HV BM-Split evo

User Guide

Innovative Measurement and Data Technology

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 convention

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
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
HV BM-Split evo	High-voltage measurement system with separate components for recording measured values (HV SAM1 evo), breakout boxes with shunt modules for current and voltage measurement (HV SBM(L)_I), and breakout boxes for voltage tapping (HV SBM(L)_U)
MC Tool	**M**easurement & **C**alibration Tool
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 BM-Split evo measurement systems comply with the requirements of EU Directive 2014/30/EU.

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 HV SAM1 evo measurement module and the HV SBM(L) evo breakout boxes may only be used in technically faultless condition and in accordance with their intended use. Please observe the safety instructions in the following chapter and the document “Safety Instructions HV BM-Split evo” to avoid user hazards and/or damage to the measurement modules.

WARNING!	
	The modules of an HV BM-Split evo measurement system are used in high-voltage applications. **Improper use may result in life-threatening electrical shocks.** ☞ Only use qualified and trained personnel (observe local guidelines/ regulations). ☞ Do not modify the modules, neither mechanically nor electrically. ☞ Observe safety instructions.

WARNING!	
	The orange lids of the breakout boxes can be removed to mount or dismount the HV power cables. If the lids of the housings are not mounted and the HV cables are not de-energized, there is a risk of accidentally touching non-insulated contacts at high-voltage potential. **If the device is not de-energized, there is a risk of life-threatening electrical shocks** ☞ Only operate the HV SBM(L) evo modules with the lids mounted. ☞ Before removing the lids, make sure that the HV power cables and connected components (HV SBM(L) evo, K917) are de-energized. ☞ Remove the lids only to connect the HV power cables and then re-mount them properly. ☞ Only use ring terminals approved by CSM for the HV power cables. ☞ Only use the installation material supplied by CSM for mounting the HV power cables. ☞ Observe the mounting instructions in the user guide. It is particularly important that the lids and the cable glands are properly mounted in order to ensure the tightness of the housing. → chapter 4 "Mounting and Installation"

WARNING!	
	If the HV power cables (busbars) are not disconnected from the power supply, there is a risk of accidentally touching live contacts with HV potential. If the power supply is not disconnected, there is a risk of life-threatening electrical shock. **If the power is not disconnected, there is a risk of life-threatening electric shocks.** ☞ Use suitable mounting materials to fix HV power cables. ☞ Only use qualified and trained personnel (observe local guidelines/ regulations).

WARNING!	
	Only ring terminals that match the conductor material of the HV power cables and the braided shields must be used. CSM provides suitable ring terminals for the inner conductors and the braided shields. **A high contact resistance between conductor and ring terminal can lead to a massive increase in temperature and, in the worst case, to the development of fire**. ☞ When connecting the inner conductors and braided shields of the HV power cables, only use ring terminals provided by CSM. ☞ HV power cables with conductors made of aluminum must only be connected to HV SBML_I evo or HV SBML_U evo breakout boxes.

WARNING!	
	The modules of an HV BM-Split evo measurement system have to be connected to the vehicle chassis 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 the ground connection is not established.** ☞ Connect all modules to the vehicle‘s potential equalization or PE using suitable ground cables. ☞ Only use qualified and trained personnel (observe local guidelines/ regulations). → chapter 4.3.2.4 "Ground connection"

WARNING!

The temperature of the shunt module in an HV SBM(L)_I evo must not exceed +120 °C. The maximum temperature may be exceeded if the current flowing through the shunt module is too high, regardless of whether the measurement system is switched on or off.

As soon as the shunt temperature exceeds this value, the HV SAM1 evo sends the error code "0x8001" instead of the measured values for U and I. The user usually does not see this error code but the error message "THERMAL_OVERLOAD" that has been generated from the DBC or A2L file. This data is sent until the temperature of the shunt drops below +115 °C again.

Exceeding the specified temperature impairs the operational safety of the 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 (observe the installation instructions in the user guide).
- ☞ Reduce or interrupt the current flow through the shunt to prevent a further temperature increase.
- ☞ Always monitor the temperature in order to make sure that the threshold value will not be exceeded.

CAUTION!

A shunt module installed in an HV SBM(L)_I evo can heat up considerably during operation under high load.

Touching the surface of the module housing may cause serious burns.

- ☞ Let the modules cool down before handling, especially before removing the orange-colored lids.
- ☞ Wear appropriate safety gloves.

NOTE!

To ensure the functionality and electrical safety of an HV BM-Split evo measurement system, all relevant components have to be checked regularly at least every 12 months. If damage is suspected, an HV isolation test must always be performed before using the system 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 damage is suspected, have an HV isolation test 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. ☞ Operate the measurement module only within the specified operating environment. → *"HV BM-Split evo" datasheet*

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-Split evo measurement systems 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 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!
	The modules of an HV BM-Split evo measurement system have been optimized for operation with mounted covers and connected HV power cables. Error-free operation is only possible with mounted housing covers and correctly connected HV power cables. ☞ All modules may only be operated with covers installed and HV power cables connected.

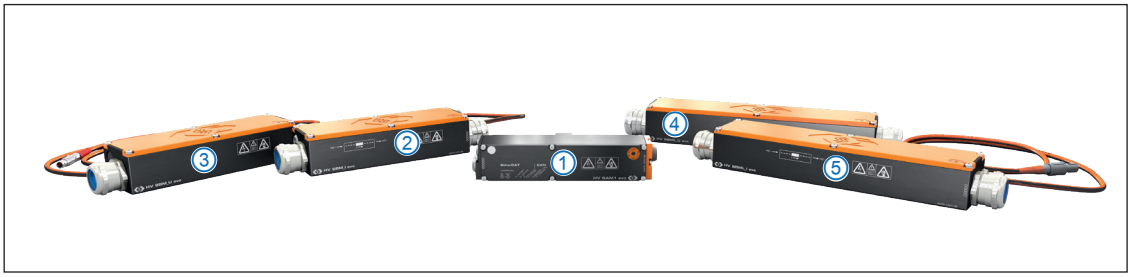


Fig. 3-1: Components of an HV BM-Split evo measurement system

i	The following collective terms apply to the breakout boxes: ▸ **HV SBM evo** refers to the breakout boxes in standard housings for connecting HV power cables made of copper, the **HV SBM_I evo** and the **HV SBM_U evo**. ▸ **HV SBML evo** refers to breakout boxes in larger housings (L = Large) for connecting HV power cables made of aluminum, the **HV SBML_I evo** and the **HV SBML_U evo**. ▸ **HV SBM(L)_I evo** and **HV SBM(L)_U evo** refer to breakout boxes in both sizes, i.e. **HV SBM_I evo** and **HV SBML_I evo** or **HV SBM_U evo** and **HV SBML_U evo**. ▸ The designation **HV SBM(L) evo** includes all four breakout boxes.

An HV BM-Split evo measurement system consists of the following components:

- **HV SAM1 evo** ①: measurement module for processing and outputting the measurement signals for I and U recorded by the **HV SBM(L)** evo for I and U.
- **HV SBM evo**: breakout boxes in standard housings
  - **HV SBM_I evo** ②: breakout box for measuring the current I and tapping the potential of HV-
  - **HV SBM_U evo** ③: breakout box for tapping the potential of HV+
- **HV SBML evo**: the breakout boxes ④ and ⑤ in larger housings to be installed in HV power cables made of aluminum. It is also possible to connect HV power cables with conductors made of copper to an **HV SBML evo**.
- **Shunt modules**: shunt modules with different measurement ranges are available for the **HV SBM_I evo** and **HV SBML_I evo**. These are selected separately and installed in the breakout box.

Further information

→ *Further information is available on the CSM website in section **Products | HV BM-Split evo** and in the following documents:*

- → *Data sheet "HV BM-Split evo"*
- → *Safety instructions "HV BM-Split evo"*
- → *Technical Information "Measurement categories for CSM HV measurement modules"*
- → *Technical Information "Deviation of Measurement"*

3.1.1 Connectors and LED indicators of an HV SAM1 evo

Fig. 3-2 shows an HV SAM1 evo measurement module with the connectors and some LED indicators on the left side of the housing and further LED indicators on the front.

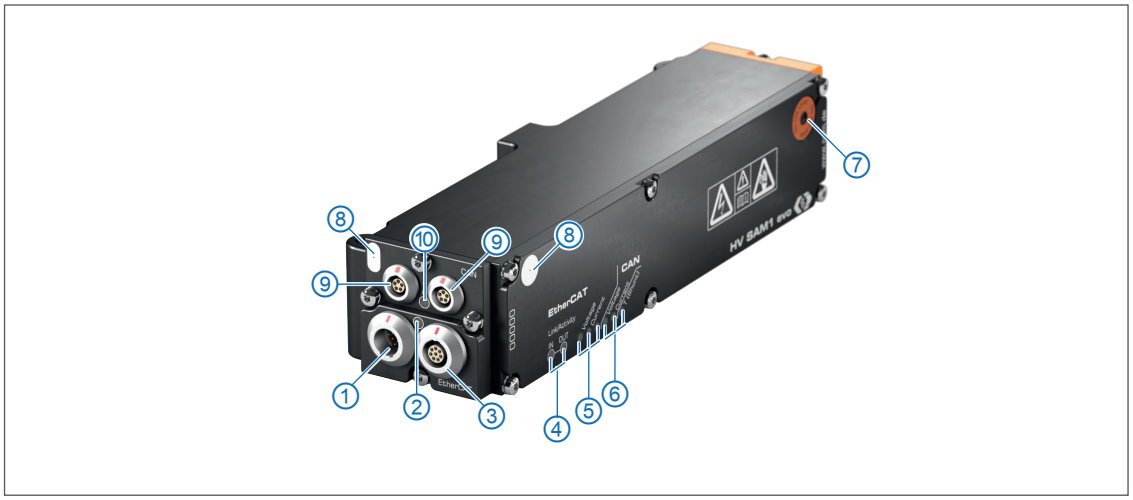


Fig. 3-2: HV SAM1 evo, connectors and LED indicators

1. EtherCAT® **IN** socket (chapter 4.3.2.1 "EtherCAT® IN socket")
2. EtherCAT®-bus status LED indicator (chapter 3.2.1.1 "EtherCAT® bus status LED indicator")
3. EtherCAT® **OUT** socket (chapter 4.3.2.2 "EtherCAT® OUT socket")
4. EtherCAT® bus Link/Activity LED indicators **IN** and **OUT** (chapter 3.2.1.3 "EtherCAT® bus Link/Activity LED indicators IN and OUT")
5. EtherCAT® bus measurement channel LED indicators (chapter 3.2.1.4 "Measurement channel LED indicators")
6. CAN bus measurement channel LED indicators (chapter 3.2.1.4 "Measurement channel LED indicators")
7. Ventilation opening with GORE™ membrane and sticker
8. Contact surface for measuring the resistance of potential equalization or protective earth (PE) to lid
9. CAN sockets (chapter 4.3.2.3 "CAN sockets")
10. CAN bus LED indicator (chapter 3.2.1.2 "CAN bus LED indicator")

Fig. 3-3: HV SAM1 evo, right side/rear side of the housing: measurement input and ground connection

1. Signal input from HV SBM(L)_I evo for current and voltage measurement
2. M8 threaded hole for ground connection (chapter 4.3.2.4 "Ground connection")

- Also located on the rear side of the housing:
  - Type label
  - Calibration labels in accordance with DIN EN ISO/IEC 17025 for I and U
- The high-voltage isolation test label is located on the top side of the housing.

→ Chapter 7.1.1 "HV SAM1 evo" and chapter 7.2 "Maintenance services"

3.1.2 HV SBM(L)_I evo connectors

Fig. 3-4 and Fig. 3-5 show the connectors of an HV SBM_I evo. The module is equipped with a cable gland on the left and right side of the housing to accommodate the HV power cables.

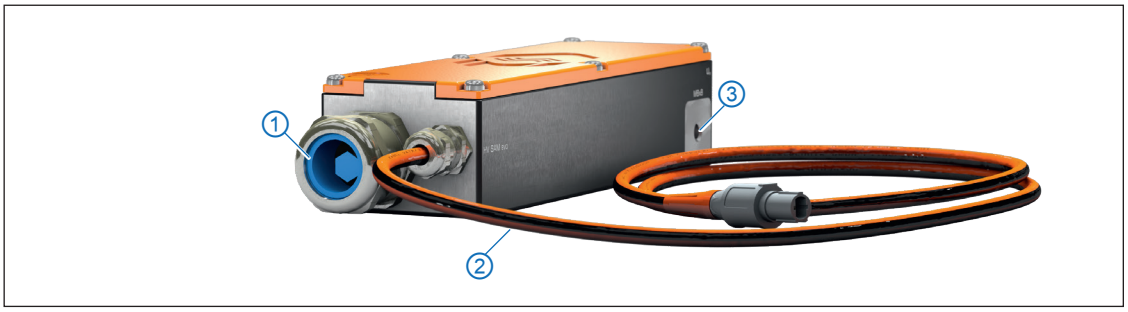


Fig. 3-4: HV SBM_I evo, right side / rear side of the housing

1. Cable gland for power cable HV- (chapter 8.1.2 "Components for the installation of HV power cables")
2. HV signal cable to HV SAM1 evo
3. Ground connection (chapter 4.3.2.4 "Ground connection")

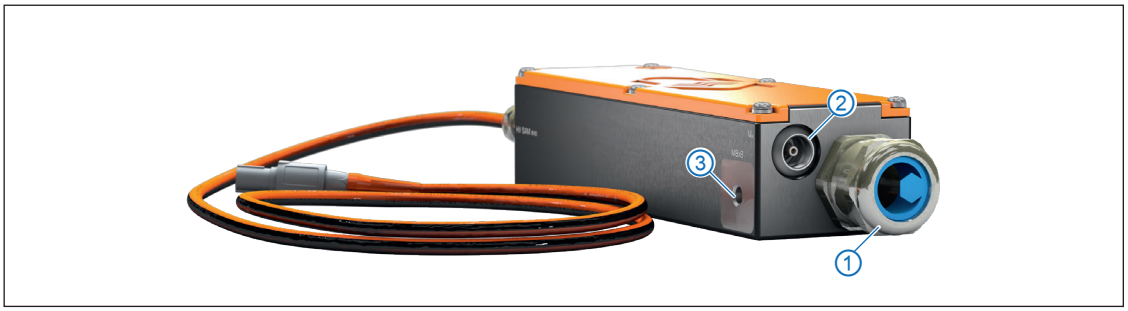


Fig. 3-5: HV SBM_I evo, left side/rear side of the housing

1. Cable gland for power cable HV- (chapter 8.1.2 "Components for the installation of HV power cables")
2. Socket for measurement cable HV+
3. Ground connection (chapter 4.3.2.4 "Ground connection")

3.1.3 HV SBM(L)_U evo

The HV SBM(L)_U evo are used for tapping the HV+ potential. The module is equipped with an HV measurement cable that must be connected to an HV SBM(L)_I evo.

