HV Breakout Module Type 1.x (1.1/1.2/1.2+S/1.2+U)

User Guide

Copyright

Trademarks

Product disposal/recycling

If 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 over 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.

Contents

1 Introduction

1.1 About this user guide

This user guide contains important information for handling the product. Please read the entire document carefully before installation and initial operation.

1.2 Symbols and writing conventions

Symbol/note	Meaning	Example of application
☞	User instruction	☞ Click on **OK** to confirm the entry.
⇨	Result of an action	⇨ The following dialog opens:
→	Cross reference to external information source(s)	→ *CSMconfig Online Help, section "Menu commands"*
→	Text highlighted in blue (with or without arrow) refers to a link link/cross reference within the document.	→ *Chapter 4.3.2.4 "Ground connection"* ☞ Continue with chapter 5.4.3.4 "Creating a new configuration.
i	This pictogram refers to important notes or additional information on a specific topic.	**i** CSM offers a mounting kit for devices in standard housings. For further information please contact our sales department.
Options | Interface	**Menu selection** Menu items, options and buttons are highlighted in bold. The vertical bar "|" separates the menu from the menu command. The example on the right means: Click on the **Options** menu and select **Interface.**	☞ Select **Options | Interface**.
(→ **Options | Interface**)	A menu option integrated into the text.	The CAN interface is selected via the **Interface** dialog (→ **Options | Interface**).

Tab. 1-1: Symbols and writing conventions

1.3 List of abbreviations

Abbreviation	Meaning
ASAM	**A**ssociation for **S**tandardization of **A**utomation and **M**easuring Systems: registered association coordinating the development of technical standards → *asam.net*
CAN	**C**ontroller **A**rea **N**etwork: serial bus system developed by Bosch for networking ECUs in vehicles
CoE	**C**ANopen **o**ver EtherCAT®: protocol for use of the CANopen family of profiles over EtherCAT®
DAQ	**D**ata **A**c**Q**uisition), e.g. DAQ software
ECAT	**E**ther**CAT**®: an Ethernet-based field bus system developed by Beckhoff company and the EtherCAT® Technology Group → *ethercat.org*
EMC	**E**lectro**M**agnetic **C**ompatibility
ESD	**E**lectro**S**tatic **D**ischarge
HV	In terms of automotive engineering, **H**igh **V**oltage is used to specify the following voltage ranges: ▸ Alternating voltage (AC) greater than 30 V and up to 1000 V ▸ Direct voltage (DC) greater than 60 V and up to 1500 V
HV BM	HV Breakout Module
MC Tool	**M**easurement & **C**alibration Tool
OBC	**O**n-**B**oard **C**harger: charging unit in an electric vehicle used for charging the vehicle battery
STG	**ST**rain **G**auge
TEDS	**T**ransducer **E**lectronic **D**ata**S**heet: sensor with integrated memory for electronic data sheet
XCP	Universal Measurement and Calibration Protocol → *asam.net*

Tab. 1-2: List of abbreviations

1.4 Warning

A warning indicates specifically or potentially dangerous situations. Failure to follow a warning could result in injury or death to persons and/or damage to property.

This guide contains warnings that the user must observe to ensure safe operation and to prevent injury to persons and damage to property.

Warning design

A warning sign consists of the following components:

- Warning symbol
- Signal word
- Source/type of hazard
- Possible consequences of non-compliance
- Measures to avert the hazard

Warning symbols

Symbol	Meaning
	General risk This symbol indicates a general hazard.
	High voltage! This symbol indicates a risk due to hazardous electrical voltage.
	Hot surface! This symbol indicates a possible risk of burns from hot surfaces.

Tab. 1-3: Warning signs

Signal words

Signal word	Meaning
WARNING	... indicates a potential hazard. Failure to follow this warning may result in serious injury, or possibly death.
CAUTION	... indicates a potential hazard. Failure to follow this warning may result in minor injuries.

Tab. 1-4: Signal words

If several potential hazards originate from one source of danger, then the warning (signal word/symbol) that indicates the greatest potential hazard is used. For example, a warning indicating danger to life or serious injury may also indicate the potential risk of property damage.

1.5 Directive

A directive contains important information about the product described in the guide. Failure to observe a directive may result in malfunction and/or damage to property and material. A directive is indicated by the blue symbol and the signal word **NOTE**.

Example

	NOTE!
	This symbol indicates important information. Failure to observe this information can impair the function or result in damage to the measurement module. ☞ Read the information carefully.

Symbols

Symbol	Meaning
	This symbol indicates important information. Failure to observe this information can impair the function or result in damage to the measurement module.
	Wear suitable safety gloves.
	Disconnect the device before starting to work.

Tab. 1-5: Symbols used in mandatory signs

1.6 Legal disclaimer

This guide and other 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.

Computer-Systeme-Messtechnik GmbH (hereafter referred to as "CSM") 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.

→ *Chapter 2 "Safety Instructions"*

1.7 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
- the user does not observe the product documentation
- the product is operated with accessories or parts which are not explicitly approved for operation by CSM

1.8 ESD Information

The manufacturer of the product declares that the HV Breakout Modules listed below comply with the requirements of EU Directive 2014/30/EU:

- HV BM 1.1
- HV BM 1.2
- HV BM 1.2+S
- HV BM 1.2+U

NOTE!	
	Electronic components can be damaged or destroyed by electrostatic discharge (ESD). ☞ Make sure that no electrostatic discharge occurs via the internal contacts of the inputs. ☞ Avoid electrostatic discharge when handling or installing sensors.

2 Safety Instructions

2.1 General safety instructions

The measurement modules comply with the latest technical developments and the recognized safety standards. The measurement modules may only be used in a technically faultless condition and in accordance with their intended use. To avoid health hazards to the user or damage to the measurement module, please observe the safety instructions in the following chapter and the document "Safety Instructions HV Breakout Module".

WARNING!	
	HV Breakout Modules (HV BM) are used in high-voltage applications. **Improper use may result in life-threatening electrical shocks.** ☞ Only use qualified and trained personnel. ☞ Observe safety instructions.

WARNING!	
	The orange lid of the device housing can be removed to mount or dismount the HV power cables. ☞ Before removing the lid, make sure that the HV power cables are de-energized. ☞ Fix the HV power cables with the ring terminals and nuts supplied or with suitable equivalents. ☞ Observe the mounting instructions in the user guide. It is particularly important that lid and cable glands are properly mounted in order to ensure the tightness of the housing. → Chapter 5 "Connecting the HV Power Cables"

WARNING!	
	When using HV power cables made of aluminum in combination with ring terminals for HV power cables made of 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.** ☞ Use ring terminals for copper cables only in combination with HV power cables made of copper! HV power cables made of aluminum require a specific connection technology. Please contact our technical support for further information.

WARNING!	
	The improper opening of the device housing compromises the operational safety of the HV measurement module and entails the risk of life-threatening electrical shocks. **If the lid is not mounted, there is danger to life by accidentally touching non-insulated contacts at high-voltage potential.** ☞ Remove the lid only to connect the HV power cables and then re-mount it properly. ☞ Do not modify the HV measurement module in any way, neither electrically nor mechanically. ☞ Only operate the high-voltage measurement module with the lid closed.

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). ☞ Only use qualified and trained personnel.

WARNING!	
	The internal temperature of the measurement module and the temperature of the shunts must not exceed +120 °C. As soon as the temperature of a shunt exceeds this value, the HV breakout module sends the error code "0x8001" instead of the measured values for U and I. The user sees the error message "THERMAL_OVERLOAD" that has been generated from the DBC or A2L file. This data is sent until the temperature of all shunts drops below +115 °C again. **Exceeding the specified temperature impairs the operational safety of the HV measurement module. There are risks including life-threatening electrical shocks and fire hazards.** ☞ Tighten the nuts for fastening the ring terminals with the specified torque to keep the contact resistance low. → Chapter 5.1.2 "Tightening torques" ☞ Reduce or interrupt the current flow through the shunts to prevent a further temperature increase of the module. ☞ Always monitor the temperatures in order to make sure that the threshold value will not be exceeded. → Chapter 6.5.3.8.7 "Shunt temperatures" and section "Info Message"

WARNING!

The measurement module has to be connected to the vehicle's potential equalization or protective earth (PE) in order to ensure user safety.

In the event of a fault, there is danger to life due to high-voltage potential if this connection is not established.

- ☞ Connect the measurement module to vehicle's potential equalization or PE using a suitable ground cable.
- ☞ Only use qualified and trained personnel.
- → Chapter 4.3.2.4 "Ground connection"

CAUTION!

The measurement module can heat up considerably if it is operated in a specific working environment (e.g. engine compartment). The shunts integrated in the measurement module can also build up heat during operation under high load.

Touching the surface of the module may cause serious burns.

- ☞ Let the measurement module cool down before handling, especially before removing the orange-colored lid.
- ☞ Wear appropriate safety gloves.

NOTE!

HV Breakout Modules have been optimized to be operated with the lid mounted and the HV power cables connected. Fault-free operation is only possible when the lid is mounted and the HV power cables are properly mounted.

- ☞ Only operate HV Breakout Modules when the lid is mounted and the HV power cables are connected.

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, an HV isolation test should be carried out immediately before putting the device in operation again.

- ☞ Make sure that a high-voltage isolation test according to the latest edition of EN 61010 is carried out at least every 12 months.
- ☞ If there is reason to assume that the isolation barrier is defective, an HV isolation test needs to be carried out immediately.

NOTE!

The M8 threaded mounting hole is designed to connect the device to the vehicle's potential equalization or to protective earth (PE) on a test bench.

- ☞ Use the threaded hole only for connecting the module to the vehicle's potential equalization or protective earth (PE).
- → Chapter 4.3.2.4 "Ground connection"

NOTE!	
	The interface cables and connection cables of the measurement modules have shields, which are connected to potential equalization or PE. The housings of the measurement modules are connected to potential equalization or PE, too. Therefore it is important that the shields of the cables and the enclosures are at the same voltage potential to avoid erroneous measurement results or destroyed measurement modules. ☞ 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. → Chapter 4.3 "Installing 1.x" ☞ Operate the measurement module only within the specified operating environment. → *HV BM 1.x datasheets*

2.2 Obligations of the operator

- The operator has to make sure that only qualified and authorized personnel are responsible for handling the product. This applies to installation and operation.
- In addition to the product's technical documentation, the operator may also have to provide operating instructions in accordance with the Occupational Safety and Health Act [1] and the Ordinance on the Use of Working Materials [1].

2.3 Intended use

- HV BM 1.x measurement modules were developed for measuring voltages and currents in high-voltage environments.
- These measurement modules may only be used under the operating conditions which are defined in the specific product's datasheet. Product safety cannot be ensured if the product is used in any other way.
- Observe the electrical safety regulations applicable at the operating site as well as the laws and regulations on occupational safety.
- Read the technical documentation accompanying the measurement module(s) (datasheet, operating instructions, etc.) and follow the instructions contained therein.
- The calibration and HV isolation testing of measurement modules may only be performed by authorized calibration laboratories (e.g. CSM calibration laboratory).
- Repair work must only be carried out by CSM.
- The operator bears full responsibility if this device is used in any way which does not comply with the intended use.

1 Outside the jurisdiction of this Act or this Ordinance, the relevant country-specific directives and ordinances applicable at the product's operating site have to be observed.

3 Product Description

3.1 Overview

NOTE!	
	HV Breakout Modules have been optimized to be operated with the lid mounted and the HV power cables connected. Fault-free operation is only possible when the lid is mounted and the HV power cables are properly mounted. ☞ Only operate HV Breakout Modules when the lid is mounted and the HV power cables are connected.

Properties

- Single-phase current and voltage measurement
  - Max. nominal voltage: up to 1000 V; For the detection of transient voltages the maximum measuring range has been dimensioned to ±2000 V.
  - Max. rated current: HV BM 1.1 up to 250 A/500 A (peak), all other HV BM 1.x modules up to 1000 A/2000 A (peak)
- Online calculation of the instantaneous power with a data rate of 1 MHz [2]
- The HV BM 1.1 is connected with a two-core HV power cable, all other HV Breakout Modules with two single-wire HV power cables.
- Maximum measurement data rates:
  - ECAT up to 1 MHz
  - CAN up to 10 kHz
- Module-specific measurement options
  - HV BM 1.2+S: additional shield current measurement
  - HV BM 1.2+U: Measurement of the voltage of HV+ → HV- and additional measurements of HV+ → housing of the HV BM 1.2+U and HV- → housing of the HV BM 1.2+U.
    The housing of the HV BM 1.2+U is typically connected to potential equalization or PE.

Module variants:

- Some modules are also available as "LE" (Light Edition) versions. The maximum measurement data rate for these measurement modules is limited to 100 kHz on the ECAT side.
- The HV BM 1.2 is also available with connectors for the HV power cables (HV BM 1.2C). Unlike the standard HV BM measurement modules, this measurement module is connected to the HV power cables via connectors instead of cable glands and ring terminals.

Further information

→ *Further information can be found on the CSM website under **Products | HV Breakout Modules** and in the following documents:*

- → *Datasheet "HV Breakout Module Type 1.1"*
- → *Datasheet "HV Breakout Module Type 1.2 | 1.2C"*
- → *Datasheet "HV Breakout Module Type 1.2+S"*
- → *Datasheet "HV Breakout Module Type 1.2+U"*
- → *Safety Instructions "HV Breakout Module"*
- → *Technical Information "Measurement Categories for CSM HV Measurement Modules"*
- → *Technical Information "Deviation of Measurement"*

2 This applies to the module types HV BM 1.1, HV BM 1.2 and HV BM 1.2+S, but not to the HV BM 1.2+U.

3.2 Connections and components

The LED indicators of HV Breakout Modules ⑤, ⑥, ⑦ are integrated into the front of the module housing.[3] The sockets for EtherCAT® ②/④ and CAN ⑪ are integrated in the left side of the housing. Two cable glands ① for installing the HV power cables are integrated into the left and right side of the housing.

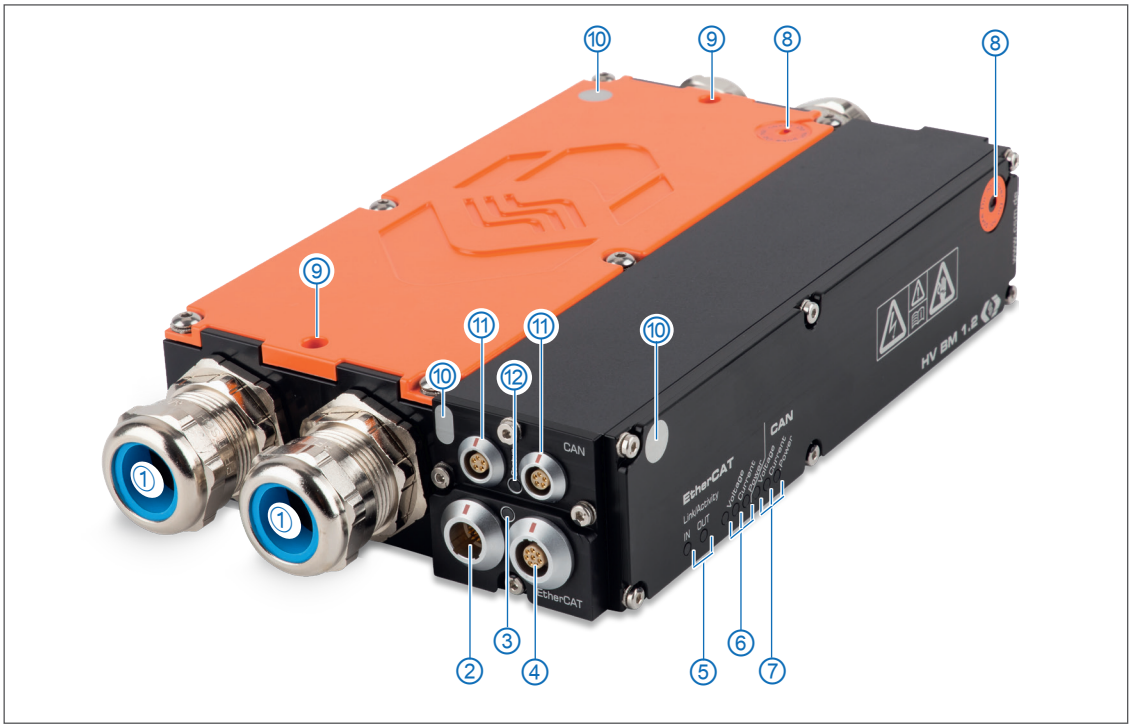


Fig. 3-1: HV BM 1.2, connections and LED indicators

1. Cable glands
2. EtherCAT® **IN** socket (chapter 4.3.2.2 "EtherCAT® IN socket")
3. EtherCAT® bus Status LED indicator (chapter 3.3.1 "EtherCAT® bus Status LED indicator")
4. EtherCAT® **OUT** socket (chapter 4.3.2.3 "EtherCAT® OUT socket")
5. EtherCAT® bus Link/Activity LED indicators **IN** and **OUT** (chapter 3.3.3 "EtherCAT® bus Link/Activity LED indicators IN and OUT")
6. EtherCAT® bus measurement channel LED indicators (chapter 3.3.4 "Measurement channel LED indicators")
7. CAN bus measurement channel LED indicators (chapter 3.3.4 "Measurement channel LED indicators")
8. Ventilation opening with GORE™ membrane and label
9. Bores for M6 threaded bolts used to fasten an HV Breakout Module
10. Contact surfaces for measuring the resistance of potential equlization or protective earth (PE) to lid [4]
11. CAN sockets (chapter 4.3.2.1 "CAN sockets")
12. CAN bus LED indicator (chapter 3.3.2 "CAN bus LED indicator")

3 The connections shown in Fig. 3-1 are identical for the versions HV BM 1.2, HV BM 1.2+S, HV BM 1.2+U. The HV BM 1.1 module differs insofar as it is only equipped with one cable gland per side ① and does not have bores for threaded bolts ⑨.

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

Rear side of the housing

- Type label and shunt label (chapter 7.1 "Type label" and chapter 7.2 "Shunt label")
- DIN EN ISO/IEC 17025 calibration labels and high-voltage isolation test label (chapter 7.3 "Maintenance services")

Others

- Four M4 threaded holes for mounting purposes are located in the bottom of the housing.
- M8 threaded hole in the right-hand side of the housing for connecting the ground cable.[5]

→ Chapter 4.3.2.4 "Ground connection"

3.3 Functional description of LED indicators

3.3.1 EtherCAT® bus Status LED indicator

The two-color status LED (Fig. 3-1, ③) is lit red for a few seconds after the module is switched on and then turns off. [6]

LED		Meaning
Color	Status	
–	off	Measurement module not connected or power supply switched off
green	flashing	50 % on, 50 % off: Device is in status PRE-OPERATIONAL.[7]
green	flashing	20 % on, 80 % off: Device is in status SAFE-OPERATIONAL.[8]
green	permanently lit	Device is in status OPERATIONAL.[9]
red	flashing	Configuration error
red	permanently lit	Measurement module is switched on or connection to power supply has been established, but there is no Ethernet communication.
green/red	flashing	New firmware is downloaded and activated.

Tab. 3-1: Status LED indicator

5 Older hardware revisions of the HV BM 1.1 and HV BM 1.2 module versions are equipped with an M6 threaded hole.
6 Status designations according to Beckhoff and EtherCAT® Technology Group EtherCAT® standard.
7 Status PRE-OPERATIONAL: Configuration/setting of the values for the measurement range
8 Status PRE-OPERATIONAL: Check the measurement range configuration and confirm if the set values are correct. If the measurement range is invalid, the measurement module remains in PRE-OPERATIONAL status.
9 Status PRE-OPERATIONAL: The module is in measurement operation.

3.3.2 CAN bus LED indicator

The LED indicator (Fig. 3-1, ⑫) between the two CAN sockets indicates the operating status of the measurement module.

LED		Meaning
Color	**Status**	
–	off	Measurement module not connected or power supply switched off
green	permanently lit	Normal operation
red	permanently 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	New firmware is downloaded and activated.

Tab. 3-2: CAN bus LED indicator

3.3.3 EtherCAT® bus Link/Activity LED indicators IN and OUT

The LED indicators for the sockets **IN** and **OUT** (Fig. 3-1, ⑤) 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	permanently lit	LED **IN**: Ethernet connection to an upstream module or gateway in the ECAT chain has been established. LED **OUT**: Ethernet connection to a downstream module or gateway in the ECAT chain has been established. No data is transferred.
green	flashing	Ethernet connection is active, i.e. data transfer is in progress.
-	off	No measurement module or XCP-Gateway connected.

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

3.3.4 Measurement channel LED indicators

The measurement channel LED indicators (Fig. 3-1, ⑥ and ⑦) show the status of the corresponding measurement channel. 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**: Status of current measurement
3. The function of the third LED depends on the module type and is indicated accordingly on the module housing. The flash codes of the third LED correspond to the flash codes of the **Current** LED (Tab. 3-4).
   - **Power** (HV BM 1.1/1.2): Status of the calculation of the instantaneous power
   - **Shield** (HV BM 1.2+S): Status of the shield current measurement
   - **Voltage 2** (HV BM 1.2+U): Status of the "+U" potential measurement

After switching-on the HV BM 1.x module, all measurement channel LED indicators are lit red, indicating the start-up process. Once the module has initialized itself and no errors were detected, the LED indicators fade out.

After self-initialization, the device checks for the connected shunt module[10]. Meanwhile the LED indicators of the channels for current measurement (**Current**) are lit red. If the shunt module has been successfully identified, the measurement channel LEDs turn off again.

The measurement ranges have to be **configured identically** on the ECAT and the CAN side to send data simultaneously via CAN and ECAT, otherwise only the module side that was configured last will send measurement values. The module side configured first no longer sends measured values, but a defined error value. This is indicated on the module by the LED indicator of the measurement channel which is **permanently lit in red**.

→ Chapter 6.5.3.8 "Measurement module settings", section "Measurement range configuration for ECAT and CAN operation"

LED		Meaning
Color	**Status**	
–	off	Normal operation or measurement module not connected or power supply switched off
red	permanently lit	Error while checking for 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 three LEDs on the corresponding side, i.e. CAN or ECAT)

Tab. 3-4: Measurement channel LED indicators

10 As for the HV BM 1.2+S, both shunt modules are checked accordingly.

4 Mounting and Installation

For trouble-free operation and a long product service life, the requirements for mounting and installation specified in this chapter must be observed.

4.1 Before mounting

HV Breakout Modules are equipped with two GORE™ membranes (Fig. 4-1), which are required for pressure compensation. To ensure the breathing function of the membranes, the ventilation openings in the front of the housing ① or in the lid of the housing ② must never be blocked/covered or permanently covered with water or other liquids. There is then a risk of condensation collecting inside the housing and damaging the measurement module.

Fig. 4-1: HV BM 1.2, ventilation openings in the housing

NOTE!
The GORE™ membranes are required for pressure compensation. ☞ When mounting the module, make sure that the ventilation opening for the GORE™ membrane is not obstructed or permanently covered by water or other liquids.

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. → *HV BM 1.x datasheets*

4.2 Mounting HV BM 1.x

CAUTION!

HV Breakout Modules can heat up considerably when current flows through them – 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).

☞ Dissipate the heat generated by attaching the module to a suitable mounting surface and by choosing sufficiently large cable cross-sections.

☞ Always monitor the temperatures in order to make sure that their limits will not be exceeded.

→ Chapter 6.5.3.8.7 "Shunt temperatures" and section "Info Message"

NOTE!

Strong magnetic fields, such as those induced by permanent magnets, may impair the trouble-free operation of the measurement module.

☞ Make sure that the mounting position of the measurement module is free from strong magnetic fields.

Requirements

- When choosing the mounting position, make sure that the ventilation opening of the GORE™ membrane is not obstructed or covered by liquids.
- Make sure that the mounting site allows for sufficient space to connect and disconnect the cables without clamping or pinching them.
- Avoid mounting locations where the module would be subjected to continuous strong vibrations and/or shocks.

Required parts/material

- HV BM 1.1: four M5 screws[11]
- HV BM 1.2: four M5 screws[11] or two M6 threaded bolts (Fig. 3-1, ⑨)

Mounting the measurement module

☞ Fasten the measurement module at the mounting position.

Please contact our support for the appropriate drill hole diagrams.

NOTE!

Mechanical modifications to the housing (e.g. by drilling additional holes) can destroy the measuring module or impair its function. Doing so would also invalidate the warranty.

☞ Never drill any holes in the housing.

☞ Observe mounting instructions.

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

4.3 Installing HV BM 1.x

4.3.1 Before installation

WARNING!
 HV Breakout Modules are used in high-voltage applications. **Improper use may result in life-threatening electrical shocks.** ☞ Only use qualified and trained personnel. ☞ Observe safety instructions.

WARNING!
 The measurement module has to be connected to the vehicle's potential equalization or protective earth (PE) in order to ensure user safety. **In the event of a fault, there is danger to life due to high-voltage potential if this connection is not established.** ☞ Connect the measurement module to vehicle's potential equalization or PE using a suitable ground cable. ☞ Only use qualified and trained personnel. → Chapter 4.3.2.4 "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). ☞ Only use qualified and trained personnel.

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

CSM provides cables for the connection of ECAT and CAN modules. → *"XCP/ECAT Accessories for CSM measurement modules" and "CAN Accessories for CSM measurement modules"* For further details please contact the CSM sales department.

CSM provides maintenance and repair services for HV BM measurement modules. → Chapter 7.3 "Maintenance services"

4.3.2 Connectors

HV BM 1.x measurement modules are equipped with an EtherCAT® and a CAN interface. The sockets are located in the left side of the housing. The HV power cables are led through cable glands into the inside of the module and connected there.

For safety reasons, the measurement module must be connected to the vehicle's potential equalization or protective earth (PE) on the test bench via the threaded hole in the right side of the housing.

WARNING!
 The measurement module has to be connected to the vehicle's potential equalization or protective earth (PE) in order to ensure user safety. **In the event of a fault, there is danger to life due to high-voltage potential if this connection is not established.** ☞ Connect the measurement module to vehicle's potential equalization or PE using a suitable ground cable. ☞ Only use qualified and trained personnel.

NOTE!
 The measurement module's power supply can be provided either via the EtherCAT® **IN** socket or the CAN sockets. The supply voltage fed to CAN is not provided to the EtherCAT® sockets and vice versa. Banana plugs of the interface cable, which are not in use, do not need to be isolated. The supply lines of the two CAN sockets are connected to each other. The same applies to the two EtherCAT® sockets.

4.3.2.1 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 CAN measurement bus with HV Breakout Modules. ☞ Ensure that the configuration settings are compatible with all devices (same CAN bit rate, different CAN identifiers). ☞ Only use qualified and trained personnel.

CSM uses by default LEMO 0B sockets for the CAN sockets. To have the device equipped with different sockets, please contact CSM. To connect a cable to this socket, the following plug with plug insert is required:

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

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

Tab. 4-1: 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. As a result, a signal at a specific pin of one socket (CAN or supply voltage) is also available at the corresponding pin of the other socket. Both sockets can be used in the same way. 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. ☞ Only use qualified and trained personnel.

4.3.2.2 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 EtherCAT® **IN** socket. EtherCAT® measurement modules receive their power supply from the XCP-Gateway, i.e. via the same cable connection.

