

Technical documentation  
last changed on: 2022-04-21

# THQ

Highly configurable AC/DC Laboratory HV-Supply

- 1 and 2 channel desktop version
- 1 - 3 channel 19" rack version
- Can be equipped with CPS, DPS or EPS modules
- Common USB and analog interface per channel
- Cost efficient and flexible
- LCD and front panel control
- 500 V – 30 kV / up to 150W per channel
- High precision / very low ripple and noise (with DPS)



## Document history

Version	Date	Major changes
1.5	2022-04-21	Improved documentation, adds Option "EPU", Table configuration, Resolution voltage measurement for interface, new dimensions drawing, small bug fixes (AIO assignment)
1.4	2021-03-04	Improved documentation (Table 6: Command descriptions <CR><LF>)
1.3	2020-11-26	Improved documentation (HV connector, PIN assignment, Part numbers)
1.2	2020-10-28	Improved documentation (Configuration order guide)
1.1	2020-04-16	Small bug fixes
1.0	2020-03-20	Initial relayouted version

## Disclaimer / Copyright

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**The information in this manual is subject to change without notice. We take no responsibility for any mistake in the document. We reserve the right to make changes in the product design without reservation and without notification to the users. We decline all responsibility for damages and injuries caused by an improper use of the device.**

# Safety


This section contains important security information for the installation and operation of the device. Failure to follow safety instructions and warnings can result in serious injury or death and property damage.

Safety and operating instructions must be read carefully before starting any operation.

We decline all responsibility for damages and injuries caused which may arise from improper use of our equipment.

## Depiction of the safety instructions


**DANGER!**



DANGER!

“Danger!” indicates a severe injury hazard. The non-observance of safety instructions marked as “Danger!” will lead to possible injury or death.


**WARNING!**



WARNING!

“Warning!” indicates an injury hazard. The non-observance of safety instructions marked as “Warning!” could lead to possible injury or death.


**CAUTION!**



CAUTION!

Advices marked as “Caution!” describe actions to avoid possible damages to property.

**INFORMATION**



INFORMATION

Advices marked as “Information” give important information.



Read the manual.



Attention high voltage!

HIGH VOLTAGE



Important information.

## Intended Use

The device may only be operated within the limits specified in the data sheet. The permissible ambient conditions (temperature, humidity) must be observed. The device is designed exclusively to control high voltage systems as specified in the data sheet. It must only be used specified in section 2 Technical data. Any other use not specified by the manufacturer is not intended. The manufacturer is not liable for any damage resulting from improper use.

## Qualification of personnel

A qualified person is someone who is able to assess the work assigned to him, recognize possible dangers and take suitable safety measures on the basis of his technical training, his knowledge and experience as well as his knowledge of the relevant regulations.

## General safety instructions

- Observe the valid regulations for accident prevention and environmental protection.
- Observe the safety regulations of the country in which the product is used.
- Observe the technical data and environmental conditions specified in the product documentation.
- You may only put the product into operation after it has been established that the high-voltage device complies with the country-specific regulations, safety regulations and standards of the application.
- The high-voltage power supply unit may only be installed by qualified personnel.

## Important safety instructions

### DANGER!



DANGER!

Before operations at the load or the high voltage output of the power supply are started, the device has to be switched off, the discharge of residual voltage has to be finished and the high voltage output of the power supply must be properly grounded. Depending on application residual voltages can be present for long time periods. These residual voltages can lead to severe injuries.

### WARNING!



WARNING!

Before connecting or disconnecting HV cables or any operation on the HV output or the application, the unit has to be switched off and discharge of residual voltage has to be finished. Depending on application residual voltages can be present for long time periods.

### WARNING!



WARNING!

To avoid injury of users it is not allowed to open the unit. There are no parts which can be maintained by users inside of the unit. Opening the unit will void the warranty.

### WARNING!



WARNING!

Do not operate the unit in wet or damp conditions.

### WARNING!



WARNING!

Do not operate the unit in an explosive atmosphere.

### WARNING!



WARNING!

Do not operate the unit if you suspect the unit or the connected equipment to be damaged.

**WARNING!**



WARNING!

The protective conductor connection must be ensured by an appropriate mains cable. Before connecting to the local power supply, check whether the nominal voltage of the devices corresponds to the mains voltage.

**WARNING!**



WARNING!

The mains connection is made with basic insulation and protective conductor. The device may only be operated with the protective earth conductor (PE) connected!

The protective conductor connections must be checked for proper function after installation.

**WARNING!**



WARNING!

The high-voltage generation may only be switched on with this device if the corresponding counterpart with arrester is contacted at the output of the high-voltage supply.

**CAUTION!**



CAUTION!

For devices equipped with a LEMO high voltage connector (L16, L30), the high voltage must not be switched on until the corresponding counterpart has been contacted.

**CAUTION!**



CAUTION!

When installing the units, make sure that an air flow through the corresponding air inlet and outlet openings is possible.

**CAUTION!**



CAUTION!

Before connecting or disconnecting the interface cable, the device must be switched off or disconnected from the mains.

**INFORMATION**



INFORMATION

Please check the compatibility with the devices used.

**INFORMATION**



INFORMATION

It is strongly recommended to read the manual before operation!

# Table of contents

Document history	2
Disclaimer / Copyright	2
<b>Safety</b>	<b>3</b>
Depiction of the safety instructions	3
Intended Use	4
Qualification of personnel	4
General safety instructions	4
Important safety instructions	5
<b>1 General description</b>	<b>9</b>
<b>2 Technical data</b>	<b>9</b>
2.1 THQ Desktop	9
2.2 19" System	11
2.3 Configurations	12
2.4 Order options	13
<b>3 Operation</b>	<b>13</b>
3.1 Operating elements	13
3.2 Displays	13
<b>4 LOCAL control</b>	<b>14</b>
<b>5 REMOTE control</b>	<b>14</b>
5.1.1 Software trip function	16
5.1.2 Polarity switching	16
5.1.3 Autostart function	16
<b>6 Reset to factory settings</b>	<b>16</b>
<b>7 USB interface</b>	<b>17</b>
<b>8 Installing the Driver</b>	<b>18</b>
8.1 Windows USB driver installation	18
8.2 Interface Test in Microsoft Windows <sup>®</sup>	19
8.3 Linux USB driver installation	20
<b>9 Command set</b>	<b>22</b>
9.1 Introduction to the command set	22
9.2 Terminology	22
9.3 Channel operation modes	22
9.4 Command description	22
9.5 Input Examples	24
9.6 Compatibility with THQ 1.xx	24
9.7 Device status	25
<b>10 Dimensional drawings</b>	<b>26</b>
<b>11 Connectors</b>	<b>35</b>
<b>12 AIO connector pin assignments</b>	<b>36</b>
<b>13 Accesories</b>	<b>37</b>
<b>14 Order guides</b>	<b>37</b>

<b>15</b>	<b>Glossary</b>	<b>38</b>
<b>16</b>	<b>Appendix</b>	<b>39</b>
<b>17</b>	<b>ASCII character table</b>	<b>40</b>
<b>18</b>	<b>Warranty &amp; service</b>	<b>41</b>
<b>19</b>	<b>Disposal</b>	<b>41</b>
<b>20</b>	<b>Manufacturer contact</b>	<b>41</b>



# 1 General description

The inexpensive and robust desktop high voltage power supplies are equipped with proven high voltage modules of the CPS, DPS and EPS series. The DESKTOP units are available in 1 or 2, the 19" SYSTEM with 1, 2 or 3<sup>1</sup> high voltage channels in many combinations. The output voltage is controlled with the 10 turn potentiometer, the USB interface or the analog I/O. Output voltage or current is displayed on a LCD per channel.

## 2 Technical data

### 2.1 THQ Desktop

SPECIFICATIONS	THQ DESKTOP			
Channels	1	2		
High voltage	Up to 30 kV	Up to 7 kV		
Module compatibility <sup>(1)</sup>	CPS, DPS, EPS	CPS, DPS (combinable)		
Voltage setting – local	10 turn potentiometer – V <sub>SET</sub> (local)			
Voltage setting – Remote	analog I/O with V <sub>set</sub> /V <sub>mon</sub> = 0 to 5 V (remote) or USB-Interface			
Current setting – local	1 turn potentiometer – I <sub>SET</sub> (local)			
Current setting – Remote	analog I/O with V <sub>SET</sub> /V <sub>MON</sub> = 0 to 5 V (remote) or USB Interface			
Resolution voltage measurement		<b>4-digit Display</b>	<b>Interface (USB)</b>	
	V <sub>nom</sub> < 1 kV	0,1 V	0,01 V	
	V <sub>nom</sub> 1 kV – 8 kV	1 V	0,1 V	
	V <sub>nom</sub> > 10 kV	10 V	1 V	
Resolution current measurement		<b>4-digit Display</b>	<b>Interface (USB)</b>	
	I <sub>nom</sub> < 10 mA	1 μA	0,1 μA	
	I <sub>nom</sub> 10 mA – < 0,1 A	10 μA	1 μA	
	I <sub>nom</sub> > 0,1 A	0,1 mA	10 μA	
<b>Measurement accuracy</b>				
The measurement accuracy is guaranteed in the range 1% • V <sub>nom</sub> < V <sub>out</sub> < V <sub>nom</sub> / 1% • I <sub>nom</sub> < I <sub>out</sub> < I <sub>nom</sub> and for 1 year				
Protection <sup>(1)</sup>	INHIBIT <sup>(2)</sup> Overload and short circuit protected <b>(ATTENTION: there is only one short circuit or arc per second allowed!)</b>			
HV connector	CPS	0 – 7 kV:	SHV	Figure 20
		≥ 10 kV:	L16	Figure 21
		≥ 20 kV:	L30	Figure 22
	DPS EPS (60W)	0 – 7 kV:	SHV	Figure 20
		≥ 10 kV:	L16	Figure 21
		≥ 20 kV:	L30	Figure 22

<sup>1</sup> depending on the model

SPECIFICATIONS	THQ DESKTOP	
Rated AC mains input	100 – 264 VAC with PFC	
Input power	75 W	100 W
Fuse	5x20mm 2.0A, inert	
AC power connector	IEC 60320-C14, Figure 23	
Connection	AIO <sup>1</sup> Figure 18, USB Figure 19	
Case	ABS, Light grey, similar RAL 7035	
Degree of protection	IP 30	
Dimensions (L/W/H)	308 x 257 x 83 mm	
Weight	2.5 kg ... 3.5 kg	
Operation temperature	0 °C ... 50 °C	
Storage temperature	-20 °C ... +60 °C	
Humidity	20 % – 80 %, not condensing	
Notes: <sup>1</sup> ) The technical parameters of the modules (CPS, DPS, EPS) can be found in the data sheets on our homepage, see 16 Appendix <sup>2</sup> ) per channel		

