Technical documentation
Last changed on: 16.10.2020

VHS

Versatile High Voltage Module in VME Standard

- 2 / 4 /12 channel, 500 V – 20 kV versions
- low ripple and noise
- hardware voltage and current limits
- voltage and current control per channel
- programmable parameters (delayed trip etc.)
- low voltage configurations possible (VMS modules)

Document history

Version	Date	Major changes
1.0	16.10.2020	Relayouted version

Disclaimer / Copyright

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

Safety

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

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

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

Depiction of the safety instructions

DANGER!

DANGER!

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

WARNING!

WARNING!

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

CAUTION!

CAUTION!

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

INFORMATION

INFORMATION

Advices marked as "Information" give important information.

Read the manual.

Attention high voltage!

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 Contents

1 General description

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

VHS modules are high voltage power supplies in VME standard. The output voltage features a high stability, low ripple and noise and a low temperature coefficient. All channels share a Common Ground (CG), which is connected to the internal crate ground. With up to 12 channels each single channel has an independent voltage and current control. Offered in different configurations the VHS module perfectly covers various kinds of applications such as detector supply, experimental setups or lab use. The module is made of high precision components such as 24 bit ADC and 20 bit DAC and provides comprehensive security features.

2 Technical Data

SPECIFICATIONS	VHS Common-GND (CG)
Polarity	Factory fixed, positive or negative
Ripple and noise (f > 10 Hz)	< 10 mV_{p-p}
Ripple and noise (f > 1 kHz)	< 2 - 3 mV_{p-p}
Stability	
Stability – [ΔV_{out} vs. ΔV_{in}]	< $1 \cdot 10^{-4} \cdot V_{nom}$
Stability – [ΔV_{out} vs. ΔR_{load}]	< $5 \cdot 10^{-4} \cdot V_{nom}$
Temperature coefficient voltage measurement	< 50 ppm / K
Temperature coefficient current measurement	< 50 ppm / K
Resolution – The resolution of measurable values depends on the settings of the sampling rate and the digital filter!	
Resolution voltage setting	< $2 \cdot 10^{-6} \cdot V_{nom}$
Resolution current setting (trip)	< $2 \cdot 10^{-6} \cdot I_{nom}$
Resolution voltage measurement [1]	< $2 \cdot 10^{-6} \cdot V_{nom}$
Resolution current measurement [I_{out} > 20 µA] [1]	< $2 \cdot 10^{-6} \cdot I_{nom}$
Measurement Accuracy – The measurement accuracy is guaranteed in the range 1% • V_{nom} < V_{out} < V_{nom} and for 1 year	
Accuracy voltage measurement	± (0.01 % • V_{out} + 0.02 % • V_{nom})
Accuracy current measurement [I_{out} > 20 µA]	± (0.02 % • I_{out} + 0.02 % • I_{nom})
Sample rates ADC (SPS)	5, 10, 25, 50, 60, 100, **500** [2]
Digital filter averages	1, 16, **64** [2], 256, 512, 1024
Voltage ramp up / down	$1 \cdot 10^{-6} \cdot V_{nom}$ /s to 0.2• V_{nom} / s
Hardware limits	Potentiometer per module [V_{max} / I_{max}]
Limit monitor volt	2.5 V
Digital interface	VMEbus
Protection	Safety loop, over load and short circuit protected (**ATTENTION:** there is only one short circuit or arc per second allowed!)
HV connector	Redel 51pole | SHV
System connector	96-pin connector according to DIN 41612 (MMS HV compatible)
Safety loop connector	Lemo 2pole
Limit monitor connector	Lemo 2pole
Case	6U VME cassette (single and double width)
Dimensions – L/W/H	164mm 4HP,(8HP) / 6U VME cassette,
Operating temperature	0 – 40 °C
Storage temperature	-20 – 60 °C
Humidity	20 – 80 %, not condensing
Notes: [1] The resolution of measurable values depends on the settings of the sampling rate and the digital filter! [2] Standard factory settings	

Table 1: Technical data: Specifications

2.1 Configurations VHS Series

CONFIGURATIONS VHS SERIES						
Type	**V_{nom}**	**I_{nom}**	**Ch**	**HV connector Standard/**opt.	**Item Code**	**Options**
VHS 40 05x	500 V	15 mA	4	SHV	VH040005x1560000200	
VHS C0 05x	500 V	15 mA	12	SHV / R51	VH120005x1560000200	ID, IU, NID, NIU
VHS 40 10x	1 kV	8 mA	4	SHV	VH040010x8050000200	
VHS C0 10x	1 kV	8 mA	12	SHV / R51	VH120010x8050000200	ID, IU, NID, NIU
VHS 40 20x	2 kV	4 mA	4	SHV	VH040020x4050000200	
VHS C0 20x	2 kV	4 mA	12	SHV / R51	VH120020x4050000200	ID, IU, NID, NIU
VHS 40 30x	3 kV	3 mA	4	SHV	VH040030x3050000200	
VHS C0 30x	3 kV	3 mA	12	SHV / R51	VH120030x3050000200	ID, IU, NID, NIU
VHS 40 40x	4 kV	2 mA	4	SHV	VH040040x2050000200	
VHS C0 40x	4 kV	2 mA	12	SHV / R51	VH120040x2050000200	ID, IU, NID, NIU
VHS 40 60x	6 kV	1 mA	4	S08	VH040060x1050000200	
VHS C0 60x	6 kV	1 mA	12	S08 / R51	VH120060x1050000200	ID, IU, NID, NIU
VHS 20 80x	8 kV	1 mA	2	SHV	VH020080x1050000200	
VHS 20 100x	10 kV	0.7 mA	2	S10	VH020100x0750000200	
VHS 20 200x	20 kV	0.4 mA	2	S20	VH020200x0450000200	

Table 2: Technical data: Configurations

2.2 Options

OPTIONS	OPTION CODE	EXAMPLE	ITEM CODE HEX CODING
POLARITY	Positive: **x = p**, Negative **x = n**	VHS 40 05**p**	
SINGLE CHANNEL INHIBIT - down	**ID** [1]		400
SINGLE CHANNEL INHIBIT - up	**IU** [1]		800
NEGATED LOGIC INHIBIT ID, IU	**N** [1]		80
Notes: [1] Only version with REEDEL HV-Connectors			

Table 3: Technical data: Options and order information

3 Handling

3.1 Connection

The supply voltages and the VME interface are connected to the module via a 96-pin connector on the rear side of the module.

