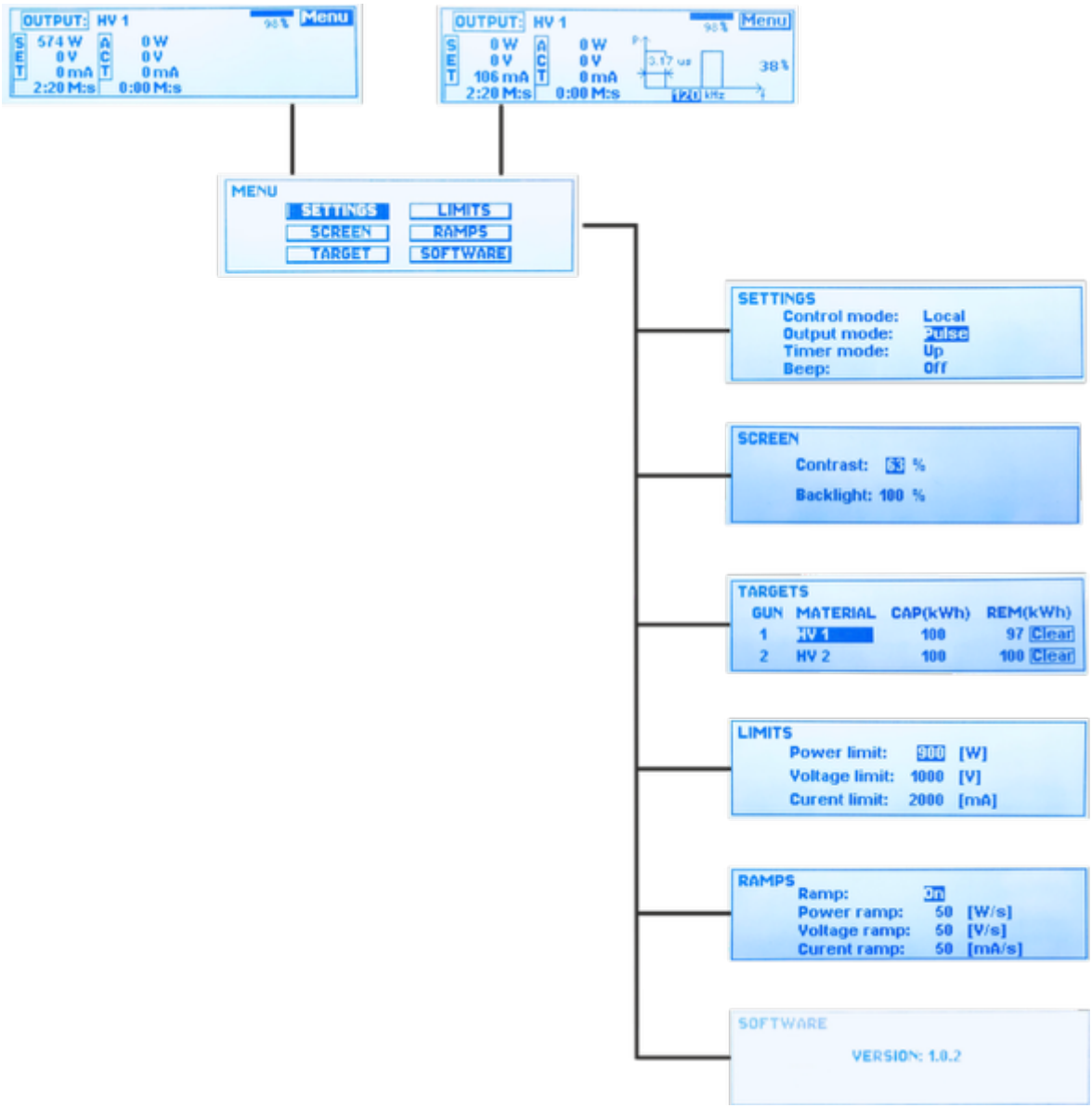


Fig.4.2.0

4.2.1. MENU NAVIGATION

Navigation on the pages can be done in two ways:

- using the buttons on the front panel,
- or rotary encoder knob

Use narrow buttons or rotary encoder to move between the options. See *Fig 4.2.1* as example of "Menu" selection, and Fig 4.2.2 as example of frequency sets – field is displayed in inverted background color. To edit selected option, just press the *Enter* button or press *Rotary Encoder*. Inverted background will start to blink; continue *Encoder* rotation to set the value. When its finished, just press *Enter* or *Encoder* once more time – inverted field will stop to blink.

Main menu interface can looks different – up to the selecting mode operation: DC mode or PulseDC mode – refer to chapter 4.3.1 for proper selection. Main menu in DC mode operation is shown in *Fig. 4.2.1* and PulseDC mode in *Fig.4.2.2*

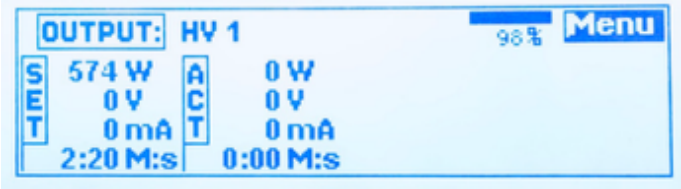


Fig.4.2.1

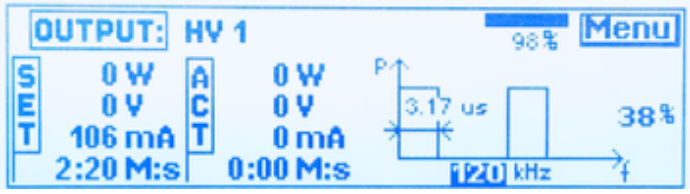


Fig.4.2.2

NOTE: In PulseDC mode operation, SET and ACTUAL values are presented in the following way:

