## Applications

- Electric vehicles
- Drones
- Energy storage
- Research programs

## Product summary

ENNOID-BMS is a configurable battery management system consisting of a Master board based on an STM32 microcontroller connected through an ISOSPI interface to several modular slave boards. ENNOID-BMS can monitor the specifics temperatures, currents & voltages that are critical for any lithium-ion battery packs. Based on the monitored inputs & the configured parameters, the master board can allow or interrupt the flow of energy from the battery pack by switching the state of external heavy-duty contactors. ENNOID-BMS can measure each cell voltage level & can trigger the passive balancing function during charging for cells above the configured limit to ensure that all cells have a similar State-Of-Charge (SOC). Parameters can be configured through the ENNOID-BMS-Tool software running on a USB connected host computer.

## Features

- Modular with master/slave topology
- 12S, 15S & 18S slaves board options
- Up to 400V operation
- Up to 500A continuous operation
- Bolt-on isolated bi-directional current sensor
- Bolt-on heavy duty contactors with direct 12V drive coil outputs for charge, discharge & precharge circuits
- Isolation between high voltage & control circuits
- Communication between slaves & master through a two-wire daisy chained ISOSPI interface
- Isolated CAN bus interface
- Isolated voltage measurement for battery, load & charger
- USB interface for programming and firmware upgrades through an easy to use graphical user interface
- OLED Display & power button
- 0V to 5V cell voltage operation

## Block diagram

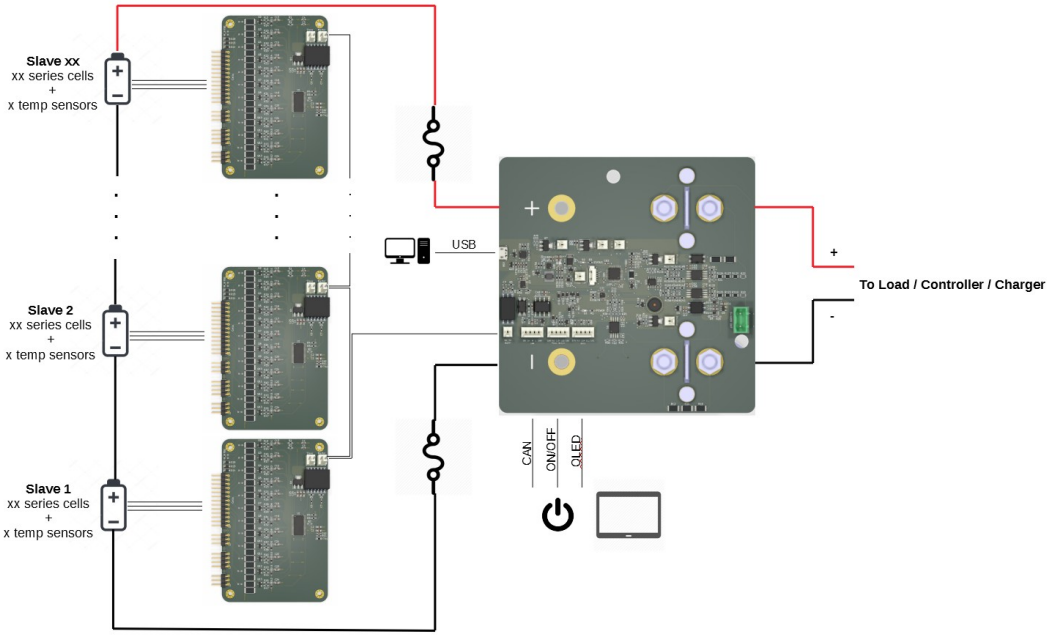



*Figure 1: Simplified block diagram*

# Pinout information

## Master board

The master board is equipped with an STM32F3 microcontroller which controls all functions of the battery management system.

