**Technical documentation**
Last changed on: 16.01.2020

# EHS Series

Versatile High Precision High Voltage Module with multiple Floating Options

- 4 / 8 / 16 / 24 / 32 / 48 channel, 100 V – 20 kV versions
- very low ripple and noise
- hardware voltage and current limits
- voltage and current control per channel
- programmable parameters (delayed trip etc.)

## Document history

| Version | Date | Major changes |
|---|---|---|
| 3.0 | 16.01.2020 | safety information, glossary, Single Channel Inhibit |
| 2.6 | 12.11.2019 | Improved documentation (Warranty, Disposal), Accessories added, Fixed error |
| 2.5 | 23.07.2019 | Added HV connector and Figures |
| 2.4 | 19.06.2019 | Improved documentation |
| 2.3 | 03.06.2019 | Fixed Itemcodes, connector codes, Error in description |
| 2.2 | 17.09.2018<br>01.10.2018<br>03.12.2018 | Added Pin assignments R51.44, R51.46, I50.52<br>Notes revised<br>CFG jumper information revised |
| 2.1 | 03.08.2017 | Fixed Itemcodes EHS CFG FLEX |
| 2.0 | 06.04.2017 | Relayouted documentation & fixes |

## Disclaimer / Copyrights

# 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 instructuions 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!

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!

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

**INFORMATION**


INFORMATION

Please check the compatibility with the devices used.

# Table of Contents

# 1 General description

## 1.1 EHS Standard series

EHS Standard modules are multichannel high voltage power supplies in MMS system (Eurocard format). The output voltage features a high stability, low ripple and noise and low temperature coefficient. With up to 48 channels each single channel has an independent voltage and current control. By offering different configurations and options this module perfectly covers various types of applications such as detector supply, experimental setup or lab use. The EHS Standard module is available in three floating versions, Common Floating Ground (CFG), Floating Ground (FG) and Common Ground (CG).

## 1.2 EHS High Precision series

The EHS High Precision modules are multichannel high voltage power supplies in MMS system (Eurocard format) with exceptionally high stability, very low temperature coefficients and very low ripple and noise characteristics. With up to 16 channels each single channel has an independent voltage and current control. Compared to a standard module the High Precision EHS is equipped with a second current measurement range to precisely meter low currents. Switching between measurement ranges is done automatically. By offering different configurations and options this module perfectly covers various types of applications such as detector supply, experimental setup or lab use. The EHS High Precision module is available in two floating versions, Common Floating Ground (CFG) and Floating Ground (FG).

# 2 Technical data

## 2.1 EHS Standard series

| SPECIFICATIONS | EHS CG | EHS CFG | EHS FG |
|---|---|---|---|
| Polarity | Factory fixed, positive or negative | | |
| Floating principle | Common Ground | Common Floating Ground | Single Floating Ground |
| Potential difference | none | 56 V channel/GND | 20 V channel/channel/GND, optionally up to 2 kV |
| Ripple and noise (f > 10 Hz) | < 10 - 20 $mV_{p-p}$ optionally VLN: < 3 - 5 $mV_{p-p}$ | < 10 $mV_{p-p}$ | |
| Ripple and noise (f > 1 kHz) | < 2 – 3 mV | | |
| **Stablity** | | | |
| Stability – [$\Delta V_{out}$ vs. $\Delta V_{in}$] | < 1 • $10^{-4}$ • $V_{nom}$ | | |
| Stability – [$\Delta V_{out}$ vs. $\Delta R_{load}$] | < 5 • $10^{-4}$ • $V_{nom}$ | < 2 • $10^{-4}$ • $V_{nom}$ | |
| Long term stability (1h warmup) 24h | < 5 • $10^{-5}$ • $V_{nom}$ | | |
| Temperature coefficient | < 50 ppm / K | | |
| Resolution voltage setting | 2 • $10^{-6}$ • $V_{nom}$ | | 4 • $10^{-5}$ • $V_{nom}$ |
| Resolution current setting | 2 • $10^{-6}$ • $I_{nom}$ | | 4 • $10^{-5}$ • $V_{nom}$ |
| Resolution voltage measurement [1] | 2 • $10^{-6}$ • $V_{nom}$ | | |
| Resolution current measurement [1] | 2 • $10^{-6}$ • $I_{nom}$ | | |
| **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 | ± (0.02 % • $I_{out}$ + 0.02 % • $I_{nom}$) | | |
| Sample rates ADC (SPS) | 5, 10, 25, 50, 60, 100, **500** [2] | | 5, 10, 25, **50** [2], 60 |
| Digital filter averages | 1, 16, **64** [2], 256, 512, 1024 | | |
| Voltage ramp up / down | up to 0.2 • $V_{nom}$ /s | up to 0.2 • $V_{nom}$ / s \| optionally up to 0.75 • $V_{nom}$ / s | |
| Hardware limits | Potentiometer per module [$V_{max}$ and $I_{max}$] | | |
| Limit monitor voltage | 2.5 V | | |
| Digital interface | CAN | | |
| Protection | Safety loop, overload and short circuit protected, optionally INHIBIT per channel (ID / IU, NID / NIU) (**ATTENTION:** there is only one short circuit or arc per second allowed!) | | |
| HV connector | R51 \| SHV \| S08 \| S10 \| C15 \| S20 | | |
| System connector | 96 PIN (MMS HV compatible) | | |
| Safety loop connector | Lemo 2pole | | |
| Limit monitor connector | Lemo 1pole | Lemo 2pole | Lemo 1pole |
| Case | 19" plug-in cassette | | |
| Dimensions – L/W/H | 220mm / 8HP / 6U | | |

| SPECIFICATIONS | EHS CG | EHS CFG | EHS FG |
|---|---|---|---|
| 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)] Factory Settings

*Table 1: Technical data: Specifications EHS Standard*

| CONFIGURATIONS EHS STANDARD SERIES | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Type** | **$V_{nom}$** | **$I_{nom}$** | **Ch** | **Max. $I_{in}$ (A)** at 24V | **Ripple ($mV_{p-p}$)** >1kHz \| 10Hz-1kHz | | **HV connector Standard/**opt. | **Item Code** | **Options** |
| **Common Ground** | | | | | | | | | |
| EHS F1 01x | 100 V | 10 mA | 16 | 1.5 | 3 | 10 | **R51.43** | EH161001x1060004300 | SLA, SLP, VLN, ID, IU |
| EHS 201 01x | 100 V | 10 mA | 32 | 3 | 3 | 10 | **R51.45** | EH321001x1060004500 | SLA, SLP, VLN, ID, IU |
| EHS F1 05x | 500 V | 8 mA | 16 | 4 | 3 | 10 | **R51.43** | EH161005x8050004300 | SLA, SLP, VLN, ID, IU |
| EHS 201 05x | 500 V | 8 mA | 32 | 8 | 3 | 10 | **R51.45** | EH321005x8050004500 | SLA, SLP, VLN, ID, IU |
| EHS F1 10x | 1 kV | 4 mA | 16 | 4 | 2 | 15 | **R51.43** | EH161010x4050004300 | SLA, SLP, VLN, ID, IU |
| EHS 201 10x | 1 kV | 4 mA | 32 | 8 | 2 | 15 | **R51.45** | EH321010x4050004500 | SLA, SLP, VLN, ID, IU |
| EHS F1 20x | 2 kV | 2 mA | 16 | 4 | 2 | 20 | **R51.43** | EH161020x2050004300 | SLA, SLP, VLN, ID, IU |
| EHS 201 20x | 2 kV | 2 mA | 32 | 8 | 2 | 20 | **R51.45** | EH321020x2050004500 | SLA, SLP, VLN, ID, IU |
| EHS F1 30x | 3 kV | 1.3 mA | 16 | 4 | 2 | 20 | **R51.43** | EH161030x1350004300 | SLA, SLP, VLN, ID, IU |
| EHS 201 30x | 3 kV | 1.3 mA | 32 | 8 | 2 | 20 | **R51.45** | EH321030x1350004500 | SLA, SLP, VLN, ID, IU |
| EHS F1 40x | 4 kV | 1 mA | 16 | 4 | 3 | 20 | **R51.43** | EH161040x1050004300 | SLA, SLP, VLN, ID, IU |
| EHS 201 40x | 4 kV | 1 mA | 32 | 8 | 3 | 20 | **R51.45** | EH321040x1050004500 | SLA, SLP, VLN, ID, IU |
| EHS F1 01x-VLN | 100 V | 10 mA | 16 | 1.5 | 3 | 3 | **R51.43** | EH161001x1060104300 | SLA, SLP, ID, IU |
| EHS 201 01x-VLN | 100 V | 10 mA | 32 | 3 | 3 | 3 | **R51.45** | EH321001x1060104500 | SLA, SLP, ID, IU |
| EHS F1 05x-VLN | 500 V | 8 mA | 16 | 4 | 3 | 3 | **R51.43** | EH161005x8050104300 | SLA, SLP, ID, IU |
| EHS 201 05x-VLN | 500 V | 8 mA | 32 | 8 | 3 | 3 | **R51.45** | EH321005x8050104500 | SLA, SLP, ID, IU |
| EHS F1 10x-VLN | 1 kV | 4 mA | 16 | 4 | 2 | 5 | **R51.43** | EH161010x4050104300 | SLA, SLP, ID, IU |
| EHS 201 10x-VLN | 1 kV | 4 mA | 32 | 8 | 2 | 5 | **R51.45** | EH321010x4050104500 | SLA, SLP, ID, IU |
| EHS F1 20x-VLN | 2 kV | 2 mA | 16 | 4 | 2 | 5 | **R51.43** | EH161020x2050104300 | SLA, SLP, ID, IU |
| EHS 201 20x-VLN | 2 kV | 2 mA | 32 | 8 | 2 | 5 | **R51.45** | EH321020x2050104500 | SLA, SLP, ID, IU |
| EHS F1 30x-VLN | 3 kV | 1.3 mA | 16 | 4 | 2 | 5 | **R51.43** | EH161030x1350104300 | SLA, SLP, ID, IU |
| EHS 201 30x-VLN | 3 kV | 1.3 mA | 32 | 8 | 2 | 5 | **R51.45** | EH321030x1350104500 | SLA, SLP, ID, IU |
| EHS F1 40x-VLN | 4 kV | 1 mA | 16 | 4 | 3 | 5 | **R51.43**, SHV | EH161040x1050104300 | SLA, SLP, ID, IU |
| EHS 201 40x-VLN | 4 kV | 1 mA | 32 | 8 | 3 | 5 | **R51.45** | EH321040x1050104500 | SLA, SLP, ID, IU |

