

## 19" / 1U – High Voltage Power Supplies HPS 300 W and 800 W series

## 19" / 1U – C-Charger High Voltage Power Supplies LPS 300 W and 800 W series

### Operator's manual

|     |                               |   |
|-----|-------------------------------|---|
| 1   | Safety instructions .....     | 3 |
| 2   | Technical data .....          | 4 |
| 2.1 | General technical data.....   | 6 |
| 3   | Functional description .....  | 7 |
| 3.1 | Operation states .....        | 8 |
| 3.2 | Safety loop (Interlock) ..... | 8 |

Operating see the attachment point 4 to 7



### 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 operator's 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.

Filename HPx-LPx\_300-800W\_HW01\_eng.\_\_\_\_; Version 5.19 as of 2009-07-15



## 1 Safety instructions

This High Voltage Power Supply has to be installed by skilled personnel 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 85 to 260 V-AC and generates an output voltage of up to 30 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  $> 6\text{kV}$ . 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 shield of the HV output is always connected to the housing (  $\perp$ /PE-connector).

If this shield is intended to use as "reverse line", then a jumper has to be plugged between the "0 V" (reverse current) and the "  $\perp$ /PE" connector.

If this jumper has been removed an additional "reverse line" from the load to the "0 V" connector must be used and this connector close to ground can be float up to max.  $\pm 300\text{ V}$ .

In this case the user is responsible that - due to the voltage between "0 V" and "  $\perp$ /PE" connector - no danger for the user may occur.

If the potential between "0 V" and "  $\perp$ /PE" connector is  $> |300|\text{ V}$  then - in order to avoid damages for the unit - the connections are short circuited with help of electronically protection circuits.

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 ( $> 15\text{ s}$ ) 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 Technical data

| 19“ / 1U - series<br>HPx <sup>1</sup> 300 W | HPx <sup>1</sup> 10 307                                                                                                                                                                                    | HPx <sup>1</sup> 20 157 | HPx <sup>1</sup> 30 107 | HPx <sup>1</sup> 40 756 | HPx <sup>1</sup> 60 506 | HPx <sup>1</sup> 80 356                                           | HPx <sup>1</sup> 120 256    | HPx <sup>1</sup> 150 206 | HPx <sup>1</sup> 200 156 | HPx <sup>1</sup> 300 106 |
|---------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------|-------------------------|-------------------------|-------------------------|-------------------------------------------------------------------|-----------------------------|--------------------------|--------------------------|--------------------------|
| Output voltage V <sub>NOM</sub> (kV)        | 1                                                                                                                                                                                                          | 2                       | 3                       | 4                       | 6                       | 8                                                                 | 12                          | 15                       | 20                       | 30                       |
| Output current I <sub>NOM</sub> (mA)        | 300                                                                                                                                                                                                        | 150                     | 100                     | 75                      | 50                      | 35                                                                | 25                          | 20                       | 15                       | 10                       |
| HV connector                                | SHV front side, opt. rear side (SHV-R)                                                                                                                                                                     |                         |                         |                         |                         |                                                                   | Lemo-HV-connector rear side |                          |                          |                          |
|                                             | 8 kV < V <sub>NOM</sub> ≤ 16kV: Lemo ERA.1Y.416.CLL<br>V <sub>NOM</sub> > 16kV: Lemo ERA.3Y.425.CLL<br><b>Attention: Use with connected HV connector only !</b>                                            |                         |                         |                         |                         |                                                                   |                             |                          |                          |                          |
| Output power                                | max. 300 W                                                                                                                                                                                                 |                         |                         |                         |                         |                                                                   |                             |                          |                          |                          |
| Polarity                                    | factory fixed ⇒ <sup>1</sup> x = p: positive ⇒ <sup>1</sup> x = n: negative                                                                                                                                |                         |                         |                         |                         |                                                                   |                             |                          |                          |                          |
| Ripple & noise [V <sub>P-P</sub> ]          | V <sub>NOM</sub> ≤ 8kV: < 1 • 10 <sup>-4</sup> • V <sub>NOM</sub>                                                                                                                                          |                         |                         |                         |                         | V <sub>NOM</sub> > 8kV: < 5 • 10 <sup>-4</sup> • V <sub>NOM</sub> |                             |                          |                          |                          |
| Voltage stability                           | < 1 • 10 <sup>-4</sup> • V <sub>NOM</sub> (load to no load, ΔV <sub>IN</sub> and repeatability)<br>in the output voltage range: 1% • V <sub>NOM</sub> ≤ V <sub>OUT</sub> ≤ V <sub>NOM</sub>                |                         |                         |                         |                         |                                                                   |                             |                          |                          |                          |
| Current stability                           | < 2 • 10 <sup>-3</sup> • I <sub>NOM</sub> (R <sub>Lmin</sub> ≤ R <sub>L</sub> < no load and ΔV <sub>IN</sub> )<br>in the output voltage range: 1% • V <sub>NOM</sub> ≤ V <sub>OUT</sub> ≤ V <sub>NOM</sub> |                         |                         |                         |                         |                                                                   |                             |                          |                          |                          |

| 19“ / 1U - series<br>HPx <sup>1)</sup> 800 W | HPx <sup>1)</sup> 10 807                                                                                                                                                                                    | HPx <sup>1)</sup> 20 407 | HPx <sup>1)</sup> 30 257 | HPx <sup>1)</sup> 40 207 | HPx <sup>1)</sup> 60 137                                          | HPx <sup>1)</sup> 80 107 | HPx <sup>1)</sup> 120 656   | HPx <sup>1)</sup> 150 506 |
|----------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------|--------------------------|--------------------------|-------------------------------------------------------------------|--------------------------|-----------------------------|---------------------------|
| Output voltage V <sub>NOM</sub> (kV)         | 1                                                                                                                                                                                                           | 2                        | 3                        | 4                        | 6                                                                 | 8                        | 12                          | 15                        |
| Output current I <sub>NOM</sub> (mA)         | 800                                                                                                                                                                                                         | 400                      | 250                      | 200                      | 130                                                               | 100                      | 65                          | 50                        |
| HV connector                                 | SHV front side, opt. rear side ( <b>SHV-R</b> )                                                                                                                                                             |                          |                          |                          |                                                                   |                          | Lemo-HV-connector rear side |                           |
|                                              | 8 kV < V <sub>NOM</sub> ≤ 16kV: Lemo ERA.1Y.416.CLL<br><b>Attention: Use with connected HV connector only !</b>                                                                                             |                          |                          |                          |                                                                   |                          |                             |                           |
| Output power                                 | max. 800 W                                                                                                                                                                                                  |                          |                          |                          |                                                                   |                          |                             |                           |
| Polarity                                     | factory fixed ⇒ <sup>1)</sup> x = p: positive ⇒ <sup>1)</sup> x = n: negative                                                                                                                               |                          |                          |                          |                                                                   |                          |                             |                           |
| Ripple & noise [V <sub>P-P</sub> ]           | V <sub>NOM</sub> ≤ 8kV: < 1 • 10 <sup>-4</sup> • V <sub>NOM</sub>                                                                                                                                           |                          |                          |                          | V <sub>NOM</sub> > 8kV: < 5 • 10 <sup>-4</sup> • V <sub>NOM</sub> |                          |                             |                           |
| Voltage stability                            | < 1 • 10 <sup>-4</sup> • V <sub>NOM</sub> (load to no load, ΔV <sub>IN</sub> and repeatability)<br>in the output voltage range: 1% • V <sub>NOM</sub> ≤ V <sub>OUT</sub> ≤ V <sub>NOM</sub>                 |                          |                          |                          |                                                                   |                          |                             |                           |
| Current stability                            | < 2 • 10 <sup>-3</sup> • I <sub>NOM</sub> ( R <sub>Lmin</sub> ≤ R <sub>L</sub> < no load and ΔV <sub>IN</sub> )<br>in the output voltage range: 1% • V <sub>NOM</sub> ≤ V <sub>OUT</sub> ≤ V <sub>NOM</sub> |                          |                          |                          |                                                                   |                          |                             |                           |

| 19“ / 1U - series LPx <sup>)1</sup> 300 W | LPx <sup>)1</sup> 10 307                                                                                                                                                                                                        | LPx <sup>)1</sup> 20 157 | LPx <sup>)1</sup> 30 107 | LPx <sup>)1</sup> 40 756 | LPx <sup>)1</sup> 60 506 | LPx <sup>)1</sup> 80 356 | LPx <sup>)1</sup> 120 256   | LPx <sup>)1</sup> 150 206 | LPx <sup>)1</sup> 200 156 | LPx <sup>)1</sup> 300 106 |
|-------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|-----------------------------|---------------------------|---------------------------|---------------------------|
| Output voltage V <sub>NOM</sub> (kV)      | 1                                                                                                                                                                                                                               | 2                        | 3                        | 4                        | 6                        | 8                        | 12                          | 15                        | 20                        | 30                        |
| Output current I <sub>NOM</sub> (mA)      | 300                                                                                                                                                                                                                             | 150                      | 100                      | 75                       | 50                       | 35                       | 25                          | 20                        | 15                        | 10                        |
| HV connector                              | SHV front side, opt. rear side ( <b>SHV-R</b> )                                                                                                                                                                                 |                          |                          |                          |                          |                          | Lemo-HV-connector rear side |                           |                           |                           |
|                                           | 8 kV < V <sub>NOM</sub> ≤ 16kV: Lemo ERA.1Y.416.CLL<br>V <sub>NOM</sub> > 16kV: Lemo ERA.3Y.425.CLL<br><b>Attention: Use with connected HV connector only !</b>                                                                 |                          |                          |                          |                          |                          |                             |                           |                           |                           |
| Output power                              | max. 300 W                                                                                                                                                                                                                      |                          |                          |                          |                          |                          |                             |                           |                           |                           |
| Discharge frequency                       | Max. one complete discharge per second,<br>at discharging up to 2 kV against GND: up to 15 Hz<br>at discharging up to 1 kV against GND: up to 60 Hz<br>discharge current must be limited external to I <sub>NOM</sub> otherwise |                          |                          |                          |                          |                          |                             |                           |                           |                           |
| Polarity                                  | factory fixed ⇒ <sup>)1</sup> x = p: positive ⇒ <sup>)1</sup> x = n: negative                                                                                                                                                   |                          |                          |                          |                          |                          |                             |                           |                           |                           |
| Voltage stability                         | < 1 • 10 <sup>-3</sup> • V <sub>NOM</sub> (load to no load, ΔV <sub>IN</sub> and repeatability)<br>in the output voltage range: 5 V ≤ V <sub>OUT</sub> ≤ V <sub>NOM</sub>                                                       |                          |                          |                          |                          |                          |                             |                           |                           |                           |
| Current stability                         | < 2 • 10 <sup>-3</sup> • I <sub>NOM</sub> (R <sub>Lmin</sub> ≤ R <sub>L</sub> < no load and ΔV <sub>IN</sub> )<br>in the output voltage range: 5 V ≤ V <sub>OUT</sub> ≤ V <sub>NOM</sub>                                        |                          |                          |                          |                          |                          |                             |                           |                           |                           |

