

Technical documentation
Last changed on: 26.03.2020

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 |
|---------|--------------------------|---|
| 3.1 | 26.03.2020 | improved documentation chapter Hardware Limit, Delayed Trip, Operation of individual channels |
| 3.0 | 25.11.2019 | safety information, glossary |
| 2.3 | 16.10.2019 | improved documentation (ADC/ SPS) |
| 2.2 | 29.07.2019 | improved documentation, error correction |
| 2.1 | 31.05.2017 01.10.2018 | Fixed Item Codes Notes revised |
| 2.0 | 16.02.2017 | Relayouted version |

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

Safety

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

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

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

Depiction of the safety instructions

| | |
|--|---|
| DANGER! | |
|  DANGER! | <p>“Danger!” indicates a severe injury hazard. The non-observance of safety instructions marked as “Danger!” will lead to possible injury or death.</p> |
| WARNING! | |
|  WARNING! | <p>“Warning!” indicates an injury hazard. The non-observance of safety instructions marked as “Warning!” could lead to possible injury or death.</p> |
| CAUTION! | |
|  CAUTION! | <p>Advices marked as “Caution!” describe actions to avoid possible damages to property.</p> |
| INFORMATION | |
|  INFORMATION | <p>Advices marked as “Information” give important information.</p> |



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.

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1 General description

CAUTION!



CAUTION!

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 – [ΔV_{out} vs. ΔV_{in}] | < $1 \cdot 10^{-5} \cdot V_{nom}$ | | |
| Stability – [ΔV_{out} vs. ΔR_{load}] | < $1 \cdot 10^{-4} \cdot V_{nom}$ | | |
| 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 ⁽¹⁾ | < $2 \cdot 10^{-6} \cdot V_{nom}$ | | |
| Resolution current measurement [$I_{out} > 20 \mu A$] ⁽¹⁾ | < $1 \cdot 10^{-4} \cdot I_{nom}$ | | |
| Measurement Accuracy – The measurement accuracy is guaranteed in the range $1\% \cdot V_{nom} < V_{out} < V_{nom}$ and for 1 year | | | |
| Accuracy voltage measurement | $0.01\% \cdot V_{out} + 0.02\% \cdot V_{nom}$ | | |
| Accuracy current measurement [$I_{out} > 20 \mu A$] | $0.2\% \cdot I_{out} + 0.2\% \cdot I_{nom}$ | | |
| 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 $1 \cdot V_{nom} / s$ | | |
| 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 SHV | |
| System connector | 96-pin connector according to DIN 41612 (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 | | |
| 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

| 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.

| INFORMATION | |
|--|--|
|  INFORMATION | <p>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).</p> <p>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.</p> |

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 occurred: 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} . At the 3U Version the potentiometers are [inside of the module](#), see Figure 4: limits and jumper 3U Model. 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 $(102 \pm 2)\% V_{nom}$ and $(102 \pm 2)\% I_{nom}$. 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 11 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 “SL-disable” on the [rear side of the module](#), see 6 Dimensional drawings.

3.5 Delayed Trip

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 11 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 *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.

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.

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

3.6 Operation of individual channels

If a channel is switched off (after power on, but also due to shut down with hardware current limit exceeded or after switching off with *KillEnable*) and if the maximum voltage in any active channel is greater 2000V (in any polarity), the output voltage can be different from 0V. The deviation can be up to 10% of the maximum set voltage. Compliance with the V_{set} value (also 0V) is only guaranteed if the channel is switched on.

