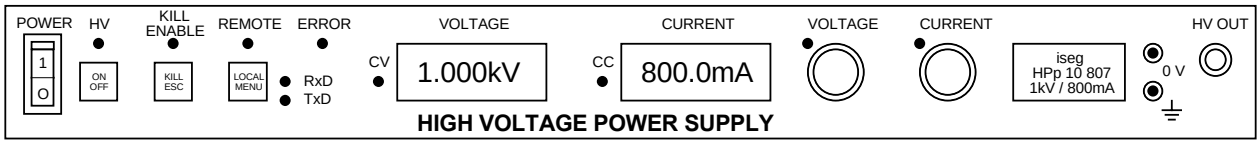
# 4 Front panel operation




Picture: HPS/LPS front panel.

Optional and if $V_{NOM}$ > 7kV: 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 $I_{SET}$.

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 • $V_{NOM}$ per second.**

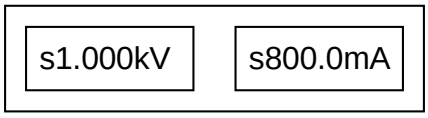
By pressing ON/OFF again, the high voltage generation is turned off, the green LED “HV” goes off. The high voltage is ramped down with the programmed ramp speed.

## 4.1 Displays

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

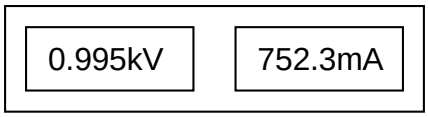
In HV-OFF state, the set values are shown on display for easy changes with the rotary encoders VOLTAGE and CURRENT. These set values are stored in processor’s EEPROM and reloaded at next start-up.

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 an 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.

| Menu | Display | Description |
|---|---|---|
| Software Voltage Limit | F01 Set Limit V | Adjust Software-voltage limit $V_{OUTmax}$ with rotary encoder VOLTAGE. $V_{SET}$ will be limited to this value. |
| Software Current Limit | F02 Set Limit I | Adjust Software-current limit $I_{OUTmax}$ with rotary encoder CURRENT. $I_{SET}$ will be limited to this value. |
| Voltage Ramp set | F03 Set Ramp V | Adjust voltage ramp speed with rotary encoder VOLTAGE in the range of 1 … 3000 V/s. |
| Current Ramp set | F04 Set Ramp I | Adjust current ramp speed with rotary encoder CURRENT.<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 be changing the ramp speed greater than 3000 V/s: "max." will be displayed. To enable the software ramp again, choose a ramp speed between 1…3000 V/s. |
| Generate HV with Power-On automatically | F05 Auto Start | Not implemented yet. |
| Control with analogue I/O automatically | F06 Auto AIF | AIF ON: Turn on HV by pushing the ON/OFF button or with INHIBIT on analogue I/O Low to High<br>AIF OFF Turn on HV by pushing the ON/OFF button<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 |
| Change Interface | F07 Set Interfce | Select external Interface with rotary encoder VOLTAGE:<br>"CAN" control via CAN-Interface<br>"RS-232" control via RS232-Interface<br>"IEEE 488" control via IEEE-Interface<br>"AIF" control via Analogue I/O |
| Change Instruction set | F08 Set Instruct | Select instruction type for RS-232 and IEEE-488 with rotary encoder VOLTAGE:<br>"EDCP" SCPI command set with EDCP (recommended)<br>"SCPI" old SCPI command set<br>"ET" old ET command set |
| Change IEEE Address | F09 Addr IEEE | Select IEEE address with rotary encoder VOLTAGE: 01 to 30 |
| Change CAN Address | F10 Addr CAN | Select CAN address with rotary encoder VOLTAGE: 00 to 63 |
| Echo on/off for RS232 | F11 Set Echo | Select Echo state with rotary encoder VOLTAGE:<br>"on" ⇒ "off" ⇒ "on" |

| Menu | Display | Description |
|---|---|---|
| Set Password | 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). |
| Show Power | F13 Show Power | Change the display to $V_{OUT}$ and $Power_{OUT}$ (on/off) |

## 4.3 Error states

The following Errors cause the High Voltage to shut down and have to be cleared before turning it on again with Button KILL/ESC or a remote command (e. g. *CLS):

- Emergency Off (EMCY)
- Current Trip (TRIP)
- Voltage Limit (VLIM)
- Current Limit (ILIM)
- Safety Loop (ILK)
- Over temperature (TEMP)

# 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 Interfce”. The device switches to REMOTE state when receiving the first command from the selected interface. The yellow LED “REMOTE” is lighting.

