SCHNIER

Operating manual
HV supply HER02/02

Item no.:
810353
120 kV
2 mA

SCHNIER

Contents

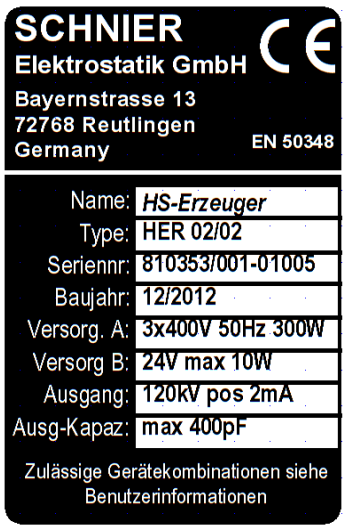
1. Product and Manufacturer

1.1. Product identification

This operating manual is part of the device:

Device name:	High-voltage generator
Type:	HER 02/01 and HER 02/02
Item number:	810353

1.2. Designation



1.3. Warranty

All warranties are void if the device is opened, modified, if parts are not replaced with the original parts or if this operating manual is not observed.

1.4. Manufacturer

SCHNIER Elektrostatik GmbH
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VAT ID No.: DE 146 481 986
Managing director: Olav Schnier

2. Guide to this Operating Manual

This operating manual must be read, understood and observed in all points by all persons with responsibility for the devices and electrostatic systems. Only with knowledge of this operating manual can errors be avoided and safe, malfunction-free operation be guaranteed. SCHNIER assumes no liability for damage that occurs due to non-compliance with this operating manual!

2.1. Target group

This operating manual is intended for:

Machine operators (such as machine setters, electricians, IT specialists or fitters), who have been trained by the manufacturer or operating company based on the operating manual and relevant safety regulations.

Maintenance specialists (such as machine setters, electricians, IT specialists or fitters), who have been trained by the manufacturer or operating company based on the operating manual and relevant safety regulations.

2.2. Accessibility to the operating manual / storing

The operating manual must always be available and easily accessible at the unit for the responsible specialists (operators, service and maintenance personnel).

The operating manual must be kept by the operating company for the entire service life of the unit. In case of a resale of the unit or of unit parts, the operating manual must be handed over to the new owner, since it is a part of the system.

2.1. Pictograms / symbols used

Pictogram / Symbol	Meaning
	Warning of a danger zone, that is used to indicate an **immediate hazardous** situation, which, if not prevented, can lead to a **serious injury or to death.**
	Warning of dangerous electrical voltage, that is used to indicate an **immediate hazardous** situation, which, if not prevented, can lead to a **serious injury or to death.**
	Warning of damage to the system or operational malfunctions.
	Hints for easy, rational proceeding

3. Intended Use

3.1. Use

This device is intended for use in stationary electrostatic systems which correspond to the safety requirements of the product standard **EN 50348**:2010 + Cor.:2010.

	**CAUTION** Any start up outside of this condition is prohibited.

This device is **not a finished** part and may only be put into operation after complete and proper installation and if it is detected that the system into which the device will be installed completely corresponds to the regulations of EN 50348.

Standard EN 50348 describes the safety requirements for stationary equipment for electrostatic application equipment for non-flammable liquid coating material. For information, and in the interests of safety, pay particular attention to the following sections of the standard EN50348:2010:

	Section EN50348	
	5.2.3	After switching off the high-voltage all high-voltage carrying parts must be discharged to a discharge energy of less than 350 mJ before these parts can be reached.
	5.3.2	When using walls, covers, signs and labels made of non-conducting material there is the risk of propagating brush discharges. These can occur if thin plastics have contact with large surface grounded conductors (e.g., metals). The dielectric strength of the coating must not exceed 4kV.
	5.4.	Describes the requirements for the high-voltage power supply which this generator is a part of.
	5.5.	The electrical equipment of the system must comply with the requirements of EN 60204-1. Especially the protective conductor section 4.2 must comply with this standard.
	5.6.1	All conductive system components, e.g., floors, transport equipment, etc., with the exception of the normal operational high-voltage carrying parts, must be grounded. The bleeder resistance may be max. 1 MΩ.

3.2. Further requirements for the surrounding system

	The HV generator must only be used in electrostatic systems within a temperature range **of 15°C to 50°C** and with a relative humidity between **10% and 70%** (not condensing).
	The HV generator is intended for **operation in a specific stationary system in an industrial environment**. Due to the occurrence of conductive or radiated interference, there may be difficulties in ensuring electromagnetic compatibility in other environments.
	To prevent hazards the entire system must undergo a risk analysis. Especially the Performance Level required in the above mentioned EN50348 standard for safety functions can only be met via a safety concept of the entire system.
	All poles of the energy supply of the high-voltage generator must be able to be disconnected from power with a circuit breaker, since the generator itself has no circuit breaker.
	The system must have an emergency stop switch, which also disconnects all poles of the power supply of the generator.
	The power supply must comply with the Overvoltage category III or better. The supply wire of the power supply must be fused with maximum 16 A.