| 19“ / 1U - series LPx <sup>1</sup> 800 W | LPx <sup>1</sup> 10 807                                                                                                                                                                                                         | LPx <sup>1</sup> 20 407 | LPx <sup>1</sup> 30 257 | LPx <sup>1</sup> 40 207 | LPx <sup>1</sup> 60 137 | LPx <sup>1</sup> 80 107 | LPx <sup>1</sup> 120 656                                                                               | LPx <sup>1</sup> 150 506 |
|------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------|-------------------------|-------------------------|-------------------------|-------------------------|--------------------------------------------------------------------------------------------------------|--------------------------|
| Output voltage V <sub>NOM</sub> (kV)     | 1                                                                                                                                                                                                                               | 2                       | 3                       | 4                       | 6                       | 8                       | 12                                                                                                     | 15                       |
| Output current I <sub>NOM</sub> (mA)     | 800                                                                                                                                                                                                                             | 400                     | 250                     | 200                     | 130                     | 100                     | 65                                                                                                     | 50                       |
| HV connector                             | SHV front side, opt. rear side ( <b>SHV-R</b> )                                                                                                                                                                                 |                         |                         |                         |                         |                         | Lemo-HV-connector rear side ERA.1Y.416.CLL<br><b>Attention: Use with connected HV connector only !</b> |                          |
|                                          |                                                                                                                                                                                                                                 |                         |                         |                         |                         |                         |                                                                                                        |                          |
| Output power                             | max. 800 W                                                                                                                                                                                                                      |                         |                         |                         |                         |                         |                                                                                                        |                          |
| Discharge frequency                      | Max. one complete discharge per second,<br>at discharging up to 2 kV against GND: up to 15 Hz<br>at discharging up to 1 kV against GND: up to 60 Hz<br>discharge current must be limited external to I <sub>NOM</sub> otherwise |                         |                         |                         |                         |                         |                                                                                                        |                          |
| Polarity                                 | factory fixed ⇒ <sup>1</sup> x = p: positive ⇒ <sup>1</sup> x = n: negative                                                                                                                                                     |                         |                         |                         |                         |                         |                                                                                                        |                          |
| Voltage stability                        | < 1 • 10 <sup>-3</sup> • V <sub>NOM</sub> (load to no load, ΔV <sub>IN</sub> and repeatability)<br>in the output voltage range: 5 V ≤ V <sub>OUT</sub> ≤ V <sub>NOM</sub>                                                       |                         |                         |                         |                         |                         |                                                                                                        |                          |
| Current stability                        | < 2 • 10 <sup>-3</sup> • I <sub>NOM</sub> (R <sub>Lmin</sub> ≤ R <sub>L</sub> < no load and ΔV <sub>IN</sub> )<br>in the output voltage range: 5 V ≤ V <sub>OUT</sub> ≤ V <sub>NOM</sub>                                        |                         |                         |                         |                         |                         |                                                                                                        |                          |

## 2.1 General technical data

| 19“ / 1U - series<br>HPx <sup>1)</sup> 300 W  |                     | 19“ / 1U - series<br>HPx <sup>1)</sup> 800 W |                                                                                                                                                                                                                                                                                                                                                     | 19“ / 1U – series<br>LPx <sup>1)</sup> 300 W |              | 19“ / 1U – series<br>LPx <sup>1)</sup> 800 W |  |
|-----------------------------------------------|---------------------|----------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------|--------------|----------------------------------------------|--|
| Accuracy                                      | voltage measurement |                                              | ± (0,5% • V <sub>OUT</sub> + 0,3% • V <sub>NOM</sub> + 1 digit)                                                                                                                                                                                                                                                                                     |                                              | for one year |                                              |  |
|                                               | current measurement |                                              | ± (0,1% • I <sub>OUT</sub> + 0,05% • I <sub>NOM</sub> + 1 digit)                                                                                                                                                                                                                                                                                    |                                              | for one year |                                              |  |
| Temperature coefficient                       |                     |                                              | < 2 • 10 <sup>-4</sup> /K                                                                                                                                                                                                                                                                                                                           |                                              |              |                                              |  |
| Display                                       |                     |                                              | 8-digit LCD-Display for current and voltage                                                                                                                                                                                                                                                                                                         |                                              |              |                                              |  |
| Resolution of voltage and current measurement |                     |                                              | 4-digit                                                                                                                                                                                                                                                                                                                                             |                                              |              |                                              |  |
| Resolution of settings                        |                     | LOCAL                                        | 4-digit                                                                                                                                                                                                                                                                                                                                             |                                              |              |                                              |  |
| Voltage / Current                             |                     | REMOte                                       | 4-digit                                                                                                                                                                                                                                                                                                                                             |                                              |              |                                              |  |
| Switching of output voltage                   |                     |                                              | with button “ON/OFF” or via remote control                                                                                                                                                                                                                                                                                                          |                                              |              |                                              |  |
| Control                                       |                     | LOCAL                                        | rotary encoders for voltage and current                                                                                                                                                                                                                                                                                                             |                                              |              |                                              |  |
|                                               | (REMOte)            | CAN                                          | via CAN-Interface                                                                                                                                                                                                                                                                                                                                   |                                              |              |                                              |  |
|                                               |                     | USB                                          | via USB-Interface                                                                                                                                                                                                                                                                                                                                   |                                              |              |                                              |  |
|                                               | optional:           | RS-232                                       | via RS232-Interface                                                                                                                                                                                                                                                                                                                                 |                                              |              |                                              |  |
|                                               | optional:           | AIF                                          | via indirect coupled analogue I/O additionally (male SUB-D-9)                                                                                                                                                                                                                                                                                       |                                              |              |                                              |  |
|                                               | optional:           | IEEE-488                                     | via IEEE-Interface additionally (male Micro D25)                                                                                                                                                                                                                                                                                                    |                                              |              |                                              |  |
|                                               | optional:           | ETH                                          | via Ethernet-Interface additionally (RJ45)                                                                                                                                                                                                                                                                                                          |                                              |              |                                              |  |
| Efficiency                                    |                     |                                              | up to 85%                                                                                                                                                                                                                                                                                                                                           |                                              |              |                                              |  |
| Supply                                        |                     |                                              | V <sub>IN</sub> = 85 up to 260 V AC with PFC<br>I <sub>IN</sub> = 1,7 A at 230V-AC / 3,5 A at 115 V-AC (300 W series),<br>I <sub>IN</sub> = 4,5 A at 230 V AC / 9 A at 115 V AC (600 W series)<br>via mains connector and switch “POWER“, isolated from HV-output,<br>fused with 2 • 6,3 A / slow (300 W series)<br>2 • 10 A / slow (800 W series). |                                              |              |                                              |  |
| Dimension                                     |                     |                                              | 1U -19“ compatible / depth: 410 mm                                                                                                                                                                                                                                                                                                                  |                                              |              |                                              |  |
| Weight                                        |                     |                                              | ca. 5,7 kg (300 W series) / ca. 6,5 kg (800 W series)                                                                                                                                                                                                                                                                                               |                                              |              |                                              |  |
| Cooling                                       |                     |                                              | Internal fan                                                                                                                                                                                                                                                                                                                                        |                                              |              |                                              |  |
| Protection                                    |                     |                                              | Over load and short circuit , voltage supply and temperature                                                                                                                                                                                                                                                                                        |                                              |              |                                              |  |
| Environment conditions                        |                     |                                              | Operating temperature: 5 up to 35 °C<br>Humidity: 30% up to 80 %, no condensation                                                                                                                                                                                                                                                                   |                                              |              |                                              |  |
| Storage temperature                           |                     |                                              | 0 up to 60 °C                                                                                                                                                                                                                                                                                                                                       |                                              |              |                                              |  |

### 3 Functional description

The High Voltage PS of the HPx<sup>1</sup> - 300 W series provide an output voltage of 0 up to 30 kV-DC at max. 300 W output power.

The High Voltage PS of the HPx<sup>1</sup> - 800 W series provide an output voltage of 0 up to 15 kV-DC at max. 800 W output power.

The control loop is designed to provide a constant voltage or current.

The High Voltage PS of the LPx<sup>1</sup> - 300 W series provide an output voltage of 0 up to 30 kV-DC at max. 300 W output power.

The High Voltage PS of the LPx<sup>1</sup> - 800 W series provide an output voltage of 0 up to 15 kV-DC at max. 800 W output power. Mains voltage is 85 - 264 V -AC 50/60 Hz (PFC is standard).

The control loop is designed to charge a capacity in constant current control mode. This capacity will discharge with the user circuit. You will find information to the discharge frequency dependence on the discharge level in chapter 2.

On LPS devices, the Software voltage ramp (0...3000V/s) can be disabled. The device then ramps to the chosen set voltages as fast as possible (see chapter 4 "Front panel operation" and 6 "Command sets").

Mains voltage is 85 to 260 V-AC 50/60 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).

If this shield is intended to use as "reverse line", then a jumper has to be plugged between the "0 V" (reverse current) and the " $\perp$ /PE" connector.

If this jumper has been removed an additional "reverse line" from the load to the "0 V" connector must be used and this connector close to ground can be float up to max.  $\pm 300$  V.

**Attention: In this case the user is responsible that – due to the voltage between "0 V" and " $\perp$ /PE" connector – no danger for the user may occur.**

If the potential between "0 V" and " $\perp$ /PE" connector is  $> |300|$  V then – in order to avoid damages for the unit – the connections are short circuited with help of internal electronically protection circuits.

### 3.1 Operation states

The device has the following operation states:

- POWER-ON Device initialises the connected Hardware (Booting)
- LOCAL Device is controlled with buttons and rotary encoders at the front panel
- REMOTE Device is remote controlled via interface (CAN, RS-232, IEEE-488)

The states LOCAL and REMOTE are further divided into:

- HV-OFF No high voltage is produced
- HV-ON High voltage according to Set values is produced

In the HV-ON state there are two modes for high voltage creation:

1. Voltage control CV:  
Control of output voltage according to set value  $V_{SET}$   
(Output current  $I_{OUT} < I_{SET}$ ), LED „CV“ lighting.
2. Current control CC (only with “Kill disable”):  
Control of output current according to set value  $I_{SET}$   
(Output current  $I_{OUT} > I_{SET}$ ), LED „CC“ lighting.

The KILL function is be set with the KILL/ESC button:

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

### 3.2 Safety loop (Interlock)

The unit is equipped with a connector for a hardware safety loop (interlock) on the rear.

If the loop is closed an internal current source (open circuit voltage 15 V / short circuit current max. 40 mA) will drive a current of ca. 12 mA through the built-in safety relay.

That will work if the impedance of the closed loop is less than 200 Ohm.

If the safety loop is opened, the relay will be drop-out and the generation of high voltage will be stopped without any semiconductor by the contacts of the safety relay only.

