

## 19“ / 3U – High Voltage Power Supplies

### HPS-series 1500 W

#### Manual

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 **Attention!**

It is forbidden to use the unit if the covers are removed!

We decline all responsibility for damages and injuries caused due to an improper use of the module. It is highly recommended to read the operators manual before any kind of 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.

Filename HPx\_1500W\_eng.\_\_\_\_; as of 2003-03-20

## 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 15 kV.

The disregard of this voltage condition can cause death, heavy injuries or material damage.



### **Danger in case of missing connector at the HV output**

The **LEMO-HV** connector will be used for units which generate output voltages > 6kV. It is forbidden to switch on this unit without a suitable connector inclusive a cable which is connected to the output connector and the load.

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 !

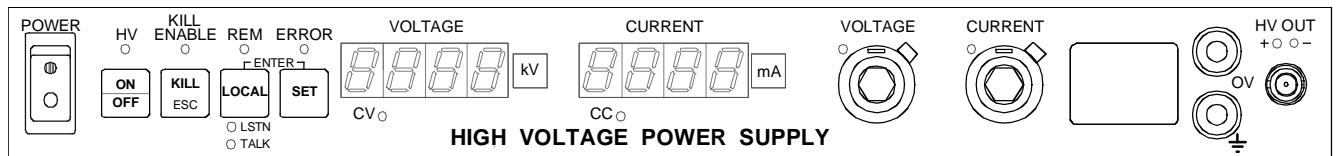
The guard connection has to be proofed through a correct mains cable. An additional guard connection is possible via the green-yellow guard connector next to the HV Output (  $\perp$ /PE-connector).

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.

If the unit will be used as desk top instrument then the enclosed unit bases have to be glued on the bottom sheet in order to guarantee a certain distance to the desk.

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 authorised people are allowed to do any service, repair or maintenance for this unit.



## 2. Description

The High Voltage PS of the HPx<sup>1</sup> - 1500 W series provide an output voltage of 0 up to 15 kV-DC at max. 1500 W output power. Mains voltage is 230 V -AC ± 10 % / 50 Hz.

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

The shield of the HV output is always connected to the housing (  $\perp$ /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" ( $I_{OUT} < \text{value "Current"}$ ), the LED "CV" is flashing.
2. Current control "CC"  
Control of the output current according to the value „Current " ( $V_{OUT} < \text{value "Voltage"}$ ), 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<sup>1</sup> - 1500 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 additionally.

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 ( $0.0 \cong V_{OUTmax}$ )	
"SET"					"ENTER"
	Software limit current	F 02	ILt	Set software-current limit with pot. "Current" $I_{OUT}$ will be limited to this value ( $0.0 \cong I_{OUTmax}$ )	
"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 ( $0.0 \cong 3000$ 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" $\Rightarrow$ IEEE-bus unit address of 01 to 31	
"SET"					"ENTER"
	Address CAN	F 12	AdrC	"SET" $\Rightarrow$ CAN-bus unit address of 00 up to 63	
"SET"					"ENTER"
	Back to F 01				