4. Installation instructions

4.1. Structure

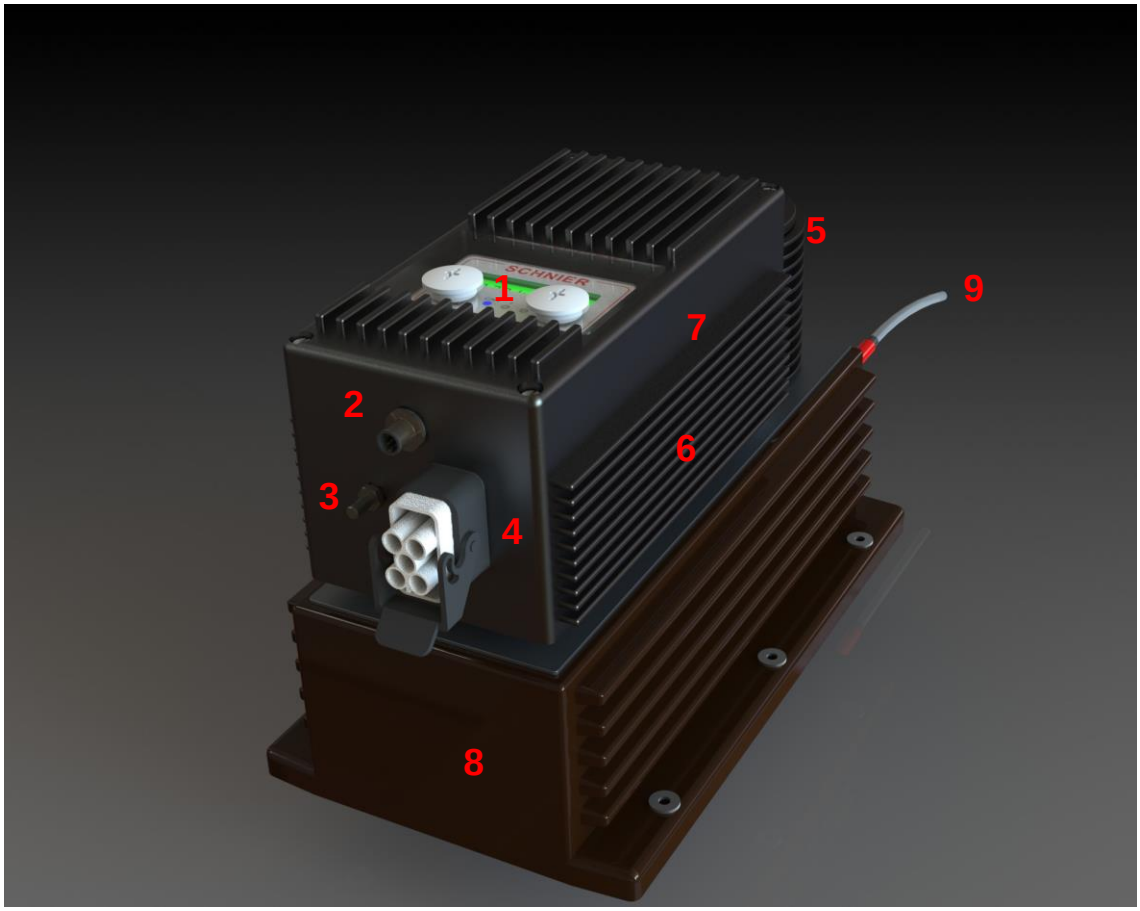


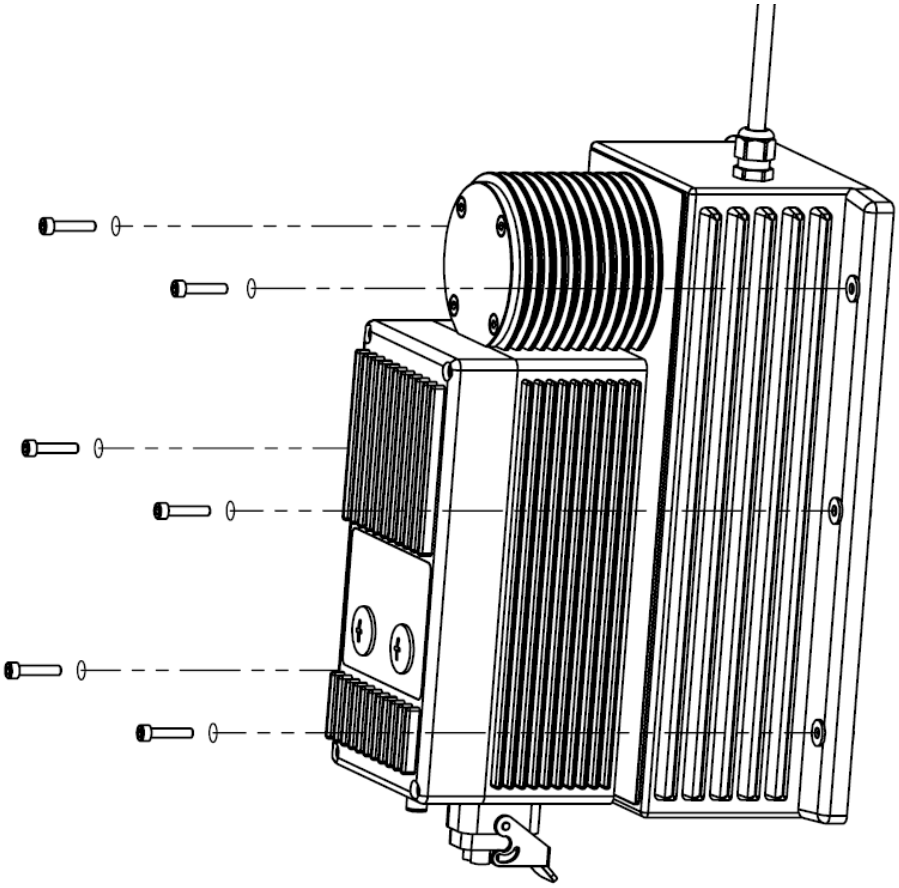
Figure 3. a

1. Display and keyboard
2. M12 Sensor / actuator plug 5 pin (24V and CAN)
3. POAG pin for ground connection
4. Power connector for power supply + feedback contact
5. Transformer unit
6. Housing lower part with power module
7. Housing upper part with control module
8. Epoxy resin housing with cascade
9. Cable screw fitting for HV connection cable

4.2. Mounting

The high-voltage generator is intended for wall mounting. So that the cooling ribs can fulfill their function the high-voltage generator must be mounted vertically (as illustrated).

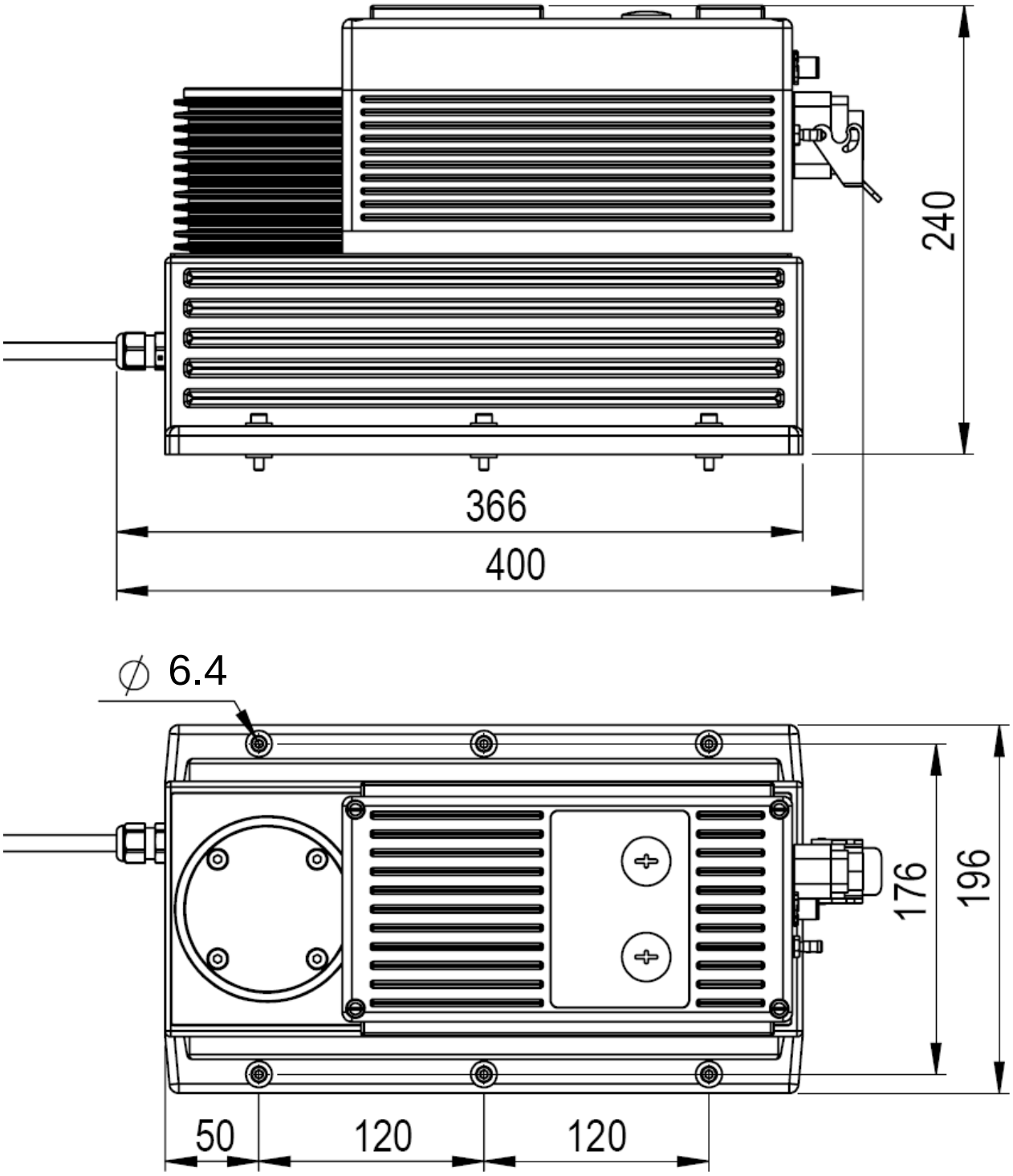
The metal housing is fabricated from seawater resistant aluminum and anodized. The brown cascade part is cast from a salt resistant epoxy resin.



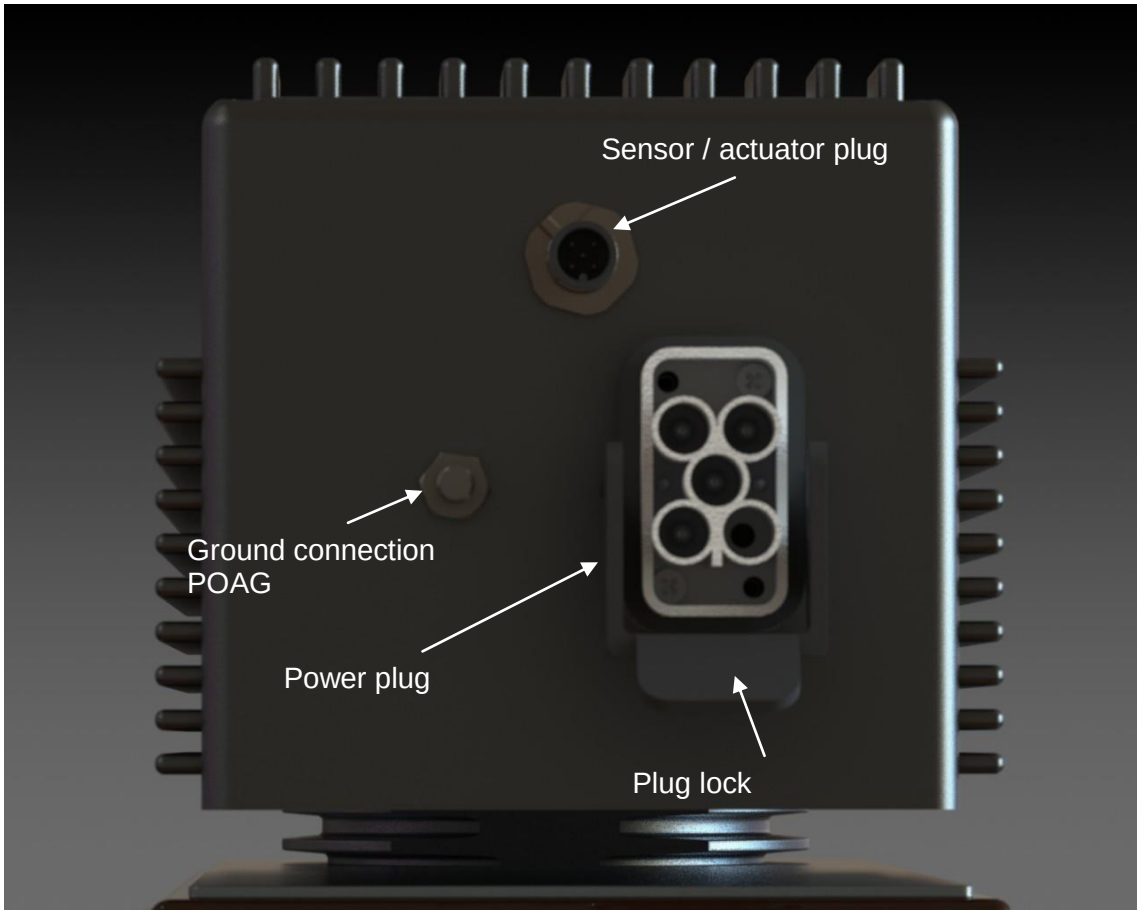
M6 screws in the appropriate length are to be used for fastening on the wall.

