HV BM 3.1 OBC

User Guide

Innovative Measurement and Data Technology

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Trademarks

Product disposal/recycling

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

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

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

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

Contact information

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

Contents

1 Introduction

1.1 About this user guide

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

1.2 Symbols and writing conventions

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

Tab. 1-1: Symbols and writing conventions

1.3 List of abbreviations

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

Tab. 1-2: List of abbreviations

1.4 Warning

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

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

Warning design

A warning sign consists of the following components:

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

Warning symbols

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

Tab. 1-3: Warning signs

Signal words

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

Tab. 1-4: Signal words

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

1.5 Directive

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

Example

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

Symbols

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

Tab. 1-5: Symbols used in mandatory signs

1.6 Legal disclaimer

This guide and other documents are part of the product and contain important information for its safe and efficient use. To maintain the high quality level the product is continuously being developed, which may result in the product's technical details changing at short notice. As a result, the contents of this documentation may differ from the technical specifications of the product. No claims against the manufacturer can therefore be derived from the contents of the product documentation.

CSM 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 safety instructions and the product documentation
  → Chapter 2 "Safety Instructions"
- 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 HV Breakout Modules of type HV BM 3.1 OBC 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 measurement modules comply with the latest technical developments and the recognized safety standards. The measurement modules may only be used in a technically faultless condition and in accordance with their intended use. To avoid health hazards or damage to the measurement module, please observe the safety instructions in the following chapter and in "Safety instructions – HV Breakout Module Type 3.1 | 3.1 OBC".

WARNING!	
	HV Breakout Modules of type HV BM 3.1 OBC are used in high-voltage applications. **Improper use poses risks such as life-threatening electrical shocks and fire hazards.** ☞ Only use qualified and trained personnel (observe local guidelines/ regulations). ☞ Do not modify the HV measurement module in any way, neither electrically nor mechanically. ☞ Observe safety instructions.

WARNING!	
	The orange lid of the device housing can be removed to mount or dismount the HV power cables. If the lid of the housing is not mounted and the HV power 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!** ☞ Before removing the lid, make sure that the HV power cables are de-energized. ☞ Remove the lid only to connect the HV power cables and then re-mount it properly. ☞ Fasten the HV power cables with the ring terminals and nuts supplied or with suitable equivalents. ☞ Only operate the high-voltage measurement module when the lid is mounted. ☞ Observe the mounting instructions in chapter 4.3.3.4. It is particularly important that lid and cable glands are properly mounted in order to ensure the tightness of the housing.

WARNING!	
	When using HV power cables made of aluminum in combination with ring terminals for HV power cables made of copper, the contact resistance between the two components increases. **This can lead to a massive increase in temperature and in the worst case to the development of fire.** ☞ Use ring terminals for copper cables only in combination with HV power cables made of copper! ☞ Observe safety instructions. HV power cables made of aluminum require a specific connection technology. Please contact our technical support for further information.

WARNING!

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

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

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

→ Chapter 4.3.2.5 "Ground connection"

WARNING!

The internal temperature of the measurement module and the temperature of the shunts must not exceed +120 °C. As soon as the temperature of a shunt exceeds this value, the HV Breakout Module sends the error code "0x8001" instead of the measured values for U and I. The user 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 all shunts drops below +115 °C again.

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

- ☞ Tighten the nuts for fastening the ring terminals with the specified torque to keep the contact resistance low.
  → Tab. 4-7 "Tightening torques"
- ☞ Reduce or interrupt the current flow through the shunts to prevent a further temperature increase of the module.
- ☞ Always monitor the temperatures in order to make sure that the threshold value will not be exceeded.

→ Chapter 5.4.3.8.7 "Shunt temperatures" and section "Info Message"

WARNING!

The behavior of the CAN bus can be influenced by connecting a CAN bus measurement module to an existing CAN bus system.

Improper handling of a CAN bus system may endanger life or cause damage to property.

- ☞ Always connect CAN bus measurement modules to a separate CAN bus system (measurement bus).
- ☞ Only use qualified and trained personnel.

CAUTION!

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

Touching the surface may cause serious burns.

- ☞ Let the measurement module cool down before handling.
- ☞ Wear appropriate safety gloves.

NOTE!

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

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

NOTE!

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

- ☞ The threaded hole is to be used exclusively for making a ground or protective earth connection.

→ Chapter 4.3.2.5 "Ground connection"

NOTE!

The interface cables and connection cables of the measurement modules have shields, which are connected to ground. The housings of the measurement modules are connected to ground (PA/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.

→ Chapter 4 "Mounting and Installation"

- ☞ Make sure that the measurement module is correctly installed.
- ☞ Operate the measurement module only within the specified operation environment.

→ *Data sheet "HV Breakout Module | Type 3.1 OBC"*

2.2 Obligations of the operator

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

2.3 Intended use

- Measurement modules of type HV BM 3.1 OBC were specifically developed for measurements on on-board chargers of electric vehicles and AC vehicle chargers.
- The device may only be used for the above-mentioned purpose and under the operating conditions stated in the technical specifications.
  → *Data sheet "HV Breakout Module | Type 3.1 OBC"*
- The operational safety of this device can only be ensured if the device is used in accordance with its intended use.
- Compliance with the intended use also includes the careful reading this user guide and observing all the instructions contained.
- The calibration of measurement modules may only be performed by authorized calibration laboratories (e.g. CSM calibration laboratory).
- Repair work must only be carried out by CSM.
- The operator bears full responsibility if this device is used in any way which does not comply strictly and exclusively 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

The HV BM 3.1 OBC from CSM was designed for the three-phase measurement of current and voltage and calculation of power on high-voltage cables with currents of up to 88 A AC.

Fig. 3-1: HV BM 3.1 OBC

HV BM 3.1 OBC		
Nominal voltage	up to ±1000 V (707 V AC)	
Nominal current	up to ±125 A (80 A AC)	
Measurement ranges	**Star voltage** -100 .. 100 V (AC 70 V) -200 .. 200 V (AC 140 V) -500 .. 500 V (AC 350 V) -1 .. 1 kV (AC 0.7 kV)	**String current** -15.6 .. 15.6 A (AC 11 A) -31.2 .. 31.2 A (AC 21 A) -62.5 .. 62.5 A (AC 43 A) -125 .. 125 A (AC 88 A)
Additional measurement channels/output signals (optional)	▸ RMS values for voltage and current (3× U, 3× I) ▸ Active, apparent and reactive power ▸ Power factor Lambda	
Measurement data rate	XCP: max. 2 MHz	CAN: max. 10 kHz
Others	Integrated XCP-Gateway (optional)	

Tab. 3-1: HV BM 3.1 OBC properties

Further information

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

- → *Data sheet "HV Breakout Module | Type 3.1 OBC"*
- → *Safety Instructions "HV Breakout Module Type 3.1 | 3.1 OBC"*
- → *Technical Information "Measurement Categories for CSM HV Measurement Modules"*
- → *Technical Information "Deviation of Measurement"*

3.2 Connections and components

The HV BM 3.1 OBC measurement module was designed for the three-phase measurement of voltage (U) and inner conductor current (I) on a multi-core high-voltage cable. The star voltages are measured directly. The inner conductor currents are measured via three shunt modules, which contain temperature sensors and memory for calibration data for automatic online temperature compensation. With the firmly mounted shunt modules, internal conductor currents of up to 88 A AC can be measured in each line.[2]

Fig. 3-2 shows the front of a HV BM 3.1 OBC with the LED indicators. The HV BM 3.1 OBC is equipped with one cable gland on the left and right side of the housing for connecting the multi-core high-voltage cables.

Front panel with LED indicators

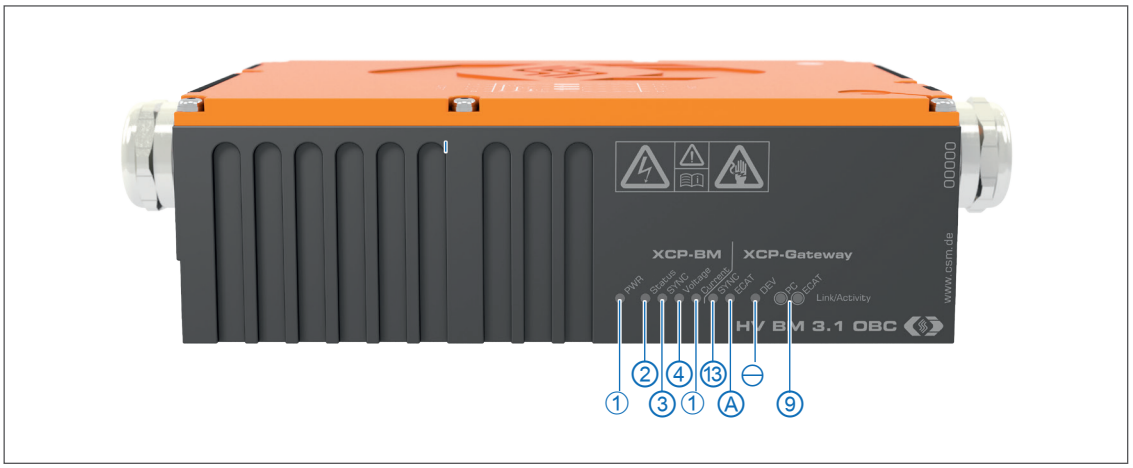


Fig. 3-2: HV BM 3.1 OBC, frontal view with LED indicators

1. **PWR –** LED indicator for **PWR IN** socket (Chapter 3.3.1.1 "PWR LED")
2. **Status** – LED indicator for internal XCP bus (Chapter 3.3.1.2 "XCP bus LED indicator")
   → Chapter 7.1 "Option HV BM 3.1 OBC XCPG"
3. **SYNC**– LED indicator for the time synchronization of the measurement module (Chapter 3.3.1.3 "SYNC indicator LED (measurement module)")
4. **Voltage**– LED indicator for voltage measurement (Chapter 3.3.1.4 "Measurement channel LED indicators")
5. **Current**– LED indicator for current measurement (Chapter 3.3.1.4 "Measurement channel LED indicators")
6. **SYNC**– LED indicator for the time synchronization of the gateway (Chapter 3.3.2.1 "SYNC LED indicator (Gateway)")
7. **ECAT**–**ECAT** LED indicator (Chapter 3.3.2.2 "DEV and ECAT LED indicators")
8. **DEV** – LED indicator for **DEV** (Chapter 3.3.2.2 "DEV and ECAT LED indicators")
9. **PC/ECAT** – Link/Activity LED indicators for the sockets **PC** and **ECAT** sockets (Chapter 3.3.2.3 "Link/Activity PC and ECAT LED indicators")

2 The three shunt modules are mounted on a circuit board that is firmly mounted in the measurement module.

Right side of the housing

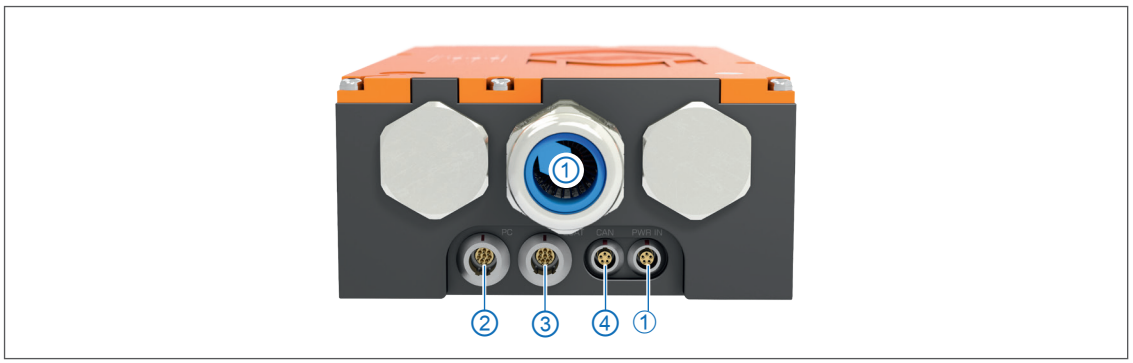


Fig. 3-3: HV BM 3.1 OBC, Right side of the housing with connectors and cable gland

1. Cable gland (Chapter 4.3.3.2 "Preparing the cable gland")
2. **PC** socket (Chapter 4.3.2.1 "PC socket")
3. **ECAT** socket (Chapter 4.3.2.2 "ECAT socket")
4. **CAN** socket (Chapter 4.3.2.3 "CAN socket and PWR IN socket")
5. **PWR IN** socket (Chapter 4.3.2.3 "CAN socket and PWR IN socket")

Left side of the housing

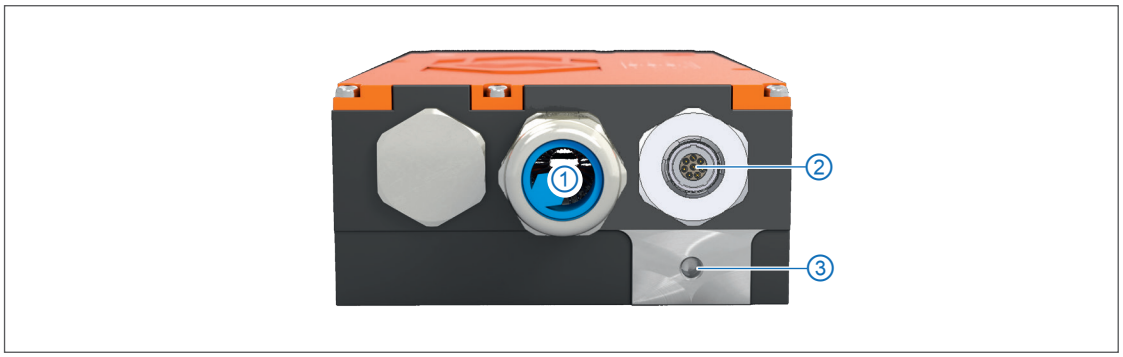


Fig. 3-4: HV BM 3.1 OBC, left side of the housing with M8 threaded hole and HV socket

1. Cable gland (Chapter 4.3.3.2 "Preparing the cable gland")
2. HV socket (Chapter 4.3.2.4 "Control Pilot (CP) socket")
3. M8 threaded hole for ground connection (Chapter 4.3.2.5 "Ground connection")

Module housing, lower side

- M4 threaded holes for mounting screws
- Type label (Chapter 6.1 "Type label")
- Options label[3]
- Calibration label I (Chapter 6.3 "Maintenance services")
- Calibration label U (Chapter 6.3 "Maintenance services")
- High-voltage isolation test label (Chapter 6.3 "Maintenance services")

3 Options have to be activated additionally, see chapter 6.2 "Options".

Others

- The lid of the housing contains a ventilation opening with a GORE™ membrane and the associated sticker, as well as a contact surface for measuring the resistance from protective earth (PE) to the lid.
  → Chapter 4.1 "Before mounting"

3.3 Functional description of LED indicators

3.3.1 Measurement module LEDs

3.3.1.1 PWR LED

The **PWR** LED (Fig. 3-2, ①) provides information on the operating status of the measurement module.

