HV Breakout Module

Type 1.1 | 1.2 | 3.1

Installation Manual

Version 01.20

Innovative Measurement and Data Technology

Copyright

Trademarks

Product disposal/recycling

When this symbol (crossed-out wheeled bin) appears on the device, this means that the European Directive 2012/19/EU applies to this device.

The correct disposal of old equipment will protect the environment and people from possible negative consequences.

Become familiar with local regulations for separate collection of electrical and electronic equipment.

Follow local regulations and do not dispose of old equipment with household waste.

Contact Information

CSM offers support for its products during the entire product life cycle. Updates for the individual components (e.g. documentation, configuration software and firmware) are made available on the CSM website. To keep up to date, it is therefore recommended that you check the download area of the CSM website for updates at least once a month.

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Contents

1 Introduction

1.1 Liability disclaimer

- This installation manual and further technical documents are part of the product and contain important information for its safe and efficient use. To maintain the high quality level the product is continuously being developed, which may result in the product's technical details changing at short notice. As a result, the contents of this documentation may differ from the technical specifications of the product. No claims against the manufacturer can therefore be derived from the contents of the product documentation.
- CSM GmbH is not liable for technical or editorial errors or missing information.
- CSM GmbH assumes no liability for damage resulting from improper use of the product and/or non-observance of the product documentation, in particular the safety instructions.

  → *See chapter 2 "Safety Instructions".*

1.2 Warranty and exclusion of warranty

The warranty covers the safety and functionality of the product within the warranty period. Excluded from the warranty are claims based on possible consequential damages caused by malfunction or non-function of the product.

The warranty shall become invalid if:

- the product is handled improperly,
- prescribed maintenance intervals are not observed,
- the product is modified by the end-user,
- the user does not observe the safety instructions and the product documentation,
- the product is operated with accessories or parts which are not explicitly approved for operation by the manufacturer of the product.

  → *See chapter 2 "Safety Instructions".*

1.3 ESD information

HV Breakout Modules have not yet been conclusively tested for conformity with the requirements of EU Directive 2014/30/EU.

2 Safety Instructions

This chapter contains important safety information. Please read the following paragraphs carefully.

2.1 General safety instructions

WARNING!	
	HV Breakout Modules (HV BM) are used in high-voltage applications. Improper handling of HV Breakout Modules may result in electrical shocks which are dangerous to life. ☞ Use only qualified and trained personnel. ☞ Observe safety instructions.

WARNING!	
	The orange cover of the housing may be opened to mount or remove the HV power cables. ☞ Before handling, especially before opening the cover, make sure that the HV power cables have been disconnected. ☞ HV BM 1.1/1.2: Fasten HV power cables only with the supplied or, alternatively, suitable ring terminals and nuts. ☞ Observe the mounting instructions in this installation manual. It is particularly important that cover and PG glands are properly mounted in order to ensure the tightness of the housing.

WARNING!	
	When using **HV power cables made of aluminum** and ring terminals made of an electrochemically nobler metal (copper), the contact resistance between the two components increases. **This can lead to a massive increase in temperature and in the worst case to the development of fire.** ☞ If ring terminals made of copper are used for connecting HV Breakout Modules, make sure that only HV power cables made of copper are used. **HV power cables made of aluminum** require a specific connection technique. Please contact our technical support for further information.

WARNING!	
	The improper opening of the device housing impairs the operational safety of the HV measurement module and entails the risk of life-threatening electrical shocks. ☞ Open the housing only to connect the HV power cables and then close it carefully. ☞ Do not carry out any mechanical or electrical modifications on the HV measurement module. ☞ Do not replace the shunt module. ☞ Only operate the measurement module when the housing is closed. HV Breakout Modules are not integrated into the interlock loop. When the cover is open, there may be high-voltage on the exposed contacts.

WARNING!	
	The behavior of the CAN bus can be influenced by connecting a CAN bus measurement module to an existing CAN bus system. **Improper use of a CAN bus system may cause life-threatening situations and material damage.** ☞ Always connect CAN bus measurement modules to a separate CAN bus system (measurement bus). ☞ Make sure that this work is only carried out by qualified and trained personnel.

Maximum internal temperature

Module version	Hardware revision	max. internal temperature
HV BM 1.1/HV BM 1.2	A	+100 °C
HV BM 1.2	B to D	+100 °C
HV BM 1.1/HV BM 1.2	as of E	+120 °C
HV BM 3.1	as of A	+120 °C

Tab. 2-1: Maximum internal temperature

WARNING!	
	The internal temperature of the measurement module must not be exceeded (see Tab. 2-1). The shunt temperature must not exceed +120 °C. As soon as that value is exceeded, the module will send the error value "0x8001" instead of a measured value until the temperature value drops below +115 °C again. Exceeding the limit impairs the operational safety of the HV measurement module and entails the risk of life-threatening electrical shocks. ☞ Switch off the power supply or interrupt the current flow through the shunt to prevent further temperature increase of the module. ☞ Always monitor the temperature of the shunt and the internal temperature of the measurement module in order to make sure at any time that they do not overheat. → *See chapter 5.2.5 "Temperature monitoring".*

WARNING!	
	The measurement module has to be connected to ground in order to ensure user safety. **If the ground connection is not established, there is danger to life due to high voltage.** ☞ Connect the measurement module to ground (PE). ☞ Make sure that this work is only carried out by qualified and trained personnel. ☞ Observe safety instructions. → *See chapter 4.4.2.4 "Ground connection".*

CAUTION!

The measurement module heats up considerably if it is operated in a corresponding working environment (e.g. engine compartment). The shunt also heats up considerably during operation under high load. The surface and the inside of the measurement module can therefore become extremely hot.

A **permanent measurement of high currents** should be avoided in order to prevent the internal temperature of the module from exceeding the permissible range.

Touching the surface may cause serious burns.

☞ Let the measurement module cool down before handling, especially before opening the orange-colored cover.

☞ Wear appropriate safety gloves, if required.

NOTE!

The isolation barrier can be damaged due to aging, overvoltage, bipolar voltage, high temperature and mechanical wear! In order to assure the proper functioning and the electrical safety of the measuring module, periodical tests of the reinforced insulation every 12 months are required! If there is reason to assume that the isolation might be defective, a test should be carried out immediately before putting the device in operation again.

☞ Make sure that a high-voltage isolation test according to EN 61010-1:2010 is carried out at least every 12 months.

☞ If there is reason to assume that the isolation barrier is defective, a HV isolation test needs to be carried out immediately.

NOTE!

The threaded mounting hole is designed to connect the housing to the vehicle chassis or to protective ground (PA/PE) in a test bench.

☞ Do not use the threaded mounting hole for any other purpose, e.g. for mounting the device.

→ *See chapter 4.4.2.4 "Ground connection".*

NOTE!

Differences in potential between the measurement module (= shield of the interface cable) and the mounting location can falsify measurement results or destroy the measurement module.

☞ Make sure that no differences in potential occur when mounting the device.

☞ Isolate the measurement module from the mounting location, if required.

NOTE!

Trouble-free operation and electrical safety can only be ensured if the measurement module is correctly installed.

☞ Make sure that the device is correctly installed.

☞ Operate the measurement module only within the specified operating environment.

→ *See HV BM datasheets for further information.*

2.2 Obligations of the operator

- The operator must ensure that only qualified and authorized personnel are entrusted with handling the product. This applies to assembly, installation and operation.
- In addition to the technical product documentation, the operator may have to provide further operating instructions in compliance with the Act on Occupational Safety and Health.

2.3 Intended use

- HV Breakout Module series measurement modules were developed for measuring voltages and currents and may only be used for this purpose.
- These measurement modules may only be used for the above-mentioned purpose and under the operating conditions stated in the technical specifications.

  → *See HV BM datasheets for further information.*
- The operational safety can only be ensured if the device is used in accordance with its intended use.
- Compliance with the intended use also means that this user guide must be carefully read and the instructions contained must be observed.
- Inspection and repair work must only be carried out by CSM.
- The operator is solely responsible if the measurement module is used in a way that does not comply with its intended use.

3 Product Description

3.1 Technical data overview

HV Breakout Modules (HV BM) are specifically designed for safe measurements on cables carrying high voltage. Current and voltage are measured and the instantaneous power is calculated online in the module.

The voltage is measured directly. The current measurement is done by using a shunt module, which contains a differential amplifier as well as a temperature sensor and memory for calibration data for automatic online temperature compensation.

The HV BM outputs the measured data at a data rate of up to 1 MHz via the EtherCAT®/ECAT interface and at a data rate of up to 10 kHz via the additional CAN interface at the same time. This allows fast data acquisition via Ethernet with simultaneous data recording via a CAN data logger.

The HV BM is integrated into the HV power cables by feeding the cables through PG glands into the inside of the module and connecting them there.

CSM provides shunt modules with different measurement ranges for HV BM 1.1 and HV BM 1.2. The shunt modules are selected individually and are permanently mounted.

→ *See HV BM datasheets for further information.*

Basic technical data

	Designation	HV BM 1.1	HV BM 1.2	HV BM 3.1
				
	Phases	1		3
Measurement range (max.)	Nominal voltage	±1000 V		
	Peak voltage	±2000 V		±1000 V
	Nominal current	±250 A	±800 A	±32 A
	Peak current	±500 A	±1400 A	±50 A
Measurement data rate (max.)	ECAT	1000 kHz		500 kHz
	CAN	10 kHz		5 kHz

Tab. 3-1: HV BM basic technical data

3.2 Connections and components

Fig. 3-1 shows the connections of an HV BM 1.2. The module versions HV BM 1.1 and HV BM 3.1 are equipped with only one PG gland ① on each side of the housing and they lack the holes for the threaded bolts ⑩. As for the HV BM 3.1, the connection sockets (CAN/EtherCAT®) are also located on the opposite side. Otherwise these modules are identical to the HV BM 1.2.

The LED indicators ⑦, ⑧, ⑨ are located in the front panel of the module housing. Depending on the module version, the sockets for CAN ②, EtherCAT® ③ and power supply ④ are embedded in the left or the right side of the housing.

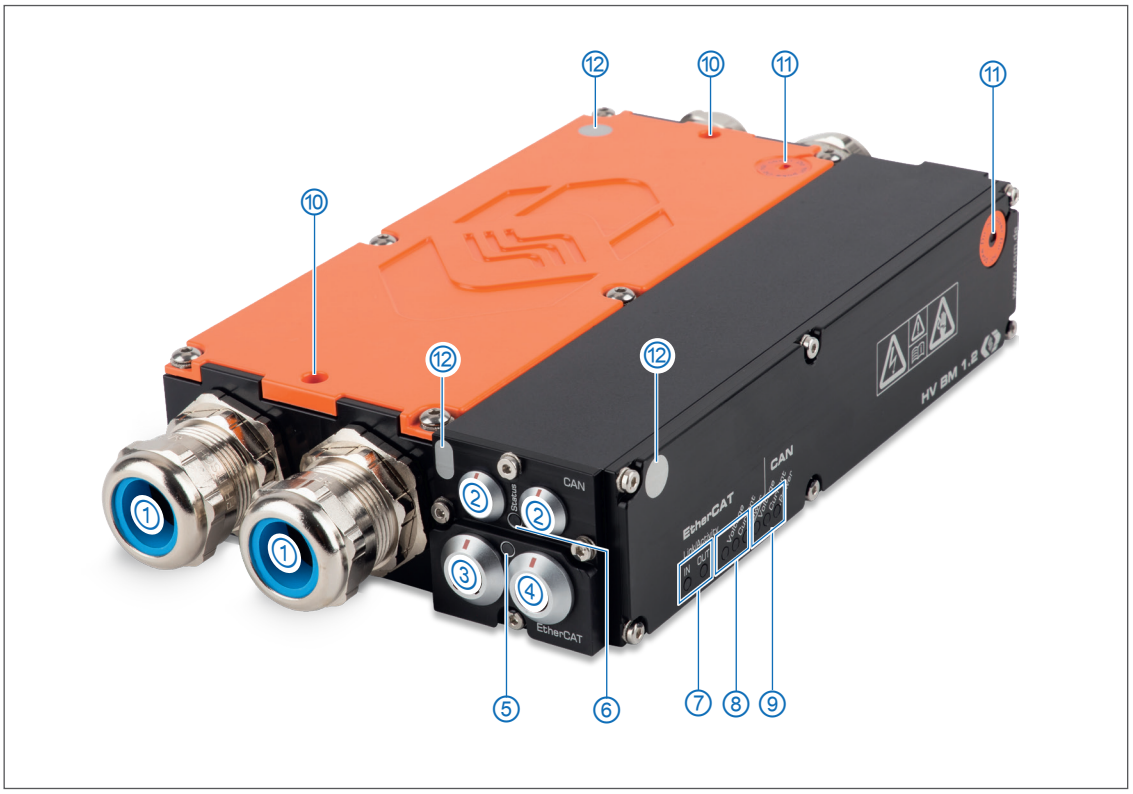


Fig. 3-1: HV BM 1.2, front view

1. PG glands
2. CAN sockets (→ *chapter 4.4.2.1 "CAN sockets"*)
3. EtherCAT® **IN** socket (→ *chapter 4.4.2.2 "EtherCAT® IN socket"*)
4. EtherCAT® **OUT** socket (→ *chapter 4.4.2.3 "EtherCAT® OUT socket"*)
5. EtherCAT® bus status LED indicator (→ *chapter 3.3.1 "Status LED indicator for EtherCAT® bus"*)
6. CAN bus LED indicator (→ *chapter 3.3.2 "CAN bus LED indicator"*)
7. LED indicators for EtherCAT® bus (→ *chapter 3.3.3 "EtherCAT® bus LED indicators"*)
8. LED indicators for EtherCAT® measurement channels (→ *chapter 3.3.4 "Measurement channel LED indicators"*)
9. LED indicators for CAN measurement channels (→ *chapter 3.3.4 "Measurement channel LED indicators"*)
10. Holes for threaded bolts for fastening multiple HV BM to each other.
11. GORE™ membrane venting grooves with corresponding sticker
12. Contact surfaces for measuring the resistance of protective earth (PE) to cover [1]

1 The positions of the contact surfaces vary depending on module type and hardware revision.

The rear side of the housing provides:

- Type label (→ *chapter 6.1 "Type label"*)
- Shunt label (→ *chapter 6.2 "Shunt label"*)
- "Next calibration date" sticker

The "HV insulation test" sticker is attached to the top side of the housing.