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.**

For CAN interface, 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 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 | HV-PS | | PC | | Connection |
|---|---|---|---|---|---|
| RS-232 | D-SUB-9 | Internal | D-SUB-9 | D-SUB-25 | 3-pol. cable |
| 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 Interfce“. 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

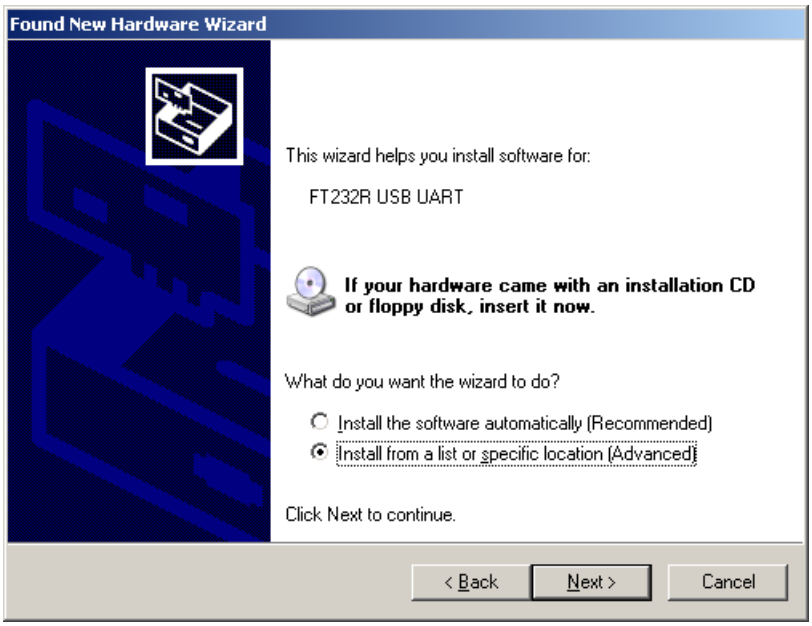
The FTDI VCP driver (Virtual COM Port) can be downloaded from:

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

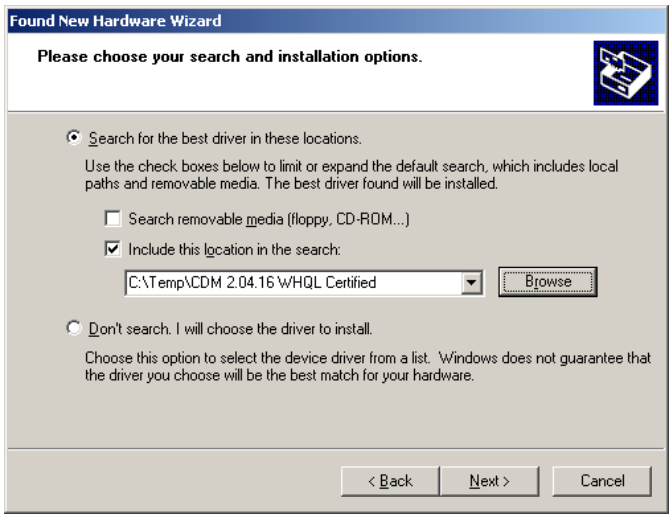
The following steps are necessary for installation:

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).

