**Technical documentation**
Last changed on: 29.07.2019

# EBS

Bipolar 4 Quadrant High Voltage Module with Common Floating Ground (CFG)

- full 4-quadrant capabilities, usable as bipolar current sink and source
- perfect for electron optical systems and capacitive loads
- low ripple and noise
- hardware voltage and current limit
- programmable parameters (delayed trip etc.)

## Document history

| Version | Date | Major changes |
|---|---|---|
| 2.2 | 29.07.2019 | improved documentation, error correction |
| 2.1 | 31.05.2017<br>01.10.2018 | Fixed Item Codes<br>Notes revised |
| 2.0 | 16.02.2017 | Relayouted version |

## Disclaimer / Copyright



# 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 warrenty.

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.

**CAUTION!**

CAUTION!

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

**INFORMATION**

INFORMATION

Advices marked as “Information” give important information.

# Table of Contents

# 1 General description

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

The bipolar EBS distribution modules are multichannel high voltage power supplies in MMS- and MMC system (Eurocard format) with full 4-quadrant capabilities. The EBS can be used as bipolar current sink and source, which perfectly meets the requirements of electron optical systems or capacitive loads. The EBS is built in common floating ground principle to reduce voltage noise level.

With up to 24 channels each single channel has an independent voltage control up to 3 kV channel-voltage-difference. The EBS configuration of output voltage and current can be customized on request. The module is made of high precision components as 24 bit ADC and 20 bit DAC and provides comprehensive security features.

# 2 Technical Data

| SPECIFICATIONS | EBS 3U | EBS 6U 500V / 1.2 kV | EBS 6U 3 kV |
|---|---|---|---|
| Polarity | bipolar | | |
| Floating principle | Common Floating Ground | | |
| Ripple and noise (f > 10 Hz) | < 20 $mV_{p-p}$ | | |
| **Stability** | | | |
| Stability – [ΔVout vs. ΔVin] | < $1 \cdot 10^{-5} \cdot V_{nom}$ | | |
| Stability – [ΔVout vs. ΔRload] | < $1 \cdot 10^{-4} \cdot V_{nom}$ | | |
| Temperature coefficient voltage measurement | < 20 ppm / K | | |
| Temperature coefficient current measurement | < 100 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) | < $1 \cdot 10^{-4} \cdot I_{nom}$ | | |
| Resolution voltage measurement | < $2 \cdot 10^{-6} \cdot V_{nom}$ | | |
| Resolution current measurement [$I_{out}$ > 20 µA] | < $1 \cdot 10^{-4} \cdot I_{nom}$ | | |
| **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] | 0.2 % • $I_{out}$ + 0.2 % • $I_{nom}$ | | |
| Sample rates ADC (SPS) | 5, 10, 25, 50, 60, 100, 500 | | |
| Digital filter averages | 1, 16, 64, 256, 512, 1024 | | |
| Voltage ramp up / down | ($1 \cdot 10^{-6} \cdot V_{nom}$ - 1• $V_{nom}$) / s | | |
| Hardware limits | Potentiometer per module [$V_{max}$ / $I_{max}$] | | |
| Limit monitor volt | 2.5 V | | |
| Digital interface | CAN | | |
| Protection | Safety loop, over load and short circuit protected | | |
| HV connector | Lemo 1pole | Redel 51pole<br>SHV 1pole | |
| System connector | 96 PIN (MMS HV compatible) | | |
| Safety loop connector | Lemo 2pole | | |
| Limit monitor connector | n. a. | Lemo 2pole | |
| Case | 19 inch plug-in cassette | | |
| Dimensions – L/W/H | 160mm / 4HP / 3U | 220mm / 8HP / 6U | |
| Operating temperature | 0 – 40 °C | | |
| Storage temperature | -20 – 60 °C | | |
| Humidity | 20 – 80 %, not condensing | | |