On the lower side of the housing there are four M4 threaded holes for mounting screws.

There is an M6 or M8 threaded hole (depending on the hardware revision) for a ground cable in the right (HV BM 1.x) or the left (HV BM 3.1) section of the housing.
→ *See chapter 4.4.2.4 "Ground connection".*

3.3 Functional description of LED indicators

3.3.1 Status LED indicator for EtherCAT® bus

After the measurement module is switched on, the two-colored status LED (Fig. 3-1, ⑤) is lit red for approx. 1.2 seconds and then fades out.[2]

LED		Meaning
Color	Status	
green	flashing	Device is in status PRE-OPERATIONAL.
green	flickering	Device is in status SAFE-OPERATIONAL.
green	continuously lit	Device is in status OPERATIONAL.
red	flashing	Configuration error
red	continuously lit	Measurement module is switched on or the power supply connection has been established but there is no Ethernet communication.
green/red	flashing	Flashing new firmware.

Tab. 3-2: Status LED

3.3.2 CAN bus LED indicator

The LED indicator (Fig. 3-1, ②) between the two CAN sockets provides information on the operating status of the measurement module.

LED		Meaning
Color	Status	
–	off	Measurement module not connected or power supply switched off
green	continuously lit	Normal operation
red	continuously lit	Measurement module is in idle mode, either because the configuration software has stopped data acquisition (no error), or because there is a CAN bus or configuration problem.
red	flashing	The measurement module has been selected via the configuration software and is in idle mode.
green/red	flashing	Firmware download in progress

Tab. 3-3: CAN bus LED indicator

2 Status designations according to Beckhoff and EtherCAT® Technology Group EtherCAT® standard.

3.3.3 EtherCAT® bus LED indicators

The LED indicators for the sockets **IN** and **OUT** (Fig. 3-1, ⑦) are lit or are flashing if the measurement module is electrically connected to an XCP-Gateway or if data is being transferred.

LED		Meaning
Color	**Status**	
green	continuously lit	Ethernet connection to HV BM or to a further measurement module has been established, no data transfer.
green	flashing	Ethernet connection is active, i.e. data transfer is in progress
-	off	No measurement module or XCP-Gateway connected.

Tab. 3-4: LED indicators **IN**/**OUT**

3.3.4 Measurement channel LED indicators

The measurement channel LED indicators (Fig. 3-1, ⑧ and ⑨) provide information on the status of the corresponding measurement channel and the sensor excitation. There are separate LED indicators for access via CAN bus or EtherCAT® bus. The measurement channels are arranged as follows (left to right):

1. **Voltage**: voltage measurement status
2. **Current**: current measurement status
3. **Power**: power calculation status

After switching-on the HV Breakout Module, all measurement channel LED indicators are lit red, indicating the start-up process of the module. Once the module has initialized itself and no errors were detected, the LED indicators will fade out.

After self-initialization, the device checks the connected shunt module. Meanwhile the measurement channel LED indicators of the current channels ("Current") are lit red. If the shunt module is correctly detected, the measurement channel LED fades out again.

The measurement range has to be **identically configured** on both the ECAT and the CAN side, otherwise the module side that was configured first will not send measurement values but a specified error value. This is indicated on the module by **measurement channel LED indictors permanently lit in red**.

LED		Meaning
Color	**Status**	
–	off	Measurement module not connected or power supply switched off or normal operation
red	continuously lit	Error while detecting the shunt module ("Current"-LEDs)
		The configurations stored in the measurement module on the CAN or EtherCAT® side differ from each other (all three LEDs of the corresponding side)
red	flashing	50% red, 50% off: disabled channel selected via configuration software
		80% red, 20% off: measured value is out of the measurement range
green	flashing	Channel selected via the configuration software (single LED)
		Module selected via the configuration software (all LEDs of the corresponding side)

Tab. 3-5: Measurement channel LED indicators

4 Mounting and installation

For trouble-free operation and a long product life, certain requirements for mounting and installation must be taken into account.

4.1 Before mounting

An HV Breakout Module is equipped with two GORE™ membranes (Fig. 4-1). These are needed to regulate pressure and humidity. To ensure fault-free operation of the device, never block, clog, or insert anything into the ventilation openings in the front side ① and the cover of the housing ②. If this happens, condensate will accumulate inside the housing and damage the measurement module.

Fig. 4-1: HV BM 1.2, section with ventilation openings

NOTE!
The GORE™ membranes are needed to regulate pressure and humidity. ☞ Do not block the ventilation opening for the GORE™ membranes during installation.

NOTE!
Trouble-free operation and electrical safety can only be ensured if the measurement module is correctly installed. ☞ Ensure correct installation. ☞ Operate the measurement module exclusively within the specified operating environment. → *See HV BM datasheets for further information.*

4.2 Mounting HV Breakout Module

CAUTION!
HV Breakout Modules can heat up very considerably when current flows through them. This applies not only during operation, but also when no measurements are to be taken, but the module is integrated in a loaded circuit (e.g. when charging the vehicle battery). ☞ Divert the resulting power dissipation, e.g. by using suitable mounting plates, which in turn are attached to the chassis. Heat-conducting paste should be applied between HV BM and mounting plate, as well as between mounting plate and chassis. ☞ Always monitor the temperature of the shunt and the internal temperature of the measurement module in order to make sure at any time that they do not overheat. → *See chapter 5.2.5 "Temperature monitoring".*

NOTE!	
	Strong magnetic fields, such as those induced by permanent magnets, may impair the trouble-free operation of the measurement module. ☞ Never attach the measurement module to a permanent magnet.

Requirements

- The ventilation openings of the GORE™ membrane must not be blocked or clogged by mounting at the intended position.
- Select a mounting position that ensures the ventilation openings are not permanently submerged in any liquid.
- The mounting position must offer sufficient space to connect and disconnect the cables without kinking or clamping them.
- Avoid mounting positions in which the modules are subjected to continuous strong vibrations and/or shocks.

Parts/material required

- four M4 screws [3]
- a suitable screwdriver or wrench

Mounting the measurement module

☞ Fasten the measurement module at the mounting position.

	Please contact our support for the appropriate drill hole diagrams.

NOTE!	
	Making mechanical modifications to the housing, such as by drilling additional holes, can impair the function of the measurement module or destroy it. Additionally this would invalidate the warranty. ☞ Never drill additional holes in the housing. ☞ Observe mounting instructions.

3 The thread depth in the module housing is 6 mm. The screw length must be chosen according to the thickness of the mounting material.

4.3 Connecting HV power cables to HV BM devices

This chapter provides information on how to connect HV power cables to an HV BM and on the preparation and handling of PG glands

i	Information on the preparation of the various HV power cables can be found in the appendix of this document. → *See chapter 7.1 "Cable preparation".*

i	Section headings with module-specific content are preceded by the module name, which indicates that non-applicable sections can be skipped.

Required tools

- Allen key, size 2.5
- Two wrenches, size SW24 (for M20), SW30 (for M25) and SW36 (for M32)
- HV BM 1.x only: Ring wrench (deep cranked) or ratchet/socket wrench (w. deep nut), size SW10 (M6) or SW13 (M8)[4]

NOTE!	
	The space inside a housing is limited. This is in particular true for module version HV BM 1.1. Therefore, ring wrenches should be avoided for assembly work if possible. ☞ Use the smallest possible socket wrench inserts for assembly.

HV BM 1.x: Connecting the HV power cables to the measurement module

WARNING!	
	HV BM 1.x devices are supplied with suitable ring terminals. ☞ Only use adequate ring terminals when mounting the HV power cables. ☞ If you want to use ring terminals other than those included in the scope of delivery, make sure that ▸ sufficient space is provided in the housing, so that there is adequate clearance between the ring terminals and the housing as well as between the ring terminals. ▸ the combination of ring terminal and nut will not extend over the threaded bolts. Otherwise the distance between nut and housing cover may be too small. There is the **risk of life-threatening electric shocks** and **short-circuits** if these instructions are not observed.

The HV power cables are connected to HV BM 1.x modules by means of ring terminals mounted on threaded bolts.

If current and voltage are to be measured:

☞ Attach an **M6** ring terminal (HV BM 1.1)[5] or an **M8** ring terminal (HV BM 1.2) to both positive HV cables (HV+).

☞ Attach **M8** ring terminals to both negative HV cables (HV-).

If only current is to be measured:

☞ Use an **M8** ring terminal.

☞ Please observe the connection diagrams in chapter 4.3.1.

4 M6 is only used for HV BM 1.1, hardware revision A. As of hardware revision E, only M8 is used.
5 See fn. 4.

4.3.1 HV BM 1.x: Connection diagrams

- The red arrows indicate the technical (positive) direction of the current.
- The blue arrow indicates the technical (positive) direction of the voltage.
- For the wiring displayed, the technical current and, if measured, the technical voltage are output with the correct polarity.

Current and voltage measurement

Fig. 4-2 shows the appropriate diagram if current and voltage are to be measured. The source is located on the left, the consumer on the right.

The current is measured in the **minus path** in order to minimize disturbances of the current measurement. The voltage is measured on the consumer side between **plus** and **minus** path.

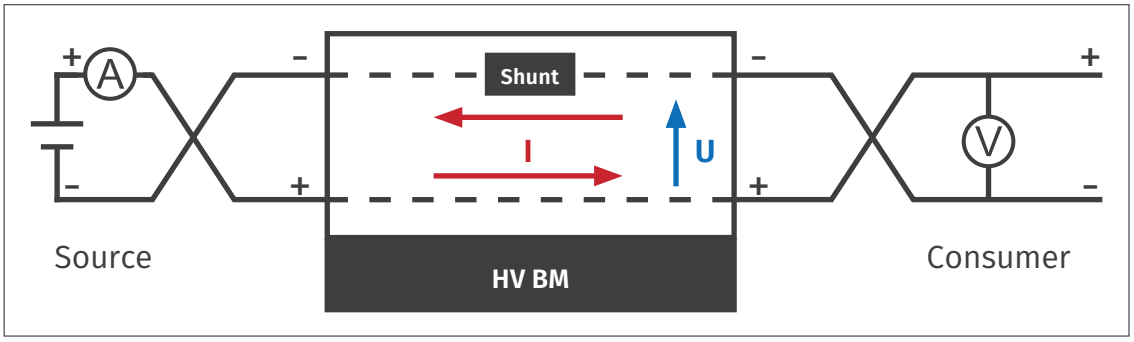


Fig. 4-2: HV BM 1.x, connection diagram for voltage and current measurement

Exclusive current measurement in the minus path

Fig. 4-3 shows the appropriate diagram if only current in the **minus path** is to be measured.