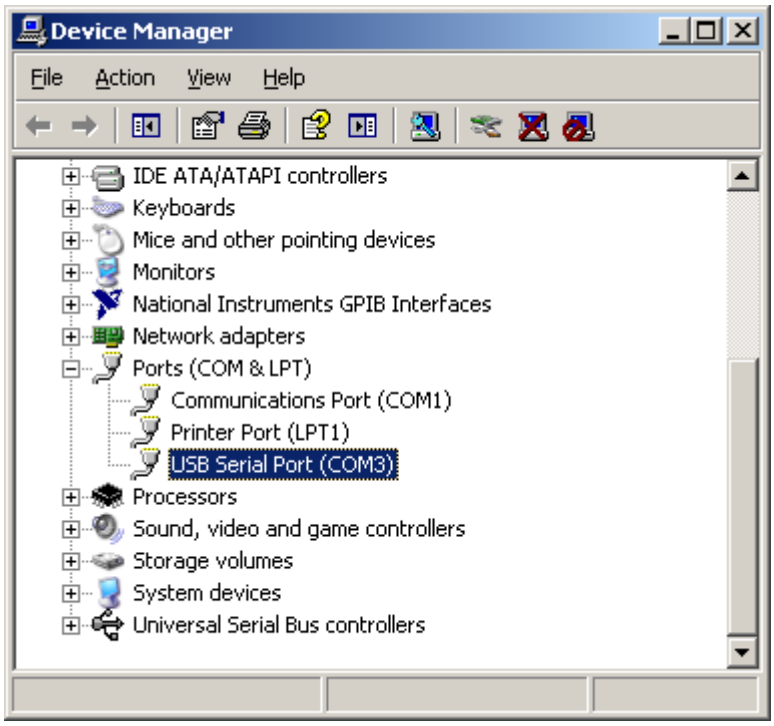
# RS-232/USB Interface Test under Windows

## Determine the serial USB interface with Device Manager

Start the Device Manger 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:

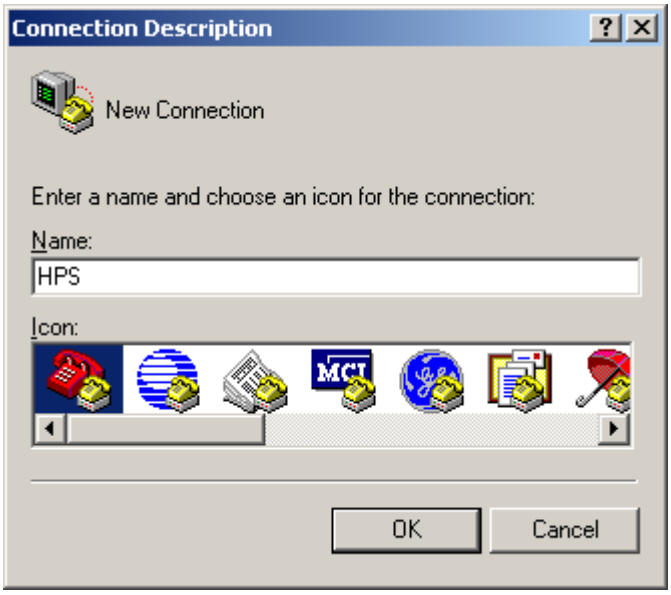



## Test with HyperTerminal

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

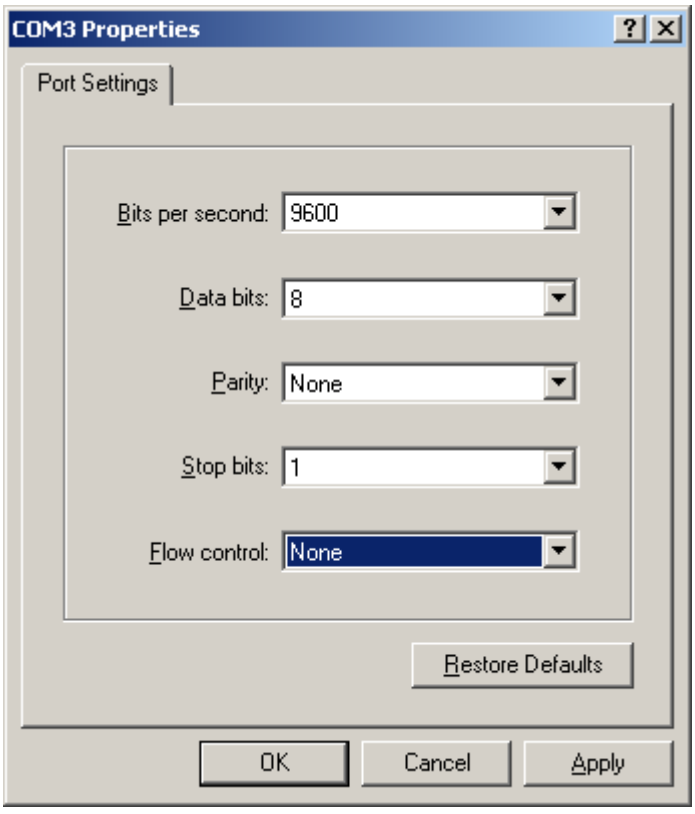
Start → Programs → Accessories → Communications →HyperTerminal

