

HV Breakout Module Type 1.2+S

User Guide



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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.



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1 Introduction















1.1 About this user guide

This user guide contains important information on mounting, installing, and configuring the following HV Breakout Module:

- ▶ HV BM 1.2+S as of hardware revision C030

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)	 <i>CSMconfig Online Help, section "Menu commands"</i>
	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" .
	This pictogram refers to important notes or additional information on a specific topic.	 <small>CSM offers a mounting kit for devices in standard housings. For further information please contact our sales department.</small>
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	Association 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 E ther C AT®: 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 C AT®: 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: <ul style="list-style-type: none"> ▶ 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 T ool
OBC	O n- B oard C harger: charging unit in an electric vehicle used for charging the vehicle battery
STG	S Train 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!	
	<p>This symbol indicates important information.</p> <p>Failure to observe this information can impair the function or result in damage to the measurement module.</p> <p> Read the information carefully.</p>

Symbols

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

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.

The manufacturer is not liable for technical or editorial errors or missing information.

No liability for damage resulting from improper use of the product and/or non-observance of the product documentation is assumed.

→ [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 the manufacturer

1.8 ESD Information




The manufacturer declares that HV Breakout Modules of type HV BM 1.2+S comply with the requirements of EU Directive 2014/30/EU.


NOTE!	
	<p>Electronic components can be damaged or destroyed by electrostatic discharge (ESD).</p> <ul style="list-style-type: none">☞ 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 may only be used in a technically faultless condition and in accordance with their intended use. Please observe the safety instructions in this chapter and in the document "Safety Instructions HV Breakout Module Type 1.1 | 1.2 | 1.2+S" to avoid user hazards and/or damage to the measurement modules.


WARNING!	
	<p>HV Breakout Modules (HV BM) are used in high-voltage applications. Improper use of may result in life-threatening electrical shocks.</p> <ul style="list-style-type: none"> ☞ Only use qualified and trained personnel (observe local guidelines/regulations). ☞ Observe safety instructions.
WARNING!	
	<p>The orange lid of the device housing can be removed to mount or dismount the HV power cables. For safety reasons, the HV measurement module must only be operated with the lid fitted.</p> <p>Operating the HV measurement module without the lid poses a risk of life-threatening electrical shocks.</p> <ul style="list-style-type: none"> ☞ Before removing the lid, make sure that the HV power cables are de-energized. ☞ Only connect HV power cables with ring terminals approved by the manufacturer. ☞ Only operate the HV measurement module with the lid mounted. ☞ It is particularly important that lid and cable glands are properly mounted in order to ensure the tightness of the housing. <p style="text-align: center;">→ Chapter 5 "Installing the HV Power Cables"</p>
WARNING!	
	<p>The measurement module must 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.</p> <ul style="list-style-type: none"> ☞ Connect the measurement module to vehicle's potential equalization or PE using a suitable ground cable. ☞ Only use qualified and trained personnel. <p style="text-align: center;">→ Chapter 4.3.2.4 "Ground connection"</p>

WARNING!	
	<p>The internal temperature of the measurement module and the temperature of the shunts must not exceed +120 °C. The shunts can heat up considerably during operation under high load. The maximum temperature can also be exceeded when no measurements are performed but the module is integrated into a loaded circuit (e.g. when charging a vehicle battery).</p> <ul style="list-style-type: none"> ▶ As soon as the temperature of a shunt exceeds +120 °C, the HV Breakout Module sends the error code "0x8001" instead of the measured values for U and I. ▶ The error message "THERMAL_OVERLOAD" generated from the DBC/A2L file is displayed in the application. ▶ These messages remain valid until the temperature of all shunts drops below 115 °C again. <p>Exceeding the specified temperature impairs the operational safety of the HV Breakout Module and can lead to life-threatening electrical shocks and fire.</p> <p>Installation & Thermal Dissipation</p> <ul style="list-style-type: none"> ☞ Dissipate the heat generated by attaching the module on a suitable mounting surface. ☞ Choose a sufficiently large cable cross-section to minimize heating due to in-line losses. <p>Electrical Connection</p> <ul style="list-style-type: none"> ☞ Tighten the nuts of the ring terminals to the specified torque to keep the contact resistance low. <p>→ Chapter 5.1.2 "Tightening torques"</p> <p>Operation & Monitoring</p> <ul style="list-style-type: none"> ☞ Monitor the internal temperature of the module and the shunt temperatures continuously to prevent overheating. <p>→ CSMconfig online help "How to use HV Breakout Modules" and "File format 'DBC' (CAN Signal Database)"</p> <ul style="list-style-type: none"> ☞ Reduce or interrupt the current flow in case of excessive temperature to prevent further heating.

WARNING!	
	<p>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.</p> <p>This can lead to a massive increase in temperature and in the worst case to the development of fire.</p> <ul style="list-style-type: none"> ☞ Use ring terminals for copper cables only in combination with HV power cables made of copper.

CAUTION!		
	<p>The shunts integrated in the measurement module can heat up significantly during operation under high load.</p> <p>Touching the surface of the module may cause serious burns.</p> <ul style="list-style-type: none"> ☞ Let the measurement module cool down before handling, especially before removing the orange-colored lid. ☞ Wear appropriate safety gloves. 	

NOTE!	
	<p>The isolation barrier can be damaged due to aging, overvoltage, bipolar voltage, incorrect operating temperature and mechanical wear.</p> <p>Periodical tests of the reinforced insulation every 12 months are required.</p> <p>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.</p> <ul style="list-style-type: none"> ☞ To ensure the proper functioning and the electrical safety of the measurement module, make sure that a high-voltage isolation test is carried out at least every 12 months. ☞ If damage to the isolation barrier is suspected, a high-voltage isolation test must be performed before the system is put back into operation. ☞ Operate the measurement module only within the specified operating conditions.

NOTE!	
	<p>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 also connected to potential equalization or PE. It is therefore important that housings and the shields are at the same potential. Otherwise, measurement results will be falsified or measurement modules destroyed.</p> <ul style="list-style-type: none"> ☞ Make sure that no differences in potential occur when mounting the device. ☞ Isolate the measurement module from the mounting location, if required.

2.2 Obligations of the operator

- ▶ The operator must ensure that only qualified and authorized personnel are entrusted with handling the product. This applies to assembly, installation and operation.
- ▶ In addition to the 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 1.2+S measurement modules were developed for measuring voltages and currents in high-voltage environments.
- ▶ These devices 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) and follow the instructions contained therein.
- ▶ The calibration of measurement modules may only be performed by authorized calibration laboratories (e.g. CSM calibration laboratory).
- ▶ Repair work must only be carried out by the manufacturer.
- ▶ 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!	
	<p>HV BM 1.2+S have been optimized for operation with the lid mounted and HV power cables connected. Fault-free operation is only possible with the lid mounted and the HV power cables correctly connected.</p> <p> Only operate an HV BM 1.2+S with the lid mounted.</p>

Characteristics

- ▶ Single-phase current and voltage measurement
 - ▶ Max. nominal voltage: up to 1000 V; For the detection of transient voltages the maximum measurement range has been dimensioned to ± 2000 V.
 - ▶ Nominal current: up to 1000 A / 2000 A (peak)²
 - ▶ Shield current: up to 250 A / ± 500 A (peak)³
- ▶ Online calculation of the instantaneous power with a data rate of 1 MHz
- ▶ Maximum measurement data rates:
 - ▶ ECAT up to 1 MHz
 - ▶ CAN up to 10 kHz

Further information

- Further information can be found on our website in section **Products | HV Breakout Modules** and in the following documents:
 - Datasheet "HV Breakout Module Type 1.2+S"
 - Safety instructions "HV Breakout Module Type 1.1 | 1.2 | 1.2+S"
 - Technical Information "Measurement Categories for CSM HV Measurement Modules"
 - Technical Information "Deviation of Measurement"

² Depending on the installed shunt module for measuring the internal conductor current

³ Depending on the shunt module installed for measuring the shield current

3.2 Connectors, displays and further components

The sockets for EtherCAT® and CAN are located on the left side of the housing (Fig. 3-1, ②/④ or ⑧). The LED indicators are integrated into the front of the module housing (Fig. 3-2, ①, ② and ③). There are two cable glands on each side of the housing for mounting the HV power cables (Fig. 3-1, ①).

