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
1.4	2021-03-04	Improved documentation (Table 3 <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

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.
⚡ HIGH VOLTAGE	Attention 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 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 residiual voltages can be present for long time periods. These residiual 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

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 units are available with either 1, 2 or 3[1] high voltage channels in many variations and combinations. The output voltage is controlled via the 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 Desktop

SPECIFICATIONS	THQ DESKTOP	
Channels	1	2
High voltage	Up to 30 kV	Up to 7 kV
Module compatibility [1]	CPS, DPS, EPS	CPS, DPS (combinable)
Resolution		
Resolution voltage setting - manual	turn potentiometer ("LOCAL")	
Resolution voltage setting - Remote	analog I/O with V_{set}/V_{mon} = 0 to 5 V ("REMOTE") or Interface	
Resolution current setting - manual	turn potentiometer ("LOCAL")	
Resolution current setting - Remote	analog I/O with V_{set}/V_{mon} = 0 to 5 V ("REMOTE") or Interface	
Resolution voltage measurement 4-digit Display	V_{out} < 1 kV: 0,1 V V_{out} 1 kV – 8 kV: 1 V V_{out} > 10 kV: 10 V	
Resolution current measurement 4-digit Display	I_{out} < 10 mA: 1 µA I_{out} 10 mA – < 0,1 A: 10 µA I_{out} > 0,1 A: 0,1 mA	
Measurement accuracy The measurement accuracy is guaranteed in the range 1% • V_{nom} < V_{out} < V_{nom} / 1% • I_{nom} < I_{out} < I_{nom} and for 1 year		
Protection [1]	INHIBIT Overload and short circuit protected **(ATTENTION: there is only one short circuit or arc per second allowed!)**	

HV connector	CPS 0 – 7 kV: SHV
	       ≥ 10 kV: L16
	       ≥ 20 kV: L30
	
	DPS SHV
	
	EPS (60W) 0 – 7 kV: SHV
	              ≥ 10 kV: L16
	              ≥ 20 kV: L30	

Rated AC mains input	100 – 264 VAC with PFC	
Input power	75 W	100 W
Fuse	5x20mm 2.0A, inert	

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1   depending on the model

SPECIFICATIONS	THQ DESKTOP
AC power connector	IEC 320 C14
Connection	AIO $^{(2}$, USB
Case	ABS, Light grey, similar RAL 7035
Degree of protection	IP 30
Dimensions (L/W/H)	308 x 257 x 83 mm (6HE, 12TE)
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: $^{1)}$ The technical parameters of the modules (CPS, DPS, EPS) can be found in the data sheets on our homepage. $^{2)}$ 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 [(1]	CPS, DPS, EPS [(3] (combinable)		
Resolution			
Resolution voltage setting - manual	turn potentiometer ("LOCAL")		
Resolution voltage setting - Remote	analog I/O with V_{set}/V_{mon} = 0 bis 5 V ("REMOTE") or Interface		
Resolution current setting - manual	turn potentiometer ("LOCAL")		
Resolution current setting - Remote	analog I/O with V_{set}/V_{mon} = 0 bis 5 V ("REMOTE") or Interface		
Resolution voltage measurement 4-digit Display	V_{out} < 1 kV: 0,1 V V_{out} 1 kV – 8 kV: 1 V V_{out} > 10 kV: 10 V		
Resolution current measurement 4-digit Display	I_{out} < 10 mA: 1 µA I_{out} 10 mA – < 0,1 A: 10 µA I_{out} > 0,1 A: 0,1 mA		
Measurement accuracy The measurement accuracy is guaranteed in the range 1% • V_{nom} < V_{out} < V_{nom} / 1% • I_{nom} < I_{out} < I_{nom} and for 1 year			
Protection [(1]	INHIBIT Overload and short circuit protected (**ATTENTION: there is only one short circuit or arc per second allowed!**)		

HV connector	CPS 0 – 7 kV: SHV
	        ≥ 10 kV: L16
	        ≥ 20 kV: L30
	
	DPS SHV
	
	EPS (60W) 0 – 7 kV: SHV
	            ≥ 10 kV: L16
	            ≥ 20 kV: L30		

Rated AC mains input	100 - 264 VAC with PFC		
Input power	75 W	100 W	200 W
Fuse	5x20mm 2.0A, inert	5x20mm 2.5A, inert	5x20mm 4.0A, inert
AC power connector	IEC 320 C14		
Connection	AIO [(2], USB		

SPECIFICATIONS	THQ 19" SYSTEM
Case	
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: [1] The technical parameters of the modules (CPS, DPS, EPS) can be found in the data sheets on our homepage. [2] per channel [3] limited to 2 units	

Table 2: Technical data THQ 19" system

3   Order options

OPTION	ORDER CODE
19" version	2HE

4   Operation and maintenance

The power supply line with the mains switch and the fuse are located at the device's rear. After power-on, the displays light up at the front and the chosen polarity is displayed on the according polarity LED.

The two-line displays for measured voltage and current, the potentiometer V_{SET} and I_{SET}, the button **REMOTE/LOCAL** and the button HV-ON/OFF are located on the front panel. Devices with option EPU also have a button **POLARITY**.

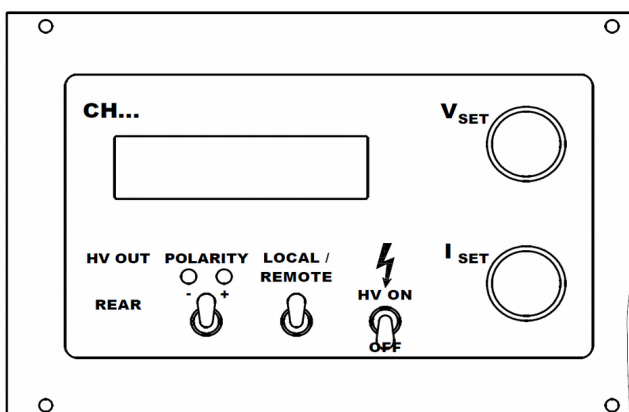The high voltage output is located at the device on rear, depending on the high voltage source.

