

## Technical information

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# NHQ High Voltage Power Supplies

High Precision Single/Dual Channel HV Module in NIM Standard

- 1/2 channels, 2 / 3 / 4 / 5 / 6 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
- RS232, analog I/O
- programmable parameters (current trip, ramp speed etc.)



## Document history

Version	Date	Major changes
3.1	2021-03-19	Improved description, cable code, order guide, Configuration item code
3.0	2020-01-16	High Precision versions removing, 8kV and 10kV versions discontinued, Notes revised, safety information, glossary, CAN discontinued, only on request
2.2	2018-01-19	High Precision versions discontinued
	2018-10-01	Notes revised
2.1	2017-09-20	Technical data: $V_{set}$ Control information added, Warranty notice fixed,
	2017-11-21	Accuracy Current Measurement for Option L added
2.0	2017-02-28	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.

## Description 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!

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

**INFORMATION**



INFORMATION

Advice 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.

**INFORMATION**



INFORMATION

Please check the compatibility with the devices used.

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# 1 General description

## CAUTION!



CAUTION!

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

The established NHQ single/dual channel HV module is cased in compact 1/12 NIM format. The NHQ series HV supplies are front panel controllable with a precise 10-turn potentiometer per channel for voltage setting and a common LCD for display of voltage or current. For remote control the NHQ comes with RS232, analog I/O. The voltage ramp is hardware fixed and can be changed in remote operation. The high voltage output is short circuit and overload protected, the INHIBIT function over external digital signal triggers the HV switch-off.

## 2 Technical Data

SPECIFICATIONS	LOW COST	STANDARD
Polarity	Switchable	
Ripple and noise (f > 10 Hz)	< 50 mV <sub>p-p</sub>	< 2   5   50 mV <sub>p-p</sub>
Stability – [ΔV <sub>out</sub> vs. ΔV <sub>in</sub> ]	< 3 • 10 <sup>-5</sup> • V <sub>nom</sub>	
Stability – [ΔV <sub>out</sub> vs. ΔR <sub>load</sub> ]	< 2 • 10 <sup>-4</sup> • V <sub>nom</sub>	< 5 • 10 <sup>-5</sup> • V <sub>nom</sub>
Temperature coefficient	< 100 ppm / K	< 50 ppm / K
LCD Display	4 digits with sign, switch controlled (voltage display in V, current display in μA)	
Resolution voltage setting	1 V	1 V
Resolution voltage measurement display	1 V	
Resolution voltage measurement remote	–	1 V
Resolution current measurement display	1 μA	
Resolution current measurement remote	1 μA	
Accuracy voltage measurement	± (0.05 % • V <sub>out</sub> + 0.02 % • V <sub>nom</sub> + 1 digit)	
Accuracy current measurement	± (0.05% • I <sub>out</sub> + 0.05% • I <sub>nom</sub> + 1 digit)	± (0.05 % • I <sub>out</sub> + 0.02 % • I <sub>nom</sub> + 1 digit)
Accuracy current measurement with option L	± (0.5% • I <sub>out</sub> + 0.5% • I <sub>nom</sub> + 1 digit)	
<b>Measurement accuracy</b> – The measurement accuracy is guaranteed in the range 1% • V <sub>mode</sub> < V <sub>out</sub> < V <sub>mode</sub> and for 1 year		
Voltage ramp hardware	500 V / s	
Voltage ramp software	–	2 – 255 V / s
Voltage Control switch MANUAL	Upper position: manual control by 10-turn potentiometer	
Voltage Control switch REMOTE	Lower position: Control by analog set and monitor voltage NHQ x12 – x14: V <sub>set/mon</sub> = V <sub>out</sub> / 400 NHQ x15 - x16: V <sub>set/mon</sub> = V <sub>out</sub> / 1000	
Protection	INHIBIT <sup>1)</sup> , hardware V/I limits (10% – steps)	
Analog / Digital Interface	AIO	RS232
HV connector	SHV	
System connector	NIM connector	
Inhibit connector	Lemo 1pole: ERN.00.250.CTL	
Interface connector	Sub-D9	
Power requirements V <sub>in</sub>	± 24 V (< 800mA) and ± 6 V (< 100mA) Option N24: ± 24 V required only	
Case	NIM Standard chassis: NIM 1/12	
Operating temperature	0 ... 50 °C	
Storage temperature	-20 ... 60 °C	
Humidity	20 – 80 %, not condensing	
Notes: <sup>1)</sup> ext.signal, TTL-Level Low=aktive → V <sub>out</sub> = 0		

