

# HV BM Split Modules



## Product Description

The **HV BM Split Modules** are designed for measurements on HV voltage carrying cables under confined space conditions, such as for measurements between HV battery and inverter. This system consists of two separate units, the shunt module **HV Split Breakout Module (HV SBM)** and the measurement module **HV Split Acquisition Module (HV SAM)**. This takes into account the limited space available at the measuring point and allows the flexible arrangement of the measurement components for precise, HV-safe acquisition of current and voltage.

The **HV BM Split Modules** are designed for simultaneous acquisition of current and voltage, from DC to high-speed AC. The HV SBMs integrated in housings are available either with cable glands or with an HV plug-in system. In the first case, the shunt module is inserted into the HV power cable for tapping the HV- or HV+ potential. For this purpose, the HV power cables are fed through cable glands into the module housing and connected to the shunt with ring terminals.

As for the version with the HV plug-in system, the HV power cable can be simply plugged in. The open variant without housing is equipped with M8 bores to connect the HV power cables or to integrate the shunt module into the busbar.

The voltage is measured directly in the HV SAM. The current is measured in the HV SBM, which includes a temperature

## Key features



- ▶ **Easy mounting in confined spaces thanks to very compact sizes and separation of tap and measurement module.**
- ▶ **Single-phase voltage (U) and current (I) measurements in HV applications, HV-safe insulated for:**
  - ▶ **rated voltages up to  $\pm 1,000$  V (measurement range up to  $\pm 2,000$  V)**
  - ▶ **currents up to  $\pm 2,000$  A (peak)**
- ▶ **Output of voltage and current with measurement data rates up to 1 MHz**
- ▶ **Output of the RMS values  $U_{eff}$  and  $I_{eff}$ , active power, apparent power, reactive power and power factor  $\Lambda$**
- ▶ **Simultaneous EtherCAT® and CAN bus communication**

sensor and a calibration data memory for automatic online temperature compensation.

The measured data is output at a data rate of up to 1 MHz via the EtherCAT® interface and simultaneously at a data rate of up to 10 kHz using the additional CAN interface. This allows fast data acquisition via Ethernet while simultaneously recording the data via CAN.

