19“ / 4U – High Voltage Power Supplies

HPS-series 3000 W

Manual

⚠ **Attention!**

The unit must not be operated with the cover removed to avoid the possibility of lethal shock to the operator!

We decline all responsibility for damages and injuries caused by an improper use of the module. It is strongly recommended to read the operators manual before operation!

Note:

All information in this document is subject to change without notice. We take no responsibility for any error in this document. We reserve the right to make changes in the product design without any notification to the users.

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1. Safety instructions

This High Voltage Power Supply has to be installed by skilled persons only.
Following instructions are made for the personal safety of the operator, the safe use of this product and the connected units.

Caution

Dangerous Voltage

This unit is supplied from line voltage of 230V and generates an output voltage of up to 4 kV and 3000 W.
The disregard of this voltage condition can cause death, heavy injuries or material damage.

Before connecting to the local mains it must be proofed that the nominal line voltage of this unit is equal to the local mains.

Caution: After system-assembly the guard connections have to be checked if they are connected correctly !

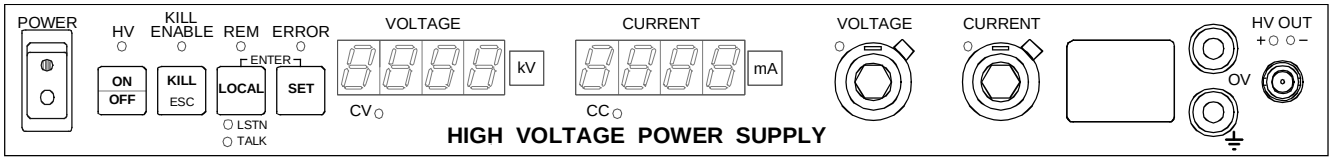
The guard connection has to be proofed through a correct mains cable. An additional guard connection is possible via the green-yellow guard connector next to the HV Output (⊥/PE-connector).

The shield of the HV output is always connected to the housing (⊥/PE-connector).

The unit is prepared to be mounted into a 19“-cabinet. In this case the necessary air flow conditions through the according air input and output slots have to be guaranteed.

Before the cover of the unit will be removed the mains connection has to be disconnected, the discharge time of at least (> 15 s) of the output capacitance has to be kept and the discharge status has to be checked afterwards.

Only skilled and authorized people are allowed to do any service, repair or maintenance for this unit.



2. Description

The High Voltage PS of the HPx[)1] - 3000 W series provide an output voltage of 0 up to 4 kV-DC at max. 3000 W output power.

Mains voltage is 219 - 264 V -AC 50/60 Hz.

The output voltage and current are limited due to the hardware circuitry. The polarity is factory fixed ([)1]x=p: positive; [)1]x=n: negative).

The shield of the HV output is always connected to the housing (⊥/PE-connector).

After “POWER ON“ the unit is ready to use, the displays are flashing.

The mode is “LOCAL“ now, the KILL-function is “disable“.

In “LOCAL“ mode the output voltage and the output current can be set via the 10 turn potentiometers on the front panel. The generation of High Voltage at the HV output (on front or rear side) is starting after pushing the button „ON/OFF“, the green LED “HV“ is flashing.

CAUTION ! The High Voltage which has been selected with help of the 10-turn potentiometer is going to ramp with 3 kV/s to the chosen voltage, this ramp is a factory setting.

After pushing the button “ON/OFF“ again the HV will be shut OFF, the LED is off.

There are 2 control modes:

1. Voltage control “CV”:
   Control of the output voltage according to the value “Voltage” (I_{OUT} < value “Current“), the LED “CV” is flashing.
2. Current control “CC”
   Control of the output current according to the value „Current ” (V_{OUT} < value “Voltage“), the LED “CC” is flashing.

The KILL-function will be set with button “KILL” .

Disable: The output voltage will be limited after reaching I_{OUTmax} .

Enable: The yellow LED “KILL ENABLE” is flashing.
The output voltage will be shut off permanently without ramp, if $I_{OUT} \geq I_{OUTmax}$.
The re-setting of the output voltage is possible after pushing button “HV-ON“ again.

