user manual
Last changed on: 01.10.2018

NHR series

Versatile High Precision HV Module in NIM Standard with reversible polarity

- 4 channel, polarity electronically switchable
- versatile 6kV-channel with switchable HV-generation modes: 6kV/2mA, 4kV/3mA and 2kV/4mA or fixed-mode 2kV/6mA-channel
- High Precision and Standard version (High Precision with second current measurement range 20µA for high resolution)
- common floating ground
- ultra low ripple and noise
- front panel control with 1,44" TFT display
- voltage and current control per channel
- programmable parameters
- hardware voltage and current limits
- USB and CAN interface

Document history

Version	Date	Major changes
1.0	14.06.2017	Initial version
1.1	20.09.2018 01.10.2018	Potential difference reduced, Layout fixes Notes revised

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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.

Important security information

It is strongly recommended to read the operator´s manual before operation. 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.

We decline all responsibility for damages and injuries caused by an improper use of the module. It is strongly recommended to read the operators manual before operation.

WARNING!	
⚠️ WARNING!	The non-observance of the advices marked as "Warning!" could lead to possible injury or death.

ATTENTION!	
⚠️ ATTENTION!	Advices marked as "Attention!" describe actions to avoid possible damages to property.

INFORMATION	
⚠️ INFORMATION	Advices marked as "Information" give important information.

Table of Contents

1 General description

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

The iseg NHR modules are multi-channel high voltage power supplies in 1/12 NIM standard cassette format.

The NHR provides up 4 channels, each with an independent voltage and current control and electronically reversible polarity. The 6kV channel provides a maximum versatility: with three electronically switchable HV-output modes it can supply 4mA up to voltages of 2kV, 3mA up to 4kV and 2mA up to 6kV. Alternatively the NHR can be equipped with cost efficient 2kV/6mA channels.

Several NHR modules can be daisy-chained by CAN and controlled for example by iseg iCS system. The hardware is made of best components such as 24 bit ADC and 20 bit DAC, the approved front panel control of the NHR series with TFT display allows user-friendly intuitive operation.

The NHR is equipped with a comprehensive set of security features like overvoltage and short circuit protection, hardware limits and much more.

2 Technical Data

SPECIFICATIONS	NHR Standard	NHR High Precision
Polarity	Electronically switchable	
Floating principle	Common Floating Ground	
Potential difference	Max. 39 V channel/GND	
Ripple and noise (f > 10 Hz)	< 10 mV_{p-p}	< 2-3 mV_{p-p}
Ripple and noise (f > 1 kHz)	< 3 mV_{p-p}	< 2 mV_{p-p}
Ripple and noise (10 Hz – 0.1Hz)		< 5-10 mV_{p-p}
Stability [ΔVout / ΔVin]	$2 \cdot 10^{-4} \cdot V_{mode}$	$1 \cdot 10^{-4} \cdot V_{mode}$
Stability - [ΔVout / ΔRload]	$2 \cdot 10^{-4} \cdot V_{mode}$	$1 \cdot 10^{-4} \cdot V_{mode}$
Temperature coefficient	50 ppm/K	30 ppm/K | 10 ppm/K (option TC)
Resolution voltage setting	$2 \cdot 10^{-6} \cdot V_{nom}$	
Resolution current setting	$2 \cdot 10^{-6} \cdot I_{nom}$	
Resolution voltage measurement	$2 \cdot 10^{-6} \cdot V_{nom}$	$1 \cdot 10^{-6} \cdot V_{nom}$
Resolution current measurement - full range	$2 \cdot 10^{-6} \cdot I_{nom}$	$1 \cdot 10^{-6} \cdot I_{nom}$
Resolution current measurement - 2nd range	n/a	50 pA [I_{out}< 20 µA]
Accuracy voltage measurement	± (0.01 % $\cdot V_{out}$ +0.02 % $\cdot V_{nom}$)	± (0.01 % $\cdot V_{out}$ +0.01 % $\cdot V_{nom}$)
Accuracy current measurement - full range	± (0.01 % $\cdot I_{out}$ +0.02 % $\cdot I_{nom}$)	± (0.01 % $\cdot I_{out}$ +0.01 % $\cdot I_{nom}$)
Accuracy current measurement - 2nd range	n/a	± (0.01 % $\cdot I_{out}$ + 4 nA)
Measurement accuracy - The measurement accuracy is guaranteed in the range 1% $\cdot V_{mode} < V_{out} < V_{mode}$ and for 1 year		
Hardware limits	Potentiometer per module [V_{max} / I_{max}]; relative to V_{nom} / I_{nom}	
Voltage ramp	$1 \cdot 10^{-6} \cdot V_{mode}$/s up to 0.2 $\cdot V_{mode}$ / s | opt. up to 0.75 $\cdot V_{mode}$ / s	
Digital interface	USB interface (potential free) CAN interface (potential free)	
Sample rates (SPS)	5, 10, 25, 50, 60, 100, 500	
Digital filter averages	1, 16, 64, 256, 512, 1024	
Power requirements of supply voltages	± 24 V: 1.5 A at full load (0.5 A with option **L**), 0.5 A with no load at V_{nom}	
Operating mode	Full module and channel control via: Front panel, USB interface: iseg SCPI, CAN interface: EDCP (Enhanced Device Control Protocol)	
Module status	green LED turns on if the channel has the status "Ready" yellow LED turns on if the channel has the status "HV ON"	
HV connector	SHV	
System connector	NIM standard compliant connector	
Safety Loop connector	Lemo 2pole: FFA.0S.302.CLAC	
Safety Loop socket	Lemo 2pole: ERA.0S.302.CLL	
Single channel inhibit connector	SUB-D9 male	
Protection	INHIBIT, Safety loop, short circuit, overload, hardware V/I limits	
Case	1/12 NIM standard cassette	
Operating temperature	0 – 40 °C	
Storage temperature	-20 - 60 °C	

