



HV Current and voltage measurement in confined spaces

CSM Web Seminars



CSM **Xplained**
measurement technology

Innovative Measurement and Data Technology

HV current, voltage and power measurement

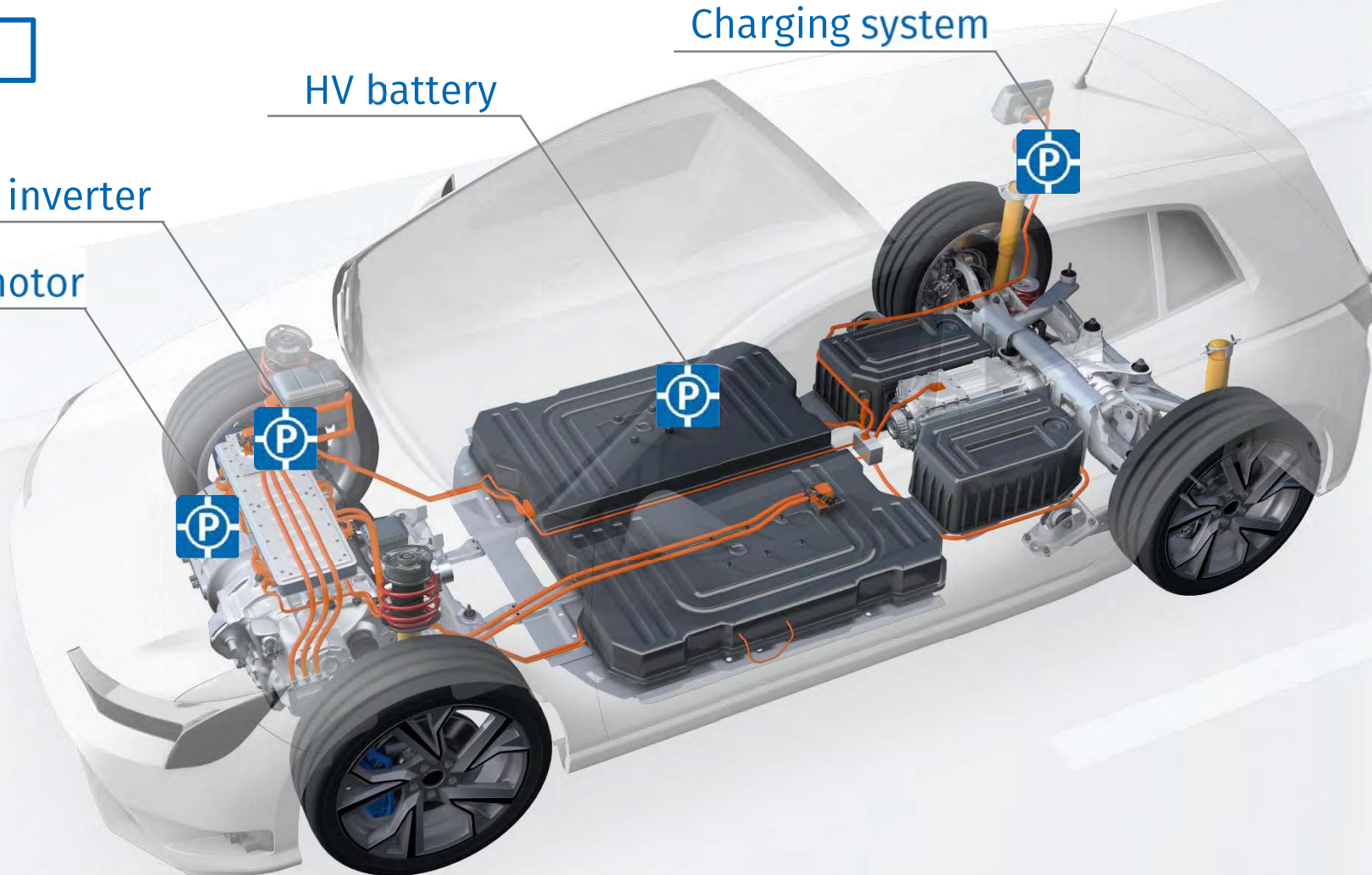
Powertrain

Charging system

HV battery

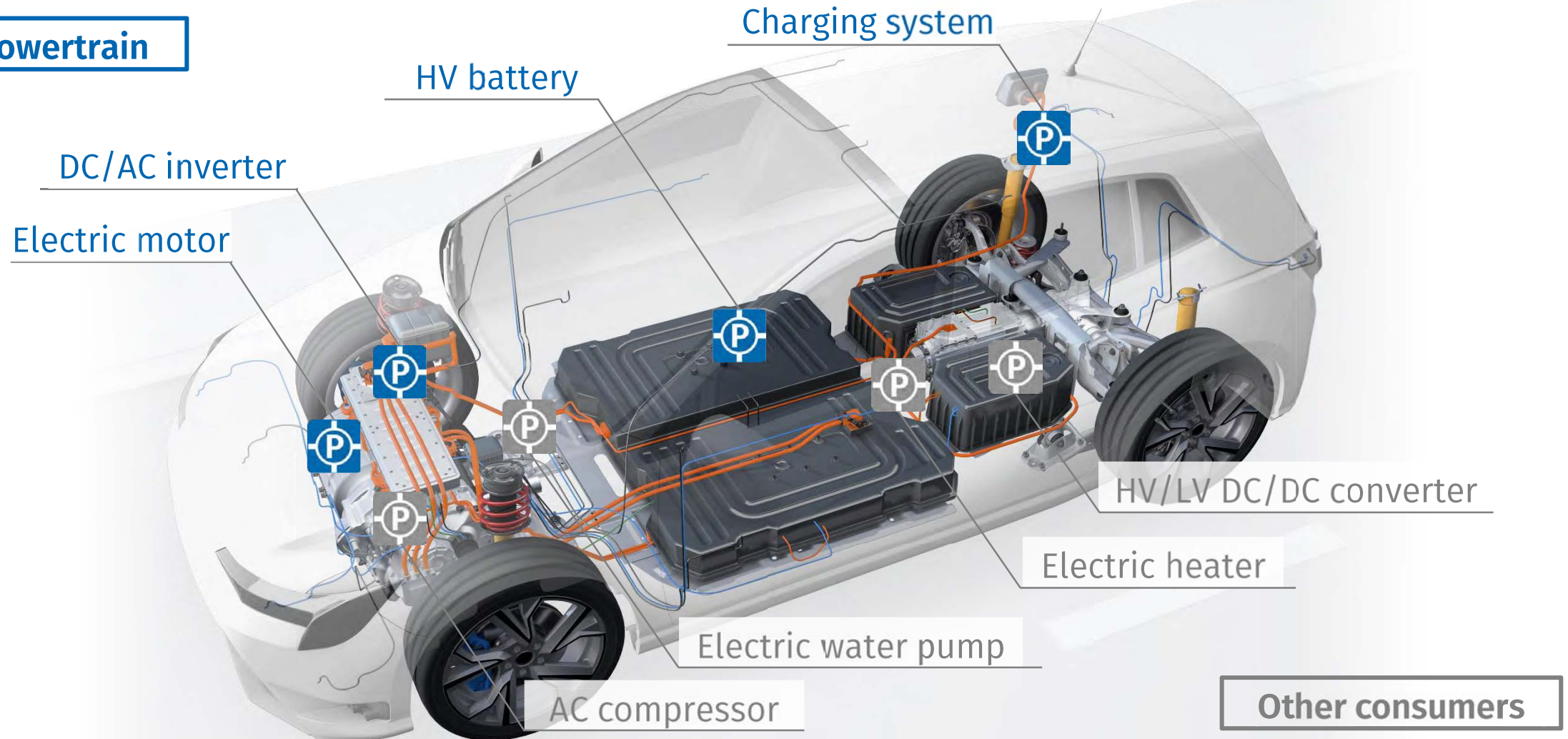
DC/AC inverter

Electric motor



HV current, voltage and power measurement

Powertrain

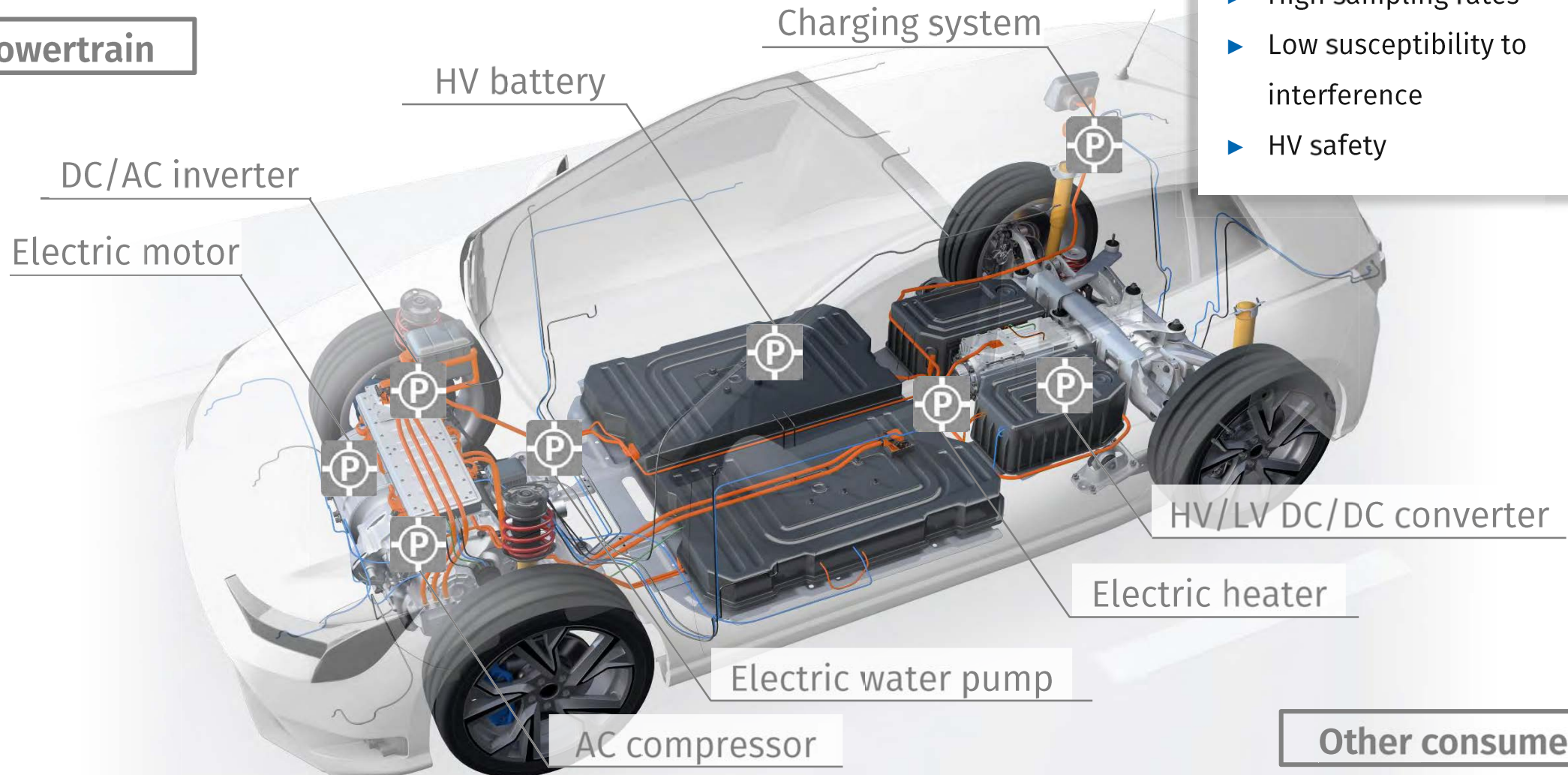


HV current, voltage and power measurement

For precise analyses

- ▶ High sampling rates
- ▶ Low susceptibility to interference
- ▶ HV safety

Powertrain



Other consumers

HV current, voltage and power measurement

For precise analyses

- ▶ High sampling rates
- ▶ Low susceptibility to interference
- ▶ HV safety

Depending on the application,
different amounts of installation space
are available for the required measurement technology.