CSM uses by default LEMO 1B sockets for the ECAT connection. For connecting a cable to this socket the following plug is required:

- **FGL.1B.308.CLL xxxxx** [12]

	Pin	Signal	Description
	1	U_{Supply}+	Power supply, plus
	2	U_{Supply}-	Power supply, ground
	3	RX -	Ethernet: Receive data, minus
	4	TX -	Ethernet: Transmit data, minus
	5	RX +	Ethernet: Receive data, plus
	6	U_{Supply}-	Power supply, ground
	7	U_{Supply}+	Power supply, plus
	8	TX +	Ethernet: Transmit data, plus
	Housing	Shield	Cable shield

Tab. 4-2: Plug (front view) for EtherCAT® **IN** socket: pin assignment

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

4.3.2.3 EtherCAT® OUT socket

The **OUT** socket is used for daisy-chaining the EtherCAT® measurement modules. CSM uses by default LEMO 1B sockets for the ECAT connection. To connect a cable to this socket, the following plug with plug insert is required:

- **FGA.1B.308.CLA xxxxx** [13]

	Pin	Signal	Description
	1	U_{Supply}+	Power supply, plus
	2	U_{Supply}+	Power supply, plus
	3	U_{Supply}-	Power supply, ground
	4	RX+	Ethernet: Receive data, plus
	5	TX-	Ethernet: Transmit data, minus
	6	RX-	Ethernet: Receive data, minus
	7	U_{Supply}-	Power supply, ground
	8	TX+	Ethernet: Transmit data, plus
	Housing	Shield	Cable shield

Tab. 4-3: Plug (front view) for EtherCAT® **OUT** socket: pin assignment

4.3.2.4 Ground connection

HV BM 1.x modules have to be connected to the vehicle's potential equalization or protective earth (PE) in order to ensure user safety. The cross section of a ground cable depends on the cross section of the HV power cable used. When selecting the ground cable cross-section, observe the recommendations according to DIN VDE 0100-540 [14].

WARNING!

The measurement module has to be connected to the vehicle's potential equalization or protective earth (PE) in order to ensure user safety.

In the event of a fault, there is danger to life due to high-voltage potential if this connection is not established.

☞ Connect the measurement module to vehicle's potential equalization or PE using a suitable ground cable.

☞ Only use qualified and trained personnel.

NOTE!

The threaded hole is designed to connect the measurement module to the vehicle's potential equalization or protective earth (PE) in a test bench.

☞ Use the threaded hole only for connecting the module to the vehicle's potential equalization or protective earth (PE).

13 "xxxxx" is a placeholder here. The actual designation depends on the diameter of the cable that is actually being used.
14 In other countries, the applicable standards/directives are to be observed.

Required parts/material

NOTE!	
	The cross-section of the ground cable or ground strap has to be sufficiently large to be able to divert the currents from the HV power cables in the event of a fault. ☞ Observe relevant standards and regulations.

- suitable ground cable (not included in the scope of delivery)
- M8 screw [15] plus washer

4.3.2.5 Connecting the cables

Cables of various lengths are available for connection to the data acquisition system and the power supply, as well as for daisy-chaining the measurement modules:

→ *"XCP/ECAT Accessories for CSM measurement modules" and "CAN Accessories for CSM measurement modules"*

CAN bus

- K176-xxxx or K85-0060: cable for connection to PC/power supply via CAN interface:
- K70-xxxx: cable for connecting/linking CAN measurement modules
- K72-0250: cable with intermediate supply voltage feed for connecting/interlinking CAN measurement modules

EtherCAT® bus

- K420-xxxx: cable for connecting an XCP-Gateway basic/pro to a PC and power supply
- K400-xxxx: cable for connecting EtherCAT® measurement module and the XCP-Gateway and for linking EtherCAT® measurement modules
- K410.1-xxxx: cable with intermediate supply voltage feed for connecting EtherCAT® measurement module and an XCP-Gateway and for linking EtherCAT® measurement modules

→ Chapter 6.1 "Example of application"

i	The K420-xxxx cable can also be used to connect an HV BM 1.x directly to a data acquisition system (PC). This requires that data acquisition software supporting EtherCAT® master operation is installed on the PC.

i	The installation of the HV power cables is described in a separate chapter. → Chapter 5 "Connecting the HV Power Cables"

15 M6 screws may still be in use in older hardware revisions. The depth of the thread in the module is 6 mm for M6 threads and 8 mm for M8 threads. The screw length has to be chosen according to the thickness of the mounting material.

Connecting the power supply

	NOTE!
	Depending on the number of measurement modules and the cable lengths in a measurement setup, an intermediate power supply may be required. An intermediate supply is also required if more current is required than the existing power supply can provide due to the increased power consumption of the measurement modules.

The HV BM 1.x modules are supplied with power either via the EtherCAT® **IN** socket or the CAN sockets (Fig. 3-1). To ensure error-free functioning, the following guidelines should be observed when choosing the appropriate power supply.

Minimum power supply voltage

The minimum power supply voltage is the minimum voltage delivered by a power supply. In an automotive application, this is usually the vehicle's on-board supply system (e.g. 12 V for passenger cars). Note that this minimum value is required for proper operation of the module. In a 12 V vehicle electrical system, for example, this value can drop for a short time (from a few milliseconds to a few seconds) during engine start-up to a value below the minimum value specified for a measurement module. During operation, it has to be ensured that the supply voltage applied to the modules of a measurement chain does not drop below the specified minimum value.[16]

Cable lengths

The resistance of a connection cable causes a voltage drop in the cable. The extent of the voltage drop depends on the length of the cable and the current flowing through it. In a supply chain, the required minimum voltage has to be applied to each module at all times.[16]

16 The minimum value specified on the type label of a measurement module has to be observed (chapter 7.1 "Type label").

5 Connecting the HV Power Cables

5.1 Installation notes

WARNING!	
	The orange lid of the device housing can be removed to mount or dismount the HV power cables. **When the lid is removed from the housing there is danger to life due to HV potential.** ☞ Before removing the lid, make sure that the HV power cables are de-energized. ☞ Fix the HV power cables with the ring terminals and nuts supplied or with suitable equivalents. ☞ Observe the mounting instructions in the user guide. It is particularly important that lid and cable glands are properly mounted in order to ensure the tightness of the housing.

WARNING!	
	When using HV power cables made of aluminum in combination with ring terminals for HV power cables made of 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.** ☞ Use ring terminals for copper cables only in combination with HV power cables made of copper! HV power cables made of aluminum require a specific connection technology. Please contact our technical support for further information.

CAUTION!	
	The measurement module can heat up considerably if it is operated in a specific working environment (e.g. engine compartment). The shunts integrated in the measurement module can also build up heat during operation under high load. **Touching the surface may cause serious burns.** ☞ Let the measurement module cool down before handling, especially before removing the orange-colored lid. ☞ Wear appropriate safety gloves, if required.

5.1.1 Required tools

- Allen key, size 2.5
- Suitable tools for fitting the cable glands (open-end or socket wrenches), size SW24 (for M20), SW30 (for M25) and SW36 (for M32)
- Ratchet/socket wrench (w. deep nut) or ring wrench (deep cranked), size SW13

NOTE!	
	The HV BM 1.1 in particular provides very limited space in the housing. For this reason, ring wrenches must not be used to mount the ring terminals. ☞ Use the smallest possible socket wrench inserts for mounting the HV power cables.

WARNING!	
	The frequency behavior of the HV BM 1.x modules was optimized using specific ring terminals. These ring terminals are not included in the scope of delivery but have to be ordered separately from CSM. **If inappropriate ring terminals are used, there is a risk of life-threatening electric shocks and short-circuits.** ☞ Use only appropriate ring terminals for fastening the HV power cables. ☞ If ring terminals other than those available from CSM are used, it has to be made sure that ▸ adequate space is available in the housing, so that the ring terminals have sufficient distance to each other and to the housing (min. 3.5 mm). ▸ the ring terminals used in combination with the nuts do not extend over the threaded bolts, otherwise the distance to the cover may be too small.

5.1.2 Tightening torques

The tightening torques specified in Tab. 5-1 apply when fitting the ring terminals of the HV power cables to the threaded bolts of the shunt modules.

The tightening torque for mounting the ring terminals of the HV+ cables on the threaded bolts of the copper domes (Fig. 5-4, ②/Fig. 5-6, ②) is always 25 Nm.

Tightening torques for shunt modules	
Module type	**Tightening torque**
50 A	5 Nm
125 A	15 Nm
250 A	25 Nm
500 A	
1000 A	

Tab. 5-1: Tightening torques for shunt modules

Earlier HV BM 1.1 measurement modules (HW rev. A) are still fitted with threaded bolts in sizes M6 and M8 and brass nuts are used to mount the HV power cables to these threaded bolts. The tightening torque for the brass nuts is 5 Nm (M6) and 15 Nm (M8).

As of hardware revision E, M8 threaded bolts in combination with steel nuts are used for module type HV BM 1.1, too. The tightening torques specified in Tab. 5-1 then also apply to module type HV BM 1.1.

5.2 Connecting HV power cables to an HV BM 1.1/HV BM 1.2

This chapter describes the installation of single-core HV power cables in an HV BM 1.2. These instructions also apply to the installation of two-core HV power cables in an HV BM 1.1.

→ Chapter 5.2.3.1 "HV BM 1.1: Connections for the cables HV- and HV+"

NOTE!	
	HV Breakout Modules have been optimized to be operated with properly connected HV power cables and the lid mounted. ☞ Only operate HV Breakout Modules when the lid is mounted and the HV power cables are properly connected.

5.2.1 Connection diagram for HV BM 1.1/HV BM 1.2

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

Current and voltage measurement

Fig. 5-1 shows the appropriate connection diagram if current and voltage are to be measured.

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.

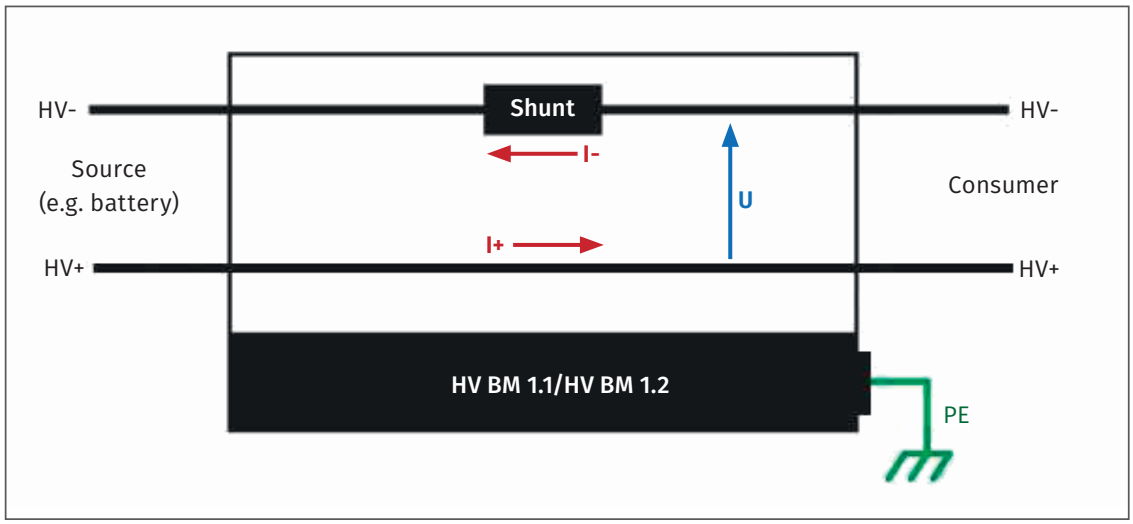


Fig. 5-1: HV BM 1.1/HV BM 1.2, connection diagram for the measurement of voltage and current

5.2.2 Opening the housing

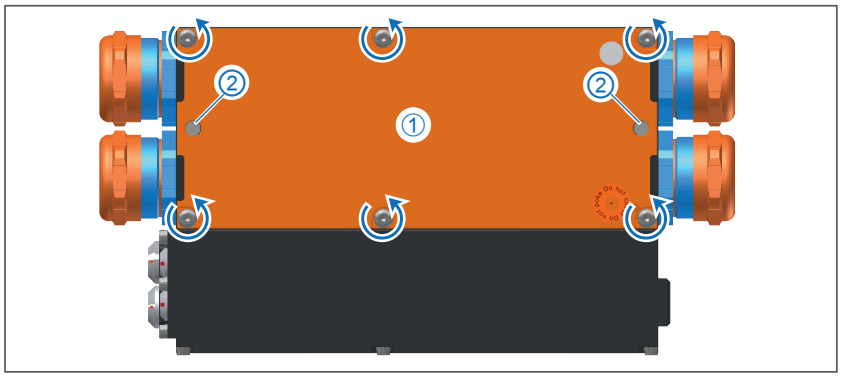


Fig. 5-2: HV BM 1.2, housing closed

☞ Loosen the Allen screws (↻) in the lid of the housing.[17]

☞ If applicable, remove the M6 threaded bolts ②.

☞ Remove the orange-colored lid ① from the housing.[18]

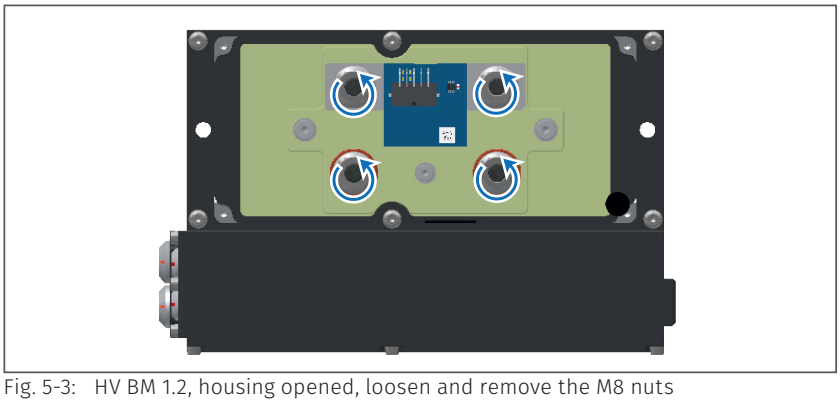


Fig. 5-3: HV BM 1.2, housing opened, loosen and remove the M8 nuts

☞ Loosen and remove the M8 nuts (↻) that have been fitted on the threaded bolts.

17 The housing lid of an HV BM 1.2 is fastened with four or six Allen screws depending on the hardware revision.
18 In hardware revision A, the HV BM 1.1 still has a green inner cover, which also has to be removed in order to be able to access the threaded bolts. As of hardware revision E, this inner cover is no longer used.

5.2.3 Connecting the HV power cables

WARNING!	
	Nuts and ring terminals must not extend over the threaded bolts, otherwise the distance to the lid may be too small. **If the distance between the threaded bolts with the mounted metal parts (e.g. ring terminals, nuts and washers) and the lid of the housing is too small, there is a risk of life-threatening electric shocks and short circuits.** ☞ Only use nuts and ring terminals supplied and recommended by CSM. ☞ If this is not possible, only use combinations of nuts and ring terminals that do not extend over the threaded bolt. ☞ Also, use only nuts with standard height. ☞ Always make sure there is sufficient space in the housing so that there is sufficient distance between the ring terminals and the housing (min. 3.5 mm).

5.2.3.1 HV BM 1.1: Connections for the cables HV- and HV+

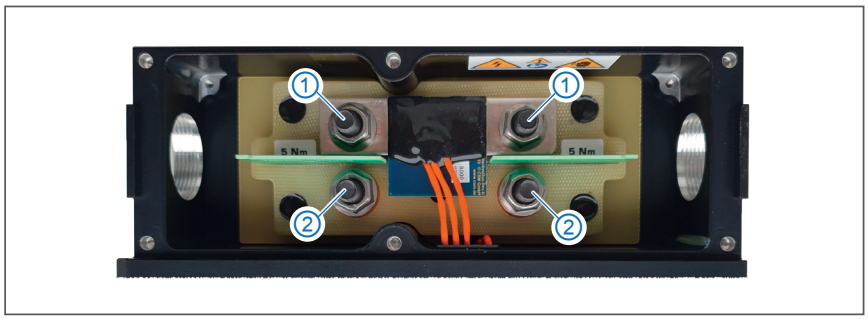


Fig. 5-4: HV BM 1.1, connections for HV power cables

For mounting the HV power cables, HV BM 1.1 are equipped with four threaded bolts[19]: two for mounting the HV- power cables on the shunt module ① and two for mounting the HV+ power cables on the busbar ②.

Mounting the HV- and HV+ power cables

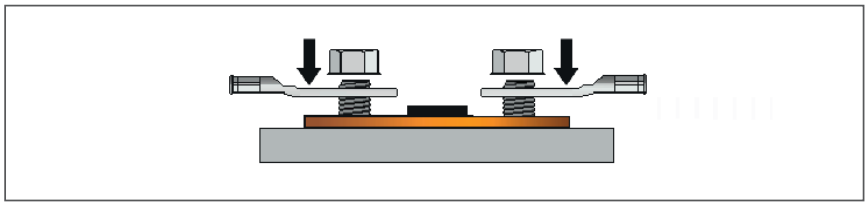


Fig. 5-5: HV BM 1.1 orientation of the ring terminals (all cable cross sections)

The four ring terminals of the HV power cables are placed on the threaded bolts as shown in Fig. 5-5 and fastened with the M8 nuts.

19 By default, the M8 nuts for mounting the HV power cables are mounted on the threaded bolts. In hardware revision A, HV BM 1.1 are still equipped with different sized threaded bolts (M6 and M8) and brass nuts. For these brass nuts, reduced tightening torques apply (see Chapter 5.1.2 "Tightening torques").

5.2.3.2 HV BM 1.2: Connections for the cables HV- and HV+

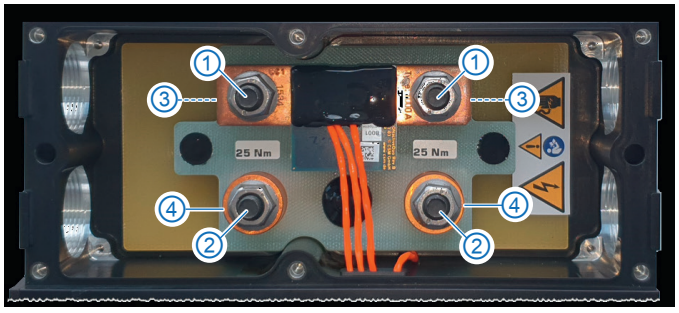


Fig. 5-6: HV BM 1.2, connections for HV power cables

For mounting the HV power cables, HV BM 1.2 are equipped with four threaded bolts: two for mounting the HV- cables on the shunt module ① and two for mounting the HV+ cables on the bus bar ②. By default, there are spacer sleeves ③ on the threaded bolts under the shunt module. The ring terminals of the HV- power cables are mounted on the threaded bolts with or without spacer sleeves, depending on the cross-section of the cable. The HV+ power cables are mounted on the threaded bolts ② resting on the copper domes ④ of the bus bar.

→ Chapter 5.2.3.2.3 "Mounting the power cables HV+ on the busbar side"

5.2.3.2.1 Mounting HV- power cables with cross-sections 50 mm², 70 mm² and 95 mm²

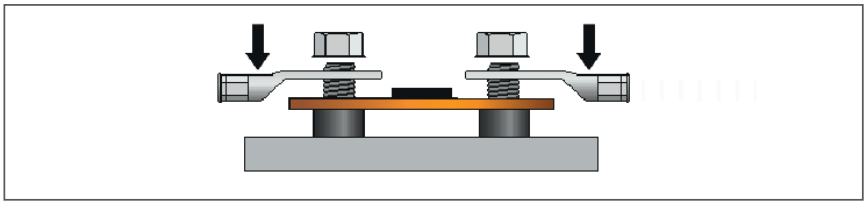


Fig. 5-7: HV BM 1.2, power cable HV-, orientation of the ring terminals for cable cross sections >35 mm²

When mounting HV- power cables with cross-sections **>35 mm² (50 mm², 70 mm² and 95 mm²)**, the shunt remains on the spacer sleeves as before. The ring terminals of the HV- power cables are placed on the threaded bolts as shown in Fig. 5-7 and Fig. 5-8 and fastened with the M8 nuts.

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

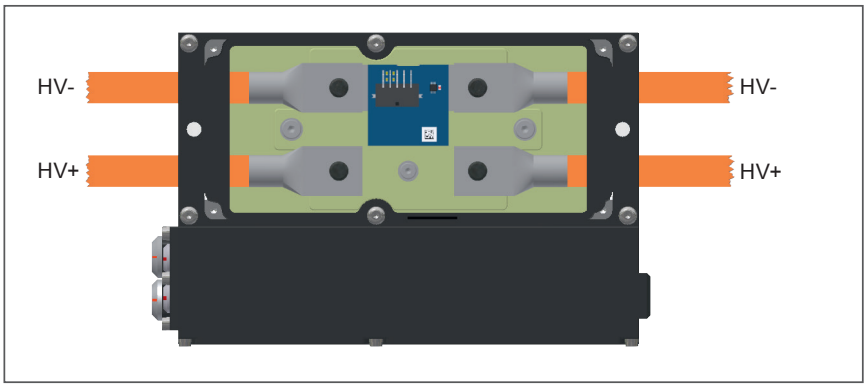


Fig. 5-8: HV BM 1.2, power cable HV- (>35 mm²), placing the ring terminals on the threaded bolts

☞ Place the ring terminals of the HV power cables on the threaded bolts as shown in Fig. 5-7 and Fig. 5-8. Make sure that the surfaces of the ring terminals rest flat on the mounting surfaces.

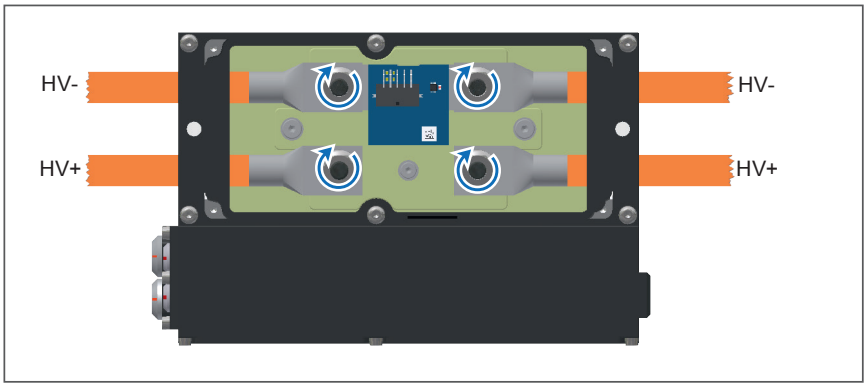


Fig. 5-9: HV BM 1.2, HV power cables (>35 mm²), fastening the ring terminals with the M8 nuts

☞ Fasten the ring terminals with the M8 nuts (↻).

☞ Tighten the M8 nuts with the required torque (Tab. 5-1).

5.2.3.2.2 Mounting the power cables HV- with cross-sections 16 mm², 25 mm² and 35 mm²

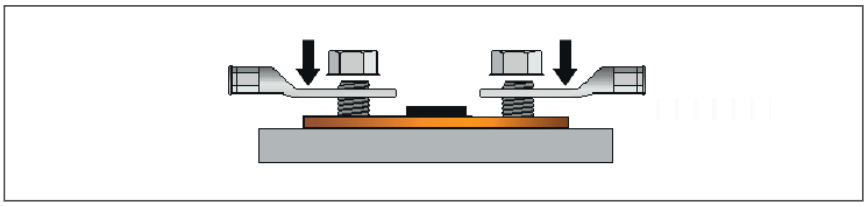


Fig. 5-10: HV BM 1.2, power cables HV-, orientation of the ring terminals for cable cross sections ≤35 mm²

In order to be able to mount the HV power cables with **cross-sections ≤35 mm² (16 mm², 25 mm²** and **35 mm²**), the spacer sleeves have to be removed from the threaded bolts. The ring terminals of the HV power cables are placed and mounted on the threaded bolts as shown in Fig. 5-10. The individual work steps are shown in Fig. 5-11 to Fig. 5-15.

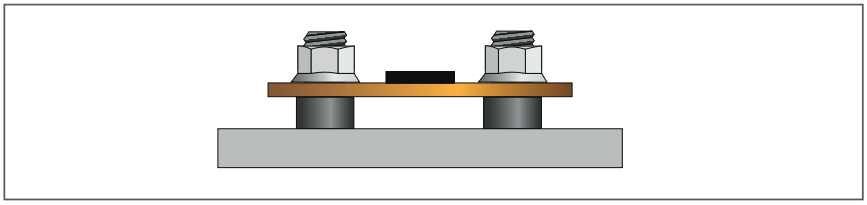


Fig. 5-11: HV BM 1.2, power cables HV- (≤35 mm²), nuts mounted on the threaded bolts

☞ Loosen the M8 nuts on either side of the shunt module and remove them from the threaded bolts.

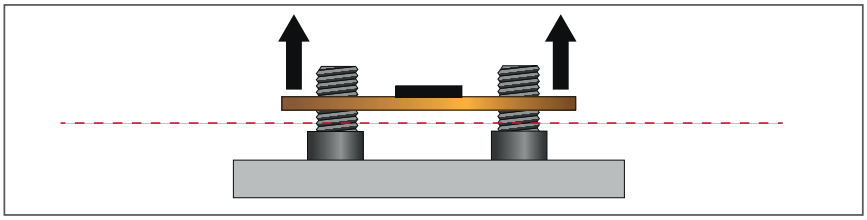


Fig. 5-12: HV BM 1.2, power cables HV- (≤35 mm²), removing the shunt module from the threaded bolts

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

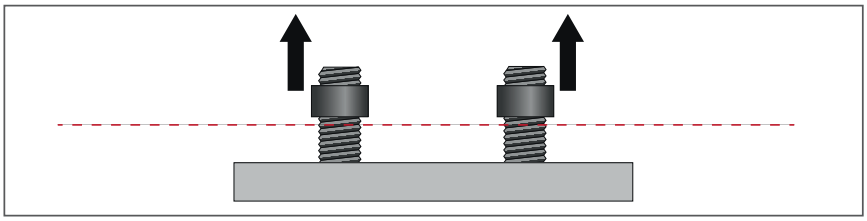


Fig. 5-13: HV BM 1.2, power cables HV- (≤35 mm²), removing the spacer sleeves from the threaded bolts

☞ Remove the spacer sleeves from the threaded bolts.

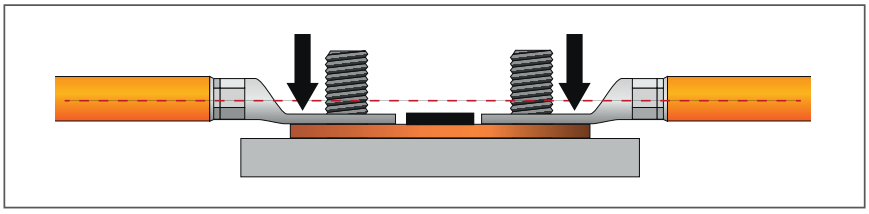


Fig. 5-14: HV BM 1.2, power cables HV- (≤35 mm²), placing the shunt module and the ring terminals on the threaded bolts

☞ Put the shunt module back on the threaded bolts.

☞ Place the ring terminals on the threaded bolts as shown in Fig. 5-14. Make sure that the surface of the ring terminal rests plane on the mounting surface (shunt module).

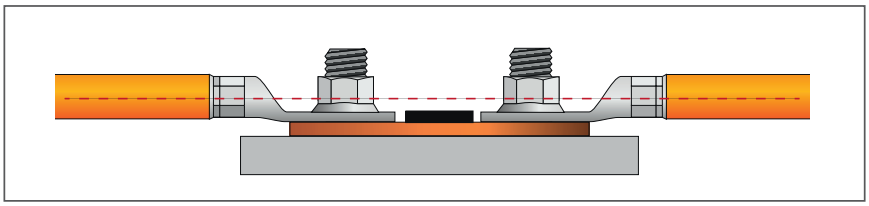


Fig. 5-15: HV BM 1.2, power cables HV- (≤35 mm²), fastening the ring terminals with the nuts

☞ Fasten the ring terminals with the M8 nuts and tighten them with the required torque (Tab. 5-1).