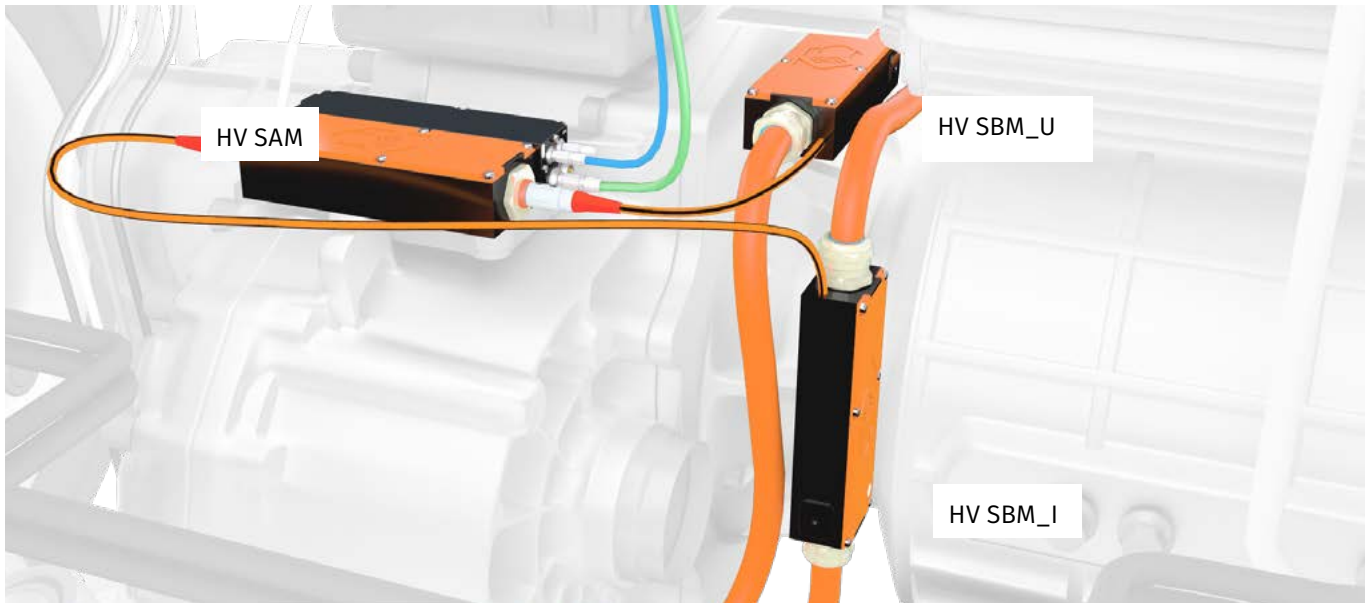


Fig. 1-1: Modular mounting of the measurement technology components

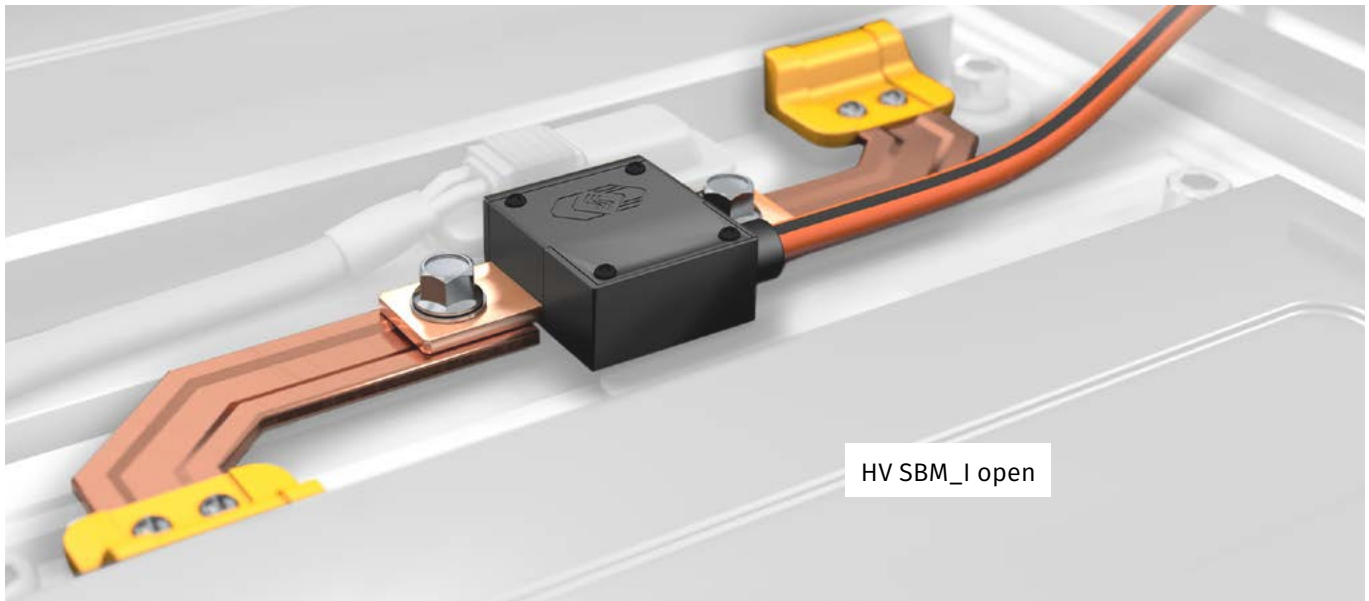


Fig. 1-2: Integration of an HV SBM\_I open into a busbar

## Maintenance

- ▶ HV isolation test according to EN 61010 at least every 12 months, see EN 61010 for scope of test
- ▶ Calibration every 12 months recommended
- ▶ HV SAM and HV SBM\_I have to be jointly calibrated

## Shipping content

- ▶ HV BM Split Modules (HV Split Breakout Module or HV Split Acquisition Module)
- ▶ Configuration software CSMconfig
- ▶ Documentation
- ▶ Device Description File (\*.xml)
- ▶ Calibration certificate in accordance with DIN EN ISO/IEC 17025 (I), calibration certificate (U)
- ▶ Test protocols for HV insulation test


## Accessories


- ▶ See data sheets "ECAT Accessories" and "CAN Accessories"



## Technical data

### HV Split Acquisition Module (HV SAM)

The **HV SAM** is a measurement module and provides two inputs, one for current and one for voltage. By separating the tapping from the measurement module, the latter no longer has to be integrated directly at the point of measurement.