Figure 1: Example Display with EPU

4.1 REMOTE/LOCAL

The analog I/O is realized by a D-SUB 9 connector per channel on the rear of the device, the digital USB interface is also connected on the rear. The REMOTE/LOCAL button is used to switch between the control system

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

The chosen control mode is saved internal and restored at next power-on. The high voltage generation is started with the internal signal INHIBIT when switching the button **HV-ON**. As another requirement, the external signal INHIBIT must not be active (HIGH level or open, see 9 Connectors and PIN assignments).

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.
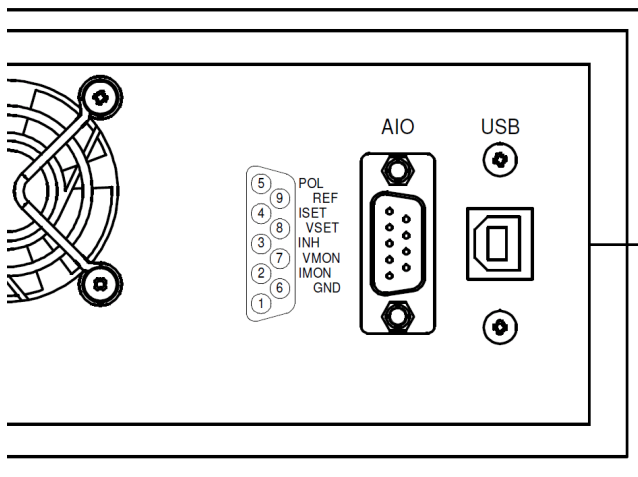
Figure 2: Example rear panel with AIO and USB

The high voltage and current can now be set with the potentiometer V_{set} and I_{set}. The actual voltage and actual current are shown on the display. They can also be monitored with the voltages V_{mon} and I_{mon} on the analogue I/O.

If the operating mode is switched to analogue I/O ("**REM**"), the output voltage and current are set to the analogue set voltages V_{set} and I_{set}.

In the simplest case, 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 3: circuit example

4.2 Remote control command

When receiving the device control command Dn^2={voltage} switches to the computer remote control mode ("**USB**").

By pressing the button **REMOTE/LOCAL**, the device switches back to local mode "**LOC**" or analogue I/O mode "**REM**". After power-on, the device starts in computer remote control mode, if the Autostart command is activated with command An^2 (see the chapter 7.4 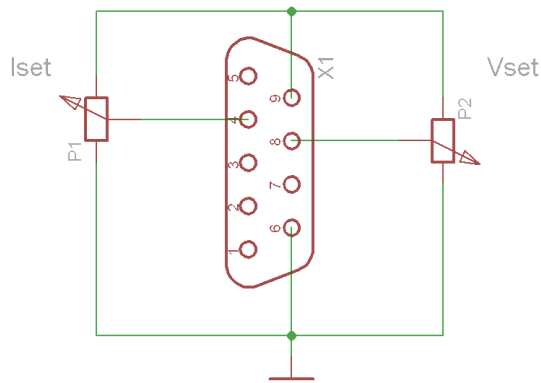The commands). The voltage (Dn^2), current (Cn^2) and polarity (Pn^2) set values for the computer control mode are saved in the internal EEPROM.

CAUTION!
⚠️ CAUTION! Before switching to computer control mode, the preset voltage and current should be checked first (read back with Dn^2 and Cn^2)!

Switching HV-ON to "**OFF**" or active INHIBIT-signal only switches off the high voltage generator, however, the output is not put to ground. The internal (approx. 2 nF) and external capacitors discharge by the internal measurement resistor (50MΩ ± 30%) and the external load. Therefore, extended discharge times may occur.

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.

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2   „n" - Number of the channel

4.3 Displays

The Display area consists of four subdivisions:

Measured voltage   Operating modus

V	0.000 kV	USB
I	0.000 mA	KILL

(**LOC**, **REM**, **USB**)

KILL on KILL enable,
TRIP on Current trip,
POL on Polarity change

Measured current

4.4 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 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 status word is set. This bit can be cleared by setting the KILL function again (Tn^3=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.

4.5 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 <u>PIN 5</u> (see 9 Connectors and PIN assignments) is not connected, the device switches to positive polarity.

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3   „n" - Number of the channel

4.6 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[4]).

CAUTION!
⚠ CAUTION!   If the switch "HV ON/OFF" is set to ON, the high voltage generation starts automatically!

4.7 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

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4   „n" - Number of the channel

5 Remote control via computer 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 at the device rear. 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[5].

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:
    - Nominal voltage
    - nominal current
    - polarity (EPU)
    - interface active after restart
2. reading functions:
    - Target voltage
    - actual voltage
    - target current
    - actual current
    - polarity
    - status
    - Identifier
    - 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 D1), 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>).