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

Tab. 3-2: **PWR** LED

3.3.1.2 XCP bus LED indicator

The two-color status LED (Fig. 3-2, ③) is lit red for a few seconds after the module is switched on and then turns off.[4]

LED		Meaning
Color	Status	
–	off	Measurement module not connected or power supply switched off
green	flashing	50 % on, 50 % off: Device is in status PRE-OPERATIONAL.[5]
green	flashing	20 % on, 80 % off: Device is in status SAFE-OPERATIONAL.[6]
green	permanently lit	Device is in status OPERATIONAL.[7]
red	flashing	Configuration error
red	permanently lit	Measurement module is switched on or connection to power supply has been established, but there is no Ethernet communication.
green/red	flashing	New firmware is downloaded and activated.

Tab. 3-3: Status LED indicator, EtherCAT® bus

4 Status designations according to Beckhoff and EtherCAT® Technology Group EtherCAT® standard.
5 Status PRE-OPERATIONAL: Configuration/setting of the values for the measurement range
6 Status PRE-OPERATIONAL: Check the measurement range configuration and confirm if the set values are correct. If the measurement range is invalid, the measurement module remains in PRE-OPERATIONAL status.
7 Status OPERATIONAL: The module is in measurement operation.

3.3.1.3 SYNC indicator LED (measurement module)

The **SYNC** LED indicator (Fig. 3-2, ③) provides information on the synchronization status of the measurement module.

LED blinking status	Meaning
off	No sync source available.
10 % green 90 % off	Synchronization is being established (e.g. PTP packages received but no time information yet).
50 % green 50 % off	Synchronization process is running.
90 % green 10 % off	All measurement modules are located within the same time domain. The data transmission of the measuring modules is thus synchronous to each other (no PTP synchronization). It is not possible to assign the time domain to further measurement modules.
100% green	Data transmission in sync with time source.
50 % green 50 % orange	Sync timeout, i.e. connection to time source interrupted.

Tab. 3-4: **SYNC** LED indicator (measurement module)

3.3.1.4 Measurement channel LED indicators

The measurement channel LED indicators (Fig. 3-2, ⑦ und ⑧) provide information on the status of the measurement channels. The measurement channels are arranged as follows (left to right):

- **Voltage**: Status of voltage measurement
- **Current**: Status of current measurement

After switching on the HV BM 3.1 OBC, all measurement channel LED indicators are lit red, indicating the start-up process of the module. Once the module has initialized itself and no errors were detected, the LED indicators of the measurement channels will fade out.

After self-initialization, the device checks the integrated shunts. During this step, the measurement channel LED of the current channels (**Current**) is lit red. If the shunts are correctly detected, the measurement channel LED fades out again.

LED		Meaning
Color	Status	
–	off	Measurement module not connected or power supply switched off or normal operation
red	permanently lit	Detection of shunts fails ("Current" LEDs)
red	flashing	50 % red, 50 % off: disabled channel selected via configuration software
		80 % red 20 % off: The measured value of at least one channel is out of range.
green	flashing	Channel selected via configuration software (single LED)
		Module selected via configuration software (both LEDs)

Tab. 3-5: Measurement channel LED indicators

3.3.2 XCP-Gateway LEDs

3.3.2.1 SYNC LED indicator (Gateway)

The SYNC LED indicator (Fig. 3-2, ③) provides information on the synchronization status of the measurement module.

LED (duty cycle)	Meaning
off	No sync source available.
10 % green 90 % off	Synchronization is being established (e.g. PTP packages received but no time information yet)
50 % green 50 % off	Synchronization process is running.
90 % green 10 % off	All measurement modules are located within the same time domain. The data transmission of the measuring modules is thus synchronous to each other (no PTP synchronization). It is not possible to assign the time domain to further gateways.
100% green	Data transmission in sync with time source.
50% green 50 % orange	Sync timeout, i.e. connection to time source interrupted.

Tab. 3-6: **SYNC** LED indicator (Gateway)

3.3.2.2 DEV and ECAT LED indicators

The LED indicators (Fig. 3-2, ⑦ and ⑧) show the operating status of the gateway.

LED				Meaning
DEV		ECAT		
green		off		Device has been booted, waiting for connection to be established, status "OK".
green		50 % orange	50 % red	Initialization of the connected EtherCAT® measurement modules has failed, check firmware version if necessary.
90 % green	10 % off	off		Measurement module initialized, connected to XCP Master (measurement or configuration software), status "OK".
50% green	50 % off	off		XCP-Gateway selected via configuration software, status "OK". The LED of the ECAT input that is currently selected in the **Interface** dialog flashes.
10 % green	90 % off	100% green		Measurement successfully started, fault-free function, status "OK"
10 % green	90 % off	50 % orange	50 % red	At least one measurement module is no longer able to measure (e.g. following a reset).

<table>
<tr><th colspan="4">LED</th><th rowspan="2">Meaning</th></tr>
<tr><th colspan="3">DEV</th><th>ECAT</th></tr>
<tr><td colspan="3">off</td><td>100% green</td><td>All measurement modules connected have been successfully initialized, status "OK".</td></tr>
<tr><td colspan="3">off</td><td>50% green | 50 % off</td><td>Measurement module connected to EtherCAT® bus selected by configuration software, status "OK".</td></tr>
<tr><td colspan="3">off</td><td>10 % red | 90% green</td><td>At least one EtherCAT® datagram has been lost or was not (only) responded to by the desired module.</td></tr>
<tr><td colspan="3">off</td><td>100 % red</td><td>Fatal EtherCAT® bus error, try re-start.</td></tr>
<tr><td colspan="2">50% green</td><td>50 % orange</td><td>off</td><td>XCP-Gateway is carrying out firmware update, status "OK".</td></tr>
<tr><td colspan="2">50 % orange</td><td>50 % red</td><td>off</td><td>Firmware update failed (e.g. due to transmission error). Try again (de-energize XCP-Gateway beforehand if necessary).</td></tr>
<tr><td>10 % orange</td><td>80% green</td><td>10% off</td><td>off</td><td>XCP-Gateway is accepting new firmware and will carry out a reset, status "OK".</td></tr>
<tr><td colspan="3">100 % red</td><td>off</td><td>Internal device error or initialization problem, attempt restart.</td></tr>
<tr><td colspan="3">100% green</td><td>100 % red</td><td>Connection between XCP-Gateway and PC OK, but the connection between XCP-Gateway and measurement modules is faulty. Check cable connections.</td></tr>
<tr><td colspan="3" rowspan="3">100 % red</td><td>100 % red</td><td rowspan="3">Initialization of additional internal structures failed, try to reconnect.</td></tr>
<tr><td>100% green</td></tr>
<tr><td>50 % orange | 50 % red</td></tr>
<tr><td colspan="3">LED flashes SOS code</td><td>off</td><td>If the DEV LED displays the SOS code (LED flashes red: 3× long, 3× short, 3× long), the start-up has failed and the XCP-Gateway is probably defective.</td></tr>
</table>

Tab. 3-7: **DEV** and **ECAT** LED indicators

3.3.2.3 Link/Activity PC and ECAT LED indicators

The LED indicators for the sockets **PC** and **ECAT** (Fig. 3-2, ⑨) light up or flash when an ECAT measurement module is electrically connected to an XCP-Gateway and when data is being transferred.

LED blinking status		Meaning
PC	**ECAT**	
100% green	100% green	Ethernet connection to PC and measuring device(s) established, no data transfer.
50 % green 50 % off	50 % green 50 % off	Ethernet connection is active, i.e. data transfer is in progress.
off	off	No measurement module connected.

Tab. 3-8: **PC** and **ECAT** LED indicators

4 Mounting and Installation

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

4.1 Before mounting

HV BM 3.1 OBC Breakout Modules are provided with a GORE™ membrane and a venting groove (Fig. 4-1). These are needed to regulate pressure and humidity. To ensure the breathing function of the membrane, the ventilation opening in the lid of the module housing ① must never be closed/covered or permanently covered by water or other liquids. There is then a risk of condensation collecting inside the housing and damaging the measurement module.

Fig. 4-1: HV BM 3.1 OBC, ventilation opening

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

NOTE!
Trouble-free operation and electrical safety can only be ensured if the measurement module is correctly installed. ☞ Ensure correct installation. ☞ Operate the measurement module exclusively within the specified operation environment. → *Data sheet "HV Breakout Module | Type 3.1 OBC"*

4.2 Mounting HV BM 3.1 OBC

CAUTION!	
	HV Breakout Modules can heat up considerably when current flows through them. This applies not only during operation, but also when no measurements are to be taken, but the module is integrated in a loaded circuit (e.g. when charging the vehicle battery). ☞ Dissipate the heat generated by attaching the module to a suitable mounting surface and by choosing sufficiently large cable cross-sections. ☞ Always monitor the temperatures in order to make sure that the threshold value will not be exceeded. → Chapter 5.4.3.8.7 "Shunt temperatures" and section "Info Message"

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

Requirements

- When choosing the mounting position, make sure that the ventilation opening of the GORE™ membrane is not obstructed or covered by liquids.
- The mounting site allows for sufficient space to connect and disconnect the cables without clamping or pinching them.
- Avoid a mounting position in which the modules are subjected to continuous strong vibrations and/or shocks.

Parts/material required

- six M4 screws [8]

Mounting the measurement module

☞ Fasten the measurement module at the mounting position.

	Please contact our support team for the appropriate drill hole diagram.

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

8 The thread depth in the module housing is 8.5 mm. The screw length must be chosen according to the thickness of the mounting material.

4.3 Installing HV BM 3.1 OBC

4.3.1 Before installation

WARNING!	
	HV Breakout Modules of type HV BM 3.1 OBC are used in high-voltage applications. **Improper use poses risks such as life-threatening electrical shocks and fire hazards.** ☞ Only use qualified and trained personnel (observe local guidelines/ regulations). ☞ Do not modify the HV measurement module in any way, neither electrically nor mechanically. ☞ Observe safety instructions.

WARNING!	
	The measurement module has 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 the measurement module to the vehicle's potential equalization or PE using a suitable ground cable. ☞ Only use qualified and trained personnel. → Chapter 4.3.2.5 "Ground connection"

WARNING!	
	The behavior of the CAN bus can be influenced by connecting a CAN bus measurement module to an existing CAN bus system. **Improper handling of a CAN bus system may endanger life or cause damage to property.** ☞ Always connect CAN bus measurement modules to a separate CAN bus system (measurement bus). ☞ Only use qualified and trained personnel.

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

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

	CSM provides maintenance and repair services for HV Breakout Modules. → Chapter 6.3 "Maintenance services"

4.3.2 Connectors

HV BM 3.1 OBC Measurement modules are equipped with an XCP and a CAN interface. The corresponding sockets are located in the right side of the housing below the connectors for the HV power cables (Fig. 3-3). The HV power cables are fed into the inside of the module on the left and right and the wires are mounted there on threaded bolts using ring terminals.

For safety reasons, HV BM measurement modules in general have to be connected to the vehicle's potential equalization or to the protective ground (PE) in the test bench using the threaded hole in the left side of the module housing.

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

4.3.2.1 PC socket

The **PC** socket is used to connect the HV BM 3.1 OBC to the data acquisition system. CSM uses LEMO 1B sockets as standard for the **PC** connection.

For connecting a cable to this socket the following plug is needed:

- **FGJ.1B.308.CLLxxxxx**[9]

	Pin	Signal	Description
	1	TP1+	Bi-directional pair 1, plus
	2	TP1-	Bi-directional pair 1, minus
	3	TP2+	Bi-directional pair 2, plus
	4	TP2-	Bi-directional pair 2, minus
	5	TP3+	Bi-directional pair 3, plus
	6	TP3-	Bi-directional pair 3, minus
	7	TP4+	Bi-directional pair 4, plus
	8	TP4-	Bi-directional pair 4, minus
	Housing	Shield	Cable shield

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

An interface cable of type K425 can be obtained through CSM.

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

4.3.2.2 ECAT socket

The **ECAT** socket is used for the daisy-chaining of EtherCAT® measurement modules. CSM uses LEMO 1B sockets as standard for the ECAT connection. For connecting a cable to this socket the following plug with plug insert (male) is needed:

- **FGA.1B.308.CLAxxxxx** [10]

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

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

A K400 connection cable can be obtained through CSM.

4.3.2.3 CAN socket and PWR IN socket

The sockets **CAN** and **PWR-IN** are identically assigned. HV BM 3.1 OBC receives its power supply through one of these sockets. All other measurement modules (ECAT and CAN) linked to the HV BM 3.1 OBC also receive their supply voltage through this socket.[11]

The other socket is used to integrate CAN-based CSM measurement modules into a measurement setup.

→ "Connecting the power supply" section

For **CAN**-/**PWR-IN** sockets, a LEMO 0B connection socket is used as standard. For connecting a cable to this socket the following plug with plug insert (male) is needed:

- **FGG.0B.305.CLA xxxxx** [10]

	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**-/**PWR-IN** socket: pin assignment

Power cables for the power supply K485 or K176 and the connection cable K70 for linking CAN measurement modules can be obtained from CSM.

