

Technical documentation
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ESS Series

Single Channel 2 Quadrant High Voltage Module with Floating Ground

- 1 channel, 10 / 20 / 30 kV versions
- 2-quadrant capabilities, usable as unipolar current sink and source
- perfect for electron optical systems and capacitive loads
- low ripple and noise
- floating ground principle
- programmable parameters (delayed trip etc.)



Document history

Version	Date	Major changes
3.1	23.09.2020	Improved description Option Lower output current, 2-quadrant operation, Protection features, Current limitation
3.0	17.08.2020	improved documentation (safety information, glossary, Safty Loop)
2.2	15.10.2019	improved documentation (Module status, SPS, ADC)
2.1	12.09.2019	improved documentation
2.0	08.01.2018	Relayouted documentation, small fixes

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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.



HIGH VOLTAGE

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

WARNING!



WARNING!

High voltage power supplies of the device class generate an output voltage up to 30 kV. The disregard of this voltage condition can cause death, heavy injuries or material damage.

CAUTION!



CAUTION!

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

ESS modules are single channel high voltage power supplies in MMS-system (Eurocard format) with 2-quadrant capabilities. It can be used as unipolar current sink and source, which perfectly covers requirements of electron optical systems or capacitive loads.

The ESS series is built in floating ground principle to reduce voltage noise level. The configuration of output voltage and current can be customized on request. The module is made of high precision components such as 24 bit ADC and 16 bit DAC.

2 Technical data

SPECIFICATIONS	ESS
Polarity	Factory fixed, positive or negative
Floating principle	Common Floating Ground
Potential difference	56 V channel to Ground
Ripple and noise (f > 10 Hz)	< 0.6 – 2.5 V (see “CONFIGURATIONS ESS SERIES”)
Ripple and noise (f > 1 kHz)	< 0.5 – 2.2 V (see “CONFIGURATIONS ESS SERIES”)
Stability	
Stability – [ΔV_{out} vs. ΔV_{in}]	< $1 \cdot 10^{-4} V_{nom}$
Stability – [ΔV_{out} vs. ΔR_{load}]	< $1 \cdot 10^{-4} V_{nom}$
Long term stability (1h warmup) 24h	< $1 \cdot 10^{-4} V_{nom}$
Temperature coefficient	< 100 ppm / K
Resolution – The resolution of measurable values depends on the settings of the sampling rate and the digital filter!	
Resolution voltage setting	$2 \cdot 10^{-5} \cdot V_{nom}$
Resolution current setting	$2 \cdot 10^{-5} \cdot I_{nom}$
Resolution voltage measurement ⁽¹⁾	< $1 \cdot 10^{-5} \cdot V_{nom}$
Resolution current measurement ⁽¹⁾	< $1 \cdot 10^{-5} \cdot I_{nom}$
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	$\pm (0.2\% \cdot V_{out} + 0.1\% \cdot V_{nom})$
Accuracy current measurement	$\pm (0.2\% \cdot I_{out} + 0.1\% \cdot I_{nom})$
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	up to $0.2 \cdot V_{nom} / s$ opt. up to $1 \cdot V_{nom} / s$
Digital interface	CAN (potential free)
Protection	overvoltage, overtemperature, Safety loop, overload and short circuit protected (there is only one complete discharge or arc per second allowed!)
HV connector	G31 S10 S20
System connector	96 PIN (MMS HV compatible, according to DIN 41612)
Safety loop connector	Lemo 2pole
Case	19" plug-in cassette
Dimensions – L/W/H	220 mm / 8HP / 6U
Operating temperature	0 – 50 °C
Storage temperature	-20 – 80 °C
Humidity	20 – 90 %, 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 EDS SERIES									
Type	V _{nom}	I _{nom}	Ch	Ripple (V _{p-p})		Max. I _{in} (A) at 24V	HV connector Standard/opt.	Item code	Options
				(customized on request) [f > 10 Hz]	[f > 1 kHz]				
ESS 10 100x	10 kV	4 mA	1	< 2.5	< 2.2	2.5	S10	ES010100x405	-
ESS 10 200x	20 kV	2 mA	1	< 0.6	< 0.5	2.5	S20	ES010200x205	-
ESS 10 300x	30 kV	1 mA	1	< 1	< 1	2	G31	ES010300x105	-

Table 2: Technical data: Configurations

OPTIONS	OPTION CODE	EXAMPLE	ITEM CODE HEX CODING
POLARITY	Positive: x = p , Negative: x = n	ESS 10 300 p	

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

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 250 kBits/s standard. Wiener M-POD Controller and older iseg hardware is set on 125 kBit/s standard bitrate.

