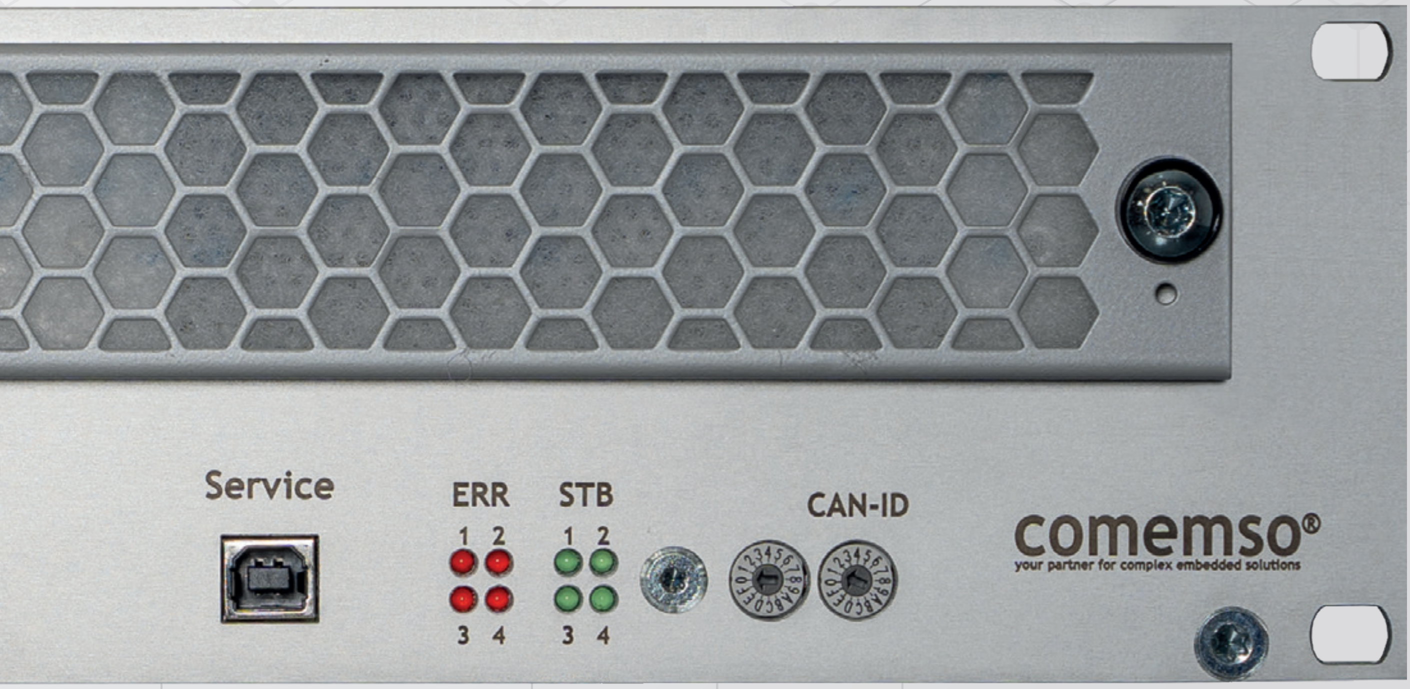
comemso
your partner for complex embedded solutions