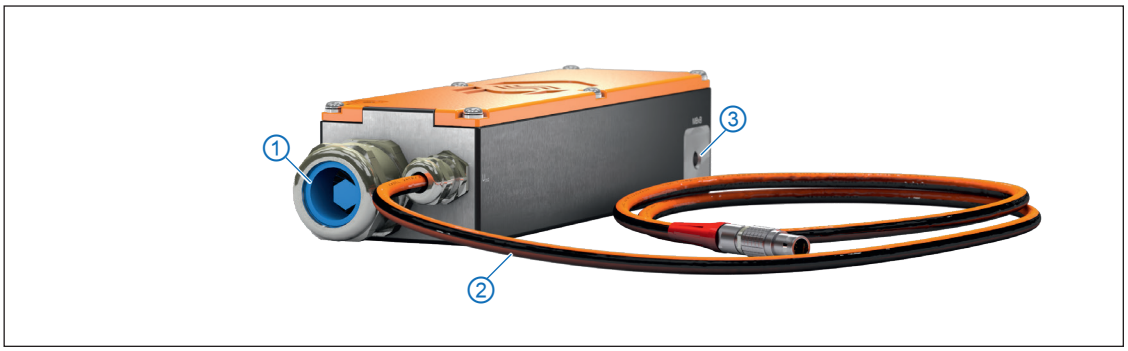


Fig. 3-6: HV SBM_U evo, right side/rear side of the housing

1. Cable gland for power cable HV+ (chapter 8.1.2 "Components for the installation of HV power cables")
2. Measurement cable HV+
3. Ground connection (chapter 4.3.2.4 "Ground connection")

3.2 Functional description of LED indicators

3.2.1 Measurement module LED indicators

3.2.1.1 EtherCAT® bus status LED indicator

The two-color status LED (Fig. 3-2, ②) is lit red for a few seconds after the module is switched on and then turns off.[2]

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.[3]
green	flashing	20 % on, 80 % off: Device is in status SAFE-OPERATIONAL.[4]
green	permanently lit	Device is in status OPERATIONAL.[5]
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	off	Status BOOT (only during firmware update) or INIT.

Tab. 3-1: EtherCAT® bus status LED indicator

3.2.1.2 CAN bus LED indicator

The LED indicator (Fig. 3-2, ⑩) 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

2 Status designations according to Beckhoff and EtherCAT® Technology Group EtherCAT® standard.
3 Status PRE-OPERATIONAL: Configuration/setting of the values for the measurement range
4 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.
5 Status OPERATIONAL: The module is in measurement operation.

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

The LED indicators for the sockets **IN** and **OUT** (Fig. 3-2, ④) are lit or are flashing if the measurement module HV SAM1 evo is connected to an XCP-Gateway or if data is being transferred.

LED status		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: EtherCAT® bus Link/Activity LED indicators **IN**/**OUT**

3.2.1.4 Measurement channel LED indicators

The measurement channel LED indicators (Fig. 3-2, ⑤ and ⑥) show the status of the corresponding measurement channel. There are separate LED indicators for access via CAN bus and EtherCAT® bus. The measurement channels are arranged as follows (left to right):

1. **Voltage**: Status of voltage measurement
2. **Current**: Status of current measurement
3. **T (Shunt)**: Status of temperature of the shunt module installed in the HV SBM(L)_I evo

After switching-on the HV SAM1 evo, all measurement channel LED indicators are lit red, indicating that the module is initializing. Once the module has initialized and no errors were detected, the LED indicators fade out.

After initialization, the device checks for the connected shunt module. 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**, in order for the HV SAM1 evo to send data simultaneously via CAN and ECAT. Otherwise only the module side that was configured last will send measurement values and 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 then **permanently lit in red**.

→ Chapter 6.3.3.8 "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

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

The modules of a HV BM-Split evo measurement system are equipped with GORE™ membranes (Fig. 4-1), which are required for pressure compensation. To ensure the breathing function of the membranes, the ventilation opening in the lid of the housing (Fig. 4-1, ①) 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.

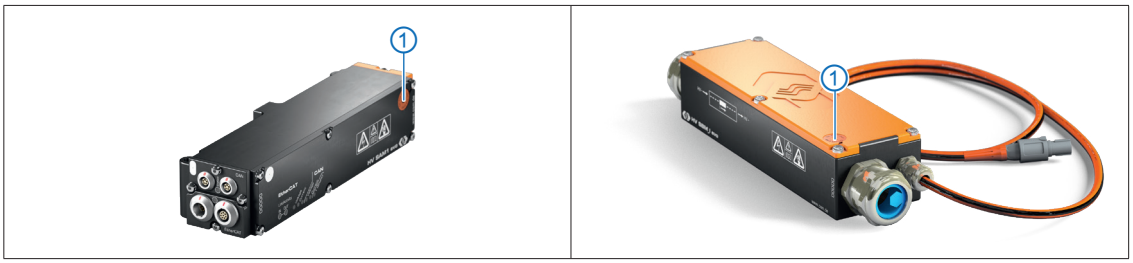


Fig. 4-1: Ventilation openings: HV SAM1 evo (left), HV SBM(L) evo (right)

NOTE!	
	The GORE™ membranes are required for pressure compensation. ☞ When mounting the modules, 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 only within the specified operating environment. → *Datasheet "HV BM-Split evo"*

4.2 Mounting HV SAM1 evo and HV SBM(L) evo modules

WARNING!

The temperature of the shunt module in an HV SBM(L)_I evo must not exceed +120 °C. A shunt module installed in an HV SBM(L)_I evo can heat up considerably during operation under high load.

The maximum temperature in an HV SBM(L)_I evo can also be exceeded if no measurements are performed but the module is integrated into a loaded circuit (e.g. when charging a vehicle battery).

Exceeding the specified temperature impairs the operational safety of the module. There are risks including life-threatening electrical shocks and fire hazards.

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

☞ Always monitor the shunt temperature of an HV SBM(L)_I evo and the internal temperature of the HV SAM1 evo to make sure that the threshold values will not be exceeded.

→ Chapter 6.3.3.8.6 "Shunt temperatures" and section "Info Message"

NOTE!

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

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

Requirements

- When choosing the mounting location, make sure that the ventilation opening of the GORE™ membrane is 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.

Please contact CSM support for the appropriate drill hole diagrams.

NOTE!

Mechanical modifications to the housing (e.g. by drilling holes into it) can impair the function of the measurement module or destroy it. Doing so would also invalidate the warranty.

☞ Never drill any holes in the housing.

☞ Observe the mounting instructions.

4.3 Installing HV SAM1 evo und HV SBM(L) evo modules

4.3.1 Before installation

WARNING!	
	The modules of an HV BM-Split evo measurement system are used in high-voltage applications. **Improper use may result in life-threatening electrical shocks.** ☞ Only use qualified and trained personnel (observe local guidelines/ regulations). ☞ Observe safety instructions.

WARNING!	
	If an HV SBM(L) evo or a K917 are connected to HV sources, HV potential will be applied to the pins of the HV connectors of the outgoing measurement cables. **If the HV connectors are not plugged in, there is a danger to life due to HV potential.** ☞ Make sure that the HV connectors are properly insulated with their protective caps when they are not plugged in. ☞ Only use qualified and trained personnel (observe local guidelines/ regulations).

WARNING!	
	The modules of an HV BM-Split evo measurement system have to be connected to the vehicle chassis or protective earth (PA/PE) in order to ensure user safety. **In the event of a fault, there is danger to life due to high-voltage potential if the ground connection is not established.** ☞ Connect all modules to the vehicle‘s potential equalization or PE using suitable ground cables. ☞ Only use qualified and trained personnel (observe local guidelines/ regulations). → Chapter 4.3.2.4 "Ground connection"

WARNING!	
	The behavior of the CAN bus can be impaired by connecting a CAN bus measurement module to an already 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, improper operating 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.

i	CSM provides cables to connect ECAT and CAN measurement modules. → *"XCP/ECAT Accessories for CSM measurement modules" and "CAN Accessories for CSM measurement modules"* Please contact the CSM sales department for further details.

i	CSM provides maintenance and repair services for HV BM-Split evo measurement systems. → Chapter 7.2 "Maintenance services"

4.3.2 Connecting an HV SAM1 evo

The HV SAM1 evo is equipped with an EtherCAT® and a CAN interface. The corresponding connection sockets are located in the left side of the housing (Fig. 3-2).

For safety reasons, the HV SAM1 evo must be connected to the vehicle's potential equalization or protective earth (PE) on the test bench by using the M8 threaded hole in the rear side of the housing (Fig. 3-3, ②).

WARNING!	
	The modules of an HV BM-Split evo measurement system have to be connected to the vehicle chassis or protective earth (PA/PE) in order to ensure user safety. **In the event of a fault, there is danger to life due to high-voltage potential if the ground connection is not established.** ☞ Connect all modules to the vehicle‘s potential equalization or PE using suitable ground cables. ☞ Only use qualified and trained personnel (observe local guidelines/ regulations).

4.3.2.1 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.CLLxxxxx** [6]

	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. 4-1: 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.

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

4.3.2.2 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.CLAxxxxx**[7]

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

4.3.2.3 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 measurement modules to a CAN measurement bus with an HV SAM1 evo. ☞ 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 as standard for the CAN ports. To connect a cable to this socket, the following plug with plug insert is required:

- **FGG.0B.305.CLA xxxxx**[7]

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

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

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

NOTE!	
	The CAN sockets 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.

4.3.2.4 Ground connection

The modules of an HV BM-Split evo measurement system 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 that is used. When selecting the ground cable cross-section, observe the recommendations according to DIN VDE 0100-540[8].

WARNING!	
	The modules of an HV BM-Split evo measurement system have to be connected to the vehicle chassis or protective earth (PA/PE) in order to ensure user safety. **In the event of a fault, there is danger to life due to high-voltage potential if the ground connection is not established.** ☞ Connect all modules to the vehicle‘s potential equalization or PE using suitable ground cables. ☞ Only use qualified and trained personnel (observe local guidelines/ regulations).

NOTE!	
	The threaded hole is designed to connect the 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).

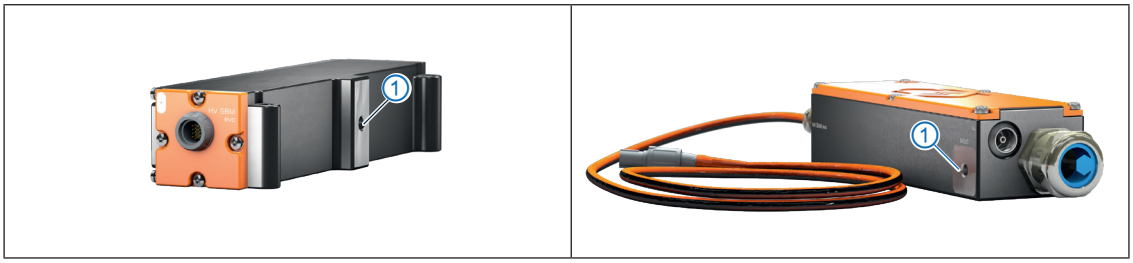


Fig. 4-2: Ground connection in the rear side of the housing: HV SAM1 evo (left) and HV SBM_I evo (right)

1. M8 threaded hole for ground connection (PA/PE)

8 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)
  When selecting the ground cable cross-section, observe the recommendations of the relevant directives or standards.
- M8 screw plus washer [9]
- suitable tools

4.3.2.5 Connection cables for an HV SAM1 evo

Cables of various lengths are available for connecting the device 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

i	The K420-xxxx cable can also be used to connect an HV SAM1 evo 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 "Installing the HV Power Cables"

9 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, one or multiple intermediate power supplies 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 SAM1 evo and any additional ECAT and CAN measurement modules connected to it can be powered via the EtherCAT® **IN** socket or via the **CAN** sockets (Fig. 3-2).

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.[10]

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.[10]

10 The minimum value specified on the type label of a measurement module has to be observed (chapter 7.1.1 "HV SAM1 evo").

5 Installing the HV Power Cables

This chapter contains information on how to connect HV-/HV+ power cables to the HV SBM(L)_I evo and HV SBM(L)_U evo modules.

5.1 Installation notes

	WARNING!
	The orange lids of the breakout boxes can be removed to mount or dismount the HV power cables. If the lids of the housings are not mounted and the HV cables are not de-energized, there is a risk of accidentally touching non-insulated contacts at high-voltage potential. **If the device is not de-energized, there is a risk of life-threatening electrical shocks.** ☞ Only operate the HV SBM(L) evo modules with the lids mounted. ☞ Before removing the lids, make sure that the HV power cables and connected components (HV SBM(L) evo, K917) are de-energized. ☞ Remove the lids only to connect the HV power cables and then re-mount them properly. ☞ Only use ring terminals approved by CSM for the HV power cables. ☞ Only use the installation material supplied by CSM for mounting the HV power cables. ☞ Observe the mounting instructions in the user guide. It is particularly important that the lids and the cable glands are properly mounted in order to ensure the tightness of the housing.