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6 Installing the Driver

6.1 Windows USB driver installation

The FTDI VCP driver (Virtual COM Port) can be downloaded from: http://download.iseg-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.
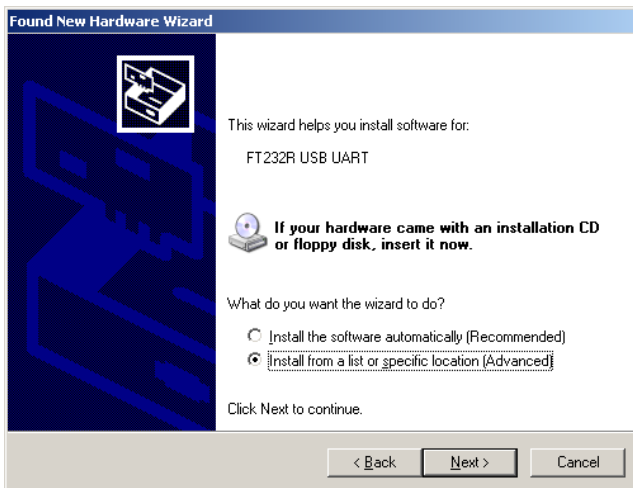

Figure 4: New Hardware

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

Figure 5: 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).

6.2 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 needed to connect to the THQ:

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

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

Now the serial interface can be opened by „Open device" and the communication tested.
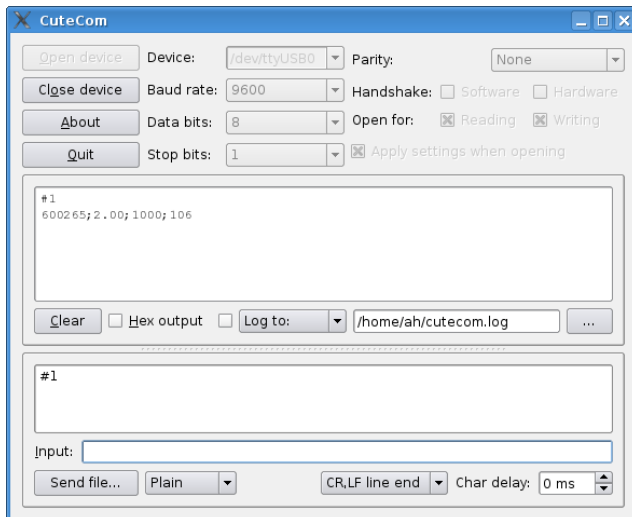
Figure 6: CuteCom

6.3 Interface Test in Microsoft Windows©6

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:
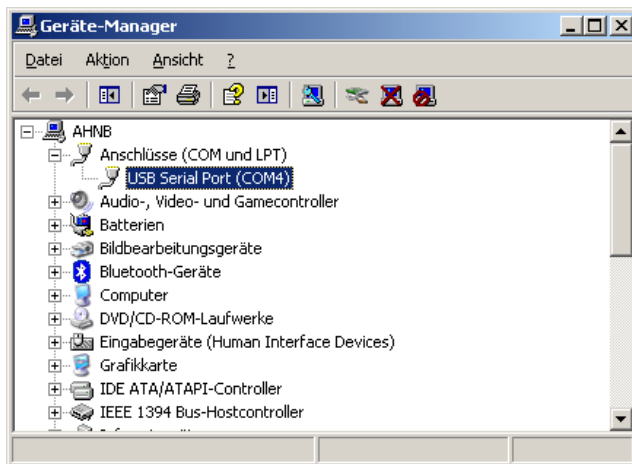
Figure 7: Device Manager under Windows 7

6   Microsoft - All rights reserved.

7 Command set

7.1 Introduction to the commands

The high voltage devices can be connected to a control computer by the USB, AIO 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

7.2 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

7.3 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.

7.4 The commands

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

INFORMATION	
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.

Command		Computer	HV Device	
Read Device identifikation		#1<CR><LF>	600000 ; 2.01 ; 3000 ; 205 <CR><LF> (serial number ; firmware ; V_{nom} ; I_{nom})	
Read actual voltage channel 1	V_{meas}	U1<CR><LF>	{Measured voltage}<CR><LF>	[V]
Read actual current channel 1	I_{meas}	I1<CR><LF>	{Measured current}<CR><LF>	[A]
Read set voltage channel 1	V_{set}	D1<CR><LF>	{Set Voltage}<CR><LF>	[V]
Write set voltage channel 1 (Channel goes into USB mode)	V_{set}	D1={voltage}<CR><LF>	0 ≤ voltage ≤ V_{nom}	[V]
Read set current channel 1	I_{set}	C1<CR><LF>	{Set current}<CR><LF>	[A]
Write set current channel 1	I_{set}	C1={current}<CR><LF>	0 < Current ≤ I_{nom}	[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	
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 3

Command		Computer	HV Device	
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 THQ 1.xx, Fehler: Verweis nicht gefunden Fehler: Verweis nicht gefunden)
Read device status channel 1		S1<CR><LF>	HL <CR><LF>	hex code ➜ see 7.6.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)

Table 4: description of commands

7.5 Examples

	Commands	Explanations
query	#1	Read identification
answer	600138;2.01;3000;405	(serial number 600138, firmware version 2.01, 3000 V, 4=4 • 10^{-5} ➜ 4 mA)

query	D=1000	Set voltage on channel 1 to 1000 V (device goes into USB mode)

query	C1=1E-3	Set current limitation on channel 1 to 1 mA

query	U2	Read measured voltage on channel 2
answer	999.7	

query	I1	Read measured current on channel 1
answer	0.028E-3	0.028E-3 = 0.028 • 10^{-3} =

query	S3	Read status of channel 3
answer	31	HV ON + NEGATIVE + USB

7.6 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 behaviour 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 repeatet first

- The current limit is transmitted in mA (for $I_{nom} \geq 1$ mA) respectively in µA (for $I_{nom} < 1$ 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 5: Examples