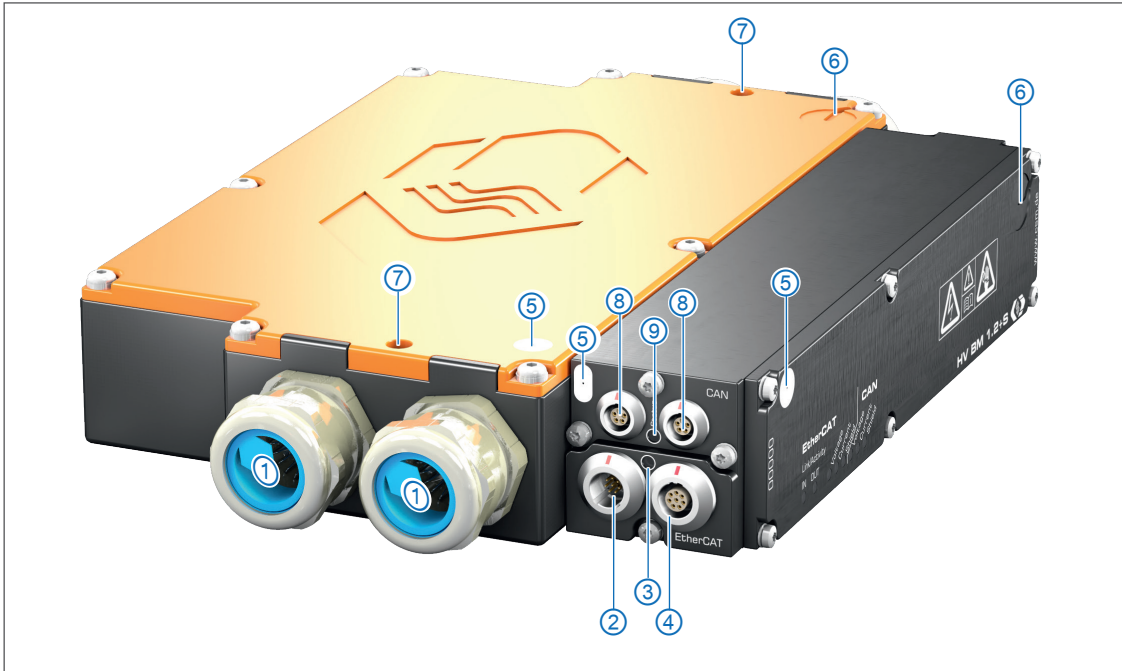


Fig. 3-1: HV BM 1.2+S, connectors and further components

1. Cable glands for the power cables HV- and HV+
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. Contact surfaces for measuring the resistance of protective earth (PE) to lid
6. Ventilation opening with GORE™ membrane and sticker
7. Threaded holes for M6 threaded bolts for mounting the HV Breakout module
8. CAN connectors ([chapter 4.3.2.1 "CAN sockets"](#))
9. CAN bus status LED indicator ([chapter 3.3.2 "CAN bus status LED indicator"](#))



Fig. 3-2: HV BM 1.2+S, LED indicators and ground connection

1. EtherCAT® bus LED indicators Link/Activity **IN** and **OUT** ([chapter 3.3.1 "EtherCAT® bus Status LED indicator"](#))
2. EtherCAT® bus measurement channel LED indicators ([chapter 3.3.4 "Measurement channel LED indicators"](#))
3. CAN bus measurement channel LED indicators ([chapter 3.3.4 "Measurement channel LED indicators"](#))
4. M8 threaded hole for connecting the ground cable ([chapter 4.3.2.4 "Ground connection"](#))

Rear side of the housing

- ▶ Type labels for measurement module and shunts ([chapter 6.1 "Type labels"](#))

Base of the:

- ▶ Six M5 threaded holes for mounting purposes are located in the underside of the housing.
- ▶ DIN EN ISO/IEC 17025 calibration stickers for U / I and high-voltage isolation test sticker ([chapter 6.2 "Maintenance services"](#))

3.3 Functional description of LED indicators

3.3.1 EtherCAT® bus Status LED indicator

The two-colour status LED (Fig. 3-1, ③) is lit red for a few seconds after the module is switched on and then fades out.⁴

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. ⁵
green	flashing	20 % on, 80 % off: Device is in status SAFE-OPERATIONAL. ⁶
green	permanently lit	Device is in status OPERATIONAL. ⁷
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: EtherCAT® bus Status LED indicator

3.3.2 CAN bus status LED indicator

The LED indicator (Fig. 3-1, ⑨) 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 has stopped the data acquisition (no error) or due to a CAN bus or a 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 status LED indicator

⁴ Status designations according to Beckhoff and EtherCAT® Technology Group EtherCAT® standard.

⁵ Status PRE-OPERATIONAL: Configuration/setting of the values for the measurement range

⁶ Status SAFE-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.

⁷ Status OPERATIONAL: The module is in measurement operation.

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

The LED indicators for the sockets **IN** and **OUT** (Fig. 3-2, ①) are lit or are flashing if the measurement module is 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 running
-	off	No measurement module or XCP-Gateway connected.

Tab. 3-3: EtherCAT® bus LED indicators Link/Activity **IN** and **OUT**

3.3.4 Measurement channel LED indicators

The measurement channel LED indicators (Fig. 3-2, ② and ③) show the status of the corresponding measurement channel. There are separate LED indicators for access via CAN bus or EtherCAT® bus (from left to right).

1. **Voltage**: Voltage measurement status
2. **Current**: Status of internal conductor current measurement
3. **Shield**: Status of the shield current measurement⁸

After switching-on the HV BM 1.2+S, the LED indicators of the measurement channel LED indicators are lit red, indicating the initialization process. Once the module has initialized and no errors were detected, the LED indicators will fade out.

After initialization, the device checks the connected shunt modules. Meanwhile the LED indicators of the channels for current measurement (**Current**) are lit red. When the shunt modules are successfully identified, the measurement channel LEDs fade out again.

The measurement range has to be configured **identically** on the ECAT and the CAN side, 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 **measurement channel LED indicators permanently lit red**.

⁸ The flash codes of the **Shield** LED indicator correspond to the flash codes of the **Current** LED indicator, see Tab. 3-4.

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

Tab. 3-4: Measurement channel LED indicators

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 BM 1.2+S measurement 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 and in the lid of the housing ② must not be blocked/covered or permanently covered with water or any other liquid. There is then a risk of condensation collecting inside the housing and damaging the measurement module.

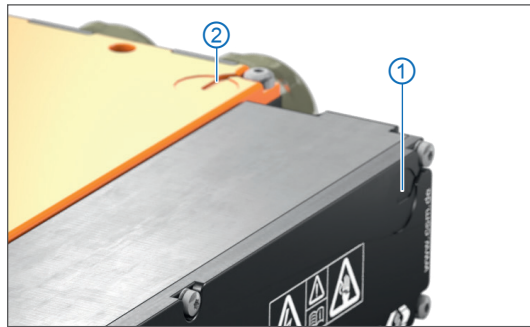





Fig. 4-1: HV BM 1.2+S, ventilation openings in the housing

NOTE!	
	<p>The GORE™ membranes are required for pressure compensation.</p> <ul style="list-style-type: none"> ☞ When mounting the module, make sure that the ventilation openings for the GORE™ membranes are not obstructed or permanently covered by water or any other liquid.
NOTE!	
	<p>Trouble-free operation and electrical safety can only be ensured if the measurement module is correctly installed.</p> <ul style="list-style-type: none"> ☞ Ensure correct installation. ☞ Operate the measurement module exclusively within the specified operation environment. <p>→ <i>Datasheet "HV Breakout Module Type 1.2+S"</i></p>

4.2 Mounting HV BM 1.2+S

NOTE!	
	<p>Strong magnetic fields, such as those induced by permanent magnets, may impair the trouble-free operation of the measurement module.</p> <p>☞ Make sure that the mounting position of the measurement module is free from strong magnetic fields.</p>

Requirements

- ▶ When choosing the mounting location, make sure that the ventilation openings of the GORE™ membranes are not obstructed or covered by liquids.
- ▶ Make sure that the mounting location 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

- ▶ Six M5 screws⁹ or two M6 threaded bolts (Fig. 3-1, ⑦)

Mounting the measurement module

☞ Mount the measurement module at the mounting location using screws or threaded bolts.


i	Please contact our support for the appropriate drill hole diagrams.
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NOTE!	
	<p>Mechanical modifications to the housing (e.g., drilling additional holes) may destroy the measurement module or impair its function. Doing so would also invalidate the warranty.</p> <p>☞ Never drill any holes in the housing.</p> <p>☞ Observe the mounting instructions.</p>

⁹ The thread depth in the module housing is 6 mm. The screw length must be chosen according to the thickness of the mounting material.

