# ENCAP
## BEYOND BATTERIES

USER MANUAL

Micro Opti Module 8KWH-48V

EN-8K-48-1C-2PA-X-X-PIB-1V0_GEN1

VERSION 1 | REVISION 0 | RELEASE DATE: 7th June 2024

## SMART MANAGEMENT

- Feature-rich Online Monitoring via Encontrol Tool
- Automatic Firmware Updates
- Warning Alarms

## EFFICIENT

- Highly Efficient: > 95% RTE (Round Trip Efficiency)
- 100% DOD (Depth of Discharge)
- 500,000 Cell Life Cycles

## SAFE & RELIABLE

- Wide Operating Temperature Range
- Deployable in Various Environments including High Altitudes
- No Thermal Runaway Risk

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# Document HISTORY

**Issue 01 (2024-6-7)**

First release

# Table of Contents

# Safety Instructions

## SAFETY GUIDELINES

### 1. PERSONAL SAFETY

- Always wear proper personal protective equipment (eyes protection, gloves, and safety shoes).

### 2. GENERAL GUIDELINE

- Do not subject the Module to strong impact.
- Do not crush or puncture the Module.
- Do not place the Module near a heat source, such as a fireplace.
- Do not disassemble the Module under any circumstances.
- Ensure precautions to prevent short-circuit under all circumstances.
- Do not touch the terminals with conductors while the Module is charging. Serious burns, shock, or material fusing may occur.
- Protect surrounding electrical components from incidental contact.
- Do not subject the Module to high pressure.
- Do not place any object on top of the Module.
- Do not drop the Module. Internal damage may occur that will not be visible.

- Do not stack Modules once they have been removed from the packaging. Instead the Modules should be placed on shelves.

- In case the Module is physically damaged for any reason, do not install and energize the Module under any circumstances and immediately contact your Reseller.

## 3. MODULE OPERATION

- Do not operate the Module above the specified voltage.

- Always make sure charger is set as recommended.

- When connecting to external devices ensure that galvanic isolation of the external device(s) does not exceed 1000V.

- Always make sure chargers are disconnected while working on Modules.

- Do not connect or disconnect terminals from the Module without first disconnecting the load.

## 4. MODULE OPERATING ENVIRONMENT

- Location: Indoor/Outdoor

- Operating Temperature Range: -30°C to 70°C (For continuous operations outside this range, please consult your Resellers or Enercap).

- Operating Humidity: Non-Condensing

- Do not charge the Module when the temperature is below -30°C.

- Do not charge the Module when temperature is above 70°C.

## 5. MODULE CLEANING

- Disconnect the power before cleaning.

- Use a soft cloth dampened in a solution of mild detergent and water.

## 6. STORAGE ENVIRONMENT

- Do not store the Module at temperature greater than 70$^o$C.

## 7. DISPOSAL

- Do not dispose the Module in fire.

- Do not dispose this Module as unsorted municipal waste. Please use a separate collection facility or contact the supplier from whom this Module was purchased. Please make sure discarded electrical waste is properly recycled per applicable regulations to reduce environmental impact.

# PRE-INSTALLATION

## INSPECTION

Document (e.g., photo) any damage and report this to your Reseller and shipping agent immediately. Remove the Module from the shipping carton and retain the shipping materials until the unit has been inspected and is determined to be operational.

## UNPACKING

The Modules and cable accessories are packed in a cardboard carton with foam padding for protection during shipping.
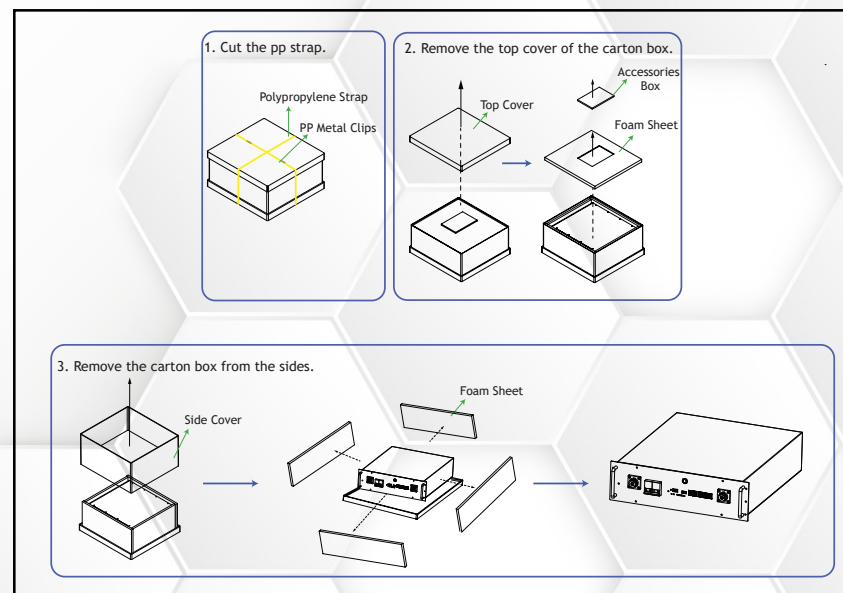


**Figure 1: Steps to unpack the Module**

## CONTENT CHECK

Check the contents of the package. The following are standard items shipped by us.

| | | |
|---|---|---|
| 8kWh-48V | USB TO RJ45 Cable | RJ45 Cable |
| Bolts M10x20mm | Washer M10 | Spring Washer M10 |
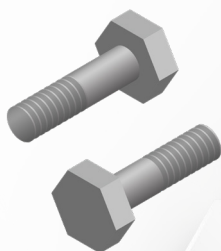
**Figure 2: Module package contents**

## HANDLING

The Modules are designed to provide years of trouble-free operation. Proper handling is required to avoid damage to the Module. In particular, the following precautions should be observed.