3.2 Module status

The module status is displayed by two LEDs on the front panel.

green LED „OK“ on	all channels have the status “OK“
green LED „OK“ off	an error occured: safety loop is possibly not closed or the power supplies are out of tolerance or the threshold of V_{max}, I_{max}, I_{set} or I_{trip} (see function descriptions for details) has been exceeded. LED will be switched off until the error has been fixed and the corresponding status bit has been erased via software interface.
yellow LED on	one or more channels have status “HV ON” or voltage on output is greater than 56V.
Green LED blinking	Firmware update is stored into flash, do not switch of power supply, crate etc.

Table 4: Module status information

3.3 Hardware Limit

The maximum output voltage for all channels (hardware voltage limit) is defined by the position of the corresponding potentiometer V_{max}. The maximum output current for all channels (hardware current limit) is defined by the position of the corresponding potentiometer I_{max}. The highest possible set value for voltage and current is given by V_{max} − 2% and I_{max} − 2%, respectively. It is possible to measure the hardware voltage and current limits at the sockets below the potentiometer. The socket voltages are proportional to the relative limits, where 2.5 V corresponds to (102 ± 2)% V_{nom} and (102 ± 2)% I_{nom}. The output voltage is limited to the specified value. If the current exceeds the hardware current limit (about 30% above the current limit value set by the limit potentiometer) the channel will be shut off without delay and ramp. In both cases the green LED on the front panel turns off.

3.4 Safety Loop

A safety loop can be implemented by the safety loop socket (SL) on the front panel and between the SLcontacts (Pin 22 and PIN 30) at the REDEL-connector, if equipped. If the safety loop is active a high voltage generation in any channel is only possible 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. For modules with a REDEL-connector the front panel SL input must be shortened. If the safety loop is opened during the operation the output voltages will be shut off without ramp and the corresponding bits in the "*ModuleStatus*" and "*ModuleEventStatus*" are cancelled (CAN_EDCP_Programmers-Guide.pdf, see chapter 9 Appendix). After closing the loop again the "*ModuleEventStatus*" has to be reset and the channels have to be switched ON. The loop connectors are potential free, the internal voltage drop is approx. 3V. By factory setup the safety loop is not active (the corresponding bits are always set). The loop can be activated by removing the jumper "ILK" on the top side of the module, see Figure 1: "ILK" Jumper.

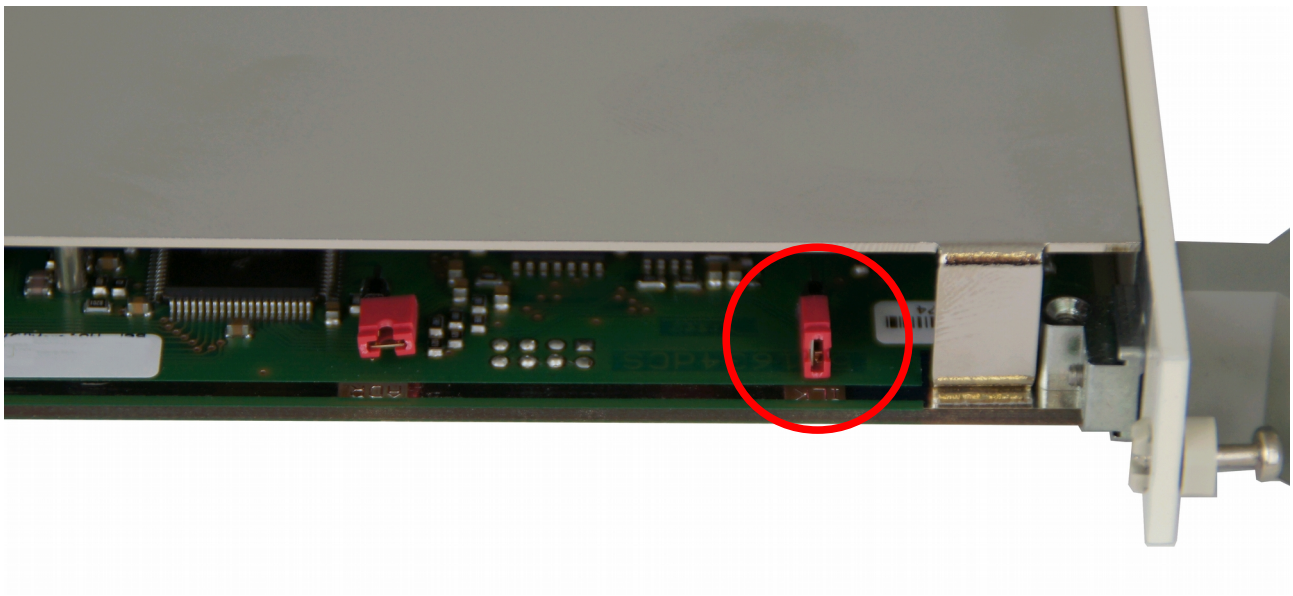


Figure 1: "ILK" Jumper

3.5 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[1] with an *INHIBIT* for each channel via a Sub-D connector.