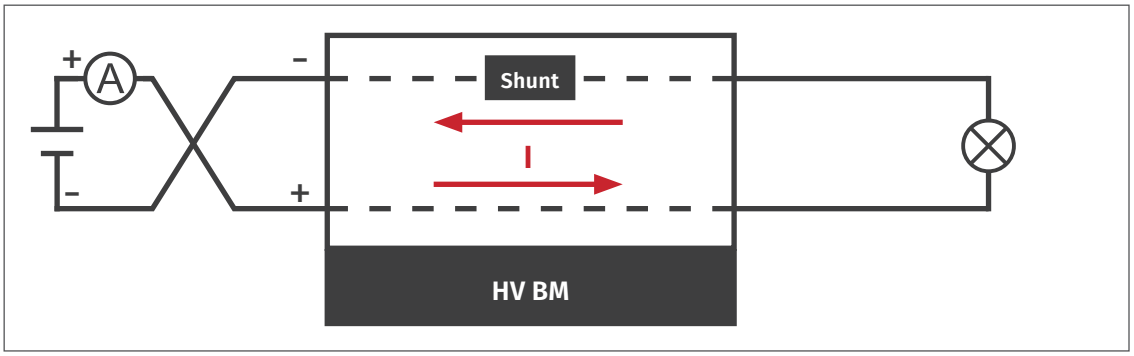


Fig. 4-3: HV BM 1.x, connection diagram for current measurement in the minus path

Exclusive current measurement in the plus path

Fig. 4-4 shows the appropriate diagram if only current in the **plus path** is to be measured.

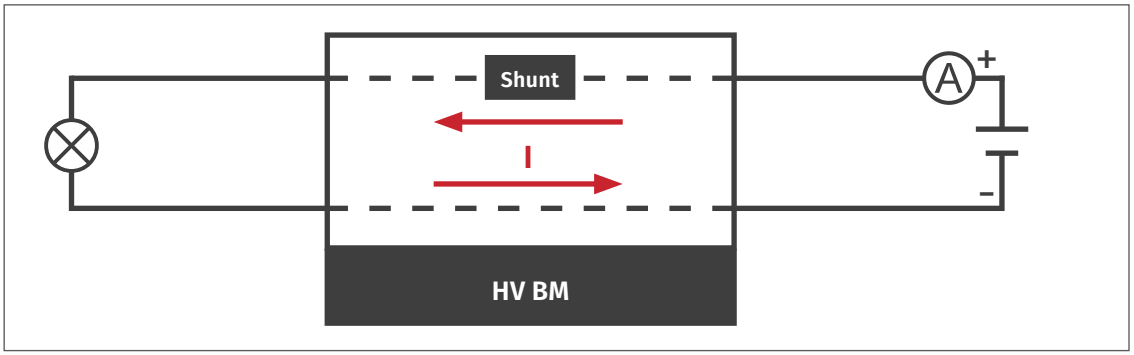


Fig. 4-4: HV BM 1.x, connection diagram for current measurement in the plus path

HV BM 3.1: Connecting the HV power cable to the module

As for the HV BM 3.1, the HV power cables are connected to the module by using Phoenix terminals. The cable cross-section may not exceed 6 mm² each. The stripping length is 12 mm. The wires can be fitted with wire end sleeves, but it is not absolutely necessary.

4.3.2 Preparing the PG gland

☞ Loosen the four pressure screws using an adequate wrench and remove them from the threads.

Some PG cable glands are equipped with a two-component silicone sealing insert (blue) and a removable inlet.

The sealing insert has a specific sealing area (cable diameter) with and without inlet. This is marked accordingly (in Fig. 4-5: 25-20 mm and 20-15 mm).

Fig. 4-5: PG glands opened

☞ Remove the sealing insert and cut out the inlet if required.

The following PG gland types are available:

CSM type	9/14	11/20	15/25
CSM article number	ART1520202	ART1520201	ART1520200
Pflitsch designation	bg 220ms tri /sc	bg 225ms tri /sc	bg 232ms tri /sc
Sealing range without inlet	9 – 14 mm	16 – 20 mm	20 – 25 mm
Sealing range with inlet	—	11 – 16 mm	15 – 20 mm
Connecting thread	M20	M25	M32
Wrench width	SW24	SW30	SW36
Tightening torque [6]	max. 10 Nm	max. 15 Nm	max. 15 Nm

Tab. 4-1: Technical data of the PG glands used

6 For tightening torques and further manufacturer information, see https://www.pflitsch.de/fileadmin/user_upload/Downloads/Kataloge/Blueglobe_Katalog_2014_web.pdf, p. 74.

4.3.3 Connecting the HV power cables

- Most of the figures in this section display the mounting of HV power cables to an **HV BM 1.2** using ring terminals. The removal of the cables is done in reverse order.
- The connecting procedure for **HV BM 1.1** and **HV BM 1.2** devices is almost identical, except for the detail. HV BM 1.1, hardware revision A, is equipped with a green inner cover which has to be removed or reinserted in an additional step. As of hardware revision E, this green inner cover is integrated in the orange housing cover, which means that the additional step is no longer required.
- As for the **HV BM 3.1**, the HV power cables are connected by means of Phoenix terminals.

→ *Please see chapter 7.1 "Cable preparation" for further information on the assembly of HV power cables.*

WARNING!	
	The improper opening of the housing during operation entails the risk of life-threatening electrical shocks. ☞ Make sure that the HV power cables have been disconnected before opening the cover.

WARNING!	
	When using **HV power cables made of aluminum** and ring terminals made of an electrochemically nobler metal (copper), the contact resistance between the two components increases. **This can lead to a massive increase in temperature and in the worst case to the development of fire.** ☞ If ring terminals made of copper are used for connecting HV Breakout Modules, make sure that only HV power cables made of copper are used. **HV power cables made of aluminum** require a specific connection technique. Please contact our technical support for further information.

CAUTION!	
	The measurement module heats up considerably if it is operated in a corresponding working environment (e.g. engine compartment). The shunt also heats up considerably during operation under high load. The surface and the inside of the measurement module can therefore become extremely hot. ☞ Let the measurement module cool down before touching and removing the cover. ☞ Always monitor the shunt temperature and the internal temperature of the measurement module in order to make sure at any time that they do not overheat. → *See chapter 5.2.5 "Temperature monitoring".*

4.3.3.1 Opening the housing[7]

Fig. 4-6: HV BM 1.2, housing closed

☞ Loosen the four or six Allen screws (↻) in the cover of the housing.
☞ Remove the orange-colored cover.

Fig. 4-7: HV BM 1.1, housing opened, inner cover inserted

☞ HV BM 1.1 (hardware revision A): Remove the green inner cover.[8]

4.3.3.2 Intermediate step: Sliding pressure screws and springs on the HV power cable

☞ If not already done, loosen and remove the pressure screws of the PG glands.

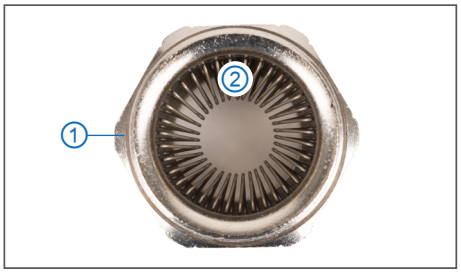


Fig. 4-8: PG gland front view (pressure screw and spring)

☞ Loosen and remove the pressure screw ① and remove the spring ② from the PG gland.

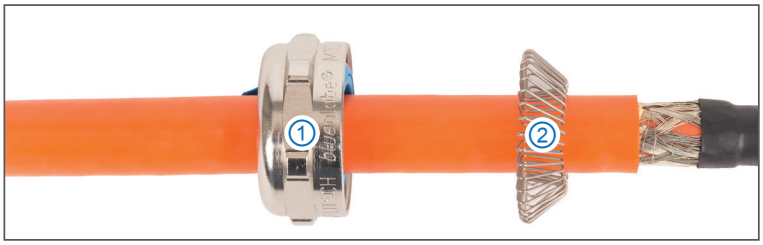


Fig. 4-9: Sliding pressure screws and springs onto the HV power cable

☞ Slide the pressure screw ① and the spring ② onto the HV power cable.
☞ Feed the HV power cable(s) through the PG gland(s) into the housing.

7 Depending on the hardware revision, details of the measurement modules shown in Fig. 4-6 to Fig. 4-13 may vary.
8 As of hardware revision E, this work step is no longer required, as the inner cover has been integrated into the housing cover.

NOTE!	
	Please note that the shield of the HV power cable must be connected to the PG gland and the housing. ▸ With a correspondingly prepared HV power cable, this can be done by means of the spring, which provides a connection between the shield and the the PG gland when the pressure screw is tightened.[9] ▸ Alternatively, the shield and housing can be directly connected by using the four M3 threaded holes in the HV BM module housing (Fig. 4-10).

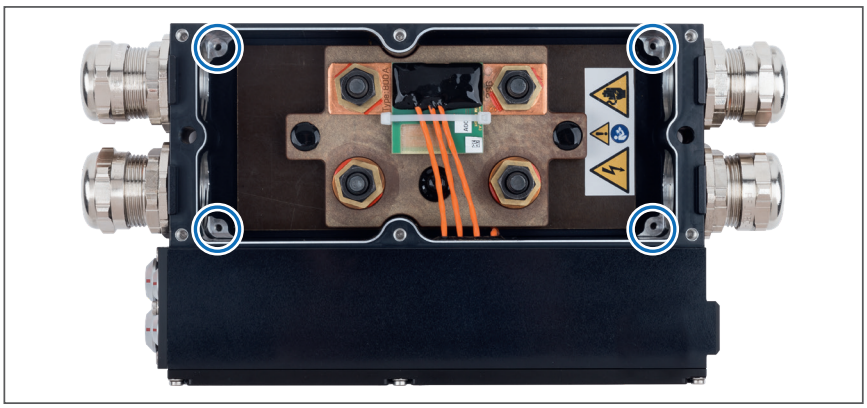


Fig. 4-10: HV BM 1.2, housing opened, M3 threaded holes marked

4.3.3.3 HV BM 1.x: Connecting the HV power cables

The scope of delivery of an HV BM 1.x includes four nuts for mounting the HV power cables on the threaded bolts.

☞ Prepare the nuts for mounting.

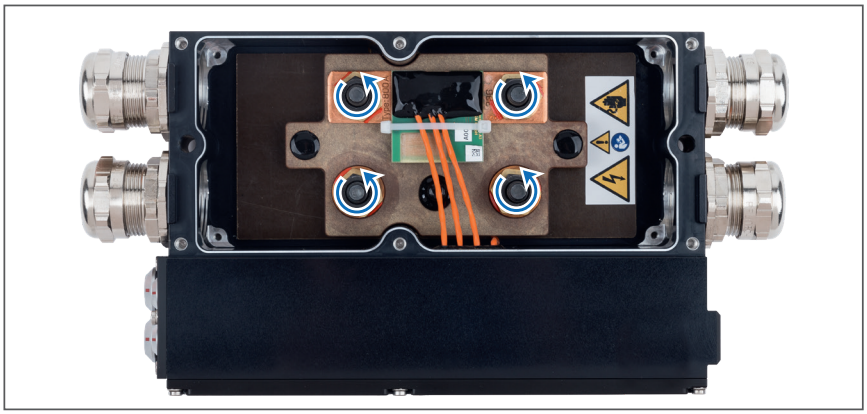


Fig. 4-11: HV BM 1.2, housing opened

If the nuts are already mounted:

☞ Loosen the four nuts (↻) and remove them from the bolts.
⇨ Another four nuts become visible.

9 See chapter 4.3.3.6 "Tighten the PG glands and close the housing" and the manufacturer's catalogue (https://www.pflitsch.de/fileadmin/user_upload/Downloads/Kataloge/Blueglobe_Katalog_2014_web.pdf, p. 79).

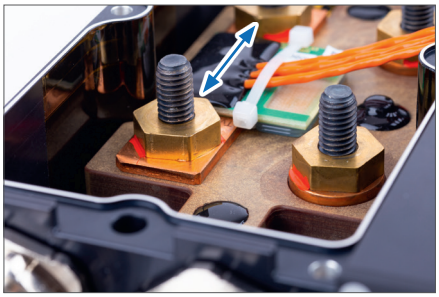


Fig. 4-12: HV BM 1.2, housing opened, additional nuts visible

NOTE!	
	Another four nuts are mounted on the threaded bolts. These nuts are located below the nuts that are used to fix the ring terminals. Two of them are used to fix the shunt to the bus bar (→ see blue arrow in Fig. 4-12). ☞ Do not loosen these four nuts under any circumstances.

