Hardware User Manual

KA49702 M483 BMS Reference Board Hardware User Manual

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1. OUTLINE

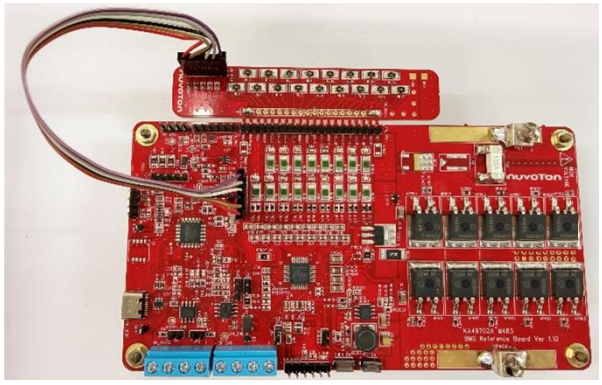
1.1 Purpose

The purpose of this manual is to explain the hardware configuration of the KA49702 M483 BMS Reference Board and to assist the user with the setup of the reference board.

1.2 Reference Board components

The reference board is made up of the following components:

a) MCU + Analog Front End (AFE) Board (Main devices: MCU M483SGCAE + BMIC KA49702A)
b) USB Type-C Data cable



MCU + AFE Board (KA49702 M483 BMS Reference Board)

USB Type-C Data cable

Figure 1.1 Reference Board components

2. MCU CONTROLLER SECTION

2.1 Introduction

The MCU controller circuit controls the BMIC with an onboard MCU M483SGCAE. It provides several control circuits and interfaces. Besides controlling the BMIC, the MCU circuit is also able to interface with a PC GUI. The PC GUI provides flexibility to the user for configuring the BMIC and status display.

The MCU controller section has the following functions:

a) MCU circuitry (including software debugging interface)
b) Power management and MCU reset circuitry
c) BMIC interface circuitry
d) LED status indication
e) USB Type-C interface
f) CAN bus interface**
g) RS485 interface**
h) UART interface**
i) Serial Flash**
j) Nuvoton Motor Driver Board (Main device: IC KA44370A) interface**

** not supported by software at this moment.

2.2 MCU controller circuit components and connector layout

The following shows the connector layout and component placement of the MCU controller section.