### 3. Technical Data

19" / 3U - series HPx <sup>1)</sup> 1500 W	HPx <sup>1)</sup> 10 158	HPx <sup>1)</sup> 20 757	HPx <sup>1)</sup> 40 357	HPx <sup>1)</sup> 80 187	HPx <sup>1)</sup> 120 127	HPx <sup>1)</sup> 150 107
Output voltage $V_{OUT\ max}$ [kV]	1	2	4	8	12	15
Output current $I_{OUT}$ [mA]	1500	750	350	180	120	100
HV-connector	SHV front side (opt. rear side)			Lemo-HV-connector rear side		
	$< 6kV \quad V_{OUT\ max} \leq 16kV: \quad \text{Lemo ERA.1Y.416.CLL}$ <b>Attention: Use with connected HV connector only !</b>					
Output power	max. 1500 W					
Efficiency	up to 85 %					
Polarity	Factory fixed $\Rightarrow$ <sup>1)</sup> x = p: positive $\Rightarrow$ <sup>1)</sup> x = n: negative					
Ripple & noise	$< 5 * 10^{-4} * V_{OUT\ max} \quad (V_{P-P})$					
Voltage stability	$< 1 * 10^{-4} * V_{OUT\ max}$ (load to no load, $\Delta V_{IN}$ and repeatability) in the output voltage range: $5 V \leq V_{OUT} \leq V_{OUT\ max}$					
Current stability	$< 2 * 10^{-3} * I_{OUT\ max}$ ( $R_{L\ min} \leq R_L < \text{no load}$ and $\Delta V_{IN}$ ) in the output voltage range: $5 V \leq V_{OUT} \leq V_{OUT\ max}$					
Display	4-digit LED-Display for current and voltage					
Resolution of voltage and current measurement	via Interface: $V_{OUT\ max} / 50000$ via Display: limited to 4 digit $I_{OUT\ max} / 50000$					
Resolution of settings	LOCAL	$V_{OUT\ max} / 2000$ and $I_{OUT\ max} / 2000$				
Voltage / Current	REmote	$V_{OUT\ max} / 50000$ and $I_{OUT\ max} / 50000$				
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	$V_{IN} = 230 V - AC \pm 10\%$ $I_{IN} = \text{max. } 10 A \text{ at } 230V-AC$ via mains connector and switch "POWER", isolated from HV-output, fused with $2 * 16 A / \text{slow}$ .					
Dimension / Weight	3U -19" compatible / depth: 450 mm / ca. 12 kg					
Cooling	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 according 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
<b>Network - Management (NMT)</b>			
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 <b>at one connected module</b> : 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 $t_{IN} \dots$ Inhibit-time: $t_{IN} \approx 15 * (ADC \text{ mux}) * t \text{ ms}$
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	R	D	r	command										DATA_n	remarks								
		T	L	/																				
		R	C	w																				
Multiplex-commands	Sub-ID	0	x	x	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	0	0	0	2 Byte DAC-value									Set voltage read
	Sub-ID	0	1	1	0	0	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	0	0	2 Byte DAC-value										Write for voltage channel 1
	Sub-ID	0	3	0	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	0	1	0	0	2 Byte ADC-value											Read output voltage (Vmeas1)
	Sub-ID	0	3	1	0	0	0	0	0	1	0	1	2 Byte ADC-value											Read output current (Cmeas1)
Status	Sub-ID	0	2	0	0	0	0	0	1	0	0	0	1 Byte Status											Set status
	Sub-ID	0	3	1	0	0	0	0	1	0	0	0	2 Byte Status											Read status
Ramp	Sub-ID	0	3	1	0	0	0	0	1	1	0	0	2 Byte value											Read ramp
	Sub-ID	0	3	0	0	0	0	0	1	1	0	0	2 Byte value											Set ramp
Status	Sub-ID	0	2	0	0	0	0	0	1	0	0	0	1 Byte Status											Set status
	Sub-ID	0	3	1	0	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	x												
EEPROM	Sub-ID	0	2	1	1	0	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	0	Data_1: EEPROM-Address											Read data of EEPROM-address
	Sub-ID	0	3	0	1	0	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 device 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		PC DSUB9	PC DSUB25	Connection 3-pol. cable
	DSUB9	Intern			
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” “Adr1” 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>mA                      example                      I,1000mA

Command to set the output current limit:

IL,<current>mA                      example                      IL,1000mA

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=5000mA, VALUE=1739mA*

Read out of set current limits:

STATUS,IL                    response example    *IL, RANGE=5000mA, VALUE=1739mA*