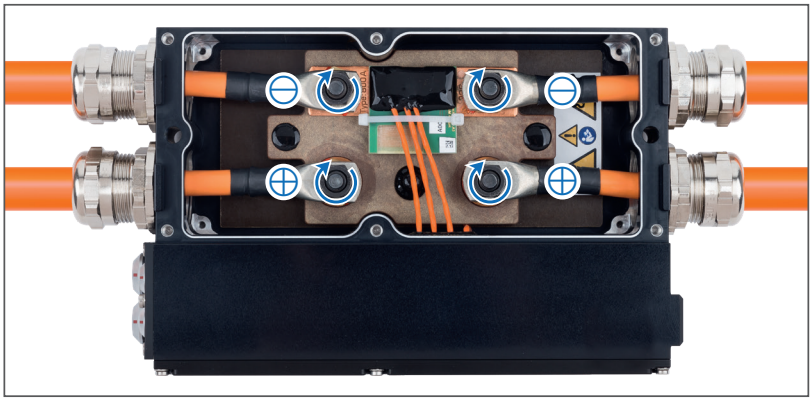


Fig. 4-13: HV BM 1.2, housing opened, HV cable mounted

☞ Place the ring terminals on the corresponding threaded bolt (⊕ or ⊖, depending on the connection diagram used).

☞ Use the four nuts to fasten the ring terminals (↻) and tighten them applying the torque specified in Tab. 4-2.

Module type	Screw type	Tightening torque
HV BM 1.1, hardware rev. A	Brass screw	5 Nm (M6) and 15 Nm (M8)
HV BM 1.2	Brass screw	15 Nm (M8)
HV BM 1.2	Steel screw	30 Nm (M8) [10]

Tab. 4-2: Tightening torques for the mounting of ring terminals

4.3.3.4 Exceptional case: Mounting ring terminals for cable cross-section 35 mm²

The following section describes the mounting of ring terminals with a 35 mm² cable cross section on the shunt side.

The instruction applies to HV BM 1.2 as of hardware revision D.

Due to the shunt design, the ring terminals for this cable cross-section have to be mounted upside down. For this purpose the spacers which are located on the threaded bolts below the shunt must be removed.

10 As of hardware revision E, M8 steel screws are exclusively used for both module versions.

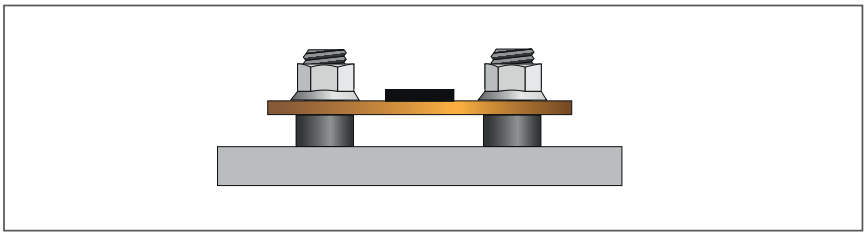


Fig. 4-14: HV BM 1.2, remove the nuts from the threaded bolts on either side

☞ Loosen the nuts on either side of the shunt module and remove them from the threaded bolts.

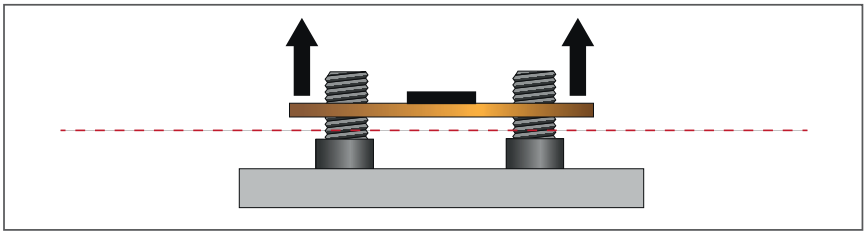


Fig. 4-15: HV BM 1.2, remove the shunt module from the threaded bolts

☞ Remove the shunt module from the threaded bolts. Make sure that the shunt cables will not be damaged.

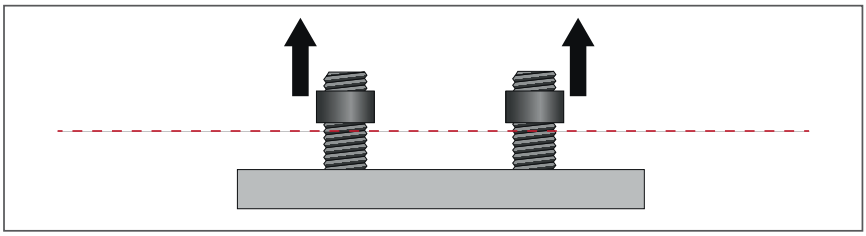


Fig. 4-16: HV BM 1.2, remove the spacers from the threaded bolts

☞ Remove the spacers from the threaded bolts.

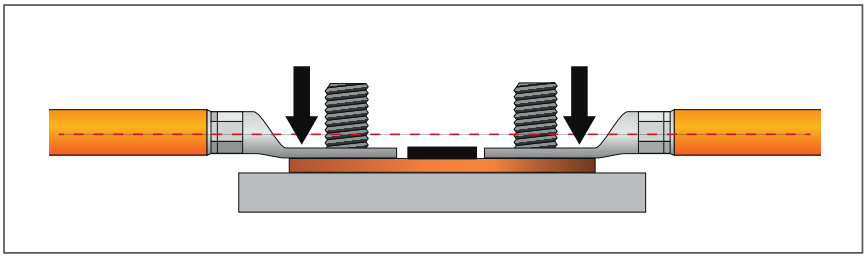


Fig. 4-17: HV BM 1.2, place the shunt module and the ring terminals on the threaded bolts

☞ Put the shunt module back on the threaded bolts.

☞ Place the ring terminals upside down on the threaded bolts. Make sure that the surface of the ring terminal rests plane on the mounting surface (shunt module).

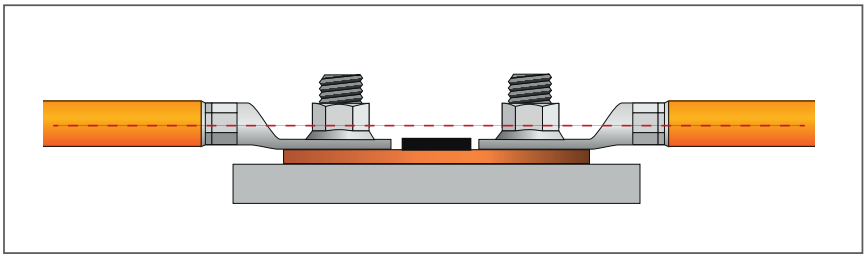


Fig. 4-18: HV BM 1.2, fasten the ring terminal with the nuts

☞ Fasten the ring terminal with the nuts. Observe the tightening torque!

→ *See Tab. 4-2: Tightening torques for the mounting of ring terminals.*

Mounting the 35 mm² ring terminals on the copper bar side

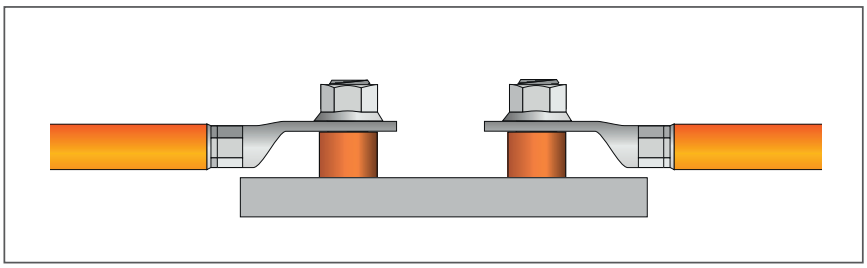


Fig. 4-19: HV BM 1.2, mounting the ring terminals on the copper bar side

☞ Mount the ring terminals on the copper bar in the usual manner.

WARNING!	
	The nuts and the ring terminals may not extend over the threaded bolts, otherwise the distance to the cover may be too small. There is then a risk of short circuits and the hazard of life threatening electric shocks. ☞ Only use the nuts and ring terminals supplied. ☞ If other components are applied, only use combinations of nuts and ring terminals that do not extend over the threaded bolt. Also, make sure that only nuts with standard dimensions are used.

WARNING!	
	The ring terminals must not touch each other or the housing during operation, otherwise there is a risk of life-threatening electric shocks and short circuits. Also, the contact resistance between the nuts and the ring terminators needs to be minimized. ☞ Tighten the nuts applying the above-mentioned torque so that the terminals are securely fixed during operation and the contact resistance between nuts and terminals is sufficiently low. ☞ Make sure that there is sufficient clearance between the ring terminals and the housing and between the ring terminals (at least 3 mm).

4.3.3.5 HV BM 3.1: Connecting the HV power cables

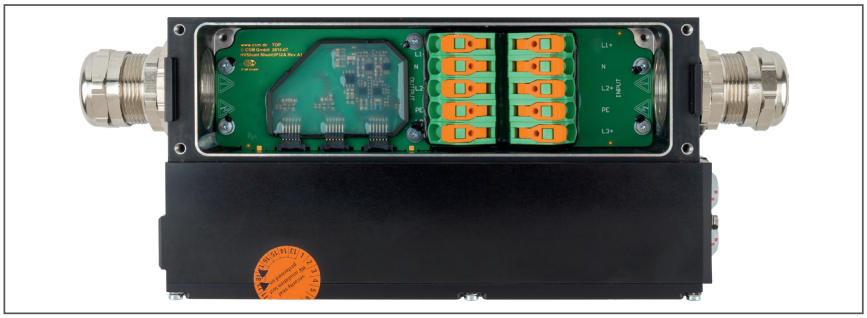


Fig. 4-20: HV BM 3.1, housing opened

☞ Open the orange caps of the Phoenix clamps.

☞ Insert the wires into the appropriate terminal (from the top down):

- **L1+** Outer conductor L1
- **N** Neutral conductor
- **L2+** Outer conductor L2
- **PE** protective conductor (Protective Earth)
- **L3+** outer conductor L3

☞ Close the orange caps.

4.3.3.6 Tighten the PG glands and close the housing

- ☞ Reinsert the spring into the PG gland, attach the pressure screw to the thread and tighten it by hand (Fig. 4-9).
- ☞ Tighten the pressure screw using the specified torque.
- ☞ Please observe the manufacturer's assembly instruction or the specified maximum tightening torques in Tab. 4-1 and the note below that table.
- ☞ HV BM 1.1: Reinsert the green inner cover. [11]

Fig. 4-21: HV BM 1.2, housing closed and HV cable mounted

- ☞ Place the cover on the housing.

NOTE!	
	To avoid water ingress, condensation, etc., special care must be taken to ensure the tightness of the housing. CSM provides a sealing cord as spare part. This should be changed e.g. if it is brittle or fragile or has been pinched. ☞ Make sure that cover and seal are properly fitted. ☞ Make sure that PG glands and HV power cables are properly mounted.

- ☞ Fix the cover using the four or six Allen screws (↻) and tighten them crosswise.

11 Applies only to HV BM 1.1, hardware revision A.

4.4 Installing HV Breakout Modules

4.4.1 Before installation

WARNING!	
	A HV Breakout Module is applied in high-voltage applications. **Improper use can be life-threatening due to high voltage.** ☞ Make sure that this work is only carried out by qualified and trained personnel. ☞ Observe safety instructions.

WARNING!	
	The measurement module has to be connected to ground in order to ensure user safety. **If the ground connection is not established, there is danger to life due to high voltage.** ☞ Connect the measurement module to ground (PE). ☞ Make sure that this work is only carried out by qualified and trained personnel. ☞ Observe safety instructions. → *See chapter 4.4.2.4 "Ground connection".*

WARNING!	
	The behavior of the CAN bus can be influenced by connecting a CAN bus measurement module to an existing CAN bus system. **Improper use of a CAN bus system may cause life-threatening situations and material damage.** ☞ Always connect CAN bus measurement modules to a separate CAN bus system (measurement bus). ☞ Make sure that this work is only carried out by qualified and trained personnel.

NOTE!	
	The isolation barrier can be damaged due to aging, overvoltage, high temperature and mechanical wear. ☞ If there is any indication that the insulation barrier may be defective, **perform an insulation test immediately** and contact CSM. Do not put the device in operation or continue to use it under any circumstances.

4.4.2 Connectors

An HV Breakout Module is equipped with a CAN and an EtherCAT® interface. The corresponding sockets are embedded in the left (HV BM 1.x) or right (HV BM 3.1) side of the housing. The HV power cables are led through PG glands into the inside of the module and connected there.

For safety reasons, the measurement module must be connected to the vehicle ground or to the protective ground (PA/PE) in the test stand via the threaded hole in the right (HV BM 1.x) or left (HV BM 3.1) side of the module.

	WARNING!
	To ensure user safety, the measurement module must be connected to vehicle ground (leakage monitor) or protective ground (PA/PE). **If the ground connection is not established, there is danger to life due to high voltage.** ☞ Connect the measurement module to ground (PE) using a suitable ground cable. ☞ Make sure that this work is only carried out by qualified and trained personnel.