1. **LIFTING THE MODULE**

1. Pull up the handle on the top of the Module, grip the Module firmly and lift it.

Keep back as erect as possible
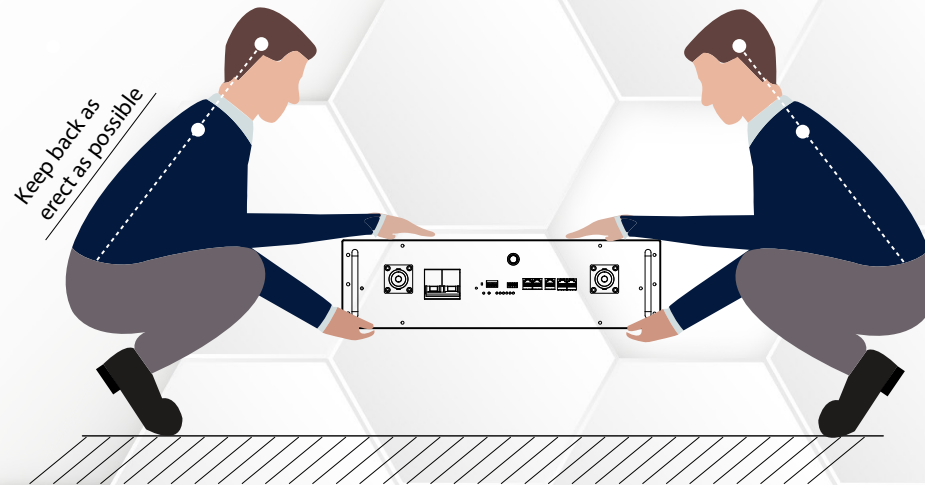
**Figure 3: Holding the Module to lift up**

2. Lift up straight, remembering not to turn your body while you are lifting.

**Figure 4: Lifting up the Module**

## LOCATION REQUIREMENTS

### 1. AREA OF INSTALLATION

- Install the Module at an appropriate height for ease of viewing LCD and operating switches.
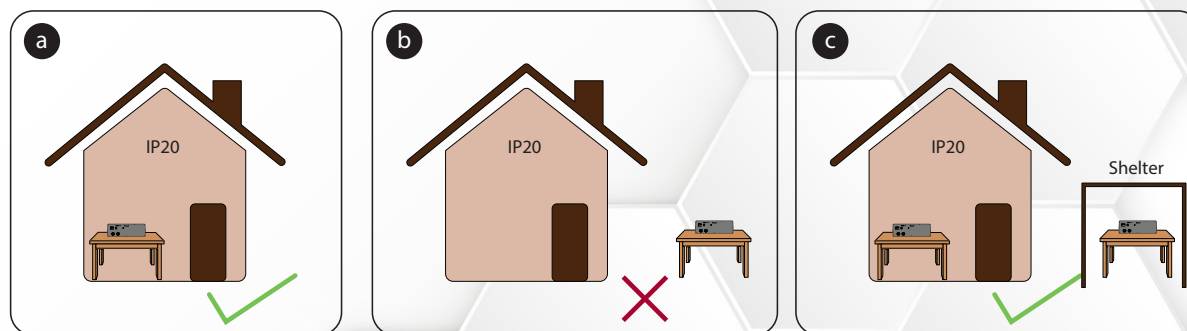


**Figure 5: Installation restriction: a) Module can be stored inside  b) Modules cannot be stored outside without shelter c) Modules can be in–stalled indoors and outdoors with shelter**

### 2. ENVIRONMENT REQUIREMENTS

- The ambient temperature and relative humidity must meet the following requirements.
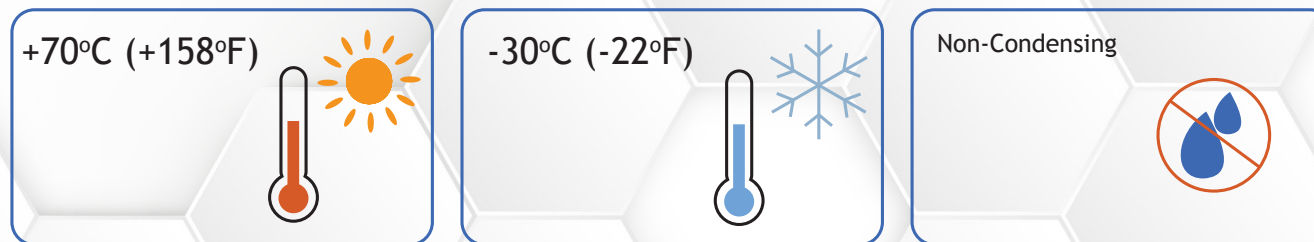


**Figure 6: Operating temperatures and humidity of Module**

## 3. ANGLE REQUIREMENT

- Never install the Module vertically, or with a forward tilt/backward tilt, or upside down.
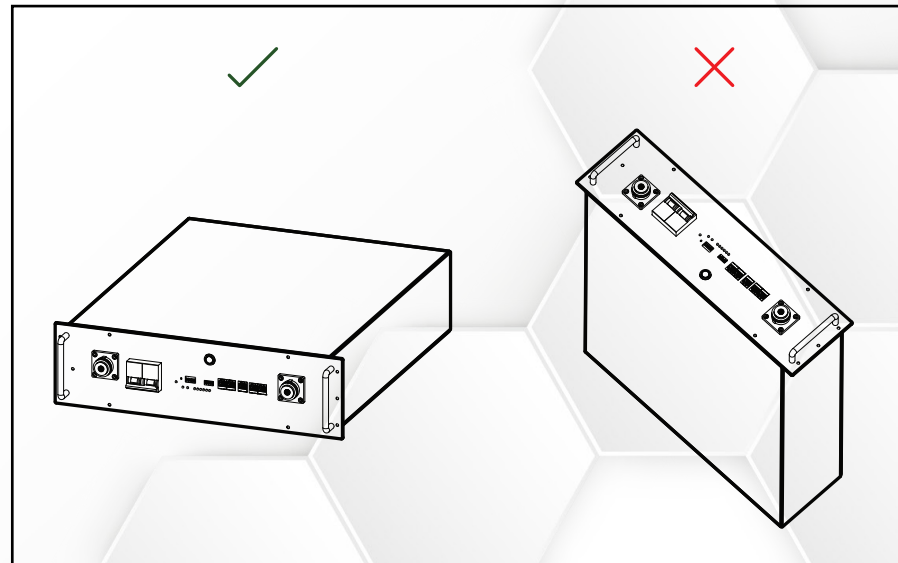
**Figure 7: 1) Correct angle position  2) Wrong angle position**

# ELECTRICAL INSTALLATION

## ELECTRICAL CONNECTIONS

### 1. CABLE SIZE

We recommend a cable size of 150mm² thickness and 1m length to hold current up to 300A. Please use a thicker cable for lengths longer than 1m.

### 2. CABLE CRIMPING

Crimp the cables for connecting the Modules in series or parallel.

- Wrap the wire crimping area with heat shrink tubing or insulation tape.

- When using a heat gun, protect the equipment from being scorched.