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

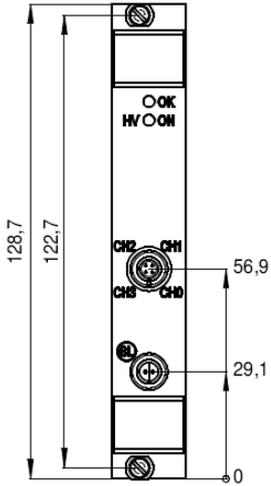
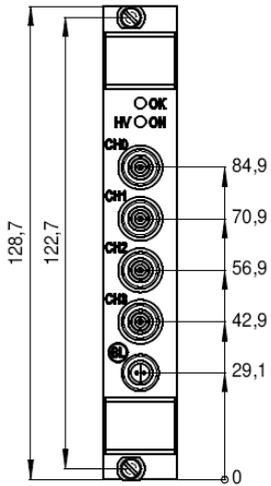
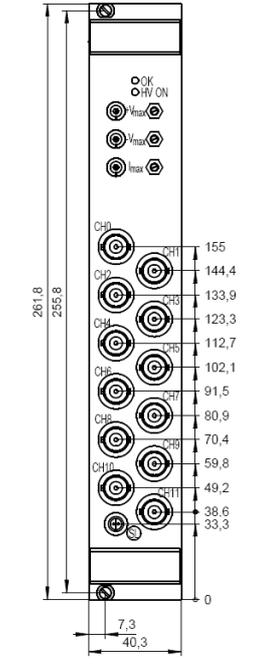
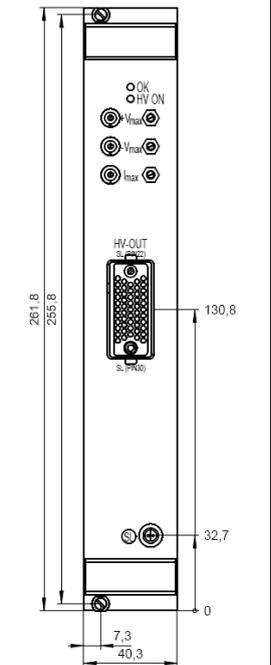
| FRONT PANELS | | | | |
|--------------|--|--|---|--|
| Channels | 4 | 4 | 12 | 12 / 24 |
| Floating | CFG | CFG | CFG | CFG |
| HV Connector | L04 | L01 | SHV | R51 |
| Options | 3U | 3U | | |
| Figure |  |  |  |  |