Installation space

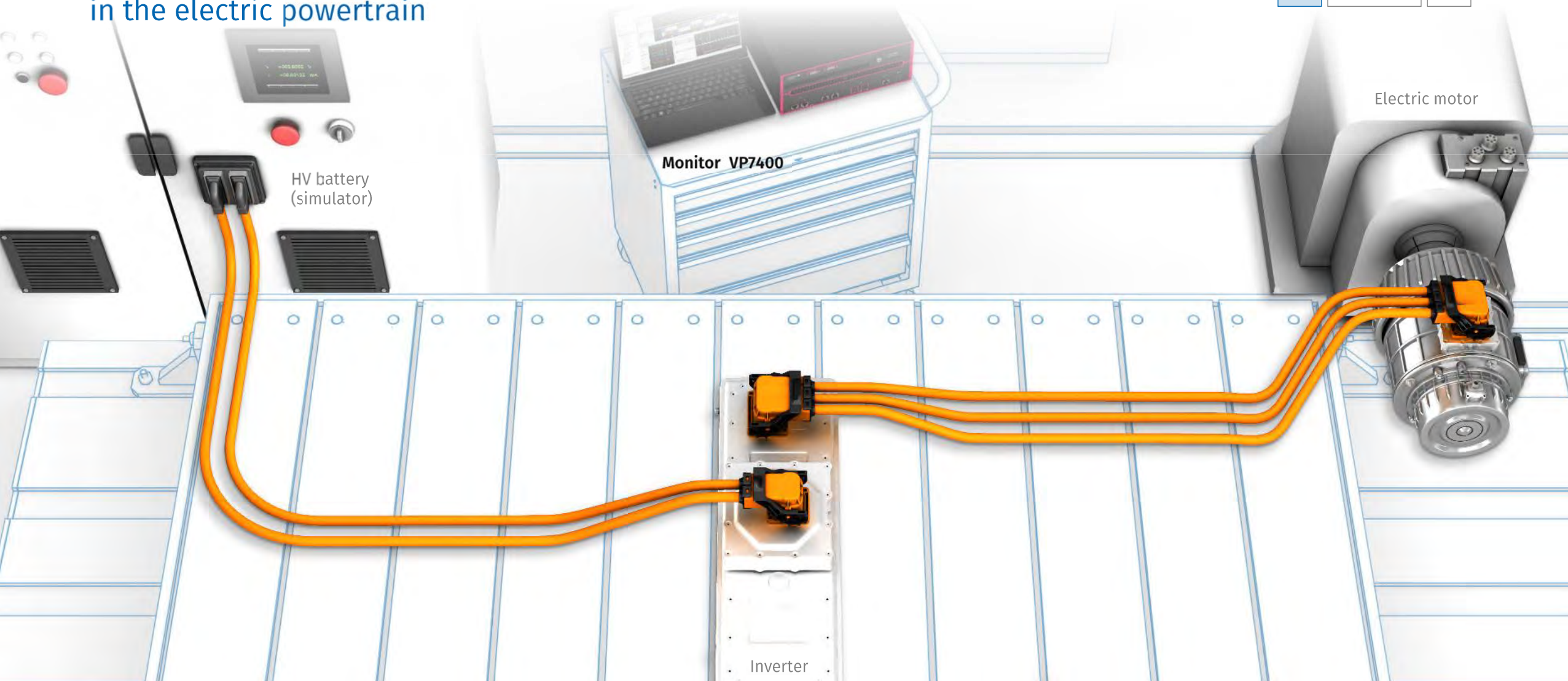
?

Test bench

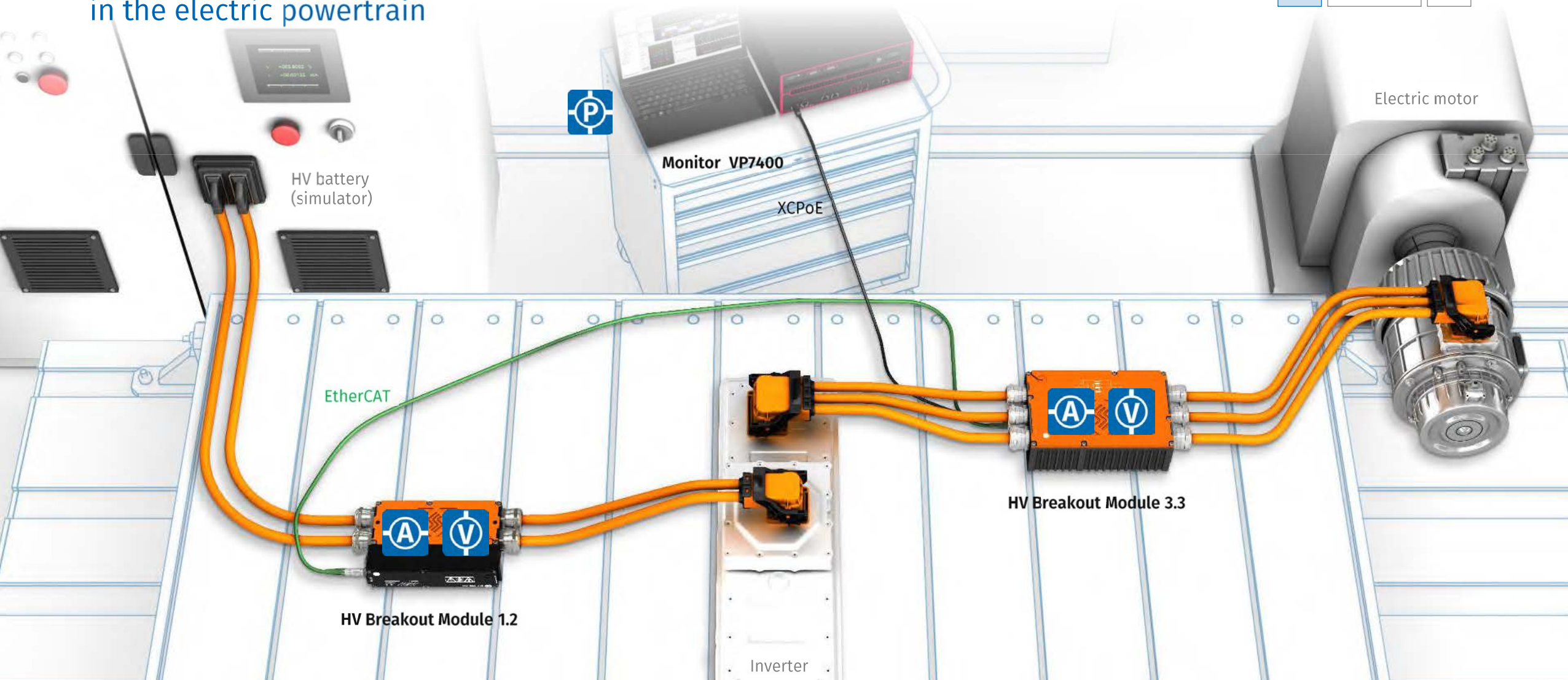
In-vehicle

Inside HV components

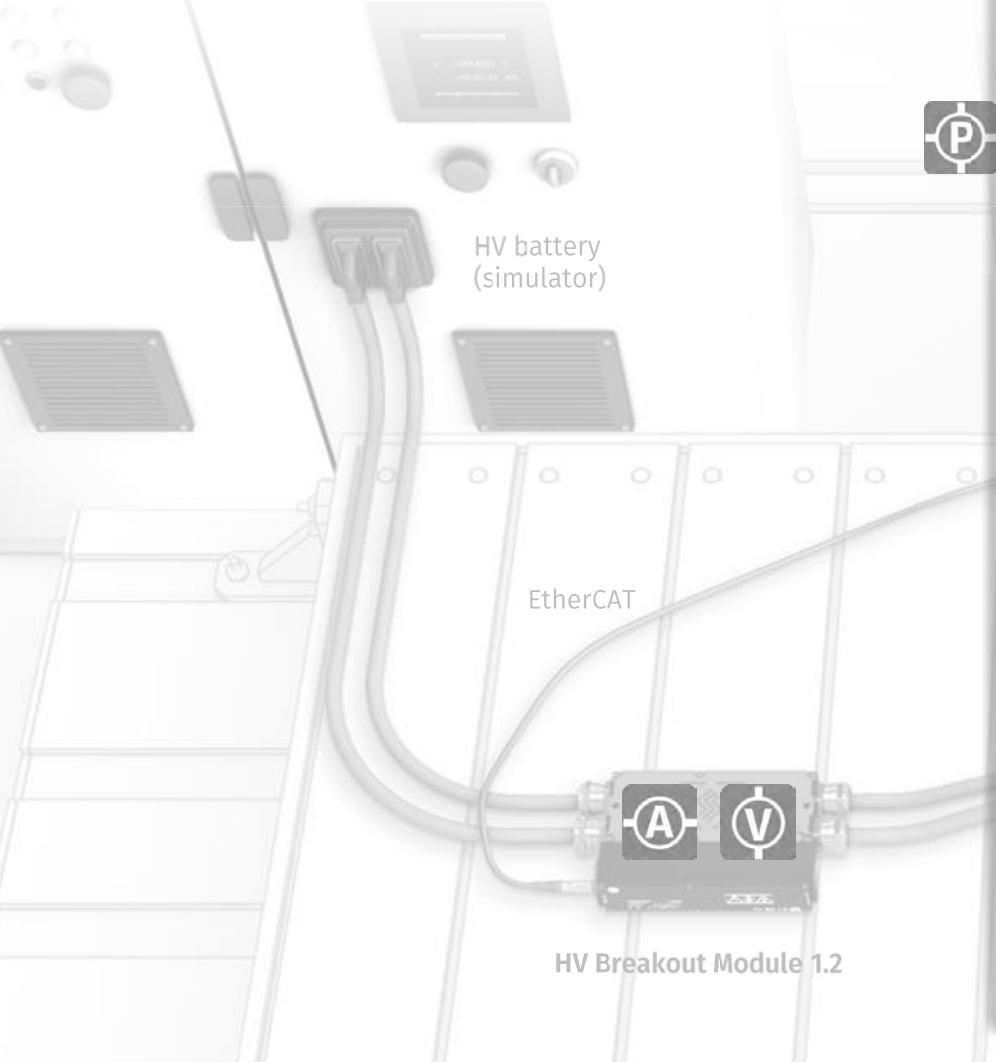
HV current, voltage and power measurement in the electric powertrain