A : Terminal Lugs
B: Cable
C: Heat Shrink Sleeve
D: Crimp Tool
E: Heat Gun
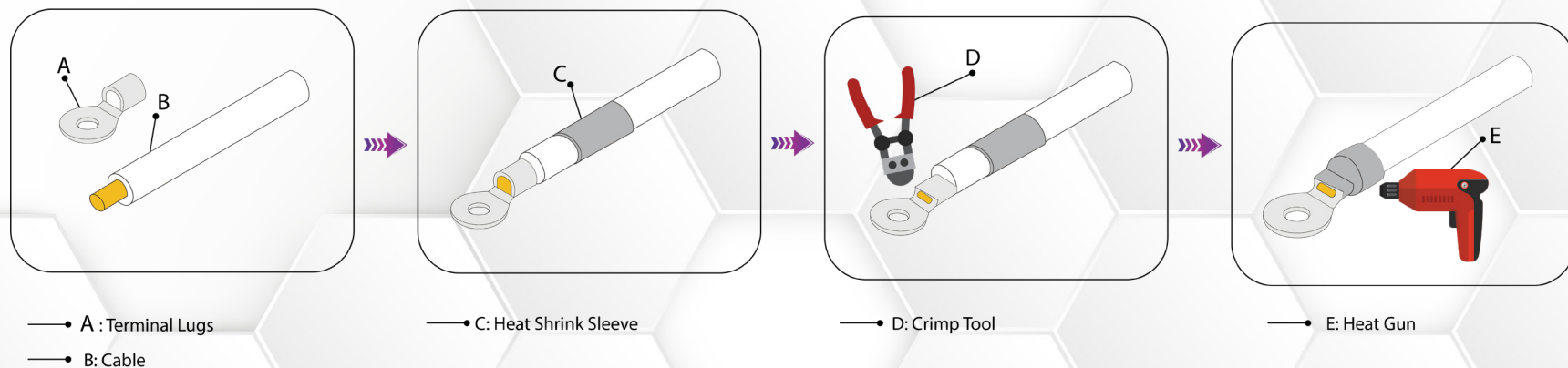
**Figure 8: Steps to crimp the cables for the terminal**

## 3. CONNECTING CABLE LUGS, WASHERS, AND BOLTS TO MODULE TERMINALS

Follow the sequence below to connect the cable lugs, washers, and bolts to the positive and negative terminals of the Module.



**Figure 9: Connecting lugs, washers, and bolts to negative terminal of Module**



**Figure 10: Connecting lugs, washers, and bolts to positive terminal of Module**

## ELECTRICAL SETUP

### 1.  CONNECTING MODULE TO POWER SUPPLY/CHARGER

Connect positive and negative terminals of charger to the positive and negative terminals of the Module, respectively.



**Recommended Settings:**

★ Power Supply or Charger Voltage: 48Vdc
★ Max. Charge Current: 170A
★ Voltage Range: 43.2Vdc to 60.8Vdc

**Figure 11: Charging Module with power supply**

## 2. CONNECTING MODULE TO LOAD/DISCHARGER

Connect positive and negative terminals of discharger to the positive and negative terminals of the Module, respectively.



Recommended Settings:

★ Discharger or Load Voltage: 48Vdc

★ Max. Discharge Current: 170A

★ Voltage Range: 43.2Vdc to 60.8Vdc
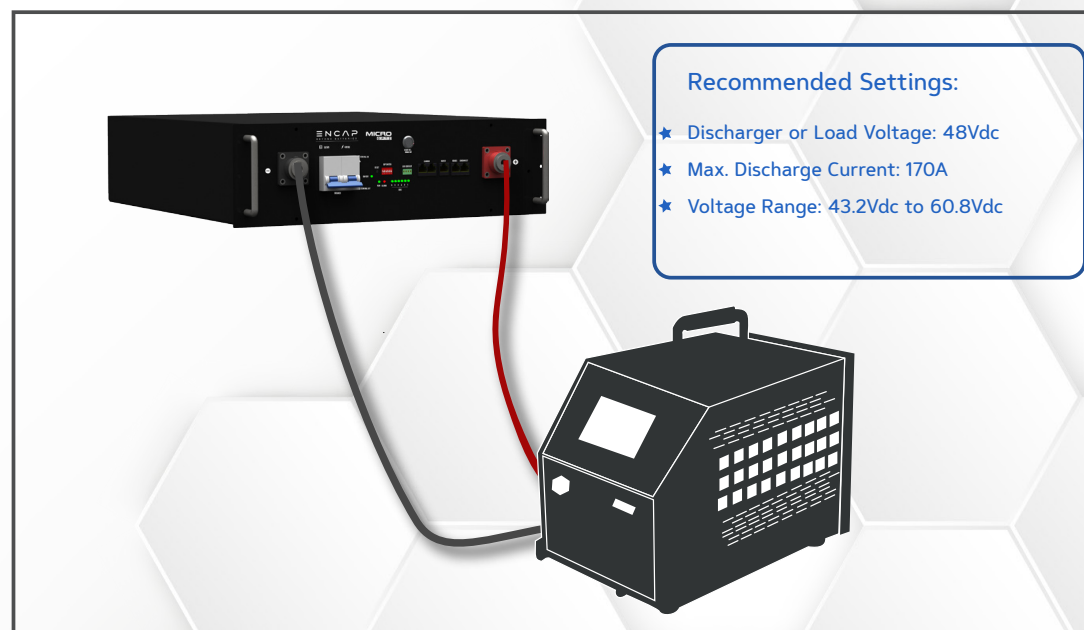
**Figure 12: Discharging Module from discharger**