4.3 Installing HV BM 1.2+S

4.3.1 Before installation

NOTE!	
	<p>Trouble-free operation and electrical safety can only be ensured if the measurement module is correctly installed.</p> <ul style="list-style-type: none"> ☞ Make sure that the device is correctly installed. ☞ Operate the measurement module only within the specified operating environment. <p>→ <i>Datasheet "HV Breakout Module Type 1.2+S"</i></p>

NOTE!	
	<p>The isolation barrier can be damaged due to aging, overvoltage, bipolar voltage, incorrect operating temperature and mechanical wear.</p> <ul style="list-style-type: none"> ☞ If a damaged isolation barrier is suspected, perform an isolation test immediately. Do not put the device in operation or continue to use it under any circumstances.

i	<p>Vector offers cables for the connection of ECAT and CAN modules.</p> <p>→ <i>"XCP/ECAT Accessories for CSM measurement modules" and "CAN Accessories for CSM measurement modules"</i></p> <p>For further details please contact the Vector sales department.</p>
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i	<p>Vector provides maintenance and repair services for HV Breakout Modules.</p> <p>→ Chapter 6.2 "Maintenance services"</p>
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4.3.2 Connectors

The HV BM 1.2+S is equipped with a CAN and an EtherCAT® interface. The sockets are located in the left side of the housing. The HV power cables are led through cable glands into the module housing and connected there (Fig. 3-1, ①).


To ensure user safety, the measurement module has to be connected to the vehicle's potential equalization or protective earth (PE) by using the threaded hole in the right side of the housing.

i	<p>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.</p> <p>The supply lines of the two CAN sockets are connected to each other. The same applies to the two EtherCAT® sockets.</p>
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4.3.2.1 CAN sockets

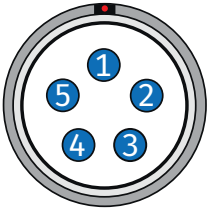
WARNING!	
	<p>The behavior of the CAN bus can be influenced by connecting a CAN bus measurement module to an existing CAN bus system.</p> <p>Improper use of a CAN bus system may cause life-threatening situations and material damage.</p> <ul style="list-style-type: none"> ☞ Always connect CAN bus measurement modules to a separate CAN bus system (measurement bus). ☞ Only use qualified and trained personnel.

The CAN connectors can be used for both transmitting 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!	
	<p>Be particularly careful when connecting third-party devices to a CAN measurement bus with HV Breakout Modules.</p> <ul style="list-style-type: none"> ☞ Ensure that the configuration settings are compatible with all devices (same CAN bit rate, different CAN identifiers). ☞ Only use qualified and trained personnel.

LEMO-0B sockets are used by default for the CAN connections. To have the device equipped with a different type of sockets, please contact the Vector sales department. To connect a cable to this socket, the following plug with plug insert (male) is required:

► FGG.0B.305.CLA xxxxx¹⁰

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

Tab. 4-1: Plug (front view) for CAN socket: pin assignment

i	<p>The CAN sockets for CAN signals and power supply are connected in parallel and have identical pin assignments. 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.</p>
---	---


¹⁰ "xxxxx" is a placeholder here. The actual designation depends on the diameter of the applied cable.

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.

A LEMO-1B socket is used by default for the ECAT connection. For connecting a cable to this socket the following plug is needed:

► **FGL.1B.308.CLL xxxxx**¹⁰

	Pin	Signal	Description
	1	Power +	Power supply, plus
	2	Power GND	Power supply, ground
	3	RX -	Ethernet: Receive data, minus
	4	TX -	Ethernet: Transmit data, minus
	5	RX +	Ethernet: Receive data, plus
	6	Power GND	Power supply, ground
	7	Power +	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

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 also available at the OUT socket.

4.3.2.3 EtherCAT® OUT socket

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


► **FGA.1B.308.CLA xxxxx**¹¹

	Pin	Signal	Description
	1	Power +	Power supply, plus
	2	Power +	Power supply, plus
	3	Power GND	Power supply, ground
	4	RX +	Ethernet: Receive data, plus
	5	TX -	Ethernet: Transmit data, minus
	6	RX -	Ethernet: Receive data, minus
	7	Power GND	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

¹¹ "xxxxx" is a placeholder here. The actual designation depends on the diameter of the applied cable.


4.3.2.4 Ground connection

WARNING!	
	<p>The measurement module has to be connected to the vehicle's potential equalization or protective earth (PE) in order to ensure user safety.</p> <p>In the event of a fault, there is danger to life due to high-voltage potential if this connection is not established.</p> <ul style="list-style-type: none"> ☞ Connect the measurement module to the vehicle's potential equalization or PE using a suitable ground cable. ☞ Only use qualified and trained personnel.

To ensure user safety, the HV BM 1.2+S must be connected to ground or the protective earth (PA/PE). For this purpose, the measurement module is equipped with an M8 threaded hole with a thread depth of 8.5 mm, located on the right side of the housing (Fig. 3-2, ④). When selecting the ground cable cross-section, observe the recommendations according to DIN VDE 0100-540¹².

NOTE!	
	<p>The threaded hole is designed to connect the measurement module to the vehicle's potential equalization or protective earth (PE) in a test bench.</p> <ul style="list-style-type: none"> ☞ Use the threaded hole only for connecting the module to the vehicle's potential equalization or protective earth (PE).

Required parts/materials

NOTE!	
	<p>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.</p> <ul style="list-style-type: none"> ☞ Observe relevant standards and regulations.

- ▶ suitable ground cable (not included in the scope of delivery)
- ▶ M8 screw¹³ 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

¹² In other countries, the applicable standards/directives are to be observed.


¹³ The screw length depends on the thickness of the material being used.

- ▶ K410.1-xxxx: cable for connecting EtherCAT® measurement module and an XCP-Gateway and for linking EtherCAT® measurement modules with intermediate supply voltage feed

i	The K420-xxxx cable can also be used to connect an HV BM 1.2+S directly to a data acquisition system (PC). This requires that data acquisition software supporting EtherCAT® master operation is installed on the PC.
----------	---

Connecting the power supply

The HV BM 1.2+S modules are supplied with power either via the EtherCAT® **IN** socket or the **CAN** sockets (Fig. 3-1).

NOTE!	
	<p>Depending on the number of measurement modules and the cable lengths in a measurement setup, one or multiple intermediate power supplies may be required.</p> <p>An intermediate supply is also required if more current is required than the power supply connected can provide due to the increased power consumption of the measurement modules.</p>

HV BM 1.2+S modules are supplied with power either via the EtherCAT® **IN** socket (Fig. 3-1, ②) or the **CAN** sockets (Fig. 3-1, ⑧).

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.¹⁴

Cable lengths


The resistance of the connection cables causes a voltage drop along 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.¹⁴


i	<p>The assembly of the HV power cables is described in chapter 5 "Installing the HV Power Cables".</p> <p>For information on how to configure CSM measurement modules, please refer to the CSMconfig online help.</p>
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¹⁴ The minimum value specified on the type label of a measurement module is decisive ([chapter 6.1 "Type labels"](#)).