⚠	**CAUTION** Tightening the screws too tight can lead to cracks in the epoxy resin and risk of injury from falling
⚠	The high-voltage generator contains live parts and must only be opened by the manufacturer.
!	To prevent electrostatic charging it is recommended to screw the generator onto a grounded, conductive base.

4.3. Fastening dimension sheet

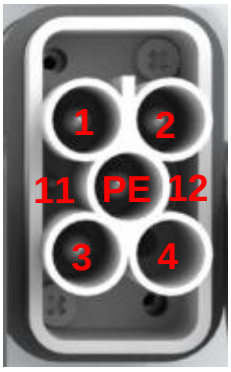


4.4. Electrical installation / pin assignments



4.4.1. Power plug

ILME CQM 04/2 or Harting HAN Q 4/2		
Pin	Description	Signal
1	Power supply L1	400 V
2	Power supply L2	400 V
3	Power supply L3	400 V
4	Not used	-
PE	Protective conductor	PE
11	Feedback	Potential-free 24V/1A
12	Feedback	Potential-free 24V/1A



CAUTION

The power supply is done via a 7-pin plug, e.g. HARTING HAN Q 4/2 or ILMA type CQM 04/2. **The plug lock must be locked before start up** (see figure).

The power supply must comply with the Overvoltage category III or better. The supply wire must be fused with maximum**16 A**.

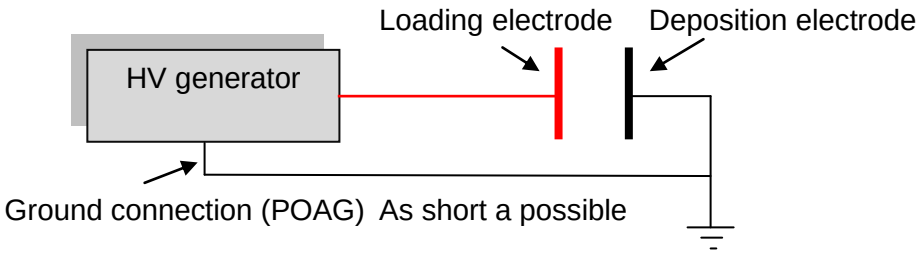
Connection PE must be connected on a circuit breaker system which complies with the safety regulations.

Plug and socket must be in **perfect condition.**

	The plug connection must meet IP54 at least. **The feedback contacts (RM) are designed for 24 V / 1A. They must only be connected to safety extra low voltage systems.**
!	To improve the immunity in industrial networks the use of a **4% 2A** line choke is recommended in the 400V supply lines. E.g. Block transformer **LR3 40-4/2** (14mH)
⚡	When using a 2A line choke the supply line must be fused with maximum **2A**.
i	When using several generators these can also be supplied via a common 4% choke. **The rated current of the choke must account for 2A per generator.** Maximum 16A for 8 generators.

4.4.2. Ground connection

The ground connection POAG is used for closing the high-voltage current circuit between the high-voltage generator and deposition electrode:



!	**CAUTION** The ground connection (Fig. 1/3) must be contacted with a POAG socket (see Figure) and connected with min. 4 mm^2 as short as possible with the operating ground of the ground electrode. This connection should not be laid parallel to power supplies or fieldbus lines.

Description: Angle socket for equipotential bonding POAG
crimp connection
Item no.: 260066

⚡	**CAUTION** The ground connection does not replace the circuit breaker (PE on power plug)

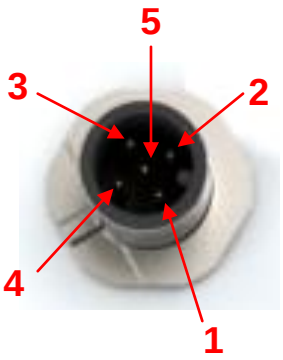
4.4.3. High Voltage Connection

	The 4mm high-voltage contact pin of the high-voltage cable must be completely plugged in and the strain relief screw connection must be tightened.
	CAUTION If shielded HV cable is used, the shielding must be grounded

4.4.4. M12 Sensor / actuator plug (safety extra low voltage)

The supply to the controls is done together with the CAN connection via a M12 sensor/ actuator plug.

M12 plug 5-pin		
Pin	Description	Signal
1	Shield	GND
2	V+	24 V DC
3	V-	0 V DC / GND
4	CAN_H	CAN High
5	Can_L	CAN Low
Screw connection		Shield



	CAUTION The control line must be shielded. Operation is only permissible with tightened lock nut of the M12 connector.
	At least an IP 54 design must be used for the counter piece.
	A CAN bus must be connected at a point in the bus with 120 Ohm. The generator does not have 120 Ohm connection re-sistance built in, this must then be connected in addition to the bus.

5. Normal operation

The specifications for the intended use according to EN 50348 apply. In addition the operating manuals of the relevant electrostatic system must be complied with!

Operation of the system must only be carried out by a trained operating team. The personnel must be informed in reasonable intervals about the accident prevention regulations and about the operation of the system.

!	**CAUTION** The 400 V supply should only be disconnected if the high-voltage was switched off beforehand. Exception: Emergency Stop in hazardous situations.
	**CAUTION** In work in which parts connected with the high-voltage output can be reached the following must be done: The high-voltage must be switched off. All high-voltage carrying parts must be discharged to a discharge energy of less than 350 mJ The 400 V supply must be safely disconnected and secured against being switched on again. The high-voltage carrying parts grounded with a suitable grounding rod.
!	The high-voltage cascade and the high-voltage transformer are enclosed in a housing with cooling ribs. Cooling ribs must be kept clean so that they do not lose their function. If dirty they must be cleaned with a suitable cleaning agent.

Fundamentally the regulations for normal operation of the HV generator must be observed during maintenance and repair work of the surrounding system. Electrical systems under power must not be worked on.

5.1. Safe switching off of the high-voltage before access

To guarantee safety before and during a release of the access to high-voltage carrying components the following sequence must be complied with and also ensured through technical actions:

1. Switch off the high-voltage via CAN command
2. Wait until "safely off" is reported via the feedback contact. This should be done after 60s at the latest. In the interest of safety also this should be monitoring in order to recognize if, for example, the system capacity changes.
3. Switch off the 400V supply

4. Secure against switching on again.

5. Though the absence of the 400V supply the generators now again report "unsafe". This depends on the system and is OK.

6. For further safety after switching off the 400 V a waiting time of 60 seconds should be implemented up to release of access.

7. Use grounding rod for grounding of the high-voltage carrying parts in operation.

6. Maintenance and Repair

The specifications for the intended use according to EN 50348 apply and the safety regulations for normal operation. In addition, the operating manuals of the relevant electrostatic system must be complied with!

The high-voltage generator has no service parts. It can only be repaired by the manufacturer.

The following sequence is recommended for disconnecting the lines:

1. Disconnect the power plug
2. Disconnect the sensor/actuator plug
3. Disconnect HV connection
4. Disconnect the ground connection

	**CAUTION** If a generator is removed from a system, no high-voltage carrying parts in operation should be touched without them being previously grounding using a grounding rod. The ground connection of the generator must be connected during this. **This especially applies to defective generators.**
	**CAUTION** The high-voltage generator contains live parts and must only be opened by the manufacturer.
	All warranties are void if the device is opened, modified or if parts are not replaced with the original parts.

7. Structure and function description

7.1. General Information

The high-voltage generator is built in a compact design. The controls, end stage, HV transformer and the HV cascade are combined in one device. The unit is supplied with 3-phase 400 V 50/60 Hz. The controls are separately supplied with 24 V. The power output stage has its own µController, which guarantees a precise and very fast control. The control module takes over all control functions with a separate microcontroller and establishes communication to the outside using CANopen.

The temperature of the end stage and the aluminum housing is monitored. If there is an impermissible temperature increase there is first a warning and if it continues to increase there is a shutdown.

7.2. Safety concept

Communication of both µcontrollers is permanently monitored. As soon as the communication is defective or interrupted, there is a shutdown and an error is reported.

The internal measurement resistance of the cascade, the current measurement and the internal protection circuit undergo a plausibility test each time the high voltage is switched on. This test runs at the start of the start up ramp and is completed after approx. 200 ms. If the test fails there is an immediate shut down and an error is reported.

The actual applied high voltage is continuously measured and monitored. The control can be preset with the system capacity via CANopen. The factory setting is at 3 nF.