10 "xxxxx" is a placeholder here. The actual designation depends on the diameter of the used cable.
11 If the HV BM 3.1 OBC is operated via the CAN bus, the **PWR IN** socket serves as the second CAN socket of a CSM CAN measure ment module. This means that the HV BM 3.1 OBC is connected to the PC for measurement data acquisition using one of the two sockets (**PWR IN** or **CAN**) via a CAN interface.

4.3.2.4 Control Pilot (CP) socket

A LEMO Redel 2P socket is used for the CP socket (Fig. 3-4, ②). To connect a measurement cable, the following plug with plug insert is required:

CFD.H08.GLA.Cxxxx [12]

	Pin	Signal	Description
 Code E	1	PE	PE conductor
	2	CP	Signal wire CP (Control Pilot)
	3	–	–
	4	–	–
	5	–	–
	6	–	–
	7	–	–
	8	–	–

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

A K981 connection cable can be obtained through CSM.

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

4.3.2.5 Ground connection

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

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

NOTE!
The M8 threaded hole in the left side of the housing is designed to connect the device to the vehicle's potential equalization or to protective ground (PE) in a test bench. ☞ Only use the threaded hole for connecting the module to the vehicle's potential equalization or to protective earth (PE).

Fig. 4-2: HV BM 3.1 OBC, left side of the housing with M8 threaded hole for ground connection

1. M8 threaded hole for ground connection (PE)

NOTE!
The thread depth in the module is 8,5 mm. Choose the screw length according to the thickness of the material used (ground cable, washer, etc.).

Required parts/material

- 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.[13]
- M8 screw (plus washer, if required)
- suitable tools

13 Outside the jurisdiction of this standard, the relevant country-specific standards or directives applicable at the operating site have to be observed.

4.3.2.6 Connecting the cables

A variety of cables in different lengths is available for connecting the device to the data acquisition system and the power supply on the one hand and for daisy-chaining the measurement modules on the other hand.

- Cable for connection to the PC: K425-xxxx
- Cables for connecting EtherCAT® modules K400-xxxx
- Cables for connecting CAN measurement modules: K70-xxxx
- Cable for connection to the power supply (XCP mode): K485-xxxx[14]
- Cable for connection to the power supply (XCP and Can mode): K176-xxxx[15]

→ Chapter 5.1 "Example of application"

	NOTE!
	Depending on the number of measurement modules and the cable lengths in a measurement setup, an intermediate power supply may be required.

Connecting the power supply

The power supply for an HV BM 3.1 OBC and any other connected ECAT and CAN measurement modules is provided via the **PWR IN** socket or via the **CAN** socket.[16]

CSM measurement modules are designed for low power consumption. In combination with the connection cables from CSM and due to their compact design, these MiniModules can in most cases be easily installed. To ensure error-free functioning, the following aspects should be considered when choosing the appropriate power supply.

Minimum power supply voltage

The minimum power supply voltage is the minimum voltage delivered by a power supply. For automotive applications, this is usually the vehicle's on-board power supply voltage (e.g. 12 V for cars). Please observe that this minimum value is decisive. 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.[17]

Cable lengths

The resistance of the connection cables causes a voltage drop along the cable. The extent of the voltage drop depends on the length of the cable and the current flowing through it. In a supply chain, the required minimum voltage has to be applied to each module.[17]

14 The Lemo connector, which is plugged into the HV BM 3.1 OBC, has an integrated CAN termination resistor.
15 A CAN termination resistor is integrated in the D-Sub 9 connector of the cable.
16 If an HV BM 3.1 OBC is operated via the CAN bus, the measurement module is connected to the PC for data acquisition via one of the CAN sockets (**CAN** or **PWR IN**) using a suitable interface cable. The other socket is used to connect additional CSM CAN measurement modules (if required).
17 The minimum value specified on the type label of a measurement module is decisive. See chapter 6.1 "Type label".

	NOTE!
	An intermediate power supply is required if, due to correspondingly higher power consumption of the HV BM 3.1 OBC, more current is required than the already available power supply can provide.

i	The following special cables are available for intermediate supply: ▸ Connection cable K72 (CAN) für HV BM 3.1 OBC ▸ Connection cable K410.1 (ECAT) for measurement chain with ECAT modules

Maximum current load of the plug connections.

	NOTE!
	When daisy-chaining modules, it has to be ensured that the maximum permissible current load of the connections (plug/socket) will not be exceeded. ☞ Make sure that the maximum current load is not exceeded.

Socket	max. current load
CAN / PWR IN	6.5 A
ECAT	5.0 A

Tab. 4-5: Max. current load for plug connections

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

4.3.3 Connecting HV power cables to an HV BM 3.1 OBC

General information

WARNING!	
	The HV power cables may only be mounted with suitable ring terminals, otherwise there is the risk of **life-threatening electric shocks** and **short-circuits**. ☞ Use only appropriate ring terminals for fastening the HV power cables. ☞ When fastening the ring terminals, make sure that the cable sections between the cable glands and threaded bolts are arranged in such a way that the HV power cables do not chafe. ☞ Make sure that there is sufficient space between the ring terminals and the housing and between each other (at least 3,5 mm). ☞ After mounting the HV power cables, fit the plastic caps (included in the scope of delivery) onto the nuts.

Required tools

- Allen key, size 2.5
- Wrenches, size SW24 (for M20), SW30 (for M25) and SW36 (for M32)
- Ring wrench, ratchet or socket wrench, size SW7, SW10.

4.3.3.1 Connection diagram

Fig. 4-3 shows the connection diagram for the 3-phase measurement of current and voltage. The HV wires L1, L2, L3 and N coming from the source (e.g. AC wallbox) are connected to the inputs on the shunt side (right). The HV wires connected to the shunt output (left) are connected to the load (e.g. on-board charger).

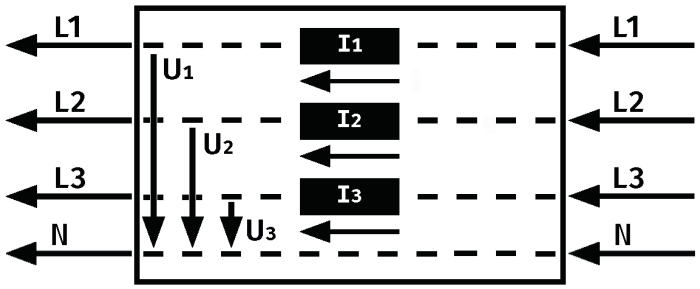


Fig. 4-3: HV BM 3.1 OBC, electrical connection diagram for current and voltage measurement

	The protective conductors (PE) of the two HV power cables are mounted on the designated threaded bolt in the measurement module (Fig. 4-7, ④). The threaded bolt for the protective earth conductor (PE) is not connected to the module housing. The measurement module has to be connected to the vehicle's potential equalization or protective earth (PE) in order to ensure user safety. → Chapter 4.3.2.5 "Ground connection"

4.3.3.2 Preparing the cable gland

☞ Loosen the pressure screws of the cable glands with a suitable wrench and remove them from the housing.

Some cable glands are equipped with a two-part silicone sealing insert (blue) and a removable inlet. The sealing insert has a specific sealing area (cable diameter) with and without inlet. This is marked accordingly (Fig. 4-4: 25-20 mm and 20-15 mm).

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

Fig. 4-4: Cable gland disassembled

Cable glands

Type	5/14	11/20	15/25
CSM article number	ART1520210	ART1520211	ART1520210
Article description	Cable gland set 5/14 w/o	Cable gland set 11/20 w/o	Cable gland set 15/25 w/o
Pflitsch designation	bg 220ms /sc	bg 225ms /sc	bg 232ms /sc
Sealing range without inlet	5 – 14 mm	16 – 20 mm	20 – 25 mm
Sealing range with inlet	—	11 – 16 mm	15 – 20 mm
Connecting thread	M20	M25	M32
Wrench width	SW24	SW30	SW36

Tab. 4-6: Technical data of the cable glands

The tightening torques for double nipples and pressure screws for the cable glands listed in Tab. 4-6 can be found in the product catalog.[18]

4.3.3.3 Fit the cable gland components onto the HV power cable

NOTE!	
	The cable glands must be unscrewed and the individual components fitted to the *not yet assembled* HV power cable.

☞ Loosen the cable gland and remove it from the housing.

☞ Disassemble the cable gland into its individual components.

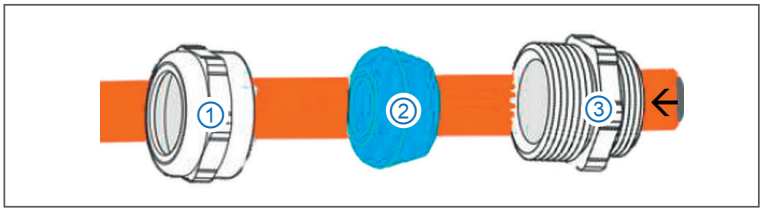


Fig. 4-5: Cable gland: Components

☞ Thread the individual components of the cable gland (pressure screw ①, sealing insert ②, and double nipple ③) onto the HV cable.

18 https://www.pflitsch.de/fileadmin/user_upload/Downloads/Kataloge/Katalog_Kabelverschraubung_2024.pdf (p. 430 or p. 438).

4.3.3.4 Connecting the wires of the HV power cables

This section describes how to connect the HV wires to the threaded bolts. The removal of the wires is done in reverse order.

WARNING!	
	The improper opening of the housing during operation entails the risk of life-threatening electrical shocks. ☞ Before opening the housing cover, always make sure that the device is de-energized.

WARNING!	
	When using HV power cables made of aluminum in combination with ring terminals for HV power cables made of copper, the contact resistance between the two components increases. **This can lead to a massive increase in temperature and in the worst case to the development of fire.** ☞ Use ring terminals for copper cables only in combination with HV power cables made of copper! HV power cables made of aluminum require a specific connection technology. Please contact our technical support for further information.

Opening the housing

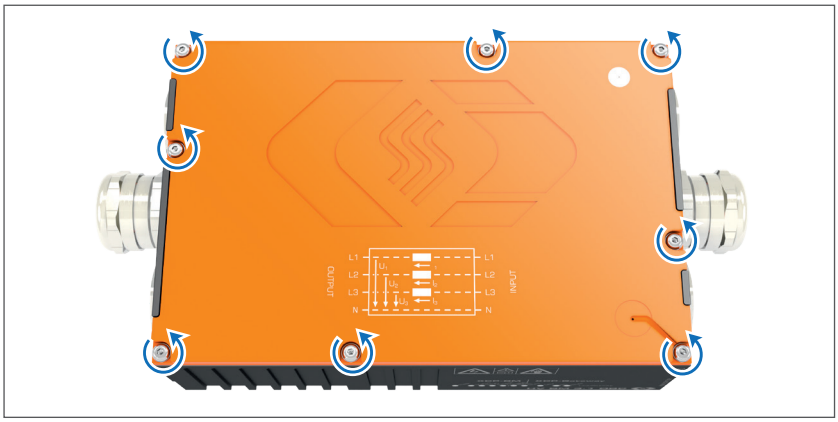


Fig. 4-6: HV BM 3.1 OBC, housing closed

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

☞ Remove the orange-colored lid.

☞ If not already done, unscrew the cable glands from the housing now and thread the components of the cable glands onto the HV power cables.

→ Chapter 4.3.3.3 "Fit the cable gland components onto the HV power cable"

☞ Prepare the HV power cables.

☞ Feed the pre-assembled HV power cables through the openings in the cable glands into the module housing.

Mounting the HV power cables on the threaded bolts

NOTE!	
	☞ Tighten the nuts for fastening the ring terminals with the specified torques (Tab. 4-7) to keep the contact resistance low.

The ring terminals of the outer conductors L1, L2 and L3 are each mounted on the correspondingly marked M6 threaded bolts of the shunt module (①, ② and ③) and fastened with M6 nuts. The conductors PE ④ and N ⑦ as well as the signal line CP ⑥ of the two HV wires are only connected to each other, i.e. the ring cable lugs of the respective conductors are placed together on the correspondingly marked threaded bolts and fastened with M6 or M4 nuts. The threaded bolt for the signal cable PP ⑤ has no function here and is not used. Finally, the plastic protective caps are fitted to the nuts (Fig. 4-7).

i	Matching M6 or M4 nuts and plastic protective caps are included in the scope of delivery and pre-assembled on the threaded bolts. Fig. 4-7 shows the threaded bolts on the right with nuts and fitted protective caps (input side) and on the left with only the screwed-on M6 or M4 nuts (output side).

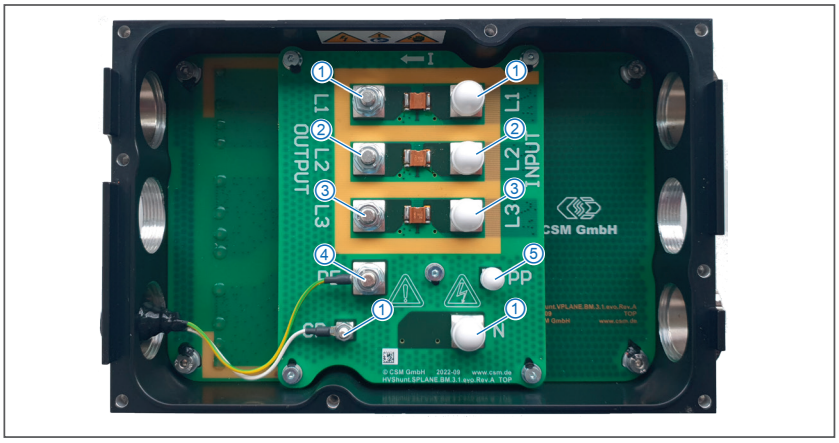


Fig. 4-7: HV BM 3.1 OBC, housing opened, threaded bolts marked

1. Outer conductor L1
2. Outer conductor L2
3. Outer conductor L3
4. PE conductor
5. Signal wire PP (Proximity Pilot, w/o function)
6. Signal wire CP (Control Pilot)
7. Neutral conductor

Tightening torques for fastening the ring terminals

Thread size	Tightening torque
M4	1.2Nm
M6	3.9Nm

Tab. 4-7: Tightening torques

Mounting the ring terminals for L1, L2 and L3

WARNING!	
	The HV power cables may only be mounted with suitable ring terminals, otherwise there is the risk of **life-threatening electric shocks** and **short-circuits**. ☞ Use only appropriate ring terminals for fastening the HV power cables. ☞ When fastening the ring terminals, make sure that the cable sections between the cable glands and threaded bolts are arranged in such a way that the HV power cables do not chafe. ☞ Ensure that the ring cable lugs have sufficient distance to the housing and to each other (at least 3.5 mm). ☞ After mounting the HV power cables, fit the plastic caps (included in the scope of delivery) onto the nuts.