INFORMATION



INFORMATION

ESS 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” (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 2-quadrant operation

The ESS is capable to operate as a current source or current sink. The voltage regulator always keeps the Set-Voltage, if possible within the limitations of the module. It switches automatically and smoothly between the two operation modes.

Measured voltages and currents are provided by the module with a sign. For the voltage the sign corresponds to the module polarity. A sign of the current measurement value equal to the polarity indicates an operation in current source mode. The opposite sign indicates operation in current sink mode.

3.4 Current limitation - Source mode

3.4.1 Constant Current Mode

The Constant Current Mode (CC) is the default response on an increased output current. If the output current would exceed the set current (I_{set}) at the specified set voltage (V_{set}) the channel operates as a constant current source at I_{set} .

3.4.2 KillEnable

The function KillEnable forces the shut down of a channel at the fastest hardware response time (smaller than 1 ms) if a specified trip current is exceeded. If *KillEnable* is active the value of the set current (I_{set}) defines the trip current. An approach or exceedance of this current (detected by a hardware signal) will immediately shut off the channel without ramp.

With KillEnable active the maximum voltage ramp speed is limited to 1 % of V_{nom} to avoid unintended current trips during ramps. It might be necessary to further reduce the ramp speed for very small trip currents or capacitive loads. Alternatively KillEnable can be activated only after the completion of the ramp.

3.4.3 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 chapter 9 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 150 ms, 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 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.

INFORMATION



INFORMATION

An activated KillEnable feature disables the Delayed Trip function

3.5 Current limitation – Sink mode

For normal current sink mode operation the ESS is able to absorb a current equal to the nominal current.

If the current consumption would exceed the nominal current to keep voltage constant, the output voltage rises until the overvoltage protection is activated at 110% V_{nom} . In this case the module is shut off and the HV-output actively discharged.

3.6 Protection features

3.6.1 Safety Loop

A safety loop can be implemented by the safety loop socket (SL) on the front panel. If the safety loop is active a high voltage generation in any channel is only possible if the safety loop is closed and an internal current in a range of 5 to 20 mA is driven through the loop. 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 9 Appendix, “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 (see Figure 1: Jumper configuration on back side) of the module.

3.6.2 Active discharging

If the high voltage output is deactivated, the output will be actively discharged. In this case the sink current is not limited and can exceed the nominal current. The user must ensure that that the sink current does not constantly exceeds $1.2 \cdot I_{nom}$.

CAUTION!



CAUTION!

The module can be damaged if the current of $1.2 I_{nom}$ is constantly exceeded in the current sink.

Channel deactivation / active discharging is enabled under the following conditions:

- module is switched off and ramp down is finished
- module is shut down without ramp
- Safety Loop is not closed
- overvoltage / overtemperature protection is activated

CAUTION!



CAUTION!

Active discharging is **not** enabled if the module power supply is interrupted!