5 Installing the HV Power Cables

5.1 Installation notes

WARNING!	
	<p>Inappropriate handling of the HV measurement module can result in life-threatening electrical shocks.</p> <p>☞ Observe all safety-related information for mounting the device.</p> <p>→ Chapter 2 "Safety Instructions"</p>

WARNING!	
	<p>During installation, minimum clearances must be maintained between the HV-conducting metal parts in the measurement module (ring terminals, nuts, threaded bolts, and HV power cables) and the lid of the housing as well as the module housing itself.</p> <p>Failure to maintain these minimum clearances poses a risk of life-threatening electrical shocks.</p> <p>☞ When installing the HV power cables, make sure that the following minimum clearances are maintained:</p> <ul style="list-style-type: none">▶ ≥ 1 mm between HV-conducting metal parts and the insulation plate mounted on the inside of the lid▶ ≥ 3.5 mm between HV-conducting metal parts and non-insulated surfaces on the inside of the lid▶ ≥ 3.5 mm between HV-conducting metal parts and the inner surfaces of the module housing <p>☞ Use only lids with fully intact insulation plates.</p>


The ring terminals for the HV power cables are not included in the scope of delivery and must be ordered separately.

WARNING!	
	<p>If inappropriate ring terminals are used, there is a risk of life-threatening electrical shocks and short-circuits.</p> <p>☞ Only connect HV power cables equipped with ring terminals approved by the manufacturer.</p> <p>☞ Observe the minimum clearances between the HV-conducting metal parts and the inside of lid of the housing.</p>

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
- ▶ Two open-end wrenches or ring wrenches, size SW10

5.1.2 Tightening torques

NOTE!	
	<p>To mount the ring terminals of the power cables HV- and HV+ on the threaded bolts of an HV Breakout Module, only use the M8 nuts and washers included in the scope of delivery.</p>

5.1.2.1 Tightening torques for the nuts of the shunt modules

For mounting the shunt modules for the measurement of the internal conductor current HV- and the shield current HV-, the tightening torques specified in [Tab. 5-1](#) apply, depending on the shunt module to be connected.

Type of module	Tightening torque
50 A	5 Nm
125 A	15 Nm
250 A	25 Nm
500 A	
1000 A	


Tab. 5-1: Tightening torques for the nuts of the shunt modules

5.1.2.2 Tightening torques for the nuts of the HV+ power cables / shielding of the HV- and HV+ power cables

Cable	Tightening torque
HV+	25 Nm
Shielding HV-/HV+	5 Nm

Tab. 5-2: Tightening torques for the nuts of the HV+ and HV-/HV+ the shielding of the HV-/HV+ power cables

5.2 Connecting the HV power cables to the device

NOTE!	
	<p>HV Breakout Modules have been optimized for operation with the lid mounted and HV power cables connected.</p> <p>☞ Only operate the HV Breakout Module with the lid mounted and HV power cables connected.</p>

5.2.1 Connection diagram for the HV BM HV BM 1.2+S

i	<ul style="list-style-type: none"> ▶ 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. ▶ In the wiring shown, the technical currents and the technical voltage are output with the correct sign.
---	--

Current and voltage measurement

Fig. 5-1 shows the appropriate connection diagram when inner conductor current, shield 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.

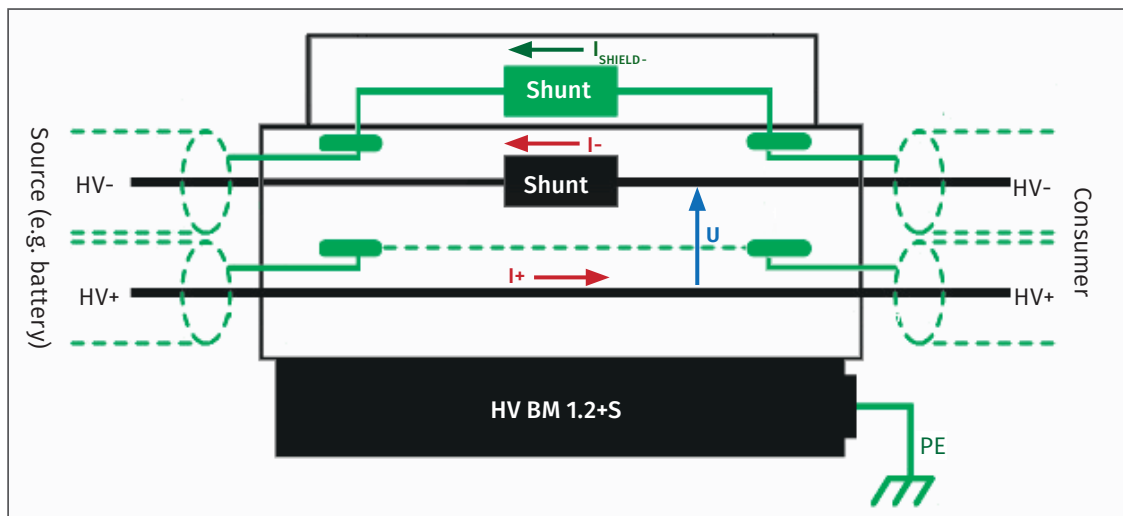



Fig. 5-1: HV BM 1.2+S, connection diagram for the measurement of voltage, inner conductor current and shield current

NOTE!	
	<p>Please note that the measurement precision of the channels for current measurement can be affected by radiated interference in the frequency range from 80 MHz to 1000 MHz and for conducted immunity in the frequency range from 20 MHz to 80 MHz.</p> <p>In environments with high RF field strengths, an increased measurement uncertainty or temporary signal offset should be taken into account for current readings.</p>

5.2.2 Opening the housing

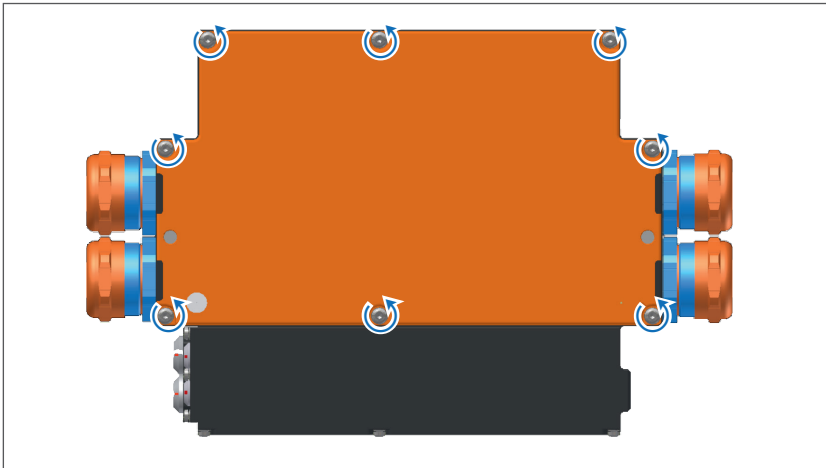


Fig. 5-2: HV BM 1.2+S, housing closed

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

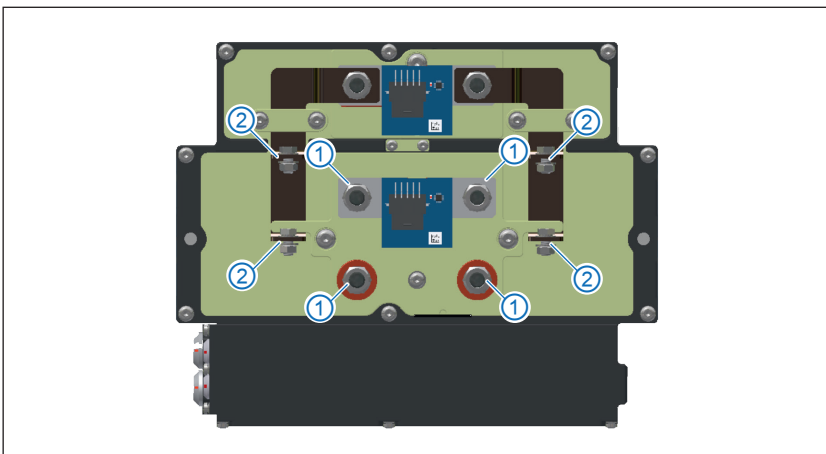



Fig. 5-3: HV BM 1.2+S, removing nuts and washers

- ☞ Loosen the M8 nuts (1) and remove them from the threaded bolts along with the washers.
- ☞ Remove the M5 nuts (2) and the washers.