☞ Loosen and unscrew the M6 nuts.

☞ Place the M6 ring terminals of the conductors on the corresponding bolts (Fig. 4-7, ① to ③).

☞ Fasten the ring terminals with the M6 nuts and tighten them with the required torque (Tab. 4-7).

Mounting the ring terminals for N, PE and CP

	When connecting the wires for **N**, **PE** and **CP**, the ring terminals of the two HV wires are mounted on the corresponding threaded bolts.

☞ Place the M6 ring terminals for the conductors N and PE on the corresponding threaded bolts (Fig. 4-7, ④ and ⑦).

☞ Place the M4 ring terminals for the CP wire on the corresponding threaded bolt (Fig. 4-7, ⑥).

☞ Fasten the ring terminals with M8 nuts. Tighten the nuts with the respective specified torque (Tab. 4-7).

☞ Fit the protective caps onto the nuts.

Mounting the cable glands

Fig. 4-8: Double nipple, mounted

☞ Attach the double nipple (Fig. 4-8, ①) to the housing by hand.

☞ Attach the pressure screws with sealing ring to the double nipples.

☞ Tighten the pressure screws.

☞ Tighten the double nipples and pressure screws with the tightening torques specified in the manufacturer's installation instructions.[19]

19 https://www.pflitsch.de/fileadmin/user_upload/Downloads/Kataloge/Katalog_Kabelverschraubung_2024.pdf (p. 430 or p. 438).

Mounting the lid of the housing

NOTE!	
	To prevent the ingress of water, condensation etc., particular attention must be paid to the tightness of the housing. CSM supplies a cover gasket as a spare part. This should be replaced if, for example, it is brittle or fragile or has been pinched. ☞ Carefully fit the lid of the housing and the gasket. ☞ Make sure that the cable glands and HV power cables are properly mounted.

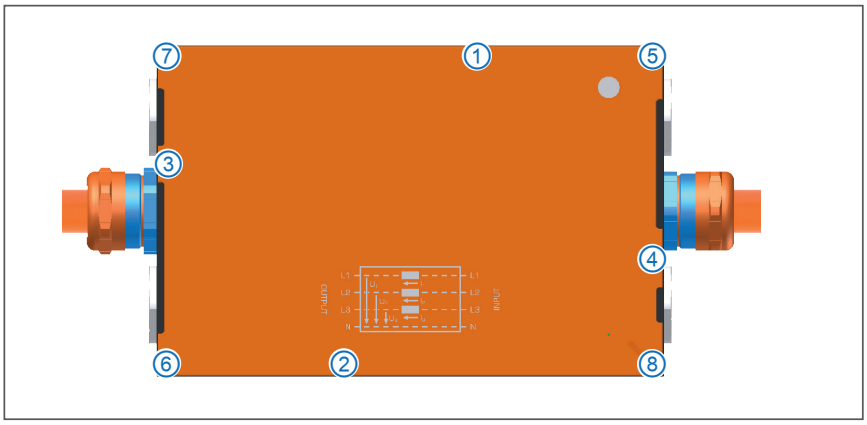


Fig. 4-9: HV BM 3.1, housing closed and HV power cable mounted

☞ Place the lid on the lower part of the housing.

☞ Use the eight Allen screws to fasten the lid. Tighten the screws in the specified order (Fig. 4-9, ① to ⑧).

5 How to use HV BM 3.1 OBC

The HV BM 3.1 OBC transmits the measurement data directly via the standard protocol XCP-on-Ethernet at a rate of up to 2 MHz per measured quantity and simultaneously at a data rate of up to 5 kHz using the additional CAN interface. CSM CAN devices can by default be connected to the CAN interface and operated. The option "HV BM 3.1 OBC XCPG" is required to be able to configure CSM CAN measurement modules by using the CAN interface of the optional XCP-Gateway. This optional XCP-Gateway is also required, for example, to connect additional CSM EtherCAT® measurement modules.

→ Chapter 6.2 "Options"

→ Chapter 7.1 "Option HV BM 3.1 OBC XCPG"

5.1 Example of application

The following figure shows an example circuit in which a HV BM 3.1 OBC is connected to a PC for data acquisition.

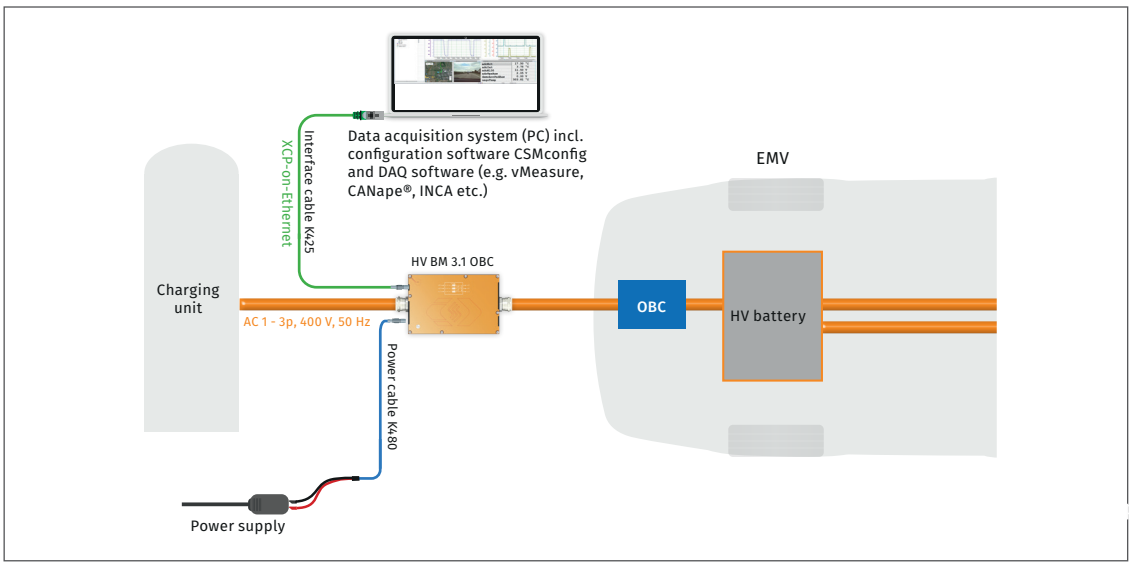


Fig. 5-1: Measurement setup (w/o using the CAN output)

The measurement setup consists of the following components:

- 1 HV BM 3.1 OBC measurement module
- 1 power supply
- 1 K425 interface cable (Chapter 4.3.2.1 "PC socket")
- 1 K485 power cable [20] (Chapter 4.3.2.3 "CAN socket and PWR IN socket")
- Data acquisition (PC) with configuration software CSMconfig and DAQ software (e.g. vMeasure, CANape®, INCA etc.)

Connecting the components

☞ Connect the interface cable to the measurement module

☞ Connect the opposite end of the interface cable to the PC for data acquisition.

☞ Connect the power cable to the measurement module.

☞ Connect the banana plugs of the interface cable to the power supply.

20 The power cable K485-xxxx is equipped with an integrated termination resistor.

5.2 CSMconfig user interface

The CSMconfig user interface consists of the following sections:

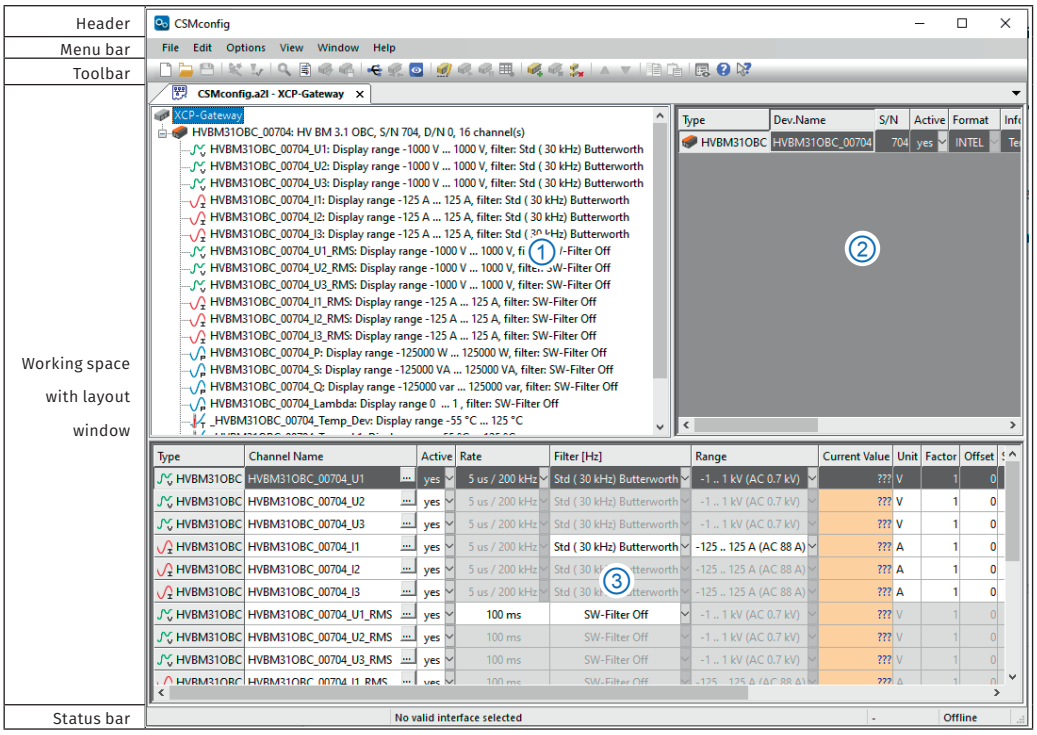


Fig. 5-2: CSMconfig user interface

5.2.1 Header

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

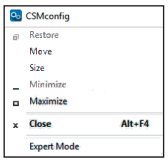


Fig. 5-3: Program menu

In addition to the standard Windows functions, it also contains the **Expert Mode** option.

→ *CSMconfig Online Help, "Expert mode"*

5.2.2 Menu bar

The commands are arranged in the following menus:

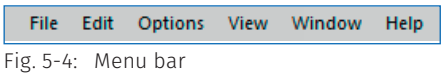


Fig. 5-4: Menu bar

→ *CSMconfig Online Help, "Menu commands"*

5.2.3 Toolbar

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

Fig. 5-5: Toolbar

→ *CSMconfig Online Help, "Toolbar"*

5.2.4 Working space

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

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

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

- **Tree view** (Fig. 5-2, ①)
- **Device list** (Fig. 5-2, ②)
- **Channel list** (Fig. 5-2, ③)

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

☞ Select **Window | View Layout**.

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

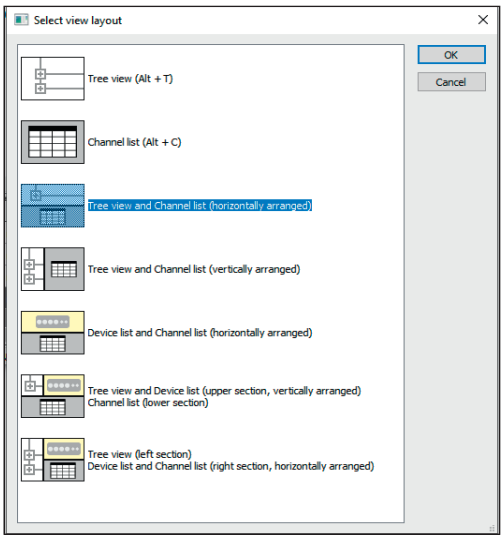


Fig. 5-6: **Select view layout** dialog

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

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

5.2.5 Status bar

Fig. 5-7: Status bar

The status bar provides the following information:

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

5.2.6 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. 5-1: Shortcuts used in CSMconfig

5.3 Preparing the module configuration

The configuration of an HV BM 3.1 OBC is done in CSM's configuration software CSMconfig. These modules are transmitting the measurement data directly using the standard protocol XCP-on-Ethernet. An extra XCP-Gateway protocol converter is not required.

In order to be able to connect further CSM EtherCAT® and CAN measurement modules, HV BM 3.1 OBC modules are equipped with an integrated XCP-Gateway, which can be optionally enabled. This is why HV BM 3.1 OBC modules are displayed as XCP-Gateways on interface level in CSMconfig.

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 most current version of CSMconfig can be found in the download area of the CSM website. Upon program start, CSMconfig can check whether a new version is available. If a more up-to-date version is available, the corresponding download link will be displayed in the dialog.

	NOTE!
	Since CSMconfig accesses the network, the firewall settings may have to be adjusted. ☞ Make sure that the ports 5555 and 5556 are unlocked for CSMconfig.

	NOTE!
	HV BM 3.1 OBC uses a fixed IP address (factory setting: 192.168.100.11). 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 3.1 OBC with the data acquisition system (PC) and the HV BM 3.1 OBC 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 192.168.100.1. ☞ Make sure that all IP addresses are unique and within the same IP address range.