**Caution: The internal and external capacities must be discharge about the load before the output will be volt-free. The internal load is very high, so a very long discharging time is possible according to the connected load.  
The unit is not equipped with an active discharging circuit!**

The safety loop is closed ex works with help of a wire strap.

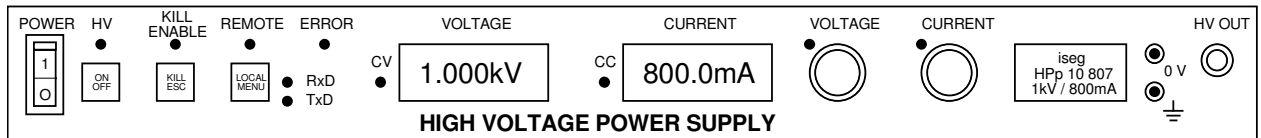
It is not possible to switch on the high voltage generation if the loop is open.

If the loop will be closed again high voltage will be switch on with HV-ON on front panel or via the digital interfaces only.

If chosen **AIF ON** in the menu F06 „Control with analogue I/O automatically“ it is able to switch on high voltage with **Low to High** on the **INHIBIT** pin of the analogue I/O too.



## 4 Front panel operation



Picture: HPS/LPS front panel.

Optional and if  $V_{NOM} > 7 \text{ kV}$ :  
connections on the rear

After pushing the POWER button the device is booting. During boot, the integrated hardware is initialised. After start-up the device is working in LOCAL mode and the KILL function is “disable”.

In LOCAL mode, the set values for voltage and current can be adjusted with the rotary encoders VOLTAGE for  $V_{SET}$  and CURRENT for  $I_{SET}$ . The yellow LEDs VOLTAGE and CURRENT are lighting. When trying to set  $V_{SET}$  or  $I_{SET}$  beyond the adjusted limit, the corresponding LED is flashing for one second.

Generation of high voltages starts by pushing the ON/OFF button. While generating high voltage, the green LED “HV” is lighting.

**Caution! The high voltage which has been selected with the rotary encoders is going to ramp to the chosen voltage with the programmed ramp speed!**  
**Factory setting for ramp speed is  $0.2 \cdot V_{NOM}$  per second.**

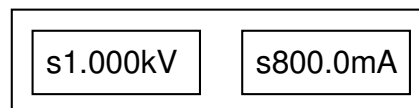
By pressing ON/OFF again, the high voltage generation is turned off, the green LED “HV” goes off. The high voltage is ramped down with the programmed ramp speed.

### 4.1 Displays

The device has two eight digit displays for voltage and current as well as for Menu control.

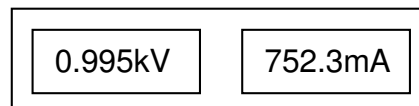
In HV-OFF state, the set values are shown on display for easy changes with the rotary encoders VOLTAGE and CURRENT. These set values are stored in processor’s EEPROM and reloaded at next start-up.

While displaying the set values for voltage and current, a small ‘s’ is flashing at the left display side:



Picture: Set values on display in HV-OFF state

In HV-ON state the measured values of voltage and current are displayed:



Picture: Measured values on displays in HV-ON state

By pressing the rotary encoder VOLTAGE or CURRENT in HV-ON state, the corresponding set value is displayed for a short time to allow exact adjustment.

If the set values aren’t changed, the device shows the measured values again after four seconds. By pressing the corresponding rotary encoder again, this delay can be shortened.

After turning high voltage off, the displays show the measured values while ramping down. After four seconds and with measured voltage lower than 60 V, the device shows the set values again.

## 4.2 Menu

In HV-OFF mode the device menu is activated by pressing the button MENU.

If no button is pressed, the display switch back to HV-OFF mode after 30 seconds. The menu can also be closed without changing any value by pressing the button ESC.

By turning the rotary encoder VOLTAGE you can scroll through the menu. By pressing the rotary encoder VOLTAGE the displayed menu point is selected. The setting can be changed by the active rotary encoder (shown by yellow LED). By pressing the active rotary encoder the changes are stored and the main menu is displayed again.

| Display           | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|-------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| F01 Set Limit V   | Adjust the Software voltage limit $V_{OUTmax}$ in the range of $0.02 \cdot V_{NOM} \leq V_{OUTmax} \leq V_{NOM}$ with rotary encoder VOLTAGE. $V_{SET}$ will be limited to this value.<br>If the Limit gets smaller than the actual value of $V_{SET}$ , $V_{SET}$ will be decreased to $V_{OUTmax}$ automatically.                                                                                                                                               |
| F02 Set Limit I   | Adjust the Software current limit $I_{OUTmax}$ in the range of $0.02 \cdot I_{NOM} \leq I_{OUTmax} \leq I_{NOM}$ with rotary encoder CURRENT. $I_{SET}$ will be limited to this value.<br>If the Limit gets smaller than the actual value of $I_{SET}$ , $I_{SET}$ will be decreased to $I_{OUTmax}$ automatically.                                                                                                                                               |
| F03 Set Ramp V    | Adjust voltage ramp speed with rotary encoder VOLTAGE in the range of 1...3000 V/s (factory setting is $0.2 \cdot V_{NOM}/s$ ).<br>On LPS devices, the software voltage ramp can be disabled. In this case, the device changes it's output voltage as fast as possible.<br>The software ramp can be disabled by setting the ramp speed greater than 3000 V/s: "max." will be displayed. To enable the software ramp again, set a ramp speed between 1...3000 V/s. |
| F04 Set Ramp I    | Adjust current ramp speed with rotary encoder CURRENT with the given values in the range of $0.02 \cdot I_{NOM}/s$ up to $I_{NOM}/s$ (factory setting is $I_{NOM}/s$ )                                                                                                                                                                                                                                                                                            |
| F05 Auto Start    | Not implemented yet.                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| F06 Auto AIF      | AIF ON: Turn on HV by pushing the ON/OFF button or with INHIBIT Low to High on analogue I/O<br>AIF OFF: Turn on HV by pushing the ON/OFF button only<br>The INHIBIT signal on analogue I/O has priority in both cases!<br>INHIBIT High to Low: turn off HV<br>Low to High: turn on HV (KILL disable)<br>Low static: HV = 0                                                                                                                                        |
| F07 Set Interface | Select external Interface with rotary encoder VOLTAGE:<br>"CAN" control via CAN-Interface<br>"RS-232" control via RS232-Interface<br>"USB" control via USB-Interface<br>"IEEE 488" control via IEEE (GPIB)-Interface<br>"Ethernet" control via Ethernet-Interface<br>"AIF" control via Analogue I/O                                                                                                                                                               |
| F08 Set Instruct  | Select instruction type for RS-232/USB/IEEE-488/Ethernet control with rotary encoder VOLTAGE:<br>"EDCP" SCPI command set with EDCP (recommended)<br>"SCPI" old SCPI command set<br>"ET" old ET command set                                                                                                                                                                                                                                                        |
| F09 Addr IEEE     | Select IEEE address with rotary encoder VOLTAGE: 01 to 30. Factory setting is 17.                                                                                                                                                                                                                                                                                                                                                                                 |
| F10 Addr CAN      | Select CAN address with rotary encoder VOLTAGE: 00 to 63. Factory setting is 0.                                                                                                                                                                                                                                                                                                                                                                                   |

| Display          | Description                                                                                                                                                                      |
|------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| F11 Set Echo     | Select Echo state for RS-232/USB control with rotary encoder VOLTAGE: "on" $\Rightarrow$ "off" $\Rightarrow$ "on"                                                                |
| F12 Set Password | The MENU settings are safed with 4 pin password. Setting position by position with rotary encoder VOLTAGE. Given the code „0000“ the password function is not active (ex works). |
| F13 Show Power   | Change the display to $V_{OUT}$ and $Power_{OUT}$ (on/off)                                                                                                                       |
| F14 Quit Menu    | Close the menu.                                                                                                                                                                  |

### 4.3 Software limits

The device uses two software limits for voltage and current.

These limits consists of two functions:

1. Limit the set values to the adjusted limits: limit  $V_{SET}$  to  $V_{OUTmax}$  resp.  $I_{SET}$  to  $I_{OUTmax}$ .
2. Set the limit bits in Channel Status and Channel Event Status, if the measured values exceed the limits:
  - isVLIM and EVLIM if  $V_{OUT} \geq V_{OUTmax} + 0.02 \cdot V_{NOM}$
  - isCLIM and ECLIM if  $I_{OUT} \geq I_{OUTmax} + 0.02 \cdot I_{NOM}$

In mode Kill enable, the bits EVLIM resp. ECLIM causes the High Voltage to shut down without ramp.

### 4.4 Error states

The following Events cause the High Voltage to shut down without ramp and have to be cleared with Button KILL/ESC or a remote command (e. g. \*CLS) before turning it on again.

| Event Bit | Display       | Description                                                 |
|-----------|---------------|-------------------------------------------------------------|
| EEMCY     | EMERGENCY OFF | Emergency off via remote control                            |
| ETRIP     | CURRENT TRIP  | Current trip ( $I_{OUT} \geq I_{SET}$ ) in mode Kill enable |
| EVLIM     | VOLTAGE LIMIT | Voltage limit exceeded in mode Kill enable                  |
| ECLIM     | CURRENT LIMIT | Current limit exceeded in mode Kill enable                  |
| ESFLPngd  | SAFETYLOOP    | Safety loop was or is open                                  |
| ETEMPngd  | OVERTEMPATURE | Maximum allowed temperature was or is exceeded              |

## 5 Interface control

For remote control, the corresponding interface (CAN, RS-232, USB, IEEE-488, Ethernet) has to be selected first in Menu "F07 Set Interface". The device switches to REMOTE state when receiving the first command from the selected interface. The yellow LED "REMOTE" is lighting. The yellow LEDs VOLTAGE and CURRENT stop lighting to indicate that no local control is possible at the moment.

By pressing the LOCAL button the remote control is suspended. The device can now be controlled via front panel. When receiving new commands via Interface, the device switches back to REMOTE state.

If the device is in "HV-ON" state via interface, high voltage can be turned off by pressing the ON/OFF button. In this case the device goes to LOCAL state as well.

**Exception: If local control is disabled (Local Lockout, see chapter 6.3), the device can only be turned off via mains switch POWER!**

While receiving or transmitting data via RS-232 or IEEE-488, the LED's RxD (Receiving) or TxD (Transmitting) are flashing.

### 5.1 CAN Interface

**Attention: Turn off the device with mains switch POWER before connecting/disconnecting the interface cable.**

The CAN interface is located at a male D-SUB-9 connector at the device rear. The pin assignment is as follows:

| Pin | Signal                |
|-----|-----------------------|
| 2   | CAN_L (CAN Low)       |
| 3   | CAN_GND (CAN Ground)  |
| 5   | CAN_SHLD (CAN Shield) |
| 7   | CAN_H (CAN High)      |

For the CAN protocol, please see the description of the EDCP protocol in the manual

CAN-Interface  
Multi-Channel High Voltage Power Supply Module  
EHS xxx and EDS xxx

Thus, the device can be controlled with the program isegCANHVControl or with the iseg OPC server.

