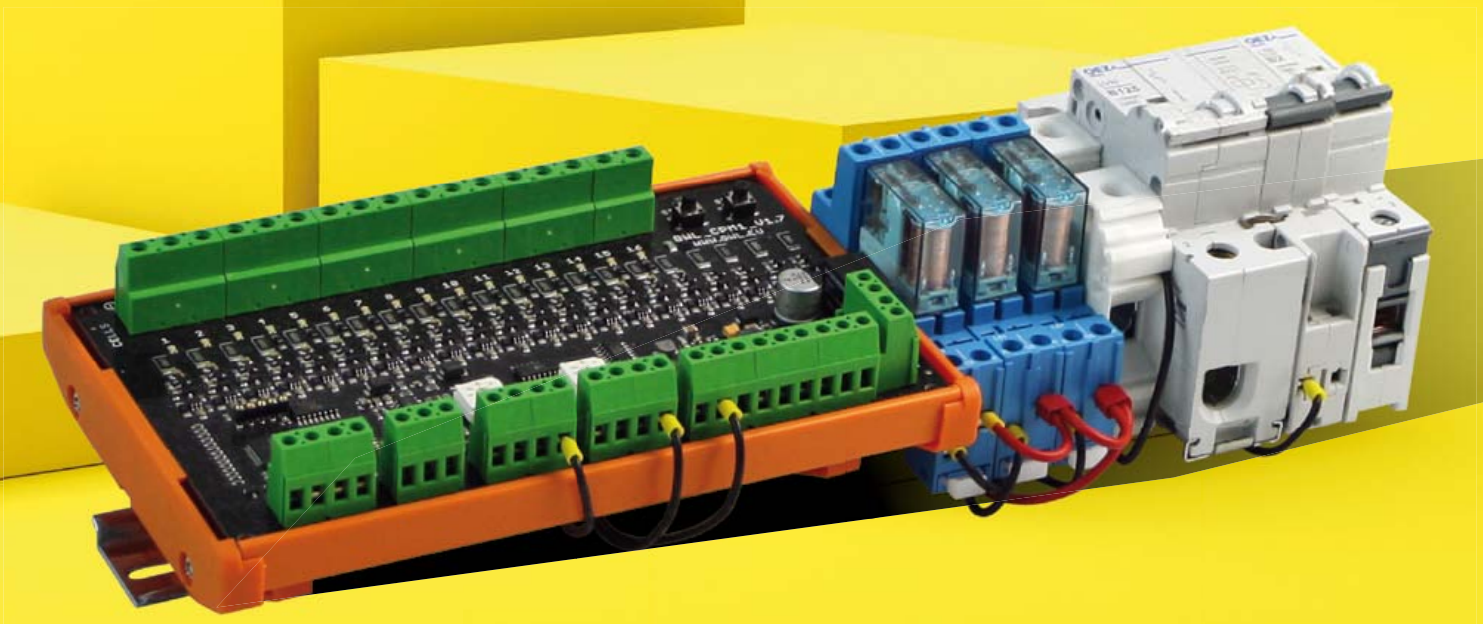




Technical manual

ELE RIX BMS BASIC



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EXM-BMS-Basic
and EXM-BMS-Basic-KIT

Description of Module

The BMS Basic module is a system platform for the management of lithium batteries. Its basic function is the protection of the battery in terms of the voltage of the individual cells and the overall current load.

This functionality is covered by a basic set of selected electrical components on a DIN rail. The module can be extended with functions as required by the application and the customer through additional components.

The module can be delivered as building blocks or at various stages and type of assembly.

MAIN FUNCTIONS AND FEATURES:

- Protection of the battery from dangerous overcharge and discharge on the level of the individual cells
- Protection (circuit breaker) of the basic power circuit and the control circuit from overload or short circuit
- Automatic emergency disconnection of the battery and simple manual disconnection of the battery
- Monitoring of up 16 battery cells and projecting their voltage states to the control outputs
- Large-scale flexibility of the outputs for controlling various devices (inverters, MPPT regulators, chargers...)
- Large-scale flexibility of placement in various applications thanks to assembly on a DIN rail (built-in to the switchboard, rack, plastic distribution board, under a BPF lid...)
- Simple service, replacement of components and extension of functions through additional modules

The module is part of the ELERIX series, meaning it is an open solution that is and will be compatible with additional products and solutions from GWL as well as other similar available components.

Potential Uses

The robust and universal nature as well as the availability of the components and technical support options predestine this module for various industrial applications and complex home installations. Its flexibility allows for the creation of many different solutions for LiFePO₄ and LTO batteries.