4 Front panel versions

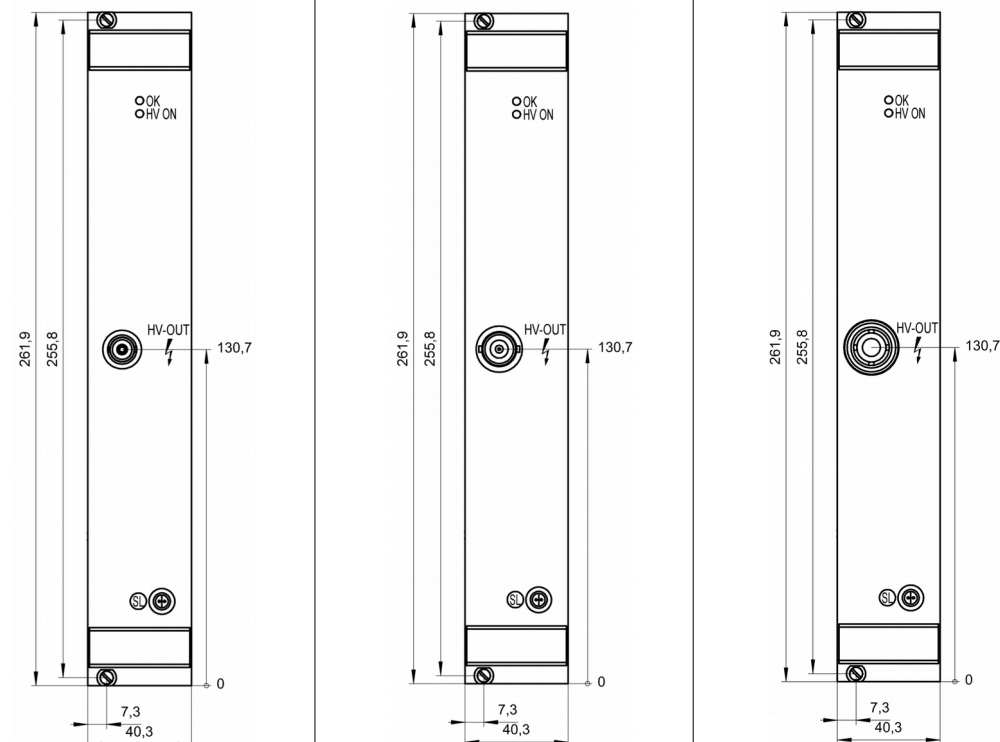
FRONT PANELS			
V _{nom}	10 kV	20 kV	30 kV
Floating	FG	FG	FG
HV Connector	S10	S20	G31
Options			
Figure			

