MP-1

DC Generator

USER MANUAL

Notice!
This operating manual is required for the safe operation of the MP-1 Generators. Therefore, you should keep the operating manual close to the unit.

Operating instructions for MP-1 Generator

DC Generator

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In the interest of providing even better equipment, HUETTINGER Electronic reserves the right to make product modifications without notification or obligation. To the best of our knowledge, the information contained in this manual is the most accurate available as of the date on the front page.

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To ensure years of dependable service, HUETTINGER Electronic ® products are thoroughly tested be among the most reliable and highest quality systems available. All parts and labour carry our standard 3-year warranty.

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Returning Units for Repair

Before returning any product for repair or adjustment, call **HUETTINGER Electronic Service** and discuss the problem with a representative service engineer. Be prepared to give the serial number of the unit and the reason for the purposed return. This consultation call will allow Customer Service to determine if the unit needs to be returned. Such technical consultation is always available at no charge.

Table of contents

1. Safety information

1.1. Important information

Safe operating procedures and proper use of the equipement are the responsibility of the user of this system.

The MP-1 Power Supply is designed to power industrial vacuum process chambers in PVD surface treatment technologies. Any other use, or any use beyond the foregoing, is deemed to be improper. The HUETTINGER Electronic company shall not be liable for any loss and damages resulting in such usage.

Correct usage also includes:

- compliance with all instructions from the operating manual,
- adherence to inspection and maintenance intervals.

1.2. Personnel

Only qualified personnel may work with the MP-1. "Qualified" means that the staff will be familiar with safe installation, maintenance and operation.

All of the personnel working with this equipment must take precautions to protect themselves against possible electrical shocks or fatal injuries. They must be acquainted with the entire MP-1 operating instruction manual and understand all of its contents.

Do not be careless around the equipment!

1.3. Safety standards profile

The MP-1 Power Supply was designed and constructed in compliance with requirements included in the following standards and EC directives:

- **EN 60950:** 1992 "Safety of information technology equipment, including electrical business equipment"
- **EN 50178:** 1998 "Electronic equipment for use in power installations"
- **EN 61000-6-4:** 2001 "Generic standards -Emission standards for industrial environments"
- **EN 61000-6-2**: 2001 "Generic standards – Immunity for industrial environments"

EC directives:

- **73/23/EEC** Low Voltage Directive – Law for electrical equipment within certain voltage limits
- **89/336 EMC** Directive as amended by 93/68/EEC – Laws relating to electromagnetic compatibility

- **Check the external fuse value and grounding circuit before switching the mains on.**
- **Never unscrew the front terminal cover before switching the mains off.**
- **The positive output of the power supply must be connected to the chamber frame potential (must be grounded).**

1.4. Transport and storage

Transport

MP-1 system must be firmly situated in a horizontal position.

Storage

Storage environments should be dry, free of aggressive vapors and not exposed to temperatures from beyond the 3k3 class range – EN 50178 (i.e.: -25, +55ºC). See table 'Environment'.

2. Explanation of symbols and notes

Failure to comply with these precautions means that slight physical injury or damage to property is possible.

Failure to comply with these warnings means that death, serious physical injury or damage to property are possible.

Failure to comply with these information can cause faults or failure of the MP-1 system performance.

Useful notice and tips about correct handling, operation and maintenance.

3. General information

The MP-1 Power Supply is designed to provide power for the magnetron ion source in an industrial vacuum process chamber for PVD surface treatment technologies.

The power-electronic design is based on switched mode technology which ensures low output current ripples, high efficiency, small dimensions and weight, low audio noise generation. Modular construction of the power converter circuits simplify transportation, installation and servicing duties.

All units are microprocessor controlled. All control-signal connections are digital and opto-isolated giving high resistance to electric disturbances.

A multi-control system gives the user a possibility of selecting from three optional control sources:

- Local: DISPLAY console located on the front panel of the MP-1.
- Remote: from a PC computer through an RS232 or RS485 link,
- Remote: Profibus

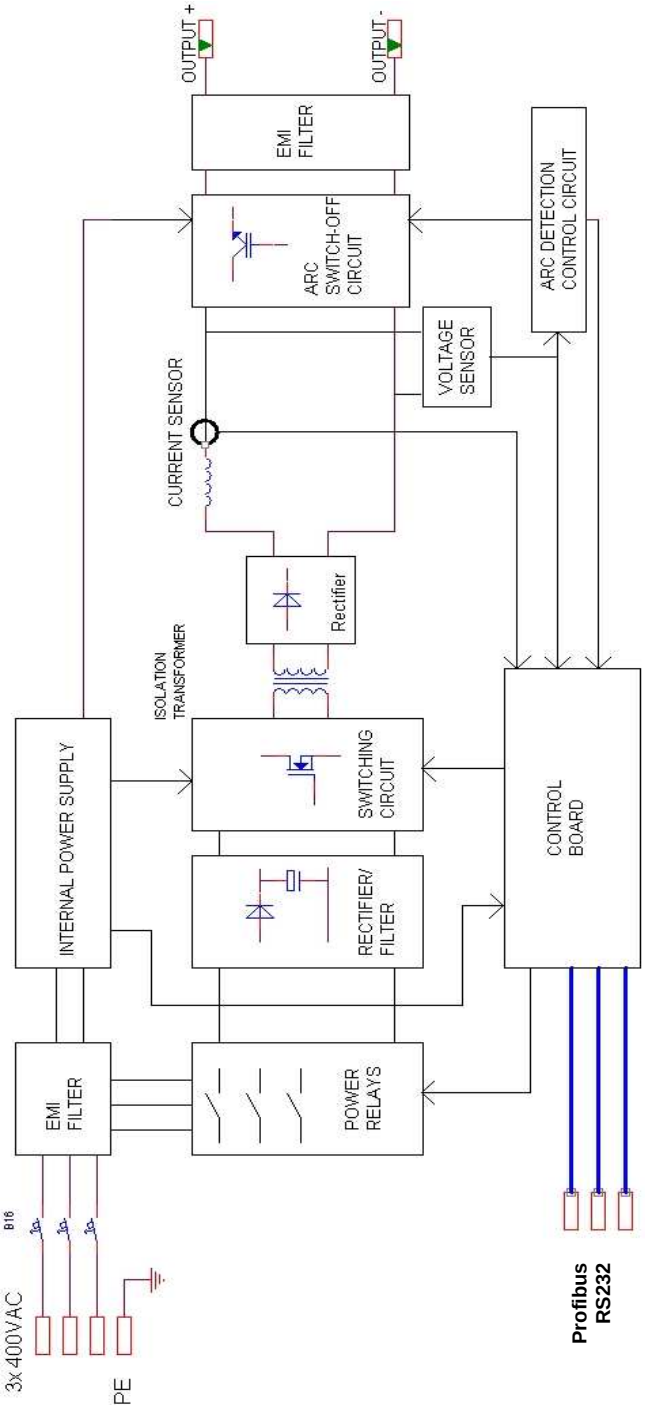
The power supply is assembled in one industrial steel enclosure in the 19" standard.

3.1. MP-1 block diagram

The power circuit consists of the following functional blocks:

- input EMI filter to reduce the EMI delivered to the mains,
- power relays which provide soft mains switch-on
- rectifier and filter
- high frequency switched-mode power converter
- high frequency transformer
- high frequency rectifier
- output filter
- arc switch-off circuit
- control electronics and auxiliary power supplies.