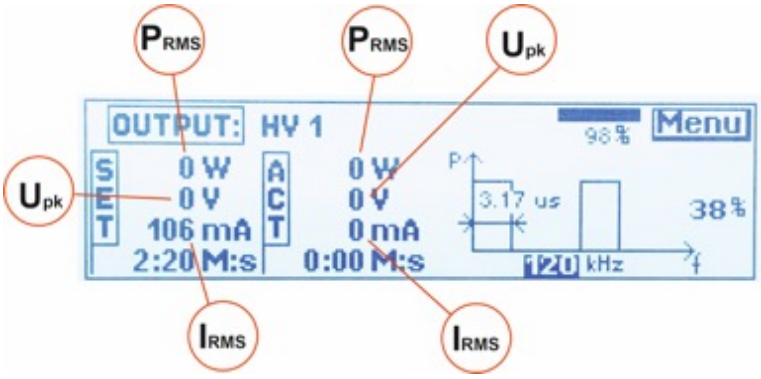


Fig. 4.2.3

Where:

P_{RMS} – RMS (Root Mean Square) output power [W]

U_{Pk} – peak output voltage [V],

I_{RMS} – RMS (Root Mean Square) output current [A],

For more details, please refer to the chapter 4.2.4

4.2.2. HV Output Selection

PPS1500U can run with 2 outputs. They are not working parallel – only one can be selected at the time. Current output selections is displayed on the main menu – *Fig4.2.4*

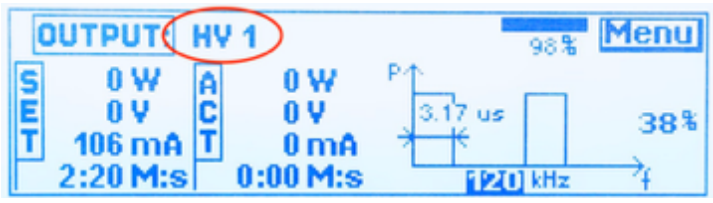


Fig. 4.2.4

NOTE: There is possible to assign any name to the output if preferred – according to used target for example. For customized naming please refer to the chapter 4.3.3

To change the output selection, turn rotary encoder knob or use arrow buttons ▲ or▼ to select *OUTPUT* field (*Fig.4.2.4*) and then press the encoder or **ENTER** button to edit mode – this will turn selected field into the blinking (about 1/s). Now HV output selection is possible – use rotary encoder or arrow buttons to change the output and confirm selection by ENTER button or rotary encoder pressing; system will return to the option selection – no blinking tabs.

4.2.3. Constant Power Operation

To operate power supply with Constant Power Operation, turn rotary encoder knob or use arrow buttons ▲ or▼ to select power in *SET* field (*Fig.4.2.5*) and then press the encoder or **ENTER** button to edit mode – this will turn selected

field into the blinking (about 1/s). Now output power set is possible – use rotary encoder or arrow buttons to change it.

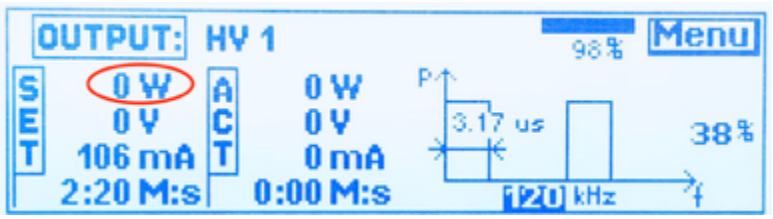


Fig. 4.2.5

NOTE: Type of operation (Constant Power, Voltage or Current) can be selected only when high voltage HV is not active. When HV stays on, then value of selected mode can be set only.

NOTE: Maximum adjustable output power value is limited by "Limit Settings" – refer to chapter 4.3.4 for details.

NOTE: Input data for Constant Power, Voltage or Current operation are set in the same way for both of mode of operation: DC or PulseDC

4.2.4 POWER CALCULATIONS

Output power of PPS1500U is different for each mode operation – DC or PulseDC . It is really important to understand how it works.
For DC mode operation it is really easy, and output power is calculated according to the following formula:

$$P_{out} = U_{out} \text{ x } I_{out}$$

where:

P_{out} – nominal output power [W]

U_{out} – nominal output voltage [V],

I_{out} – nominal output current [A],

Maximum output voltage for DC operation is 1000 V (1200V during ignition), and max output current is 3A, however max output power is 1500W, and PPS1500U is operating according to the following characteristic:

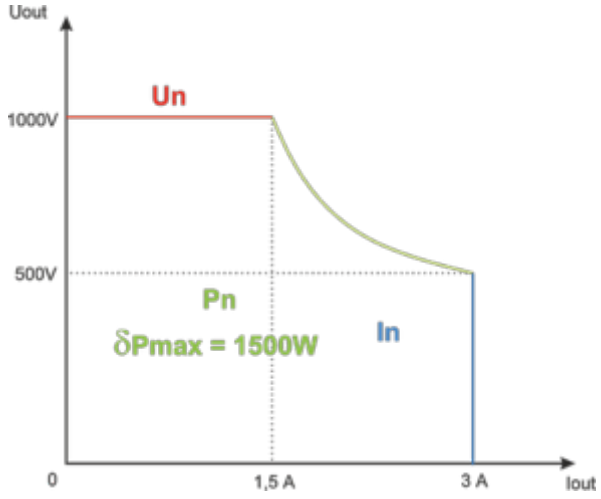


Fig.4.2.6 PPS1500U output characteristic in DC mode

For PulseDC operation mode it has to be considered, that output power is defined as a multiplication of a root mean square values of current and voltage. The RMS values are calculated for each factor separately. The output power can be estimated according to the formula:

$$P_{OUT} = \sqrt{\frac{1}{T}\int_0^T [P(t)^2]\,dt}$$

where:

***P*$_{out}$** – rms output power [W]

P(t) – power per time [V],

T – period [s],

Power is the rate, per unit time, at which energy is transferred. For better understanding how the power is calculated see the picture below.