NEW GENERATION

BATTERY CELL SIMULATOR COMPACT

Generation 8



electric mobility south-west

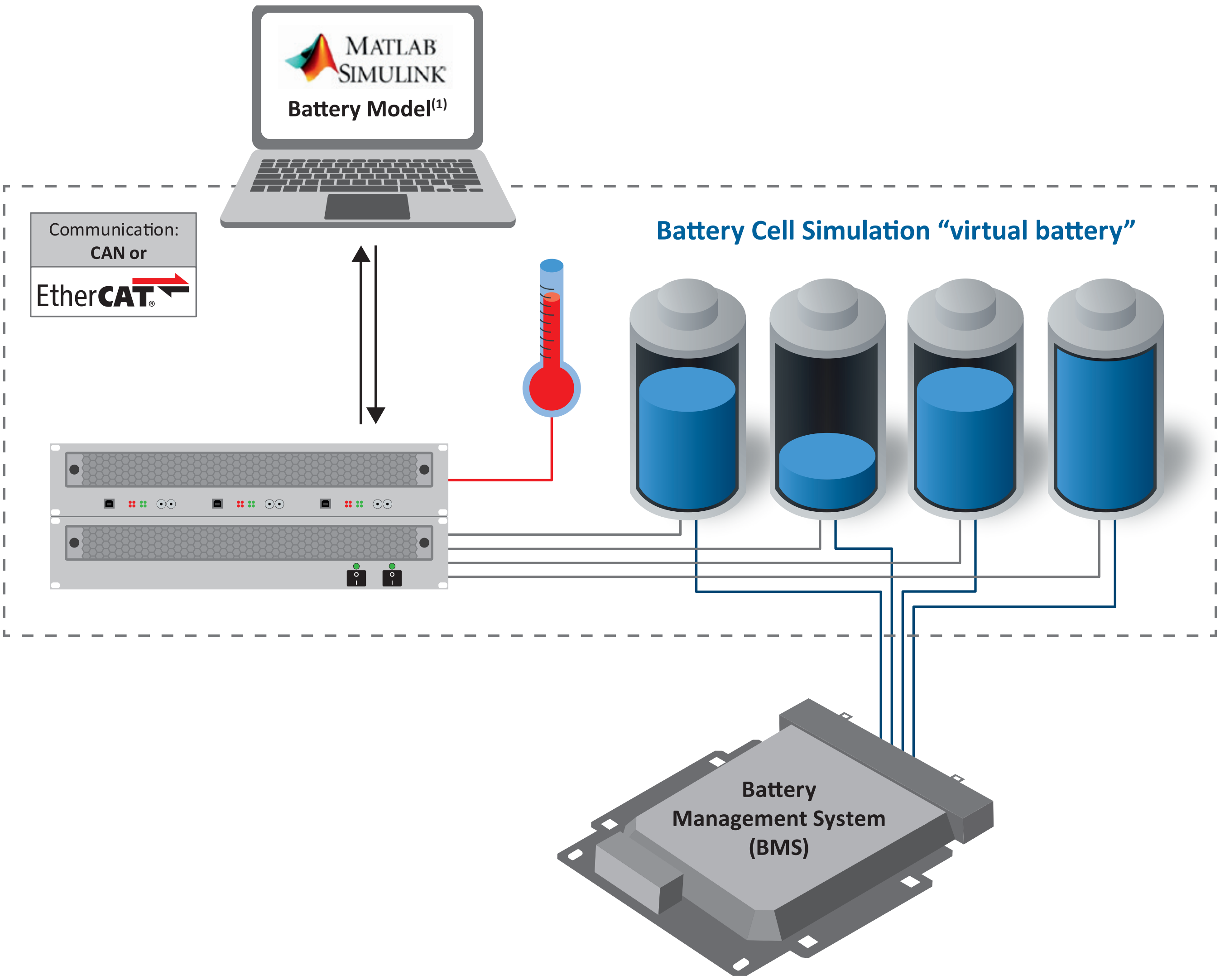
FUNDED BY
Federal Ministry of Education and Research

INVENTED IN GERMANY

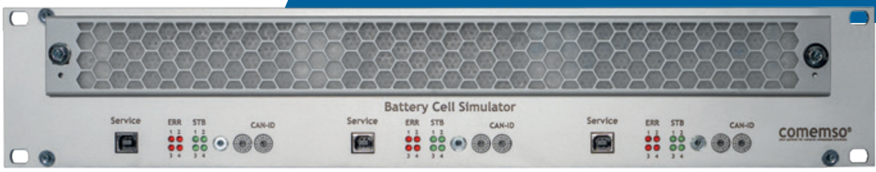
ES France - Département Puissance Energie - 127 rue de Buzenval BP 26 - 92380 Garches
Tél. 01 47 95 99 45 - Fax. 01 47 01 16 22 - e-mail: tem@es-france.com - Site Web: www.es-france.com

The new generation of the Battery Cell Simulator.

The generation 8 allows you to test your Battery Management System on cell-level with high-precision and more dynamic as ever before. The electrical emulation of such virtual battery cells puts you into the position to achieve safe, reproducable and full automated testing of your BMS. The Battery Cell Simulator is the core of every BMS test system. This product information gives you an overview of the BMS test product family and the available variants of the battery cell emulation hardware.



(1) Not offered by comemso.



INNOVATION BW 2013
Innovation Award Baden-Württemberg
Dr.-Rudolf-Eberle-Preis
Award Winner 2013

- High Current variant with currents up to 6.0 A(1)
- Carry out an adjustment of voltage calibration via the USB interface
- Better ventilation and therefore less heating of the cells
- Individual cells can be sent separately to comemso for repairs
- Easier Firmware updates
- Cell supply range 0.01 .. 8 V up to 6.5 A with an accuracy of +/- 500 µV as well active and passive compensation
- Current measurement up to +/- 6.5 A
- Coulomb measurement (Charge / Discharge)
- Integrated simulation of individual cell failure
- Communication via CAN or EtherCAT
- Fully scalable systems with up to 144 cells per rack and up to 204 cells in different Versions
- High reliability with 3 years warranty

Set the voltage source and current load flexibly.