Table 1: Technical data THQ DESKTOP

## 2.2 19" System

SPECIFICATIONS		THQ 19" SYSTEM		
Channels	Up to 3			
High voltage	Up to 30 kV			
Module compatibility <sup>(1)</sup>	CPS, DPS, EPS <sup>(3)</sup> (combinable)			
<b>- wie 1 und 2 Kanal</b>				
voltage setting – local	turn potentiometer – V <sub>SET</sub> (local)			
Resolution voltage setting – Remote	analog I/O with V <sub>set</sub> /V <sub>mon</sub> = 0 to 5 V (remote) or Interface			
Resolution current setting – local	turn potentiometer – I <sub>SET</sub> (local)			
Resolution current setting – Remote	analog I/O with V <sub>set</sub> /V <sub>mon</sub> = 0 to 5 V ("remote") or Interface			
Resolution voltage measurement		<b>4-digit Display</b>	<b>Interface (USB)</b>	
	V <sub>out</sub> < 1 kV	0,1 V	0,01 V	
	V <sub>out</sub> 1 kV – 8 kV	1 V	0,1 V	
Resolution current measurement		<b>4-digit Display</b>	<b>Interface (USB)</b>	
	I <sub>out</sub> < 10 mA	1 µA	0,1 µA	
	I <sub>out</sub> 10 mA – < 0,1 A	10 µA	1 µA	
	I <sub>out</sub> > 0,1 A	0,1 mA	10 µA	
<b>Measurement accuracy</b>				
The measurement accuracy is guaranteed in the range 1% · V <sub>nom</sub> < V <sub>out</sub> < V <sub>nom</sub> / 1% · I <sub>nom</sub> < I <sub>out</sub> < I <sub>nom</sub> and for 1 year				
Protection <sup>(1)</sup>	<b>INHIBIT</b> Overload and short circuit protected <b>(ATTENTION: there is only one short circuit or arc per second allowed!)</b>			
HV connector	CPS	0 – 7 kV:	SHV	Figure 20
		≥ 10 kV:	L16	Figure 21
		≥ 20 kV:	L30	Figure 22
	DPS		SHV	Figure 20
	EPS (60W)	0 – 7 kV:	SHV	Figure 20
		≥ 10 kV:	L16	Figure 21
≥ 20 kV:		L30	Figure 22	
Rated AC mains input	100 – 264 VAC with PFC			
Input power	75 W	100 W	200 W	
Fuse	5x20mm 2.0A, inert		5x20mm 4.0A, inert	
AC power connector	IEC 60320-C14, Figure 23			
Connection	AIO <sup>(2)</sup> Figure 18, USB Figure 19			

SPECIFICATIONS		THQ 19" SYSTEM
<b>Case</b>		
Dimensions (L/W/H)	310 mm / 19" / 2U	
Weight	4 kg ... 6.5 kg	
Operation temperature	0 °C ... 50 °C	
Storage temperature	-20 °C ... 60 °C	
Humidity	20 % – 80 %, not condensing	
Notes:		
<sup>1)</sup> The technical parameters of the modules (CPS, DPS, EPS) can be found in the data sheets on our homepage, see 16 Appendix		
<sup>2)</sup> per channel		
<sup>3)</sup> limited to 2 units (EPS series), see 16 Appendix		

Table 2: Technical data THQ 19" system

## 2.3 Configurations

channels	module series	numbers of modules	voltage per channel	type	item code
1	CPS	1	up to 7 kV	DESKTOP	T1070006
1	DPS	1	up to 6 kV	DESKTOP	T1070006EPU
1	EPS <sup>(1)</sup>	1	up to 6 kV	DESKTOP	T1070010
1	CPS	1	10kV and 15 kV	DESKTOP	T1160006
1	EPS <sup>(1)</sup>	1	8 kV to 15kV	DESKTOP	T1160010
1	CPS	1	20kV and 30 kV	DESKTOP	T1300006
1	EPS	1	20kV and 30 kV	DESKTOP	T1300010
2	CPS	2	up to 7 kV	DESKTOP	T2070006
2	DPS <sup>(3)</sup>	2	up to 6 kV	DESKTOP	T2070006EPU
2	CPS	2	10kV and 15 kV	DESKTOP	T2160006
1	CPS or DPS	1	up to 30 kV	19" SYSTEM	T1300006_2HE
1	EPS <sup>(2)</sup>	1	up to 30 kV	19" SYSTEM	T1300020_2HE
2	CPS and/or DPS	2	up to 30 kV	19" SYSTEM	T2300006_2HE
2	EPS and CPS or DPS <sup>(4)</sup>	2	up to 30 kV	19" SYSTEM	T2300020_2HE
3	CPS and/or DPS	3	up to 30 kV	19" SYSTEM	T3300010_2HE
Notes:					
<sup>1)</sup> – only 60 W EPS devices					
<sup>2)</sup> – 60 W or 150 W EPS devices					
<sup>3)</sup> – combinations of CPS and DPS devices are also possible					
<sup>4)</sup> – only one 60 W EPS device					

Table 3:THQ configurations

## 2.4 Order options

OPTION	ORDER CODE
19" version	2HE
For DPS modules with switchable polarity for DESKTOP	EPU

Table 4: Order options

## 3 Operation

### 3.1 Operating elements

The power supply line with the mains switch and the fuse are located at the device rear. The USB connector and the AIO connectors per channel are also located there.

The high voltage output is located at the device front or rear, depending on the high voltage source.

The front panel contains the operating elements per channel: A two line display for measured voltage and current, two LEDs for the polarity, the potentiometer  $V_{SET}$  and  $I_{SET}$ , the button **REMOTE/LOCAL** (see section 5 REMOTE control) and the button **HV-ON/OFF** are located on the front panel. Devices with option EPU (electronic polarity switching) also have a button **POLARITY** (see section 5.1.2 Polarity switching).

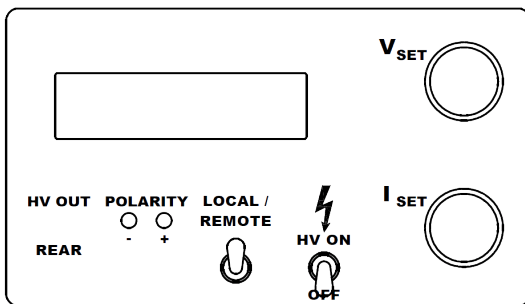


Figure 1: Display without EPU

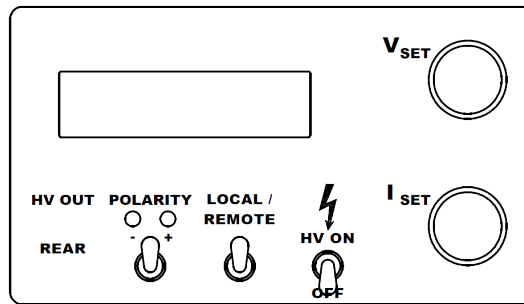


Figure 2: Display with EPU

After power-on, the displays light up and the chosen polarity is displayed on the according polarity LED.

### 3.2 Displays

The display area consists of four subdivisions:

Measured voltage				Operating mode	
V	0.000	kV	USB	(LOC, REM, USB)	
I	0.000	mA	KILL	KILL on KILL enable, TRIP on Current trip, POL on Polarity change	
Measured current					

The operation mode is either LOC (local), REM (AIO remote) or USB. These operation modes are described in the following subsections.

## 4 LOCAL control

The potentiometers  $V_{SET}$  and  $I_{SET}$  on the front panel are used to control voltage and current in the "LOCAL" mode. The switch "HV ON/OFF" activates or deactivates the high voltage generation. The measured voltage and current are shown on the display. They can also be monitored with the voltages  $V_{mon}$  and  $I_{mon}$  on the analogue I/O (see next section).

### INFORMATION



INFORMATION

The high voltage generation starts with a ramp speed of  $V_{nom} / 4s$  (hardware ramp) to the set voltage chosen with the potentiometer  $V_{SET}$  when the HV switch is switched ON.

Switching HV-ON to "OFF" or activating the INHIBIT-signal (see next section) only switches off the high voltage generator, but does not put the output to ground. The internal (approx. 2 nF) and external capacitors discharge by the internal measurement resistor ( $50M\Omega \pm 30\%$ ) and the external load.

### CAUTION!



CAUTION!

Hence, long discharging times are possible! Control the discharging status on the display respectively the monitor voltages before touching any parts under tension.

## 5 REMOTE control

The analog I/O is realized by a D-SUB 9 connector (Figure 18) per channel at the device rear. The REMOTE/LOCAL button is used to switch between the control with:

- the local potentiometers on the front panel (**LOCAL**, "LOC" in display) or
- remote control via analog I/O on the rear panel (**REMOTE**, "REM" in display).

The chosen control mode is saved internally and restored at next power-on. The high voltage generation is started when switching the button **HV-ON**. As another requirement, the external signal INHIBIT must not be active (HIGH level or open, see chapter 11 Connectors).

### INFORMATION



INFORMATION

If the control mode is local ("LOC"), the high voltage generation starts with a ramp speed of  $V_{nom} / 4s$  (hardware ramp) to the set voltage chosen with the potentiometer  $V_{SET}$ .

The device also ramps to this value when switching back from analogue I/O ("REM") to local ("LOC") control.

The analog I/O connectors (Figure 18) and their pin assignments (Table 11: AIO pin assignment) are shown in the following Figure 3: Rear panel with AIO and USB connectors.

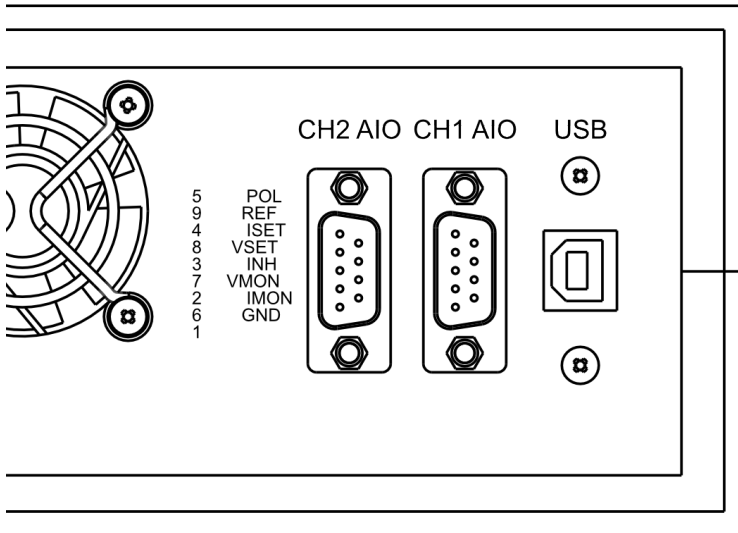


Figure 3: Rear panel with AIO and USB connectors

All analog signals have 5 Volt levels.

If the operating mode is switched to analog I/O ("REM"), the output voltage and current are set to the analogue input signals  $V_{set}$  and  $I_{set}$ . The output signals  $V_{mon}$  and  $I_{mon}$  monitor the measured voltage respective current.

The INHIBIT input signal enables (when high or open) or disables the high voltage generation. When INHIBIT is high, the HV-ON-switch on the front panel must also be set to "ON" to enable high voltage generation.

Switching HV-ON to "OFF" or active INHIBIT-signal only switches off the high voltage generator, but does not put the output to ground. The internal (approx. 2 nF) and external capacitors discharge by the internal measurement resistor ( $50\text{ M}\Omega \pm 30\%$ ) and the external load.

**CAUTION!**



CAUTION!

Hence, long discharging times are possible! Control the discharging status on the display respectively the monitor voltages before touching any parts under tension.

The POLARITY input signal switches between positive or negative polarity (only for DPS modules, see 12 AIO connector pin assignments). The REFERENCE output signal provides a +5 Volt reference voltage, that can, for example, be used to connect potentiometers to the set values (see figure 4 AIO circuit for simple  $V_{set}$  and  $I_{set}$  control). In the simplest case to provide set voltage and current via AIO, two potentiometers are connected between the internal reference voltage  $V_{ref}$  and ground and the sliding contacts are connected to  $V_{set}$  and  $I_{set}$ .

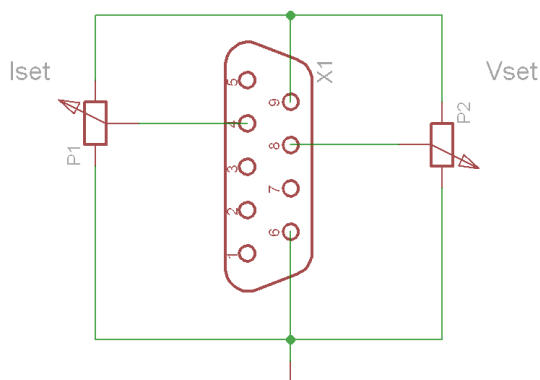


Figure 4: AIO circuit for simple  $V_{set}$  and  $I_{set}$  control

### 5.1.1 Software trip function

It is possible to turn off High voltage when reaching the preset current limit (KILL enable). This function can only be used with the computer interface. The delay for detecting a trip is about 50...100 ms.