HV current, voltage and power measurement in the electric powertrain



HV current, voltage and power in the electric powertrain



HV Breakout Modules

HV Breakout Modules
on www.csm.de



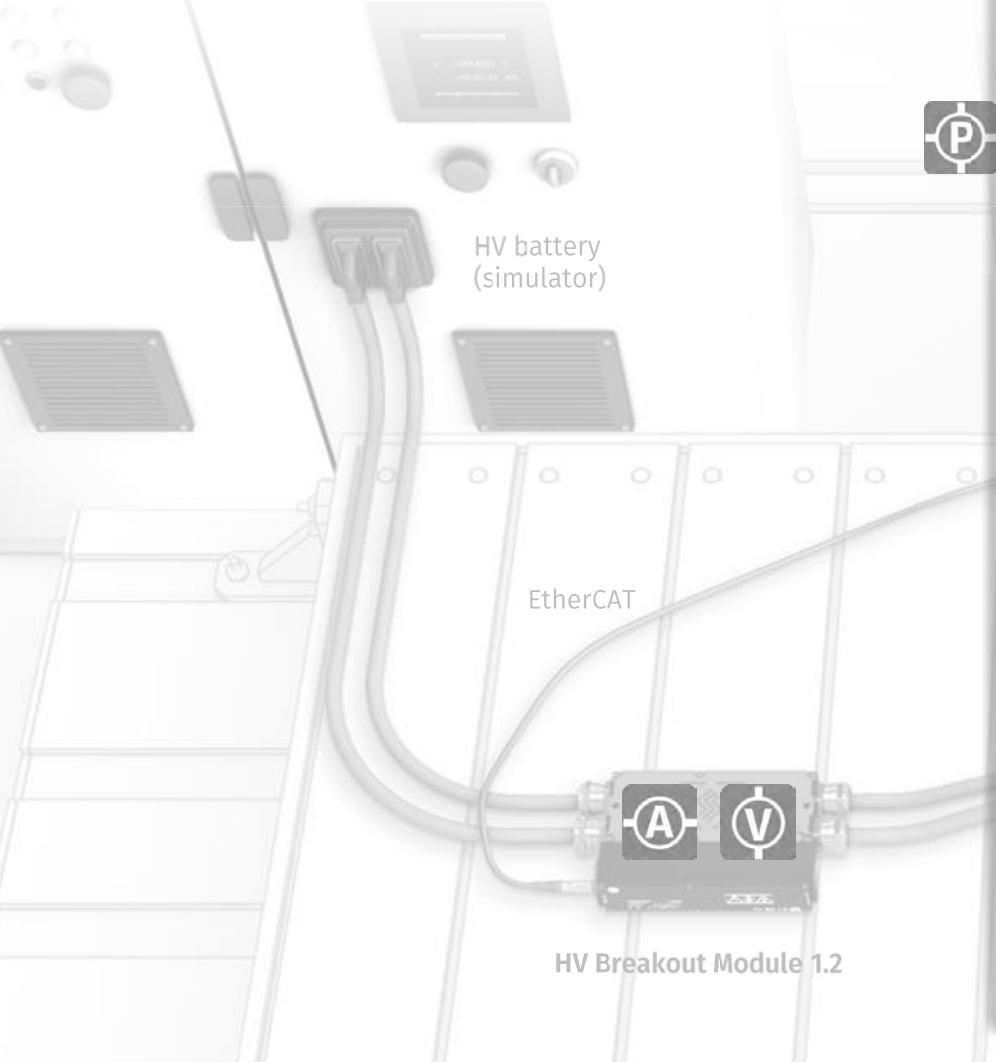
Fast measurement of high currents, voltages and powers

- ▶ HV-safe, rugged housing
- ▶ Compact and low-interference measurement solution



HV Breakout Module 1.2C for single-phase measurements in separate HV+ and HV- lines with PowerLok connector system

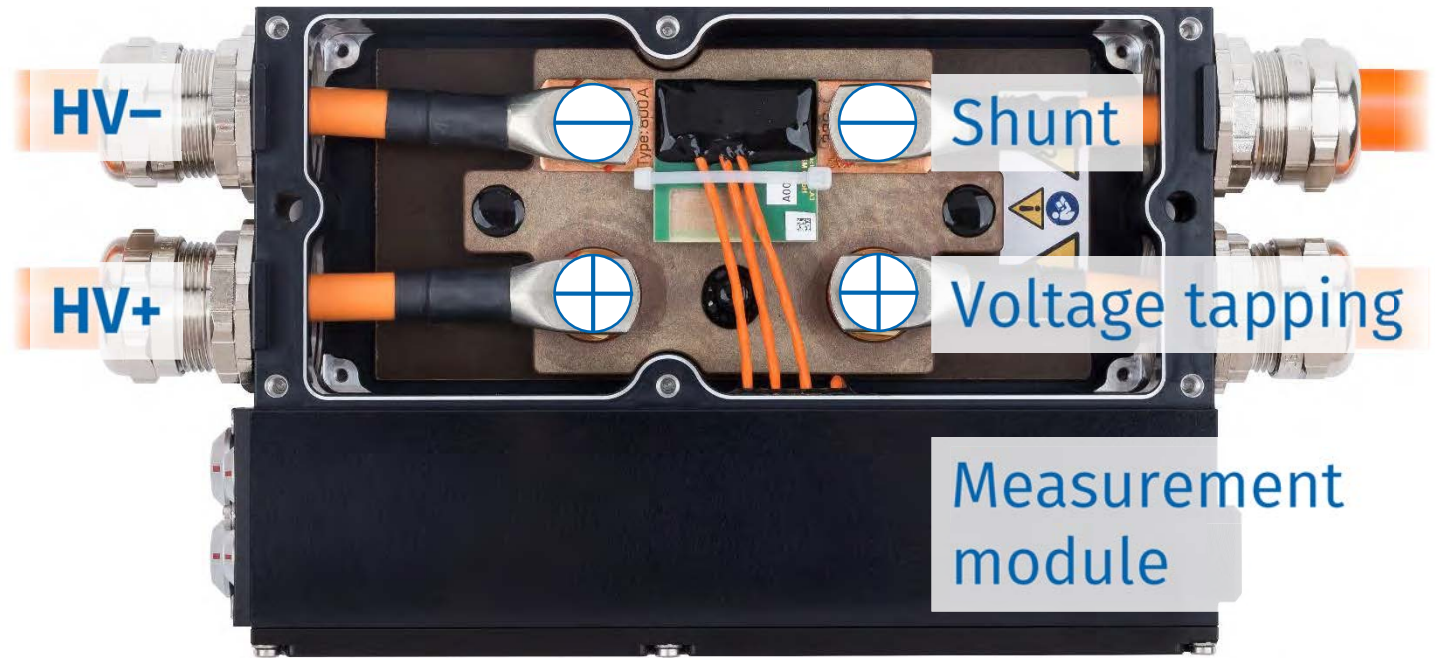
HV current, voltage and power in the electric powertrain



HV Breakout Modules

Fast measurement of high currents, voltages and powers

- ▶ Current measurement with temperature-compensated shunt modules up to $\pm 1,000$ A (peaks up to $\pm 2,000$ A)
- ▶ Voltage measurement up to $\pm 1,000$ V (measurement range up to $\pm 2,000$ V)



HV Breakout Module 1.2 (cover open)

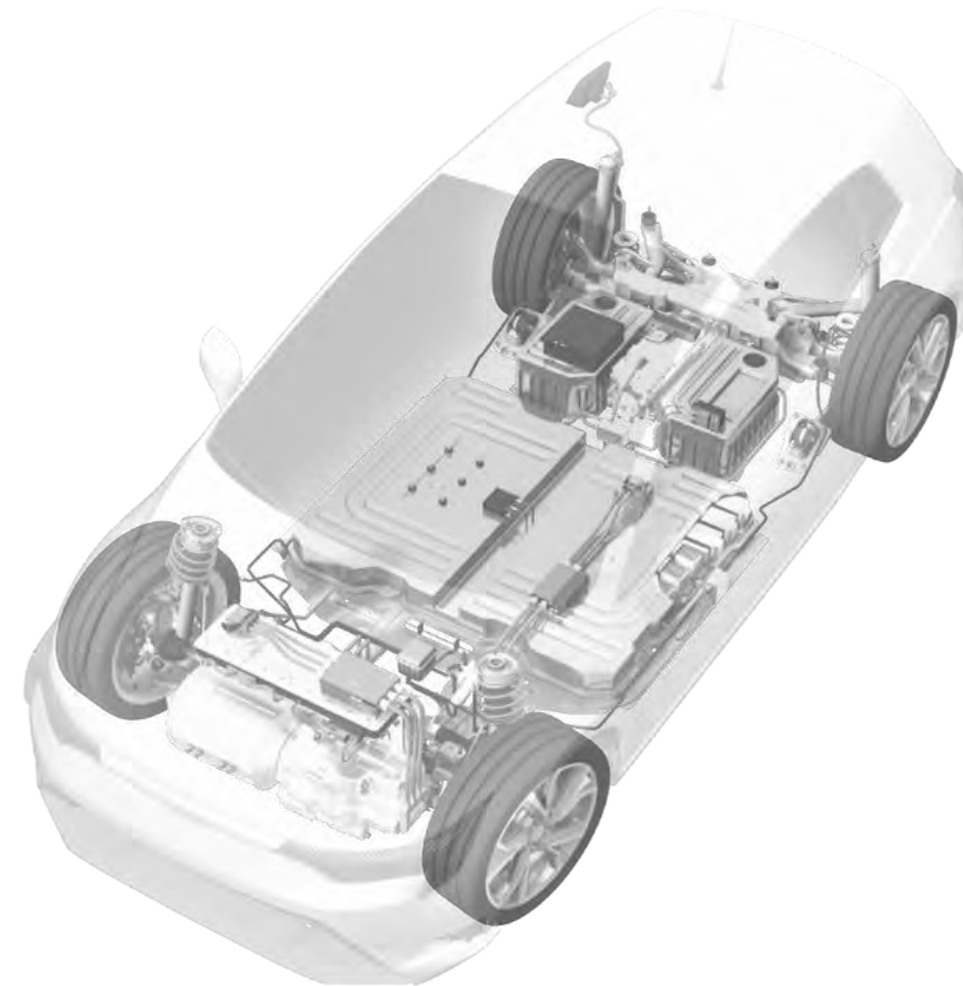
HV Breakout Modules

Fast measurement of high currents, voltages and powers

- For applications in the vehicle and test bench



HV Breakout Module 1.2 for single-phase measurements in separate HV+ and HV- cables with plug-in system



Inverter efficiency measurement in test vehicles



Power measurement

- ▶ HV Breakout Modules in HV power cables
- ▶ HV-safe installation
- ▶ Shielding must be closed
- ▶ Accident safety
- ▶ Data acquisition / data logging
- ▶ Online analysis while driving



Inverter efficiency measurement in test vehicles

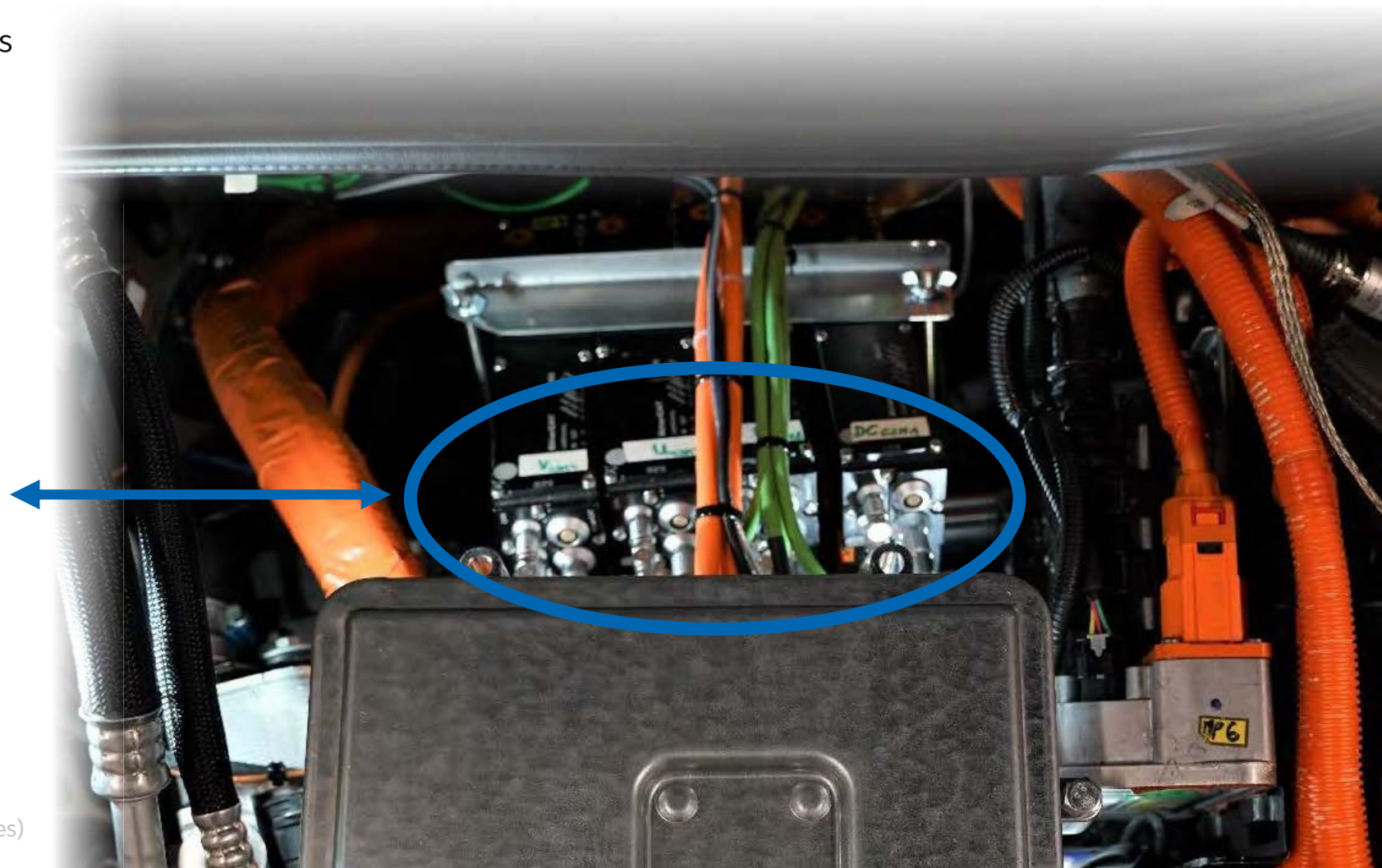


- Installation of CSM HV Breakout Modules for power measurement in confined vehicle installation spaces