5.2.3.2.3 Mounting the power cables HV+ on the busbar side

The HV+ power cables are mounted as shown below.

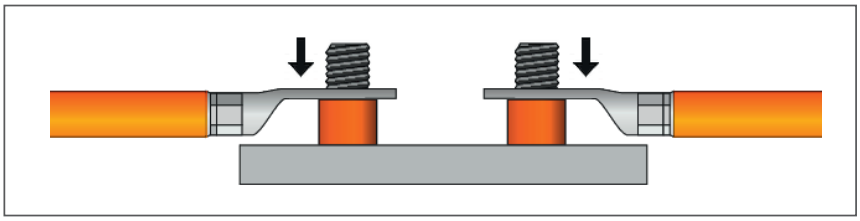


Fig. 5-16: HV BM 1.2, power cables HV+, placing the ring terminals on the threaded bolts

☞ Place the ring terminals of the HV+ power cables on the threaded bolts as shown in Fig. 5-16.

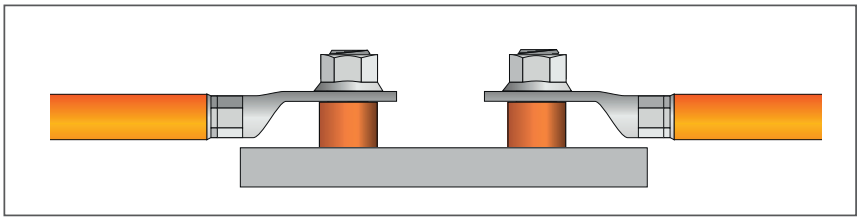


Fig. 5-17: HV BM 1.2, power cables HV+, fastening the ring terminals with the M8 nuts

☞ Fasten the ring terminals with the M8 nuts and tighten them with the required torque (Tab. 5-1).

5.2.4 Mounting the cable glands and the lid of the housing

NOTE!	
	In order to prevent water ingress, condensation, etc., the tightness of the housing has to be ensured. CSM provides the gasket for the housing lid as a spare part. The gasket should be changed e.g. if it is brittle or fragile or has been damaged. ☞ Make sure that cover and seal are properly fitted. ☞ Make sure that cable glands and HV power cables are properly mounted.

5.2.4.1 Mounting the cable glands

i	In the following description, it is assumed that the components of the cable glands have been fitted to the HV power cables before crimping the ring terminals. → Chapter 8.1.3 "Preparing the cable glands"

☞ Attach the double nipples of the cable glands with the springs inserted to the housing and fasten them by hand. Make sure that there is full contact between the springs and the stripped shields of the HV power cables.

☞ Attach the pressure screws with sealing inserts to the double nipples and tighten them by hand.

☞ Tighten the pressure screws and double nipples with the specified torque. Please observe the mounting instructions of the manufacturer.[20]

5.2.4.2 Mounting the lid of the housing

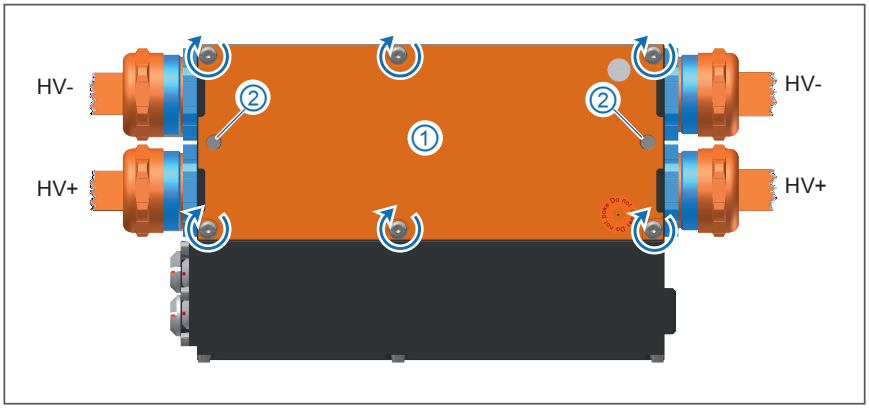


Fig. 5-18: HV BM 1.2, HV power cables mounted, housing closed

☞ Place the orange lid ① on the housing.[21]

☞ Fix the housing cover with the Allen screws (↻).

☞ If applicable, re-mount the M6 threaded bolts ②.

20 Pflitsch Cable Gland Catalogue 2024

21 As for the HV BM 1.1, hardware revision A, the green inner cover has to be reinserted beforehand.

5.3 Connecting HV power cables to an HV BM 1.2+S

NOTE!
HV Breakout Modules have been optimized to be operated with properly connected HV power cables and the lid mounted. ☞ Only operate HV Breakout Modules when the lid is mounted and the HV power cables are properly connected.

5.3.1 Connection diagram for HV BM 1.2+S

- The red arrows indicate the technical direction of the inner conductor current.
- The green arrows indicate the technical direction of the shield current.
- The blue arrow indicates the technical direction of the voltage.
- For the wiring displayed, the technical currents and the technical voltage are output with the correct polarity.

Current and voltage measurement

Fig. 5-19 shows the appropriate connection diagram if the inner conductor current, the shield current and the voltage are to be measured.

The currents are measured in the **minus path** in order to minimize disturbances of the current measurements. The voltage is measured on the consumer side.

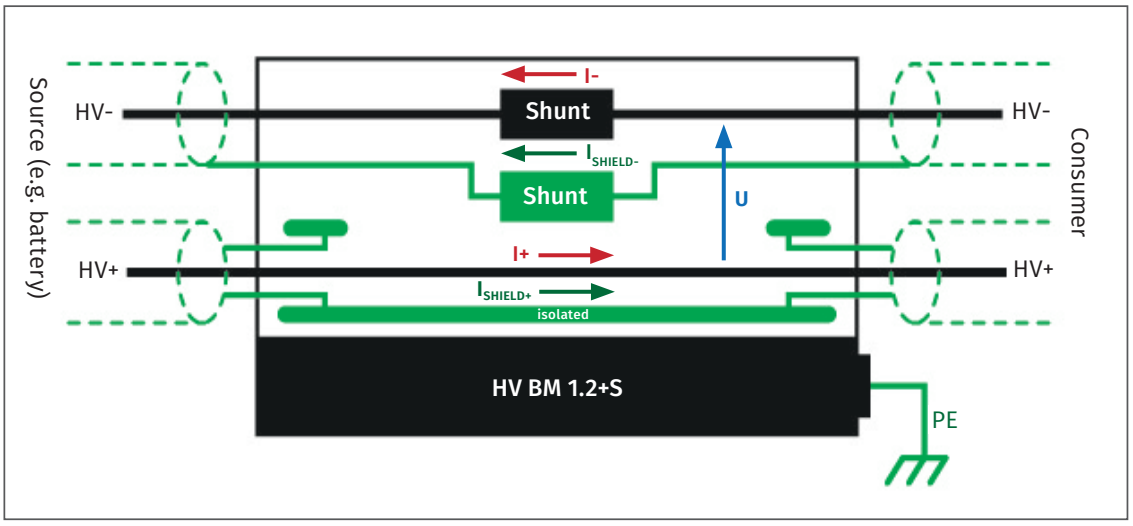


Fig. 5-19: HV BM 1.2+S, connection diagram for the measurement of voltage, inner conductor current and shield current

5.3.2 Opening the housing

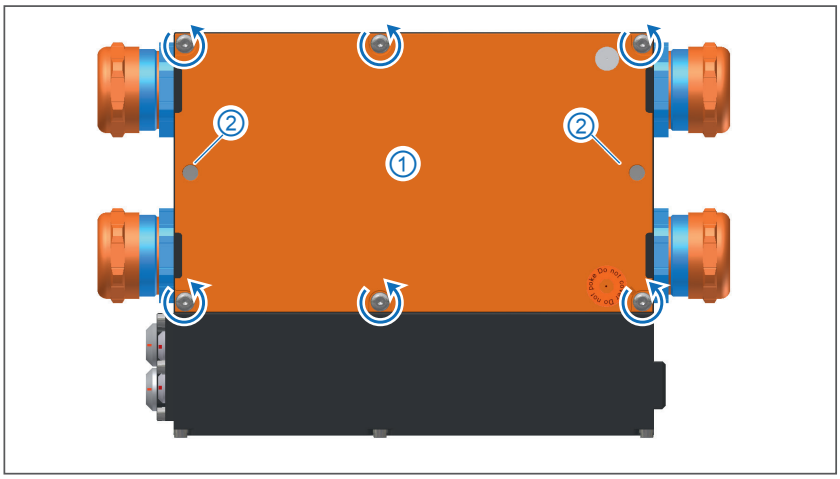


Fig. 5-20: HV BM 1.2+S, housing closed

☞ Loosen the Allen screws (↻) in the lid of the housing.
☞ If applicable, remove the M6 threaded bolts ②.
☞ Remove the orange-colored lid ① from the housing.

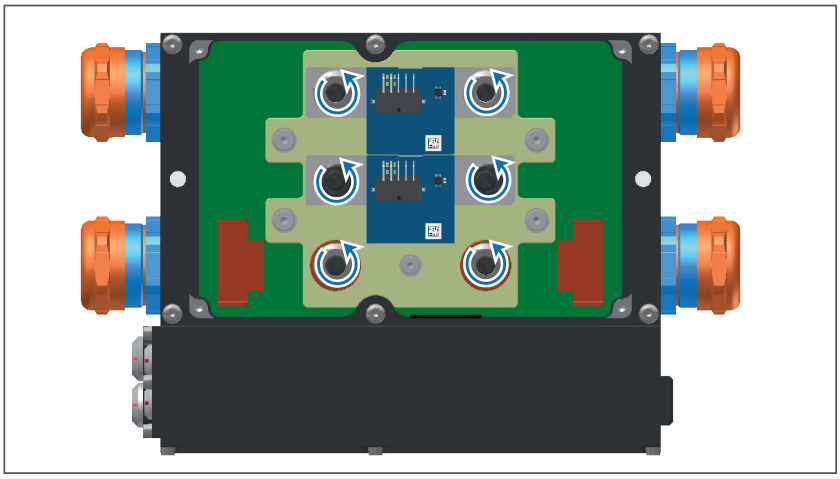


Fig. 5-21: HV BM 1.2+S, lid removed from the housing

☞ Loosen the M8 nuts (↻) and remove them from the threaded bolts.

5.3.3 Mounting HV power cables to an HV BM 1.2+S

WARNING!	
	Nuts and ring terminals must not extend over the threaded bolts, otherwise the distance to the lid may be too small. **If the distance between the threaded bolts with the mounted metal parts (e.g. ring terminals, nuts and washers) and the lid of the housing is too small, there is a risk of life-threatening electric shocks and short circuits.** ☞ Only use nuts and ring terminals supplied and recommended by CSM. ☞ If this is not possible, only use combinations of nuts and ring terminals that do not extend over the threaded bolt. ☞ Also, use only nuts with standard height. ☞ Always make sure there is sufficient space in the housing so that there is sufficient distance between the ring terminals and the housing (min. 3.5 mm).

5.3.3.1 HV BM 1.2+S: Connections for the HV- and HV+ cables

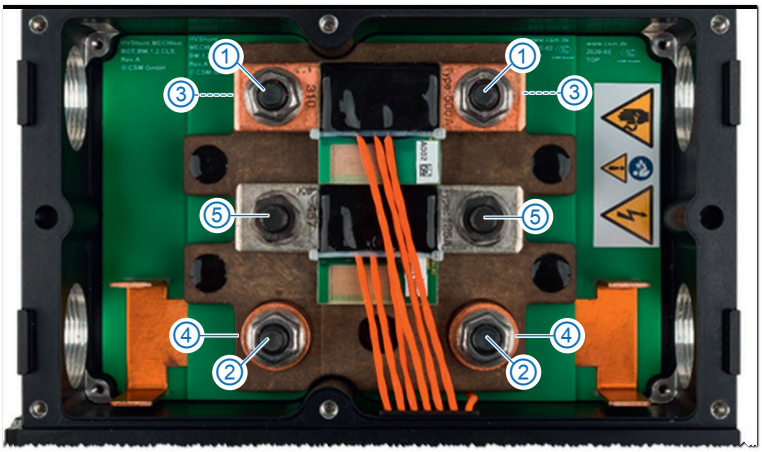


Fig. 5-22: HV BM 1.2+S, connections for the power cables HV- and HV+

An HV BM 1.2+S is equipped with a second shunt for shield current measurement and therefore comes with six M8 threaded bolts. By default, there are spacer sleves ③ on the threaded bolts under the shunt for measuring the inner conductor current ①. The shunt for shield current measurement is mounted on the threaded bolts ⑤ without any spacer sleeves. The HV+ power cables are mounted on the threaded bolts ② resting on the copper domes ④ of the busbar. The M8 nuts for mounting the HV power cables are attached to the threaded bolts.

NOTE!	
	When using the HV BM 1.2+S, the braided shields of the HV power cables are not connected to the module housing/vehicle's potential eqalization via the triangular springs in the cable glands, but rather ▸ connected to the second shunt (power cable HV-) and ▸ soldered to the feedthrough (power cable HV+). The triangular springs in the cable glands are therefore not required and can be removed. → Chapter 8.1.3 "Preparing the cable glands"

5.3.3.1.1 Mounting the HV- power cables on the shunt for the inner conductor current measurement

NOTE!

- The mounting instructions in chapter 5.3.2.1.1 apply to HV BM 1.2+S as of hardware revision C000[22] which are equipped with frequency response-optimized shunt modules.
- Different mounting instructions apply to the installation of HV power cables on older shunt modules (see chapter 5.3.3.1.2 and chapter .

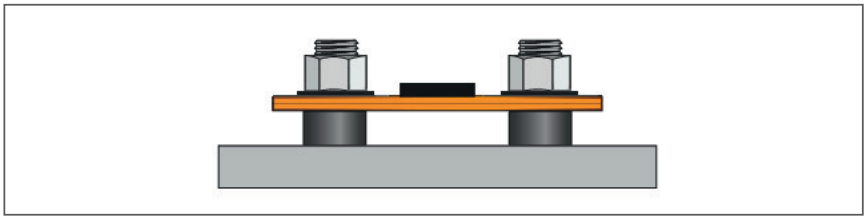


Fig. 5-23: HV BM 1.2+S, shunt module without HV power cables connected to it

When mounting the HV power cables on shunt modules as of HW revision C000, the shunt module rests on the spacers regardless of the cross-section of the HV- power cables (Fig. 5-23). The ring terminals are placed on the threaded bolts as shown in Fig. 5-24 and Fig. 5-25 and fastened with M8 nuts plus washers.

☞ Loosen the M8 nuts to install the HV power cables.

☞ Remove the M8 nuts and washers from the threaded bolts.

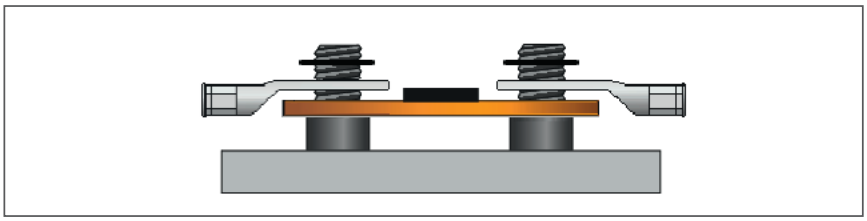


Fig. 5-24: HV BM 1.2+S, placing ring terminals and washers on the threaded bolts

☞ Place the ring terminals on the threaded bolts as shown in Fig. 5-24.

☞ Put on the washers.

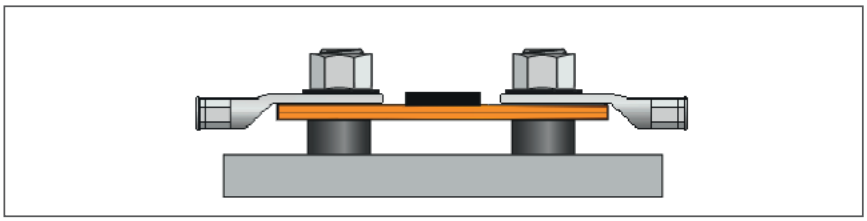


Fig. 5-25: HV BM 1.2+S, fastening the ring terminals with the M8 nuts

☞ Fasten the ring terminals with the M8 nuts and tighten them with the specified torque (Tab. 5-1).

22 The hardware revision number can be found on the type label of the shunt module (chapter 7.2 "Shunt label").

5.3.3.1.2 Mounting the HV- power cables with cable cross-sections 50 mm², 70 mm² and 95 mm² to the shunt (HW rev. A and B) for measuring the inner conductor current

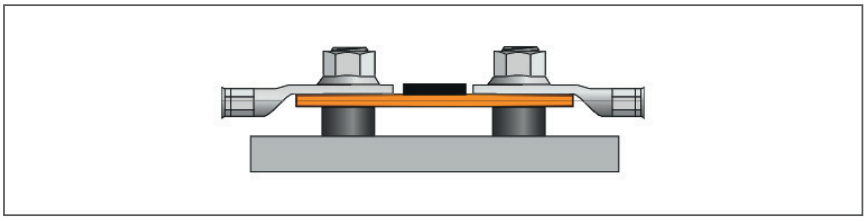


Fig. 5-26: HV BM 1.2+S, orientation of the ring terminals for cable cross-sections >35 mm²

When mounting the HV- power cables with **cross-sections >35 mm²** (**50 mm²**, **70 mm²** and **95 mm²**), the shunt rests on the spacer sleeves (Fig. 5-26). The HV- power cables can be mounted without any further intermediate steps. The ring terminals of the HV power cables are placed on the threaded bolts as shown in Fig. 5-27 to Fig. 5-29 and fastened with the M8 nuts.

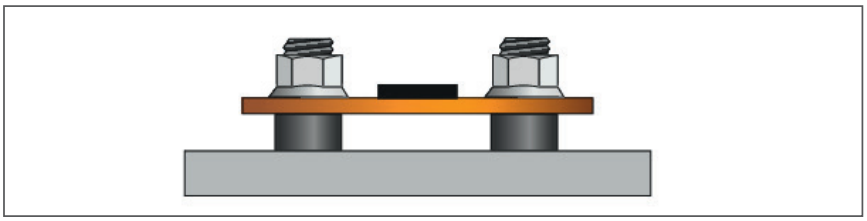


Fig. 5-27: HV BM 1.2+S, power cable HV- (>35 mm²), loosen and remove the M8 nuts

☞ Loosen the M8 nuts and remove them from the threaded bolts.

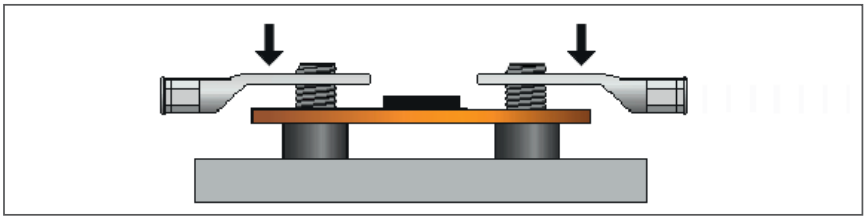


Fig. 5-28: HV BM 1.2+S, power cable HV- (>35 mm²), placing the ring terminals on the threaded bolts

☞ Place the ring terminals on the shunt module as shown in Fig. 5-28.

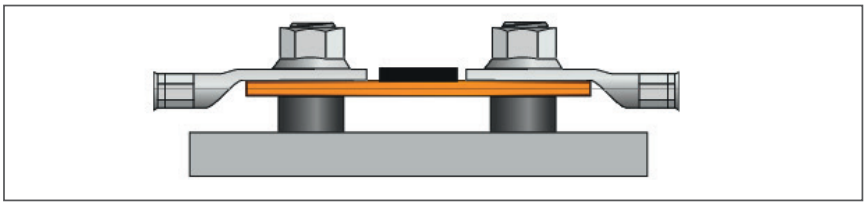


Fig. 5-29: HV BM 1.2+S, power cable HV- (>35 mm²), fastening the ring terminals with the M8 nuts

☞ Fasten the ring terminals with the M8 nuts and tighten them with the required torque (Tab. 5-1).

5.3.3.1.3 Mounting the HV- power cables with cable cross-sections 16 mm², 25 mm² and 35 mm² to the shunt (HW rev. A and B) for measuring the inner conductor current

i	To make sure that the distance between the shunt module for measuring the inner conductor current and the shunt module for measuring the shield current does not get too small, standard M8 nuts (DIN 934) and washers with a thickness of 1 mm have to be used when mounting HV cables with cable cross-sections ≤35 mm².

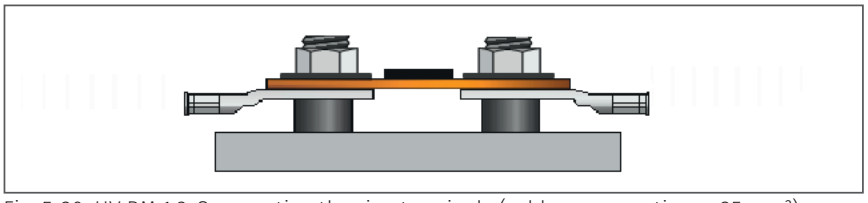


Fig. 5-30: HV BM 1.2+S, mounting the ring terminals (cable cross sections ≤35 mm²)

For HV power cables with **cable cross-sections ≤35 mm²** (**16 mm²**, **25 mm²** and **35 mm²**), the shunt module has to be re-fitted (Fig. 5-30). The individual steps are shown in Fig. 5-31 to Fig. 5-32.

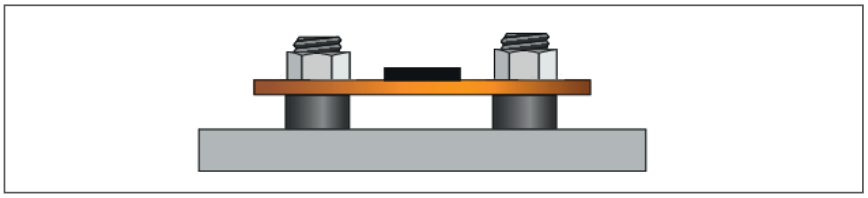


Fig. 5-31: HV BM 1.2+S, power cable HV- (≤35 mm²), loosen and remove the M8 nuts

☞ Loosen the M8 nuts and remove them from the threaded bolts.

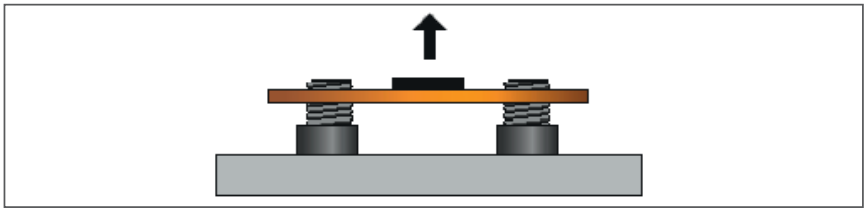


Fig. 5-32: HV BM 1.2+S, power cable HV- (≤35 mm²), removing the shunt module from the threaded bolts

☞ Remove the shunt module for measuring the inner conductor current from the threaded bolts. Make sure that the shunt cables will not be damaged.

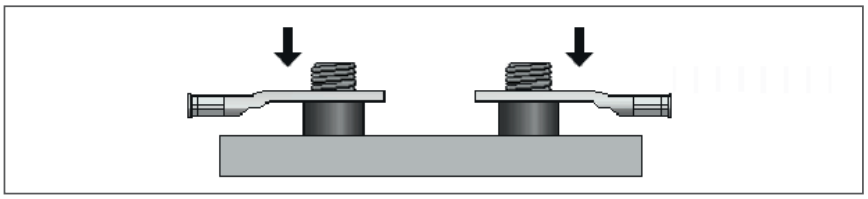


Fig. 5-33: HV BM 1.2+S, power cable HV- (≤35 mm²), placing the ring terminals on the threaded bolts

☞ Place the ring terminals on the corresponding threaded bolt.

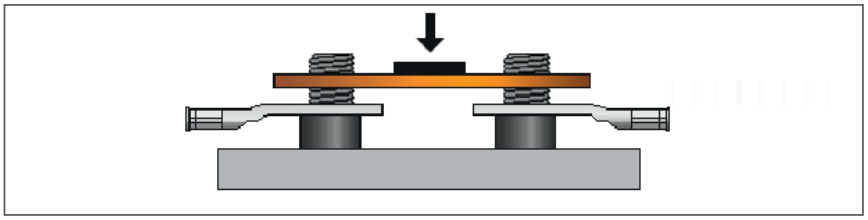


Fig. 5-34: HV BM 1.2+S, power cable HV- (≤35 mm²), placing the shunt module on the ring terminals

☞ Place the shunt module on the ring terminals.

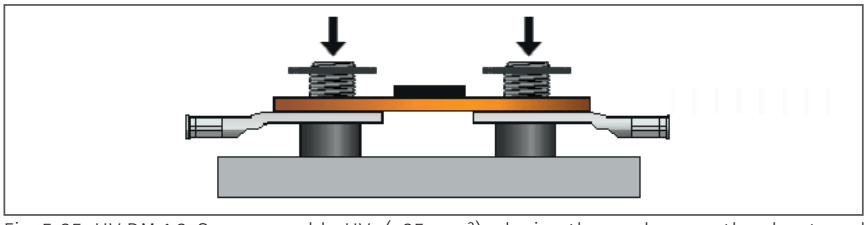


Fig. 5-35: HV BM 1.2+S, power cable HV- (≤35 mm²), placing the washers on the shunt module

☞ Place the washers on the shunt module.

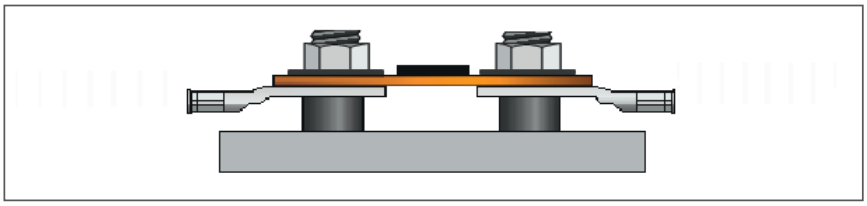


Fig. 5-36: HV BM 1.2+S, power cable HV- (≤35 mm²), fastening the shunt module with the M8 nuts

☞ Fix the shunt module with the M8 nuts.

☞ Tighten the M8 nuts with the required torque (Tab. 5-1).

5.3.3.2 Mounting the braided shield of power cable HV- to the shunt for shield current measurement

i	The ring terminals used for connecting the HV- shield to the shunt for shield current measurement are mounted as shown in Fig. 5-38 and Fig. 5-39 regardless of the cable cross-section.

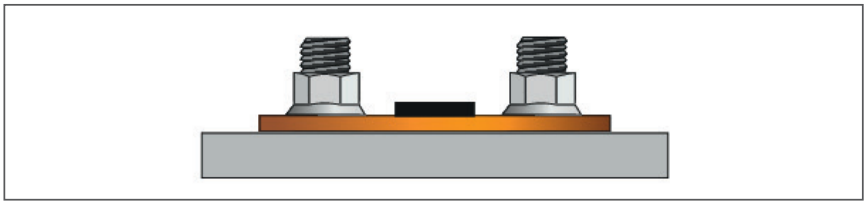


Fig. 5-37: HV BM 1.2+S, braided shield HV-, loosen the M8 nuts at the shunt module for the shield current measurement

☞ Loosen the M8 nuts and remove them from the threaded bolts.