- Stationary energy storage – photovoltaic systems, backup sources
- Machines, industrial electromobility, boats, recreational vehicles
- For various LifePO₄ and LTO batteries form 24 to 48V (a max. of 16 cells in a series)
- Can be assembled by the customer with technical support provided by GWL (manual, instructional videos, individual support)
- The option to have the module delivered assembled in a distribution board or integrated in an ELERIX BPF battery box

Functions Explained

Individual battery cells are monitored via the ELERIX CPM module (for more information see the module manual: <https://shop.gwl.eu/Battery-Management/GWL-Cell-Performance-Monitor.html>).

Three auxiliary socket relays with a pair of switch contacts are connected to selected switch CPM outputs. K1 Umin and K2 Umax relays are used for switching on appliances and chargers using software, for the direct switching on of small loads (up to 6A) and to control indicator lights, acoustic alarms, performance relays etc. These relays are permanently switched on when operational (if they are not being used, remove them from the socket to decrease consumption of the module itself). The K3 Uemergency relay is used to disconnect the battery in an emergency. This occurs by switching off the main circuit breaker of the battery (125A) by sending an impulse to its voltage trigger. Control voltage leading to the actual connectors that is primed and can be switched off is also available.

The basic set can be extended to include other circuit breaking, removable and communication features. Some typical extensions are listed in this manual. Various custom user connections can be created using different combinations of components and the way they are connected (including reconnecting the basic BMS Basic version).



WARNING

If the user is connecting all the BMS Basic outputs, it is important to maintain their maximum load according to the values listed in this manual. These values must be adequately lowered for induction and capacity loads!

“Assembly” Set

List of components:

- › ELERIX CPM ----- 1 ks
- › ELERIX CPM ----- 1 pc
- › CPM Holder ----- 1 pc
- › Relay finder ----- 3 pcs
- › Socket finder ----- 3 pcs
- › 6A circuit breaker ----- 1 pc
- › 125A circuit breaker ----- 1 pc
- › 125A circuit breaker voltage trigger --- 1 pc
- › RS clip 35 mm² ----- 1 pc
- › RS clip 2.5 mm² blue ----- 2 pcs
- › RS clip 2.5 mm² red ----- 2 pcs
- › RS terminal cover 2.5 mm² ----- 1 pc
- › DIN rail ----- 1 pc

The components are sent in a package and are designed so that the customer can assemble and connect them him/herself according to basic technical support provided by GWL. It is possible to order the assembly of the module including connecting it as well as other services, e.g. extending it using other components, as part of paid technical support. This basic set is in a scope of 18 modules on a 330mm DIN rail.

“Plastic Distribution Board” Set

The list of components is identical as in the “Assembly” Set. The components are attached and connected in a plastic distribution board on a DIN rail for 22 modules, meaning there is a reserve in the distribution board for adding other components in a scope of 4 modules.

“Rack rail 19”3U” Set

The list of components is identical as in the “Assembly” set. The components are attached and connected on a rack rail for 22 modules; the distribution board has a reserve for adding additional components in a scope of 4 modules.