*Table 2: Technical data: Configurations of Standard*

| CONFIGURATIONS EHS STANDARD SERIES | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Type** | **$V_{nom}$** | **$I_{nom}$** | **Ch** | **Max. $I_{in}$ (A)** at 24V | **Ripple ($mV_{p-p}$)** >1kHz\|10Hz-1kHz | | **HV connector Standard/**opt. | **Item Code** | **Options** |
| **Common Floating Ground** | | | | | | | | | |
| EHS 80 01x | 100 V | 10 mA | 8 | 1 | 3 | 5 | **SHV**, R51.41 | EH080001x1060000200 | SLA, SLP, VCT, ID, IU |
| EHS F0 01x | 100 V | 10 mA | 16 | 2 | 3 | 5 | **SHV**, R51.43 | EH160001x1060000200 | SLA, SLP, VCT, ID, IU |
| EHS 80 05x | 500 V | 15 mA | 8 | 4 | 3 | 10 | **SHV**, R51.41 | EH080005x1560000200 | SLA, SLP, VCT, ID, IU |
| EHS F0 05x | 500 V | 15 mA | 16 | 8 | 3 | 10 | **SHV**, R51.43 | EH160005x1560000200 | SLA, SLP, VCT, ID, IU |
| EHS 80 10x | 1 kV | 8 mA | 8 | 4 | 3 | 10 | **SHV**, R51.41 | EH080010x8050000200 | SLA, SLP, VCT, ID, IU |
| EHS F0 10x | 1 kV | 8 mA | 16 | 8 | 3 | 10 | **SHV**, R51.43 | EH160010x8050000200 | SLA, SLP, VCT, ID, IU |
| EHS 80 20x | 2 kV | 4 mA | 8 | 4 | 3 | 10 | **SHV**, R51.41 | EH080020x4050000200 | SLA, SLP, VCT, ID, IU |
| EHS F0 20x | 2 kV | 4 mA | 16 | 8 | 3 | 10 | **SHV**, R51.43 | EH160020x4050000200 | SLA, SLP, VCT, ID, IU |
| EHS 80 30x | 3 kV | 3 mA | 8 | 4 | 3 | 10 | **SHV**, R51.41 | EH080030x3050000200 | SLA, SLP, VCT, ID, IU |
| EHS F0 30x | 3 kV | 3 mA | 16 | 8 | 3 | 10 | **SHV**, R51.43 | EH160030x3050000200 | SLA, SLP, VCT, ID, IU |
| EHS 80 40x | 4 kV | 2 mA | 8 | 4 | 3 | 10 | **SHV**, R51.41 | EH080040x2050000200 | SLA, SLP, VCT, ID, IU |
| EHS F0 40x | 4 kV | 2 mA | 16 | 8 | 3 | 10 | **SHV**, R51.43 | EH160040x2050000200 | SLA, SLP, VCT, ID, IU |
| EHS 80 60x | 6 kV | 1 mA | 8 | 3 | 3 | 10 | **S08** | EH080060x1050000300 | SLA, SLP, VCT, ID, IU |
| EHS F0 60x | 6 kV | 1 mA | 16 | 6 | 3 | 10 | **S08** | EH160060x1050000300 | SLA, SLP, VCT, ID, IU |
| EHS 40 80x | 8 kV | 1 mA | 4 | 2.2 | 3 | 10 | **S08** | EH040080x1050000300 | SLA, SLP, VCT, ID, IU |
| EHS 40 100x | 10 kV | 0.75 mA | 4 | 2.2 | 3 | 10 | **S10** | EH040100x7540000400 | SLA, SLP, VCT, ID, IU |
| EHS 40 150x | 15 kV | 0.5 mA | 4 | 2.2 | 3 | 10 | **C15**, S20 | EH040150x5040002300 | SLA, SLP, VCT, ID, IU |
| EHS 40 200x | 20 kV | 0.4 mA | 4 | 2.2 | 3 | 10 | **S20** | EH040200x4040000500 | SLA, SLP, VCT, ID, IU |
| **Floating Ground** | | | | | | | | | |
| EHS 86 01x | 100 V | 10 mA | 8 | 1.5 | 3 | 5 | **SHV**, R51.47 | EH086001x1060000200 | SLA, SLP, F02, F20, ID, IU |
| EHS F6 01x | 100 V | 10 mA | 16 | 3 | 3 | 5 | **SHV**, R51.48 | EH166001x1060000200 | SLA, SLP, F02, F20, ID, IU |
| EHS 86 05x | 500 V | 15 mA | 8 | 4.5 | 3 | 10 | **SHV**, R51.47 | EH086005x1560000200 | SLA, SLP, F02, F20, ID, IU |
| EHS F6 05x | 500 V | 15 mA | 16 | 9 | 3 | 10 | **SHV**, R51.48 | EH166005x1560000200 | SLA, SLP, F02, F20, ID, IU |
| EHS 86 10x | 1 kV | 8 mA | 8 | 4.5 | 3 | 10 | **SHV**, R51.47 | EH086010x8050000200 | SLA, SLP, F02, F20, ID, IU |
| EHS F6 10x | 1 kV | 8 mA | 16 | 9 | 3 | 10 | **SHV**, R51.48 | EH166010x8050000200 | SLA, SLP, F02, F20, ID, IU |
| EHS 86 20x | 2 kV | 4 mA | 8 | 4.5 | 3 | 10 | **SHV**, R51.47 | EH086020x4050000200 | SLA, SLP, F02, F20, ID, IU |
| EHS F6 20x | 2 kV | 4 mA | 16 | 9 | 3 | 10 | **SHV**, R51.48 | EH166020x4050000200 | SLA, SLP, F02, F20, ID, IU |
| EHS 86 30x | 3 kV | 3 mA | 8 | 4.5 | 3 | 10 | **SHV**, R51.47 | EH086030x3050000200 | SLA, SLP, F02, F20, ID, IU |
| EHS F6 30x | 3 kV | 3 mA | 16 | 9 | 3 | 10 | **SHV**, R51.48 | EH166030x3050000200 | SLA, SLP, F02, F20, ID, IU |
| EHS 86 40x | 4 kV | 2 mA | 8 | 4.5 | 3 | 10 | **SHV**, R51.47 | EH086040x2050000200 | SLA, SLP, F02, F20, ID, IU |
| EHS F6 40x | 4 kV | 2 mA | 16 | 9 | 3 | 10 | **SHV**, R51.48 | EH166040x2050000200 | SLA, SLP, F02, F20, ID, IU |
| EHS 86 60x | 6 kV | 1 mA | 8 | 3.5 | 3 | 10 | **S08** | EH086060x1050000300 | SLA, SLP, F02, F20, ID, IU |
| EHS F6 60x | 6 kV | 1 mA | 16 | 7 | 3 | 10 | **S08** | EH166060x1050000300 | SLA, SLP, F02, F20, ID, IU |
| EHS 46 80x | 8 kV | 1 mA | 4 | 2.5 | 3 | 10 | **S08** | EH046080x1050000300 | SLA, SLP, F02, F20, ID, IU |
| EHS 46 100x | 10 kV | 0.75 mA | 4 | 2.5 | 3 | 10 | **S10** | EH046100x7540000400 | SLA, SLP, F02, F20, ID, IU |
| EHS 46 150x | 15 kV | 0.5 mA | 4 | 2.5 | 3 | 10 | **C15**, S20 | EH046150x5040002300 | SLA, SLP, F02, F20, ID, IU |
| EHS 46 200x | 20 kV | 0.4 mA | 4 | 2.5 | 3 | 10 | **S20** | EH046200x4040000500 | SLA, SLP, F02, F20, ID, IU |

*Table 3: Technical data: Configurations of Standard*

| CONFIGURATIONS EHS STANDARD SERIES | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Type** | **$V_{nom}$** | **$I_{nom}$** | **Ch** | **Max. $I_{in}$ (A)** at 24V | **Ripple ($mV_{p-p}$)** >1kHz\|10Hz-1kHz | | **HV connector** **Standard**/opt. | **Item Code** | **Options** |
| **Common Floating Ground – (EHS FLEX)** | | | | | | | | | |
| EHS F5 01x | 100 V | 10 mA | 16 | 1 | 3 | 5 | **SHV** | EH165001x1060000200 | SLA, SLP |
| EHS 185 01x | 100 V | 10 mA | 24 | 1.5 | 3 | 5 | **R51.44** | EH245001x1060004400 | SLA, SLP |
| EHS 305 01x | 100 V | 10 mA | 48 | 3 | 3 | 5 | **R51.46**, I52 | EH485001x1060004600 | SLA, SLP |
| EHS F5 05x | 500 V | 6 mA | 16 | 3 | 3 | 10 | **SHV** | EH165005x6050000200 | SLA, SLP |
| EHS 185 05x | 500 V | 6 mA | 24 | 4.5 | 3 | 10 | **R51.44** | EH245005x6050004400 | SLA, SLP |
| EHS 305 05x | 500 V | 6 mA | 48 | 9 | 3 | 10 | **R51.46**, I52 | EH485005x6050004600 | SLA, SLP |
| EHS F5 10x | 1 kV | 3 mA | 16 | 3 | 3 | 10 | **SHV** | EH165010x3050000200 | SLA, SLP |
| EHS 185 10x | 1 kV | 3 mA | 24 | 4.5 | 3 | 10 | **R51.44** | EH245010x3050004400 | SLA, SLP |
| EHS 305 10x | 1 kV | 3 mA | 48 | 9 | 3 | 10 | **R51.46**, I52 | EH485010x3050004600 | SLA, SLP |
| EHS F5 20x | 2 kV | 1.5 mA | 16 | 3 | 3 | 10 | **SHV** | EH165020x1550000200 | SLA, SLP |
| EHS 185 20x | 2 kV | 1.5 mA | 24 | 4.5 | 3 | 10 | **R51.44** | EH245020x1550004400 | SLA, SLP |
| EHS 305 20x | 2 kV | 1.5 mA | 48 | 9 | 3 | 10 | **R51.46**, I52 | EH485020x1550004600 | SLA, SLP |
| EHS F5 30x | 3 kV | 1 mA | 16 | 3 | 3 | 10 | **SHV** | EH165030x1050000200 | SLA, SLP |
| EHS 185 30x | 3 kV | 1 mA | 24 | 4.5 | 3 | 10 | **R51.44** | EH245030x1050004400 | SLA, SLP |
| EHS 305 30x | 3 kV | 1 mA | 48 | 9 | 3 | 10 | **R51.46**, I52 | EH485030x1050004600 | SLA, SLP |

*Table 4: Technical data: Configurations of Standard / Flex series*

## 2.2 Technical data: EHS High Precision series

| SPECIFICATIONS | EHS HP CFG | EHS HP FG |
|---|---|---|
| Polarity | Factory fixed, positive or negative | |
| Floating principle | Common Floating Ground | Single Floating Ground |
| Potential difference | 56 V channel/GND | 20 V channel/channel/GND, optionally up to 2 kV |
| Ripple and noise (f > 10 Hz) | < 3 – 10 $mV_{p-p}$ | |
| Ripple and noise (f > 1 kHz) | < 1 – 2 $mV_{p-p}$ | |
| Ripple and noise (f > 10 Hz – 0.1 Hz) | < 5 – 30 $mV_{p-p}$ | |
| **Stablity** | | |
| Stability – [$\Delta V_{out}$ vs. $\Delta V_{in}$] | < 1 • $10^{-5}$ • $V_{nom}$ | |
| Stability – [$\Delta V_{out}$ vs. $\Delta R_{load}$] | < 1 • $10^{-4}$ • $V_{nom}$ | |
| Long Term Stability (1h Warmup) 24h | < 2 • $10^{-5}$ • $V_{nom}$ | |
| Temperature coefficient | < 30 ppm / K \| < 10 ppm / K (option T10) | |
| **Resolution** – The resolution of measurable values depends on the settings of the sampling rate and the digital filter! | | |
| Resolution voltage setting | 2 • $10^{-6}$ • $V_{nom}$ | |
| Resolution current setting [$I_{out}$ > 20 µA] | 2 • $10^{-6}$ • $I_{nom}$ | |
| Resolution voltage measurement [1] | 1 • $10^{-6}$ • $V_{nom}$ | |
| Resolution current measurement [$I_{out}$ > 20 µA] [1] | 1 • $10^{-6}$ • $I_{nom}$ | |
| Resolution current measurement [$I_{out}$ < 20 µA] [1] | 50pA | |
| **Measurement accuracy** – The measurement accuracy is guaranteed in the range 1% • $V_{nom}$ < $V_{out}$ < $V_{nom}$ and 1 year | | |
| Accuracy voltage measurement | ± (0.01 % • $V_{out}$ + 0.01 % • $V_{nom}$) | |
| Accuracy current measurement [$I_{out}$ > 20 µA] | ± (0.01 % • $I_{out}$ + 0.02 % • $I_{nom}$) | |
| Accuracy current measurement [$I_{out}$ < 20 µA] | ± (0.01 % • $I_{out}$ + 4 nA) | |
| Sample rates ADC (SPS) | 5, 10, 25, **50** [2], 60, 100, 500 | 5, 10, 25, **50** [2], 60 |
| Digital filter averages | 1, 16, **64** [2], 256, 512, 1024 | |
| Voltage ramp | 1•$10^{-6}$ • $V_{nom}$ up to 0.2 • $V_{nom}$ | |
| Hardware limits | Potentiometer per module [$V_{max}$ / $I_{max}$] | |
| Limit Monitor voltage | 2.5 V | |
| Digital Interface | CAN | |
| Protection | Safety loop, overload and short circuit protected, optionally INHIBIT per channel (ID / IU, NID / NIU) (**ATTENTION:** there is only one short circuit or arc per second allowed!) | |
| HV connector | R51 \| SHV \| S08 \| C15 \| S20 | |
| System connector | 96 PIN | |
| Safety loop connector | Lemo 2pole | |
| Limit monitor connector | Lemo 2pole | Lemo 1pole |
| Case | 19 inch plug-in cassette | |
| Dimensions – L/W/H | 220mm / 8HP / 6U | |

| SPECIFICATIONS | EHS HP CFG | EHS HP FG |
|---|---|---|
| Operating temperature | 0 ... 40 °C | |
| Storage temperature | -20 ... 60 °C | |
| Humidity | 20 – 80 %, not condensing | |
| Notes:<br>[1)] The resolution of measurable values depends on the settings of the sampling rate and the digital filter!<br>[2)] Factory Settings | | |