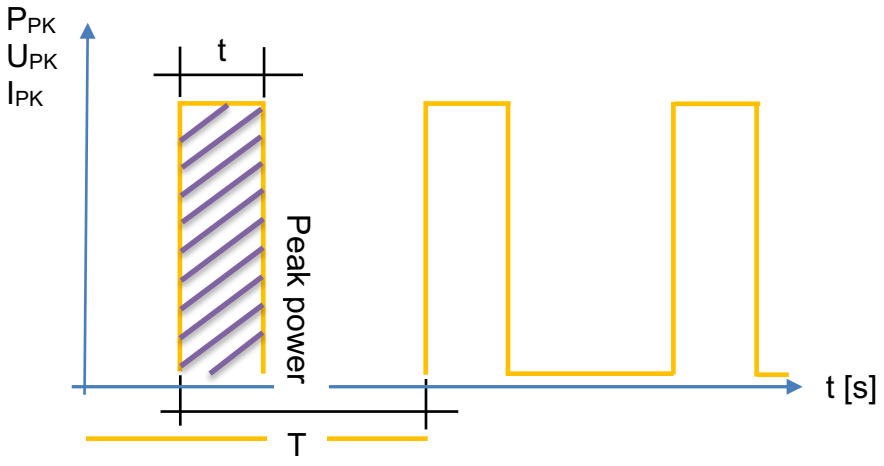


Fig.4.2.7 Output signal of the PPS1500U in PulseDC mode

where:

P_{PK}, U_{PK}, I_{PK} – peak value of power, voltage and current, respectively

t – pulse width,

T – pulse repetition interval.

In the table below are presented relations between peak/average/rms power.

Peak Power	Average Power	RMS Power
$P_{PK} = U_{PK} I_{PK}$	$P_{AV} = P_{PK} \frac{t}{T}$	$P_{RMS} = P_{Pk} \sqrt{\frac{t}{T}}$

Since the output signal of current and voltage of PPS1500U in PulseDC mode are like square wave, (waves with distorted, irregular patterns—spikes, pulse trains, squares, triangles, sawtooths and any other ragged or angular waves) the output power is calculated as a RMS value of it. Thus, RMS determine power which is the true electrical power delivered to the load.

During the operation in PulseDC mode, the parameters displayed on the LDC are:

Power: displayed power is calculated according to the RMS power formula as described above,

Voltage: displayed voltage is a peak pulse voltage,

Current: displayed current is a RMS value of it.

Refer also to Fig.4.2.3 for display details

For proper calculation power from displayed values of voltage and current, some recalculation should be done. Since the current is displayed as a RMS value and voltage as a peak value, the voltage should be also calculated as a RMS value of it.

4.2.5. CONSTANT VOLTAGE OPERATION

To operate power supply with Constant Voltage Operation, turn rotary encoder knob or use arrow buttons ▲ or▼ to select voltage in *SET* field (*Fig.4.2.8*) and then press the encoder or **ENTER** button to edit mode – this will turn selected

field into the blinking (about 1/s). Now output voltage set is possible – use rotary encoder or arrow buttons to change it.

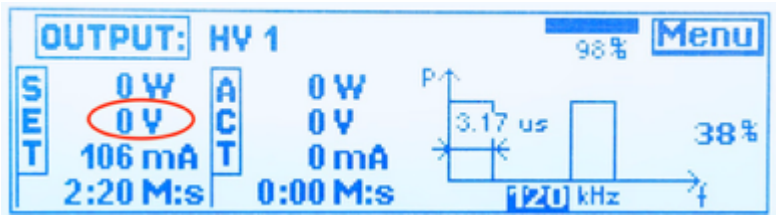


Fig. 4.2.8

NOTE: Type of operation (Constant Power, Voltage or Current) can be selected only when high voltage HV is not active. When HV stays on, then value of selected mode can be set only.

NOTE: Maximum adjustable output voltage value is limited by "Limit Settings" – refer to chapter 4.3.4 for details.

NOTE: Input data for Constant Power, Voltage or Current operation are set in the same way for both of mode of operation: DC or PulseDC

4.2.6. CONSTANT CURRENT OPERATION

To operate power supply with Constant Current Operation, turn rotary encoder knob or use arrow buttons ▲ or▼ to select output current in *SET* field (*Fig.4.2.9*) and then press the encoder or **ENTER** button to edit mode – this will turn selected field into the blinking (about 1/s). Now output current set is possible – use rotary encoder or arrow buttons to change it.

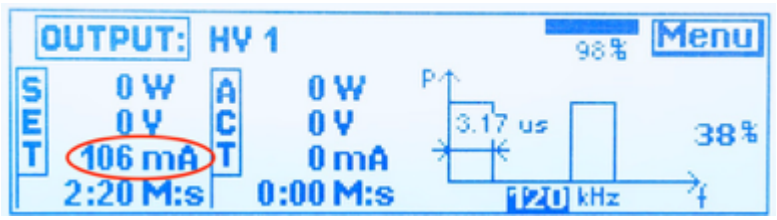


Fig. 4.2.9

NOTE: Type of operation (Constant Power, Voltage or Current) can be selected only when high voltage HV is not active. When HV stays on, then value of selected mode can be set only.

NOTE: Maximum adjustable current value is limited by “Limit Settings” – refer to chapter 4.3.4 for details.

NOTE: Input data for Constant Power, Voltage or Current operation are set in the same way for both of mode of operation: DC or PulseDC

4.2.7 TIMER OPERATION

PPS1500U can run with no limited operation time or according to the required timer set.

Turn rotary encoder or use arrow buttons ▲ or▼ to select timer TAB; press **ENTER** button or rotary knob to edit. Press **ENTER** button or rotary knob again to confirm the settings – *Fig. 4.2.10*

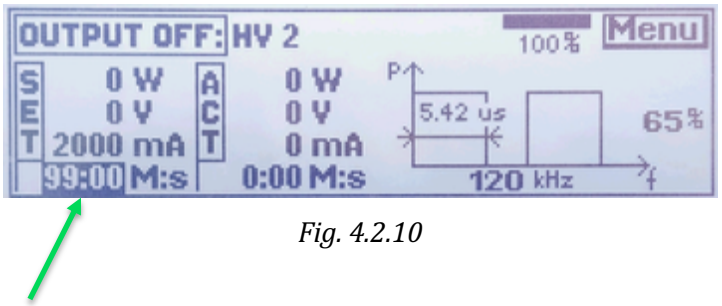


Fig. 4.2.10

To set the unit into no timer operation (Timer Off) set all timer values to 0 (0:00:M:s). If timer is set to 0, then HV activation will activate HV output active as long as HV button is pressed again.

Any other sets will automatically set the unit into the time counter operation – count down to 0:00:M:s. Timer will start counting as only high voltage operation is started (HV On) and will switch the high voltage off when timer will reach 0 (0:00:M:ss).

