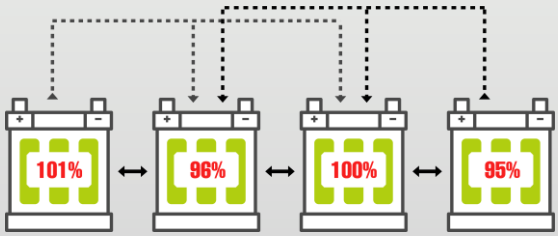
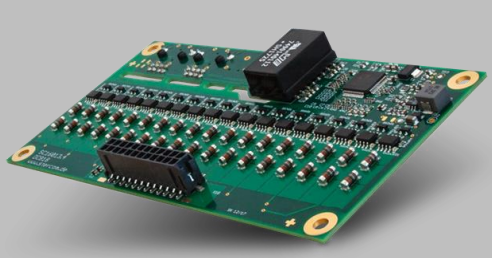
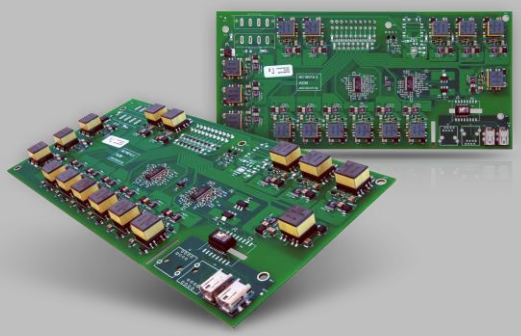
Advanced Cell- and Battery Management



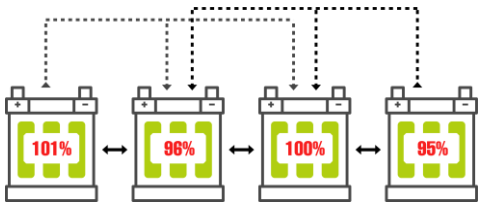
- ✓ Safe, Intelligent Cell Monitoring and Management
- ✓ Scalable Tree Structure for very big Cluster structures
- ✓ Isolated CellCom interface for high voltage stack arrangements
- ✓ All Lithium or UltraCap cell technologies
- ✓ Precise SoC measurement
- ✓ Patented SoH measurement of the battery down to individual cell level

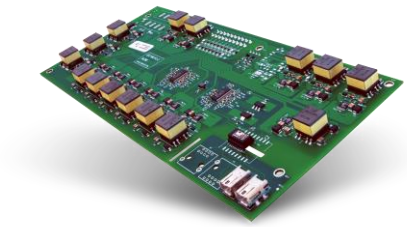




ACT „Active-Charge-Transfer" Balancing

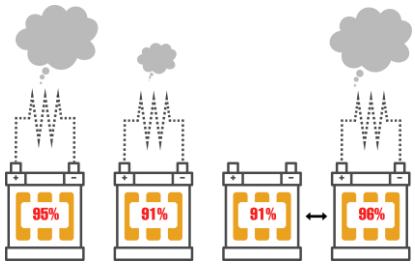
- ✓ Active charge transfer moves charge from one cell to the module
- ✓ High balancing currents of up to 5 Apeak, max. 3 Arms
- ✓ Charge transfer efficiency up to 92%
- ✓ Support of the weakest cell in the stack allows DoDs up to 100 % of total battery capacity
- ✓ Very low standby losses
- ✓ Ideal for bigger LiION Cells, configurable for all cell technologies up to 4.2 V cell voltage

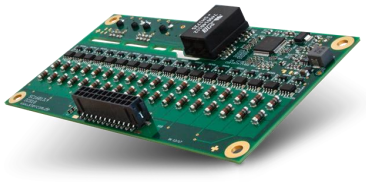




DCB Dynamic Cell Balancing

- ✓ Dynamic Cell Balancing allows for adjustment of deviating cells even with low SoC
- ✓ Typical balancing currents 0.45 A @ 2,7 V cell voltage
- ✓ Suitable for all cell technologies up to 5 V cell voltage
- ✓ Cell monitoring from 0.3 V is suitable for UltraCaps