According to the formula:

$$E = C1/2 \times U^2$$

E = Residual energy in joules [J]
C = System capacity in farad [F]
U = Voltage in volts [V]

the µController calculates the dangerous voltage level.

Basics for this are 0.24 mJ. At 3 nF and 0.24 mJ the voltage threshold lies at 400 V. As soon as the applied high voltage lies above this value "unsafe" is reported, regardless of whether the high voltage is switched on or not. If the high voltage lies below 400 V (with setting 3nF) “safe" is reported. The message is output via CANopen and is additionally available as potential-free relay output. The relay is a safety relay and is continuously monitored. For additional safety the relay is delayed by 10 seconds after switching off the high voltage regardless of U actual (see also 4.3).

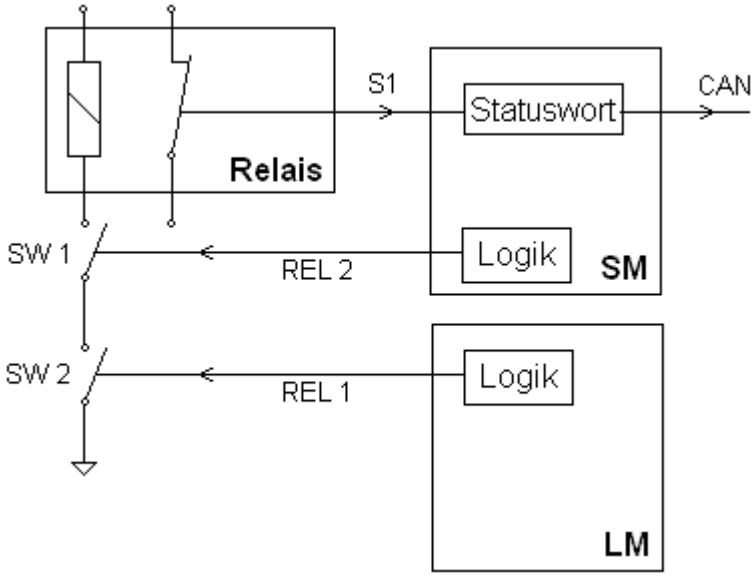
High voltage-ON is additionally reported via CANopen if the high voltage is switched on and the output voltage has reached at least 90 % of U target.

The 400 V input voltage is measured on the power module and monitored. With more that 10% over-voltage there is a shut down and an error is reported. If the 400 V is not applied an error is also output.

The software of the power module and the control modules are continually checked and monitored. For errors there is a shutdown and the error output.

7.3. Description of the safety feedback

The state of the high-voltage generator is transmitted via the bit "Device is safely off" in the status word (see in document "Explanation of the status word") of a PDO via CAN interface. As shown in the illustration, the bit "Device is safety off" corresponds to the condition of the safety relay. The bit is set if the high-voltage generator is in a new state and the safety relay is closed. The bit is reset if the high-voltage generator is in an unsafe condition and thus the safety relay is open.



The safety relay is controlled both by the control module and the power module. Only if the control signals REL1 and REL2 are simultaneously set are the switches SW1 and SW2 closed and the safety relay is energized. The control conditions are listed in the following table.

The plausibility of the safety relay is checked by a monitoring function. If the safety relay cannot be controlled by the control signals, "Safety error" is set in the status word. The plausibility of the safety relay can also be checked through the bit "OPEN safety contact" in the control word. The safety relay can only be controlled by this bit, if the high voltage is not switched on (the bit "High voltage ON" equals 0). The state of the safety relay can be determined by the bit "Safety contact OPEN" in status word. If the safety relay functions correctly, the bit "Safety contact OPEN" must equal the bit "OPEN safety contact".

Control signal	Condition	Conditions
REL 1	1 safe	1. The bit "High voltage ON" in the control word equals 0. 2. The bit "OPEN safety contact" in the control word equals 0. 3. The output voltage is smaller than the safety level that corresponds to the residual energy. 4. No relevant malfunction is detected from the CM and PM. (see below).
	0 unsafe	One of the above conditions is not met.
REL 2	1 safe	1. No relevant malfunction detected from the PM. (see below). 2. The 10 second waiting time after HV-OFF (re-setting the bit "High voltage ON" in the control word) has elapsed.
	0 unsafe	One of the above conditions is not met.

	**CAUTION** The safety relay should be tested at least once per month by the bit Open safety contact from the higher-level control system.

For the following malfunctions the safety relay is **opened**:

Malfunction messages of the control module:		
Malfunction	**Cause**	**Remedy**
Current measure-ment*	If the current measurement or Imess suppressor diode is not OK in the test phase (shortly after switching on the HV).	Check by the manufacturer required.
Udutycycle*	If the output line is not in the range that corresponds to the control variable of the controller.	Check the high voltage cir-cuit for short circuit. If the error continually occurs: Check by the manufacturer required.
ProgrammTest*	If the checksum of the program is not correct.	Check by the manufacturer required.

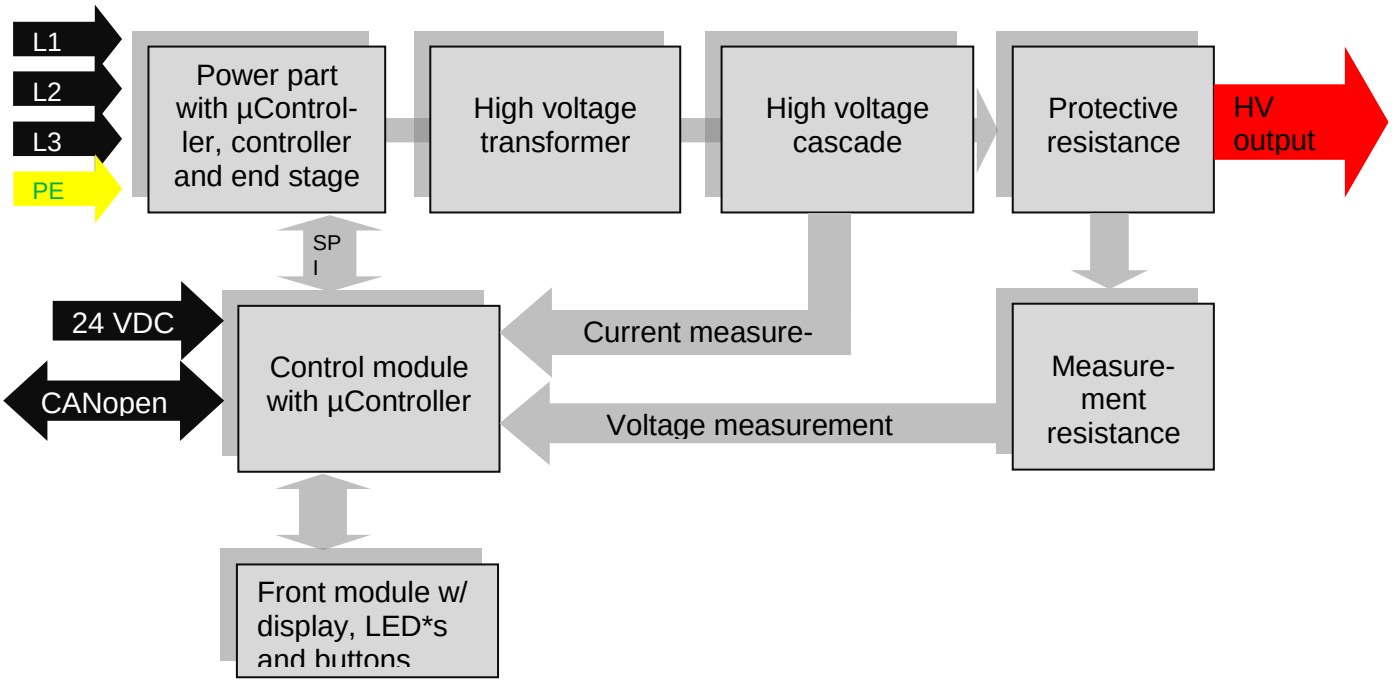
400V supply voltage.	If the 400V supply voltage is missing or the communication between the power module and control module is interrupted.	Check supply voltage. If the error continually occurs: Check by the manufacturer required.
Safety*	If the plausibility test of the safety relay failed	Check by the manufacturer required.
Self-test*	If the output voltage of 2.8 KV is not reached within 200 ms then the HV generator has failed the self test.	Check the high voltage circuit for short circuit. Otherwise: Check by the manufacturer required.
Malfunction of the power module:		
Shutdown-LM	If the output voltage is larger than approx. 140 kV.	Acknowledge error if the error occurs continually: check by the manufacturer required.
Internal communication	If the communication between the control module and power module is distorted by the SPI interface.	Acknowledge error. Check supply voltages.

	The malfunctions marked with * **(current measurement, Udutycycle, ProgramTest, Safety, Self test)** indicates continuous error of the device. These errors can possibly falsify the function of the feedback "safe off". Therefore, these should not be acknowledged without taking suitable actions to eliminate any hazard. (For this refer to the instructions under Maintenance and Repair).

The following malfunction messages are not device-related, but rather operation-related and do not lead to the feedback "unsafe".