Table 1 Technical data: Specifications

CONFIGURATIONS							
Type	V <sub>nom</sub>	I <sub>nom</sub>	Ripple (mV <sub>p-p</sub> ) >10Hz	INTERFACE	HV connector	Item Code	Options
<b>STANDARD</b>							
NHQ n02M	2 kV	6 mA	2	RS232	SHV	Nn0-20000	L, N24
NHQ n03M	3 kV	4 mA	2	RS232	SHV	Nn0-30000	L, N24
NHQ n04M	4 kV	3 mA	2	RS232	SHV	Nn0-40000	L, N24
NHQ n05M	5 kV	2 mA	5	RS232	SHV	Nn0-50000	L, N24
NHQ n06L	6 kV	1 mA	5	RS232	SHV	Nn0-60000	L, N24
NHQ n32M	2 kV	6 mA	2	CAN	SHV		L, N24
NHQ n33M	3 kV	4 mA	2	CAN	SHV		L, N24
NHQ n34M	4 kV	3 mA	2	CAN	SHV		L, N24
NHQ n35M	5 kV	2 mA	5	CAN	SHV		L, N24
NHQ n36L	6 kV	1 mA	5	CAN	SHV		L, N24
<b>LOW COST</b>							
NHQ n12M	2 kV	6 mA	50	AIO	SHV	Nn1-20000	L, N24
NHQ n13M	3 kV	4 mA	50	AIO	SHV	Nn1-30000	L, N24
NHQ n14M	4 kV	3 mA	50	AIO	SHV	Nn1-40000	L, N24
NHQ n15M	5 kV	2 mA	50	AIO	SHV	Nn1-50000	L, N24
NHQ n16L	6 kV	1 mA	50	AIO	SHV	Nn1-60000	L, N24
Notes: replacement characters: n – Number of channels (1 or 2), o – options							

Table 2 Technical data

OPTIONS / ORDER INFO	INFO	EXAMPLE
<b>±24 V SUPPLY ONLY</b>	±24 V = <b>N24</b>	
<b>LOWER OUTPUT CURRENT</b>	<b>L</b> (100 μA)	