→ Chapter 5.4.3.5 "Communication parameter settings"

Setting the IP address of the network card

	NOTE!
	To change the IP address of the PC, extended user rights or administrator rights may be required.[21]

Windows 10

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

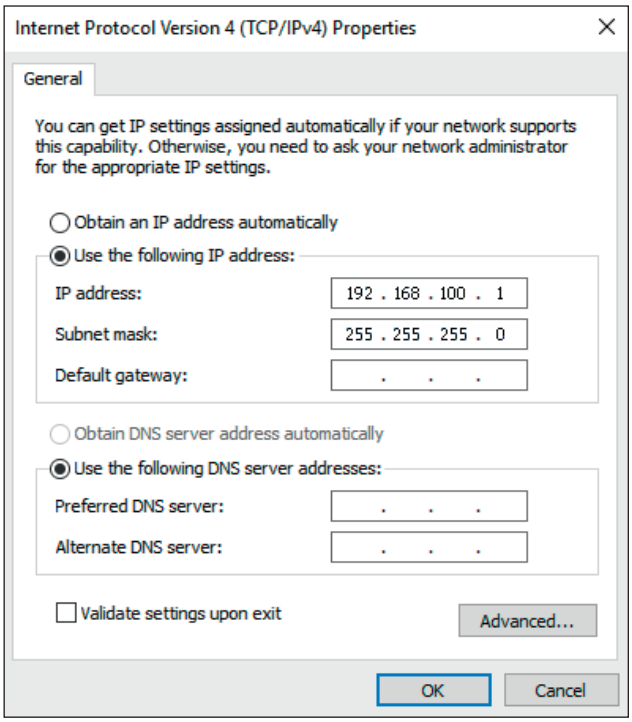


Fig. 5-8: Windows 10/11: **Internet Protocol Version 4 (TCP/IPv4) Properties** dialog

☞ Enter the required address into the **IP address** field (here: 192.168.100.1).
⇨ The **Subnet mask** entry is added automatically.
☞ Click **OK** to finish the process.

21 Information on setting the IP addresses for Vector interfaces is provided in the CSMconfig Online Help, section "Connecting and configuring Vector Interfaces in CSMconfig".

Windows 11

☞ Select **Start | Settings | Network & Internet**.
  ⇨ The **Network & Internet** window opens.
☞ Select **Ethernet** from the **Network adapter** list and choose the required Ethernet network.
☞ The **Ethernet properties** dialog opens.
☞ Select **Internet Protocol Version 4 (TCP/IPv4)**.
  ⇨ The dialog **Internet Protocol Version 4 (TCP/IPv4) Properties** is displayed (Fig. 5-8).
☞ Enter the required address into the **IP address** field (here: 192.168.100.1).
  ⇨ The **Subnet mask** entry is added automatically.
☞ Click **OK** to finish the process.

5.4 Configuring HV BM 3.1 OBC

The following paragraphs contain information on the following topic(s):

- HV BM 3.1 OBC Module settings
- Creating a standard configuration with (offline and online) with an HV BM 3.1 OBC in CSMconfig

i	With an HV BM 3.1 OBC the measurement data can be sent via the standard XCP-on-Ethernet protocol and via CAN. → Chapter 5.4.3.7 "Measurement channel settings" and chapter 5.4.3.8 "Measurement module settings"

i	An HV BM 3.1 OBC has an internal XCP-Gateway that can be activated via the "HV BM 3.1 OBC XCPG" option. With the internal XCP-Gateway activated, EtherCAT® measurement modules can also be detected and integrated into measurement setups. → Chapter 7.1.2 "Operation with option HV BM 3.1 OBC XCPG activated"

i	In addition to the measurement channels for voltage, current and power measurement, an HV BM 3.1 OBC can also calculate other power and RMS values. These additional channels are not available by default and have to be activated with the option "HV BM 3.1 OBC Calc". → Chapter 5.4.3.8 "Measurement module settings" → *CSMconfig Online Help, "Calculation of Power and RMS Values"*

In CSMconfig, configurations can be created both *online* and *offline*.

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

The user can choose from three different view modes for configuration:
Tree view, **Device list** or **Channel list**. These views are combined into configuration layouts in a higher-level window.

→ Chapter 5.2.4 "Working space"

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

5.4.1 Dialogs and windows

i	Which views are displayed during configuration depends on the configuration layout defined in the **Select view layout** dialog.

Example

If a new configuration file is created, 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 and XCP measurement modules.

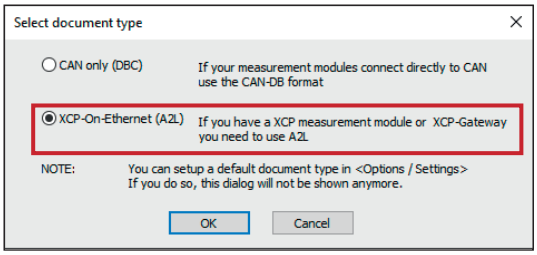


Fig. 5-9: **Select document type** dialog, **XCP-on-Ethernet (A2L)** selected

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

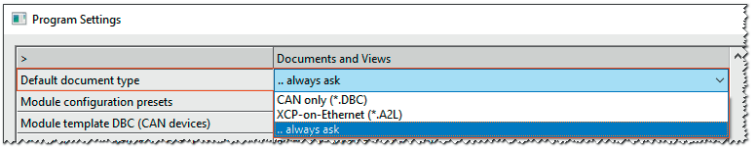


Fig. 5-10: **Program Settings** dialog, **Default document type** options

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

→ *CSMconfig Online Help, "Program Settings"*

5.4.2 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 CSMconfig.

⇨ The CSMconfig program window opens.

☞ Select **File | New**.

⇨ The **Select document type** dialog (Fig. 5-9) opens.

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

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

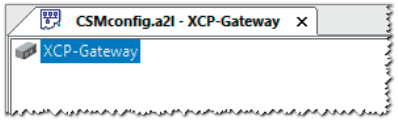


Fig. 5-11: Layout window **CSMconfig.a2l**, **Tree view**

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

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

⇨ The context menu opens.

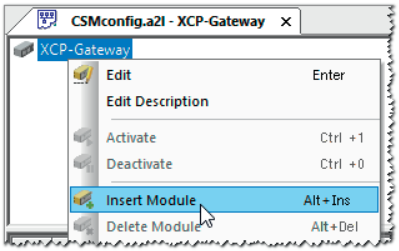


Fig. 5-12: **CSMconfig.a2l** window, **Tree view**, context menu

☞ Select **Insert Module**.

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

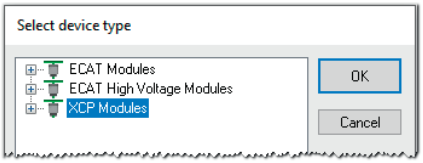


Fig. 5-13: **Select device type** dialog

	NOTE!
	The **Select device type** dialog is used to select module series, e.g. "AD MM series" (CAN) or "HV AD MM series" (ECAT). However, no specific module variants can be specified, such as "AD4 MC10" or "HV AD4 XW1000". 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 required measurement module is not displayed in the selection window, click on the corresponding **+** symbol on the left.

⇨ The submenu opens.

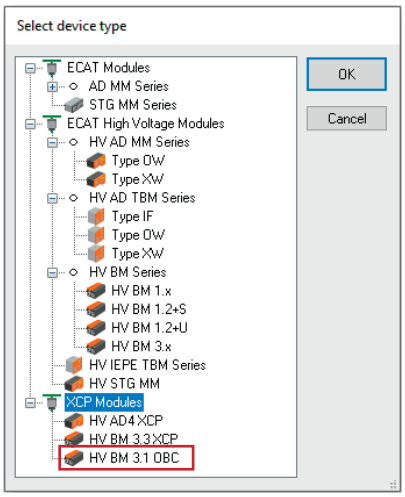


Fig. 5-14: **Select device type** dialog, subentries faded in

☞ Select module type (**XCP Modules | HV BM 3.1 OBC**).

☞ Confirm selection with **OK**.

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

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

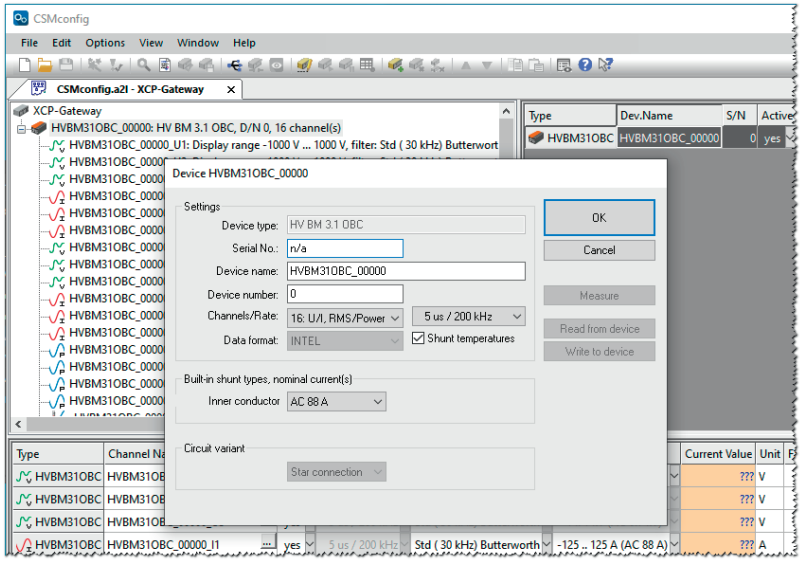


Fig. 5-15: **Device configuration dialog**, configuration window **CSMconfig.a2l** in the background

Notes on the configuration of measurement channels and the measurement modules can be found in the section "Online configuration".

→ Chapter 5.4.3.7 "Measurement channel settings" or chapter 5.4.3.8 "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 5.4.3.8.12 "Transmitting configuration data and verifying measurement values"

5.4.3 Online configuration

5.4.3.1 Preparing configuration

☞ Before starting an online configuration, make sure that

- HV BM 3.1 OBC and computer are properly connected via a suitable interface or a LAN interface
- further measurement modules (if applicable) are properly connected to the HV BM 3.1 OBC and the required options are available
- the latest version of CSMconfig has been installed on the PC

5.4.3.2 Starting the program

☞ Start CSMconfig.

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

☞ If an interface is displayed in the status bar of the program window (Fig. 5-16), proceed with chapter 5.4.3.4 "Creating a new configuration file".

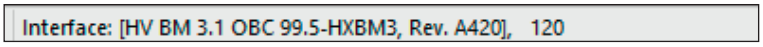


Fig. 5-16: Status bar: “XCP Gateway” interface

☞ If no interface is displayed in the status bar (Fig. 5-17), continue with chapter 5.4.3.3 "Selecting a communication interface".

Fig. 5-17: Status bar: "No valid interface selected"

5.4.3.3 Selecting a communication interface

HV BM 3.1 OBC are designed as bus interfaces which is why they are displayed as XCP-Gateway in the configuration and listed in the **Interface** dialog. If no XCP-Gateway is displayed in the status bar after program start-up, the message **No valid interface selected** will be shown instead (Fig. 5-17). This means that either no or a different interface was previously activated and the matching 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.

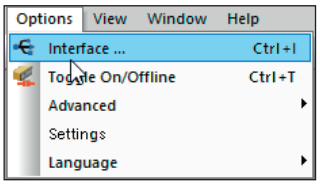


Fig. 5-18: **Options | Interface**

☞ Select **Options | Interface**.

⇨ The **Interface** dialog opens.

⇨ In an HV BM 3.1 OBC, the interface with the serial number extension *.5 is selected by default.

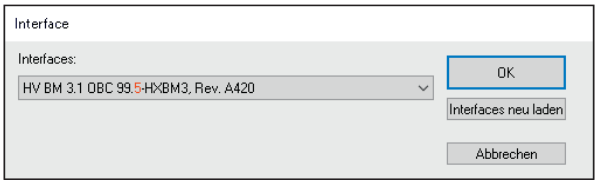


Fig. 5-19: **Interface** dialog

If the optional XCP-Gateway has been enabled (option "HV BM 3.1 OBC XCPG"), three communication interfaces are available for the HV BM 3.1 OBC in the **Interface** dialog (Fig. 5-20).

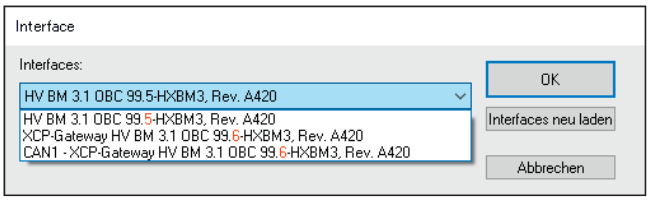


Fig. 5-20: **Interface** dialog, further communication interfaces

- The standard XCP-Gateway with the serial number suffix *.5
- The optional/activated XCP-Gateway and the CAN interface assigned to it, each with the serial number suffix *.6

→ Chapter 7.1 "Option HV BM 3.1 OBC XCPG"

If the activated (optional) interface is to be used instead of the standard interface, e.g. to connect and operate CSM EtherCAT measurement modules to the HV BM 3.1 OBC, select the XCP-Gateway with serial number extension *.6 (Fig. 5-21).

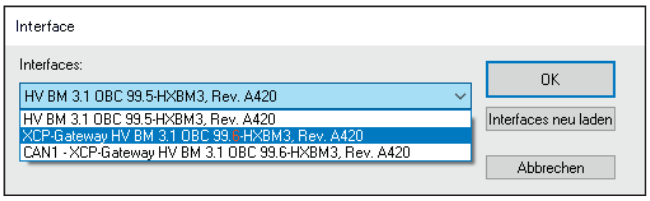


Fig. 5-21: **Interface** dialog, select optional XCP-Gateway (*.6)

☞ Select the required interface.

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

5.4.3.4 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 5.4.3.6 "Scan Bus and Auto-Configuration"

☞ Select **File | New**.

⇨ The **Select document type** dialog (Fig. 5-9) opens.

⇨ For the configuration of XCP/ECAT measurement modules via an XCP-Gateway, choose **XCP-on-Ethernet (A2L)** and confirm with **OK**.

⇨ The configuration window **CSMconfig.a2l** opens.

Fig. 5-22: **CSMconfig.a2l** window, **Tree view**

5.4.3.5 Communication parameter settings

The communication parameters used by the data acquisition software to establish the connection to an HV BM 3.1 OBC are specified in the **XCP-Gateway Configuration** dialog. Modifications are only necessary if the default settings do not match the settings of the PC which is used for data acquisition.

The communication between CSMconfig and the HV BM 3.1 OBC can be carried out without changing these parameters.

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

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

In the following example, the HV BM 3.1 OBC is connected with a network interface with the following IP settings:

- Class C network, subnet mask 255.255.255.0
- Fixed host IP address: 192.168.100.56

→ "Setting the IP address of the network card"

This corresponds to the Windows default settings for network configurations.