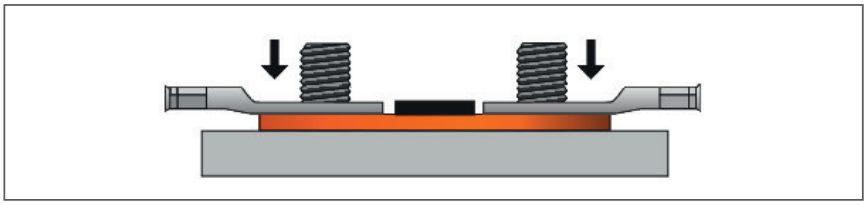


Fig. 5-38: HV BM 1.2+S, braided shield HV-, placing the ring terminals on the threaded bolts

☞ Place the ring terminals on the threaded bolts as shown in Fig. 5-34.

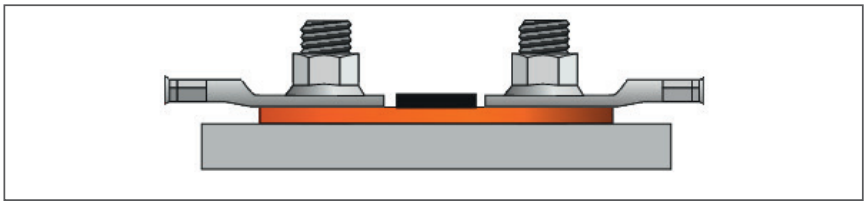


Fig. 5-39: HV BM 1.2+S, power cable HV-, fastening the ring terminals with the M8 nuts

☞ Fasten the ring terminals with the M8 nuts and tighten them with the required torque (Tab. 5-1).

5.3.3.3 Mounting the power cables HV+ on the busbar side

5.3.3.3.1 Mounting the inner conductor on the threaded bolt

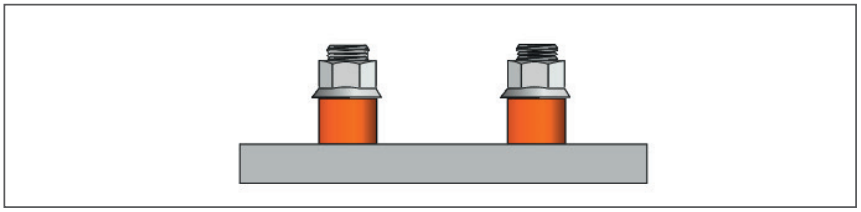


Fig. 5-40: HV BM 1.2+S, power cable HV+, loosen and remove the M8 nuts

☞ Loosen the M8 nuts and remove them from the threaded bolts.

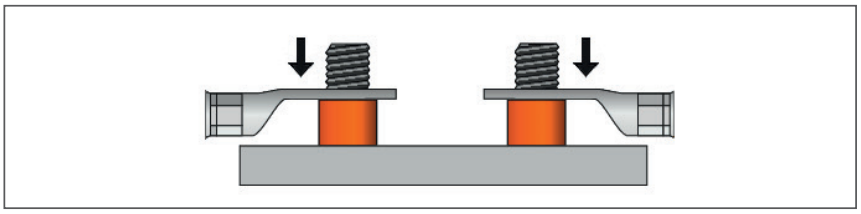


Fig. 5-41: HV BM 1.2+S, power cable HV+, placing the ring terminals on the threaded bolts

☞ Place the ring terminals on the threaded bolts on the busbar side as shown in Fig. 5-37.

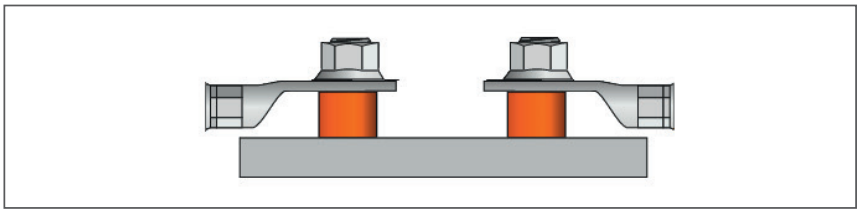


Fig. 5-42: HV BM 1.2+S, power cable HV+, fastening the ring terminals with the M8 nuts

☞ Fasten the ring terminals using the M8 nuts and tighten them with a torque of 25 Nm.

5.3.3.3.2 Soldering the braided shield to the solder lugs of the feedthrough

Fig. 5-43: HV BM 1.2+S, power cable HV+, strands of the braided shield, twisted, insulated and tinned

☞ Solder the twisted and tinned braided shield strands (Fig. 5-39) to the solder lugs of the feedthrough (Fig. 5-40, ⑤).

☞ Provide suitable insulation (heat-shrink tubing/insulation tape) for the exposed braided shield (Fig. 5-39).

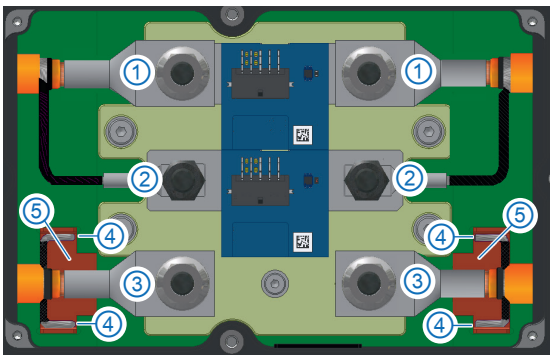


Fig. 5-44: HV BM 1.2+S, HV power cables connected

1. Inner conductor HV-
2. Shield power cable HV-
3. Inner conductor HV+
4. Shield power cable HV+
5. Feedthrough with solder lugs

5.3.4 Mounting the cable glands and the lid of the housing

NOTE!	
	To avoid water ingress, condensation, etc., special care must be taken to ensure the tightness of the housing. CSM provides the gasket for the housing lid as a spare part. The gasket 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 cable glands and HV power cables are properly mounted.

5.3.4.1 Mounting the cable glands

☞ Attach the double nipples of the cable glands to the housing and fasten them by hand.

☞ Attach the pressure screws with sealing inserts to the double nipples and fasten them by hand.

☞ Tighten the pressure screws and double nipples with the specified torque. Please observe the mounting instructions of the manufacturer.[23]

5.3.4.2 Mounting the lid of the housing

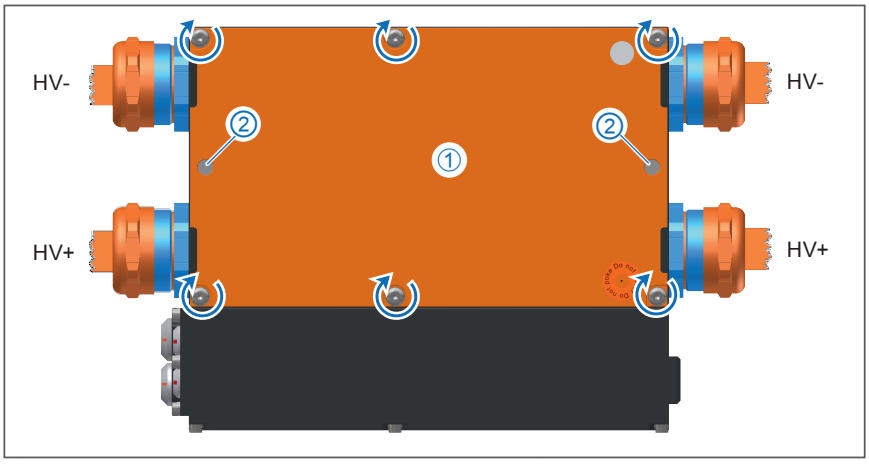


Fig. 5-45: HV BM 1.2+S, HV power cables mounted, housing closed

☞ Place the orange lid ① on the housing.

☞ Fix the housing cover with the Allen screws (↻).

☞ If applicable, re-mount the M6 threaded bolts ②.

WARNING!	
	Nuts and ring terminals must not extend over the threaded bolts, otherwise the distance to the lid may be too small. **If the distance between the threaded bolts with the mounted metal parts (e.g. ring terminals, nuts and washers) and the lid of the housing is too small, there is a risk of life-threatening electric shocks and short circuits.** ☞ Tighten the nuts with the specified torque so that the ring terminals will be securely fastened during operation (Tab. 5-1). ☞ Make sure that the ring terminals are sufficiently spaced from each other and from the housing (min. 3.5 mm).

23 Pflitsch Cable Gland Catalogue 2024

5.4 Connecting HV power cables to an HV BM 1.2+U

NOTE!
HV Breakout Modules have been optimized to be operated with properly connected HV power cables and the lid mounted. ☞ Only operate HV Breakout Modules when the lid is mounted and the HV power cables are properly connected.

5.4.1 Installation notes

CSM recommends soldering the braided shields of the HV power cables of the HV BM 1.2+U to the solder lugs of the feedthrough. The braided shields can also be connected to the housing if required. The HV power cables have to be prepared depending on how the braided shields are connected to the HV BM 1.2+U.

NOTE!
Mounting the HV power cables to an HV BM 1.2+U How the HV power cables for an HV BM 1.2+U are to be mounted depends primarily on whether the shields are connected to the module housing via the cable glands or soldered to the feedthrough (Fig. 5-46, ④). If the shields are soldered to the feedthrough, the specifications for mounting the power cables HV- and HV+ are identical to those for mounting the power cable HV+ for the HV BM 1.2+S: → Chapter 8.1.7.2 "Preparing the HV+ power cables (braided shield soldered to the feedthrough)" If the shields are connected to the module housing/ground via the cable glands, the specifications for mounting both HV power cables are identical to those for mounting the HV power cables to an HV BM 1.2: → Chapter 8.1.6.1 "Preparing single- and two-core HV power cables (HV BM 1.2 and HV BM 1.1)"

Installation of the HV power cables with braided shields contact via cable glands

If the braided shields of both HV power cables are contacted via the cable glands and connected to the module housing, the installation instructions for the HV power cables of the HV BM 1.2 apply.

→ Chapter 5.2.3.2 "HV BM 1.2: Connections for the cables HV- and HV+"

Installation of the HV power cables when the braided shields are soldered to the feedthrough

If the braided shields of both HV power cables are soldered to the feedthrough, the installation instructions for the power cables HV+ of the HV BM 1.2+S apply.

→ Chapter 5.3.3.3 "Mounting the power cables HV+ on the busbar side"

If the braided shields are soldered to the feedthrough, the triangular springs in the cable glands are no longer required. The triangular springs are only required for establishing contact between the shield and the housing. → Chapter 8.1.3 "Preparing the cable glands"

5.4.2 Internal potential tap for HV BM 1.2+U

NOTE!	
	The HV BM 1.2+U has an extra internal cable ②, a potential tap that is used for the additional channels for voltage measurement. For correct measurement of HV+ → vehicle's potential equalization or protective earth and HV- → vehicle's potential equalization or protective earth, the potential tap ② has to be connected to the module housing ③ "+U" mode), otherwise the measured values of these additional measurement channels will not be correct. During the HV isolation test, the potential tap ② has to be connected to the isolated point ①, otherwise a leak to the vehicle's potential equalization or protective earth will be detected. For the standard measurement of HV+ → HV-, it is not important whether the potential tap is connected to ③ or to ①.

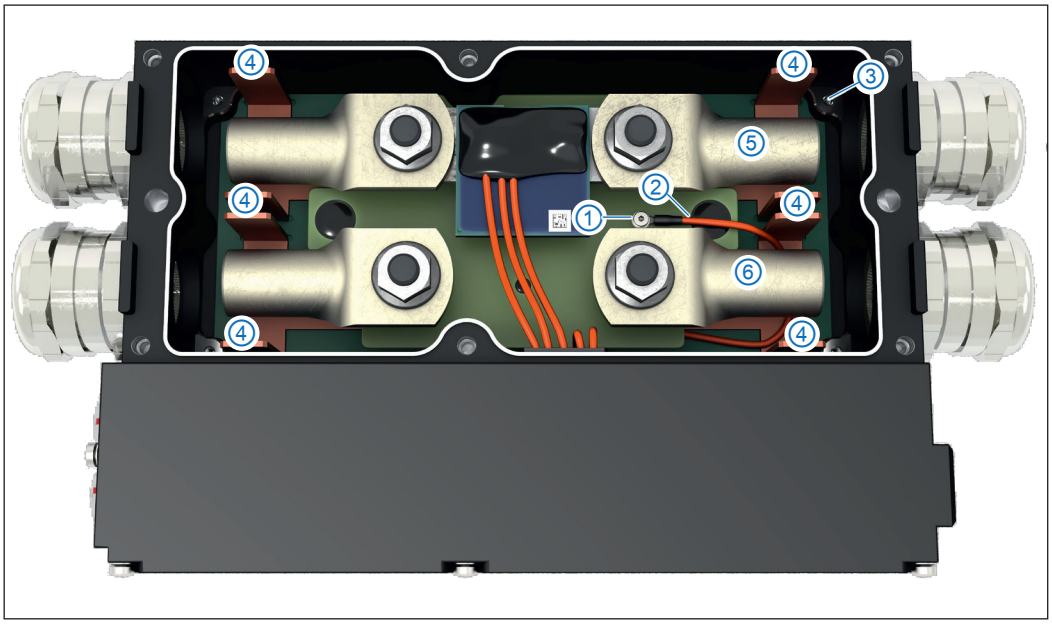


Fig. 5-46: HV BM 1.2+U, options for ground connection

- On delivery, the cable is connected to point ③ and thus to the module housing ("+U" mode).[24] This option is used, for example, to check the symmetry of the voltages HV- ⑤ to the vehicle's potential equalization/protective earth and HV+ ⑥ to the vehicle's potential equalization/ protective earth.
- Voltages are potential differences, e.g. between HV+ and HV-. The measurements of the additional voltages between HV+ or HV- and the grounded housing of the HV BM 1.2+U require contacting the housing. To establish that contact, the thin orange cable ②has to be connected to point ③. If this connection is made, an isolation test will fail due to the intentional high impedance connection between HV+ or HV- and the grounded housing of the HV BM 1.2+U. Therefore, for isolation testing, the thin orange cable must not be connected to point ③, but to point ①, which is an isolated point. Measurements between HV+and HV- are not affected, no matter whether the thin orange cable is connected to point ③ or to point ①. However, the measurements of the additional voltages between HV+ or HV- and the grounded housing of the HV BM 1.2+U deliver only valid values, when the thin orange cable ② is contacted to point ③.

24 For safety reasons, the module housing always has to be connected to protective earth/the vehicle's potential equalization → chapter 4.3.2.4 "Ground connection".

5.4.3 Connection diagrams HV BM 1.2+U

i	▸ The red arrows indicate the technical direction of the inner conductor current. ▸ The blue arrows indicate the technical direction of the voltages. ▸ For the wirings displayed in Fig. 5-47 and Fig. 5-48, the technical current and the technical voltages are output with the correct polarity.

5.4.3.1 Current/voltage measurements (orange cable connected to housing/PE, Fig. 5-46, ③)

Fig. 5-47 shows the appropriate connection diagram if the inner conductor current and the following voltages are to be measured:

- Voltage measurement between HV+ and HV-
- Voltage measurement between HV- and housing/PE
- Voltage measurement between HV+ and housing/PE

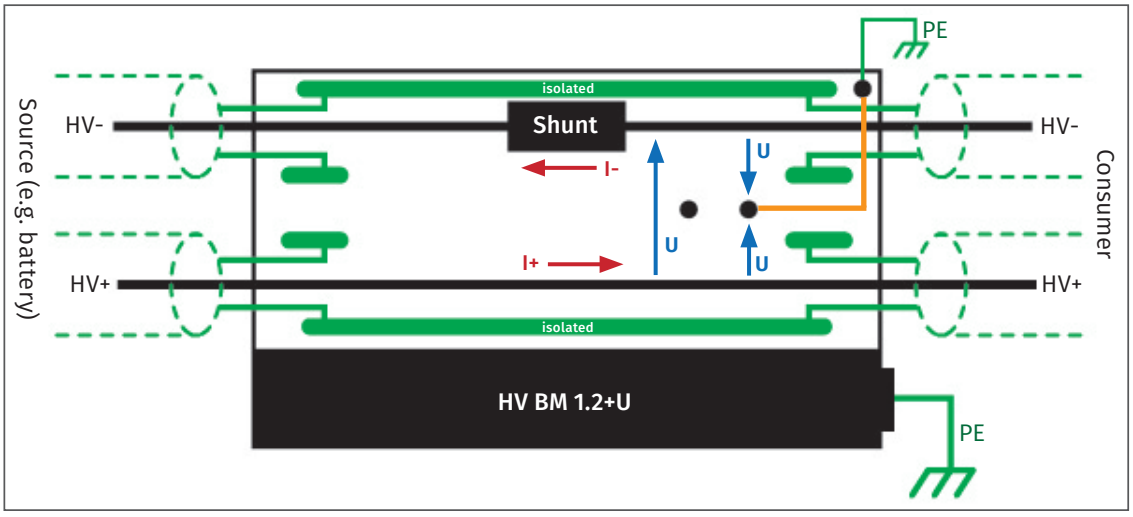


Fig. 5-47: HV BM 1.2+U, connection diagram for the measurement of voltages HV+ -> HV-, HV- > PE, HV+ -> PE and current

5.4.3.2 Current/voltage measurements (orange cable connected to isolated point, Fig. 5-46, ①)

Fig. 5-48 shows the connection diagram for an HV isolation test. Only the inner conductor current and the voltage between HV+ and HV - are properly measured.

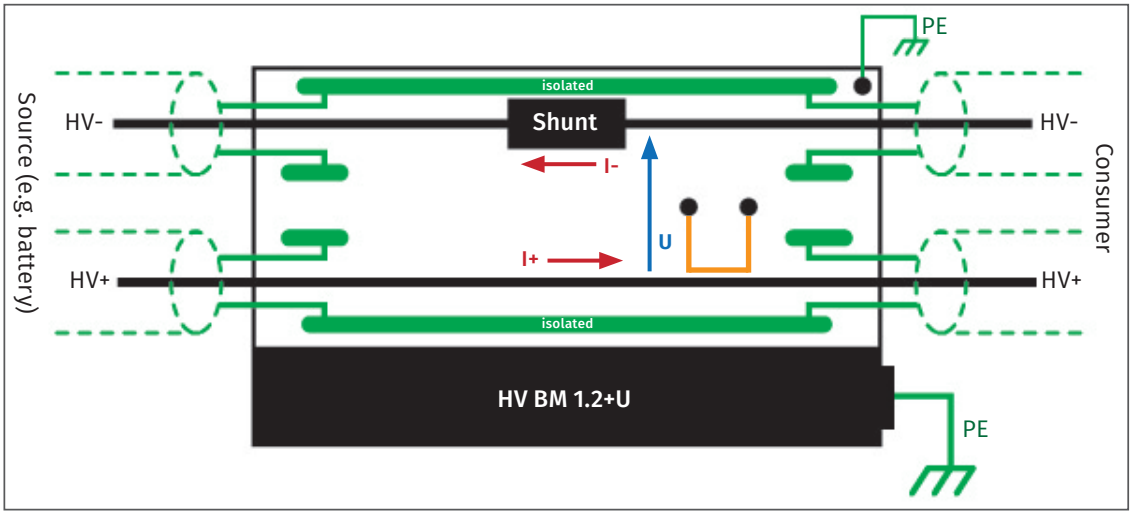


Fig. 5-48: HV BM 1.2+U, connection diagram for the measurement of voltage HV+ -> HV- and current

The source is located on the left, the consumer on the right.

The currents are measured in the **minus path** in order to minimize disturbances of the current measurement. The voltage(s) is/are measured on the consumer side.

5.4.4 Measurement functions

- Voltage measurement between HV+ and HV- (Fig. 5-46, ⑥ and ⑤) (all HV BM 1.x)
- Measurement of the inner conductor current (all HV BM 1.x)
- Voltage measurement between HV+ and housing (Fig. 5-46, ⑥ and ③) (only HV BM 1.2+U)
- Voltage measurement between HV- and housing (Fig. 5-46, ⑤ and ③) (only HV BM 1.2+U)

The additional voltage measurements are used, for example, to check the symmetry of the voltages HV+ ⑥ and HV- ⑤ with respect to the vehicle's potential equalization/protective earth.

	NOTE!
	For "+U" mode measurements, the thin orange cable (Fig. 5-46, ②) is connected directly to the module housing (Fig. 5-46, ③). The internal resistance of the measurement input, which is in parallel with the isolation barrier, reduces the effective isolation resistance in "+U" mode from 50 GΩ to 4 MΩ. If the module is not operated in "+U" mode, there is no reduction of the effective isolation resistance. ☞ Only use qualified and trained personnel.

5.5 Connecting the shields using the M3 threaded holes

As an alternative to the connection via cable glands (chapter 5.2.2), the shields can also be connected to the module housing using the four M3 threaded holes (◯)

NOTE!	
	The stripping dimensions of the HV power cables depend on whether the braided shields are connected to the module housing via the cable glands or by using the M3 threaded holes. → Chapter 8.1.5 "Stripping lengths for HV power cables"

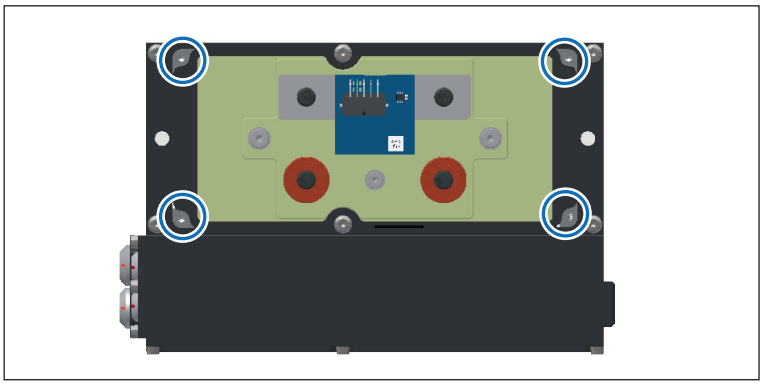


Fig. 5-49: HV BM 1.2, housing open, M3 threaded holes marked

Mounting the HV power cables

☞ Place the ring terminals for the inner conductors on the threaded bolts.

☞ Fasten the ring terminals for the inner conductors with the M8 nuts. Observe the tightening torques specified in Tab. 5-1 when tightening the nuts.

☞ Fasten the ring terminals for the braided shields with an M3 screw and washer.

→ For more information on mounting the HV power cables, see chapter 5.2.2 "Opening the housing".

6 How to Use HV BM 1.x Measurement Modules

HV BM 1.x modules can be operated via ECAT as well as via CAN which means measurement data is 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 following section explains a configuration using the ECAT side of an HV BM 1.2 as example. The procedure is identical for the module's ECAT and CAN component. The CAN-specific features will be explained in the relevant sections.

6.1 Example of application

The following figure shows an example of a measurement setup in which an HV BM 1.2 is connected to a PC for data acquisition.

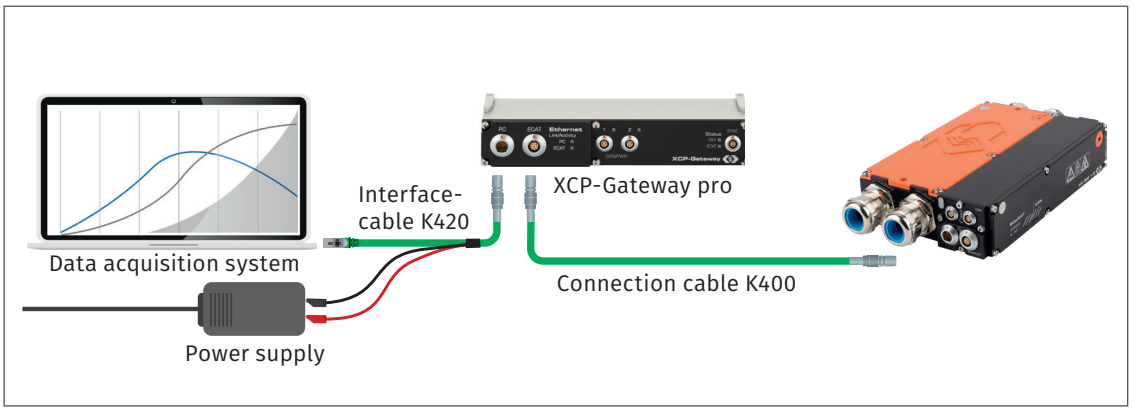


Fig. 6-1: Measurement setup with an HV BM 1.2

The measurement setup consists of the following components:

- 1 HV BM 1.2
- 1 XCP-Gateway pro
- 1 K420 interface cable
- 1 K400 connection cable
- 1 power supply
- Data acquisition system (PC) with configuration software CSMconfig and DAQ software (e.g. vMeasure, CANape, INCA etc.)

Connecting the components

☞ Connect the interface cable to the XCP-Gateway.
☞ Connect the HV BM 1.2 to the XCP-Gateway.
☞ Connect the far end of the interface cable to the data acquisition system (computer).
☞ Connect the banana plugs of the interface cable to the power supply.

6.2 CSMconfig User Interface

The CSMconfig user interface consists of the following sections:

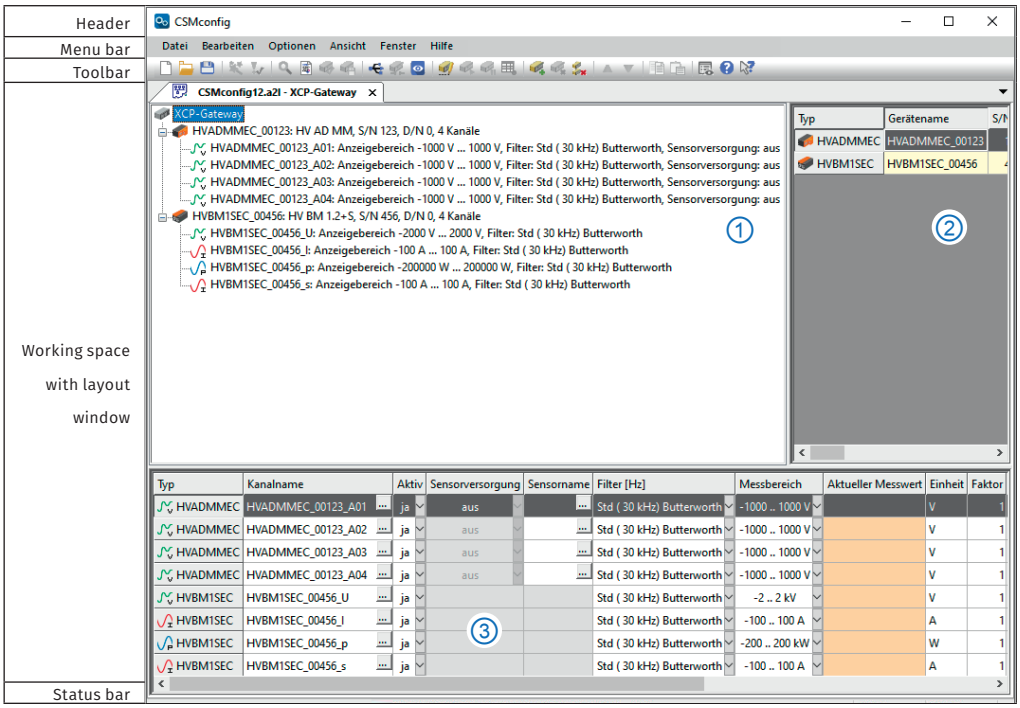


Fig. 6-2: CSMconfig user interface

6.2.1 Header

Clicking the program icon on the left opens the program menu.