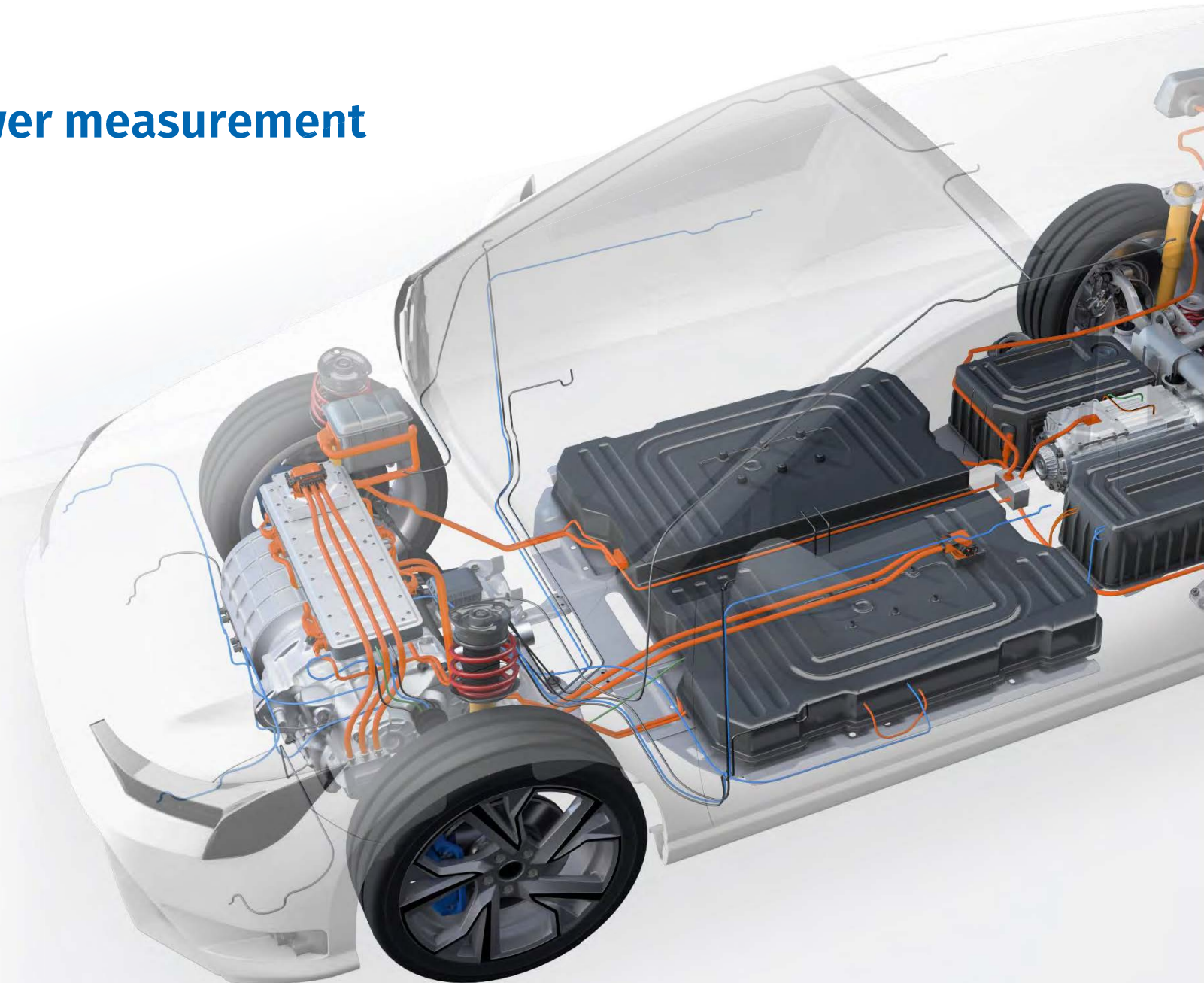
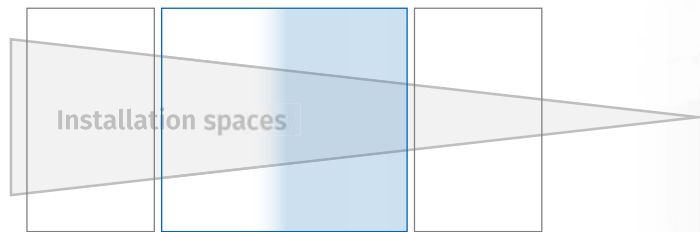
HV Breakout Modules 1.2

(using the example of Vitesco test vehicles)



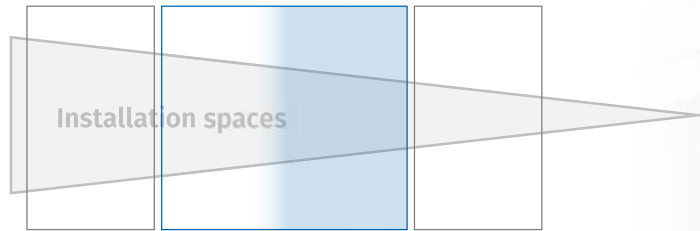
HV current, voltage and power measurement in confined spaces

- ▶ HV power cables in narrow manholes
- ▶ Tightly installed HV assemblies

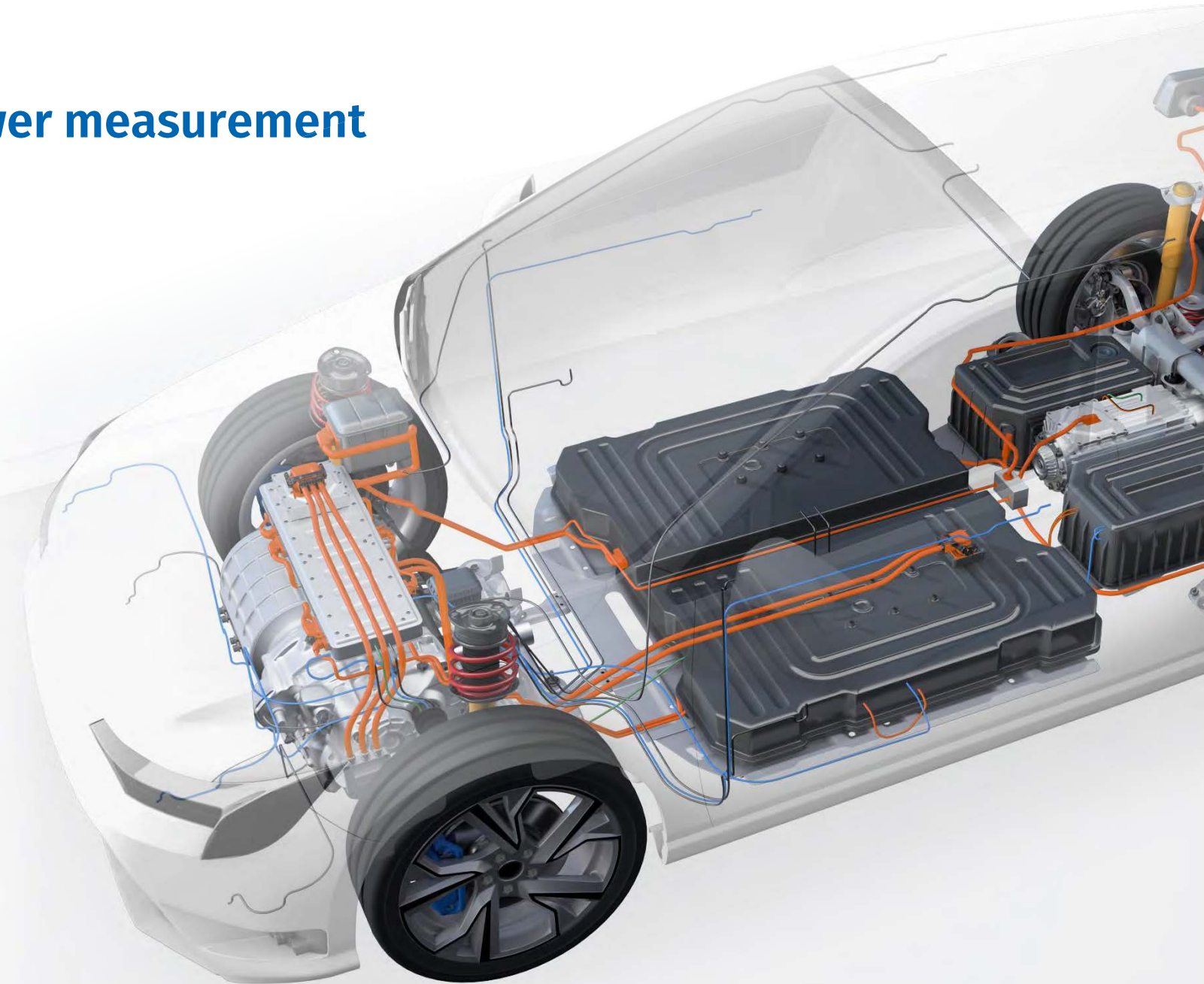


HV current, voltage and power measurement in confined spaces

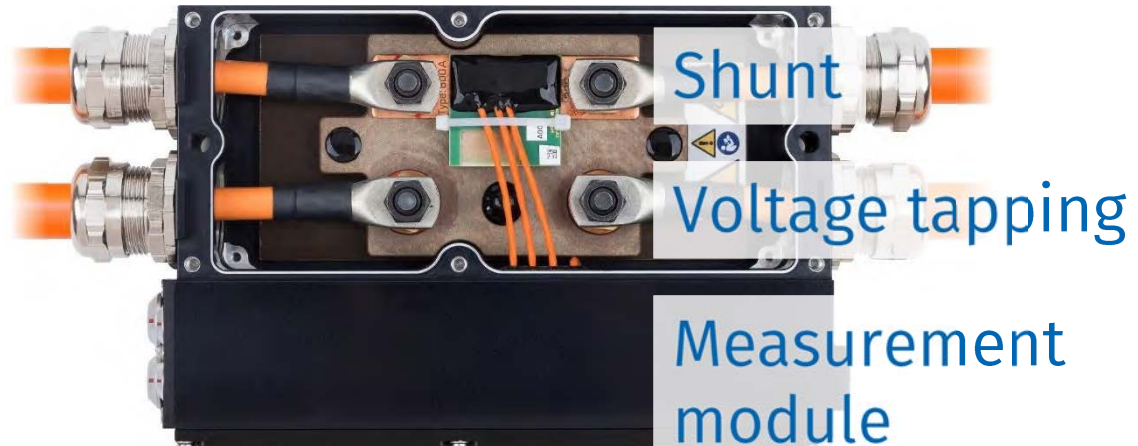
- ▶ HV power cables in narrow cable ducts
- ▶ Tightly installed HV assemblies