	NOTE!
	The measurement module's power supply can be provided either via CAN or EtherCAT® socket. The supply lines of the two CAN sockets are connected to each other. The same applies to the two EtherCAT® sockets. The CAN and EtherCAT® interfaces are nevertheless separated from each other. This means that the supply voltage fed to CAN is not provided at the EtherCAT® sockets and vice versa. Banana plugs which are not in use do not need to be isolated.

4.4.2.1 CAN sockets

The CAN connectors can be used for both CAN signals and power supply. The interface cable connects the measurement module to the data acquisition system (PC or data logger) and (if required) to the power supply.

	NOTE!
	Be particularly careful when connecting third-party devices to a measurement bus with HV Breakout Module devices. ☞ Make sure that the configuration settings are compatible with all devices (same CAN bit rate, different CAN identifiers). ☞ Make sure that this work is only carried out by qualified and trained personnel.

CSM uses LEMO 0B sockets as standard for the CAN sockets. To connect a cable to this socket, the following plug with plug insert is required:

- **FGG.0B.305.CLA xxxxx** [12]

12 "xxxxx" is a placeholder here. The actual designation depends on the diameter of the cable used.

	Pin	Signal	Description
	1	Power +	Power supply, plus
	2	Power GND	Power supply, ground
	3	CAN_H	CAN high
	4	CAN_L	CAN low
	5	CAN_GND	CAN ground
	Housing	Shield	Cable shield

Tab. 4-3: Plug (front view) for CAN socket: Pin assignment

NOTE!	
	The CAN sockets for CAN signals and power supply are connected in parallel and have identical pin assignments. The signal applied to a specific pin is therefore always available at both sockets. Also, either socket can be used as well for **CAN OUT** as for **CAN IN** purposes. This enables simple cabling with only one cable between two measurement modules. At the end of the measurement chain, a CAN termination resistor is plugged into the open CAN socket. ☞ Make sure that this work is only carried out by qualified and trained personnel.

	The LEMO 0B socket is CSM's standard version. To equip the measurement module with other sockets, please contact the sales department.

4.4.2.2 EtherCAT® IN socket

The measurement module is connected to the XCP-Gateway (alternatively to an EtherCAT® master) or to an upstream EtherCAT® measurement module via the **IN** socket. EtherCAT® measurement modules receive their power supply from the XCP-Gateway, i.e. via the same cable connection.

CSM uses LEMO 1B sockets as standard for the **IN** socket. To connect a cable to this socket, the following plug with socket insert is required:

- **FGL.1B.308.CLL xxxxx** [13]

	Pin	Signal	Description
	1	V_{Batt} +	Power supply, plus
	2	GND	Ground
	3	RX -	Ethernet: Receive data, minus
	4	TX -	Ethernet: Transmit data, minus
	5	RX +	Ethernet: Receive data, plus
	6	GND	Ground
	7	V_{Batt} +	Power supply, plus
	8	TX +	Ethernet: Transmit data, plus

Tab. 4-4: Plug (front view) for **IN** socket: Pin assignment

13 "xxxxx" is a placeholder here. The actual designation depends on the diameter of the cable used.

NOTE!	
	The power supply is looped through from the **IN** socket to the **OUT** socket. Thus, a signal at a specific pin of the **IN** socket is always available at the **OUT** socket, too. ☞ Make sure that this work is only carried out by qualified and trained personnel.

4.4.2.3 EtherCAT® OUT socket

The **OUT** socket is used for the daisy-chaining of EtherCAT® measurement modules.

CSM uses LEMO 1B sockets as standard for the **OUT** socket. To connect a cable to this socket, the following plug with plug insert is required:

- **FGA.1B.308.CLA xxxxx** [14]

	Pin	Signal	Description
	1	V_{Batt} +	Power supply, plus
	2	V_{Batt} +	Power supply, plus
	3	GND	Ground
	4	RX +	Ethernet: Receive data, plus
	5	TX -	Ethernet: Transmit data, minus
	6	RX -	Ethernet: Receive data, minus
	7	GND	Ground
	8	TX +	Ethernet: Transmit data, plus

Tab. 4-5: Plug (front view) for **OUT** socket: Pin assignment

4.4.2.4 Ground connection

The HV BM has to be connected to ground in order to ensure user safety. The cross section of a ground cable depends on the cross section of the HV power cable used.

WARNING!	
	To ensure user safety, the measurement module must be connected to vehicle ground (leakage monitor) or protective ground (PA/PE). **If the ground connection is not established, there is danger to life due to high voltage.** ☞ Connect the measurement module to ground (PE) using a suitable ground cable. ☞ Make sure that this work is only carried out by qualified and trained personnel.

NOTE!	
	The threaded hole (M6 or M8, depending on the hardware revision) in the right (HV BM 1.x) or the left (HV BM 3.1) section of the housing has been designed to connect the housing to the vehicle ground or to the protective ground (PA/PE) in the test bench. ☞ Don't use the threaded mounting hole for any other purpose, e.g. for mounting the device.

14 "xxxxx" is a placeholder here. The actual designation depends on the diameter of the cable used.

Required parts/materials

- suitable ground cable (not included in the scope of delivery)

  Observe the recommendations according to DIN VDE 0100-540 when choosing the ground cable cross-section.
- M6 or M8 screw (plus washer, if required) [15]
- suitable tool (wrench, screwdriver, socket wrench, etc.)

Connecting the ground cable

☞ To fix the ground cable to the housing, insert the screw and tighten it carefully.

15 The thread depth in the module housing is 6 mm for M6 and 8 mm for M8. The screw length must be chosen according to the thickness of the mounting material (ground cable, washer, etc.).

5 How to use HV Breakout Modules

An HV Breakout Module can be operated via ECAT as well as via CAN. This means measurement values are sent via both bus types. In the configuration software CSMconfig, such a module can therefore be read in and configured as an ECAT module and as a CAN module.

The configuration is explained below using the ECAT component of the HV Breakout Module. The procedure is identical for the module's ECAT and CAN component - the CAN-specific features are explained in the relevant sections.

5.1 Application example

The figure below shows an example in which an HV BM 1.1 module is linked to a data acquisition system (PC) via an XCP-Gateway pro protocol converter.

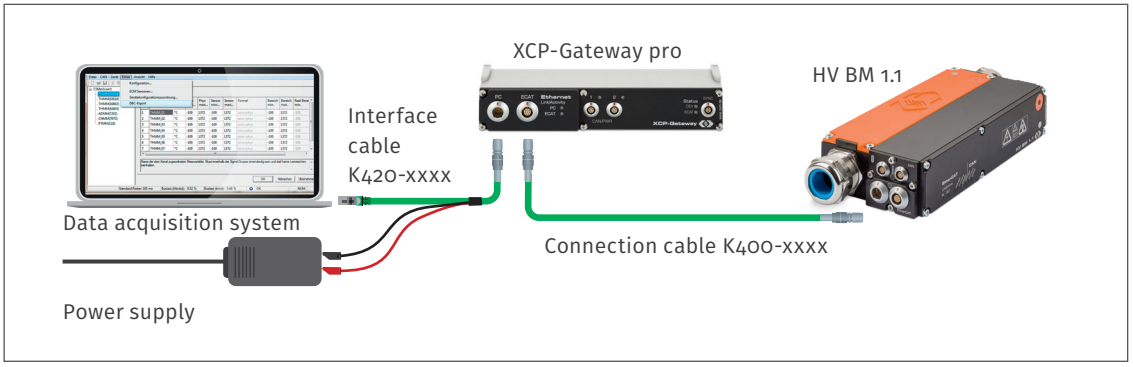


Fig. 5-1: Measurement setup with an HV BM 1.1 connected to an XCP-Gateway

The installation consists of the following components:

- HV BM 1.1 measurement module
- XCP-Gateway pro protocol converter
- Power supply → *See chapter 4.4.2 "Connectors".*
- Data acquisition (PC) with configuration software CSMconfig and DAQ software (e.g. vMeasure, CANape®, INCA etc.)
- Interface cable with power supply connectors K420-xxxx
- Connection cable K400-xxxx

To operate the HV Breakout Module via CAN as well:

- CAN interface

or

- 1 free CAN interface at an XCP-Gateway pro (measurement data rate: max. 1 kHz)

and

- matching connection cable and CAN termination plug

Connecting the components

☞ Connect the interface cable to the XCP-Gateway.
☞ Connect the XCP-Gateway pro to the HV Breakout Module.
☞ Connect the other end of the interface cable with the PC.
☞ Connect the banana plugs of the interface cable to the power supply (→ *see chapter 4.4.2 "Connectors"*).
☞ To configure the CAN side of the HV Breakout Module, connect a separate CAN interface (or a free CAN interface of an XCP-Gateway pro) to the HV Breakout Module's CAN socket which is not in use.

5.2 HV Breakout Module configuration

Configuration in CSMconfig

The CSM configuration software CSMconfig is required in order to configure an HV Breakout Module via XCP-Gateway.

The following sections describe how to create a simple configuration and how to save a configuration file in using CSMconfig.

Views

CSMconfig provides three different views (windows) for configuration: **Tree view**, **Device list** or **Channel list**. As of program version 8.12 these configuration views are integrated in a higher-level window to form configuration layouts. The views available for creating a new configuration document depend on the selected configuration layout, which can be specified via **Window | Select View Layout**. The following paragraphs contain the basic steps for a configuration in online mode using the **Tree view** window.

NOTE!

It is assumed here that you are familiar with the basic functions of CSMconfig. If this is not the case, you will find a detailed description of the software in the online help, which is available in the CSMconfig menu via **Help | Help Topics**.

NOTE!

We recommend always using the latest version of CSMconfig. Old versions may not support all module variants and functions. The most current version of CSMconfig can be found in the download area of the CSM website.

→ *See https://s.csm.de/en-cfg*

As of version 8.8.0 CSMconfig automatically checks upon each program start if a new version is available. If a more up-to-date version is available, the corresponding download link will be displayed in the dialog.

Ports and IP address range

NOTE!

As CSMconfig accesses the network, the firewall settings may need to be changed.

☞ Ensure that the ports 5555 and 5556 are enabled for use by CSMconfig.

NOTE!

An XCP-Gateway uses a fixed IP address (factory setting: 192.168.100.3). To be able to communicate with the XCP-Gateway from the data acquisition software, the IP addresses of the network adapter connecting the XCP-Gateway with the data acquisition system (PC) and the XCP-Gateway itself need to be within the same address range. A typical IP address for the network adapter of the PC which is suitable for the factory setting is IP address 192.168.100.1.

☞ Ensure that the IP addresses are in the same address range, but not identical.

☞ If you click on **Adjust IP to my NIC** in the **XCP-Gateway Configuration** dialog, this adjustment is made automatically.

5.2.1 Preparing configuration

☞ Before starting an online configuration, make sure that
- Measurement module and XCP-Gateway (or CAN interface) are properly connected
- XCP-Gateway (or CAN interface) is properly connected to the data acquisition PC
- CSMconfig is installed on the PC
- the latest firmware version has been installed on the measurement module and the XCP-Gateway

☞ Start CSMconfig.

☞ Select the required XCP-Gateway (or CAN interface) in the **Interface** dialog (**Options** | **Interface** or **Ctrl** + **I**) if it is not yet displayed in the status bar of CSMconfig.

5.2.2 Auto-Configuration

Auto-Configuration provides the means to detect the measurement modules connected to the bus and to read out configurations stored in a device. However, an automatic channel configuration in its actual sense (e.g. setting the measurement range) is not performed. A new configuration document is automatically created when executing the command.

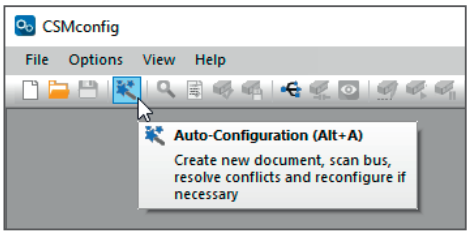


Fig. 5-2: **Auto-Configuration** option

☞ Select **Auto-Configuration (File | Auto-Configuration** or **Alt + A).**
⇨ The bus is checked for available measurement modules.
⇨ The **AutoConfig - Tree View** window opens.

NOTE!	
	If **Auto-Configuration** fails to find any modules: ▸ Make sure that the correct interface has been selected. ▸ Check the connections and the power supply. ▸ Is the module's status LED lit? ▸ Are the network settings correct? ▸ Does the firewall block the Ethernet access from CSMconfig? ▸ Is the CSMconfig installation up to date? Make sure that always the latest version is installed. ☞ If CSMconfig still doesn't work, please contact our support.