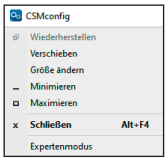


Fig. 6-3: Program menu

In addition to the functions for modifying the position and resizing of the program window, it also contains the option **Expert Mode**.

→ *CSMconfig Online Help, "Expert mode"*

6.2.2 Menu bar

The commands are arranged in the following menus:

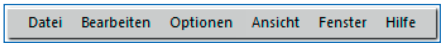


Fig. 6-4: Menu bar

→ *CSMconfig Online Help, "Menu commands"*

6.2.3 Toolbar

The toolbar contains the most frequently used menu commands. A command is executed by clicking on the corresponding icon.

Fig. 6-5: Toolbar

→ *CSMconfig Online Help, "Toolbar"*

6.2.4 Working space

The configuration data is stored in a configuration document. Depending on the bus system, the configuration document is either saved as a DBC file (CAN) or an A2L file (XCP-on-Ethernet).

→ *CSMconfig Online Help, "Configuration document (DBC-/A2L-File)"*

CSMconfig provides various configuration views to create or process a configuration document:

- **Tree view** (Fig. 6-2, ①)
- **Device list** (Fig. 6-2, ②)
- **Channel list** (Fig. 6-2, ③)

These views are integrated in a higher-level window, the layout window. The **Select view layout** dialog offers a number of layouts with different combinations of configuration views.

☞ **Select Window | Select View Layout**.

⇨ The **Select view layout** dialog opens.

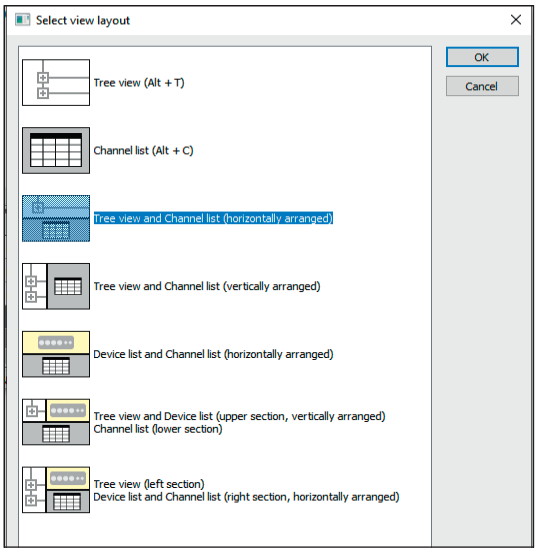


Fig. 6-6: **Select view layout** dialog

☞ Select the matching layout and confirm your choice by clicking on **OK**.

→ *CSMconfig Online Help, "Configuration views and layout window"*

6.2.5 Status bar

Fig. 6-7: Status bar

The status bar provides the following information:

- The interface currently connected to the PC or the message "No valid interface selected"
- The bus system of the active configuration.
- The configuration status: "Online" or "Offline"

6.3 Shortcuts used in CSMconfig

Shortcut	Menu command/meaning
Alt + A	Auto Configuration
Alt + INS	Insert Module
Alt + DEL	Delete Module
Alt + F4	Exit
Alt + M	CSMview
Alt + R	Report...
Alt + U	Firmware update
Entry field	Edit
F1	Help
F11	Resize grid columns
Ctrl + 0 (zero)	Deactivate
Ctrl + 1	Activate
Ctrl + B	Scan Bus
Ctrl + C	Copy
Ctrl + F4	Close
Ctrl + D	Move Down
Ctrl + F6	Next (configuration document)
Ctrl + G	Reconfigure All
Ctrl + I	Interface...
Ctrl + K	Check Document
Ctrl + N	New
Ctrl + O	Open
Ctrl + P	Print
Ctrl + R	Read from device
Ctrl + S	Save
Ctrl + T	Toggle On/Offline
Ctrl + U	Move Up
Ctrl + V	Insert
Ctrl + W	Write settings to device
Shift + Ctrl + F6	Previous (configuration document)

Tab. 6-1: Shortcuts used in CSMconfig

6.4 Preparing the module configuration

The configuration software CSMconfig is used to configure an HV BM 1.x module in conjunction with an XCP-Gateway protocol converter[25]. The measurement module can also be configured via an EtherCAT® master.

CANopen over EtherCAT® (CoE) is used as application protocol.

	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. https://s.csm.de/de-cfg As of version 8.8.0 CSMconfig can check 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.

	NOTE!
	As CSMconfig accesses the network, the firewall settings may need to be changed. ☞ Ensure that ports 5555 and 5556 are activated for use by CSMconfig.

	NOTE!
	HV BM 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 HV BM with the data acquisition system (PC) and the HV BM need to be within the same address range. A typical IP address (IPv4)for the network adapter of the PC which is suitable for the factory setting is IP address 192.168.100.1. ☞ Make sure that the IP addresses are in the same address range, but different from each other.

→ Chapter 6.5.3.5 "Communication parameter settings"

25 Instead of an XCP Gateway module, it is also possible to use an XCP measurement module with an integrated and enabled XCP Gateway.

Setting the IP address of the network card

	NOTE!
	To change the IP address, extended user rights or administrator rights may be required.[26]

Windows 10

☞ Select **Start | Control Panel | Network and Sharing Center**.
⇨ The **Network and Sharing Center** dialog opens.
☞ Select **View your active networks**, then click on the **Wireless Network Connection** entry
⇨ The **Wireless Network Connection Status** dialog opens.
☞ Click on **Properties**.
⇨ The **Wireless Network Connection Properties** dialog opens.
☞ Select the **Internet Protocol Version 4 (TCP/IPv4)** option and click **Properties**.
⇨ The **Internet Protocol Version 4 (TCP/IPv4) Properties** dialog opens.

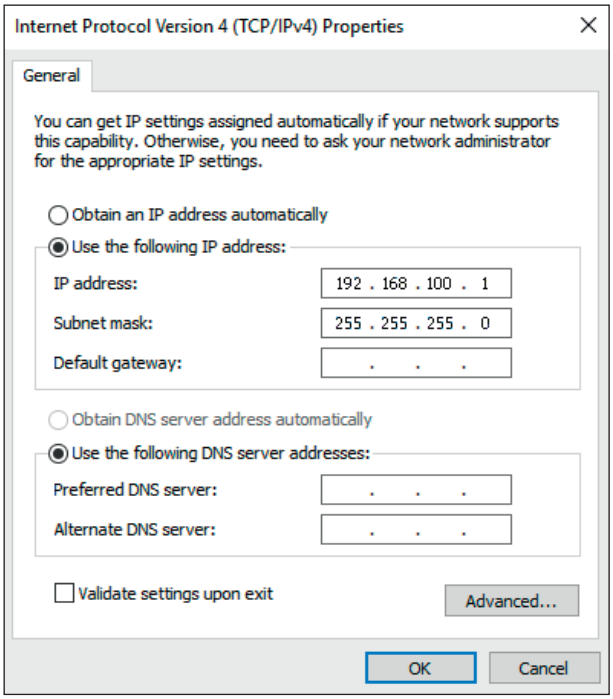


Fig. 6-8: Windows 10/11: **Internet Protocol Version 4 (TCP/IPv4) Properties** dialog

☞ Enter the required address under **IP address** (in this case: 192.168.100.1).
⇨ The entry in the **Subnet mask** field is filled in automatically.
☞ Click **OK** to finish the process.

26 Information on setting the IP addresses for Vector interfaces is provided in the CSMconfig online help, section “Connecting and configuring Vector Interfaces in CSMconfig”.

Windows 11

☞ Select **Start | Settings | Network & Internet.**
  ⇨ The **Network & Internet** window opens.
☞ Select **Ethernet** from the **Network adapter** list and choose the required Ethernet network.
☞ The **Ethernet properties** dialog opens.
☞ Select **Internet Protocol Version 4 (TCP/IPv4)**.
  ⇨ The **Internet Protocol, Version 4 (TCP/IPv4) Properties** dialog opens (Fig. 6-8).
☞ Specify the required IP-address in the **IP address** field (192.168.100.1).
  ⇨ The entry in the **Subnet mask** field is filled in automatically.
☞ Click **OK** to finish the process.

6.5 Configuring HV BM 1.x modules

The following sections contain information on the following topics:

- HV BM 1.x module settings
- Creating a standard configuration with (offline and online) with an HV BM 1.2 in CSMconfig

Online configuration

- The measurement modules are linked to the configuration software.
- A configuration can be transferred to a single or to all measurement modules of a measurement chain in CSMconfig immediately after completion.

Offline configuration

- There is no connection between configuration software and measurement module(s). The configuration document is created "offline", which means without connection to the measurement chain.
- If an online connection to the measurement chain is established at a later time, the configuration can then be transferred using CSMconfig.

Configuration 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.

→ Chapter 6.2.4 "Working space"

The following paragraphs contain the basic steps for a configuration using the **Tree view** window.

6.5.1 Dialogs and windows

i	The views that are available during configuration depend on the configuration layout specified in the **Select view layout** dialog.

Example

If a new configuration file is created using the **New** command, the **Select document type** dialog is displayed by default. Select the file type required for the configuration here. Use document type **XCP-on-Ethernet (A2L)** for measurement applications with ECAT measurement modules.

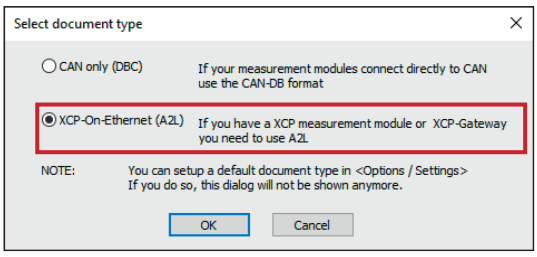


Fig. 6-9: **Select document type** dialog, **XCP-on-Ethernet (A2L)** selected

The settings used to create a new configuration file can be specified in the **Program Settings** dialog. The **Default document type** option offers the following options for creating configuration files:

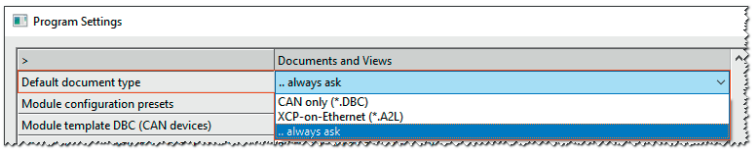


Fig. 6-10: **Program Settings** dialog, **Default document type** options

- **... always ask** (default): The **Select document type** dialog is used.
- **CAN only (*.DBC)**: When a new configuration file is created, the *.DBC file type is automatically used.
- **XCP-on-Ethernet (*.A2L)**: When a new configuration file is created, the *.A2L file type is automatically used.

→ *CSMconfig online help, "Program Settings"*

6.5.2 Offline configuration

The following sections describe the steps for configuration in **offline mode**. This file can be transferred to a measurement module at a later time or made available for further use in other tools such as vMeasure CSM, CANape or INCA.

☞ Start up CSMconfig.

⇨ The CSMconfig program window opens.

☞ Select **File | New**.

⇨ The **Select document type** dialog (Fig. 6-9) opens.

☞ For configurations with ECAT measurement modules (XCP-Gateway), select **XCP-on-Ethernet (A2L)** and confirm with **OK**.

⇨ The **Tree view** window opens (here **CSMconfig.a2l**).

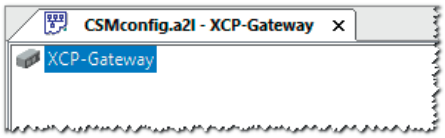


Fig. 6-11: **CSMconfig.a2l**, **Tree view**

→ *User guide "XCP-Gateway Series", chapter "Communication parameter settings"*

☞ Move the mouse pointer to the window and right-click.

⇨ The context menu opens.

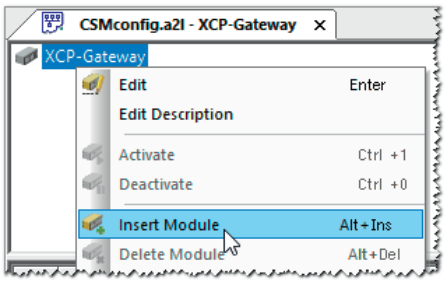


Fig. 6-12: **CSMconfig.a2l** window, **Tree view**, context menu

☞ Select **Insert Module.**

⇨ The **Select device type** dialog opens.

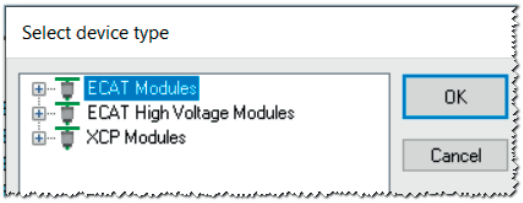


Fig. 6-13: **Select device type** dialog

	NOTE!
	This dialog is designed to select a module series (e.g. AD MM series or HV TH MM series) but not specific module variants (e.g. ADMM 8 pro or HV THMM 4). The options displayed in the dialogs for device and channel configuration comply with the highest configuration level of the corresponding module series. When transferring the configuration file to the measurement module, if some of the settings are not compatible, an error message appears indicating the incorrect setting (e.g. measurement data rate too high).

☞ If the desired measurement module is not displayed in the selection window, click on the + sign in front of the appropriate category.

⇨ The submenu opens.

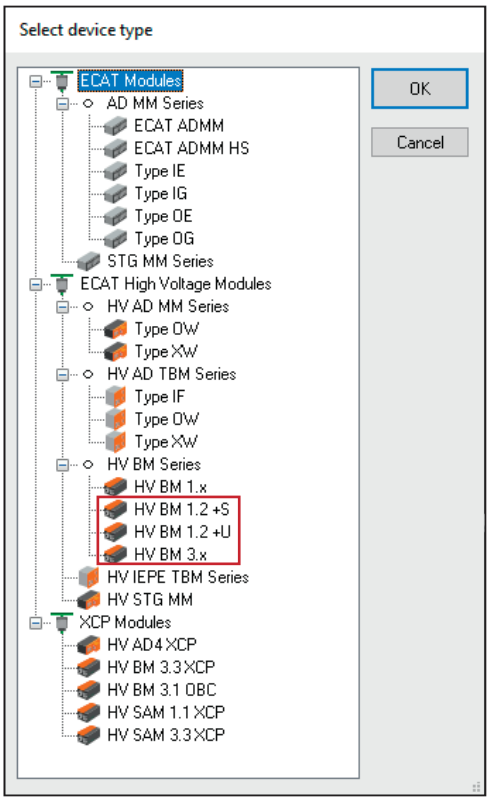


Fig. 6-14: **Select device type** dialog, subentries faded in

☞ Select the module series (e.g. **ECAT High Voltage Modules** | **HV BM Series** | **HV BM 1.x**) and confirm selection with **OK**.

⇨ The **Device configuration dialog** is displayed.

⇨ The layout window **CSMconfig.a2l** appears in the background.

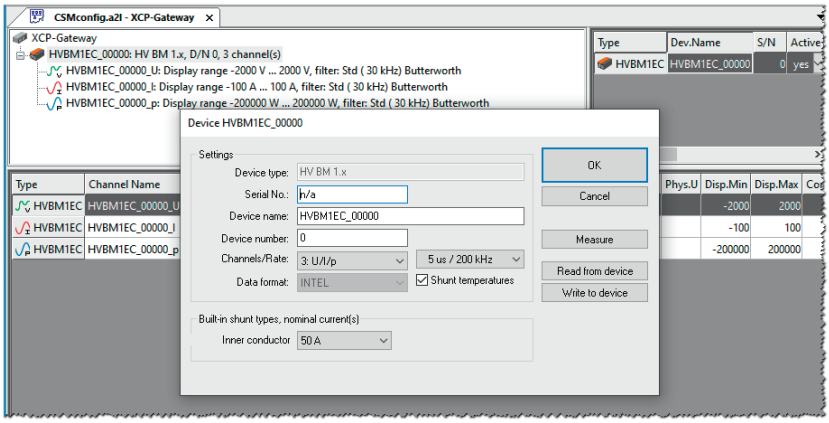


Fig. 6-15: **Device configuration dialog**, **CSMconfig.a2l** window in the background

Information on the configuration of measurement channels and the measurement module can be found in the online configuration section.

→ Chapter 6.5.3.7 "Measurement channel settings" or chapter 6.5.3.8 "Measurement module settings"

When a connection to the measurement setup has been established, the configuration has to be transferred to the corresponding measurement module using the command **Write to Device**.

→ Chapter 6.5.3.8.11 "Transmitting configuration data and verifying measurement values"

6.5.3 Online configuration

6.5.3.1 Preparing the configuration

☞ Before starting an online configuration, make sure that

- Measurement module(s) are correctly connected to the XCP-Gateway
- XCP-Gateway and computer are properly connected via a suitable interface
- the power supplies are connected
- the latest version of CSMconfig has been installed on the PC

6.5.3.2 Starting the program

☞ Start up CSMconfig.

⇨ The program window opens (the last loaded configuration may be displayed).

☞ If an interface is displayed in the status bar (Fig. 6-16), continue with chapter 6.5.3.4 "Creating a new configuration file".

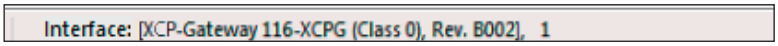


Fig. 6-16: Status bar: "XCP Gateway" interface

☞ If no interface is displayed in the status bar (Fig. 6-17), continue with chapter 6.5.3.3 "Selecting a communication interface".

Fig. 6-17: Status bar: "No valid interface selected"

6.5.3.3 Selecting a communication interface

The XCP-Gateway was designed as a bus interface, which is why it is listed in the **Interface** dialog. If no XCP-Gateway is displayed in the status bar after the program has started, the message **No valid interface selected** will instead be shown (Fig. 6-17). This means that a suitable communication interface still has to be selected.

After the program has been started CSMconfig checks the communication interfaces for available connections. These interfaces are listed in the **Interface** dialog.

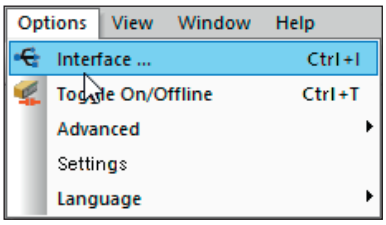


Fig. 6-18: **Options | Interface**

☞ Select **Options | Interface**.

⇨ The **Interface** dialog opens.

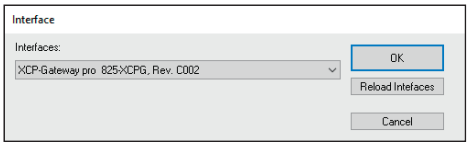


Fig. 6-19: **Interface** dialog

☞ If the required interface is not displayed, click on the arrow ▼ to the right.

⇨ The pull-down menu opens.

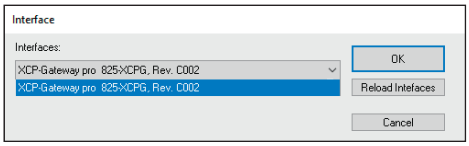


Fig. 6-20: **Interface** dialog, pull-down menu expanded

☞ Select the required interface (XCP-Gateway).

☞ Click on **OK** to confirm the selection.

6.5.3.4 Creating a new configuration file

i	The procedure described in the following section is not required if the configuration is performed using the option **Auto-Configuration**.

→ Chapter 6.5.3.6 "Scan Bus and Auto-Configuration"

☞ Select **File | New**.

⇨ The **Select document type** dialog (Fig. 6-9) opens.

⇨ For configurations via an XCP-Gateway, choose **XCP-on-Ethernet (A2L)** and confirm with **OK**.

⇨ The **CSMconfig.a2l** window opens.

Fig. 6-21: **CSMconfig.a2l** window, **Tree view**

6.5.3.5 Communication parameter settings

The communication parameters used by the data acquisition software to establish the connection to one or more measurement modules via the XCP-Gateway are specified in the **XCP-Gateway Configuration** dialog. Changing these settings is only necessary, if the default settings do not match the settings of the PC used for data acquisition.

The communication between CSMconfig and XCP Gateway - and thus also the configuration of the measurement modules connected to the XCP Gateway - can be carried out without any adjustment of these parameters.

☞ Go to the **Tree view** window and double-click on the **XCP-Gateway** entry.

⇨ The **XCP-Gateway Configuration** dialog opens.

In the following example, the XCP-Gateway is connected with a network interface with the following IP settings:

- Class C network, subnet mask 255.255.255.0
- Fixed host IP address: 192.168.100.1

→ "Setting the IP address of the network card"

This corresponds to the Windows default settings for network configurations.

- By default CSMconfig assigns the IP address 192.168.100.3 (host + 2).
- The port for XCP communication is 5555 (+ 5556 for broadcast commands).

This IP configuration is used by the XCP-Gateway for measurements.

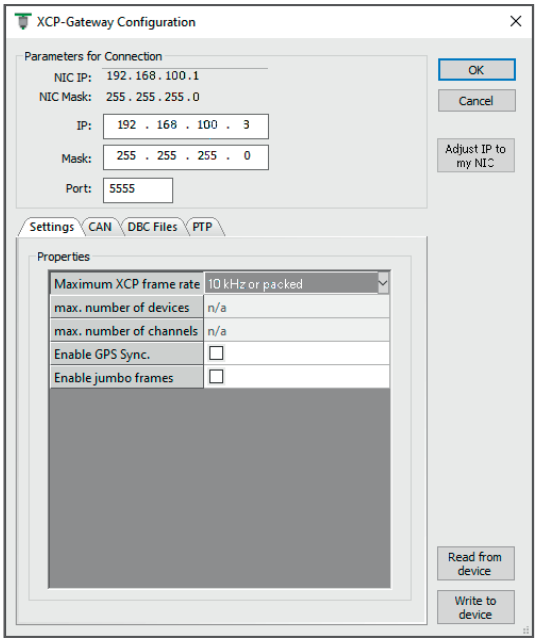


Fig. 6-22: **XCP Gateway Configuration** dialog, **Settings** tab

Section Parameters for Connection

- **NIC IP**: IP address of the network card to which the XCP-Gateway is connected.
- **NIC mask**: By default, the NIC mask is set to 255.255.255.0 (class C).

- **IP address**: Input field for the IP address of the XCP-Gateway. Input field for the IP address of the XCP-Gateway The address 192.168.100.3 (host + 2) is assigned by default. If more than one XCP module or gateway is connected to a port via a switch, it has to be made sure that the default address is only used once, i.e. only by one XCP gateway.
- **Subnet mask**: By default, the subnet mask is set to 255.255.255.0 (class C).
- **Port**: The default setting for communication via XCP is port 5555.

Adapting the IP address to a network card (Network Interface Card, NIC)

- If measurement will be done with a different PC/NIC, the XCP-Gateway connection parameters must match the network settings on the other machine.
- If you use PC and network adapter card for both configuration and measurements, the IP addresses of the network adapter and the XCP-Gateway must be in the same address range (Fig. 6-23, green markers), but they must not be identical (Fig. 6-23, blue markers). If necessary, the IP address can be adjusted clicking the button **Adjust IP to my NIC**. The IP address is automatically adjusted to the IP address of the network adapter. A manual modification of the **IP address** entry is not required.

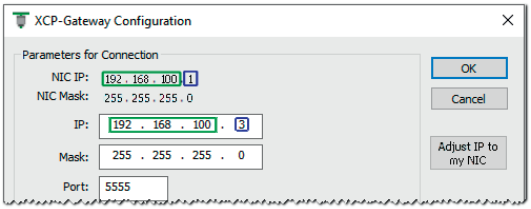


Fig. 6-23: **Adjust IP to my NIC** command

☞ Click **Adjust IP to my NIC** to adjust the IP address to the network adapter.

⇨ The IP address is adjusted and displayed in the **IP** field.

☞ Click on **Write to device** to transfer the settings to the XCP-Gateway.

CSMconfig reads out the parameters of the network card to which the XCP-Gateway is connected. This is the data displayed in the **Settings** tab. If no XCP-Gateway is connected, the settings of the previous configuration or the default settings are used.

Tabs

The **XCP-Gateway Configuration** dialog contains additional setting options spread out over up to five tabs.

The following sections describe the functions and setting options of the **Settings** tab (Fig. 6-22).

- **max. XCP frame rate:** This selection menu includes two options for data acquisition via XCP:
  - **2 kHz**: for low sampling rates (≥ 500 µs) and a larger number of measurement channels. The lower frame rate of 2 kHz allows a larger number of measurement channels (up to 600 channels and 100 measurement modules per XCP-Gateway). If this option is selected, the sampling rate of the connected measurement module may not exceed 2 kHz.
    → Rate ≥ 500 µs, max. 100 devices, 600 channels
  - **10 kHz or packed**: for high sampling rates (< 500 µs to 1 µs) and a low(er) number of measurement channels. The higher frame rate of 10 kHz allows up to 150 channels and 25 measurement modules per XCP-Gateway. With sampling rates over 10 kHz (i.e. when the sampling rate is higher than the frame rate), the XCP-Gateway automatically switches to "packed" mode. The higher the sampling rate – up to 4 MHz is possible, depending on the measurement module – the lower the number of channels and measurement modules which can be operated on the gateway. → Max. 25 devices, 150 channels, "packed" mode for rates under 100 µs
- **max. number of devices**: maximum number of measurement modules that can be connected to this XCP-Gateway
- **max. number of channels**: maximum number of measurement channels which can be assigned to this XCP-Gateway
- **Enable GPS Sync.**: This option can be used to enable time synchronization by receiving the UTC time signal via GPS.
- **Enable jumbo frames**: By using jumbo frames, transmission capacities can be optimized and the data transmission rate in the network can be increased.

→ *User guide "XCP-Gateway Series", chapter "Communication parameter settings"*

6.5.3.6 Scan Bus and Auto-Configuration

The **Scan Bus** and **Auto-Configuration** functions are provided to check which measurement modules are connected to the bus.

Measurement modules connected to the bus can be identified and the stored configurations can be read out using both functions. In addition to detecting modules, **Auto Configuration** also provides the option to resolve potential conflicts (e.g. CAN ID conflicts or name assignment conflicts). An automatic channel configuration in its very sense (e.g. setting the measurement range), however, is not performed.

Running Scan Bus

Scan Bus searches the bus for connected measurement modules. The configuration data is summarized in order to be finally saved in a configuration document.

	NOTE!
	A configuration document has to be opened in order to perform **Scan Bus**. ☞ Select **File	New**.

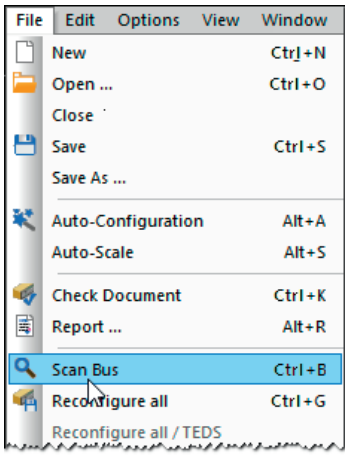


Fig. 6-24: **File | Scan Bus**

☞ Select **File | Scan Bus**.

⇨ The bus is checked for available measurement modules.

⇨ Detected measurement modules are listed below the bus level.