*Table 5: Technical data: Specifications EHS High Precision*

| CONFIGURATIONS EHS HIGH PRECISION SERIES | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Type** | **$V_{nom}$** | **$I_{nom}$** | **Ch** | **Max. $I_{in}$ (A)** at 24V | **Ripple ($mV_{pp}$)** >1kHz\|10Hz-1kHz\|0.1-10Hz | | | **HV Connector Standard/**opt. | **Item Code** | **Options** |
| **Common Floating Ground** | | | | | | | | | | |
| EHS 82 01x | 100 V | 10 mA | 8 | 1 | 2 | 3 | 5 | **SHV,** R51.41 | EH082001x1060000200 | SLA, SLP, TC, VCT, 1CR, ID, IU |
| EHS F2 01x | 100 V | 10 mA | 16 | 2 | 2 | 3 | 5 | **SHV,** R51.43 | EH162001x1060000200 | SLA, SLP, TC, VCT, 1CR, ID, IU |
| EHS 82 05x | 500 V | 10 mA | 8 | 4 | 2 | 5 | 5 | **SHV,** R51.41 | EH082005x1060000200 | SLA, SLP, TC, VCT, 1CR, ID, IU |
| EHS F2 05x | 500 V | 10 mA | 16 | 8 | 2 | 5 | 5 | **SHV,** R51.43 | EH162005x1060000200 | SLA, SLP, TC, VCT, 1CR, ID, IU |
| EHS 82 10x | 1 kV | 8 mA | 8 | 4 | 2 | 5 | 5 | **SHV,** R51.41 | EH082010x8050000200 | SLA, SLP, TC, VCT, 1CR, ID, IU |
| EHS F2 10x | 1 kV | 8 mA | 16 | 8 | 2 | 5 | 5 | **SHV,** R51.43 | EH162010x8050000200 | SLA, SLP, TC, VCT, 1CR, ID, IU |
| EHS 82 20x | 2 kV | 4 mA | 8 | 4 | 2 | 5 | 5 | **SHV,** R51.41 | EH082020x4050000200 | SLA, SLP, TC, VCT, 1CR, ID, IU |
| EHS F2 20x | 2 kV | 4 mA | 16 | 8 | 2 | 5 | 5 | **SHV,** R51.43 | EH162020x4050000200 | SLA, SLP, TC, VCT, 1CR, ID, IU |
| EHS 82 30x | 3 kV | 3 mA | 8 | 4 | 2 | 5 | 10 | **SHV,** R51.41 | EH082030x3050000200 | SLA, SLP, TC, VCT, 1CR, ID, IU |
| EHS F2 30x | 3 kV | 3 mA | 16 | 8 | 2 | 5 | 10 | **SHV,** R51.43 | EH162030x3050000200 | SLA, SLP, TC, VCT, 1CR, ID, IU |
| EHS 82 40x | 4 kV | 2 mA | 8 | 4 | 2 | 5 | 10 | **SHV** | EH082040x2050000200 | SLA, SLP, TC, VCT, 1CR, ID, IU |
| EHS F2 40x | 4 kV | 2 mA | 16 | 8 | 2 | 5 | 10 | **SHV** | EH162040x2050000200 | SLA, SLP, TC, VCT, 1CR, ID, IU |
| EHS 82 60x | 6 kV | 1 mA | 8 | 3 | 2 | 10 | 15 | **S08** | EH082060x1050000300 | SLA, SLP, TC, VCT, 1CR, ID, IU |
| EHS F2 60x | 6 kV | 1 mA | 16 | 6 | 2 | 10 | 15 | **S08** | EH162060x1050000300 | SLA, SLP, TC, VCT, 1CR, ID, IU |
| EHS 42 80x | 8 kV | 1 mA | 4 | 2.2 | 2 | 5 | 10 | **S08** | EH042080x1050000300 | SLA, SLP, VCT, 1CR, ID, IU |
| EHS 42 100x | 10 kV | 0.75 mA | 4 | 2.2 | 2 | 5 | 20 | **S10** | EH042100x7540000400 | SLA, SLP, VCT, 1CR, ID, IU |
| EHS 42 150x | 15 kV | 0.5 mA | 4 | 2.2 | 2 | 5 | 30 | **C15**, S20 | EH042150x5040002300 | SLA, SLP, VCT, 1CR, ID, IU |
| EHS 42 200x | 20 kV | 0.4 mA | 4 | 2.2 | 2 | 7 | 30 | **S20** | EH042200x4040000500 | SLA, SLP, VCT, 1CR, ID, IU |

*Table 6: Technical data: Configurations of Common Floating Ground*

| CONFIGURATIONS EHS HIGH PRECISION SERIES | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Type** | **$V_{nom}$** | **$I_{nom}$** | **Ch** | **Max. $I_{in}$ (A)** at 24V | **Ripple ($mV_{pp}$)** >1kHz\|10Hz-1kHz\|0.1-10Hz | | | **HV Connector Standard/**opt. | **Item Code** | **Options** |
| **Common Floating Ground L** | | | | | | | | | | |
| EHS 82 01x | 100 V | 100 µA | 8 | 0.4 | 1 | 1 | 5 | **SHV,** R51.41 | EH082001x1040000200 | SLA, SLP, TC, VCT, ID, IU |
| EHS F2 01x | 100 V | 100 µA | 16 | 0.8 | 1 | 1 | 5 | **SHV,** R51.43 | EH162001x1040000200 | SLA, SLP, TC, VCT, ID, IU |
| EHS 82 05x | 500 V | 100 µA | 8 | 0.4 | 1 | 5 | 5 | **SHV,** R51.41 | EH082005x1040000200 | SLA, SLP, TC, VCT, ID, IU |
| EHS F2 05x | 500 V | 100 µA | 16 | 0.8 | 1 | 5 | 5 | **SHV,** R51.43 | EH162005x1040000200 | SLA, SLP, TC, VCT, ID, IU |
| EHS 82 10x | 1 kV | 100 µA | 8 | 0.4 | 1 | 5 | 5 | **SHV,** R51.41 | EH082010x1040000200 | SLA, SLP, TC, VCT, ID, IU |
| EHS F2 10x | 1 kV | 100 µA | 16 | 0.8 | 1 | 5 | 5 | **SHV,** R51.43 | EH162010x1040000200 | SLA, SLP, TC, VCT, ID, IU |
| EHS 82 20x | 2 kV | 100 µA | 8 | 0.4 | 1 | 5 | 5 | **SHV,** R51.41 | EH082020x1040000200 | SLA, SLP, TC, VCT, ID, IU |
| EHS F2 20x | 2 kV | 100 µA | 16 | 0.8 | 1 | 5 | 5 | **SHV,** R51.43 | EH162020x1040000200 | SLA, SLP, TC, VCT, ID, IU |
| EHS 82 30x | 3 kV | 100 µA | 8 | 0.4 | 1 | 5 | 10 | **SHV,** R51.41 | EH082030x1040000200 | SLA, SLP, TC, VCT, ID, IU |
| EHS F2 30x | 3 kV | 100 µA | 16 | 0.8 | 1 | 5 | 10 | **SHV,** R51.43 | EH162030x1040000200 | SLA, SLP, TC, VCT, ID, IU |
| EHS 82 40x | 4 kV | 100 µA | 8 | 0.5 | 1 | 5 | 10 | **SHV** | EH082040x1040000200 | SLA, SLP, TC, VCT, ID, IU |
| EHS F2 40x | 4 kV | 100 µA | 16 | 1 | 1 | 5 | 10 | **SHV** | EH162040x1040000200 | SLA, SLP, TC, VCT, ID, IU |
| EHS 82 60x | 6 kV | 100 µA | 8 | 0.5 | 1 | 5 | 10 | **S08** | EH082060x1040000300 | SLA, SLP, TC, VCT, ID, IU |
| EHS F2 60x | 6 kV | 100 µA | 16 | 1 | 1 | 5 | 10 | **S08** | EH162060x1040000300 | SLA, SLP, TC, VCT, ID, IU |
| EHS 42 80x | 8 kV | 100 µA | 4 | 0.5 | 1 | 5 | 10 | **S08** | EH042080x1040000300 | SLA, SLP, VCT, ID, IU |
| EHS 42 100x | 10 kV | 100 µA | 4 | 0.5 | 1 | 5 | 20 | **S10** | EH042100x1040000400 | SLA, SLP, VCT, ID, IU |
| EHS 42 150x | 15 kV | 100 µA | 4 | 0.8 | 1 | 5 | 30 | **C15**, S20 | EH042150x1040002300 | SLA, SLP, VCT, ID, IU |
| EHS 42 200x | 20 kV | 100 µA | 4 | 1 | 1 | 5 | 30 | **S20** | EH042200x1040000500 | SLA, SLP, VCT, ID, IU |

*Tabelle 7: Technical data: Configurations of Common Floating Ground L*

| CONFIGURATIONS EHS HIGH PRECISION SERIES | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Type** | **$V_{nom}$** | **$I_{nom}$** | **Ch** | **Max. $I_{in}$ (A)** at 24V | **Ripple ($mV_{pp}$)** >1kHz \| 10Hz-1kHz \| 0.1-10Hz | | | **HV Connector Standard/**opt. | **Item Code** | **Options** |
| **Floating Ground** | | | | | | | | | | |
| EHS 84 01x | 100 V | 10 mA | 8 | 1,5 | 2 | 3 | 5 | **SHV,** R51.47 | EH084001x1060000200 | SLA, SLP, TC, 1CR, F02, F20, ID, IU |
| EHS F4 01x | 100 V | 10 mA | 16 | 3 | 2 | 3 | 5 | **SHV,** R51.48 | EH164001x1060000200 | SLA, SLP, TC, 1CR, F02, F20, ID, IU |
| EHS 84 05x | 500 V | 10 mA | 8 | 4.5 | 2 | 5 | 5 | **SHV,** R51.47 | EH084005x1060000200 | SLA, SLP, TC, 1CR, F02, F20, ID, IU |
| EHS F4 05x | 500 V | 10 mA | 16 | 9 | 2 | 5 | 5 | **SHV,** R51.48 | EH164005x1060000200 | SLA, SLP, TC, 1CR, F02, F20, ID, IU |
| EHS 84 10x | 1 kV | 8 mA | 8 | 4.5 | 2 | 5 | 5 | **SHV,** R51.47 | EH084010x8050000200 | SLA, SLP, TC, 1CR, F02, F20, ID, IU |
| EHS F4 10x | 1 kV | 8 mA | 16 | 9 | 2 | 5 | 5 | **SHV,** R51.48 | EH164010x8050000200 | SLA, SLP, TC, 1CR, F02, F20, ID, IU |
| EHS 84 20x | 2 kV | 4 mA | 8 | 4.5 | 2 | 5 | 5 | **SHV,** R51.47 | EH084020x4050000200 | SLA, SLP, TC, 1CR, F02, F20, ID, IU |
| EHS F4 20x | 2 kV | 4 mA | 16 | 9 | 2 | 5 | 5 | **SHV,** R51.48 | EH164020x4050000200 | SLA, SLP, TC, 1CR, F02, F20, ID, IU |
| EHS 84 30x | 3 kV | 3 mA | 8 | 4.5 | 2 | 5 | 10 | **SHV,** R51.47 | EH084030x3050000200 | SLA, SLP, TC, 1CR, F02, F20, ID, IU |
| EHS F4 30x | 3 kV | 3 mA | 16 | 9 | 2 | 5 | 10 | **SHV,** R51.48 | EH164030x3050000200 | SLA, SLP, TC, 1CR, F02, F20, ID, IU |
| EHS 84 40x | 4 kV | 2 mA | 8 | 4.5 | 2 | 5 | 10 | **SHV** | EH084040x2050000200 | SLA, SLP, TC, 1CR, F02, F20, ID, IU |
| EHS F4 40x | 4 kV | 2 mA | 16 | 9 | 2 | 5 | 10 | **SHV** | EH164040x2050000200 | SLA, SLP, TC, 1CR, F02, F20, ID, IU |
| EHS 84 60x | 6 kV | 1 mA | 8 | 3.5 | 2 | 10 | 15 | **S08** | EH084060x1050000300 | SLA, SLP, TC, 1CR, F02, F20, ID, IU |
| EHS F4 60x | 6 kV | 1 mA | 16 | 7 | 2 | 10 | 15 | **S08** | EH164060x1050000300 | SLA, SLP, TC, 1CR, F02, F20, ID, IU |
| EHS 44 80x | 8 kV | 1 mA | 4 | 2.5 | 2 | 5 | 10 | **S08** | EH044080x1050000300 | SLA, SLP, 1CR, F02, F20, ID, IU |
| EHS 44 100x | 10 kV | 0.75 mA | 4 | 2.5 | 2 | 5 | 20 | **S10** | EH044100x7540000400 | SLA, SLP, 1CR, F02, F20, ID, IU |
| EHS 44 150x | 15 kV | 0.5 mA | 4 | 2.5 | 2 | 5 | 30 | **C15**, S20 | EH044150x5040002300 | SLA, SLP, 1CR, F02, F20, ID, IU |
| EHS 44 200x | 20 kV | 0.4 mA | 4 | 2.5 | 2 | 7 | 30 | **S20** | EH044200x4040000500 | SLA, SLP, 1CR, F02, F20, ID, IU |
| **Floating Ground L** | | | | | | | | | | |
| EHS 84 01x | 100 V | 100 µA | 8 | 0.8 | 1 | 1 | 5 | **SHV,** R51.47 | EH084001x1040000200 | SLA, SLP, TC, F02, F20, ID, IU |
| EHS F4 01x | 100 V | 100 µA | 16 | 1.5 | 1 | 1 | 5 | **SHV,** R51.48 | EH164001x1040000200 | SLA, SLP, TC, F02, F20, ID, IU |
| EHS 84 05x | 500 V | 100 µA | 8 | 0.8 | 1 | 5 | 5 | **SHV,** R51.47 | EH084005x1040000200 | SLA, SLP, TC, F02, F20, ID, IU |
| EHS F4 05x | 500 V | 100 µA | 16 | 1.5 | 1 | 5 | 5 | **SHV,** R51.48 | EH164005x1040000200 | SLA, SLP, TC, F02, F20, ID, IU |
| EHS 84 10x | 1 kV | 100 µA | 8 | 0.8 | 1 | 5 | 5 | **SHV,** R51.47 | EH084010x1040000200 | SLA, SLP, TC, F02, F20, ID, IU |
| EHS F4 10x | 1 kV | 100 µA | 16 | 1.5 | 1 | 5 | 5 | **SHV,** R51.48 | EH164010x1040000200 | SLA, SLP, TC, F02, F20, ID, IU |
| EHS 84 20x | 2 kV | 100 µA | 8 | 0.8 | 1 | 5 | 5 | **SHV,** R51.47 | EH084020x1040000200 | SLA, SLP, TC, F02, F20, ID, IU |
| EHS F4 20x | 2 kV | 100 µA | 16 | 1.5 | 1 | 5 | 5 | **SHV,** R51.48 | EH164020x1040000200 | SLA, SLP, TC, F02, F20, ID, IU |
| EHS 84 30x | 3 kV | 100 µA | 8 | 0.8 | 1 | 5 | 10 | **SHV,** R51.47 | EH084030x1040000200 | SLA, SLP, TC, F02, F20, ID, IU |
| EHS F4 30x | 3 kV | 100 µA | 16 | 1.5 | 1 | 5 | 10 | **SHV,** R51.48 | EH164030x1040000200 | SLA, SLP, TC, F02, F20, ID, IU |
| EHS 84 40x | 4 kV | 100 µA | 8 | 1 | 1 | 5 | 10 | **SHV** | EH084040x1040000200 | SLA, SLP, TC, F02, F20, ID, IU |
| EHS F4 40x | 4 kV | 100 µA | 16 | 2 | 1 | 5 | 10 | **SHV** | EH164040x1040000200 | SLA, SLP, TC, F02, F20, ID, IU |
| EHS 84 60x | 6 kV | 100 µA | 8 | 1 | 1 | 5 | 10 | **S08** | EH084060x1040000300 | SLA, SLP, TC, F02, F20, ID, IU |
| EHS F4 60x | 6 kV | 100 µA | 16 | 2 | 1 | 5 | 10 | **S08** | EH164060x1040000300 | SLA, SLP, TC, F02, F20, ID, IU |
| EHS 44 80x | 8 kV | 100 µA | 4 | 0.8 | 1 | 5 | 10 | **S08** | EH044080x1040000300 | SLA, SLP, F02, F20, ID, IU |
| EHS 44 100x | 10 kV | 100 µA | 4 | 0.8 | 1 | 5 | 10 | **S10** | EH044100x1040000400 | SLA, SLP, F02, F20, ID, IU |
| EHS 44 150x | 15 kV | 100 µA | 4 | 1 | 1 | 5 | 10 | **C15**, S20 | EH044150x1040002300 | SLA, SLP, F02, F20, ID, IU |
| EHS 44 200x | 20 kV | 100 µA | 4 | 2 | 1 | 5 | 10 | **S20** | EH044200x1040000500 | SLA, SLP, F02, F20, ID, IU |