With the new generation of the battery cell simulator, even more precise functional tests of battery management systems are now possible. Each cell has an electronic load that can be used for active and passive balancing. This constant current sink can generate currents up to 6.0 A (depending on selected features). Even with a cable length of up to 5 m (16 ft), the comemso BCS delivers maximum accuracy directly on the BMS test object.

Fault simulation and current measurement.

Each cell offers a fault simulation to generate short circuits, cable breaks and polarity changes (reverse polarity). In addition, each cell output has a high-precision current measurement system. This market innovation enables the BCS to measure both equalizing currents and leakage currents per cell, e.g. by a switched-off BMS.

In this way, deep discharges of entire battery modules can be analyzed quickly and with the help of the integrated Coulomb measurement, compensation processes can be verified for each cell. The entire communication for the high-performance measurements and the highly dynamic control, even with > 120 cells, takes place via CAN or EtherCAT with 100 MBit/s.

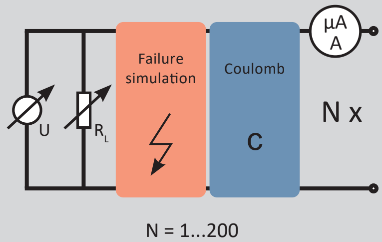
The comemso battery cell simulation combines high-precision emulation of battery cells with high-resolution measurement technology and extended validation options.

(1) without the µA board

Structure of a battery cell simulation system.

Virtual Battery Cell

With integrated fault simulation including Coulomb and leakage current measurement.

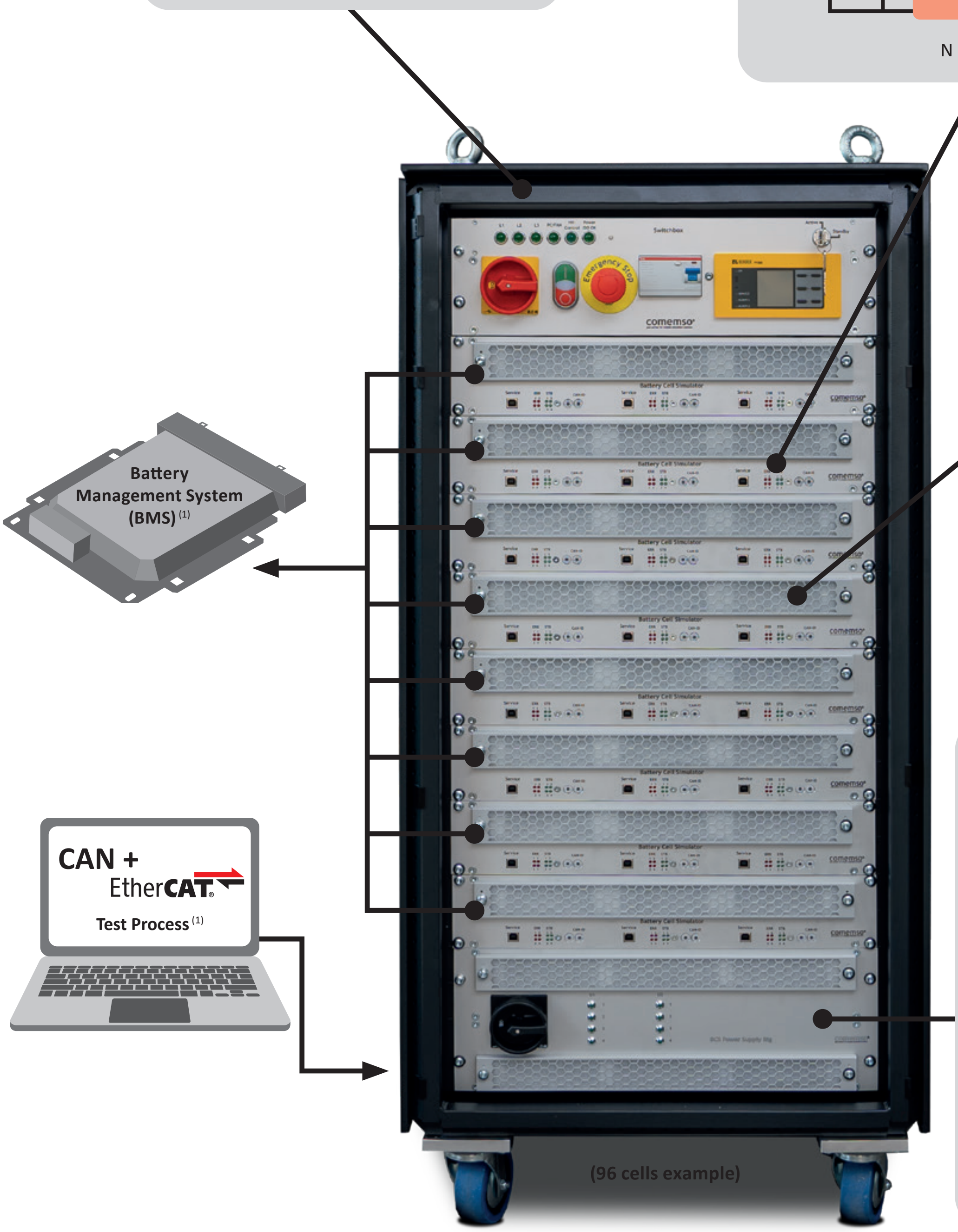


Completely individual

A large mix of modules with scalable variants and different functions.