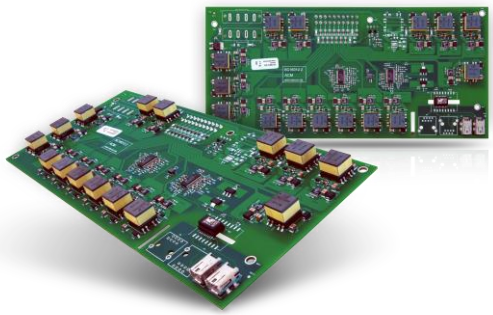


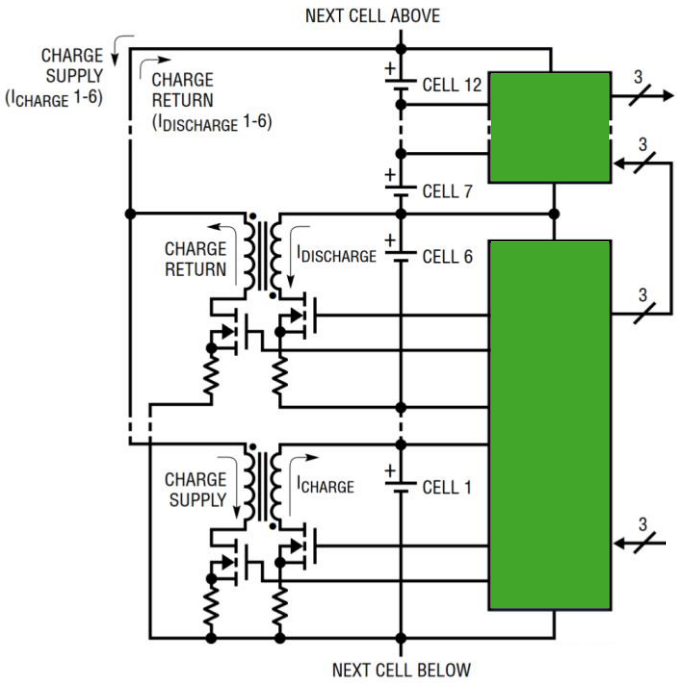


Active Charge Transfer Balancing (ACT)

Highlights

- ✓ Active cell balancing with high precision cell monitoring
- ✓ Suitable for all kinds of high Ah battery cells and supercapacitors (UltraCaps)
- ✓ High transfer currents (< 5 A peak) for rapid cell balancing
- ✓ Integrated temperature-monitoring (two per module)
- ✓ Scalable for high stack voltages





Functionalities

- ✓ Up to 92 % charge transfer efficiency using isolated flyback-converters per cell
- ✓ Scalable up to 1.500 V stack voltages
- ✓ Precise cell voltage measurement with 1 mV resolution
- ✓ Monitoring & Balancing even during battery charging and discharging mode
- ✓ Variable cell configuration with up to 16 cells per module (ACT16)
- ✓ Inter Module Charge Transfer via "Power Daisy Chain"
- ✓ Communication with the Stercom String Management Controller (SMC) via isolated CellCom bus (Data Daisy Chain)

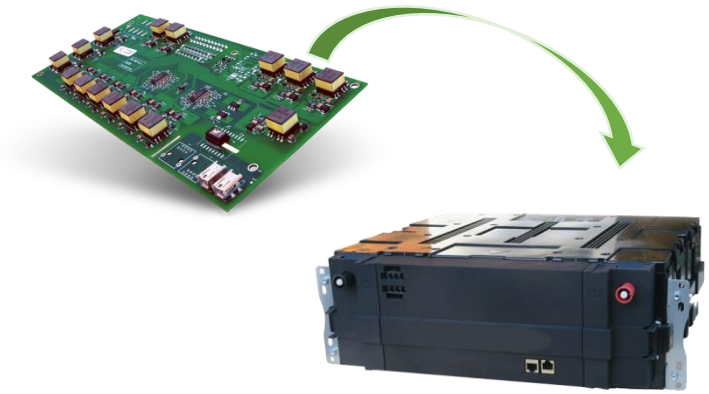
Active Charge Transfer Balancing (ACT)