5.2.3 Connecting the HV power cables to the HV BM 1.2+S

WARNING!	
	<p>Nuts and ring terminals may not extend over the threaded bolts, otherwise the distance to the cover is too small.</p> <p>If the distance between the threaded bolts with the mounted metal parts (ring terminals, nuts, and washers) and the lid is too small, there is a risk of life-threatening electrical shocks and short circuits.</p> <ul style="list-style-type: none"> ☞ Only use ring terminals approved by the manufacturer for the HV power cables. ☞ Only use the M8 nuts and washers mounting supplied by the manufacturer to mount the HV power cables. ☞ Make sure that the ring terminals are correctly installed. ☞ Always ensure there is sufficient space in the housing so that the ring terminals maintain sufficient distance from the housing and from each other (min. 3.5 mm).

5.2.3.1 HV BM 1.2+S: connections for the HV- and HV+ power cables

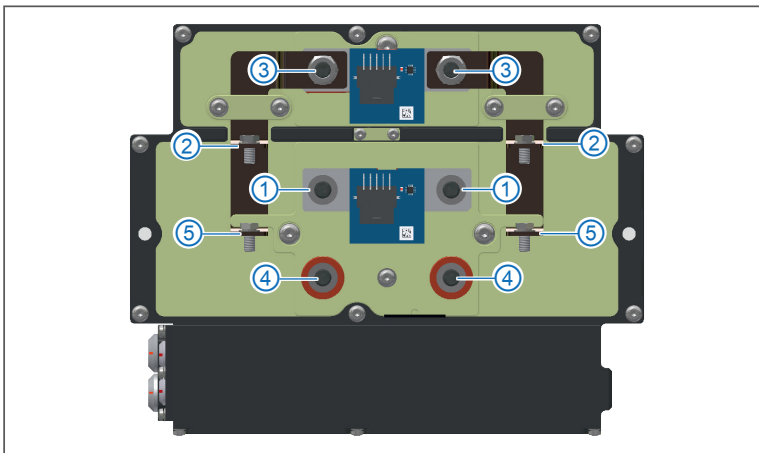


Fig. 5-4: HV BM 1.2+S, connectors for the HV power cables

Fig. 5-4 shows the connection terminals for mounting the inner conductors of the HV power cables HV- ① and HV+ ④ and the shields of the HV power cables ② and ⑤.

- ▶ The inner conductors of the power cables HV- are connected to the threaded bolts ①, on which the shunt module for measuring the inner conductor current is pre-mounted.
- ▶ The shunt for shield current measurement is pre-mounted on the threaded bolts ③. The shields of the HV power cables are connected to the busbars ② leading to the shunt with ring terminals using M5 screws/nuts.
- ▶ The inner conductors of the HV+ power cables are connected to the threaded bolts ④.
- ▶ The shielding of the HV power cables is connected to the busbars ⑤ using ring terminals with M5 screws/nuts.
- ▶ Upon delivery of the measurement module, the M8 nuts/washers for mounting the inner conductors of the power cables HV- and HV+ are pre-mounted on the threaded bolts.
- ▶ For mounting the ring terminals of the HV- and HV+ shieldings, M5 screws/nuts with one toothed washer and one flat washer are pre-mounted on the busbars ② and ⑤.

5.2.3.2 Mounting the HV- power cables to the shunt for measuring the inner conductor current


NOTE!	
	<p>The mounting instructions in this user guide apply exclusively to HV BM 1.2+S devices as of hardware revision C030, which are equipped with frequency response-optimized shunt modules from hardware revision C000¹⁵ onwards. For measurement and shunt modules with older hardware revisions, different mounting instructions apply when connecting the HV power cables. The differences are described in a previous version of this user guide.</p> <p>☞ Please contact Vector Support if you need this user guide.</p>

Fig. 5-5 shows the shunt module for measuring the inner conductor current. The shunt module rests on the spacer sleeves ①, regardless of the cross-section of the HV power cables that are used. The ring terminals are placed on the shunt modules as shown in Fig. 5-6 and Fig. 5-7 and fastened with M8 nuts.

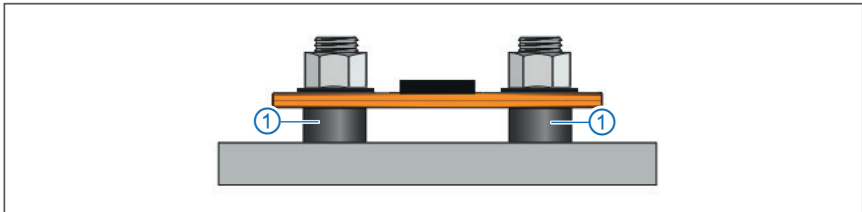


Fig. 5-5: HV BM 1.2+S, shunt module mounted on spacer sleeves

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

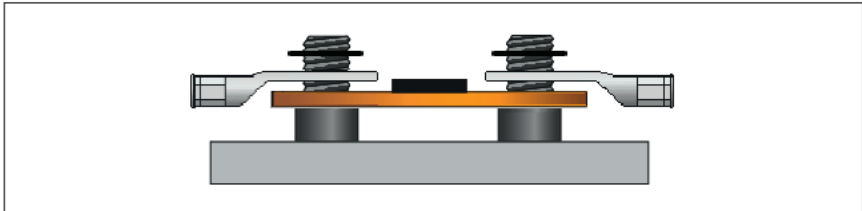


Fig. 5-6: HV BM 1.2+S, placing ring terminals and washers on the threaded bolts

☞ Place the ring terminals on the shunt module as shown in Fig. 5-6.

☞ Place the washers on top of the shunt module.

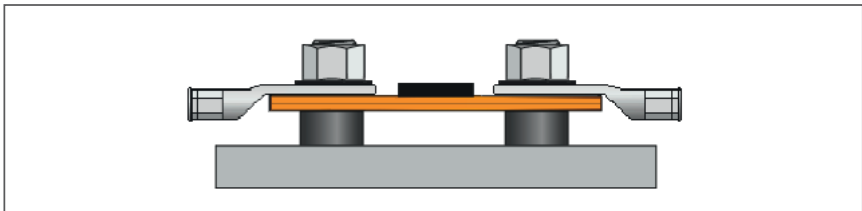


Fig. 5-7: HV BM 1.2+S, fastening the ring terminals with the M8 nuts

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

¹⁵ The hardware revision number is located on the type label of the measurement module and the shunt modules (Chapter 6.1 "Type Labels").

5.2.3.3 Mounting of HV+ cables to the cable feed-through

Fig. 5-8 shows the threaded bolts for the ring terminals of the HV+ power cables. The ring terminals are placed on copper domes as shown in Fig. 5-9 and Fig. 5-10 and fastened with M8 nuts.

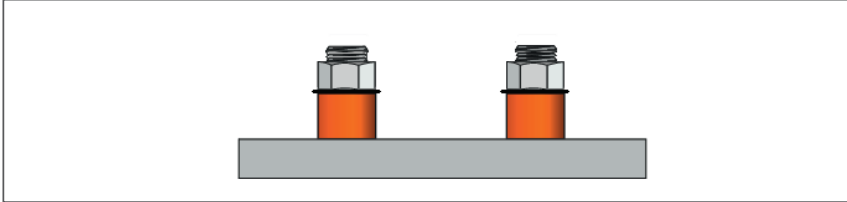


Fig. 5-8: HV BM 1.2+S, copper domes/threaded bolts for the HV+ power cables

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

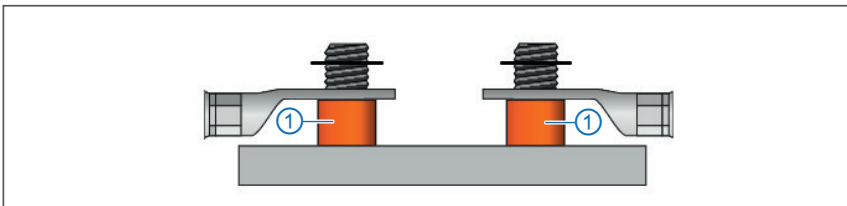


Fig. 5-9: HV BM 1.2+S, placing the ring terminals of the power cables HV+ on the threaded bolts

☞ Place the ring terminals on the copper domes ① as shown in Fig. 5-9.

☞ Place the washers on top of the ring terminals.