	WARNING!
	Only ring terminals that match the conductor material of the HV power cables and the braided shields must be used. CSM provides suitable ring terminals for the inner conductors and the braided shields. **A high contact resistance between conductor and ring terminal can lead to a massive increase in temperature and, in the worst case, to the development of fire**. ☞ When connecting the inner conductors and braided shields of the HV power cables, only use ring terminals provided by CSM. ☞ HV power cables with conductors made of aluminum must only be connected to HV SBML_I evo or HV SBML_U evo breakout boxes.

	CAUTION!
	A shunt module installed in an HV SBM(L)_I evo can heat up considerably during operation under high load. **Touching the surface of the module housing may cause serious burns.** ☞ Let the modules cool down before handling, especially before removing the orange-colored lids. ☞ Wear appropriate safety gloves.

5.1.1 Required tools

- Allen key, size 2.5
- Open-end 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

WARNING!	
	CSM provides specific ring terminals for mounting the HV power cables. 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 electrical shocks and short-circuits.** ☞ Only connect HV power cables with ring terminals approved by CSM.

5.1.2 Tightening torques

5.1.2.1 Tightening torques for the nuts fixing the shunt modules (HV- power cable)

Depending on the shunt module to be connected, the tightening torques specified in Tab. 5-1 apply to the installation of the ring terminals of the HV power cables.

Shunt 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 fixing the shunt modules (HV SBM(L)_I evo)

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

Cable	Tightening torque
HV+	25 Nm
HV-/HV+ shielding	3.9 Nm

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

5.2 Connecting HV power cables to HV SBM(L)_I evo and HV SBM(L)_U evo

This chapter describes the installation of HV power cables in HV SBM(L)_I evo and HV SBM(L)_U evo modules.

	NOTE!
	The modules of an HV BM-Split evo measurement system have been optimized for operation with the lids mounted and the HV power cables connected. Error-free operation is only possible with the housing lids mounted and the HV power cables correctly connected. ☞ Only operate the modules with the lids mounted and the HV power cables properly connected.

	NOTE!
	Please note that the shielding of both HV power cables has to be connected to the module housing via the M6 threaded bolts (Fig. 5-7 / Fig. 5-8, ②).

i	The HV power cables for HV SBM evo and HV SBML evo modules are assembled differently and are therefore not interchangeable. Information on how to assemble the HV power cables can be found in the appendix to this user guide. → Chapter 8.1 "Assembling HV power cables for HV SBM(L) evo"

5.2.1 Opening the housing

Fig. 5-1 and Fig. 5-2 show an HV SBM_I evo with and without lid. The procedure described in this section applies to all HV SBM(L) evo.

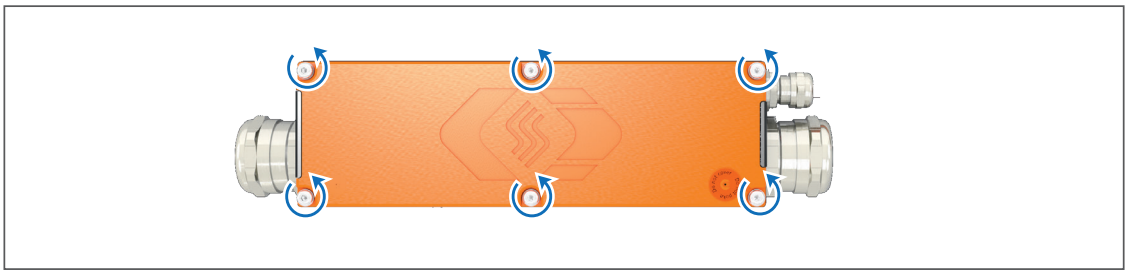


Fig. 5-1: HV SBM_I evo, lid mounted

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

☞ Remove the orange-colored lid from the housing.

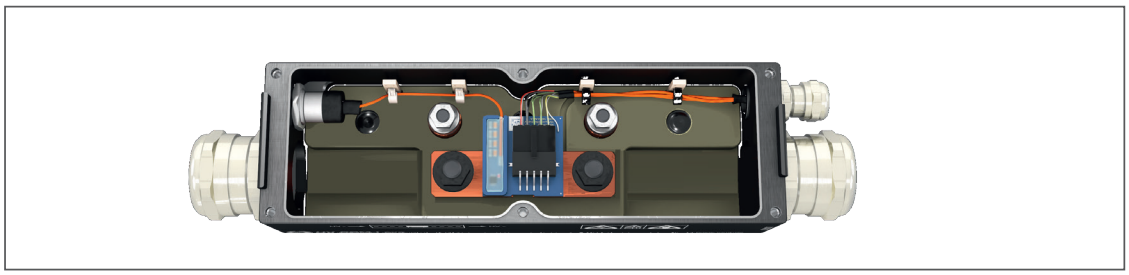


Fig. 5-2: HV SBM_I evo, lid removed from the housing

5.2.2 Connecting the HV power cables to HV SBM evo modules

WARNING!	
	Nuts and ring terminals must not extend over the threaded bolts, otherwise the distance to the lid is too small. **Otherwise, there is a risk of life-threatening electric shocks and short circuits.** ☞ Only use ring terminals approved by CSM for connecting the ring terminals. ☞ Only use the nuts provided by CSM for mounting the HV power cables. ☞ 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).

Connections for the HV-/HV+ cables and the shielding

- HV SBM_I evo (Fig. 5-3) and HV SBM_U evo (Fig. 5-4) are each equipped with two M8 threaded bolts ① for mounting the power cables HV- and HV+.
- The HV SBML_I evo and HV SBML_U evo modules (Fig. 5-7 and Fig. 5-8) have larger housings to accommodate longer ring terminals for mounting aluminum HV power cables. The installation of the HV power cables corresponds to the procedure for module types HV SBM_I evo and HV SBM_U evo.
- In all modules, the braided shields of the HV- and HV+ power cables are connected to the M6 threaded bolts ② with ring terminals.
- The nuts and washers for mounting the ring terminals are mounted on the threaded bolts. The ring terminals for the shunt or the copper plate are fastened with M8 flange nuts. The ring terminals for the shielding are mounted with standard size M6 nuts and washers.

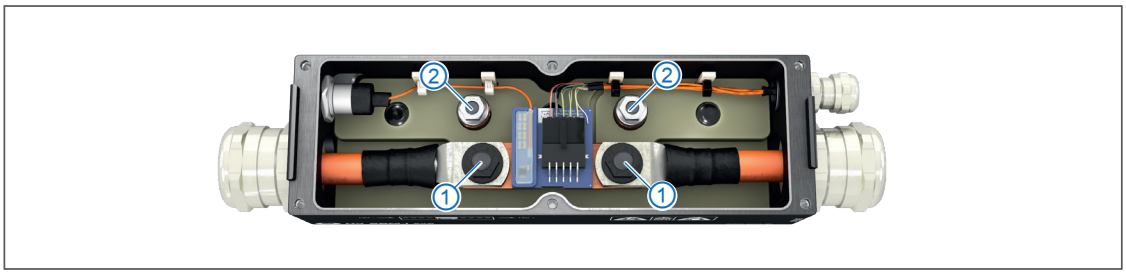


Fig. 5-3: HV SBM_I evo, connections for the HV- power cables and the shielding

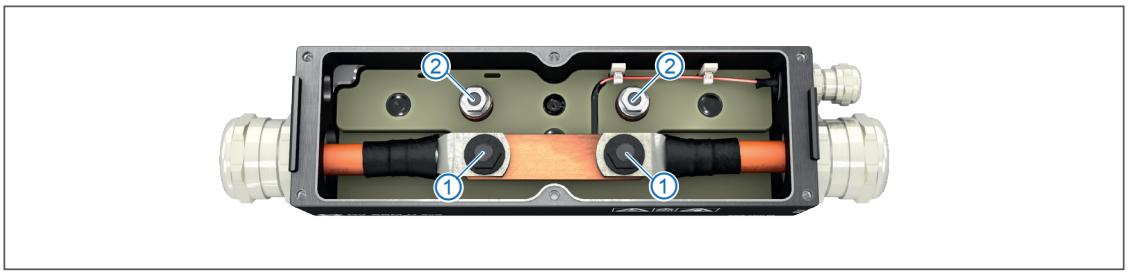


Fig. 5-4: HV SBM_U evo: connections for the HV+ power cables and the shielding

1. M8 threaded bolts for connecting the HV- and HV+ power cables
2. M6 threaded bolts for connecting the shielding

5.2.2.1 HV SBM evo: Mounting HV- and HV+ power cables (all cable cross-sections)

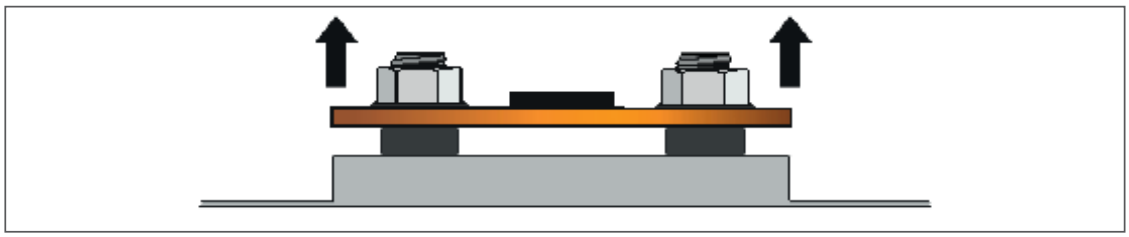


Fig. 5-5: HV SBM_I evo, removing the M8 nuts from the threaded bolts

☞ Loosen and remove the M8 nuts mounted on the threaded bolts.

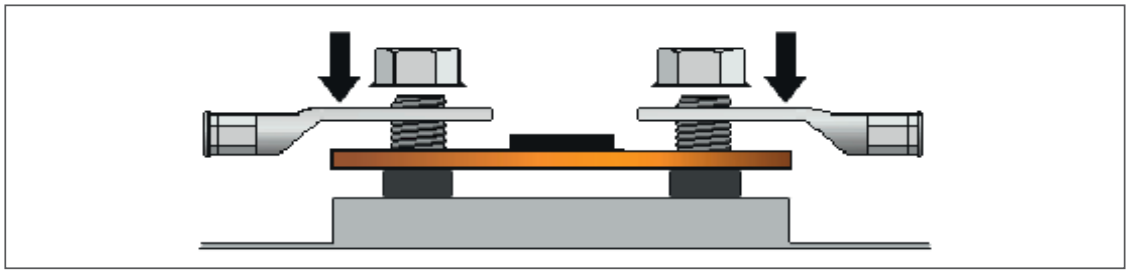


Fig. 5-6: HV SBM_I evo, mounting the ring terminals of the HV- power cables with the M8 nuts

☞ Place the ring terminals on the threaded bolts as shown in Fig. 5-6.

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

i	The same procedure is used to mount the ring terminals of the **HV+ cables** on an **HV SBM_U evo**, i.e. the ring terminals are placed on the threaded bolts and mounted as shown Fig. 5-6. The tightening torque for mounting the **HV+ cables** is always 25 Nm (see Tab. 5-2).

5.2.3 Connecting the HV power cables to an HV SBML evo

WARNING!	
	Nuts and ring terminals must not extend over the threaded bolts, otherwise the distance to the lid is too small. **Otherwise, there is a risk of life-threatening electrical shocks and short circuits.** ☞ Only use ring terminals approved by CSM for connecting the ring terminals. ☞ Only use the nuts provided by CSM for mounting the HV power cables. ☞ 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).

WARNING!	
	Only ring terminals that match the conductor material of the HV power cables and the braided shields must be used. CSM provides suitable ring terminals for the inner conductors and the braided shields. **A high contact resistance between conductor and ring terminal can lead to a massive increase in temperature and, in the worst case, to the development of fire.** ☞ When connecting the inner conductors and shielding of the HV power cables, only use ring terminals provided by CSM. ☞ HV power cables with conductors made of aluminum must only be connected to HV SBML_I evo or HV SBML_U evo breakout boxes.

Connections for the HV-/HV+ power cables and the shielding

HV SBML_I evo (Fig. 5-7) and HV SBML_U evo (Fig. 5-8) are designed for connecting HV power cables made of aluminum using longer Al/Cu ring terminals. The module design is basically the same as that of the HV SBM evo modules (Fig. 5-3 and Fig. 5-4).

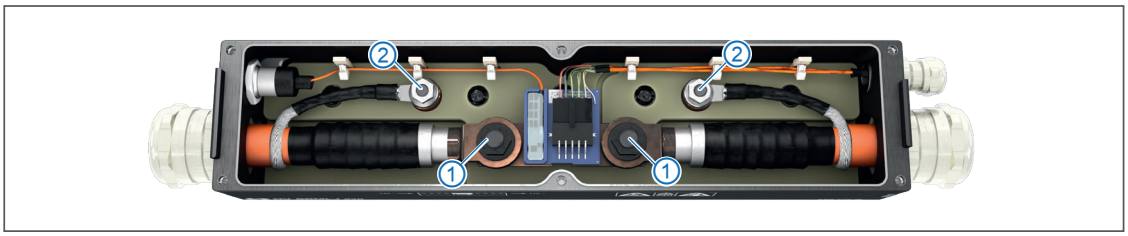


Fig. 5-7: HV SBML_I evo, connections for the HV- power cables and the shielding

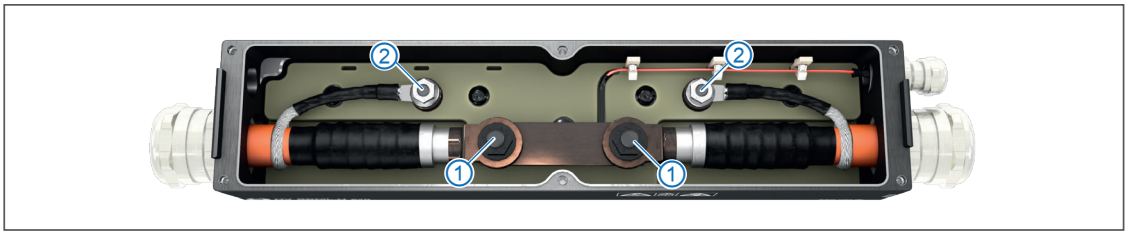


Fig. 5-8: HV SBML_U evo: connections for the HV+ power cables and the shielding

1. M8 threaded bolts for connecting the HV- and HV+ power cables
2. M6 threaded bolts for connecting the shielding

5.2.3.1 HV SBML evo: Mounting HV- and HV+ power cables (all cable cross-sections)

NOTE!	
	HV SBML evo breakout boxes are designed for mounting HV power cables made of aluminum with Al/Cu ring terminals. Provided that suitable ring terminals are used, it is also possible to connect HV power cables with conductors made of copper to these modules.