If KILL is enable (KILL is shown in Display), the high voltage will shut down if the current limit is achieved. In this case, the bit TRIP in the status word is set. This bit can be cleared by setting the KILL function again ( $Tn^2=1$ ) or by disabling KILL ( $Tn^3=0$ ). In both cases, the high voltage has to be set again ( $V_{set}$  is set to zero at Trip).

By switching to mode local, the KILL function is turned off (KILL disable). A pending Trip is cleared by switching HV-ON/OFF → OFF → ON.

### 5.1.2 Polarity switching

The output voltage polarity can be changed with the POLARITY switch at front panel, over analogue I/O or with the computer interface (with command  $Pn^3$ ) if  $V_{out} = 0$  V. Previously, set the voltage to zero and control the discharge process.

#### CAUTION!



CAUTION!

Don't switch POLARITY when displayed voltage is greater than 100 V!

The chosen polarity is signalled by the corresponding status LED at the front panel and can be requested over computer interface with the command  $Pn^3$ .

For safety purposes, the high voltage generation is stopped for about one second before the polarity is switched. After another second, the device is operating again.

If the control mode is switched to analogue I/O („REM”) with button **REMOTE/LOCAL** and Pin 5 at the AIO connector(see section 11 Connectors and 12 AIO connector pin assignments) is not connected, the device switches to positive polarity.

### 5.1.3 Autostart function

With active Autostart, the device switches to mode computer remote control after power-up and restores the last settings of voltage and current. The Autostart function can be activated for every channel separately (with command  $An^3$ ).

#### CAUTION!



CAUTION!

- If the switch "HV ON/OFF" is set to ON,
  - and no external INHIBIT is applied
- the high voltage generation starts automatically!

## 6 Reset to factory settings

If the button **HV-ON/OFF** is set to OFF and **REMOTE/LOCAL** is pressed during power-on, the following settings are reset:

- Saved voltage for computer interface to zero
- Saved current for computer interface to nominal current
- Operating mode local
- compatibility mode off

2 „n” - Number of the channel

3 „n” - Number of the channel



## 7 USB interface

The computer interface allows to control all relevant parameters of the high voltage source. Up to three high voltage channels can be controlled over one computer interface. The USB interface is realized with a female USB-B connector (Figure 19) at the device rear ( Figure 3: Rear panel with AIO and USB connectors). Internal, the USB is implemented with 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](#)<sup>4</sup>.

The data exchange is character-orientated, with echo in direction “computer to HV source”. The direction “HV source to computer (answer)” is free-running.

The hardware settings of the virtual serial interface are:

- 9600 bit/s
- 8 bit/character
- no parity
- 1 stop bit.

No flow control (handshake) is used.

When using the HV source via computer interface, the following functions are possible:

1. write functions:
  - Set Nominal voltage
  - Set Nominal current
  - Set Polarity (EPU)
  - Set Interface active after restart
2. reading functions:
  - Set Target voltage
  - Set Actual voltage
  - Set Target current
  - Set Actual current
  - Set Polarity
  - Set Status
  - Set Identifier
  - Set Interface active after restart

When operating in local or analogue I/O mode, the read functions are possible via computer interface.

When setting a voltage value over interface (command D#<sup>5</sup>), the device switches to mode computer control.

The command transfer uses ASCII characters. Every command line is terminated by <CR><LF> (0x0D 0x0A or 13 10).

A new command may be sent immediately after the last answer was completely received (including <CR><LF>).

<sup>4</sup> © National Instruments Corporation. All rights reserved.

<sup>5</sup> # number of channels (1, 2 or 3)

## 8 Installing the Driver

### 8.1 Windows USB driver installation

The FTDI VCP driver (Virtual COM Port) can be downloaded from: <http://download.iseq-hv.com>  
under Software → Tools → “FTDI-USB-Serial-Driver-Windows-2.x.x.exe”

1. Download and install the driver
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.

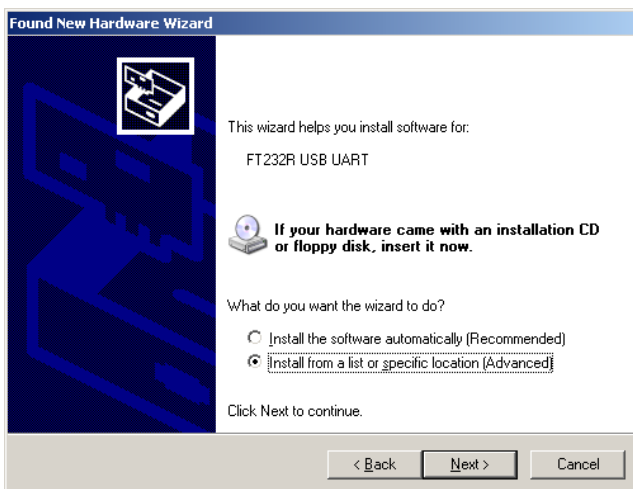


Figure 5: New Hardware

4. Please choose the directory you extracted the driver to and the click Next.
5. After some copying you get the final dialog.

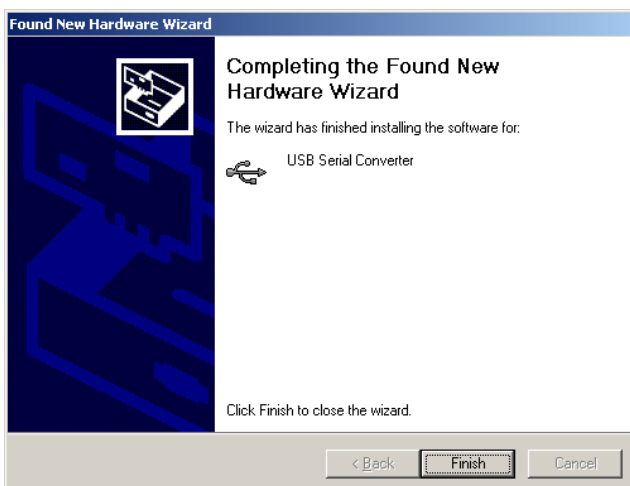


Figure 6: Finish Install

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).

## 8.2 Interface Test in Microsoft Windows <sup>6</sup>

To determine if the installation was successful, check if the serial USB interface is shown in the Device Manager.

Start the Device Manager with:

Windows XP: Start → Settings → Control Panel → System → Device Manager

or Windows 7: Start → Control Panel → Device Manager

or Windows 10: Press the key combination Windows + R. Type the command: devmgmt.msc.

All devices get an USB Serial Port assigned in section Ports (COM & LPT), in this case COM4:

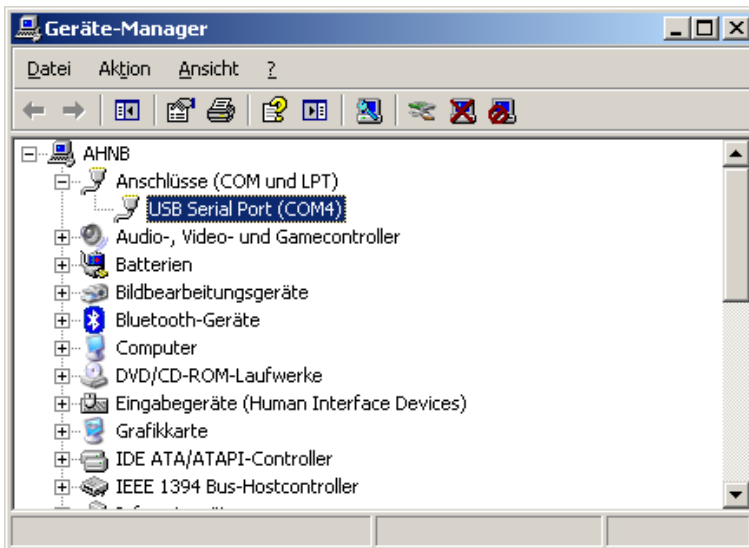


Figure 7: Device Manager under Windows 7

6 Microsoft - All rights reserved.

## 8.3 Linux USB driver installation

The driver is already included in Linux Kernel series 2.6 and higher and should be loaded automatically when connecting the device. The driver provides a virtual serial port like /dev/ttyUSB0 that can be accessed with a Terminal program (e.g. [CuteCom](#)).

Make sure you have the proper permissions to access the serial port /dev/ttyUSB0, e.g. by adding your user to the group dialout.

The following dmesg output shows how the device is recognized and the driver loaded:

```
[234.496011] usb 1-2: new full speed USB device using uhci_hcd and address 2
[234.694884] usb 1-2: configuration #1 chosen from 1 choice
[234.704371] usb 1-2: New USB device found, idVendor=0403, idProduct=6001
[234.704376] usb 1-2: New USB device strings: Mfr=1, Product=2, SerialNumber=3
[234.704380] usb 1-2: Product: FT232R USB UART
[234.704382] usb 1-2: Manufacturer: FTDI
[234.704385] usb 1-2: SerialNumber: A60075cx
[234.807627] usbcore: registered new interface driver usbserial
[234.807649] usbserial: USB Serial support registered for generic
[234.807679] usbcore: registered new interface driver usbserial_generic
[234.807683] usbserial: USB Serial Driver core
[234.816739] usbserial: USB Serial support registered for FTDI USB Serial Device
[234.816774] ftdi_sio 1-2:1.0: FTDI USB Serial Device converter detected
[234.816805] ftdi_sio: Detected FT232RL
[234.816855] usb 1-2: FTDI USB Serial Device converter now attached to ttyUSB0
[234.816872] usbcore: registered new interface driver ftdi_sio
[234.816876] ftdi_sio: v1.4.3:USB FTDI Serial Converters Driver
```

The following picture shows the connection to the THQ with the graphical Terminal program CuteCom (Download at <http://cutecom.sourceforge.net>).

The following settings are used to connect to the THQ:

Device /dev/ttyUSB0 (or other interface, see dmesg output)

Parameter	Value
Baud rate	9600
Data bits	8
Stop bits	1
Parity	None
Handshake	None
Line end	CR,LF

Table 5: CuteCom connection parameters

Now the serial interface can be opened by „Open device“ and the communication tested.

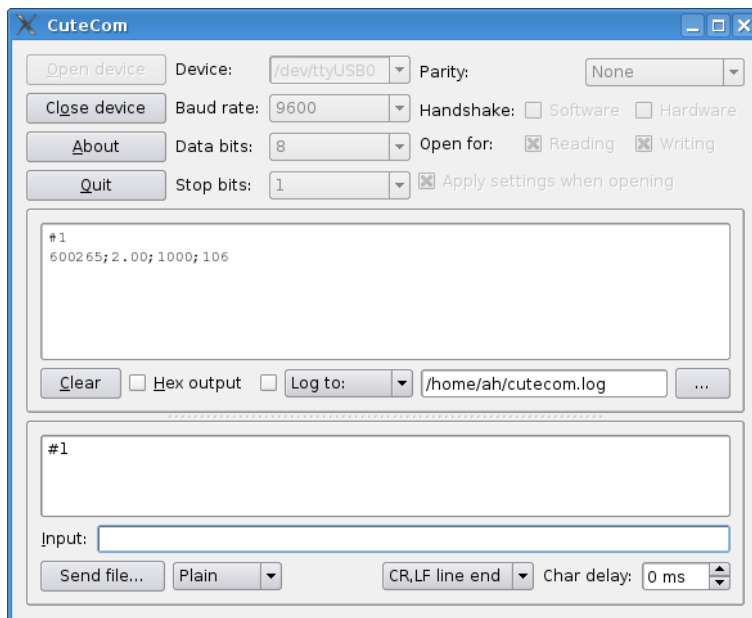


Figure 8: CuteCom main window

## 9 Command set

### 9.1 Introduction to the command set

The high voltage devices can be connected to a control computer by the USB interface. All these interfaces use the same general format for commands and query responses. The commands are transmitted as plain text, encoded in the standard 7-bit ASCII character set.