4.2.8 FREQUENCY SET IN PULSEDC OPERATION

Frequency range of operation can be set direct from the main screen menu – there are no needs to go into the advanced settings.

Turn rotary encoder or use arrow buttons ▲ or▼ to select frequency TAB; press **ENTER** button or rotary knob to edit. Press **ENTER** button or rotary knob again to confirm the settings – *Fig. 4.2.11*

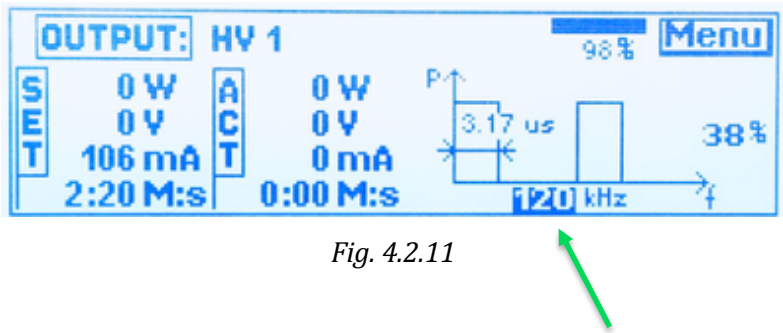


Fig. 4.2.11

NOTE: Frequency and duty cycle chart is displayed only when PulseDC mode is selected – ref. to chapter 4.3.1

4.2.9 DUTY CYCLE SET IN PULSEDC OPERATION

Duty cycle of the pulse in PulseDC operation can be adjusted from 2…70%.

NOTE: The lowest duty cycle strongly depends on minimum impulse time which cannot be shorter than 1,5 us

Select duty cycle field, and press **ENTER** button or rotary knob for pulse duty cycle set – *Fig. 4.2.12*

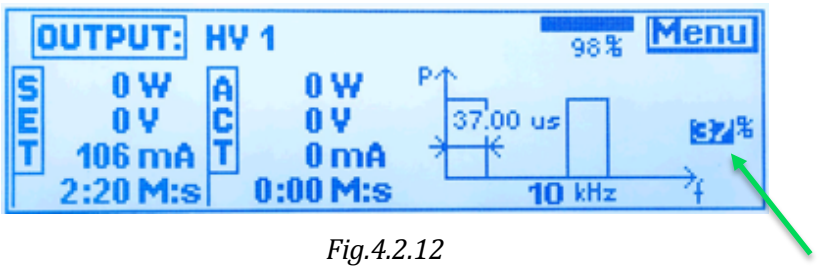


Fig.4.2.12

Pulse duration is directly depended on the frequency, and automatically changing when frequency change as well. Pulse with is given in the time period and displayed at the graph – *Fig.4.2.13*

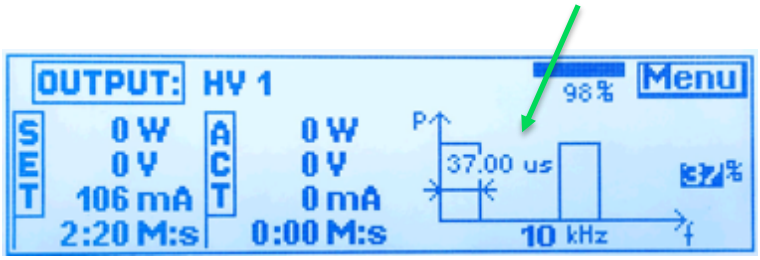


Fig. 4.2.13

NOTE: Frequency and duty cycle chart is displayed only when PulseDC mode is selected – ref. to chapter 4.3.1

4.3 MENU OPTIONS NAVIGATION AND SETTINGS

All of the advanced options of operation can be set in the MENU folder. Select *Menu* tab (*Fig. 4.1.1*) on the main page interface and press *Enter* button or *Knob* to switch to the sub menu operations. *Menu* window will pop up than – *Fig.4.3.0*

Fig. 4.3.0

4.3.1 SETTINGS MENU

Turn rotary encoder or use arrow buttons ▲ or▼ to select *Settings* tab; press **Enter** button rotary knob to edit – Fig 4.3.1

Fig.4.3.1

the following window will pup-up:

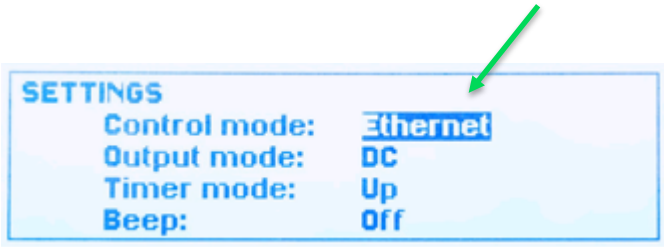


Fig.4.3.2

The following options are possible to set than:

1. ***Control mode:*** Local, Analog, Serial, or EthernetIP – Fig.4.3.2
   Turn rotary encoder or use arrow buttons ▲ or▼ to select *Control Mode* TAB; press **ENTER** button or rotary knob to edit. Press **ENTER** button or rotary knob again to confirm the settings.
   The following option to set are possible than:
   - *Local:* PPS1500U is controlled by active user interfacing using front panel buttons and rotary encoder are active and are set for device interfacing,
   - *Analog:* PPS1500U can be controlled via analogue interface – see chapter 3.3.5 for details,
   - *Serial:* PPS1500U is controlled by serial interface – see chapter 3.3.6 and 5.2 for hardware details and separate *"PPS1500U Serial Protocol"*
   - Ethernet: PPS1500U is controlled via Ethernet LAN interface using serial protocol - see chapter 3.3.7 and 5.3 for hardware details and separate *"PPS1500U Serial Protocol"*

NOTE: Not all of the options can be available – it is up to the firmware version. Contact with supplier for details

NOTE: one mode is active at the time only – sets and reads possibility. However always passive mode is accessible for all existing interfaces – all parameters can be always monitored, but can be set only from the selected mode

2. ***Output Mode:*** DC or PULSE – *Fig.4.3.3*

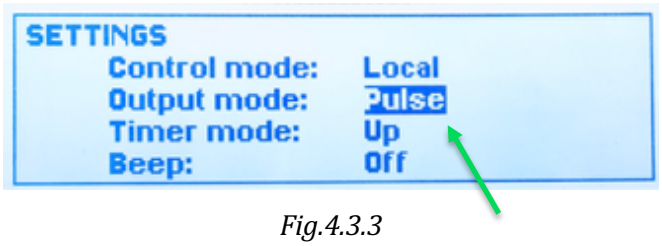


Fig.4.3.3

Turn rotary encoder or use arrow buttons ▲ or▼ to select *Output Mode* TAB; press **ENTER** button or rotary knob to edit. Press **ENTER** button or rotary knob again to confirm the settings.