BCS compact slide-in module

Simulation of 12 cells per module.



Compact Power Supply

Large version

- 4 height units (HU)
- up to 10 BCS modules at max. 6 A source or up to 12 BCS modules at max. 5 A source

Small version

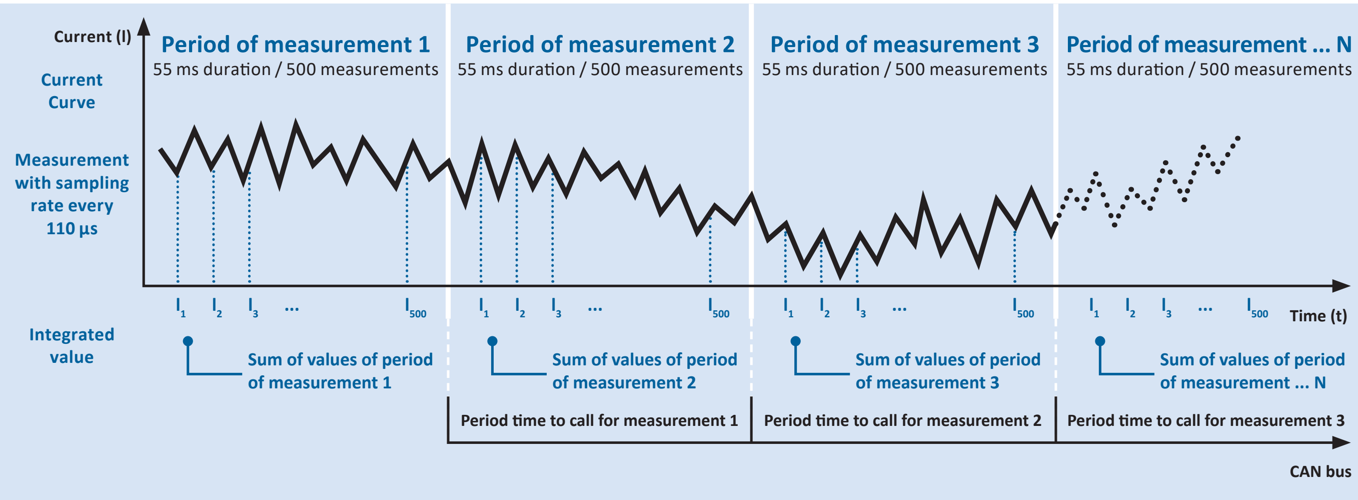
- 2 height units (HU)
- up to 5 BCS modules at max. 3 A source

(1) Not included with BCS products.

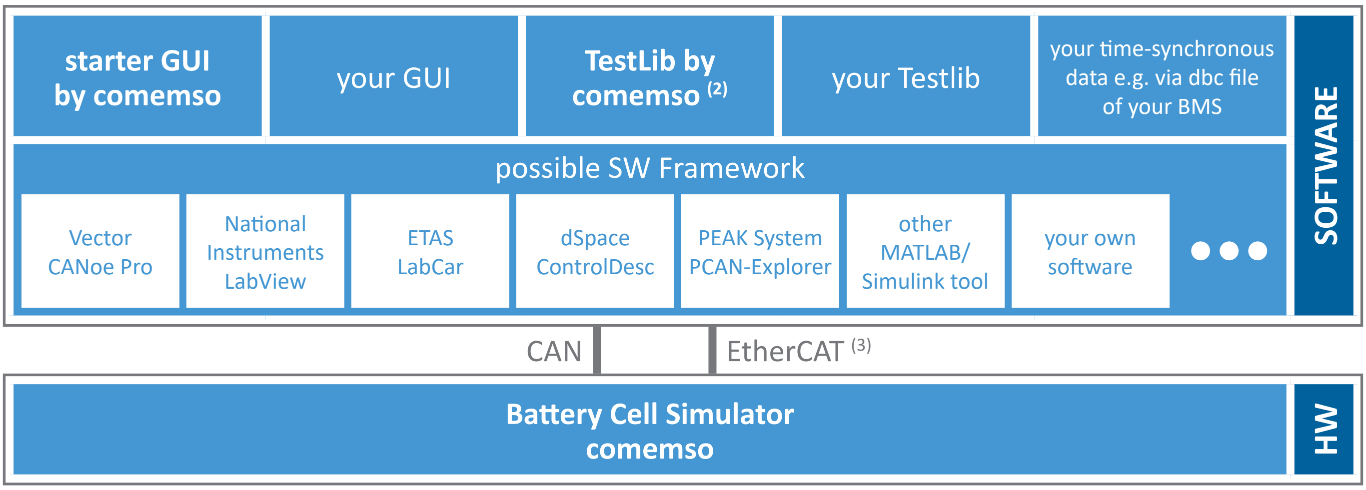
The Coulomb current measurement shortly explained.