*Table 8: Technical data: Configurations of Floating Ground and Floating Ground L*

## 2.3 Options

| OPTIONS | OPTION CODE | EXAMPLE | ITEM CODE HEX CODING |
|---|---|---|---|
| **POLARITY** | Positive: **x = p**,<br>Negative **x = n** | EHS 82 05**p** | |
| **VERY LOW NOISE (only EHS CG Series)** | **VLN** | | 010 |
| **SINGLE CHANNEL INHIBIT - down** | **ID** | | 400 |
| **SINGLE CHANNEL INHIBIT - up** | **IU** | | 800 |
| **NEGATED LOGIC INHIBIT ID, IU** | **N** | | 80 |
| **VOLTAGE CORRECTION by TEMPERATURE** | **VCT** | | 008 |
| **LOWER TEMPERATURE COEFFICIENT** | **TC** | T10 | 004 |
| **ACTIVE SAFETY LOOP** | **SLA** | | 001 |
| **INTERNALLY POWERED SAFETY LOOP** | **SLP** | | 002 |
| **ONLY ONE CURRENT RAGE FOR HIGH PRECISION MODULES** | **1CR** | | 020 |
| **200 V ISOLATION FOR FLOATING GND** | **F02** | | 100 |
| **2,000 V ISOLATION FOR FLOATING GND** | **F20** | | 200 |
| **LOWER OUTPUT CURRENT** [1] | **L** ($I_{nom}$ = 100 µA) | | – |
| Notes:<br>[1] Requires option „1CR“. | | | |

*Table 9: Technical data: Options and order information*

# 3 Handling

## 3.1 Connection

The supply voltages and the CAN interface are connected to the module via a 96-pin connector on the rear side of the module. The physical address of the module, determined by the slot position in the crate, is also accessible via this connector Modules and crate controllers with different settings of bit rate do not work on the same CAN-Line.

**INFORMATION**


Note: For proper operation the module must be configured with the correct CAN bitrate, which meets the configuration of the crate controller, the module will be used with. The delivery condition is shown on the modules typeplate (side plate of the module).
Typically newer iseg crate controllers (CC24, CC23, CC238) are delivered with 250kBits/s standard. Wiener M-POD Controller and older iseg hardware is set on 125 kBit/s standard bitrate.

**INFORMATION**


Note: EHS modules with Common Floating Ground (CFG) will be delivered with a jumper, which connects the module-GND with the crate-GND. To operate in CFG configuration the jumper (CG-CFG) on the module back must be removed. (*see: Dimensional drawing*)

## 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<br>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 voltage on output is more than 56V |
| green LED blinking | Firmware update is stored into flash, do not switch of power supply, crate etc. |

*Table 10: 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 and current are limited to the specified value. If a limit is reached or exceeded in any channel the green LED “OK” at 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, the corresponding bit in ModuleStatus is canceled and in ModuleEventStatus ist set (see *CAN_EDCP_Programmers-Guide.pdf*). 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. 3 V. By factory setup the safety loop is not active (the corresponding bits are always set). The loop can be activated by removing the jumper “SL-disable” on the rear side of the module.

## 3.5 Delayed Trip

### 3.5.1 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 manual *CAN_EDCP_Programmers-Guide.pdf* (see **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.

### 3.5.2 Limitations

For some older types of HV modules with single-channel floating GND the current set value cannot be set exactly to zero (e.g., due to an uncompensatable offset). For these modules, the limitation of the output current to very low values (< 0.5 % $I_{nom}$) is not guaranteed.

For all recent EHS models the value of the set current can be continuously adjusted with the type-specific resolution down to zero.

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 or 10 µA in all voltage classes. These are designated e.g. for semiconductor detectors, which only require a few microampere operating current.

### 3.5.3 Modules with two current measurement ranges

High Precision HV 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 specified, 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 microamps 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 (for EHS CFG) – 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 11: 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 front panel of the HV-module. The direction of the male connector does not matter.

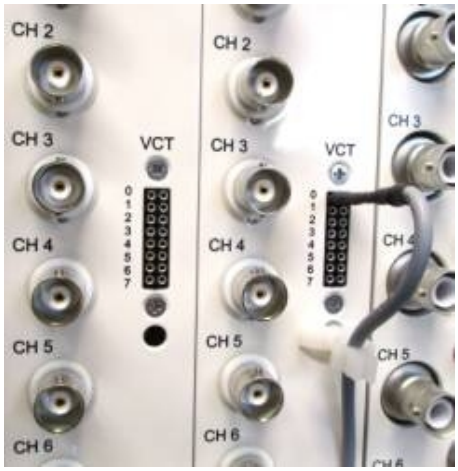



*Figure 1: VCT modul*

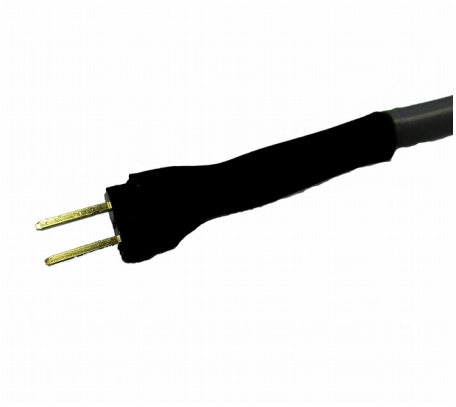


*Figure 2: VCT*

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 ($T_{ref}$) of the corresponding sensor and the set voltage as reference values.

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

$$V = V_{ref} + a \bullet (T - T_{ref})$$ **(a...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.

Note:

- 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.pdf" (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 or LEMO-connector. The assignment of the channels is described in detail in the appendix (see 7.Connectors and PIN assignments).

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 "6.5.1.7 External channel inhibit" in the CAN_EDCP_Programmers-Guide.pdf):

- 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.

## 4.3 SLA – Active safety loop

Actively opens the Safety loop in case of a trip or a delayed trip. This option allows to shut down other modules and devices by interrupting the SL when a trip is detected.

## 4.4 SLP – Internally powered safety loop

Internal current source for the Safety Loop (no galvanic isolation of the SL and the crate GND).

## 4.5 1CR – One current measurement range only (HP series)

Only one current measurement range for High Precision Modules.

## 4.6 F02 – High floating voltage

200 V isolation for Modules with FG.

## 4.7 F20 – Very high floating voltage

2.000 V isolation for Modules with FG.

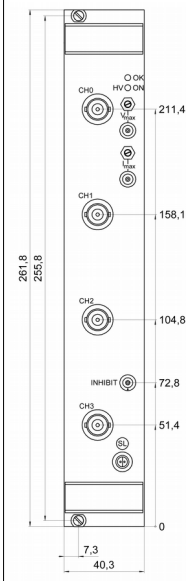
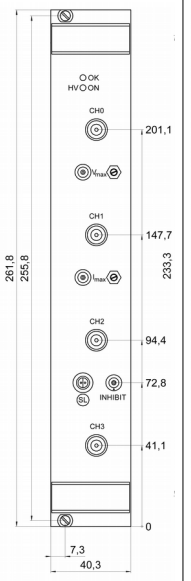
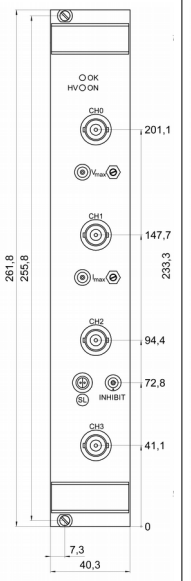
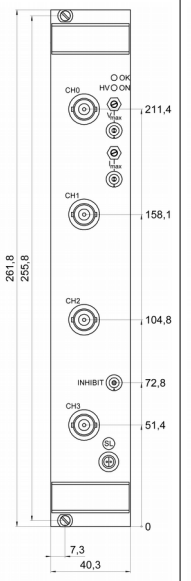
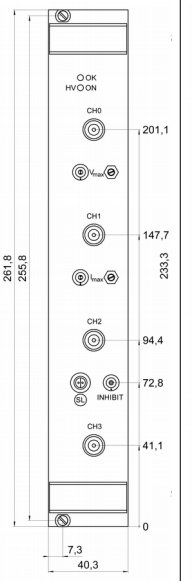
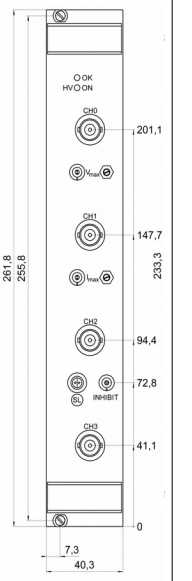
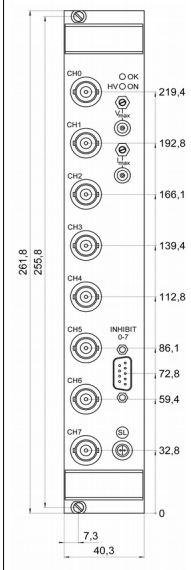
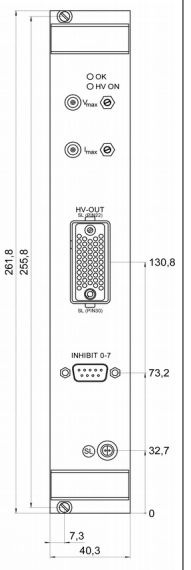
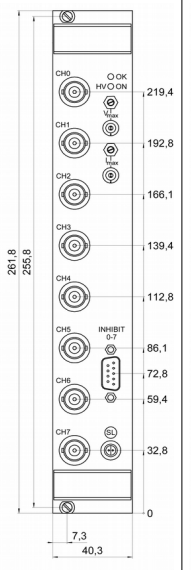
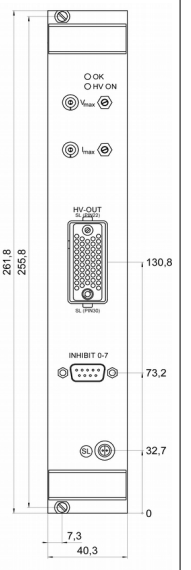
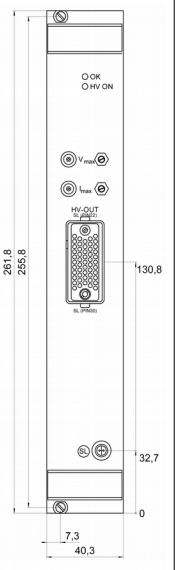
## 4.8 TC – Lower temperature coefficient

Improved temperature coefficient of 10ppm/K (T10).