Table 1: Technical data: Specifications

CONFIGURATIONS NHR									
Type	Ch	Precision	V_{nom}	I_{nom}	Ripple (mV$_{P-p}$) >1kHz|10Hz-1kHz		HV output mode (V_{mode} / I_{mode})	Item Code	Options
NHR 20 20	2	Standard	2000 V	6 mA	3	10	2 kV / 6 mA	NR020020r605	VCT,IU,ID
NHR 20 60	2	Standard	6000 V	4 mA	3	10	6 kV / 2mA 4kV / 3mA 2kV / 4mA	NR020060r405	VCT,IU,ID
NHR 40 20	4	Standard	2000 V	6 mA	3	10	2 kV / 6 mA	NR040020r605	VCT,IU,ID
NHR 40 60	4	Standard	6000 V	4 mA	3	10	6 kV / 2mA 4kV / 3mA 2kV / 4mA	NR040060r405	VCT,IU,ID
NHR 22 20	2	High	2000 V	6 mA	2	2	2 kV / 6 mA	NR022020r605	VCT,IU,ID,TC,L
NHR 22 60	2	High	6000 V	4 mA	2	3	6 kV / 2mA 4kV / 3mA 2kV / 4mA	NR022060r405	VCT,IU,ID,TC,L
NHR 42 20	4	High	2000 V	6 mA	2	2	2 kV / 6 mA	NR042020r605	VCT,IU,ID,TC,L
NHR 42 60	4	High	6000 V	4 mA	2	3	6 kV / 2mA 4kV / 3mA 2kV / 4mA	NR042060r405	VCT,IU,ID,TC,L

Table 2: Technical data: Configurations

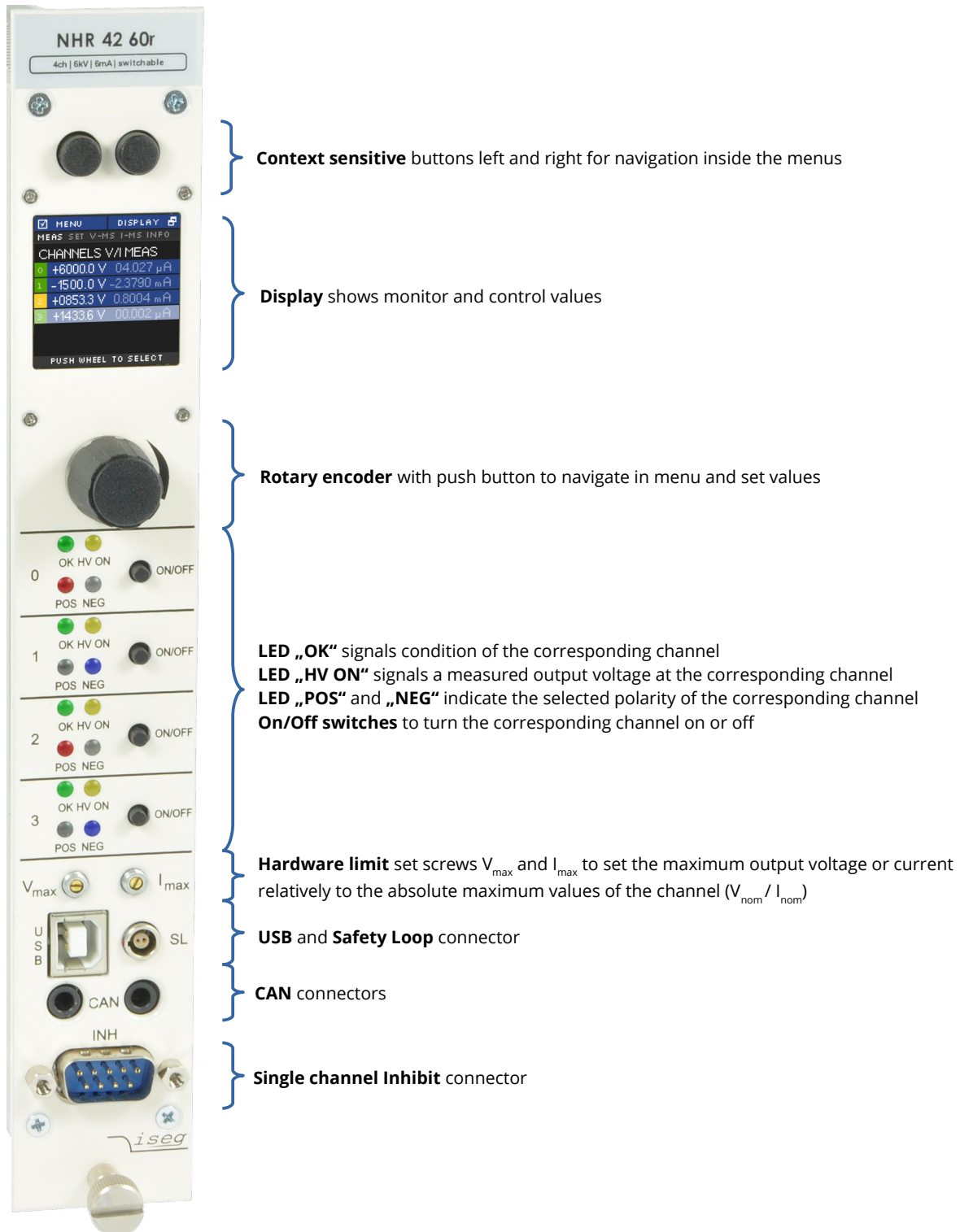| OPTIONS / ORDER INFO	INFO	EXAMPLE	ITEM CODE HEX CODE
SINGLE CHANNEL INHIBIT - down	ID	NHR 4260 ID	400
SINGLE CHANNEL INHIBIT - up	IU	NHR 4260 IU	800
VOLTAGE CORRECTION by TEMPERATURE	VCT	NHR 4260 VCT	008
LOWER TEMPERATURE COEFFICIENT	TC	NHR 4260 T10	004
LOWER OUTPUT CURRENT	L (I_{nom} = 100 µA)	NHR 4260 L	-