7.7 Device status

The device status is an 8 bit word and is transmitted hexadecimal. The meaning of the status bits is explained in 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	7	**1**	_	_	_	_	_	_	_
		Limit not reached		**0**	_	_	_	_	_	_	_
KILL	Kill-Enable/Disable	Kill enable	6	_	**1**	_	_	_	_	_	_
		Kill disable		_	**0**	_	_	_	_	_	_
INH	INHIBIT	HV-ON	5	_	_	**1**	_	_	_	_	_
		HV-OFF		_	_	**0**	_	_	_	_	_
POLN	Polarity negative	Negative	4	_	_	_	**1**	_	_	_	_
		(positive / unknown)		_	_	_	**0**	_	_	_	_
POLP	Polarity positive	Positive	3	_	_	_	_	**1**	_	_	_
		(negative / unknown)		_	_	_	_	**0**	_	_	_
AUTO	Computer interface active after power-on	Active	2	_	_	_	_	_	**1**	_	_
		Not active		_	_	_	_	_	**0**	_	_
MODE	Control via …	analog I/O (REM)	1	_	_	_	_	_	_	**1**	**1**
		Local control (LOC)		_	_	_	_	_	_	**1**	**0**
		Computer interface (USB)	0	_	_	_	_	_	_	**0**	**1**
		Reserved		_	_	_	_	_	_	**0**	**0**
Notes: ⌴ – not taken into consideration											