The INHIBIT signals are TTL-level, the signal logic and default states can be configured. The following settings are possible:

Option – IU (default)

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

Option – ID

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

Option – NIU

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

Option – NID

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

The INHIBIT signal must be applied for at least 100 ms to guarantee a detection. If an Inhibit signal is detected, the channel status bit '*Is External Inhibit*' and the channel event status bit '*Event External Inhibit*' are set. One of the following reactions to this signal can be programmed, see chapter "*External channel inhibit*" in the "CAN_EDCP_Programmers-Guide.pdf" (see 9 Appendix):

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

When the INHIBIT is no longer active, the Inhibit flag must be reset before the voltage can be switched on again.

1 Only version with REEDEL HV-Connectors

3.6 Jumper ADR

The ADR jumper (Figure 2: “ADR” jumper) is locatet on the top. If this is plugged in, the base address is reset to factory setting. See 9 Appendix “VHS_interface_manual_en” Manual.

CAUTION!

CAUTION!

When the jumper "ADR" is set the Base Address of the module will reset to the default address 0x4000 after a power up. This function can be used when there is no communication for instance the Base Address is unknown. When the jumper is not set the stored address inside of the module will be used as Base Address.

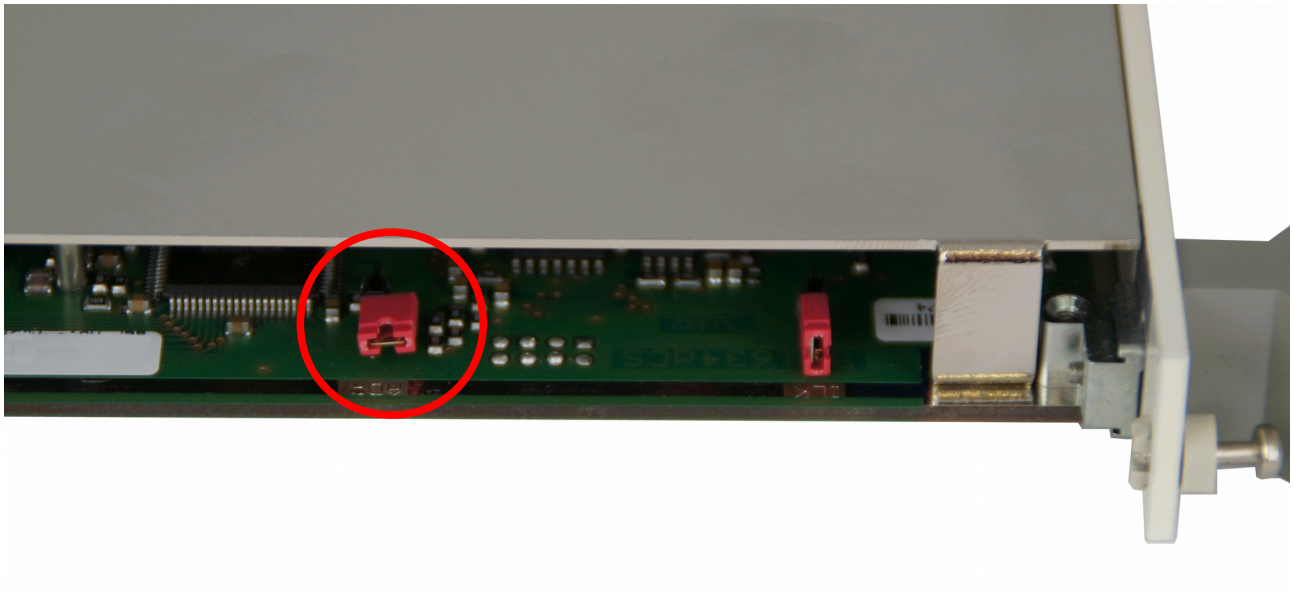
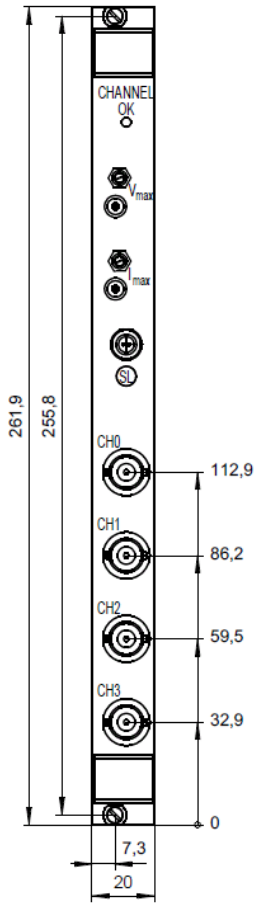
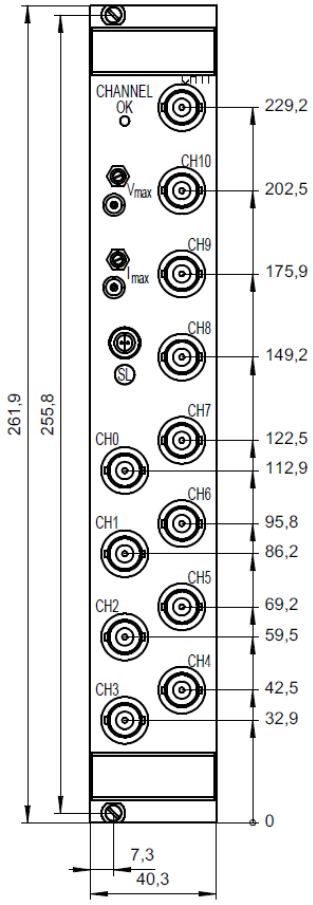
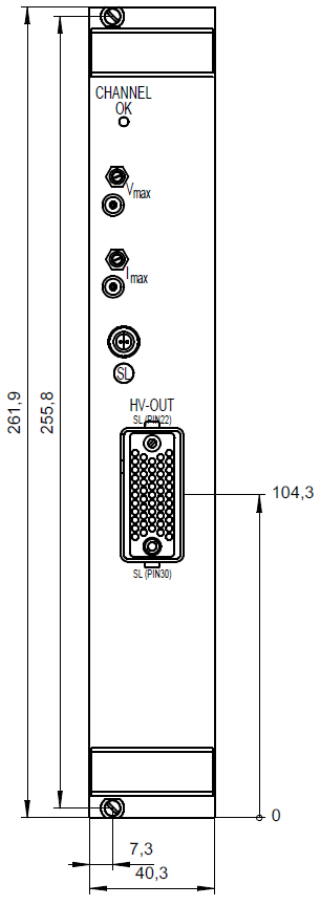