Table 3: Technical data: Options and order information
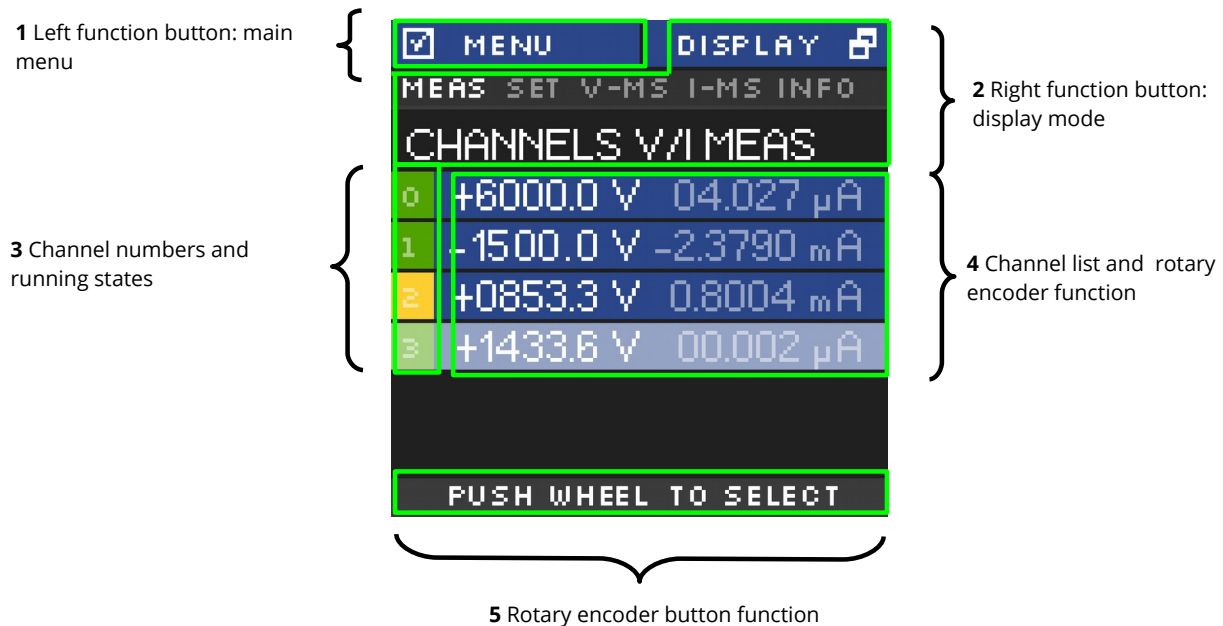
3 Handling

3.1 Connection

The supply voltages are connected to the module via the NIM-connector on the rear side of the module. An USB connector and two 3,5mm audio jack connectors for the CAN interface are located on the front panel. The second CAN connector can be used to daisy-chain several NHR and/or NHS modules.

3.2 Front Panel Control

Context sensitive buttons left and right for navigation inside the menus

Display shows monitor and control values

Rotary encoder with push button to navigate in menu and set values

LED „**OK**" signals condition of the corresponding channel
LED „**HV ON**" signals a measured output voltage at the corresponding channel
LED „**POS**" and „**NEG**" indicate the selected polarity of the corresponding channel
On/Off switches to turn the corresponding channel on or off

Hardware limit set screws V_{max} and I_{max} to set the maximum output voltage or current relatively to the absolute maximum values of the channel (V_{nom} / I_{nom})

USB and **Safety Loop** connector

CAN connectors

Single channel Inhibit connector

3.2.1 Main Screen (Channel List)

After start up of the NHR the display will show a Main screen similar to the following image which consists of 5 elements:

1 Left function button: main menu

2 Right function button: display mode

3 Channel numbers and running states

4 Channel list and rotary encoder function

5 Rotary encoder button function

1. Left function button: main menu

Shows the function of the left button. If the user pushes the left button in Main screen, the display will show the Menu screen.

2. Right function button: display mode

If the user pushes the right button in Main screen, the Main screen will switch to the next display mode, which is shown directly above the channel list.

Following display modes are available:

1. V/I-MEAS	→	voltage and current – measured values
2. V/I-SET	→	voltage and current – set values
3. V-MS	→	voltage – measured and set values
4. I-MS	→	current – measured and set values
5. INFO	→	maximal values of the selected output mode

3. Channel numbers and running states

This is part of the channel list (4) and shows the corresponding channel number. The background color signals the running state of each channel. The background colours means the following:

Black	→	the channel is switched off
Green	→	the channel is switched on
Yellow	→	the channel is switched on but no regulation (CV, CC) is active
Orange	→	the channel is switched on but has unmasked error event(s)
Red	→	the channel has at least one masked error event

4. Rotary encoder button function

If the user presses the button of the rotary encoder, the menu will switch to the channel menu of the marked channel.

5. Channel list and rotary encoder function

The channel list shows-dependent on the display mode-measure and/or set values of voltage and current for each channel.

In display mode VI-MEAS the following can be seen:

If a channel is switched off, the values of V_{meas} and I_{meas} are grey.

If a channel is in constant voltage regulation, V_{meas} value is white and Imeas value is grey

If a channel is in constant current regulation, V_{meas} value is grey and Imeas value is white

The channel row which is slightly brighter (in image channel 4) is the marked channel by the rotary encoder. Turning the rotary encoder counter-clockwise will mark the channel above the current channel and turning clockwise will mark the channel below the current channel.