Table 6: Device status

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

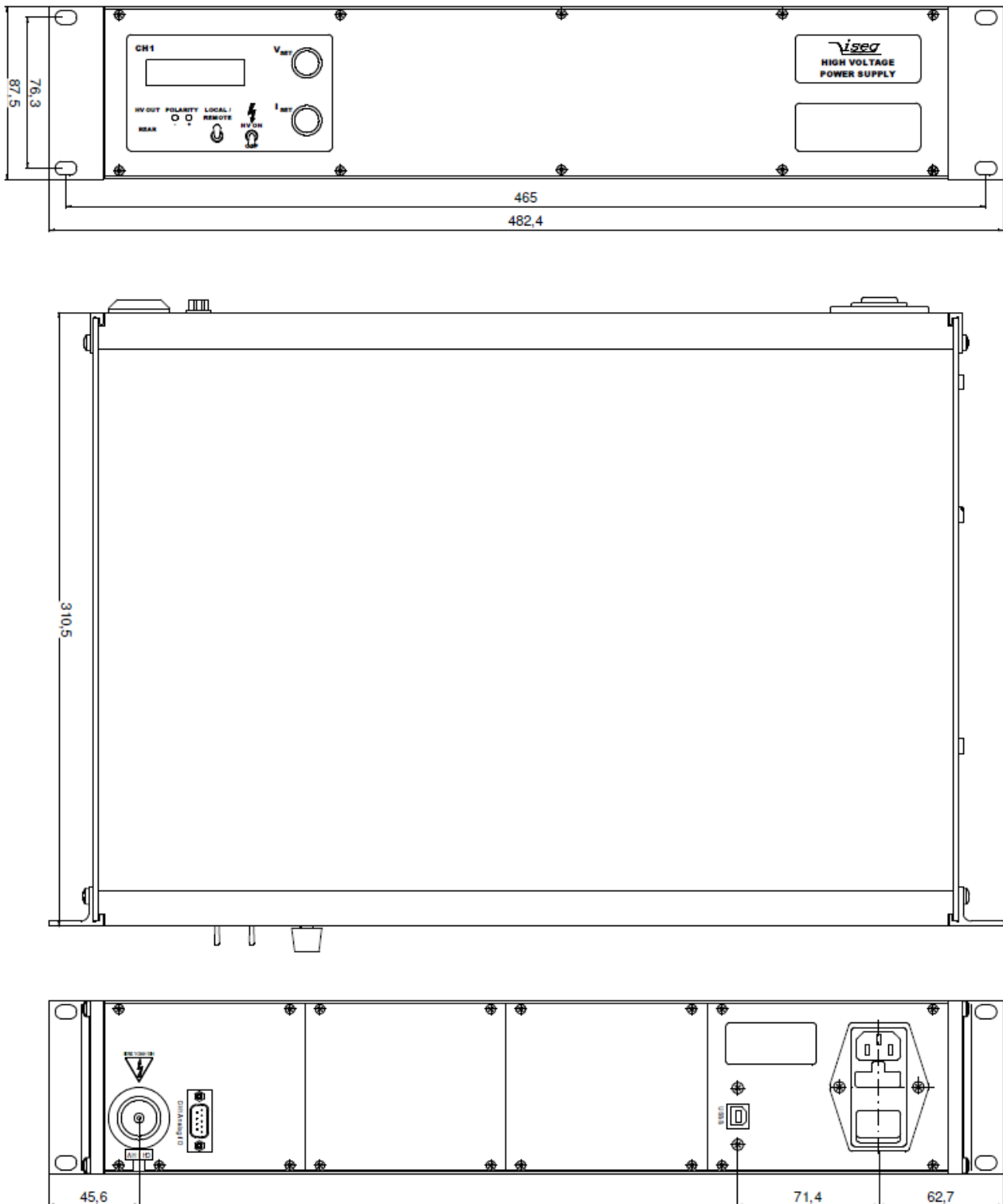*Table 7: Examples for Status*

8 Dimensional drawings

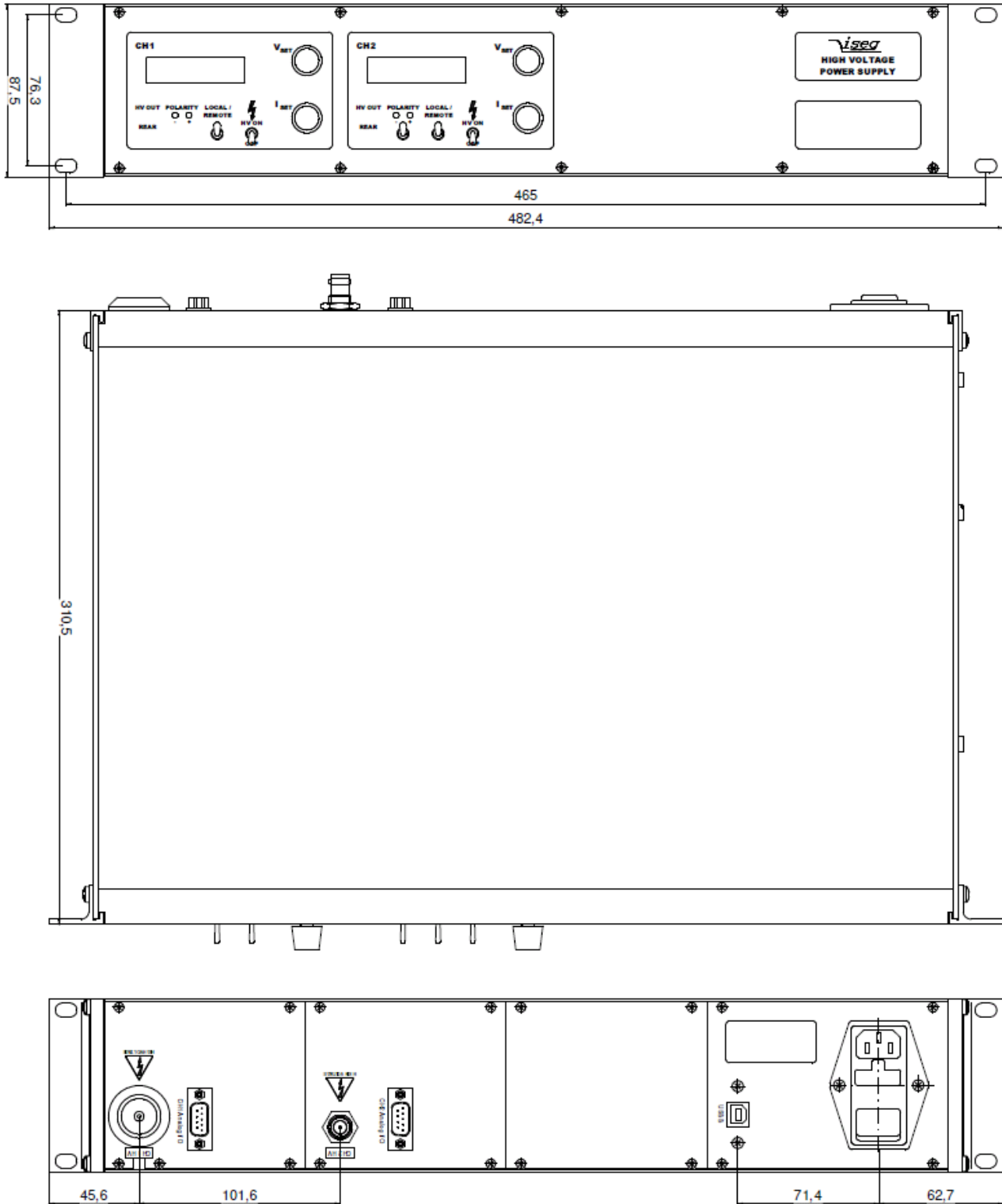*Figure 8: THQ 19 Zoll, Example for 1 Channel 30kV*

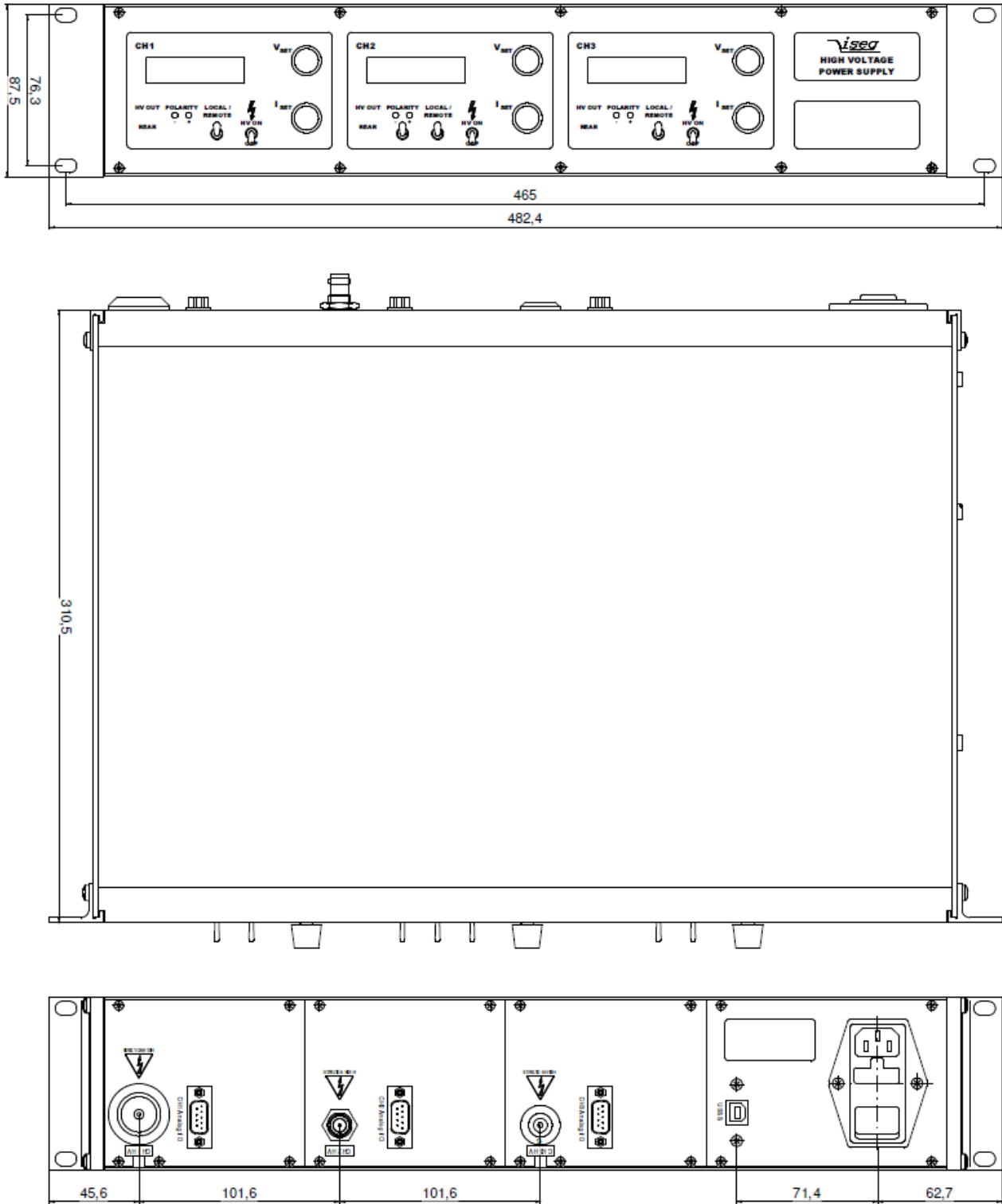*Figure 9: THQ 19 Zoll, Example for 2 Channel*