5.2.3 Device configuration dialog

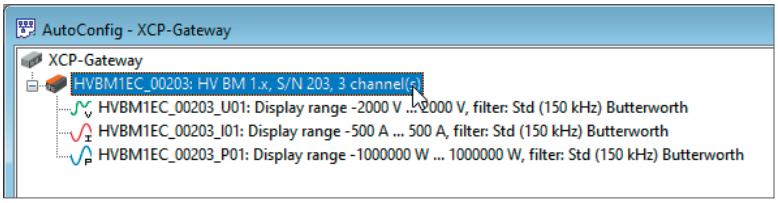


Fig. 5-3: **AutoConfig - XCP-Gateway** window, module connected via ECAT

☞ Double-click on the device entry using the left mouse button.
⇨ The **Device configuration dialog** is displayed.

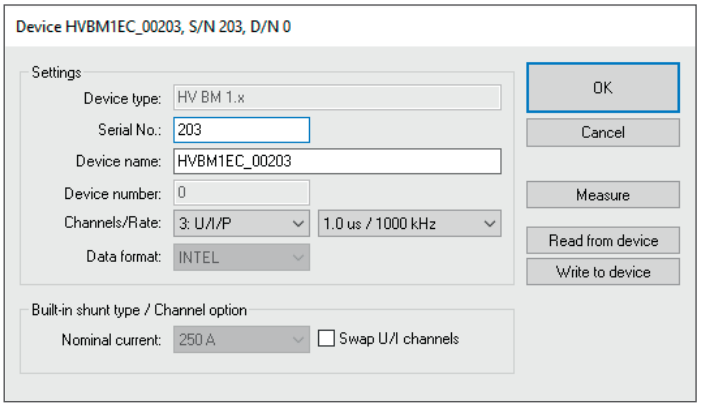


Fig. 5-4: Channel configuration dialog, module connected via ECAT

The number of available measurement channels is specified in the **Channels** selection menu (left). The default settings are **3: U/I/P** (HV BM 1.x) and **9: U/I/P** (HV BM 3.1). The following channels are active, depending on the settings:

- 3 or 9 channels: U, I, P voltage, current, instantaneous power
- 2 or 6 channels: U, I voltage, current
- 1 or 3 channels: U voltage
- 1 or 3 channels: I current

This cannot be done directly on the CAN side. Proceed as follows in order to measure just current on the CAN side as well:

☞ Enable the option **Per channel configuration** in the **CAN** section (see below).
☞ Then enter the CAN ID "0" or "0x0000" for the U and P channels in the **CAN ID** field of the **Channel Configuration Dialog**.

The selection menu **Rate** (right) is used to set the measurement data rate which is valid for all measurement channels.

NOTE!	
	The online-calculation of the measurement values for the instantaneous power is always carried out at the highest rate of 1,000 kHz (HV BM 1.x) or 500 kHz (HV BM 3.1). The software filter is only applied after the instantaneous power has been calculated.

In the lower section of the dialog, the **shunt type that is installed** in the HV Breakout Module is displayed.

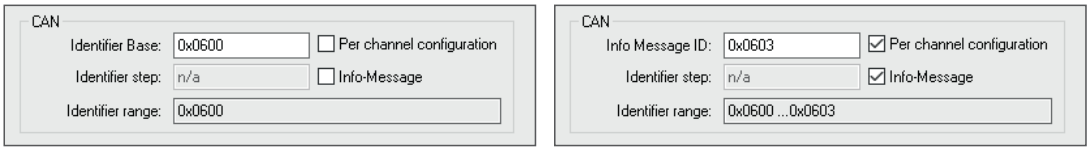


Fig. 5-5: Device configuration dialog, **CAN** section

If the HV Breakout Module is connected via CAN, the **CAN** section is displayed as well. There, the user can set the **Identifier base** (CAN-ID) and enable the options **Per channel configuration** and **Info Message** (Fig. 5-5, left). If both options are used simultaneously (Fig. 5-5, right), an **Info Message ID** has to be assigned as well. The corresponding field will be displayed instead of the **Identifier base**.

5.2.4 Channel Configuration Dialog

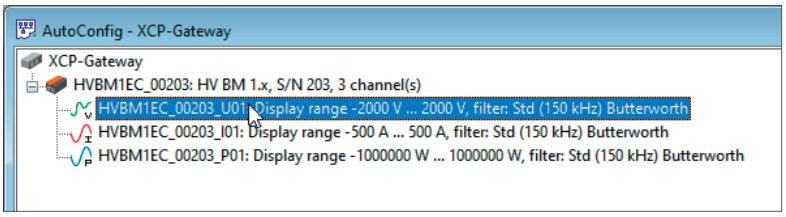


Fig. 5-6: **AutoConfig - XCP-Gateway** window, module connected via ECAT

☞ Double-click on the selected channel entry with the mouse pointer.
⇨ The **Channel configuration dialog** opens.

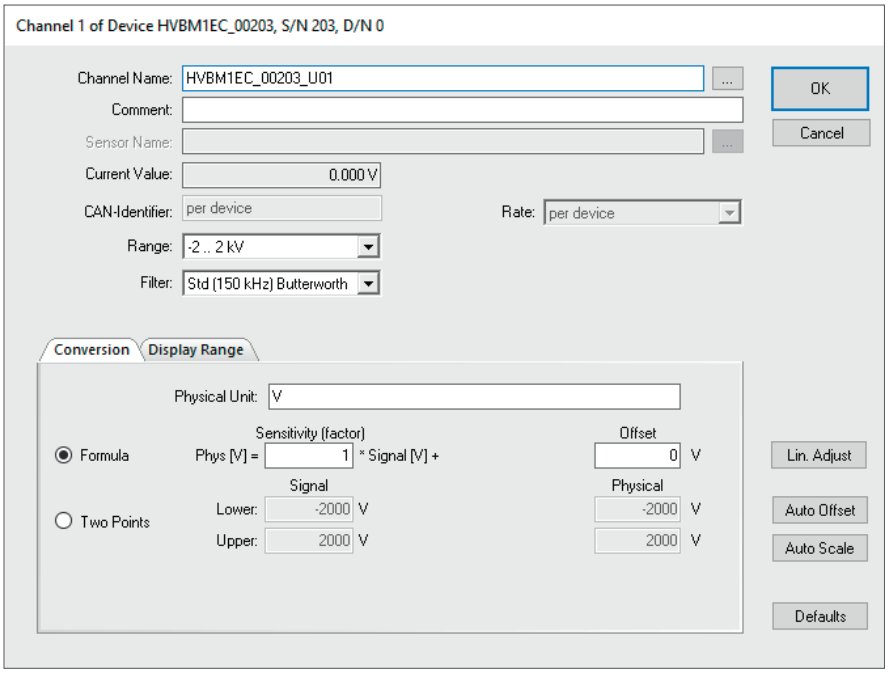


Fig. 5-7: Channel configuration dialog, module connected via ECAT

The most important parameters are:

- **Channel Name** and **Comment**
- **Range**
- Software **Filter** applied according to the power calculation
- **Conversion** (scaling), entered as **Factor**/**Offset** or **Two Points**

→ *See CSMconfig online help for further information.*

NOTE!

The measurement range has to be **identically configured** on both the ECAT and the CAN side, otherwise the module side that was configured first will send the error value "0x8000" instead of the measurement values. This is indicated on the module by **measurement channel LED indictors permanently lit in red**. In CSMconfig, this error is displayed in the **Device configuration** dialog (→ **Ctrl** + **R**), **Operation mode** row (see Fig. 5-8).

☞ Adjust the measurement range settings and write them to the module.

⇨ The red LEDs fade out and both sides of the module will be activated again.

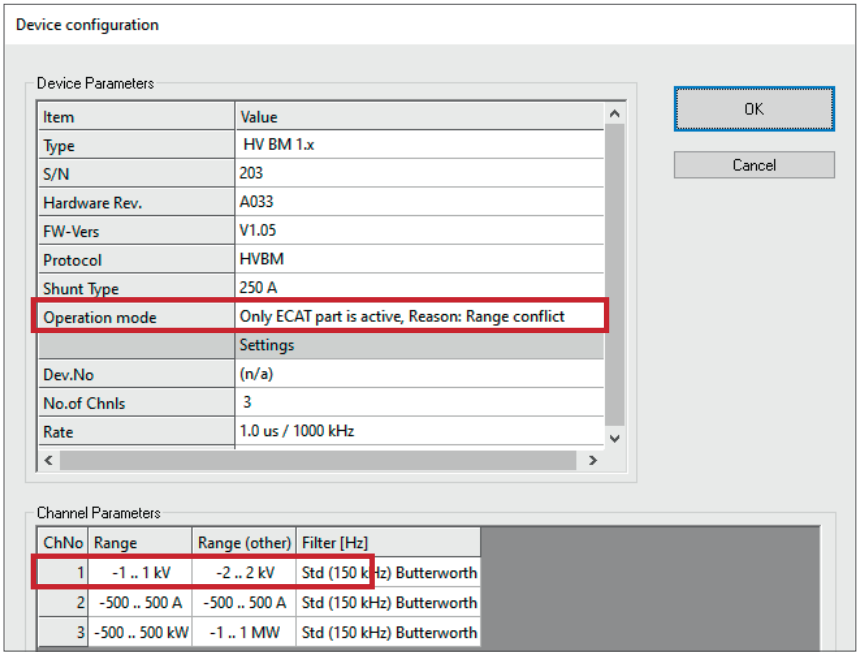


Fig. 5-8: **Device Configuration Dialog**, display of divergent measurement ranges

The channel dialog is identical on the CAN side. The only exception: If the option **Per channel configuration** has been enabled, the options **CAN identifier** and **Rate** will be available.

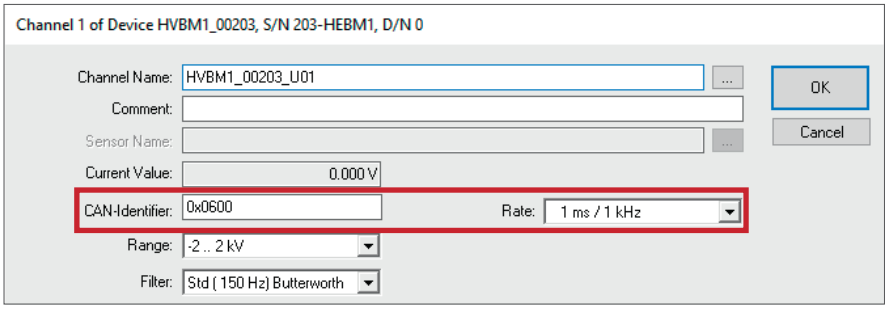


Fig. 5-9: **Channel Configuration Dialog**, module connected via CAN and **Per channel configuration** enabled

5.2.5 Temperature monitoring

CAUTION!	
	The internal temperature of the measurement module must not be exceeded. → *See chapter 2.1 "General safety instructions", Tab. 2-1.* The shunt temperature must not exceed +120 °C. As soon as that value is exceeded, the module will send the error value "0x8001“ instead of a measured value until the temperature value drops below +115 °C again.

HV Breakout Modules are equipped with built-in sensors which allow temperature monitoring. The following temperature signals are available:

- **_devicename_PT1Lo** shunt temperature
- **_devicename_PT2Lo** internal temperature of the module

devicename refers to the **name of the device** as specified the field **Device name** of the **Device Configuration Dialog**, e.g. HVBM1EC_00042.

If an **XCP-Gateway pro** is applied, the temperature signals are automatically displayed as additional measurement values in the DAQ software when using the ECAT side.

When accessing via the CAN side, the temperature signals can be enabled as follows:

☞ Open the **Device configuration** dialog as described above.
☞ Enable the **Info Message** option.
⇨ The signals are displayed in the DAQ software as additional measurement values.

→ *See CSMconfig online help for further information.*

5.2.6 Complete the configuration

5.2.6.1 Transferring configuration data to the measurement module

After the channels and the measurement module have been configured for both the CAN and the ECAT side, the configuration data needs to be transferred to the measurement module. This procedure must be performed for both configuration documents (CAN and ECAT).

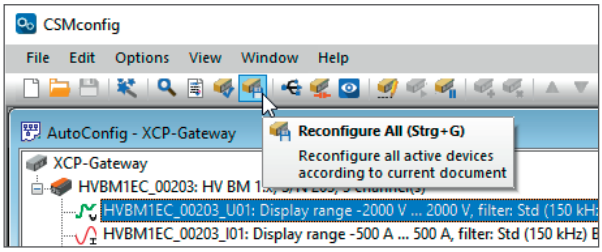


Fig. 5-10: **Reconfigure all** option

☞ Select **Reconfigure all** (→ **Ctrl** + **G**).

or

☞ Right-click on the device.
☞ Select **Write settings to device** (→ **Ctrl** + **W**).

