Technical information
Last changed on: 2021-01-11

VHQ series

High Precision Dual Channel High Voltage Module in VME Standard

- 2 channels, 2 / 3 / 4 / 5 kV and customized versions
- LCD for voltage and current display
- switchable polarity
- very low ripple and noise
- front panel control with high precise 10-turn potentiometers
- hardware voltage and current limits with 10% step
- VMEbus compliant
- programmable parameters (current trip, ramp speed etc.)

Document history

Version	Date	Major changes
3.0	2021-01-11	improved documentation (safety information, Glossary, Disposal, Technical data: Specifications and Configurations, Options and order information, Connectors and PIN assignments, Connectors part number information)
2.0	2018-10-01	Notes revised
1.0	2017-02-28	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.

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 for the generation of high voltage as specified in the data sheet. 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

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!

The high-voltage cable must be professionally connected to the consumer/load and the connection insulated with the appropriate dielectric strength. Do not power the consumer/load outside of its specified range.

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!

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.

CAUTION!


CAUTION!

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

CAUTION!


CAUTION!

When controlling, with software, the high voltage systems, make sure that nobody is near the high voltage or can be injured.

INFORMATION


INFORMATION

Please check the compatibility with the devices used.

Table of Content

1 General description

CAUTION!

CAUTION!

The devices must only be used in combination with iseg approved crates.

VHQ STANDARD series are two channel high voltage supplies in 6U VME format, 164 mm deep, double width. The unit offers manual control and operation via VME bus. The use of the VME interface supports extended functionality compared to manual control.

The high voltage supplies provide a high precision output voltage together with very low ripple an noise, even under full load. Separate hardware switches allow to put voltage and current limits in 10%-steps. An INHIBIT input protects sensitive devices. Additionally, a maximum output current per channel can be specified via the interface. The high voltage source is protected against overload and short circuit. The output polarity can be switched over. The HV-GND is connected to the chassis and the powering GND.

VHQ HIGH PRECISION series are single- or dual-channel high voltage supplies with higher stability and improved capabilities compared to the VHQ STANDARD series in 6U VME format, 164 mm deep, double width. The units offer manual control and operation via VME bus. The use of the VME interface supports extended functionality compared to manual control.

The high voltage supplies provide a high precision output voltage together with very low ripple an noise, even under full load. Separate hardware switches allow to put voltage and current limits in 10%-steps. An INHIBIT input protects sensitive devices. Additionally, a maximum output current per channel can be specified via the interface. The high voltage source is protected against overload and short circuit. The output polarity can be switched over. The HV-GND is connected to the chassis and the powering GND.

2 Technical Data

SPECIFICATIONS	STANDARD	HIGH PRECISION
Polarity	Switchable	
Ripple and noise (f > 10 Hz) [1]	< 2 | 5 mV_{p-p}	
Stability – [ΔV_{out} vs. ΔV_{in}] [1]	< 3 •10^{-5}• V_{nom}	
Stability – [ΔV_{out} vs. ΔR_{load}] [1]	< 2 • 10^{-4} • V_{nom}	< 5 •10^{-5}• V_{nom}
Temperature coefficient	< 50 ppm / K	< 30 ppm / K
LCD Display	4 digits with sign, switch controlled voltage display in [V] current display in [A]	
Resolution voltage setting – display	1 V	
Resolution voltage setting – remote	1 V	100 mV / with option VHR 1 • 10^{-5} • V_{nom}
Resolution voltage measurement – display	1 V	
Resolution voltage measurement – remote	1V	100 mV / with option VHR 1 • 10^{-5} • V_{nom}
Resolution current measurement display	1µA	1µA Option 2MA: 10nA Option 2MA0n1: 1nA
Resolution current measurement remote	1 µA Option L: 100 nA [I_{out} ≤ 100 µA]	100 nA Option 2MA: 1nA [I_{out} ≤ 65 µA] Option 2MA0n1: 100 pA [I_{out} ≤ 6.5 µA]
Measurement accuracy – The measurement accuracy is guaranteed in the range 1% • V_{nom} < V_{out} < V_{nom} and for 1 year		
Accuracy voltage measurement	± (0.05 % • V_{out} +0.02 % • V_{nom}+ 1 digit)	
Accuracy current measurement	± (0.05% I_{out} + 0.02% I_{nom} + 1 digit)	
Voltage ramp – hardware	500 V / s	
Voltage ramp – software	2 – 255 V / s	
Protection	Overload and short circuit protected (**ATTENTION: there is only one short circuit or arc per second allowed!** separate current and voltage limit (hardware, rotary switch in10%-steps) INHIBIT (external signal, TTL level, Low=active)	
Interface	VMEbus	
HV connector	SHV	
System connector	96-pin VME connector according to DIN 41612	
Inhibit connector	Lemo 1pole: ERN.00.250.CTL	
Interface connector	Sub-D9	
Power requirements V_{input}	± 12 V (< 850mA with option HCU 1.6 A) ± 5 V (< 300mA)	
Case	VME cassette, width 2 HP / 6U / 164 mm deep	
Operating temperature	0 – 50 °C	
Storage temperature	-20 -60 °C	
Humidity	max. 70 %	