Table 5: Front panel versions

6 Dimensional drawings

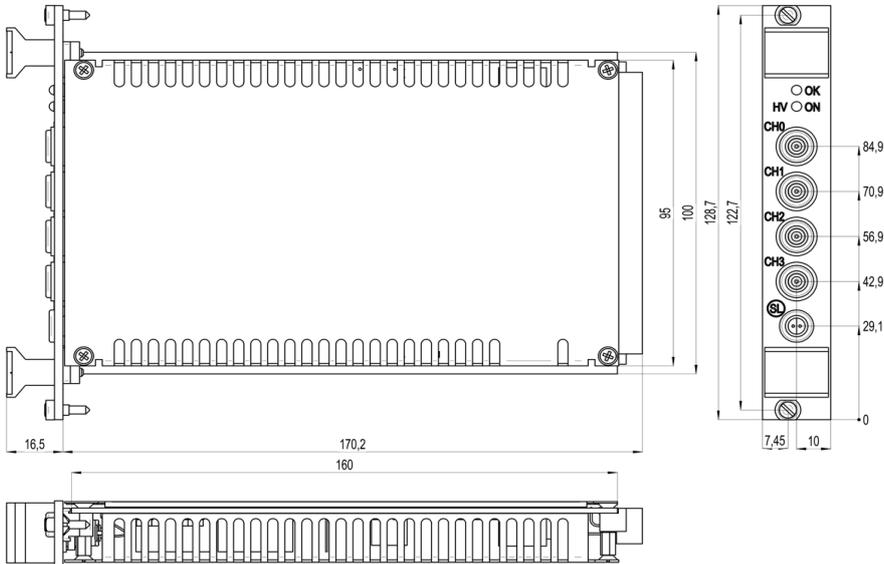


Figure 1: dimensional drawing 3U

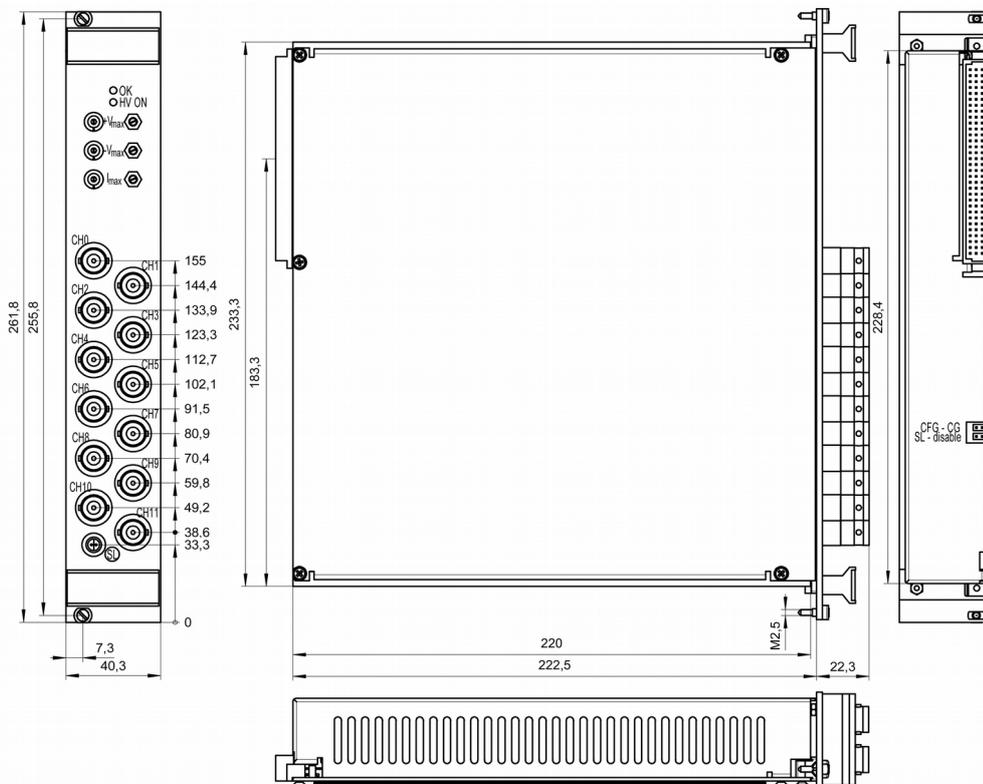


Figure 2: dimensional drawing 6U SHV

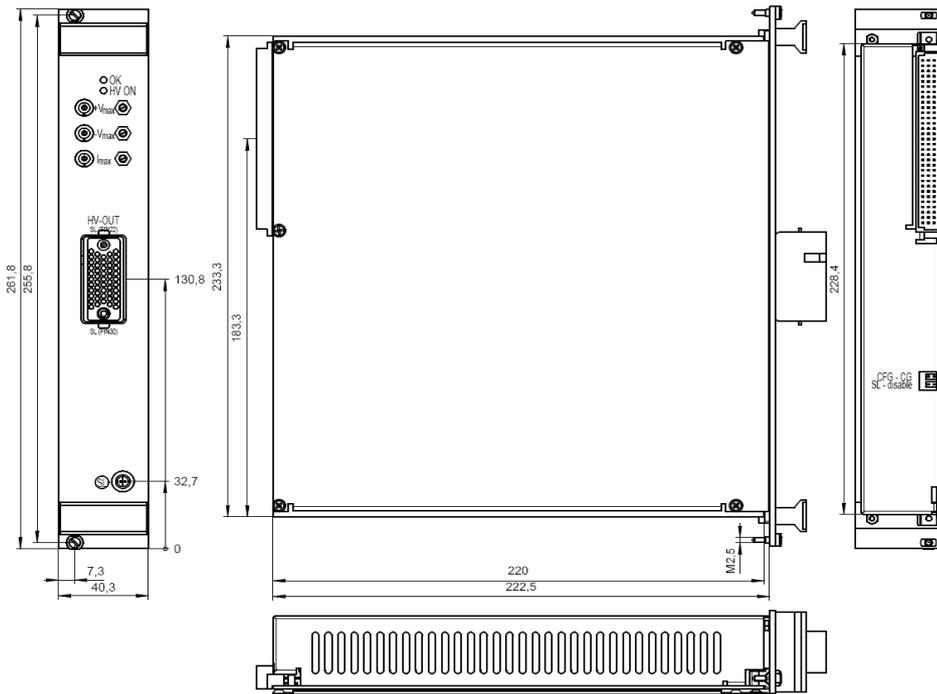


Figure 3: dimensional drawing 6U REDEL

7 Limits and Jumper

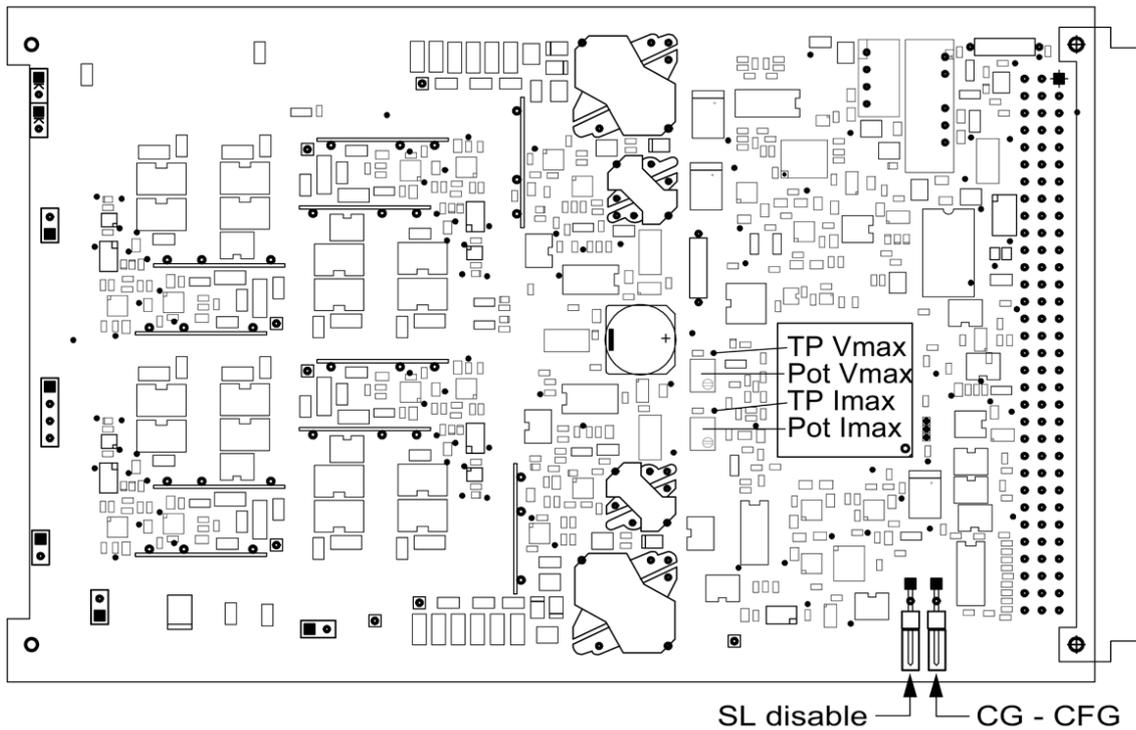


Figure 4: limits and jumper 3U Model

8 Connectors and PIN assignments

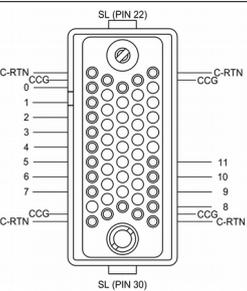
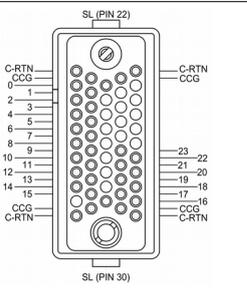
| HV CONNECTOR ASSIGNMENTS | | | | |
|--------------------------|---|---|--|---|
| Name | R51.42 | R51.44 | L04 | L01 |
| Figure |  |  |  |  |
| Name | SHV | S08 | | |
| Figure |  |  | | |

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 (RADIAL) | | | |
| Socket | R317.580.000 | Connector | R317.005.000 / Z592474 |
| L01 (LEMO) | | | |
| Socket | ERA.05.250.CLL | Connector | FFA.05.250.CTAK47 / Z592635 |
| L04 (LEMO) | | | |
| Socket | EGG.0B.304.CLL | Connector | FGG.0B.304.CLAD52 |
| Safety Loop (LEMO) | | | |
| Socket | ERA.05.302.CLL | Connector | FFA.05.302.CLAC / Z592312 |
| Limit monitor 2pol. (LEMO) | | | |
| Socket | EGG.00.302.CLL | Connector | FGG.00.302.CLAD |

Table 8: Connectors part number information

9 Accessories

CAUTION!



CAUTION!

Only use genuine iseq 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 <i>LLL = length in m⁽¹⁾</i> |