The Standard units of the HPx[)1] - 3000 W series are with CAN- and RS232-Interface.

As an option available is:
- IEEE-Interface additionally and
- indirect coupled analogue I/O with $V_{SET/MON}$ = 0 up to 5 V.

In menu “SET“ under function 09 the existing or selected interface has to be selected before.

If an existing interface has been selected by menu „SET“ the control of the device will be activated automatically due to receipt of the according commands coming in (e.g. from a PC) and the yellow LED is flashing.
By pushing the push button „LOCAL“ the remote control will be stopped and the device will be switched into „HV-OFF“. The receipt of commands in case of remote will activate the device immediately.
Analogue control via analogue I/O can be selected by push button „LOCAL“ (exception see menu „SET“, function 08), the yellow LED „REM“ is flashing. By pushing „LOCAL“ again the devices runs back to the mode „HV-OFF“ and manual mode.

In menu “SET“ further configurations are possible. The access is by pushing button “SET“ into “OFF“ mode.

With push button “SET“ all function are available by scrolling. The desired function will be selected by pushing “SET“ and “LOCAL“ simultaneously ⇒ Function “ENTER”.

The selected values will be stored and activated by the “ENTER“ function. If this has been made successfully the unit is back in “HV-OFF“ mode.

Pushing the button “ESC“ is going back to menu “SET“ without any change of the pre-selected values.

Pushing button “LOCAL“ is always leading back to manual mode. In this case the HV will be shut off. (⇒ HV-OFF).

If no push button of the menu will be switched the display is automatically going back to the mode „HV-OFF“ after a delay time of 30 sec.

	Menu	Display		Description	
	Software limit voltage	F 01	ULt	Set software-voltage limit with pot. “Voltage”. V_{OUT} will be limited to this value (0.0 ≅ V_{OUTmax})	
“SET“					“ENTER“
	Software limit current	F 02	ILt	Set software-current limit with pot. “Current“ I_{OUT} will be limited to this value (0.0 ≅ I_{OUTmax})	
“SET“					“ENTER“
	Hardware limit I_{max}	F 03	HCLt	Not implemented	
“SET“					“ENTER“
	Pre-setting U-SET	F 04	USEt	Values > 0 with pot. “Voltage“ will be set automatically with “HV-ON“, LED at the pot. is off.	
“SET“					“ENTER“
	Pre-setting I-SET	F 05	ISEt	Values > 0 with pot. “Current“ will be set automatically with “HV-ON“, LED at the pot. is off.	
“SET“					“ENTER“
	Ramp set	F 06	rSEt	Set of Ramp with pot. “Voltage“ in a range of 10 up to 3000 V/s (0.0 ≅ 3000 V/s, factory setting)	
“SET“					“ENTER“
	Polarity set	F 07	PSEt	Not implemented	
“SET“					“ENTER“
	Control with analogue I/O automatically	F 08	Auto	ON with “SET”: Control is in remote control mode via analogue I/O after “POWER-ON” and “HV-ON” automatically The INHIBIT signal on analog I/O has be priority! “INHIBIT“ High to Low: HV switch off always, Low to High: HV switch on always, LOW static, HV=0 Activate/Switch on with „HV-ON“ or „INHIBIT“ or OFF with “SET”: Control is in “LOCAL” control mode after “POWER-ON” and “HV-ON” “INHIBIT“ High to Low: HV switch off always, LOW static, HV=0 Switch on with „HV-ON“ only	
“SET“					“ENTER“
	Change interface	F 09	ChIF	“CAn” remote control via CAN-Interface “SET” “r232” remote control via RS232-Interface “SET” “IEEE” remote control via IEEE-Interface “SET” “aIF” remote control via analogue I/O “SET” back to “CAn”	
“SET“					“ENTER“
	Instruction set	F 10	InSt	“SCPI” control under SCPI-command set (IEEE and RS232) “SET” “Et” control under command set of ET System electronic GmbH (IEEE and RS232) “SET” back to “SCPI”	
“SET“					“ENTER“
	Address IEEE	F 11	AdrI	“SET” ⇒ IEEE-bus unit address of 01 to 31	
“SET“					“ENTER“
	Address CAN	F 12	AdrC	“SET” ⇒ CAN-bus unit address of 00 up to 63	
“SET“					“ENTER“
	Back to F 01				