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:



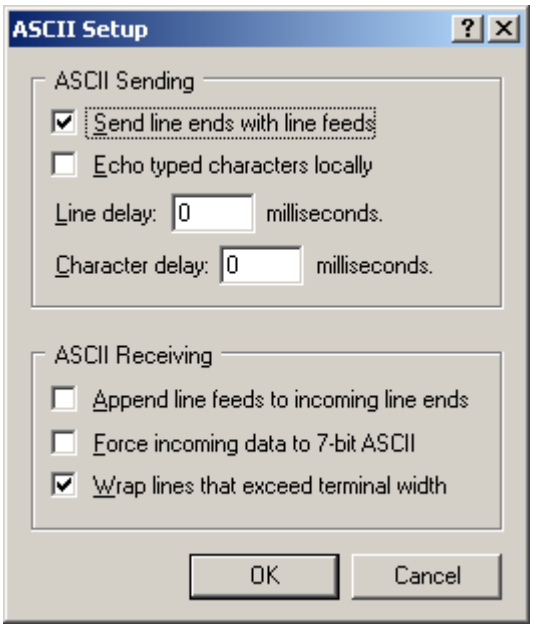

After clicking OK, the interface setup is finished.


iseg Spezialelektronik GmbH
Bautzner Landstr. 23
D - 01454 Radeberg / Rossendorf
Email: sales@iseg-hv.de
http://www.iseg-hv.de
Tel ++ 49 (0)351 / 26 996 - 0
Fax ++ 49 (0)351 / 26 996 - 21