- CSMconfig reads the IP address of the connected module. The default address is 192.168.100.11.
- The port for XCP communication is 5555 (+ 5556 for broadcast commands).

This IP configuration is used by the HV BM 3.1 OBC for performing the measurements.

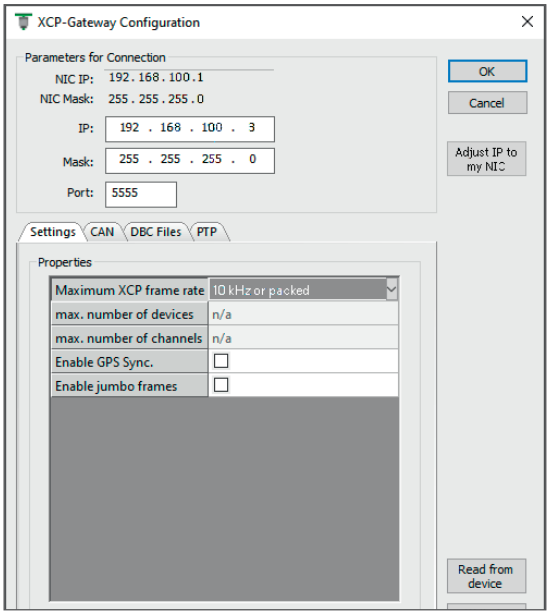


Fig. 5-23: **XCP Gateway Configuration** dialog, **Settings** tab

Section Parameters for Connection

- **NIC IP**: IP address of the network card to which the HV BM 3.1 OBC 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 HV BM 3.1 OBC. Upon delivery, the HV BM 3.1 OBC uses the IP address 192.168.100.11. If more than one XCP module or gateway is connected to a port via a switch, it has to be made sure that the default address is only used once, i.e. only by one XCP-Gateway.
- **Subnet mask**: By default, the subnet mask is set to 255.255.255.0 (class C).
- **Port**: The default setting for communication via XCP is port 5555.

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

- If measurement will be done with a different PC/NIC, the HV BM 3.1 OBC connection parameters must match the network settings on the other machine.
- If you use PC and network adapter card for both configuration and measurements, the IP addresses of the network adapter and the HV BM 3.1 OBC have to be in the same address range (Fig. 5-24, green markers), but they must not be identical (Fig. 5-24, blue markers). If necessary, the IP address can be adjusted clicking the button **Adjust IP to my NIC**. The IP address is automatically adjusted to the IP address of the network adapter. A manual modification of the **IP address** entry is not required.

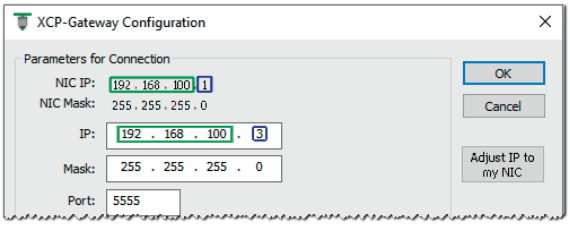


Fig. 5-24: **Adjust IP to my NIC** command

☞ 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** (Fig. 5-23) to transfer the settings to the HV BM 3.1 OBC.

CSMconfig reads out the parameters of the network card to which the HV BM 3.1 OBC is connected. This is the data displayed in the **Settings** tab. If no HV BM 3.1 OBC is connected, the settings of the previous configuration or the default settings are used.

Tabs

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

The following sections describe the functions and setting options of the **Settings** tab (Fig. 5-23).

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

- **Enable GPS Sync.**[22]: 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"*

5.4.3.6 Scan Bus and Auto-Configuration

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

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

Running Scan Bus

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

	NOTE!
	A new configuration document must be created in order to perform **Scan Bus**. ☞ Select **File | New**.

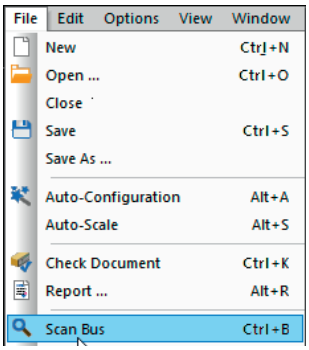


Fig. 5-25: **File | Scan Bus**

☞ Select **File | Scan Bus**.

⇨ The bus is checked for available measurement modules.

⇨ Detected measurement modules are listed below the bus level.

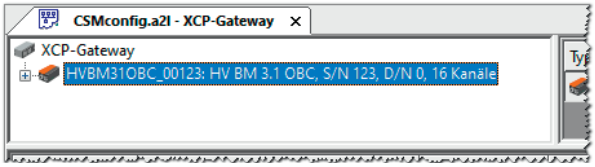


Fig. 5-26: **CSMconfig.a2l** window, **Tree view**, detected measurement modules

22 This option is only available for XCP-Gateway 4S pro. It is displayed in CSMconfig when an HV BM 3.1 OBC is connected, but it cannot be activated.

Running Auto-Configuration

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

→ Chapter 5.4.3.9 "Saving the measurement configuration"

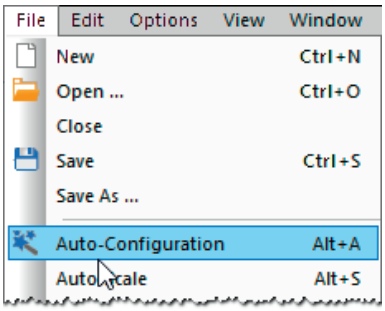


Fig. 5-27: **File | Auto-Configuration**

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

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

⇨ The configuration window **AutoConfig** opens.

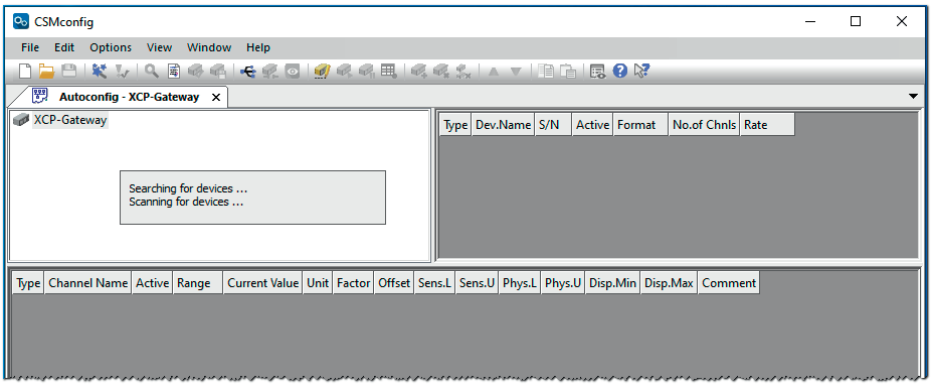


Fig. 5-28: **AutoConfig** window, "Searching for devices .../Scanning for devices ..."

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

⇨ Upon process completion, the following dialogs are displayed:

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

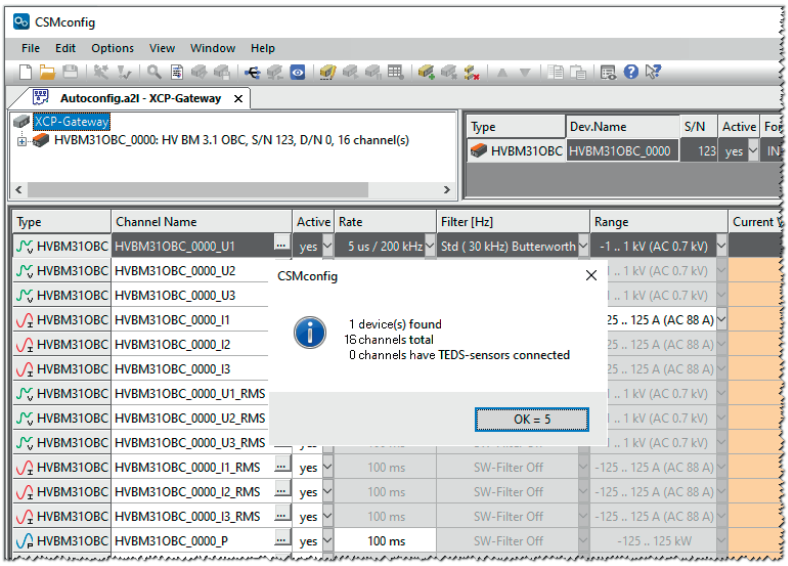


Fig. 5-29: **Auto-Configuration** is performed.

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

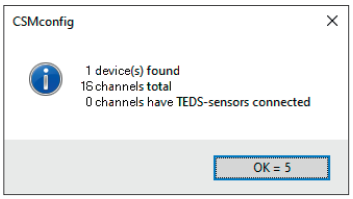


Fig. 5-30: **Auto-Configuration** message window

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

→ Chapter 5.4.3.9 "Saving the measurement configuration"

5.4.3.7 Measurement channel settings

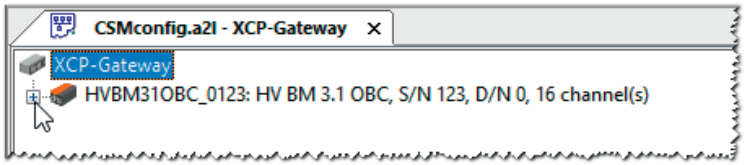


Fig. 5-31: **CSMconfig.a2l** window, **Tree view**, channel list faded out

☞ 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.

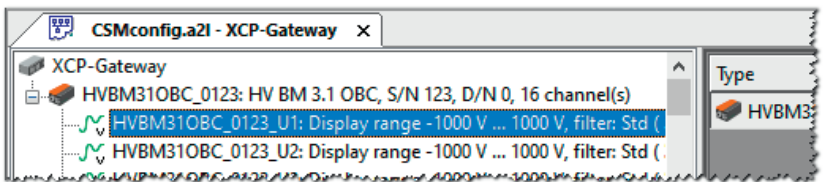


Fig. 5-32: **CSMconfig.a2l** window, **Tree view**, channel list faded in

☞ Double-click on the selected channel entry.

⇨ The **Channel configuration dialog** opens.

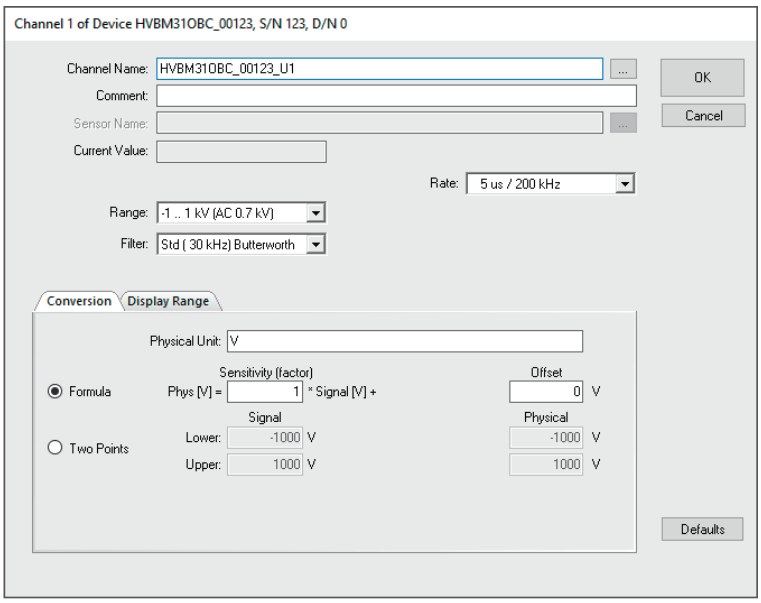


Fig. 5-33: **Channel configuration dialog** (HV BM 3.1 OBC)

☞ Make the required settings (Table "HV BM 3.1 OBC – channel configuration options").
☞ Click on **OK** to close the dialog.
☞ For configuring the remaining device channels, proceed as described above.
→ *CSMconfig Online Help, "Channel configuration dialog"*

HV BM 3.1 OBC – channel configuration options

Field	Function
General Settings	
Channel Name	Input field for channel name. This name is stored in the A2L 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	Not available for HV breakout modules and therefore greyed out
Current value	This field displays the currently measured value of the channel.
Rate	The option **Rate** is used to define the channel-specific transmission rate.

Field	Function	
General Settings (cont.)		
Measurement range	**Star voltage** -100 .. 100 V (AC 70 V) -200 .. 200 V (AC 140 V) -500 .. 500 V (AC 350 V) -1 .. 1 kV (AC 0.7 kV)	**String current** -15.6 .. 15.6 A (AC 11 A) -31.2 .. 31.2 A (AC 21 A) -62.5 .. 62.5 A (AC 43 A) -125 125 A (AC 88 A)
	→ "Measurement range configuration for ECAT and CAN operation"	
Buttons		
Defaults	The settings in the dialog are reset to the factory settings. The content of some specific fields, however (e.g. **Channel Name**), remains unchanged.	
Auto-Offset	The **Offset compensation** function of the **Auto-Scale** wizard is called up.	
Auto-Scale	The **Two Points** function of the **Auto-Scale** wizard is called up.	
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 **Conversion** and **Display Range** tabs.	
Formula	The **Formula** section provides options to create a formula in order to convert a value into another measured variable using **Sensitivity (factor)** and **Offset**.	
Sensitivity (factor)	Input field for the scaling parameter	
Offset	Input field for the offset value	
Two Points	The **Two Points** function converts sensor readings into another measured variable by defining two points on one axis.	
Signal	Measured values supplied by the sensor	
Lower	Lower sensor reading	
Upper	Upper sensor reading	
Physical	Scaled measured values in the measured variable set under **Physical Unit**.	
Lower	Lower value to be defined by the user	
Upper	Upper value to be defined by the user	

Field	Function
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 define the lower and upper limit for the measurement range displayed 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. 5-2: Channel configuration options (module connected via XCP)

When operated in CAN mode, the **CAN identifier** option will also be displayed

General Settings	
CAN identifier	The channel-specific CAN identifier is defined with this option. This option is only available on the CAN side. To be able to use this function, the option **Per channel configuration** in the Device configuration dialog has to be enabled.
Rate	As in XCP mode, this option is used to define the channel-specific transmission rate. To be able to use the **Rate** option in CAN mode, the option **Per channel configuration** has to be activated in the Device configuration dialog.