## 5.2 RS-232- / USB Interface

**Attention:** Turn off the device with mains switch POWER before connecting/disconnecting the interface cable.

**Attention:** If you device is equipped with RS-232 and USB Interface, only one of them must be connected to the HPS at the same time.

### RS-232

The RS-232 interface is located at a female D-SUB-9 connector at the device rear.

The electrical transfer is working indirectly coupled via RxD and TxD related to GND. The D-SUB-9 pin assignment 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 connections shown in the table have to be made.

| Signal<br>RS-232 | HV-PS   |          | PC      |          | Connection<br>3-pol. cable |
|------------------|---------|----------|---------|----------|----------------------------|
|                  | D-SUB-9 | Internal | D-SUB-9 | D-SUB-25 |                            |
| RxD              | 2       |          | 2       | 3        |                            |
| TxD              | 3       |          | 3       | 2        |                            |
| GND              | 5       |          | 5       | 7        |                            |
|                  | 4       | ┌┐       | 4       | 20       | ┌┐                         |
|                  | 6       | ┌┐       | 6       | 6        | ┌┐                         |
|                  | 8       | ┌┐       | 8       | 5        | ┌┐                         |

### USB

The USB interface is realized with a female USB-B connector at the device rear. Internal, the USB is implemented as an USB-serial converter FTDI FT232R.

This device functions as virtual serial port in PC, and thus can be used with every program that supports a serial port, e. g. a terminal program or LabVIEW.

### Programming

The following description applies both to RS-232 and USB interface.

For remote control, "RS-232" must be selected in Menu "F07 Set Interface". The device switches to REMOTE state when receiving the first command via interface.

The (virtual) serial Interface is set to 9600 Bit/s, 8 Bit/character, no parity, 1 Stop-Bit.

The data transfer is character oriented, while the synchronization 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.

The Echo can be permanently disabled (Factory setting is "Echo on"):

1. On front panel via Menu "F11 Set Echo".
2. Via SCPI instruction set with EDCP

The command transfer works with ASCII code. Commands are terminated by <CR><LF> (\$0D \$0A or 13 10). On input side, no leading zeros are needed. Output is fixed format without leading zero.

A minimum time delay of 20 ms between write and read instructions is needed.

## Windows USB driver installation

The FTDI VCP driver (Virtual COM Port) can be downloaded from:

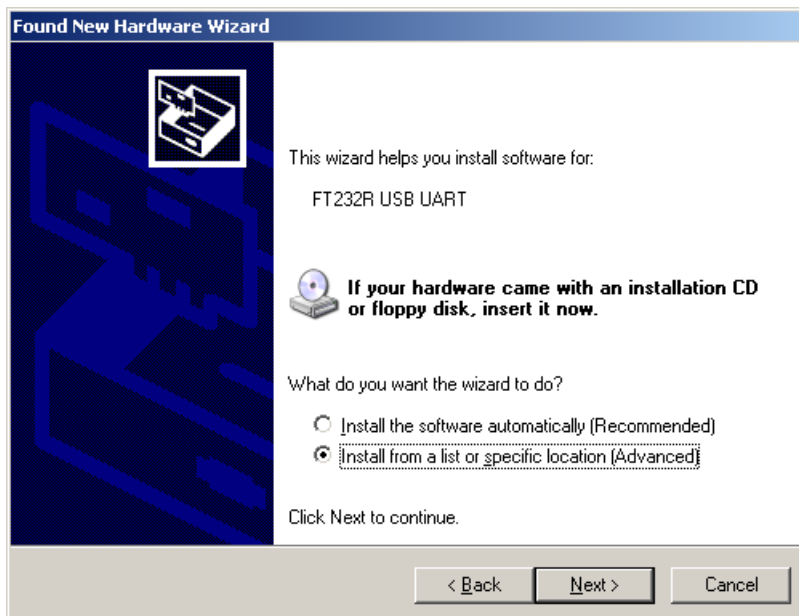
<http://www.iseg-hv.com> → Download → Software → USB driver for THQ/EHQ

The following steps are necessary for installation:

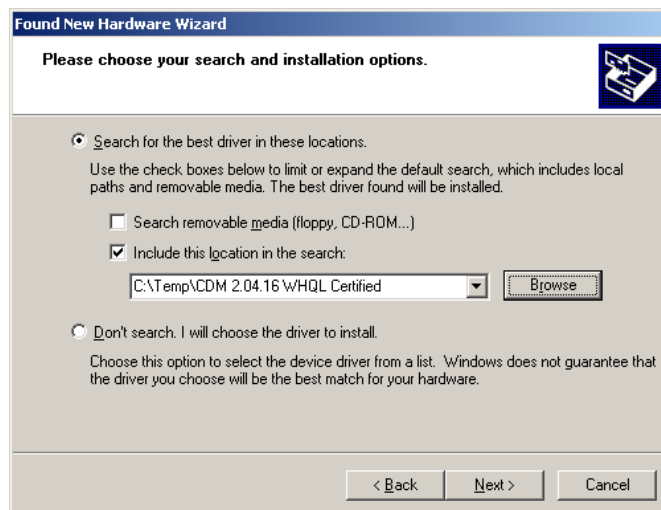
1. Extract the FTDI driver “CDM 2.04.16 WHQL Certified.zip“, e. g. to C:\Temp\
2. Connect the HV device to the computer via USB
3. The Found new Hardware wizard appears.  
Please choose “No, not this time” in the first dialog and then click Next.



4. Choose “Install from a list or specific location” in the next dialog and then click Next:



5. Please choose the directory you extracted the driver to and the click Next:



6. After some copying you get the final dialog:



It may be necessary to do the steps 3 to 6 again, before the device can be used (the first time, a bus driver is installed, the second time, the virtual COM port driver is installed).

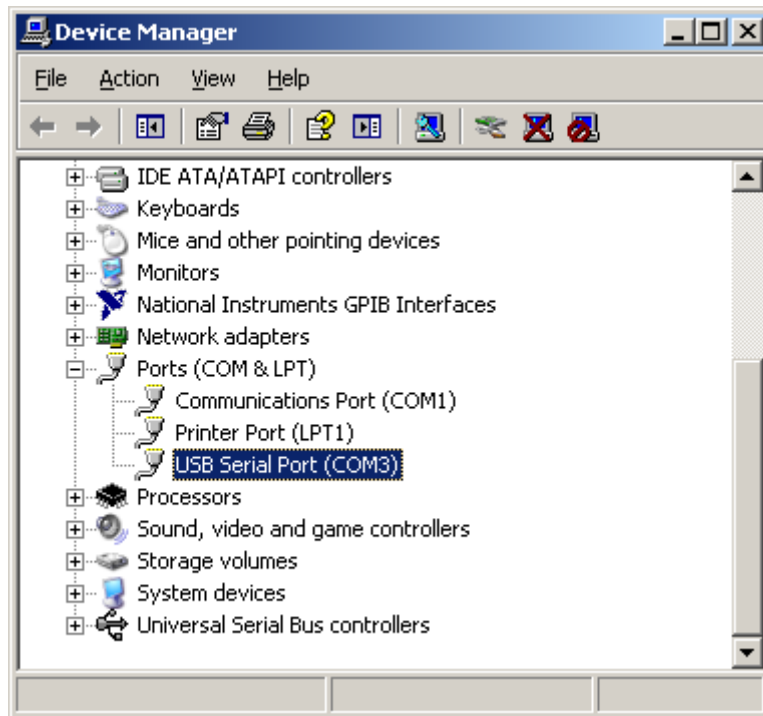
## RS-232/USB Interface Test under Windows

### Determine the serial USB interface with Device Manager

Start the Device Manager with:

Start → Settings → Control Panel → System → Device Manager

All HPS devices with USB interface get an USB Serial Port assigned in section Ports (COM & LPT), in this case COM3:

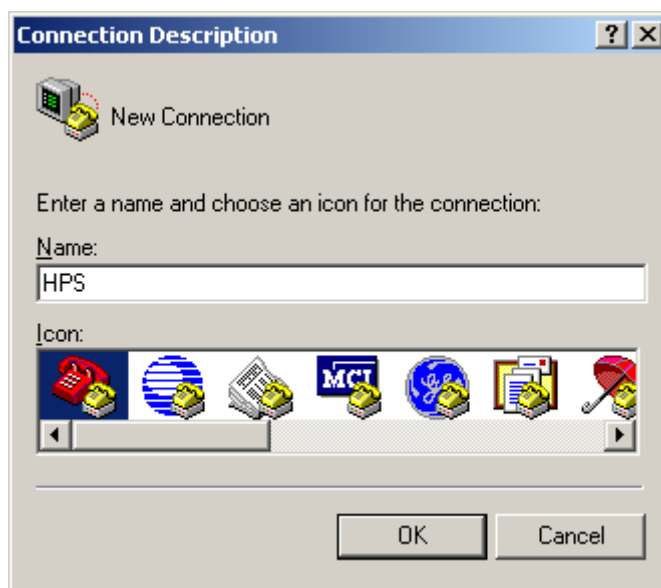


### Test with HyperTerminal

HyperTerminal is included in Windows 2000 / XP and can be started with:

Start → Programs → Accessories → Communications → HyperTerminal

Create a new connection with menu „File → New Connection“, name it e. g. “HPS” and click OK.

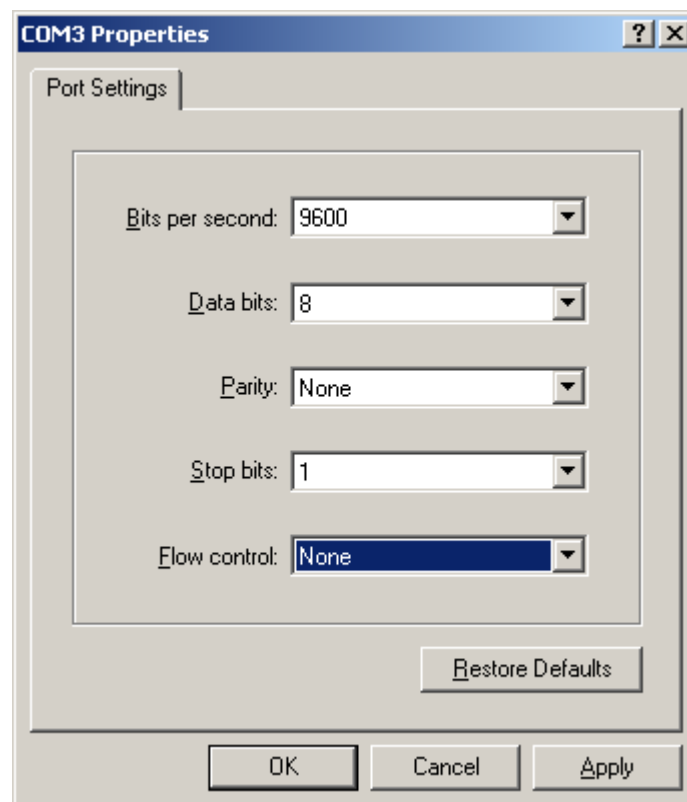




The following dialog appears. Choose your serial port and click OK:



Please enter the interface parameters in the following dialog:

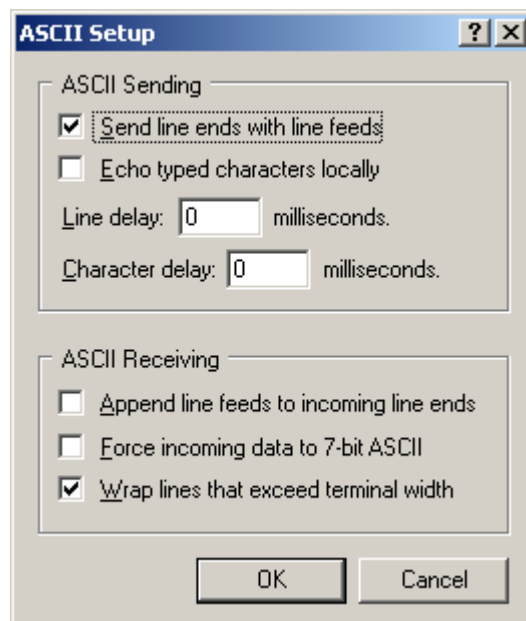


After clicking OK, the interface setup is finished.