Technical Data ACT

	ACT16	Comment
Cells per board/module	Up to 16	
Max. board voltage	80 V	
Min. board voltage	10 V	Minimum Board supply voltage
Balancing current	< 5 Apeak, 3 Arms	Unidirectional
Charge Transfer Efficiency	Up to 92 %	
Isolation test voltage	3000 VAC for 1 Minute	According to VDE AR-E 2510, DIN EN 62477-1, 61800-5-1
Standby consumption	<1 mW	
Resolution of the cell voltage measurement	1 mV	1.2 mV total measurement accuracy
Board dimensions	264 x 125 mm	
Digital Interfaces	CellCom	Isolated bus for up to 16 hosts
Temperature sensors	2 external NCT + 1 on-board NTC	
Power Daisy Chain		Charge Transfer into the next module in a serial arrangement

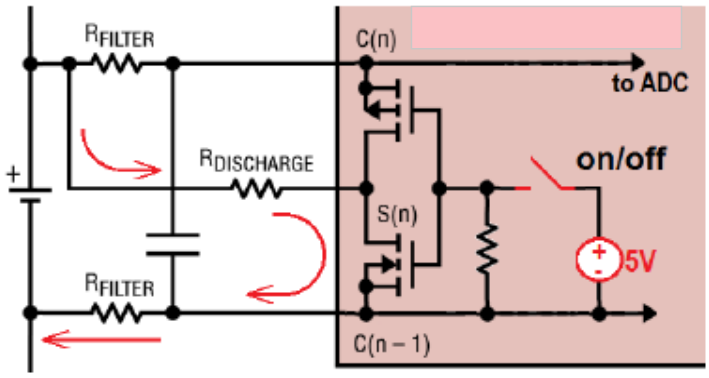
Applications

- ✓ Low and high-voltage applications with high capacity LI-Ion batteries
- ✓ Up to 1.500V stack voltages
- ✓ Hybrid energy storage systems



Dynamic Cell Balancing (DCB)

- ✓ Precise measurement of the single cell voltages with 1 mV resolution
- ✓ Dynamic balancing of unsymmetrical cells even at low SoC
- ✓ Independent max balancing to protect the cell from over-charging
- ✓ Isolated temperature measurements on the board
- ✓ Isolated external NTC temperature sensors per board
- ✓ Powered from the Battery/UC-Module
- ✓ Very low power consumption and sleep mode
- ✓ Full monitoring function already at 5 V module voltage through a built-in power supply
- ✓ Safe & Isolated communication to the String Management Controller (SMC) via Data Daisy Chain (CellCom)
- ✓ Variable cell configuration with up to 18/24 cells per module (DCB18/24)
- ✓ Scalable up to 1.500 V stack voltage



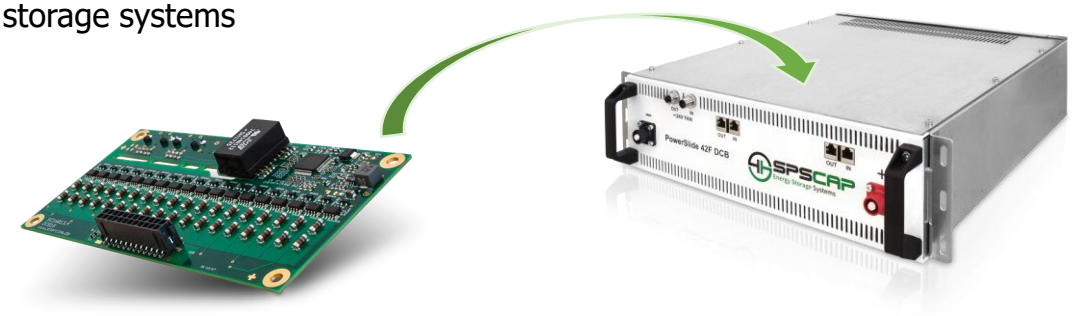
Dynamic Cell Balancing (DCB)

