

HV Breakout Module

Type 1.1



Product description

CSM's **High Voltage Breakout Modules (HV BM) 1.1** have been specifically designed for **single-phase measurement applications** on cables carrying high voltage. They are suited for simultaneous measurement of internal conductor current, voltage and instantaneous power. Also RMS values such as U_{rms} and I_{rms} , active power, apparent power, reactive power and power factor can be calculated.

The two-wire HV power cable is connected inside the **HV BM 1.1** with ring terminals to M8 bolts and cable glands are used for sealing. Typical applications are e.g. measurements between HV battery and inverter.

Voltage is measured directly. The current measurement is done with a built-in shunt module. This module contains, among other things, a temperature sensor and a memory chip for calibration data for automatic online temperature compensation.

The **HV BM 1.1** outputs the measured data with a maximum data rate of up to 1MHz via EtherCAT® interface and simultaneously with a data rate of up to 10kHz via the additional CAN interface. The calculated quantities are optionally available (with the option "Calc." enabled) and are sent with a transmission rate of up to 100Hz. This allows high speed data acquisition simultaneously via Ethernet and data recording via CAN.

Maintenance

- ▶ HV isolation at least every 12 months, see EN 61010 for scope of testing
- ▶ Calibration every 12 months recommended

Key features

- ▶ Single-phase measurement of voltage (U) and current (I) in HV applications, HV-safe enclosure
 - ▶ Nominal voltages up to $\pm 1,000V$ (measurement range up to $\pm 2,000V$)
 - ▶ Currents up to $\pm 250A$ (peak)
- ▶ Output of voltage and current with up to 1MHz measurement data rate
- ▶ Output of RMS values U_{rms} and I_{rms} , active power, apparent power, reactive power and power factor lambda
- ▶ Simultaneous EtherCAT® and CAN bus communication


Scope of delivery


- ▶ HV Breakout Module 1.1
- ▶ Configuration software CSMconfig
- ▶ Documentation
- ▶ Device Description File (*.xml)
- ▶ Calibration certificate for I and U in accordance with DIN EN ISO/IEC 17025
- ▶ HV isolation test protocol

Accessories

- ▶ See "XCP/ECAT Accessories" and "CAN Accessories" datasheets

Technical data

Type designation	HV BM 1.1
	
Technical data valid as of revision	F031
Installation in	two-wire HV power cables for HV+ and HV-
Number of measured phases	1
Number of cable glands	1 per side
Internal conductor cross section	2 × 2.5 mm ² up to 2 × 25 mm ²
Cable outer diameter	9 mm up to 25 mm (depending on the cable gland used) ¹ See "Cable glands" section
Measurement signals	voltage, current and instantaneous power
Measurement ranges	
Voltage	±100, ±200, ±500, ±1,000, ±2,000 V ²
Internal conductor current ¹	four configurable measurement ranges ($I_{\text{meas.}}$) depending on mounted shunt module $I_1 = I_{\text{peak}}, I_2 = I_{\text{rated}}, I_3, I_4$ See "Shunt modules" section
Internal resolution	16 bit
Internal sampling rate	1 MS/s
Power calculation	permanently online with 1 MHz
Measurement data rate/ send rate	
ECAT	1, 2, 5, 10, 20, 50, 100, 200, 500, 1,000 kHz ³
CAN	1, 2, 5, 10, 20, 50, 100, 200, 500 Hz, 1, 2, 5, 10 kHz ⁴
HW input filter	8 th order Bessel low-pass-filter, cutoff frequency approx. 250 kHz
SW filter	
ECAT	<ul style="list-style-type: none"> ▶ Off, only for sending rate of 1,000 kHz
Options for SW filter, adjustable per channel	<ul style="list-style-type: none"> ▶ 6th order Butterworth low-pass-filter, range: 10 Hz to 200 kHz: <ul style="list-style-type: none"> ▶ automatically adjusted on sending rate or ▶ user-selectable cutoff frequency
CAN	<ul style="list-style-type: none"> ▶ Off, only for sending rate of 10 kHz
Options for SW filter, adjustable per channel	<ul style="list-style-type: none"> ▶ 6th order Butterworth low-pass-filter, range: 0.1 Hz to 2 kHz: <ul style="list-style-type: none"> ▶ automatically adjusted based on sending rate or ▶ user-selectable cutoff frequency ▶ Average value per sending interval
Output signals	
ECAT and CAN	voltage, current, instantaneous power, shunt temperature, module temperature
CAN	<p>Optionally calculated quantities:</p> <p>RMS values for voltage and current, active power, apparent power, reactive power and power factor Lambda</p> <p>→ Adjustable integration times 10 ms to 10 s</p>