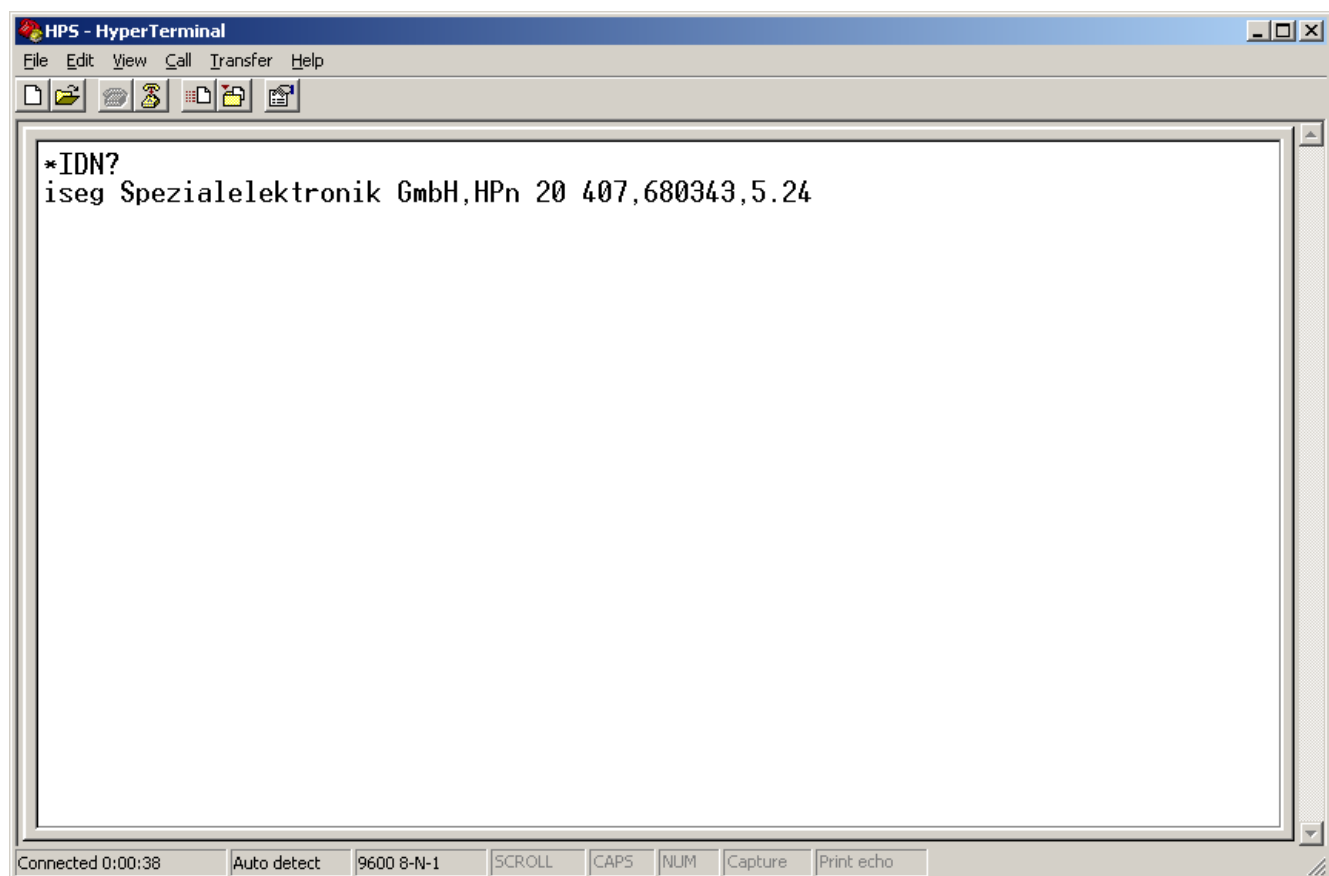
As last step, under:

File → Properties → Settings → ASCII Setup

the setting “Send line ends with line feeds” has to be made (see following picture).



You can now test the communication with the device:



## 5.4 IEEE-488 Interface (GPIB)

**Attention:** Turn off the device with mains switch POWER before connecting/disconnecting the interface cable.

### IEEE-488 Interface

The IEEE-488 bus interface was implemented with a NEC 7210 compatible IEEE controller. The following interface functions according to IEC 625 are available:

|     |                     |                            |
|-----|---------------------|----------------------------|
| SH1 | Source Handshake:   | all functions (no polling) |
| AH1 | Acceptor Handshake: | all functions (no polling) |
| T6  | Talker:             | standard equipment         |
| L4  | Listener:           | standard equipment         |

To connect the device to the IEEE bus, a Micro-D25 male connector is located at the device rear. An adapter cable with a 24 pin connector following IEEE-488.2 standard is available optional.

For remote control, the IEEE interface must be selected in Menu "F09 Set Interfce" by choosing "IEEE". The IEEE address (0...30) can be selected in Menu "F11 Addr IEEE". The device ships from the factory with a IEEE address of 17.

When receiving control commands over IEEE, the device switches to REMOTE state and the yellow LED "REMOTE" is lighting.

By pushing the LOCAL button, remote control is suspended and the device switches to LOCAL state.

If the device is in REMOTE state and high voltage is on, pushing ON/OFF turns off the HV generation and the device switches to LOCAL state.

In both cases, when receiving new commands via interface, it switches back to REMOTE state.

### Programming

The command transfer works with ASCII code. Commands are terminated by <CR><LF> (\$0D \$0A or 13 10). Alternatively, the control line EOI (End or Identify) can be set together with the command's last character. On input side, no leading zeros are needed. Output is fixed format without leading zero.

A minimum time delay of 5 ms between two IEEE commands is needed.

## 5.5 Ethernet Interface

**Attention:** Turn off the device with mains switch **POWER** before connecting/disconnecting the interface cable.

The Ethernet Interface with 10-MBit/s, Full-Duplex, is connected via RJ-45 socket on the device rear.

The device can be connected to a switch via patch cable. If it shall be connected to a PC directly, a crossover cable has to be used.

“Ethernet” has to be set in menu “F09 Set Interfce“. The additional settings (IP address, net-mask, default gateway) have to be made with the SCPI Instruction set with EDCP. This can be done over Ethernet or RS-232. Ex works settings are as follows:

|                  |               |
|------------------|---------------|
| IP-address:      | 192.168.16.13 |
| Net mask:        | 255.255.255.0 |
| Default Gateway: | 192.168.16.1  |
| Command port:    | 10001 (fixed) |

The connection can be tested with the ping command (Start → programs → accessories → command).

```
C:\>ping 192.168.16.13
```

```
Ping will done for 192.168.16.13 with 32 bytes data:
```

```
Answer from 192.168.16.13: bytes=32 time=4ms TTL=128
Answer from 192.168.16.13: bytes=32 time=4ms TTL=128
Answer from 192.168.16.13: bytes=32 time=4ms TTL=128
Answer from 192.168.16.13: bytes=32 time=4ms TTL=128
```

```
Ping statistic for 192.168.16.13:
Package: sent = 4, received = 4, lost = 0
Time in millisecond:
minimum = 1ms, maximum = 4ms, average = 1ms
```

During communication the HV unit act as server, the control PC act as client. The following table shows the principle sequence of communication PC to HV unit.

| Step | Function call | Computer → HV-Unit | HV-Unit → Computer                  |
|------|---------------|--------------------|-------------------------------------|
| 1.   | connect()     | SYN                |                                     |
| 2.   |               |                    | SYN, ACK                            |
| 3.   |               | ACK                |                                     |
| 4.   | send()        | "*IDN?\r\n"        |                                     |
| 5.   | recv()        |                    | "iseg Spezialelektronik GmbH [...]" |
| 6.   | closesocket() | FIN, ACK           |                                     |
| 7.   |               |                    | FIN, ACK                            |
| 8.   |               | ACK                |                                     |

The first three packages are for the establishing of a TCP-Connection (three way handshake). Fourth step is the inquiry from PC to HV unit. The order is ASCII coded in data field of the TCP packet. The answer is also ASCII coded send to the PC in step 5. Package No. 6 confirms the receipt of the packet and sends a FIN for termination of connection. Step 7 and 8 are the confirmation of termination of connection from HV unit and PC.

The communication can be monitored with a network sniffer (e. g. Wireshark). Control is done with the instruction sets described later. The preferred command set for Ethernet is “SCPI with EDCP”, as you can build longer Frames which reduces Ethernet Overhead.