3. Technical Data

19“ / 4U - series HPx)1 3000 W			HPx)1 10 308	HPx)1 20 158	HPx)1 40 757
Output voltage $V_{OUT\ max}$ [kV]			1	2	4
Output current I_{OUT} [mA]			3000	1500	750
HV-connector			SHV rear side (opt. front side)		
Output power			max. 3000 W		
Efficiency			up to 90%		
Polarity			factory fixed $\Rightarrow$)1x = p: positive $\Rightarrow$)1x = n: negative		
Ripple & noise			$< 2 * 10^{-3} * V_{OUTmax}$ (V_{P-P})		
Voltage stability			$< 1 * 10^{-4} * V_{OUTmax}$ (load to no load, ΔV_{IN} and repeatability) in the output voltage range: $5\ V \leq V_{OUT} \leq V_{OUTmax}$		
Current stability			$< 2 * 10^{-3} * I_{OUTmax}$ ($R_{Lmin} \leq R_L <$ no load and ΔV_{IN}) in the output voltage range: $5\ V \leq V_{OUT} \leq V_{OUTmax}$		
Accuracy	voltage measurement		± (0,05% * V_{out} + 0,02% * $V_{out\ max}$ + 1 digit) for one year		
	current measurement		± (0,05% * I_{out} + 0,02% * $I_{out\ max}$ + 1 digit) for one year		
Display			4-digit LED-Display for current and voltage		
Resolution of voltage and current measurement			via Interface: V_{OUTmax} / 50000 I_{OUTmax} / 50000 via Display: limited to 4 digit		
Resolution of settings		LOCAL	V_{OUTmax} / 2000 and I_{OUTmax} / 2000		
Voltage / Current		REmote	V_{OUTmax} / 50000 and I_{OUTmax} / 50000		
Switching of output voltage			with button “ON/OFF” or via remote control		
Control		LOCAL	10-turn potentiometer for voltage and current		
	(REMote)	CAN	via CAN-Interface (also for diagnosis / software update)		
		RS232	via RS232-Interface		
	optional:	aIF	via indirect coupled analogue I/O additionally		
	optional:	IEEE	via IEEE-Interface additionally		
Supply			V_{IN} = 219 - 264 V -AC 50/60 Hz I_{IN} = 18 A at 230V-AC via mains connector and switch “POWER“, isolated from HV-output, fused with 2 * 20 A / slow.		
Dimension / Weight			4U -19“ compatible / depth: 450 mm / ca. 14 kg		
Cooling			forced cooling by internal fan		
Protection			over load and short circuit , voltage supply and temperature		
Environment conditions			operating temperature: 5 up to 35 °C humidity: 30% up to 80 %, no condensation		
Storage temperature			0 up to 60 °C		

4. Description of the CAN Interface.

The integrated CAN-Interface of the HPS series offers 2 functions.

Either the interface gives access to the implemented firmware of the processor controlled unit, this is important for the service outside and for the update of software generally

or a remote control can be established via this robust and simple industry interface for up to 64 HV units at one serial CAN-Bus line. A Command structure similar to the CAN-Open version (CAL-based Draft Standard 301 / Ver. 3.0) has been used.

Function of the CAN-Interface

The use of the CAN-Interface can be selected by menu “F09“ “CAn“.
As soon as the unit receives the according commands via the interface the unit is running under remote control and the yellow LED „REM“ is flashing.
Switching the push button „LOCAL“ again the control runs back to „HV-OFF“. The receipt of commands via interface activates the remote mode again.

The electrical transmission of all CAN-commands is indirect coupled under signal CAN_L and CAN_H, related to CAN_GND.

The pin assignment of the D-Sub-9 connector on the rear side of the unit is written in following table.