## 4.9 VLN

Reduced ripple see technical data.

# 5 Front panel versions

| FRONT PANELS | | | | | | |
|---|---|---|---|---|---|---|
| Channels | 4 | 4 | 4 | 4 | 4 | 4 |
| Floating | FG | FG | FG | CFG | CFG | CFG |
| HV Connector | SHV / S10 | C15 | S20 | SHV / S10 | C15 | S20 |
| Options | INHIBIT | INHIBIT | INHIBIT | INHIBIT | INHIBIT | INHIBIT |
| Figure |  |  |  |  |  |  |
| **FRONT PANELS** | | | | | | |
| Channels | 8 | 8 | 8 | 8 | | 32 |
| Floating | FG | FG | CFG | CFG | | CG |
| HV Connector | SHV / S08 | R51 | SHV / S08 | R51 | | R51 |
| Options | INHIBIT | INHIBIT | INHIBIT | INHIBIT | | - |
| Figure |  |  |  |  | |  |

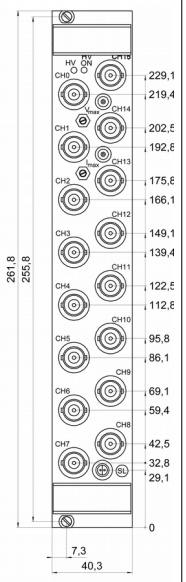
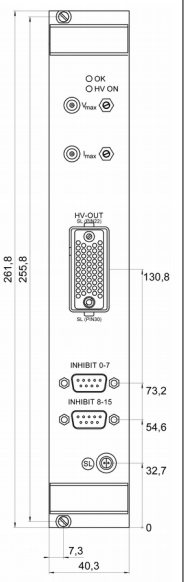
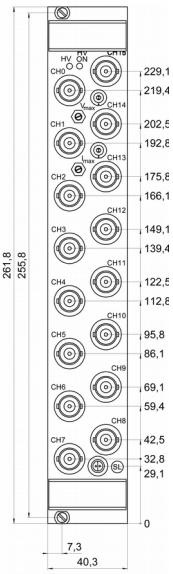
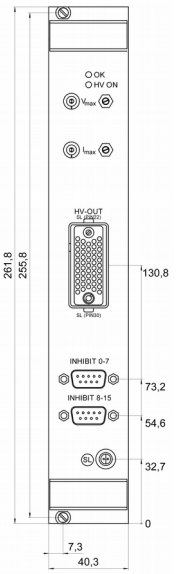
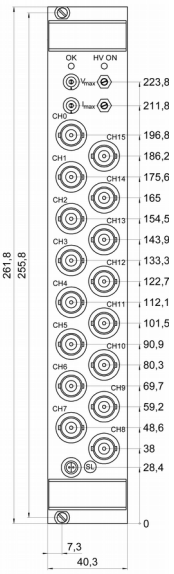
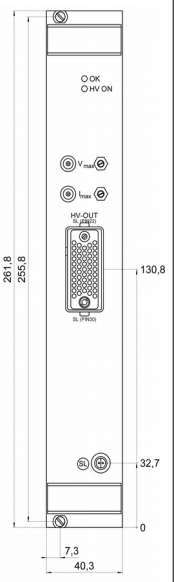
| FRONT PANELS | | | | | | |
|---|---|---|---|---|---|---|
| Channels | 16 | 16 | 16 | 16 | 16 | 16 |
| Floating | FG | FG | CFG | CFG | CFG | CG |
| HV Connector | SHV /S08 | R51 | SHV /S08 | R51 | SHV /S08 | R51 |
| Options | - | INHIBIT | - | INHIBIT | - | - |
| Figure |  |  |  |  |  |  |