Malfunction messages of the control module (CM)		
Malfunction	**Cause**	**Remedy**
Umin	If the output voltage during I-mode is smaller than the threshold value in the object directory.	Check parameters and if necessary adapt to the operating conditions. Check the high voltage circuit for short circuit / leakage currents. Acknowledge error.
Imax	If the output current during U-mode is larger than the threshold value in the object directory.	Check parameters and if necessary adapt to the operating conditions. Check the high voltage circuit for short circuit / leakage currents. Acknowledge error
Over-temperature cascade	If the temperature of the cascade is above 65 °C.	Check ambient temperature (max. 50°C). Check fan: Check cooling ribs (see 4.1)
Over-temperature power module	If the temperature of the power module is above 75 °C.	Check ambient temperature (max. 50°C). Check by the manufacturer required.
Invalid parameter	If any parameter in the object directory is set with an invalid value.	Check parameters.
Node guarding	If the generator has not received any node guarding object within its lifetime. (The communication is interrupted via the CAN-Bus).	Check CAN connection. Check system software.
Malfunction of the power module (PM).		
Over-voltage	If 400V supply voltage is over 10 percent too high.	Check supply voltage. Acknowledge error.

7.4. Block diagram



7.5. Technical data

Power supply voltage	400 V 50/60 Hz 3 phases max. 1 A (power part)
	24 V DC max. 250 mA (control)
Output voltage	10-120 kV
Output current	2 mA
Ambient conditions	+5°C to 50°C or* 55°C, max. 70% r.H.
Storage temperatures	-20°C - +70°C
Dimensions	Approx. 400 x 200 X 200
Weight	Approx. 14 kg
Protection class	IP 65
HV connection	Anode tube with 4 mm jack
Bus connection	CANopen
Operating modes	Current and voltage constant
Safety	Feedback contact "safely discharge"
Display + buttons	Single row 16 characters, 2 buttons 3 LED's For setting the bus address and display of current and voltage in running operation

* Operation up to 55°C. The temperature optimized version of the generator (recognizable by the cooling ribs of the electronic housing) allows operation above 50 degrees to 55 degrees. The internal temperature of the device is monitored and if necessary a warning is output.

8. Start up of the CANopen interface

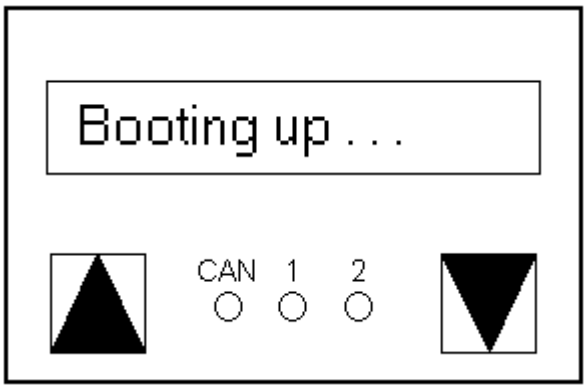
	**ATTENTION** **The node guarding function in the higher-level control system must be activated. It is necessary to detect interruptions in the communication with the CAN-Master and then to switch off the high voltage.**

8.1. First setting of the node ID and baud rate

The address and baud rate must be set on the device beforehand so that the higher order controls can communicate with the generator via the CAN interface.

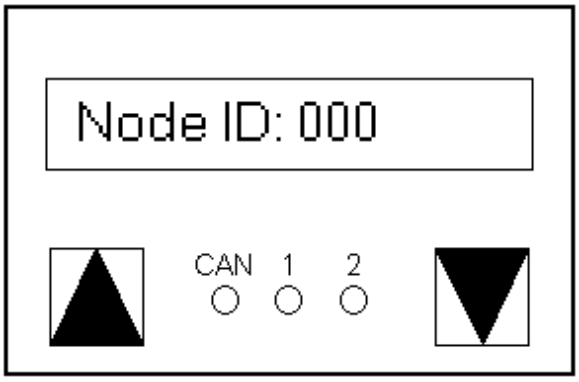
	**NOTE** These settings are also possible without power supply
	**NOTE** Node ID 2 is set at the factory

After applying 24V supply in the M12 plug, the text "Booting up..." is displayed on the display of the high-voltage generator (Figure 3.a / 1) for approx.5s:



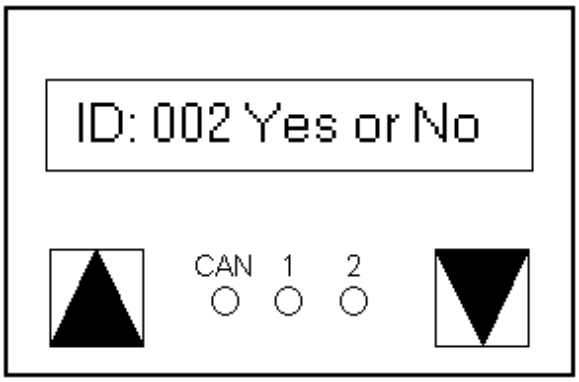
Booting up

After starting the text "Node ID: XXX" is shown on the display. If XXX equals 000, this means that no valid Node ID is present in the EEPROM.



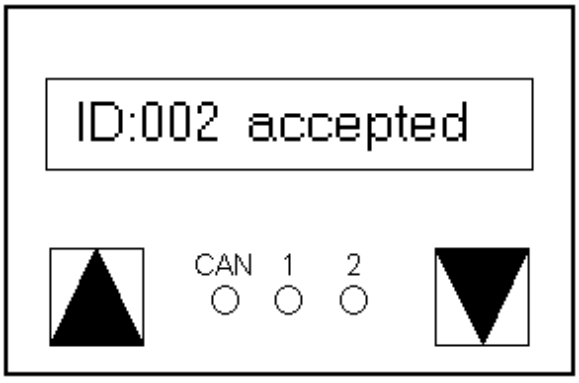
Node ID is not available

The generator controls waits until a valid Node ID is input with the buttons. The digit can be selected using the left button. By pressing the right button the number of the corresponding digit is incremented by one. Both buttons must be pressed at the same time and held for 1 second to confirm. If the yellow and blue LEDs are lit, the Node ID has been accepted. When both buttons are released the input Node ID is shown on the display:



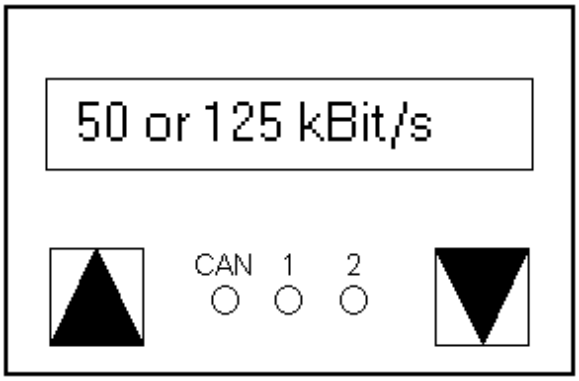
Entered Node ID

To confirm press the left button so that the cursor is on "YES". And then the right button must be pressed so that the confirmation is accepted. If "NO" is selected, a new Node ID can be entered. After the Node ID is accepted a confirmation text is shown on the display:



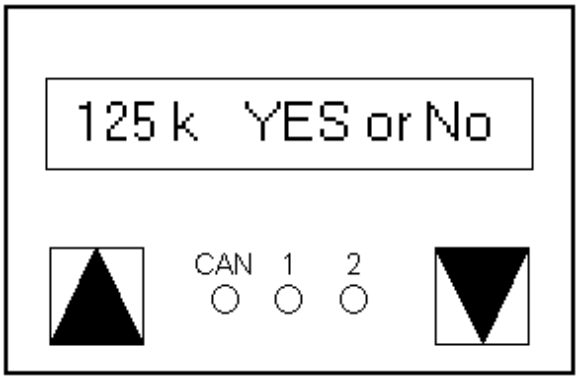
Node-ID is accepted

Then the baud rate is requested:



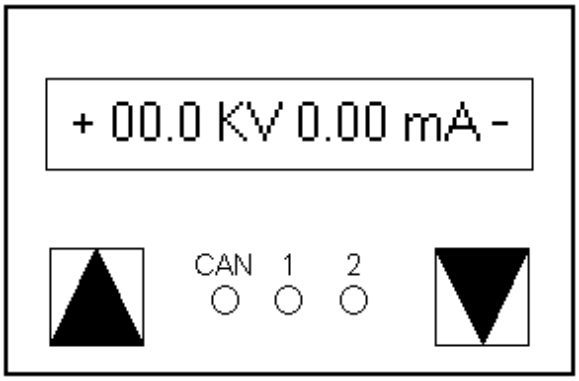
Baud rate is requested

The baud rate can be selected between 125 kbit/s and 50 kbit/s using the left button. The right button is for confirmation. Using the right button the selected baud rate is shown on the display and a confirmation is expected:



Selected baud rate

After confirmation of the baud rate a bootup message is sent via the CAN interface of the high-voltage generator. The text "+ 00.0 KV 0.00mA -" is shown on the display:



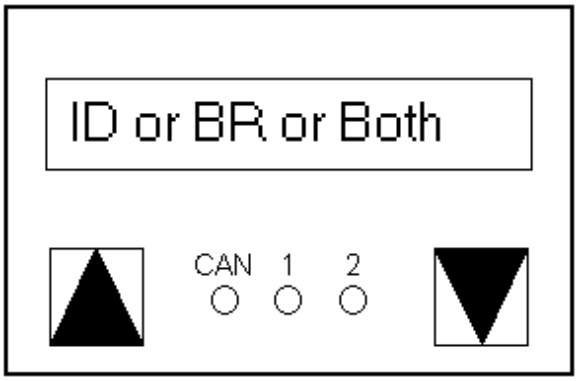
Actual values of the voltage and current

This is the display during operation. If the CAN connection is interrupted during operation, then the text "**BF CANopen**" appears.