<b>Type designation</b>	HV SAM
	
<b>Inputs</b>	2 analog inputs (voltage, current)
Measurement ranges	
Voltage	$\pm 100, \pm 200, \pm 500, \pm 1,000\text{V}, \pm 2,000\text{V}^1$
Current <sup>2</sup>	four adjustable measurement ranges ( $I_{\text{Meas}}$ ) depending on the shunt installed $I_1 = I_{\text{Peak}}, I_2 = I_{\text{Rated}}, I_3, I_4$ <a href="#">See section ""HV Split Breakout Modules (HV SBM)""</a>
Internal resolution	16 bit
Internal sampling rate	1MS/s
Measurement data rate/ send 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 Bessel filter, threshold frequency approx. 250 kHz
SW input filter	Switchable 6th order Butterworth filter, Threshold frequency automatically adjusted to the measurement data rate, Can also be specified individually for voltage, current and power: Threshold frequency up to 200 kHz (ECAT) Output rate of up to 2 kHz, additional average value filter
<b>Output signals</b>	
ECAT	Voltage, current, instantaneous power
CAN	Voltage, current, RMS values for voltage and current, active power, apparent power and reactive power, power factor
Integration time f. RMS values and power calculation	10ms to 10s
<b>Field of application<sup>5</sup></b>	For measurements in HV environments <sup>6</sup> For details, please refer to the applicable document: "Technical Information: Fields of application for CSM High-Voltage Measurement Modules".
Nominal voltage (unipolar & bipolar)	up to 1,000V DC
<b>Routine test<sup>7</sup></b>	An isolation test <sup>8</sup> has to be performed at least once every 12 months.

<b>Type designation</b>	HV SAM
	
<b>EtherCAT® interface</b>	Ethernet 100 Base-TX, 100 Mbit/s EtherCAT® slave controller, synchronization via Distributed Clocks or Sync Manager 3
Configuration	with CSMconfig via XCP-Gateway or EtherCAT® master software via CANopen over EtherCAT® (CoE), settings and configurations stored in the device
<b>CAN interfaces</b>	CAN 2.0B (active), High Speed (ISO 11898-2:2016), 125 Kbit/s to 1 Mbit/s, up to 2 Mbit/s with CSMcan interface, data transfer free running
Configuration	via CAN bus with CSMconfig, settings and configuration data stored in the device
<b>LED indicators</b>	
ECAT	Status, Link Activity IN, Link Activity OUT
CAN	Power, status
Measurement channel	Configuration, operation
<b>Measurement categories<sup>7</sup></b>	
CAT 0	1,000 V
CAT II	600 V
CAT III	300 V
<b>Power supply</b>	
Minimum	7 V DC (-10 %)
Maximum	30 V DC (+10 %)
Power consumption	typ. 2.5 W
<b>Housing</b>	aluminum with HV designation (RAL2003)
Protection class	IP67
Ground connection	M8 threaded hole
Weight	approx. 1,200 g
Dimensions (W × H × D)	approx. 200 × 45 × 120 mm
<b>Connectors</b>	
EtherCAT®IN	LEMO 1B, 8-pole, code L
EtherCAT®OUT	LEMO 1B, 8-pole, code A
CAN <sup>8</sup>	LEMO 0B, 5-pole, code G
Signal input 1 (HV SBM_I)	LEMO Redel 2P, 8-pole, code E
Signal input 2 (HV SBM_U/K912)	LEMO Redel 2P, 8-pole, code D

<b>Type designation</b>	HV SAM
	
<b>Operating and storage conditions</b>	
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 and CAT III)
Pollution degree	4
Storage temperature	-40 °C to +120 °C
<b>Conformity</b>	
<b>Safety</b>	EN 61010-1:2020 EN 61010-2-030:2010
<b>Part number</b>	ART1513010

<sup>1</sup> For the measurement of transient overvoltages, the measurement range has been dimensioned to  $\pm 2,000\text{V}$ .

