Technical documentation
Last changed on: 2021-03-17

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
3.5	2021-03-17	Improved description, Item code revision and customization
3.4	2020-10-09	Improved description C-RTN, CCG, RTN (Table 6: HV Connector)
3.3	2020-07-13	Improved documentation (Inhibit)
3.2	2020-06-10	Figure for Jumper configuration (CG-CFG)
3.1	2020-03-26	improved documentation chapter Hardware Limit, Delayed Trip, Operation of individual channels
3.0	2019-11-25	safety information, glossary
2.3	2019-10-16	improved documentation (ADC/ SPS)
2.2	2019-07-29	improved documentation, error correction
2.1	31.05.2017 01.10.2018	Fixed Item Codes Notes revised
2.0	2017-02-16	Relayouted version

Disclaimer / Copyright

Safety

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

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

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

Depiction of the safety instructions

DANGER!

DANGER!

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

WARNING!

WARNING!

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

CAUTION!

CAUTION!

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

INFORMATION

INFORMATION

Advice 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!

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!

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!

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!

Do not operate the unit in wet or damp conditions.

WARNING!

Do not operate the unit in an explosive atmosphere.

WARNING!

Do not operate the unit if you suspect the unit or the connected equipment to be damaged.

CAUTION!


Caution!

When installing the units, make sure that an air flow through the corresponding air inlet and outlet openings is possible.

CAUTION!


Caution!

When controlling, with software, the high voltage systems, make sure that nobody is near the high voltage or can be injured.

INFORMATION


INFORMATION

Please check the compatibility with the devices used.

Table of Contents

1 General description

CAUTION!

CAUTION!

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

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 [3]	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 • 10^{-5} • V_{nom}		
Stability – [ΔV_{out} vs. ΔR_{load}]	< 1 • 10^{-4} • 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 • 10^{-6} • V_{nom}		
Resolution current setting (trip)	< 1 • 10^{-4} • I_{nom}		
Resolution voltage measurement [1]	< 2 • 10^{-6} • V_{nom}		
Resolution current measurement [I_{out} > 20 µA] [1]	< 1 • 10^{-4} • 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** [2]		
Digital filter averages	1, 16, **64** [2], 256, 512, 1024		
Voltage ramp up / down	1 • 10^{-6} • V_{nom} /s to 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 (**ATTENTION:** there is only one short circuit or arc per second allowed!)		
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
[3] External INHIBIT in ECH14A is not supported, the EBS module will not shut off with the INHIBIT.

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	EB040005105oooccrk	–
EBS C0 05	500 V	1 mA	12	1 kV	1.2	**SHV**, R42	EB120005105oooccrk	SLA, SLP
EBS 180 05	500 V	1 mA	24	1 kV	2.2	**R44**	EB240005105oooccrk	SLA, SLP
EBS C0 12	1.2 kV	0.5 mA	12	2.4 kV	1.4	**SHV**, R42	EB120012504oooccrk	SLA, SLP
EBS 180 12	1.2 kV	0.5 mA	24	2.4 kV	2.8	**R44**	EB240012504oooccrk	SLA, SLP
EBS C0 12	1.2 kV	1 mA	12	1.2 kV	1.4	**SHV**, R42	EB120012105oooccrk	SLA, SLP
EBS 180 12	1.2 kV	1 mA	24	1.2 kV	2.8	**R44**	EB240012105oooccrk	SLA, SLP
EBS C0 30	3 kV	0.5 mA	12	3 kV	1.6	**SHV**, R42	EB120030504oooccrk	SLA, SLP
EBS 180 30	3 kV	0.5 mA	24	3 kV	3,2	**R44**	EB240030504oooccrk	SLA, SLP
Notes: replacement characters: o – options, c – connector, r – revision, k – customization								

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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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.

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EBS 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 *Figure 1: Jumper configuration on back side.*

Figure 1: Jumper configuration on back side

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 off 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 5: 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 ± 2)% V_{nom} and (102 ± 2)% I_{nom}. The output voltage is limited to the specified value. If the current exceeds the hardware current limit (about 30% above the current limit value set by the limit potentiometer) the channel will be shut off without delay and ramp. In both cases the green LED on the front panel turns off.