Figure 2: “ADR” jumper

4 Front panel versions

FRONT PANELS			
Channels	4	12	12
HV Connector	SHV / S08	SHV / S08	R51
Figure			

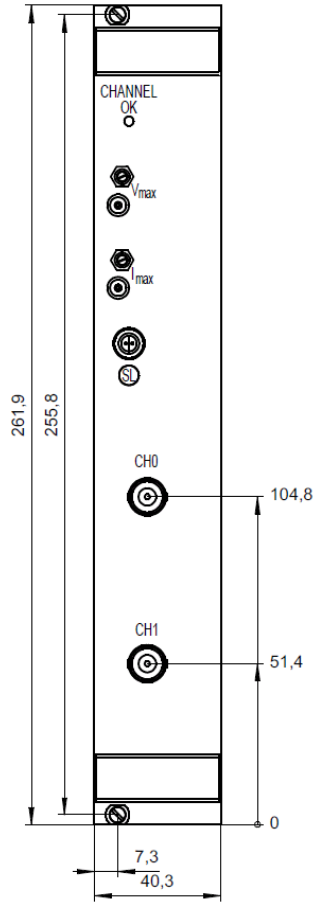
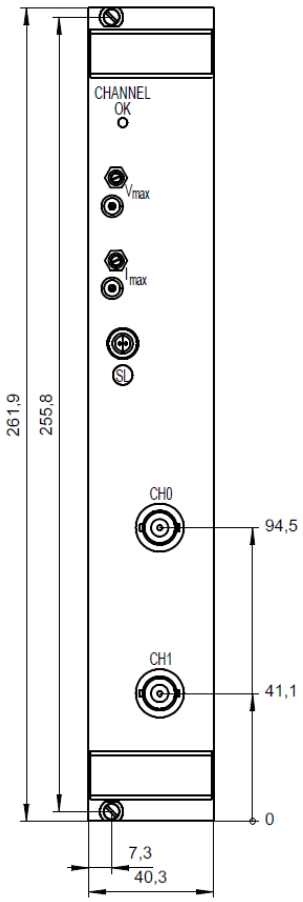
FRONT PANELS			
Channels	2	2	
HV Connector	S10	S20	
Figure			