If you take a current measurement at a high frequency, but you only get a lower sample rate from your host PC to request these measurements, you lose important information, e.g. for the verification of your compensation algorithm[1].
To minimize this effect, the "Extended" version of the BCS cards has an internal integration of current values which are measured every 110 µs. In total, 500 measured values (=55 ms) are added. This result is converted into a physical value by means of calibration data and can then be read out via the CAN bus. The flag "Coulomb Measurement (NewValue)" in the CAN message is set to TRUE and after transmission back to FALSE.

Description of the Coulomb current measurement principle. (Charging/discharging measurement)



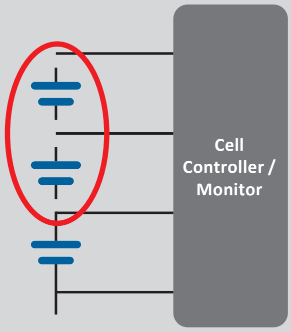
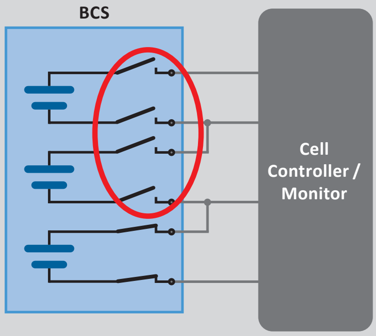
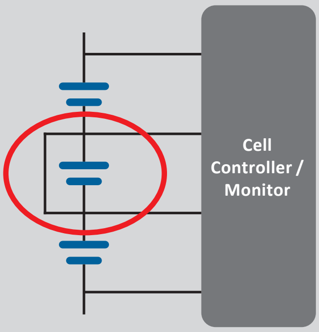
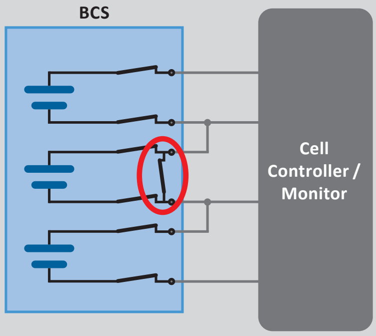
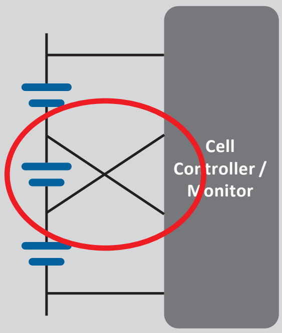
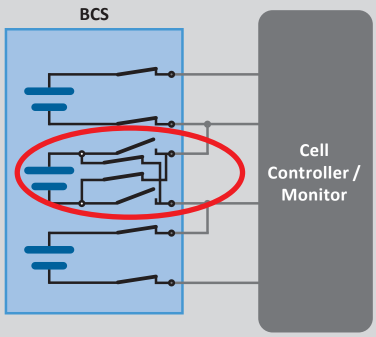
The basic system architecture with ideally matched hardware and software.



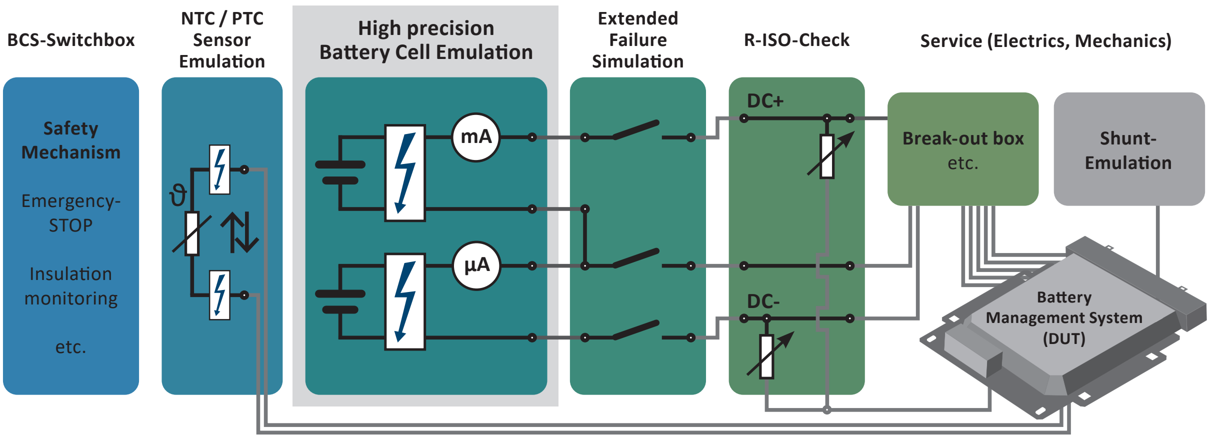
System architecture with worldwide established components in the automotive sector for a ready-to-use system with a short introduction effort.
(1) from "Basic"-version and higher | (2) engineering service | (3) on demand