3.4 Safety Loop

A safety loop can be implemented by the safety loop socket (SL) on the front panel and between the SLcontacts (Pin 22 and PIN 30) at the REDEL-connector, if equipped. If the safety loop is active a high voltage generation in any channel is only possible if the safety loop is closed and an external current in a range of 5 to 20 mA of any polarity is driven through the loop. For modules with a REDEL-connector the front panel SL input must be shortened. If the safety loop is opened during the operation the output voltages will be shut off without ramp and the corresponding bits in the “*ModuleStatus*” and “*ModuleEventStatus*” are cancelled (“CAN EDCP Programmers-Guide”, see chapter 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 Figure 1: Jumper configuration on back side.

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”, see chapter 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.

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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

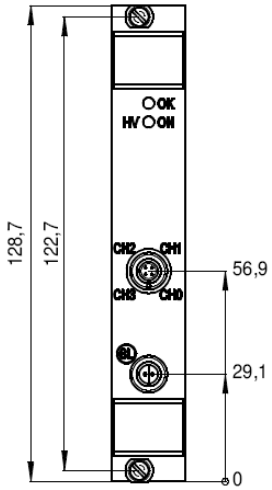
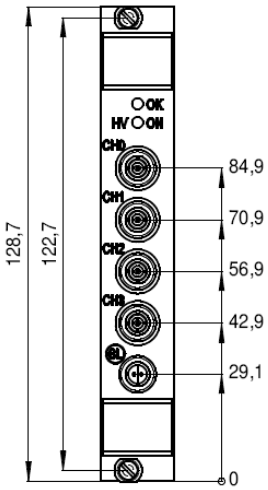
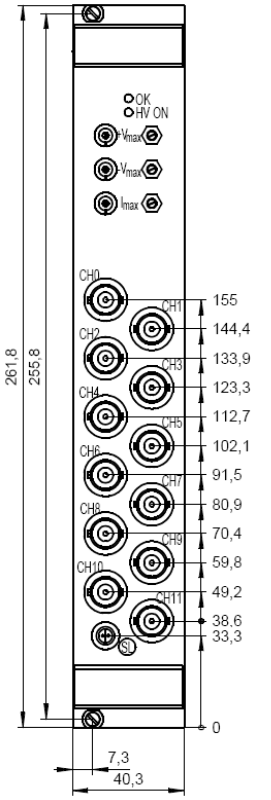
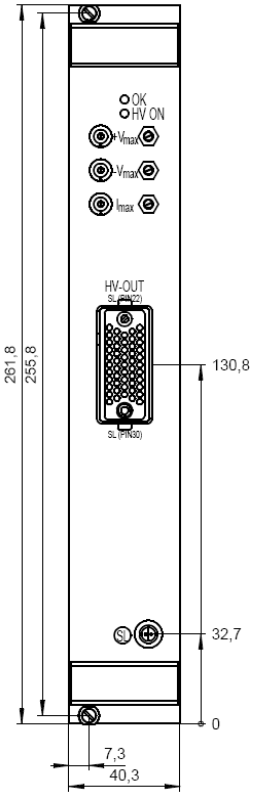
FRONT PANELS				
Channels	4	4	12	12 / 24
Floating	CFG	CFG	CFG	CFG
HV Connector	L04	L01	SHV	R51
Options	3U	3U	–	–
Figure				