A block diagram of the MP-1 is shown below:



3.2. Output power characteristic for the MP-1 module

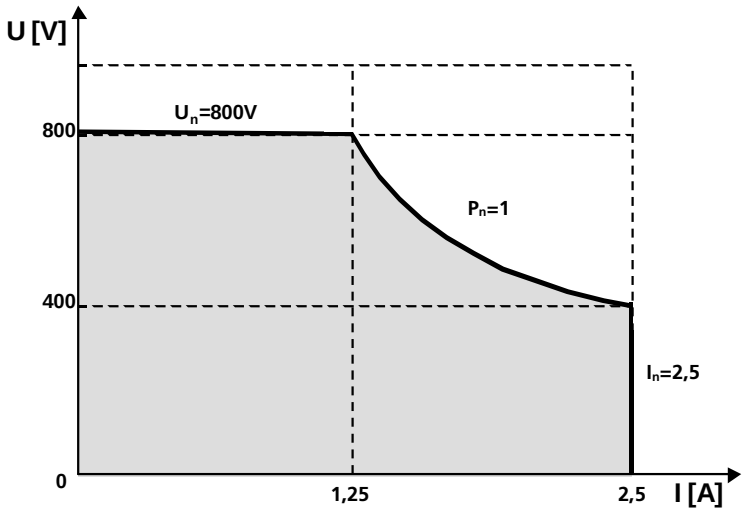


Fig.1. Output power characteristic for MP-1 module.

4. Electrical and mechanical specification

4.1. Electrical and mechanical specification in tables

Electrical specification - input characteristics

Overall			
Mains voltage	**V**		3 x 400V ±10%
Mains frequency	**Hz**		50 - 60Hz
Maximum mains input current	**A**		3 x 2A

Electrical specification – output characteristics

Power supply section:			
Output voltage and current:	**V**		0 … 800V 0 … 1.25 A 0 … 400V 0 … 2.5 A (see power characteristic Fig.1)
Control modes:			Local – display panel Remote – RS232 Remote – Profibus
Output parameters control			U voltage regulation I current regulation P power regulation:
Arc detection criteria: **Imax** an arc is detected when output current exceeds the Im	**A**		adj. I_{max} threshold 100 … 2600 mA,
U x I (cross detection) an arc is detected (if UxI detection mode is enabled) when output current exceeds the Ix threshold value while the output voltage drops below the Ux value	**V** **A**		adj. U threshold 0 … 200 V, adj. I threshold 50 … 2500 mA
dU (dynamic voltage change) an arc is detected (in case dU detection mode is enabled) when the output voltage drops rapidly by 75% of its value			preset ΔU = 75% actual output voltage value
Maximum arcing frequency	**Arc/s**		max 20
Fusing	**A**		10A, C-class installed inside of the enclosure
Efficiency	**%**		ca. 95%

Mechanical Specification

Mechanical Specification:			
Size (Width x Height x Length)	**mm**		**(19")** 482 x 133 x 545
Weight	**kg**		11

Environmental specification

Ambient operating temperature	**°C** **°F**		0 … +35 +32…+95
Storage temperature	**°C** **°F**		-25 … +55 -13 … +131
Relative humidity	**%** **g/m³**		5...85 (Non-condensing) 1…25
Air pressure	**kPa** **mbar**		80-106 800-1060 (approximately 2000 above sea level)
Pollution degree			<2 (see chapter 5.1 – installation site – contamination)

5. Installation

5.1. Installation site

Enclosure

The MP-1 power supply is built in a standard 19" enclosure and is designed to fit into a standard 19", 600mm deep rack cabinet. The weight of this device is ca. 11kg, and the mechanical construction of the cabinet should be strong enough to hold it. Forced ventilation inside cabinet is recommended. Inlet air temperature should not exceed 35°C.

Contamination

Cooling air should be free from corrosive vapors and particles that could become conductive particularly after exposure to moisture. A proper environment conditions ensure long lasting reliable performance- significantly increasing the MTBF.

Unpacking

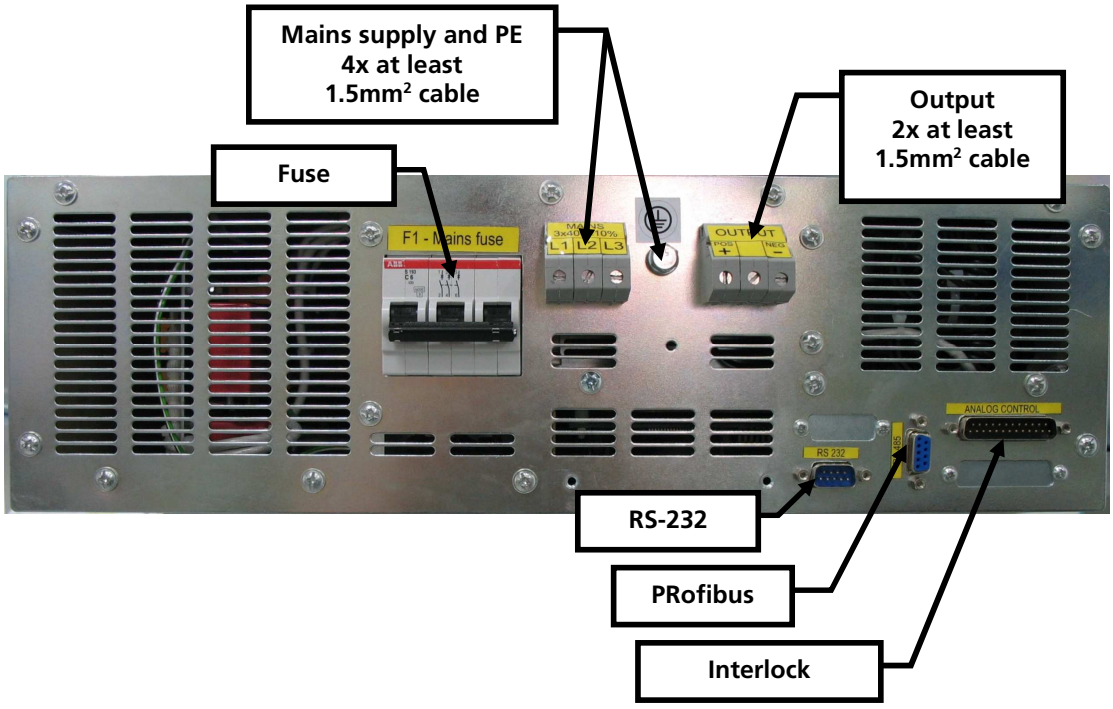
Inspect the devices packaging for damage and compare its contents with delivery documents.

5.2. Fusing

The MP-1 power supply has a set of 10A, class C mains fuses installed on the rear side of the enclosure. Also small fuses are installed inside the unit to protect the control circuits supply transformer. In case these fuses break, an examination of the power supply's interior is necessary, so the user should not exchange these fuses by himself.

6. Connecting the power supply

All connection terminals are located at the rear side, and should be covered by a protection grid after cabling.



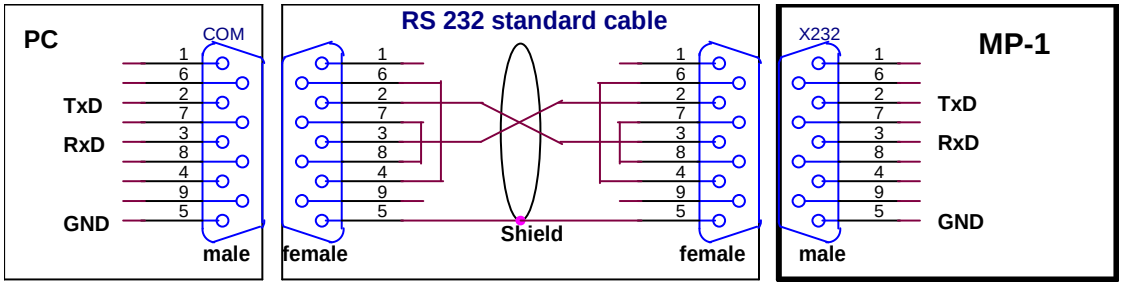
6.1. Connection terminals

Terminal	Description	Cable	Cable endings
MAINS	3 x 400VAC	min. 3 x 1.5mm²	3x ferrule
OUTPUT	800V / 2.5A	min. 2 x 1.5mm² twisted pair cable.	2x ferrule
PE	Protective earth	min. 1.5mm²	∅ 6 mm