**How can the safe and proven
HV Breakout Module measuring
principle be used?**



HV BM Split

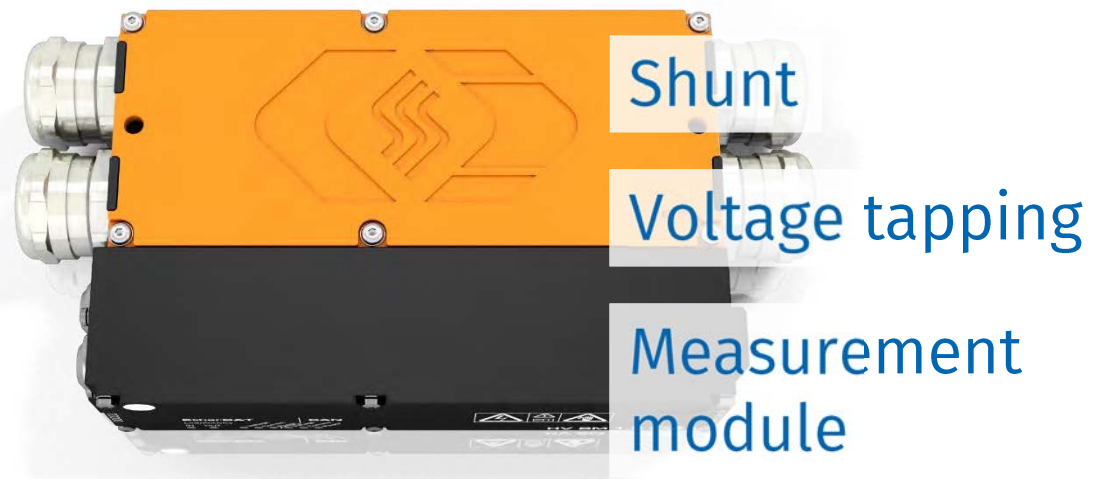


HV Breakout Module 1.2

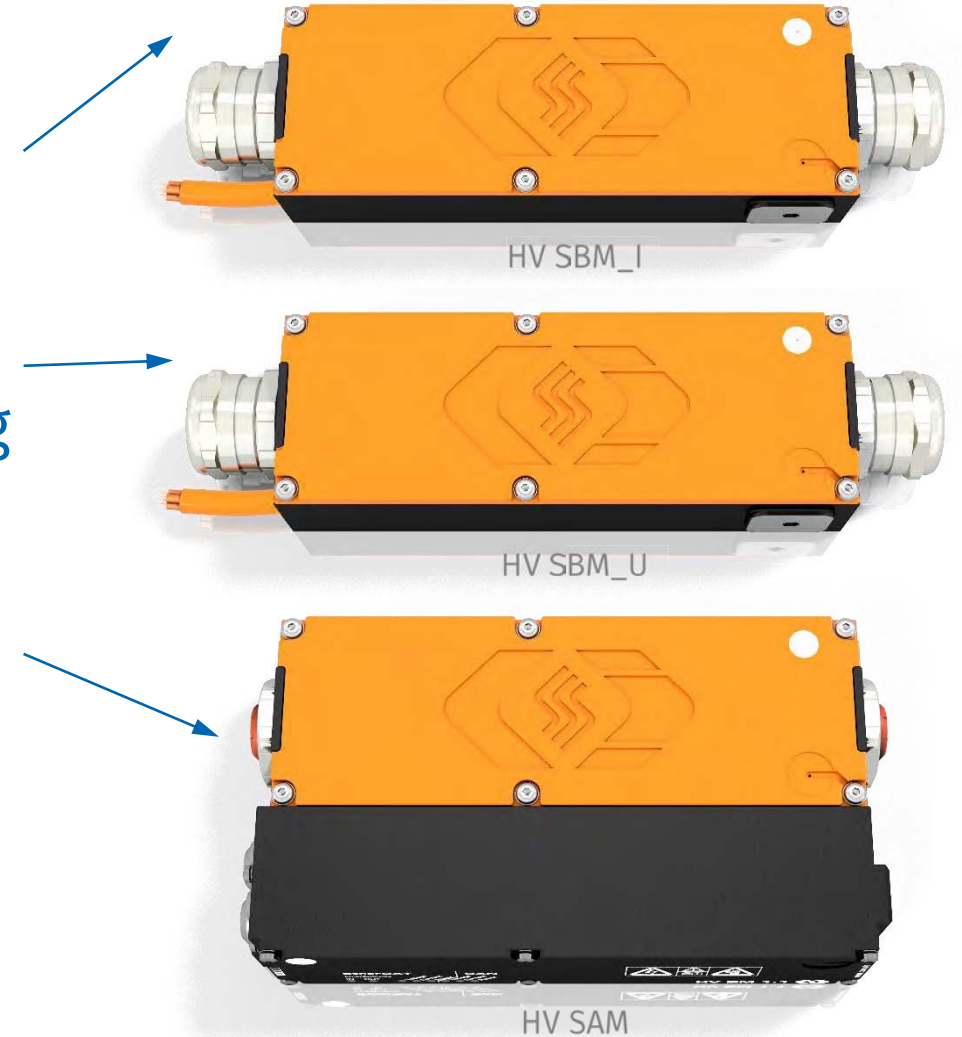
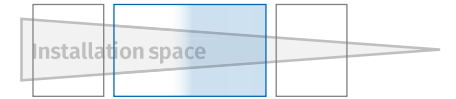
HV Split Breakout
Modules
on www.csm.de



HV BM Split



HV Breakout Module 1.2



HV BM Split Modules

HV SBM - Split Breakout Modules

- ▶ **Current and voltage measurement**
- ▶ HV SBM_I Breakout Module
- ▶ HV SBM_U Breakout Module
- ▶ **Connection options**
 - Cable glands and ring terminals
 - PL500 connector system („C“ variants)



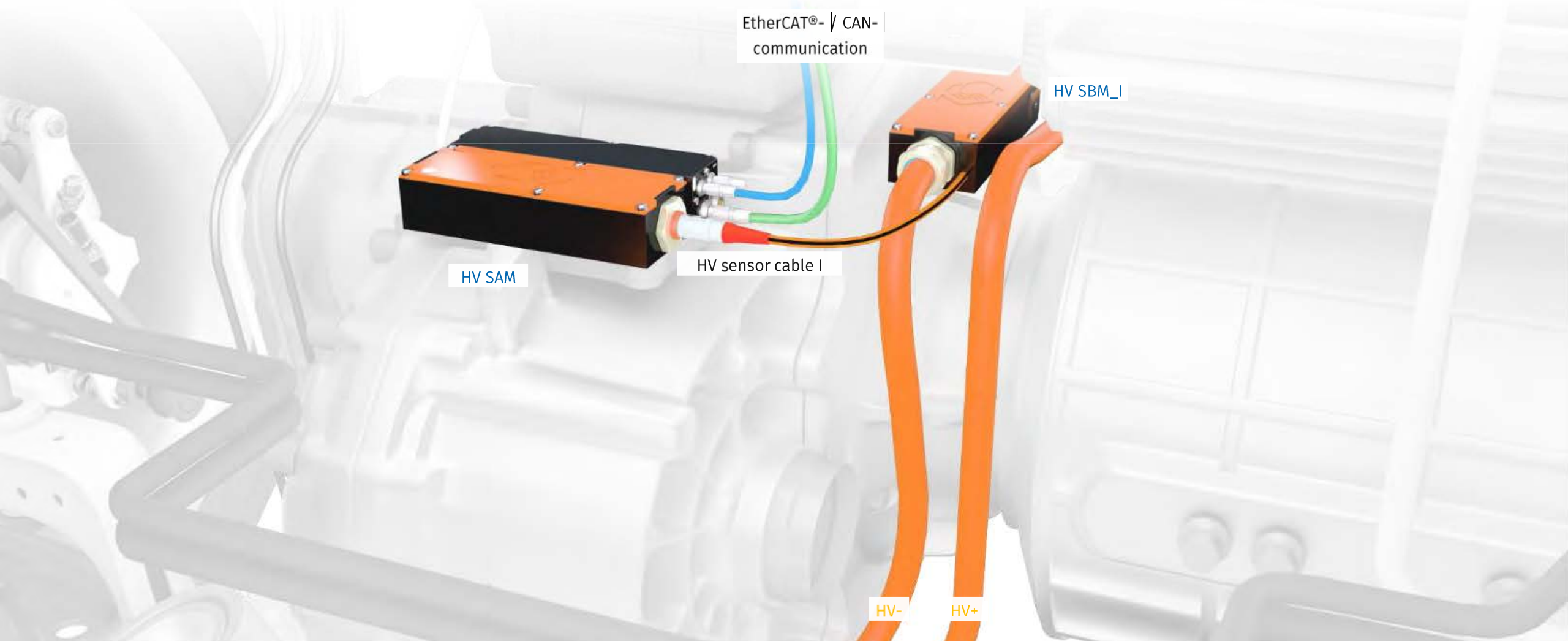
HV SAM - Split Acquisition Module

- ▶ **Data processing**
- ▶ Two signal inputs for current and voltage
- ▶ Connection of HV SBM to HV SAM via high-voltage connector
- ▶ EtherCAT® and CAN interfaces for data transmission



HV BM Split

Current measurement in the HV vehicle electrical system



HV SBM

Shunt current measurement

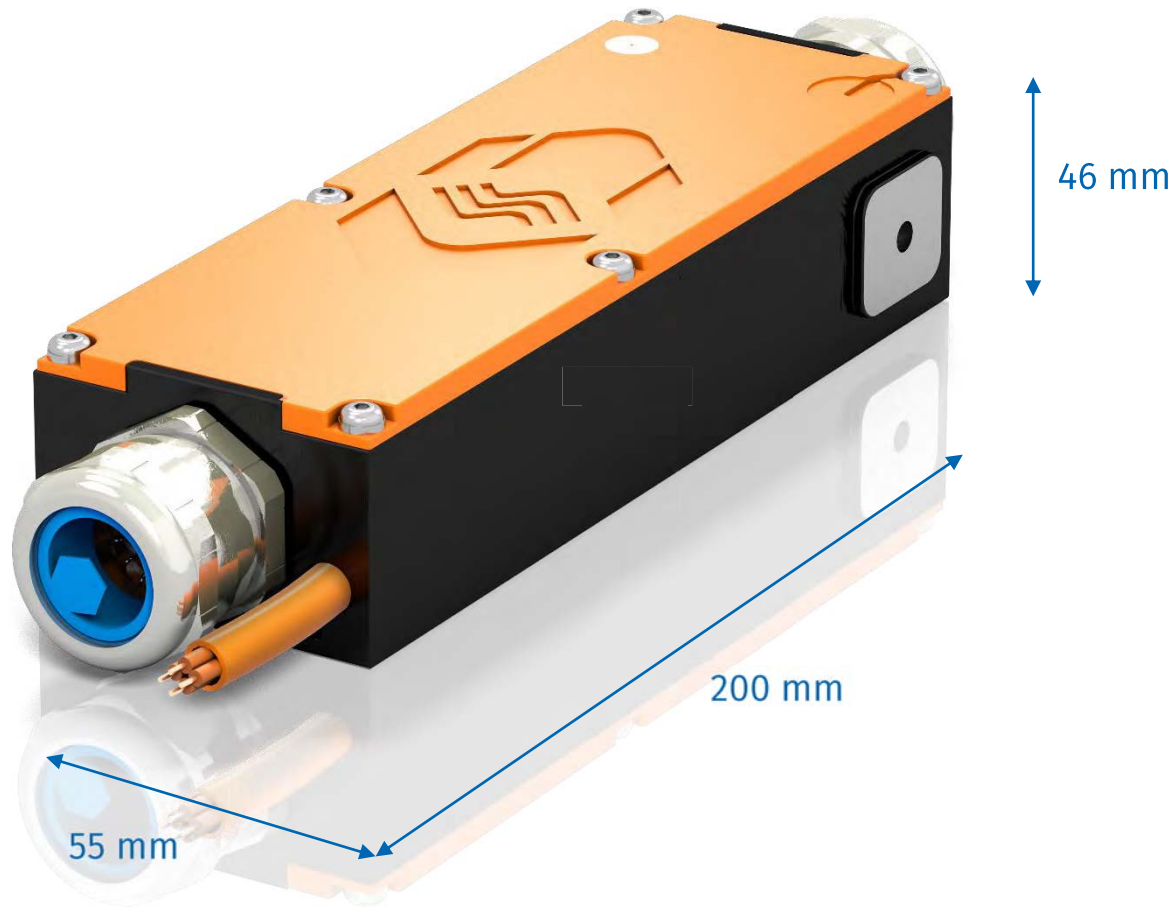
Rated current I_{rated} [A]	Peak current I_{peak} [A]
±50	±100
±125	±250
±250	±500
±500	±1.000
±1.000	±2.000