## Programming

Simple programming example (without error handling) for communication with the HV device over Ethernet. This program was compiled and tested with Microsoft Visual C++ 6.0 on Windows XP.

```
#include <stdio.h>
#include <winsock.h>

int main(int argc, char *argv[])
{
    WSADATA    wsadata;
    SOCKET     sock;
    SOCKADDR_IN sockaddr_in;
    int        retcode;
    char        cmd[255] = "*IDN?\r\n";
    char        ans[255];

    // init sockets (Berkeley style, UNIX compatible)
    WSStartup(2, &wsadata);

    // create TCP socket
    sock = socket(AF_INET, SOCK_STREAM, IPPROTO_TCP);

    // bind socket to dynamic port
    memset(&sockaddr_in, 0, sizeof(sockaddr_in));
    sockaddr_in.sin_family = AF_INET;           // UDP, TCP
    sockaddr_in.sin_port   = htons(10001);      // Remote Port
    sockaddr_in.sin_addr.S_un.S_un_b.s_b1 = 192; // IP address
    sockaddr_in.sin_addr.S_un.S_un_b.s_b2 = 168;
    sockaddr_in.sin_addr.S_un.S_un_b.s_b3 = 16;
    sockaddr_in.sin_addr.S_un.S_un_b.s_b4 = 13;

    // connect to server (three way handshake)
    connect(sock, (SOCKADDR *)&sockaddr_in, sizeof(SOCKADDR_IN));

    // send command to server
    send(sock, cmd, strlen(cmd), 0);

    // read answer from server
    retcode = recv(sock, ans, sizeof(ans), 0);

    // close socket (three way handshake) and clean up
    closesocket(sock);
    WSACleanup();

    // print answer to screen
    printf("%s\n", ans);

    return 0;
}
```

## 5.6 Analogue I/O Interface

**Attention:** Turn off the device with mains switch **POWER** before connecting/disconnecting the interface cable.

**Attention:** All control inputs and outputs are indirect coupled to the HV-OUT.

All control inputs and outputs are available at the male D-SUB-9 connector on the rear side of the unit according to the following table.

| Analogue I/O with male SUB-D-9 connector |                    |                            |                                                                                                                   |
|------------------------------------------|--------------------|----------------------------|-------------------------------------------------------------------------------------------------------------------|
| Pin 1 / 6                                | @GND               | Ground                     |                                                                                                                   |
| Pin 2                                    | V <sub>I-MON</sub> | Current monitor            |                                                                                                                   |
| Pin 3                                    | INHIBIT            | TTL level / Input          | <b>Low = active:</b> $\Rightarrow V_{OUT} = 0$<br><b>High / offen:</b> $\Rightarrow V_{OUT}$ according set values |
| Pin 4                                    | V <sub>I-SET</sub> | Current control            |                                                                                                                   |
| Pin 5                                    | Cmode              | TTL level / Output         | <b>Low</b> = Current control (CC), <b>High</b> = Voltage control (CV)<br>reaction time < 100 ms                   |
| Pin 7                                    | V <sub>V-MON</sub> | Voltage monitor            |                                                                                                                   |
| Pin 8                                    | V <sub>V-SET</sub> | Voltage control            |                                                                                                                   |
| Pin 9                                    | V <sub>REF</sub>   | Internal reference voltage | V <sub>REF</sub> = 5 V / 1 mA                                                                                     |

### Operation with analogue I/O

You can choose control with the analogue interface "AIF" in the menu „F07 Set Interface“ and then switch push button "LOCAL" in order to switch to analogue remote control, the yellow LED "REM" is lighting now (exception see "Auto AIF").

By pushing LOCAL again the mode runs back to menu and „HV-OFF“. To use the unit in LOCAL mode again you must choose an other interface in the menu „F07 Set Interface“ (e.g. RS-232).

The generation of high voltage will start with pushing "HV ON" (exception see "Auto AIF") according to the analogue set values and will stop with pushing "HV OFF" or with external INHIBIT (LOW = active).

The reaction to the active INHIBIT signal is according to the setting of the KILL function:

- KILL disable: generation of HV will be stopped, with Low to High on INHIBIT the output will be ramp to the chosen voltage/current with the programmed ramp speed!
- KILL enable: generation of HV will be stopped, with Low to High on INHIBIT the output will be volt-free. The generation of high voltage will start with pushing "HV ON" only (exception see "Auto AIF").

### Automatic function "Auto AIF"

If the control mode is chosen with analogue interface "AIF" in the menu „F07 Set Interface“ you can set the automatic function "Auto AIF" in the menu „F06 Auto AIF" to "ON".

Now it is able to start the generation of HV according to the set values with the INHIBIT signal Low to High, without pushing "HV ON"!

|                 |                                                                                        |
|-----------------|----------------------------------------------------------------------------------------|
| <b>Caution!</b> | <b>The high voltage generation will start with each Low to High Signal on INHIBIT!</b> |
|-----------------|----------------------------------------------------------------------------------------|

If you choose an other interface in the menu „F07 Set Interface“, the function "Auto AIF" will be set to "OFF" automatically. If you will use „Auto AIF" again, you must choose "AIF" in the menu „F07 Set Interface" before and than set the automatic function "Auto AIF" in the menu „F06 Auto AIF" to "ON".

## Control inputs

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

The output voltage is proportionally to the external control voltage of 0 to 5 V DC between pin 8 (+  $V_{V-SET}$ , indirect coupled) and pin 6 (@GND, indirect-coupled).

Example: HPp 40 357, maximum voltage = 4 kV

| $V_{V-SET}$ (V) |                | Output voltage (kV) |
|-----------------|----------------|---------------------|
| 5.0             | corresponds to | 4.0                 |
| 2.5             | corresponds to | 2.0                 |
| 1.0             | corresponds to | 0.8                 |

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

The output current is proportionally to the external control voltage of 0 to 5 V DC between pin 4 (+  $V_{I-SET}$ , indirect coupled) and pin 6 (@GND, indirect-coupled).

Example: HPp 40 357, maximum current = 350 mA

| $V_{I-SET}$ (V) |                | Output current (mA) |
|-----------------|----------------|---------------------|
| 5.0             | corresponds to | 350                 |
| 2.5             | corresponds to | 175                 |
| 1.0             | corresponds to | 70                  |

- **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 to GND-HV and metal box).

High voltage generation will be **started** according to the settings with TTL-level Low to **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.

## Monitor outputs

- **Voltage monitor output**  $V_{V-MON} = 0 \text{ to } 5 \text{ V}$

An analogue monitor signal proportionally to the output voltage is available. This monitor voltage is measured between pin 7 ( $V_{V-MON}$ , indirect-coupled) and pin 6 (@GND, indirect-coupled).

Example: HPp 40 357, maximum output voltage = 4 kV

| $V_{V-MON}$ (V) |                | Output voltage (kV) |
|-----------------|----------------|---------------------|
| 5.0             | corresponds to | 4.0                 |
| 2.5             | corresponds to | 2.0                 |
| 1.0             | corresponds to | 0.8                 |

- **Current monitor output**  $V_{I-MON} = 0 \text{ to } 5 \text{ V}$

An analogue monitor signal proportionally to the output current is available. This monitor voltage is measured between pin 2 ( $V_{I-MON}$ , indirect-coupled) and pin 6 (@GND, indirect-coupled).

Example: HPp 40 357, maximum output current = 350 mA

| $V_{I-MON}$ (V) |                | Output current (mA) |
|-----------------|----------------|---------------------|
| 5.0             | corresponds to | 350                 |
| 2.5             | corresponds to | 175                 |
| 1.0             | corresponds to | 70                  |

## 6 Command sets

### 6.1 SCPI command set with EDCP

This is the recommended command Set.

To use this command set, choose "EDCP" in the menu or the \*INSTR command. (EDCP = Enhanced Device Communication Protocol). This command set is oriented on the iseg EDCP CAN Protocol with Status and Event handling.

The Status and Event Status Fields are explained after the SCPI table.

| Common Commands              |                                                                                 |
|------------------------------|---------------------------------------------------------------------------------|
| *IDN?                        | Query Module Identification                                                     |
| *CLS                         | Clear Module (Event-)Status                                                     |
| *RST                         | Reset device to save values<br>(Turn HV off with ramp, Vset= 0, Iset= Inominal) |
| *LLO                         | Local Lockout (disable front panel buttons)                                     |
| *GTL                         | Goto Local (enable front panel buttons)                                         |
| *INSTR?                      | Query instruction set                                                           |
| *INSTR,EDCP                  | Switch to EDCP SCPI command set                                                 |
| SCPI Commands                |                                                                                 |
| :VOLTage                     |                                                                                 |
| <Voltage>[V]                 | Set Channel Voltage                                                             |
| :LIMit <Voltage>[V]          | Set Voltage Limit                                                               |
| :BOUnds <Voltage>[V]         | Set Channel Voltage Bounds                                                      |
| { ON   OFF }                 | Set Channel On / Off (with configured ramp speed)                               |
| EMCY OFF                     | Shut Channel Emergency Off (without ramp)                                       |
| EMCY CLR                     | Leave state emergency off                                                       |
| :CURRent                     |                                                                                 |
| <Current>[A]                 | Set Channel Current                                                             |
| :LIMit <Current>[A]          | Set Current Limit                                                               |
| :BOUnds <Current>[A]         | Set Channel Current Bounds                                                      |
| :EVEnt                       |                                                                                 |
| CLEAR                        | Clear Channel Event Status                                                      |
| :MASK <Word>                 | Set Channel Event Mask                                                          |
| :MEASure                     |                                                                                 |
| :VOLTage?                    | Query Measured Channel Voltage (V)                                              |
| :CURRent?                    | Query Measured Channel Current (A)                                              |
| :CONFIgure                   |                                                                                 |
| Set/Get module configuration |                                                                                 |
| :RAMP                        |                                                                                 |
| :VOLTage <RampSpeed>[V/s]    | Set Module Voltage Ramp Speed                                                   |
| :VOLTage MAX                 | LPS only: disable Software Voltage Ramp                                         |
| :CURRent <RampSpeed>[A/s]    | Set Module Current Ramp Speed                                                   |
| :EVEnt                       |                                                                                 |
| :CLEAR                       | Clear Module Event Status                                                       |
| :MASK                        |                                                                                 |
| :KILL?                       | Query Module Kill Status                                                        |
| :KILL { 0   1 }              | Set Kill Disable (0) or Kill Enable (1)                                         |

<sup>1</sup>, <sup>2</sup> If the high voltage is shut down with :VOLT EMCY OFF, the channel is hold in state Emergency Off. To turn on the High Voltage again, the state Emergency Off must be leaved with :VOLT EMCY CLR. Furthermore, the Channel EventStatus Bit EEMCY must be cleared e. g. with \*CLS.



