



# HV Breakout Module

## Type 1.1 | 1.2



### Product description

CSM's HV Breakout Modules (BM) Type 1.1 and 1.2 have been specifically designed for **single-phase measurement applications** on cables carrying high voltage. They are suited for power, current and voltage evaluation of DC and high speed AC.

The HV BM is to be inserted into the HV power cables (HV+/HV-) by feeding the cables through PG cable glands into the module and connecting them there. Typical applications are for example measurements between inverter and electric motor.

Voltage is measured directly. Current measurement is performed by a shunt module. This module contains a differential amplifier, a temperature sensor and a memory chip for calibration data for automatic online temperature compensation.

The HV BM outputs the measured data with a maximum data rate of up to 1 MHz via EtherCAT® interface and simultaneously with a data rate of up to 10 kHz via the additional CAN interface. This allows high speed data acquisition via Ethernet and data recording via CAN data logger at the same time.

### Maintenance

- ▶ HV isolation test according to EN 61010 at least every 12 months
- ▶ Calibration every 12 months recommended

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### Key features



- ▶ **Single-phase measurement of voltage (U) and current (I) in HV applications**
- ▶ Voltages up to  $\pm 1,000$  V (measurement range up to  $\pm 2,000$  V)
- ▶ Currents up to  $\pm 1,400$  A (peak)
- ▶ Online power calculation with 1 MHz data rate calculation, 100 % synchronous
- ▶ Simultaneous EtherCAT® and CAN bus communication
- ▶ Output of voltage, current and power with up to 1 MHz measurement data rate

### Shipping content

- ▶ HV Breakout Module 1.1 | 1.2
- ▶ Configuration software CSMconfig
- ▶ Documentation
- ▶ Device Description File (\*.xml)
- ▶ Test report
- ▶ HV isolation test protocol

### Accessories


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

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## Technical data

Type designation	HV BM 1.1	HV BM 1.2
<b>Inputs</b>	HV power cables for HV+ and HV-	
Number of measured phases	1	
Number of PG cable glands	1 (per side)	2 (per side)
Cable outer diameter	from 9 mm up to 25 mm (depending on the PG cable gland used) <sup>1)</sup> ▶ see "PG cable glands" section	
<b>Measurement signals</b>	<b>voltage, current and power</b>	
Measurement ranges		
Voltage	±100, ±200, ±500, ±1,000 V (extended ±2,000 V) <sup>2)</sup>	
Current <sup>1)</sup>	four configurable measurement ranges ( $I_{meas.}$ ) depending on mounted shunt module $I_1 = I_{peak}, I_2 = I_{rated}, I_3, I_4$ ▶ see "Shunt modules" section	
Power	results from the product of the configured measurement ranges $P_{meas.} = U \times I_{meas.}$ $P_{meas.}, P_{meas.}/2, P_{meas.}/4, P_{meas.}/8$	
Internal resolution	16 bit	
Internal sampling rate	1 MHz	
Power calculation	permanently online with 1 MHz	
Measurement data rate		
ECAT	1, 2, 5, 10, 20, 50, 100, 200, 500, 1,000 kHz <sup>3)</sup>	
CAN	1, 2, 5, 10, 20, 50, 100, 200, 500 Hz, 1, 2, 5, 10 kHz <sup>4)</sup>	
HW input filter	8th order Butterworth filter, threshold frequency approx. 360 kHz	
SW input filter	switchable 6th order Butterworth filter, threshold frequency automatically adjusted to measurement data rate, alternatively individually adjustable for voltage, current and power	
ECAT	threshold frequency up to 300 kHz	
CAN	threshold frequency up to 2 kHz, additional average value filter	
<b>Measurement uncertainty</b>		
Voltage		
Gain error at 25 °C	max. ±0.05 % of measured value	
Offset and scaling error	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	max. ±0.15 % of measured value	
Offset and scaling error	max. ±0.05 % of range	
Gain drift	max. ±25 ppm/K of measured value	
Zero drift	max. ±15 ppm/K of range	