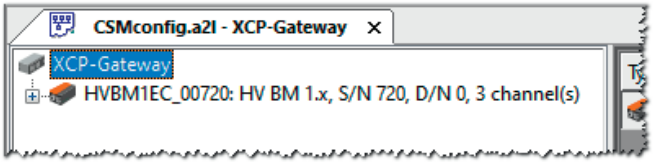


Fig. 6-25: **CSMconfig.a2l** window, **Tree view**, detected measurement modules

Running Auto-Configuration

If the command **Auto-Configuration** is used instead of **Scan bus**, there is no need to create a new configuration file beforehand. A new configuration file is automatically created when executing the command. Upon process completion, the new configuration file needs to be named and stored in the required folder.

→ Chapter 6.5.3.9 "Saving a configuration"

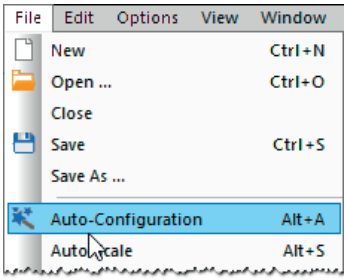


Fig. 6-26: **File | Auto-Configuration**

☞ Select **File | Auto-Configuration**.

⇨ The bus will be scanned for measurement modules and possibly existing conflicts.

⇨ The **AutoConfig** window opens.

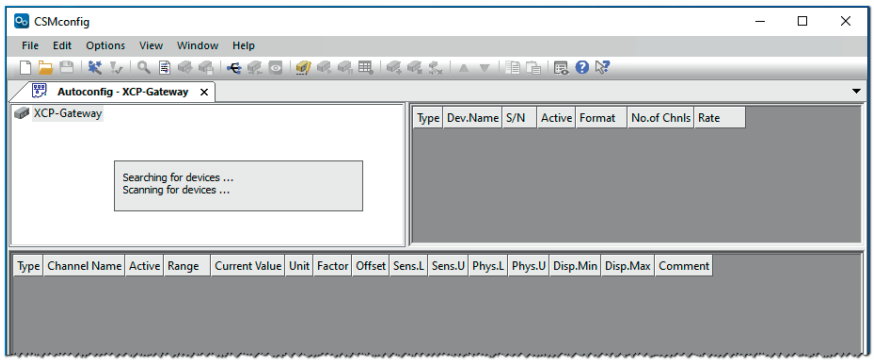


Fig. 6-27: **AutoConfig** window, "Searching for devices.../Scanning for devices..."

⇨ Auto-Configuration is performed, the message **"Searching for devices .../Scanning for devices ..."** is displayed.

⇨ When the process is completed, the following windows are displayed:

- **AutoConfig**: the connected measurement modules are displayed.

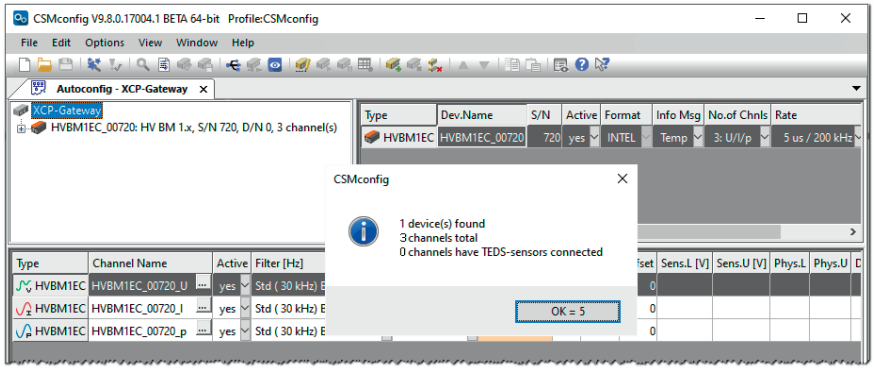


Fig. 6-28: **Auto-Configuration** is performed.

⇨ In another window, a message appears indicating how many measurement modules and channels have been detected.

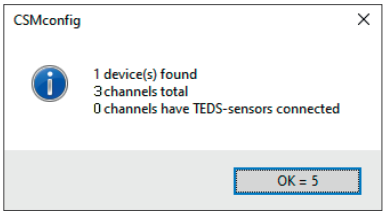


Fig. 6-29: Message window after **Auto Configuration** has been completed

The **OK** button in this window contains an automatic counter that counts down from "5" to "0". The window closes automatically as soon as the counter has reached "0". The window can be closed immediately by clicking on **OK**.

→ Chapter 6.5.3.9 "Saving a configuration"

6.5.3.7 Measurement channel settings

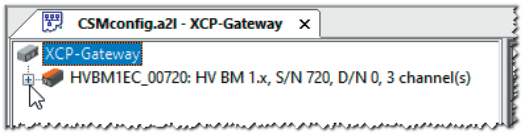


Fig. 6-30: **CSMconfig.a2l** window, **Tree view**, channel list faded out

☞ If the measurement channel list is not visible, click on the **+** symbol left from the device entry to open the tree.

⇨ A list of the available measurement channels is displayed.

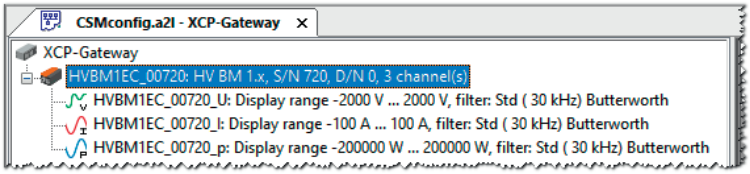


Fig. 6-31: **CSMconfig.a2l** window, **Tree view**, channel list faded in

☞ Double-click on the selected channel entry.

⇨ The **Channel configuration dialog** opens.

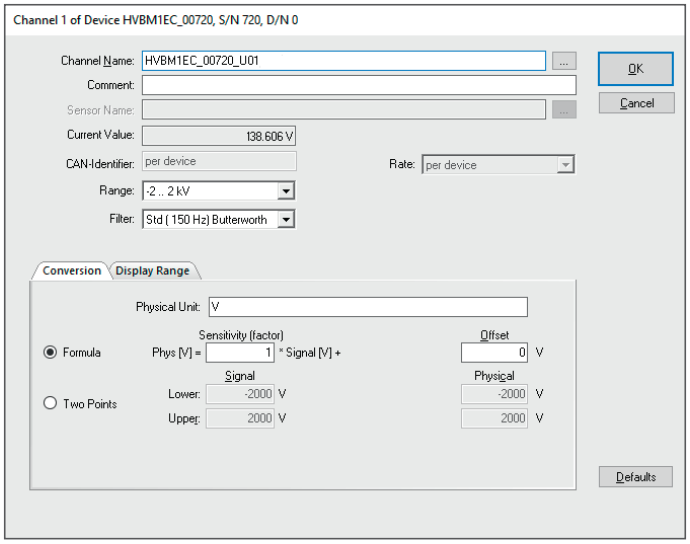


Fig. 6-32: **Channel configuration dialog** (HV BM 1.2)

☞ Make the required settings (Table "Channel configuration options HV BM 1.x modules").

☞ Click on **OK** to close the dialog.

☞ For configuring the remaining device channels, proceed as described above.

→ *CSMconfig online help, "Channel configuration dialog"*

Channel configuration options HV BM 1.x modules

Field	Function
General settings	
Channel Name	Input field for channel name. This name is stored in the DBC file and will be used by the DAQ software as identifier. Allowed characters: [a...z], [A...Z], [0...9] and [_] (max. 32 characters) It is possible to integrate a signal database in CSMconfig. The signal database is called up by clicking the ... button. This database allows signal names (channel names) to be selected and assigned to the measurement channel. A comment may have been assigned to the signal name. If so, it will be displayed in the **Comment** field after the signal name has been selected. A greyed-out button indicates that no signal database is available. → *CSMconfig online help, "Channel configuration dialog"*
Comment	Input field for additional text, e.g. channel-specific notes/comments; Any character may be used (max. 100 characters)
Sensor Name	This functionality is not available for HV BM 1.x modules and is therefore greyed out.
Current Value	Indicates the current measured value of the channel.
CAN Identifier	The channel-specific CAN identifier is defined with this option. This option is only available on the CAN side. To be able to use this function, the **Per channel configuration** option in the **Device configuration dialog** has to be enabled.
Measurement range	Pull-down menu for setting the measurement range: Voltage U: ±50 V, ±100 V, ±200 V, ±500 V, ±1 kV and ±2 kV[27] Current I: up to 1000 A (2000 A_{peak}), depending on the shunt module selected[28] Shield current I_S (HV BM 1.2+S): up to 250 A (500 A_{peak}), depending on the shunt module selected[29] The instantaneous power p is the product of U × I.
Buttons	
Defaults	Resets the settings in the dialog to the factory defaults. The content of some specific fields, however (e.g. **Channel Name**), remains unchanged.
Auto-Offset	... calls up the **Auto-Offset** function of the **Auto-Scale** wizard.
Auto Scale	... calls up the **Two Points** function of the **Auto-Scale** wizard.
Conversion tab	
Using physical scaling, the measured values supplied by a sensor can be scaled into any measured variable using downstream DAQ software (e.g. vMeasure CSM, INCA or CANape). CSMconfig provides the options **Formula** (scaling as a linear function) and **Two Points** (scaling over two points) here.	

27 In order to be able to record transient overvoltages, the measurement range has been dimensioned for ±2,000 V.
28 See specifications in the HV BM 1.x data sheets.
29 See specifications in the datasheet "HV Breakout Module Type 1.2+S".

Field	Function
Conversion tab (cont.)	
Physical Unit	Input field for the channel measurement unit. Allowed characters: [a...z], [A...Z], [0...9], [_], [°], [µ], [²] and [³] (max. 32 characters) The unit entered here is automatically displayed as measurement unit in the **Conversion** and **Display Range** tabs.
Formula	The **Formula** section provides options to create a formula in order to convert a value into another measured variable using **Sensitivity (factor)** and **Offset**.
Sensitivity (factor)	Input field for the scaling parameter
Offset	Input field for the offset value
Two Points	The **Two Points** function converts sensor readings into another measured variable by defining two points on one axis.
Signal	Measured values supplied by the sensor
Lower	Lower sensor reading
Upper	Upper sensor reading
Physical	scaled measured values in the measured variable set under **Physical Unit**
Lower	Lower value to be defined by the user
Upper	Upper value to be defined by the user
Display Range tab	
The default values for the measured value display can be defined in a downstream MC or DAQ tool here.	
Device	The lower and upper limit values of the scaled measurement range are displayed in the greyed-out fields.
Minimum	Display of the lower limit value of the scaled measurement range
Maximum	Display of the upper limit value of the scaled measurement range
User	These parameters are used to set the lower and upper limits for the display of the measured value range in the downstream MC or DAQ software. By default, it shows the minimum or maximum value of the measurement range that is displayed in the **Device** field.
Minimum	Minimum value to be defined by the user and used in the MC or DAQ software.
Maximum	Maximum value to be defined by the user and used in the MC or DAQ software.

Tab. 6-2: Channel configuration options (HV BM 1.x modules)

Measurement range configuration for ECAT and CAN operation

In order for the measurement data to be output on the CAN and the ECAT side, the measurement range has to be **configured identically** on both sides. If not, the module side that has been configured first will no longer send any measured values, but the error value "0x8000" or the error message "CONFIGURATION_ERROR".

This is indicated on the module by **measurement channel LED indictors permanently lit in red**. This error is displayed in the **Operation mode** row of the **Device configuration** dialog (see Fig. 6-33).

☞ Go to the **Device configuration dialog** (Fig. 6-35) and click on **Read from device**.

⇨ The dialog **Device configuration** opens (Fig. 6-33).

☞ Adjust the measurement range settings in the **Channel Parameters** section and then click **OK** to close the dialog again.

⇨ The **Device configuration dialog** opens.

☞ Click on **Write to Device** to store the adjusted data in the measurement module.

⇨ The red LEDs fade out and both sides of the module (ECAT and CAN) will be enabled again.

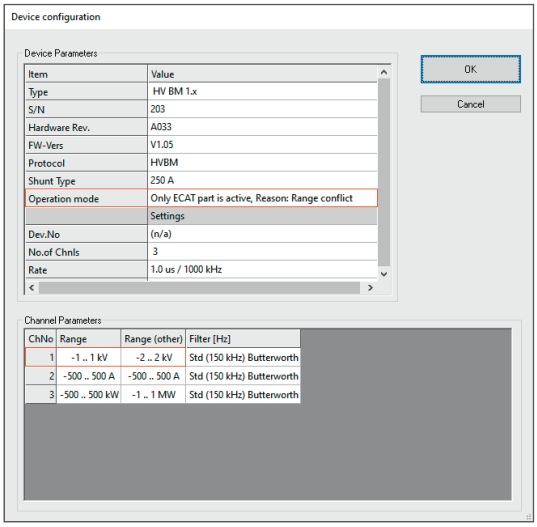


Fig. 6-33: Dialog **Device configuration**, differing measurement ranges for CAN and ECAT

6.5.3.8 Measurement module settings

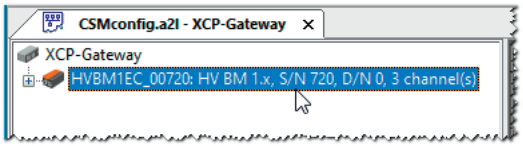


Fig. 6-34: **CSMconfig.a2l** window, module connected via ECAT

☞ Double-click on the device entry using the left mouse button.

⇨ The **Device configuration dialog** opens.

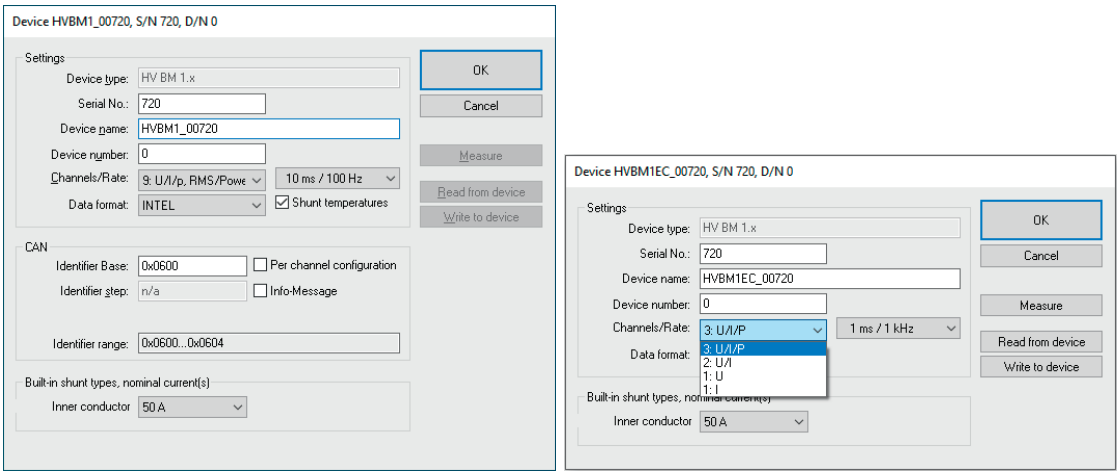


Fig. 6-35: **Device configuration dialog**, module connected via CAN (left) and via ECAT (right)

6.5.3.8.1 Device type

If **Scan Bus** or **Auto-Configuration** is performed during an online configuration, the measurement module that has been detected will be displayed in the **Device type** field.

In an offline configuration, the field **Device type** displays the device type that has been selected in the dialog **Select device type** (Fig. 6-14).

6.5.3.8.2 Serial No.

If **Scan Bus** or **Auto-Configuration** is performed in an online configuration, the detected serial number is displayed in the **Serial No.** field. The serial number is used to identify a measurement module in a measurement setup.

In an offline configuration, the serial number of the measurement device for which the configuration is created has to be entered manually into the **Serial No.** field.

6.5.3.8.3 Device name

A default name is displayed under **Device name** consisting of the name of the device type and the serial number. Alternatively, an individual, user-defined name can be entered.

The following conditions/limitations must be observed when assigning names:

- The maximum length of the name is 24 characters.
- Allowed characters: [a...z], [A...Z], [0...9] and [_].
- The name must start with a letter or [_].
- The name needs to be unique. It may only be used once per configuration file.

If the default name is retained, it will be automatically adjusted as soon as the serial number is changed. The name entered in this field is also used as a component for the channel designation (Fig. 6-35).

6.5.3.8.4 Device number

The **Device number** field is provided for entering a device number. However, the use of this number is not mandatory.

6.5.3.8.5 Channels

The number of measurement channels which are available is specified in the **Channels** selection menu. The following options can be selected in the default scope of functions:

HV BM 1.1/1.2	HV BM 1.2+S	HV BM 1.2+U
▸ **3: U/I/P** – voltage, current, instantaneous power ▸ **2: U/I** – voltage, current ▸ **1: U** – voltage ▸ **1: I** – current[30]	▸ **4: U/I/P +S** – voltage, current, instantaneous power, shield current ▸ **3: U/I/P** – voltage, current, instantaneous power ▸ **3: U/I +S** – voltage, current, shield current ▸ **2: U/I** – voltage, current ▸ **2: U +S** – voltage, shield current ▸ **2: I +S** – current, shield current[31] ▸ **1: U** – voltage ▸ **1: I** – current[31]	▸ **4: U/I/+U/-U** – voltage, current, U+ potential and U- potential ▸ **2: U/I** – voltage, current ▸ **1: U** – voltage

Tab. 6-3: HV BM 1.x: Setting options **Channels** menu

In addition to the measurement of voltage, current and the calculation of the instantaneous power, HV BM 1.x modules can optionally calculate further power and RMS values on the CAN side. These additional channels are not available by default and have to be activated with the option "Calc.".[31]

Module type	Setting options	Channels additionally available
HV BM 1.1/HV BM 1.2	▸ **9: U/I/p, RMS/Power**	1× U_{RMS} RMS voltage value 1× I_{RMS} RMS current value 1× P Active power 1× S Apparent power 1× Q Reactive power 1× λ Power factor
HV BM 1.2+S	▸ **10: U/I/p, +S, RMS/Power**	
HV BM 1.2+U	▸ **10: U/I/+U/-U, +S, RMS/Power**	

Tab. 6-4: HV BM 1.x: Additional channels for power and RMS measurements

→ *CSMconfig online help, "Calculation of Power and RMS Values" and "HV BM 1.x Device Configuration"*

30 Only available on the ECAT-side
31 The measurement modules concerned must also fulfil the necessary hardware and firmware version requirements.

Measuring just the current in CAN bus mode

When operating the measurement module on the CAN bus, there is no option "1:I" for measuring only the current. To be able to measure just the current on the CAN side, the following steps are required:

☞ Enable the option **Per channel configuration** in the **CAN** section (Fig. 6-38).

☞ Then enter the CAN ID "0" or "0x0000" for the "U" and "P" channels in the **CAN ID** field of the Channel configuration dialog.

→ *CSMconfig online help, "HV BM 1.x device configuration"*

6.5.3.8.6 Rate

The measurement data rate valid for all channels is set via the selection menu **Rate**.

6.5.3.8.7 Shunt temperatures

HV Breakout modules are equipped with built-in sensors which allow the monitoring of the shunt temperatures. The **Shunt temperatures** option is active by default, i.e. these signals are transmitted both on the CAN side and on the ECAT side as standard and displayed in the DAQ software as further measured values. This option can be disabled if the temperature signals are not to be transmitted.

For the HV BM 1.x modules, the **Shunt temperatures** option provides the following signals:

- *_devicename_Temp_Shield* HV BM 1.2+S: Shunt temperature, shield current measurement
- *_devicename_Temp_L1* HV BM 1.1/1.2: Shunt temperature, measurement of inner conductor current HV BM 3.3/HV BM 3.1 OBC: Shunt temperature, phase 1

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

6.5.3.8.8 Data format

The selection menu **Data format** provides two formats for the transmission of CAN messages (no function and greyed out for ECAT measurement modules):

- INTEL (LSB first, Little Endian)
- MOTOROLA (MSB first, Big Endian)

6.5.3.8.9 **Built-in shunt types, nominal currents**

The **Built-in shunt types, nominal currents** section displays the shunts installed in the module. The HV BM 1.2+S is equipped with two shunts (1× inner conductor current, 1× shield current).

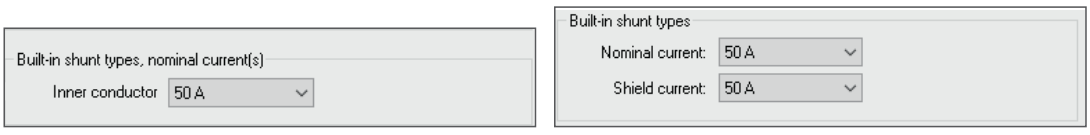


Fig. 6-36: **Built-in shunt types, nominal current(s)** dialog section: HV BM 1.1/1.2 (left), HV BM 1.2+S (right)

6.5.3.8.10 HV BM 1.x in CAN bus mode

If the measurement module is connected via CAN, the **Device Configuration dialog** will also include the **CAN** section (Fig. 6-35).

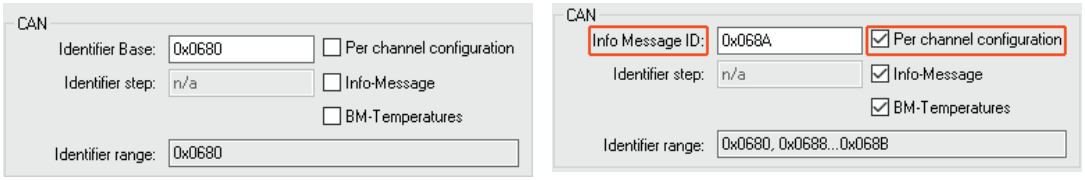


Fig. 6-37: Device configuration dialog, dialog section **CAN**

Identifier base

The start identifier is displayed in the **Identifier Base** field. The initial value displayed here depends on the settings made in the **Program Settings** dialog in section **CAN: Identifier base**. This value can be modified if required (e.g. in case of a CAN-ID conflict).

→ *CSMconfig online help, "Program Settings" and "AutoConfig options"*

Identifier step

As for HV Breakout Modules, the **Identifier step** field has no function. This field is thus greyed out.

Identifier Range

The range of the CAN identifiers used is displayed in the **Identifier range** field. By default, CAN identifiers and transmission rate (Fig. 6-35) are specified per device.

Per channel configuration

The option **Per channel configuration** provides the means to set CAN identifier and transmission rate *individually for each channel*. Activating this option has the following effects:

- In the Settings dialogue area, the Rate pull-down menu fades out.
- The name of the **Identifier base** field changes into **Info Message ID** Fig. 6-37. This field then displays the start ID of the optional CAN message that has been activated first.
- The options **CAN identifier** and **Rate** are now available in the **Channel configuration dialog** (Fig. 6-38).

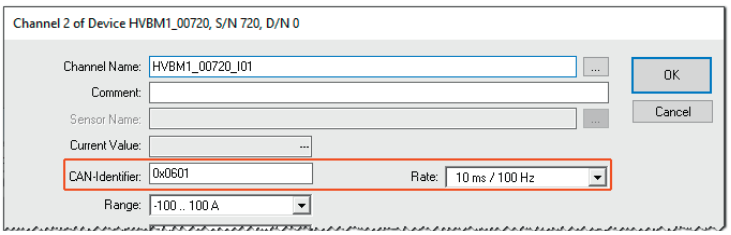


Fig. 6-38: **Channel configuration dialog**, module connected via CAN and **Per channel configuration** enabled

i	The **Per channel configuration** functionality is only available for particular CAN measurement modules. A list containing these measurement modules can be found in the online help. → *CSMconfig online help, "Specifying CAN ID and Send Rate per Channel"*

Info Message

The option **Info Message** can be used to transmit further CAN signals in addition to the recorded measurement values. This option is **disabled by default** and has to be enabled for these signals to be transmitted.

As for HV Breakout Modules, the info message contains the following signals:

- *_devicename_Temp_Dev* Internal temperature of the measurement module
- *_devicename_Temp_Shunt* HV BM shunt temperature[32]

→ *CSMconfig online help, "How to use HV Breakout Modules" and "File format 'DBC' (CAN Signal Database)"*

	NOTE!
	Each additional CAN message requires a further CAN ID. If the option **Info message** is activated in addition to the **Shunt temperatures** option (which is activated by default), two additional CAN IDs are required (→ increased bus load).

6.5.3.8.11 Transmitting configuration data and verifying measurement values

Read from device / Write to Device

- **Read from device** reads the configuration from a measurement module. The firmware version and the hardware revision number of the measuring module are also read out.
- **Write to Device** transfers the configuration data to the measurement module.

  ☞ Click on the **Write to device** button to start the process.

  ⇨ The following message is displayed:

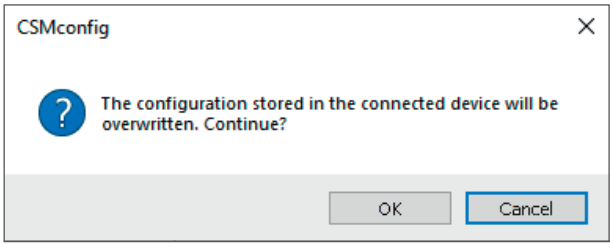


Fig. 6-39: Safety prompt before overwriting the old configuration

☞ Click on **OK** to save the new configuration.

⇨ A message indicates the successful reconfiguration of the measurement module.

or

☞ Click **Cancel** to retain the configuration that has previously been stored in the measurement module.

→ *CSMconfig online help, "Device configuration dialog"*

32 "*_devicename_Temp_Shunt*" transmits the signals of *one* shunt and is therefore only to be used for transmitting the shunt temperature of HV breakout modules with only one shunt (HV BM 1.1/HV BM 1.2/HV BM 1.2+U). In combination with HV Breakout Modules equipped with two (HV BM 1.2+S) or three shunts (HV BM 3.1 OBC/HV BM 3.3), only the highest of the available shunt temperatures will be transmitted via this signal.

Check measured values

The **Measure** command can be used to check the plausibility of measurements.

☞ Click on **Measure** (Fig. 6-29).

⇨ The **Measurement Values** window opens.

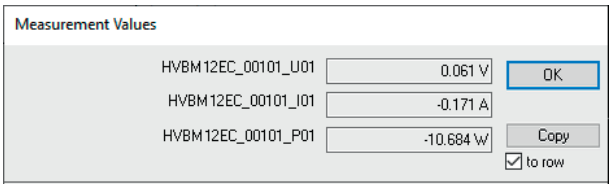


Fig. 6-40: **Measurement Values window** (HV BM 1.2)

☞ Click **OK** to close the **Measurement Values** window.

☞ Click **OK** to close the **Device configuration dialog**.

6.5.3.9 Saving a configuration

The configuration can then be saved in an A2L file. The default path for the storage of configuration files refers to the CSMconfig installation directory. If user rights are restricted, the program prompts the user to save the file in the corresponding user directory.

Changing the path for file storage

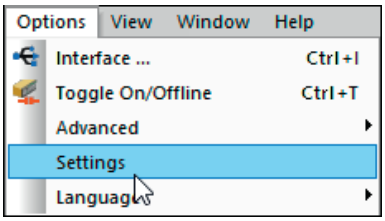


Fig. 6-41: **Options | Settings**

☞ Select **Options | Settings**.

⇨ The **Program Settings** dialog opens.