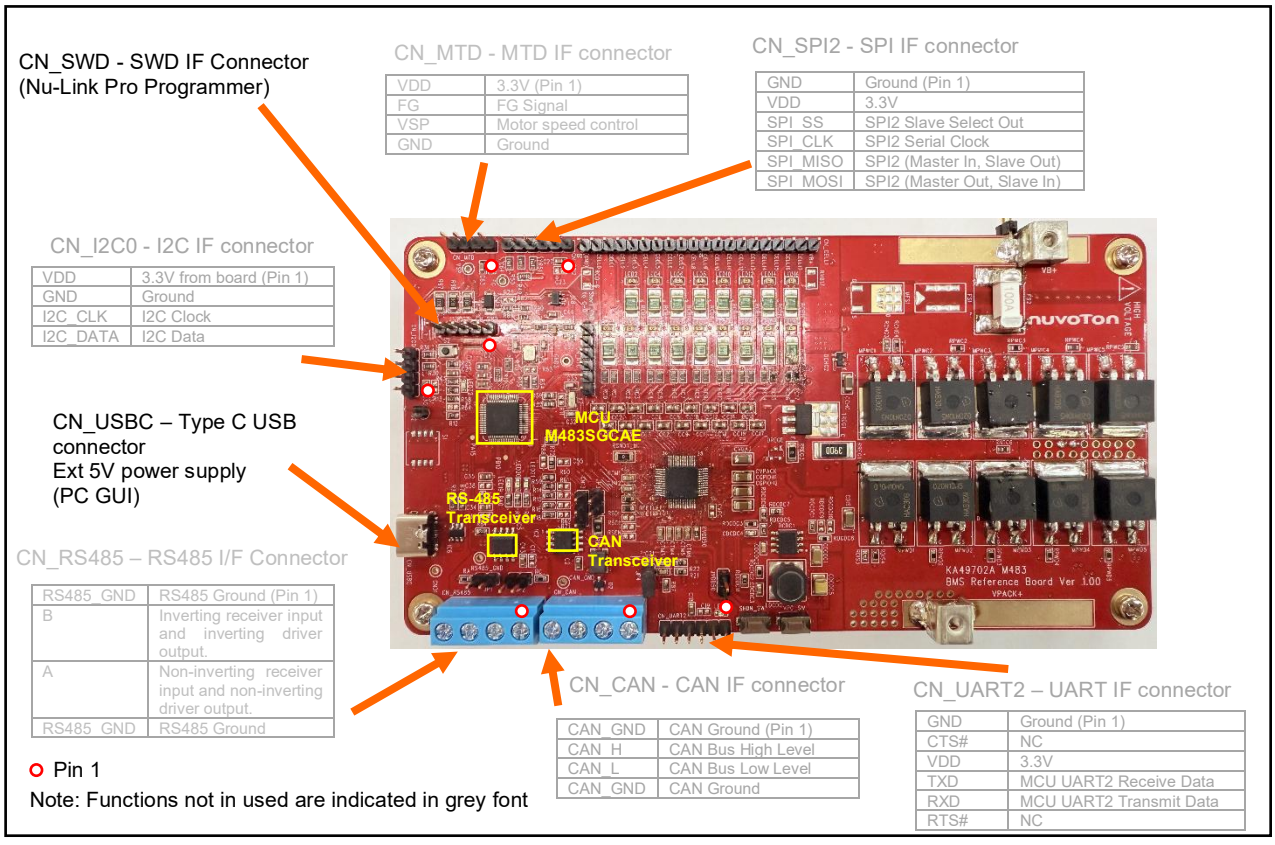


Figure 2.1 Top side of the MCU portion of the Reference Board

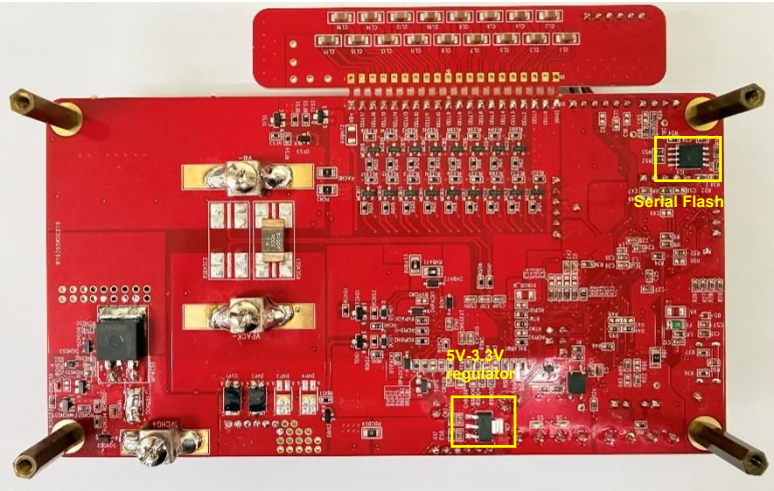


Figure 2.2 Bottom side of the MCU portion of the Reference Board

2.3 Power Management

Providing flexibility for the user in using the reference board for their application, the MCU board incorporates several options to supply the required voltage to the reference board.

a) 5V Power supply from the DC-DC converter and step down to 3.3V using LDO.
b) Power supply from BMIC (max 50mA)
c) External 5V power supply from USB Type-C connector (As the MCU is using 3.3V, step down LDO is used)

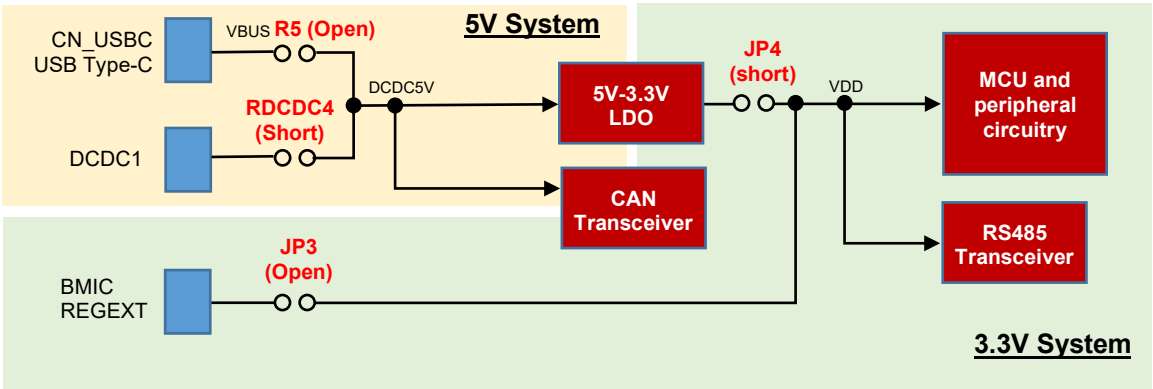


Figure 2.3 Power distribution diagram on MCU circuit

Note :

1. By default, Option (a) is selected (RDCDC4 and JP4 are shorted, others are opened)
2. To use the CAN bus function, 5V must be supplied.