Table 5: Front panel versions

6 Dimensional drawings

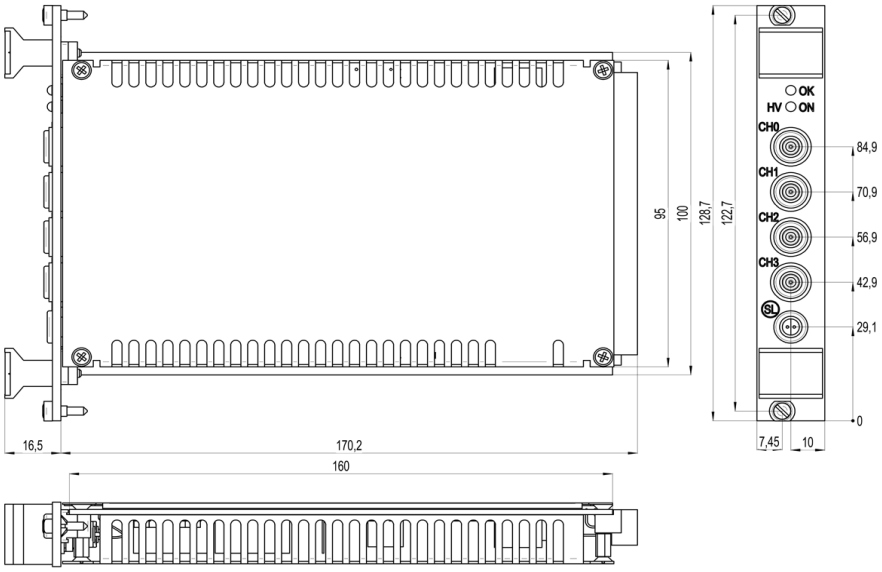


Figure 2: dimensional drawing 3U

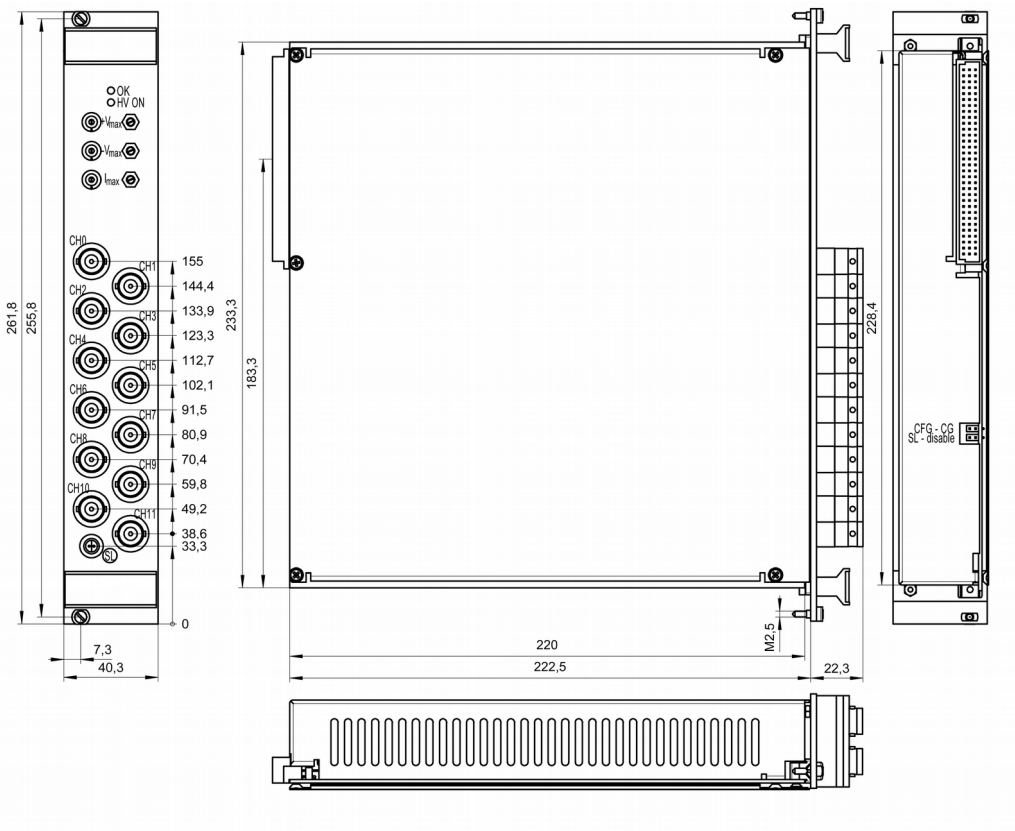


Figure 3: dimensional drawing 6U SHV

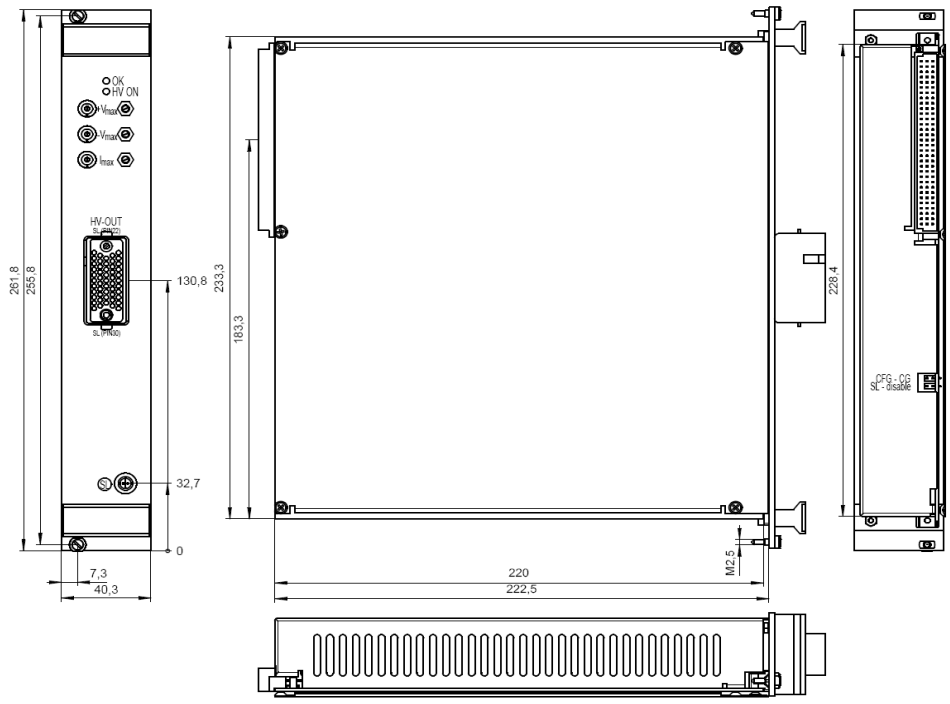


Figure 4: dimensional drawing 6U REDEL

7 Limits and Jumper

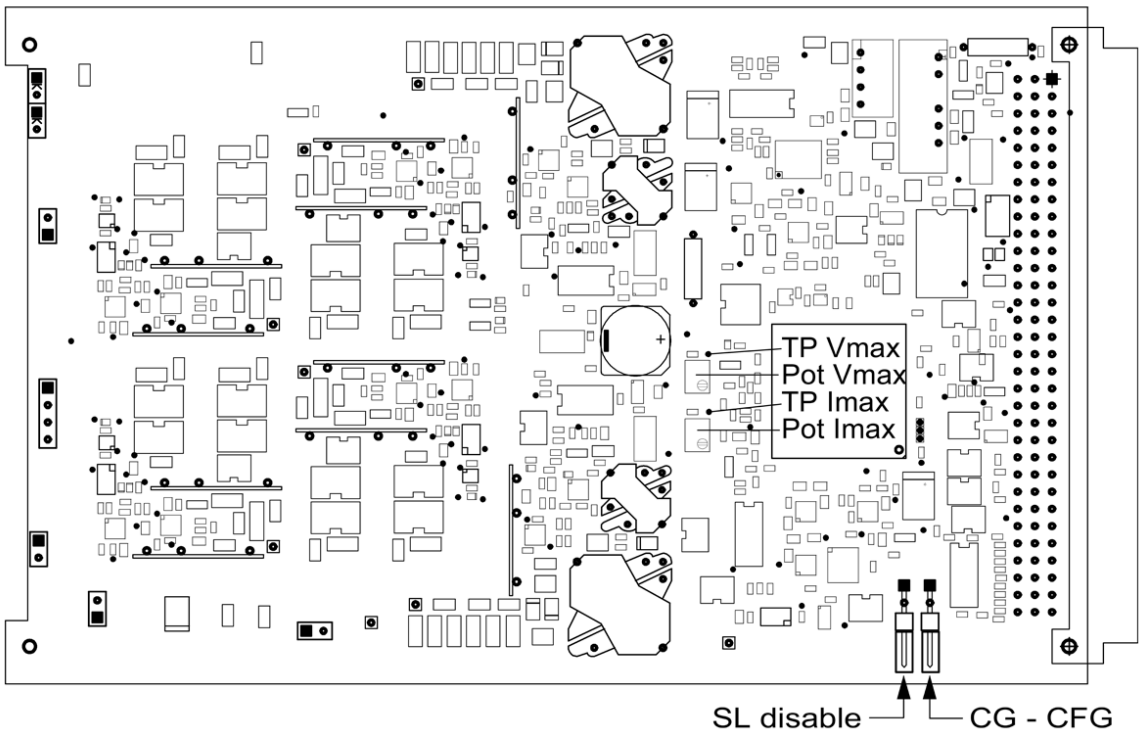


Figure 5: limits and jumper 3U Model

8 Connectors and PIN assignments

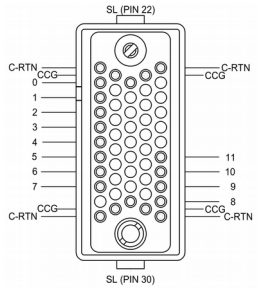
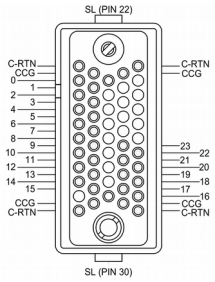
HV CONNECTOR ASSIGNMENTS				
Name	R51.42	R51.44	L04	L01
Figure				
Name	SHV			
Figure				
Notes: C-RTN: Common Return CCG: Common Crate Ground HV: High Voltage SL: Safty Loop				

Table 6: HV Connector

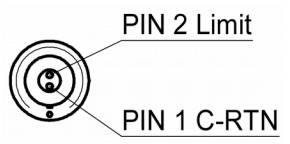
SAFETY LOOP				
Name	Safety Loop socket			
Figure				
LIMIT MONITOR				
Name	Limit monitor socket			
Figure				

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		
Socket	Z592340	Connector	57K101-006N3 / Z590162
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