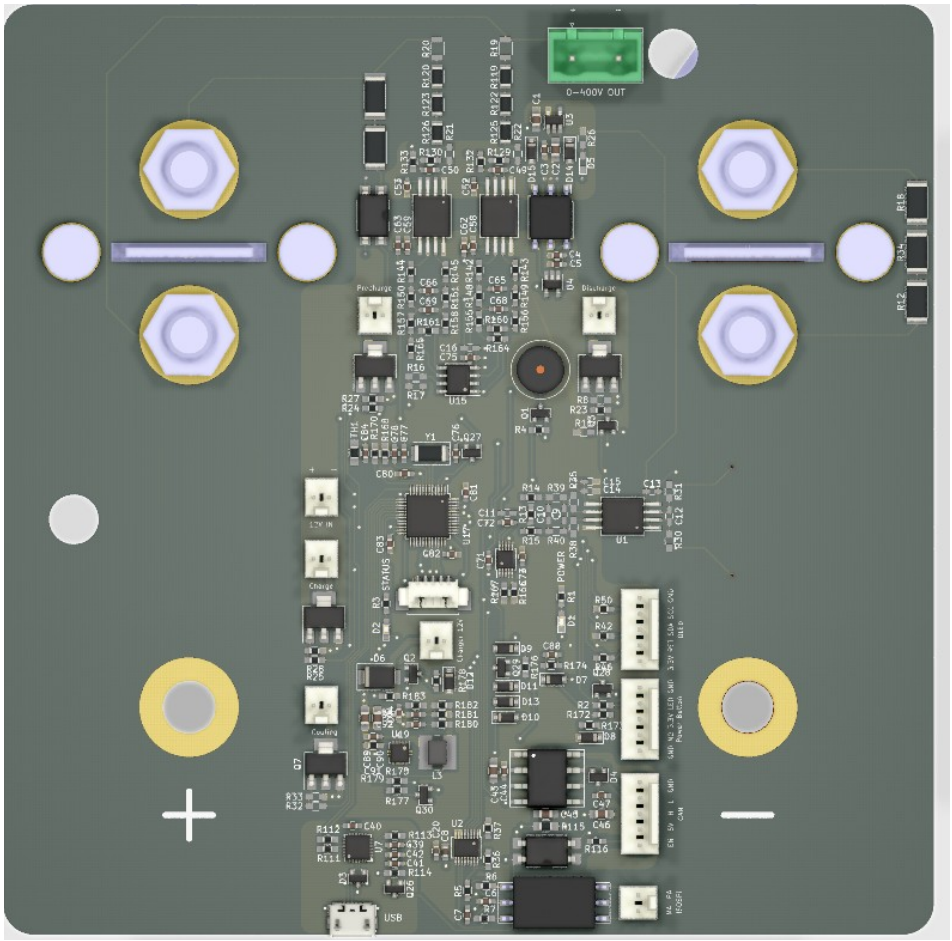


*Figure 2 : Master board*

| Pinout name | Pinout description | |
|---|---|---|
| 0-400V OUT* | + | Positive output for PSU |
| | - | Negative output for PSU |
| 12V IN | + | Positive 12V input |
| | - | Negative 12V input |
| Master | PA | Isolated ISOSPI communication 2 wire interfaces with slave boards |
| | MA | Isolated ISOSPI communication 2 wire interfaces with slave boards |
| USB* | Micro-USB interface with ENNOID-BMS-tool software on a computer | |
| CAN* | EN | External enable signal |
| | 5V | External 5V for CAN |
| | H | CANH |
| | L | CANL |
| | GND | CANGND |

| | | |
|---|---|---|
| OLED* | 3.3V | +3.3V |
| | RST | No connect |
| | SDA | SDA signal output for OLED display |
| | SCL | SCL signal output for OLED display |
| | GND | ISOGND |
| Power Button* | GND | ISOGND |
| | N.O. | Normally open pin for power button |
| | 3.3V | No connect +3.3V |
| | LED | +3.3V for LED (optional) |
| | GND | ISOGND |
| Debug* | +3.3V | |
| | SWCLK | |
| | ISOGND | |
| | SWDIO | |
| | NRST | |

*Not mandatory for operation

## Slave board LTC68XX

The slave board are equipped with LTC68XX multicell battery monitor IC. The slave boards are powered directly by the lithium-ion cells they monitor.