- ▶ Four measurement ranges are available for each shunt
- ▶ Includes memory for the calibration data for automatic online temperature compensation and identification
- ▶ **Proven technology of HV Breakout Modules**



HV SBM

Dimensions for cable cross sections up to 95 mm²



Dimensions without cable glands



HV BM Split

Current measurement in the HV vehicle electrical system



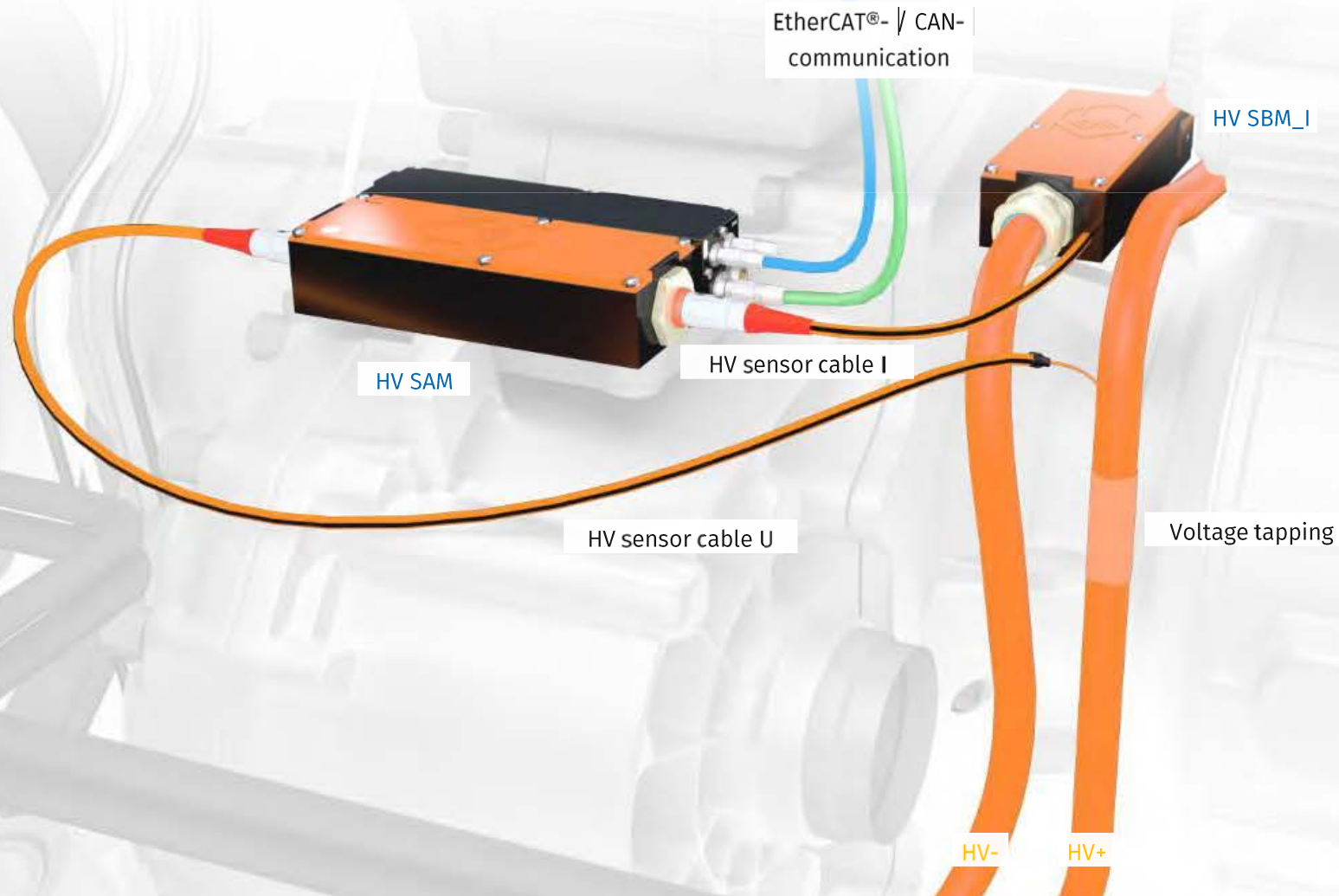
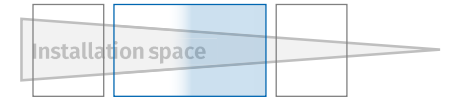
HV SAM

- ▶ Measurement data rate / transmission rate up to 1 MHz
- ▶ Optional: RMS values of I and U, active, apparent and reactive power as well as phase angle (output via CAN)



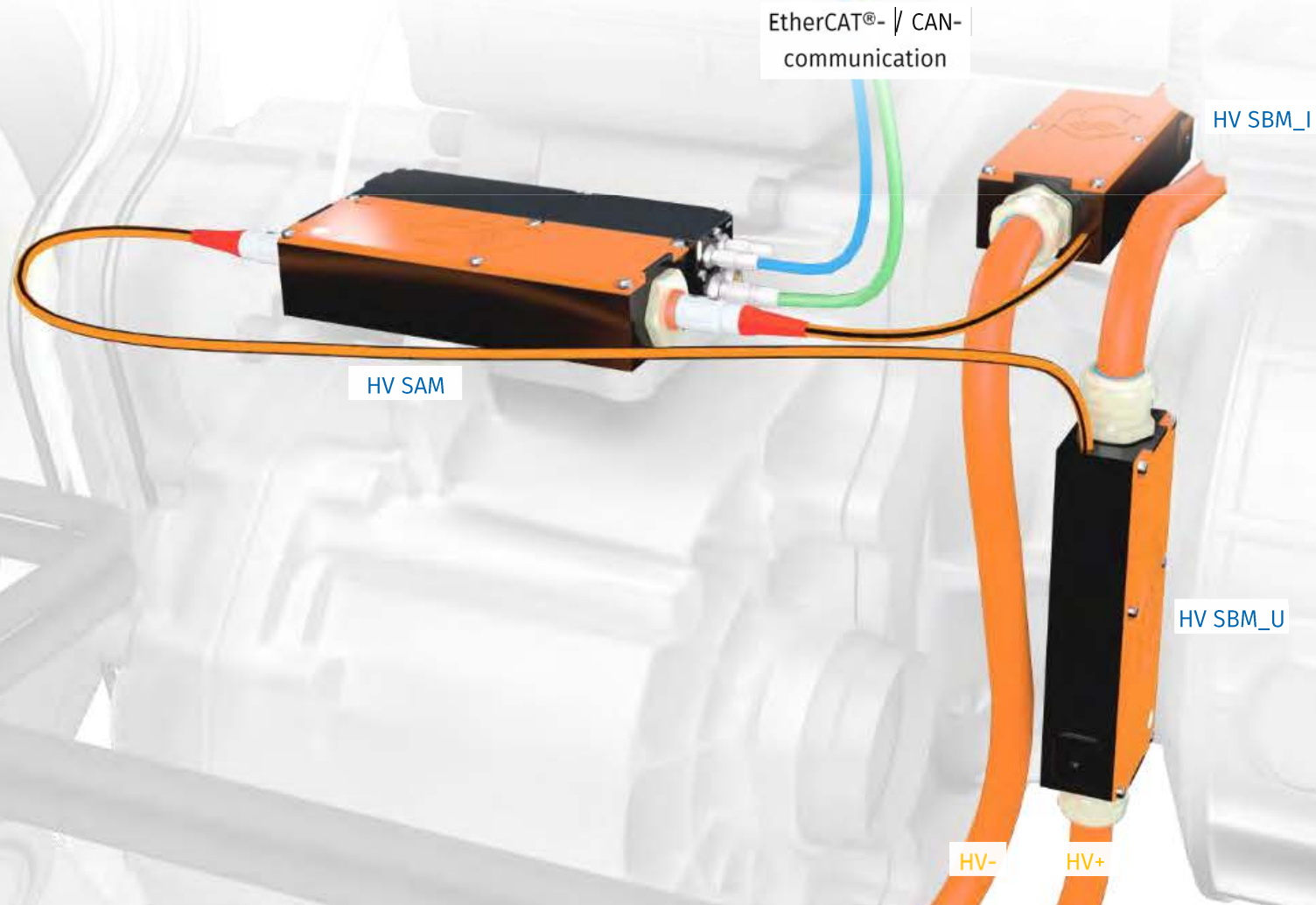
HV BM Split

Current and voltage measurement in the HV vehicle electrical system

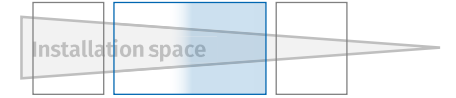


HV BM Split

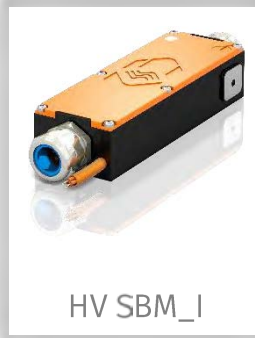
Current and voltage measurement in the HV vehicle electrical system