## PARTS DESCRIPTION

CIRCUIT BREAKER

**3**

NEGATIVE TERMINAL **2**

DIP SWITCH

**4**

WAKE ON

MODULE HANDLES **1**

**5**

**2** POSITIVE TERMINAL

**11** ENCONNECT

**10** RS485

LED ILLUSTRATION **6**

**9** RS232

DRY CONTACT **7**

**8** CANBUS
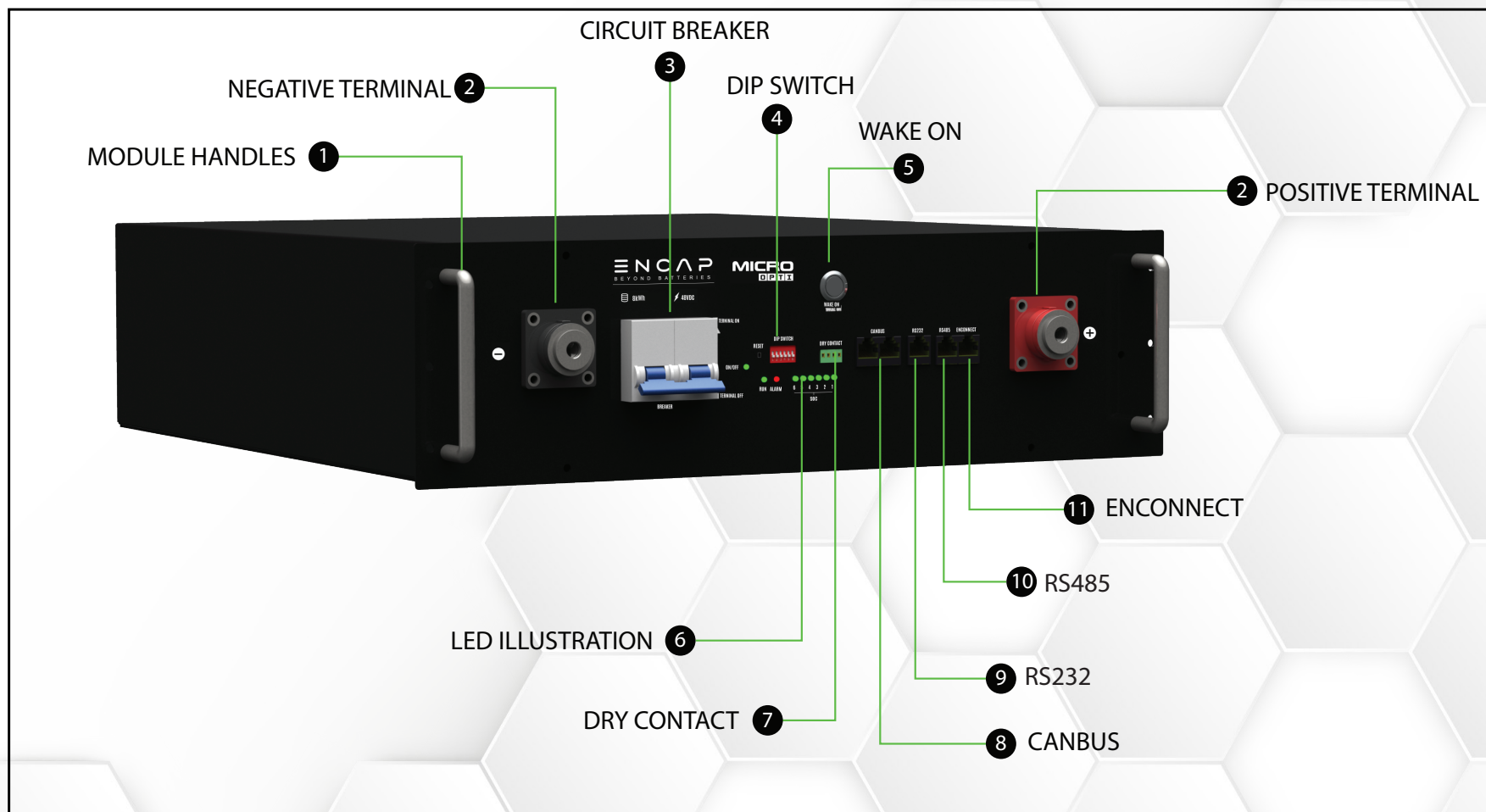
**Figure 13: Module parts description**

## 1. MODULE HANDLES

Two carrying handles are fitted to the front face and back of each Module to ensure easy and safe handling and lifting onto the pedestal. Four people are recommended for stacking the Modules.

## 2. TERMINAL

ENCAP has 300A positive and negative terminals. The terminals are equipped with one fastening point supplied with M10x20mm bolts to accommodate interconnecting busbars and cable lugs.

## 3. CIRCUIT BREAKER

The Module has 125A 2P manual circuit breaker. This breaker serves as over current protection for the Module.

## 4. DIP SWITCH

When the Module is used in parallel, the address can be set through the DIP switch to distinguish different Modules, to avoid setting the address to the same, the definition of the BMS DIP switch refers to the following table. Note: Dials 1, 2, 3, and 4 are valid dials, and dials 5 and 6 are reserved for extended functions.
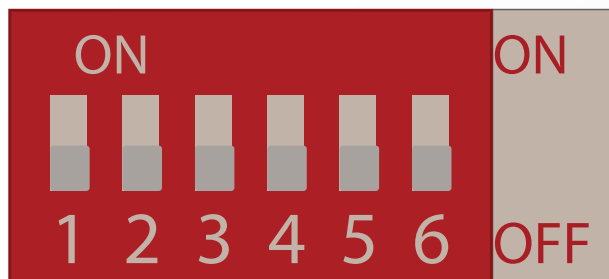
**Figure 14: DIP Switch**

| Address | Dial Switch Position | | | | Explanation |
|---------|------|------|------|------|-------------|
|  | #1 | #2 | #3 | #4 |  |
| 0 | OFF | OFF | OFF | OFF | No cascade, single machine use |
| 1 | ON | OFF | OFF | OFF | When Module is connected in parallel, both dial 0 and 1 can serve as the master |
| 2 | OFF | ON | OFF | OFF | Let Module 2 set to be slave |

| 3 | ON | ON | OFF | OFF | Let Module 3 set to be slave |
|---|----|----|-----|-----|------------------------------|
| 4 | OFF | OFF | ON | OFF | Let Module 4 set to be slave |
| 5 | ON | OFF | ON | OFF | Let Module 5 set to be slave |
| 6 | OFF | ON | ON | OFF | Let Module 6 set to be slave |
| 7 | ON | ON | ON | OFF | Let Module 7 set to be slave |
| 8 | OFF | OFF | OFF | ON | Let Module 8 set to be slave |
| 9 | ON | OFF | OFF | ON | Let Module 9 set to be slave |
| 10 | OFF | ON | OFF | ON | Let Module 10 set to be slave |
| 11 | ON | ON | OFF | ON | Let Module 11 set to be slave |

| 12 | OFF | OFF | ON | ON | Let Module 12 set to be slave |
| 13 | ON | OFF | ON | ON | Let Module 13 set to be slave |
| 14 | OFF | ON | ON | ON | Let Module 14 set to be slave |
| 15 | ON | ON | ON | ON | Let Module 15 set to be slave |

## 5. WAKE-ON BUTTON

The BMS of the Module goes in a dormant state to save power when not in use for an hour.

You can quickly wake-up the BMS.

Do the following to wake up the BMS;

▢    Press the Wake-ON button, the LCD will power On.