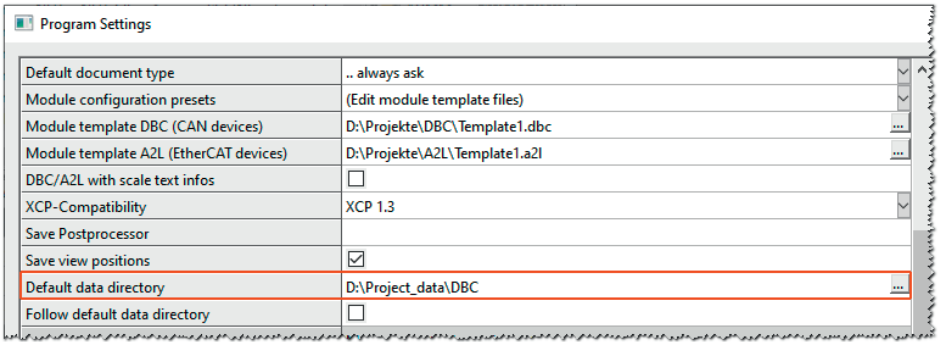


Fig. 6-42: **Program Settings** dialog, option **Default data directory**

☞ Enter the new path in the **Default data directory** field.

☞ Click on **OK** to close the **Program Settings** dialog.

i	If the option **Follow default data directory** is enabled, CSMconfig always sets the path that the user last used for storing a DBC or A2L file in the **Default data directory** path.

Saving an A2L file

☞ Select **File | Save**.

⇨ The **Save As** dialog opens.

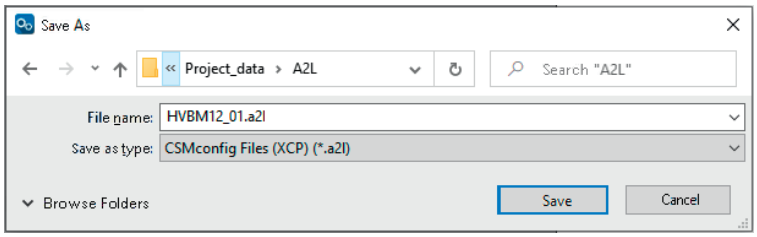


Fig. 6-43: Dialog **Save As**

☞ Select a directory, enter the name in the **File name** field and confirm with **Save**.

⇨ The configuration file with the file extension *.a2l is saved in the current folder.

⇨ The name of the newly created configuration file appears in the header of the **Tree View** window (here: HVBM12_01.a2l).

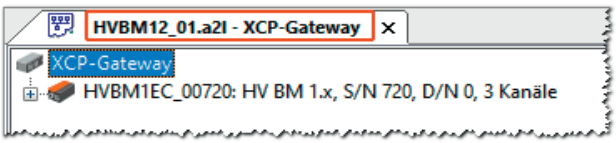
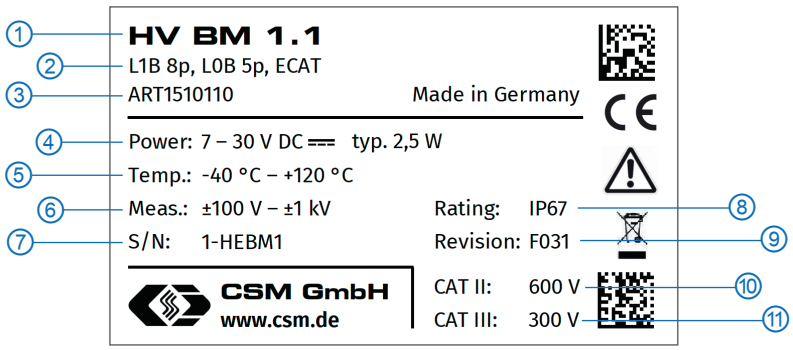


Fig. 6-44: New file name in the header: **HVBM12_01.a2l**

7 Maintenance and Cleaning

7.1 Type label

The type label shows the technical data of the measurement module.



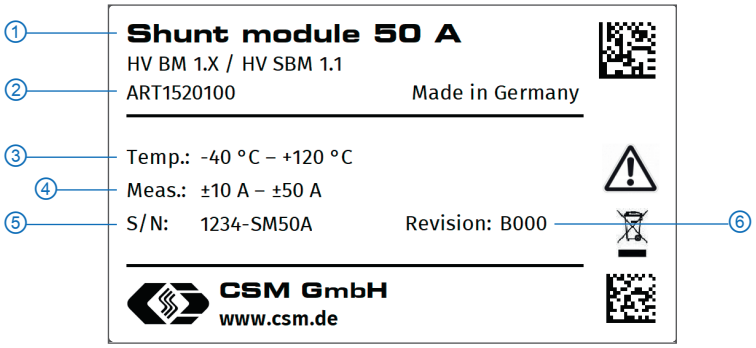
①	HV BM 1.1	Device type
②	L1B 8p, L0B 5p, ECAT	Device details: ▸ L1B 8p - EtherCAT® sockets: LEMO 1B, 8-pole ▸ L0B 5p - CAN sockets: LEMO 0B, 5-pole ▸ ECAT - bus system
③	ART1510110	Part number of the measurement module
④	Power: 7 – 30 V DC, typ. 2.5 W	Power supply range, typical power consumption
⑤	Temp.: -40 °C – +120 °C	Operating temperature range
⑥	Meas.: ±100 V – ±1 kV	Measurement ranges
⑦	S/N: HEBM1	Measurement module serial number
⑧	Rating: IP67	Protection class
⑨	Revision: F031	Hardware revision number
⑩	CAT II: 600 V	Measurement category II [33]
⑪	CAT III: 300 V	Measurement category III [34]

Tab. 7-1: Type label

33 For further information, please refer to the Technical Information "Measurement Categories for CSM HV Measurement Modules".

7.2 Shunt label

The type label is attached to the back of the module and contains details on the built-in shunt. Module version HV BM 1.2+S is equipped with two shunts (1× inner conductor current, 1× shield current) and therefore has two shunt labels.



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 ranges
⑤	S/N: 1234-SM50A	Serial number of the shunt module
⑥	Revision: B000	Hardware revision number

Tab. 7-2: Shunt label

7.3 Maintenance services

The following testing certificates are issued for HV BM 1.x measurement modules:

- DIN EN ISO/IEC 17025 calibration certificates for U and I
- Testing certificate (HV isolation test)

This is documented by corresponding labels attached to the rear or the top side of the module housing.

Fig. 7-1: DIN EN ISO/IEC 17025 calibration label

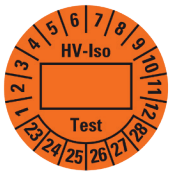


Fig. 7-2: High-voltage isolation test label

	NOTE!
	An isolation test is required every 12 months in order to ensure the measurement module's operational safety. ☞ Make sure that a high-voltage isolation test according to the latest edition of EN 61010 is carried out at least every 12 months.

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.

- HV isolation test (functional testing included)
- DIN EN ISO/IEC 17025 calibration (including function test)
- Repair service

Monitoring of calibration due date[34]

The feature for calibration due date monitoring provides the option to specify the period of time for which the calibration of a module is valid (**Calibration interval**). In addition, it is possible to define the period of time during which CSMconfig indicates the impending expiration of the validity of the calibration with recurring messages (**Lead warn time**).

☞ Select **Options | Settings** from the menu.

⇨ The **Program Settings** dialog opens.

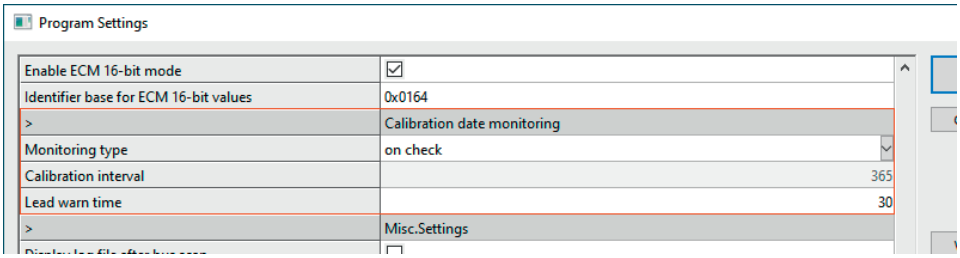


Fig. 7-3: **Program Settings** dialog, **Calibration date monitoring** section

☞ Make the required settings in section **Calibration date monitoring**.

→ *CSMconfig online help, "Program Settings"*

34 When monitoring the calibration date, CSMconfig checks the date that has been written to the measurement module during calibration. The calibration date is only available if the measurement module has been calibrated at the CSM calibration laboratory.

7.4 Cleaning instructions

WARNING!
 HV Breakout Modules are used in high-voltage applications. **Improper use may result in life-threatening electrical shocks.** ☞ Observe safety instructions.

NOTE!
 ☞ De-energize 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.

8 Appendix

8.1 Preparing HV power cables

8.1.1 General information

The following sections contain information on how to mount HV power cables to the various types of HV Breakout Modules.

	NOTE!
	CSM provides sets of ring terminals for module type HV BM 1.1 (Tab. 8-1), which are designed for the limited space available in the HV Breakout Module and for the dimensions of shielded two-core high-voltage power cables with conductors made of copper in accordance with LV 216-2 Tables A.5.1 and A.5.2. For the module types HV BM 1.2, HV BM 1.2+S and HV BM 1.2+U, CSM provides sets of ring terminals (Tab. 8-1) that are designed for the limited space available in the HV Breakout Module and for the dimensions of shielded single-core high-voltage power cables with fine-stranded copper conductors in accordance with LV 216-2 Table A.2. CSM recommends mounting the HV power cables for vehicles in HV Breakout Modules only with ring terminals that have been supplied by CSM.

8.1.2 Components for mounting HV power cables

Cross section	Cable (example)	Ring terminals	Cable gland
2× 6 mm²	Coroflex FHLR2GCB2G 2× 6 mm²	ART1520532 Ring Terminal Set 6 mm² HV BM 1.1	ART1520202 Cable gland set 9/14 HV BM
16 mm²	Coroflex FHLR2GCB2G 16 mm²	ART1520521 Ring Terminal Set 16 mm² HV BM 1.2	ART1520202 Cable gland set 9/14 HV BM
25 mm²	Coroflex FHLR2GCB2G 25 mm²	ART1520522 Ring Terminal Set 25 mm² HV BM 1.2	ART1520202 Cable gland set 9/14 HV BM
35 mm²	Coroflex FHLR2GCB2G 35 mm²	ART1520523 Ring Terminal Set 35 mm² HV BM 1.2	ART1520201 Cable gland set 11/20 HV BM
50 mm²	Coroflex FHLR2GCB2G 50 mm²	ART1520544 Ring Terminal Set 50 mm² HV BM 1.2	ART1520201 Cable gland set 11/20 HV BM
70 mm²	Coroflex FHLR2GCB2G 70 mm²	ART1520545 Ring Terminal Set 70 mm² HV BM 1.2	ART1520201 Cable gland set 11/20 HV BM
			ART1520200 Cable gland set 15/25 HV BM
95 mm²	Coroflex FHLR2GCB2G 95 mm²	ART1520526 Ring Terminal Set 95 mm² HV BM 1.2	ART1520200 Cable gland set 15/25 HV BM

Tab. 8-1: Components for single- and two-core HV power cables

8.1.3 Preparing the cable glands

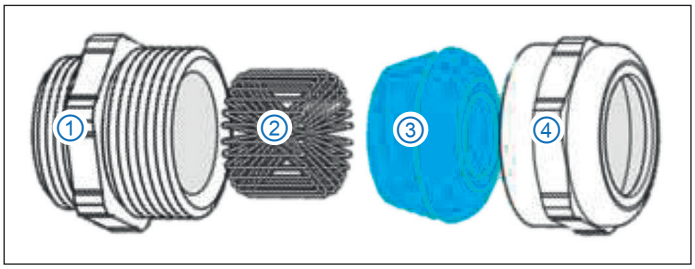


Fig. 8-1: Components of a cable gland with triangular spring 'TRI' contacting the braided shield

1. Double nipple
2. Triangular spring 'TRI'
3. Sealing insert
4. Pressure screw

i	The triangular springs (Fig. 8-1, ③) are needed to establish contact between the braided shield of the HV power cable and the module housing. If no contact between braided shield and housing is required, these springs can be omitted.

The two-part silicone sealing insert[35] with removable inlet has two zones (cable diameter): 1× with inlet and 1× without inlet. Fig. 8-2 shows the sealing insert of a cable gland with the sealing ranges 25 – 20 mm (without inlet) and 20 – 15 mm (with inlet). If necessary, the inlet has to be removed from the sealing insert.

Fig. 8-2: Cable gland with sealing insert

The following cable glands are available for mounting the HV power cables:

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

Tab. 8-2: Technical data of the cable glands used

The scope of delivery of the **9/14** and **11/20** cable glands includes reducers from M32 to M20 and from M32 to M25. The tightening torques for double nipples and pressure screws as well as further manufacturer information can be found in the product catalogue. [36]

35 The sealing insert is not available for all cable glands, see Tab. 8-2.
36 Pflitsch Cable Gland Catalogue 2024

8.1.4 Installation instructions for pressure screw and triangular spring

NOTE!	
	Depending on which HV power cables and cable glands are used, there is a risk of chafing. ☞ Protect the HV power cables with suitable heat-shrink tubing if required.

To ensure proper contact between the braided shield ① and the triangular spring ② in the cable gland (Fig. 8-3), the cable has to be mounted carefully, so that the position of the stripped cable matches that of the triangular spring.[37]

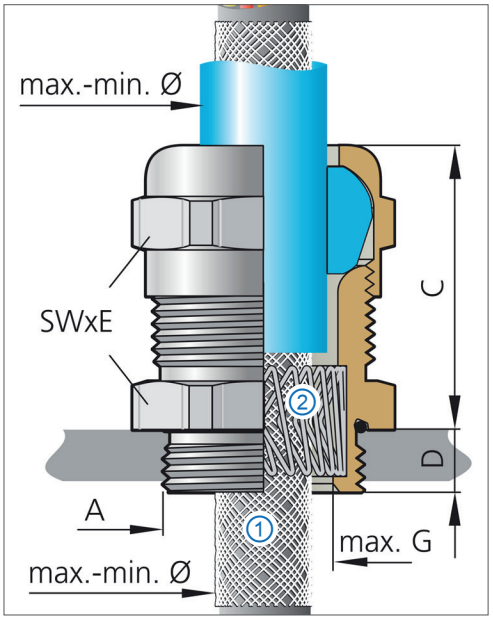


Fig. 8-3: Cable gland (longitudinal section)

i	These springs can be removed if the braided shields are soldered to the feedthrough.

37 For further information on Pflitsch blueglobe TRI cable glands, see Pflitsch Cable Gland Catalogue 2024.

NOTE!	
	Please note that the use of a reducer increases the overall length of a cable gland. If a reducer from M32 to M25 or M20 is used, the overall length of the cable gland is increased by approx. 4 mm (Fig. 8-5).

If a reducer is used, this also increases the distance between the ring terminal and the area of the HV power cable that needs to be stripped in order to establish contact between the triangular spring and the braided shield of the HV power cable (Fig. 8-5).

Fig. 8-4: Cable gland: without reducer (left) and with reducer (right) ①

To establish a good electrical connection between module housing and the braided shield of the cable, the triangular spring in the cable gland requires an approx. 10 mm long contact area on the cable shield.

If a reducer is used, as shown in the right-hand illustration in Fig. 8-4, the overall length of the cable gland increases by 4 mm. This has to be kept in mind when preparing an HV power cable.

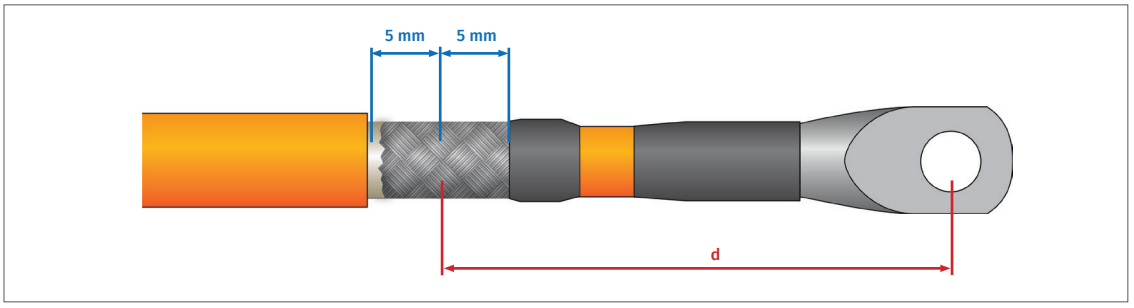


Fig. 8-5: HV power cable, contact area for spring

- without reducer (M32): d = 70 mm
- with reducer (M32 to M25 or M20): d = 74 mm

8.1.5 Stripping lengths for HV power cables

How HV power cables are to be mountes/stripped depends on the following aspects:

- What type of module are the HV power cables connected to?
- How are the braided shields of the HV power cables connected?
  - Are the braided shields connected to ground/protective earth or are they fed through?
  - If the braided shields are connected to ground/protective earth, will the connection be made via the cable glands (chapter 8.1.6 and onward) or by using the M3 threaded holes in the module housing (chapter 8.1.9)?
- Which cable cross-section is used?

i	When connecting the power cables HV- and HV+ to an HV BM 1.2+S, the braided shields of the HV power cables are *not* connected to the module housing. When connecting the power cables HV- and HV+ to an HV BM 1.2+U, the braided shields of the HV power cables *should* be soldered to the feedthrough.

8.1.6 Mounting of HV power cables to HV BM 1.1 and HV BM 1.2

In principle, the same guidelines apply when mounting the HV power cables to the module types HV BM 1.1 and HV BM 1.2.

- The inner conductors of the HV- power cables are connected to the shunt for measuring the inner conductor current.
- The inner conductors of the HV+ power cables are connected to the threaded bolts of the copper domes (copper busbar).
- The braided shields are connected to the housing/ground, either via the cable glands or by using the M3 threaded holes.

NOTE!	
	The information in this chapter applies when contacting the braided shields via the cable glands. When the braided shields are connected via the M3 threaded holes, different dimensions for the stripping of the cables apply. → Chapter 8.1.9 "Preparing the HV power cables when connecting the braided shields to the M3 threaded holes"

Cable cross section	Stripping length of outer sheath	Length of braided shield	Stripping length of inner sheath
2× 6 mm²	75 mm	17 mm	-
35 mm²	65 mm	17 mm	20 mm
50 mm²	62 mm	17 mm	12 mm
70 mm²	55 mm	17 mm	15 mm
95 mm²	55 mm	17 mm	25 mm

Tab. 8-3: Dimensions for the preparation of HV power cables for module types HV BM 1.1 and HV BM 1.2

8.1.6.1 Preparing single- and two-core HV power cables (HV BM 1.2 and HV BM 1.1)

i	The steps 1 to 5 for the installation described below are identical for single-core cables (HV BM 1.2) and two-core cables (HV BM 1.1). The steps 6 to 8 differ depending on whether it is a single-core or a two-core HV power cable.

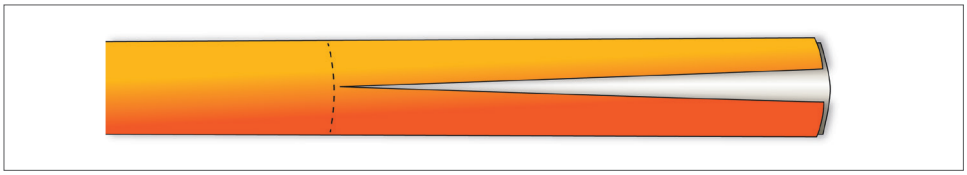


Fig. 8-6: Step 1: Removing the outer sheath

☞ Remove the required length of the outer sheath (Tab. 8-3). Make sure that the braided shield lying underneath will not be damaged.

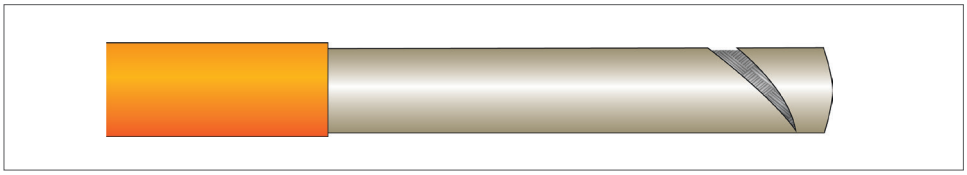


Fig. 8-7: Step 2: Removing the protective foil.

☞ Remove the protective foil from the braided shield.

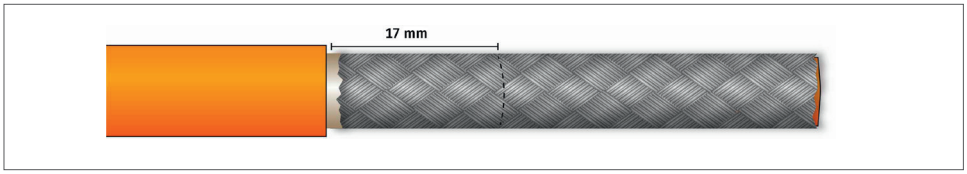


Fig. 8-8: Step 3: Applying the mark on the braided shield

☞ Mark a 17 mm long section on the braided shield (Tab. 8-3).

☞ Remove the remaining braided shield.

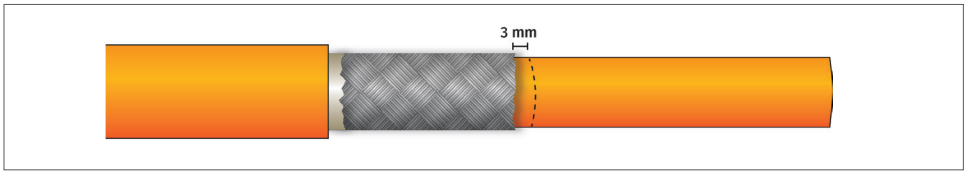


Fig. 8-9: Step 4: Marking the inner sheath

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

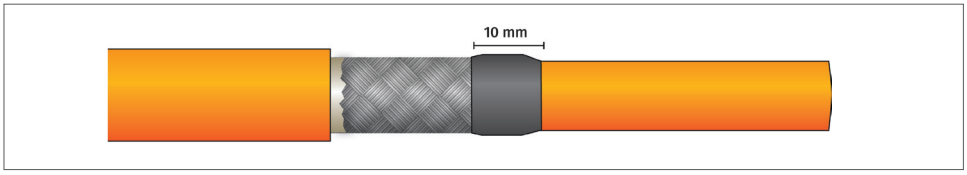


Fig. 8-10: Step 5: Attaching and fixing the heat-shrink tubing

☞ Slide a 10 mm long piece of heat-shrink tubing over the HV power cable up to the mark (Fig. 8-9).

☞ Fix the heat-shrink tubing.

8.1.6.1.1 Single-core cable (HV BM 1.2)

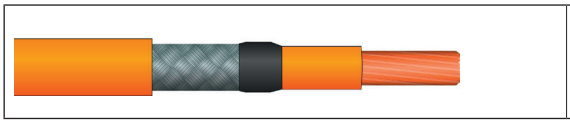


Fig. 8-11: Step 6: Stripping the inner sheath

☞ Remove the inner sheath to the required length (Tab. 8-3).

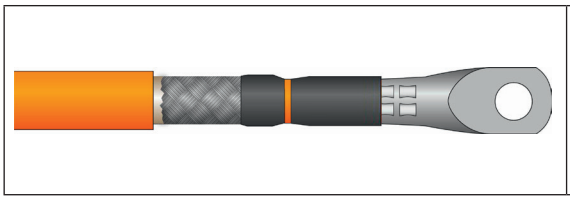


Fig. 8-13: Step 7: Sliding the heat-shrink tubing over the cable and attaching the ring terminal

☞ Slide an approx. 25 mm long piece of heat-shrink tubing over the inner sheath.

☞ Attach the ring terminal to the stripped conductor.

☞ Use the crimping pliers to crimp the ring terminal.

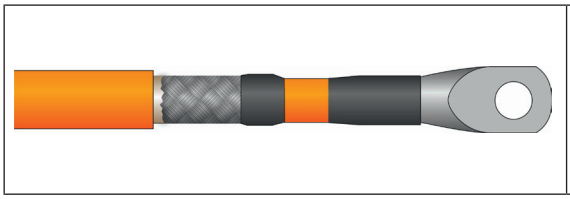


Fig. 8-15: Step 8: Placing/fixing the heat-shrink tubing

☞ Slide the heat-shrink tubing over the crimped end of the ring terminal, so that the end of the ring cable lug is sufficiently covered.

☞ Fix the heat-shrink tubing.

8.1.6.1.2 Two-core cable (HV BM 1.1)

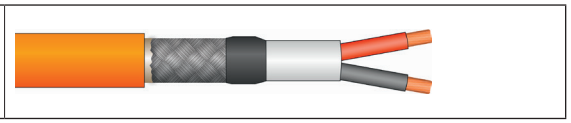


Fig. 8-12: Step 6: Stripping inner sheath/single wires

☞ Strip the inner sheath to 30 mm.

☞ Strip the black and red single wires to 8 mm each.

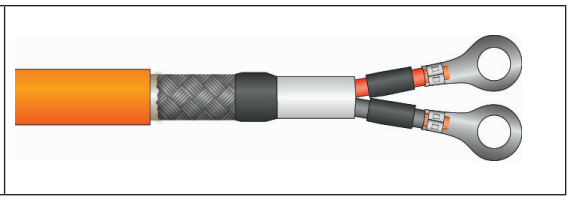


Fig. 8-14: Step 7: Fitting the heat-shrink tubings and attaching the ring terminals

☞ Slide a sufficiently long piece of heat-shrink tubing over each single wire.

☞ Attach the ring terminals to the stripped wires.

☞ Use the crimping pliers to crimp the ring terminals.

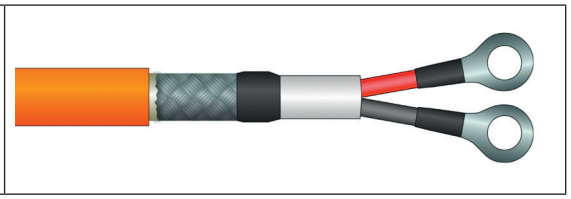


Fig. 8-16: Step 8: Placing/fixing the heat-shrink tubings

☞ Slide the heat-shrink tubings over the crimped ends of the ring terminals so that the crimped ends and the red or black sheath of the individual wires are sufficiently covered.

☞ Fix the heat-shrink tubings.

→ Chapter 5.2 "Connecting HV power cables to an HV BM 1.1/HV BM 1.2"

8.1.7 Preparing HV power cables for module type HV BM 1.2+S

8.1.7.1 Preparing the HV- power cables

The following information applies to the preparation of HV- power cables.

- The inner conductor is connected to the shunt for measuring the inner conductor current.
- The shield is connected to the shunt for measuring the shield current.

The stripping lengths and specifications for shortening the inner conductor vary depending on the cross-section of the HV power cable.

Cable cross section	Stripping length of outer sheath	Length of braided shield	Shortening of inner conductor	Stripping length of inner sheath
35 mm²	80 mm	55 mm	47 mm	18 mm
50 mm²	80 mm	55 mm	50 mm	13 mm
70 mm²	70 mm	55 mm	43 mm	17 mm
95 mm²	70 mm	58 mm	35 mm	25 mm

Tab. 8-4: Dimensions for the preparation of HV- power cables (HV BM 1.2+S)

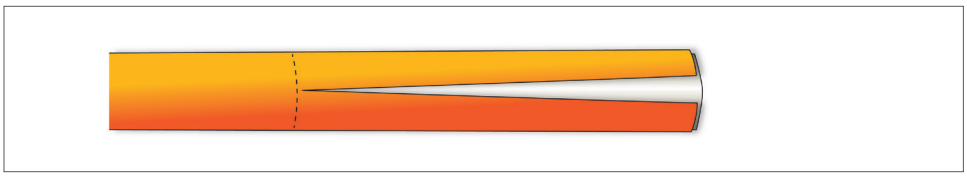


Fig. 8-17: Step 1 (HV BM 1.2+S, HV-): Removing outer sheath and protective foil

☞ Remove the outer sheath as specified in Tab. 8-4. Make sure that the braided shield lying underneath will not be damaged.