8.2. Changing the Node ID and/or baud rate

If XXX equals a number between 1 and 127, it means that a valid Node ID has already been set. If no change is done to the Node ID or baud rate with the buttons, after 5 seconds the bootup message is sent via the CAN interface of the high-voltage generator and the generator is ready. The text "+ 00.0 KV 0.00mA -" is shown on the display.

If the Node ID or the baud rate should be changed, one of the two buttons must be pressed within 5 seconds after the display of the Node ID. The text "ID or BR or Both" is shown on the display:



Options for changes

The left button is for the selection of options. The right button is for confirmation of the options. If only the Node ID must be changed, only the "ID" is selected. The same applies for the baud rate. If the Node ID and the baud rate must be changed, the option "Both" must be selected.

9. Description of the CANopen interface

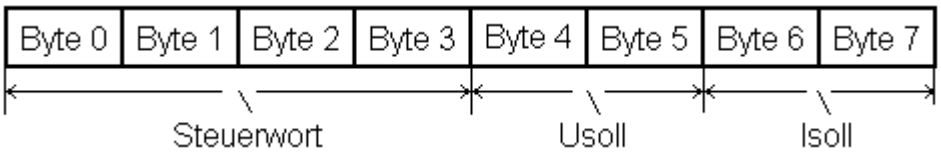
If a bootup message will be sent via the CAN interface of the high-voltage generator, then the high-voltage generator is ready for operation.

As soon as the higher order controls has put the generator in "Operational Mode" this can be controlled or queried via the following Pos and SDOs. Essentially these are status and control words with bits and various parameter bytes or words. (see overview at the end of the operating manual)

9.1. The control word

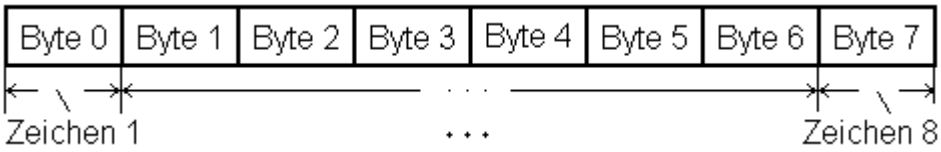
The high-voltage generator is controlled by the receiving-PDO "RXPDO1" with the COB-ID "0x200+Node-ID". The text on the display can be entered via PDO "RXPDO2" (COB-ID:0x300+Node-ID) and "RXPDO3" (COB-ID:0x400+Node-ID). The state of the high-voltage generator is saved in the transmission-PDO "TXPDO1" with the COB-ID "0x180+NODE-ID" and queried via SYN object.

The data contents in the RXPDO1 contains three objects from the object directory. The three objects are arranged so:



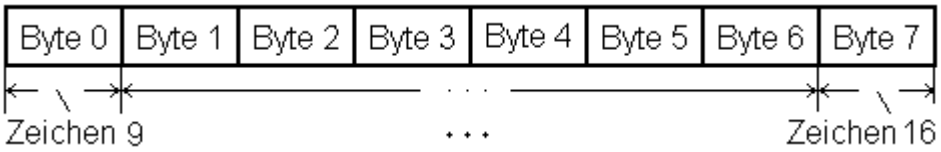
Data contents of the RXPDO1

The data contents in the RXPDO2 contain the numbers 1 to 8 on the display:



Data contents of the RXPDO2

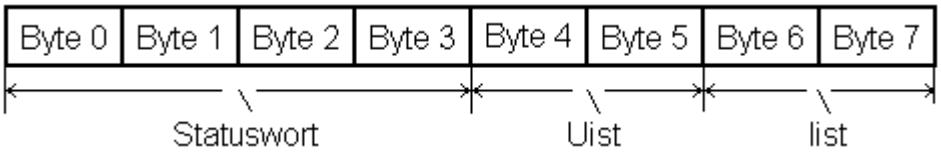
The data contents in the RXPDO3 contain the numbers 9 to 16 on the display. (See Figure 5.2.3.) As soon as the text on the display of RXPDO2 and RXPDO3 is overwritten, the output voltage and the output current is overwritten on the display. The display then shows only the contents that RXPDO2 and RXPDO3 contain.



Data contents of the RXPDO3

9.2. The status word

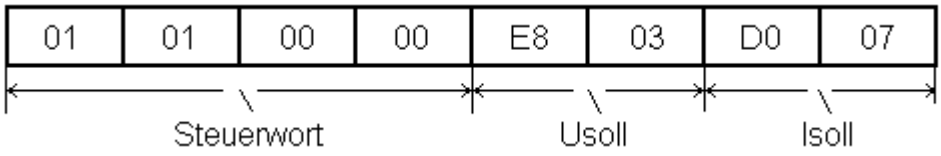
The data contents in the TXPDO1 contains three objects from the object directory. The three objects are arranged so:



Data contents of the TXPDO1

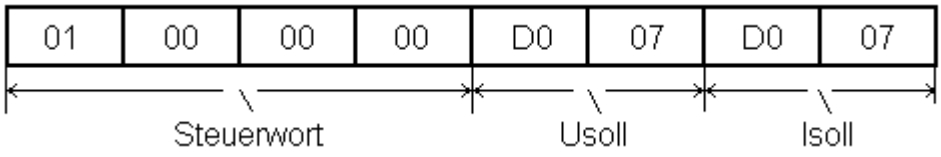
Example: 10kV, U-mode, 2mA:

The generator supplies 10 kV controlled. However, if the current of 2mA is reached, then it is limited to this value, i.e. if necessary the voltage decreases. The numbers are displayed here in hexadecimal.



RXPDO1 for 10 kV and 2 mA in U-mode

Example: 20kV, I-mode, 2mA:
In I-mode the roles of U target and I target are exchanged with each other. If the high-voltage generator, for example, is switched on for 2 mA and 20 kV by RXPDO1 with I-mode, the Utarget does not limit the output current, as long as the output voltage is below 20 kV. (See Figure 5.3.3.) If the output voltage reaches 20 kV, the output current does not continue to increase. (The high-voltage generator behaves than as in U mode).



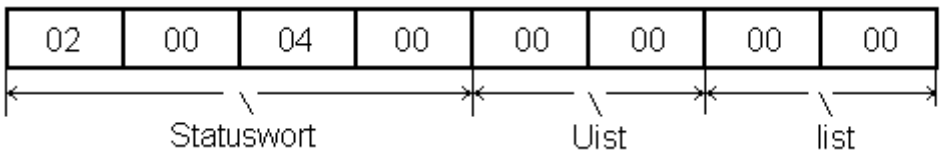
RXPDO1 for 20 kV and 2 mA in I-mode

9.3. Output from messages and warnings

Under certain conditions the high-voltage generator switches off the output voltage. This can be from user specified conditions, as for example Umin threshold during I-mode, number of electrical arcs reached, etc. In addition permanent self tests and temperature monitoring is done, that lead to warnings or to shut down.

In this case the generator sets the corresponding bit and always the collective message "Collective malfunction" in the status word.

The high-voltage generator is then in an error state. The state of the high-voltage generator can be determined from the TXPDO1 via SYN-object. If the high voltage is switched off, for example, due to exceeding Imax in U-mode, the TXPDO1 looks like the following:

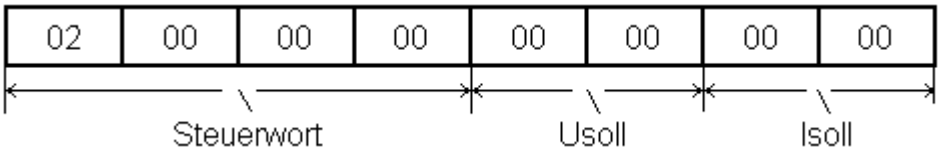


TXPDO1 for Imax switch off during U-mode

The output voltage and the output current in an ideal case fall back to 0. The speed is dependent upon the system capacity.