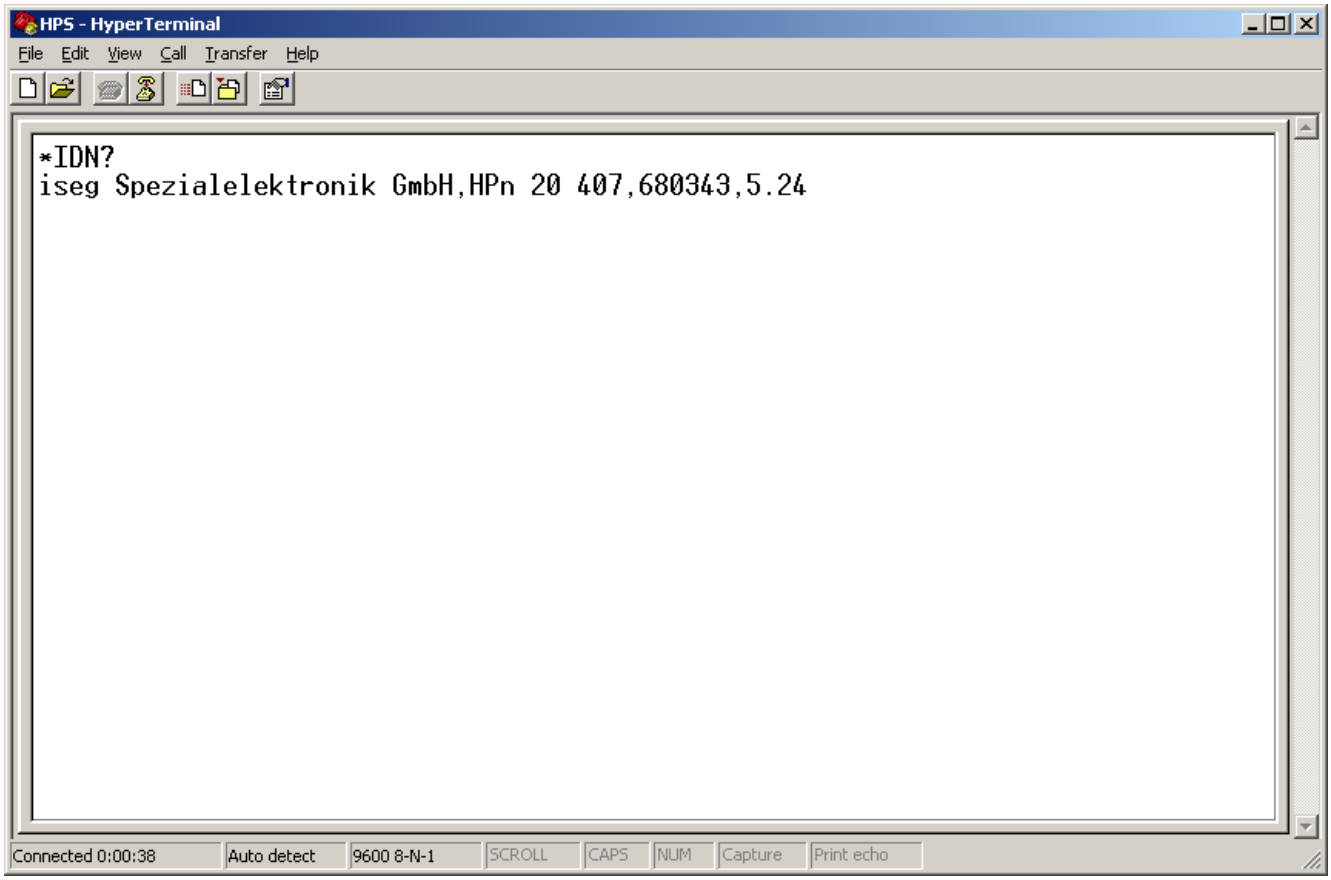
As last step, under:

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 15.

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: | 5006 (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?" | |
| 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?";
      char        ans[255];

      // init sockets (Berkeley style, UNIX compatible)
      WSAStartup(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(5006);         // 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) + 1, 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 | $V_{I\text{-}MON}$ | Current monitor | |
| Pin 3 | INHIBIT | TTL level / Input | **Low** = **active**: $\Rightarrow V_{OUT} = 0$<br>**High** / **offen**: $\Rightarrow V_{OUT}$ according set values |
| Pin 4 | $V_{I\text{-}SET}$ | Current control | |
| Pin 5 | Cmode | TTL level / Output | **Low** = Current control (CC), **High** = Voltage control (CV) reaction time < 100 ms |
| Pin 7 | $V_{V\text{-}MON}$ | Voltage monitor | |
| Pin 8 | $V_{V\text{-}SET}$ | Voltage control | |
| Pin 9 | $V_{REF}$ | Internal reference voltage | $V_{REF}$ = 5 V / 1 mA |

### Operation with analogue I/O

You can choose control with the analogue interface “AIF” in the menu „F07 Set Interfce“ and then switch push button “LOCAL” in order to switch to analogue remote control, the yellow LED “REM” is flashing 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 Interfce” (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 Interfce“ 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”!

| **Caution!** | **The high voltage generation will start with each Low to High Signal on INHIBIT!** |
|---|---|

If you choose an other interface in the menu „F07 Set Interfce“, 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 Interfce“ before and than set the automatic function “Auto AIF” in the menu „F06 Auto AIF“ to “ON”.