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=5000mA, VALUE=1739mA*

## Read out of unit status

<i>STATUS,DI</i>	<i>response DI, b<sub>15</sub> b<sub>14</sub> b<sub>13</sub> b<sub>12</sub> b<sub>11</sub> b<sub>10</sub> b<sub>9</sub> b<sub>8</sub> b<sub>7</sub> b<sub>6</sub> b<sub>5</sub> b<sub>4</sub> b<sub>3</sub> b<sub>2</sub> b<sub>1</sub> b<sub>0</sub></i>		
		<i>0</i>	<i>1</i>
<i>#define IpErr</i>	<i>b15</i>	<i>no input error</i>	<i>input error</i>
<i>#define Ramp</i>	<i>b14</i>	<i>no ramp</i>	<i>ramp</i>
<i>#define CutOut</i>	<i>b13</i>	<i>-</i>	<i>emergency off</i>
<i>#define TpErr</i>	<i>b12</i>	<i>no trip error</i>	<i>trip error</i>
<i>#define F3</i>	<i>b11</i>	<i>reserved</i>	
<i>#define F2</i>	<i>b10</i>	<i>reserved</i>	
<i>#define menu1</i>	<i>b9</i>	<i>submenu off</i>	<i>submenu on</i>
<i>#define menu0</i>	<i>b8</i>	<i>menu off</i>	<i>menu on</i>
<i>#define err</i>	<i>b7</i>	<i>no error</i>	<i>error</i>
<i>#define Creg</i>	<i>b6</i>	<i>no current control</i>	<i>current control</i>
<i>#define Vreg</i>	<i>b5</i>	<i>no voltage control</i>	<i>voltage control</i>
<i>#define pol</i>	<i>b4</i>	<i>negative</i>	<i>positive</i>
<i>#define inh</i>	<i>b3</i>	<i>no ext. inhibit</i>	<i>external inhibit</i>
<i>#define local</i>	<i>b2</i>	<i>remote</i>	<i>local</i>
<i>#define kilena</i>	<i>b1</i>	<i>kill disable</i>	<i>kill enable</i>
<i>#define on</i>	<i>b0</i>	<i>off</i>	<i>high voltage is ON</i>

## Read of LAM Status

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

## 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 1.000kV

Command to set the output current:

:CURRent <current>mA                      example            :CURR 1000mA

Command to set the output current limit:

:LIMIT:CURRent <current>mA                example            :LIMIT :CURR 1000mA

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=5000mA, VALUE=1739mA

Read out of SET current limit:

:READ:LIMIT:CURRent? Response example IL, RANGE=5000mA, VALUE=1739mA

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=5000mA, VALUE=1739mA

## Read out of the unit Status

:READ:STATus?	response	DI, b <sub>15</sub> b <sub>14</sub> b <sub>13</sub> b <sub>12</sub> b <sub>11</sub> b <sub>10</sub> b <sub>9</sub> b <sub>8</sub> b <sub>7</sub> b <sub>6</sub> b <sub>5</sub> b <sub>4</sub> b <sub>3</sub> b <sub>2</sub> b <sub>1</sub> b <sub>0</sub>	
		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 <sub>I-MON</sub>	INHIBIT	V <sub>I-SET</sub>	n.c.	@GND	V <sub>V-MON</sub>	V <sub>V-SET</sub>	V <sub>REF</sub>
	Current monitor	TTL-level, <b>Low</b> = active: ⇒ V <sub>OUT</sub> = 0 <b>High</b> or <b>open</b> : ⇒ V <sub>OUT</sub> = according setting	Current control			Voltage monitor	Voltage control	internal reference voltage V <sub>REF</sub> = 5 V

### Control Inputs

Remote Control Voltage (CV):                      V<sub>V-SET</sub> = 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<sub>V-SET</sub>), 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<sub>I-SET</sub> = 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<sub>I-SET</sub>), 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

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

An analogue output monitor signal is available proportionally to the output voltage. The monitor voltage is connected to pin 7 ( $V_{V-MON}$ ) 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

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

An analogue monitor voltage according to the real output current is also available. This voltage is connected to pin 2 ( $V_{I-MON}$ ) 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 ( $T_u \leq 35^\circ\text{C}$ )

- 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 be checked from an authorised agent or must be shipped to the factory.