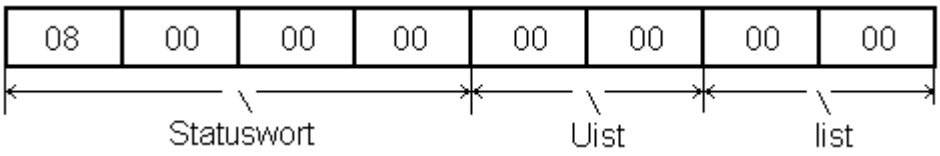
9.4. Acknowledging a message

The malfunction must be acknowledged before the high voltage can be switched back on. The malfunction should be acknowledged through RXPDO1 as shown here as an example:



RXPDO1 for acknowledging malfunction

If the malfunction is acknowledged and the output voltage is under the safety level and 10 seconds have elapsed since the switch off, the safety contact is closed. The condition of the high-voltage generator is then as shown in the example:



TXPDO1 displays a safe condition

The output voltage and the output current cannot have small values due to the residual energy, for example. If the malfunction is acknowledged, but the output voltage is not under the safety level or the 10 seconds has not elapsed, the state of the high-voltage generator looks like this:

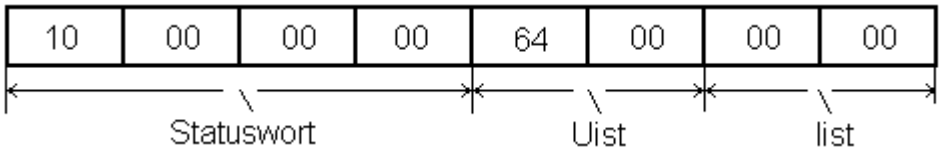


Figure 6.4.c TXPDO1 shows an unsafe state

This means that the high-voltage generator can not detect a safe state and therefore the feedback contact remains open. As example the output voltage shows 1 kV.

9.5. Description of the control bits

Byte	Bit	Status bit	Explanations
0	0	High voltage ON	1: The high voltage should be switched on 0: The high voltage should be switched off
	1	Acknowledge malfunction	1: All malfunctions should be acknowledged 0: no action **Caution:** During malfunction acknowledgment the bit "High voltage ON" must be reset.
	2	Reserve	
	3	Reserve	
	4	OPEN safety contact	1: The safety contact should be opened. 0: The safety contact should be closed. **Caution:** Only if the high voltage is switched off can the safety contact be controlled.
	5	Actuation of yellow LED	1: The yellow LED should be switched on. 0: The yellow LED should be switched off.
	6	Actuation of green LED	1: The green LED should be switched on. 0: The green LED should be switched off.
	7	Actuation of display backlight	1: The background illumination of the display should be switched on. 0: The background illumination of the display should be switched off.
1	0	Operating mode	1: U-mode 0: I-mode
	1	Reserve	
	2	Reserve	
	3	Reserve	
	4	Reserve	
	5	Reserve	
	6	Reserve	
	7	Reserve	
2 + 3	0..7	Reserve	

9.6. Description of the status bits

Byte	Bit	Status bit	Explanations
0	0	High voltage is ON	1: Output voltage larger than 90% of voltage target value and the power module working. 0: no high voltage
	1	Collective malfunction	1: If any individual malfunction occurs. 0: no malfunction
	2	Collective warning	1: If any individual warning occurs. 0: no warning
	3	Device is safely off	1: Output voltage is smaller as safety voltage. No error is present. The safety relay is energized. 0: The device is in error state and/or unsafe.
	4	OPENED safety contact	1: Safety relay failed. 0: Safety relay energized.
	5	Left button	1: Left button pressed. 0: Automatically reset if the status word is queried via SYN object.
	6	Right button	1: Right button pressed. 0: Automatically reset if the status word is queried via SYN object.
	7	Reserve	
1	0	Operating mode	1: U-mode 0: I-mode No effect. If the current target value is reached before the voltage target value, the current is restricted, i.e. I-mode. U-mode is the opposite.
	1	Fan speed (internal fan)	1: Fan speed is less than 80% of the specified value. 0: Fan speed OK

Byte	Bit	Status bit	Explanations
	2	Electrical arcing warning	1: Electrical arcing detected. 0: Automatically reset if the status word is queried via SYN object.
	3	Umax reached during I-mode	1: Output voltage larger than the threshold in object directory. 0: If the output voltage is smaller than the threshold in the object directory.
	4	Over-temp. Cascade warning	1: Measured temperature of the cascade over 60 °C. 0: Measured temperature of the cascade under 60 °C.
	5	Over-temp. PM warning	1: Measured temperature of the power module above 70 °C. 0: Measured temperature of the power module under 70 °C.
	6	Current measurement error	1: Current measurement or suppressor diode is not OK in the test phase (shortly after switching on the HV). 0: If this malfunction does not occur or is acknowledged.
	7	Udutycycle error	1: Output power not in the range of the control variable of the controller 0: If this malfunction does not occur or is acknowledged.
2	0	Switching off ProgrammTest	1: Checksum of the program is incorrect. 0: If this malfunction does not occur or is acknowledged.
	1	Umin switch off during I-mode	1: Output voltage during I-mode is smaller than the threshold value in the object directory. 0: If this malfunction does not occur or is acknowledged.
	2	Imax switch off during U-mode	1: Output current during U-mode has threshold value in the object. 0: If this malfunction does not occur or is acknowledged.
	3	Reserve	

Byte	Bit	Status bit	Explanations
	4	dI/dt switch off	1: Change of the output current larger than the threshold value in the object directory. A single malfunction. 0: If this malfunction does not occur or is acknowledged. The specified error is set so that this switch off is deactivated. Because this switch off disturbs the electrical arc detection function.
	5	Switch off after electrical arcs/t	1: Number of electrical arcs within tü equals or is larger than the limit value I in the object directory. 0: If this malfunction does not occur or is acknowledged.
	6	Switch off over-temperature of the cascade	1: Temperature of the cascade above 65 °C. 0: If this malfunction does not occur or is acknowledged.
	7	Switch off over-temperature of the power module	1: Temperature of the power module above 75 °C. 0: If this malfunction does not occur or is acknowledged.
3	0	Invalid parameter	1: Some parameter in the object directly set with invalid value. 0: If this malfunction does not occur or is acknowledged.
	1	Error 400V supply voltage.	1: 400V supply voltage is missing or the communication between the power module and control module is interrupted. 0: If this malfunction does not occur or is acknowledged.
	2	Safety error	1: Plausibility check of the safety relay failed. 0: If this malfunction does not occur or is acknowledged.
	3	Self test error	1: If the output voltage does not reach 3 kV within 200 ms then the HV generator has failed the self test. 0: If this malfunction does not occur or is acknowledged.

Byte	Bit	Status bit	Explanations
	4	Switch off Shut down power module	1: Output voltage larger than 75 KV. 0: If this malfunction does not occur or is acknowledged.
	5	Power module over-voltage warning	1: 400V supply voltage exceeded by more than 10 %. 0: If this warning does not appear or was acknowledged.
	6	Node guarding error	1: The generator did not receive any node guarding object in the lifetime. 0: If this malfunction does not occur or is acknowledged.
	7	Internal communication error	1: Communication between the control module and power module is distorted by the SPI interface. 0: If this malfunction does not occur or is acknowledged.

Note to the **Over-voltage warning**: The generator monitors the supply voltage. It switches off for protection with brief over-voltages, until the over-voltage has subsided and then again immediately resumes operation without error message. Only if this occurs more than 10 times (can be set) in 5 minutes is "Over-voltage error" output (this applies as of SW Version 2.2.2, however previously in this case was switched off).

9.7. Settings via SDOs

The basic settings are accessible via the above described PDOs. Other setting options are possible via SDOs. These are listed and described in the following object directory.