Table 5: Front panel versions

5 Dimensional drawings

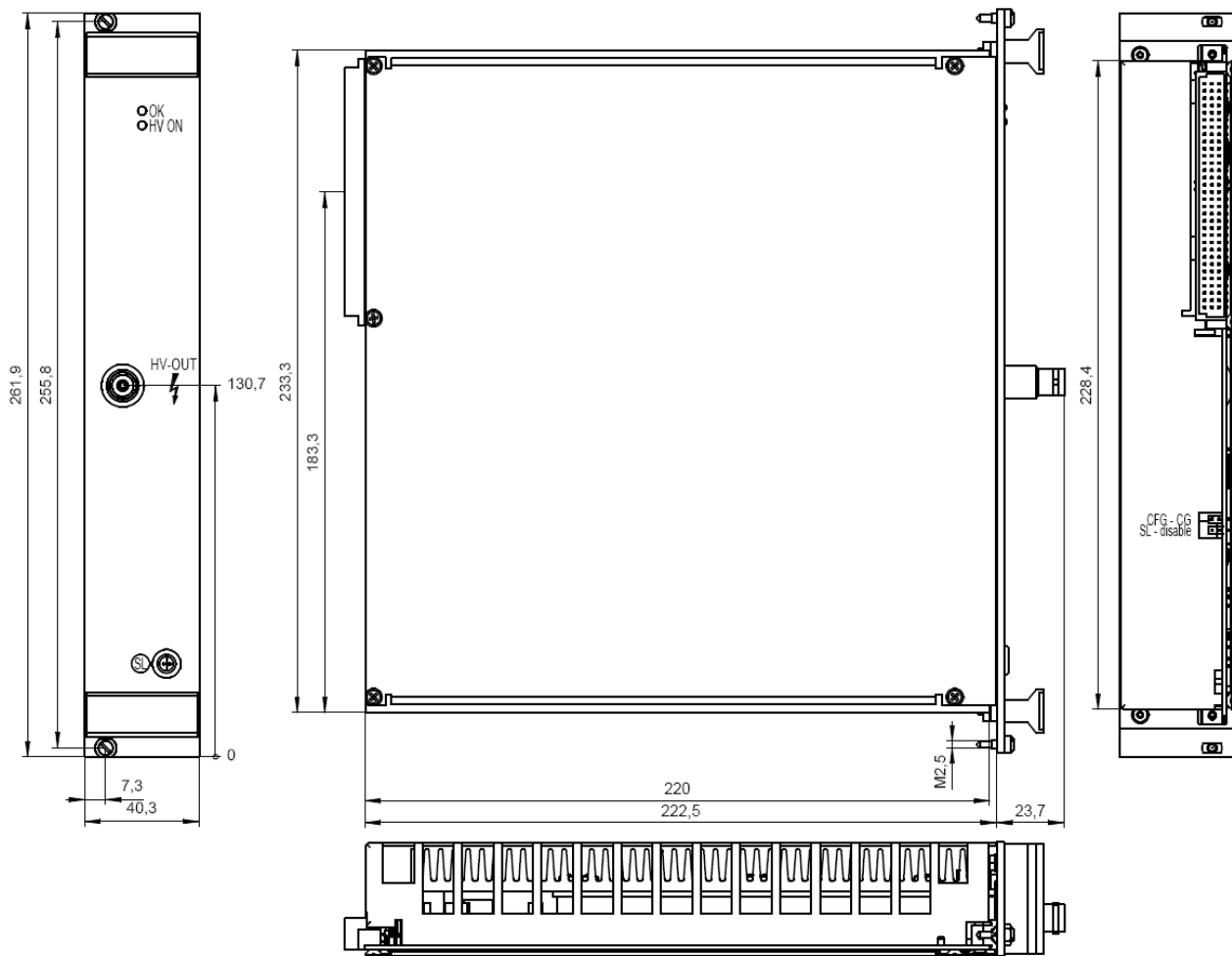


Figure 2: ESS 10 100x

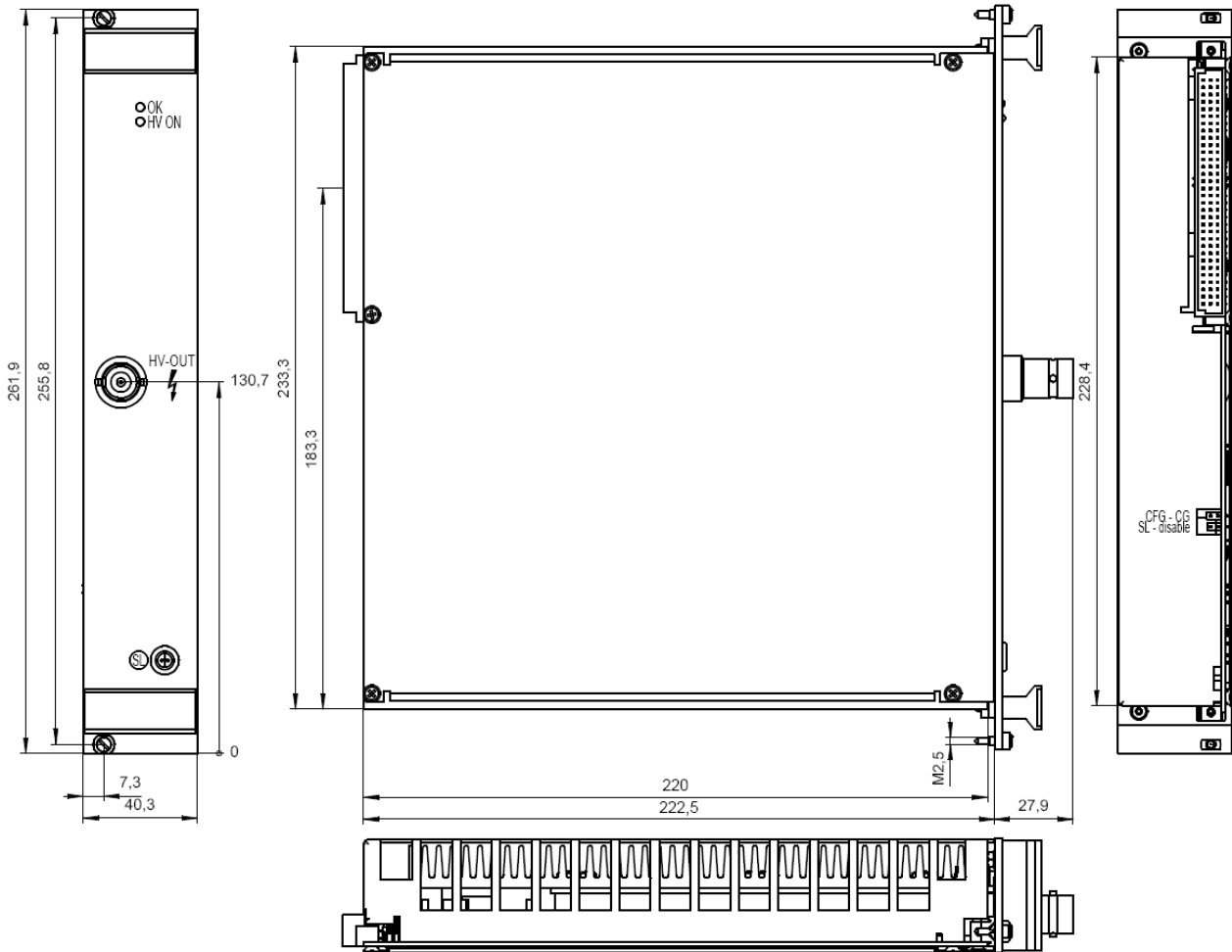


Figure 3: ESS 10 200x

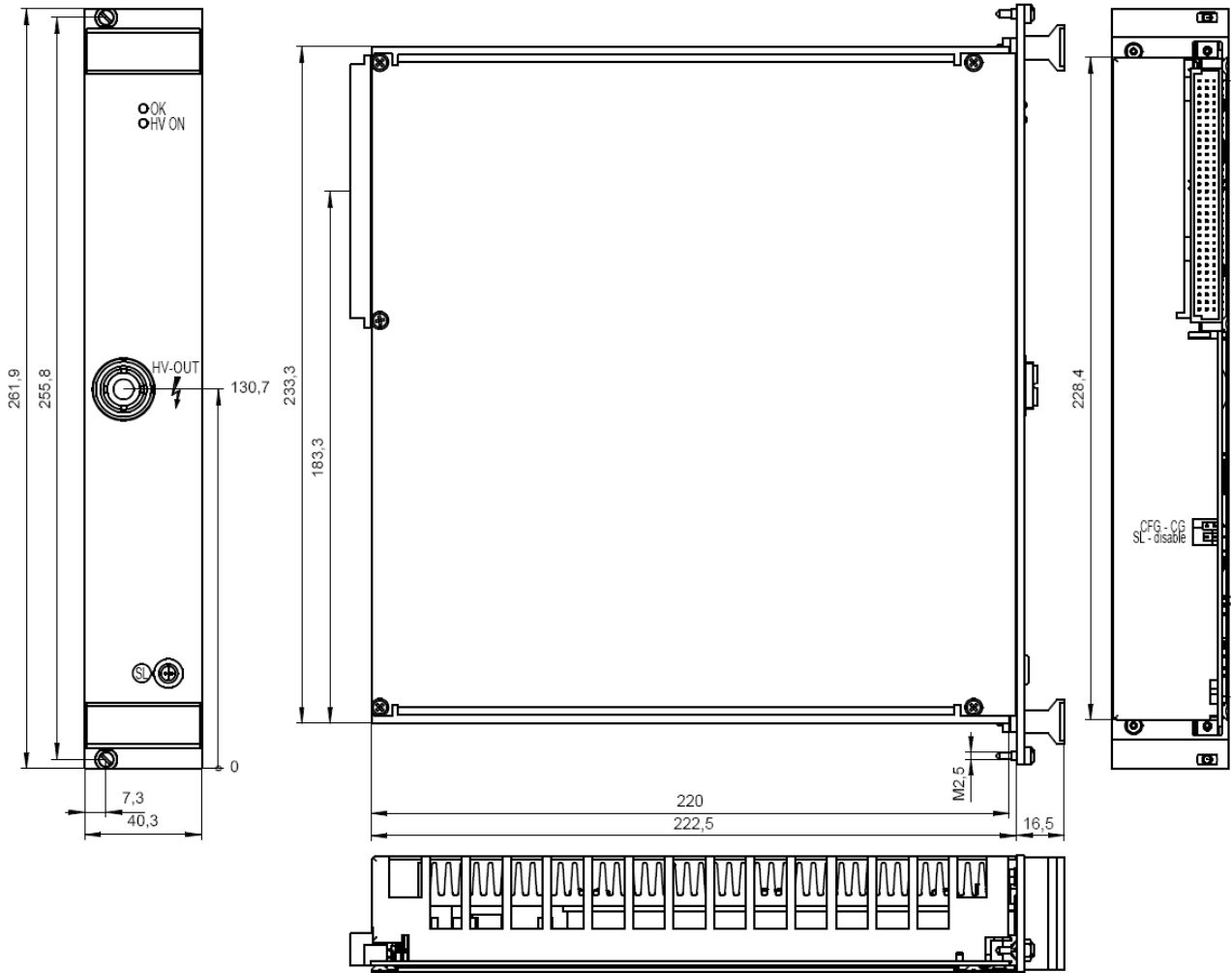


Figure 4: ESS 10 300x

6 Connectors and PIN assignments

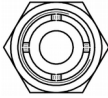



HV CONNECTOR ASSIGNMENTS			
Name	G31	S10	S20
Figure			
SAFETY LOOP			
Name	Safety Loop socket		
Figure			