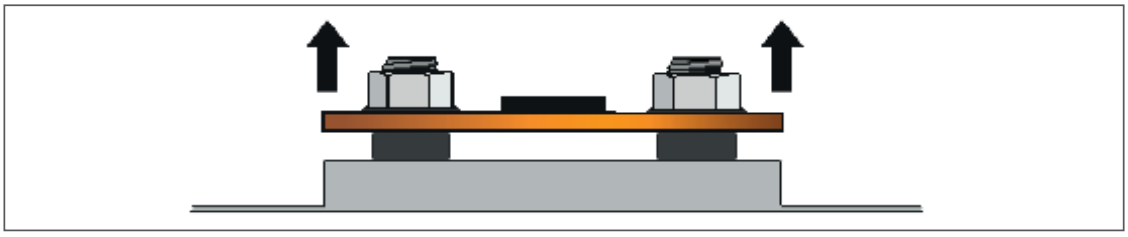


Fig. 5-9: HV SBML_I evo, removing the M8 nuts from the threaded bolts

☞ Loosen and remove the M8 nuts mounted on the threaded bolts.

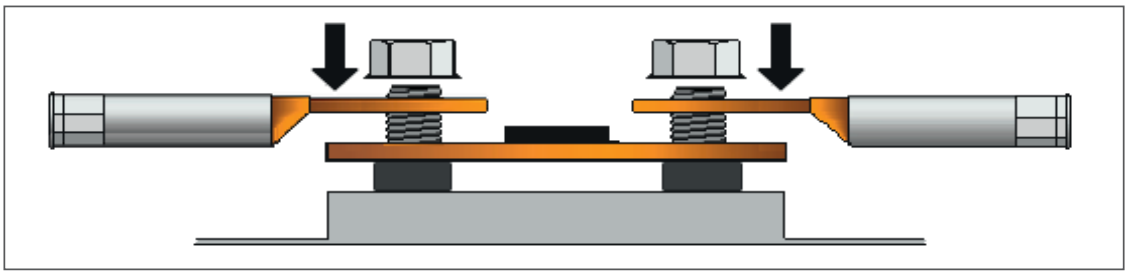


Fig. 5-10: HV SBML_I evo, mounting the ring terminals of the HV- power cables with the M8 nuts

☞ Place the ring terminals on the threaded bolts as shown in Fig. 5-10.

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

i	The same procedure is used to mount the ring terminals of the **HV+ cables** on an **HV SBM_U evo**, i.e. the ring terminals are placed on the threaded bolts and mounted as shown in Fig. 5-10. The tightening torque for mounting the **HV+ cables** is always 25 Nm (see Tab. 5-2).

5.2.4 Connecting the shielding to HV SBM(L) evo modules

i	The procedure for connecting the shielding of the HV- and HV+ power cables is the same for all four modules. Since the HV power cables for the HV SBM evo and the HV SBML evo modules are assembled in different ways, they cannot be interchanged. → Chapter 8.1 "Assembling HV power cables for HV SBM(L) evo"

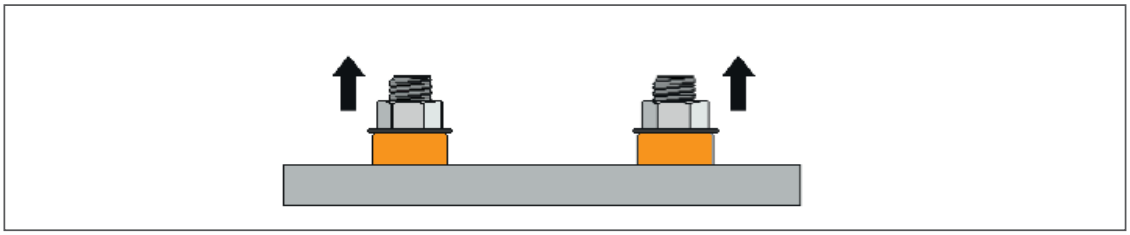


Fig. 5-11: HV SBM(L) evo, HV-/HV+ shielding, loosen the M6 nuts and remove them from the threaded bolts

☞ Loosen the M6 nuts mounted on the threaded bolts.

☞ Remove the M6 nuts and the washers.

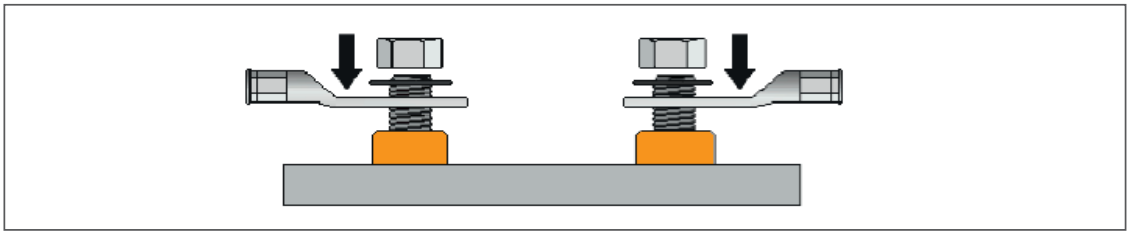


Fig. 5-12: HV SBM(L) evo, HV-/HV+ shielding, fixing the ring terminals with the M6 nuts

☞ Place the ring terminals on the threaded bolts as shown in Fig. 5-12.

☞ Place the washers on the ring terminals.

☞ Place the M6 nuts on the threaded bolts and tighten them with a tightening torque of 3.9 Nm (see Tab. 5-2).

5.2.5 Mounting the cable glands and the lid of the housing

NOTE!	
	In order to prevent water ingress and condensation, the tightness of the housing has to be ensured. ☞ 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 by CSM. ☞ Make sure that cover and seal are properly fitted. ☞ Make sure that cable glands and HV power cables are properly mounted.

5.2.5.1 Mounting the cable glands

i	In the following description, it is assumed that the components of the cable glands have been mounted on the HV power cables *before the assembly*. → Chapter 8.1.2 "Components for the installation of HV power cables"

☞ Screw the double nipples of the cable glands onto the housing and tighten them by hand.

☞ Screw the pressure screws with sealing inserts onto the double nipples and tighten them by hand.

☞ Tighten the pressure screws and double nipples with the specified torques. Observe the mounting instructions of the manufacturer. [11]

5.2.5.2 Mounting the lid of the housing (all module versions)

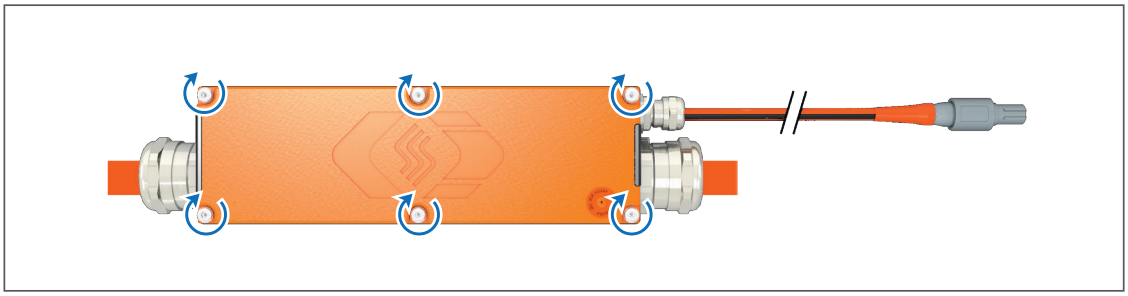


Fig. 5-13: HV SBM_I evo, lid and HV power cables mounted

☞ Place the lid on the housing.

☞ Fix the lid with the Allen screws (↻) and tighten them crosswise.

11 Tightening torques and further manufacturer information are available on the manufacturer's website at pflitsch.de/en.

6 How to Use HV BM-Split evo Measurement Systems

HV SAM1 evo measurement modules operate via both ECAT and CAN, which means that measured values are sent via both bus types. In CSMconfig, the module can therefore be read in and configured as an ECAT and as a CAN module. The configuration is explained here using the ECAT side as an example. The procedure is identical for the ECAT and CAN sides of the module. Any CAN-specific features of operation are discussed in the relevant sections.

6.1 CSMconfig User Interface

The CSMconfig user interface consists of the following sections:

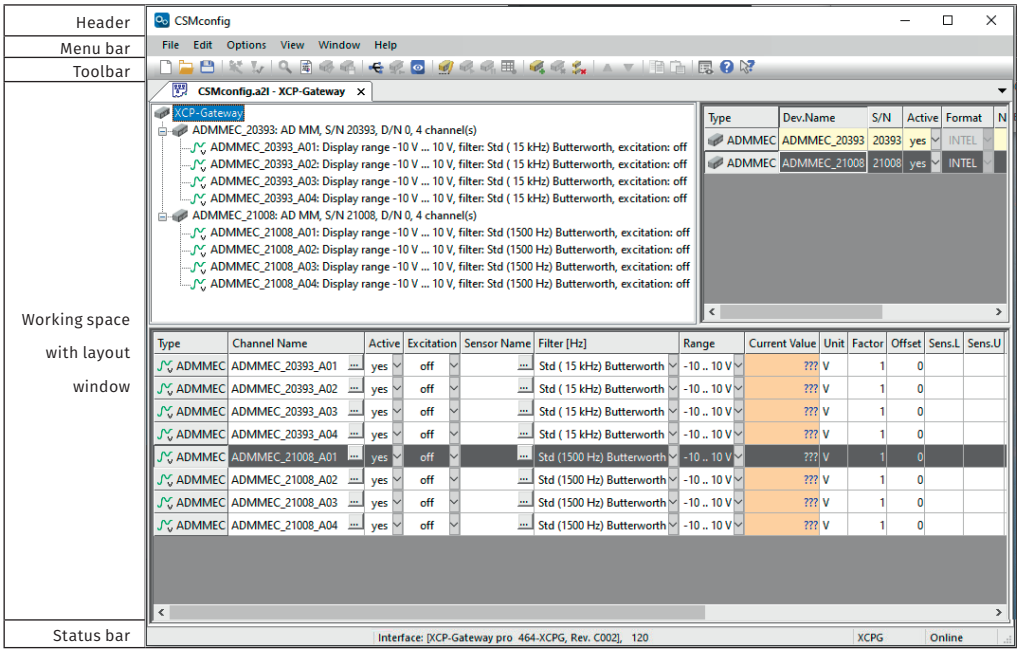


Fig. 6-1: CSMconfig user interface

6.1.1 Header

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

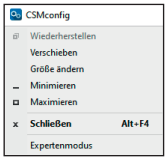


Fig. 6-2: Program menu

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"*

6.1.2 Menu bar

The commands are arranged in the following menus:

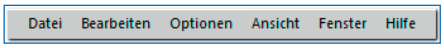


Fig. 6-3: Menu bar

→ *CSMconfig Online Help, "Menu commands"*

6.1.3 Toolbar

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

Fig. 6-4: Toolbar

→ *CSMconfig Online Help, "Toolbar"*

6.1.4 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. 6-1, ①)
- **Device list** (Fig. 6-1, ②)
- **Channel list** (Fig. 6-1, 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.

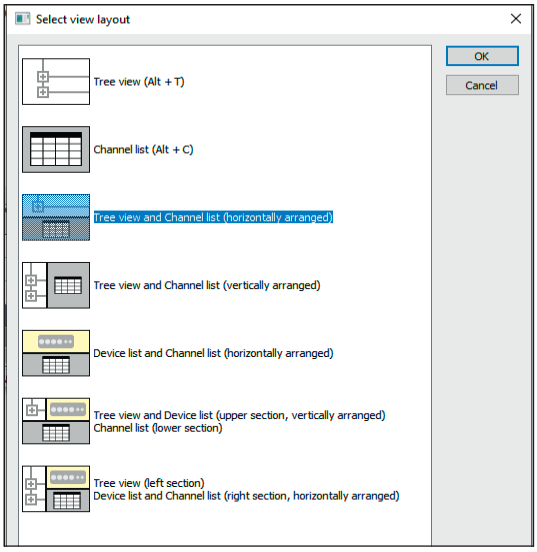


Fig. 6-5: **Select view layout** dialog

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

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

6.1.5 Status bar

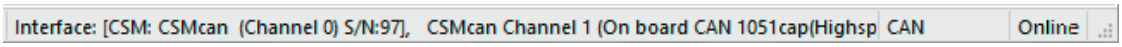


Fig. 6-6: Status bar

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"

6.2 Preparing the module configuration

The configuration software CSMconfig is used to configure an HV SAM1 evo in conjunction with an XCP-Gateway protocol converter[12]. The measurement module can also be configured via an EtherCAT® master. CANopen over EtherCAT® (CoE) is used as application protocol.

	NOTE!
	It is recommended always to use the latest version of CSMconfig. Older versions may not support all module variants and functions. The latest version of CSMconfig is available in the download section of the CSM website. CSMconfig can check for new versions every time the program is started. If a newer version is available, the corresponding download link will be displayed in the dialog box.