*Table 1: Technical data: Specifications*

| CONFIGURATIONS EBS | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Type** | **$V_{nom}$** | **$I_{nom}$** | **Ch** | **Max. voltage difference channel to channel** | **Max. $I_{in}$ (A)** at 24V | **HV connector** **Standard**/opt. | **Item Code** | **Options** |
| EBS 40 05 | 500 V | 1 mA | 4 | 1 kV | 0.6 | **L01**, L04 | EB0400051050001100 | – |
| EBS C0 05 | 500 V | 1 mA | 12 | 1 kV | 1.2 | **SHV**, R42 | EB1200051050000200 | SLA, SLP |
| EBS 180 05 | 500 V | 1 mA | 24 | 1 kV | 2.2 | **R44** | EB2400051050004400 | SLA, SLP |
| EBS C0 12 | 1.2 kV | 0.5 mA | 12 | 2.4 kV | 1.4 | **SHV**, R42 | EB1200125040000200 | SLA, SLP |
| EBS 180 12 | 1.2 kV | 0.5 mA | 24 | 2.4 kV | 2.8 | **R44** | EB2400125040004400 | SLA, SLP |
| EBS C0 12 | 1.2 kV | 1 mA | 12 | 1.2 kV | 1.4 | **SHV**, R42 | EB1200121050000200 | SLA, SLP |
| EBS 180 12 | 1.2 kV | 1 mA | 24 | 1.2 kV | 2.8 | **R44** | EB2400121050004400 | SLA, SLP |
| EBS C0 30 | 3 kV | 0.5 mA | 12 | 3 kV | 1.6 | **SHV**, R42 | EB1200305040000200 | SLA, SLP |
| EBS 180 30 | 3 kV | 0.5 mA | 24 | 3 kV | 3,2 | **R44** | EB2400305040004400 | SLA, SLP |

*Table 2: Technical data: Configurations*

| OPTIONS | OPTION CODE | EXAMPLE | ITEM CODE HEX CODING |
|---|---|---|---|
| **ACTIVE SAFETY LOOP** | **SLA** | | 001 |
| **INTERNALLY POWERED SAFETY LOOP** | **SLP** | | 002 |

*Table 3: 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.

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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.

## 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 have status “HV ON” or voltage on output is greater than 56V |
| Green LED blinking slow | prepares firmware update |
| Green LED blinking fast | 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 $V_{max}$. At the 3U Version the potentiometers are inside of the module. The 6U versions are equipped with two independent potentiometers for the positive and negative voltage limit. 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 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 (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. If the measured current exceeds the set current the programmed timeout counter is decremented, keeping the output voltage. If the current returns to a value <$I_{set}$ before timeout the counter will be reset. So this process can be restarted if the current rises again.

Note that the actual current is acquired approximately every 150ms, which can lead to delays in the detection of an exceeded or again reduced current.

If the current at any time 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.

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.

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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. However, the actual discharge time strongly depends on the connected load.

# 4 Options

## 4.1 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.

## 4.2 SLP – Internally powered safety loop

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

# 5 Front panel versions

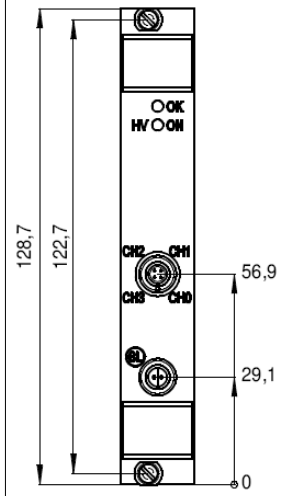
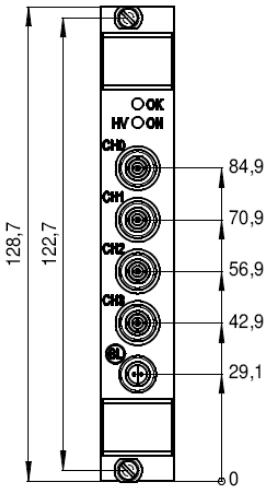
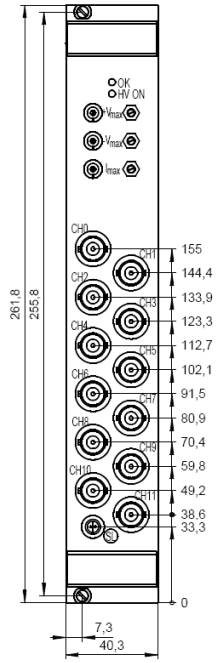
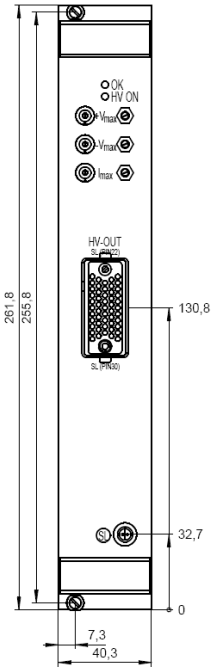
| FRONT PANELS | | | | |
|---|---|---|---|---|
| Channels | 4 | 4 | 12 | 12 / 24 |
| Floating | CFG | CFG | CFG | CFG |
| HV Connector | L04 | L01 | SHV | R51 |
| Options | 3U | 3U | | |
| Figure |  |  |  |  |