Table 6: Connector and pin assignments

CONNECTORS PART NUMBERS (manufacturer code / iseg accessory parts item code)			
POWER SUPPLY SIDE		CABLE SIDE	
G31 (GES)			
Socket	7331053	Connector	7331052 / Z592501
S10 (KINGS)			
Socket	1064-1 QD	Connector	1065-1 QD / Z592512
S20 (KINGS)			
Socket	1764-1	Connector	1765-1 / Z592668
Safety Loop (LEMO)			
Socket	ERA.OS.302.CLL	Connector	FFA.OS.302.CLAC / Z592312

Table 7: Connectors part number information

7 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
Lemo plug 2-pole without collet chuck (SL)	Z592312
GES 30kV HV cable plug (HS 31 T)	Z592501
Kings 10kV HV cable plug single pole (1065-1)	Z592512
Kings 20kV HV cable plug single pole (1765-1)	Z592668

Table 8: Accessory item

8 Order guides

CABLE ORDER GUIDE				
POWER SUPPLY SIDE CONNECTOR	CABLE CODE	CABLE DESCRIPTION	LOAD SIDE CONNECTOR	ORDER CODE LLL = length in m [†]
G31	02	Lemo HV-cable shielded 30kV (Lemo 130660)	open	G31_C02-LLL
S10	04	HV cable shielded 30kV (HTV-30S-22-2)	open	S10_C04-LLL
S20	02	Lemo HV-Kabel shielded 30kV (Lemo 130660)	open	S20_C02-LLL

[†] 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)								
ES	01	0	300	P	105	000	02	00
High Voltage Series	Numbers of channels	Class	V _{nom}	Polarity	I _{nom} (nA)	Option (hex)	HV-Connector	Customized Version
		0 = standard	three significant digits • 100V For Example: 030 = 3000V	p = positive n = negative	two significant digits + number of zeros For Example: 105 = 1mA		04 = S10 05 = S20 08 = G31	00 = none

Table 10: item code parts for different configurations

9 Appendix

For more information please use the following download links:

This document
http://download.iseq-hv.com/SYSTEMS/MMS/ESS/iseq_datasheet_ESS_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

10 Glossary

SHORTCUT	MEANING
V_{nom}	nominal output voltage
V_{out}	output voltage
V_{set}	set value of output voltage
V_{mon}	monitor voltage
V_{meas}	digital measured value of voltage
V_{p-p}	peak to peak ripple voltage
V_{in}	input / supply voltage
V_{type}	type of output voltage (AC, DC)
V_{ref}	internal reference voltage
V_{max}	limit (max.) value of output voltage
$\Delta V_{out} - [\Delta V_{in}]$	deviation of V_{out} dep. on variation of supply voltage
$\Delta V_{out} - [\Delta R_{load}]$	deviation of V_{out} dep. on variation of output load
V_{bounds}	Voltage bounds, a tolerance tube $V_{set} \pm V_{bounds}$ around V_{set}
I_{nom}	nominal output current
I_{out}	output current
I_{set}	set value of output current
I_{mon}	monitor voltage of output current
I_{meas}	digital measured value of current
I_{trip}	current limit to shut down the output voltage
I_{in}	input / supply current
I_{max}	limit (max.) value of output current
I_{limit}	Current Limit.
I_{bounds}	Current bounds, a tolerance tube $I_{set} \pm I_{bounds}$ around I_{set}
P_{nom}	nominal output power
P_{in}	input power
P_{in_nom}	nominal input power
T	temperature
T_{REF}	Reference temperature
ON	HV ON/OFF
/ON	HV OFF/ON
CH	channel(s)
HV	high voltage
LV	low voltage
GND	signal ground
INH	Inhibit
POL	Polarity
KILL	KillEnable

11 Warranty & Service

This device is made with high care and quality assurance methods. The standard factory warranty is 36 months. Please contact the iseg sales department if you wish to extend the warranty.

CAUTION!



Repair and maintenance may only be performed by trained and authorized personnel.

For repair please follow the RMA instructions on our website: www.iseg-hv.com/en/support/rma

12 Disposal

INFORMATION



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

13 Manufacturer contact

iseg Spezialelektronik GmbH

Bautzner Landstr. 23

01454 Radeberg / OT Rossendorf

GERMANY

FON: +49 351 26996-0 | FAX: +49 351 26996-21

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