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Measurement deviation ⁵	
Voltage	
Gain error at 25 °C ⁶	typ. ±0.005 % of measured value max. ±0.05 % of measured value
Offset and scaling error ⁶	typ. ±0.003 % of range max. ±0.02 % of range
Gain drift	max. ±20 ppm/K of measured value
Zero drift	max. ±10 ppm/K of range
Current	online calculation with stored calibration data, with temperature compensation
Gain error at 25 °C ⁶	typ. ±0.03 % of measured value max. ±0.15 % of measured value
Offset and scaling error ⁶	typ. ±0.02 % of range max. ±0.05 % of range
Gain drift	max. ±25 ppm/K of measured value
Zero drift	max. ±15 ppm/K of range
Fields of application ¹	for measurements in HV environments ⁸
Nominal voltages (unipolar & bipolar)	up to ±1,000 V
Routine test	HV isolation test according to EN 61010-1
EtherCAT® interface	Ethernet 100 Base-TX, 100 Mbit/s, EtherCAT® slave controller, synchronization via Distributed Clocks or Sync Manager 3
Configuration	with configuration software CSMconfig via XCP-Gateway or EtherCAT® master software via CANopen over EtherCAT® (CoE), settings and configuration stored in the module
CAN interface	CAN 2.0B (active), High Speed (ISO 11898-2:2016), 125 kbit/s to max. 1 Mbit/s, up to 2 Mbit/s with suitable CSM interface, data transfer "free running"
Configuration	via CAN bus using CSMconfig, settings and configuration stored in the module
LED indicators	
ECAT	Status, Link Activity IN, Link Activity OUT
CAN	Power, Status
Measurement channel	Configuration, Operation

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Measurement categories⁹	
CAT 0	1,000V DC
CAT II	600V
CAT III	300V
Power supply	
Minimum	7V DC (-10 %)
Maximum	30V DC (+10 %)
Power consumption	typ. 2.5 W
Housing	aluminum with HV designation (RAL 2003)
Protection class ¹⁰	IP67
Ground connection	M8 threaded hole
Weight (device)	approx. 1,200 g (incl. shunt module, without cable glands)
Dimensions (w × h × d)	approx. 200 × 45 × 120 mm (without cable glands)
Connectors	
EtherCAT®IN	LEMO 1B, 8-pole, code L
EtherCAT®OUT	LEMO 1B, 8-pole, code A
CAN ¹¹	LEMO 0B, 5-pole, code G
Power HV+/HV- cables	cable glands with shielding taps
Operating and storage conditions	
Operating temperature range	-40 °C to +120 °C
Relative humidity	5 % to 95 % (non-condensing)
Operating altitude	max. 5,000 m above sea level (CAT 0) max. 3,000 m above sea level (CAT II und CAT III)
Pollution degree ¹⁰	4
Storage temperature	-40 °C to +120 °C
Conformity	CE
Device safety	EN 61010-1:2010 + A1:2019 + A1:2019/AC:2019 with EN IEC 61010-2-030:2021 + A11:2021

¹ Cable glands and shunt module are selected separately.

² The measurement ranges of the analog inputs are dimensioned for ±2,000V for acquiring transient overvoltages.

³ All measurement data rates are configurable via XCP-Gateway. When configuring via a standard EtherCAT® master, a maximum measurement data rate of 10 kHz/channel is supported.

⁴ In order to be able to use a measurement data rate of 10 kHz for all measurement signals, a CAN interface with 2 Mbit/s is required.

⁵ The values for current differ depending on the frequency. Further information can be found in the Technical Information document on the subject of "Deviation of Measurement".

⁶ The typical value is based on a statistically relevant number of calibrations. It is defined as the limit value below which 70% of all measured deviations lie.

⁷ Please read the CSM document "Safety Instructions HV Breakout Module"

⁸ According to EN 61010-1:2010 + A1:2019 + A1:2019/AC:2019 with EN IEC 61010-2-030:2021 + A11:2021




⁹ Further information can be found in the Technical Information document "Measurement Categories for CSM HV Measurement Modules".

¹⁰ Only if installed correctly. Please follow the assembly instructions in the installation manual.

¹¹ Optionally available in other variants.

Cable glands

Depending on the cable outer diameters, different cable glands must be adapted to the **HV BM 1.1**. Only suitable combinations (cables + cable glands) ensure the tightness of the housing. The cable glands are selected separately. The following sizes are currently available:

Sizes	9/14	11/20	15/25
			
Cable outer diameter			
D1 maximum	14 mm	20 mm	25 mm
D1 minimum	9 mm	11 mm	15 mm
D2 maximum	12 mm	17 mm	21 mm

Shunt modules

For the **HV BM** CSM offers shunt modules with different measurement ranges. The shunt modules are selected separately and installed permanently. The maximum operating time depends, among other things, on the ambient temperature and the resulting power loss in the measurement module. Under certain circumstances, the rated current cannot be applied permanently without the shunt module overheating. Its temperature must not exceed +120 °C.

Rated current I_{rated} [A]	±50	±125
Peak current I_{peak} [A]	±100	±250
Measurement ranges I_1, I_2, I_3, I_4 [A]	±100, ±50, ±25, ±10	±250, ±125, ±50, ±25
Resolution at I_{peak} [mA/digit]	3	7
Resistance [$\mu\Omega$]	500	200



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