



Low voltage - Battery module (System voltage 52 V)



Lithium iron nano-phosphate cell

## eSafe Battery modules 2,4 kWh

Data sheet, last updated 08/2018

- Each module self-sufficient
- Integrated control
- Newly developed protection (Pyrofuse)
- High accuracy current measurement (shunt measurement)
- Retrospective expandable (up to 16 modules per string)

With eSafe you can reduce energy costs and also consume self-generated solar power on your own. Just like a real "safe", the eSafe keeps and preserves the valuable solar energy until you need it.

### BATTERIES "MADE IN GERMANY"

The eSafe is equipped with 16 gas-tight, cylindrical lithium iron anophosphate cells from our own production in Hamburg. The essential parameters here are longevity, safety, current load, energy density and environmental friendliness.

### BATTERY MANAGEMENT SYSTEM - BMS

The BMS system is an innovative measuring, monitoring and control system with integrated fuse and independent administration. This means that every 19 inch slot/module monitors and controls itself, without an external higher-level control unit or protection.

### ESPECIALLY DEVELOPED FOR THE SAFETY OF OUR BATTERY MODULE: THE PYROFUSE

For measuring we use the shunt measuring method. A specially developed for our battery module Pyrofuse ensures in each eSafe for guaranteed power separation in the event of a short circuit. This innovative system sets new standards for the safety of energy storage systems.

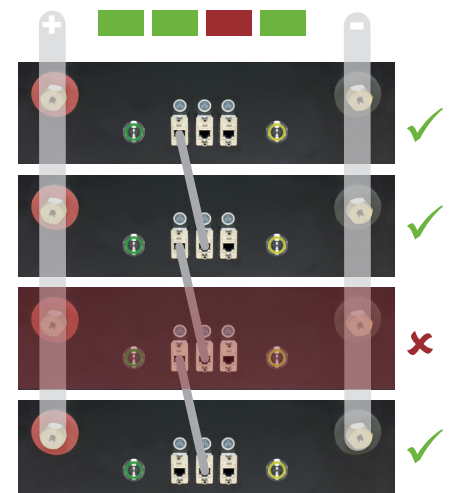
### THE OPERATION IS THAT EASY

- The front buttons activate and program the modules
- Constant illumination of the respective LED confirms the function

During operation, the inverter is controlled accordingly by the master. The data of the slaves are communicated / transferred via CAN-bus. The total SOC of the system is determined by the master, which is also responsible for the release of the Pyrofuse.

The modules are scalable up to 16 pieces per string.

All CAN messages concerning the communication with the inverter are already implemented.



Each module works independently with its own electronic fuse! As a result, there is no complete failure, if a module should not work correctly.

## TECHNICAL SPECIFICATIONS - PER CELL

### Electrical properties

• Nominal voltage at 0.2 C; 25°C	3.3 V
• Specific energy content at 0.2 C; 25°C	158 Wh
• Nominal capacity at 0.2 C; 25°C	48 Ah
• Nominal capacity at 0.2 C; 0°C	ca. 43 Ah
• Capacity at 1 C	ca. 47 Ah
• Internal resistance/impedance up to 1 kHz	0.8 mΩ
• DC resistance (VDA) - 2s discharge 5 C up to 50% SOC; 25°C	< 1.6 mΩ
• Specific gravimetric energy density	138 Wh/kg
• Specific volumetric energy density	250 Wh/l
• Specific gravimetric power density	2685 W/kg
• 2 s pulsed discharge up to 100% SOC; 25°C	
• Specific volumetric power density 2 s pulsed discharge up to 100% SOC; 25°C	4730 W/l

### Conditions of use

• Recommended charging current	bis 48 A (=C)
• Maximum continuous charging current	I < 50 A
• Maximum charging current for 10 sec.	I < 80 A
• Charging cut-off voltage	3.48 V
• Discharge voltage at 0.2 C	U = 2,8 V
• Recommended continuous discharge current	48 A
• Maximum continuous discharge current	I < 80 A
• Recommended operating temperature range	-10° bis +50°C
• Recommended charging temperature range	0° bis +40°C
• Temperature range for storage and transport	-10° bis +45°C
• Cycle stability of 100% DOD at 25°C; 1C/1C	>6000 Zyklen
• Cycle stability of 90% DOD at 25°C; 1C/1C	>8000 Zyklen

eSafe Guarantee / Cycles: 10 years or 8000 cycles, 90 % DoD

## TECHNICAL SPECIFICATIONS - BMS

### Hardware Overview

- Controller: NXP S32K144
- Analog frontend: TI BQ76L455
- Fuse: Pyrofuse

### Cell data measurement

- Number of voltage measuring channels: 16 Measuring range 1 V to 5 V
- Temperature: 5 channels, with 2 additional. Onboard temperature sensors

### Cell monitoring and balancing

- Cell parameters
- Passive balancing with currents up to 500mA @ 3.3V UCELL

### Current measurement

- Current measurement: high-precision shunt measurement

### Communication

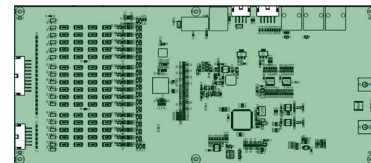
- 2x CAN 2.0B 500kHz, for communication between the master to slaves BMS and Master to Inverter

### Control IOs

- KL15, activate the system
- LED, control over the condition

### Safety

- Exceeding the cell parameters leads to the triggering of the pyrofuse



Controller

The SOC prediction can only be determined by the Coulomb Counting due to the special properties of a LiFePO4 Cell in the middle working range. According to the communication with the inverter, the system is automatically approached to the upper limit to ensure an accurate voltage measurement.