| R51.42-G | 07 | HV cable 6kV Kerpen SL-v2YCeHI 37xAWG26/7red | R51.42-A | RG42_C07-LLL_RA42 |
| R51.44-G | 07 | HV cable 6kV Kerpen SL-v2YCeHI 37xAWG26/7red | R51.44-A | RG44_C07-LLL_RA44 |
| 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 significant digits • 100V For Example: 030 = 3,000V | two significant digits + number of zeros For Example: 504 = 500µA | Sum of the hex codes (see Table 3: Technical data: Options and order information) For Example: SLP = 002 | 03 = S08 11 = Lemo L01 21 = Lemo L04 42 and 44 = Redel Multipin (see Table 8: Connectors part number information) | 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.iseq-hv.com/SYSTEMS/MMS/EBS/iseq_datasheet_EBS_en.pdf |
| CAN EDCP Programmers-Guide |
| http://download.iseq-hv.com/SYSTEMS/MMS/CAN_EDCP_Programmers-Guide.pdf |
| iseq Hardware Abstraction Layer |
| http://download.iseq-hv.com/SYSTEMS/MMS/iseqHardwareAbstractionLayer.pdf |

12 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 |

13 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

14 Disposal

INFORMATION



INFORMATION

All high-voltage equipment and integrated components are largely made of recyclable materials. Do not dispose the device with regular residual waste. Please use the recycling and disposal facilities for electrical and electronic equipment available in your country.

15 Manufacturer contact

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