Notes:
[1] Specifications for stability, ripple and noise are guaranteed in the range 2% • V_{nom} < V_{out} ≤ V_{nom}

Table 1: Technical data: Specifications

CONFIGURATIONS					
Model	**V_{nom}**	**I_{nom}**	**Standard Ripple**	**Item Code**	**Options**
STANDARD					
VHQ 202M	2 kV	3 mA	2 mV_{p-p}	V20-20	HCU, L
VHQ 203M	3 kV	2 mA	2 mV_{p-p}	V20-30	HCU, L
VHQ 204M	4 kV	1 mA	5 mV_{p-p}	V20-40	HCU, L
VHQ 205M	5 kV	1 mA	5 mV_{p-p}	V20-50	HCU, L
VHQ 202M HCU	2 kV	6 mA	2 mV_{p-p}	V20-20HCU	
VHQ 203M HCU	3 kV	4 mA	2 mV_{p-p}	V20-30HCU	
VHQ 204M HCU	4 kV	3 mA	5 mV_{p-p}	V20-40HCU	
VHQ 205M HCU	5 kV	2 mA	5 mV_{p-p}	V20-50HCU	
HIGH PRECISION					
VHQ 222M	2 kV	3 mA	2 mV_{p-p}	V22-20	2MA, 2MA0n1, HCU
VHQ 223M	3 kV	2 mA	2 mV_{p-p}	V22-30	2MA, 2MA0n1, HCU
VHQ 224M	4 kV	1 mA	2 mV_{p-p}	V22-40	2MA, 2MA0n1, HCU
VHQ 225M	5 kV	1 mA	5 mV_{p-p}	V22-50	2MA, 2MA0n1, HCU
VHQ 222M HCU	2 kV	6 mA	2 mV_{p-p}	V22-20HCU	2MA, 2MA0n1
VHQ 223M HCU	3 kV	4 mA	2 mV_{p-p}	V22-30HCU	2MA, 2MA0n1
VHQ 224M HCU	4 kV	3 mA	2 mV_{p-p}	V22-40HCU	2MA, 2MA0n1
VHQ 225M HCU	5 kV	2 mA	5 mV_{p-p}	V22-50HCU	2MA, 2MA0n1

Table 2: Technical data: Configurations

OPTIONS / ORDER INFO	INFO	INFO
HIGH CURRENT OUTPUT	**HCU**	
LOWER OUTPUT CURRENT	**L** (100 µA)	Standard only
2ND CURRENT MEAS. RANGE	**2MA** ≙ 100 µA	High Precision only
2ND CURRENT MEAS. RANG | HIGH RESOLUTION	**2MA0n1** ≙ 10 µA	High Precision only
VERY HIGH VOLTAGE RESOLUTION 10mV	**VHR**	