The CAN-Bus on the first and last unit has to be connected between CAN_H and CAN_L with an impedance of 120 Ω.

PIN	2	3	5	7
Signal	CAN_L	CAN_GND (GND)	CAN_SHLD (shield)	CAN_H

During Power ON-Reset the HPS-unit is in CAN-Status “INIT“ mode ,
afterwards it changes to CAN-Status “Operational“.

The bit rate can be selected between 20, 50, 100 and 125 kBit/s (factory fixed 125 kBit/s).

Only through the global command “STOP“ the CAN-Interface can be switched to CAN-Status “Pre-operational“ .

Only in “INIT“ or “Pre-operational“ mode the access to the service of the Network-Management (NMT) and Distribution-Management (DBT) is possible.

The global command “ADJUST“ is able to change ADC-, DAC- , SUB-Identifier and Inhibit-time in EEPROM in the DBT.

After using “Adjust“ the global command „ADJUST“ has to be locked again.

Only in status “Operational“ the HPS unit can be controlled via CAN-Bus (read values and status, set values).

After Power ON-Reset or after global command “START“ the interface of the unit is automatically in status “Operational“.

Table 1.0

Services	ID (with RTR=0)	DLC	DATA_1
Network - Management (NMT)			
START / STOP / RESET/ADJUST global	0	1	Bit 0 = 1 ⇒ Start Bit 1 = 1 ⇒ Stop Bit 2 = 1 ⇒ Reset CAN-Interf. Bit 4 = 1 ⇒ Adjust Bit 5 = 1 ⇒ INIT

These identifiers have been fixed via the ID - Distribution (DBT) Service:

Table 2.0

ID – Distribution (DBT) Service	ID	DLC	DATA_1	DATA_n							Remarks
DBT – Master - Request	2024d 7E8h (RTR=1)	0									Request from host only **at one connected module**: message address and ID´s of modules
DBT - Slave - Service	2023d 7E7h (RTR=0)	8	Mod.-Adr.	2	3	4	5	6	7	8	Message with module address and the according ID´s
DBT - Master - Service	2024d 7E8h (RTR=0)	8	Mod.-Adr.	ADC -ID		DAC -ID		Sub-ID		t	Allocate new ID´s t_{IN} ... Inhibit-time: $t_{IN} \approx 15 * (\text{ADC mux}) * t$ ms
DBT - Master - Service ⇓	2024d 7E8h (RTR=0)	2	0x80	Mod.-Adr.							Request from Host to module address message of ID´s on address.
DBT - Slave - Service	2023d 7E7h (RTR=0)	8	Mod.-Adr.	2	3	4	5	6	7	8	Message with module address and the according ID´s

Table 3.0

Sub-Identifier (Sub-ID)

E-command	ID	RTR	DLC	r/w	command							DATA_n	remarks
Multiplex-commands	Sub-ID	0	x	x	0	x	x	x	x	x	x		Work on multiplexed DAC/ADC – channels of the selected modules (Sub-ID)
DAC	Sub-ID	0	1	1	0	0	0	0	0	0	0	2 Byte DAC-value	Set voltage read
	Sub-ID	0	1	1	0	0	0	0	0	0	1	2 Byte DAC-value	Set current read
	Sub-ID	0	3	0	0	0	0	0	0	0	0	2 Byte DAC-value	Write for voltage channel 1
	Sub-ID	0	3	0	0	0	0	0	0	0	1	2 Byte DAC-value	Write for current channel 1
ADC	Sub-ID	0	3	1	0	0	0	0	1	0	0	2 Byte ADC-value	Read output voltage (Vmeas1)
	Sub-ID	0	3	1	0	0	0	0	1	0	1	2 Byte ADC-value	Read output current (Cmeas1)
Status	Sub-ID	0	2	0	0	0	0	1	0	0	0	1 Byte Status	Set status
	Sub-ID	0	3	1	0	0	0	1	0	0	0	2 Byte Status	Read status
Ramp	Sub-ID	0	3	1	0	0	0	1	1	0	0	2 Byte value	Read ramp
	Sub-ID	0	3	0	0	0	0	1	1	0	0	2 Byte value	Set ramp
Status	Sub-ID	0	2	0	0	0	0	1	0	0	0	1 Byte Status	Set status
	Sub-ID	0	3	1	0	0	0	1	0	0	0	2 Byte Status	Read status
Module command	Sub-ID	0	x	x	1	x	x	x	x	x	x		
EEPROM	Sub-ID	0	2	1	1	0	0	0	0	0	0	EEPROM-Address	Read / Write Access, (Request from host)
	Sub-ID	0	3	1	1	0	0	0	0	0	0	Data_1: EEPROM-Address	Read data of EEPROM-address
	Sub-ID	0	3	0	1	0	0	0	0	0	0	Data_2: Data on address	Write data on EEPROM-address only in CAN-status “Initialisation“ !
Bit rate	Sub-ID	0	2	1	1	0	0	0	0	1	1	old Bit-rate	Read Bit-Rate
	Sub-ID	0	2	0	1	0	0	0	0	1	1	new rate	Only values of 20, 50, 100, 125 for Bit rate
													in kBit/s accepted
Unit-ID	Sub-ID	0	6	1	1	0	0	0	1	1	0	3 byte serial no. and 2 byte software-release	