Table 5: Front panel versions

5 Dimensional drawings

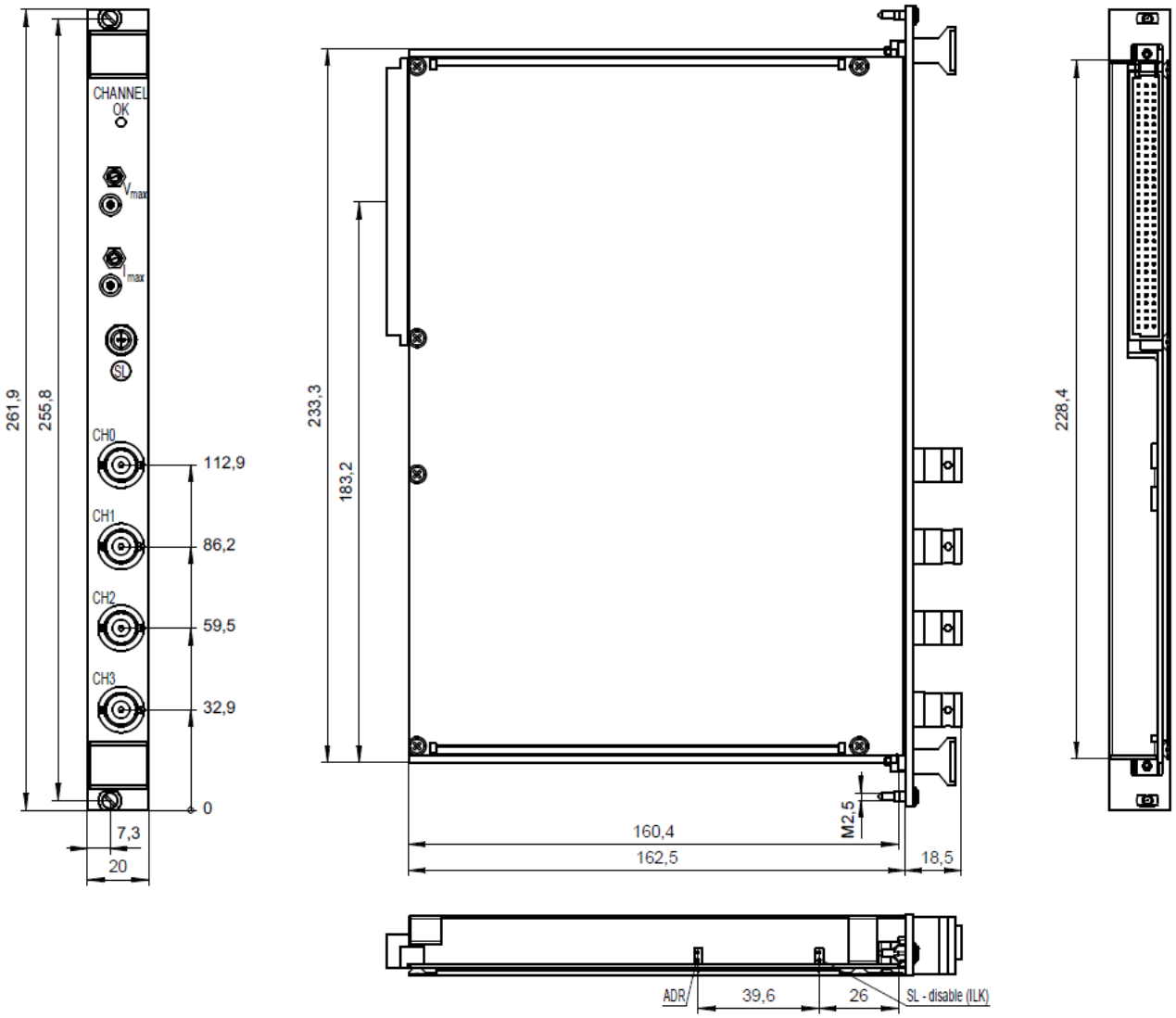


Figure 3: 4 channels with SHV / S08 HV-Connector

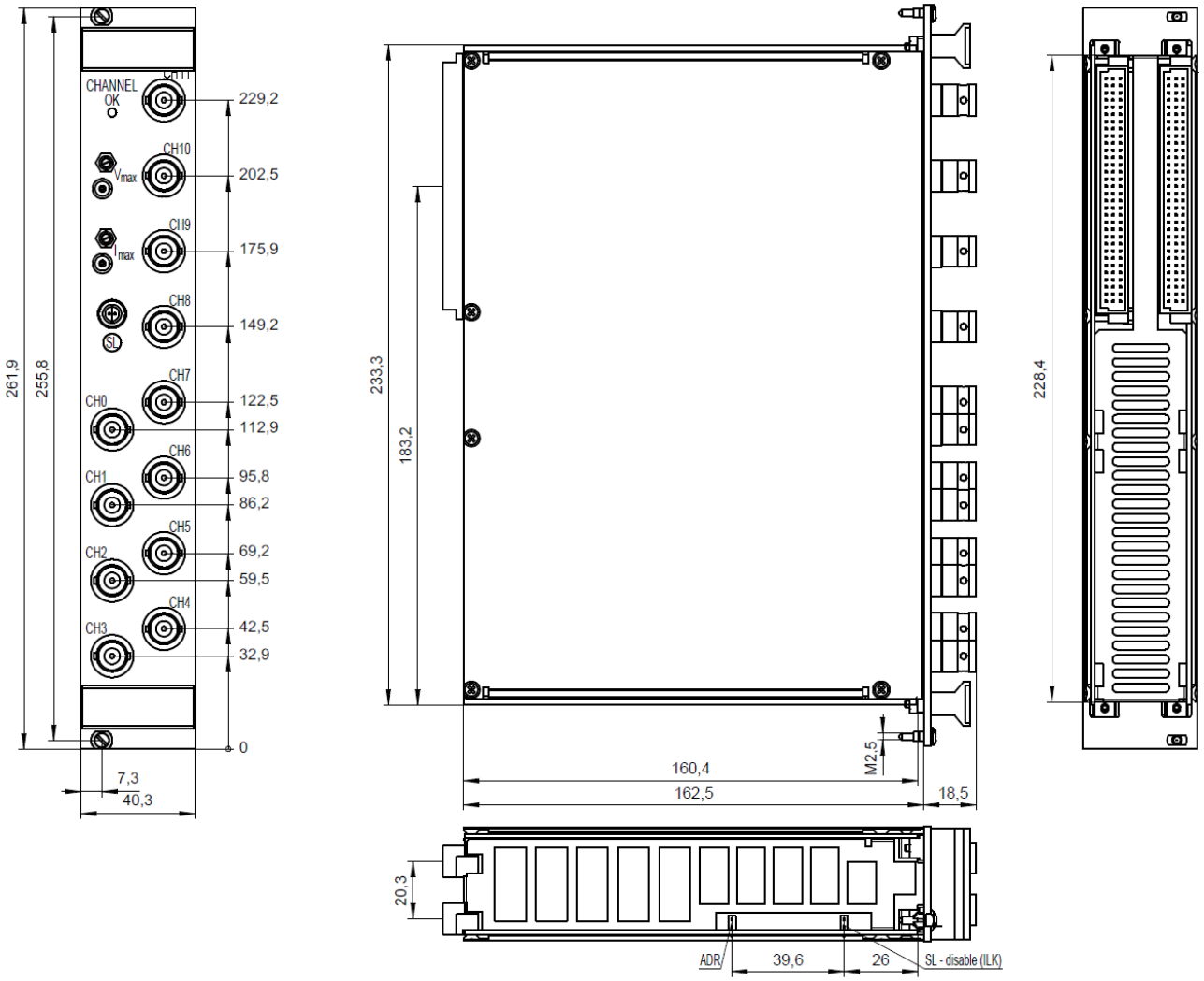


Figure 4: 12 channels with SHV / S08 HV-Connector

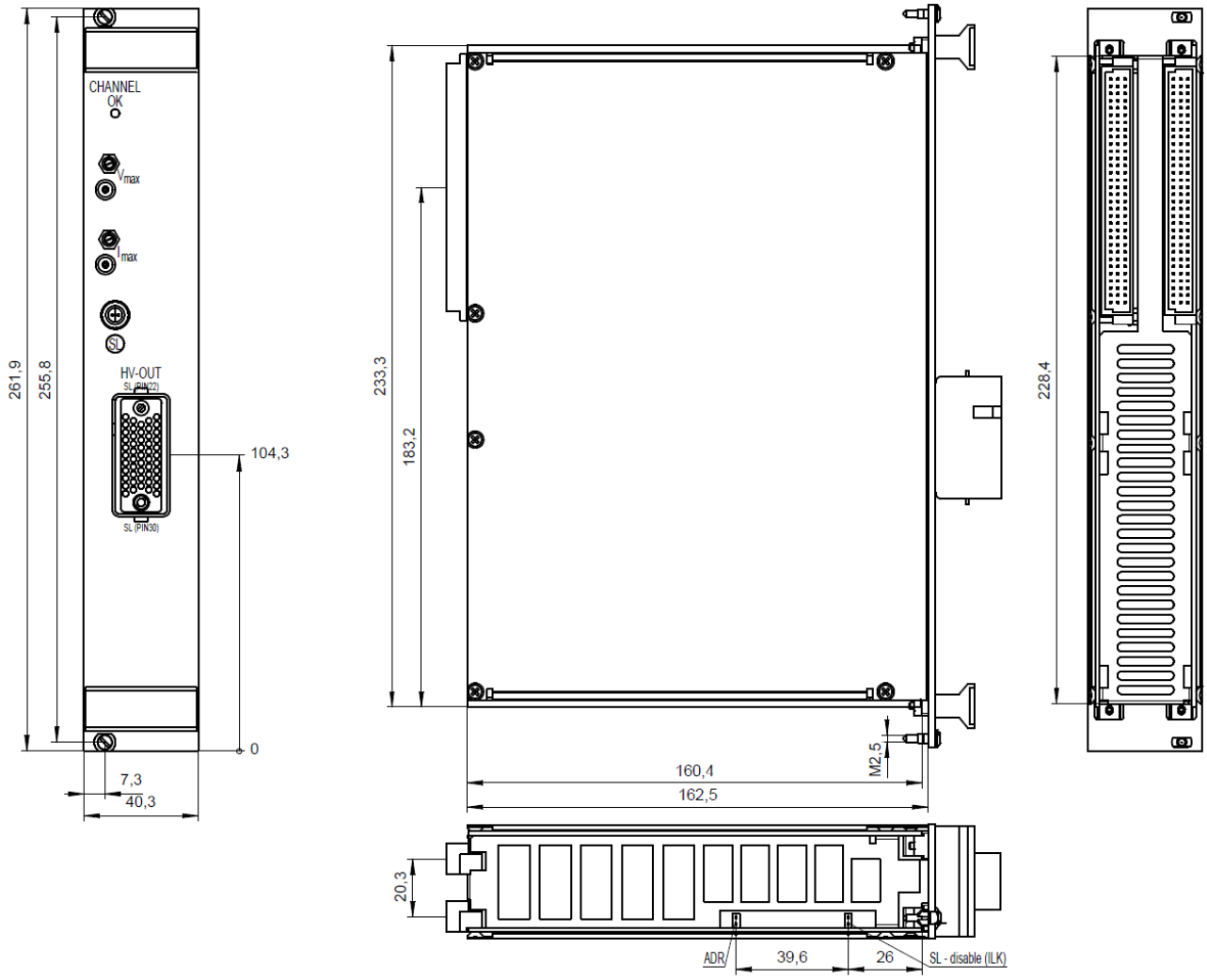