3.2.2 Menu Screen

By pressing the left button in Main screen, the display will switch to the menu screen, that looks similar to the image below:
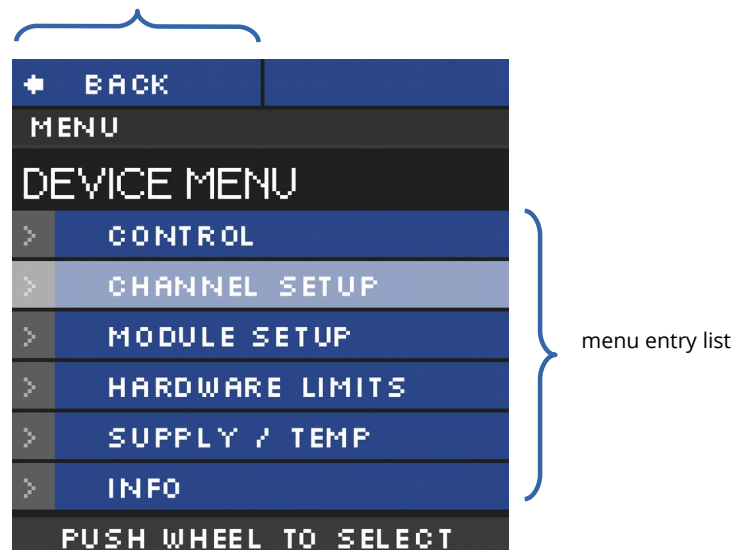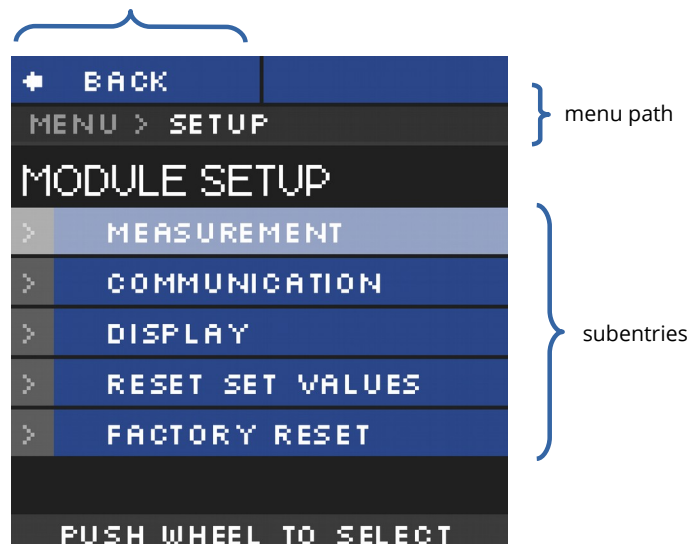

The menu screen shows menu entries to set up behavior and check information of the device hardware.

To enter a menu entry, the user has to mark an entry by turning rotary encoder and then pressing the rotary encoder button. The selected entry is then shown in the menu path.

3.2.3 Menu Structure

Available Menu entries are:

| Entry	Subentry	Subentry	Content
CONTROL	VOLTAGE RAMP	-	Set voltage ramp speed
	CURRENT RAMP	-	Set current ramp speed
	CLEAR ALL EVENTS	-	Clear all events
	SET KILL ENABLE	-	Set mode Kill Enable/Disable
	DELAYED TRIP ACTION	-	Enable and define action for delayed trip
	DELAYED TRIP TIME	-	Set time for delayed trip
CHANNEL SETUP	ALL CHANNELS	POLARITY	Set polarity of channel
	CHANNEL 0	OUTPUT-MODE	Set output-mode of channel
	CHANNEL 1		
	CHANNEL 2		
	CHANNEL 3		
MODULE SETUP	MEASUREMENT	ADC SAMPLE RATE	Set ADC sample rate
		DIGITAL FILTER	Set digital filter steps
	COMMUNICATION	CAN BUS BITRATE	Set CAN bus bitrate
		CAN BUS ADDRESS	Set CAN bus ID
	DISPLAY	POWER SAVE	Set display power safe mode
	RESET SET VALUES	-	Reset all set values
	FACTORY RESET	-	Reset all settings to factory default
HARDWARE LIMITS	-	-	Shows hardware limits V_{max} and I_{max}. This screen is automatically shown, if the hardware limits were changed.
SUPPLY / TEMP	-	-	Shows supply voltages and temperature
INFO	-	-	Shows serial number, firmware name and release, nominal voltage and current

Table 4: Menu Structure

3.2.4 Editing Menu Entries

A Menu entry that has a fixed amount of possible values can be easily edited by turning the rotary encoder, the selected value will be shown at the bottom of display screen.

A submit and save of the selected value is done by pressing the rotary encoder button.

A reset to its default value is done by pressing the right button.

current value
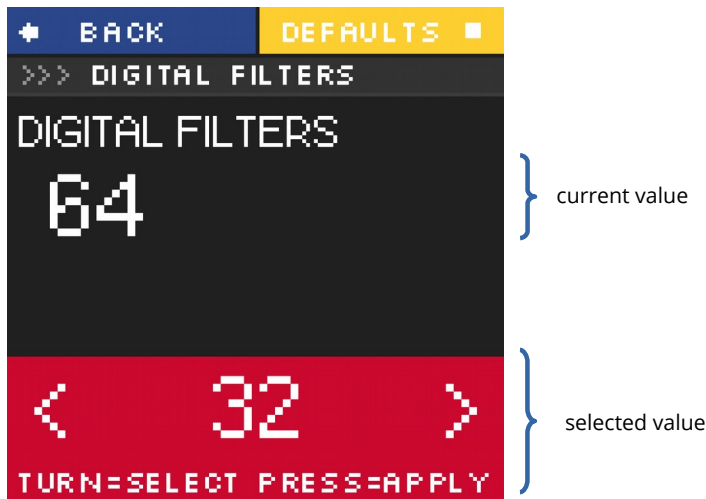
selected value

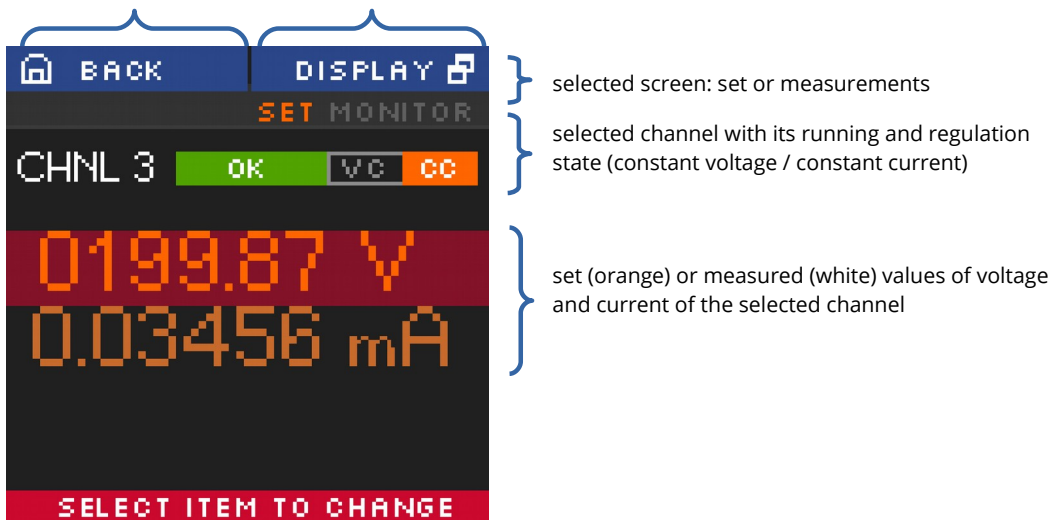A menu entry with a none-fixed amount of values e.g. voltage ramp speed is edited a little bit different.