Technical Data DCB

	DCB18	DCB24	Comment
Cells per board/module	18	24	
Max. voltage of the board	90 V	120 V	
Min. Voltage of the board	5 V	5 V	Voltage booster for operations from 5V
Balancing current	450 mA @ 2.7 V	350 mA @ 4.2 V	
Isolation test voltage	3.000 VAC for 1 min		According to VDE AR-E 2510 eg. DIN EN 62477-1 or 61800-5-1 or other applicable standard
Standby consumption	1 mW		
Resolution of the cell voltage	1 mV		1.2 mV total measurement accuracy
Dimensions	150 x 75 mm	110 x 80 mm	
Digital interfaces	CellCom		Isolated bus with up to 30 hosts
Temperature sensors	5 outboard NTC + 4 onboard NTC	2 x outboard NTC + 2 x intern NTC + 1 x ext. Linear Heat detection	

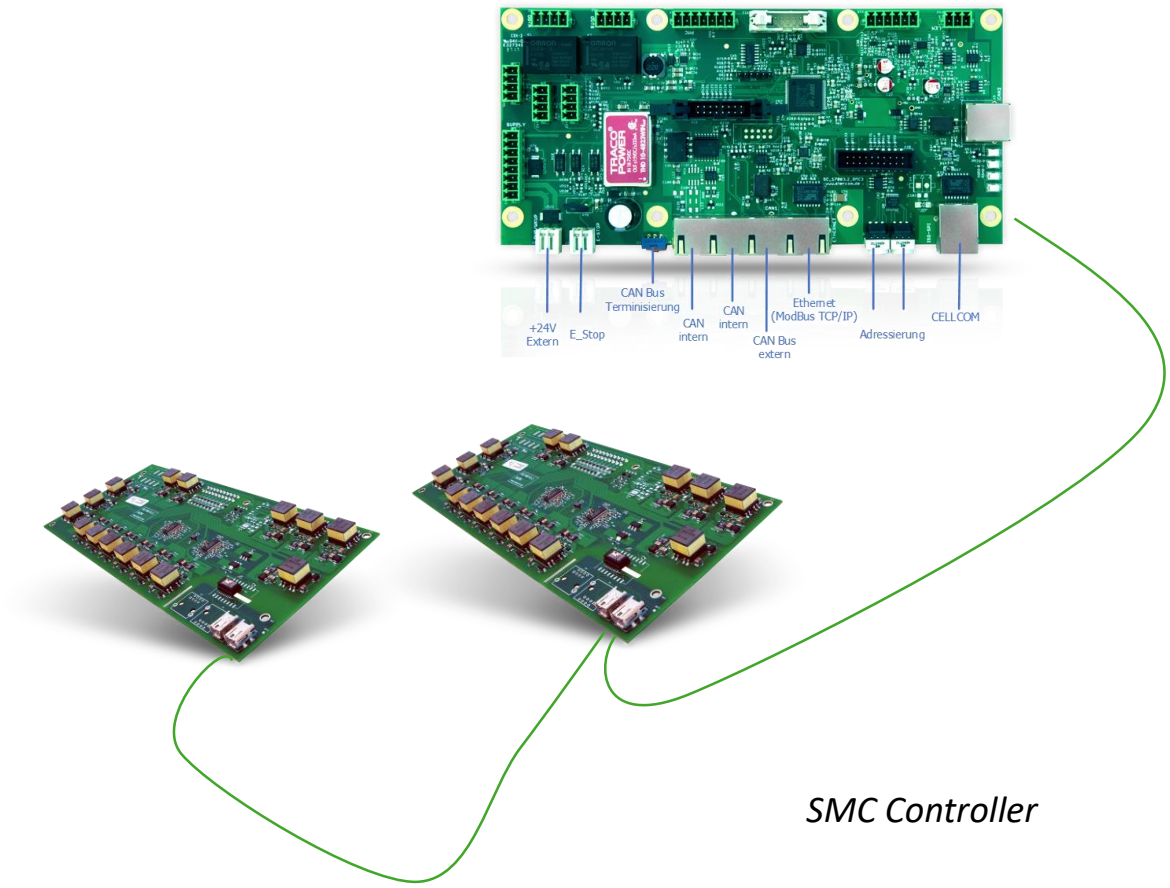
Applications

- ✓ Intelligent UltraCap modules (eg. PowerSlide)
- ✓ Intelligent Li-Ion modules
- ✓ Stack arrangement up to 1.500 VDC String Voltage
- ✓ Hybrid energy storage systems



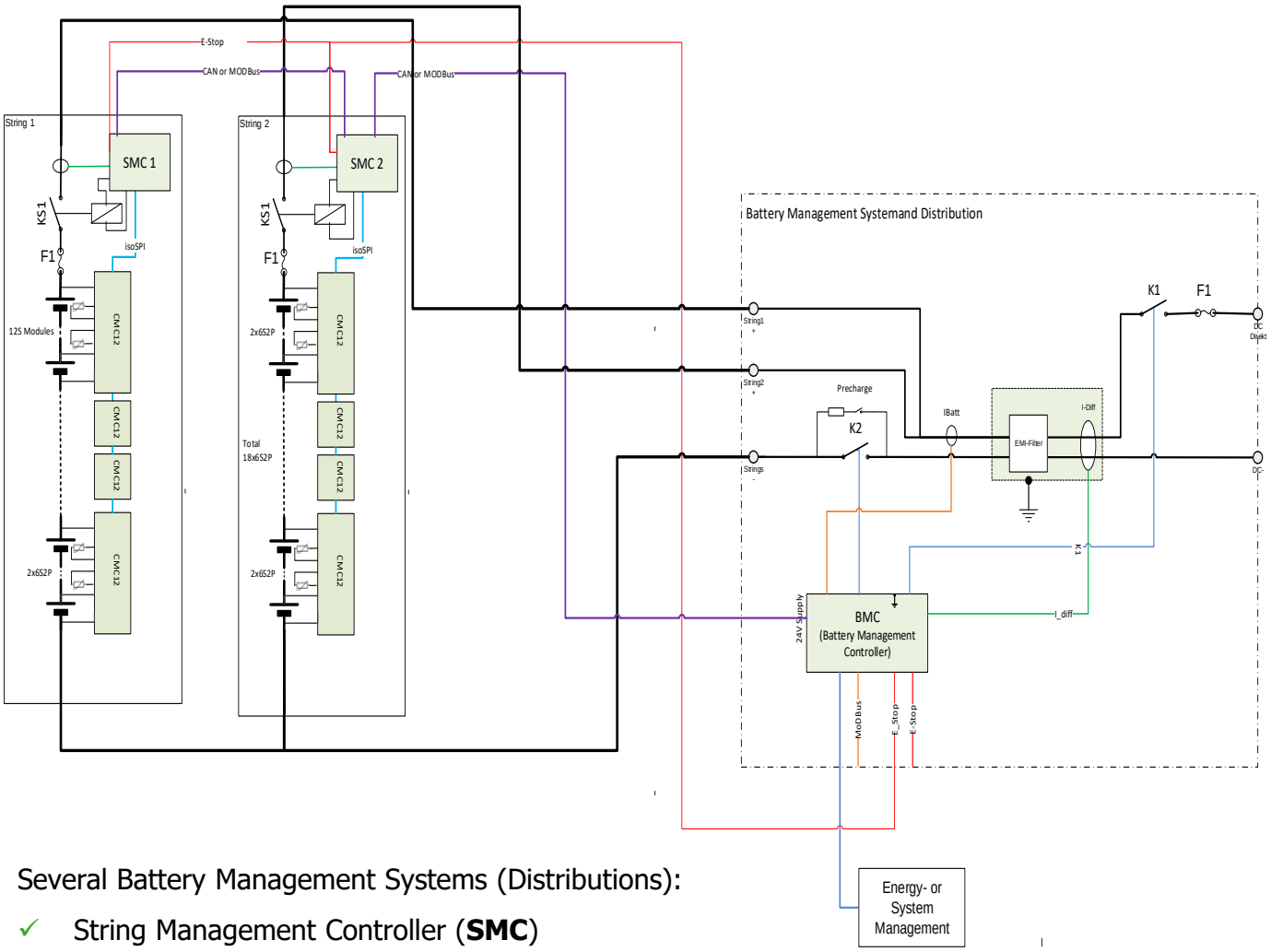
String Management Controller (SMC)