*Table 12: Front panel versions*

# 6 Dimensional Drawings

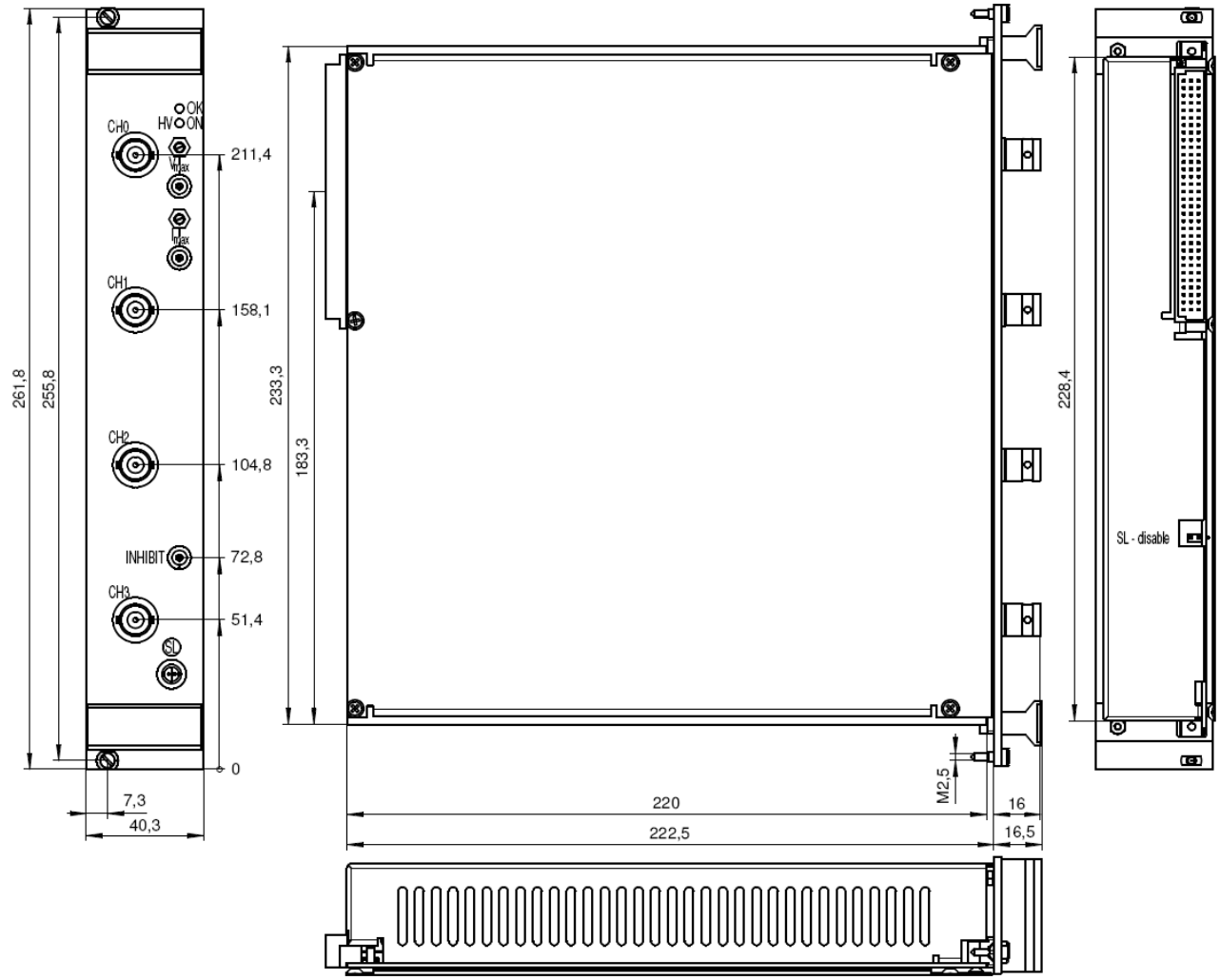



*Figure 3: 4 channels with SHV*

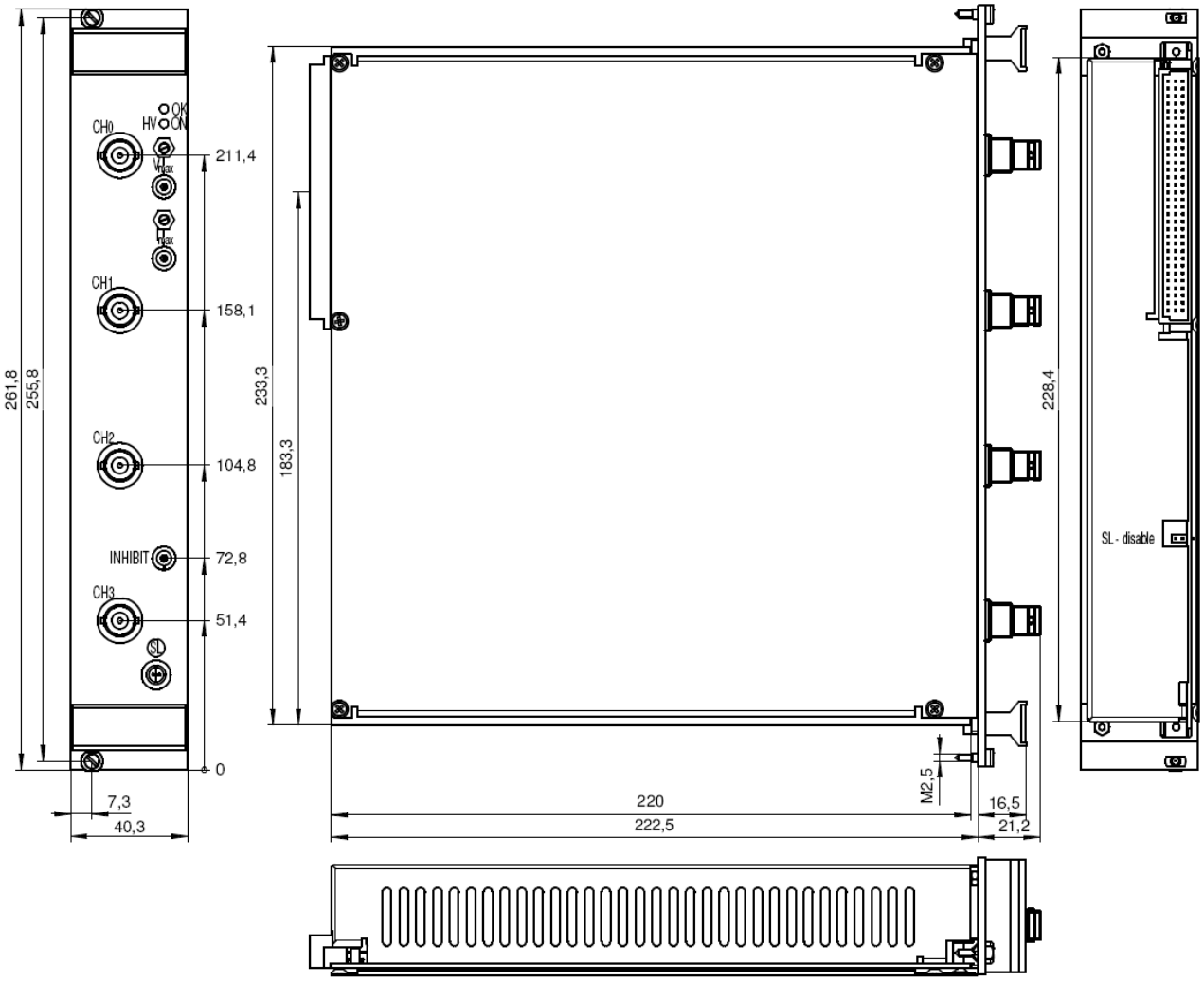



*Figure 4: 4 channels with S10*

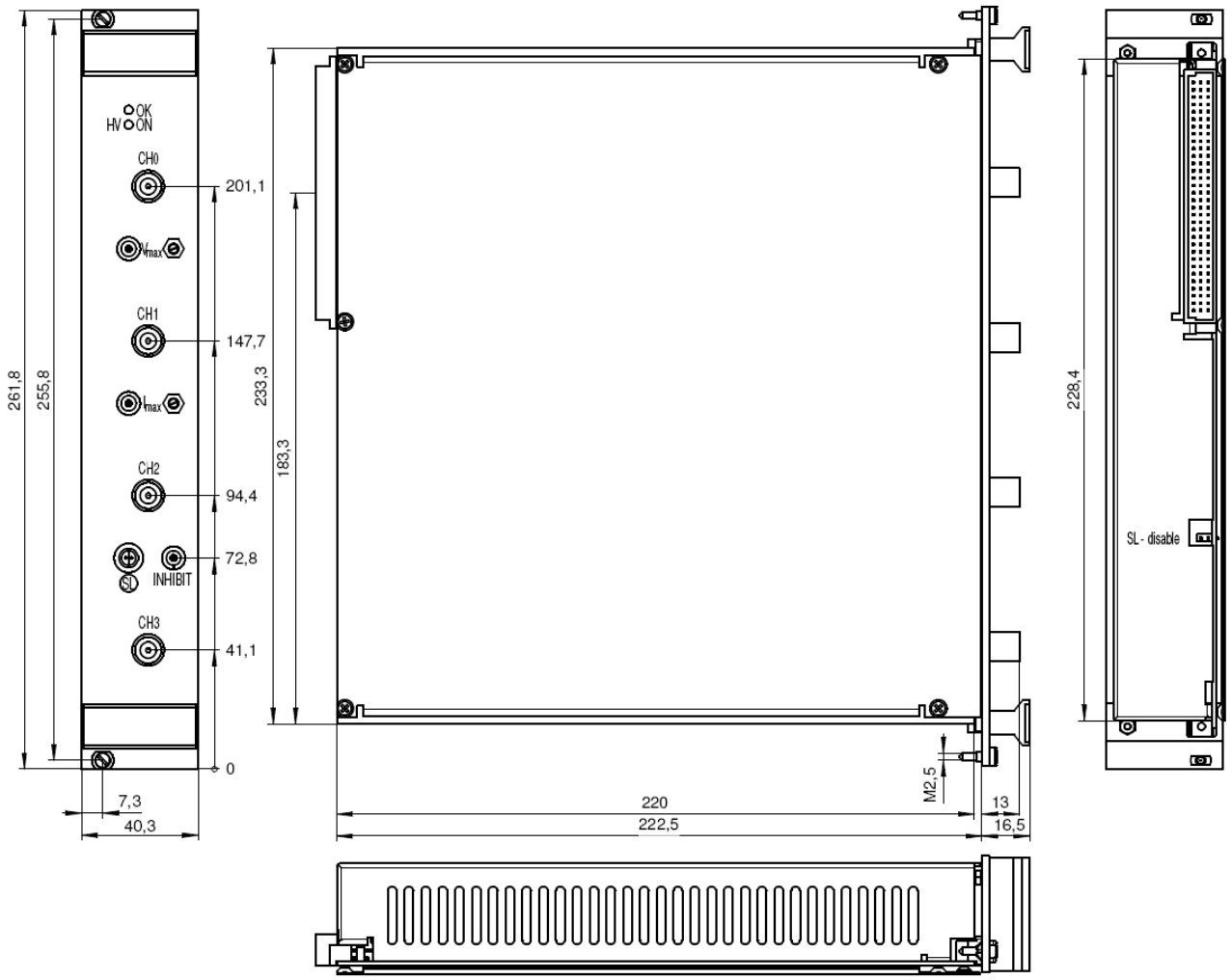



*Figure 5: 4 channels with S15*

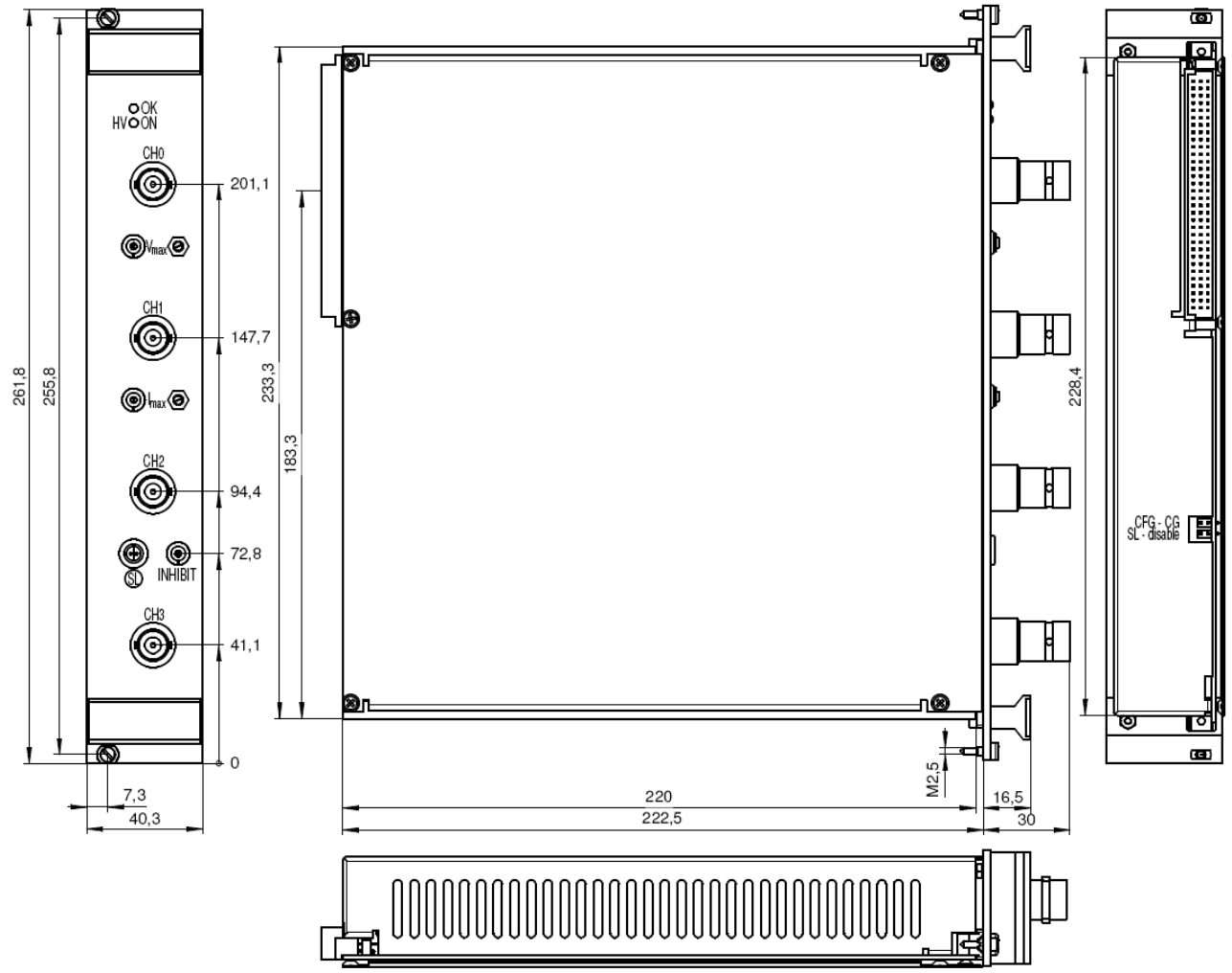



*Figure 6: 4 channels with S20*

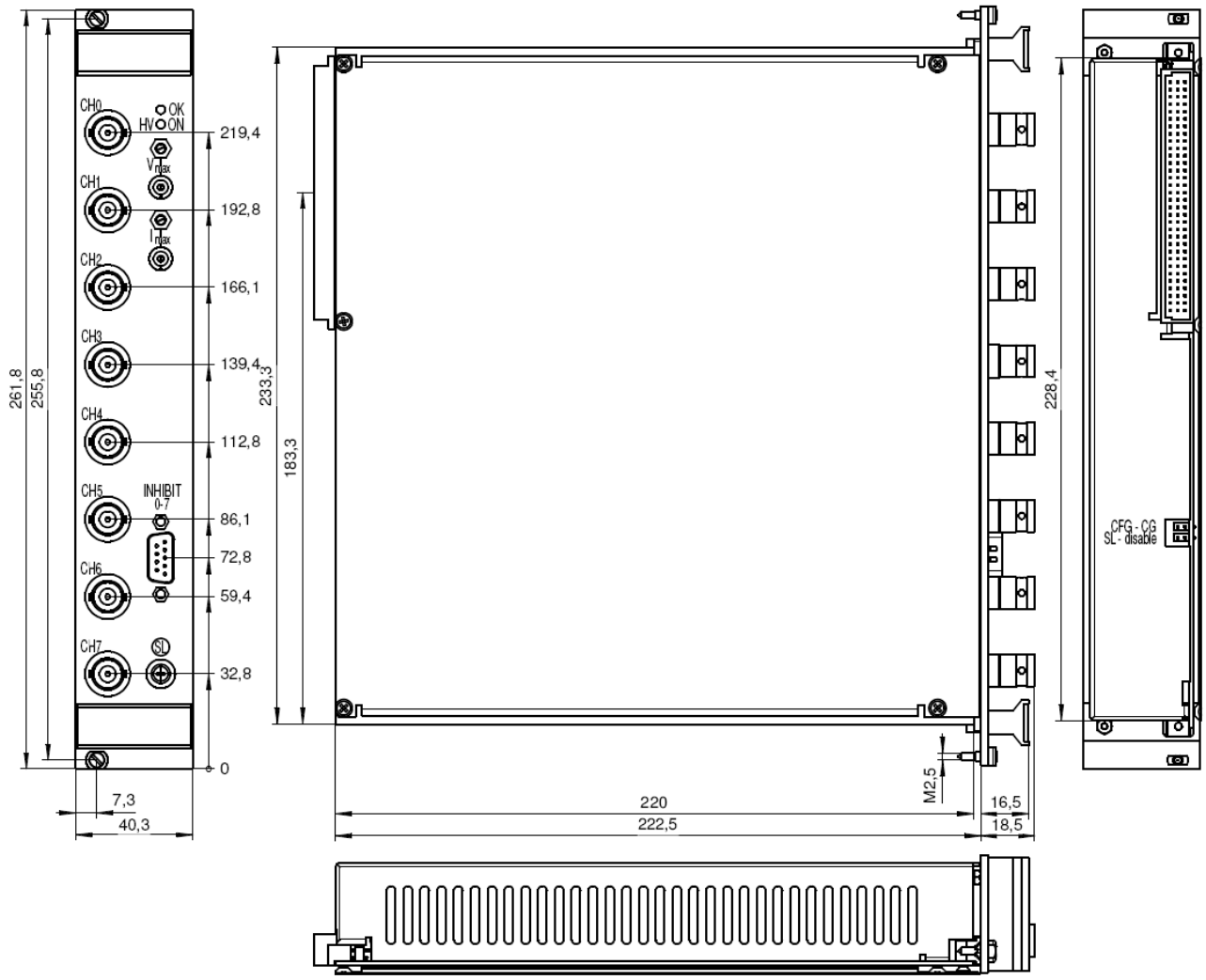



*Figure 7: 8 channels with SHV and Inhibit*

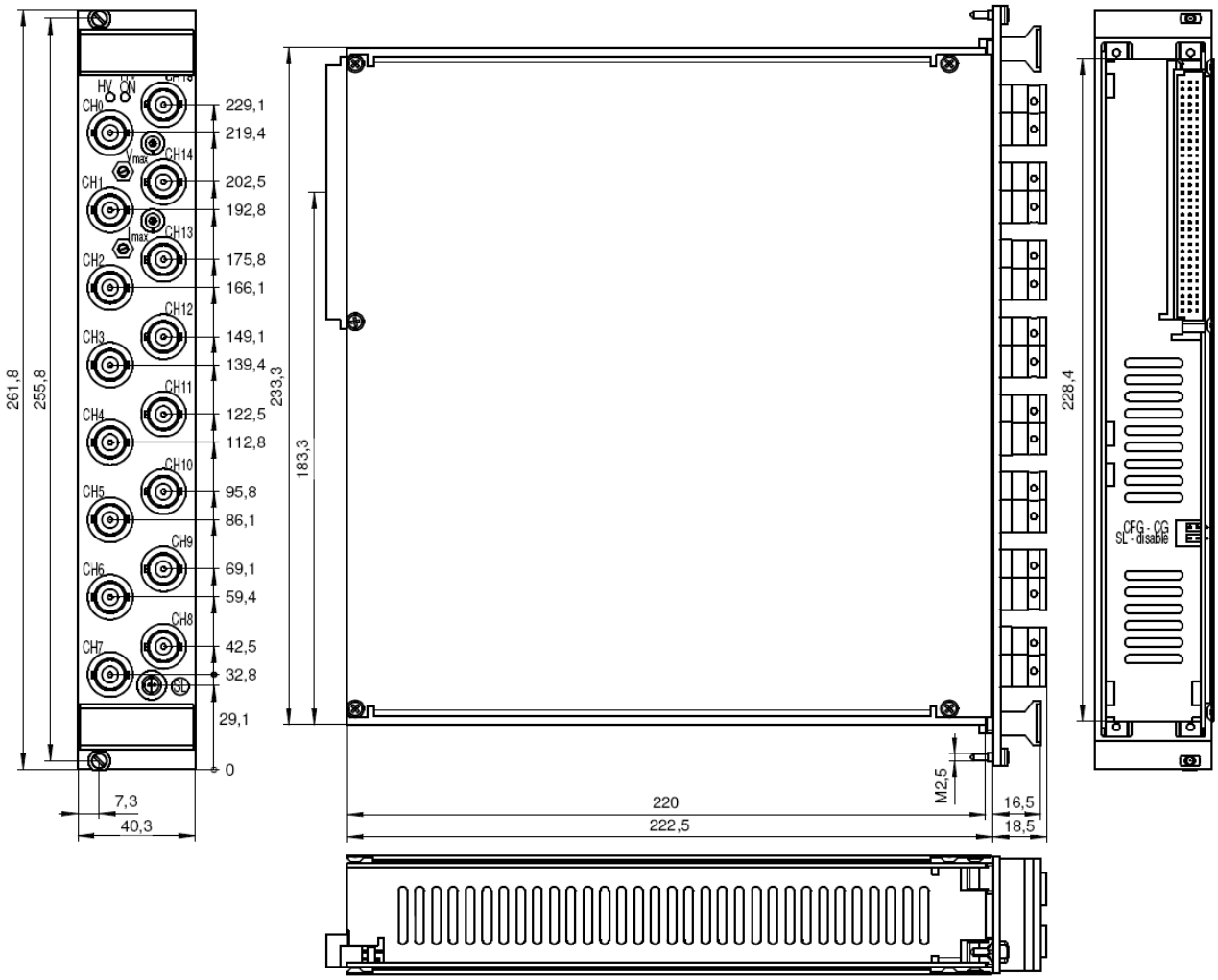



*Figure 8: 16 channels with SHV*

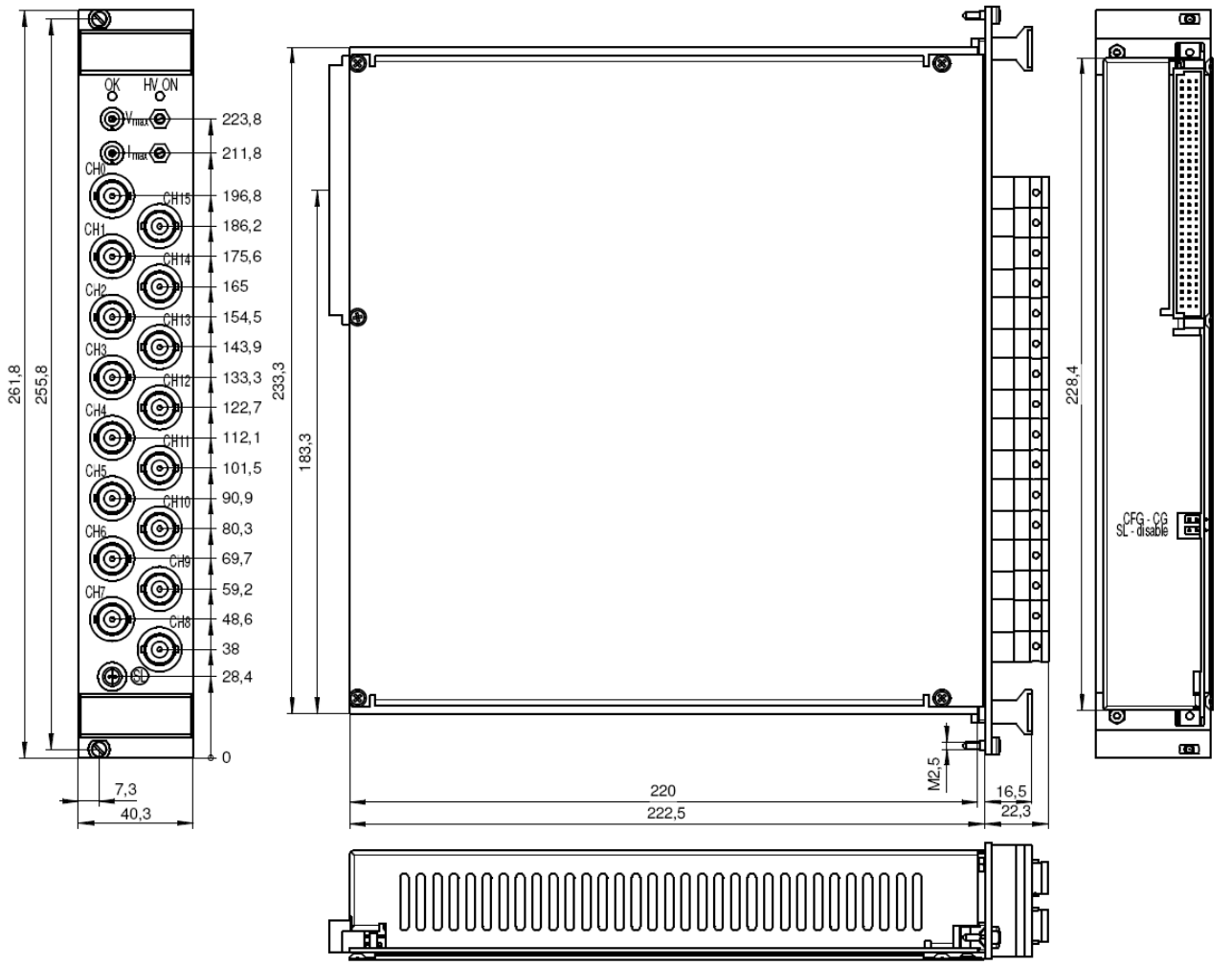



*Figure 9: 16 channels with SHV*

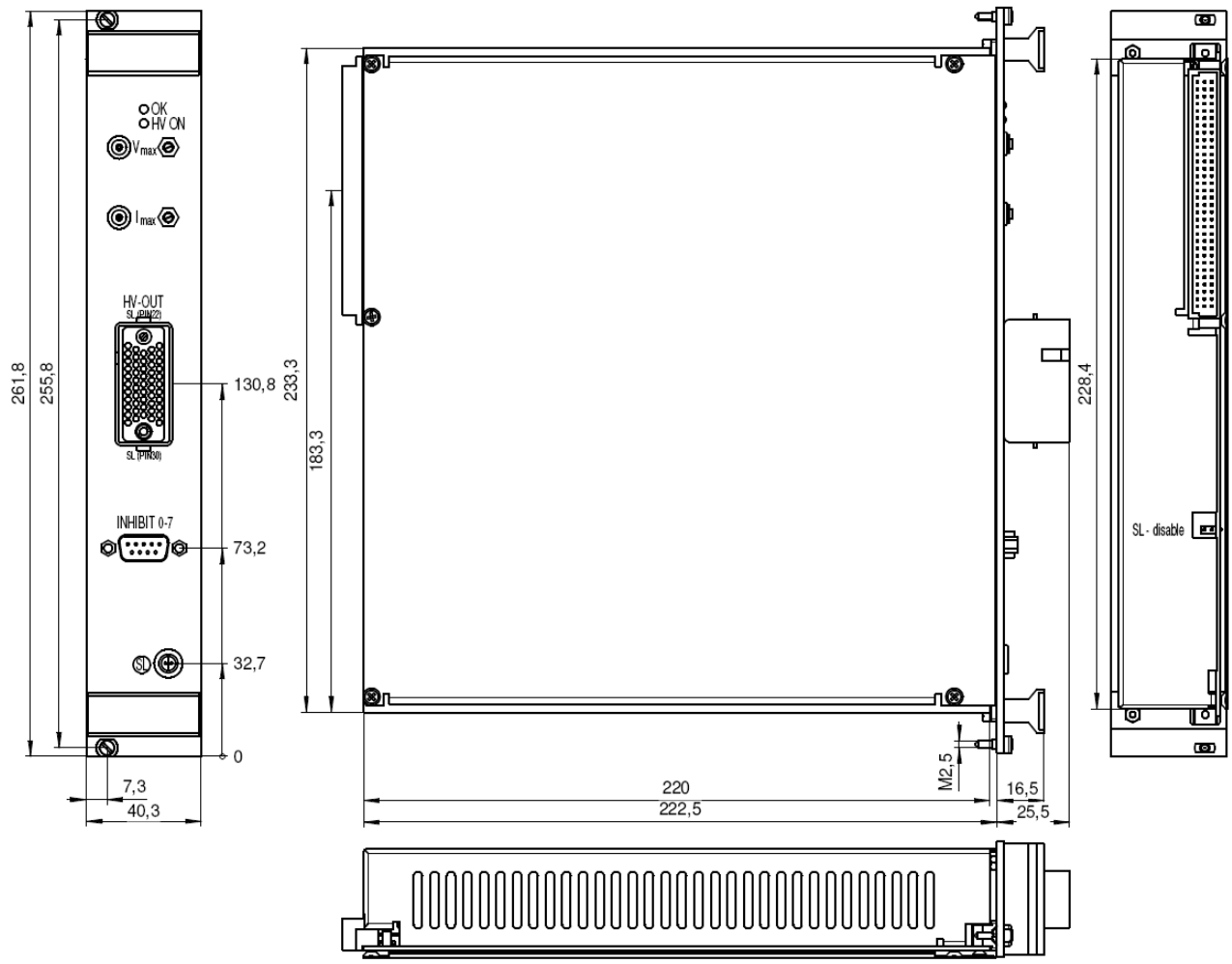



*Figure 10: 8 channels with Redel and Inhibit*

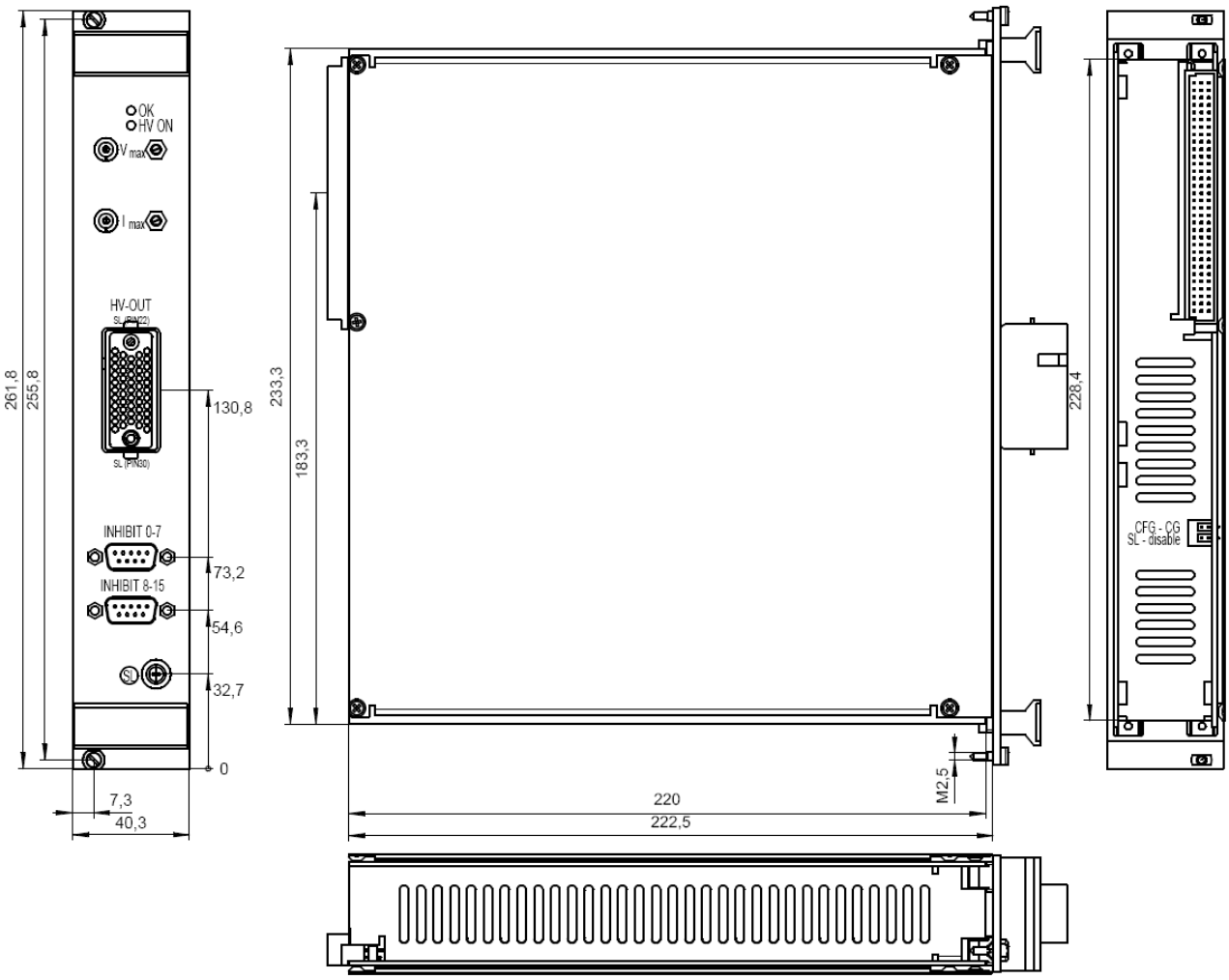



*Figure 11: 16 channels with Redel and Inhibit*

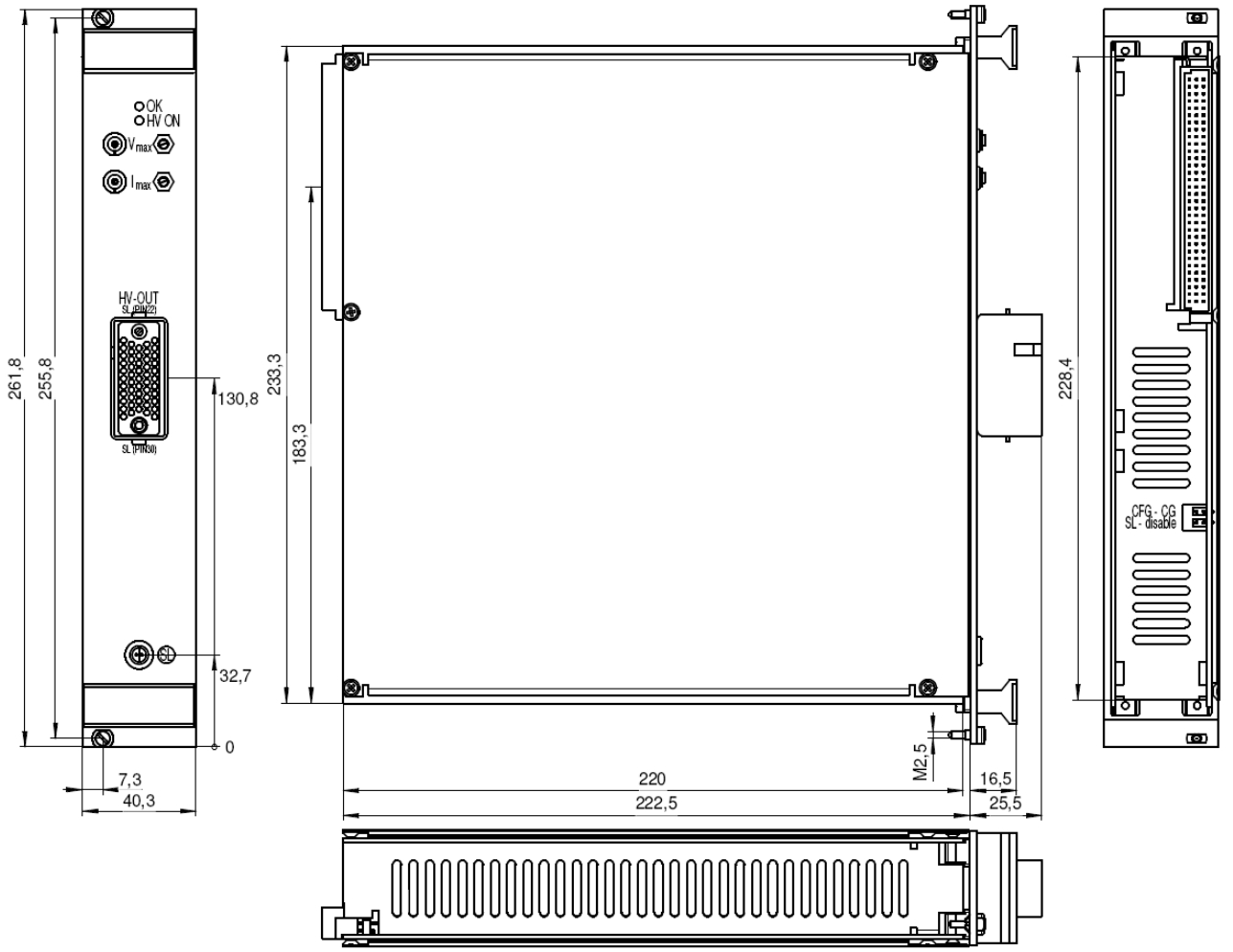
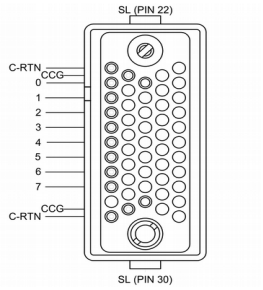
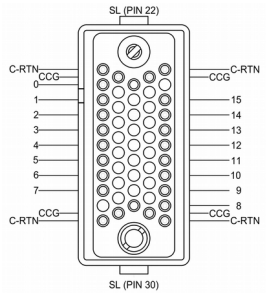
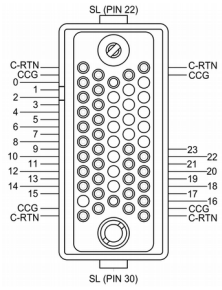
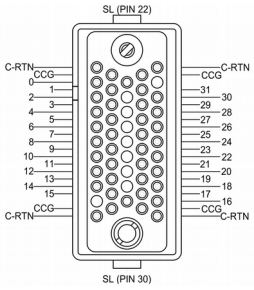
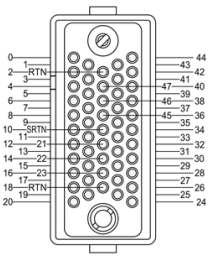
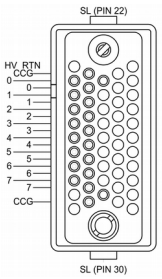
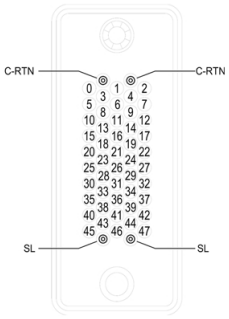
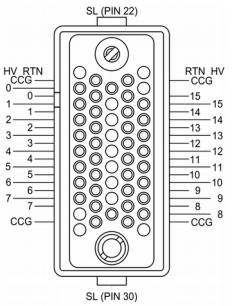


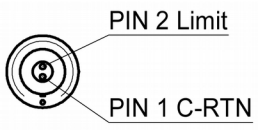

*Figure 12: 48 channels with Redel*

# 7 Connectors and PIN assignments

| HV CONNECTOR ASSIGNMENTS | | | | |
|---|---|---|---|---|
| Name | R51.41 | R51.43 | R51.44 | R51.45 |
| Figure |  |  |  |  |
| Name | R51.46 | R51.47 | I52 | |
| Figure |  |  |  | |

| HV CONNECTOR ASSIGNMENTS | | | | |
|---|---|---|---|---|
| Name | R51.48 | SHV | S08 | |
| Figure |  |  |  | |

| HV CONNECTOR ASSIGNMENTS | | | | |
|---|---|---|---|---|
| Name | S10 | S20 | C15 | |
| Figure |  |  |  | |

<table>
<tr><th colspan="2">SAFETY LOOP</th><th colspan="3">LIMIT MONITOR</th></tr>
<tr><td>Name</td><td>Safety Loop socket</td><td>Limit monitor socket CFG</td><td>Limit monitor socket CG/F</td><td></td></tr>
<tr><td>Figure</td><td>  </td><td> 
</td><td>  </td><td></td></tr>
<tr><th colspan="5">INHIBIT</th></tr>
<tr><td>Name</td><td colspan="2">INHIBIT connector- DSUB9</td><td>INHIBIT connector- DSUB9</td><td>INHIBIT connector - LEMO</td></tr>
<tr><td>Figure</td><td>
<table>
<tr><th>PIN</th><th>INHIBIT 1</th><th>INHIBIT 2</th></tr>
<tr><td>1</td><td>CHANNEL 0</td><td>CHANNEL 8</td></tr>
<tr><td>2</td><td>CHANNEL 1</td><td>CHANNEL 9</td></tr>
<tr><td>3</td><td>CHANNEL 2</td><td>CHANNEL 10</td></tr>
