



Revision C, 2024-07-04

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SAFETY

To ensure the security of you and your surroundings, please read these rules and follow all the guidelines contained installation instructions:

- DO NOT use the system where it may cause interference (eg. medical equipment);
- DO NOT use the system in an explosive environment;
- The system is NOT resistant to the chemical environment and mechanical stress;
- All electrical equipment MUST be rated for the voltage of the battery and battery management system;
- Use double-insulated tools;
- DO NOT short-circuit the battery or battery management system terminals, this could cause the damage to the product or the personal property;
- DO NOT lay tools or metal parts on top of the batteries or near the battery management system cable lugs;
- Before establishing connections, make sure to verify polarity.



This list is not exhaustive, and it is the responsibility of the system designer / installer to conduct their own failure mode analysis and determine what is required.



Working around batteries is DANGEROUS. Risk associated with improper use of the battery with the *Tiny BMS* device includes: short-circuit, fire or explosion.



Read the ENTIRE documentation to become familiar with the *Tiny BMS* device and its features before operating. Failure to operate the product correctly and safely may result in damage to the product, personal property and cause serious injury.



Throughout the literature the term "Note:" will be used to indicate procedures which, if not properly followed, create a possibility of physical property damage.



Using *Tiny BMS* device requires at least basic knowledge in electronics and electrical engineering. *Enepaq* will not be held responsible for damage to the battery or any consequence, if the *Tiny BMS* device is used improperly and no warranty is provided in such case.

TINY BMS POWER UP

Step 1: Prepare cells connections: connect the assembly(-ies) of balancing connector to battery cells first. Double and triple-check voltages are in sequence on the connector(s). If there are less than *16* cells, lower contacts should be unused.

Step 2: Connect main power lines of the battery to *B*- and *B*+ terminals. Make sure connections are strong and contain no fuses or switches. *BMS* will boot up and beep several times.

Step 3: Connect balancing connector(s) to *BMS* ports *CELL01-CELL16*.

Note: Incorrect wiring may damage the *Tiny BMS* device. Verify proper wiring before inserting the harness into the connector. Remove the harness from the connector before altering any battery connections. Damage caused by wiring errors are not covered by warranty.

Note: Connection sequence is important. *Tiny BMS* is supplied from *B*- and *B*+ solder-pads and incorrect connection can lead to permanent damage of the board. Main rule is to avoid balancing wire connection without *B*- and *B*+ being connected. When disconnecting from battery, disconnect balancing wires first, only then followed by *B*+ and *B*- solder-pads.

Step 4: Connect *USB* cable to *Windows PC* and *BMS* device, launch *Enepaq Battery Insider* configuration utility. When connected, it will appear as a virtual *COM* port and the *Battery Insider* will connect to it automatically. While communication is ongoing, *BMS* stays in *Idle* state (activity *LED* indicator blinks)

Note: The cable is not galvanically-isolated. Take spacial care and give your full attention to avoid ground loops. Alternatively, use *USB* isolator.

BATTERY CELLS SETTINGS CONFIGURATION

Step 1: Configure battery parameters under the *Cell Settings* tab *Balancing* and *State of Charge* group boxes:

- Number of Series Cells value;
- Allowed Disbalance value;
- Early Balancing Threshold value;
- Battery Capacity value;
- Initial battery SOC value (Set SOC manually). SOC value is set to 100 % automatically on Fully Charged event.



Balancing]
Early Balancing Threshold	3.20 V
Allowed Disbalance	15 mV
Number of Series Cells	13
State of Charge Step 1	
State of Charge	
Battery Capacity	10.0 Ah
Set SOC manually	50 %

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Step 2: Upload settings to BMS.

Step 3: Configure battery parameters under the *Safety* tab *Critical Events* group box:

- Over-Voltage Cutoff threshold;
- Under-Voltage Cutoff threshold.

Step 4: Upload settings to BMS.

Step 5-6: Go back to *Cell Settings* tab and adjust cell charging and discharging characteristics:

- Fully Charged Voltage threshold;
- Fully Discharged Voltage threshold.

Step 7: Upload settings to BMS.

Note: These settings has a relationship *Under-Voltage Cutoft < Fully Discharged Voltage < Fully Charged Voltage < Over-Voltage Cutoft* and the *Battery Insider* will not allow the user to set these values in any other way.

Step 1: Select *BMS* mode (*Dual Port* or *Single Port*) under the *Peripherals* tab.

Step 2: Upload settings to BMS.

Note: When *BMS* mode has been changed and settings successfully uploaded to *BMS*, it automatically restarts itself and automatically reconnects with the *Battery Insider* again.

Step 3: Configure load parameters under the *Peripherals* tab *Load* group box:

- Set Load Switch Type to Discharge FET. Alternatively, Set Single Port Switch Type to Internal FET, if BMS Mode parameter is configured to Single Port.
- Select *Ignition* pin (*Ignition* feature is recommended when manual load control, bluetooth, *CAN* bus communication is required or to enter lowest possible current consumption sleep mode);
- Set load Precharge to Disabled (Precharge is not allowed when internal FETs are used);
- Leave *Precharge Duration* configured to 0.1 s default value.