Technical Specifications

Model

ELERIX BMS Basic – DIN rail

Dimensions, weight

Length/width/height

330/107/80

Weight

Voltage, current, performance

No. of cells of protected LiFePO4 battery min/max

8/16

No. of cells of protected LTO battery min/max

10/16

Voltage of protected battery min/max

24/60V

Capacity of protected battery

No limit

Current value of power circuit breaker

125A

Current value of the circuit breaker in the control circuit

6A

Current load of contracts of auxiliary relays

6A

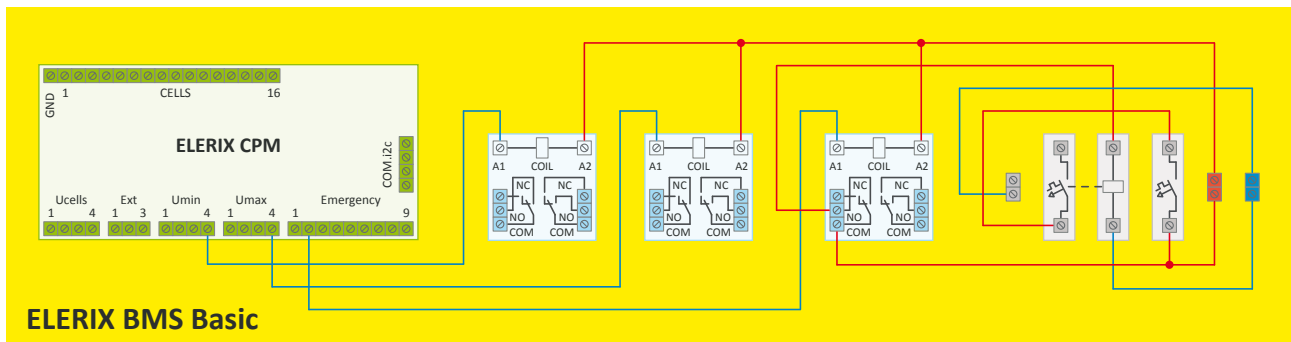
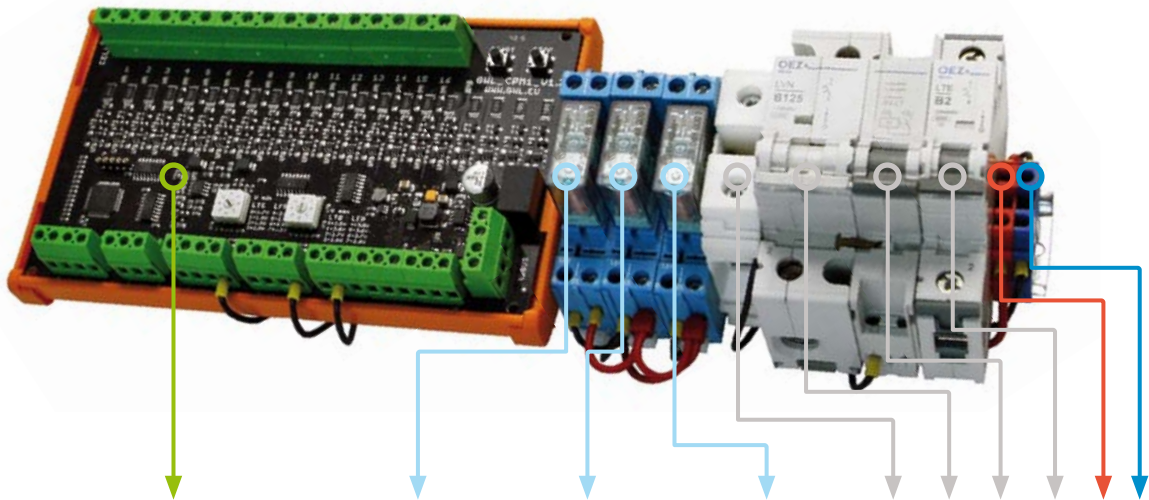
Own consumption of auxiliary relay

0,64W

Own consumption of CPM

0,65W

Identification of Components, Description of Their Outputs and Their Usage



GREEN OUTPUTS

- aux relay switching
- low energy coil power relay switching
- signaling switching