## 6. LED INDICATION

## TABLE 1: LED WORKING STATUS INDICATION

| STATUS | Normal / Alarm / Protection | O N / OFF | RUN | ALM | LED | | | | | | EXPLANATION |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Shutdown | Hibernate | OFF | OFF | OFF | OFF | OFF | OFF | OFF | OFF | OFF | OFF |
| Standby | Normal | Solid Green | Flash 1 | OFF | According to the State of Charge (SOC) indication | | | | | | Standby status |
| | Alarm | Solid Green | Flash 1 | Flash 3 | | | | | | | Module low pressure |
| Charge | Normal | Solid Green | Solid Green | OFF | According to the State of Charge (SOC) indication | | | | | | The maximum power LED flashes (flashing 2), and the ALM does not flash during the overcharge alarm |
| | Alarm | Solid Green | Solid Green | Flash 3 | | | | | | | |
| | Over Charge protection | Solid Green | Solid Green | OFF | Solid Green | Solid Green | Solid Green | Solid Green | Solid Green | Solid Green | If there is no mains supply, the indicator turns to standby |
| | Temperature, over current, failure Protect | Solid Green | OFF | Solid Green | OFF | OFF | OFF | OFF | OFF | OFF | Stop charging |

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| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Discharge | Normal | Solid Green | Flash 3 | OFF | According to the electric quantity indication | | | | | | | |
| | Alarm | Solid Green | Flash 3 | Flash 3 | | | | | | | | |
| | Under voltage protection | Solid Green | OFF | OFF | OFF | OFF | OFF | OFF | OFF | OFF | Stop discharging |
| | Temperature, over current, short circuit, Reverse connection, failure protection | Solid Green | OFF | Solid Green | OFF | OFF | OFF | OFF | OFF | OFF | Stop discharging |
| Invalid | | OFF | OFF | Solid Green | OFF | OFF | OFF | OFF | OFF | OFF | Stop charging and Discharging |

TABLE 1: CAPACITY INDICATION

| Status | | Charge | Discharge | | | | | | Status | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Capacity indicator light | | | L6 | L5 | L4 | L3 | L2 | L1 | L6 | L5 | L4 | L3 | L2 | L1 |
| S O C % | 0~6.6% | OFF | OFF | OFF | OFF | OFF | OFF | Flash2 | OFF | OFF | OFF | OFF | OFF | Solid Green |
| | 16.6~33.2% | OFF | OFF | OFF | OFF | OFF | Flash2 | Solid Green | OFF | OFF | OFF | OFF | Solid Green | Solid Green |
| | 33.2~49.8% | OFF | OFF | OFF | OFF | Flash2 | Solid Green | Solid Green | OFF | OFF | OFF | Solid Green | Solid Green | Solid Green |
| | 49.8~66.4% | OFF | OFF | OFF | Flash2 | Solid Green | Solid Green | Solid Green | OFF | OFF | Solid Green | Solid Green | Solid Green | Solid Green |
| | 66.4~83.0% | OFF | OFF | Flash2 | Solid Green | Solid Green | Solid Green | Solid Green | OFF | Solid Green | Solid Green | Solid Green | Solid Green | Solid Green |
| | 83.0~100% | Flash2 | Solid Green | Solid Green | Solid Green | Solid Green | Solid Green | Solid Green | Solid Green | Solid Green | Solid Green | Solid Green | Solid Green | Solid Green |
| Run LED | | | Solid Green | | | | | | Flash 3 | | | | | |

## TABLE 3: LED FLASHING INSTRUCTION

| Flash Mode | ON | OFF |
|:---:|:---:|:---:|
| Flash 1 | 0.25S | 3.75S |
| Flash 2 | 0.5S | 0.5S |

## 7. DRY CONTACT

The purpose of the Dry Contact output is to send the information about unexpected or unwanted events occurring in the Module to other apparatus so that external equipment can understand the current state of the Module and act accordingly.

DRY CONTACT PIN CONFIGURATION:

G - Ground (for isolation)

I1- Pin 1

I2- Pin 2

I3- Pin 3

## 8. CAN COMMUNICATION, RS485 COMMUNICATION

The default communication rate of CAN is 500K, which can be connected to the host computer and can be upgraded.

RS485 default communication rate 9600, can be connected to the host computer, can be upgraded.

CAN and RS485 are dual parallel communication interfaces, support 15 groups of battery parallel communication, CAN when the host is connected to the inverter, RS485 should be parallel, RS485 when the host is connected to the inverter, CAN should be parallel, the two situations need to brush the corresponding program.

## CAN PIN CONFIGURATION
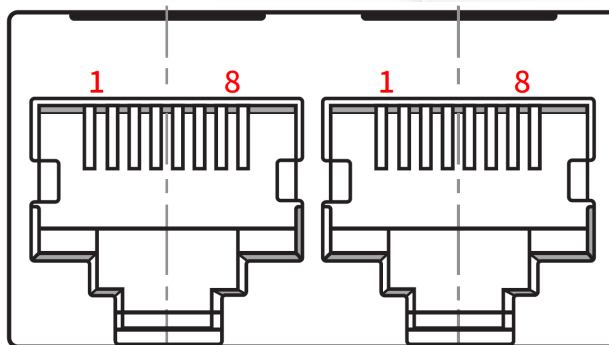


| CAN–Using 8P8C vertical RJ45 socket | | | |
|---|---|---|---|
| RJ45 pin | Define a description | RJ45 pin | Define a description |
| 1 | CANH | 9 | CANH |
| 2 | CANL | 10 | CANL |
| 3 | ISO-GND | 11 | ISO-GND |
| 4 | CANL | 12 | CANL |
| 5 | CANH | 13 | CANH |
| 6 | ISO-GND | 14 | ISO-GND |
| 7 | NC | 15 | NC |
| 8 | NC | 16 | NC |

## RS485 PIN CONFIGURATION
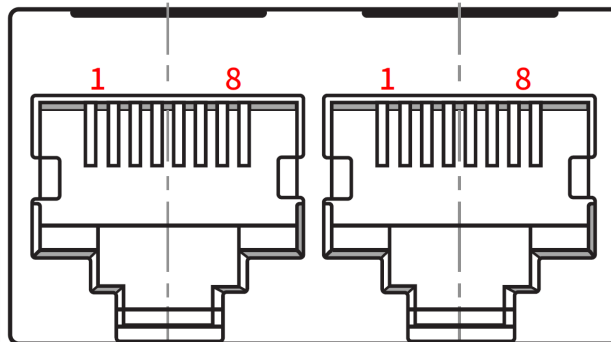


| RS485-Using 8P8C vertical RJ45 socket | | | |
|---|---|---|---|
| RJ45 pin | Define a description | RJ45 pin | Define a description |
| 1 | RS485-B | 9 | RS485-B |
| 2 | RS485-A | 10 | RS485-A |
| 3 | ISO-GND | 11 | ISO-GND |
| 4 | NC | 12 | NC |
| 5 | NC | 13 | NC |
| 6 | ISO-GND | 14 | ISO-GND |
| 7 | RS485-A | 15 | RS485-A |
| 8 | RS485-B | 16 | RS485-B |

## 9. RS232 COMMUNICATION

The RS232 interface can be connected to the host computer, the default baud rate is 9600bps, and the display screen can only choose one of the two, and cannot be shared at the same time.