*Table 5: Front panel versions*

# 6 Dimensional drawings

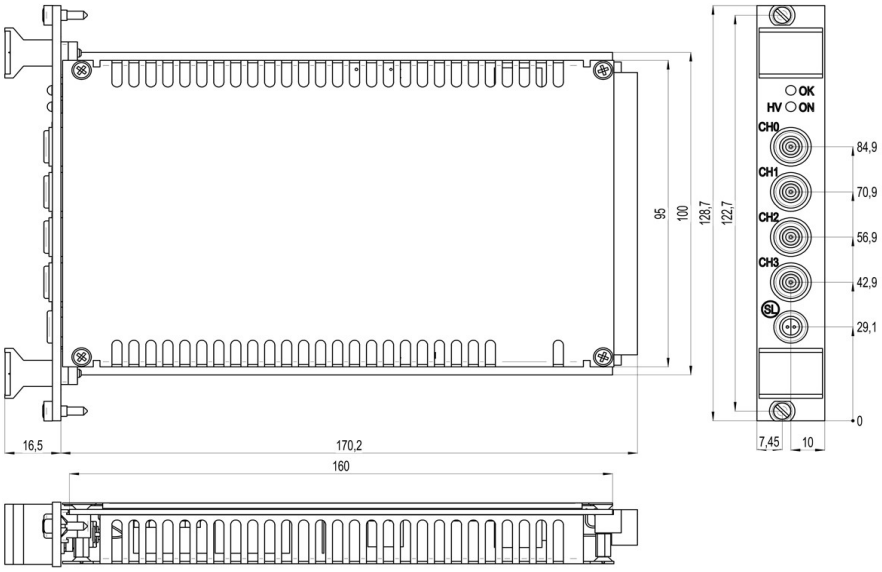



*Figure 1: dimensional drawing 3U*

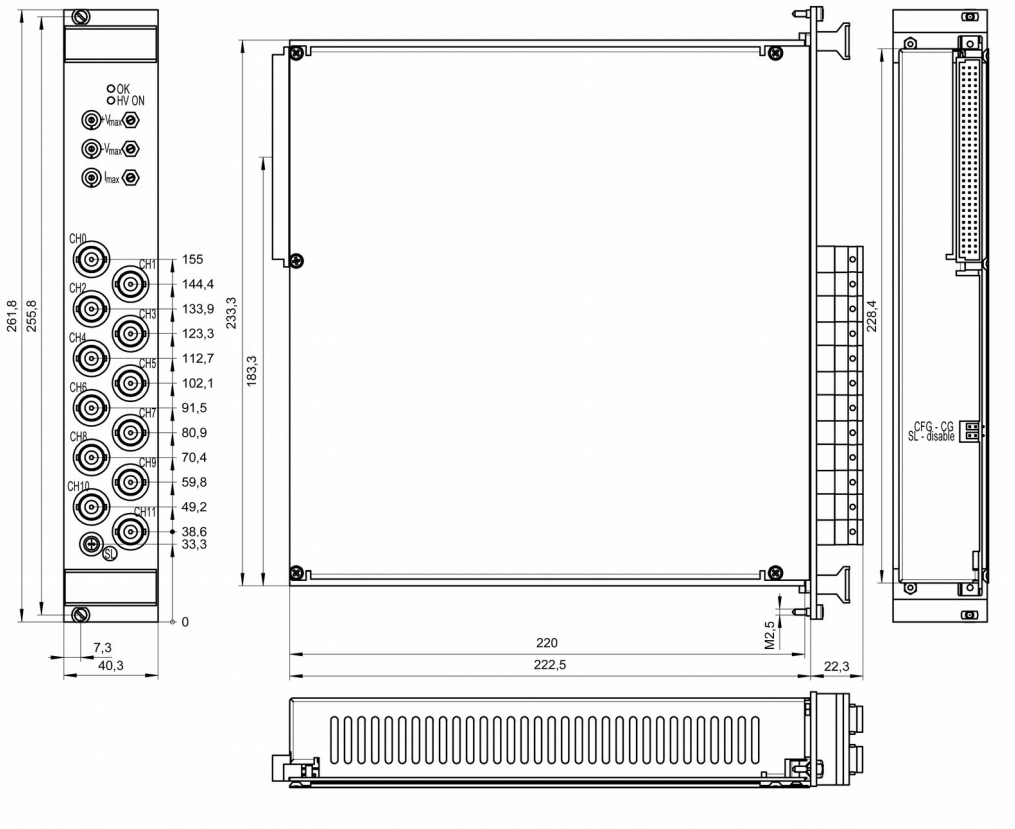



*Figure 2: dimensional drawing 6U SHV*

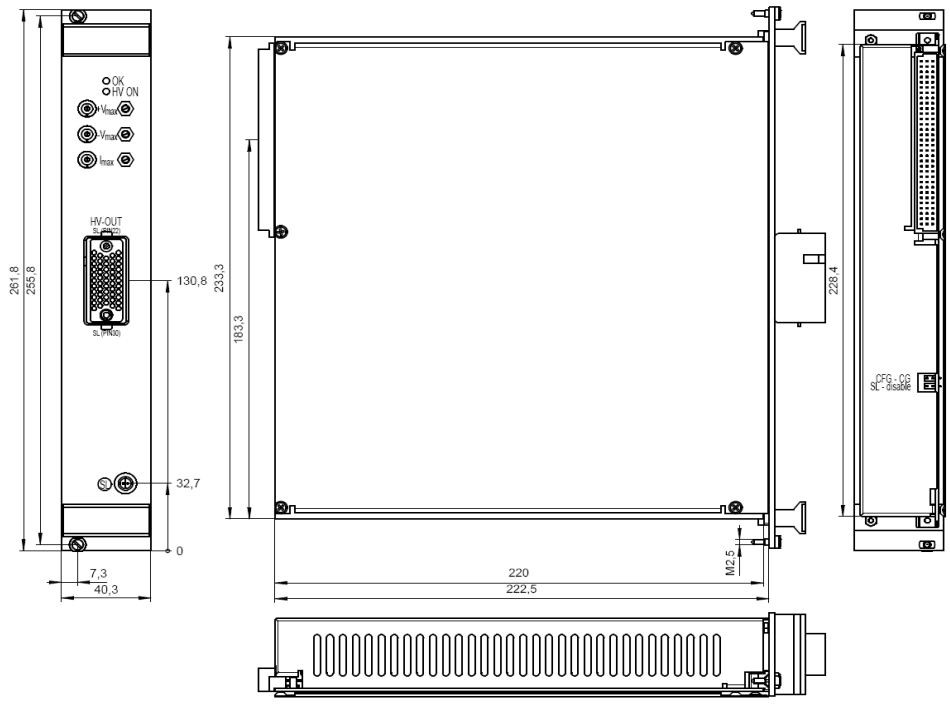



*Figure 3: dimensional drawing 6U REDEL*

# 7 Limits and Jumper

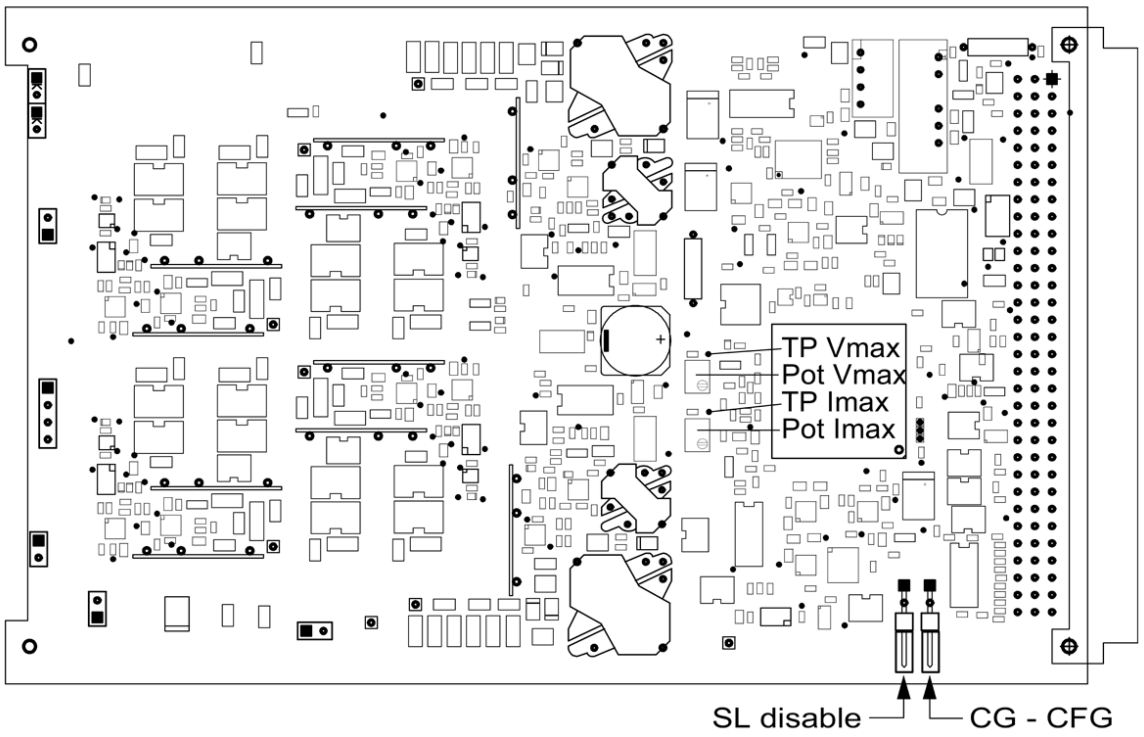



*Figure 4: limits and jumper 3U Model*

# 8 Connectors and PIN assignments

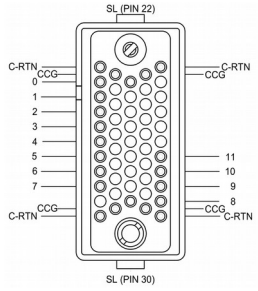
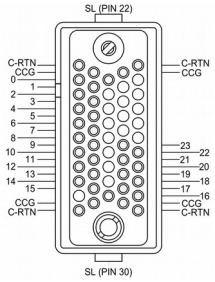
| HV CONNECTOR ASSIGNMENTS | | | | |
|---|---|---|---|---|
| Name | R51.42 | R51.44 | L04 | L01 |
| Figure |   |   |   |  |
| Name | SHV | S08 | | |
| Figure |  |  | | |

*Table 6: HV Connector*

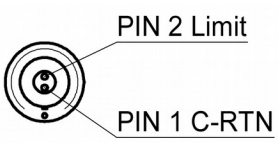
| SAFETY LOOP | | | | |
|---|---|---|---|---|
| Name | Safety Loop socket | | | |
| Figure |  | | | |
| **LIMIT MONITOR** | | | | |
| Name | Limit monitor socket | | | |
| Figure |   | | | |

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

| **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 |
| **L01 (LEMO)** | | | |