HV current and voltage measurement in confined spaces



Current measurement



HV SBM_I

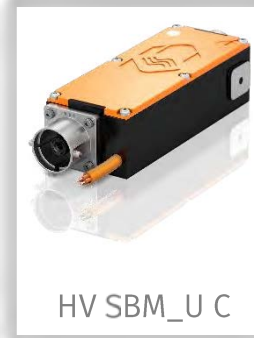


HV SBM_I C

Voltage measurement



HV SBM_U



HV SBM_U C



Sensor cable

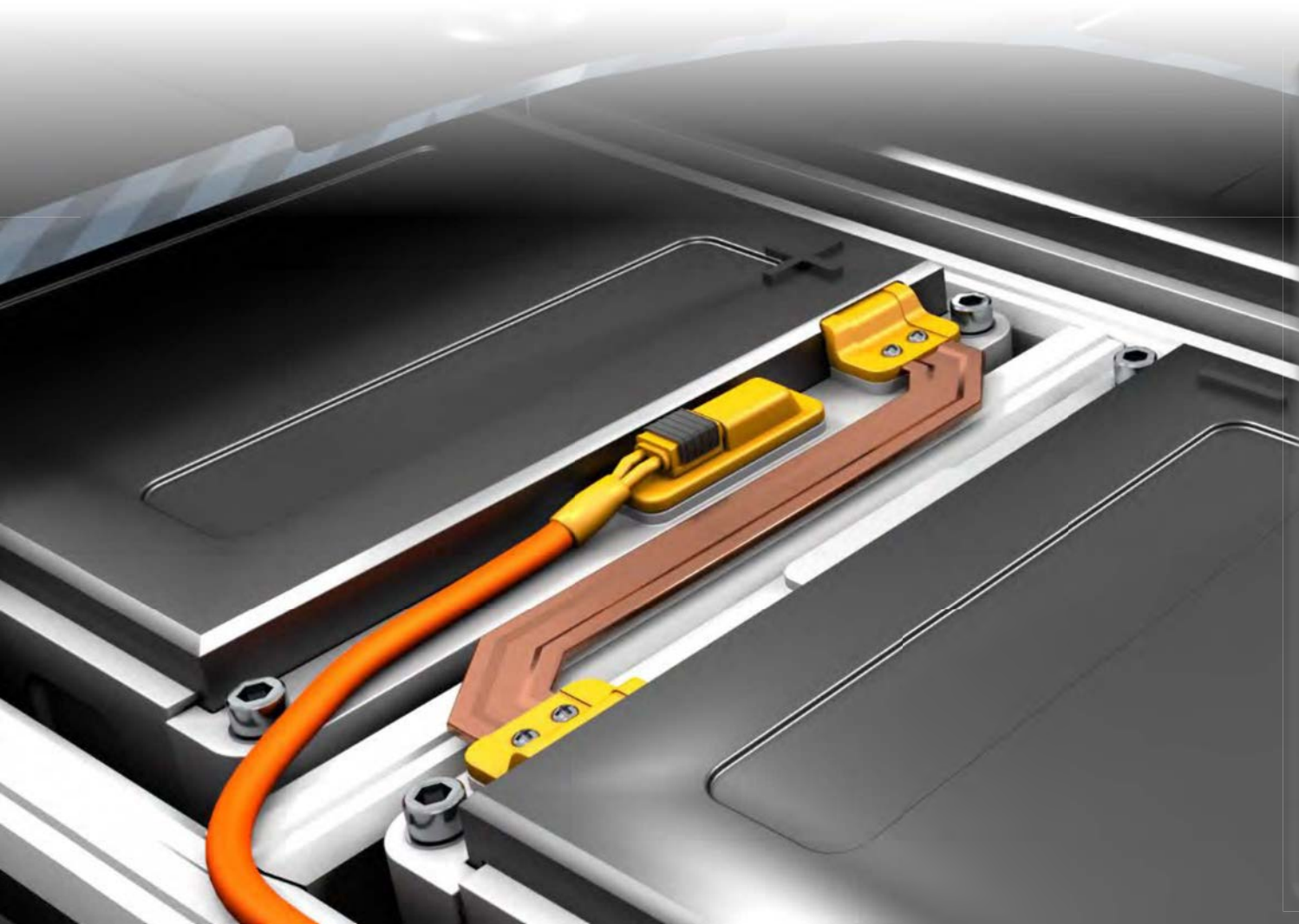
Measurement module



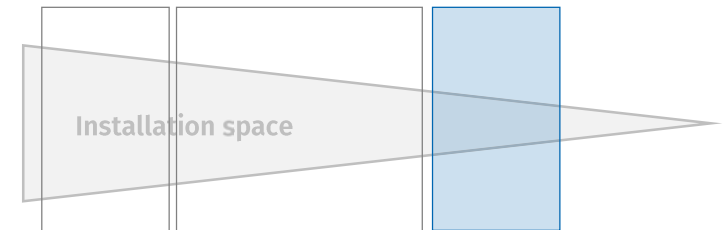
HV SAM

Measurement in
HV power cables

Measurement in HV components and busbars



- ▶ Busbars in HV batteries
- ▶ Measurement in e-axes and power electronics



Open Shunt Module measurements

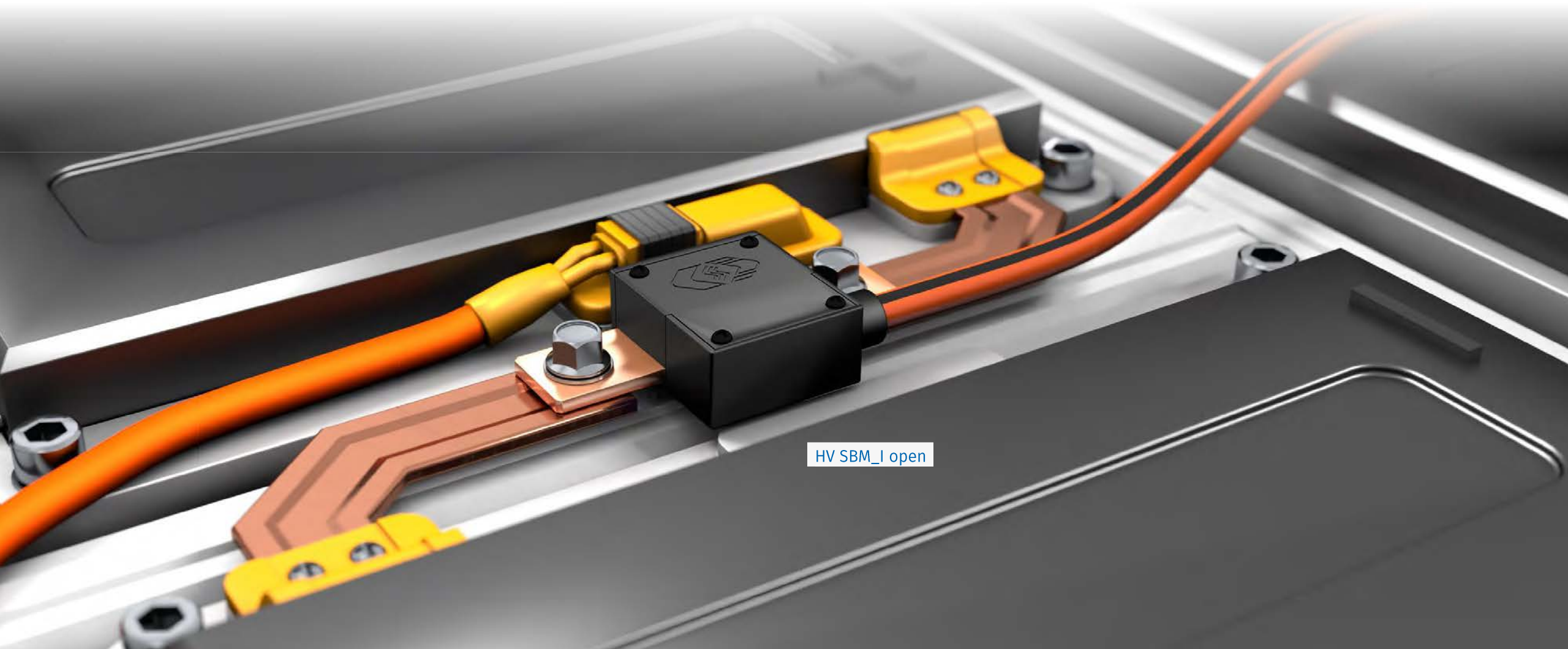
Encapsulated shunt module

- ▶ Shunt data and identification
- ▶ Calibration data with temperature compensation characteristic field
- ▶ Temperature sensor for online temperature compensation
- ▶ HV safe cable for connection to HV SAM



HV BM Split

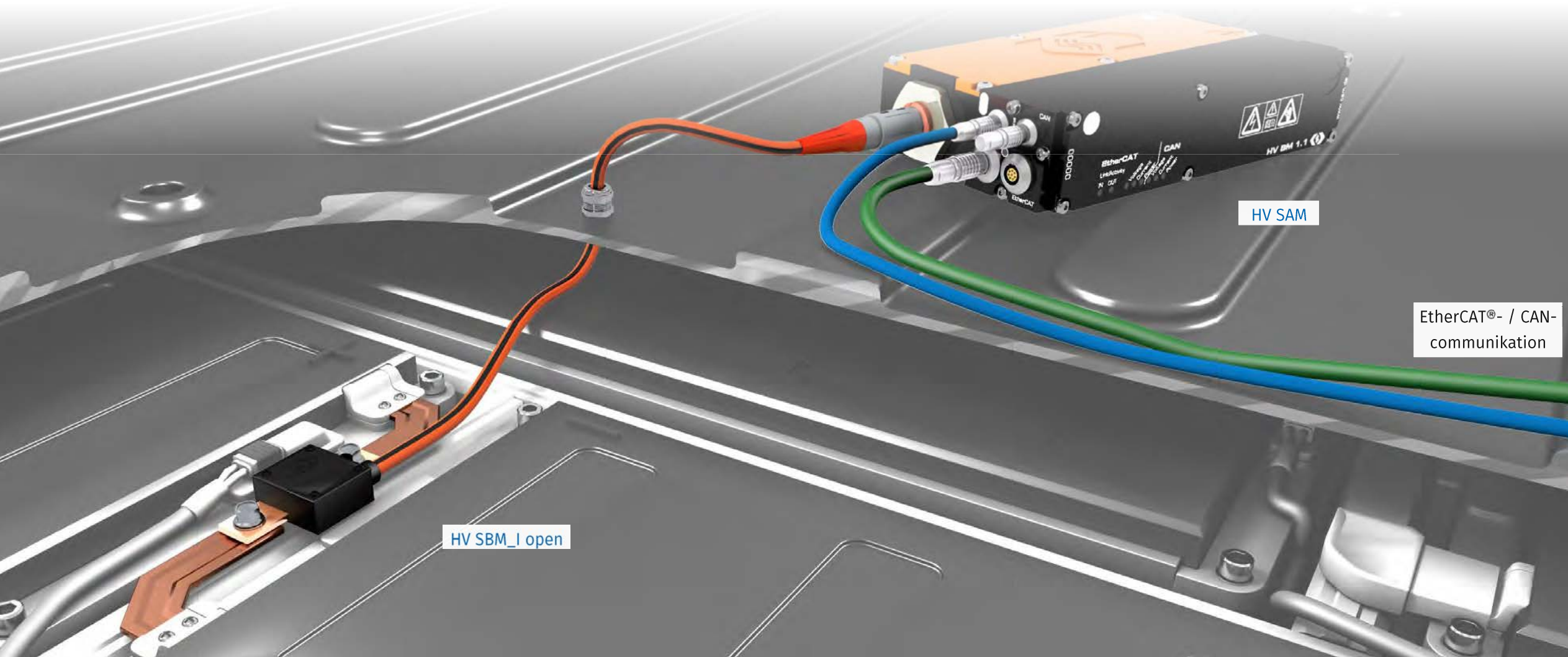
Measurement on busbars with HV SBM_I open