## RS232 PIN CONFIGURATION
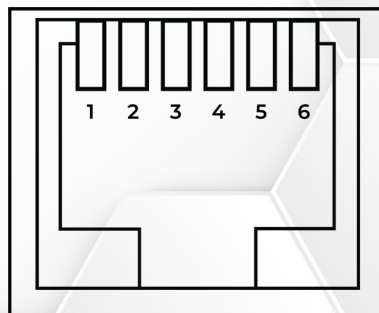


| RS232-Using 6P6C vertical RJ11 socket ||
|---|---|
| RJ11 pin | Define a description |
| 1 | NC |
| 2 | NC |
| 3 | 232TX |
| 4 | 232RX |
| 5 | GND |
| 6 | NC |

## 10. ENCONTROL

The ENCONTROL tool is an OLED display designed for Module monitoring and configuring the Module. Please note that it is not part of the standard Module and require separate purchase.

## ENCONTROL CONNECTION WITH MODULE:

Connect the USB part of cable with the USB port of Encontrol and RJ45 with enconnect port of the Module as illustrated in the picture below:
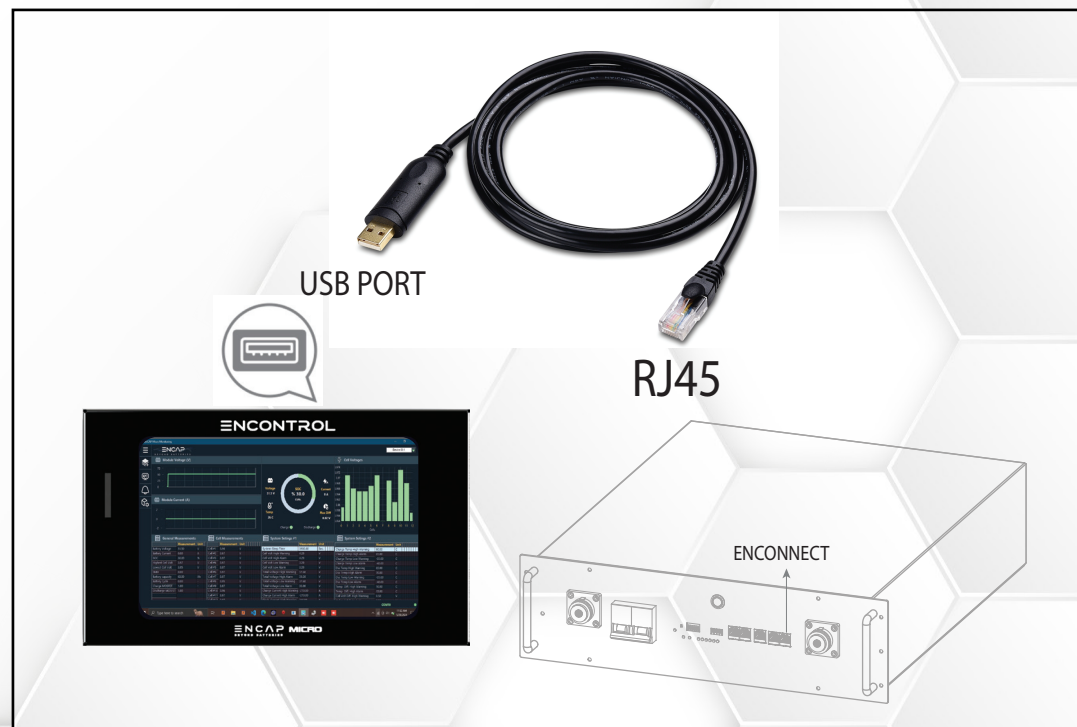


**Figure 15: Connecting Encontrol with Module**

## 1. DASHBOARD

The first page on LCD is dashboard by default.

This shows the general dashboard of the Module. User can see Module voltage, current, Ambient temperature, Max cell voltage difference and charge or discharge status

If more than 1 module is connected, click on the drop down menu to select the required Module

Menu Bar

This section shows the voltage graph of the selected module

This section shows the current graph of the selected module

General Measurements shows the voltage, current, SOC and general parameters of the Module.

This section shows the voltage graphs of all the cells of the module
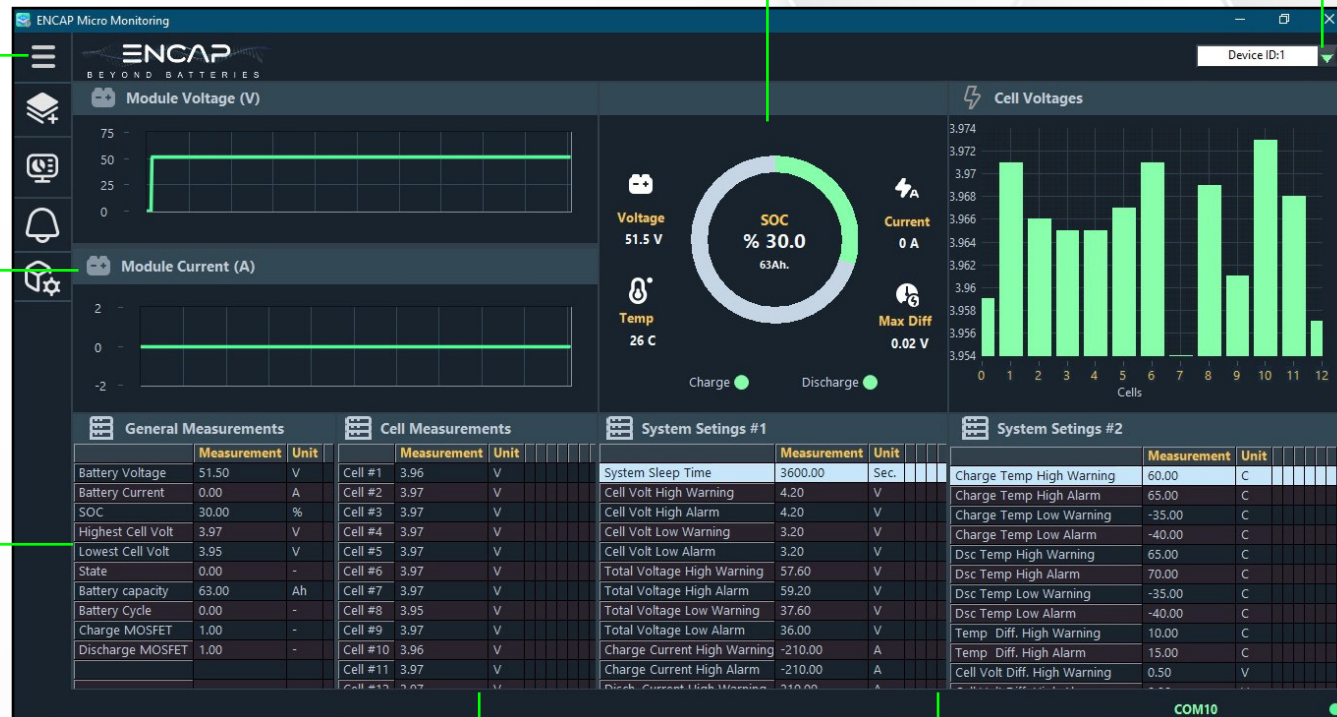
Cell Measurements shows the voltages of all the cells of the Module