5.2.6.2 Saving a configuration

The configuration documents must be saved in order to be able to record and interpret measurement data with a DAQ tool. Matching A2L (XCP/ECAT) and DBC (CAN) files are required in order to perform measurements. Also, these files can be used to easily apply or restore already completed configurations to a module.

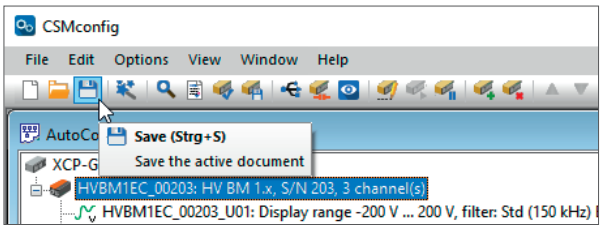


Fig. 5-11: **Save** option

☞ Select **File | Save** (→ **Ctrl** + **S**).

NOTE!	
	The A2L and DBC file used in the measurement software must match the configuration stored in the module. Otherwise incorrect measurement values or no values at all are received.

5.2.6.3 Documenting a configuration

In addition to saving the configuration files, a finished configuration can be documented very easily and concisely in CSMconfig.

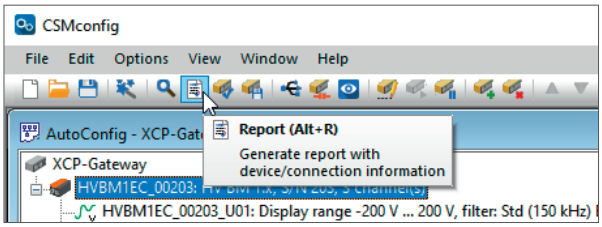


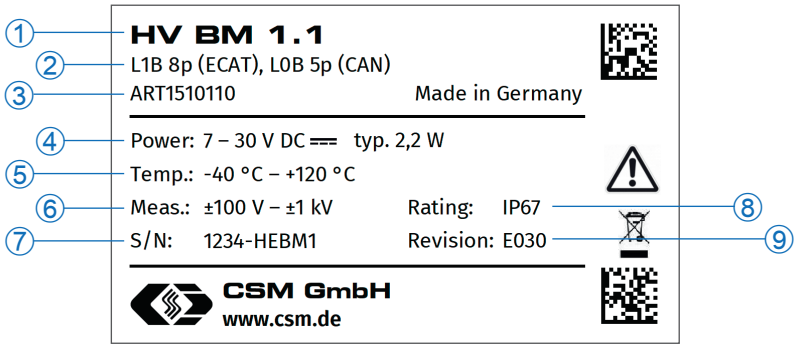
Fig. 5-12: **Report...** option

☞ Create and save a **Report... (→ Alt + R)** in HTML format.

6 Maintenance and Cleaning

6.1 Type label

The type label is attached to the back of the module and contains the following information:

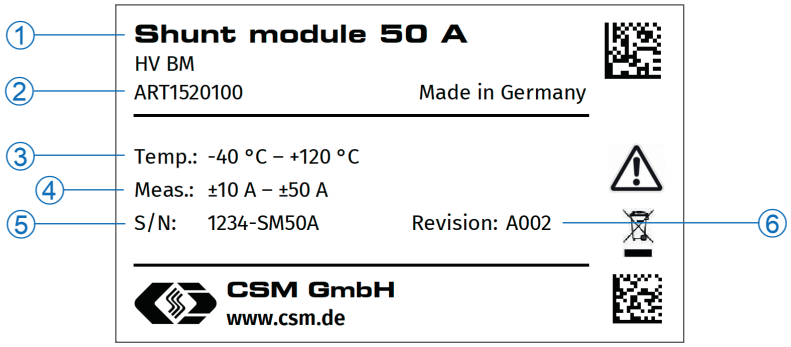


①	HV BM 1.1	Device type
②	L1B 8p (ECAT), L0B 5p (CAN)	Device details: ▸ L1B 8p - EtherCAT® sockets: LEMO 1B, 8-pole ▸ ECAT - bus system ▸ L0B 5p -CAN sockets: LEMO 0B, 5-pole ▸ CAN – bus system
③	ART1510110	Part number of the measurement module
④	Power: 7 – 30 V DC, typ. 2.2 W	Power supply range, typical power consumption
⑤	Temp.: -40 °C – +120 °C	Operating temperature range
⑥	Meas.: ±100 V – ±1 kV	Measurement range
⑦	S/N: 1234-HEBM1	Measurement module serial number
⑧	Rating: IP67	Protection class
⑨	Revision: E030	Hardware revision number

Tab. 6-1: Type label

6.2 Shunt label

The shunt label is attached to the back of the module and contains details on the built-in shunt.



①	Shunt module 50 A	Shunt type/nominal current of the shunt module
②	ART1520100	Part number
③	Temp.: -40 °C – +120 °C	Operating temperature range
④	Meas.: ±10 A – ±50 A	Measurement range
⑤	S/N: 1234-SM50A	Serial number of the shunt module
⑥	Revision: A002	Hardware revision number

Tab. 6-2: Shunt label

6.3 Maintenance services

Upon delivery, a safety certificate (high-voltage insulation test) and a test protocol is issued for every HV Breakout Module. This is documented by corresponding stickers attached to the top or the rear side of the device housing.

To ensure reliability and functionality, a measurement module should be checked at least every 12 months. CSM offers maintenance packages and a repair service for this purpose.

- High-voltage isolation test (functional testing included)
- Calibration (functional testing included)
- Repair service

6.4 Cleaning instructions

NOTE!	
	☞ Disconnect the measurement module before starting to work.

NOTE!	
	The surface of the housing is sensitive to aggressive cleaning agents, solvents and abrasive media. ☞ Do not use aggressive cleaning agents or solvents to clean the measurement module. ☞ Use only a moist cloth.

7 Appendix

7.1 Cable preparation

7.1.1 PG gland and spring

NOTE!	
	Depending on the HV power cables and cable bushings used, there is a risk of chafing on the pressure screws of the PG glands. ☞ Protect the HV power cables by using suitable shrink sleeves if required.

The spring ① is located exactly on the same level as the sealing insert ② inside the connecting thread of the PG gland (Fig. 7-1). To ensure proper contact between the cable shield and the spring in the PG gland, the cable must be carefully assembled.

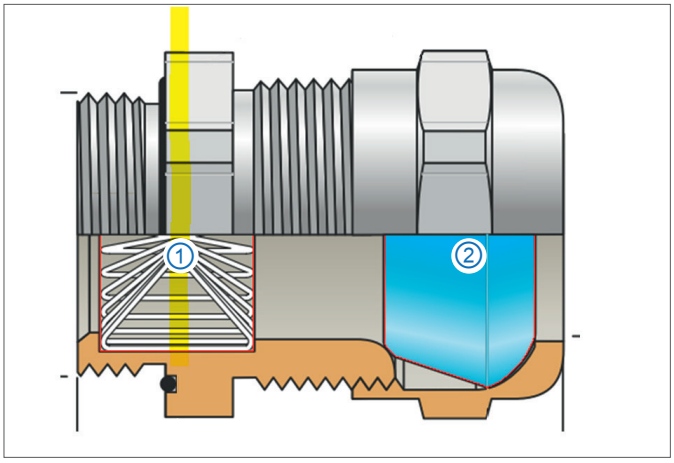


Fig. 7-1: PG gland (longitudinal section)

NOTE!	
	Please note that the installation height of a PG gland changes if a reduction is used. If a reduction for an M25 or M20 thread is used with an M32 PG gland, the total height of the gland increases by approx. 4 mm (Fig. 7-2).

If a reduction is used when mounting an HV power cable, the installation height of the PG gland changes accordingly. This will also affect the distance between the ring terminal and the segment of the HV power cable that must be stripped to establish contact between the spring and the cable shield (Fig. 7-3).

Fig. 7-2: PG gland: without reduction (left) and with reduction (right) ①

To establish an optimum connection between module housing and cable shield, the spring in the PG gland requires a 14 mm wide contact strip on the cable shield.

If a reduction is used, as shown in the right illustration in Fig. 7-2, the overall height of the PG gland increases by approx. 4 mm

This has to be taken into account when preparing a HV power cable.

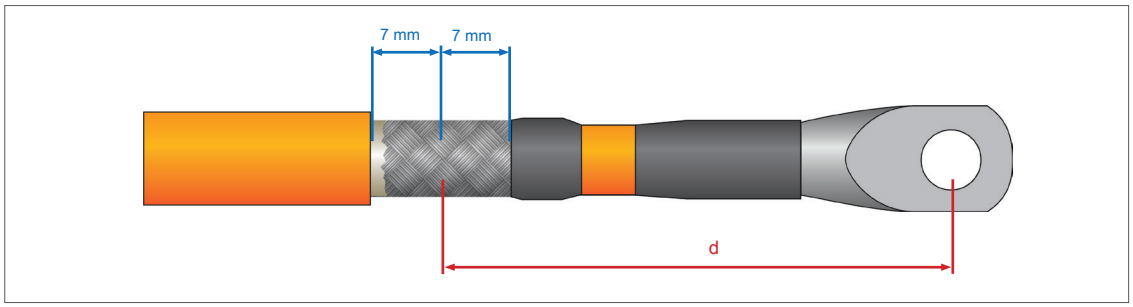


Fig. 7-3: HV power cable, contact area for spring

- without reduction (M32): d = 70 mm
- with reduction (M25): d = 74 mm

7.1.2 Cable assembly for cross sections 35 mm² to 95 mm²

NOTE!	
	☞ Observe the instructions for connecting HV power cables with a cable cross-section of 35 mm² to the shunt. → *See .chapter 4.3.3.4 "Exceptional case: Mounting ring terminals for cable cross-section 35 mm²"*

The following section schematically illustrates and describes the assembly of HV power cables for the cable cross-sections 35 mm², 50 mm², 70 mm² and 95 mm². These HV power cables are used exclusively to connect HV BM 1.2 measurement modules.

Tab. 7-1 provides information on the cables used as well as the ring terminals and PG glands required for the corresponding cable cross section.

Cable cross section	Cable	Ring terminals	PG gland
35 mm²	Coroplast FHLR2GCB2G 35 mm²	ART1520523 Ring Terminal Set 35 mm² HV BM 1.2	ART1520201 PG cable gland set 11/20 HV BM
50 mm²	Coroplast FHLR2GCB2G 50 mm²	ART1520524 Ring Terminal Set 50 mm² HV BM 1.2	ART1520201 PG cable gland set 11/20 HV BM
70 mm²	Coroplast FHLR2GCB2G 70 mm²	ART1520545 Ring Terminal Set 70 mm² HV BM 1.2	ART1520201 PG cable gland set 11/20 HV BM
95 mm²	Coroplast FHLR2GCB2G 95 mm²	ART1520526 Ring Terminal Set 95 mm² HV BM 1.2	ART1520200 PG cable gland set 15/25 HV BM

Tab. 7-1: Components for single-wire HV power cables

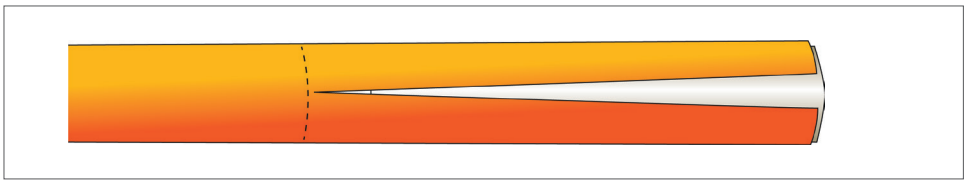


Fig. 7-4: Step 1: Removing the outer sheath

☞ Remove the outer sheath to the required length.[16] Make sure that the shielding mesh lying underneath will not be damaged.

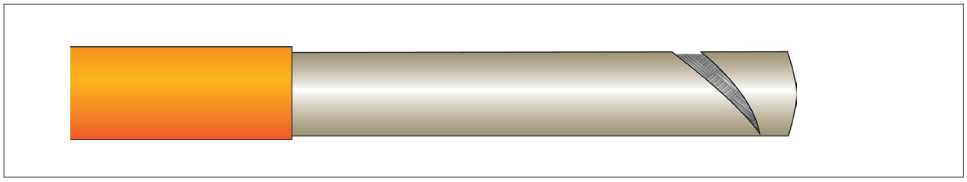


Fig. 7-5: Step 2: Removing the protective foil.

☞ Remove the protective foil from the shielding mesh.