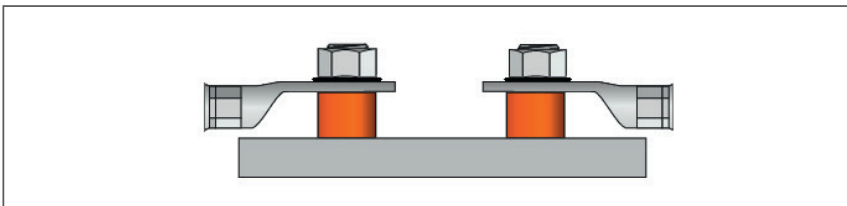


Fig. 5-10: HV BM 1.2+S, power cable HV+, fastening the ring terminals with the M8 nuts

☞ Fasten the ring terminals with the M8 nuts and tighten with the specified torque of 25 Nm (Tab. 5-2).

5.2.3.4 Mounting the shielding (HV- and HV+) to the busbar

The ring terminals for the shielding of the power cables HV- and HV+ are mounted to the busbars using M5 screws and nuts.

Fig. 5-11 shows a mounted ring terminal for the shielding HV- or HV+. A toothed washer and a standard washer are used to mount the ring terminals:

- ▶ 1 toothed washer between the head of the M5 screw ① and the busbar ③
- ▶ 1 (standard) washer between the ring terminal ④ and the M5 nut ⑤

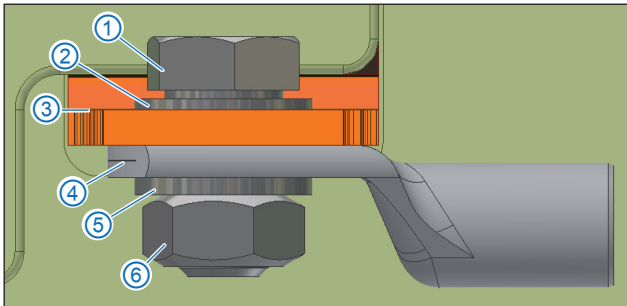



Fig. 5-11: Mounted ring terminal of the HV-/HV+ shielding


1. M5 screw
2. Toothed washer
3. Busbar
4. Ring terminal
5. Washer
6. M5 nut

Mounting the ring terminal to the busbar

- ☞ Remove the M5 nut ⑥ and the washer ⑤ from the M5 screw ①.
- ☞ Place the ring terminal ④ of the HV-/HV+ shielding onto the thread of the M5 screw ① as shown in Fig. 5-11. Make sure that the base of the ring terminal rests flat on the mounting surface of the copper rail ③.
- ☞ Place the washer ⑤ on the ring terminal ④.
- ☞ Hand-tighten the M5 nut ⑥.
- ☞ Place an open-end or ring wrench on both the M5 screw ① and the M5 nut ⑥ and tighten the M5 nut to the specified torque of 5 Nm (Tab. 5-2).

5.2.4 Mounting the cable glands and the lid of the housing

WARNING!	
	<p>The safety distance between the insulation plate on the inside of the lid and the HV-conducting metal parts (upper edge of M8 nuts) must be > 1 mm.</p> <p>When using the ring terminals supplied by the manufacturer and approved mounting materials (M8 nuts and washers) and provided that the installation is done correctly, this safety distance will be maintained.</p> <p>If the insulation is damaged or the minimum distance between the live metal parts and the lid of the housing is insufficient, there is a risk of life-threatening electrical shock!</p> <ul style="list-style-type: none"> ☞ Use only lids with fully intact insulation plates. ☞ Observe the minimum distance (> 1 mm) between the live metal parts and the lid of the housing.

NOTE!	
	<p>In order to prevent water ingress and condensation, the tightness of the housing has to be ensured.</p> <ul style="list-style-type: none"> ☞ Check the housing's gasket surface for the orange lid and the gasket in the lid before attaching the lid. Damaged gaskets should be replaced. ☞ 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

- ☞ 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 at www.pflitsch.de.

5.2.4.2 Mounting the lid of the housing

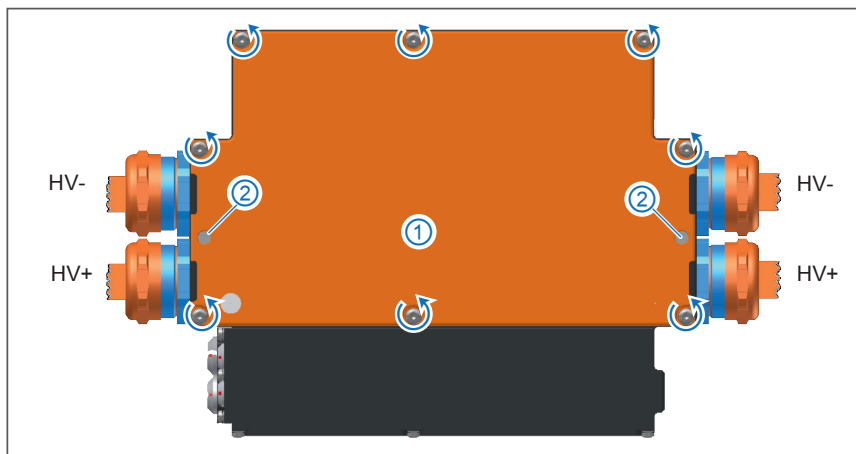


Fig. 5-12: HV BM 1.2+S, HV power cables mounted, lid mounted on the housing

- ☞ Place the orange lid ① on the housing.
- ☞ Fix the lid using the eight Allen screws (1).
- ☞ If applicable, re-mount the M6 threaded bolts ②.

6 Maintenance Services and Cleaning Instructions

6.1 Type labels

6.1.1 Measurement module HV BM 1.2+S

①	HV BM 1.2+S	Device type
②	L1B 8p, L0B 5p, ECAT	Device details: <ul style="list-style-type: none"> ▶ L1B 8p - EtherCAT® sockets: LEMO 1B, 8-pole ▶ L0B 5p - CAN sockets: LEMO 0B, 5-pole ▶ ECAT - bus system
③	ART1510129	Part number of the measurement module
④	Power: 7 – 30 V DC, typ. 3 W	Power supply range, typical power consumption
⑤	Temp.: -40 °C – +120 °C	Operating temperature range
⑥	Meas.: ±100 V – ±1000 V	Measurement ranges
⑦	S/N: 25-HEBS1	Serial number of the measurement module
⑧	CAT II: 600 V	Measurement category II ¹⁵
⑩	CAT III: 300 V	Measurement category III ¹⁵
⑪	Rating: IP67	Protection class
⑪	Revision: C030	Hardware revision number

Tab. 6-1: Type label for measurement module HV BM 1.2+S

¹⁵ For further information, please refer to the Technical Information "Measurement Categories for CSM HV Measurement Modules".

6.1.2 Shunt modules

Module version HV BM 1.2+S is equipped with two shunts (1× inner conductor current, 1× shield current) and has therefore two shunt labels. The shunt labels are placed on the rear of the measurement module and contain technical data of the installed shunt modules.

①	Shunt module 250 A	Shunt type/nominal current of the shunt module
②	HV BM 1.2+S	Type of measurement module in which the shunt module is installed
③	ART1520182	Part number of the measurement module
④	Temp.: -40 °C – +120 °C	Operating temperature range
⑤	Meas.: ±50 A – ±250 A	Measurement ranges
⑥	S/N: 25-SM250A	Serial number of the shunt module
⑦	Revision: C000	Hardware revision number

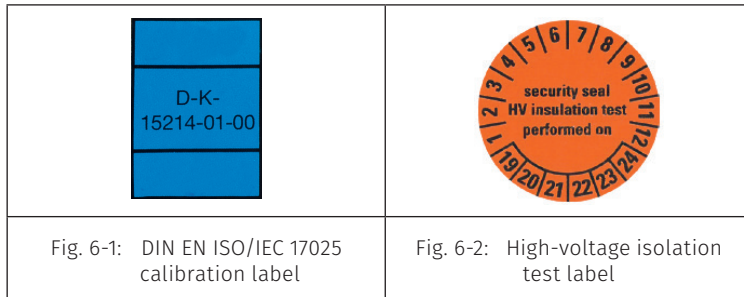
Tab. 6-2: Type labels for shunt modules


6.2 Maintenance services

The following testing certificates are issued for HV BM 1.2+S measurement modules:

- ▶ Calibration certificate in accordance with DIN EN ISO/IEC 17025 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.