System settings shows all the parameters set by the user

## 2. MENU BAR

Click on the menu bar, to extend the table. User has access to four features from the table.
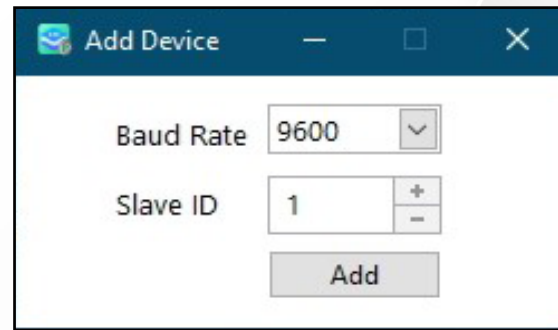
1. Add Device

2. Configure Module

3. Check Alarms

4. Calibrations

# 1 ADD DEVICE:

If you want to add more Module, click on Add Device.

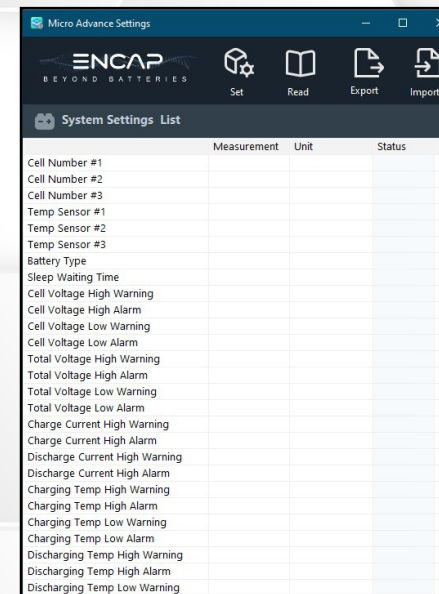In the prompt window add the slave ID and click add.



# 2 CONFIGURE MODULE

Click on Configure Module, system setting list widow will open.

This page shows all the parameter settings from the BMS.

This page has four control buttons:

1. Set

2. Read

3. Export

4. Import

- *READ:*

  If you want to see BMS parameter settings, click on read button to see all the parameters.

- *SET:*

  If you want to set the parameter setting, Click on set.

- *EXPORT & IMPORT*

  If you want to export the set parameters to another Module, click on export and save the file in the destination file. Now click on the import file to get all the parameter set values.

# 3 CHECK ALARMS:

Encap Module has all the alarms settings with protection feature as default. This page shows all the logged alarms with time and date.
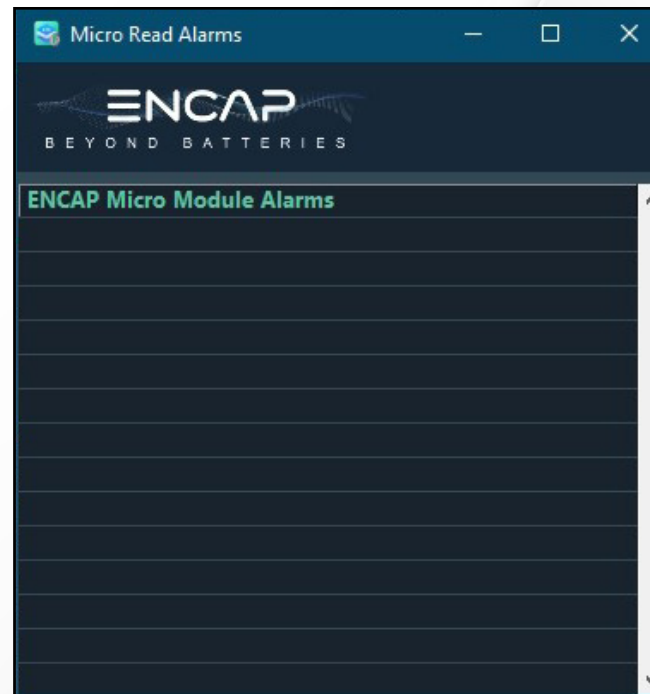
# 4 CALIBRATIONS:

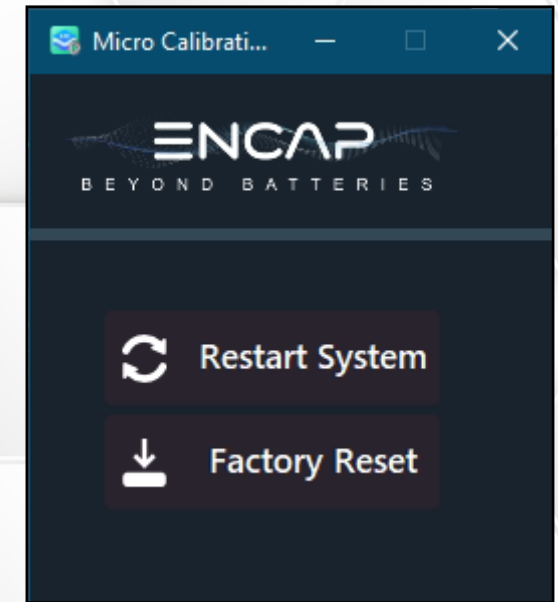Users can do two type of calibrations:

1. Restart System

2. Factory Reset

# 1. RESTART SYSTEM

If the Module is frozen or unresponsive, click on restart Module System to force-restart the Module.

# 2. FACTORY RESET

If you want to reset the parameter settings, click on factory reset.

# PARALLEL CONNECTION OF MODULES

Any number of Modules can be connected in parallel. All Modules must be at 100% SOC before connecting in parallel.