Table 3 Technical data: Options and order information

## 3 NHQ 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

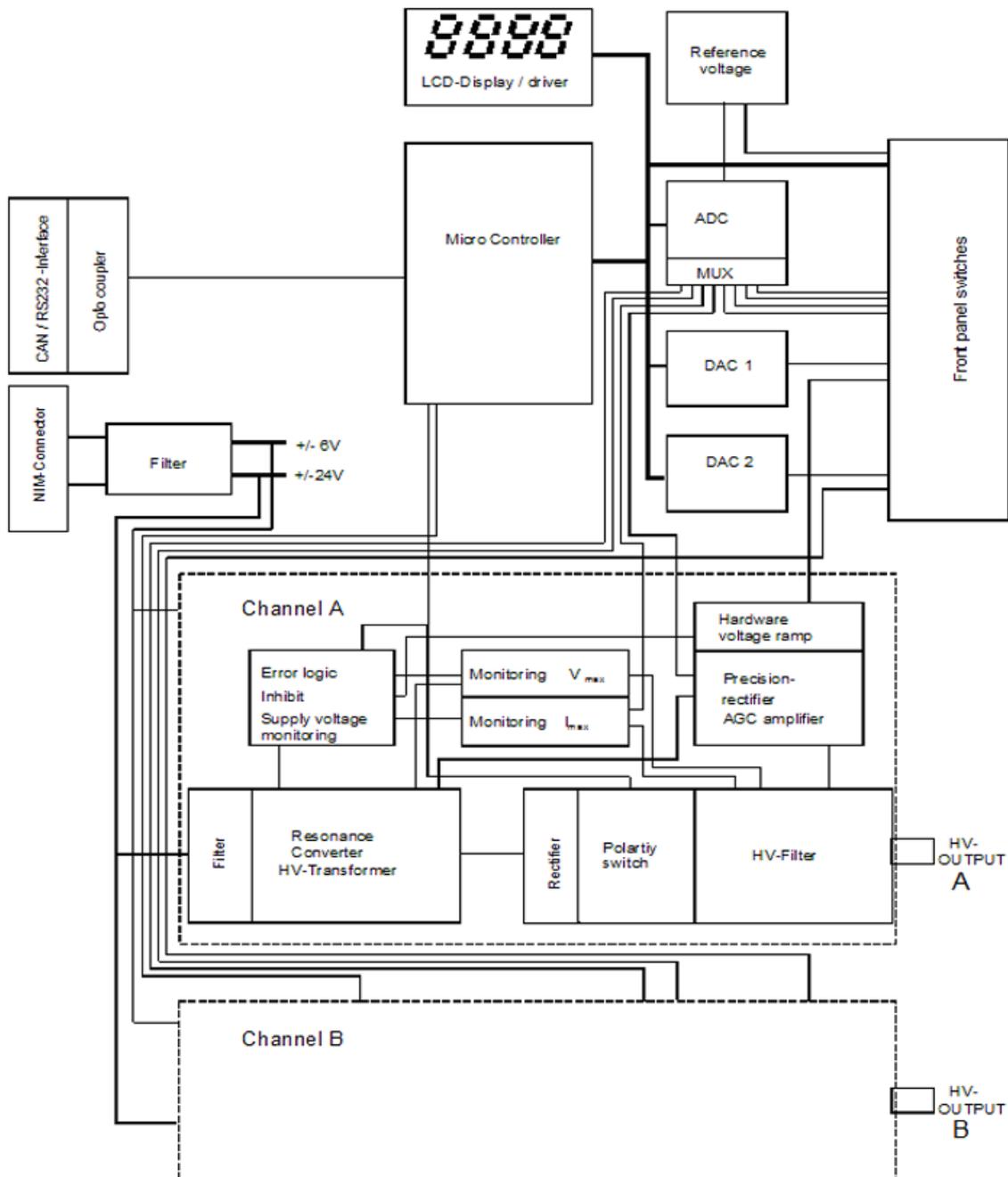


Figure 1: Block diagram

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 interference 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.

## 4 Handling

The NIM connector, the HV-outputs and the 9 pin female Sub-D connector for the RS 232 or Analog I/O interface are located on the rear panel. 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!

It is not allowed to change the polarity under power!

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 RS232 control is switched over to manual control while operating.

Output voltage in [V] or output current in [ $\mu$ A] 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 "Read status word" and then "Start voltage change" via serial interface. If "Auto start" is active, "Start voltage change" is not necessary.

The maximum output voltage and current can be selected in 10%-steps with the rotary switches  $V_{max}$  and  $I_{max}$  (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. If "Auto start" is active, "Start voltage change" is not necessary.

Note:

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.