5. Description of the RS232-Interface

The RS232-Interface is also connected to a D-Sub-connector on the rear side of the unit. Before working under RS232-Interface the menu„F09“ „r232“ has to be selected.
As soon as the device receives according commands via the interface the device is under remote control and the LED „REM“ is flashing.
Pushing „LOCAL“ again the device is back in manual mode and „HV-OFF“ . The receipt of commands activates the devise again under remote control.

The data transfer is character oriented, while the synchronisation in direction "Computer to HV PS unit” (Input direction) is made by echoes. The transfer direction “HV-PS to computer“ (Output direction) is free running. Programmable delay breaks can be set between the transfer code , so that enough time is available for data taking and data interpretation.
The factory setting is 3 ms.

The RS232-Interface is set to 9600 Bit/s, 8 Bit/character, no parity, 1 Stop-Bit.

The electrical transfer is working indirectly coupled via RxD and TxD related to GND. The pin assignment of the D-Sub 9 is in the following table .

The cable connection to the computer is 1:1 (no zero modem-cable !). If no 9-pole cable is available , then the bridges mentioned in the table have to be made.

Signal RS 232	HV-PS DSUB9	HV-PS Intern	PC DSUB9	PC DSUB25	Connection 3-pol. cable
RxD	2		2	3	
TxD	3		3	2	
GND	5		5	7	
	4	┐	4	20	┐
	6	┤	6	6	┤
	8	┘	8	5	┘

Syntax

The transfer of commands works in ASCII-code. The end of a set of characters is made by <CR><LF> ($0D $0A or 13 10). On input side the leading zeros are useless, the output side is in fixed format.
In order to establish the synchronisation between the computer and the HV unit at first <CR><LF> have to be sent.

6. Description of the IEEE-Interface

The IEEE 488.2 bus interface was implemented with an IEEE controller compatible to the NEC 7210 controller. The following functions are available according IEC 625:

SH1	Source Handshake	:	all functions
AH1	Acceptor Handshake	:	all functions
T6	Talker	:	standard equipment
L4	Listener	:	standard equipment

The transmission is made with ASCII-commands.
The end of transmission is made by „Line feed“ (“\n”; $0A,10) .

The IEEE-Interface is connected to the 24-pin connector according IEEE 488.2 standard on the rear. Before working under IEEE-Interface the menu “F09“ “IEEE“ has to be selected and the menu “F11” “AdrI” has to be set the IEEE unit address and the device has to be switched to **POWER-OFF**.

After POWER-ON again and as soon as the device receives the according commands via the interface it runs under remote control and the yellow LED „REM“ is flashing.
By pushing „LOCAL“ the remote control will be stopped and the device runs into the mode „HV-OFF“.
The receipt of commands activates the remote control again.

7. Command sets

7.1 ET-command set

The menu „F10“ „ET“ has to be selected.