HV SBM_I open

HV BM Split

Measurement on busbars with HV SBM_I open



HV current and voltage measurement in confined spaces



Current measurement

Measurement in
HV power cables



Measurement in
HV components and
busbars



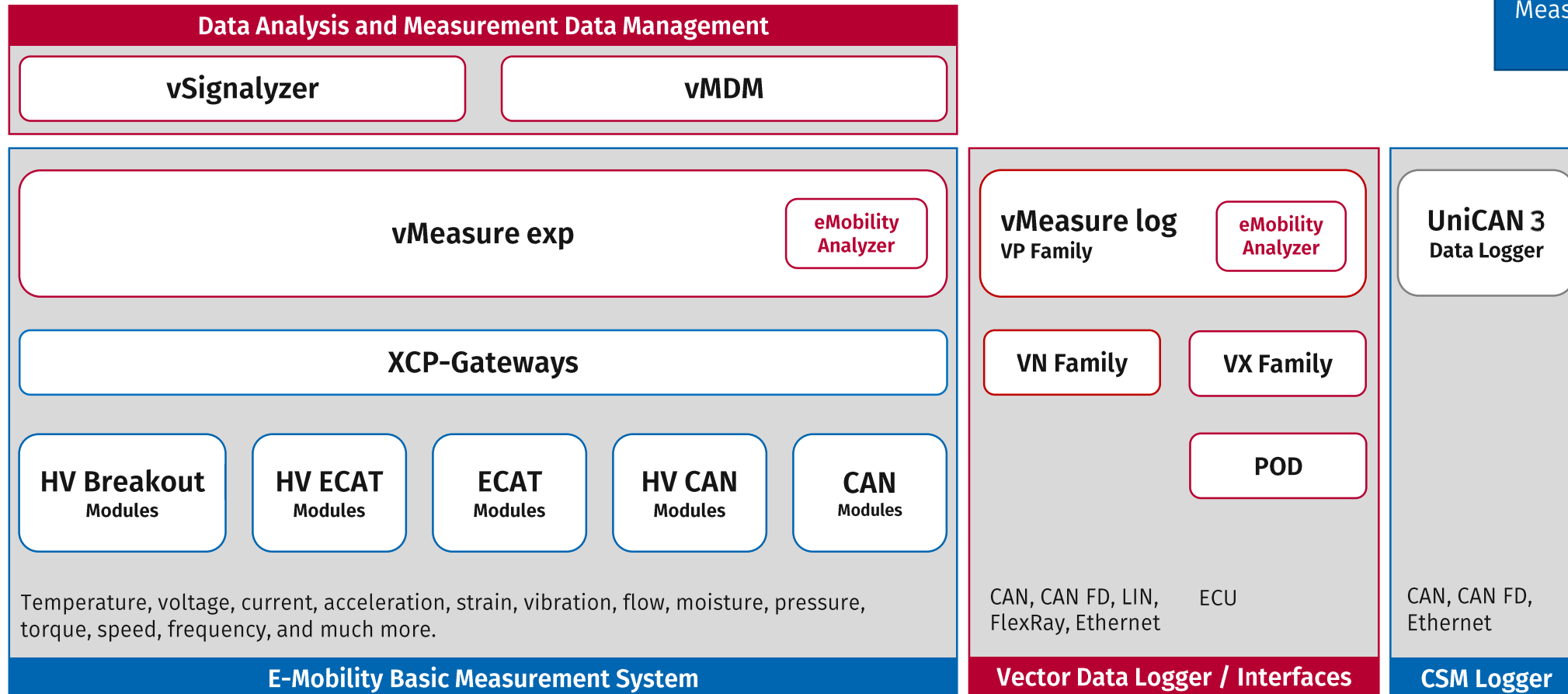
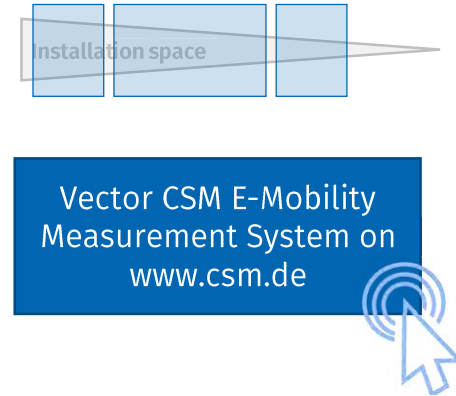
Voltage measurement



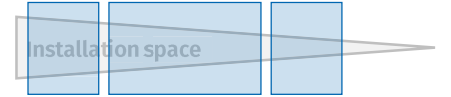
Measurement module



Vector CSM E-Mobility Measurement System



Vector CSM E-Mobility Measurement System



Temperatures



Pressure



HV currents



HV voltages



Mechanical stresses



Electrical power



Humidity

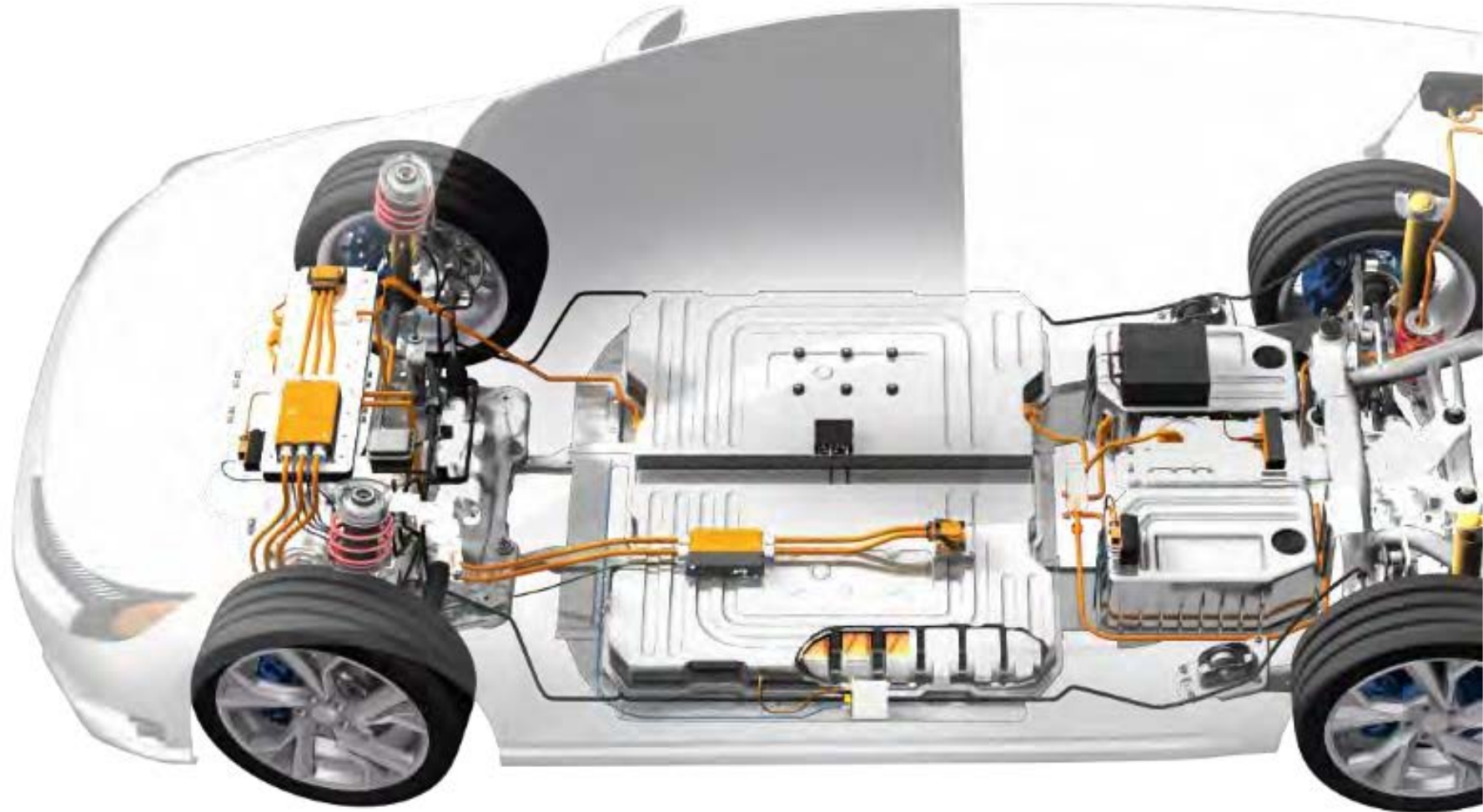


Flows

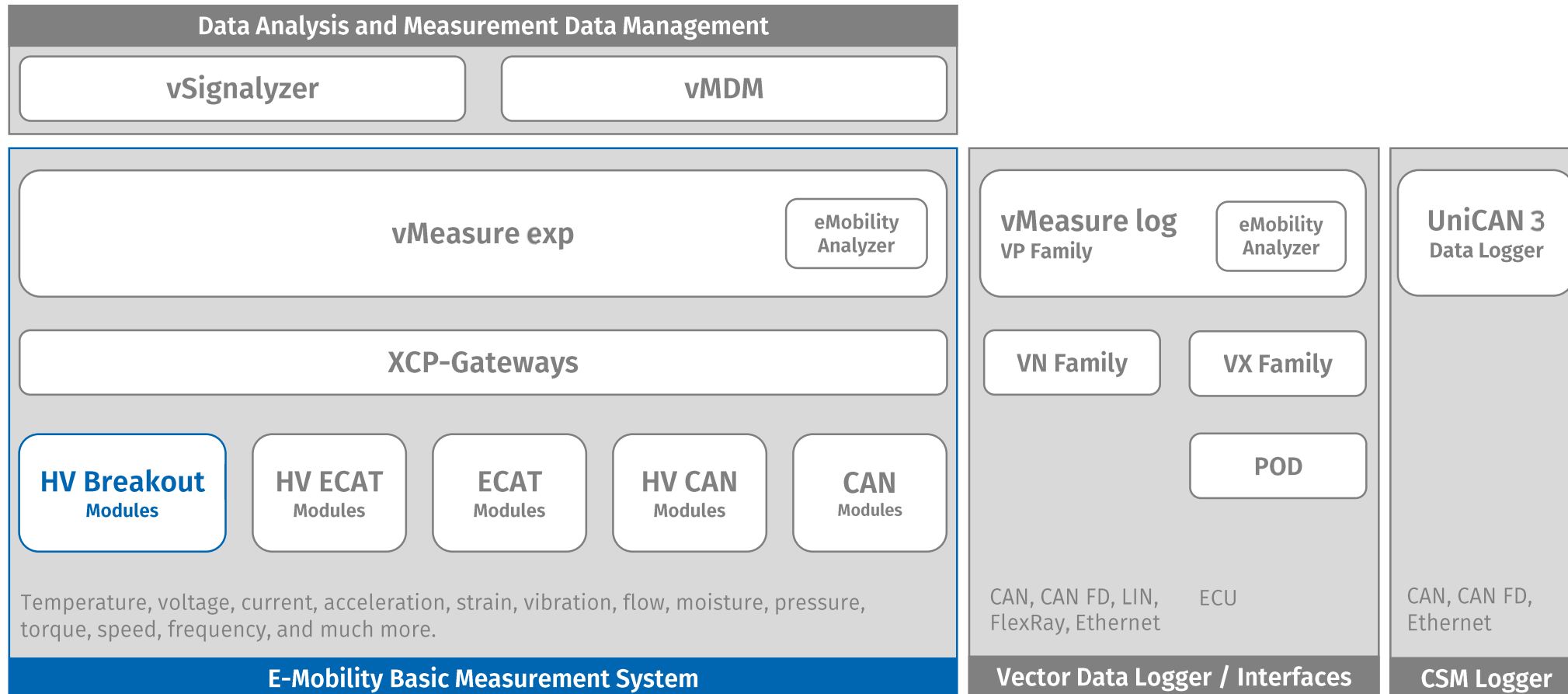
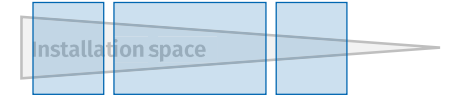


Vibrations




...



Vector CSM E-Mobility Measurement System



Fast HV current, voltage and power measurement

		Installation space		
Location		Test bench	In-vehicle	Inside HV component
Measurement technology		 <p>HV Breakout Modules C</p>	 <p>HV Breakout Modules</p>	 <p>HV BM Split</p>
	Values	Inner conductor current, voltage, instantaneous power	Inner conductor current, shield current, voltage, instantaneous power	Inner conductor current, voltage, instantaneous power
Connection		PL500-, PL300-connector system	Ring terminals (cable glands), individual connector system	PL500 connector system, ring terminals (cable glands), directly in busbars

About CSM

CSM has been setting technological standards for decentralized measurement technology in vehicle development for over 35 years. Our CAN bus and EtherCAT® measurement devices support worldwide renowned vehicle manufacturers, suppliers and service providers in their developments.

Continuous innovation and long-term satisfied customers are our guarantee for success. Together with our partner Vector Informatik, we have developed an easily scalable and powerful E-Mobility Measurement System for hybrid and electric vehicles and are constantly expanding the areas of application. With our high-voltage safe measurement systems designed for fast and synchronous measurements and power analyses, we actively accompany the change to **E-Mobility**.

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