	NOTE!
	Since CSMconfig requires ports 5555 and 5556 for communication, the firewall settings may need to be adjusted. ☞ Ensure that the firewall is configured in such a way that it allows incoming and outgoing traffic on the ports 5555 and 5556.

	NOTE!
	HV SAM1 evo 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 6.3.3.5 "Communication parameter settings"

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

6.2.1 Changing the IP address of the network card

	NOTE!
	To change the IP address, extended user rights or administrator rights may be required.[13]

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.

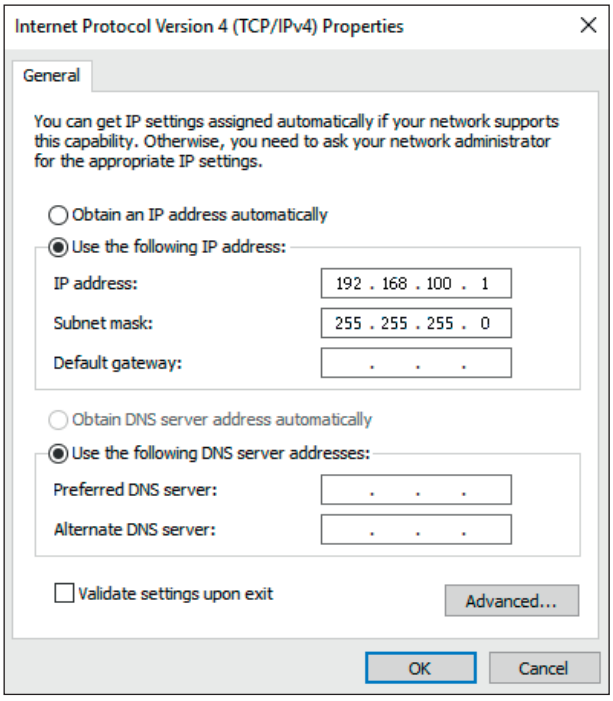


Fig. 6-7: Windows 10, **Internet Protocol Version 4 (TCP/IPv4) Properties** dialog

☞ 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.

13 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.**

☞ Select **Network & internet** from the left sidebar.

⇨ The options for **Network & internet** are displayed.

☞ Select **Advanced network settings**.

⇨ The options for **Advanced network settings** are displayed.

☞ Select the required Ethernet network from the **Network adapters** list.

☞ Go to the **View additional properties** section and click on the arrow on the right.

⇨ The options for **View additional properties** are displayed.

☞ Go to **IP assignment** and click on **Edit**.

⇨ The **Edit IP settings** dialog opens. If the option "Automatic (DHCP)" is set, the remaining setting options of the dialog box will be hidden.

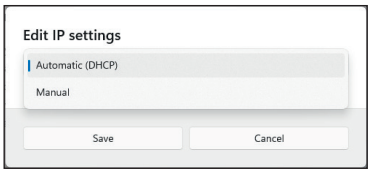


Fig. 6-8: Windows 11, **Edit IP Settings** dialog, settings hidden

☞ In this case, change the setting from "Automatic (DHCP)" to "Manual" (Fig. 6-8).

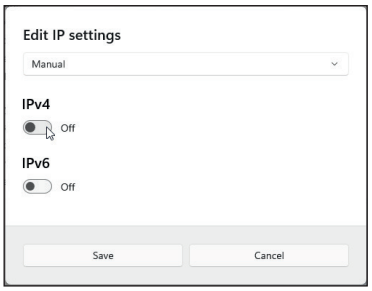


Fig. 6-9: Windows 11, **Edit IP Settings** dialog, IP options

☞ Next, enable the required internet protocol (**IPv4** or **IPv6**) (Fig. 6-9).

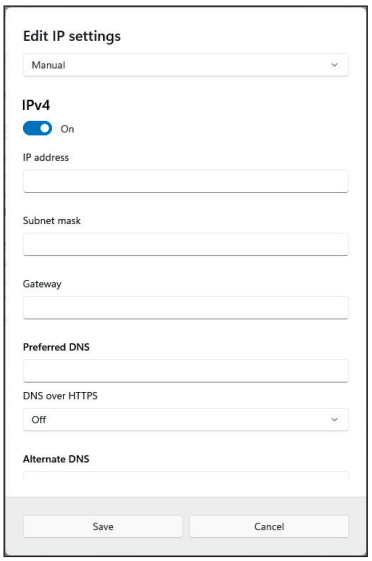


Fig. 6-10: Windows 11, **Edit IP Settings** dialog, full setting options

☞ Make the required settings (**IP address**, etc.) and then click **Save** (Fig. 6-10).

6.3 Configuring HV SAM1 evo

The following sections contain information on the following topics:

- HV SAM1 evo module settings
- Creating a standard configuration with (offline and online) with an SAM1 evo 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 6.1.4 "Working space"

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

6.3.1 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.

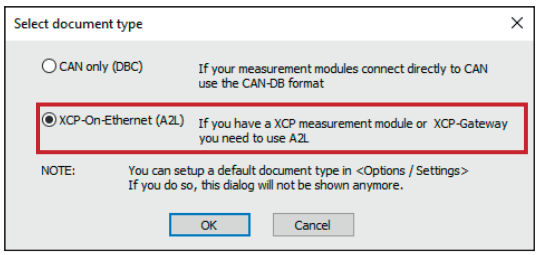


Fig. 6-11: **Select document type** dialog, **XCP-on-Ethernet (A2L)** selected

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:

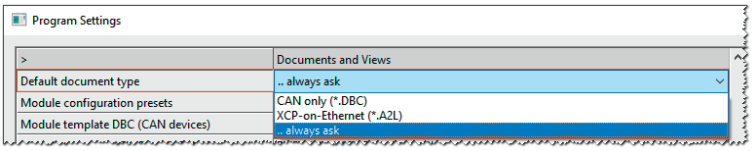


Fig. 6-12: **Program Settings** dialog, **Default document type** options

- **... 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"*

6.3.2 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. 6-11) 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**).

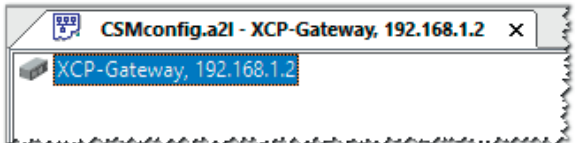


Fig. 6-13: **CSMconfig.a2l**, **Tree view**

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

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

⇨ The context menu opens.

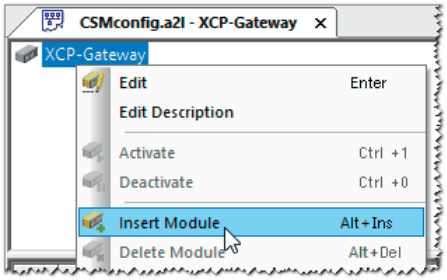


Fig. 6-14: **CSMconfig.a2l** window, **Tree view**, context menu

☞ Select **Insert Module.**

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

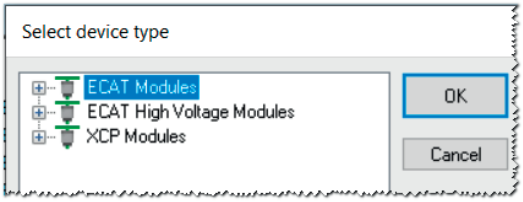


Fig. 6-15: **Select device type** dialog

	NOTE!
	This dialog is designed to select a module series (e.g. **AD MM series, Type IG**) but not specific module variants (e.g. **AD4 IG100**). 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.

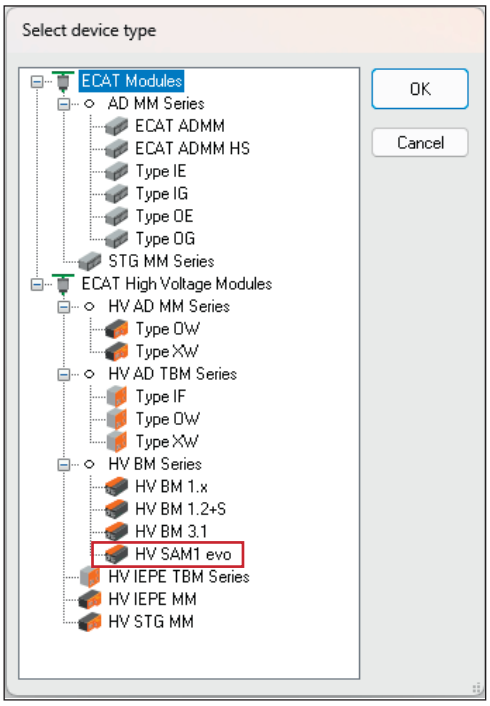


Fig. 6-16: **Select device type** dialog, subentries faded in

☞ Select the module series (e.g. **ECAT High Voltage Modules** | **HV BM Series** | **HV SAM1 evo**) and confirm selection with **OK**.

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

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

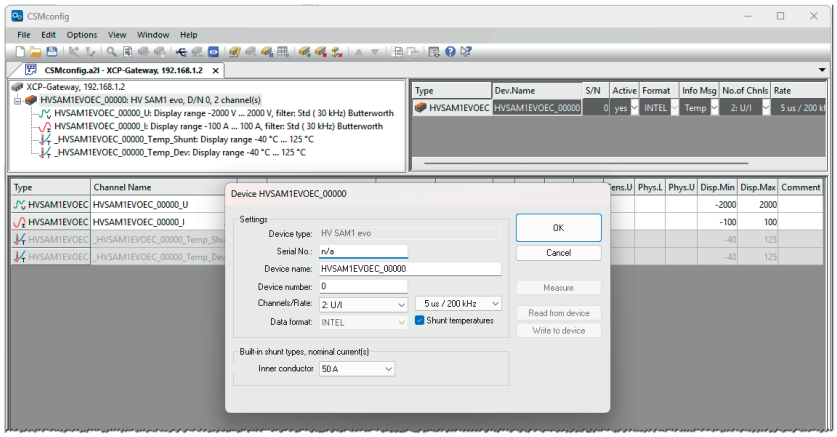


Fig. 6-17: **Device configuration dialog**, **CSMconfig.a2l** window in the background

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

→ Chapter 6.3.3.7 "Measurement channel settings" or chapter 6.3.3.8 "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 6.3.3.8.10 "Transmitting configuration data and verifying measurement values"

6.3.3 Online configuration

6.3.3.1 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

6.3.3.2 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. 6-18), continue with chapter 6.3.3.4 "Creating a new configuration file".

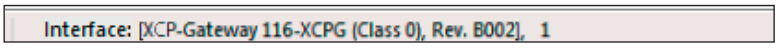


Fig. 6-18: Status bar: "XCP Gateway" interface

☞ If no interface is displayed in the status bar (Fig. 6-19), continue with chapter 6.3.3.3 "Selecting a communication interface".

Fig. 6-19: Status bar: "No valid interface selected"

6.3.3.3 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. 6-19). 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.

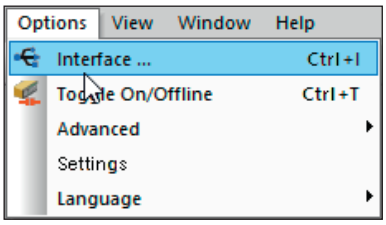


Fig. 6-20: **Options | Interface**

☞ Select **Options | Interface**.

⇨ The **Interface** dialog opens.

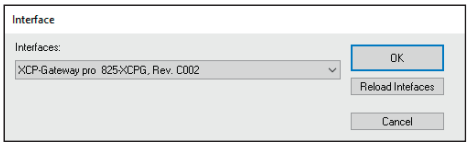


Fig. 6-21: **Interface** dialog

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

⇨ The drop-down menu opens.

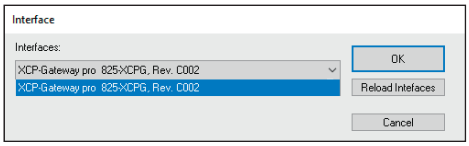


Fig. 6-22: **Interface** dialog, drop-down menu expanded

☞ Select the required interface (XCP-Gateway).

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

6.3.3.4 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 6.3.3.6 "Scan Bus and Auto-Configuration"

☞ Select **File | New**.

⇨ The **Select document type** dialog (Fig. 6-11) opens.

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

⇨ The **CSMconfig.a2l** window opens.

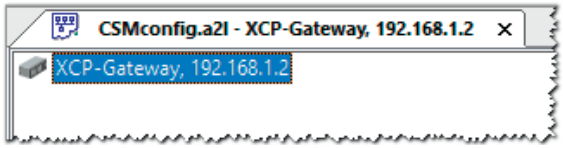


Fig. 6-23: **CSMconfig.a2l** window, **Tree view**

6.3.3.5 Communication parameter settings

The communication parameters used by the data acquisition software to establish the connection to one or more measurement modules via 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 to 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

→ Chapter 6.2.1 "Changing 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 is the IP configuration the XCP-Gateway will use for measurements.

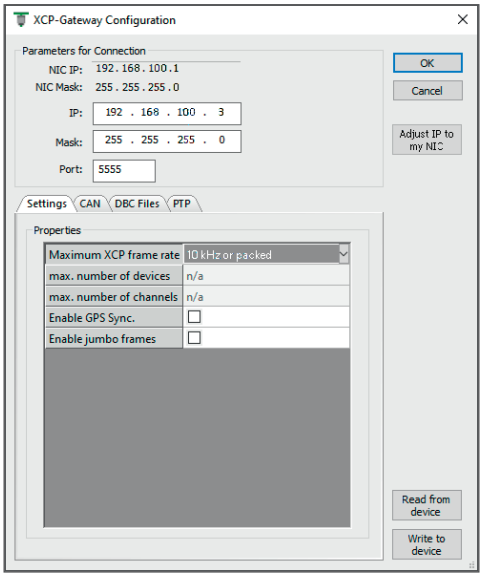


Fig. 6-24: **XCP Gateway Configuration** dialog, **Settings** tab

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 performed with a different PC/NIC, the XCP-Gateway connection parameters must match the network settings on the other machine.
- If PC and network adapter are used for both, configuration and measurements, the IP addresses of the network adapter and the XCP-Gateway have to be in the same address range (Fig. 6-25, green markers), but they must not be identical (Fig. 6-25, blue markers). If required, the IP address can be adjusted by clicking the button **Adjust IP to my NIC**. The IP address is then automatically adjusted to the IP address of the network adapter. A manual modification of the **IP address** entry is not required.