Table 3: Technical data: Options and order information

3 VHQ Description

3.1 High Voltage Supply

For the high voltage generation a patented highly efficient resonance converter circuit is used, which provides a sinusoidal voltage with low harmonics for the HV-transformer. For the high voltage rectification high speed HV-diodes are used. A high-voltage switch, connected to the rectifier allows the selection of the polarity. The consecutive active HV-filter damps the residual ripple and ensures low ripple and noise values as well as the stability of the output voltage. A precision voltage divider is integrated in the HV-filter to provide a feedback voltage for the output voltage control, an additional voltage divider supplies the signal for the maximum voltage monitoring. A precision control amplifier compares the feedback voltage with the set value given by the DAC (remote control) or the potentiometer (manual control). Signals for the control of the resonance converter and the stabilizer circuit are derived from the result of the comparison. The two-stage layout of the control circuit results in an output voltage, stabilized with very high precision to the set point.

Separate security circuits prevent exceeding the front-panel switch settings for the current I_{max} and voltage V_{max} limits.
A monitoring circuit prevents malfunction caused by low supply voltage.

The internal error detection logic evaluates the corresponding error signals and the external INHIBIT signal and impacts the output voltage according to the setup. In addition this allows the detection of short over currents due to single flashovers.

3.2 Digital control unit

A micro controller handles the internal control, evaluation and calibration functions of both channels. The actual voltages and currents are read cyclically by an ADC with a connected multiplexer. The readings are processed and displayed on the 4 digit LCD. The current and voltage hardware limits are retrieved cyclically several times per second. A reference voltage source provides a precise voltage reference for the ADC and the control voltage for the manual operation mode of the unit. In the computer controlled mode the set values for the corresponding channels are generated by a 18-Bit DAC.

3.3 Filter

A special feature of the unit is a tuned filtering concept, which prevents perturbation of the unit by external electromagnetic radiation, as well as the emittance of interferences by the module. A filtering network for the supply voltages is located next to their connectors, the converter circuits of the individual channels are protected by additional filters. The high-voltage filters are housed in individual metal enclosures to shield even minimal interference radiation.