☞ Remove the protective foil from the braided shield.

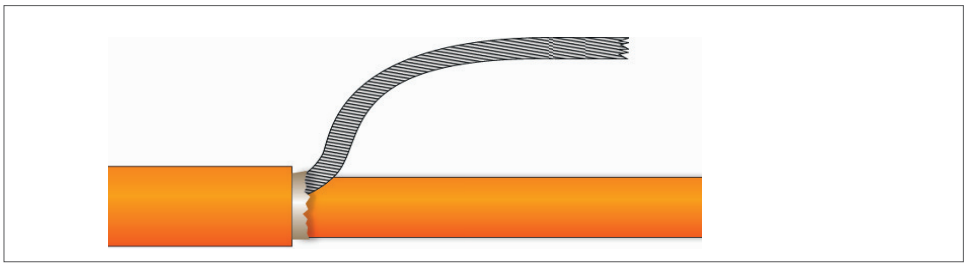


Fig. 8-18: Step 2 (HV BM 1.2+S, HV-): Twisting the braided shield into a strand

☞ Twist the braided shield into a strand and shorten it as specified in Tab. 8-4.

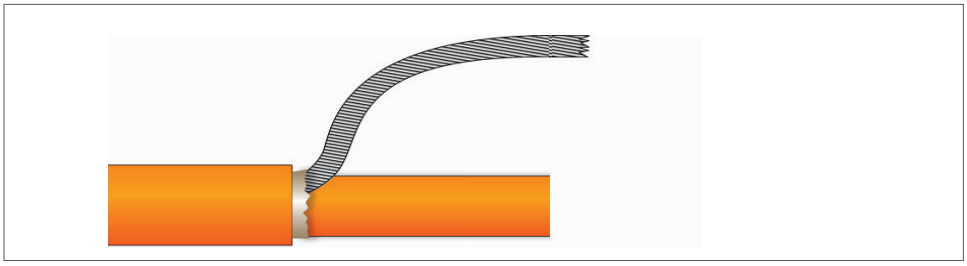


Fig. 8-19: Step 3 (HV BM 1.2+S, HV-): Shortening the inner conductor

☞ Shorten the inner conductor as specified in Tab. 8-4.

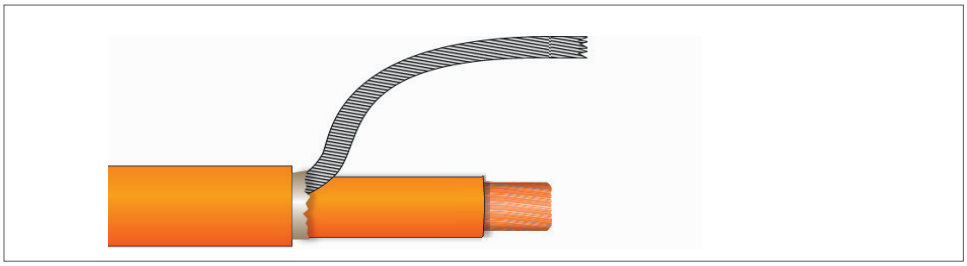


Fig. 8-20: Step 4 (HV BM 1.2+S, HV-): Stripping the inner sheath

☞ Remove the inner sheath as specified in Tab. 8-4.

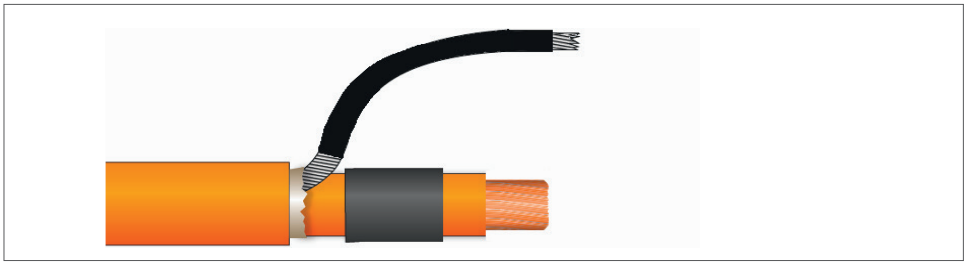


Fig. 8-21: Step 5 (HV BM 1.2+S, HV-): Applying the heat-shrink tubings

☞ Slide sufficiently long pieces of heat-shrink tubing onto the sheath of the inner conductor and the strand of braided shield respectively.

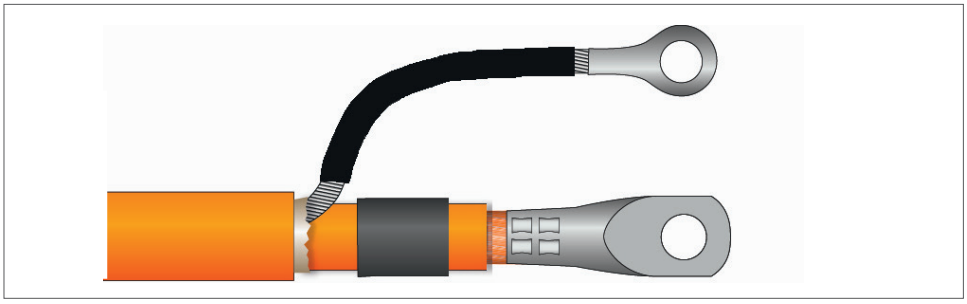


Fig. 8-22: Step 6 (HV BM 1.2+S, HV-): Attaching and crimping the ring terminals

☞ Attach the ring terminals to the stripped inner conductor and the strand of braided shield.

☞ Crimp the ring terminals.

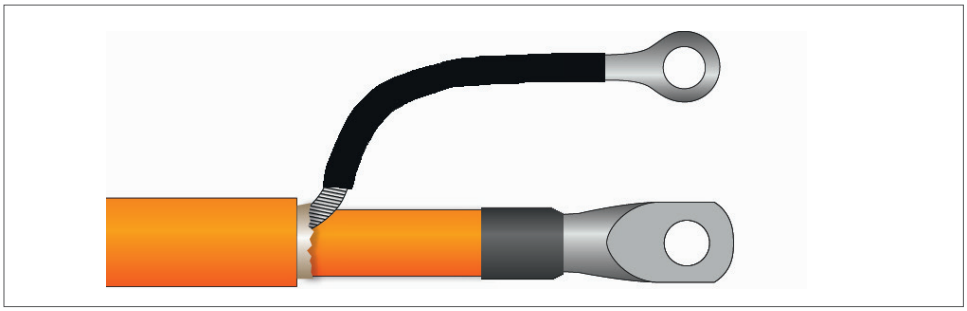


Fig. 8-23: Step 7 (HV BM 1.2+S, HV-): Applying and fixing the heat-shrink tubings

☞ Slide the heat-shrink tubings over the crimped ends of the ring terminals so that the crimped ends are sufficiently covered.

☞ Fix the heat-shrink tubings.

8.1.7.2 Preparing the HV+ power cables (braided shield soldered to the feedthrough)

The following details apply to the mounting of the HV+ power cables.

- The inner conductor is connected to the copper busbar using a ring terminal.
- The braided shield is connected to an isolated feedthrough for continuity via solder. The braided shield is divided and twisted into two strands of equal length prior to soldering to the feedthrough (Fig. 8-24).

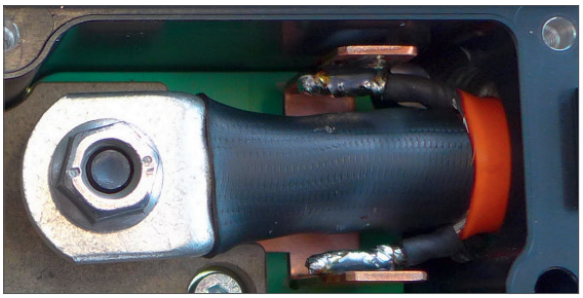


Fig. 8-24: HV+ power cable, strands of braided shield soldered to the feedthrough

The stripping lengths and specifications for shortening the inner conductor vary depending on the cross-section of the HV power cable.

Cable cross section	Stripping length of outer sheath	Length of braided shield	Shortening of inner conductor	Stripping length of inner sheath
35 mm²	50 mm	2× 28 mm	17 mm	18 mm
50 mm²	30 mm	2× 18 mm	–	13 mm
70 mm²	35 mm	2× 18 mm	8 mm	17 mm
95 mm²	40 mm	2× 28 mm	5 mm	25 mm

Tab. 8-5: Dimensions for the preparation of HV+ power cables (HV BM 1.2+S)

i	The installation information in this chapter also applies to module type **HV BM 1.2+U** if the braided shields of the HV- and HV+ power cables are soldered to the feedthrough.

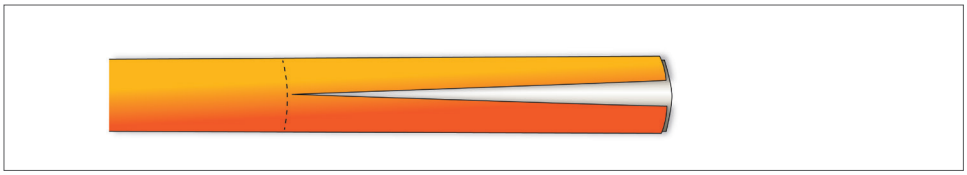


Fig. 8-25: Step 1 (HV BM 1.2+S): Removing outer sheath and protective foil

☞ Remove the outer sheath as specified in Tab. 8-5. Make sure that the braided shield lying underneath will not be damaged.

☞ Remove the protective foil from the braided shield.

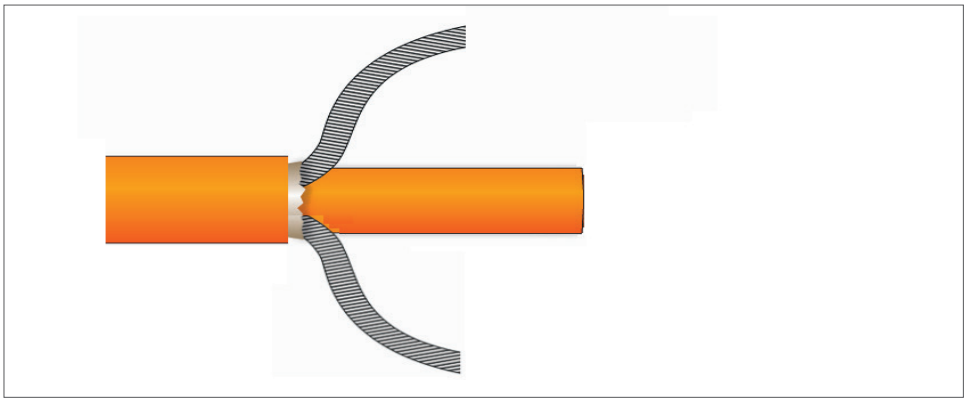


Fig. 8-26: Step 2 (HV BM 1.2+S, HV-): Twisting/shortening the braided shield

☞ Divide the braided shield, twist it into two strands of equal length and shorten them as specified in Tab. 8-5.

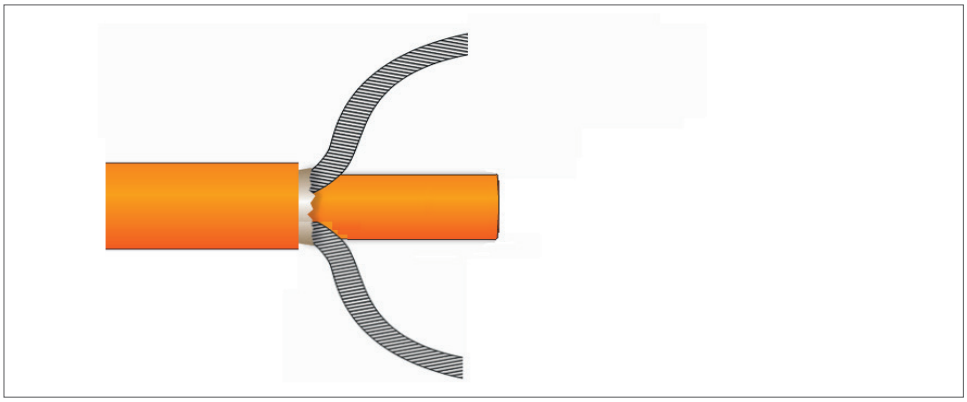


Fig. 8-27: Step 3 (HV BM 1.2+S, HV-): Shortening the inner conductor

☞ Shorten the inner conductor as specified in Tab. 8-5.

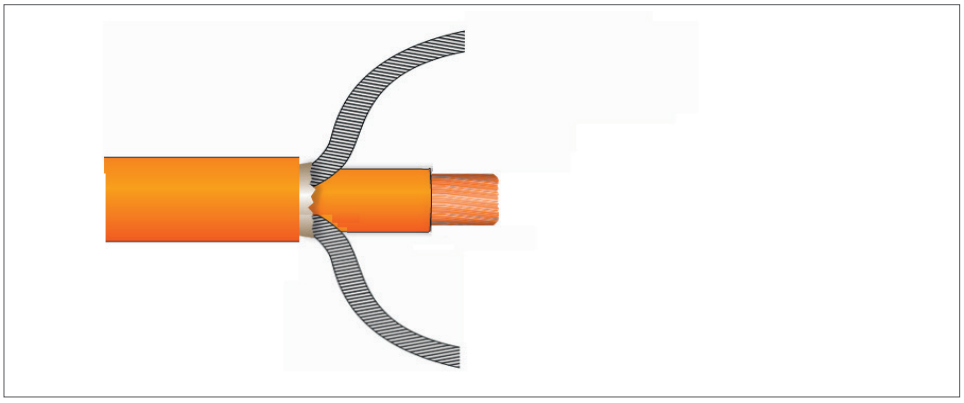


Fig. 8-28: Step 4 (HV BM 1.2+S): Stripping the inner conductor

☞ Strip the inner conductor as specified in Tab. 8-5.

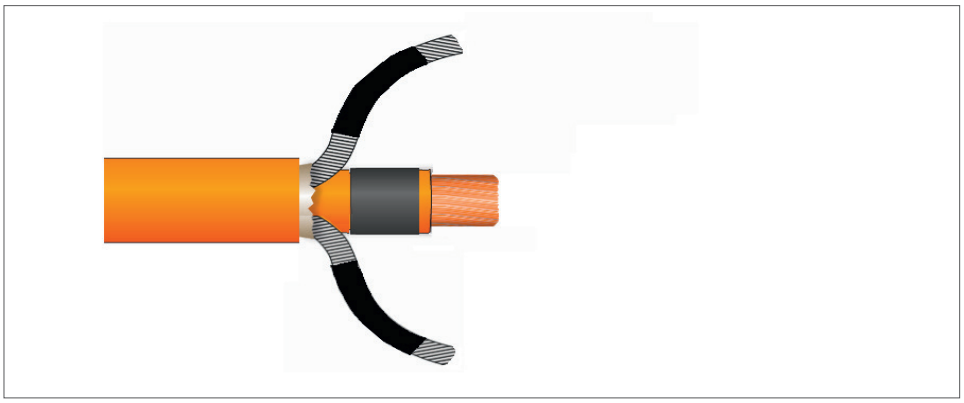


Fig. 8-29: Step 5 (HV BM 1.2+S): Applying heat-shrink tubing(s)

☞ Slide a piece of heat-shrink tubing of suitable length onto the inner sheath.[38]

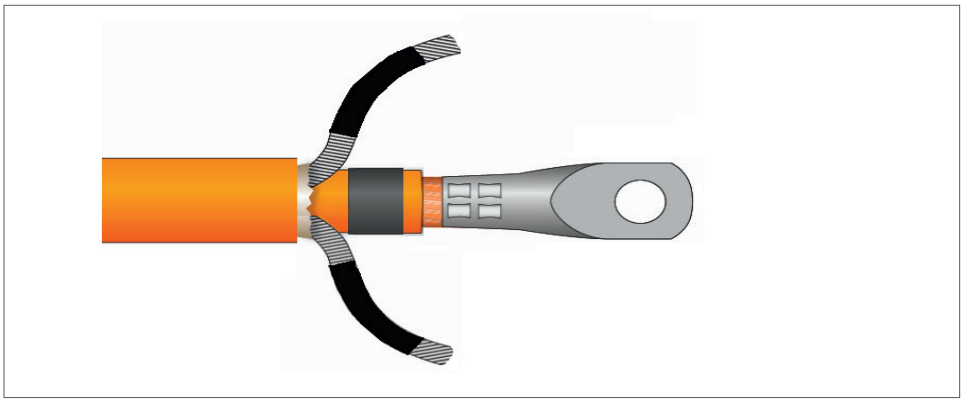


Fig. 8-30: Step 6 (HV BM 1.2+S): Attaching and crimping the ring terminal

☞ Attach the ring terminal to the stripped inner conductor.
☞ Crimp the ring terminal.

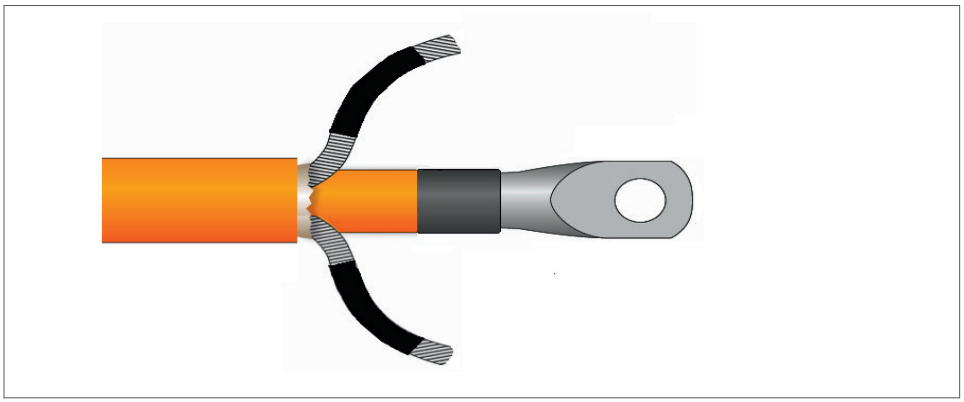


Fig. 8-31: Step 7 (HV BM 1.2+S): Applying and fixing shrink sleeve/shrink sleeves

☞ Slide the heat-shrink tubing over the crimped end of the ring terminal, so that the end of the ring terminal is sufficiently covered.
☞ Fix the heat-shrink tubing.
☞ Tin the ends of the strands of braided shields (Fig. 5-43).

38 If necessary, fit two pieces of heat-shrink tubing of suitable length onto the strands of braided shield.

8.1.8 Preparing HV power cables for module type HV BM 1.2+U

For connecting the braided shields to the feedthrough:

→ Chapter 8.1.7.2 "Preparing the HV+ power cables (braided shield soldered to the feedthrough)"

For connecting the braided shields to the module housing/ground via the cable glands, the specifications for mounting the single-core power cables (HV-/HV+) in the following chapter apply:

→ Chapter 8.1.6.1 "Preparing single- and two-core HV power cables (HV BM 1.2 and HV BM 1.1)"

8.1.9 Preparing the HV power cables when connecting the braided shields to the M3 threaded holes

8.1.9.1 Cable glands

Connecting the braided shields via the M3 threaded holes in the module housing is suitable for the module types HV BM 1.1 and HV BM 1.2.

NOTE!	
	If the braided shields are connected via the M3 threaded holes, the triangular springs have to removed from the cable glands.

→ Fig. 8-1 and chapter 8.1.3 "Preparing the cable glands"

8.1.9.2 Preparing the single-core HV power cables

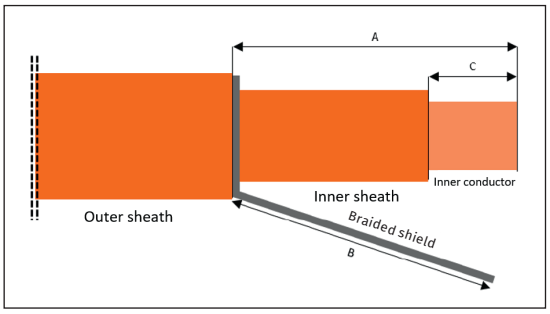


Fig. 8-32: Dimensions for the preparation of single-core HV power cables

Fig. 8-32 shows an example of specifications for the mounting of a single-core HV power cable when the braided shield is connected using the M3 threaded holes. The stripping lengths for **A**, **B** and **C** depend on the cross-sections of the HV power cable being used (Tab. 8-6).

Cable cross section	A – Stripping length of outer sheath	B – Length of braided shield	C – Stripping length of inner sheath
16 mm²	35 mm	30 mm	15 mm
35 mm²	50 mm	40 mm	20 mm
50 mm²	45 mm	40 mm	14 mm
70 mm²	40 mm	40 mm	18 mm
95 mm²	40 mm	40 mm	25 mm

Tab. 8-6: Dimensions for the preparation of single-core HV power cables

Preparing HV power cables (single-core)

☞ Remove the outer sheath in the required length (Tab. 8-6, **A**). Make sure that the braided shield lying underneath will not be damaged.

☞ Remove the protective foil from the braided shield.

☞ Twist the braided shield into a strand and shorten it to the required length (Tab. 8-6, **B**).

☞ Remove the inner sheath in the required length (Tab. 8-6, **C**).

☞ Attach ring terminals to the stripped inner conductor (inner conductor current measurement) and the strand of braided shield. Observe the orientation of the ring terminals.

☞ Crimp the ring terminal (inner conductor).

☞ Crimp the ring terminal for the braided shield.

☞ Slide a piece of heat-shrink tubing in the required length onto the strand of braided shield and fix it.

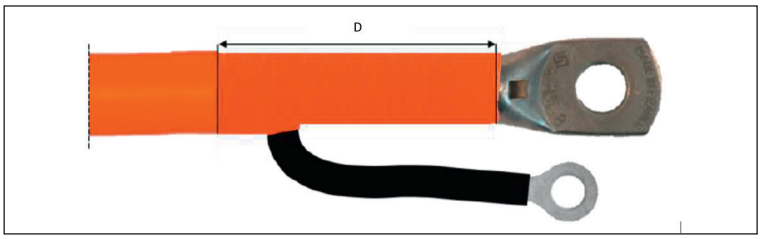


Fig. 8-33: Single-core HV power cable: stripped section (D)

☞ Double-wrap the stripped section on the HV power cable (Fig. 8-33, **D**) with insulating tape.

8.1.9.3 Preparing two-core HV power cables

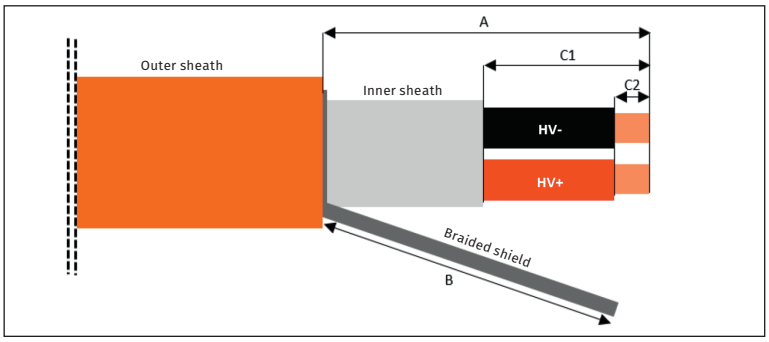


Fig. 8-34: Dimensions for the preparation of two-core HV power cables

Fig. 8-34 shows an example of specifications for the preparation of a two-core HV power cable when the braided shield is connected by using the M3 threaded holes. The stripping lengths for **A**, **B**, **C1** and **C2** depend on the cross-section of the HV power cable being used (Tab. 8-7).

Cable cross section	A – Stripping length of outer sheath	B – Length of braided shield	C1– Stripping length of inner sheath	C2 – Stripping length of single wires
2× 6 mm²	60 mm	50 mm	30 mm	6 mm

Tab. 8-7: Dimensions for the preparation of two-core HV power cables

Preparing two-core HV power cables

☞ Remove the outer sheath in the required length (Tab. 8-7, **A**).
Make sure that the braided shield lying underneath will not be damaged.

☞ Remove the protective foil from the braided shield.

☞ Twist the braided shield into a strand and shorten it to the required length (Tab. 8-7, **B**).

☞ Remove the inner sheath in the required length (Tab. 8-7, **C1**).

☞ Strip the red and black single wires (Tab. 8-7, **C2**).

☞ Attach the ring terminals to the stripped wires.

☞ Crimp the ring terminals.

☞ Slide the heat-shrink tubing in the required length onto the strand of braided shield and fix it.

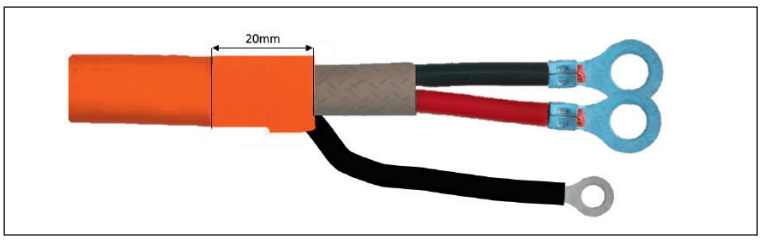


Fig. 8-35: Two-core HV power cable: apply insulating tape to the marked section

☞ Double-wrap the area marked in Fig. 8-35 (approx. 20 mm) on the HV conductor with insulating tape.

8.2 Distance between the threaded bolts used for connecting the shunt module

An HV Breakout Module that is only used temporarily can be removed from the HV power cable and bypassed. The distance between the two threaded bolts on which the shunt module is mounted is 60 mm for all HV Breakout Modules.

This distance is 60 mm for all HV Breakout Modules.

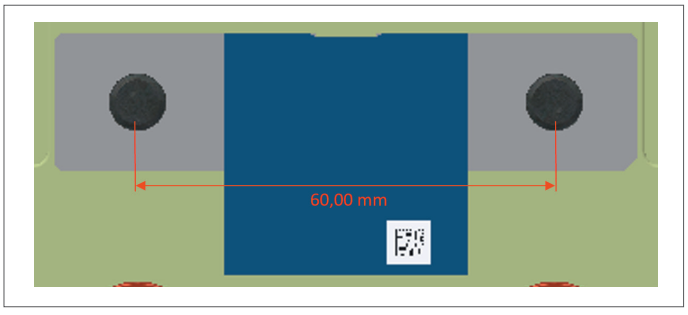


Fig. 8-36: Distance between threaded bolts

8.3 List of figures

8.4 List of tables

CSM GmbH Headquarters (Germany)

Raiffeisenstr. 36 • 70794 Filderstadt
+49 711 77 96 40 sales@csm.de

CSM Office Southern Europe (France, Italy)

ArchParc • Immeuble ABC 1 • Entrée A
60, rue Douglas Engelbart • 74160 Archamps, France
+33 4 50 95 86 44 info@csm-produits.fr

CSM Products, Inc. USA (USA, Canada, Mexico)

1920 Opdyke Court, Suite 200 • Auburn Hills, MI 48326
+1 248 836 4995 sales@csmproductsinc.com

CSM (RoW)

Vector Informatik (China, Japan, Korea, India, Great Britain)
ECM AB (Sweden)
DATRON-TECHNOLOGY (Slovakia, Czech Republic)

Our partners guarantee you worldwide availability.
Feel free to contact us.

CSM GmbH Germany is certified.

ISO 9001, ISO 14001
Certified Integrated Quality and Environmental Management System
www.tuv-sud.com/ms-cert

DAkkS
Deutsche Akkreditierungsstelle
D-K-15214-01-00