Type designation	HV BM 1.1	HV BM 1.2
<b>Fields of application</b> <sup>5)</sup>	for measurements in HV environments <sup>6)</sup> For details see co-applicable document: “Technical Information: Fields of Application for CSM HV Measurement Modules”.	
Measurement voltages (unipolar & bipolar)	up to 1,000 V peak	
<b>Routine test</b> <sup>5)</sup>	test voltage <sup>6)</sup> 3,100 V DC, isolation test is to be performed at least every 12 months	
<b>EtherCAT® interface</b>	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 configurations stored in the device	
<b>CAN interface</b>	CAN 2.0B (active), High Speed (ISO 11898-2:2016), 125 kBit/s to max. 1 MBit/s, up to 2 MBit/s with CSMcan Interface, data transfer free running	
Configuration	via CAN bus using CSMconfig, settings and configurations stored in the module	
<b>Power supply</b>		
Minimum	7 V DC (-10 %)	
Maximum	30 V DC (+10 %)	
Power consumption	typ. 2.6 W <sup>7)</sup>	
<b>LED indicators</b>		
ECAT	Status / Link Activity IN / Link Activity OUT	
CAN	Power / Status	
Measurement channel	configuration / operation	
<b>Housing</b>	aluminum with HV designation (RAL 2003)	
Protection class	IP67 <sup>8)</sup>	
Ground connection	M6 threaded hole	
Weight	approx. 1,200 g	approx. 1,400 g
	incl. shunt module, without PG cable glands	
Dimensions (w × h × d)	approx. 200 × 45 × 100 mm	approx. 200 × 45 × 135 mm
	without PG cable glands	
<b>Connectors</b>		
EtherCAT® IN	LEMO 1B, 8-pole, code L	
EtherCAT® OUT	LEMO 1B, 8-pole, code A	
CAN <sup>9)</sup>	LEMO 0B, 5-pole, code G	
Power HV+ / HV- cables	PG cable glands with shielding taps	
<b>Operating and storage conditions</b>		
Operating temperature range	-40 °C to +100 °C	
Relative humidity	5 % to 95 % (non-condensing)	

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Operating altitude	max. 5,000 m above sea level	
Pollution degree	4 <sup>8)</sup>	
Storage temperature	-40 °C to +100 °C	
Conformity	 (in preparation)	
Device safety	EN 61010-1:2010	

<sup>1</sup> PG cable glands and shunt module are selected separately and already mounted.

<sup>2</sup> The measurement ranges of the analog inputs are dimensioned for  $\pm 2,000$  V for acquiring transient overvoltages.

<sup>3</sup> 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.

<sup>4</sup> 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.

<sup>5</sup> Please read the CSM document "Safety Instructions HV Breakout Module"!

<sup>6</sup> According to EN 61010-1:2010

<sup>7</sup> The specified power consumption is valid as of hardware revision A031. For older hardware revisions the following applies: typ. 2.9 W.

<sup>8</sup> Only if installed correctly, please follow the assembly instructions in the installation manual.

<sup>9</sup> Optionally available in other variants.

## PG cable glands

Depending on the cable outer diameters, different PG cable glands must be adapted to the **HV BM**. Only suitable combinations (cables + PG cable glands) ensure the tightness of the housing. The PG cable glands are selected separately, included in the shipping content and already mounted. The following types are currently available:

Type	9/14	11/20	15/25
Cable outer diameter			
Minimum	9 mm	11 mm	15 mm
Maximum	14 mm	20 mm	25 mm
Part number	ART1520202	ART1520201	ART1520200

## Shunt modules

For the **HV BM**, CSM offers shunt modules with different measurement ranges. The shunt modules are selected separately and installed permanently. The largest two shunt modules (with a rated current of  $\pm 500$  A and  $\pm 800$  A) can only be used with the HV BM 1.2. 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]	$\pm 50$	$\pm 125$	$\pm 250$	$\pm 500$	$\pm 800$
Peak current $I_{peak}$ [A]	$\pm 100$	$\pm 250$	$\pm 500$	$\pm 1,000$	$\pm 1,400$
Measurement ranges $I_1, I_2, I_3, I_4$ [A]	$\pm 100, \pm 50,$ $\pm 25, \pm 10$	$\pm 250, \pm 125,$ $\pm 50, \pm 25$	$\pm 500, \pm 250,$ $\pm 125, \pm 50$	$\pm 1,000, \pm 500,$ $\pm 250, \pm 125$	$\pm 1,400, \pm 800,$ $\pm 500, \pm 250$
Resolution at $I_{peak}$ [mA/digit]	3	7	15	30	43
Resistance [ $\mu\Omega$ ]	500	200	100	50	35

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May 06, 2019