 Connect the positive (+) terminal and negative (-) terminal of all Modules as illustrated.

 Connect all the RS485 ports with the cable provided.

Refer to the parallel connection of the Modules as shown below and make your connections accordingly.
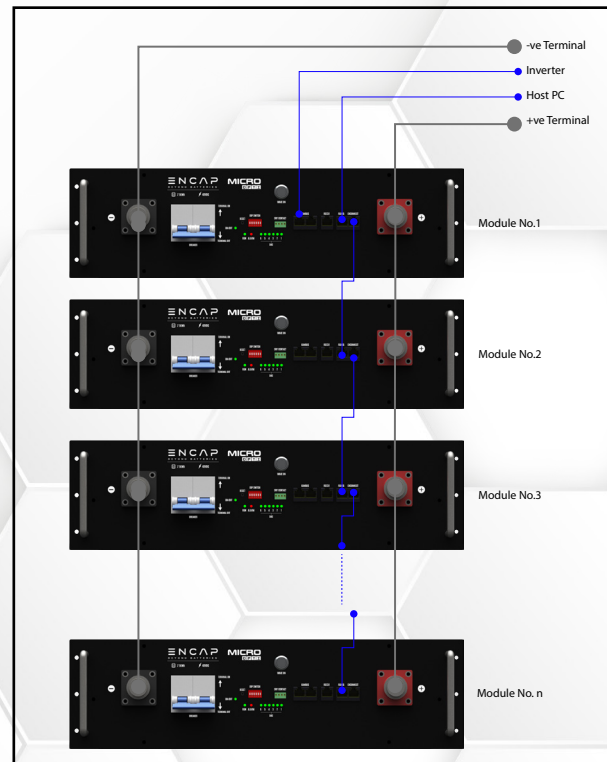


**Figure 16: Parallel Connection of Modules**

# SERIES CONNECTION OF MODULES

All Modules must be at 100% SOC before connecting in series. Maximum of eight (8) Modules can be connected in series. Modules can only be

connected in series through Encontactor and Encontroller.

 Connect the positive (+) terminal and negative (-) terminal of all Modules as illustrated.

 Connect all the RS485 ports with the cable provided.

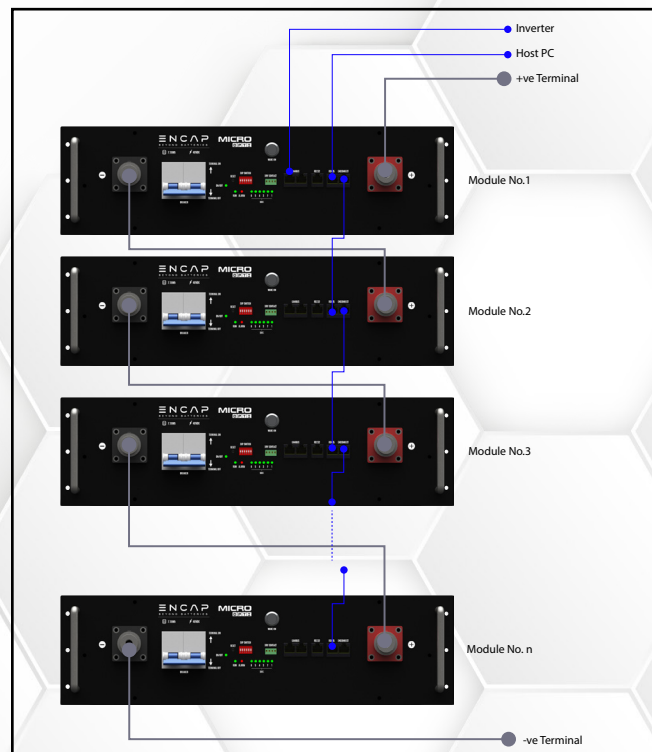Refer to the series connection of the Modules as shown below and make your connections accordingly.



**Figure 17: Series Connection of Modules**

# PROTECTION

## INTRODUCTION

Module will trip under any excessive use conditions to prevent damage to itself and to the connected equipment. Specified limits for excessive current, high voltage and low voltage are provided in Module's Technical Data Sheet.

## OVER-CURRENT

When the Module has an over-current fault, the terminals cut off, which means the Module will not take more current from the charging device.

## MODULE FULLY CHARGED

When the Module voltage reaches the maximum voltage limit, the electronic switch will stop further charging and will go into standby mode. This means that each cell from the Module has reached to maximum rated voltage. The Module terminal will not activate unless you start discharging the Module.

## MODULE FULLY DISCHARGED

When the Module voltage reaches the minimum voltage limit, the electronic switch will stop further discharging and will go into standby mode. The Module terminal will not activate unless you start charging the Module.

## CELL OVER-TEMPERATURE

When the ambient cell temperature reaches above 70°C, the electronic switch will stop further charging or discharging the Module and will go into standby mode. The Module terminal will not activate unless the ambient cell temperature goes below 70°C .

## TERMINAL OVER-TEMPERATURE

When the terminal temperature reaches above 70°C, the electronic switch will stop further charging or discharging and will go into standby mode. The Module terminal will not activate unless the terminal temperature goes below 70°C .

## STATE OF CHARGE (SOC)

When the SOC reaches to 20% or 80% the electronic switch will stop further discharging or charging of the Module respectively.

## CELL BALANCING

1. **DESCRIPTION**

If there is cell over voltage or cell under voltage, or if the delta voltage is greater than specified range, the Module will stop charging/discharging and the Equalizer will automatically turn-on to remove cell imbalance. After the Equalizer has balanced cell voltages [voltage difference is within ± 0.05V], the Module will automatically resume charging or discharging, as the case may, before the equalizer turned on.

## KEY FEATURES

- Low power consumption.

- Accurate SOC estimation.

- Smart active cell balancing

- Long service life.

## PHYSICAL FEATURES

1. ENCAP Module has embedded functionality in the event of:

- High Cell Voltage

- Low Cell Voltage

- High Terminal Voltage

- Low Terminal Voltage

- High Terminal Current

- High Ambient Temperature

- High Module Temperature

- Cells Imbalance

- Low SOC

- High SOC

2. Front panel of ENCAP Module has Wake on Button. When the Module is not in use for an hour, it goes to a dormant state to save power and the LCD will blank out. Pressing the Wake-on Button will turn on the LCD..

## TECHNICAL FEATURES

3. ENControl tool has memory card that logs the following values.

- Terminal Voltage
- Terminal Current
- Module SOC
- Ambient Temperature
- Terminal Temperature
- Time Stamp
- Parameters Graphs
- Measurement Monitoring
- Alarm Monitoring