



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

Innovative Measurement and Data Technology

Technical data

| Type designation | HV BM 1.1 | HV BM 1.2 |
|--------------------------------|---|---|
| |  |  |
| Inputs | 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) ¹⁾ ▶ see "PG cable glands" section | |
| Measurement signals | voltage, current and power | |
| Measurement ranges | | |
| Voltage | ±100, ±200, ±500, ±1,000 V (extended ±2,000 V) ²⁾ | |
| 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 | |
| Power | results from the product of the configured measurement ranges $P_{\text{meas.}} = U \times I_{\text{meas.}}$ $P_{\text{meas.}}, P_{\text{meas.}}/2, P_{\text{meas.}}/4, P_{\text{meas.}}/8$ | |
| 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 ³⁾ | |
| CAN | 1, 2, 5, 10, 20, 50, 100, 200, 500 Hz, 1, 2, 5, 10 kHz ⁴⁾ | |
| 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 | |
| Measurement uncertainty | | |
| 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 | |
| Measurement error | max. ±0.2 % of measured value | |
| Temperature drift | max. ±10 ppm/K of measured value | |

| Type designation | HV BM 1.1 | HV BM 1.2 |
|--|--|---------------------------|
| Fields of application ⁵⁾ | for measurements in HV environments ⁶⁾ 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 | |
| Routine test ⁵⁾ | test voltage ⁶⁾ 3,100 V DC, isolation test is to be performed at least every 12 months | |
| 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 configurations stored in the device | |
| 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 CSMcan Interface, data transfer free running | |
| Configuration | via CAN bus using CSMconfig, settings and configurations stored in the module | |
| Power supply | | |
| Minimum | 7 V DC (-10 %) | |
| Maximum | 30 V DC (+10 %) | |
| Power consumption | typ. 2.6 W ⁷⁾ | |
| LED indicators | | |
| ECAT | Status / Link Activity IN / Link Activity OUT | |
| CAN | Power / Status | |
| Measurement channel | configuration / operation | |
| Housing | aluminium with HV designation (RAL 2003) | |
| Protection class | IP67 ⁸⁾ | |
| 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 | |
| Connectors | | |
| EtherCAT® IN | LEMO 1B, 8-pole, code L | |
| EtherCAT® OUT | LEMO 1B, 8-pole, code A | |
| CAN ⁹⁾ | LEMO 0B, 5-pole, code G | |
| Power HV+ / HV- cables | PG cable glands with shielding taps | |
| Operating and storage conditions | | |
| Operating temperature range | -40 °C to +100 °C | |
| Relative humidity | 5 % to 95 % (non-condensing) | |
| Operating altitude | max. 5,000 m above sea level | |
| Pollution degree | 4 ⁸⁾ | |
| Storage temperature | -40 °C to +100 °C | |

| | | |
|------------------|--|-----------|
| Type designation | HV BM 1.1 | HV BM 1.2 |
| Conformity |  (in preparation) | |
| Device safety | EN 61010-1:2010 | |

¹ PG cable glands and shunt module are selected separately and already mounted.

² The measurement ranges of the analog inputs are dimensioned for $\pm 2,000$ V 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 Please read the CSM document "Safety Instructions HV Breakout Module"!

⁶ According to EN 61010-1:2010

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

⁸ Only if installed correctly, please follow the assembly instructions in the installation manual.

⁹ 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 ± 500 A and ± 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] | ± 50 | ± 125 | ± 250 | ± 500 | ± 800 |
|---|-----------------------------------|------------------------------------|-------------------------------------|--|--|
| Peak current I_{peak} [A] | ± 100 | ± 250 | ± 500 | $\pm 1,000$ | $\pm 1,400$ |
| Measurement ranges I_1, I_2, I_3, I_4 [A] | $\pm 100, \pm 50, \pm 25, \pm 10$ | $\pm 250, \pm 100, \pm 50, \pm 25$ | $\pm 500, \pm 250, \pm 100, \pm 50$ | $\pm 1,000, \pm 500, \pm 250, \pm 100$ | $\pm 1,400, \pm 800, \pm 500, \pm 250$ |
| Resolution at I_{peak} [mA/digit] | 3 | 7 | 15 | 30 | 43 |
| Resistance [$\mu\Omega$] | 500 | 200 | 100 | 50 | 35 |

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