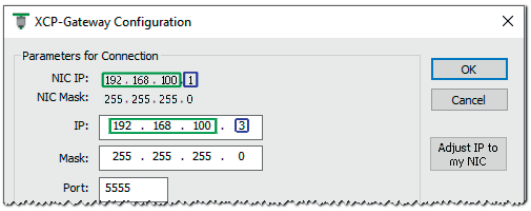


Fig. 6-25: **Adjust IP to my NIC** command

☞ 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 that is displayed in the **Settings** tab. If no XCP-Gateway is connected, the settings of the previous configuration or the default settings will be used.

Tabs

The **XCP-Gateway Configuration** dialog contains additional setting options arranged in up to five tabs. This section describes the functions and setting options of the **Settings** tab (Fig. 6-24).

- **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 the 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"*

6.3.3.6 Scan Bus and Auto-Configuration

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

Both functions can be used to detect measurement modules connected to the bus and read out the stored configurations. In addition to the detection of modules, **Auto Configuration** 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**.

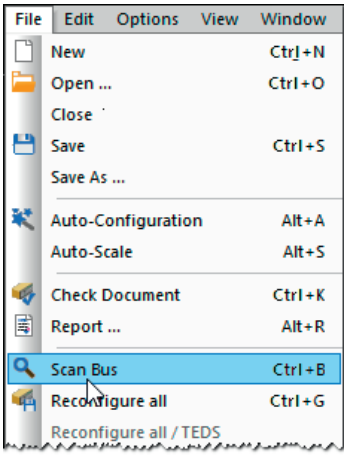


Fig. 6-26: **File | Scan Bus**

☞ Select **File | Scan Bus**.

⇨ The bus is checked for available measurement modules.

⇨ Detected measurement modules are listed in the **Tree view** below the bus level.

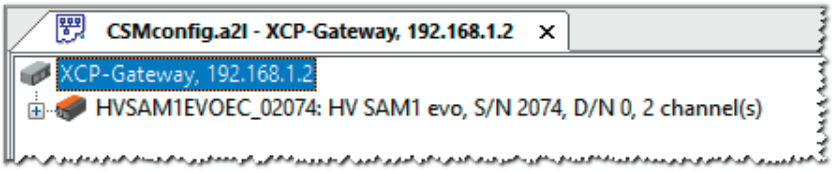


Fig. 6-27: **CSMconfig.a2l** window, **Tree view**, detected measurement module

Running Auto-Configuration

If **Auto-Configuration** is used instead of **Scan bus**, a new configuration file is automatically created when executing the command. Upon process completion, the new configuration file has to be named and stored in the required folder.

→ Chapter 6.3.3.9 "Saving a configuration"

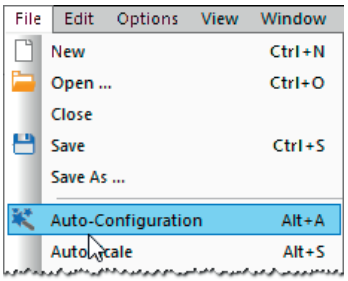


Fig. 6-28: **File | Auto-Configuration**

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

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

⇨ The **AutoConfig** window opens.

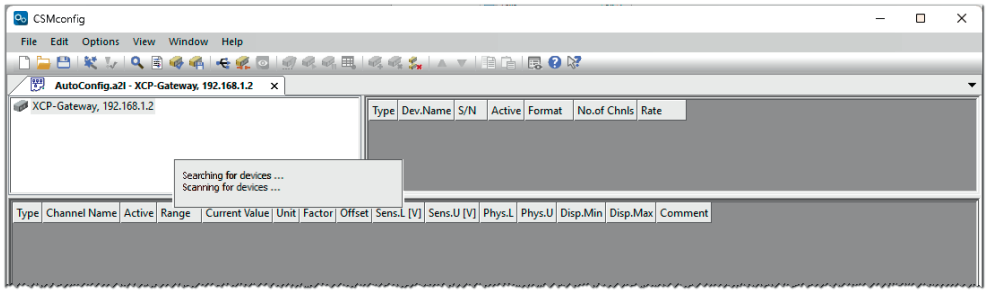


Fig. 6-29: **AutoConfig** window, "Searching for devices.../Scanning for devices..."

⇨ 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** shows the measurement modules that have been detected.

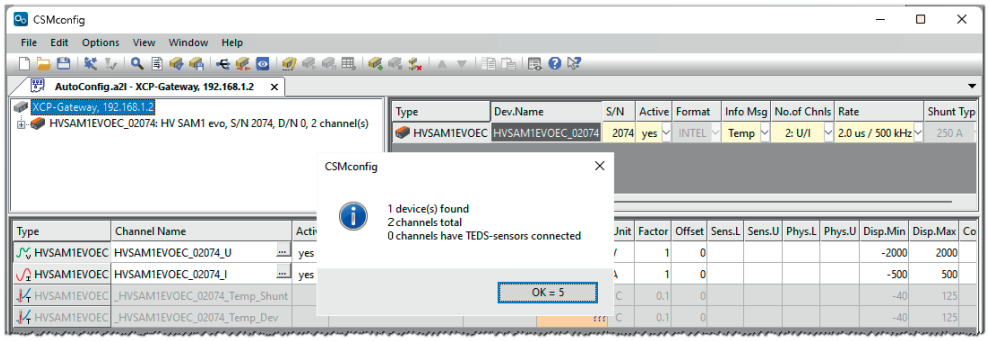


Fig. 6-30: **Auto-Configuration** is performed.

- In another window, a message is shown indicating how many measurement modules and channels have been detected.

Fig. 6-31: Message window after **Auto Configuration** has been completed

The **OK** button in this window contains an automatic counter counting 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 6.3.3.9 "Saving a configuration"

6.3.3.7 Measurement channel settings

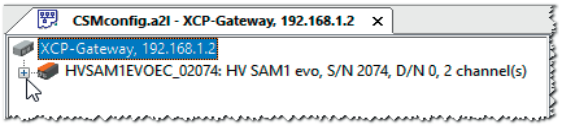


Fig. 6-32: **CSMconfig.a2l** window, **Tree view**, channel list faded out

☞ 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.

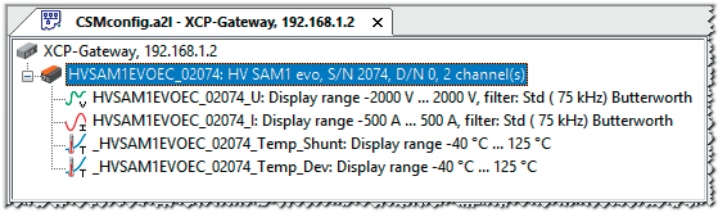


Fig. 6-33: **CSMconfig.a2l** window, **Tree view**, channel list faded in

☞ Double-click on the selected channel entry.

⇨ The **Channel configuration dialog** opens.

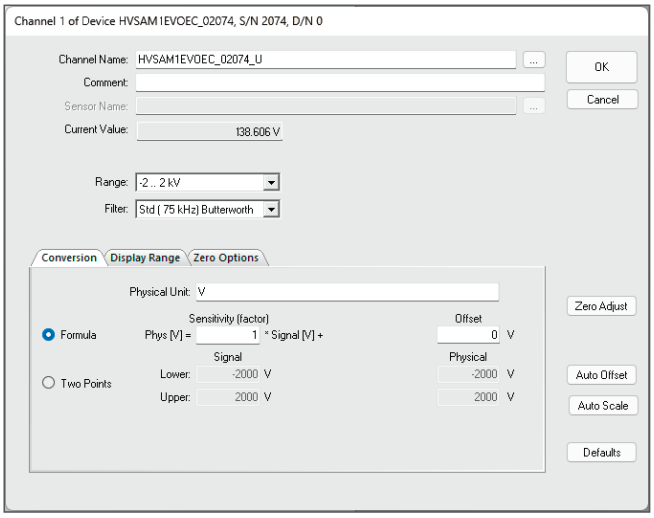


Fig. 6-34: **Channel configuration dialog** (HV SAM1 evo)

☞ Make the required settings ("Channel configuration options HV SAM1 evo")

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

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

Channel configuration options HV SAM1 evo

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	Functionality is not available for HV SAM1 evo and 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 of the module. To be able to use this function, the **Per channel configuration** option in the **Device configuration dialog** has to be enabled.
Measurement range	Drop-down menu for setting the measurement range: Voltage U: ±50 V, ±100 V, ±200 V, ±500 V, ±1 kV and ±2 kV[14] Current I: up to 1000 A (2000 A_{peak}), depending on the shunt module selected[15]
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.	
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 tabs **Conversion** and **Display Range**.
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**.

14 In order to be able to record transient overvoltages, the measurement range has been dimensioned for ±2,000 V.
15 See specifications in the HV BM-Split evo data sheet.

Field	Function
Conversion tab (cont.)	
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. 6-1: Channel configuration options (HV SAM1 evo)

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 ranges have 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 O**peration mode** row of the **Device configuration** dialog (see Fig. 6-35).

☞ Go to the **Device configuration dialog** (Fig. 6-37) and click on **Read from device**.

⇨ The dialog **Device configuration** opens (Fig. 6-35).

☞ 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 available again.

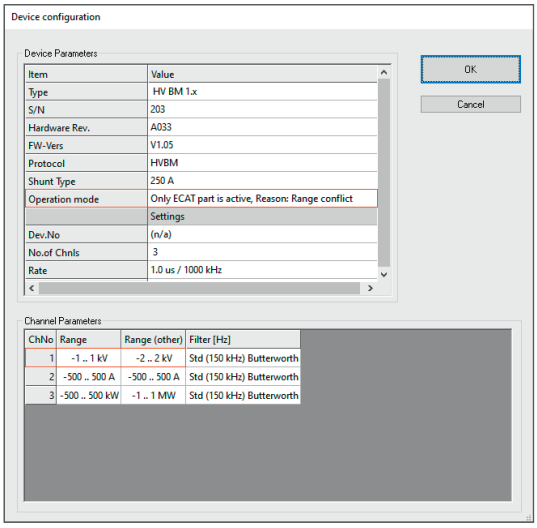


Fig. 6-35: Dialog **Device configuration**, differing measurement ranges for CAN and ECAT

6.3.3.8 Measurement module settings

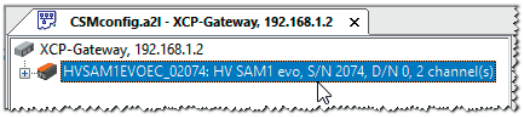


Fig. 6-36: **CSMconfig.a2l** window, module connected via ECAT

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

⇨ The **Device configuration dialog** opens.

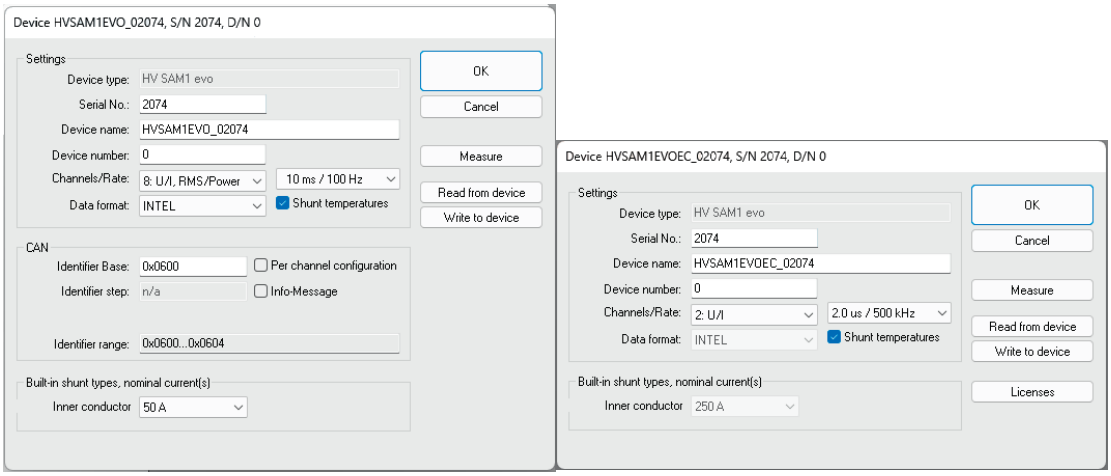


Fig. 6-37: **Device configuration dialog**, module connected via CAN (left) and via ECAT (right)

6.3.3.8.1 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. 6-16).

6.3.3.8.2 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.

6.3.3.8.3 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.

6.3.3.8.4 Device number

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

6.3.3.8.5 Channels

The number of available measurement channels is specified in the **Channels** drop-down menu. The following options can be selected in the standard functional range:

- **2: U/I** – voltage, current
- **1: U** – voltage
- **1: I** – current[16]

In addition to the measurement of voltage and current, HV SAM1 evo modules can optionally calculate further power and RMS values on the CAN side.

These additional channels are only available if the option "Calculated Channels" has been enabled.[17] The menu item "8: U/I, RMS/Power" can then be selected in the **Channels** drop-down menu. In addition to the above-mentioned channels for measuring voltage and current, the following channels will be available:

- 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

→ *CSMconfig online help, "Calculation of Power and RMS Values" and "HV SAM1 evo Device Configuration"*

Measuring only 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. For measuring only the current on the CAN side, proceed as follows:

☞ Enable the option **Per channel configuration** in the **CAN** section (Fig. 6-40).