## 5 Control elements

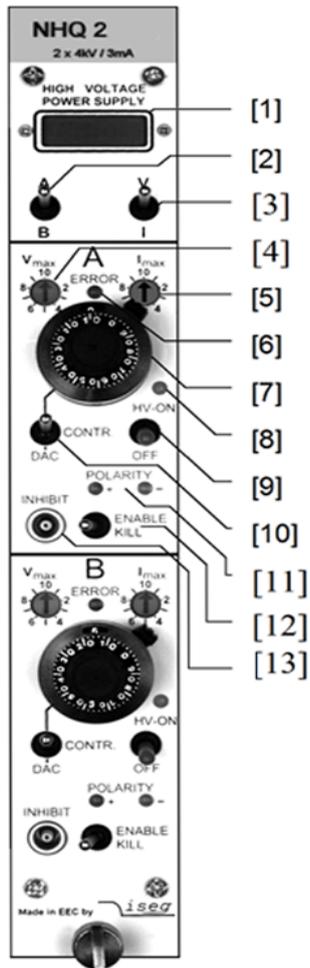


Figure 2: Frontpanel

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 indicator LED
9	HV-On switch
10	Control switch
11	Polarity indicator LEDs
12	KILL switch
13	INHIBIT input

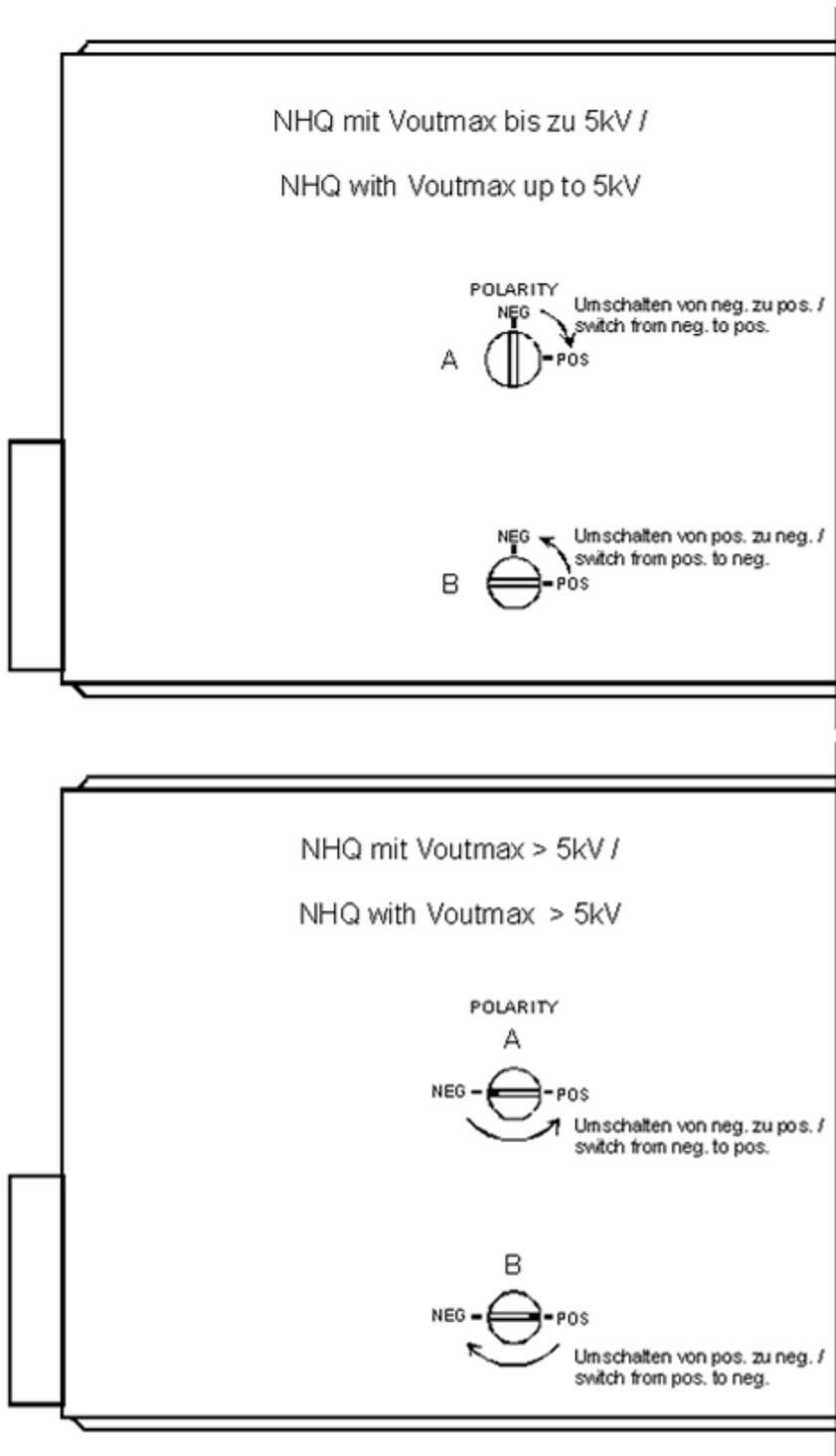


Figure 3: Polarity Switch – Side view