- ✓ Isolated CellCom bus for up to 30 DCB18/24 per string
- ✓ Isolated power supply with input voltage range from 18…75 V
- ✓ Optional current measurement for detection of state of charge (SoC) and state of health (SoH)
- ✓ Grouping of several strings for big battery clusters via CAN Cluster Bus
- ✓ Interface for 2x contactor or 1x static switch control
- ✓ Communication link to the charger or energy management via external interfaces
  - ModBus TCP/IP
  - CAN
- ✓ Auto Setting of Cell Types and Battery Configuration
- ✓ Address selection switch for cluster applications with several strings



SMC Controller

Typical ESS Arrangements



Several Battery Management Systems (Distributions):

- ✓ String Management Controller (**SMC**)
- ✓ Coordination and Monitoring of Battery Strings
- ✓ Communication to a System Energy Management via CAN, MODBus or Ethernet
- ✓ Visual Studio Service and Monitoring Interface
- ✓ Redundant Battery current and voltage monitoring
- ✓ Pre-charge feature

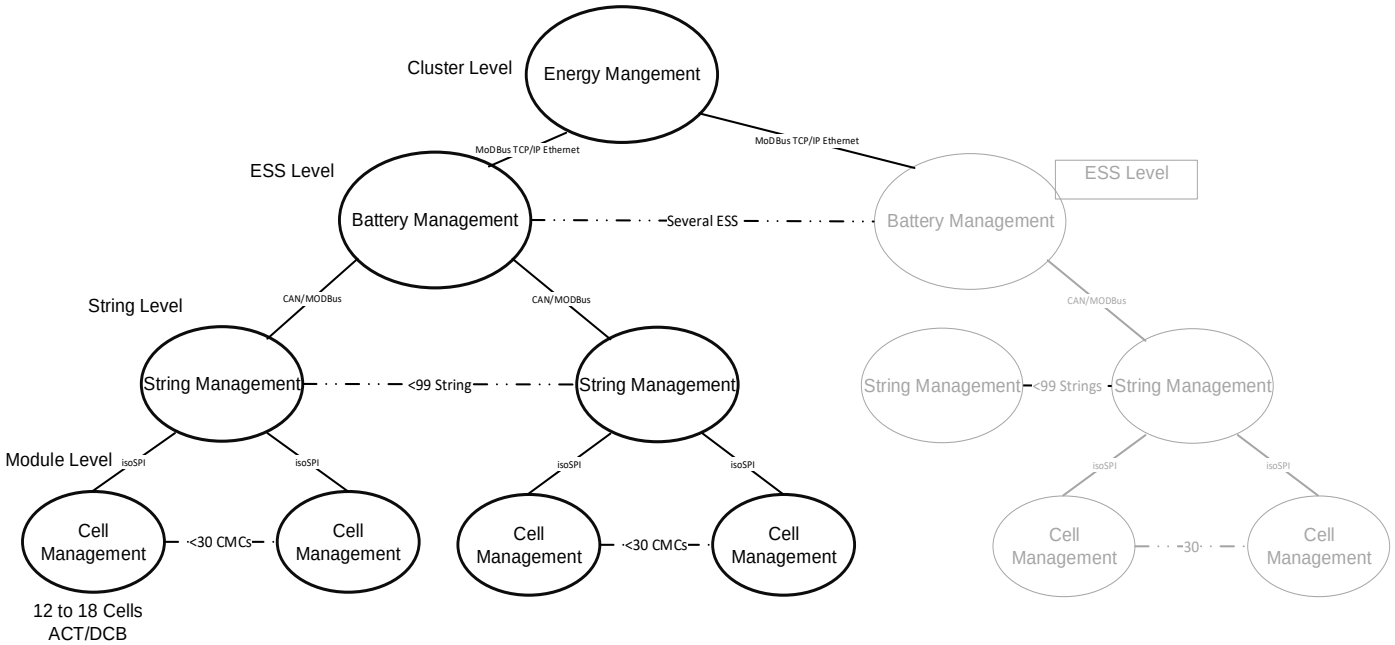
Up to 99 Strings with:

- ✓ String Management Controllers **SMC**
- ✓ Communication from SMC to all SMCs via CellCom
- ✓ Communication from SMC to Cell Balancing Units (CBU) via CAN or MODBus
- ✓ String Auto-Configuration
- ✓ String Auto Connect/Disconnect mode

Up to 30 **SMC**s per String with:

- ✓ 16, 18/24 Cells per SMC
- ✓ Precise Voltage monitoring
- ✓ Precise Temperature monitoring
- ✓ Active or Dynamic Cell Balancing
- ✓ Communication via isolated CellCom

ESS Communication Tree



- ✓ Automatic Detection of SMC arrangement
- ✓ AutoConfig Features to automatically detect number of modules/number of strings
- ✓ AutoConfig Mode on String Management level
- ✓ Flexible Scaling to very big ESS or Energy Cluster System
- ✓ Standard- or Custom- Interfaces to the Energy Management
- ✓ Access of overview Data or detailed information down to cell level by Energy Management
- ✓ Firmware Download Features through the whole structure