The selected value is also shown at the bottom of the display but with a digit hilighted by a cursor. A short press on the rotary encoder button and the cursor will jump to the next lower digit. Turning the rotary encoder changes the selected value in the resolution of the corresponding digit.

A submit and save of the selected value is done by pressing and holding the rotary encoder button for more than one second.

3.2.5 Channel Details

To change the set values of a channel or to monitor one single channel with larger digits, the Channel screen needs to be entered. This can be done in Main screen by turning the rotary encoder until the wished channel is marked and then pressing the rotary encoder button to select it. A screen similar to the following will be shown.

back to Main screen with left button

switch screen between set and measured values with right button

selected screen: set or measurements

selected channel with its running and regulation state (constant voltage / constant current)

set (orange) or measured (white) values of voltage and current of the selected channel

3.2.6 Editing Channel Set Values

In the channel screen it is possible to edit set values of the selected channel. This is done by marking current or voltage value by turning rotary encoder and applying this by pressing the rotary encoder button. An edit field beneath the shown values will be displayed.

The edit value is shown with a digit hi-lighted by a cursor. A short press on the rotary encoder button and the cursor will jump to the next lower digit. Turning the rotary encoder changes the selected value in the resolution of the digit.

Submit and apply of the edit value is done by pressing and holding the rotary encoder button for more than one second.

There are two modes of editing available: manual and auto-apply. In manual mode, the edited value is not accepted until the user applied it with pressing and holding the rotary encoder button. In auto-apply mode the edit value is immediately accepted as turning the rotary encoder.

cancel edit with left button

switch edit mode with right button:
manual or auto-apply mode

edit field
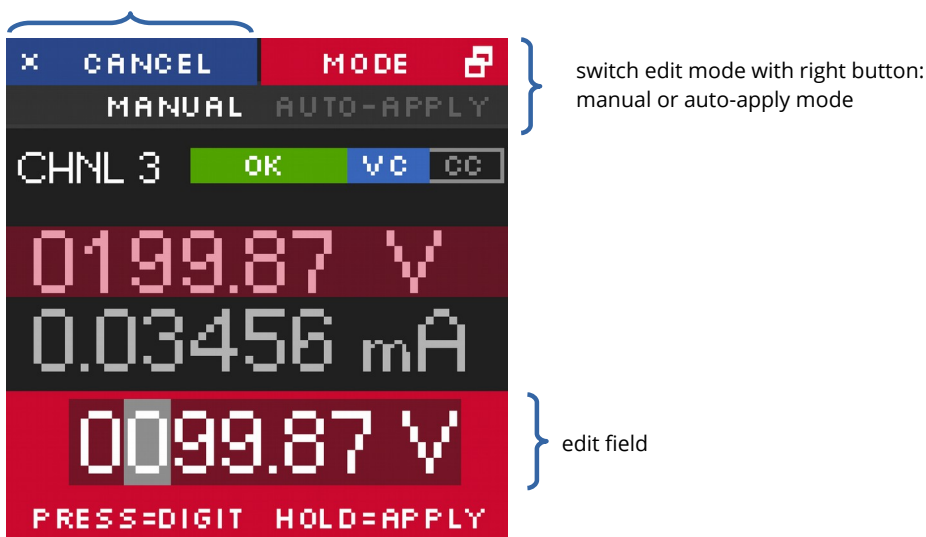
3.3 Channel Switches and LEDs

The front panel of the NHR device is equiped for each channel with a "On/Off" switch to turn the channel on and off, two status LEDs ("OK" and "HV ON") and two LEDs ("POS" and "NEG") to indicate the selected polarity.

The green LED "OK" signals the general condition of the channel and the yellow LED "HV ON" signals measured output voltage at the corresponding channel or is flashing shortly every time the user presses the corresponding "On/Off" switch.

Following behaviors are possible:

LED "OK"	LED "HV ON"	Meaning
not illuminated	not illuminated	An error event occurred, the channel cannot be switched on.
not illuminated	illuminated	An error occurred but there is still a measured voltage at the channel.
illuminated	not illuminated	The channel is switched off and can be turned on.
illuminated	illuminated	The channel is turned on and there is output voltage at the channel.
	flashing	The channel is ramping up or down

Table 5: LED Status information

3.4 Remote Control

The NHR devices offer two remote control interfaces: USB and CAN.

With the USB connector, one NHR can be controlled with the iseg SCPI instruction set. Available control applications are iseg Terminal and iseg SCPI Control. Please consider the SCPI Documentation (see appendix) for further details.

With the CAN interface connectors, up to 64 NHR/NHS devices can be controlled on one CAN line. Therefore every device has to have a unique CAN Bus address, which can be configured in the Device Menu. Please consider EDCP-CAN-Documentation (see appendix) for further details.

3.5 Polarity and Output-Mode selection

For all channels of NHR devices the polarity can be electronically switched. This can be done via the front panel (*MENU→CHANNEL SETUP→CHANNEL X→POLARITY*) or via remote control.

Modules with V_{nom}=6kV (except option **L**) also provide switchable HV-output modes which allow to switch the nominal values of a channel between 2kV/4mA, 4kV/3mA and 6kV/2mA. This can be done via the front panel (*MENU→CHANNEL SETUP→CHANNEL X→OUTPUT-MODE*) or via remote control.

Switching the polarity or output mode is only allowed if the corresponding channel is switched off and discharged below $0.002 \cdot V_{nom}$. The module blocks all switching attempts if these conditions are not satisfied.

CAUTION!
⚠️ CAUTION!	The device is not designed to operate as a current sink. Never apply external voltages of opposite polarity to the selected one or with values greater than the maximum value of the selected output mode. This can damage the module.

3.6 Protection Features

3.6.1 Hardware Limit

The maximum output voltage for all channels (hardware voltage limit) is defined through the position of the corresponding potentiometer Vmax . The maximum output current for all channels (hardware current limit) is defined through the position of the corresponding potentiometer Imax . The greatest possible set value for voltage and current is given by V_{max} – 2% and I_{max} – 2%, respectively. The percental values always refer to the nominal values of the channel, V_{nom} and I_{nom} . E.g. for a 6kV/4mA module the reference values are 6kV and 4mA, independent of the selected output mode.