<tr><td>4</td><td>CHANNEL 3</td><td>CHANNEL 11</td></tr>
<tr><td>5</td><td>CHANNEL 4</td><td>CHANNEL 12</td></tr>
<tr><td>6</td><td>CHANNEL 5</td><td>CHANNEL 13</td></tr>
<tr><td>7</td><td>CHANNEL 6</td><td>CHANNEL 14</td></tr>
<tr><td>8</td><td>CHANNEL 7</td><td>CHANNEL 15</td></tr>
<tr><td>9</td><td>GND</td><td>GND</td></tr>
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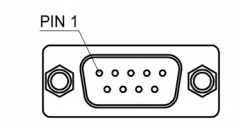
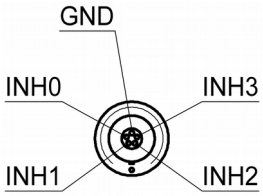
</td><td> 
</td><td> 
</td><td></td></tr>
</table>

*Table 13: Connector and pin assignments*

| **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 |
| **I52 (RADIALL 52 PINS)** | | | |
| Socket | 691803004 | Connector | 691802002 |
| Socket Contacts | 691804200 | Contacts | 691804300 |
| Socket Contacts Safety Loop | 691804230 | Connector contacts (SL) | 691804300 |
| **SHV (ROSENBERGER)** | | | |
| Socket | 57S501-200N3 | Connector | 57K101-006N3 / Z590162 |
| **S08 (RADIALL)** | | | |
| Socket | R317.580.000 | Connector | R317.005.000 / Z592474 |
| **S10 (KINGS)** | | | |
| Socket | 1064-1 QD | Connector | 1065-1 QD / Z592512 |
| **S20 (KINGS)** | | | |
| Socket | 1764-1 | Connector | 1765-1 / Z592668 |
| **C15 (CPE)** | | | |
| Socket | 23.100.151-046 | Connector | 23.100.052-045 / Z592717 |
| **Safety Loop (LEMO)** | | | |
| Socket | ERA.0S.302.CLL | Connector | FFA.0S.302.CLAC / Z592312 |
| **Limit monitor 1pol. (LEMO)** | | | |
| Socket | ERN.00.250.CTL | Connector | FFA.00.250.CTAC31 / Z200793 |
| **Limit monitor 2pol. (LEMO)** | | | |
| Socket | EGG.00.302.CLL | lConnector | FGG.00.302.CLAD / Z201466 |
| **INHIBIT 5pol. (LEMO)** | | | |
| Socket | EGG.00.305.CLL | Connector | FGG.00.305.CLAD35 / Z592723 |

*Table 14: Connectors part number information*

# 8 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 |
|---|---|
| VCT cable, NTC shrink wrapped, 10m | Z595094 |
| 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 |
| CPE HV cable socket crimp 15kV, 1mA | Z592717 |
| Lemo plug 2-pole without collet chuck (SL) | Z592312 |
| 1-pin LEMO connector, FFA.00.250.CTAC31 | Z200793 |
| 2-pin LEMO connector, FGG.00.302.CLAD30 | Z201466 |
| 5-pin LEMO plug | Z592723 |

# 9 Order guides

**CABLE ORDER GUIDE**

| POWER SUPPLY SIDE CONNECTOR | CABLE CODE | CABLE DESCRIPTION | LOAD SIDE CONNECTOR | ORDER CODE *LLL = length in m* [1] |
|---|---|---|---|---|