3.4 Block Diagram

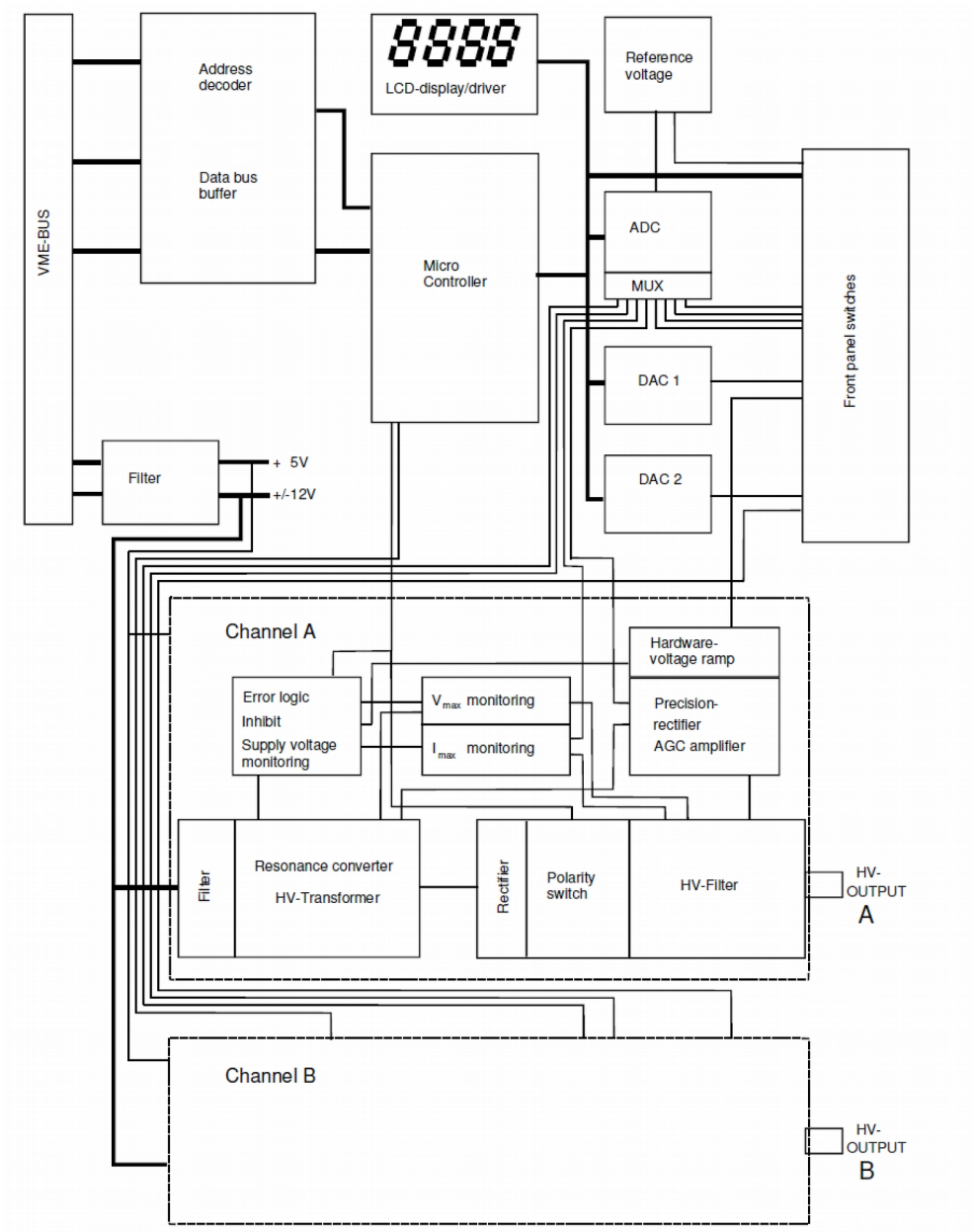

Figure 1: Block Diagram

3.5 Handling

By connecting the VME-connector on the rear side the unit is set into the operating state. Before the unit is powered the desired output polarity must be selected by the rotary switch on the cover side. The chosen polarity is displayed by a LED on the front panel and a sign on the LCD.

CAUTION!


CAUTION!

Before changing the polarity of modules with switchable polarity, the high voltage generation must be switched off. The HV-Output including connected loads must not have any residual voltage. Nonobservance of this condition may damage the module.

If the switch setting is undefined (not at one of the end positions) high voltage cannot be switched on.

High voltage output is switched on with the HV-ON switch at the front panel. The viability is signaled by the yellow LED.

CAUTION!


CAUTION!

If the CONTROL switch is in upper position (manual control), high voltage is generated at the HV-output on the rear side, started with a ramp speed from 500 V/s (hardware ramp) to the set voltage chosen via the 10-turn potentiometer.
This is also the case, if VME control is switched over to manual control while operating.

If the CONTROL switch is in lower position (DAC), high voltage will be activated only after receiving corresponding VME commands.

Output voltage in [V] or output current in [µA] will be displayed on the LCD depending on the position of the Measuring switch.

For two channel units the Channel switch selects whether channel (A) or channel (B) is displayed.

In the manual control mode the output voltage can be set via 10-turn potentiometer in a range from 0 to the maximum voltage.

If the CONTROL switch is switched over to remote control, the DAC takes over the last set output voltage of the manual control. The output voltage can be changed remotely with a programmable ramp speed (software ramp) from 2 to 255 V/s in a range from 0 to the maximum voltage.

The maximum output current for each channel (current trip) can be set via the remote interface in units of the resolution of the upper measurement range. If the output current exceeds the programmable limit, the output voltage will be shut off permanently by the software. A recovery of the voltage is possible after reading "*Status register 2*" and then "*Start voltage change*" via interface.