Terminal	Description	Cable	Cable endings
RS232	RS232 Com. with PC	Standard RS232 cable. Pins 6 and 7 must be shorted. See RS-232 cable description.	SUBD 9pin female
Profibus	Communication with PC	One twisted pair shielded for Profibus;	SUBD 9pin male with terminators
Interlock		see below	SUBD 9pin male

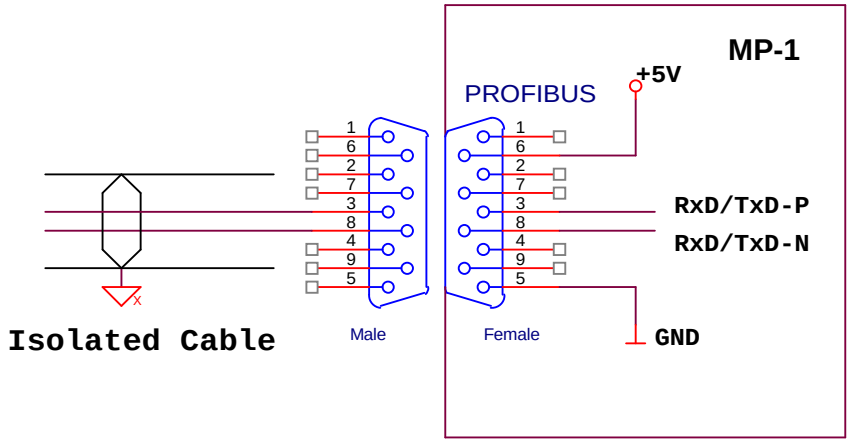
6.2. RS-232 terminal description

Pin no	Name	Type	Description
1	-	n/c	n/c
2	**TxD**	Digital output	RS232 transmit data
3	**RxD**	Digital input	RS232 receive data
4	-	n/c	n/c
5	**GND**	GND	Can be used for cable shield
6	-	n/c	n/c
7	-	n/c	n/c
8	-	n/c	n/c
9	-	n/c	n/c



6.3. Profibus terminal description

Pin no	Name	Type	Description
1	n/c	n/c	n/c
2	n/c	n/c	n/c
3	**RxD/TxD-P**	Digital I/O	Differential I/O signal
4	n/c	n/c	n/c
5	**DGND**	GND	Isolated Profibus ground
6	**VP**	+5V DC	Isolated Profibus supply voltage
7	n/c	n/c	n/c
8	**RxD/TxD-N**	Digital I/O	Differential I/O signal
9	n/c	n/c	n/c

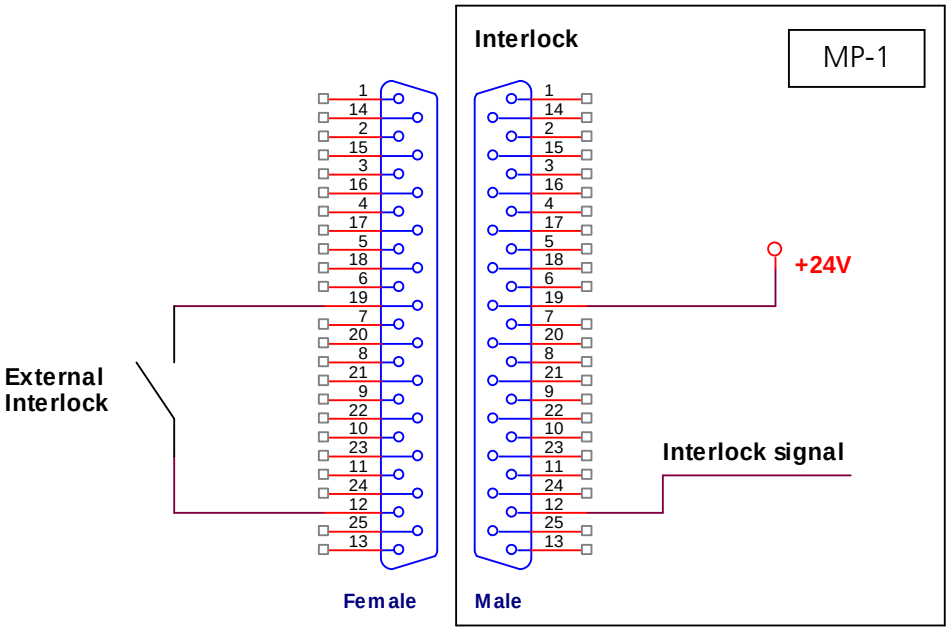


6.4. External Interlock

The Interlock feature is a circuit used for emergency interlock system. After disconnecting interlock loop (pins 12 and 19) power supply is immediately switched off - power relays are open.

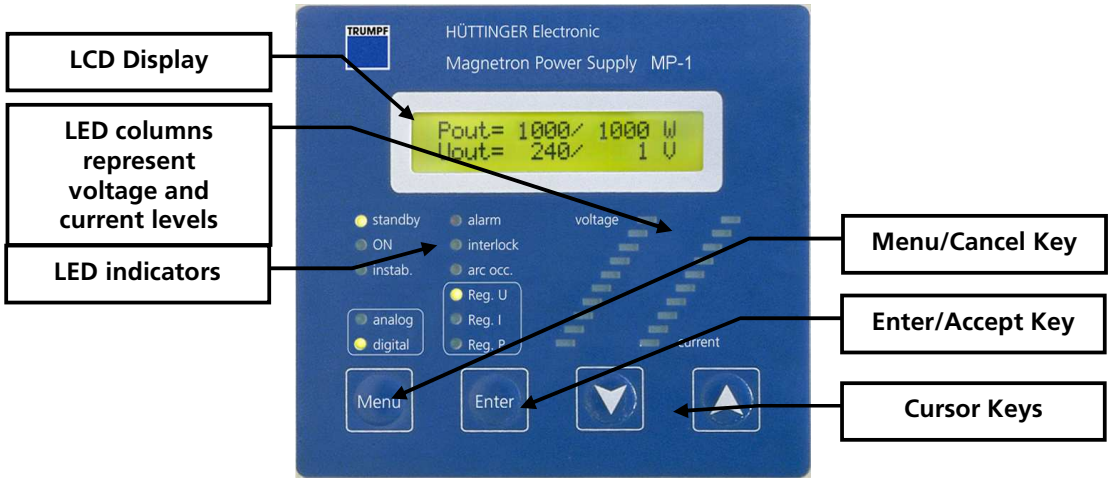
SUBD25pin MALE (at device side)

Pin nr	Name	Type	Description
12	**Interlock**	Digital input	Must be connected to 24V (pin 19) to enable power supply switch-ON. This is a relay-based hardware connection.
19	**+24V**	Supply output	24V supply for all digital inputs.



7. Working with the Front Panel Console

All indications and settings can be accessed through the front panel of the device. The next several pages contain description of the MP-1 Front Panel Console functions (illustrated in the menu map on page 20) and step-by-step instructions on how to access them.