<sup>2</sup> The HV SBM is selected separately, as are the cable glands.

<sup>3</sup> All measurement data rates can be configured via the XCP-Gateway. A standard EtherCAT® master supports a maximum measurement data rate of 10 kHz/channel.

<sup>4</sup> A CAN interface with 2MBit/s is required to be able to use a measurement data rate of 10 kHz for all measurement signals.

<sup>5</sup> In addition, be sure to observe CSM document "Safety Instructions Split Breakout Module | PG Series"!

<sup>6</sup> According to EN 61010-1:2020 with EN 61010-2-030:2010

<sup>7</sup> For further information, please refer to the Technical Information "Measurement Categories for CSM HV Measurement Modules".

<sup>8</sup> Optionally available in other variants.

## HV Split Breakout Modules (HV SBM)

The **HV SBM** are used for tapping the current and the potentials HV+ and HV-. These signals are measured directly and transmitted to the HV SAM using shielded cables. The housing versions of the HV SBM are available with cable gland and connection via ring terminals as well as with a PL500 plug-in system. For measurement in busbars there is an open version which is more compact and allows direct connection via M8 bores.

### HV SBM with housing

Type designation	HV SBM_I	HV SBM_U
		
<b>Inputs</b>	HV- power cable	HV+ power cable
	When connecting the HV power cables to the HV SBM, be sure to observe the document "Safety Instructions HV Split Breakout Module" valid for the corresponding module version.	
Number of measured phases	1	
Number of cable glands	1 (on each side)	
Cable cross sections	16 mm <sup>2</sup> to 95 mm <sup>2</sup>	
Outer cable diameter	9 mm to 25 mm (depending on the cable gland used) <i>See section "Cable glands"</i>	
<b>Connectors</b>		
Connecting cable to HV SAM	2 m HV measurement cable with LEMO REDEL 2P, 8-pole, code E	2 m HV measurement cable with LEMO REDEL 2P, 8-pole, code D
HV+/HV- power cable <sup>1</sup>	Current and HV- potential tap	HV+ potential tap
	Connection via ring terminals and cable glands with adapter for shielding <sup>2</sup>	
Ground connection	M8 threaded hole	
<b>Housing</b>	aluminum with HV designation (RAL2003)	
Protection class	IP67 <sup>3</sup>	
Weight	approx. 870 g	approx. 780 g
Dimensions (W × H × D)	approx. 200 × 46 × 55 mm (w/o cable glands) approx. 264 × 46 × 55 mm (with cable glands)	
<b>Measurement categories<sup>4</sup></b>		
CAT 0	1,000 V	
CAT II	600 V	
CAT III	300 V	
<b>Operating and storage conditions</b>		
Operating temperature range	-40 °C to +120 °C	
Relative humidity	5 % to 95 % (non-condensing)	
Operating Altitude	max. 5,000 m above sea level max. 3,000 m above sea level (CAT II and CAT III)	
Pollution degree	4 <sup>3</sup>	
Storage temperature	-40 °C to +120 °C	

<b>Type designation</b>	HV SBM_I	HV SBM_U
		
<b>Conformity</b>	<b>CE</b> (in preparation)	
<b>Safety</b>	EN 61010-1:2020 EN 61010-2-030:2020	
<b>Part number</b>	ART1523200	ART1523110




<sup>1</sup> The cable glands are to be selected separately.

<sup>2</sup> Version with plug-in connector available on request.

<sup>3</sup> Correct installation provided! Be sure to observe the mounting instructions in the installation manual.

<sup>4</sup> For further information, please refer to the Technical Information "Measurement Categories for CSM HV Measurement Modules".