The following special ASCII characters are used in this document:

<CR> (0x0D) the carriage return character

<LF> (0x0A) the line feed character

### 9.2 Terminology

Syntax	Declaration
$V_{nom}$	Voltage nominal, the maximum possible output voltage
$I_{nom}$	Current nominal, the maximum possible output current
$V_{set}$	Voltage Set, the user-controllable demanded output voltage
$V_{meas}$	Voltage Measure, the actual measured output voltage
$I_{set}$	Current Set, the user-controllable demanded output current
$I_{meas}$	Current Measure, the actual measured output current


### 9.3 Channel operation modes

Operation Mode	Description
Off	The channel is off, it does not generate high voltage. If all status conditions are satisfied, the channel can be turned on.
On	The channel is actively generating high voltage.
Output Polarity	THQ devices provide switchable output polarities, positive and negative.

### 9.4 Command description

The commands are transmitted in the ASCII character set. The command end is formed with the character string <CR><LF>.


**INFORMATION**



For devices with two or three high voltage channels, the other channels can be addressed, by replacing channel '1' with '2' or '3', e.g. "#1", "#2", "#3".

INFORMATION

**INFORMATION**



In the event of an error (incorrect input, wrong channel, invalid value) "???? <CR><LF>" is returned.

INFORMATION

Command		Computer	HV Device	
Read device identification		#1<CR><LF>	600000 ; 2.01 ; 3000 ; 205 <CR><LF> (serial number ; firmware ; V <sub>nom</sub> ; I <sub>nom</sub> )	
Read measured voltage channel 1	V <sub>meas</sub>	U1<CR><LF>	{Measured voltage}<CR><LF>	[V]
Read measured current channel 1	I <sub>meas</sub>	I1<CR><LF>	{Measured current}<CR><LF>	[A]
Read set voltage channel 1	V <sub>set</sub>	D1<CR><LF>	{Set Voltage}<CR><LF>	[V]
Write set voltage channel 1 (Channel goes into USB mode)	V <sub>set</sub>	D1={voltage}<CR><LF>	0 ≤ voltage ≤ V <sub>nom</sub>	[V]
Read set current channel 1	I <sub>set</sub>	C1<CR><LF>	{Set current}<CR><LF>	[A]
Write set current channel 1	I <sub>set</sub>	C1={current}<CR><LF>	0 < Current ≤ I <sub>nom</sub>	[A]
Read Polarity channel 1		P1<CR><LF>	{+   -}<CR><LF>	positive or negative polarity
Write Polarity channel 1		P1={+   -}<CR><LF>		set positive or negative for EPU only
Read Autostart channel 1		A1<CR><LF>	{1   0}<CR><LF>	1= USB active after power-on 0= Local Mode after power-on
Write Autostart channel 1		A1={1   0}<CR><LF>		1= USB active after power-on 0= Local Mode after power-on
Set double echo (see compatibility mode)		E1={1   2}<CR><LF>	E1=1<CR><LF> E1=2<CR><LF>	single Echo (ex works) double Echo (as in 9.6 Compatibility with THQ 1.xx)
Read device status channel 1		S1<CR><LF>	HL<CR><LF>	hex code → see 9.7 Device status
Read KILL function channel 1		T1<CR><LF>	{1   0}<CR><LF>	1= KILL enabled 0= KILL disabled
Write KILL function channel 1 (computer control only)		T1={1   0}<CR><LF>		1= enable KILL (and clear Trip) 0= disable KILL (and clear Trip)
Notes: Other channels can be used in devices with two or three high voltage channels by replacing channel '1' with '2' or '3', e. g.: "#1" "#2".				

Table 6: Command descriptions

## 9.5 Input Examples

Commands		Explanations
query	#1	Read identification
answer	600138;2.01;3000;405	serial number 600138, firmware version 2.01, nominal voltage 3000 V, nominal current $40 \cdot 10^5 \text{ nA} = 4 \text{ mA}$ Explanations: $405 = 40 \cdot 10^5 \cdot 10^{-9} = 40 \cdot 10^{-4} = 4 \cdot 10^{-3} = 4 \text{ mA}$
command	D1=1000	Set voltage on channel 1 to 1000 V (device goes into USB mode)
command	C1=1E-3	Set current limitation on channel 1 to 1 mA
query	U2	Read measured voltage on channel 2
answer	999.7	999.7 V
query	I1	Read measured current on channel 1
answer	0.028E-3	$0.028 \text{ E-3} = 0.028 \cdot 10^{-3} = 28 \text{ } \mu\text{A}$
query	S3	Read status of channel 3
answer	31	HV ON + NEGATIVE + USB

## 9.6 Compatibility with THQ 1.xx

The instruction set was simplified with Version 2.00. It is recommended to use the new instruction set for communication with the device. However, it is possible to emulate the behavior of THQ firmware 1.xx. To do so, the command E1=2 has to be sent to the device. If the device has more than one channel, the command has to be executed for every channel.

The following differences apply in compatibility mode:

- For every answer, the command is repeated first
- The current limit is transmitted in mA (for  $I_{\text{nom}} \geq 1 \text{ mA}$ ) respectively in  $\mu\text{A}$  (for  $I_{\text{nom}} < 1 \text{ mA}$ ).

query	#1	Query identifier
answer	#1	
answer	600123;2.01;5000;205	serial 600123, Version 2.01, 5000 V, 2 mA
query	C1=2	Set current limit in channel 1 to 2 mA
answer	C1=2	
query	C1	Query current limit in channel 1
answer	C1	
answer	2.0	Current limit = 2 mA

Table 7: Examples



## 9.7 Device status

The device status is an 8 bit word and is transmitted hexadecimal. The meaning of the status bits is explained in the following table:

status	description	possible states	Bit	High	Low
TRIP	In mode Kill Enable the current limit was reached and the High voltage is turned off.	Limit reached → HV OFF Limit not reached	7	1 _ _ _ _ 0 _ _ _ _	_ _ _ _ _ _ _ _ _ _
KILL	Kill-Enable/Disable	Kill enable Kill disable	6	_ 1 _ _ _ _ 0 _ _ _	_ _ _ _ _ _ _ _ _ _
INH	INHIBIT	HV-ON HV-OFF	5	_ _ 1 _ _ _ _ 0 _ _	_ _ _ _ _ _ _ _ _ _
POLN	Polarity negative	Negative (positive / unknown)	4	_ _ _ 1 _ _ _ _ 0 _	_ _ _ _ _ _ _ _ _ _
POLP	Polarity positive	Positive (negative / unknown)	3	_ _ _ _ _ _ _ _ _ _	1 _ _ _ _ 0 _ _ _ _
AUTO	Computer interface active after power-on	Active Not active	2	_ _ _ _ _ _ _ _ _ _	_ 1 _ _ _ _ 0 _ _ _
MODE	Control via ...	analog I/O (REM) Local control (LOC) Computer interface (USB) Reserved	1  0	_ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _	_ _ 1 1 _ _ 1 0 _ _ 0 1 _ _ 0 0
Notes: _ – not taken into consideration/ don't care					

Table 8: Device status decoding

status	High	Low	description
11	0 0 0 1	0 0 0 1	POLN: negative MODE: Computer interface (USB)
71	0 1 1 1	0 0 0 1	KILL: enable INH: enable POLN: negative MODE: Computer interface (USB)
0A	0 0 0 0	1 0 1 0	POLP: positive MODE: Local control (LOC)
2B	0 0 1 0	1 0 1 1	INH: HV-ON POLP: positive AUTO: Not active MODE: analog I/O (REM)

Table 9: Examples for Status

## 10 Dimensional drawings

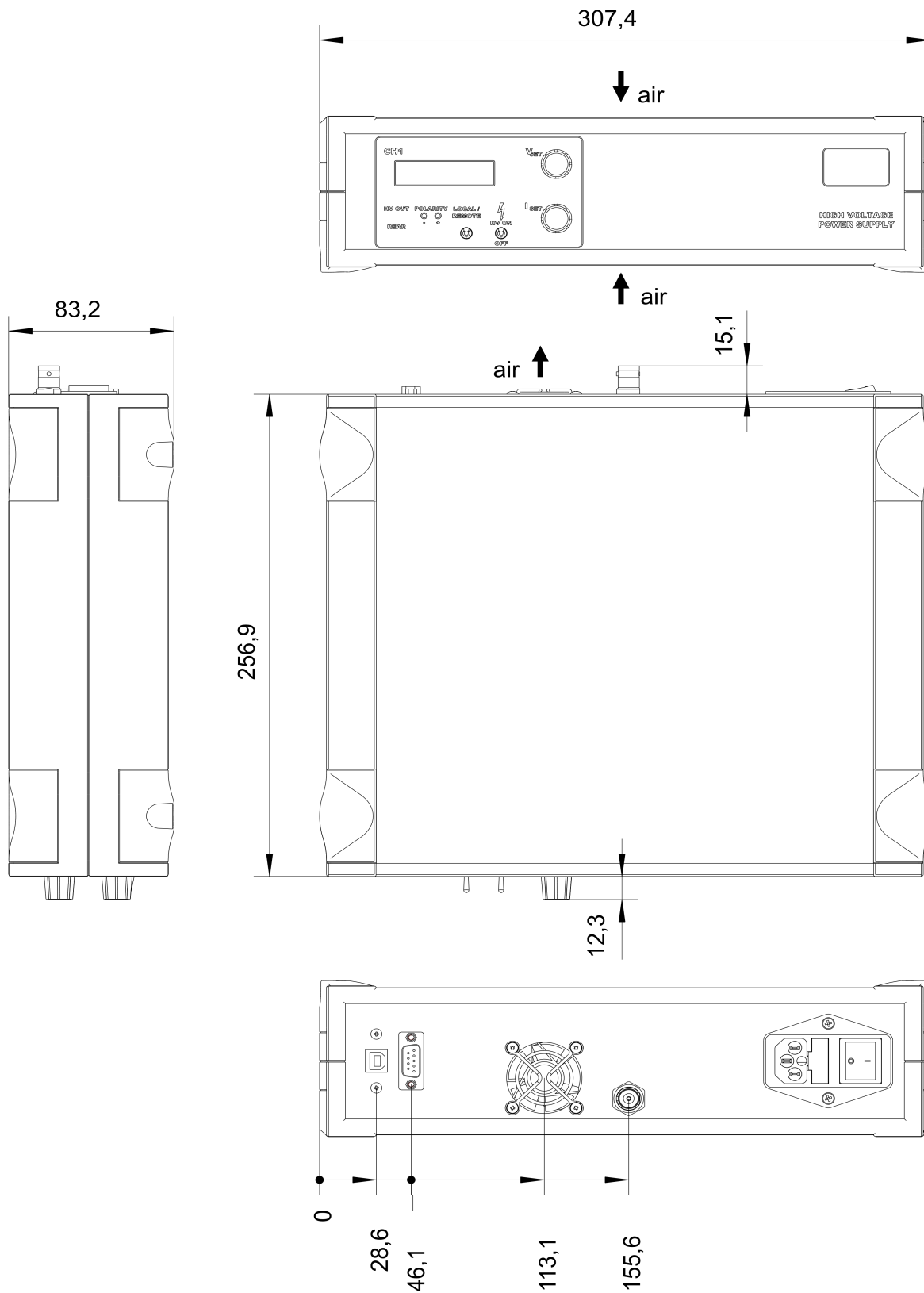


Figure 9: THQ DESKTOP, 1-channel 7kV (SHV)