NOTE!	
	<p>A high-voltage isolation test must be carried out on a regular basis to ensure operational safety.</p> <p>☞ Make sure that a high-voltage isolation test according to the latest edition of EN 61010 is carried out at least every 12 months.</p>

To ensure reliability and functionality, Vector provides maintenance packages and a repair service:

- ▶ Calibration certificate in accordance with DIN EN ISO/IEC 17025, incl. functional testing
- ▶ HV isolation test, incl. functional testing
- ▶ Repair service

Monitoring of calibration due date¹⁶

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.

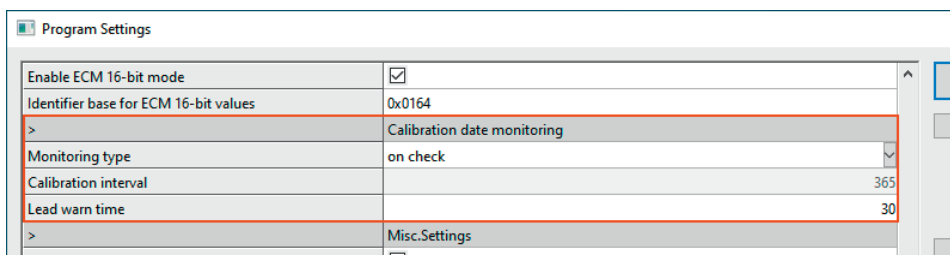





Fig. 6-3: **Program Settings** dialog, **Calibration date monitoring** section

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

→ *CSMconfig Online help, "Program Settings"*

¹⁶ 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.


6.3 Cleaning instructions

WARNING!	
	<p>HV Breakout Modules are used in high-voltage applications. Improper use can be life-threatening due to high voltage potential.</p> <p>☞ Observe safety instructions.</p>
NOTE!	
	<p>☞ De-energize the measurement module before starting to work.</p>
NOTE!	
	<p>The surface of the housing is sensitive to aggressive cleaning agents, solvents and abrasive media.</p> <p>☞ Do not use aggressive cleaning agents or solvents to clean the measurement module.</p> <p>☞ Use only a moist cloth.</p>

7 Appendix

7.1 Assembling HV power cables for HV BM 1.2+S

7.1.1 General information on the assembly of HV power cables

NOTE!	
	<p>Sets of ring terminals are provided for connecting HV power cables, which are designed to fit both the space available in an HV BM 1.2+S and the dimensions of single-core, shielded HV power cables.</p> <p>It is recommended only to use the sets of ring terminals selected by the manufacturer when installing the HV power cables in an HV BM 1.2+S.</p>

7.1.1.1 Components for the installation of HV power cables

Cable glands for HV power cables

Cable glands in various sizes are available for the HV BM 1.2+S, depending on the outer diameter of the HV power cable. Only suitable combinations of HV power cable and cable gland can ensure the tightness of the gland.

→ Datasheet "HV Breakout Module Type 1.2+S"

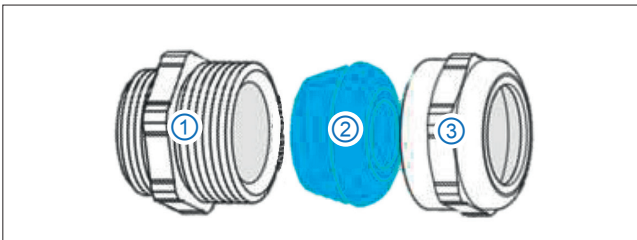



Fig. 7-1: Components of a cable gland

1. Double nipple
2. Sealing insert
3. Pressure screw

NOTE!	
	<p>The tightening torques for double nipples and pressure screws, as well as further information on the cable glands used, can be found in the product catalog at www.pflitsch.de.</p>

The two-part silicone sealing insert with removable inlet has two zones for different cable diameters:


- ▶ 1× with inlet
- ▶ 1× without inlet


Fig. 7-2 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. 7-2: Cable gland dismantled

Pressure screw

NOTE!	
	Depending on which HV power cables and cable glands are used, there is a risk of chafing if they are not installed correctly. ☞ Protect the HV power cables by using suitable shrink sleeves if required.

NOTE!	
	Please note that using 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. 7-3).

If a reducer is used when installing an HV power cable, the length of the cable gland increases by approximately 4 mm (see Fig. 7-3, ①). This also changes the distance between the ring terminal and the segment of the HV power cable that must be stripped.



Fig. 7-3: Cable gland: without reduction (left) and with reduction (right)

7.1.2 Quick guide for assembling HV power cables

- ▶ The HV power cables for HV- and HV+ are assembled identically.
- ▶ The dimensions for the assembly of HV power cables depend on the cable cross-section used.
- Details on the assembly of HV power cables can be found in Tab. 7-1 and Tab. 7-2.

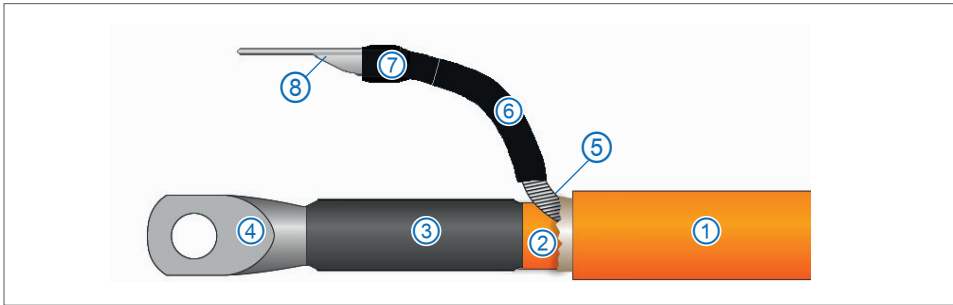


Fig. 7-4: Assembled HV power cable

- | | |
|--|---|
| ① Outer sheath | ⑤ Braided shield, twisted into a strand |
| ② Inner sheath | ⑥ Heat-shrink tubing "Braided shield 1" |
| ③ Heat-shrink tubing "Inner conductor" | ⑦ Heat-shrink tubing "Braided shield 2" |
| ④ Ring terminal "Inner conductor" | ⑧ Ring terminal braided shield |

7.1.2.1 Stripping dimensions and length specifications for assembling HV power cables

Conductor cross section	Stripping length outer sheath	Shortening of braided shield	Stripping length inner sheath
35 mm ²	55 mm	25 mm	17.5 mm
50 mm ²	55 mm	25 mm	20 mm
70 mm ²	50 mm	20 mm	22 mm
95 mm ²	50 mm	20 mm	24 mm

Tab. 7-1: Information on the assembly of HV power cables to be connected to an HV BM 1.2+S

7.1.2.2 Size and length of the heat-shrink tubing for inner conductor and braided shield

Conductor cross section	Heat-shrink tubing (diameter/length)		
	Inner conductor	Braided shield ①	Braided shield ②
35 mm ²	12.7 mm / 50 mm	6.4 mm / 25 mm	9.5 mm / 20 mm
50 mm ²	12.7 mm / 47 mm	4.8 mm / 25 mm	9.5 mm / 20 mm
70 mm ²	19.1 mm / 45 mm	6.4 mm / 20 mm	9.5 mm / 20 mm
95 mm ²	19.1 mm / 45 mm	6.4 mm / 35 mm	9.5 mm / 20 mm

Tab. 7-2: Size and length of the heat-shrink tubing for inner conductor and braided shield

7.1.2.3 Power cable assembly step by step

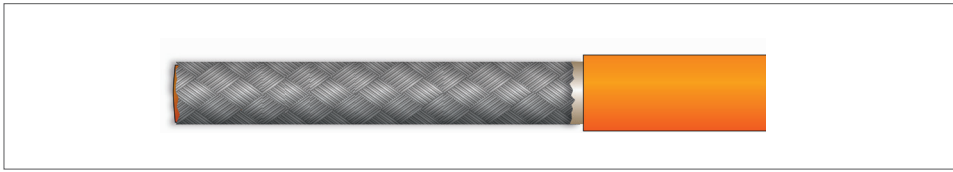


Fig. 7-5: Step 1: Removing outer sheath and protective foil

- ☞ Remove the outer sheath as specified in [Tab. 7-1](#).
- ☞ Make sure that the braided shield lying underneath will not be damaged.
- ☞ Remove the protective foil from the braided shield.