ES France - Département Puissance Energie - 127 rue de Buzenval BP 26 - 92380 Garches
Tél. 01 47 95 99 45 - Fax. 01 47 01 16 22 - e-mail: tem@es-france.com - Site Web: www.es-france.com

Integrated failure simulation for each cell.

No.	Test case failure simulation	Sketch	Realisation
1	a) Connection of different cells to the BMS. b) Broken cell stack. Cause: a) Such as a sequenced connecting of the cells to the BMS by the ECU connector. b) Cable/connection breakage.		
2	Short circuit of one cell. Cause: Defect of cell or failure on cell controller.		
3	Polarity change of a cell. Cause: Mistake in cabling.		

BMS test bench extendable by further failure insulation, measurements and emulation.



All solutions above are comemso products. Further information about the individual products can be found as a brochure at comemso.com or on request at sales@comemso.de.

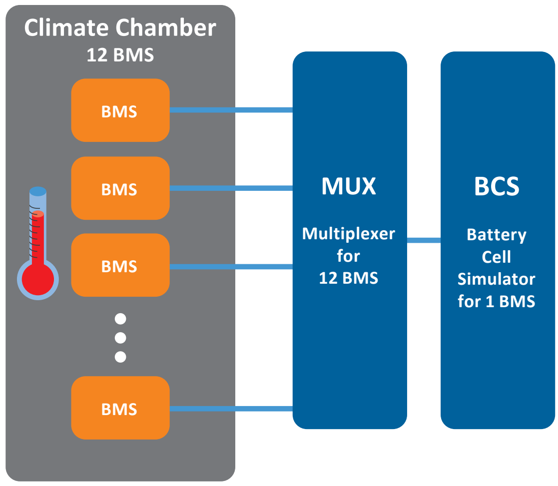
Battery cell simulation especially for End-Of-Line (EOL) testing.

The focus of End-Of-Line tests are different from the conventional battery cell simulation, therefore comemso offers a special end-of-line version of its battery cell simulator. This type of tests requires a higher accuracy, as this process is also used for the calibration of BMS cell measurements. However, a lower dynamic range is also required, since the validation of the balancing algorithm is not the key focus. You will find the differences in the technical data.

Prepared for all climatic conditions.

The robustness of a BMS should not only be guaranteed under the best conditions, but also in rough climate situations. Battery Management Systems must ensure that all safety algorithms work, even in cold and hot areas or under salty or sandy conditions. Many Tier1s therefore include a climate chamber in their end-of-line tests to ensure that they can guarantee full performance under all conditions throughout the life of the EV.

A time-efficient production is very important, but the start-up of the climate chamber is time-consuming. Comemso therefore offers a cost effective solution where you can place up to 12 BMS in a climatic chamber, ramp up or down the temperature and perform all EOL tests shortly for one after the next BMS. To achieve this, a multiplexer (MUX) of the Battery Cell Simulator is used. This MUX is designed to maintain the high accuracy of cell emulation required for EOL testing.



The block diagram shows an example of 12 BMS as described in the table below. A custom number of BMS is also possible.

MUX configurations:

Quantity	Cells	FSU support	Channel A	Channel A+B[1]
3 BMS	24 .. 200	●	●	
6 BMS	24 .. 200	●	●	●
12 BMS	24 .. 200	●	●	●

***Note:** Several customers also use comemso's MUX to extend full test automation of various BMS in the development stage.*

[1]Channel B can be used to power the BMS (e.g. 11 pcs) to keep them "alive" while another BMS is being extensively tested.