The output voltage and current are limited to the specified value. If the maximum voltage or current of the selected output mode (V_{mode} or I_{mode}) is below this limit, this will further limit the output.

If a limit is reached or exceeded in any channel the corresponding green LED on the front panel turns off.

3.6.2 Safety Loop

A safety loop can be implemented via the safety loop socket (SL) on the front panel.

If the safety loop is active, then an output voltage in any channel is only present if the safety loop is closed and an external current in a range of 5 to 20 mA of any polarity is driven through the loop. The loop connectors are potential free, the internal voltage drop is approx. 3 V.

If the safety loop is opened during the operation, the output voltages are shut off without ramp. Furthermore, the corresponding bits in the „ModuleStatus" and „ModuleEventStatus" registers are set (see EDCP-CAN-Documentation in appendix)). After closing the loop again, the „ModuleEventStatus" register must be reset to turn the channels on again.

By factory setup the safety loop is not active (the corresponding bits are always set). The loop can be activated by removing the internal jumper. The jumper can be accessed via a ventilation slot on the bottom of the module (see

dimensional drawings for exact position).

3.6.3 Single channel Inhibit

INFORMATION	
⚠	INHIBIT is an external signal, that switches off the high voltage for the device or a specific channel
INFORMATION	

The Sub-D connector on the bottom of the front panel allows to install an Inhibit for each channel. The pin assignment is as follows:

Channel 0-3 / GND	0	1	2	3	GND				
SUB-D9 connector pin	1	2	3	4	5	6	7	8	9

Table 6: INHIBIT connector pinout

INHIBIT Option-ID: The INHIBIT pins are internally connected to the module GND via pull down resistors (approx. 10 kΩ). This ensures that a disconnected cable always causes an interlock. HV generation according to the settings is only possible if the corresponding INHIBIT pin is actively pulled to TTL High level.

INHIBIT Option-IU: The INHIBIT pins are internally connected to 5V via pull up resistors (approx. 10 kΩ). HV generation according to the settings is possible with TTL High level or open INHIBIT pins. If the INHIBIT contact pin (n) is connected to the module GND or a TTL-LOW potential for at least 100 milliseconds, an Inhibit signal is generated. The channel status bit isExternalInhibit and the channel event status bit EExternalInhibit are set. One of the following reactions to this signal can be programmed:

- No Action (default)
- Turn off the channel with ramp
- Shut down the channel without ramp
- Shut down all channels without ramp

These reactions can be programmed by the CAN interface, see chapter Delayed Trip in EDCP-CAN-Documentation in appendix for reference.

When the INHIBIT is no longer active (TTL-HIGH potential or not connected), the Inhibit flag must be reset before the voltage can be switched on again (consider EDCP-CAN-Documentation in appendix).

3.7 Floating GND configuration

The NHR module is a module with Common Floating Ground (CFG). All HV-channels have a common return potential (module GND), which is galvanically isolated from the crate GND. A protection circuit prevents differences between the two GND potentials of more than 56V. The galvanic isolation can be removed by placing a jumper on a two-pin connector located in a ventilation slot on the top of the module (see dimensional drawings for exact position).

The GND of the digital interfaces (USB and CAN) is isolated from both, the module GND and the crate GND.

3.8 The function "Delayed Trip"

3.8.1 Operating principle

The function "*Delayed Trip*" provides a user-configurable, time-delayed response to an increased output current (I_{out}) higher than the set current (I_{set}). The response to this kind of event can be, for example, to ramp down the channel with the programmed ramp. A detailed description for the configuration can be found in the EDCP-CAN-Documentation in

appendix.

By a programmable timeout with one millisecond resolution, the trip can be delayed up to four seconds. During this time, the output current is limited to the value of I_{set} (constant current mode).

The hardware regulation signals, constant voltage (CV) or constant current (CC), are sampled every millisecond by the microprocessor. Once the constant current mode is active, the programmed timeout counter is decremented. If the HV channel returns to constant voltage mode before timeout (i.e. $I_{out} < I_{set}$), the counter will be reset. So this process can be restarted if the current rises again.

To guarantee a sufficient resolution for the current set values, a nominal current adequate to the application should be selected. iseg offers HV modules with nominal currents reduced to 100 µA in all voltage classes. These are designated e.g. for semiconductor detectors, which only require a few microampere operating current.

3.8.2 Modules with two current measurement ranges

High Precision NHR modules with two current ranges are a particular case. In these HV modules the high current output is combined with a picoampere resolution in the low current measurement range. The range switching is done by the microprocessor depending on I_{meas}:

High measuring range: $I_{nom-low} < I_{meas} < I_{nom}$

Low measuring range: $0 < I_{meas} < I_{nom-low}$

The typical value for $I_{nom-low}$ is 20 µA.

As long as a set current in the high measuring range is used, everything is working as described above. If a set current in low measuring range is nomified, the current limitation is set to 120 % of the low measuring range.

Example: $I_{nom-low}$ = 20 µA → current limitation is set to 24 µA if I_{set} = 10 µA

Now the channel operates in the low measuring range only. A software comparison of set current I_{set} and measured current I_{meas} is performed in addition to the described hardware CC and CV signals sampling.

With this principle, two requirements are met:

- the output current will not exceed 24 µA even during fast changes and
- the delayed trip function is extended into the region of very small currents (picoampere) for these HV modules.

For the software comparison, a delay between 80 milliseconds and 1 second must be expected. This depends on the modules ADC (Analog-to-digital-converter) configuration.

This time can be adjusted by changing the ADC sample rate to meet the requirements of the application. Higher ADC sample rates lead to shorter delays but also reduce the resolution.

If the *Delayed Trip* function is activated the voltage ramp should be limited to 1 % of V_{nom} before. Higher values could trigger a trip by internal charge balancing during a ramp, even though the output current does not exceed the set value I_{set}. If the connected load contains capacities or if I_{set} is very small, it might be necessary to further reduce the ramp speed. Alternatively, the *Delayed Trip* can be activated only after the completion of the ramp.