The most important states are displayed on **LED indicators** for quick identification. These are:

Name	Color	Meaning
standby	green	The power supply is powered, but not switched-on yet.
ON	green	The power supply is running.
instab	green	Not used.
analog, digital	green green	Show the actual control mode. Analog LED lights if controlled through the analog connector. Digital LED lights if controlled through the RS232 or RS485 connector. Both LEDs are dark when controlled by the display console. Digital LED blinks to show proper RS transmission during PC monitoring.
Alarm	red	Blinks when critical conditions occur. Also an audible signal is sounded then.
Interlock	yellow	Interlock or door-closed detection circuits open,
Arc occ.	yellow	Blinks each time an arc is detected
Reg U Reg I Reg P	green green green	Indicate which regulator is currently active

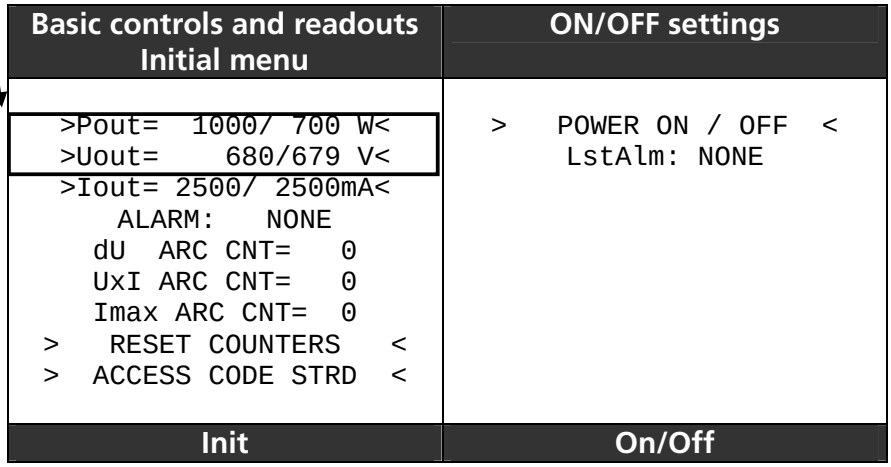
[1)] This LED blinks in standby mode when parameters are being changed (display panel in Modify Mode) to indicate the mode that the parameters refer to.

The data displayed on the LCD display is organized into several **item lists**.
The 2 basic ones are:

- Basic controls and readouts,
- Basic ON/OFF and mode control.

Use arrow keys ⮝ and ⮟ to scroll **display window** along the list

Use **MENU/CANCEL** key to switch between the **item lists**



An item, which can be modified, is indicated by a line-cursor: > modifiable item <. In this case it is sensitive to the ENTER/ACCEPT key. If the correct ACCESS CODE has been previously selected, pressing ENTER/ACCEPT will bring us into MODIFY mode and allow modification of the selected item values. The MODIFY mode is indicated by two arrows: → Value = 0000 ← . The value can be now modified by using the ⮝ and ⮟ keys.

Press **ENTER/ACCEPT** soft key to activate the new setting.
Press **MENU/CANCEL** soft key to leave MODIFY mode without changing the settings.

The **ACCESS CODE** feature keeps critical data from being accidentally changed. It also provides access to additional item lists, which are used during testing and service operations.

The initial access level is **STANDARD** (STRD). This allows the user to change the voltage, current and power settings for the power supply's regulators, reset the arc counters, switch the power supply on and off, change the operating modes and – of course – change the access level by entering the appropriate ACCESS CODE.

Selecting **SETUP** (SETP) access level will reveal a fourth item list – the **USER SETUP**, and allow the user to change the rest of the settings. The access code for this level is initially 1.

The available item lists after entering the **SETUP** access code will be:

Init	On/Off	User Setup Menu	Producer and product information
see above	see above	USER SETUP MENU: >CONTROL: DISPLAY < >ArcDet Imax =2500mA< >ArcDet Ix =2500mA< >ArcDet Ux = 100V < Enable / Disable >Imax: ENABLE < >UxI : ENABLE < >dU : ENABLE < >BreakTime = 20ms < >RampRate = 30units< >Ix setting= NORM >Profibus ID 120< >RS SPEED 9600 bps <	HUETTINGER Electronic tel:+48 22 7620000 tel:+48 606 298900 info@ pl.huettinger.com DEVICE: MP-01 PVD-Power Supply MAINS: 3x400V+/-10% 50/60Hz, 3x 2A OUTPUT: Pmax= 1kW U=0-800V I=0–2.5A PROGRAM VERSIONS: P15con4 :MP01-9 P15AD2 : AD-4 P15user2: U-7

There is one more level. It is the **SERVICE** (SERV) access level. It enables modification of input and output calibration values, voltage thresholds etc. Since improper modification of any of these settings may cause a malfunction of the device, the access code to this level is known by the service staff only.

8. Description of displayed data and settings

8.1. Basic controls and readouts

Display	Modif.	Description
>Pout = 1000/ 700 W<	Yes	Power regulator setting (first number) and actual power supply's output power readout (second number).
>Uout = 680/ 545 V<	Yes	Voltage regulator setting (first number) and actual power supply's output voltage readout (second number).
>Iout = 1.0/ 0.5 A<	Yes	Current regulator setting (first number) and actual power supply's output current readout(second number).
ALARM: NONE	No	When the ALARM LED blinks, this cyclically displays the states which caused the alarm.
dU ARC CNT = 45	No	Number of arcs detected by the dU criteria, which occurred from the last counter reset (max 10000)
UxI ARC CNT= 1300	No	Number of arcs detected by U x I criteria, which occurred from the last counter reset (max 10000)
ImaxARC CNT= 300	No	Number of arcs detected by the Imax, which occurred from the last counter reset (max 10000)
> RESET COUNTERS <	-	Press ENTER to reset the arc counters.
>ACCESS CODE STRD<	Yes	Entering the appropriate access code gives access to the **USER SETUP MENU** list and **SERVICE SETUP** list.

8.2. ON/OFF control

Display	Modif.	Description
> POWER OFF <	Yes	Setting this item to ON or OFF will switch the power supply ON or OFF if the DISPLAY control mode is selected (user setup menu).
LstAlm: NONE	No	If the power supply has been switched off due to an alarm state, this alarm statement will be displayed here.

8.3. User setup menu

User setup menu: (accessible from USER access level).

Display	Modif.	Description
>CONTROL: ANALOG<	Yes	The control mode (control source) can be switched between **DISPLAY**-console control or **ANALOG** - connector control. The RS232 connection mode is automatically activated when RS232 transmission is detected and the RS232 control feature in ***PVD Power*** is selected at the PC, and deactivated when this feature is deselected or no transmission is present for more then 5sec.
>ArcDet Imax = 2500mA<	Yes	I threshold 0.1 … 2.6A
>ArcDet Ix = 2500mA<	Yes	I threshold 0.05 … 2.5A
>ArcDet Ux =200V<	Yes	U threshold 0 … 200V
Enable/Disable:		
>Imax: ENABLE		Enable / Disable for **Imax** function
>UxI : DISABLE		Enable / Disable for **U x I** function
>dU : DISABLE		Enable / Disable for **dU** function
>BreakTime= 20ms<	Yes	After an arc is detected the power supply's output shuts off for the amount of time 2 … 60ms.
>RampRate= 30units<	Yes	The voltage recovery ramp slope setting. The higher the setting, the faster (steeper) the recovery ramp.
>Ix setting NORM <	Yes	**AUTO:** The actual Ix threshold is set either to the Ix setting or the Iout setting depending on which one of them is LOWER. **NORM**: AUTO feature disabled
>Profibus ID 120<		Profibus ID setting
>RS SPEED 9600bps<		Baud Rate for serial port (2400 - 38400)

9. Interfaces

9.1. RS-232 communication protocol

The MP acts as a slave device in the communication process. It never initiates a transmission. The master computer (PC) sends a command which is executed by the MP and a reply is generated (with respect to note 1). The recognized commands are presented below. Additional commands can be implemented if necessary.

The baud rate can be set from 2400 to 38400 from the MP's front panel console to correspond to the rate set at the PC.