The following mode of operation are possible to set:

- *DC* mode operation: PPS1500U will operate with DC voltage, current or power operation; see chapter 4.3.3 for details,
- *Pulse: PPS1500U* will operate with PulseDC voltage, current or power operation; see chapter 4.3.3 for details,

3. ***Timer Mode:*** Up or Down – *Fig.4.3.4*

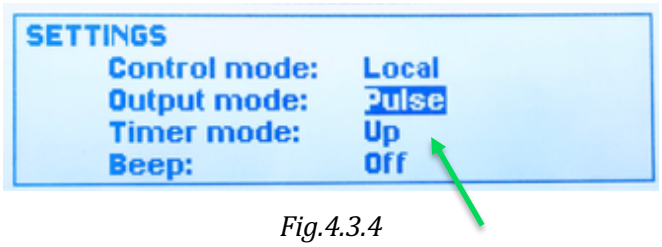


Fig.4.3.4

Turn rotary encoder or use arrow buttons ▲ or▼ to select *Timer Mode* tab; press **ENTER** button or rotary knob to edit. Press **ENTER** button or rotary knob again to confirm the settings.

The following timer of operation are possible to set:

- *Up*: operation of PPS1500U is active continually and follows clock counting when HV ON is activated; time of operation is displayed at the main screen – see chapter 4.2.7 for details,
- *Down*: operation of PPS1500U is active only for the time period which has been set on the main screen and counts down when HV ON is activated; actual remain time is displayed at the main screen – see chapter 4.2.7 for details.

4. ***Beep:*** On or Off – *Fig.4.3.5*

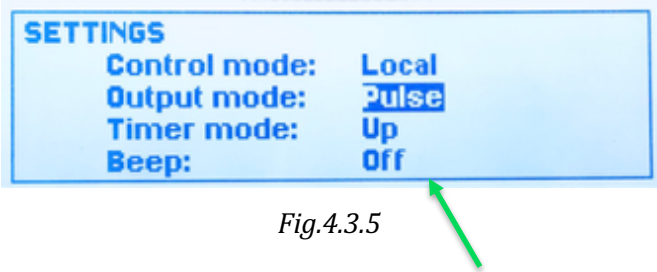


Fig.4.3.5

Turn rotary encoder or use arrow buttons ▲ or▼ to select *Beeper* field; press **ENTER** button or rotary knob to edit. Press **ENTER** button or rotary knob again to confirm the settings.

The following operation are possible to set:

- *On*: any press buttons or knob operation of PPS1500U are confirmed by short beep sound; also, any error message end and of operation in case *Timer Down* operation, will be indicated by beep sound,
- *Off*: turns off all of the sound effects of PPS1500U

4.3.2 SCREEN MENU

Turn rotary encoder or use arrow buttons ▲ or▼ to select *Screen* tab; press **ENTER** button rotary knob to edit – Fig 4.3.6

Fig.4.3.6

the following window will pup-up:

Fig.4.3.7

The following options are possible to set than:

1. ***Contrast:*** the LCD contrast; adjustable from 30…100% – Fig.4.3.7
   Turn rotary encoder or use arrow buttons ▲ or▼ to select *Contrast* tab; press **ENTER** button or rotary knob to edit. Press **ENTER** button or rotary knob again to confirm the settings.
2. ***Backlight:*** the LCD brightness; adjustable from 10…100% – Fig.4.3.7
   Turn rotary encoder or use arrow buttons ▲ or▼ to select *Backlight* tab; press **ENTER** button or rotary knob to edit. Press **ENTER** button or rotary knob again to confirm the settings.

4.3.3 TARGET MENU

Turn rotary encoder or use arrow buttons ▲ or▼ to select *Target* tab; press **ENTER** button rotary knob to edit – *Fig 4.3.8*

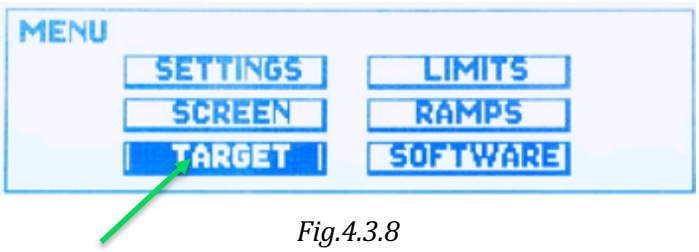


Fig.4.3.8

the following window will pup-up:

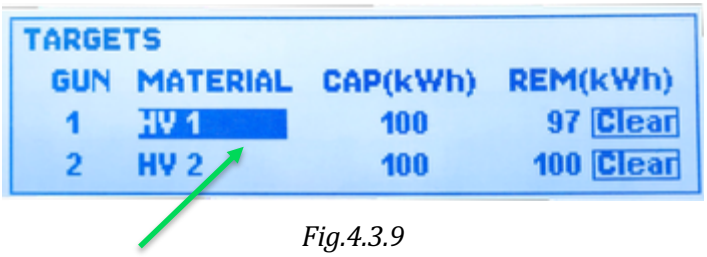


Fig.4.3.9

The target menu allows to set material names and target capacity for individual outputs. Also individual output names can be assigned here. The following options are possible to set than:

1. ***MATERIAL:*** customized name of the output can be assigned here for convenience instead of "HV1" or "HV2" by default. This assigned name of output is displayed on main screen under the normal operation than – see chapter 4.2.2 for details

   Turn rotary encoder or use arrow buttons ▲ or▼ to select *MATERIAL* tab; press **ENTER** button or rotary knob to edit. Press **ENTER** button or rotary knob again to confirm the settings.
2. ***CAP:*** capacity of the used target is entered here in reference to the target manufacturer specification – *Fig.4.3.10*

Fig.4.3.10

Each output activation decreases target lifetime according to the used time. Remaining lifetime is automatically calculated and updated under the *REM* tab. Additionally consumption is presented as % in the live time bar at the main screen – see chapter 4.1.7 for details.