|                   |                                   |                                                       |
|-------------------|-----------------------------------|-------------------------------------------------------|
| <b>:CONFigure</b> |                                   |                                                       |
| <b>:ETHernet</b>  |                                   |                                                       |
|                   | <b>:ADDRess</b> <xxx.xxx.xxx.xxx> | Set Ethernet IP Address                               |
|                   | <b>:ADDRess?</b>                  | Query Ethernet IP Address                             |
|                   | <b>:NETmask</b> <xxx.xxx.xxx.xxx> | Set Ethernet IP Netmask                               |
|                   | <b>:NETmask?</b>                  | Query Ethernet IP Netmask                             |
|                   | <b>:GATEway</b> <xxx.xxx.xxx.xxx> | Set Ethernet IP Default Gateway                       |
|                   | <b>:GATEway?</b>                  | Query Ethernet IP Default Gateway                     |
|                   | <b>:MAC?</b>                      | Query Ethernet MAC Address                            |
| <b>:SERIAL</b>    |                                   | RS-232/USB Configuration                              |
|                   | <b>:BAUDrate?</b>                 | Query Serial Baudrate                                 |
|                   | <b>:ECHO</b> { 0   1 }            | Set Serial Echo Off (0) or Echo On (1)                |
|                   | <b>:ECHO?</b>                     | Query Serial Echo                                     |
| <b>:GPIB</b>      |                                   |                                                       |
|                   | <b>:ADDRess?</b>                  | Query IEEE-488/GPIB Address                           |
| <b>:CAN</b>       |                                   |                                                       |
|                   | <b>:ADDRess?</b>                  | Query CAN Address                                     |
| <b>:READ</b>      |                                   |                                                       |
|                   | <b>:VOLTage?</b>                  | Query Set Voltage (V)                                 |
|                   | <b>:LIMit?</b>                    | Query Voltage Limit (V)                               |
|                   | <b>:NOMinal?</b>                  | Query Nominal Voltage (V)                             |
|                   | <b>:BOUNds?</b>                   | Query Voltage Bounds (V)                              |
|                   | <b>:CURRent?</b>                  | Query Set Current (A)                                 |
|                   | <b>:LIMit?</b>                    | Query Current Limit (A)                               |
|                   | <b>:NOMinal?</b>                  | Query Nominal Current (A)                             |
|                   | <b>:BOUNds?</b>                   | Query Current Bounds (A)                              |
| <b>:RAMP</b>      |                                   |                                                       |
|                   | <b>:VOLTage?</b>                  | Query Voltage Ramp Speed (V/s)                        |
|                   | <b>:CURRent?</b>                  | Query Current Ramp Speed (A/s)                        |
| <b>:MODule</b>    |                                   |                                                       |
|                   | <b>:STATus?</b>                   | Query Module Status Word                              |
|                   | <b>:EVEnt</b>                     |                                                       |
|                   | <b>:STATus?</b>                   | Query Module Event Status                             |
|                   | <b>:MASK?</b>                     | Query Module Event Mask                               |
|                   | <b>:SUPply?</b>                   | Query Module Supply State<br>(1 = good, 0 = not good) |
|                   | <b>:TEMPerature?</b>              | Query measured Module Temperature (°C)                |
| <b>:CHANnel</b>   |                                   |                                                       |
|                   | <b>:STATus?</b>                   | Query Channel Status Word                             |
|                   | <b>:EVEnt</b>                     |                                                       |
|                   | <b>:STATus?</b>                   | Query Channel Event Status Word                       |
|                   | <b>:MASK?</b>                     | Query Channel Event Status Mask                       |

## Output formats for voltage and current:

| Vnominal                                           | Output format voltage values |
|----------------------------------------------------|------------------------------|
| $100\text{ V} \leq V_{\text{nom}} < 1\text{ kV}$   | 123.456V                     |
| $1\text{ kV} \leq V_{\text{nom}} < 10\text{ kV}$   | 1.23456E3V                   |
| $10\text{ kV} \leq V_{\text{nom}} < 100\text{ kV}$ | 12.3456E3V                   |

| Inominal                                           | Output format current values |
|----------------------------------------------------|------------------------------|
| $1\text{ mA} \leq I_{\text{nom}} < 10\text{ mA}$   | 1.23456E-3A                  |
| $10\text{ mA} \leq I_{\text{nom}} < 100\text{ mA}$ | 12.3456E-3A                  |
| $100\text{ mA} \leq I_{\text{nom}} < 1\text{ A}$   | 123.456E-3A                  |
| $1\text{ A} \leq I_{\text{nom}} < 10\text{ A}$     | 1.23456A                     |
| $10\text{ A} \leq I_{\text{nom}} < 100\text{ A}$   | 12.3456A                     |

### Examples:

*Read Module Identification:*

\*IDN?  
iseg Spezialelektronik GmbH,HPp 40 207,680001,5.24

*Set Voltage to 1000.501 V*

:VOLT 1000.501

*Set Current to 1.58 mA*

:CURR 0.00158

*Set Voltage Ramp speed to 300 Volt per second*

:CONF:RAMP:VOLT 300

### Advanced Examples:

*Set and read back Voltage and Current:*

:VOLT 2000.5; :READ:VOLT?; :CURR 0.2; :READ:CURR?  
2.00050E3V;200.000E-3A

*Read actual measured Voltage and Current:*

:MEAS:VOLT?; CURR?  
2.00028E3V;19.997E-3A

## Channel status (read access)

:READ:CHANnel:STATus?

|        |        |        |        |        |        |      |      |
|--------|--------|--------|--------|--------|--------|------|------|
| Bit15  | Bit14  | Bit13  | Bit12  | Bit11  | Bit10  | Bit9 | Bit8 |
| isVLIM | isCLIM | isTRP  | isEINH | isVBND | isCBND | res  | res  |
| Bit7   | Bit6   | Bit5   | Bit4   | Bit3   | Bit2   | Bit1 | Bit0 |
| isCV   | isCC   | isEMCY | isRAMP | isON   | isIERR | res  | res  |

The ChannelStatus register describes the *actual* status. Depending on the status of the channel the bits will be set or reset.

| Bit    | Name                    | Bit is 1                                                                                | Bit is 0                   |
|--------|-------------------------|-----------------------------------------------------------------------------------------|----------------------------|
| isVLIM | IsVoltageLimitExceeded  | Voltage limit set by $V_{max}$ is exceeded                                              | Voltage limit not exceeded |
| isCLIM | IsCurrentLimitExceeded  | Current limit set by $I_{max}$ is exceeded                                              | Current limit not exceeded |
| isTRIP | IsTripExceeded          | Trip is set when Voltage or Current limit or Iset has been exceeded (when KillEnable=1) | No Trip                    |
| isEINH | IsExtInhibit            | External Inhibit active                                                                 | No External Inhibit        |
| isVBND | IsVoltageBoundsExceeded | Voltage out of bounds                                                                   | Voltage in bounds          |
| isCBND | IsCurrentBoundsExceeded | Current out of bounds                                                                   | Current in bounds          |
| IsCV   | IsControlledVoltage     | Voltage control active (evaluation is guaranteed when no ramp is running)               | Voltage control not active |
| IsCC   | IsControlledCurrent     | Current control active (evaluation is guaranteed when no ramp is running)               | Current control not active |
| isEMCY | IsEmergencyOff          | Emergency off without ramp                                                              | No Emergency Off           |
| isON   | IsOn                    | HV is On                                                                                | HV is Off                  |
| isRAMP | IsRamping               | Ramp is running                                                                         | No Ramp is running         |
| isIERR | InputError              | Input error                                                                             | No Input error             |
| res    | Reserved                |                                                                                         |                            |

## Channel event status (read/write access)

:READ:CHANnel:EVent:STATus?

|       |       |       |       |         |        |      |      |
|-------|-------|-------|-------|---------|--------|------|------|
| Bit15 | Bit14 | Bit13 | Bit12 | Bit11   | Bit10  | Bit9 | Bit8 |
| EVLIM | ECLIM | ETRP  | EEINH | EVBNDs  | ECBNDs | res  | res  |
| Bit7  | Bit6  | Bit5  | Bit4  | Bit3    | Bit2   | Bit1 | Bit0 |
| ECV   | ECC   | EEMCY | EEOR  | EOn2Off | EIER   | res  | Res  |

The Channel EventStatus register describes the *captured* status. Depending on the status of the channel the bits will be set but not reset. A reset has to be done by the user by writing an 1 to this event bit. All Events can be cleared by :EVENT:CLEAR.

| Bit     | Name                   | Description                                                                                    |
|---------|------------------------|------------------------------------------------------------------------------------------------|
| EVLIM   | EventVoltageLimit      | Event: Voltage limit has been exceeded                                                         |
| ECLIM   | EventCurrentLimit      | Event: Current limit has been exceeded                                                         |
| ETRIP   | EventTrip              | Event: Trip is set when Voltage or Current limit or Iset has been exceeded (when KillEnable=1) |
| EEINH   | EventExtInhibit        | Event: External Inhibit                                                                        |
| EVBNDs  | EventVoltageBounds     | Event: Voltage out of bounds                                                                   |
| ECBNDs  | EventCurrentBounds     | Event: Current out of bounds                                                                   |
| ECV     | EventControlledVoltage | Event: Voltage control                                                                         |
| ECC     | EventControlledCurrent | Event: Current control                                                                         |
| EEMCY   | EventEmergencyOff      | Event: Emergency off                                                                           |
| EEOR    | EventEndOfRamp         | Event: End of ramp                                                                             |
| EOn2Off | EventOnToOff           | Event: Change from state "On" to "Off" without ramp                                            |
| EIER    | EventInputError        | Event: Input Error                                                                             |
| res     | Reserved               |                                                                                                |

An event bit is permanently set if the corresponding status bit is 1 or is changing to 1. Different to the status bit an event bit isn't automatically reset. A reset has to be done by the user by writing an 1 to this event bit.

If one of the EventStatus Bits EVLIM, ECLIM, ETRIP, EEINH, EVBNDs, ECBNDs, EEMCY is set, it prevents turning on the High Voltage again until the corresponding bit is cleared.

## ModuleStatus (read access)

:READ:MODule:STATus?

|          |          |          |         |           |         |          |          |
|----------|----------|----------|---------|-----------|---------|----------|----------|
| Bit15    | Bit14    | Bit13    | Bit12   | Bit11     | Bit10   | Bit9     | Bit8     |
| isKILena | isTEMPgd | isSPLYgd | isMODgd | isEVNTact | isSFLPg | isnoRAMP | isnoSERR |
| Bit7     | Bit6     | Bit5     | Bit4    | Bit3      | Bit2    | Bit1     | Bit0     |
| res      | res      | res      | isSrv   | res       | res     | res      | isADJ    |

The status bits as there are IsTemperatureGood, IsSupplyGood, IsModuleGood, IsEventActive, Is-SafetyLoopGood, IsNoRamp and IsNoSumError indicate the single status for the complete module.

| Bit       | Name              | Bit is 1                                           | Bit is 0                                                |
|-----------|-------------------|----------------------------------------------------|---------------------------------------------------------|
| isKILena  | IsKillEnable      | Module is in state Kill enable                     | Module is in state Kill disable                         |
| isTEMPgd  | IsTemperatureGood | Module Temperature < 55 °C                         | Module temperature > 55°C<br>High voltage is turned off |
| isSPLYgd  | IsSupplyGood      | Power Supply is good                               | Power Supply is not good                                |
| isMODgd   | IsModuleGood      | Module status is good                              | Module status bad                                       |
| isEVNTact | IsEventActive     | At least one masked Event is active                | No masked Event is active                               |
| isSFLPg   | IsSafetyLoopGood  | Safety Loop is closed                              | Safety Loop is open                                     |
| isnoRAMP  | IsNoRamp          | All channels stable, no ramp active.               | At least one channel is ramping                         |
| isnoSERR  | IsNoSumError      | No sum error                                       | Sum error active                                        |
| isSrv     | IsServiceNeeded   | Hardware failure detected:<br>consult manufacturer | No Hardware failure detected                            |
| isADJ     | IsFineAdjustment  | Adjustment is on                                   | Adjustment is off                                       |
| Res       | Reserved          |                                                    |                                                         |

## Module EventStatus (read/write access)

### :READ:MODule:EvEnt:STATus?

The Module EventStatus register describes the *captured* status. Depending on the status of the module the bits will be set but not reset. A reset has to be done by the user by writing an 1 to this event bit. All Events can be cleared by :CONFIGURE:EVENT:CLEAR.

| Bit15 | Bit14   | Bit13    | Bit12 | Bit11 | Bit10    | Bit9 | Bit8 |
|-------|---------|----------|-------|-------|----------|------|------|
| Res   | ETMPngd | ESPLYngd | res   | res   | ESFLPngd | res  | res  |
| Bit7  | Bit6    | Bit5     | Bit4  | Bit3  | Bit2     | Bit1 | Bit0 |
| res   | res     | res      | res   | ESrvc | res      | res  | res  |

|          |                         |                                                                                                                                                                                  |
|----------|-------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| ETEMPngd | EventTemperatureNotGood | Event: Temperature is above 55°C                                                                                                                                                 |
| ESPLYngd | EventSupplyNotGood      | Event: at least one of the supplies is not good                                                                                                                                  |
| ESFLPngd | EventSafetyLoopNotGood  | Event: Safety loop is open                                                                                                                                                       |
| ESrvc    | EventService            | Event: A hardware failure of the HV module has been detected. The HV is switched off without the possibility to switch on again. Please consult the iseg Spezialelektronik GmbH. |
| res      | Reserved                |                                                                                                                                                                                  |

## 6.2 ET command set (Compatibility to old HPS)

This command set is selected via Menu "F10 Set Instruct" → "ET".