Step 4: Configure charger parameters under the *Peripherals* tab *Charger* group box:

- Set Charger Type to Generic CC/CV;
- Set Charger Detection to Internal;
- Set Charger Switch Type to Charge FET (If BMS Mode parameter is configured to Dual Port).

Step Z 📃	Upload to BMS	
Critical Events		
Over-Voltage Cutoff		4.20 V
Under-Voltage Cutoff	Step 3	2.90 V
Step 4 🛕	Upload To BMS	
Fully Charged	Voltage 4.00 V St	ер 5
Fully Discharged \	Voltage 3.00 V St	ep 6
Step 7 🛕	Upload To BMS	

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Mode		
BMS Mode	Step 1	Dual Port 🔹
Single Port Switch Typ	e	Internal FET 🔹
Step 2	🚖 Upload To B	MS
Switch Type		Discharge FFT 🔹
Ignition		DIDO1 •
Precharge	Step 3	Disabled 🔻
Precharge Duration		0.1 s 🔹

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Step 5: Upload settings to BMS.

Step 6: Configure peripherals dependent *Tiny BMS* safety parameters under the *Safety* tab *Critical Events* group box:

- Discharge Over-Current Cutoff value;
- Charge Over-Current Cutoff value;
- Over-Heat Cutoff value;
- Low Temperature Charger Cutoff value;
- Automatic Recovery value.

Step 7: Adjust peripherals dependent *Tiny BMS Charge Finished Current* parameter under the *Cell Settings* tab.

Step 8: Upload settings to BMS.

Charger				
Charger Type		Generic	CC/CV	•
Detection	Step 4	Internal		•
Switch Type		Charge	FET	•
Step 5	💧 Uploa	d To BMS		
Discharge Over-Current Cutoff 60		А		
Charge Over-Current Cutoff			20	А
Over-Heat Cutoff 6			60	°C
Low Temperature Charger Cutoff 1 °C			°C	
Automatic Recovery 5 s			s	
Charge Finished Current 1.00 A Step 7				
Step 8 🔒 Upload To BMS				

PERIPHERALS AND SAFETY CONFIGURATION FOR HIGH POWER APPLICATIONS

Step 1: Select *BMS* mode (*Dual Port* or *Single Port*) under the *Peripherals* tab.

Step 2: Upload settings to BMS.

Note: When *BMS* mode has been changed and settings successfully uploaded to *BMS*, it automatically restarts itself and automatically reconnects with the *Battery Insider*.

Step 3: Configure load parameters under the *Peripherals* tab *Load* group box:

- Set Load Switch Type to one of the external output pins (AIDO. DIDO, AIHO). Alternatively, Set Single Port Switch Type, if BMS Mode parameter is configured to Single Port.
- Select *Ignition* pin (*Ignition* feature is recommended when manual load control, bluetooth, *CAN* bus communication is required or to enter lowest possible current consumption sleep mode);
- Set load *Precharge* to one of the available external output pins (*AIDO. DIDO, AIHO*), if necessary. Load *Precharge* can be controlled with internal *FETs*, if both load and charger are controlled by relays / contactors;
- Set Precharge Duration to appropriate value, if the load Precharge feature is enabled before.

Step 4: Configure charger parameters under the *Peripherals* tab *Charger* group box:

• Set Charger Type to Generic CC/CV;

Mode		
BMS Mode Step 1	Dual Port 🔹	
Single Port Switch Type	Internal FET 🔹	
Step 2 Depload To B	MS	
Switch Type	AIDO1 •	
Ignition	DIDO1 •	
Precharge	Disabled 🔹	
Precharge Duration	0.1 s 🔹	

- Set *Charger Detection* to one of the available external input pins;
- Set Charger Switch Type to one of the available external output pins (AIDO. DIDO, AIHO) (If BMS Mode parameter is configured to Dual Port).

Step 5: Upload settings to BMS.

Step 6: Connect external *LEM* current sensor to the *Tiny BMS* external current sensor connector.

Step 7: Manually restart the *BMS*. After the *BMS* device will be restarted, the external current sensor will be in use, and a high over-current thresholds unlocked.

Step 8: Configure peripherals dependent *Tiny BMS* safety parameters under the *Safety* tab *Critical Events* group box:

- Discharge Over-Current Cutoff value;
- Charge Over-Current Cutoff value;
- Over-Heat Cutoff value;
- Low Temperature Charger Cutoff value;
- Automatic Recovery value.

Step 9: Adjust peripherals dependent *Tiny BMS Charge Finished Current* parameter under the *Cell Settings* tab.

Step 10: Upload settings to BMS.