LIGHT BLUE OUTPUTS

- low load switching
- power relay switching
- signaling switching

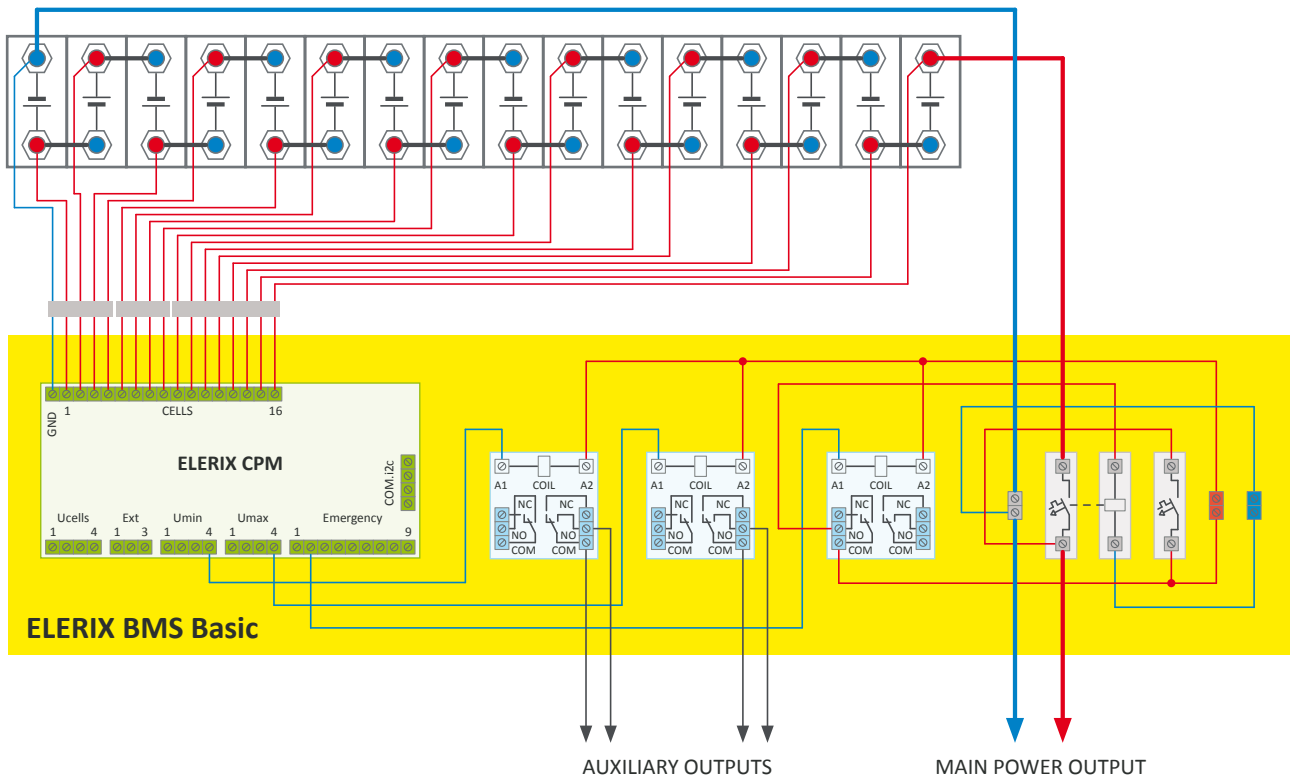
WHITE and GRAY OUTPUTS

- Protected power circuit:
- short circuit
 - overload
 - over/under voltage of any cell

RED and BLUE OUTPUTS

- Protected control circuit:
- short circuit
 - overload
 - over/under voltage of any cellany cell