Remaining value can be reset at any time by choosing *Clear* tab – Remaining value come back to the entered capacity value than - *Fig. 4.3.11*

Fig. 4.3.11

Turn rotary encoder or use arrow buttons ▲ or▼ to select *CAP* tab; press **ENTER** button or rotary knob to edit. Press **ENTER** button or rotary knob again to confirm the settings.

4.3.4 LIMITS MENU

Turn rotary encoder or use arrow buttons ▲ or▼ to select *Limits* tab; press **ENTER** button rotary knob to edit – *Fig 4.3.12*

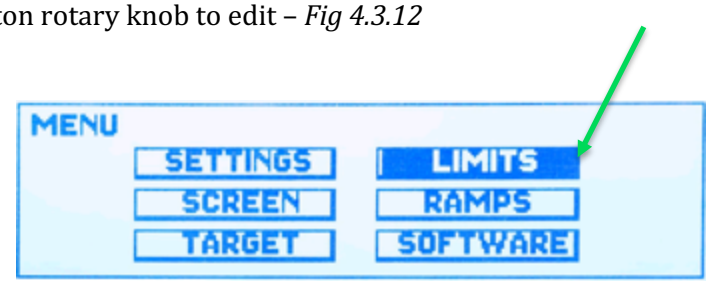


Fig.4.3.12

the following window will pup-up:

Fig.4.3.13

The following options are possible to set than:

1. ***Power limit:*** output power of PPS1500U can be limited with this option – *Fig.4.3.13*

   Turn rotary encoder or use arrow buttons ▲ or▼ to select *Power Limit* tab; press **ENTER** button or rotary knob to edit. Press **ENTER** button or rotary knob again to confirm the settings.

NOTE: Power limit sets are different for DC or PulseDC mode. Max power limit for DC mode can be set up to 1500W, and PulseDC up to 900W. See chapter 4.2.4 for details.

2. ***Voltage limit:*** output voltage of PPS1500U can be limited with this option – *Fig.4.3.13.* Max output voltage can be set from 200 …. 1000 V for any mode.

   Turn rotary encoder or use arrow buttons ▲ or▼ to select *Voltage Limit* tab; press **ENTER** button or rotary knob to edit. Press **ENTER** button or rotary knob again to confirm the settings.

3. ***Current limit:*** output current of PPS1500U can be limited with this option – *Fig.4.3.13.* Max output current can be set from 5 …. 3000 mA for any mode.

   Turn rotary encoder or use arrow buttons ▲ or▼ to select *Current Limit* tab; press **ENTER** button or rotary knob to edit. Press **ENTER** button or rotary knob again to confirm the settings.

4.3.5 RAMPS MENU

Turn rotary encoder or use arrow buttons ▲ or▼ to select *Ramps* tab; press **ENTER** button rotary knob to edit – *Fig 4.3.14*

Fig.4.3.14

the following window will pup-up:

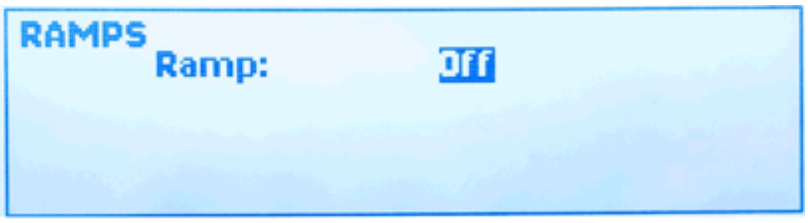


Fig.4.3.15

Turn rotary encoder or use arrow buttons ▲ or▼ to select *Ramp* tab; press **ENTER** button or rotary knob to activate the ramps options. Following window will pup-up – *Fig.4.3.16*

Fig.4.3.16

NOTE: Power ramp sets are different for DC or PulseDC mode. Max power ramp for DC mode can be set up to 1500W/s, and PulseDC up to 900W/s. See chapter 4.2.4 for details.

1. ***Power ramp:*** output power of PPS1500U can fallow the power ramp set. It can be set from 1….1500W/S for DC mode operation or from 1…900 W/S for PulseDC mode operation. Units cannot be changed.
   Turn rotary encoder or use arrow buttons ▲ or▼ to select *Power ramp* tab; press **ENTER** button or rotary knob to edit. Press **ENTER** button or rotary knob again to confirm the settings.

2. ***Voltage ramp:*** output voltage ramp of PPS1500U can be set with this option. It can be set from 1…1000V/s for any mode of operation.
   Turn rotary encoder or use arrow buttons ▲ or▼ to select *Voltage ramp* tab; press **ENTER** button or rotary knob to edit. Press **ENTER** button or rotary knob again to confirm the settings.

3. ***Current ramp:*** output current ramp of PPS1500U can be set with this option. It can be set from 1...3000mA/s for any mode of operation. Turn rotary encoder or use arrow buttons ▲ or▼ to select *Current ramp* tab; press **ENTER** button or rotary knob to edit. Press **ENTER** button or rotary knob again to confirm the settings.

NOTE: If Ramps are activated, all of the ramps works simultaneously – it is independent from Constant Power, Voltage or Current operation.

NOTE: Sometimes there is a problem to start the plasma with some gases, target materials and vacuum conditions. Turn the Ramp option off and try again if any problem with plasma exist.

4.3.6 SOFTWARE MENU

Turn rotary encoder or use arrow buttons ▲ or▼ to select *SOFTWARE* tab; press **ENTER** button rotary knob to edit – *Fig 4.3.17*

Fig.4.3.17

Most common information are displayed here. Software version is part of it – *Fig.4.3.18*

Fig.4.3.18

NOTE: Firmware can be upgraded by the user at any time. Refer to the "PPS1500U Firmware Upgrade manual" – contact with the manufactures for upgrades.