Battery Cell Simulator **for Development.**

Technical data:

GENERAL	
Communication	CAN bus/EtherCAT
Temperature range	Lab conditions
Resolution on timing	500ns (Pulse and pause of PWM)
Connector	115V/230V or CEE 3 x 16A
Isolation cell/communication	2kV
Isolation cell/cell	60V
Amount of cells	12 .. 204
Cells per rack	up to 144
Safety	Integrated emergency shutdown management
CELL SUPPLY SOURCE PER CELL	
Voltage range	0.01 .. 8V
Nominal current	0 .. 6.0A
DC Accuracy	+/-0.5mV
Ripple	+/- 3mV (fg = 5kHz)
Step response 1 to 4V	ca. 0.3ms
Step response 4 to 1V	1 .. 10ms (depending on load)
Short-circuit-proof	yes
INTERNAL ELECTRONIC LOAD PER CELL	
Nominal current	► 0 .. 5A basic ► 6 A with HiCurrent variant
Resolution	200µA (over CAN bus controlled)
Constant current	yes

ELECTRIC FAILURE SIMULATION PER CELL	
	► Broken wire ► Short circuit ► Polarity reversal
MEASUREMENT SYSTEM PER CELL [mA]	
Range	+/- 6.5A
Accuracy	+/- 2mA
MEASUREMENT SYSTEM PER CELL [µA]	
Range	+/- 10mA
Accuracy	+/- 10µA
COULOMB MEASUREMENT PER CELL (SINGLE MODE)	
Accuracy	+/- 3mA*0.1ms = +/- 3*10^-7As
Resolution	+/- 0.2mA*0.1ms = +/- 2*10^-8As
Sampling time	110µs
CAN resolution	1/10000mC
Measurement range	+/- 6.5A
Averaging	No averaging (integration is sufficient)
Hardware filter (Baseboard rev. 7.2.6)	100 R, 47nF = 29µs

Overview of variants:

Product variant	Light	Light + F	Basic	Basic + F	Basic + F + µA	Basic + F + HiCurrent	Full
Height	2 HU	2 HU	2 HU	2 HU	2 HU	2 HU	2 HU
Cells per module	12	12	12	12	12	12	12
Max. number of cells	204	204	204	204	204	204	204
Source [1]	1.0A	1.0A	5.0A	5.0A	5.0A	6.0A	6.0A
Sink [1]	1.0A	1.0A	5.0A	5.0A	5.0A	6.0A	6.0A
Fault simulation		●		●	●	●	●
Current measurement µA					●		●
Current measurement +/- 5A	●	●	●	●	●	●	●
Fast current measurement (Coulomb)			●	●	●	●	●
CAN-Baud rate 500kBd	●	●	●	●	●	●	●
CAN-Baud rate 1MBd	●	●	●	●	●	●	●

[1] Sink and source: values can be reached separately – not in combination. Example: If sink has 2.0A setting, then the source is only max. 2.9A (4.9 .. 2.0A)

Battery Cell Simulator
for End-Of-Line Test.

Technical data:

GENERAL	
Communication	CAN bus/EtherCAT
Temperature range	Lab conditions
Connector	115V/230V or CEE 3 x 16A
Isolation cell/communication	2kV
Isolation cell/cell	60V
Amount of cells	12 .. 204
Cells per rack	up to 144
Safety	Integrated emergency shutdown management
CELL SUPPLY SOURCE PER CELL	
Voltage range	0.85 .. 6.5V
Nominal current	0 .. 5.0A
DC Accuracy	+/-0.3mV
Ripple	+/- 3mV (fg = 5kHz)
Step response 1 to 4V	ca. 0.3ms
Step response 4 to 1V	1 .. 10ms (depending on load)
Short-circuit-proof	yes
INTERNAL ELECTRONIC LOAD PER CELL	
Nominal current	0 .. 5A basic
Resolution	200µA (over CAN bus controlled)
Constant current	yes

ELECTRIC FAILURE SIMULATION PER CELL	
	► Broken wire ► Short circuit ► Polarity reversal
MEASUREMENT SYSTEM PER CELL [mA]	
Range	+/- 6.5A
Accuracy	+/- 2mA
MEASUREMENT SYSTEM PER CELL [µA]	
Range	+/- 10mA
Accuracy	+/- 10µA
COULOMB MEASUREMENT PER CELL (SINGLE MODE)	
Accuracy	+/- 3mA*0.1ms = +/- 3*10^-7As
Resolution	+/- 0.2mA*0.1ms = +/- 2*10^-8As
Sampling time	110µs
CAN resolution	1/10000mC
Measurement range	+/- 6.5A
Averaging	No averaging (integration is sufficient)
Hardware filter (Baseboard rev. 7.2.6)	100 R, 47nF = 29µs

Overview of variants:

Product variant	Light	Basic	Basic + F + µA
Height	2 HU	2 HU	2 HU
Cells per module	12	12	12
Max. number of cells	204	204	204
Source (1)	1.0A	5.0A	5.0A
Sink (1)	1.0A	5.0A	5.0A
Fault simulation			•
Current measurement µA			•
Current measurement +/- 5 A	•	•	•
Fast current measurement (Coulomb)		•	•
CAN-Baud rate 500 kBd	•	•	•
CAN-Baud rate 1 MBd	•	•	•

(1) Sink and source: values can be reached separately – not in combination. Example: If sink has 2.0A setting, then the source is only max. 2.9A (4.9 .. 2.0A)

The modular Battery Cell Simulator - a little insight into possibilities.