INFORMATION	
⚠ INFORMATION	An activated KillEnable feature disables the Delayed Trip function.

An active *KillEnable* function disables the *Delayed Trip* function. If *KillEnable* is active and a trip occurs, the channel is shut down without ramp at the fastest hardware response time (smaller than 1 ms). However, the actual discharge time strongly depends on the connected load.

4 Options

4.1 VCT – voltage correction by temperature

This option allows a temperature dependent correction of the output voltage. The temperatures are measured with a distinct sensor for each channel. An user-adjustable VCT-coefficient allows to specify a linear relationship between the measured temperature and the output voltage. As an option one sensor per module can be orded.

4.1.1 Technical data

Sensor type	EPCOS B57867S0502F140
Temperature range	-40 ... 80°C
Accuracy of temperature measurement	±0.5 K (0 ... 60°C)
Resolution of temperature measurement	1 mK (0 ... 60°C)
Temperature update rate	15 updates/min

Table 5: Technical data VCT sensor

4.1.2 Operation

The connector of the temperature sensor must be plugged in the slot of the corresponding channel on the VCT-connector at the rear panel of the HV-module.

A programmable VCT-coefficient for each channel defines the rate and the direction of the voltage correction. The temperatures, measured at the sensors can be read out from the module.

At the time a HV-channel is switched on or the output voltage is set by the user, the module registers the temperature of the corresponding sensor and the set voltage as reference values.

If the temperature at the sensor changes, the output voltage is automatically adjusted according to the formula:

$$V = V_{ref} + a*(T-T_{ref}) \qquad (a...\text{VCT-coefficient})$$

Example: A channel is set to 60V. At the time it is switched on a temperature of 25°C is measured. The VCT-coefficient is set to +1V/K. If the temperature now increases to 26°C the output voltage will increase to 61V. (For channels with a negative output voltage the voltage changes from –60V to –61V).

A VCT-coefficient of -1V/K would decrease the voltage to 59V.

Notes:

- During operation the values for V_{set} are adjusted. If a channel is switched off the adjusted set value will be kept, not the original value set by the user.
- If the VCT-coefficient if modified during operation, V_{ref} and T_{ref} are reset to the present values to prevent a sudden voltage change.
- If the temperature sensor is dis- and reconnected during operation, V_{ref} and T_{ref} are reset to the present values to prevent a sudden voltage change.
- The temperature dependent voltage correction can be deactivated by setting the VCT-coefficient to 0 or by disconnecting the temperature sensor. If this is done during operation, the channel will keep the actual voltage set.
- If the temperature sensor is disconnected a temperature of -273.15°C is shown for that channel.

- The VCT data points are described in the reference manual "**CAN EDCP Programmers-Guide**" *(see appendix)* and in the manual "**iseg Hardware Abstraction Layer**" *(see appendix).*

4.2 Single Channel Inhibit (IU, ID, NIU, NID)

INFORMATION
⚠️ INFORMATION   INHIBIT is an external signal, that switches off the high voltage for the device or a specific channel

Optionally it is possible to equip modules with an *INHIBIT* for each channel via a Sub-D connector. Channel 0 to 3 corresponds to Pin 1 to 4 at the Sub-D connector, Pins 5-9 are connected to GND.

KILL-enable = 1: Voltage is switched off permanently without ramp. ChannelEventStatus flag 'EEINH' is set. The green LED at the front panel turns off.

KILL-enable = 0: ChannelStatus flag 'isEINH' and ChannelEventStatus flag EEINH are set. The action of the HV channel can be defined via the Monitoring group. The green LED at the front panel turns off.

The *INHIBIT* signal must be applied for at least 100 ms to guarantee a detection. When the INHIBIT is no longer active, the INHIBIT flag must be reset before the voltage can be switched ON again.

The *INHIBIT* signal are TTL-level, the signal logic and default states depend on the selected option (**IU**, **ID**, **NIU**, **NID**) and are listed in the subsections 4.2.1 - 4.2.4.

4.2.1 IU

INHIBIT signal logic:	LOW-active (LOW→ HV-generation stopped)
default state:	HIGH (internal pull-up resistor applied)
open *INHIBIT* signal input:	HV enabled

4.2.2 ID

INHIBIT signal logic:	LOW-active (LOW→ HV-generation stopped)
default state:	LOW (internal pull-down resistor applied)
open *INHIBIT* signal input:	HV disabled

4.2.3 NIU

INHIBIT signal logic:	*HIGH-active (HIGH→ HV-generation stopped)*
default state:	HIGH (internal pull-up resistor applied)
open INHIBIT signal input:	*HV disabled*

4.2.4 NID

INHIBIT signal logic:	HIGH-active (HIGH→ HV-generation stopped)
default state:	LOW (internal pull-down resistor applied)
open *INHIBIT* signal input:	HV enabled

4.3 L – Lower output current (HP only)

The output current is limited to a lower value, e.g. 100 µA.