Figure 5: 12 channels with Reedel HV-Connector

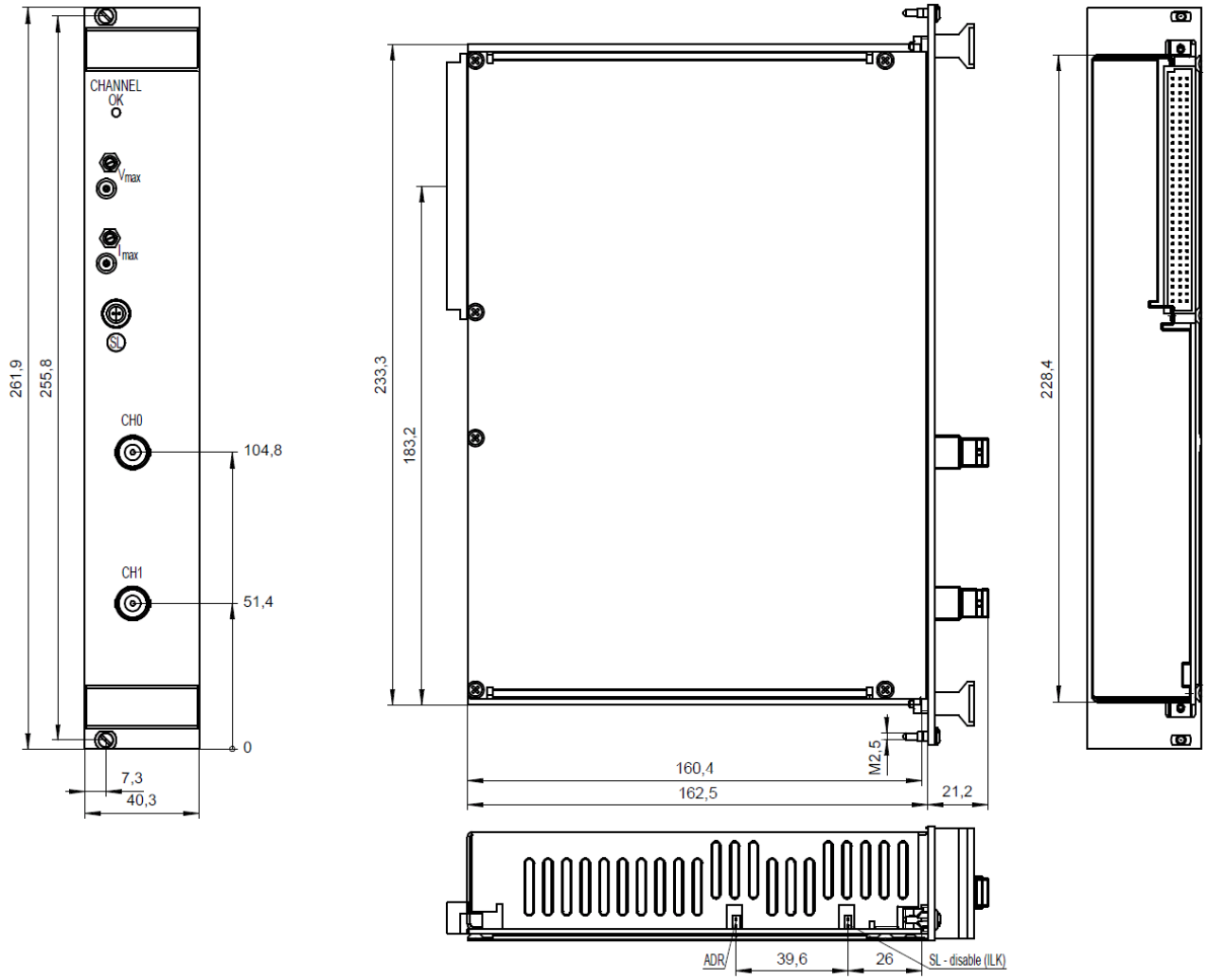


Figure 6: 2 channels with S10 HV-Connector

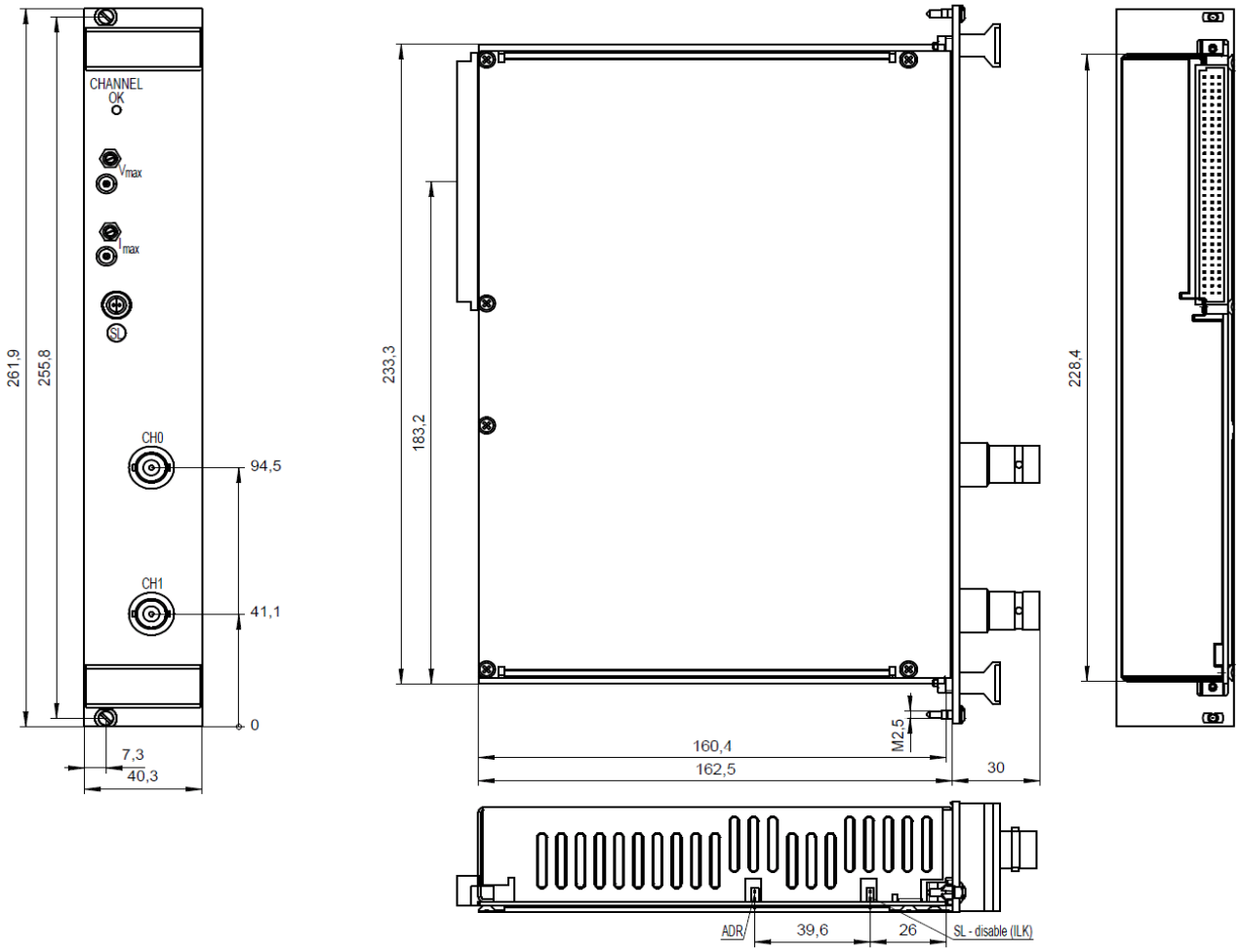


Figure 7: 2 channels with S20 HV-Connector

6 Connectors and PIN assignments

6.1 HV Connectors

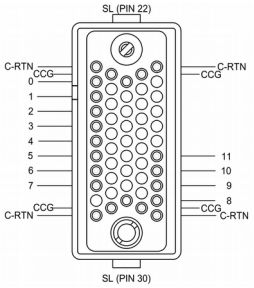
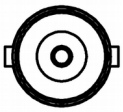
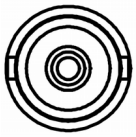
HV CONNECTOR ASSIGNMENTS				
Name	R51.42	SHV / S08	S10	S20
Figure				
Notes: C-RTN: Common Return CCG: Common Crate Ground HV: High Voltage RTN: Return SRTN: Special Return, checks if the contact is plugged in SL: Safty Loop				