## 6 Dimensional drawings

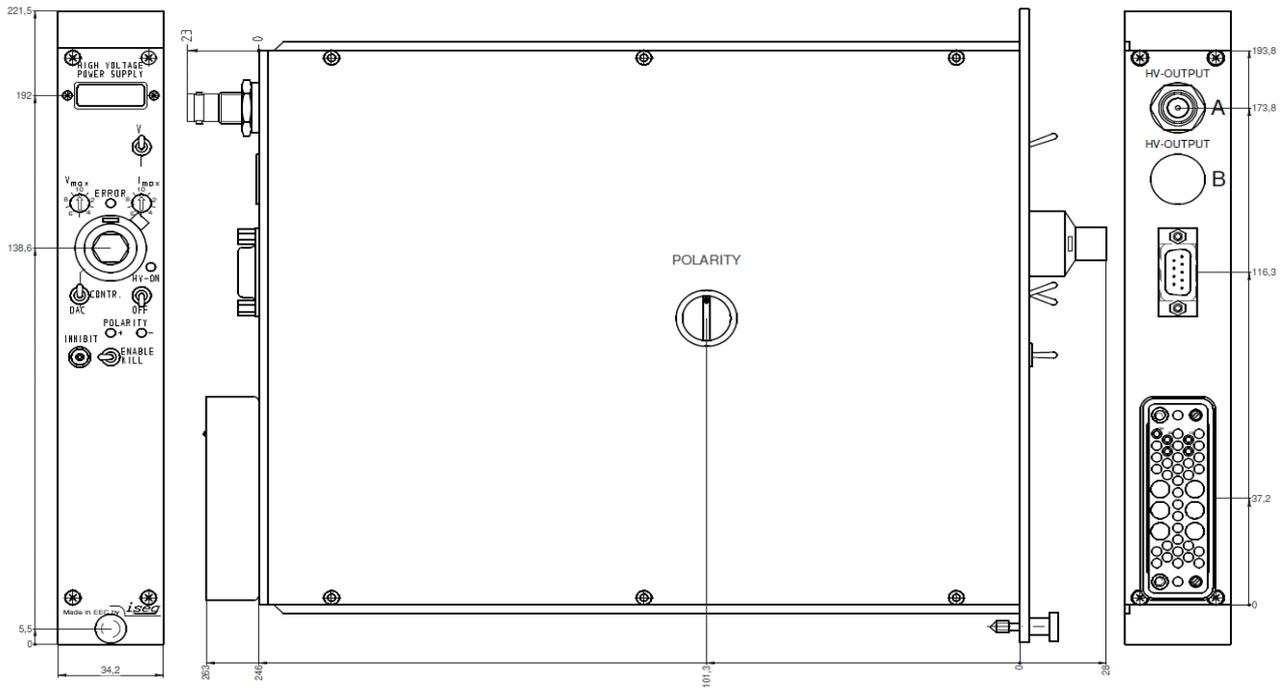


Figure 4: Dimensional drawing - NHQ 1 channel

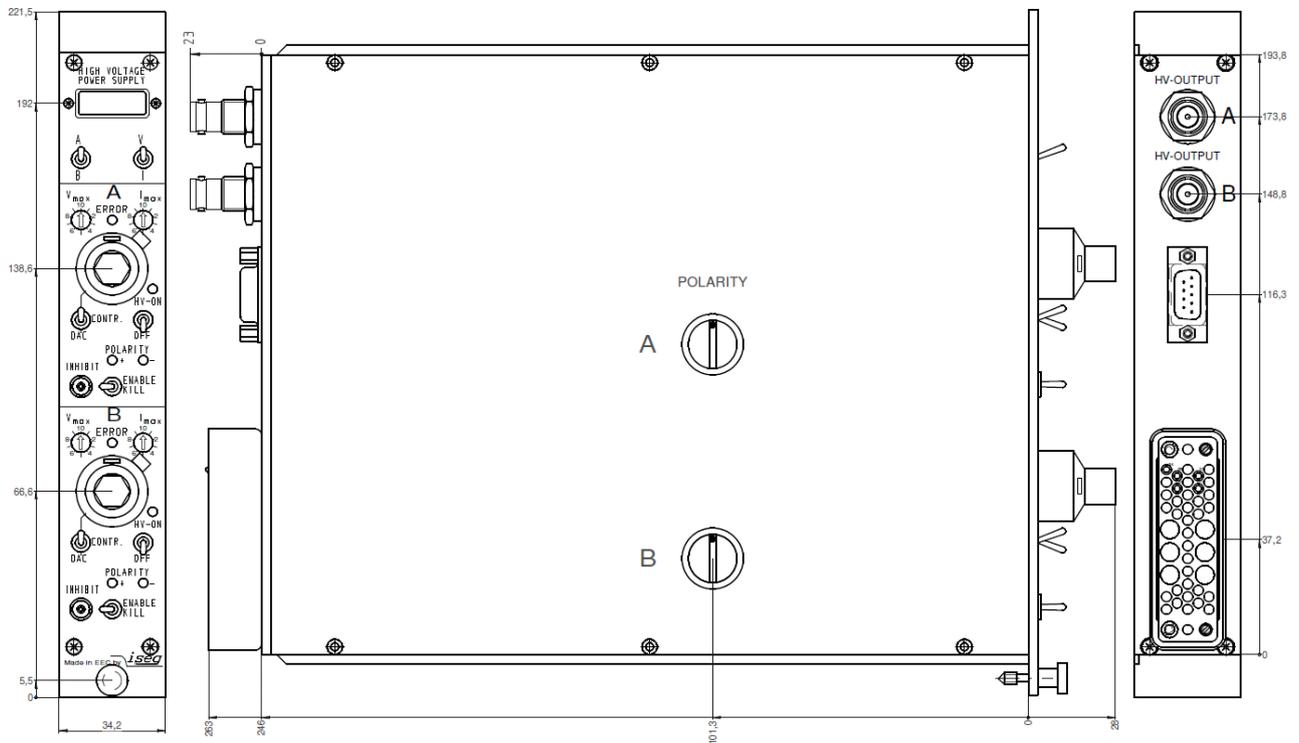


Figure 5: Dimensional drawing - NHQ 2 channels

## 7 PIN assignments

### 7.1 Analog I/O

PIN		DESCRIPTION
1	VSET <sub>A</sub>	Set voltage channel – A
2		
3	VMON <sub>A</sub>	Monitor voltage channel – A
4		
5	GND	Ground
6		
7	VSET <sub>B</sub>	Set voltage channel – B
8		
9	VMON <sub>B</sub>	Monitor voltage channel – B

Table 4 PIN assignment Analog I/O

### 7.2 RS 232

Signal RS 232	HV-supply Sub-D9	Int.	PC Sub-D9	PC Sub-D25	Connection 3-lead cable
RxD	2		2	3	
TxD	3		3	2	
GND	5		5	7	
	4	⌈ (bridged)	4	20	⌈ (bridged)
	6	⌋ (bridged)	6	6	⌋ (bridged)
	8	⌌ (bridged)	8	5	⌌ (bridged)