8913 Normal run

PC to MP

0	1	2	3	4	5 - 8	9-12	13-16	17,18	19	20	21
$16	$E9	$89	$13	Adr	Uset	Iset	Pset	ignored	Bits	SH[2)]	SL[2)]

Where:

Adr Address for RS485 0 ... 255 [1)]
Uset (float) Voltage setpoint [V] 0 ... 800V
Iset (float) Current setpoint [A] 0 ... 2500mA
Pset (float) Power setpoint[kW] 0 … 1kW

Bits: Control bits:

0: PC controls the MP (1), Monitoring only (0)
1: -
2: Mains relays ON (1), OFF (0)
3: Power ON (1), OFF (0)
4: -
5: Reset arc counters (for 1 transmission is enough)
6: RegSel1
7: RegSel2

	RegSel1	RegSel2
Regulator P	0	0
Regulator I	1	0
Regulator U	0	1
Presputter	1	1

MP reply to PC

0	1	2	3	4-7	8-11	12-13	14-15	16	17
$16	$E9	$40	00	Uact	Iact	Im cnt	UxI cnt	Bits1	Bits2
18	**19**	**20**	**21**						
dU cnt	-	SH[2)]	SL[2)]						

Where:

Uact (float)	Output average voltage [V]	0...800V
Iact (float)	Output average current [A]	0...2500mA
Im cnt (integer)	Arc counter (Imax criteria)	0...10000
UxI cnt (integer)	Arc counter (UxI criteria)	0...10000
Ud cnt (integer)	Arc counter (dU criteria)	0...10000

Bits0: Acknowledge bits:

0: PC control acknowledge (1), analog or display console (0)
1: =1
2: Relays ON ack. (1), or OFF (0)
3: Power ON (1), INHIBIT (0)
4: =1
5: UxI enabled
6: dU enabled
7: =1 after RESET until the 1-st transmission to PC

Bits1: more acknowledge bits.

0: Interlock (1), no interlock (0)
1: OverTemp Bit: 1=Overtemp
2: PowerFail (1), power OK (0)
3: Display Fail (1), display OK (0)
4: Communication with pulse unit Fail (1) OK (0)
5: EEprom data sum error (1), OK (0)
6: EEprom write Error (1), OK (0)
7: AlarmActive (1), inactive (0).

Other parameters can be accessed for reading or adjustment through their channel numbers. Byte, integer and float values have separate channel number lists. The command strings for reading and setting these values together with the channel lists are presented below.

However, the user must be aware, that changing the values by using these Set… commands will interrupt the operation of the power supply for ca. 100ms each time the command is executed. This time is needed to store the new data into an EEPROM memory, verify the contents and calculate new checksums. Therefore, it is wise not to use these commands under power-on conditions. Also changing some parameters (dynamic settings) may spoil the performance of the power supply.

8003 Set a floating point value

PC to MP

0	1	2	3	4	5	6
$0D	$F2	$80	$03	Adr	Chan1	Chan2
7	**8**	**9**	**10**	**11**	**12**	
Val0	Val1	Val2	Val3	SH[2)]	SL[2)]	

Where:

Adr	Adres for RS485	0..255 [1)]
Chan (int)	Channel number	
Val (float)	Value to be set	

MP reply

0	1	2	3	4	5
$06	$F9	AckH[3)]	AckL[3)]	SH[2)]	SL[2)]

8004 Read a floating point value

PC to MP

0	1	2	3	4	5	6
$09	$F6	$80	$04	Adr	Chan1	Chan2
7	**8**					
SH[2)]	SL[2)]					

Where:

Adr	Adres for RS485	0..255 [1)]
Chan (int)	Channel number	

MP reply (OK.)

0	1	2	3	4	5	6
$0A	$F5	$40	$00	Val0	Val1	Val2
7	**8**	**9**				
Val3	SH[2)]	SL[2)]				

MP reply (Fail)

0	1	2	3	4	5
$06	$F9	AckH[3)]	AckL[3)]	SH[2)]	SL[2)]

8006 Set a byte value

PC to MP

0	1	2	3	4	5	6
$0A	$F5	$80	$06	Adr	Chan1	Chan2
7	**8**	**9**				
Val	SH[2)]	SL[2)]				

Where:

Adr	Adres for RS485	0..255 [1)]
Chan (int)	Channel number	
Val (byte)	Value to be set	

MP reply

0	1	2	3	4	5
$06	$F9	AckH[3)]	AckL[3)]	SH[2)]	SL[2)]

8007 Read a byte value

PC to MP

0	1	2	3	4	5	6
$09	$F6	$80	$07	Adr	Chan1	Chan2
7	**8**					
SH[2)]	SL[2)]					

Where:

Adr	Adres for RS485	0..255 [1)]
Chan (int)	Channel number	

MP reply (OK.)

0	1	2	3	4	5	6
$07	$F8	$40	$00	Val	SH[2)]	SL[2)]

Where:

Val (byte)	Asked byte value

MP reply (Fail)

0	1	2	3	4	5
$06	$F9	AckH[3)]	AckL[3)]	SH[2)]	SL[2)]

8008 Set an integer value

PC to MP

0	1	2	3	4	5	6
$0B	$F4	$80	$08	Adr	Chan1	Chan2
7	**8**	**9**				
ValH	ValL	SH[2)]	SL[2)]			

Where:

Adr	Adres for RS485	0..255 [1)]
Chan (int)	Channel number	
ValH, ValL (word)	Value to be set	

MP reply

0	1	2	3	4	5
$06	$F9	AckH[3)]	AckL[3)]	SH[2)]	SL[2)]

8009 Read an integer value

PC to MP

0	1	2	3	4	5	6
$09	$F6	$80	$09	Adr	Chan1	Chan2
7	**8**					
SH[2)]	SL[2)]					

Where:

Adr	Adres for RS485	0..255 [1)]
Chan (int)	Channel number	

MP reply (OK.)

0	1	2	3	4	5	6	6
$08	$F7	$40	$00	ValH	ValL	SH[2)]	SL[2)]

Where:

Val (byte)	Asked byte value

MP reply (Fail)

0	1	2	3	4	5
$06	$F9	AckH[3)]	AckL[3)]	SH[2)]	SL[2)]

Channel numbers:

Byte:

Chan	Text	Range	Adjustable?
0.	Address for RS485 communication	0 … 255	YES
1.	Break time [ms]	2 … 60	YES
2.	Ramp rate [V/ms]	5 … 40	YES
	PID settings for regulators		
3.	KpU_HV	0 … 200	YES
4.	TiU_HV	0 … 200	YES
5.	TdU_HV	0 … 200	YES
6.	KpI_HV	0 … 200	YES
7.	TiI_HV	0 … 200	YES
8.	TdI_HV	0 … 200	YES
9.	RplMax	0 … 100	YES
10.	ImPsp	20 … 255	YES
$8003	Imax arc detection criteria enabled	0 … 1	YES
$8004	UxI arc detection criteria enabled	0 … 1	YES
$8005	dU arc detection criteria enabled	0 … 1	YES

Integer

Chan	Text	Range	Adjustable?
28	Power supply software version	0…255	NO
29	Pulse controller software version	0…255	NO
30	Analog interface (if installed) software version	0…255	NO

Float

Chan	Text	Range	Adjustable?
	Arc detection threshold settings		
0	Current threshold for Imax arc det. criteria:	100...2600mA	YES
1	Current threshold for Ix arc det. criteria:	50...2500mA	YES
2	Voltage threshold for Ix arc det. criteria:	0…200V	YES
	Internal temperature values and voltages		
3	At control PCB	0…100°C	NO
4	GB	0…100°C	NO
5	Rect	0…100°C	NO
6	At transformer	0…100°C	NO
7	Rectified mains voltage (nomin: 650V)	0…700V	NO
8	Controller supply voltage (nomin: 24V)	0...35V	NO

NOTES:

1) If Adr=255 the MP will always react to the received command, regardless its own address, but it will send a reply (confirmation) only if its own address matches the Adr.

2) SH, SL are the high and low bytes of the check-sum. The check-sum is an arithmetic sum of bytes 2 … (n-2), where n is the number of the last byte of transmission.