Module Basic Configuration, Connection and Usage

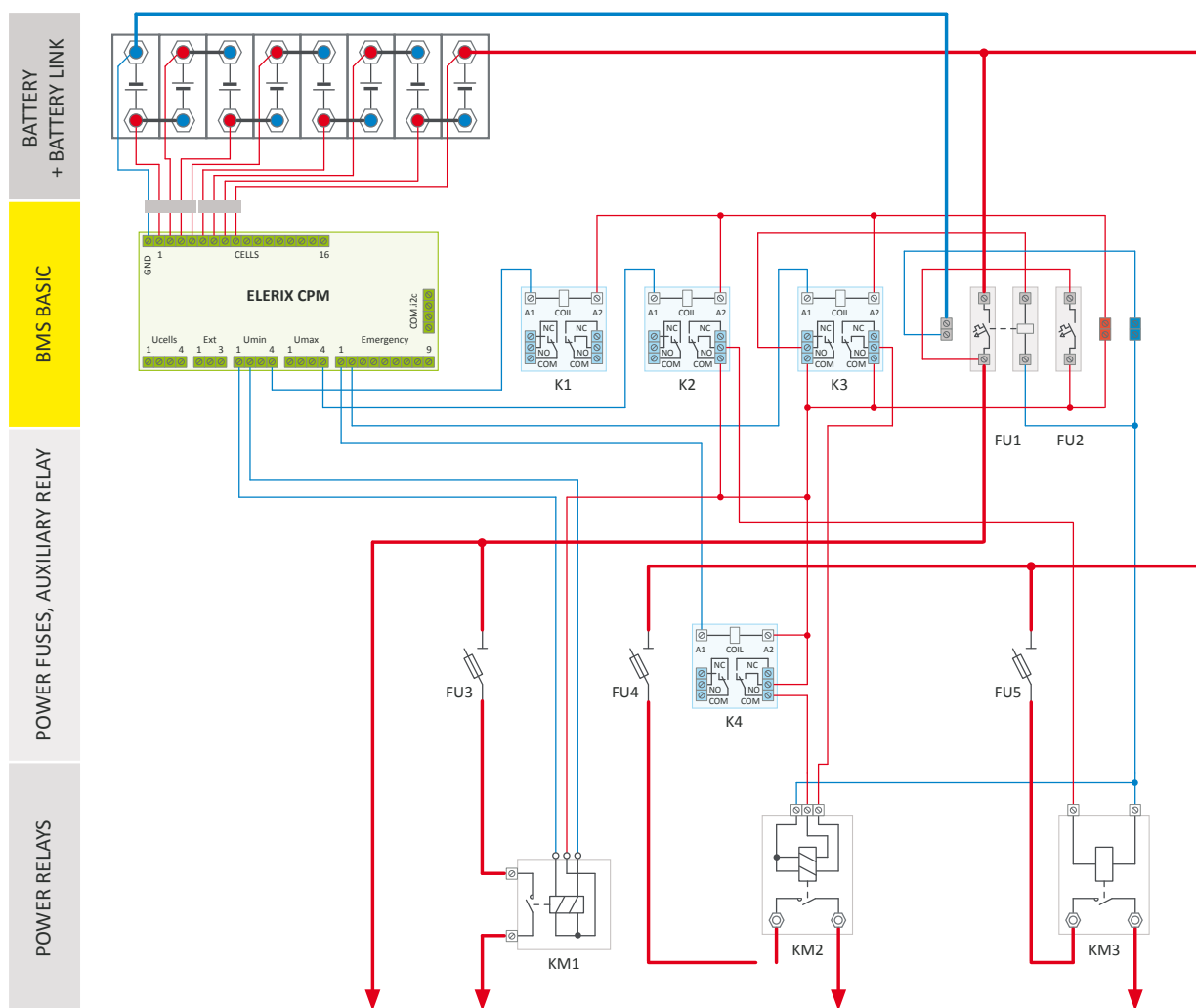


Typical Extension Features

- ▶ Multiplying modules used in BMS Basic (auxiliary relay, circuit breakers with trigger 125A and 32A)
- ▶ ELERIX BCC Module for controlling the CPM module and communicating with it
- ▶ Modules for service balancing
- ▶ Performance single inductors and bistable relay, SS relay, Victron Battery Protect etc.
- ▶ Additive sorting of entire BMS Basic modules for sets comprising more than 16 cells

Some Examples of Connections and Extensions of the BMS Basic Module

a) EXTENSION OF PROTECTED CIRCUITS



A load as well as a charger can be connected on the output of the FU1 circuit breaker in the basic BMS Basic configuration in certain cases. The nature of the application, however, often requires that the load and the charger be controlled separately or that the load be divided into two branches, which are switched on separately etc.

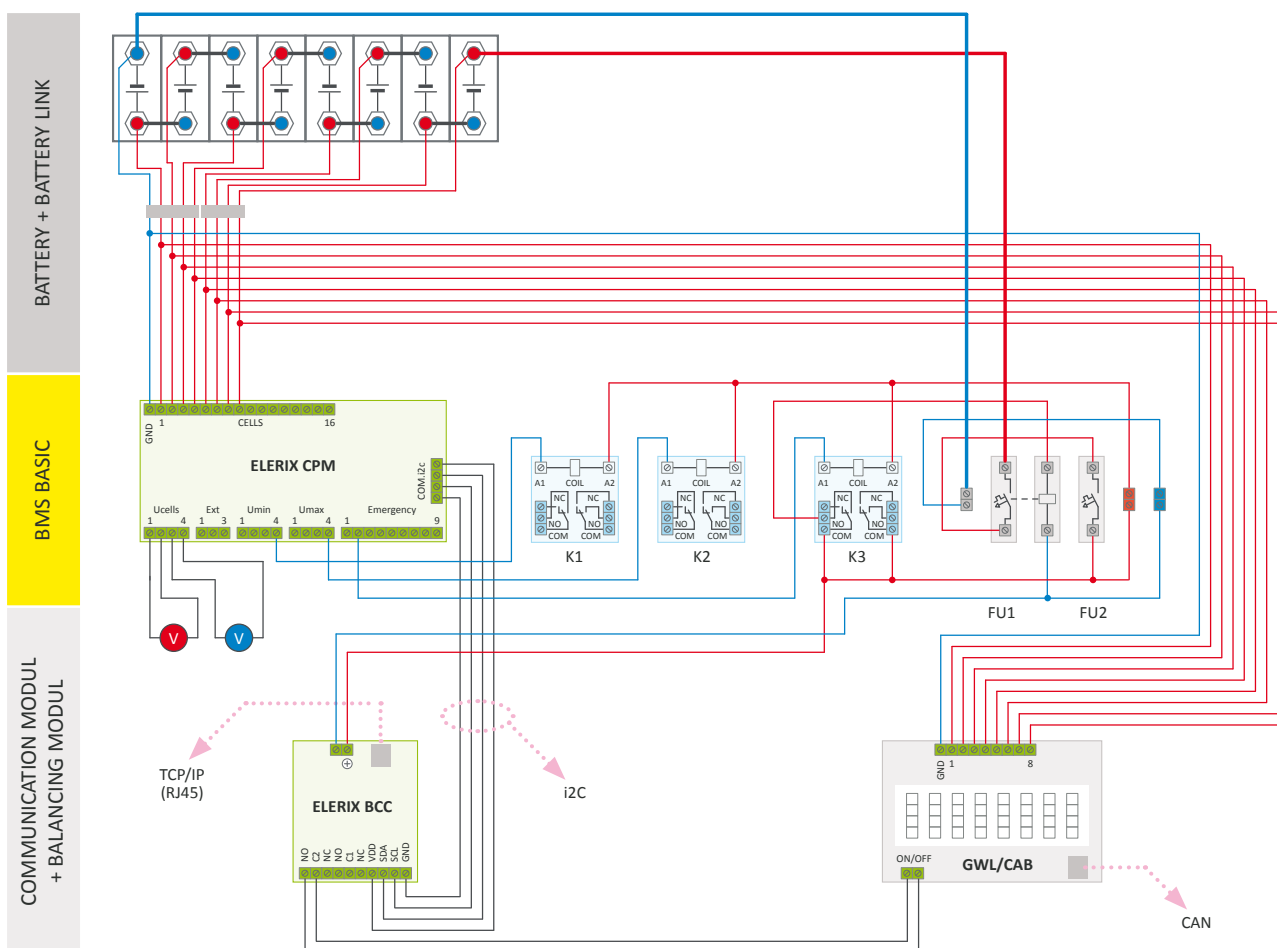
Description of one connection example:

The Bistable KM1 relay with a lower performance of inductors (according to the CPM specification) is controlled via “green” outputs. These outputs can also be used to control auxiliary NO/NC single inductor relays into the corresponding inductor power.

The bistable KM2 power relay with a large input power of the inductors must be controlled via impulses from auxiliary K3 and K4 relays, which increase the impulses from the CPM outputs. Similarly, the K2 auxiliary relay can be used to control standard single inductor power KM3 relays (in this case a power charger).

It is therefore always best, and may even be necessary, to use the “light blue” outputs for switching on power relays.

b) COMMUNICATION AND SERVICE BALANCING



High-impedance voltmeters can be connected to the “green” outputs on the CPM to get basic information on the battery status. They transmit the value of the cell with the lowest (Umin - red) and the highest (U max - blue) voltage from the entire module. “Green” IQ BUS outputs provide information on voltage in the i2c protocol, which can be used for the connected customer device (open source).

The connection to the additional ELERIX BCC component allows for listing of all values in the PC. Concurrently, it allows for remote setup of voltage limits and controlling the “green” switch CPM outputs as well as resetting and turning the CPM control board on and off. (Remote setup is preferred over mechanical setup of the voltage switches). BCC has two auxiliary relays integrated, which can be used to switch on other devices in various modes and one-time commands. In the example listed, a cell service balancer is switched on if a Umin/Umax state of the cells reaches a set limit. BCC manual: <https://shop.gwl.eu/Battery-Management/GWL-Battery-Communicator-and-Controller.html>

The passive CAB balancing module (under preparation) balances the battery cells if needed using a selected balancing current and provides additional functions. One of these is the collection of values of voltage, current and SoC for the CAN bus, which can be used for the connected customer device (open source).



WARNING

Disconnecting an active MPPT regulator from the battery may damage it in certain cases (in some products).