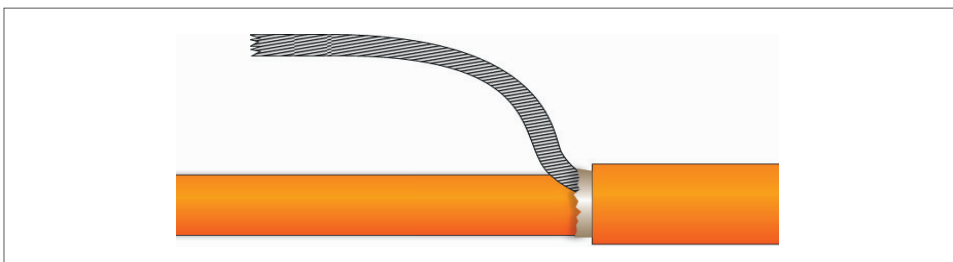


Fig. 7-6: Step 2: Twist and shorten the braided shield

- ☞ Twist the braided shield into a strand and shorten it as specified in [Tab. 7-1](#).

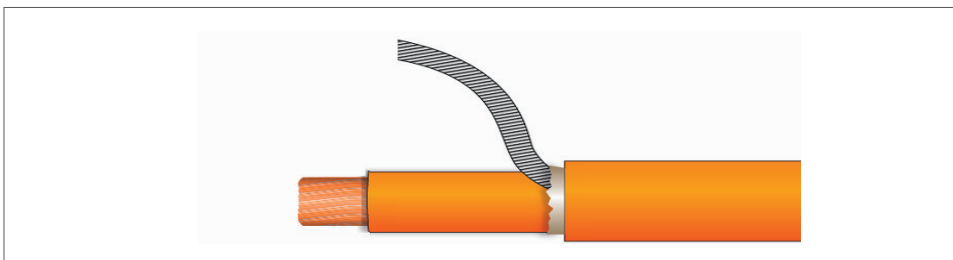


Fig. 7-7: Step 3: Dismantling the inner sheath

- ☞ Remove the inner sheath as specified in [Tab. 7-1](#).

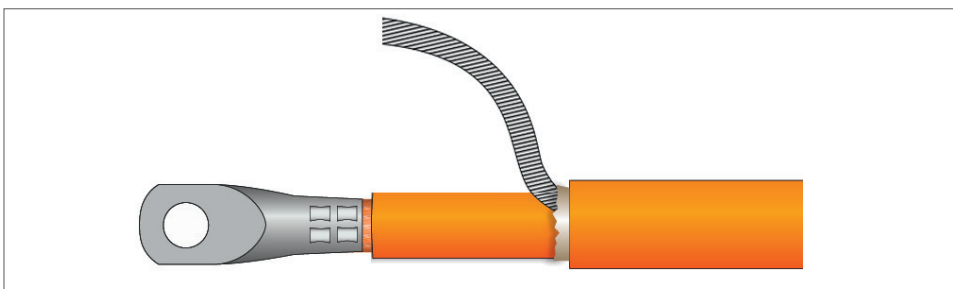


Fig. 7-8: Step 4: Attaching the ring terminal to the inner conductor and crimp it.

- ☞ Attach the ring terminal to the stripped section of the inner conductor and crimp it.

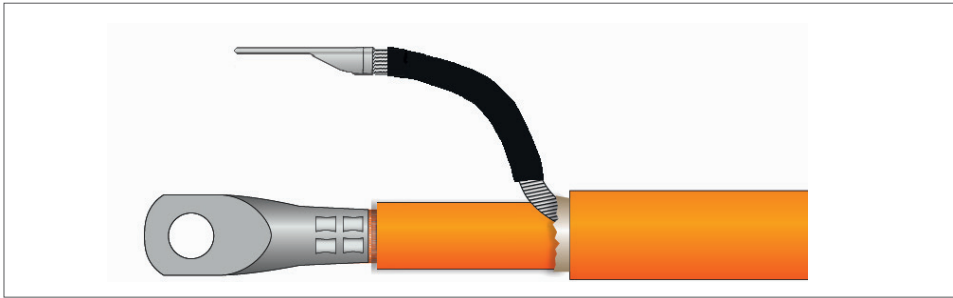


Fig. 7-9: Step 5: Slide on the "Braided shield 1" heat-shrink tubing, attach ring terminal and crimp

- ☞ Slide the "Braided shield 1" heat-shrink tubing (see [Tab. 7-2](#)) onto the twisted braided shield and fix it by applying heat.
- ☞ Attach the ring terminal to the twisted braided shield and crimp.

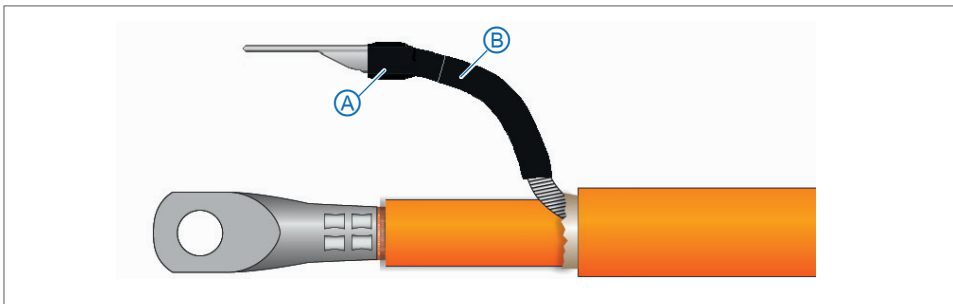


Fig. 7-10: Step 6: Pull the "Braided shield 2" heat-shrink tubing onto the braided shield and fix in place

- ☞ Pull the "Braided shield 2" heat-shrink tubing (see [Tab. 7-2](#)) over the ring terminal onto the twisted braided shield. Make sure that the "Braided shield 2" heat-shrink tubing covers the crimped end of the ring terminal **A** and the end of the "Braided shield 1" heat-shrink tubing **B**.
- ☞ Fix the "Braided shield 2" heat-shrink tubing by applying heat.

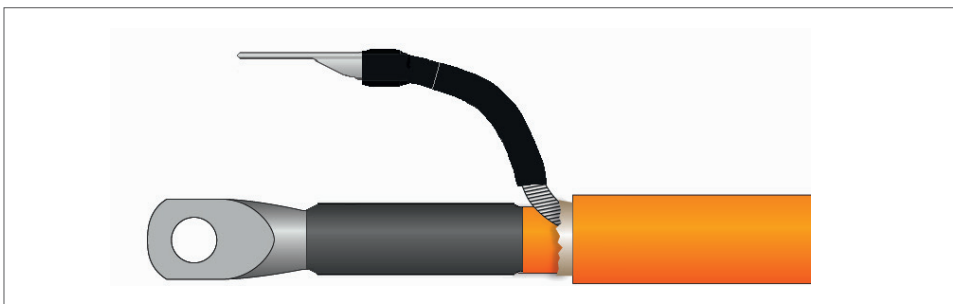


Fig. 7-11: Step 7: Pull the heat-shrink tubing over the ring terminal onto the inner conductor and fix it in place

- ☞ Pull the "Inner conductor" heat-shrink tubing (see [Tab. 7-2](#)) over the ring terminal onto the inner conductor. Make sure that the heat-shrink tubing covers the crimped end of the ring terminal and the sheath of the inner conductor.

7.1.3 Distance between the threaded bolts used for connecting the shunt modules

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.

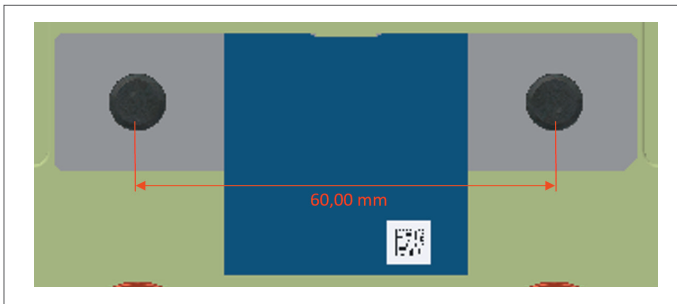


Fig. 7-12: Distance between threaded bolts

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