## Control inputs

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

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

Example: HPp 40 357, maximum voltage = 4 kV

| $V_{V\text{-}SET}$ (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):** **$V_{I\text{-}SET}$ = 0 to 5 V**

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

Example: HPp 40 357, maximum current = 350 mA

| $V_{I\text{-}SET}$ (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** **$V_{V\text{-}MON}$ = 0 to 5 V**

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

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

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

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

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

| $V_{I\text{-}MON}$ (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** | | | |
| **:VOLT**age | | | |
| | <Voltage>[V] | | Set Channel Voltage |
| | **:LIM**it <Voltage>[V] | | Set Voltage Limit |
| | **:BOU**nds <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 |
| **:CURR**ent | | | |
| | <Current>[A] | | Set Channel Current |
| | **:LIM**it <Current>[A] | | Set Current Limit |
| | **:BOU**nds <Current>[A] | | Set Channel Current Bounds |
| **:EV**ent | | | |
| | **CLEAR** | | Clear Channel Event Status |
| | **:MASK** <Word> | | Set Channel Event Mask |
| **:MEAS**ure | | | |
| | **:VOLT**age**?** | | Query Measured Channel Voltage (V) |
| | **:CURR**ent**?** | | Query Measured Channel Current (A) |
| **:CONF**igure | | | Set/Get module configuration |
| | **:RAMP** | | |
| | | **:VOLT**age <RampSpeed>[V/s] | Set Module Voltage Ramp Speed |
| | | **:CURR**ent <RampSpeed>[A/s] | Set Module Current Ramp Speed |
| | **:EV**ent | | |
| | | **:CLEAR** | Clear Module Event Status |
| | | **:MASK** | |
| | **:KILL?** | | Query Module Kill Status |
| | **:KILL** { **0** \| **1** } | | Set Kill Disable (0) or Kill Enable (1) |

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

| | | | |
|---|---|---|---|
| **:CONF**igure | | | |
| | **:ETH**ernet | | |
| | | **:ADDR**ess <xxx.xxx.xxx.xxx> | Set Ethernet IP Address |
| | | **:ADDR**ess**?** | Query Ethernet IP Address |
| | | **:NET**mask <xxx.xxx.xxx.xxx> | Set Ethernet IP Netmask |
| | | **:NET**mask**?** | Query Ethernet IP Netmask |
| | | **:GATE**way <xxx.xxx.xxx.xxx> | Set Ethernet IP Default Gateway |
| | | **:GATE**way**?** | Query Ethernet IP Default Gateway |
| | | **:MAC?** | Query Ethernet MAC Address |
| | | | |
| | **:SERIAL** | | RS-232/USB Configuration |
| | | **:BAUD**rate**?** | Query Serial Baudrate |
| | | **:ECHO** { **0** \| **1** } | Set Serial Echo Off (0) or Echo On (1) |
| | | **:ECHO?** | Query Serial Echo |
| | | | |
| | **:GPIB** | | |
| | | **:ADDR**ess**?** | Query IEEE-488/GPIB Address |
| | | | |
| | **:CAN** | | |
| | | **:ADDR**ess**?** | Query CAN Address |
| | | | |
| **:READ** | | | |
| | **:VOLT**age**?** | | Query Set Voltage (V) |
| | | **:LIM**it**?** | Query Voltage Limit (V) |
| | | **:NOM**inal**?** | Query Nominal Voltage (V) |
| | | **:BOU**nds**?** | Query Voltage Bounds (V) |
| | | | |
| | **:CURR**ent**?** | | Query Set Current (A) |
| | | **:LIM**it**?** | Query Current Limit (A) |
| | | **:NOM**inal**?** | Query Nominal Current (A) |
| | | **:BOU**nds**?** | Query Current Bounds (A) |
| | | | |
| | **:RAMP** | | |
| | | **:VOLT**age**?** | Query Voltage Ramp Speed (V/s) |
| | | **:CURR**ent**?** | Query Current Ramp Speed (A/s) |
| | | | |
| | **:MOD**ule | | |
| | | **:STAT**us**?** | Query Module Status Word |
| | | **:EV**ent | |
| | | **:STAT**us**?** | Query Module Event Status |
| | | **:MASK?** | Query Module Event Mask |
| | | **:SUP**ply**?** | Query Module Supply State<br>(1 = good, 0 = not good) |
| | | **:TEMP**erature**?** | Query measured Module Temperature (°C) |
| | | | |
| | **:CHAN**nel | | |
| | | **:STAT**us**?** | Query Channel Status Word |
| | | **:EV**ent | |
| | | **:STAT**us**?** | Query Channel Event Status Word |
| | | **:MASK?** | Query Channel Event Status Mask |