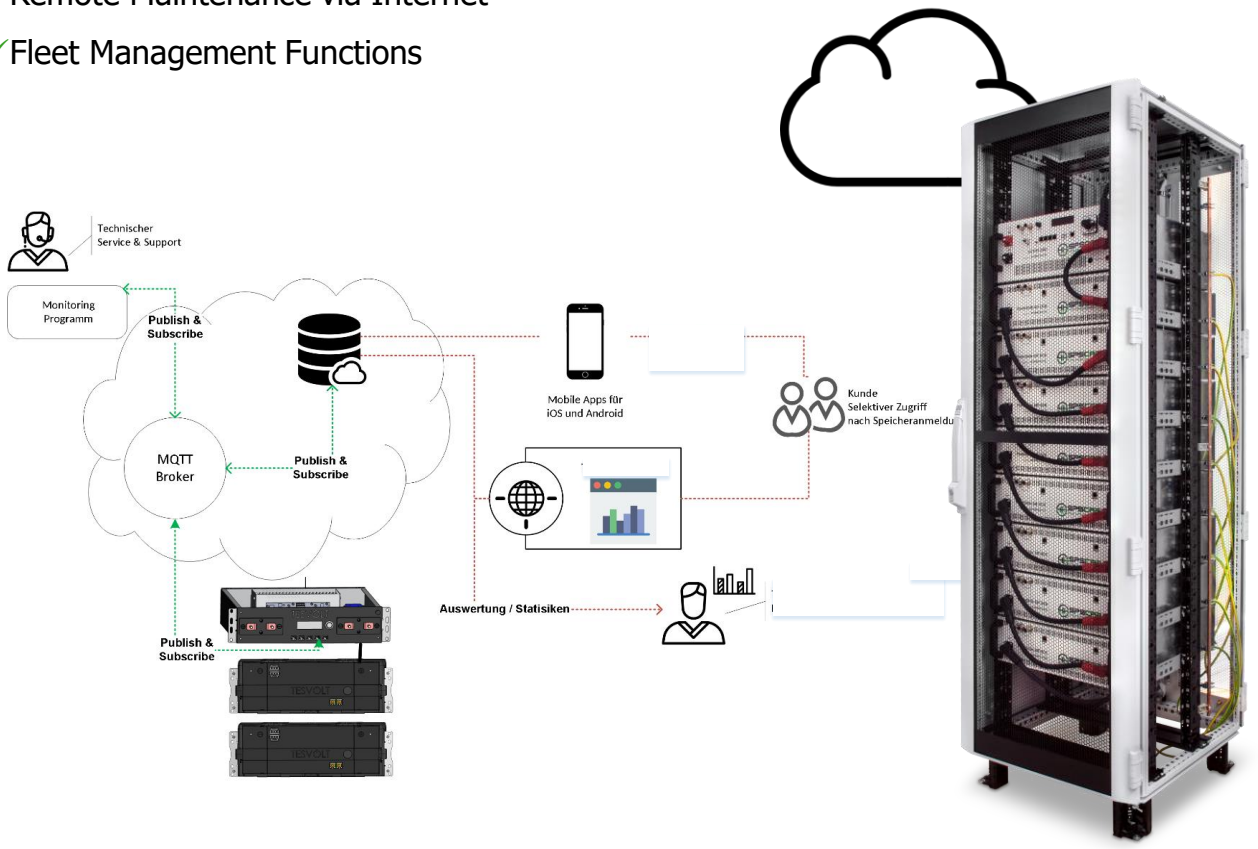
Stercom Visalisation and Portal

Stercom „Visual Studio" Portal

✓Service and Maintenance Portal for external access

✓Remote Maintenance via Internet

✓Fleet Management Functions



Stercom Visual Studio