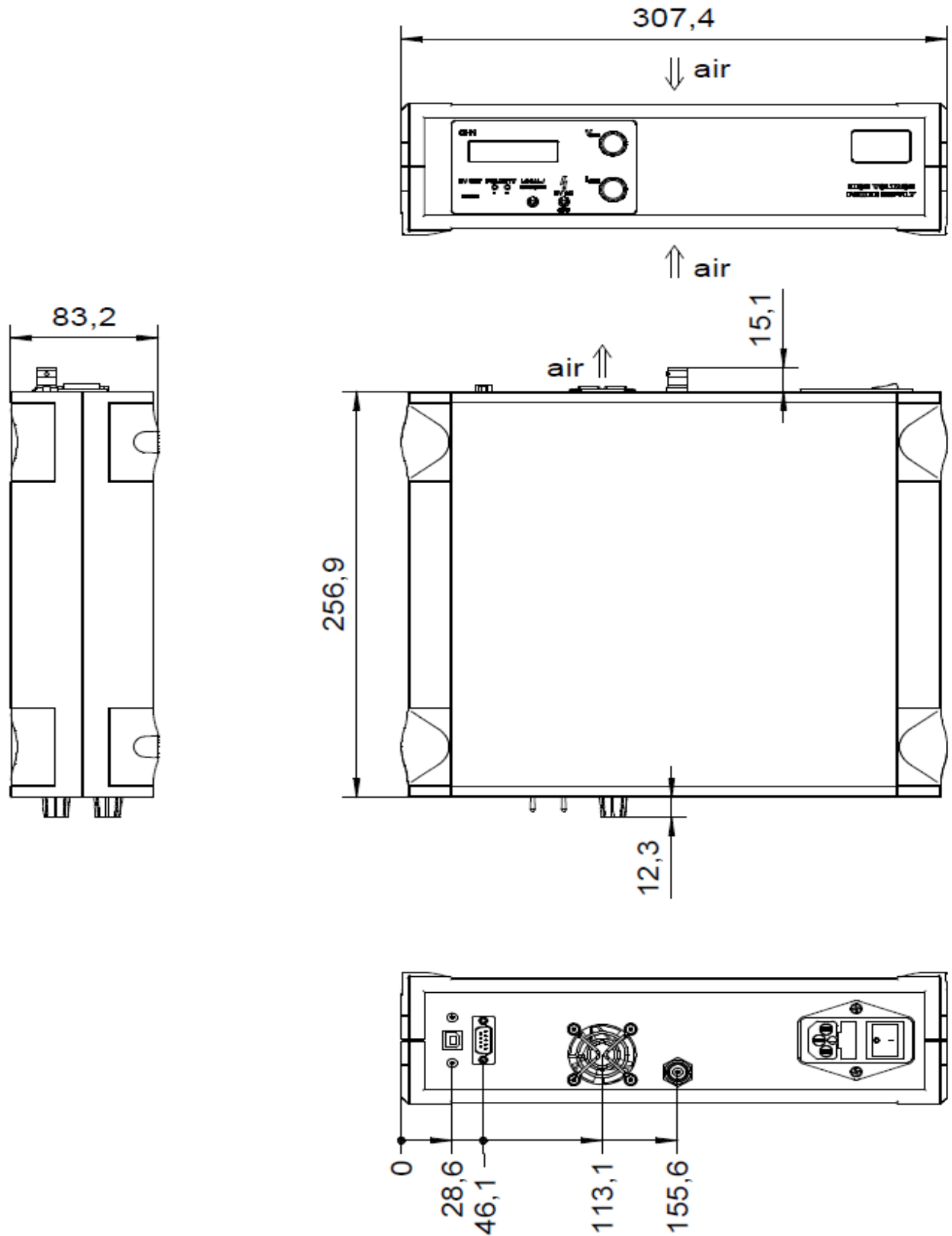*Figure 10: THQ 19 Zoll, Example for 3 Channel*