☞ 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 SAM1 evo Device Configuration"*

Rate

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

16 Option only available on the ECAT side
17 The measurement modules in question must also meet the necessary requirements in terms of hardware and firmware versions.

6.3.3.8.6 Shunt temperatures

The HV SAM1 evo can send two temperature values: the internal temperature of the measurement module HV SAM1 evo and the temperature of the sensor module installed in the HV SBM(L)_I evo which is connected to the HV SAM1 evo. The **Shunt temperatures** option in the device configuration dialog is by default enabled which means that these signals are transmitted and displayed as additional measured values in the DAQ software. This option can be disabled if the transmission of temperature signals is not required.

Regarding the HV SAM1 evo, the **Shunt temperatures** option contains the following signals:

- *_devicename_Temp_Shunt*: temperature of the shunt module installed in the HV SMB(L)_I evo
- *_devicename_Temp_Dev*: internal temperature of the HV SAM1 evo

i	"*devicename*" refers to the name of the device as specified the field **Device name** of the device configuration dialog, e.g. **HVSAM1EVOEC_00042**.

6.3.3.8.7 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)

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

As for the HV SAM1 evo, the **Built-in shunt types, nominal currents** section displays the shunt module installed in the connected HV SMB(L)_I evo.

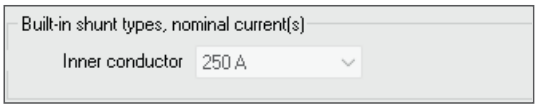


Fig. 6-38: Dialog section **Built-in shunt types, nominal current(s)**

6.3.3.8.9 HV SAM1 evo in CAN bus mode

If the measurement module is connected via CAN, the **Device Configuration dialog** additionally provides a **CAN** section (Fig. 6-37).

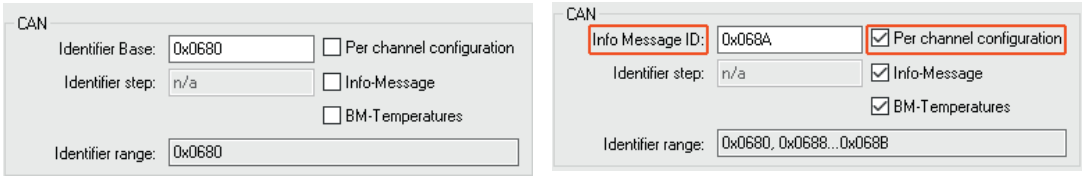


Fig. 6-39: Device configuration dialog, dialog section **CAN**

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 changed if required (e.g. in case of a CAN-ID conflict).

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

Identifier step

As for HV SAM1 evo 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 are specified per device (Fig. 6-37).

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:

- The **Rate** drop-down menu in the **Settings** section of the dialog fades out.
- The name of the **Identifier base** field changes into **Info Message ID** (Fig. 6-39). This field then displays the start ID of the optional CAN message that has been activated first.
- In the **Channel configuration dialog**, the options **CAN identifier** and **Rate** are accessible (Fig. 6-40).

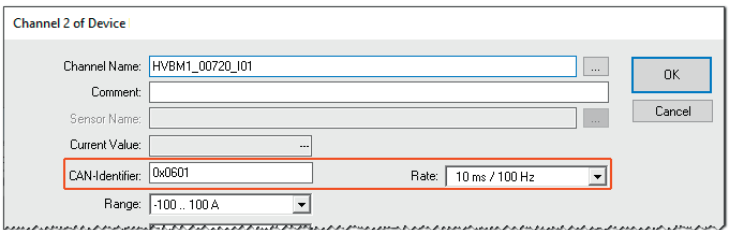


Fig. 6-40: **Channel configuration dialog**, module connected via CAN and **Per channel configuration** enabled

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 the HV SAM1 evo, the info message contains the following signals:

- *_devicename_Temp_Shunt*: temperature of the shunt module installed in the HV SMB(L)_I evo
- *_devicename_Temp_Dev*: internal temperature of the HV SAM1 evo [18]

→ *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 **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).

6.3.3.8.10 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 measurement 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:

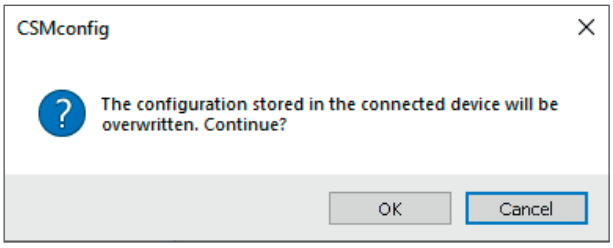


Fig. 6-41: Safety prompt before overwriting the old configuration

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

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

or

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

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

18 "*_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 SAM1 evo, HV BM 1.1, HV BM 1.2 and HV BM 1.2+U). For 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. 6-31).

⇨ The **Measurement Values** window opens.

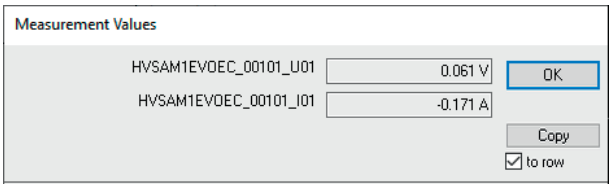


Fig. 6-42: **Measurement Values window** (HV SAM1 evo)

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

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

6.3.3.9 Saving a configuration

The configuration can 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

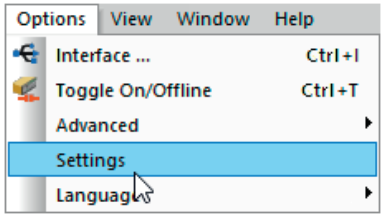


Fig. 6-43: **Options | Settings**

☞ Select **Options | Settings**.

⇨ The **Program Settings** dialog opens.

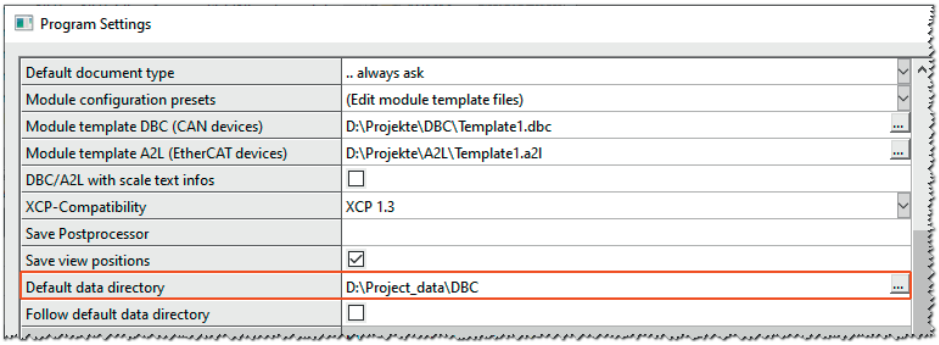


Fig. 6-44: **Program Settings** dialog, option **Default data directory**

☞ 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.

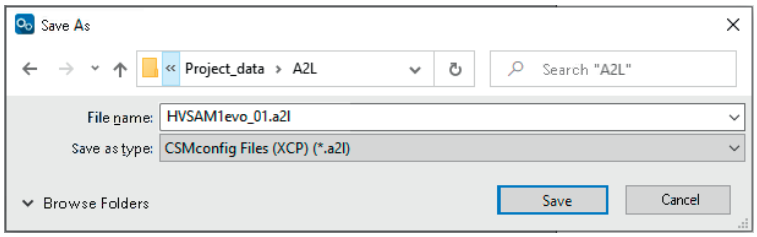


Fig. 6-45: Dialog **Save As**

☞ 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: **HVSAM1evo_01.a2l**).

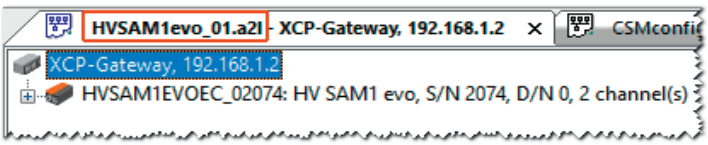


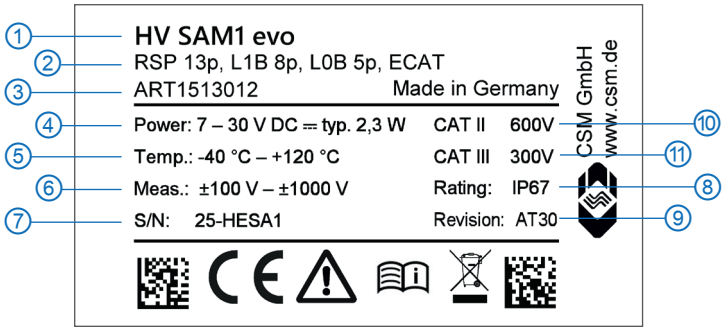
Fig. 6-46: New file name in the header: **HVSAM1evo_01.a2l**

7 Maintenance and Cleaning

7.1 Type labels

7.1.1 HV SAM1 evo

The type label showing the technical data for the HV SAM1 evo is attached to the rear side of the housing.



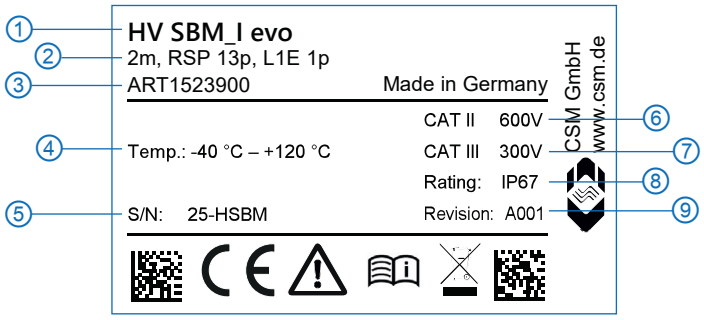
①	HV SAM1 evo	Device type
②	RSP 13p, L1B 8p, L0B 5p, ECAT	Device details: ▸ RSP 13p - Socket measurement channels: LEMO Redel SP, 13-pole ▸ L1B 8p - EtherCAT® **IN** / EtherCAT® **OUT** sockets: LEMO 1B, 8-pole ▸ L0B 5p - CAN sockets: LEMO 0B, 5-pole ▸ ECAT - network protocol
③	ART1513012	Part number of the measurement module
④	Power: 7 – 30 V DC, typ. 2.3 W	Power supply range, typical power consumption
⑤	Temp.: -40 °C – +120 °C	Operating temperature range
⑥	Meas.: ±100 V – ±1000 V	Measurement range current
⑦	S/N: 25-HESA1	Serial number of the measurement module
⑧	CAT II: 600 V	Measurement category II according to EN 61010-2-030:2020 [19]
⑨	CAT III: 300 V	Measurement category III according to EN 61010-2-030:2020 [19]
⑩	Rating: IP67	Protection class
⑪	Revision: AT30	Hardware revision number

Tab. 7-1: HV SAM1 evo type label

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

7.1.2 HV SBM_I evo / HV SBML_I evo

The type label is attached to the rear side of the breakout box. The technical data of an HV SBM_I evo and an HV SBML_I evo are identical.



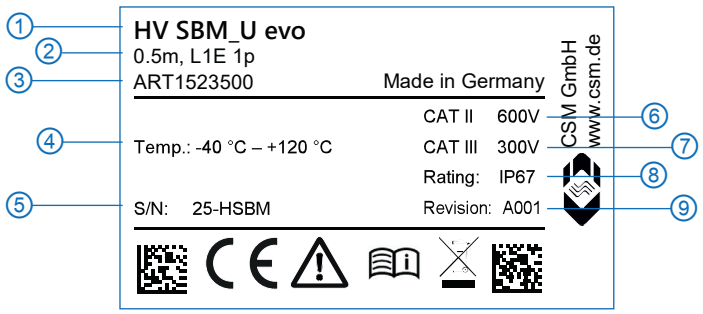
①	HV SBM_I evo / HV SBML_I evo	Device type
②	2 m, RSP 13p, L1E 1p	Device details: ▸ 2 m - HV signal cable to HV SAM1 evo, length 2 m ▸ RSP 13p - plug for measurement channels: LEMO Redel SP, 13-pole ▸ L1E 1p - socket: LEMO 1E, 1-pole
③	ART1523900 / ART1524400	Part number of the module
④	Temp.: -40 °C – +120 °C	Operating temperature range
⑤	S/N: 25-HSBM	Serial number of the module
⑥	CAT II: 600 V	Measurement category II according to EN 61010-2-030:2020 [20]
⑦	CAT III: 300 V	Measurement category III according to EN 61010-2-030:2020 [20]
⑧	Rating: IP67	Protection class
⑨	Revision: A001	Hardware revision number

Tab. 7-2: Type label HV SBM_I evo / HV SBML_I evo

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

7.1.3 HV SBM_U evo / HV SBML_U evo

The type label is attached to the rear side of the breakout box. The technical data of an HV SBM_U evo and an HV SBML_U evo are identical.



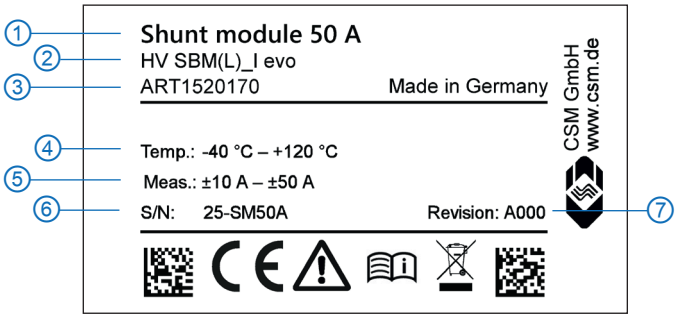
①	HV SBM_U evo / HV SBML_U evo	Device type
②	0.5 m, L1E 1p	Device details: ▸ 0.5 m - HV measurement cable to HV SBM(L)_I evo, length 0.5 m ▸ L1E 1p - plug: LEMO 1E, 1-pole
③	ART1523500 / ART1523600	Part number of the module
④	Temp.: -40 °C – +120 °C	Operating temperature range
⑤	S/N: 25-HSBM	Serial number of the module
⑥	CAT II: 600 V	Measurement category II according to EN 61010-2-030:2020 [21]
⑦	CAT III: 300 V	Measurement category III according to EN 61010-2-030:2020 [21]
⑧	Rating: IP67	Protection class
⑨	Revision: A001	Hardware revision number

Tab. 7-3: Type label HV SBM_U evo / HV SBML_U evo

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

7.1.4 Shunt module

The type label of the shunt module with the technical data is attached to the rear side of the HV SBM(L)_I evo in which it has been installed.