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

Table 9: Accessory

10 Order guides

CABLE ORDER GUIDE					
POWER SUPPLY SIDE CONNECTOR	**V_{max}**	**CABLE CODE**	**CABLE DESCRIPTION**	**LOAD SIDE CONNECTOR**	**ORDER CODE** ***LLL = length in m*** [1]
R51.42-G	≤ 4 kV	07	HV cable 6kV Kerpen SL-v2YCeHI 37xAWG26/7red	R51.42-A	RG42_C07-*LLL*_RA42
R51.44-G	≤ 4 kV	07	HV cable 6kV Kerpen SL-v2YCeHI 37xAWG26/7red	R51.44-A	RG44_C07-*LLL*_RA44
L01	≤ 1 kV	01	HV cable shielded 9kV	open	L01_C01-LLL
SHV	≤ 5 kV	04	HV cable shielded 30kV (HTV-30S-22-2)	open	SHV_C04-*LLL*
Notes [1] Length building examples: 10cm ➜ 0.1, 2.5m ➜ 2.5, 12m ➜ 012, 999m ➜ 999					

Table 10: Guideline for cable ordering

CONFIGURATION ORDER GUIDE (item code parts)								
EB	**24**	**0**	**030**	**504**	**000**	**02**	**0**	**0**
High Voltage Bipolar Distributor	Numbers of channels	Class	V_{nom}	I_{nom} (nA)	Option (hex)	HV-Connector	Revision	Customized Version
	4, 12 or 24 channel	0 = Standard	three significante digits • 100V For Examle: 030 = 3000V	two significante digits + number of zeros For Examle: 504 = 500µA	Sum of the hex codes (see Table 3: Technical data: Options and order information) For Example: SLP = 002	02 = SHV 11 = Lemo L01 21 = Lemo L04 42 and 44 = Redel Multipin see Table 8: Connectors part number information	one digit 0 = no revision For Example: A = first revision B = second revision	one digit 0 = no customization

Table 11: 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 Glossary

SHORTCUT	MEANING
V_{nom}	nominal output voltage
V_{out}	output voltage
V_{set}	set value of output voltage
V_{mon}	monitor voltage of output voltage
V_{meas}	digital measured value of output 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
ΔV_{out} – $[\Delta V_{in}]$	deviation of V_{out} depending on variation of supply voltage
ΔV_{out} – $[\Delta R_{load}]$	deviation of V_{out} depending 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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