Figure 11: THQ Desktop, Example for 1 Channel up to 7kV
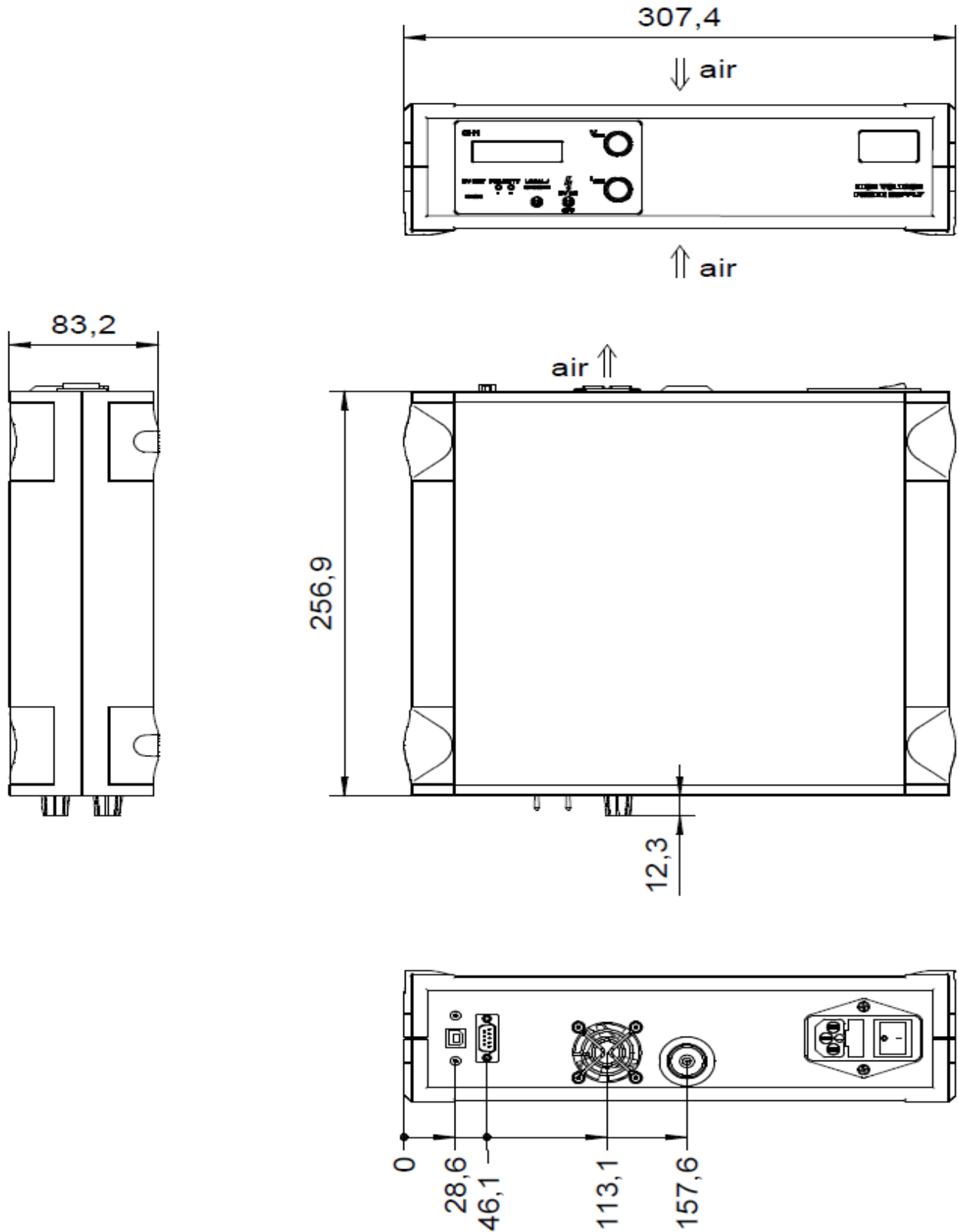
Figure 12: THQ Desktop, Example for 1 Channel 30kV
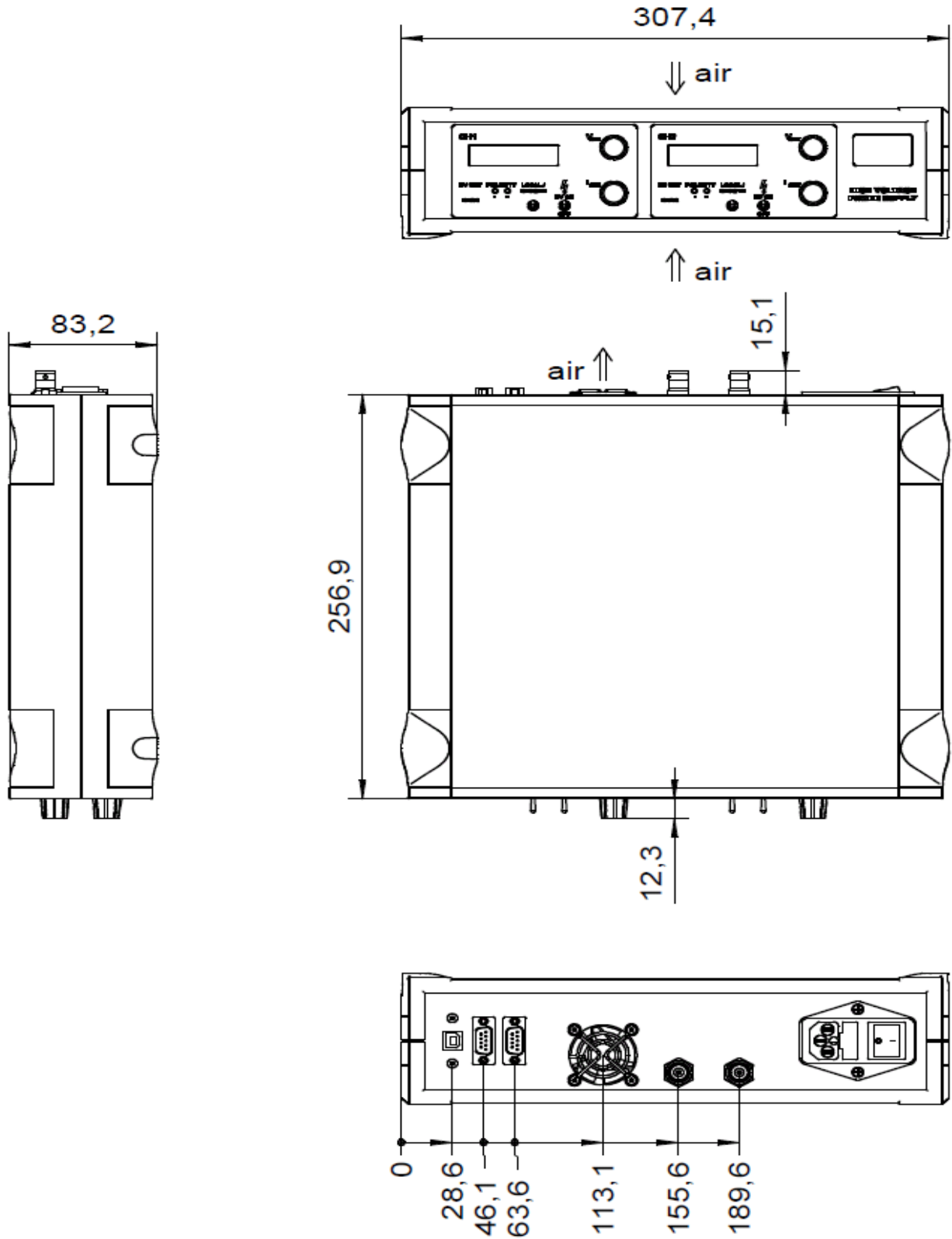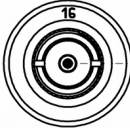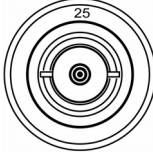
Figure 13: THQ Desktop, Example for 2 Channel up to 7kV