3) AckH and AckL are acknowledge codes which are listed below.

Acknowledge and failure codes (HEX format)

4000 OK
Transmission OK. and command executed.

4001 Transmission length error
Byte1 is not a negation of byte0.

4002 Check sum error
The two byte checksum is not equal to the sum of bytes nr 2 … (n-2)

4003 Command not executable
Command is understood, but can not be executed due to technical conditions.

4004 Command not understood
Command is not implemented.

9.1. Profibus communication protocol

PROFIBUS is an interface that allows you communicate with the MP01 from a PROFIBUS master . The BP unit acts as a slave device in the communication process. It never initiates a transmission. The PROFIBUS master sends a command coded in modules, which is executed by the MP, after that generated is reply. The recognized modules are presented below. Additional modules or functions can be implemented if it is necessary.

Baud Rate for communication between PROFIBUS master and PROFIBUS slave

The PROFIBUS slave in the MP has the auto –baude feature, which allows to adjust automatically to the rate of the PROFIBUS master system during start-up. Baud rate are accessible in discrete steps from 9.6 kbits to 12 Mbits.

Settings of PROFIBUS ID

The ID number is setting by using the front panel console of MP. The software read the ID number from MP at the beginning the program. If the ID number was changed, the unit must be restarted.

PROFIBUS module construction

MP01 use two modules, which have a different length of byte. It is very important to put modules in properly order, otherwise the "Parameter data error" can be appearing.

All integer (2 byte) values are given with the MSB first. There is no possibility to set the float value, but it can be implemented if it is necessary. All types of modules are presented below.

Module 1 - Outputs- (identification 0x82,0x0D,0x00,0x01)

0	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**
Ctrl	Uset0	Uset1	Iset0	Iset1	Pset0	Pset1	Chan0	ValH	ValL	Chan1	Chan2
12	**13**										
Val	Chan3										

This module is represented by 16 bytes, where:

Ctrl – control byte represented by 8 control bits:

0: PROFIBUS master controls the MP (1)
1: -
2: Mains relays ON (1), OFF (0)
3: -
4: -
5: Reset arc counters (for 1 transmission is enough)
6: Presputter
7: -

Uset - Voltage setpoint, represented by a 16bit (two bytes Uset0 and Uset1) integer number. Scaling: 0..10000 represents 0..800V

Iset - Current setpoint, represented by a 16bit (two bytes Iset0 and Iset1) integer number. Scaling: 0..10000 represents 0.. 2500 mA

Pset - Power setpoint, represented by a 16bit (two bytes Pset0 and Pset1) integer number. Scaling: 0..10000 represents 0..1000 W

Chan0, ValH, ValL – write integer value

These three bytes enables to write new threshold values. The first byte - Chan0 - represent channel number, second and third bytes - ValH, ValL - represent the new value in integer. If new value was wrote properly, the MP confirm this, sending in "ValHi" and "ValLi" new, just written value. The list of available channels presented is on the next page. Scaling is: 0..10000 represents 0..1000 value.

Chan1 - read integer value

This output byte enables to read threshold values or temperatures and represent channel number of the value, which will be read. The list of available channels presented is on the next page.

Chan2, Val – write byte value

These three bytes enables to write new byte values (new PI regulators settings, etc.). The first byte - Chan0 -represent the channel number and the second byte - Val - represent the new value in byte. If new value was wrote properly, the MP confirm this, sending in "ValB" new, just written value. The list of available channels presented is on the next page.

Chan3 - read byte value

This output byte enables to read byte value from selected channel and represents channel number of the value, which will be read. The list of available channels; presented is on the next page.

Module 1 - Inputs- (identification 0x42,0x12,0x00,0x02)

0	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**
Uact0	Uact1	Iact0	Iact1	Pact0	Pact1	Imcn0	Imcn1	UxIc0	UxIc1	dUcn0	dUcn1
12	**13**	**14**	**15**	**16**	**17**	**18**					
Bits0	Bits1	Chan4	ValHi	ValLi	Chan5	ValB					

This module is represented by 19 bytes, where:

Uact - Average voltage readout, represented by a 16bit (two bytes Uact0 and Uact1) integer number. Scaling: 0..10000 represents 0..800V

Iact - Average current readout, represented by a 16 bit (two bytes Iact0 and Iact1) integer number. Scaling: 0..10000 represents 0..2500 mA

Pact - Average power readout, represented by a 16bit (two bytes Pact0 and Pact1) integer number. Scaling: 0..10000 represents 0..1000 W

Imcn - Arc counter for Imax criteria, represented by a 16bit (two bytes Imcn0 and Imcn 1) integer number. Show actual value of Imax counter.
The range of Imcn counter is: 0 - 10000.

UxIc - Arc counter for UxI criteria, represented by a 16bit (two bytes UxIc0 and UxIc1) integer number. Show actual value of UxI counter.
The range of Imcn counter is: 0 - 10000.

dUcn - Arc counter for dU criteria, represented by a 16bit (two bytes dUcn0 and dUcn1) integer number. Show actual value of dU counter.
The range of Imcn counter is: 0 - 10000.

Bits - Represented by a 16bit (two bytes Bits0 and Bits1), show basis information about MP. The description and complete information about acknowledge

Bits0: Acknowledge bits:
- 0: PC control acknowledge (1), analog or display console (0)
- 1: -
- 2: Relays ON ack. (1), or OFF (0)
- 3: Power ON (1), INHIBIT (0)
- 4: -
- 5: UxI enabled
- 6: dU enabled
- 7: =1 after RESET until the 1-st transmission to PC

Bits1: more acknowledge bits.
- 0: Interlock (1), no interlock (0)
- 1: OverTemp Bit: 1=Overtemp
- 2: PowerFail (1), power OK (0)
- 3: Display Fail (1), display OK (0)
- 4: Communication with pulse unit Fail (1) OK (0)
- 5: EEprom data sum error (1), OK (0)
- 6: EEprom write Error (1), OK (0)
- 7: AlarmActive (1), inactive (0).

Chan4, ValHi ValLi - read integer value

These three bytes are reply for a command – read integer value (setting channel Chan1) or write integer (setting channel Chan0) in output module. Chan4 byte represents channel number of written or read value.

After writing value (setting channel Chan1) MP unit confirm its - if new value was written properly, send in "Chan4" channel number and in "ValHi" and "ValLi" new, just written value. If not, the MP unit will send in all theses bytes the 0xFF value.
The scaling is:
For channel number 1 to channel 3 is: 0..10000 represents 0..10000 value
For channel number 4 to channel 9 is: 0..10000 represents 0..1000 value

Chan5,ValB - read byte value

These two bytes are reply for a command – read byte value (setting by channel Chan3) or write byte (setting by channel Chan2) in output module. Chan5 byte represents channel number of written or read value.

After writing value (setting channel Chan3) MP unit confirm its – if new value was written properly, send in "Chan5" channel number and in "ValB" new, just written value. If not, the MP unit will send in all theses bytes the 0xFF value.