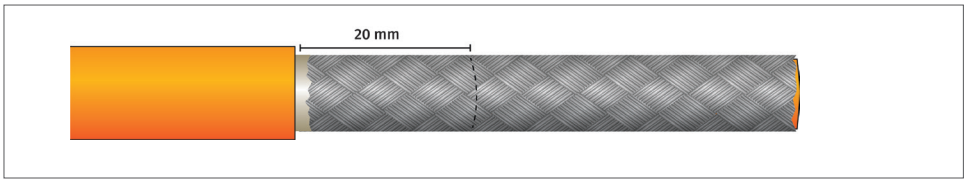


Fig. 7-6: Step 3: Applying a mark on the shielding

☞ Mark a 20 mm wide segment on the shielding mesh.

☞ Remove the remaining shielding mesh.

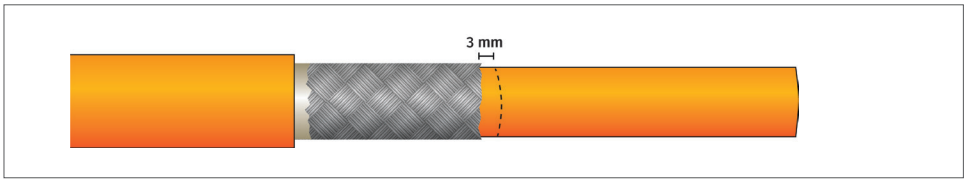


Fig. 7-7: Step 4: Marking the inner sheath

☞ Apply a mark on the inner sheath with a distance of 3 mm to the end of the shielding mesh.

16 Stripping length of the outer sheath depending on the cable cross section: 35 mm²: 65 mm, 50 mm²: 62 mm, 70 mm²: 55 mm, 95 mm²: 55 mm

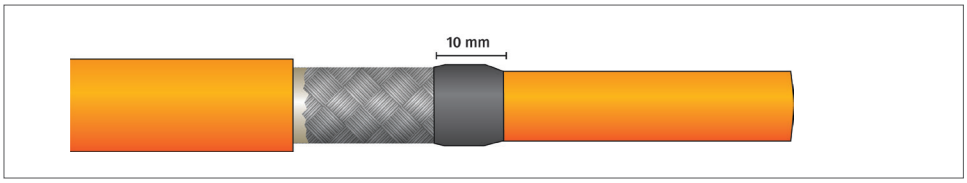


Fig. 7-8: Step 5: Attaching and fixing the shrink sleeve

☞ Slide a 10 mm long piece of shrink sleeve over the HV power cable up to the marking (Fig. 7-7).

☞ Fix the shrink sleeve by applying heat.

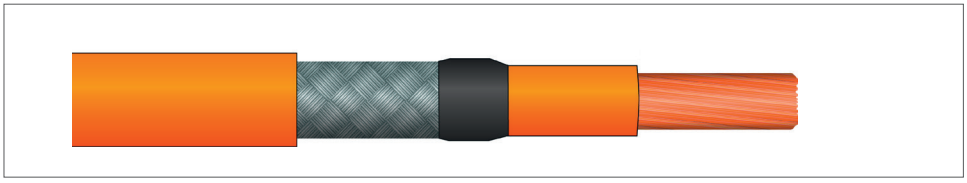


Fig. 7-9: Step 6: Dismantling the wire

☞ Remove the inner sheath to the required length.[17]

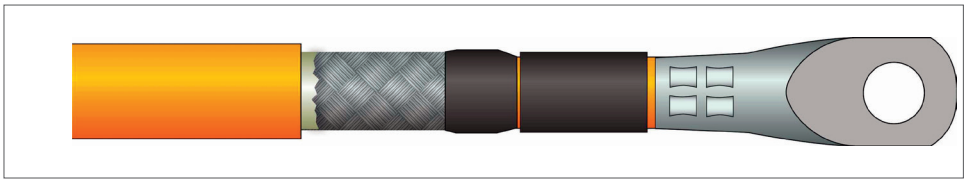


Fig. 7-10: Step 7: Sliding the shrink sleeve over the cable and attaching the ring terminal

☞ Slide an approx. 25 mm long piece of shrink sleeve over the cable.

☞ Attach the ring terminal to the dismantled wire.

☞ Use the crimping pliers to crimp the ring terminal at two points and then solder it.

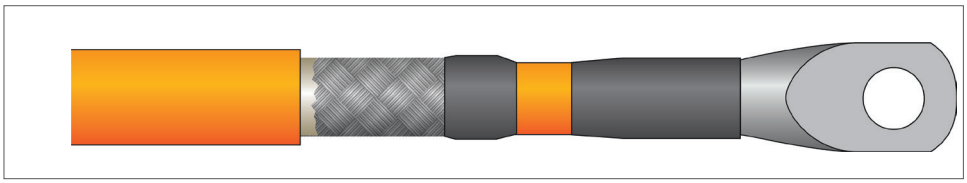


Fig. 7-11: Step 8: Placing and fixing the shrink sleeve

☞ Slide the shrink sleeve over the crimped end of the ring terminal so that about 15 mm of the shrink sleeve will cover the ring terminal.

☞ Fix the shrink sleeve by applying heat.

→ *For information on how to connect the HV power cables to the measurement module, please refer to chapter 4.3.3.3 "HV BM 1.x: Connecting the HV power cables".*

17 Stripping length of the inner sheath depending on the cable cross section: 35 mm²: 20 mm, 50 mm²: 12 mm, 70 mm²: 15 mm, 95 mm²: 25 mm

7.1.3 HV BM 1.1 connection example, cable cross-section 2x 6 mm²

Cable	Coroplast FHLR2GCB2G 2 x 6 mm²
Ring terminals	ART1520512 Ring Terminal Set 6 mm² HV BM 1.1 (HW rev. A) ART1520532 Ring Terminal Set 6 mm² HV BM 1.1 (as of HW rev. E)
PG gland	ART1520201 PG cable gland set 11/20 HV BM

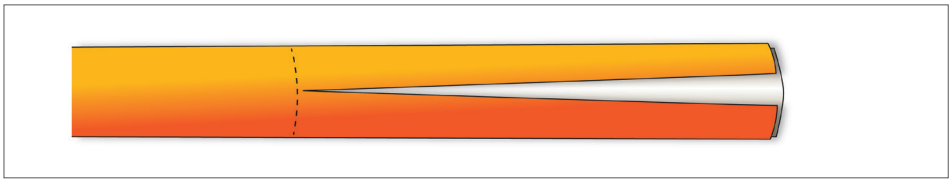


Fig. 7-12: Step 1: Removing the outer sheath

☞ Remove the outer sheath over a length of 75 mm. Make sure that the shielding mesh lying underneath will not be damaged.

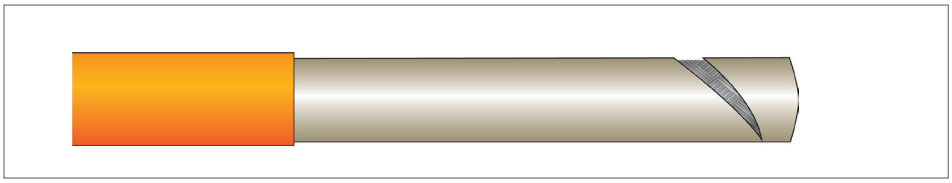


Fig. 7-13: Step 2: Removing the protective foil.

☞ Remove the protective foil from the shielding mesh.

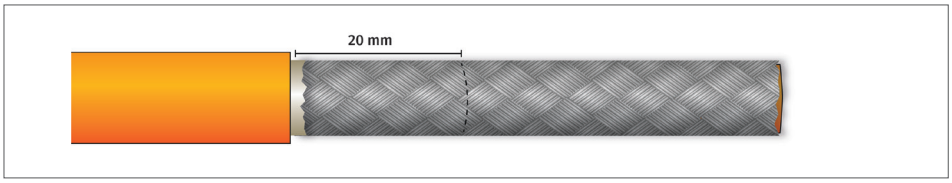


Fig. 7-14: Step 3: Applying a mark on the shielding

☞ Mark a 20 mm wide segment on the shielding mesh.

☞ Remove the remaining shielding mesh.

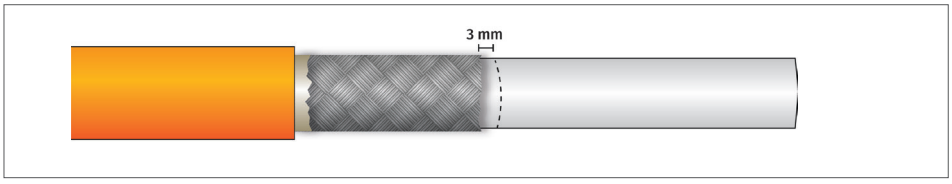


Fig. 7-15: Step 4: Marking the inner sheath

☞ Apply a mark on the inner sheath with a distance of 3 mm to the end of the shielding mesh.

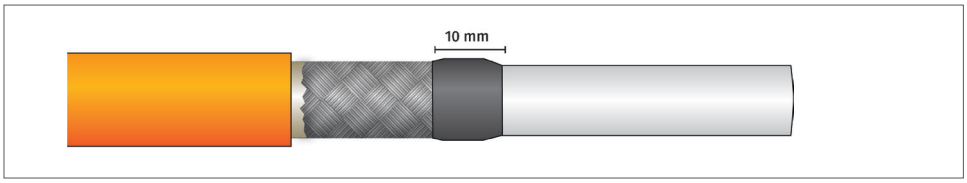


Fig. 7-16: Step 5: Attaching and fixing the shrink sleeve

☞ Slide a 10 mm long piece of shrink sleeve over the HV power cable up to the marking (Fig. 7-15).

☞ Fix the shrink sleeve by applying heat.

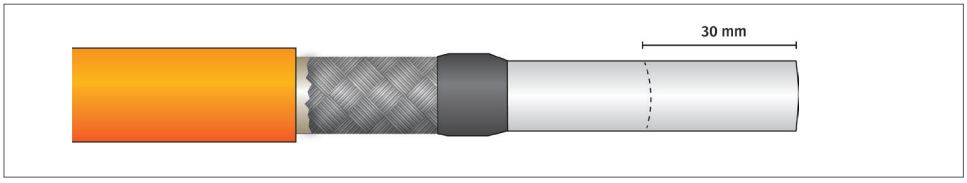


Fig. 7-17: Step 6: Dismantling the inner sheath

☞ Remove the grey inner sheath over a length of 30 mm.

⇨ A red and a black wire will appear.

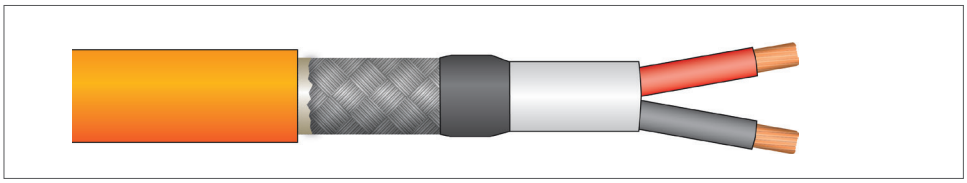


Fig. 7-18: Step 7: Dismantling the red and black wire

☞ Dismantle both wires over a length of 8 mm.

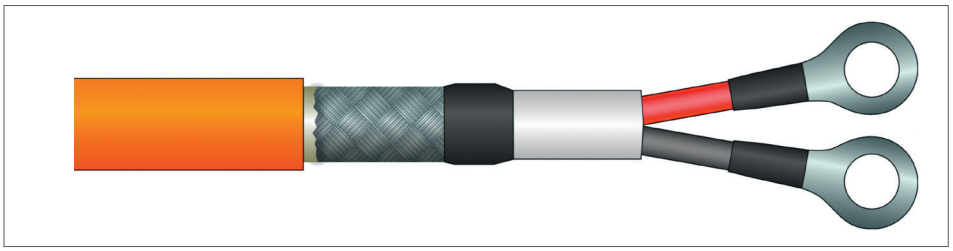


Fig. 7-19: Step 8: Attaching and fixing the ring terminal

☞ Slide 12 mm long pieces of shrink sleeve onto the red and the black wire.

☞ Attach M8 ring terminals to the dismantled wires.[18]

☞ Use the crimping pliers to crimp the ring terminals and then solder them.

☞ Slide the shrink sleeves over the ring terminals, so that they cover the crimped terminal ends and the red or black wire by 6 mm each.

☞ Fix the shrink sleeve by applying heat.

→ *For information on how to connect the HV power cables to the measurement module, please refer to chapter 4.3.3.3 "HV BM 1.x: Connecting the HV power cables".*

18 As of hardware revision E, M8 ring terminals are used for both wires. For hardware revision A, an M6 ring terminal is used for the red wire instead of an M8 ring terminal.

7.2 List of figures

7.3 List of tables

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