**Output formats for voltage and current:**

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

| Inominal | Output format current values |
|---|---|
| **1 mA ≤ $I_{nom}$ < 10 mA** | **1.23456E-3A** |
| **10 mA ≤ $I_{nom}$ < 100 mA** | **12.3456E-3A** |
| **100 mA ≤ $I_{nom}$ < 1 A** | **123.456E-3A** |
| **1 A ≤ $I_{nom}$ < 10 A** | **1.23456A** |
| **10 A ≤ $I_{nom}$ < 100 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 | isSFLPgd | isnoRAMP | isnoSERR |
| Bit7 | Bit6 | Bit5 | Bit4 | Bit3 | Bit2 | Bit1 | Bit0 |
| res | res | res | isSrvc | res | res | res | isADJ |

The status bits as there are IsTemperatureGood, IsSupplyGood, IsModuleGood, IsEventActive, IsSafetyLoopGood, 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<br>High voltage is turned off | Module Temperature < 55 °C |
| 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 |
| isSFLPgd | 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 |
| isSrvc | 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 |
| ESrvs | 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, $b_{15}\,b_{14}\,b_{13}\,b_{12}\,b_{11}\,b_{10}\,b_9\,b_8\,b_7\,b_6\,b_5\,b_4\,b_3\,b_2\,b_1\,b_0$*

| | | | *0* | *1* |
|---|---|---|---|---|
| #define | IERR | b15 | *no Input Error* | *Input error* |
| #define | RAMP | b14 | *no Ramp* | *Ramp* |
| #define | EMCY | b13 | *no Emergency* | *Emergency* |
| #define | TRIP | b12 | *no Trip error* | *Trip error* |
| #define | RES5 | b11 | *Reserved* | |
| #define | RES4 | b10 | *Reserved* | |
| #define | RES3 | b9 | *Reserved* | |
| #define | RES2 | b8 | *Reserved* | |
| #define | SERR | b7 | *no Sum error* | *Sum error* |
| #define | IREG | b6 | *no Current control* | *Current control* |
| #define | VREG | b5 | *no Voltage control* | *Voltage control* |
| #define | POL | b4 | *negative Polarity* | *positive Polarity* |
| #define | INH | b3 | *no external Inhibit* | *external Inhibit* |
| #define | RES1 | b2 | *Reserved* | |
| #define | KILena | b1 | *Kill disable* | *Kill enable* |
| #define | ON | b0 | *no High voltage active* | *High voltage active* |

## 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 ist 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,* $b_{15}\,b_{14}\,b_{13}\,b_{12}\,b_{11}\,b_{10}\,b_9\,b_8\,b_7\,b_6\,b_5\,b_4\,b_3\,b_2\,b_1\,b_0$

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 | *Instruction type, SCPI* |
| *INSTR,SCPI | Change to SCPI instruction set | |
| *INSTR,ET | Change to ET instruction set | |
| **Read/change RS-232 Echo state** | | |
| *ECHO? | Query Echo status | *Echo off* |
| *ECHO*ON | Turn on Echo | |
| *ECHO*OFF | Turn off Echo | |

# 7 Troubleshooting

## 7.1 Error messages on Displays

| Error messages during operation | |
|---|---|
| **Display:** | **Meaning:** |
| ERROR SAFETYLP | Safety loop (Interlock) is not closed. Device cannot create high voltage. |
| ERROR INHIBIT | No high voltage can be created because of external inhibit (analogue I/O). |
| ERROR EMERGNCY | High voltage has been shut down with Emergency Off. |
| ERROR I-TRIP | Current limit reached during “Kill enable. High voltage has been shut down. |
| ERROR V-LIMIT | Voltage Limit $V_{max}$ has been exceeded. |
| ERROR I-LIMIT | Current Limit $I_{max}$ has been exceeded. |
| ERROR OVERTEMP | 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 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 flashing | ⇒ | - check mains voltage and connection |
| Unit does not provide output voltage but the displays are flashing. | ⇒ | - Check of environmental temperature (Tu ≤ 35°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.