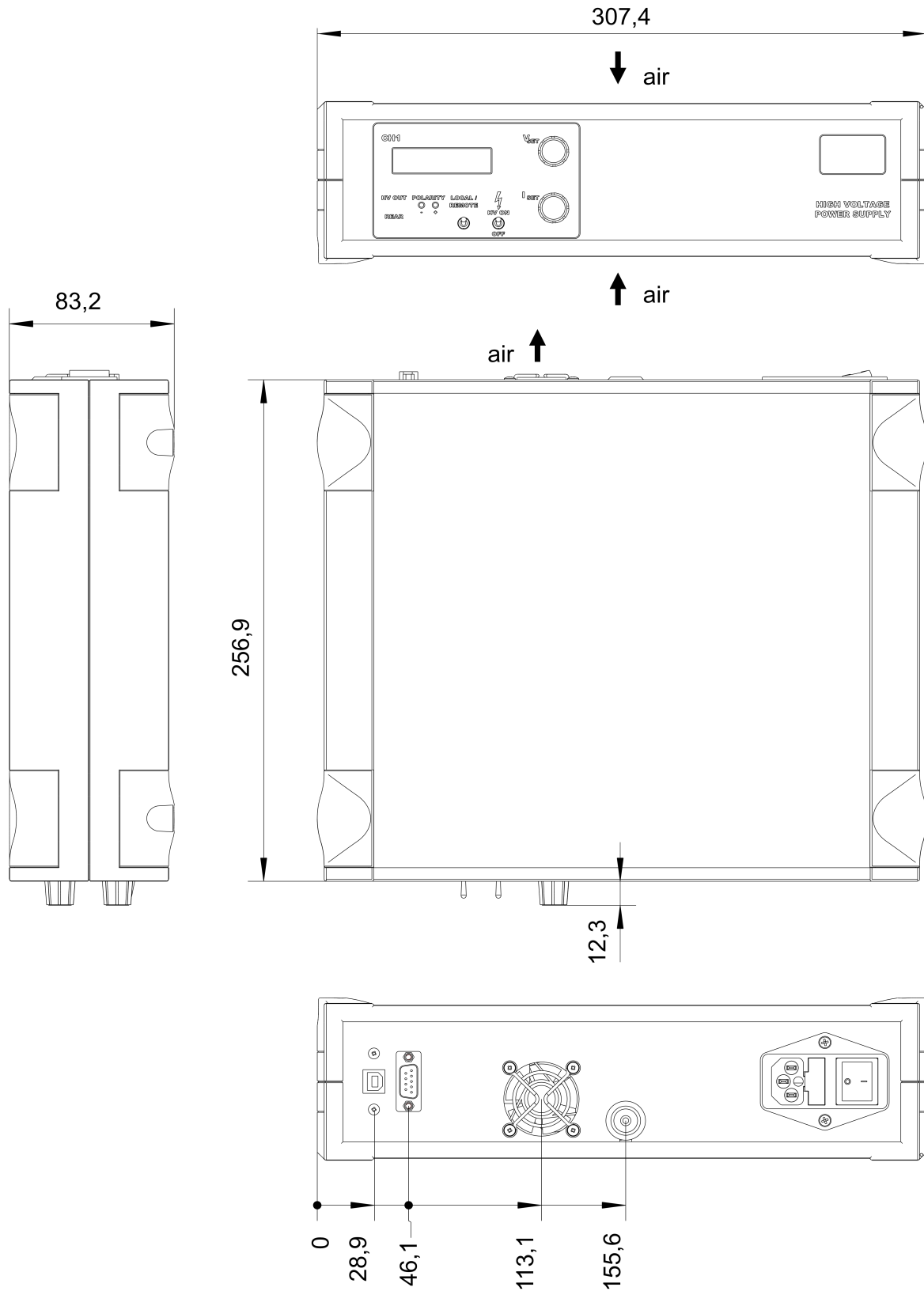


Figure 10: THQ DESKTOP, 1-channel 16kV (L16)

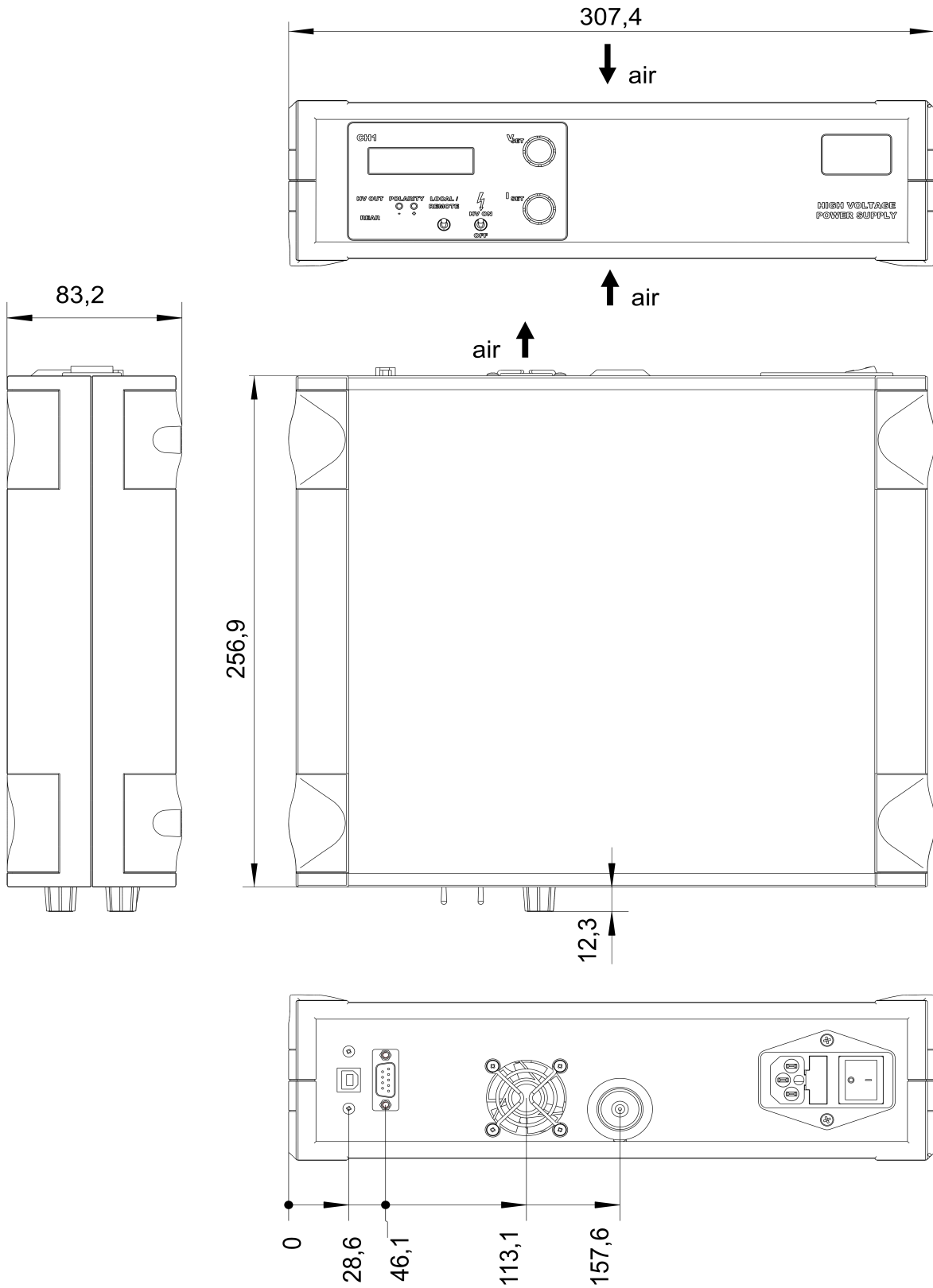


Figure 11: THQ DESKTOP, 1-channel 30kV (L30)

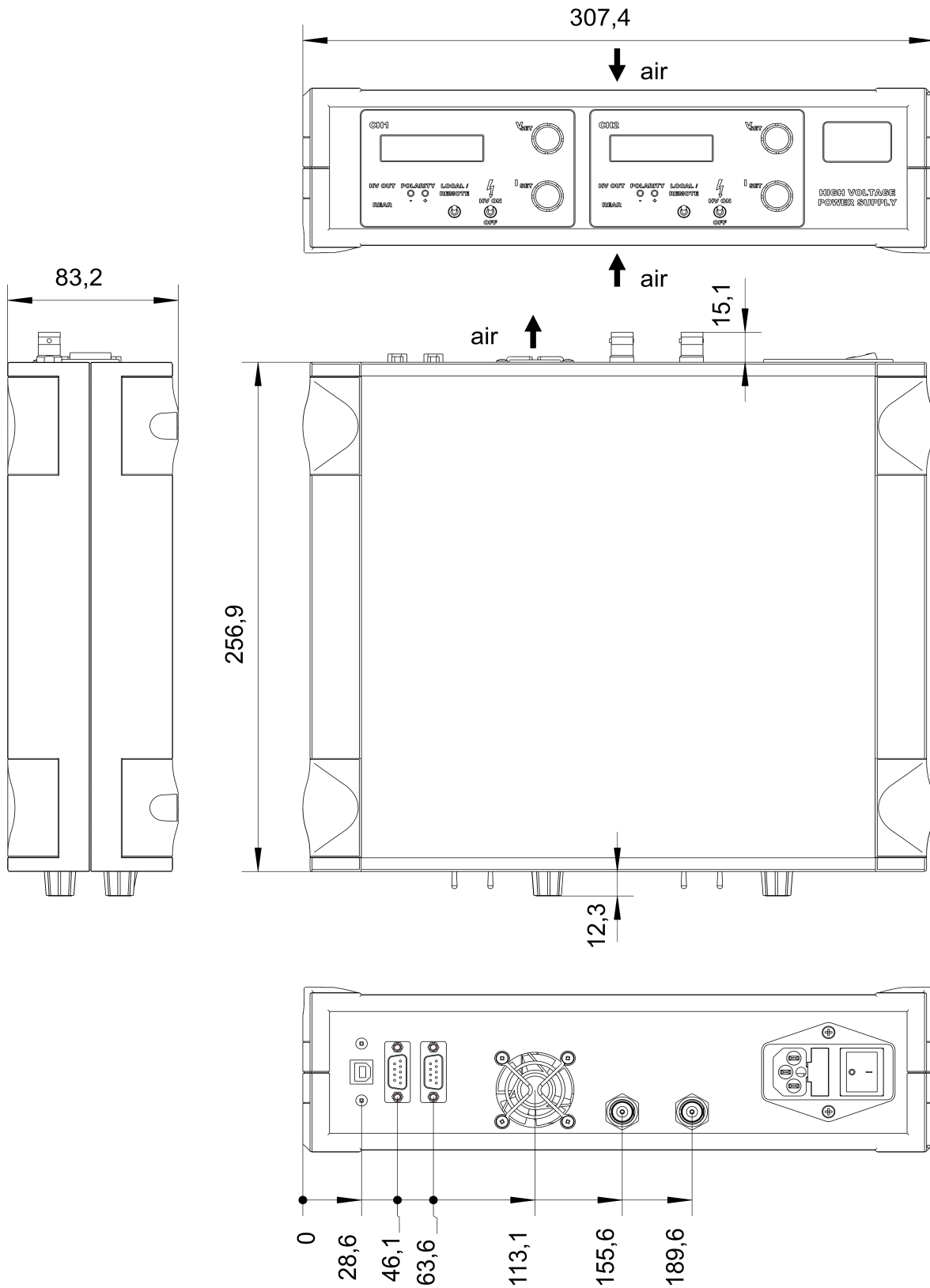


Figure 12: THQ DESKTOP, 2-channel 7kV (SHV)