①	Shunt module 50 A	Shunt type/nominal current of the shunt module
②	HV SBM(L)_I evo	Breakout box in which the shunt module is installed
③	ART1520170	Part number
④	Temp.: -40 °C – +120 °C	Operating temperature range
⑤	Meas.: ±10 A – ±50 A	Measurement range current
⑥	S/N: 25-SM50A	Serial number of the shunt module
⑦	Revision: A000	Hardware revision number

Tab. 7-4: Type label of shunt module

7.2 Maintenance services

The following certificates are issued for the components of an HV BM-Split evo measurement system:

	HV SAM1 evo	HV SBM_I evo / HV SBML_I evo	Shunt module	HV SBM_U evo / HV SBML_U evo	K917 [22]
Calibration certificate in accordance with DIN EN ISO/IEC 17025 for U and I	✓	✗	✓	✗	✗
Testing certificate HV isolation test	✓	✓	✗	✓	✗

Tab. 7-5: Certificates for calibration and HV isolation test

The calibration and HV isolation test are documented by a corresponding sticker attached to the module housing.

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

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

	NOTE!
	All components of an HV BM-Split evo measurement system require an HV isolation test in accordance with the current edition of the EN 61010 standard to be performed at least every 12 months.

To ensure reliability and functionality, an HV BM-Split evo measurement system should be checked at least every 12 months. CSM offers maintenance packages and a repair service for this purpose.

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

22 The K917 is tested by the manufacturer.

Monitoring of calibration due date[23]

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 times**).

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

⇨ The **Program Settings** dialog opens.

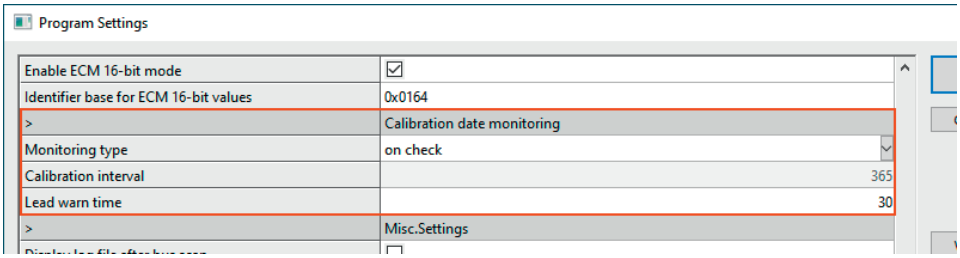


Fig. 7-3: **Program Settings** dialog, **Calibration date monitoring section**

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

→ *CSMconfig online help, section "Program Settings"*

7.3 Cleaning instructions

WARNING!

HV BM-Split evo measurement systems are used in high-voltage applications.

Improper use may result in life-threatening electrical shocks.

☞ Observe safety instructions.

NOTE!

☞ De-energize the modules 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.

23 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.

8 Appendix

8.1 Assembling HV power cables for HV SBM(L) evo

8.1.1 Information on the assembly of HV power cables (copper and aluminum)

NOTE!	
	CSM offers specific sets of ring terminals for connecting HV power cables made of copper and aluminum, which are designed to fit both the space available in the HV SBM(L) evo and the dimensions of single-core, shielded HV power cables. CSM recommends that the HV power cables in HV SBM(L) evo should only be assembled with ring terminal sets provided by CSM.

8.1.2 Components for the installation of HV power cables

8.1.2.1 Cable glands for HV power cables made of copper and aluminum

Depending on the outer diameter of the HV power cable, cable glands in different sizes are required for the HV SBM(L) evo. Only suitable combinations of HV power cable and cable gland can ensure the tightness of the module housing.

→ *Data sheet "HV BM-Split evo"*

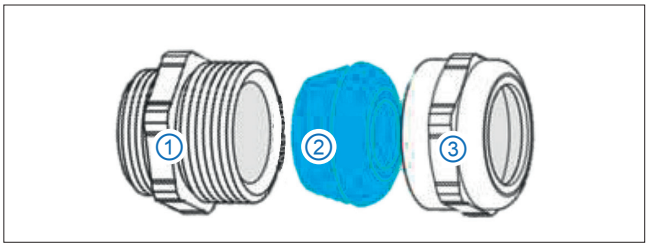


Fig. 8-1: Components of a cable gland

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

NOTE!	
	For tightening torques for double nipples and pressure screws, as well as further information on the cable glands used, see the manufacturer's information at *www.pflitsch.de/en*.

The two-part silicone sealing insert with removable inlet has two zones (cable diameter):

- 1× with inlet
- 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, disassembled

8.1.2.2 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 with suitable heat-shrink tubing if required.

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. 8-3).

If a reducer is used when installing a high-voltage cable, the length of the cable gland increases by approximately 4 mm (right image in Fig. 8-3, ①). This also changes the distance between the ring terminal and the area of the HV power cable that needs to be stripped.

Fig. 8-3: Cable glands : left without reducer, right with reducer

8.1.3 Stripping dimensions for assembling HV power cables

How HV power cables for connection to an HV SBM(L) evo are to be assembled/stripped depends on the cross-section of the HV power cable used and the materials of the inner conductor and the braided shield. The most common combinations are Cu/Cu, Al/Al, and Al/Cu.

- Tab. 8-1: Specifications for HV power cables with inner conductor and braided shield made of copper
- Tab. 8-2: Specifications for HV power cables with inner conductor and braided shield made of aluminum
- Tab. 8-3: Specifications for HV power cables with inner conductor made of aluminum and braided shield made of copper

WARNING!	
	Only ring terminals that are compatible with the conductor material of the HV power cables and shields may be used. CSM provides suitable ring terminals for inner conductors and braided shields, which in turn are adapted to the materials used in the HV SBM(L) evo. **High contact resistance between the conductor and the ring terminal can lead to a significant increase in temperature and, in the worst case, to fires.** ☞ Only use ring terminals provided by CSM to connect the inner conductors and braided shields of HV power cables. ☞ Only connect HV power cables with aluminum conductors to HV SBML_I evo and HV SBML_U evo modules.

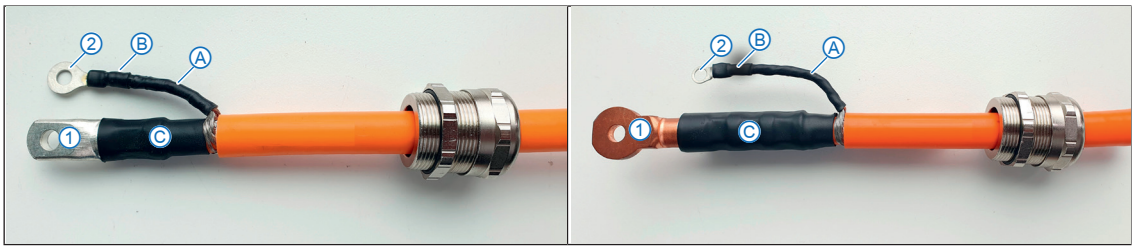


Fig. 8-4: HV power cables (cross-section 70 mm²), copper on the left and aluminum on the right

8.1.3.1 Stripping dimensions for HV power cables with inner conductor and braided shield made of copper for connection to an HV SBM evo

Conductor cross-section	Stripping length outer sheath	Shortening of inner conductor	Stripping length of inner sheath	Heat-shrink tubing Ⓒ inner conductor	Heat-shrink tubing Ⓐ for braided shield	Heat-shrink tubing Ⓑ for braided shield
25 mm²	55 mm	10 mm	15 mm	approx. 40 mm	approx. 50 mm	approx. 20 mm
35 mm²	55 mm	10 mm	15 mm	approx. 40 mm	approx. 50 mm	approx. 20 mm
50 mm²	55 mm	10 mm	20 mm	approx. 40 mm	approx. 50 mm	approx. 20 mm
70 mm²	55 mm	15 mm	20 mm	approx. 45 mm	approx. 50 mm	approx. 20 mm
95 mm²	55 mm	10 mm	25 mm	approx. 45 mm	approx. 55 mm	approx. 20 mm
120 mm²	55 mm	12 mm	27 mm	approx. 45 mm	approx. 40 mm	approx. 20 mm

Tab. 8-1: Stripping dimensions for HV cables (HV SBM evo) with inner conductor and braided shield made of Cu

8.1.3.2 Stripping dimensions for HV power cables with inner conductor and braided shield made of aluminum for connection to an HV SBML evo

Conductor cross-section	Stripping length outer sheath	Shortening of inner conductor	Stripping length of inner sheath	Heat-shrink tubing Ⓒ inner conductor	Heat-shrink tubing Ⓐ for braided shield	Heat-shrink tubing Ⓑ for braided shield
16 mm²	70 mm	–	25 mm	approx. 75 mm	approx. 65 mm	approx. 20 mm
25 mm²	70 mm	–	35 mm	approx. 75 mm	approx. 65 mm	approx. 20 mm
35 mm²	70 mm	–	40 mm	approx. 75 mm	approx. 65 mm	approx. 20 mm
50 mm²	70 mm	–	40 mm	approx. 78 mm	approx. 65 mm	approx. 20 mm
70 mm²	70 mm	–	48 mm	approx. 75 mm	approx. 65 mm	approx. 20 mm
95 mm²	70 mm	–	48 mm	approx. 75 mm	approx. 40 mm	approx. 20 mm
120 mm²	70 mm	–	48 mm	approx. 75 mm	approx. 55 mm	approx. 20 mm

Tab. 8-2: Stripping dimensions for HV power cables (HV SBML evo) with inner conductor/braided shield made of Al

8.1.3.3 Stripping dimensions for HV power cables with inner conductor made of aluminum and braided shield made of copper for connection to an HV SBML evo

Conductor cross-section	Stripping length outer sheath	Shortening of inner conductor	Stripping length of inner sheath	Heat-shrink tubing Ⓒ inner conductor	Heat-shrink tubing Ⓐ for braided shield	Heat-shrink tubing Ⓑ for braided shield
16 mm²	70 mm	9 mm	25 mm	approx. 75 mm	approx. 65 mm	approx. 20 mm
25 mm²	70 mm	9 mm	35 mm	approx. 75 mm	approx. 65 mm	approx. 20 mm
35 mm²	70 mm	9 mm	40 mm	approx. 75 mm	approx. 65 mm	approx. 20 mm
50 mm²	70 mm	4 mm	40 mm	approx. 78 mm	approx. 65 mm	approx. 20 mm
70 mm²	70 mm	9 mm	48 mm	approx. 75 mm	approx. 65 mm	approx. 20 mm
95 mm²	70 mm	4 mm	48 mm	approx. 75 mm	approx. 40 mm	approx. 20 mm
120 mm²	70 mm	3 mm	48 mm	approx. 75 mm	approx. 55 mm	approx. 20 mm

Tab. 8-3: Stripping dimensions for HV power cables (HV SBML evo) with inner conductor made of Al and braided shield made of Cu

8.1.3.4 Steps for assembling HV power cables

WARNING!	
	☞ Only connect HV power cables with aluminum conductors to HV SBML_I evo and HV SBML_U evo modules.

Preparing HV power cables

1. Make sure to mount the cable gland components on the HV power cables *before* starting the assembly.
2. Select the table with the matching stripping dimensions based on the cable type.
   - HV power cables with inner conductor/braided shield made of copper → Tab. 8-1
   - HV power cables with inner conductor/braided shield made of aluminum → Tab. 8-2
   - HV power cables with inner conductor made of aluminum/braided shield made of copper → Tab. 8-3
3. Remove the outer sheath.
   - The stripping length depends on the cable cross-section (→ Tab. 8-1 - Tab. 8-3, column "Stripping length outer sheath").

4. Twist the braided shield.
   - ▸ The braided shield strand is later fitted with a ring terminal.
5. Shorten the inner conductor.
   - ▸ Only required for HV power cables with an inner conductor made of copper (→ Tab. 8-1, column "Shortening of inner conductor")
6. Strip the inner conductor.
   - ▸ The stripping length depends on the cross-section the material of the conductor (→ Tab. 8-1 - Tab. 8-3, column "Stripping length of inner sheath").

Fitting the ring terminals

i	Fig. 8-4 shows two examples of prefabricated HV cables, both with a cross-section of 70 mm² (copper on the left and aluminum on the right). Please note the position of the heat-shrink tubing (Ⓐ, Ⓑ, Ⓒ) and the ring terminals (①, ②).

1. Place the ring terminal ① on the inner conductor and crimp.
2. Slide the heat-shrink tubing Ⓐ on the twisted braided shield.
3. Fix the heat-shrink tubing Ⓐ by applying heat.
4. Slide the heat-shrink tubing Ⓑ on the twisted braided shield.
5. Place the ring terminal ② on the twisted braided shield and crimp.
6. Slide the heat-shrink tubing Ⓑ over the crimped end of the ring terminal ② and fix by applying heat.
7. Slide the heat-shrink tubing Ⓒ over the crimped end of the ring terminal ① and fix by applying heat.

8.2 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. 8-4: Shortcuts used in CSMconfig

8.3 List of figures

8.4 List of tables

CSM GmbH

Raiffeisenstr. 36
70794 Filderstadt
Germany

Technical Questions:
www.csm.de/service-and-support

Sales Contact:
www.vector.com/contact

Part of the Vector Group