| Socket | ERA.0S.250.CLL | Connector | FFA.0S.250.CTAK47 / Z592635 |
| **L04 (LEMO)** | | | |
| Socket | EGG.0B.304.CLL | Connector | FGG.0B.304.CLAD52 |
| **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 |

*Table 8: Connectors part number information*

# 9 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 |
|---|---|
| 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 |
| SHV coupler screw for RG58 | Z590162 |
| SHV coupler screw for >5kV | Z592474 |
| Lemo plug 1-pole with accessories | Z592635 |
| Lemo plug 2-pole without collet chuck (SL) | Z592312 |
| REDEL pin contact | Z592189 |
| REDEL SL pin contact | Z592261 |
| Lemo plug 4pol. | Z592705 |

# 10 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 | R51.42-A | R42G_C07-*LLL*_R42A |
| R51.44-G | 07 | HV cable 6kV Kerpen SL-v2YCeHI 37xAWG26/7red | R51.44-A | R44G_C07-*LLL*_R44A |
| | | | | |
| L01 | 01 | HV cable shielded 9kV | open | L01_C01-LLL |
| SHV | 04 | HV cable shielded 30kV (HTV-30S-22-2) | open | SHV_C04-*LLL* |

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

*Table 9: Guideline for cable ordering*

| **CONFIGURATION ORDER GUIDE** (item code parts) | | | | | | | |
|---|---|---|---|---|---|---|---|
| **EB** | **24** | **0** | **030** | **504** | **000** | **02** | **00** |
| High Voltage Bipolar Distributor | Numbers of channels | Class | $V_{nom}$ | $I_{nom}$ (nA) | Option (hex) | HV-Connector | Customized Version |
| | | 0 = Standard | three significante digits •100V<br>For Examle:<br>030 = 3,000V | two significante digits + number of zeros<br>For Examle:<br>504 = 500µA | Sum of the hex codes (see Table 3 - OPTIONS)<br>For Example:<br>SLP = 002 | 02 = SHV<br>03 = S08<br>11 = Lemo L01<br>21 = Lemo L04<br>42 and 44 = Redel Multipin<br>(see Connectors and PIN assignments) | 00 = none |

*Table 10: Item code parts for different configurations*

# 11 Appendix

For more information please use the following download links:

| **This document** |
|---|
| http://download.iseg-hv.com/SYSTEMS/MMS/EBS/iseg_datasheet_EBS_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 |

# 12 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

# 13 Manufacturer´s contact

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