## HV SBM open

<b>Type designation</b>	HV SBM_I open <sup>1</sup>		K912
			
<b>Inputs</b>	HV- power cable		HV+ power cable
	When connecting the HV power cables to the HV SBM, be sure to observe the document "Safety Instructions HV Split Breakout Module" valid for the corresponding module version.		
Number of measured phases	1		
<b>Connection</b>			
Connecting cable to HV SAM	2 m HV measurement cable with LEMO Redel 2P, 8-pole, code E	HV measurement cable with LEMO Redel 2P, 8-pole, code D	
HV+/HV- power cable	Connection via M8 bores using ring terminals		Connection via open cable end
Weight	approx. 190 g		155 g (2 m cable)
Dimensions	① 84 × 20 × 3 mm ② 39 × 41 × 19 mm (W × H × D)		2 m or 3 m available
<b>Measurement categories<sup>2</sup></b>			
CAT 0	1,000 V		
CAT II	600 V		
CAT III	300 V		
<b>Operating and storage conditions</b>			
Operating temperature range	-40 °C to +120 °C	-40 °C to +125 °C	
Relative humidity	5 % to 95 % (non-condensing)		
Operating Altitude	max. 5,000 m above sea level (CAT 0) max. 3,000m above sea level (CAT II and CAT III)		
Pollution degree	2		
Storage temperature	-40 °C to +120 °C	-40 °C to +125 °C	
<b>Conformity</b>	CE (in preparation)		
<b>Safety</b>	EN 61010-1:2020 EN 61010-2-030:2020		
<b>Part number</b>	ART152300x (x depends on measurement range)	ART1423703 (2 m) ART1423704 (3 m)	

<sup>1</sup> CSM provides HV SBM\_I shunts with various measurement ranges. See section "Shunts" for further information.

<sup>2</sup> For further information, please refer to the Technical Information "Measurement Categories for CSM HV Measurement Modules".



## Error of measurement<sup>1</sup>

The data (current) in the table below is valid for joint calibration of HV SAM and HV SBM.

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 adjustment 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

## Cable glands

Depending on the outer cable diameter, different types of cable glands have to be used for the HV SBM. The tightness of the housing can only be maintained with suitable combinations of cables and cable glands. The cable glands are selected separately. The following types are currently available:

Type	9/14	11/20	15/25
			
Outer cable diameter			
D <sub>1</sub> max.	14 mm	20 mm	25 mm
D <sub>1</sub> min.	9 mm	11 mm	15 mm
D <sub>2</sub> max.	12 mm	17 mm	21 mm

## Shunts

CSM offers shunts with variety measurement ranges. For the **HV SBM** in housing, these shunts are selected separately and will be permanently installed in the module housing. **HV SBM\_I open** are available with the various measurement ranges as ready potted units equipped with measurement cable. The maximum operating time depends, among other things, on the ambient temperature and the resulting power loss in the HV SBM. This means that the rated current may not be applied continuously without causing the HV SBM to overheat. The temperature must not exceed +120 °C.

Nominal current I <sub>Rated</sub> [A]	±50	±125	±250	±500	±1,000
Peak current I <sub>Peak</sub> [A]	±100	±250	±500	±1,000	±2,000
Measurement range I <sub>1</sub> , I <sub>2</sub> , I <sub>3</sub> , I <sub>4</sub> [A]	±100, ±50, ±25, ±10	±250, ±125, ±50, ±25	±500, ±250, ±125, ±50	±1,000, ±500, ±250, ±125	±2,000, 1,000, ±500, ±250
Resolution at I <sub>Peak</sub> [mA/Digit]	3	7	15	30	60
Measurement resistor [μΩ]	500	200	100	50	35

<sup>1</sup> For further information, please refer to the Technical Information on "Error of measurement"



**CSM GmbH Headquarters** (Germany)

Raiffeisenstrasse 36 • 70794 Filderstadt • Germany  
☎ +49 711-77 96 40 ✉ sales@csm.de

**CSM Office Southern Europe** (France, Italy)

Site d'Archamps  
178, rue des Frères Lumière • Immeuble Alliance – Entrée A  
74160 Archamps France  
☎ +33 450-95 86 44 ✉ info@csm-produits.fr

**CSM Products, Inc. USA** (USA, Canada, Mexico)

1920 Opdyke Court, Suite 200 • Auburn Hills, MI 48326  
☎ +1 248 836-4995 ✉ sales@csmproductsinc.com

**CSM** (RoW)

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