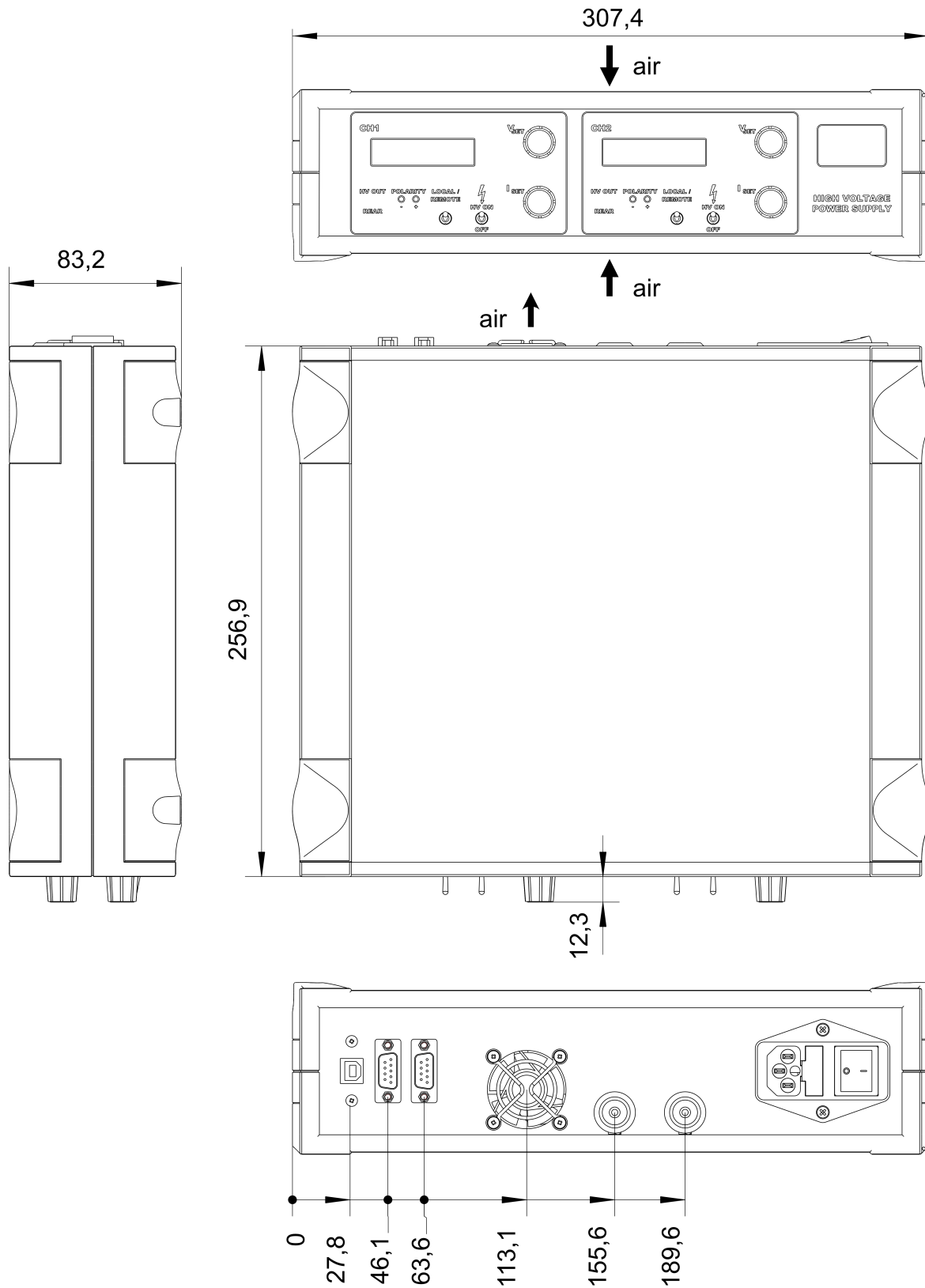


Figure 13: THQ DESKTOP, 2-channel 16kV (L16)

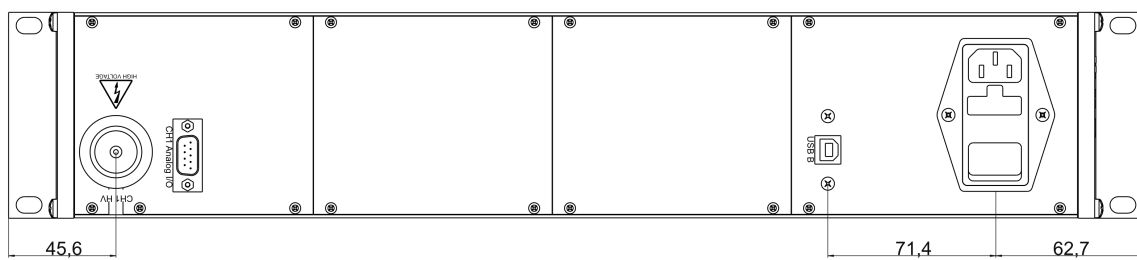
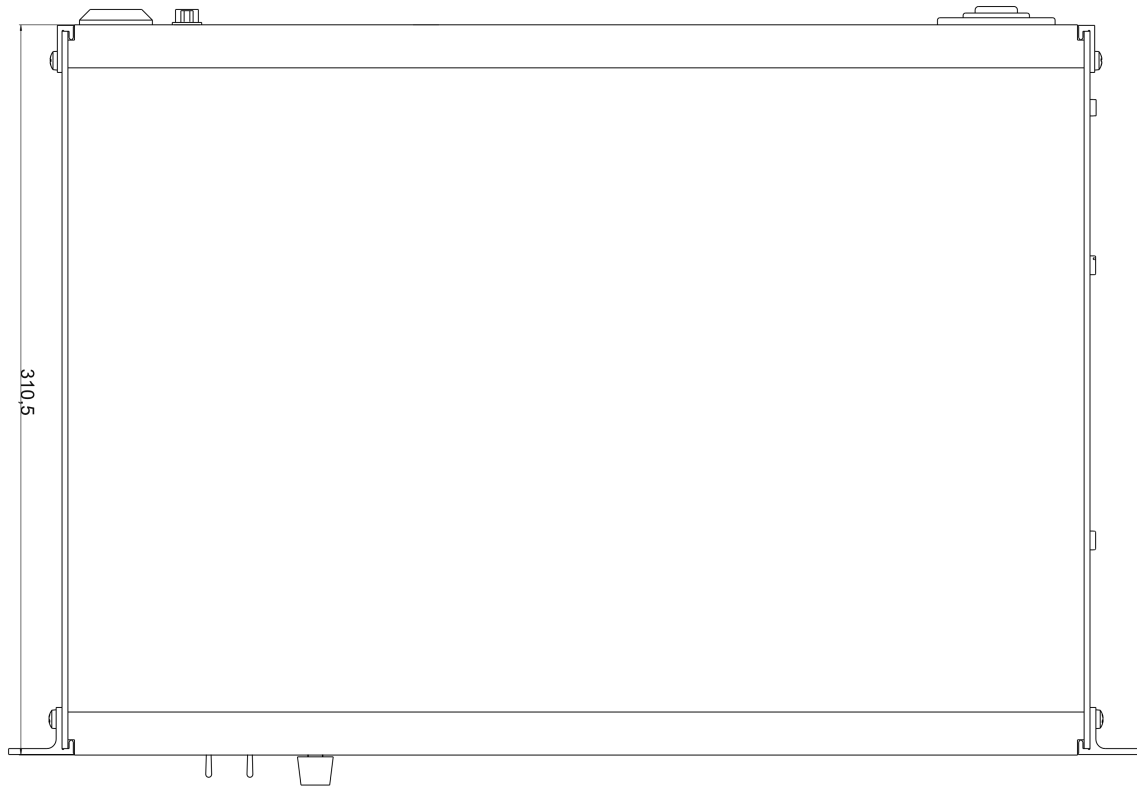
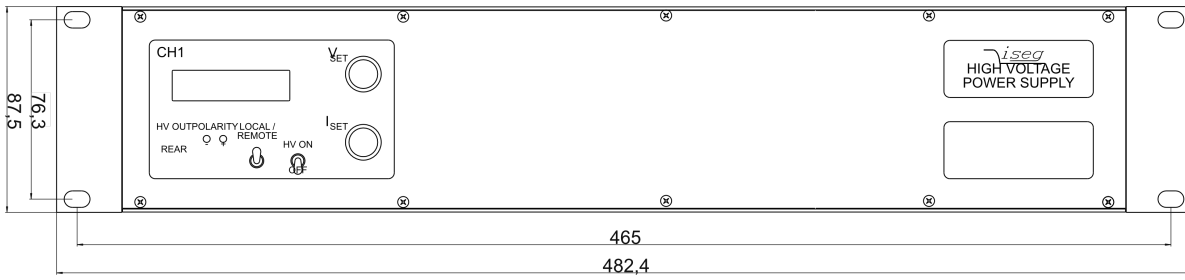


Figure 14: THQ 19-Zoll SYSTEM, 1-channel 30kV (L30)

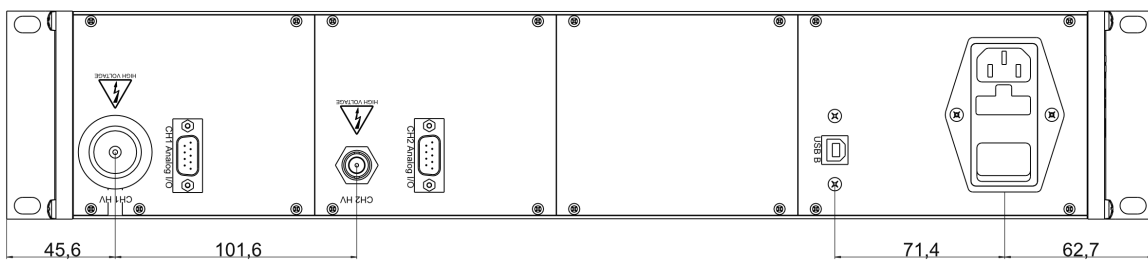
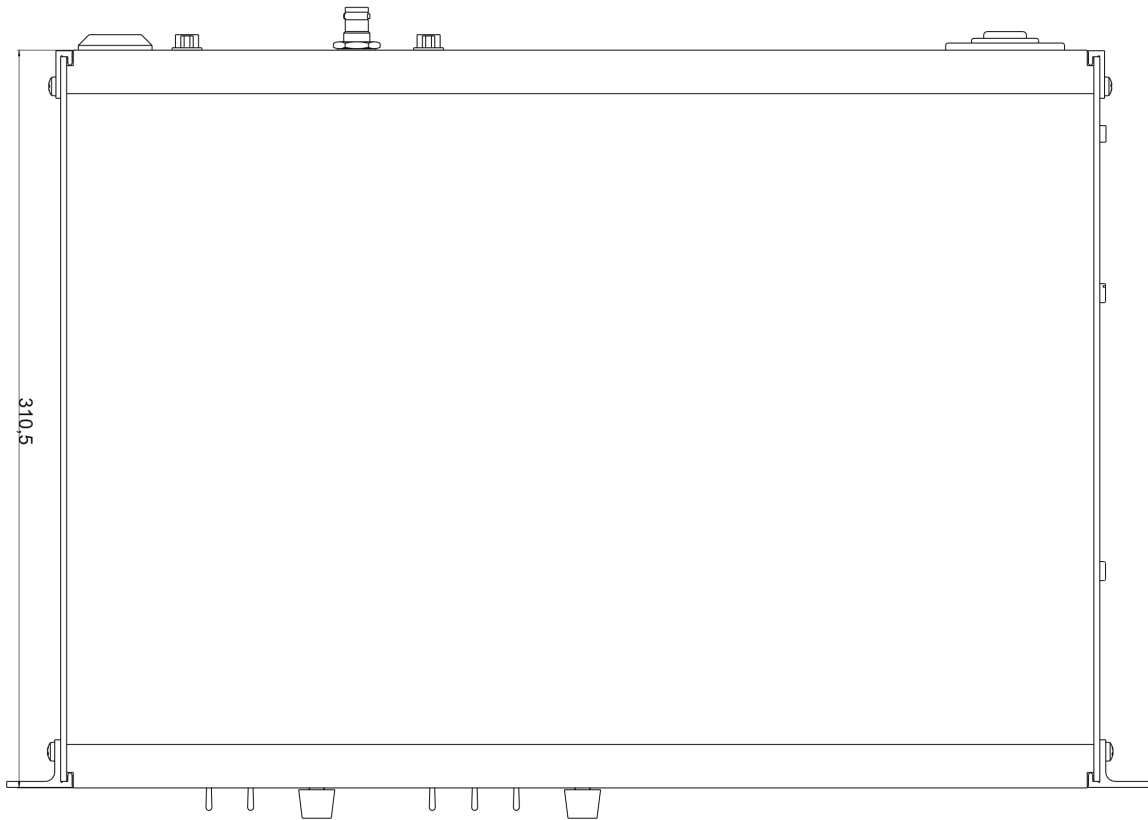
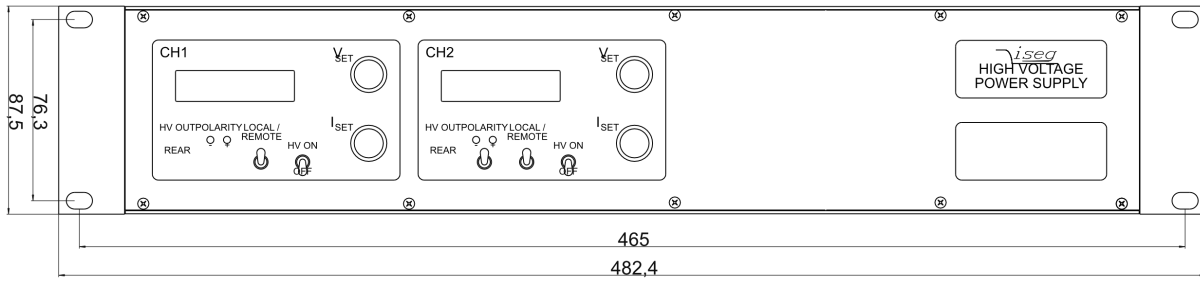