9 Connectors and PIN assignments

HV CONNECTOR ASSIGNMENTS				
Name	SHV	L16	L30	
Figure				

PART NUMBER (Manufacturer code / iseg Accessories Article code)			
HIGH VOLTAGE SIDE		CABLE SIDE	
SHV			
Socket	R317.580.000	Connector	R317.005.000 / Z592474
L16 (LEMO)			
Socket	ERA.1Y.416.CLL	Connector	FFR1Y.416.CFAE55R / Z592437
L30 (LEMO)			
Socket	ERA.3Y.425.CCL	Connector	FFR.3Y.425.CFAE55 / Z592495

Table 8: Part number Information
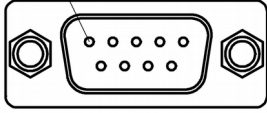
CONNECTOR ASSIGNMENTS				
Name	SUB D9			
Figure	PIN 1			

Table 9: Connectors

PIN	NAME	DESCRIPTION	VALUE
5	POL	Polarity	TTL level, LOW ➔ negative HIGH or n.c. ➔ positive
9	REF	V_{ref} Reference voltage for a external potentiometer (Sliding contact on V_{SET} and/or I_{SET})	5 V
4	ISET	I_{set} Set voltage of output current (R_{IN} = 10 kΩ)	0 – 5 V V_{4-6} = 0 to 5 V ➔ I_{out} = 0 to I_{nom} ± 1% n.c. ➔ I_{nom} is possible
8	VSET	V_{set} Set value of output voltage	0 – 5 V
3	INH	Inhibit, LOW = active, shut down the output voltage	TTL-level, LOW ➔ HV OFF HIGH or n.c. ➔ HV ON
7	VMON	V_{mon} Monitor voltage (R_{OUT} = 10 kΩ)	0 – 5 V
2	IMON	I_{mon} Monitor voltage of output current, (Ri = 10 kΩ)	0 – 5 V
6	GND	Signal ground	
1	n.c.		

Table 10: PIN Assignment

10 Accesories

CAUTION!
⚠ CAUTION!   Only use genuine iseg parts like power cables, CAN cables and terminators for stable and safe operation.

ACCESSORY ITEM	ORDER ITEM CODE
Genuine power cable – EU Plug	Z592069

Tabelle 11: Accessory items

11 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	xHE	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 significante digits 070 = 7 kV 300 = 30 kV	three significante digits For Example: 010 = 10 · 10 [W] = 100W	2HE = 19" version	00 = none

Table 12: Configuration item code

12 Appendix

For more information please use the following download links:

This document
https://iseg-hv.com/download/AC_DC/THQ/iseg_manual_THQ_en.pdf
CPS Series
https://iseg-hv.com/en/products/detail/CPS
DPS Series
https://iseg-hv.com/en/products/detail/DPS
EPS Series
https://iseg-hv.com/en/products/detail/EPS
Labview - National Instruments
https://www.ni.com/
CuteCom
http://cutecom.sourceforge.net
FTDI-USB-Serial-Driver
https://iseg-hv.com/download/?dir=SOFTWARE/Tools

13 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	DEL

14 Glossary

SHORTCUT	MEANING
V_{nom}	nominal output voltage
V_{out}	output voltage
V_{set}	set value of output voltage
V_{mon}	monitor voltage
V_{meas}	digital measured value of 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} dep. on variation of supply voltage
$\Delta V_{out} - [\Delta R_{load}]$	deviation of V_{out} dep. 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
/ON	HV OFF/ON
CH	channel(s)
HV	high voltage
LV	low voltage
GND	signal ground
INH	Inhibit
POL	Polarity
KILL	KillEnable

15   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

16   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.

17   Manufacturer contact

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