Setting commands:

Command to set the HV:

U,<voltage>kV	example	U,1.000kV

Command to set the HV limit:

UL,<voltage>kV	example	UL,1.000kV

Command to set the output current:

I,<current>A	example	I,1.000A

Command to set the output current limit:

IL,<current>A	example	IL,1.000A

Command to set the ramp speed of the output voltage:

RAMP,<rampspeed>V/s	example	RAMP,3000V/s

Command to set the ON and OFF switch of the HV.

HV,ON
HV,OFF

Command to set the KILL-Function of „ Enable“ and „Disable“

KILL,ENable
KILL,DISable

Command for „Emergency OFF“

EMCY OFF

The HV generation will be switched OFF permanently and the values of voltage and current set to 0.

Read out of the setting commands

Read out of set HV:

STATUS,U	response example	*U, RANGE=3.000kV, VALUE=2.458kV*

Read out of set HV limit:

STATUS,UL	response example	*UL, RANGE=3.000kV, VALUE=2.458kV*

Read out of set current :

STATUS,I	response example	I, RANGE=5.000A, VALUE=1.739A

Read out of set current limits:

STATUS,IL	response example	IL, RANGE=5.000A, VALUE=1.739A

Read out of set ramp speed:

STATUS,RAMP	response example	RAMP, RANGE=3000V/s, VALUE=1000V/s

Commands to read the actual measurement values

Measuring of the actual output voltage

STATUS,MU response example *UM, RANGE=3000V, VALUE=2.458kV*

Measurement of the output current:

STATUS,MI response example *IM, RANGE=5.000A, VALUE=1.739A*

Read out of unit status

STATUS,DI response DI, $b_{15}\,b_{14}\,b_{13}\,b_{12}\,b_{11}\,b_{10}\,b_9\,b_8\,b_7\,b_6\,b_5\,b_4\,b_3\,b_2\,b_1\,b_0$

			0	*1*
#define	*IpErr*	*b15*	*no input error*	*input error*
#define	*Ramp*	*b14*	*no ramp*	*ramp*
#define	*CutOut*	*b13*	*-*	*emergency off*
#define	*TpErr*	*b12*	*no trip error*	*trip error*
#define	*F3*	*b11*	*reserved*	
#define	*F2*	*b10*	*reserved*	
#define	*menu1*	*b9*	*submenu off*	*submenu on*
#define	*menu0*	*b8*	*menu off*	*menu on*
#define	*err*	*b7*	*no error*	*error*
#define	*Creg*	*b6*	*no current control*	*current control*
#define	*Vreg*	*b5*	*no voltage control*	*voltage control*
#define	*pol*	*b4*	*negative*	*positive*
#define	*inh*	*b3*	*no ext. inhibit*	*external inhibit*
#define	*local*	*b2*	*remote*	*local*
#define	*kilena*	*b1*	*kill disable*	*kill enable*
#define	*on*	*b0*	*off*	*high voltage is ON*

Read of LAM Status

STATUS,LAM	*response*	*LAM,ERROR*	*(Inhibit during Kill enable, no voltage and no current loop is locked)*
LAM,INHIBIT	*(external inhibit has been scanned)*		
		LAM,TRIP ERROR	*(software current trip occurred)*
		LAM,INPUT ERROR	*(wrong input string has been scanned from interface)*
		LAM,OK	*(no Look At Me status has been found)*

Read of unit identifier

ID response example ID, iseg Spezialelektronik r1.00 Type HPN 30 107

7.2 SCPI-set of commands

In menu „F10“ „SCPI“ has to be selected.

Setting commands:

Command to set the HV:

:VOLTage <voltage>kV example :VOLT *1.000kV*

Command to set the HV:

:LIMIT:VOLTage <voltage>_kV example :LIMIT:VOLT *1.000 kV*

Command to set the output current:

:CURRent <current>_A example :CURR *1.000 A*

Command to set the output current limit:

:LIMIT:CURRent <current>_A example :LIMIT:CURR *1.000 A*

Command to set the ramp speed of output voltage:

:CONFigure:RAMP <ramp speed>V/s example *RAMP 3000V/s*

Command to switch the HV ON and OFF:

:VOLTage ON
:VOLTage OFF

Command for „Emergency OFF“

:VOLTage EMCY OFF

(The HV generation has been shut off permanently and the Set-values for voltage and current have been set to 0.)