The maximum output voltage and current can be selected in 10%-steps with the rotary switches Vmax and Imax (switch dialed to 10 corresponds to 100%) independently of programmable current trip. The red error LED on the front panel signals if the output voltage or current approaches the limits.

The KILL switch specifies the response on exceeding limits or on the external protection signal at the INHIBIT input as follows:

Switch to the right position: (ENABLE KILL)

When exceeding I_{max} or in the presence of an INHIBIT signal (Low=active) the output voltage will be shut off permanently without ramp. The output voltage is only restored after switching HV-ON or KILL or "*Read status word*" and then "*Start voltage change*" by DAC control.

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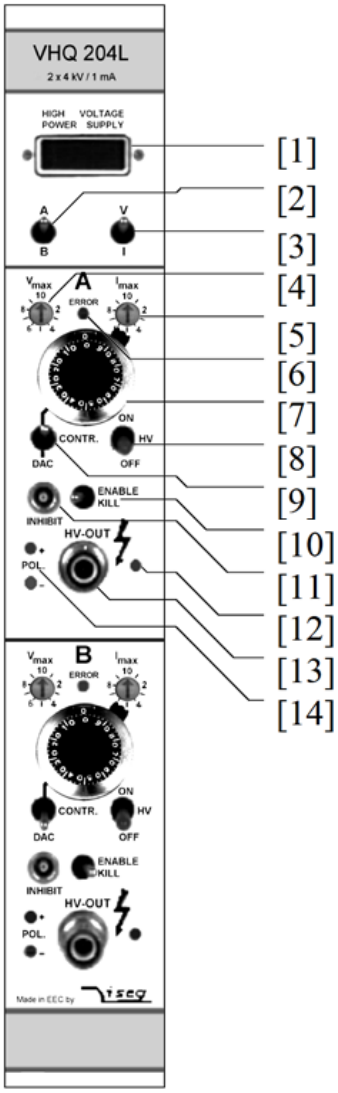
If a capacitance is effective at the HV-output or when using a high voltage ramp speed (hardware ramp) under high loads, then the KILL function may be triggered by the capacitor charging currents. In this case smaller output voltage change rates (software ramp) should be used or ENABLE KILL should only be selected once the set voltage is reached at the output.

Switch to the left position: (DISABLE KILL)

The output voltage is limited to V_{max}, the output current to I_{max} respectively; INHIBIT shuts the output voltage off without ramp, the previous voltage setting will be restored with hard- or software ramp once INHIBIT no longer being present.

3.6 Control elements



ELEMENT #	DESCRIPTION
1	4 digit LC display
2	Channel switch
3	Measurement switch
4	Voltage limit rotary switch
5	Current limit rotary switch
6	Error indicator LED
7	10 – turn potentiometer
8	HV-On switch
9	Control switch
10	KILL switch
11	INHIBIT input
12	HV-On indicator LED
13	HV output
14	Polarity indicator LEDs