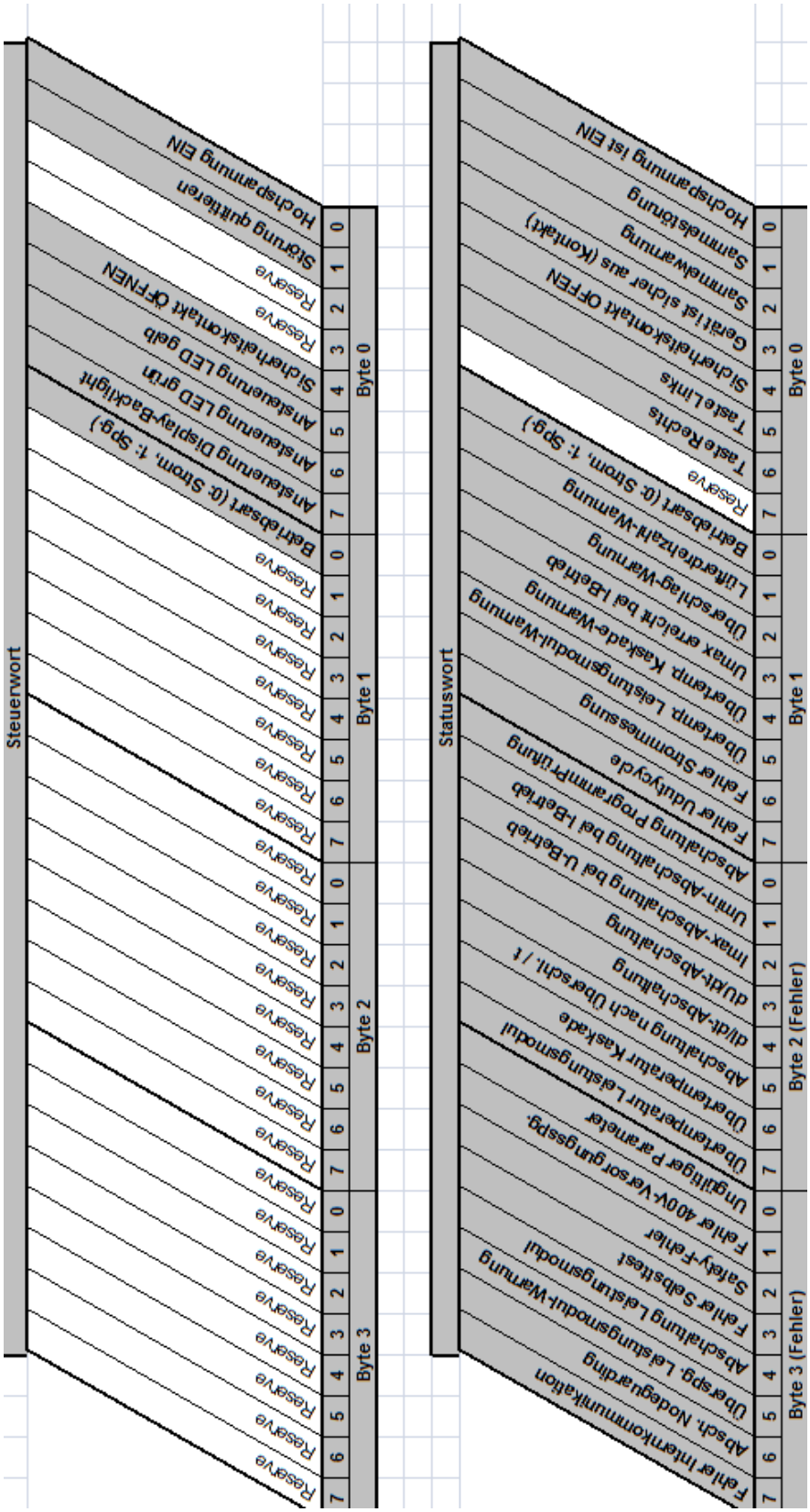
System capacity	Required for the calculation of the "Safe" threshold (see above) and must be measured by the operator.
Threshold for Umin switch off	During I-mode is switched off as soon as this value is not reached
Threshold for Umax warning/limit	During I-mode limit to this value and a warning output
Threshold for Imax switch off	During U-mode is switched off at Imax
Electrical arcing detection	This setting influences the sensitivity during the detection of electrical arcing **Normally it should not be changed.**
U- start up ramp	Start up ramp speed after switching on the high voltage

Number of electrical arcs n, Time tü	It can be entered how many electrical arcs in a time tü are permitted without being switched off.
Time for maintaining the voltage at a low level	After an electrical arc the voltage is reduced for the time defined here.
Percent reduction	Input of by what % the current target value the voltage will be reduced
Time for the voltage reduction	Input in which time after an ace the voltage will be reduced (ramp)
Threshold for switch off over-voltage power module	Input of how many over-voltages occurrences on the supply within 5 minutes are allowed before a warning is output.

9.8. Electronic description of the interface

A so-called eds file is made available from SCHNIER for programming the higher-level control system. Generally speaking this can read in and contains all format descriptions of the objects in machine-readable form.

9.9. Overview of control and status word



Index 0x2000 .. 0x5FFF --> Herstellerspezifische Daten

Index	Subindex	Datentyp	Länge	Parameter	Einheit	Zugriff	Zugriffsart	Min	Default	Max	Bemerkung
				Geräteinformationen							
0x2000	-	UNSIGNED8	8 Bit	CANopen Node ID	-	R	SDO	1	0	127	Einstellung an Gerät
0x2001	-	UNSIGNED32	32 Bit	Firmware-Version	-	R	SDO	0.0.1		255.255.255	
				Prozessdaten							
0x2010	-	UNSIGNED32	32 Bit	Steuerwort	-	RW	RxPDO1		-		
0x2011	-	UNSIGNED32	32 Bit	Statuswort	-	R	TxPDO1		-		
0x2012	-	UNSIGNED16	16 Bit	Spannung Sollwert	10 V	RW	RxPDO1	1000		12000	Begrenzung in I-Betrieb
0x2013	-	UNSIGNED16	16 Bit	Strom Sollwert	µA	RW	RxPDO1	0		2000	Begrenzung in U-Betrieb
0x2014	-	UNSIGNED16	16 Bit	Spannung Istwert	10 V	R	TxPDO1	0	-	16000	
0x2015	-	UNSIGNED16	16 Bit	Strom Istwert	µA	R	TxPDO1	0	-	3000	
0x2016	-	UNSIGNED32	4 Bytes	Displaytext Zeichen 1..4	-	RW	RxPDO2		-		
0x2017	-	UNSIGNED32	4 Bytes	Displaytext Zeichen 5..8	-	RW	RxPDO2		-		
0x2018	-	UNSIGNED32	4 Bytes	Displaytext Zeichen 9..12	-	RW	RxPDO3		-		
0x2019	-	UNSIGNED32	4 Bytes	Displaytext Zeichen 13..16	-	RW	RxPDO3		-		
				Parameter							
0x2020	-	UNSIGNED16	16 Bit	Anlagenkapazität	pF	RW	SDO	1	3000	65535	Wert 0 ist ungültig
0x2021	-	UNSIGNED16	16 Bit	Schwelle für Umin-Abschaltung	10 V	RW	SDO	0	1500	11999	nur relevant in I-Betrieb
0x2022	-	UNSIGNED16	16 Bit	Schwelle für Umax-Warnung/-Begrenzung	10 V	RW	SDO	1	5000	12000	nur relevant in I-Betrieb
0x2023	-	UNSIGNED16	16 Bit	Schwelle für Imax-Abschaltung	µA	RW	SDO	1	2000	2000	nur relevant in U-Betrieb
0x2024	-	UNSIGNED16	16 Bit	Schwelle dU/dt-Überschlagerkennung/-Abschaltung	10V/ms	RW	SDO	1	500	65535	
0x2025	-	UNSIGNED16	16 Bit	Schwelle dI/dt-Abschaltung	5µA/ms	RW	SDO	1	65000	65535	
0x2026	-	UNSIGNED16	16 Bit	U-Hochlauframpe	10 V/s	RW	SDO	1	1000	6000	
0x2027	-	UNSIGNED16	16 Bit	I-Hochlauframpe	µA/s	RW	SDO	1	1000	8000	derzeit nicht aktiv
0x2028	-	UNSIGNED8	8 Bit	Anzahl Überschläge n innerhalb Zeit t_0	Überschläge	RW	SDO	0	3	255	
0x2029	-	UNSIGNED32	32 Bit	Zeit t_0 für Abschaltung nach n Überschlägen	ms	RW	SDO	0	60000	2^32-1	
0x2030	-	UNSIGNED16	16 Bit	Zeit für Anhalten der Spannung auf dem niederigen Niveau	ms	RW	SDO	0	3000	65535	
0x2031	-	UNSIGNED16	16 Bit	Prozent für die Spannungsreduzierung	%	RW	SDO	0	50	100	
0x2032	-	UNSIGNED8	8 Bit	Zeit für die Spannungsreduzierung	ms	RW	SDO	0	10	127	
0x2033	-	UNSIGNED8	8 Bit	Anzahl Überspannung n innerhalb 5 Minuten	Überspannung	RW	SDO	1	10	50	
0x2034	-	UNSIGNED16	16 Bit	Anzahl Überspannung über ganze Zeit	Überspannung	R	SDO	0	0	65535	

SCHNIER

10. Declaration of Conformity

Manufacturer:

SCHNIER Elektrostatik GmbH
Bayernstrasse 13
D-72768 Reutlingen

Product designation: High voltage generator
Model / generator number Type HER 02/01 810353 and
Type HER 02/02 810353/001

We hereby declare, that the above described devices due to their design and construction as well as in the version that we have put into circulation correspond with the EC Directives:

EC Directive 2006/42/EC (Machine Directive)
EC Directive 2004/108/EC (EMV Directive)

The Directive 2006/95/EC (low voltage directive) was complied with in regards to its safety goals (see Annex no 1.5.1 of Directive 2006/42/EC)

Related harmonized standards:

EN 50348:2010 Stationary electrostatic application equipment for non-flammable liquid coating material - Safety requirements

EN ISO 12100-1:2003/A1:2009 Safety of machinery - Basic concepts; general principles for design - Part 1: Basic terminology and methodology (ISO 12100-1:2003) + 1st amendment

EN ISO 12100-2:2003/A1:2009 Safety of machinery - Basic concepts; general principles for design - Part 2: Technical principles (ISO 12100-2:2003)+ 1st amendment

EN 60204-1:2006/A1:2009 Safety of machinery - Electrical equipment of machines - Part 1: General requirements (IEC 60204-1:2005, modified + 1st amendment

EN 61000-6-2:2005 Electromagnetic compatibility (EMC) - Part 6-2: Generic standards - Immunity for industrial environments

EN 61000-6-4:2007 Electromagnetic compatibility (EMC) - Part 6-4: Generic standards - Emission standard for industrial environments

Rommelsbach 08.10.2012

Olav Schnier (Managing director)