5. INTERFACE CONFIGURATION

5.1 ANALOG INTERFACE CONFIGURATION

The PPS1500U can be controlled by I/O analog interface. To configure I/O port as the master control of the device go to the *Control mode* tab and select *Analog* mode – Fig. 5.1.0 Turn rotary encoder or use arrow buttons ▲ or▼ to navigate; press **ENTER** button or rotary knob to edit. Press **ENTER** button or rotary knob again to confirm the settings.

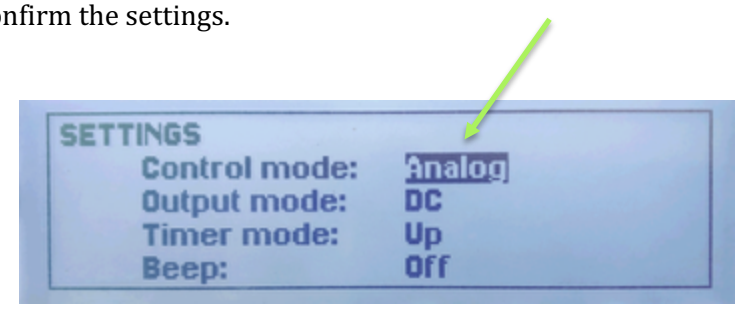


Fig.5.1.0

NOTE: no other settings for Analog interface are needed. For more hardware specification please refer to chapters 3.3.5 and 4.3.1 for details

NOTE: all Analog and digital outputs are active always – even when different interface is selected.

5.2 SERIAL RS232/485 INTERFACE CONFIGURATION

The PPS1500U can be controlled by one of serial port as well.

NOTE: only one kind of serial interface (RS232 or RS485) is available and it is up to hardware configuration upon the order process.

To configure serial port as the master control of the device go to the *Control mode* tab and select *Serial* mode – Fig. 5.2.0 Turn rotary encoder or use arrow buttons ▲ or▼ to navigate; press **ENTER** button or rotary knob to edit. Press **ENTER** button or rotary knob again to confirm the settings.

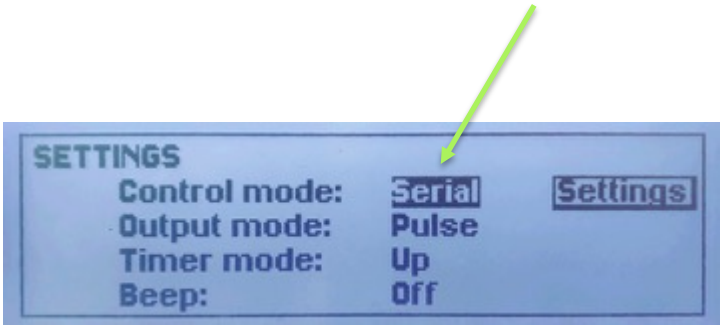


Fig.5.2.0

Go to the *Settings* tab with the next step to configure main parameters – *Fig.5.2.1*

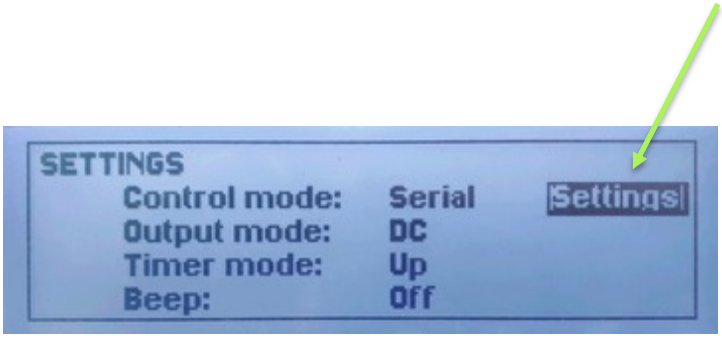


Fig.5.2.1

There are only two parameters to be set (*Fig. 5.2.2*):

- baudrate (can be selected from: 2400 kBs, 4800 kBs, 9600 kBs, 19 200 kBs, 38 400 kBs, 57 600 kBs, 115 200 kBs)
- device address (can be selected from 1 ….. 247)

Fig.5.2.2

NOTE: no other settings for Serial interface are needed. For more hardware specification please refer to chapters 3.3.6 and 4.3.1 for details

NOTE: unit address is used only for RS485 communication, where this parameter has to be different for each the same device in the same network

NOTE: if connection cannot be established, ensure about the proper address settings, and try to set slower baudrate

5.3 ETHERNET INTERFACE CONFIGURATION

The PPS1500U can be also controlled by Ethernet-LAN port.

To configure LAN port as the master control of the device, go to the *Control mode* tab and select *Ethernet* mode – Fig. 5.3.0 Turn rotary encoder or use arrow buttons ▲ or▼ to navigate; press **ENTER** button or rotary knob to edit. Press **ENTER** button or rotary knob again to confirm the settings.

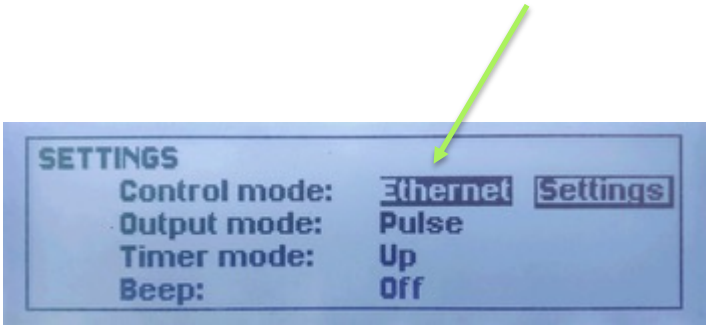


Fig.5.3.0

Go to the *Settings* tab with the next step to configure main parameters – *Fig.5.3.1*

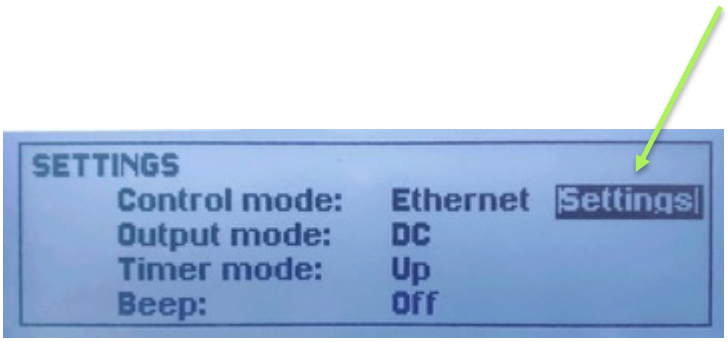


Fig.5.3.1

There are four parameters to be set (*Fig. 5.3.2*):