Command to set the KILL-Function on „Enable“ or „Disable“

:CONFigure:KILL ENable
:CONFigure:KILL DISable

Read out of the settings commands

Read out of SET HV:

:READ:VOLTage? Response example U, RANGE=3.000kV, VALUE=2.458kV

Read out of SET HV limit:

:READ:LIMIT:VOLTage? Response example UL, RANGE=3.000kV, VALUE=2.458kV

Read out of SET current :

:READ:CURRent? Response example I, RANGE=5.000A, VALUE=1.739A

Read out of SET current limit :

:READ:LIMIT:CURRent? Response example IL, RANGE=5.000A, VALUE=1.739A

Read out of SET Ramp:

:READ:RAMP? Response example Ramp, RANGE=3000 V/s, VALUE=3000 V/s

Read out of unit identifier:

:READ:IDNT? Response example ID, iseg Spezialelektronik 3.00 Type HPN 30 107

Commands to read the actual measurement values

Measurement of the output voltage:

:MEASure:VOLTage? Response example UM, RANGE=3.000kV, VALUE=2.458kV

Measurement of the output current:

:MEASure:CURRent? Response example IM, RANGE=5.000A, VALUE=1.739A

Read out of the unit Status

:READ:STATus? *response* *DI,* $b_{15}\, b_{14}\, b_{13}\, b_{12}\, b_{11}\, b_{10}\, b_9\, b_8\, b_7\, b_6\, b_5\, b_4\, b_3\, b_2\, b_1\, b_0$

			0	*1*
#define	*IpErr*	*b15*	*no input error*	*input error*
#define	*Ramp*	*b14*	*no ramp*	*ramp*
#define	*CutOut*	*b13*	*-*	*emergency off*
#define	*TpErr*	*b12*	*no trip error*	*trip error*
#define	*F3*	*b11*	*reserved*	
#define	*F2*	*b10*	*reserved*	
#define	*menu1*	*b9*	*submenu off*	*submenu on*
#define	*menu0*	*b8*	*menu off*	*menu on*
#define	*err*	*b7*	*no error*	*error*
#define	*Creg*	*b6*	*no current control*	*current control*
#define	*Vreg*	*b5*	*no voltage control*	*voltage control*
#define	*pol*	*b4*	*negative*	*positive*
#define	*inh*	*b3*	*no ext. inhibit*	*external Inhibit*
#define	*local*	*b2*	*remote*	*local*
#define	*kilena*	*b1*	*kill disable*	*kill enable*
#define	*on*	*b0*	*off*	*high voltage is on*

Read out of the LAM Status

:READ:LAM?	*response*	*LAM,ERROR*	*(Inhibit during Kill enable, no voltage and no current loop is locked)*
		LAM,INHIBIT	*(extern Inhibit has been scanned)*
		LAM,TRIP ERROR	*(software current trip occurred)*
		LAM,INPUT ERROR	*(wrong input string has been scanned from interface)*
		LAM,OK	*(no Look At Me status has been found)*

Common commands

**RST*		*all Set Values are deleted*
**IDN?*	*Response example*	*ID, iseg Spezialelektronik 3.00 Typ HPN 30 107*
**GTL*		*go to local, local-button is enabled*
**LLO*		*local logout, Local-Button is disabled*
**CLS*		*clear Status*
**TST?*		*check the system*

8. Description of analogue I/O

ATTENTION !	All control inputs and outputs are indirect-coupled to the HV-OUT.

All control inputs and outputs are available at the connector on the rear side of the unit (instead RS232 connector).
You can choose the analogue interface “aIF” in the menu 09 “Change interface” and then switch push button “LOCAL” in order to switch to remote control , the yellow LED “REM” is flashing now. (exception see menu “SET” , function 08).
By pushing LOCAL again the mode runs back to manual mode and „HV-OFF” .