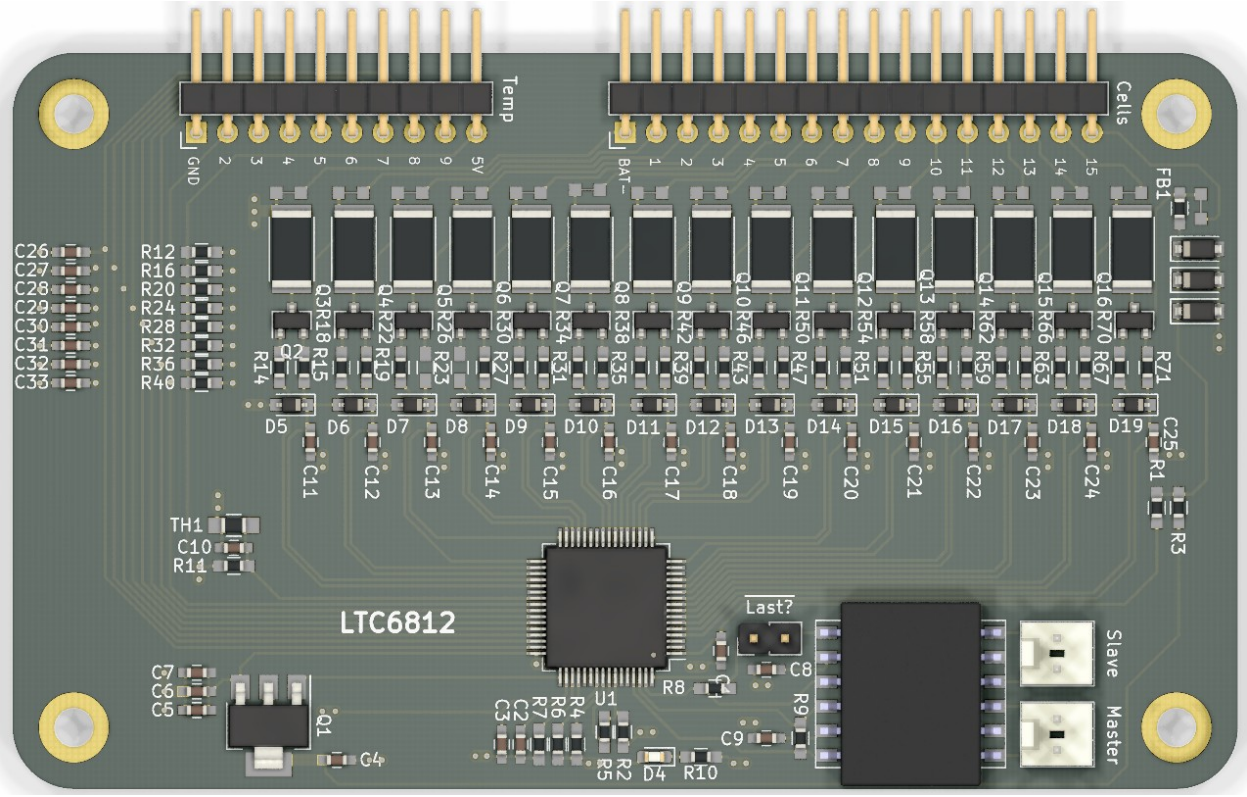



*Figure 3: Slave board*

| Pinout name | Pinout description | |
|---|---|---|
| Master | Isolated ISOSPI communication 2 wire interfaces towards previous slave board or master board | |
| Slave | Isolated ISOSPI communication 2 wire interfaces towards next slave board | |
| LAST? | Leave pins unconnected for the last slave board in the battery pack. Otherwise, those pins must be shorted. | |
| Cells | BAT- | Connect to negative voltage of the battery module |
| | 1 to XX | Connect all subsequent pins to the next cells positive voltage levels. |
| Temp | GND | Temperature sensor negative terminal |
| | 1 to X | Temperature sensor positive terminal. |

# Other related hardware

## Current sensor

We recommend using ENNOID-BMS integrated 500A current sensor. Other CAN bus current sensors are also supported.

## Power supply

ENNOID-BMS require a 12V power supply which can supply power for the Master-BMS board. A peak current of approx. 3A is required for a few milliseconds for closing the high current external contactors. Only a few milliamps are required afterward closing. The power supply must be able to handle contactors peak loads.

We recommend using our ENNOID-BMS PSU board:  0-400V input isolated with 12V-5A DC output

## OLED display

SSD1306 compatible OLED display is not mandatory for operating ENNOID-BMS but is recommended.