Mid-Size BCS
36 Cells +
Customization

Mid-Size BCS
60 Cells + Customization

Mid-Size BCS
24 – 60 Cells +
Temperature
emulation etc.

Small-Size BCS
12 Cells +
R-ISO Check

Small-Size BCS
12 – 36 Cells

Full-Size BCS (two systems)
2x 156 Cells + Customization

Full-Size BCS
96 – 200 Cells or more + Temperature emulation etc.

Full-Size BCS
120 Cells + Customization

Mid-Size BCS
72 Cells + Temperature emulation etc.

Full-Size BCS
2x 120 Cells = 240 Cells + Customization

Full-Size BCS
3x 96 Cells for End-Of-Line Test

Mid-Size BCS
60 Cells + Temperature emulation etc.

Mid-Size BCS
36 Cells + Customization, Extendable


comemso
www.comemso.de

Please scan or photograph the completed sheet and send it to sales@comemso.com. Alternatively, you can download a PDF file from www.comemso.com/BCS_Specification_Sheet.pdf

Specification sheet for Battery Cell Simulator (BCS).

In order to provide you with the most accurate offer possible, we kindly ask you to answer the following questions about your technical requirements:

Company: ______________________ Name: ______________________

Department: ______________________ Mail: ______________________

Street: ______________________ Phone: ______________________

ZIP/City: ______________________ Country: ______________________

A. I am a: ☐ EV manufactor ☐ BMS manufactor ☐ Chip manufactor ☐ Integrator ☐ Other ________

B. I do: ☐ Research ☐ Development ☐ Production / End of Line (EOL) test

1. Cell simulation / emulation
   a) How many cells should be simulated? ______ Cells (204 Cells possible)
   b) Which balancing current is needed? In the source ______ A (passive balancing), in the load: ______ A (active balancing).
   c) Equipment options:
      ☐ mA + Coulomb measure ☐ µA measure ☐ Standard Fault sim ☐ Extended Fault Simulation (FSU)
   d) Connection to test device:
      ☐ Cable set (open wire) ☐ cable set + Cascading Box ☐ Break-out-Box (lower accuracy)

2. Temperature simulation
   Amount of channels: ______ ☐ with fault simulation

3. Insulation resistance
   Changeable for isolation measurement test of DUT (Device under test): ______ channels

4. BMS current measurement test
   ☐ by shunt emulation (-150 mV .. +150 mV) ☐ by current sensor emulation (-6 V .. +6 V)

5. Housing and components
   ☐ Rack / table system needed ☐ Integration in customer's rack / table system
   ☐ Switch box (with emergency stop etc.) ☐ Switch box (with emergency stop etc.) and insulation monitor

Remarks: ______________________

6. Control and communication software
   a) Is a software needed? ☐ PCAN ☐ CANoe ☐ NI LabVIEW ☐ ETAS LABCAR
      ☐ dSpace ControlDesk ☐ other MATLAB tool ☐ other: ______________
   b) Is a startup project needed? ☐ for PCAN ☐ for CANoe ☐ for NI LabVIEW ☐ for ETAS LABCAR
      ☐ for dSpace ControlDesk ☐ for other MATLAB tool ☐ for other: ______________
   c) Needed interfaces? ☐ CAN (incl.) ☐ EtherCAT (surcharge)
   d) Further requirements: ______________________

7. Project conditions
   a) Number of test systems needed? ______________
   b) When does the project start? ______________ c) What is you project budget? ______________ €/$
   d) Is there a specification? ☐ Yes ☐ No If yes, please provide.
   e) Are other departments involved in the project? ☐ Yes ☐ No
      If yes, who are the contact persons? ______________________
   f) Who is the technical contact person for the project? ______________________
   g) Who is the responsible purchaser? ______________________
   h) Who releases the project final? ______________________
   i) Is a pilot installation planned? ☐ Yes ☐ No

8. Is an extension planned in the next 1-2 years?
   ☐ ☐

Space for your notes.

For details and individual configurations, please contact: sales@comemso.de

Space for your notes.

For details and individual configurations, please contact: sales@comemso.de

comemso GmbH
Karlsbader Str. 13
D - 73760 Ostfildern
Mail: sales@comemso.de
Phone: +49 711 982 98-200

comemso_BCS-COMPACT_2021-01