Table 6: HV Connector

6.2 Safty Loop

SAFETY LOOP				
Name	Safety Loop socket			
Figure				

Table 7: Safety Loop Connector (drawings not to scale)

6.3 Limit Connectors

LIMIT MONITOR				
Name	Limit monitor socket CG/F			
Figure				

Table 8: Limit Connector (drawings not to scale)

6.4 Connectors Part Numbers

CONNECTORS PART NUMBERS (manufacturer code / iseg accessory parts item code)			
POWER SUPPLY SIDE		**CABLE SIDE**	
R51 (REDEL 51 PINS)			
Socket	SLG.H51.LLZG	Connector	SAG.H51.LLZBG / Z200325
Socket contacts (male)	FFA.05.403.ZLA1 / Z592189	Connector contacts (female)	ERA.05.403.ZLL1 / Z592263
Contacts Saf. Loop (male)	FGG.2B.565.ZZC / Z592261	Contacts Saf. Loop (female)	EGG.3B.665.ZZM / Z592262
		Socket Load Side	SLA.H51.LLZBG / Z201035
	SHV (ROSENBERGER)		
Socket	57S501-200N3	Connector	57K101-006N3 / Z590162
S08 (RADIALL)			
Socket	R317.580.000	Connector	R317.005.000 / Z592474
Safety Loop (LEMO)			
Socket	ERA.0S.302.CLL	Connector	FFA.0S.302.CLAC / Z592312
Limit monitor 2pol. (LEMO)			
Socket	EGG.00.302.CLL	Connector	FGG.00.302.CLAD / Z201466
S10 (KINGS)			
Socket	1064-1 QD	Connector	1065-1 QD / Z592512
S20 (KINGS)			
Socket	1764-1	Connector	1765-1 / Z592668

Table 9: Connectors part number information

7 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
Kings 10kV HV cable plug single pole (1065-1)	Z592512
Kings 20kV HV cable plug single pole (1765-1)	Z592668
Lemo plug 2-pole without collet chuck (SL)	Z592312
2-pin LEMO connector, FGG.00.302.CLAD30	Z201466
REDEL coupling Socket, without contacts	Z200325
REDEL Socket contact, ERA.05.403.ZLL1	Z592263
REDEL SL sockets Contact, EGG.3B.665.ZZM	Z592262
REDEL socket carrier red SLA.H51.LLZG	Z201035
REDEL pin contact	Z592189
REDEL SL pin contact	Z592261

Table 10: Accessory

8 Order guides

CABLE ORDER GUIDE				
POWER SUPPLY SIDE CONNECTOR	**CABLE CODE**	**CABLE DESCRIPTION**	**LOAD SIDE CONNECTOR**	**ORDER CODE** ***LLL = length in m*** [1]
R51.42-G	07	HV cable 6kV Kerpen SL-v2YCeHI 37xAWG26/7red	R51.41-A	RG43_C07-*LLL*_RA43
SHV	04	HV cable shielded 30kV (HTV-30S-22-2)	open	SHV_C04-*LLL*
S08	04	HV cable shielded 30kV (HTV-30S-22-2)	open	S08_C04-*LLL*
S10	04	HV cable shielded 30kV (HTV-30S-22-2)	open	S10_C04-*LLL*
S20	02	Lemo HV cable shielded 30kV (Lemo 130660)	open	S20_C02-*LLL*
[1] *Length building examples:* *10cm ➞ 0.1, 2.5m ➞ 2.5, 12m ➞ 012, 999m ➞ 999*				

Table 11: Guideline for cable ordering

CONFIGURATION ORDER GUIDE (item code parts)								
VH	**04**	**0**	**030**	**P**	**504**	**000**	**02**	**00**
High Voltage Distinct Source	Numbers of channels	Class	V_{nom}	Polarity	I_{nom} (nA)	Option (hex)	HV-Connector	Customized Version
		0 = Standard	three significante digits • 100V For Examle: 030 = 3,000V	p = positive n = negative	two significante digits + number of zeros For Examle: 504 = 500µA	See Table 3: Technical data: Options and order information For Examle: 400 = ID	02 = SHV 03 = S08 04 = S10 05 = S20 42 = Redel Multipin (see Table 6: HV Connector)	00 = none

Table 12: Item code parts for different configurations

9 Appendix

For more information please use the following download links:

This document
http://download.iseg-hv.com/SYSTEMS/MMS/VHS/iseg_datasheet_VHS_en.pdf
CAN EDCP Programmers-Guide
http://download.iseg-hv.com/SYSTEMS/MMS/CAN_EDCP_Programmers-Guide.pdf
VME VHS Programmers-Guide

10 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

11 Warranty & Service

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

12 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.

13 Manufacturer contact

iseg Spezialelektronik GmbH
Bautzner Landstr. 23
01454 Radeberg / OT Rossendorf
GERMANY
FON: +49 351 26996-0 | FAX: +49 351 26996-21

www.iseg-hv.com | info@iseg-hv.de | sales@iseg-hv.de