Figure 15: THQ 19-Zoll SYSTEM, 2-channel (L30 and SHV sample)



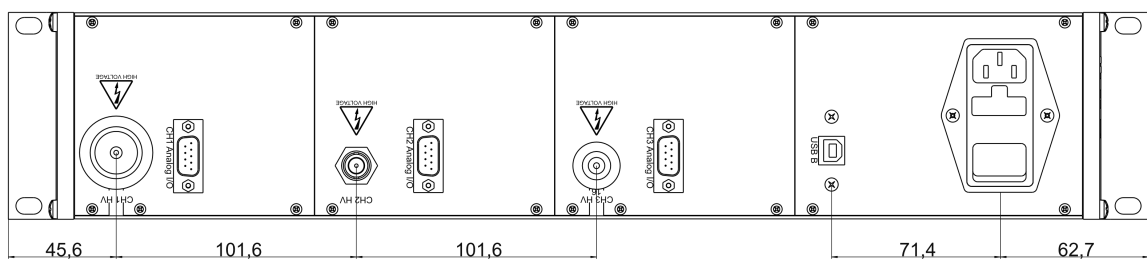
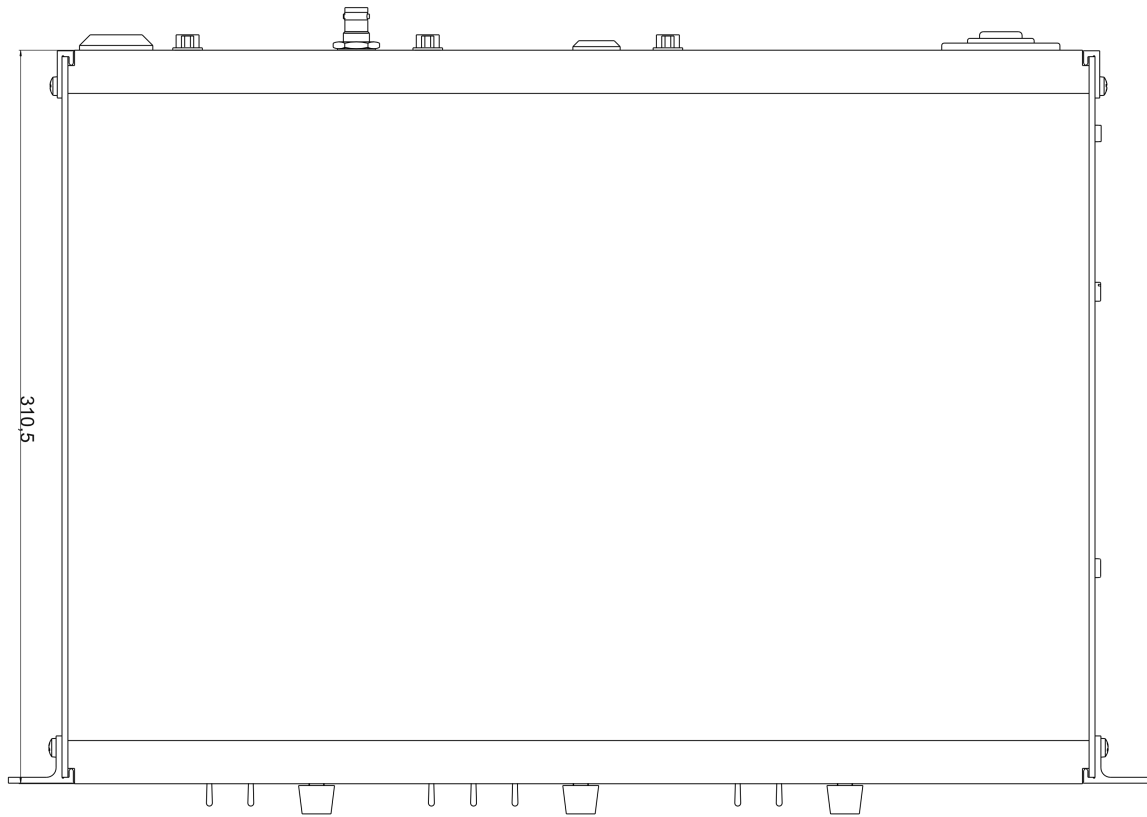
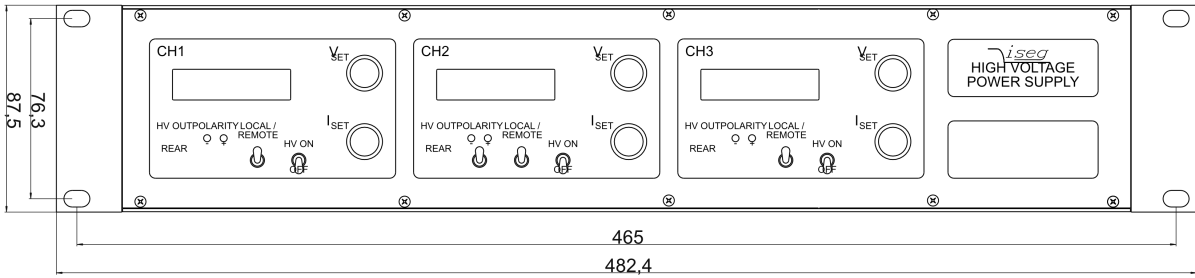


Figure 16: THQ 19-Zoll SYSTEM, 3-channel (L30, SHV and L16 sample)

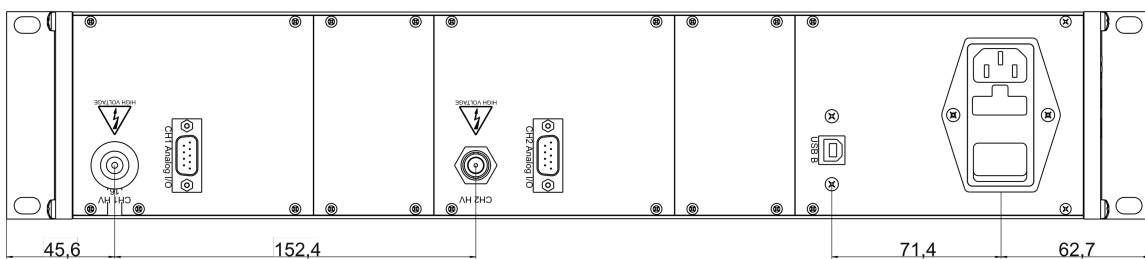
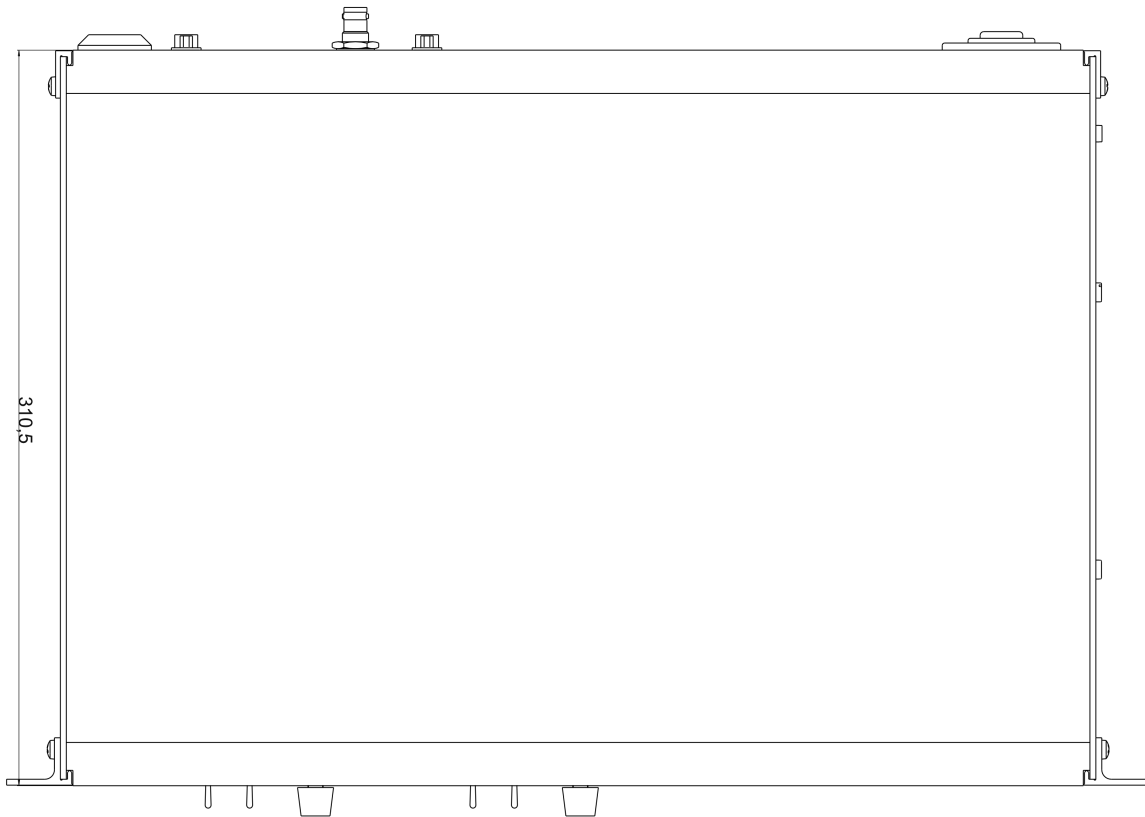
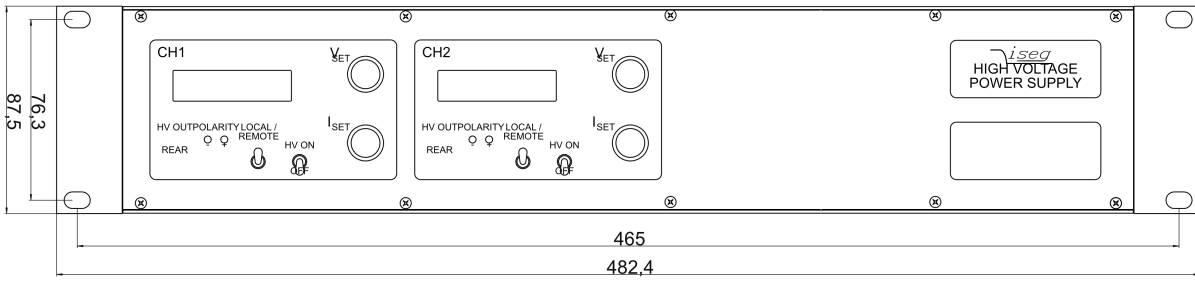