Channel address:

Byte:

Chan	Text	Range	Adjustable?
11.	ID number	1 … 127	NO
12.	Break time [ms]	2 … 60	YES
13.	Ramp rate [V/ms]	5 … 40	YES
	PID settings for regulators		
14.	KpU	0 … 200	YES, but do not change the setting without consulting AC
15.	TiU	0 … 200	
16.	TdU	0 … 200	
17.	KpI	0 … 200	
18.	TiI	0 … 200	
19.	TdI	0 … 200	
20.	Phase Detection Treshold	0 … 200	
21.	Imax Presputter	20 … 255	
23.	Profibus version	0…255	NO
24.	Power supply software version	0…255	NO
25.	Pulse controller software version	0…255	NO
26.	Analog interface (if installed) software version	0…255	NO

Integer

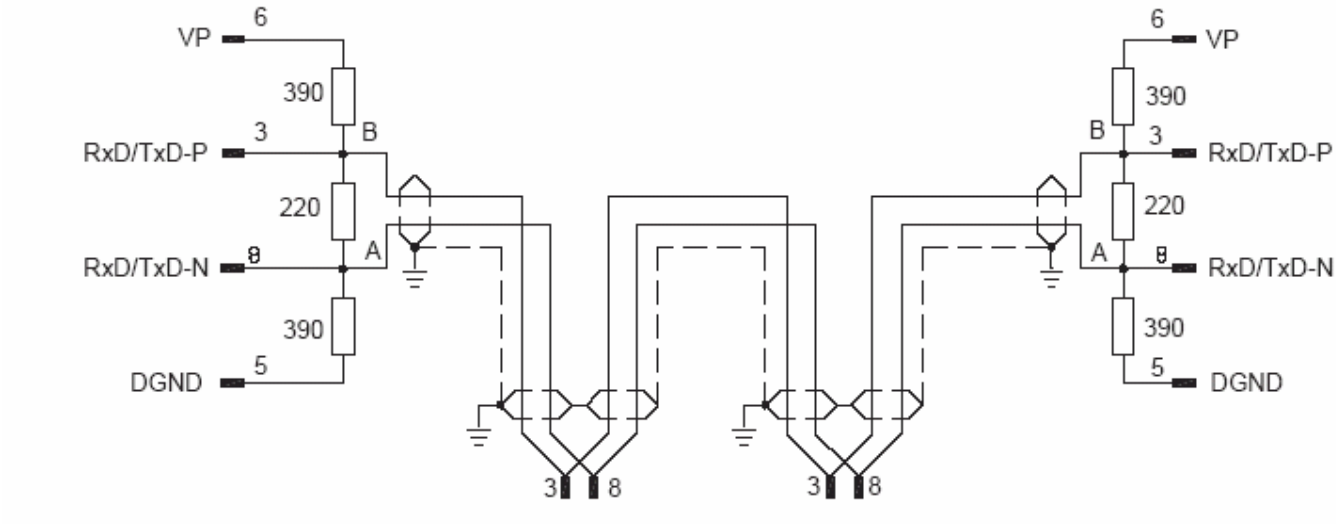
Chan	Text	Range	Adjustable?
	Arc detection threshold settings		
1.	Current threshold for Imax arc det. criteria:	100... 2600A	YES
2.	Current threshold for Ix arc det. criteria:	50... 2500A	YES
3.	Voltage threshold for Ix arc det. criteria:	2…200V	YES
	Internal temperature values and voltages		
4.	At control PCB	0…100°C	NO
5.	At HF rectifier	0…100°C	NO
6.	At pulse switch semicond.	0…100°C	NO
7.	At transformer	0…100°C	NO
8.	Rectified mains voltage (nomin: 650V)	0…700V	NO
9.	Controller supply voltage (nomin: 24V)	0...35V	NO

Profibus safety

In any case when the PROFIBUS slave lost connection with PROFIBUS master or when master stops communicating, the MP01 turn off output power and restart PROFIBUS slave. After then the PROFIBUS slave will be try to connect with PROFIBUS master.

Physical layer and configuration of MP01

To connect the MP with the PROFIBUS, an isolated RS-485 interface (according with EN 50170) is required. Please ensure that termination resistors are available at both ends of the cable. If special PROFIBUS connectors are being used, these resistors are often found inside the connector and must be switched on. The cable shield should be firmly connected to ground at every device. Make sure that there is no potential difference between the grounds at the devices.



GSD files

GSD (Electronic data sheet of a device) files contain and describe the functions and character of PROFIBUS device. Therefore, to use this unit in a PROFIBUS system, it needs to have a specific GSD file that is compatible with the unit. Please, use only this GSD file, which is delivered with MP.

Specification for PROFIBUS slave MP:

Configuration data: in accordance with GSD file (MP_v2.gsd)
Technology: ASIC
Physical separation fieldbus side: Standard
Baud rate for RS485: Automatic detection up to 12 Mbaud
Sync: Supported
Freeze: Supported
Primitive fieldbus ID: 126
Dipswitch: Supported

APPENDIX A
Arc detection criteria

This circuit is responsible for:

- measuring the voltage and current at the output terminals of the power supply,
- arc occurrence detection and a switch-off initiation,
- a time control of a switch-off procedure.

The output voltage is measured through a high-voltage isolation amplifier. The output current is measured a LEM transducer. The arc detector circuit bears quite complex ideas which may require some theoretical explanation.

Electric arcs, which will occur inside the vacuum chamber during any stage of the surface treatment process may negatively affect the treated surface and for that reason should be extinguished as soon as possible. From the electrical point of view an arc occurrence is a rapid change of impedance at the chambers electric terminals.

The **MP** arc detection system is equipped with three types of parameter "traps" to ensure fast response to arc occurrence.

Imax - a programmable, maximum current trap level,
U x I - voltage-current trap pair (UxI) with both constant, programmable voltage (Ux) and current (Ix) levels,
dU - a dynamic voltage trap level

$\mathbf{I_{max}}$ and **dU** traps are a single parameter type (an arc is detected when the working point crosses one current or voltage level).

UxI requires crossing both - current and voltage levels to detect the arc.

Once arcs are detected, their number is displayed on the LCD display with respect to 2 types of traps – Imax and UxI + dU - which has detected the arc. Once an arc has been detected the shut-down signal is activated and the output power of the power supply is switched off. At this same moment a time control procedure is called and a **shut-down time interval** is provided.

When the shut-down time interval has elapsed, the shut-down signal is released and the power units return to it's previous voltage setting with a voltage ramp which is also programmable. By setting the **ramp rate** parameter, the time after which the voltage reaches its stable value may be controlled.

I_{max}

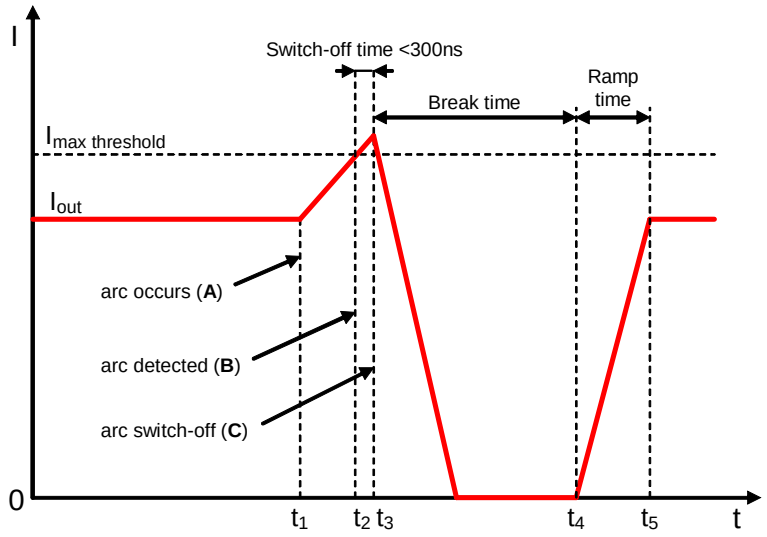


Fig. 5.1. **I_{max}** criteria arc detection example.