4.4 T10 – Lower temperature coefficient (HP only)

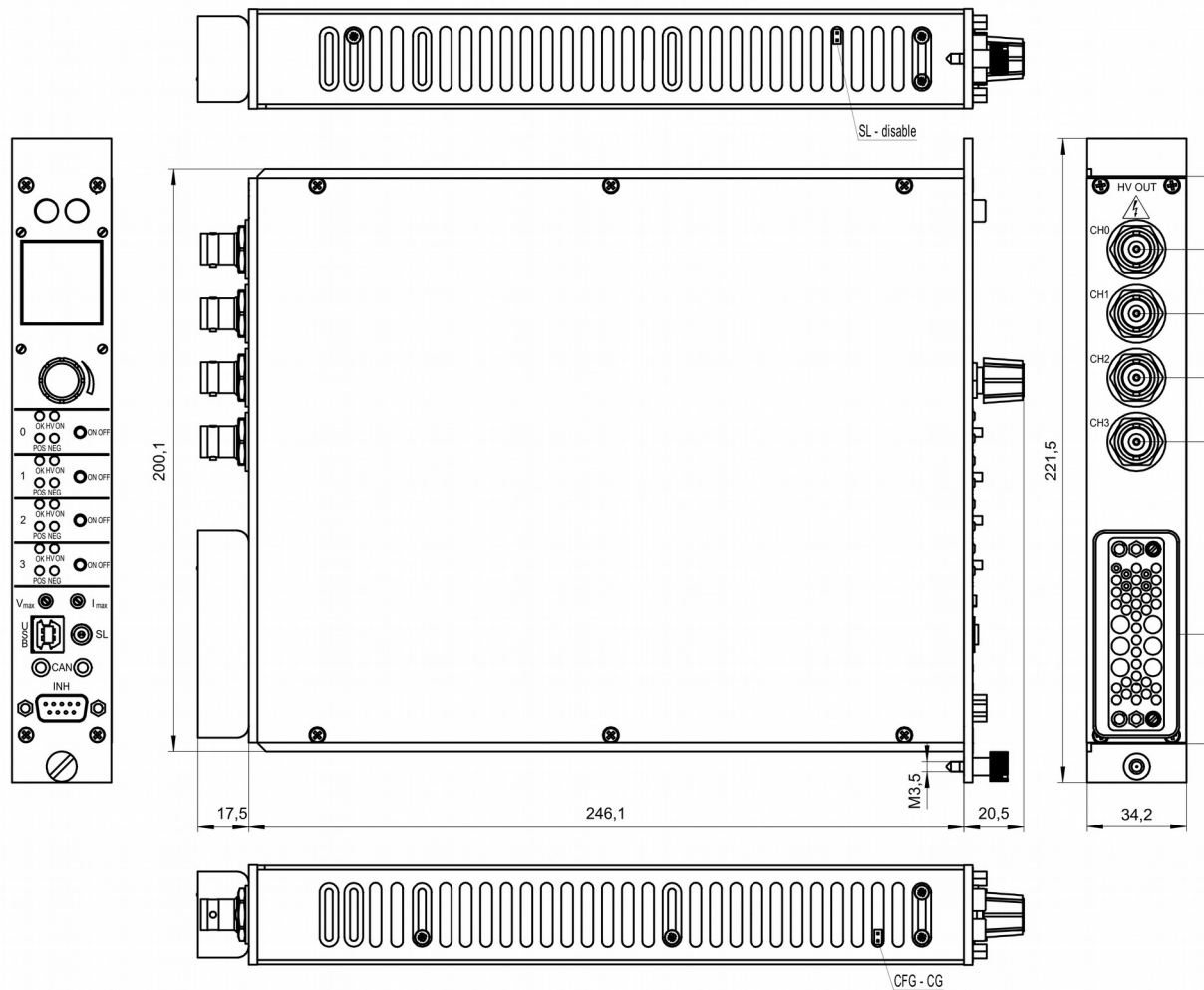Improved temperature coefficient of 10ppm/K

5 Dimensional drawings

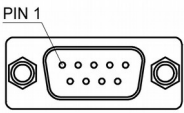*Figure 1: Dimensional drawings*

6 Connectors and PIN assignments

HV CONNECTOR ASSIGNMENTS				
Name	SHV	BNC		
Figure				

INHIBIT				
Name	INHIBIT connector- DSUB9	INHIBIT connector- DSUB9		
Figure	PIN / INHIBIT 1 1 CHANNEL 0 2 CHANNEL 1 3 CHANNEL 2 4 CHANNEL 3 5 GND 6 GND 7 GND 8 GND 9 GND			

Table 7: Connector and pin assignments

CONNECTORS PART NUMBERS (manufacturer code / iseg accessory parts item code)			
POWER SUPPLY SIDE		CABLE SIDE	
SHV (ROSENBERGER)			
Socket		Connector	57K101-006N3 / Z590162

Table 8: Connectors part number information

7 Order guides

CABLE ORDER GUIDE				
POWER SUPPLY SIDE CONNECTOR	CABLE CODE	CABLE DESCRIPTION	LOAD SIDE CONNECTOR	ORDER CODE LLL = length in m (*
SHV	04	HV cable shielded 30kV (HTV-30S-22-2)	open	SHV_1C04-LLL
*) Length building examples: 10cm => 0.1, 2.5m => 2.5, 12m => 012 , 999m => 999				

Table 9: Guideline for cable ordering

CONFIGURATION ORDER GUIDE (item code parts)								
NR	04	0	020	r	605	000	02	00
High Voltage, Distinct Source	Numbers of channels	Class	V_{nom}	Polarity	I_{nom} (nA)	Option (hex)	HV-Connector	Customized Version
	02 = 2ch 04 = 4ch	0 = Standard 4 = High Precision	three significante digits *100V For Examle: 020 = 2000V	r = reversible	two significante digits + number of zeros For Examle: 605 = 6mA	Sum of the hex codes (s. table 3) For Example: IU + TC = 804	02 = SHV	00 = none

Table 10: Item code parts for different configurations

8 Appendix

For more information please use the following download links:

This document
https://iseg-hv.com/download/SYSTEMS/NIM/NHR/iseg_manual_NHR_en_1.1.pdf
iCS (iseg Communication Server)
https://iseg-hv.com/download/?dir=SOFTWARE/iCS
SCPI Programmers-Guide
https://iseg-hv.com/download/SOFTWARE/isegSCPI/SCPI_Programmers-Guide.pdf
CAN EDCP Programmers-Guide
https://iseg-hv.com/download/SOFTWARE/isegEDCP/CAN_EDCP_Programmers-Guide.pdf
isegHAL (Hardware Abstraction Layer)
https://iseg-hv.com/download/SOFTWARE/iCS/doc/isegHAL/index.html
iCSservice-API
https://iseg-hv.com/download/SOFTWARE/iCS/doc/iCSservice/iCSapiWebsocket_Docu.html
https://iseg-hv.com/download/SOFTWARE/iCS/doc/iCSservice/iCSapiWebsocket_Example.html
isegIOC (EPICS Input / Output Controller)
https://iseg-hv.com/download/SOFTWARE/iCS/doc/isegIOC/isegIOC_doc.pdf
https://iseg-hv.com/download/SOFTWARE/iCS/doc/isegIOC/isegIOC_sampleScript.zip

9 Warranty & Service

This device is made with high care and quality assurance methods. The factory warranty is up to 36 months, starting from date of issue (invoice). Within this period a 5 years warranty extension can be ordered at additional charge. Please contact iseg sales department.

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

10 Manufacturer´s contact

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