Figure 2: Front panel

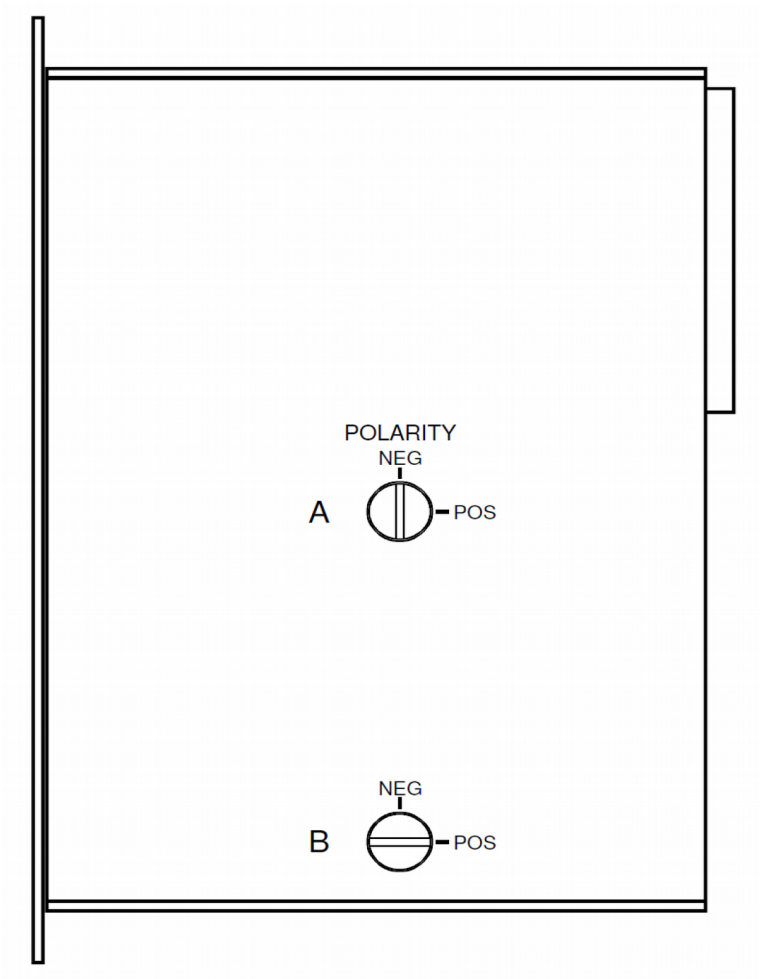


Figure 3: Side plate polarity switch, example: Channel A negative, Channel B positive