UxI

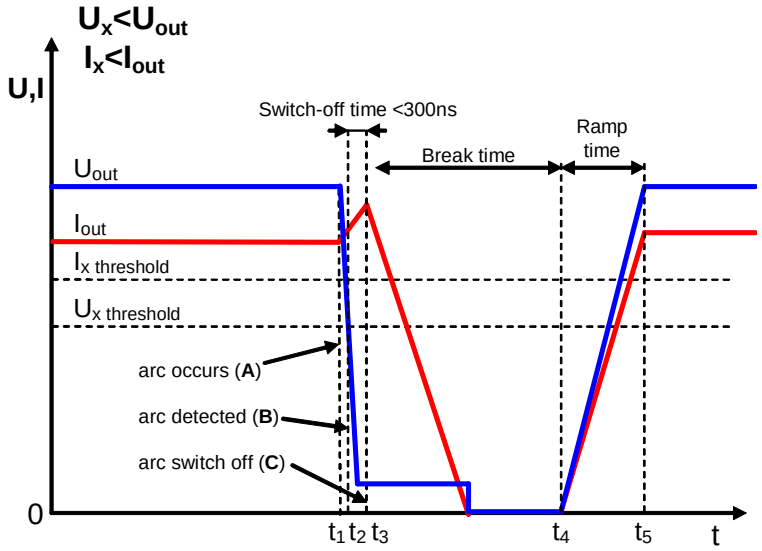


Fig. 5.2. **UxI** (cross detection) criteria arc detection example. $U_x<U_o$, $I_x<I_o$.

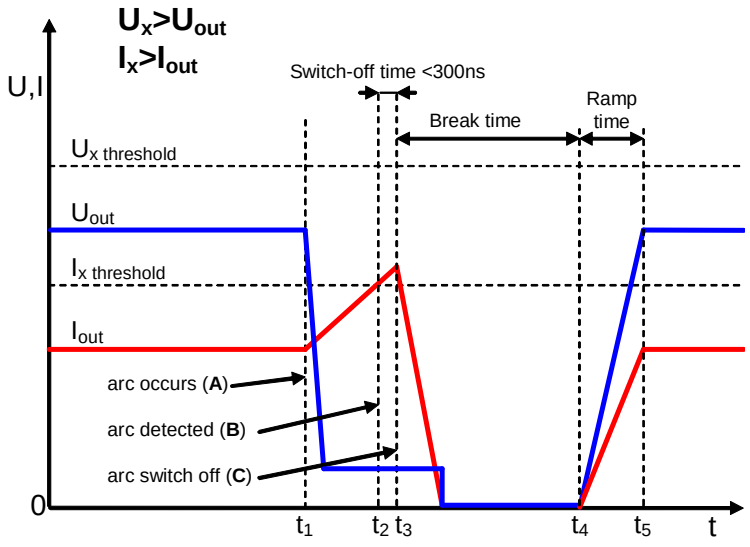


Fig.5.3. **UxI** (cross detection) criteria arc detection example. $U_x>U_o$, $I_x>I_o$.

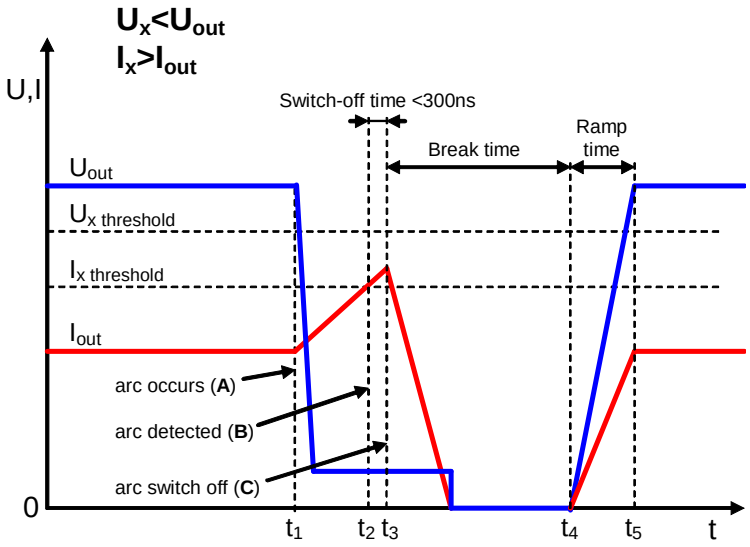


Fig. 5.4. **UxI** (cross detection) criteria arc detection example. $U_x<U_{out}$, $I_x>I_{out}$.

dU

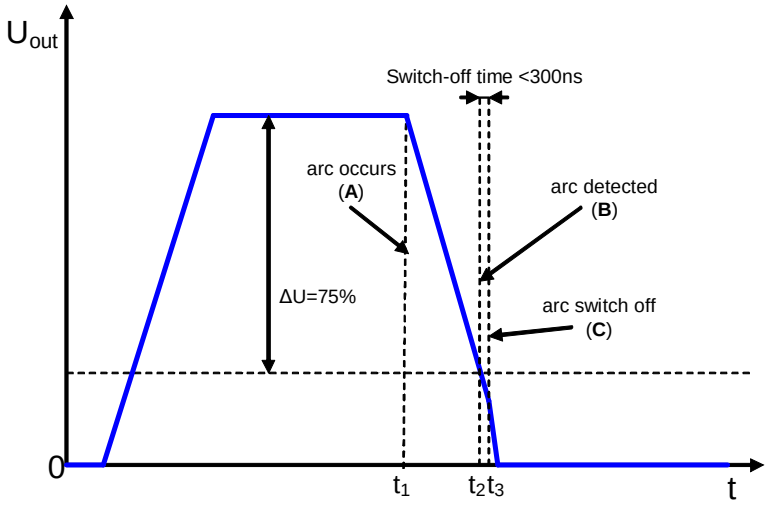


Fig. 5.5. dU (dynamic voltage change) criteria example

APPENDIX B
Presputter mode in MP power supplies

The idea of the new presputter mode is to deliver greater energies into arcs, which occur during presputtering in order to decrease the presputter time of the cathode.

Increasing the arc energy.

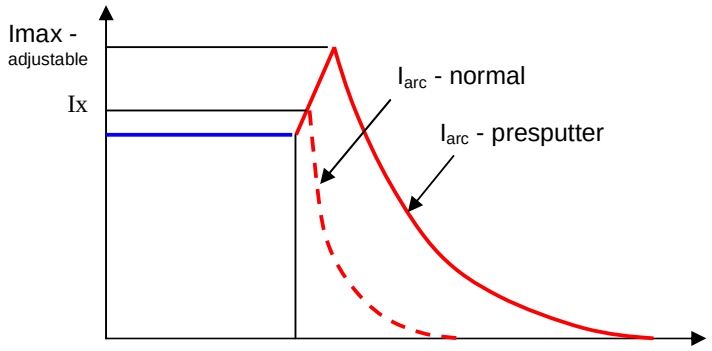
The normal arc suppression feature performs a short circuit at the output of the power supply when the arc occurs. This keeps the internal inductor current as well as some capacitive current from going into the arc. In order to increase arc energy, in the presputter mode this short circuit is not performed.

Selecting presputter mode.

The presputter mode is selected through the analog interface signals. As you know, the power supplies can work in 3 modes: power, voltage or current control. The selection of one of these 3 modes is done by a 2-bit digital signal (RegSel0 and RegSel1). Since 2 bits give 4 possible states, and we only need 3 to select control mode, the 4-th combination (both signals HIGH) is used to select presputter mode. In this mode, the power supply operates in power control mode.

Controlling the presputter mode performance.

In presputter mode the UxI and dU arc detection criteria are automatically disabled, leaving Imax as the only one active. Also, the Imax value is set separately for the presputter mode ("Imax-presptr" value in the USERS SETUP MENU on the display panel). This allows the user to set the amount of the charge in the internal inductor at switch-off. The arc energy is proportional to the square of this current value.



The MP-1 power supply is delivered in a ready to use condition. If all connections have been made properly and the operating instructions will carefully be followed there should be no problems with the activation of the power supply. The default settings should give proper behavior of the device in the most commonly used system configuration.

It would be useful, however to learn as much about the maintenance and operation principals as possible before proceeding with the startup. Understanding the systems operating principals will help the user obtain more useful information from the controllers display and understand the behavior of the entire power supply. Introducing any changes into the devices settings will obviously require full knowledge of the system (and also the password).