Tab. 5-3: Additional channel configuration options (module connected via XCP)

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 on both sides have to be **configured identically**. If not, the module side that has been configured first will no longer send any measured values, but the error value "0x8000" or the error message "CONFIGURATION_ERROR".

This is indicated on the module by **measurement channel LED indictors permanently lit in red**. This error is displayed in the **Operation mode** row of the **Device configuration** dialog (see Fig. 5-34).

☞ Go to the **Device configuration dialog** and click on **Read from device** (Fig. 5-36).
⇨ The dialog **Device configuration** opens.

☞ 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 on the measurement module will go out and both module sides (XCP and CAN) will be operational again.

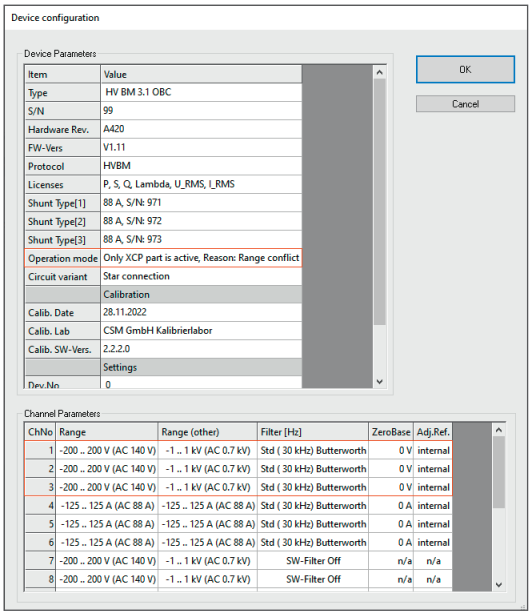


Fig. 5-34: Dialog **Device configuration**, display of divergent measurement ranges

5.4.3.8 Measurement module settings

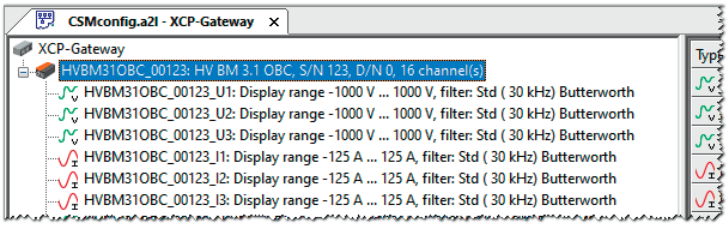


Fig. 5-35: **Tree view**, measurement module selected

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

⇨ The **Device configuration dialog** opens.

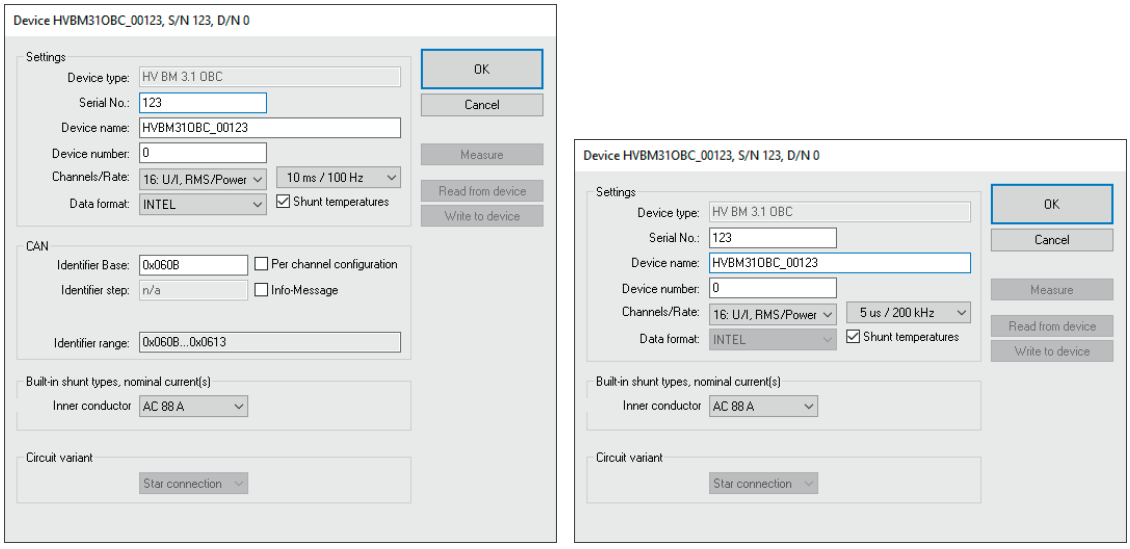


Fig. 5-36: **Device configuration dialog**, measurement module connected via CAN (left) and via XCP (right)

5.4.3.8.1 Device type

If **Scan Bus** or **Auto-Configuration** are performed in an online configuration, the detected device type will be displayed in the fields **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. 5-14).

5.4.3.8.2 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.

5.4.3.8.3 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 remains unchanged, it will be automatically modified as soon as the serial number is changed. The name entered in this field is also used as a component for the channel designation (Fig. 5-36).

5.4.3.8.4 Device number

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

5.4.3.8.5 Channels

The number of measurement channels which are available is specified in the **Channels** selection menu. The default setting for a HV BM 3.1 OBC is "6: U/I" (six channels). The setting "16: U/I, RMS/Power", which provides the additional channels for calculating the power and RMS values, is only available if the extended channel range has been enabled via the option "HV BM 3.1 OBC Calc".

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

i	If an HV BM 3.1 OBC is operated with the extended channel range via XCP, the setting "16: U/I, RMS/Power" is greyed out in the **Channels** selection menu (Channel configuration dialog). It is then no longer possible to switch to "6: U/I" (six channels).

Setting options	Available channels	
6:	3× U 3× I	Voltage Current
16: U/I, RMS/Power	3× U 3× I 3× U_{RMS} 3× I_{RMS} 1× P 1× S 1× Q 1× λ	Voltage Current RMS Voltage RMS Current Active power Apparent power Reactive power Power factor

Tab. 5-4: Measurement channels setting optionsHV BM 3.1 OBC

How to measure only one measured variable in CAN bus mode

To be able to measure just one measured value, the following steps are required:

☞ Enable the option **Per channel configuration** in the **CAN** section.

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

☞ Assign a CAN ID to the channels for the requested measured variables.

→ *CSMconfig Online Help, "HV BM 3.1 OBC Device configuration"*

Performing measurements with less than three phases

The HV BM 3.1 OBC provides an option to deactivate individual phases. The deactivation is done in the **Channel list** by switching the setting option from "Yes" to "No" in the **Active** column of the selected phase(s) (Fig. 5-37).

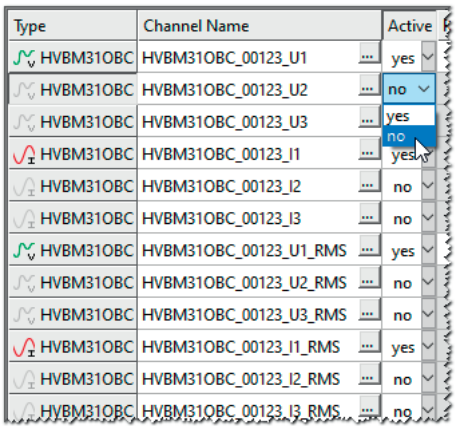


Fig. 5-37: HV BM 3.1 OBC in the **Channel list**, phases U2 and U3 deactivated.

Along with the phases ($U_{2/3}$), the channels $I_{2/3}$ connected to these channels and the RMS channels $U_{2/3\_RMS}$ and $I_{2/3\_RMS}$ are also deactivated (Fig. 5-37).

	NOTE!
	Deactivated measurement channels are not taken into account when calculating the apparent, active and reactive power.

5.4.3.8.6 Rate

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

5.4.3.8.7 Shunt temperatures

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

As for the HV BM 3.1 OBC, the **Shunt temperatures** option contains the following signals:

- *_devicename_Temp_L1* HV BM 3.3/HV BM 3.1 OBC: Shunt temperature, Phase 1
- *_devicename_Temp_L2* HV BM 3.3/HV BM 3.1 OBC: Shunt temperature, Phase 2
- *_devicename_Temp_L3* HV BM 3.3/HV BM 3.1 OBC: Shunt temperature, Phase 3

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

5.4.3.8.8 Data format

The selection menu **Data format** provides two formats for the transmission of CAN messages (non-functional and greyed out in XCP and ECAT mode):

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

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

The **Inner conductor current** section shows the type of shunt installed in the module.

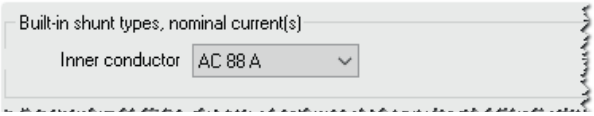


Fig. 5-38: Dialog section **Built-in shunt types, nominal current(s)**

5.4.3.8.10 Circuit variant

The section **Circuit variant** displays the measurement mode of the HV Breakout Module. With regard to the HV BM 3.1 OBC, only the **Star connection** measurement mode is available.

Fig. 5-39: Dialog section **Circuit variant**

5.4.3.8.11 HV Breakout Modules in CAN bus operation

If an HV Breakout Module is connected via CAN, the **Device Configuration dialog** will also include the **CAN** section (Fig. 5-36).

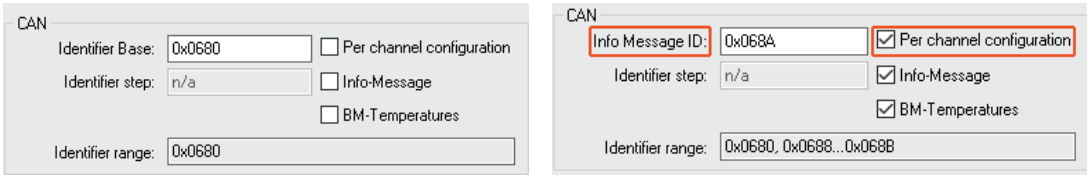


Fig. 5-40: Device configuration dialog, dialog section **CAN**

Identifier base

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

→ *CSMconfig Online Help, "Program Settings" and "AutoConfig options"*

Identifier step

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

Identifier Range

The range of the CAN identifiers used is displayed in the **Identifier range** field. By default, CAN identifiers and transmission rate (Fig. 5-36) are specified per device.

Per channel configuration

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

- In the dialog section **Settings** the **Rate** pull-down menu fades out.
- The name of the **Identifier base** field changes into **Info Message ID** Fig. 5-40. This field then displays the start ID of the optional CAN message that has been activated first.
- The options **CAN identifier** and **Rate** are now available in the **Channel configuration dialog** (Fig. 5-41).

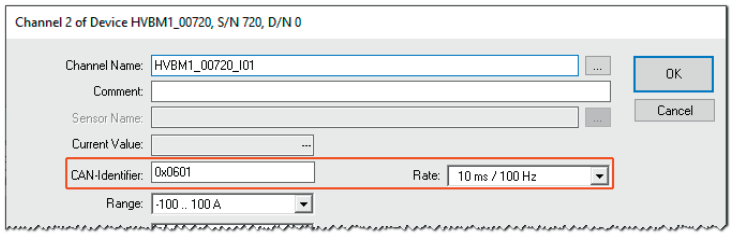


Fig. 5-41: **Channel configuration dialog**, module connected via CAN and **Per channel configuration** enabled

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

Info Message

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

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

- *_devicename_Temp_Dev* Internal temperature of the measurement module
- *_devicename_Temp_Shunt* HV BM shunt temperature[23]

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

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

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

5.4.3.8.12 Transmitting configuration data and verifying measurement values

Read from device / Write to Device

- **Read from device** is reading a configuration from a measurement module The firmware version and the hardware revision number are also read out.
- Write to device **writes a configuration to a measurement module.**

  ☞ Click on **Write to Device** to write the configuration data to the measurement module.

  ⇨ The following message is displayed:

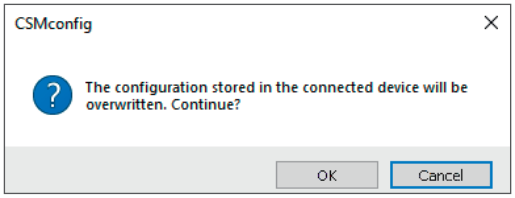


Fig. 5-42: Safety prompt before overwriting the old configuration

☞ Click **OK** to write the configuration to the device.

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

or

☞ Click on **Cancel** to keep the old configuration.

→ *CSMconfig Online Help, "Device configuration dialog"*

Verifying the measurement values

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

☞ Click on **Measure** (Fig. 5-36).

⇨ The **Measurement Values** window opens.

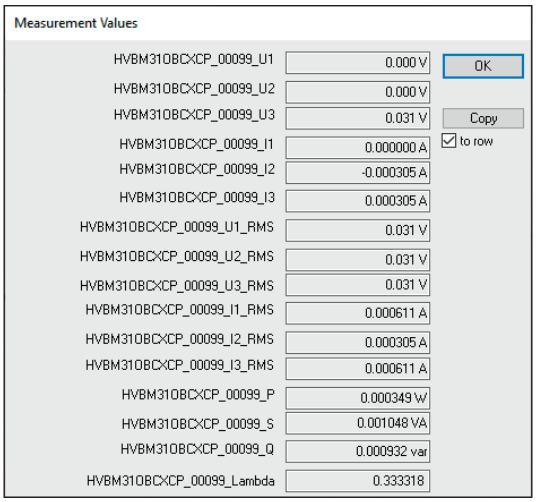


Fig. 5-43: **Measurement Values** window

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

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

5.4.3.9 Saving the measurement configuration

Finally, the configuration can be saved in a DBC/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

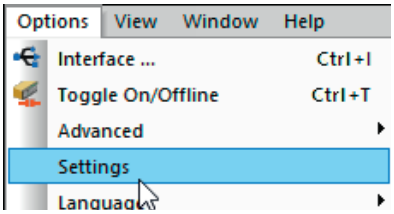


Fig. 5-44: **Options | Settings**

☞ Select **Options | Settings**.