Analogue I/O with male SUB - D - 9 connector

Pin 1	Pin 2	Pin 3	Pin 4	Pin 5	Pin 6	Pin 7	Pin 8	Pin 9
@GND	$V_{I\text{-}MON}$	INHIBIT	$V_{I\text{-}SET}$	n.c.	@GND	$V_{V\text{-}MON}$	$V_{V\text{-}SET}$	V_{REF}
	Current monitor	TTL-level, **Low** = active: ⇒ V_{OUT} = 0 **High** or **open**: ⇒ V_{OUT} = according setting	Current control			Voltage monitor	Voltage control	internal reference voltage V_{REF} = 5 V

Control Inputs

Remote Control Voltage (CV): $V_{V\text{-}SET}$ = 0 to 5 V

The output voltage is proportionally to the external control voltage of 0 to 5 V DC. For this purpose following connections have to be provided: control voltage pos. (+) to pin 8 ($V_{V\text{-}SET}$), control voltage GND to pin 6 (@GND-analogue indirect-coupled to GND-HV and metal box) .

Example: HPp 40 357

Maximum voltage = 4 kV

5.0 V	control voltage corresponds to	4	kV	output voltage
2.5 V	control voltage corresponds to	2	kV	output voltage
1.0 V	control voltage corresponds to	0,8	kV	output voltage

Remote Control Current (CC): $V_{I\text{-}SET}$ = 0 to 5 V

The output current can be set proportionally to an external control voltage of 0 to 5 V DC. For this purpose following connections have to be provided: control voltage pos. (+) to pin 4 ($V_{I\text{-}SET}$), control voltage GND to pin 6 (@GND-analogue indirect-coupled to GND-HV and metal box).

Example: HPp 40 357

Maximum current = 350 mA

5.0 V	control voltage corresponds to	350	mA	output current (“KILL” must be disable!)
2.5 V	control voltage corresponds to	175	mA	output current
1.0 V	control voltage corresponds to	70	mA	output current

INHIBIT TTL-Level

High voltage generation will be **shut off** with help of the TTL-level **LOW** on pin 3 related to GND - analogue (@GND-analogue indirect-coupled with GND-HV and metal box).

High voltage generation will be **started** according to the TTL-level **High** or **open** on pin 3 in case of “KILL” is disabled. If “KILL” is enabled also the push button “HV-ON” has to be pushed.

Control Outputs

Monitor-output voltage $V_{V\text{-}MON}$ = 0 to 5 V

An analogue output monitor signal is available proportionally to the output voltage. The monitor voltage is connected to pin 7 ($V_{V\text{-}MON}$) and pin 6 (@GND-analogue indirect-coupled with GND-HV and metal box).

Example: HPp 40 357

Maximum voltage = 4 kV

5.0 V	monitor voltage corresponds to	4	kV	output voltage
2.5 V	monitor voltage corresponds to	2	kV	output voltage
1.0 V	monitor voltage corresponds to	0,8	kV	output voltage

Monitor-output current $V_{I\text{-}MON}$ = 0 to 5 V

An analogue monitor voltage according to the real output current is also available. This voltage is connected to pin 2 ($V_{I\text{-}MON}$) and pin 6 (@GND-analogue indirect-coupled with GND-HV and metal box).

Example: HPp 40 357

Maximum current = 350 mA

5.0 V	monitor voltage corresponds to	350	mA	output current
2.5 V	monitor voltage corresponds to	175	mA	output current
1.0 V	monitor voltage corresponds to	70	mA	output current

9. Trouble shooting

Unit does not provide output voltage, and the displays are not flashing	⇒	- check mains voltage and connection
Unit does not provide output voltage but the displays are flashing.	⇒	- Check of environmental temperature (Tu ≤ 35°C)
		- Check of Control
During switch ON external fuses are blowing	⇒	- Replace to slow blow fuse (switch ON current peak 25 A)

If these provisions do not lead to a good result this unit has to checked from an authorised agent or must be shipped to the factory.