Table 5 PIN assignment RS232

## 8 Connectors and cables

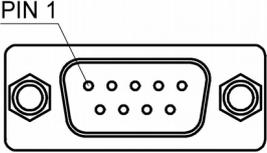
HV CONNECTOR ASSIGNMENTS			
Name	SHV		
Figure			
CONNECTOR ASSIGNMENTS			
Name	INHIBIT	DSUB9	
Figure			

Table 6 Connector and pin assignments

CONNECTORS PART NUMBERS (manufacturer code / iseg accessory parts item code)			
POWER SUPPLY SIDE		CABLE SIDE	
<b>SHV</b>			
Socket		Connector	57K101-006N3 / Z590162
<b>LEMO 1pol.</b>			
Socket	ERN.00.250.CTL	Connector	FFA.00.250.CTAC31 / Z200793

Table 7 Connectors part number information

## 9 Accessories

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

ACCESSORY ITEM	ORDER ITEM CODE
SHV coupler screw for RG58	Z590162
SHV coupler screw for > 5kV	Z592474
1-pin LEMO connector, FFA.00.250.CTAC31	Z200793

Table 8 Accessory

## 10 Order guides

CABLE ORDER GUIDE					
POWER SUPPLY SIDE CONNECTOR	V <sub>max</sub>	CABLE CODE	CABLE DESCRIPTION	LOAD SIDE CONNECTOR	ORDER CODE <i>LLL = length in m<sup>(1)</sup></i>
SHV	≤ 5kV	04	HV cable shielded 30kV (HTV-30S-22-2)	open	SHV_C04-LLL
S08	≤ 8kV	04	HV cable shielded 30kV (HTV-30S-22-2)	open	S08_C04-LLL
Notes: <sup>1)</sup> Length building examples: 10cm → 0.1, 2.5m → 2.5, 12m → 012, 999m → 999					

Table 9: Cable order guide

CONFIGURATION ORDER GUIDE (item code parts)						
N	1	0	-	20	xxx	00
NIM Series	Numbers of channels	Class		V <sub>nom</sub>	Options	Customized Version
	1 = one channel 2 = two channel	0 = Standard 1 = Low Cost		two significant digits • 100V  For Example: 20 = 2000V	See for more details under 2 Technical Data	00 = none

Table 10 Item code parts for different configurations

## 11 Appendix

For more information please use the following download links:

<b>This document</b>
<a href="http://download.iseg-hv.com/SYSTEMS/NIM/NHQ/iseg_datasheet_NHQ_en.pdf">http://download.iseg-hv.com/SYSTEMS/NIM/NHQ/iseg_datasheet_NHQ_en.pdf</a>
<b>Archive</b>
<a href="http://download.iseg-hv.com/SYSTEMS/NIM/NHQ/archive">http://download.iseg-hv.com/SYSTEMS/NIM/NHQ/archive</a>
<b>RS232 Programmers-Guide</b>
<a href="http://download.iseg-hv.com/SYSTEMS/NIM/NHQ/NHQ-RS-232-Programmers-Guide.pdf">http://download.iseg-hv.com/SYSTEMS/NIM/NHQ/NHQ-RS-232-Programmers-Guide.pdf</a>
<b>CAN Programmers-Guide</b> (devices discontinued)
<a href="http://download.iseg-hv.com/SYSTEMS/NIM/NHQ/NHQ-CAN-Programmers-Guide.pdf">http://download.iseg-hv.com/SYSTEMS/NIM/NHQ/NHQ-CAN-Programmers-Guide.pdf</a>

## 12 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
/ON	HV OFF/ON
CH	channel(s)
HV	high voltage
LV	low voltage
GND	signal ground
INH	Inhibit
POL	Polarity
KILL	KillEnable

## 13 Warranty & Service

This device is made with high care and quality assurance methods. The factory warranty is up to 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](http://www.iseg-hv.com/en/support/rma)

## 14 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.

## 15 Manufacturer's contact

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