### Setting commands

Command:

*Command example:*

Command to set an output voltage:

U,<Voltage>kV

*U,1.000kV*

Command to set a voltage limit:

UL,<Voltage>kV

*UL,1.000kV*

Command to set an output current:

I,<Current>mA

*I,30mA*

Command to set a current limit:

IL,<Current>mA

*IL,30mA*

Command to set the Voltage ramp speed:

RAMP,<Rampspeed>V/s

*RAMP,3000V/s*

Command to switch the high voltage on and off:

HV,ON

HV,OFF

Command for setting the KILL function „Enable“ or „Disable“:

KILL,ENable

*KILL,EN*

KILL,DISable

Command for Emergency off (The HV generation is shut off permanently and the set values for voltage and current are set to Zero):

EMCY OFF

### Read out the setting commands

Command:

*Response example:*

Read out the set voltage:

STATUS,U

*U, RANGE=3.000kV, VALUE=2.458kV*

Read out the voltage limit:

STATUS,UL

*UL, RANGE=3.000kV, VALUE=2.458kV*

Read out the set current:

STATUS,I

*I, RANGE=100.0mA, VALUE=30.0mA*

Read out the current limit:

STATUS,IL

*IL, RANGE=100.0mA, VALUE=30.0mA*

Read out the voltage ramp speed:

STATUS,RAMP

*RAMP, RANGE=3000V/s, VALUE=1000V/s*

## Read out the measurement values

Read measured output voltage:

STATUS,MU

UM, RANGE=3.000kV, VALUE=2.458kV

Read measured output current:

STATUS,MI

IM, RANGE=100.0mA, VALUE=25.3mA

## Read out the device status

STATUS,DI

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 | IERR   | b15 | <i>no Input Error</i>         | <i>Input error</i>         |
| #define | RAMP   | b14 | <i>no Ramp</i>                | <i>Ramp</i>                |
| #define | EMCY   | b13 | <i>no Emergency</i>           | <i>Emergency</i>           |
| #define | TRIP   | b12 | <i>no Trip error</i>          | <i>Trip error</i>          |
| #define | RES5   | b11 | <i>Reserved</i>               |                            |
| #define | RES4   | b10 | <i>Reserved</i>               |                            |
| #define | RES3   | b9  | <i>Reserved</i>               |                            |
| #define | RES2   | b8  | <i>Reserved</i>               |                            |
|         |        |     |                               |                            |
| #define | SERR   | b7  | <i>no Sum error</i>           | <i>Sum error</i>           |
| #define | IREG   | b6  | <i>no Current control</i>     | <i>Current control</i>     |
| #define | VREG   | b5  | <i>no Voltage control</i>     | <i>Voltage control</i>     |
| #define | POL    | b4  | <i>negative Polarity</i>      | <i>positive Polarity</i>   |
| #define | INH    | b3  | <i>no external Inhibit</i>    | <i>external Inhibit</i>    |
| #define | RES1   | b2  | <i>Reserved</i>               |                            |
| #define | KILena | b1  | <i>Kill disable</i>           | <i>Kill enable</i>         |
| #define | ON     | b0  | <i>no High voltage active</i> | <i>High voltage active</i> |

## Read out the LAM status

STATUS,LAM

|                   |                                               |
|-------------------|-----------------------------------------------|
| LAM,ERROR         | External Inhibit occurred during Kill enable  |
| LAM,EMERGENCY     | High Voltage was shut down with Emergency Off |
| LAM,SAFETY LOOP   | Safety Loop was opened                        |
| LAM,INHIBIT       | External Inhibit occurred                     |
| LAM,TRIP ERROR    | Software current trip occurred                |
| LAM,VOLTAGE LIMIT | Voltage has exceeded set value                |
| LAM,CURRENT LIMIT | Current has exceeded set value                |
| LAM,INPUT ERROR   | Wrong command received                        |
| LAM,OK            | Status OK                                     |

## Read out the device identification

ID

ID, iseg Spezialelektronik r5.01 sn.680041 Typ HPn 30 107



### 6.3 SCPI command set (Compatibility to old HPS)

This instruction set is selected with Menu "F10 Set Instruct" → "SCPI".

#### Setting commands

Command:

*Command example:*

Command to set an output voltage:

:VOLTage <Voltage>kV

:VOLT 1.000kV

Command to set a voltage limit:

:LIMIT:VOLTage <Voltage>kV

:LIMIT:VOLT 1.000kV

Command to set an output current:

:CURRent <Current>mA

:CURR 30mA

Command to set a current limit:

:LIMIT:CURRent <Current>mA

:LIMIT:CURR 30mA

Command to set a voltage ramp speed:

:CONFigure:RAMP <Rampspeed>V/s

:CONF:RAMP 3000V/s

Command to turn high voltage on and off:

:VOLTage ON

:VOLTage OFF

Command for Emergency off (The HV generation is shut off permanently and the set values for voltage and current are set to Zero):

:VOLTage EMCY OFF

Command for setting KILL function "Enable" or "Disable":

:CONFigure:KILL ENable

:CONF:KILL EN

:CONFigure:KILL DISable

#### Read out the setting commands

Command:

*Response example:*

Command to read out the set voltage:

:READ:VOLTage?

U, RANGE=3.000kV, VALUE=2.458kV

Command to read out the voltage limit:

:READ:LIMIT:VOLTage?

UL, RANGE=3.000kV, VALUE=2.458kV

Command to read out the set current:

:READ:CURRent?

I, RANGE=100.0mA, VALUE=30.0mA

Command to read out the current limit:

:READ:LIMIT:CURRent?

IL, RANGE=100.0mA, VALUE=30.0mA

Command to read out the voltage ramp speed:

:READ:RAMP?

Ramp, RANGE=3000V/s, VALUE=3000V/s

## Read out the measurement values

Read measured output voltage:

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

Read measured output current:

:MEASure:CURRent? *IM, RANGE=100.0mA, VALUE=25.3mA*

## Read out the device status

:READ:STATus? *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>*

For status field description, see chapter 6.1, device status.

## Read out the LAM status

:READ:LAM?

For LAM status description, see chapter 6.1, LAM status.

## Read out the device identification

:READ:IDNT? *ID, iseg Spezialelektronik r5.01 sn.680042 Typ HPn 30 107*

## 6.4 Common command set (Compatibility to old HPS)

The Common commands can be used all the time, independently from selected instruction set (ET or SCPI).

A response example for commands that returns an answer is shown at the right side (*printed Italic*).

Command *Response example:*

## Read out the device identification

\*IDN? *ID, iseg Spezialelektronik r5.01 sn.680043 Typ HPn 30 107*

## Device control

|      |                                      |
|------|--------------------------------------|
| *LLO | Local Lockout: disable local buttons |
| *GTL | Go to Local: enable local buttons    |
| *CLS | Clear Status: clear error status     |
| *RST | Reset: Device is rebooting           |

## Read/change Instruction set

|             |                                |                               |
|-------------|--------------------------------|-------------------------------|
| *INSTR?     | Query current instruction set  | <i>Instruction type, SCPI</i> |
| *INSTR,SCPI | Change to SCPI instruction set |                               |
| *INSTR,ET   | Change to ET instruction set   |                               |

## Read/change RS-232 Echo state

|           |                   |                 |
|-----------|-------------------|-----------------|
| *ECHO?    | Query Echo status | <i>Echo off</i> |
| *ECHO*ON  | Turn on Echo      |                 |
| *ECHO*OFF | Turn off Echo     |                 |

### 7.1 Error messages on Displays

| Error messages during operation |                                                                                                           |
|---------------------------------|-----------------------------------------------------------------------------------------------------------|
| Display:                        | Meaning:                                                                                                  |
| SAFETYLOOP                      | Safety loop (Interlock) is not closed. Device can't create high voltage.                                  |
| EXTERNAL INHIBIT                | No high voltage can be created because of external inhibit (analogue I/O).                                |
| EMERGENCY                       | High voltage has been shut down without ramp due to Emergency Off.                                        |
| CURRENT TRIP                    | Current set value reached during Kill enable. High voltage has been shut down without ramp.               |
| VOLTAGE LIMIT                   | Voltage Limit $V_{max}$ has been exceeded.<br>In Kill enable, the high voltage is shut down without ramp. |
| CURRENT LIMIT                   | Current Limit $I_{max}$ has been exceeded.<br>In Kill enable, the high voltage is shut down without ramp. |
| OVERTEMPERATURE                 | High voltage has been shut down because of over temperature.<br>Let device cool down.                     |
| ERROR SUPPLY                    | Internal power supply is bad. Device must be shipped to service.                                          |
| ERROR SERVICE                   | High voltage generator is bad. Device must be shipped to service.                                         |
| Error messages during boot      |                                                                                                           |
| Display:                        | Meaning:                                                                                                  |
| ERROR RTC                       | Real time clock battery is low. Contact service.                                                          |
| CONTACT SERVICE                 | Device must be shipped to the factory for service.                                                        |
| ERROR AIF                       | Analogue interface (optional) is not working. Contact service.                                            |
| ERROR IEEE                      | IEEE interface (optional) is not working. Contact service.                                                |

### 7.2 General errors

- |                                                                         |   |                                                                                            |
|-------------------------------------------------------------------------|---|--------------------------------------------------------------------------------------------|
| Unit does not provide output voltage, and the displays are not lighting | ⇒ | - check mains voltage and connection                                                       |
| Unit does not provide output voltage but the displays are lighting.     | ⇒ | - Check of environmental temperature ( $T_A \leq 35^\circ\text{C}$ )<br>- 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.

**Cal Power**

Via Acquarana, 29 22100 COMO  
tel. 031.526.566 (r.a.) fax 031.507.984  
info@calpower.it www.caltower.it