⇨ The **Program Settings** dialog opens.

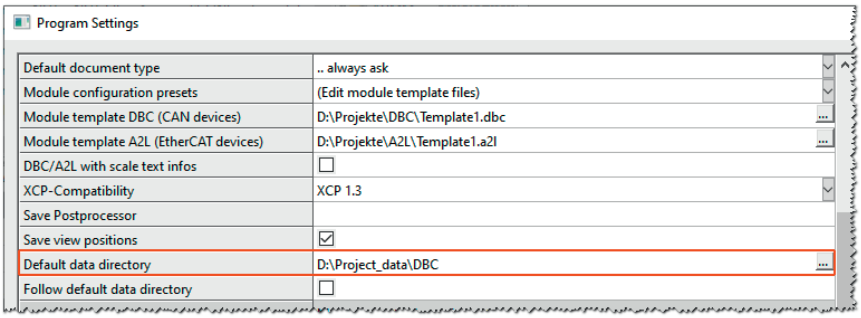


Fig. 5-45: **Program Settings** dialog, option **Default data directory**

☞ 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 the configuration file (A2L/DBC)

☞ Select **File | Save**.

⇨ The **Save As** dialog opens.

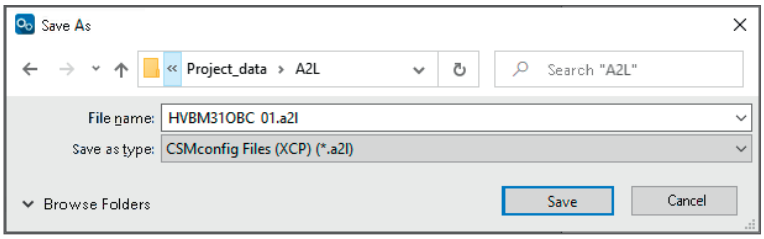


Fig. 5-46: **Save As** dialog

☞ Select the directory, enter the required file name into the field **File name** and confirm by clicking on **Save**.

⇨ The configuration file with the extension *.a2l is stored in the current directory.

⇨ The name of the newly created configuration file appears in the header of the **Tree View** window (here: HVBM31OBC_01.a2l).

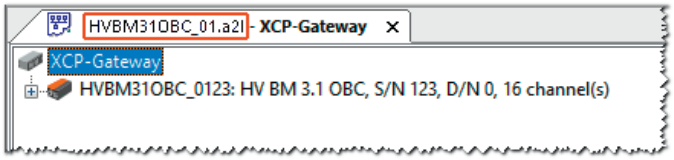
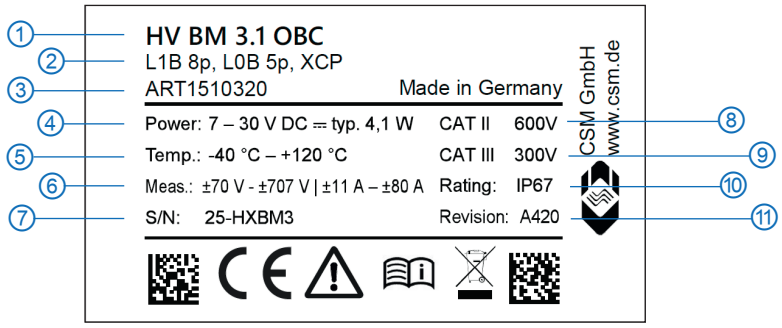


Fig. 5-47: New file name in the header: **HVBM31OBC_01.a2l**

6 Maintenance Services and Cleaning Instructions

6.1 Type label

The type label provides the following technical data:



①	HV BM 3.1 OBC	Device type
②	L1B 8p, L0B 5p, XCP	Device details: ▸ L1B 8p – PC/ECAT sockets: LEMO 1B, 8-pole ▸ L0B 5p - CAN/PWR IN sockets: LEMO 0B, 5-pole ▸ XCP - Bus system
③	ART1510320	Part number of the measurement module
④	Power: 7 – 30 V DC, typ. 4.1 W	Power supply range, typical power consumption
⑤	Temp.: -40 °C – +120 °C	Operating temperature range
⑥	Meas.: ±70 V – ±707 V | ±11 A – ±88 A	Measurement ranges for current and voltage
⑦	S/N: 25-HXBM3	Serial number of the measurement module
⑧	Rating: IP67	Protection class
⑨	Revision: A420	Hardware revision number
⑩	CAT II: 600 V	Measurement category II according to EN 61010-2-030:2020 [24]
⑪	CAT III: 300 V	Measurement category III according to EN 61010-2-030:2020 [24]

Tab. 6-1: Type label

24 See document "Measurement Categories for CSM HV Measurement Modules" for further information.

6.2 Options

The following options are available for the HV BM 3.1 OBC:

- Option "HV BM 3.1 OBC XCPG" This option provides the means to connect CSM ECAT and CAN measurement modules.
- Option "HV BM 3.1 OBC PTP": PTP support
- Option "HV BM 3.1 OBC Calc": optional channels for calculating power and RMS values (P, S, Q; U_{RMS}, I_{RMS}) and Lambda; output via XCP-on-Ethernet and CAN
- Option "HV BM 3.1 OBC PAK": Transfer of measurement configurations (CSMconfig) to the PAK software

6.3 Maintenance services

The following testing certificates are issued for HV BM 3.1 OBC measurement modules:

- Calibration certificates in accordance with DIN EN ISO/IEC 17025 for I and U
- Testing certificate (HV isolation test)

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

Fig. 6-1: DIN EN ISO/IEC 17025 calibration label

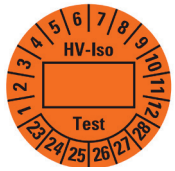


Fig. 6-2: High-voltage isolation test label

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

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

- High-voltage isolation test (incl. functional testing)
- Calibration in accordance with DIN EN ISO/IEC 17025 for I and U (incl. functional testing)
- Repair service

Monitoring of calibration due date[25]

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

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

⇨ The **Program Settings** dialog opens.

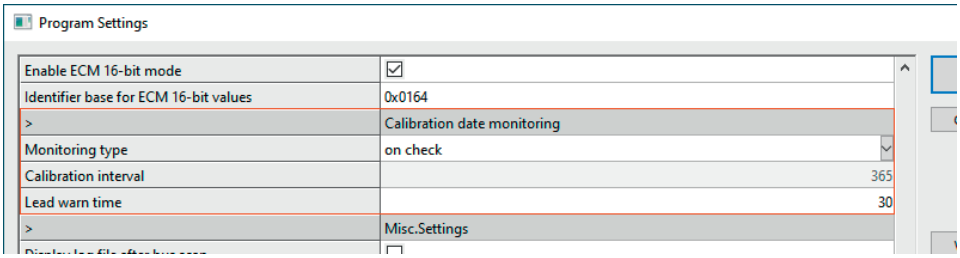


Fig. 6-3: **Program Settings** dialog, section **Calibration date monitoring**

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

→ *CSMconfig Online Help, section "Program Settings"*

6.4 Cleaning instructions

WARNING!	
	HV Breakout Modules of type HV BM 3.1 OBC are used in high-voltage applications. **Improper use poses risks such as life-threatening electrical shocks and fire hazards.** ☞ Observe safety instructions.

NOTE!	
	☞ De-energize the measurement module before starting to work.

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

25 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 a CSM calibration laboratory

7 Appendix

7.1 Option HV BM 3.1 OBC XCPG

7.1.1 Operation without option HV BM 3.1 OBC XCPG

Fig. 7-1 shows the block diagram of an HV BM 3.1 OBC with the standard range of functions, i.e. the option "HV BM 3.1 OBC XCPG" is not enabled. When operated in XCP mode, the HV BM 3.1 OBC sends the measurement data recorded via the measurement electronics ① via XCP ② to the PC socket ④. The XCP-Gateway is displayed in CSMconfig as an interface with the designation "HV BM 3.1 OBC xx.5".

When operated in CAN mode, the measurement data is sent to the CAN socket ⑥ via the CAN bus ③.

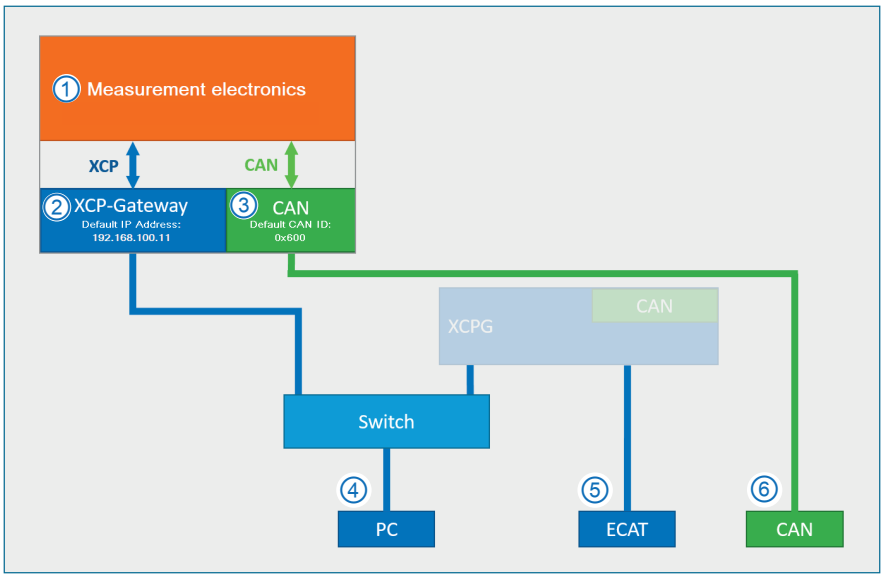


Fig. 7-1: Option "HV BM 3.1 OBC XCPG" not enabled

CSM CAN measurement modules can also be connected to the HV BM 3.1 OBC via the CAN socket ⑥ and integrated into a measurement setup.

If the HV BM 3.1 OBC is operated in CAN mode and a measurement chain with CAN measurement modules is connected, it behaves like any CSM CAN measurement module.

Depending on the mode selected, the configuration data is stored in a DBC file (CAN) or in an A2L file (XCP).

NOTE!	
	The option "HV BM 3.1 OBC XCPG" (chapter 7.1.2) is required to integrate ECAT measurement modules into a measurement setup via the ECAT socket ⑤.

7.1.2 Operation with option HV BM 3.1 OBC XCPG activated

The "HV BM 3.1 OBC XCPG" option is required to be able to use CSM ECAT measurement modules via the HV BM 3.1 OBC.

→ Chapter 6.2 "Options"

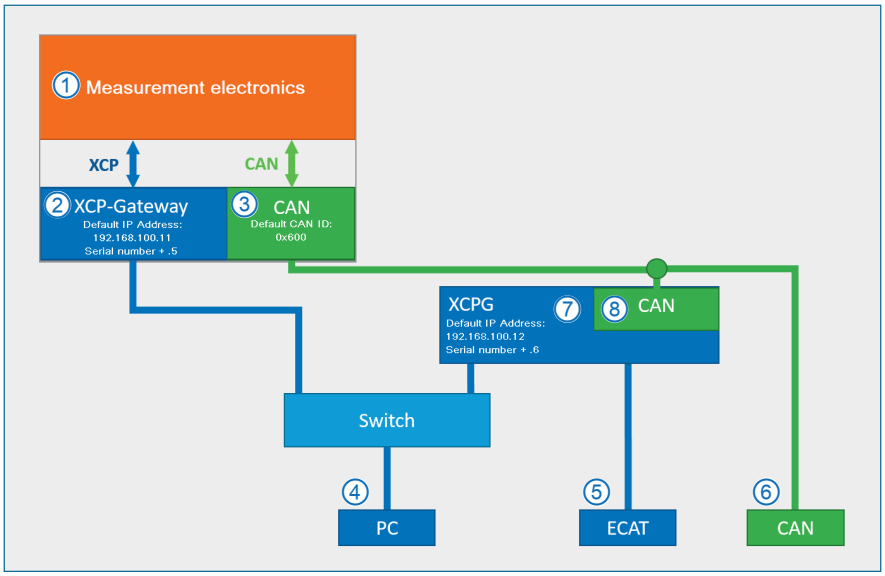


Fig. 7-2: Option "HV BM 3.1 OBC XCPG" activated

If the optional XCP-Gateway "XCPG" ⑦ is activated, CSM ECAT measurement modules can be integrated into a measurement setup via the ECAT socket ⑤. The optional XCP-Gateway is displayed in CSMconfig as an interface with the designation "HV BM 3.1 OBC xx.6". The CAN socket ⑥ will still be used to send your own data to CAN. With the optional XCP-Gateway, these signals are recorded/handled as follows:

- The CAN interface ⑧ of the optional XCP-Gateway ⑦ records the CAN signals ③ sent by the measurement electronics ① of the HV BM 3.1 OBC as well as the signals of the CSM CAN measurement modules connected via the CAN socket ⑥ and sends them to the PC socket ④ via the optional XCP-Gateway ⑦.
- The signals from the connected CSM ECAT measurement modules are captured via the ECAT socket ⑤, converted into XCP-on-Ethernet in the optional XCP-Gateway ⑦ and sent to the PC socket ④.

Eventually, there are two A2L files:

- an A2L file with the measurement signals recorded via the measurement electronics ① of the HV BM 3.1 OBC
- an A2L file with the signals of the CSM ECAT measurement modules connected to the ECAT socket ⑤ and the CAN signals recorded via the CAN interface ⑧ of the optional XCP-Gateway ⑦

Regarding the configuration of the measurement modules in CSMconfig, this means:

- To configure the measurement signals recorded by the measurement electronics of the HV BM 3.1 OBC, select the XCP-Gateway ②.
- To configure the measurement signals of the measurement modules connected to the CAN or the ECAT socket (⑤ or ⑥), select the optional XCP-Gateway "XCPG" ⑦.

→ Chapter 5.4.3.3 "Selecting a communication interface"

7.2 List of figures

7.3 List of tables

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