FINAL CONFIGURATION STEPS

Finally, configure other additional features like external *Temperature Sensor Type*, *Speed Sensor Input* or *Broadcast* features, if necessary. After all the configuration is done, it is strongly recommended to restart the *Tiny BMS* device to recover all the incorrect *BMS Fault* states, which occurred during initial cells connection and configuration. After the *BMS* device was restarted, clear all *Faults* and *Statistics* values to start record and monitor the battery parameters from the beginning.

Charger			
Charger Type		Generic CC/C	/ •
Detection	Step 4	DIDO2	•
Switch Type		AIDO2	T
Step 5	💧 Upload To	BMS	
Step 6	Message		Event Code
External Current S	ensor Connected (BN	MS restart required)	0x0F
Step 7	C Restart BM	ИS	
Discharge Over-Cur	rent Cutoff		600 A
Charge Over-Curren	it Cutoff		20 A
Over-Heat Cutoff	2	Step 8	60 °C
Low Temperature Ch	harger Cutoff		1 °C
Automatic Recovery	,		5 s
Charge Fi	nished Current	1.00 A Step	9
Step	10 🚖 Upload	d To BMS	

Maintenance		
Required BMS restart:		
After an external current sensor was connected or disconnected		
To recover from incorre	ect BMS state	
(e.g. Under-Voltage fault after the initial connection of the cells)		
 After BMS firmware malfunction occurred 		
Step 2 😃	Restart BMS	

TINY BMS BLUETOOTH CONNECTION WITH BATTERY INSIDER

Enepaq bluetooth adapter, connected to *Tiny BMS* device only works when *BMS* is in active state. This means, that charger or load should be connected to wake up the device from sleep mode, or alternatively, *Ignition* feature must be enabled before, using *USB-UART* cable and *Ignition* signal (high logic level voltage) should be applied to the configured *Ignition* pin. Once the *BMS* is in active state and bluetooth module is connected, the *Tiny BMS* bluetooth module should be paired on the *PC* side (*Enepaq* bluetooth module pin code is always 0516). After the *PC* and *Tiny BMS* is successfully paired, the *Battery Insider* application can be launched and it will automatically connects to *Tiny BMS* device.

Note: *Battery Insider* may require much more time to find the correct virtual *COM* port and connect to *Tiny BMS* device.

Note: When *Ignition* feature is enabled, *Ignition* can be activated (high logic level) by connecting configured *Ignition* pin to battery pack positive terminal B+. For safety reasons it is highly recommended to use about a 1 $k\Omega$ resistor in series between configured *Ignition* pin and B+.

Note: BMS firmware update feature using Bluetooth communication is not possible.

TINY BMS BLUETOOTH CONNECTION WITH ENEPAQ BATTERY INSIDER

Step 1: Connect USB-UART cable to Windows PC and BMS device, launch Enepaq Battery Insider configuration utility.

Step 2: Enable *Ignition* feature under *Peripherals* tab.

Step 3: Configure, if necessary, *Speed Sensor Input* feature under *Peripherals* tab *Display* group box:

- Speed Sensor Input channel;
- Distance Unit;
- Pulses Per Unit value.

Step 4: Configure *Broadcast* feature under *Peripherals* tab *Display* group box:

- Set Protocol to CA V3;
- Adjust *Broadcast* duration.

Step 5: Upload settings to BMS.

Step 6: Disconnect *USB-UART* cable from *Tiny BMS* device, instead connect bluetooth module. Activate *Ignition* by connecting configured *Ignition* pin to *B*+ (high logic level voltage).

Note: For safety reasons it is highly recommended to use about a $1 k\Omega$ resistor in series between configured *Ignition* pin and *B*+.

Step 7: On the windows device side, before launching *Enepaq Battery insider* application for the first time, pair the windows device with the *Tiny BMS* (*Enepaq* bluetooth module pin code is always 0516).

Step 8: Once bluetooth connection is established, launch *Enepaq Battery Insider* application. The connection status on the bottom left of the screen should be *Connected* and all battery parameters should be displayed on the dashboard.



TINY BMS SOC-BAR LED INDICATOR CONFIGURATION

Step 1: Configure *Broadcast* feature under *Peripherals* tab *Display* group box:

- Set Protocol to SOC BAR;
- Adjust *Broadcast* duration (at least 1.0 s should be selected).

Step 2: Upload settings to BMS.

Step 3: Disconnect *USB-UART* cable from *Tiny BMS* device, instead connect *SOC-BAR LED* indicator.

Note: SOC-BAR LED indicator is turned off when BMS device is in sleep mode or the BMS estimated SOC value reached 0 %.

Speed Sensor Input		DIDO2 •
Distance Unit		Kilometers 🔹
Pulses Per Unit		1000
Protocol	Stop 1	SOC BAR 🔹
Broadcast	Step 1	1.0 s 🔹

Document revision history

Revision	Date	Description
А	2018-07-30	Initial release.
В	2022-03-24	Company rebranded to Enepaq.
С	2025-07-04	Added v2.2 connection diagram.