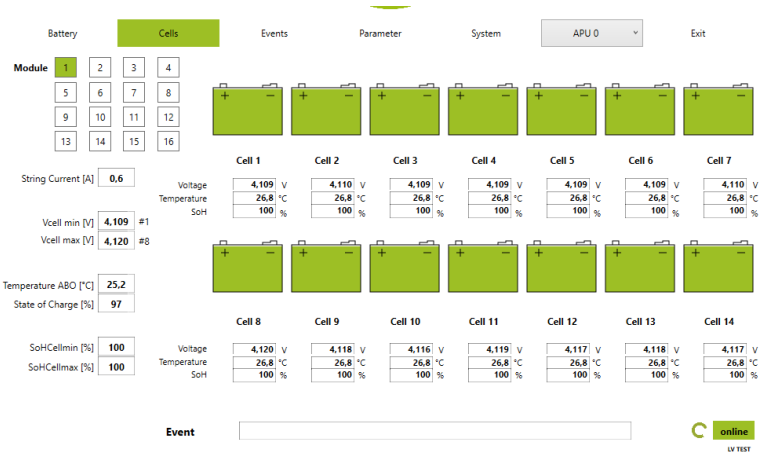
✓Visualizing of Cluster, String, Modul and Cell-Status

✓Event- and Error Buffer for easy Trouble Shooting

✓Remote Parameter Settings

✓Firmware Updates

✓Easy to use



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