| R51.41-G | 07 | HV cable 6kV Kerpen SL-v2YCeHI 37xAWG26/7red | R51.41-A | RG41_C07-*LLL*_RA41 |
| R51.43-G | 07 | HV cable 6kV Kerpen SL-v2YCeHI 37xAWG26/7red | R51.43-A | RG43_C07-*LLL*_RA43 |
| R51.45-G | 08 | HV cable 6kV Kerpen SL-v2YCeHI 56xAWG26/7red | R51.45-A | RG45_C08-*LLL*_RA45 |
| R51.47-G | 07 | HV cable 6kV Kerpen SL-v2YCeHI 37xAWG26/7red | R51.47-A | RG47_C07-*LLL*_RA47 |
| R51.48-G | 08 | HV cable 6kV Kerpen SL-v2YCeHI 56xAWG26/7red | R51.48-A | RG48_C08-*LLL*_RA48 |
| | | | | |
| 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* |
| C15 | 12 | HV cable Prev3864L for 15 kV CPE connectors | open | C15_C12-*LLL* |

[1] *Length building examples: 10cm ➞ 0.1, 2.5m ➞ 2.5, 12m ➞ 012 , 999m ➞ 999*

*Table 15: Guideline for cable ordering*

| **CONFIGURATION ORDER GUIDE** (item code parts) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **EH** | **16** | **0** | **030** | **P** | **305** | **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 (CFG)<br>1 = Standard (CG)<br>2 = High Precision (CFG)<br>4 = High Precision (FG)<br>5 = Flex channels (CFG)<br>6 = Standard (FG) | three significante digits • 100V<br>For Examle:<br>030 = 3000V | p = positive<br>n = negative | two significante digits + number of zeros<br>For Examle:<br>305 = 3mA | Sum of the hex codes (see Technical Data and Options)<br>For Example:<br>IU + TC = 804 | 02 = SHV<br>03 = S08<br>04 = S10<br>05 = S20<br>23 = C15<br>41 to 48 = Redel Multipin (see Connectors and PIN assignments) | 00 = none |

*Table 16: Item code parts for different configurations*

# 10 Appendix

For more information please use the following download links:

| **This document** |
|---|
| http://download.iseg-hv.com/SYSTEMS/MMS/EHS/iseg_datasheet_EHS_en.pdf |
| **CAN EDCP Programmers-Guide** |
| http://download.iseg-hv.com/SYSTEMS/MMS/CAN_EDCP_Programmers-Guide.pdf |
| **iseg Hardware Abstraction Layer** |
| http://download.iseg-hv.com/SYSTEMS/MMS/isegHardwareAbstractionLayer.pdf |

# 11 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 Vout dep. on variation of supply voltage |
| $\Delta V_{out}$ [$\Delta R_{load}$] | 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 |

# 12 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

# 13 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.

# 14 Manufacturer contact

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