Figure 17: THQ 19-Zoll SYSTEM, 2-channel (EPS modules, L16 and SHV sample)

# 11 Connectors

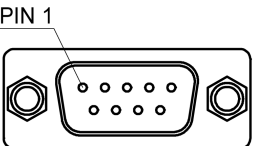


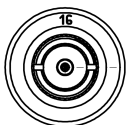
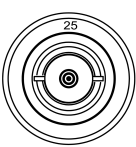
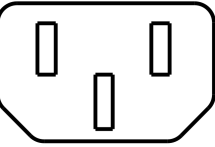
CONNECTORS - POWER SIDE		PART NUMBERS (manufacturer code / iseg accessory parts item code)	
<b>AIO</b>	D-SUB9 - male	<b>CABLE SIDE</b>	
 Figure 18	connector manufacturer iseg part number	D SUD9 various manufacturer	
<b>USB-B</b>		<b>CABLE SIDE</b>	
 Figure 19	connector manufacturer iseg part number	USB various manufacturer	USB 1.0/ 2.0, Type B, plug
<b>SHV</b>		<b>CABLE SIDE</b>	
 Figure 20	part number manufacturer iseg part number	R317.005.000 Radiall Z592474	
<b>L16</b>		<b>CABLE SIDE</b>	
 Figure 21	part number manufacturer iseg part number	FFR1Y.416.CFAE55R LEMO Elektronik GmbH Z592437	
<b>L30</b>		<b>CABLE SIDE</b>	
 Figure 22	part number manufacturer iseg part number	FFR.3Y.425.CFAE55 LEMO Elektronik GmbH Z592495	
<b>AC POWER</b>		<b>CABLE SIDE</b>	
 Figure 23	connector manufacturer iseg part number	IEC 60320-C13 various manufacturer Z592069	

Table 10: Connectors

## 12 AIO connector pin assignments

PIN	NAME	DESCRIPTION	VALUE
1	n.c.		
2	IMON	$I_{mon}$ Monitor voltage of output current, ( $R_i = 10\text{ k}\Omega$ )	0 – 5 V
3	INH	Inhibit, LOW = active, shut down the output voltage	TTL-level, LOW → HV OFF HIGH or n.c. → HV ON
4	ISET	$I_{set}$ Set voltage of output current ( $R_{IN} = 10\text{ k}\Omega$ )	0 – 5 V $V_{4-6} = 0\text{ to }5\text{ V}$ → $I_{out} = 0\text{ to }I_{nom} \pm 1\%$ n.c. → no output current
5	POL	Polarity <sup>(1)</sup>	TTL level, LOW → negative HIGH or n.c. → positive
6	GND	Signal ground	
7	VMON	$V_{mon}$ Monitor voltage ( $R_{OUT} = 10\text{ k}\Omega$ )	0 – 5 V
8	VSET	$V_{set}$ Set value of output voltage	0 – 5 V
9	REF	$V_{ref}$ Reference voltage for external potentiometer (Sliding contact on $V_{SET}$ and/or $I_{SET}$ ), see Figure 4: AIO circuit for simple Vset and Iset control	5 V
Notes: <sup>(1)</sup> – only DPS			

Table 11: AIO pin assignment

## 13 Accessories

### CAUTION!



CAUTION!

Only use genuine iseq parts like power cables, cables and terminators for stable and safe operation.

### ACCESSORY ITEM

### ORDER ITEM CODE

Genuine power cable – EU Plug

Z592069

Table 12: Accessory items

## 14 Order guides

### INFORMATION



INFORMATION

High voltage cables and accessories can be found in the manuals of the high voltage modules (CPS, DPS, EPS) built into the THQ.

### CONFIGURATION ORDER GUIDE (item code parts)

T	3	300	010	000	00
Type	number of channels	maximum voltage of module	Output Power of System	Option	Customized Version
THQ	1 = one channel 2 = two channel 3 = three channel	three significant digits 070 = 7 kV 300 = 30 kV	three significant digits  For Example: 010 = 10 • 10 [W] = 100W	2HE = 19" system see 2.4 Order options	00 = none

Table 13: Configuration item code

## 15 Glossary

SHORTCUT	MEANING
$V_{nom}$	nominal output voltage
$V_{out}$	output voltage
$V_{set}$	set value of output voltage
$V_{mon}$	monitor voltage of output voltage
$V_{meas}$	digital measured value of output voltage
$V_{p-p}$	peak to peak ripple voltage
$V_{in}$	input / supply voltage
$V_{type}$	type of output voltage (AC, DC)
$V_{ref}$	internal reference voltage
$V_{max}$	limit (max.) value of output voltage
$\Delta V_{out} - [\Delta V_{in}]$	deviation of $V_{out}$ depending on variation of supply voltage
$\Delta V_{out} - [\Delta R_{load}]$	deviation of $V_{out}$ depending on variation of output load
$V_{bounds}$	voltage bounds, a tolerance tube $V_{set} \pm V_{bounds}$ around $V_{set}$
$I_{nom}$	nominal output current
$I_{out}$	output current
$I_{set}$	set value of output current
$I_{mon}$	monitor voltage of output current
$I_{meas}$	digital measured value of current
$I_{trip}$	current limit to shut down the output voltage
$I_{in}$	input / supply current
$I_{max}$	limit (max.) value of output current
$I_{limit}$	current limit
$I_{bounds}$	current bounds, a tolerance tube $I_{set} \pm I_{bounds}$ around $I_{set}$
$P_{nom}$	nominal output power
$P_{in}$	input power
$P_{in,nom}$	nominal input power
T	temperature
$T_{REF}$	reference temperature
ON	HV ON
OFF	HV OFF
CH	channel(s)
HV	high voltage
LV	low voltage
GND	signal ground
INH	Inhibit
POL	Polarity
KILL	KillEnable

## 16 Appendix

For more information please use the following download links:

<p><b>This document</b></p> <p><a href="https://iseq-hv.com/download/AC_DC/THQ/iseq_manual_THQ_en.pdf">https://iseq-hv.com/download/AC_DC/THQ/iseq_manual_THQ_en.pdf</a></p>
<p><b>CPS Series</b></p> <p><a href="https://iseq-hv.com/en/products/detail/CPS">https://iseq-hv.com/en/products/detail/CPS</a></p>
<p><b>DPS Series</b></p> <p><a href="https://iseq-hv.com/en/products/detail/DPS">https://iseq-hv.com/en/products/detail/DPS</a></p>
<p><b>EPS Series</b></p> <p><a href="https://iseq-hv.com/en/products/detail/EPS">https://iseq-hv.com/en/products/detail/EPS</a></p>
<p><b>Labview</b> (National Instruments <sup>7</sup>)</p> <p><a href="https://www.ni.com/">https://www.ni.com/</a></p>
<p><b>CuteCom</b></p> <p><a href="http://cutecom.sourceforge.net">http://cutecom.sourceforge.net</a></p>
<p><b>FTDI-USB-Serial-Driver</b></p> <p><a href="https://iseq-hv.com/download/?dir=SOFTWARE/Tools">https://iseq-hv.com/download/?dir=SOFTWARE/Tools</a></p>

Manufacturers website (connectors)	
LEMO Elektronik GmbH	<a href="https://www.lemo.com/">https://www.lemo.com/</a>
Radiall	<a href="https://www.radiall.com/">https://www.radiall.com/</a>

<sup>7</sup> © National Instruments Corporation. All rights reserved.

## 17 ASCII character table

Hex	Dec	Char	Hex	Dec	Char	Hex	Dec	Char	Hex	Dec	Char
0x00	0	<NUL>	0x20	32	␣	0x40	64	@	0x60	96	`
0x01	1	<SOH>	0x21	33	!	0x41	65	A	0x61	97	a
0x02	2	<STX>	0x22	34	"	0x42	66	B	0x62	98	b
0x03	3	<ETX>	0x23	35	#	0x43	67	C	0x63	99	c
0x04	4	<EOT>	0x24	36	\$	0x44	68	D	0x64	100	d
0x05	5	<ENQ>	0x25	37	%	0x45	69	E	0x65	101	e
0x06	6	<ACK>	0x26	38	&	0x46	70	F	0x66	102	f
0x07	7	<BEL>	0x27	39	'	0x47	71	G	0x67	103	g
0x08	8	<BS>	0x28	40	(	0x48	72	H	0x68	104	h
0x09	9	<HT>	0x29	41	)	0x49	73	I	0x69	105	i
0x0A	10	<LF>	0x2A	42	*	0x4A	74	J	0x6A	106	j
0x0B	11	<VT>	0x2B	43	+	0x4B	75	K	0x6B	107	k
0x0C	12	<FF>	0x2C	44	,	0x4C	76	L	0x6C	108	l
0x0D	13	<CR>	0x2D	45	-	0x4D	77	M	0x6D	109	m
0x0E	14	<SO>	0x2E	46	.	0x4E	78	N	0x6E	110	n
0x0F	15	<SI>	0x2F	47	/	0x4F	79	O	0x6F	111	o
0x10	16	<DLE>	0x30	48	0	0x50	80	P	0x70	112	p
0x11	17	<DC1>	0x31	49	1	0x51	81	Q	0x71	113	q
0x12	18	<DC2>	0x32	50	2	0x52	82	R	0x72	114	r
0x13	19	<DC3>	0x33	51	3	0x53	83	S	0x73	115	s
0x14	20	<DC4>	0x34	52	4	0x54	84	T	0x74	116	t
0x15	21	<NAK>	0x35	53	5	0x55	85	U	0x75	117	u
0x16	22	<SYN>	0x36	54	6	0x56	86	V	0x76	118	v
0x17	23	<ETB>	0x37	55	7	0x57	87	W	0x77	119	w
0x18	24	<CAN>	0x38	56	8	0x58	88	X	0x78	120	x
0x19	25	<EM>	0x39	57	9	0x59	89	Y	0x79	121	y
0x1A	26	<SUB>	0x3A	58	:	0x5A	90	Z	0x7A	122	z
0x1B	27	<ESC>	0x3B	59	;	0x5B	91	[	0x7B	123	{
0x1C	28	<FS>	0x3C	60	<	0x5C	92	\	0x7C	124	
0x1D	29	<GS>	0x3D	61	=	0x5D	93	]	0x7D	125	}
0x1E	30	<RS>	0x3E	62	>	0x5E	94	^	0x7E	126	~
0x1F	31	<US>	0x3F	63	?	0x5F	95	_	0x7F	127	□

Table 14: ASCII character table



## 18 Warranty & service

This device is made with high care and quality assurance methods. The standard factory warranty is 12 months. Please contact the iseg sales department if you wish to extend the warranty.

### CAUTION!



CAUTION!

Repair and maintenance may only be performed by trained and authorized personnel.

For repair please follow the RMA instructions on our website: [www.iseg-hv.com/en/support/rma](http://www.iseg-hv.com/en/support/rma)

## 19 Disposal

### INFORMATION



INFORMATION

All high-voltage equipment and integrated components are largely made of recyclable materials. Do not dispose the device with regular residual waste. Please use the recycling and disposal facilities for electrical and electronic equipment available in your country.

## 20 Manufacturer contact

**iseg Spezialelektronik GmbH**

Bautzner Landstr. 23

01454 Radeberg / OT Rossendorf

GERMANY

FON: +49 351 26996-0 | FAX: +49 351 26996-21

[www.iseg-hv.com](http://www.iseg-hv.com) | [info@iseg-hv.de](mailto:info@iseg-hv.de) | [sales@iseg-hv.de](mailto:sales@iseg-hv.de)