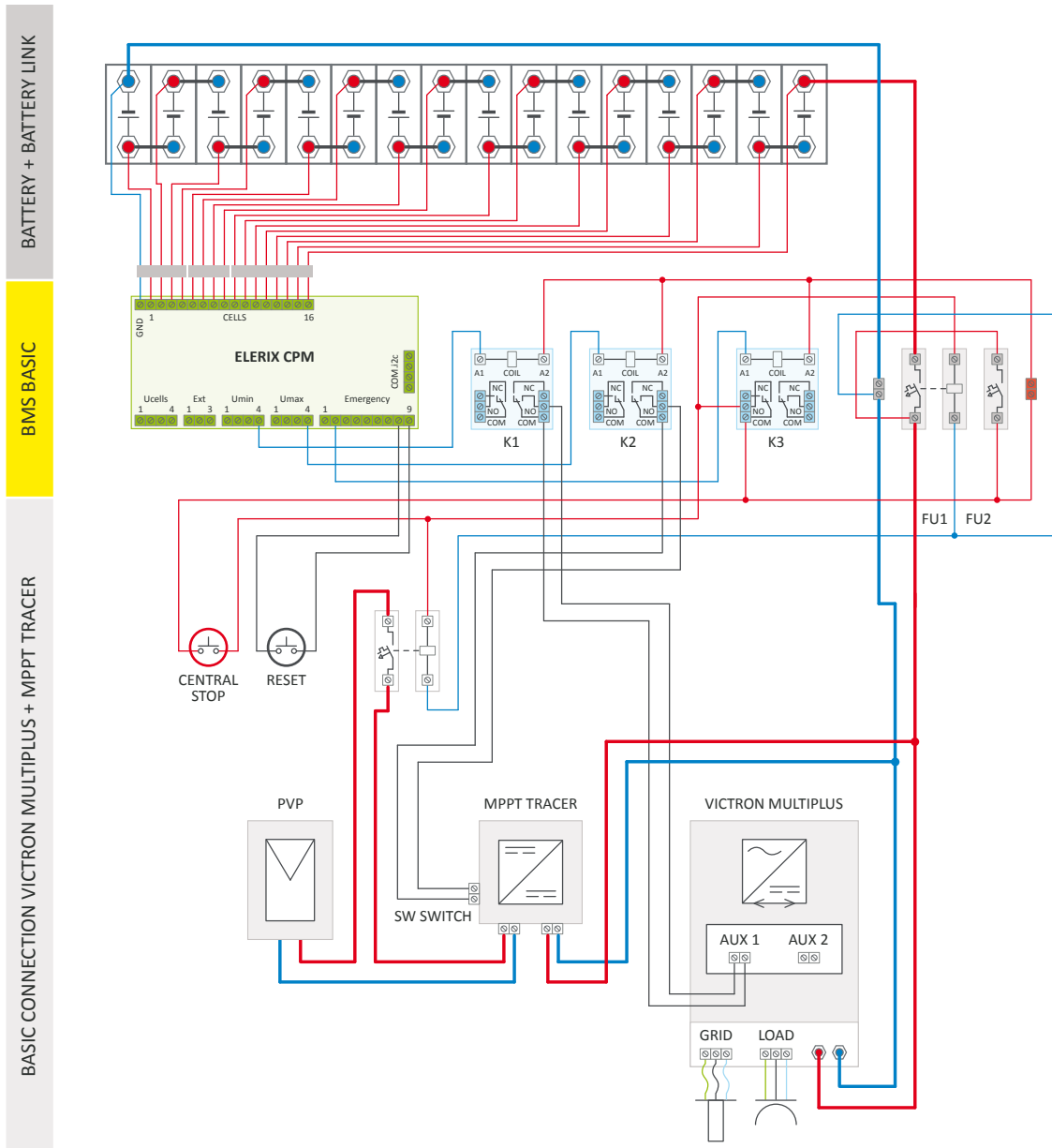
If the entire battery is disconnected in the active MPPT regulator mode (any charger) and in an active load, it can cause adverse statuses as a result of overflow from the charger to the appliance without support from the battery.

This is why we recommend disconnecting the charger and appliance on separate branches, see the connection example a) or to use devices, which allow for software (SW) disconnections, as is the case here:

Once U_{min} is reached on a battery cell, the appliance is disconnected using software via K1 relays. Similarly, if U_{max} is reached on one of the cells, the MPPT regulator is disconnected using software via the K2 relay. The battery remains connected and the load and charger are automatically connected again in a voltage hysteresis according to the CPM setting or by resetting the CPM.

The U_{min}/U_{max} battery cell protection using the K3 relay and the circuit breaker voltage trigger are then used only as backup and for emergencies

d) CONNECTION WITH VICTRON MULTIPLUS AND MPPT VE SMATR SOLAR



BATTERY + BATTERY LINK

BMS BASIC

BASIC CONNECTION VICTRON MULTIPLUS + MPPT TRACER

Basic battery management in an off-grid or hybrid system with Victron features can be carried out in the following manner:

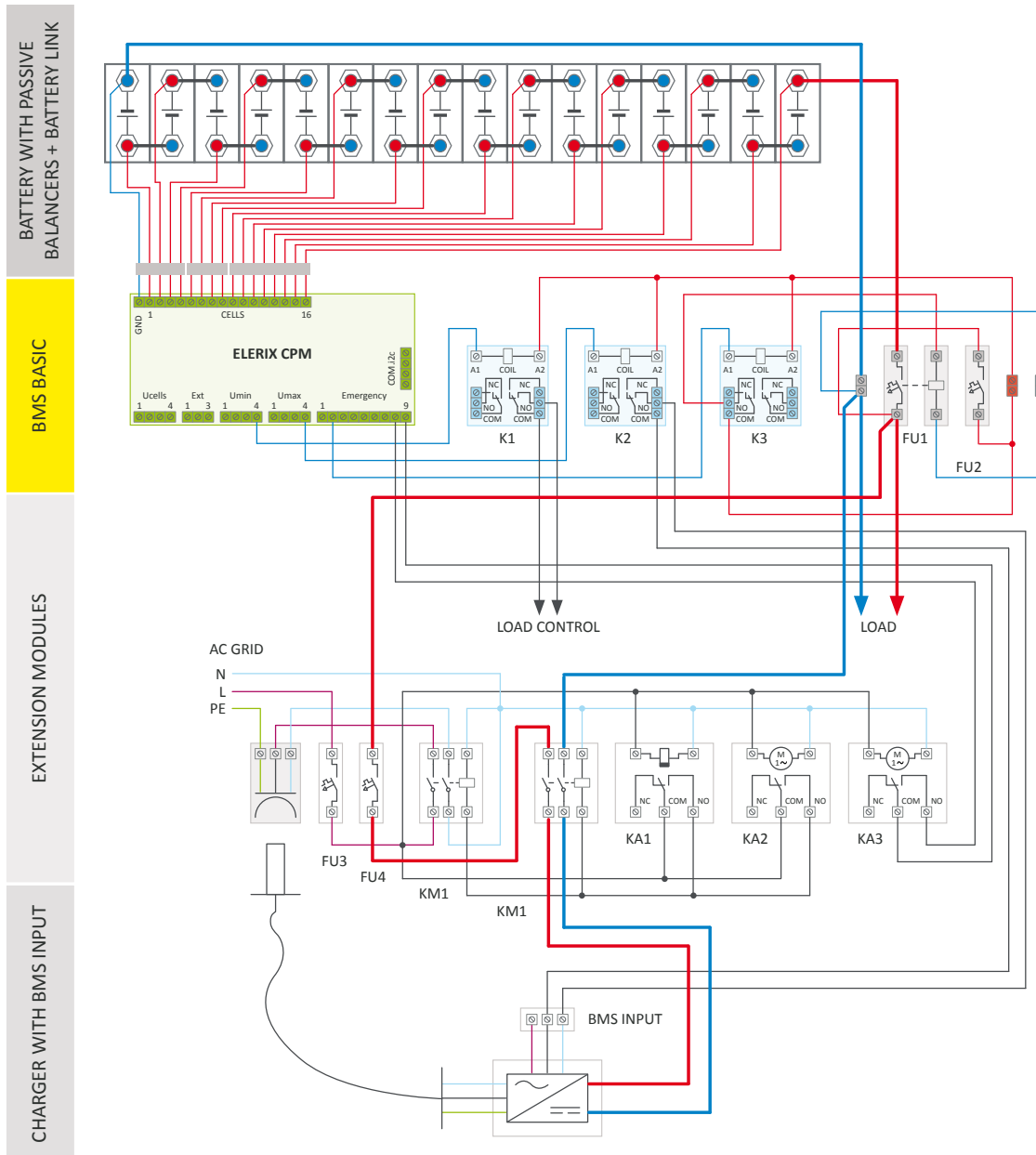
When operational, the MPPT regulator is managed through its own internal logic based on the overall battery voltage and charging current. Once U_{max} is reached on one of the cells, it is disconnected using software via the K2 relay. Once $U_{emergency}$ (emergency status) is reached, the source is disconnected - i.e. the PV panels are disconnected by switching off the FU3 circuit breaker via its voltage trigger and the K3 relay.

Victron Multiplus is set using its own internal logic for the given mode (ESS, UPS, Off Grid...) based on the overall battery voltage and the current load. We set the SW disconnection of the inverter on one of its AUX inputs when this AUX is disconnected (the "Two Signals BMS - battery empty" assistant), which disconnects the load via the K2 relay once U_{min} is reached on one of the battery cells.

The FU1 circuit breaker with the voltage trigger is used for the automatic disconnection of the system from all sources of energy once $U_{emergency}$ is reached, or manually via Central Stop (emergency status).

The module can be extended using additional Victron features for monitoring, communication and other purposes (e.g. BMV, GX series etc.).

e) COMPLETE CHARGER MANAGEMENT (UPS SYSTEMS)



This extension of the BMS Basic module is used for the complete management of the network charger. It is suitable, e.g. for service-free charging of the battery in backup systems and so forth. It provides the following functions and modes:

- ▶ Disconnection of AC and DC on the charger in rest mode (KM1, KM2 contractors)
- ▶ Charger protection on the AC and DC side (of the FU3 and FU4 circuit breakers)
- ▶ Emergency disconnection of the charger during dangerous voltage levels on one of the battery cells (CPM K3 auxiliary relay \rightarrow voltage trigger on the FU1 circuit breaker)
- ▶ Automatic switching on of the battery charging during a grid outage in a selected time (KA1 time relay \rightarrow KM1, KM2)
- ▶ Periodic charging of the battery in a selected daily or weekly mode (KA2 timer \rightarrow KM1, KM2)
- ▶ Switching the charger to cell balancing mode (CPM K2 auxiliary relay \rightarrow charger BMS output)
- ▶ Reset the balancing mode of the charger and emergency statuses in a selected daily or weekly mode (KA3--> reset CPM)

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