## Power button

Power button N.O. type toggle switch is normally required for activating ENNOID-BMS. External activation of ENNOID-BMS is also possible through CAN bus.

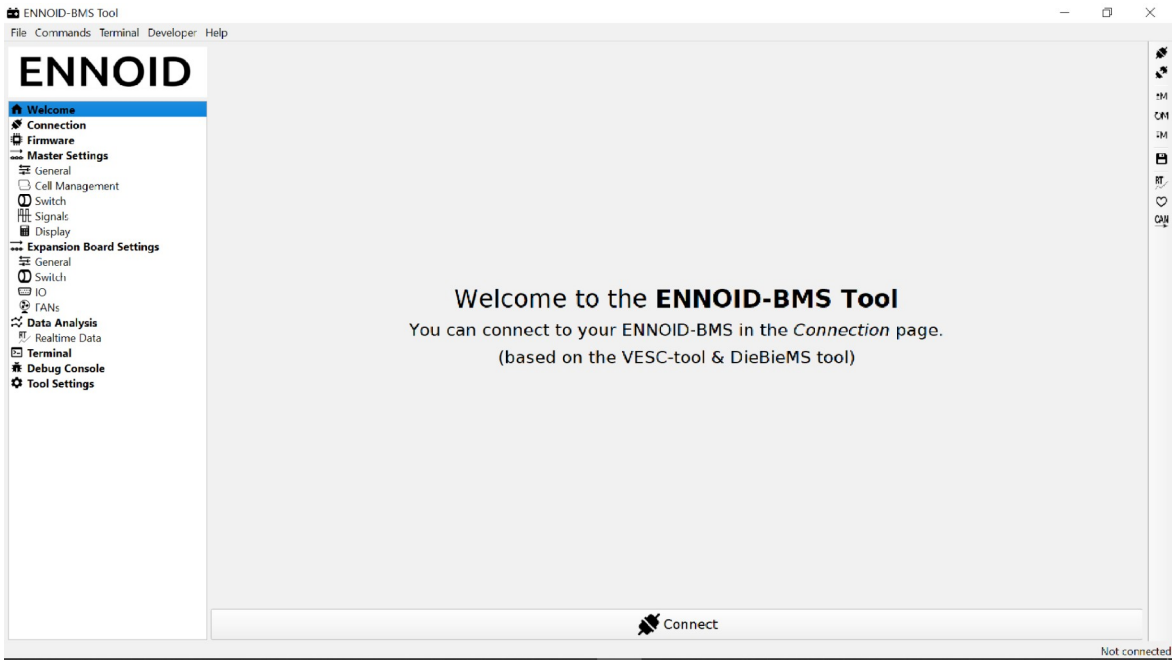
## Contactor

EVC500 or similar contactors with built-in economizer are required.

## Software

Download ENNOID-BMS-Tool software for windows:

https://github.com/EnnoidMe/ENNOID-BMS-Tool/releases




## ENNOID-BMS configuration

1. Connect at minimum a 12V power supply to ENNOID-BMS Master board.
2. Connect a host computer running the ENNOID-BMS-Tool to the ENNOID-BMS master board with a micro USB cable. (Warning: some cheap USB cables cannot carry data and won't work with ENNOID-BMS) Power LED indicator should light up. Click connect on the connection page. The app should now show "connected" in the right side bottom corner.
3. Go into firmware tab and upload latest firmware (this step is needed only for initial setup or uploading a new firmware version)
4. Under *"Master Settings"* tab, user can define all parameters of the BMS (Tabs under *"Expansion board Settings"* are not required for configuring ENNOID-BMS). Modified parameters can be read, applied & saved by clicking on the associated buttons on the right-side panel.
5. For real-time data logging & for testing purposes, the "*Data Analysis*" tab shows in real time the measured pack voltage, load voltage, current, Temperatures, BMS status & all cells voltages. You need to click on the "RT" button on the left side of the screen to activate real time communication.
6. Once properly configured, you can operate the ENNOID-BMS & your personalized battery pack without a host computer.
7. For specific projects, the power button & the OLED display can be bypassed by using the CAN bus communication option. The BMS can be configured to communicate through CAN bus with a motor controller & with a vehicle control unit that implement the VESC standard.

Enjoy!