- DHCP on/off – manual or automating IP address assign,
- IP address (IVP4 standard),
- Net Mask – network mask
- Gateway – gateway of the connected network

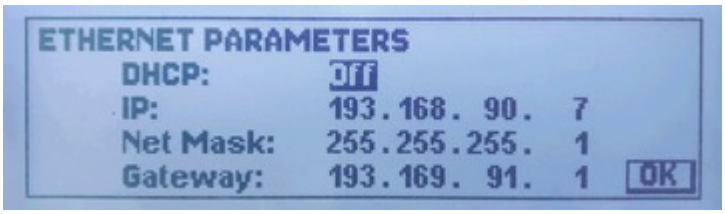


Fig.5.3.2

NOTE: as serial TCP ModBUS is implemented, the 5th parameter which Port is, is by default set to 502

6. MAINTENANCE AND SERVICE

6.1 MAINTENANCE

The PPS1500U does not require any special maintenance work except filter cleaning and exchange.

Important: Please check and exchange filters on the rear panel frequently. Do not remove EMI filters!

To exchange the filters please use a flat screwdriver or knife and remove the upper fan cover – Fig. 6.1.0

Fig. 6.1.0

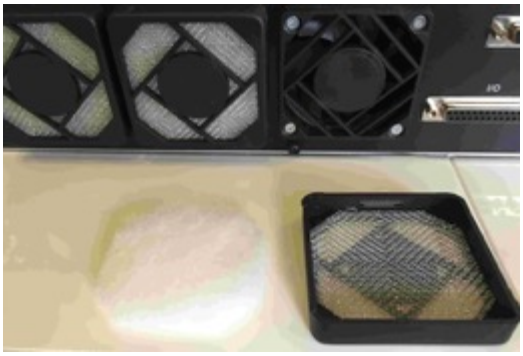


Fig. 6.1.1

Exchange the filters and put them back. Please take care to close the cover correctly - a click should be heard when pressing in place. See Fig. 6.1.2

Fig. 6.1.2

Please contact the supplier for spare part numbers and pricing.

6.1.1 CLEANING

For cleaning the outside of the device, a slightly moistened cloth will usually do. Do not use any aggressive or abrasive cleaning agents.

Mains voltage.

Components inside of the PPS1500U are components to mains voltage.

Do not insert any objects through the louvers of the device. Protect the device from liquids.

Do not open the device.

7. STORAGE AND DISPOSAL

7.1 PACKAGING

Please keep the original packaging. The packaging is required for storing the PPS1500U and for shipping it to an EDFelectronics service center.

7.2 STORAGE

The PPS1500U may only be stored in a dry room. The following requirements must be met:

Ambient temperature:	-20….+60 °C
Humidity:	as low as possible. Preferably in an air-tight plastic bag with a desiccant.

7.3 DISPOSAL

The product must be disposed of in accordance with the relevant local regulations for the environmentally safe disposal of systems and electronic components.

8. ADDITION

8.1. TROUBLESHOOTING

Pos.	Error:	Problem description:	Solution:
1.	No reaction after powering on – LCD display stays dark; no LEDs illuminating	Probably power failure	- check main cord connection, - check fuses in the main power socket – ref.. to section - Replace main cord
2.	"No Interlock !!!" message when switching to operation mode (HV on)	There is no hardware interlock connected	Check hardware interlock connection, or check external interlock source – refer to section: 3.3.5
3.	"Interlock lost !!! HV Off" message on LCD display	This message appears only when hardware interlock is missed during operation (when HV ON)	Check hardware interlock connection, or check external interlock source – refer to section: 3.3.5
4.	No output voltage, but maximum current appears („Imax" on LCD display)	The maximum current has been exceed	Probably output shortcut – check cable and the load connection
5.	No HV LED identification on when HV ON (max. Current appears)	Probably output shortcut	Check cable and the load connection
6.	No HV LED identification on when HV ON (0 V and 0mA on LCD display)	Limits are set to zeros or internal HV module failure	Check Limits settings – section: 4.3.1
7.	„Over Temperature!" message	Internal temperature exceeded 65 °C during normal operation (HV ON)	Internal temperature too high – ensure the air flow on the rear side of the PPS1500U is correct, and that external temperature is not too high. Clean/exchange filters – see section: 6.1. Check if fans are rotating

9. INDEX

10. WARRANTY CONDITIONS

LIMITED WARRANTY

EDFelectronics warrants to the purchaser or end user of the equipment it sells that such equipment will be free from defects in material and workmanship under normal use and service. This warranty is for a period of 27 months from the date of original shipment or two years (24 months) from the date the equipment is placed in use by the purchaser or end user thereof, whichever occurs first. This warranty is void if the equipment is not used, operated, and maintained in accordance with the manual accompanying the equipment. EDFelectronics shall not be responsible for any direct or indirect loss or damage resulting from accident, negligence of a user, alteration, abuse, or misuse of the equipment. Upon acceptance of this Limited Warranty, purchaser waives all warranties, guarantee, or remedies not specifically stated in this Limited Warranty. This warranty does not cover ordinary wear and tear or expendable components.

EDFelectronics's obligation under this Limited Warranty is, at EDFelectronics's option, to repair or replace any defective equipment or parts of the equipment, without charge to the purchaser, which are returned, shipping prepaid, to the EDFelectronics facility. For return or repair of equipment, purchaser must contact EDFelectronics for a Return Materials Authorization (RMA) prior to shipment of the equipment to EDFelectronics. If EDFelectronics has designated an Authorized Warranty Service Representative in the purchaser's country, contact may be made with the Authorized Warranty Service Representative and defective equipment may be delivered to such Authorized Warranty Service Representative to service warranty claims.

This warranty is in lieu of all other warranties, expressed or implied, including the implied warranties of merchantability and fitness for any particular purpose. The purchaser acknowledges the purchaser is not relying in EDFelectronics's skill or judgment to select or furnish equipment suitable for any particular purpose.