4 Dimensional drawings

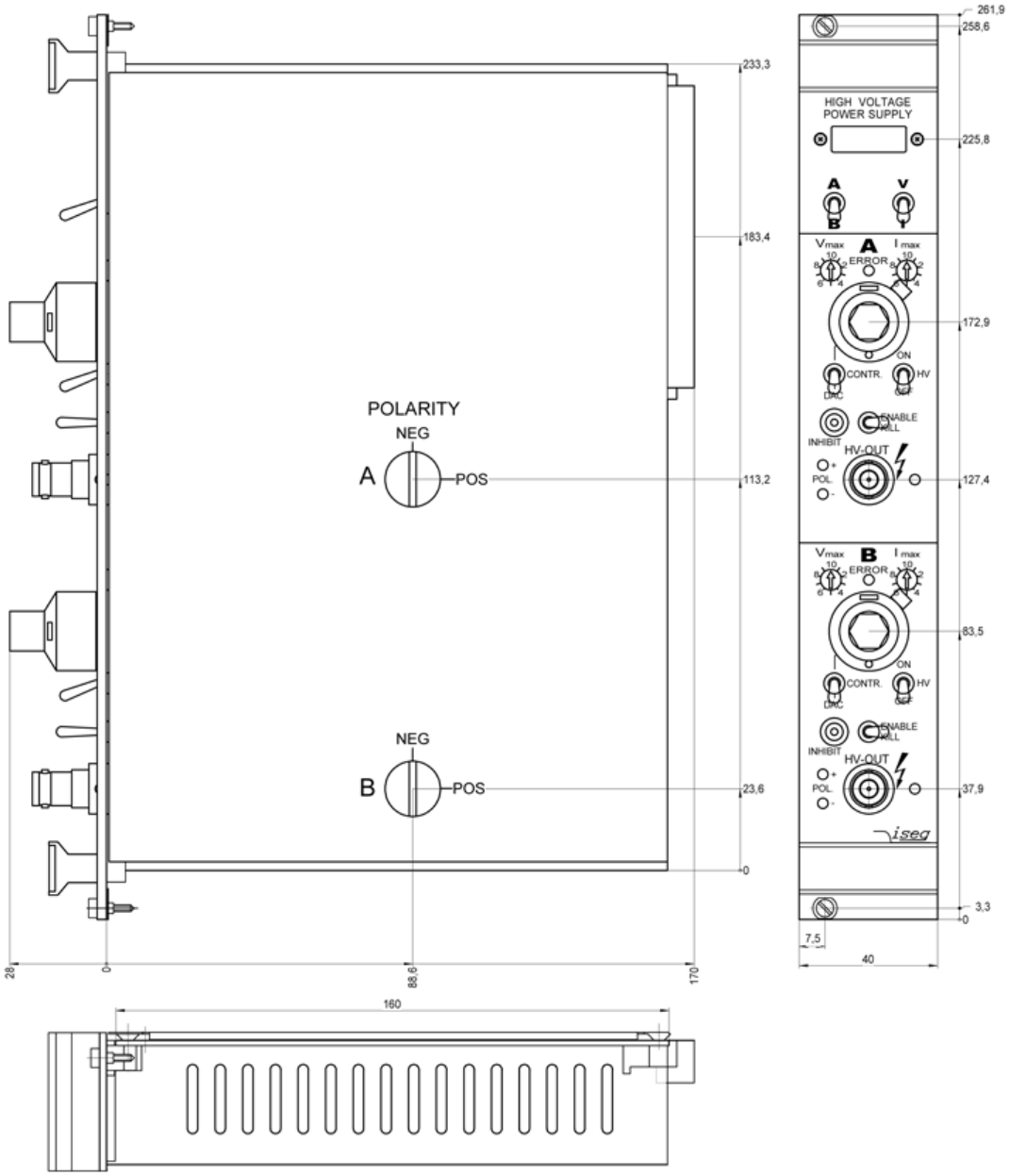


Figure 4: Dimensional drawing – VHQ

5 Connectors and PIN assignments

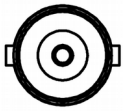
HV CONNECTOR ASSIGNMENTS			
Name	SHV / S08		
Figure			
LIMIT MONITOR			
Name	Limit monitor socket		
Figure			

Table 4: Connector and pin assignments

CONNECTORS PART NUMBERS (manufacturer code / iseg accessory parts item code)			
POWER SUPPLY SIDE		**CABLE SIDE**	
SHV (ROSENBERGER)			
Socket	57S501-200N3	Connector	57K101-006N3 / Z590162
S08 (RADIALL)			
Socket	R317.580.000	Connector	R317.005.000 / Z592474
Limit monitor 1pol. (LEMO)			
Socket	ERN.00.250.CTL	Connector	FFA.00.250.CTAC31 / Z200793

Table 5: Connectors part number information

6 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
SHV coupler screw for RG58	Z590162
SHV coupler screw for RG58, >5kV	Z592474

7 Order guides

CABLE ORDER GUIDE				
POWER SUPPLY SIDE CONNECTOR	**CABLE CODE**	**CABLE DESCRIPTION**	**LOAD SIDE CONNECTOR**	**ORDER CODE** *LLL = length in m* [1]
SHV	04	HV cable shielded 30kV (HTV-30S-22-2)	open	SHV_C04-*LLL*
[1] *Length building examples:* *10cm ➜ 0.1, 2.5m ➜ 2.5, 12m ➜ 012, 999m ➜ 999*				

Table 6: Guideline for cable ordering

CONFIGURATION ORDER GUIDE (item code parts)						
V	**2**	**0**	**-**	**30**	**XXX**	**00**
High Voltage Source	Numbers of channels	Class		V_{nom}	Option	Customized Version
VME Modul		0 = Standard		three significante digits • 100V For Examle: 30 = 3000V	See chapter Table 3: Technical data: Options and order information	

8 Appendix

For more information please use the following download links:

This document
http://download.iseg-hv.com/SYSTEMS/VME/VHQ/iseg_datasheet_VHQ_en.pdf
VHQ / VME Programmers-Guide
http://download.iseg-hv.com/SYSTEMS/VME/VHQ/VME-VHQ-Programmers-Guide.pdf

9 Glossary

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
ΔV_{out} [ΔV_{in}]	deviation of Vout dep. on variation of supply voltage
ΔV_{out} [ΔR_{load}]	deviation of Vout 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

10 Warranty & service

This device is made with high care and quality assurance methods. The factory warranty is Standard 36 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

11 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.

12 Manufacturer contact

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