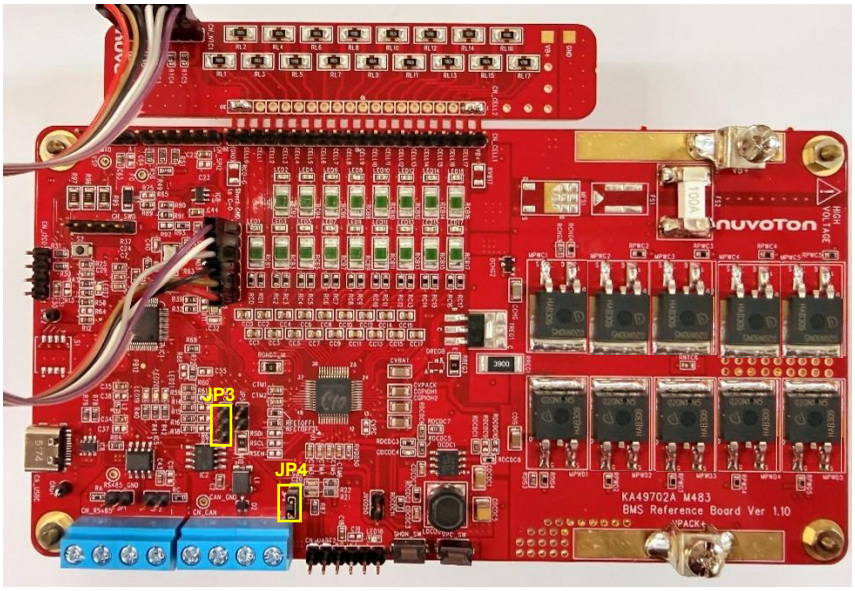


Figure 2.4 Power distribution jumper setting and location

2.4 MCU Manual Reset

On-board push-button tact switch S2 is used to enable manual reset of the MCU. Press and release the push button to reset the MCU manually.

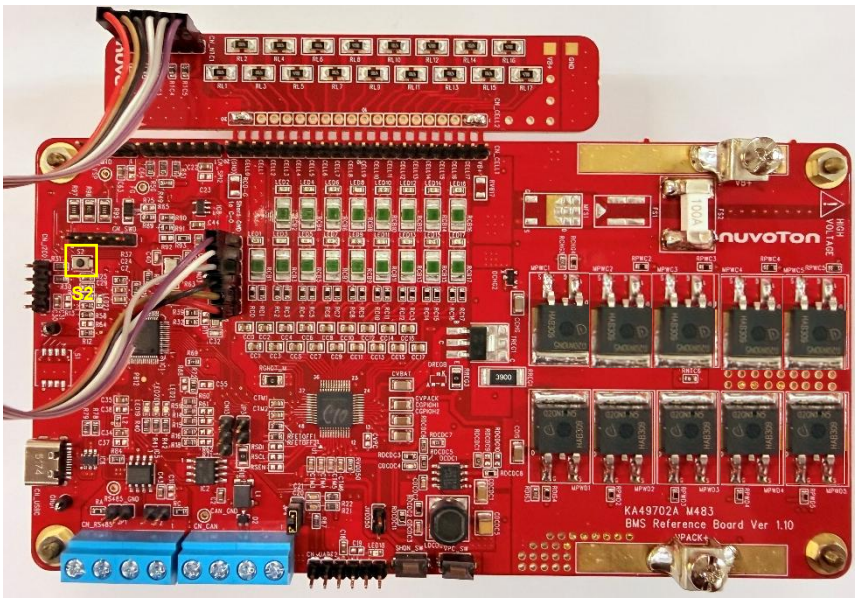


Figure 2.5 Push button S2 for MCU manual reset

2.5 LED Indicator

For ease of operation status notification, MCU controller circuit has LED indicator for critical operation and error notification.

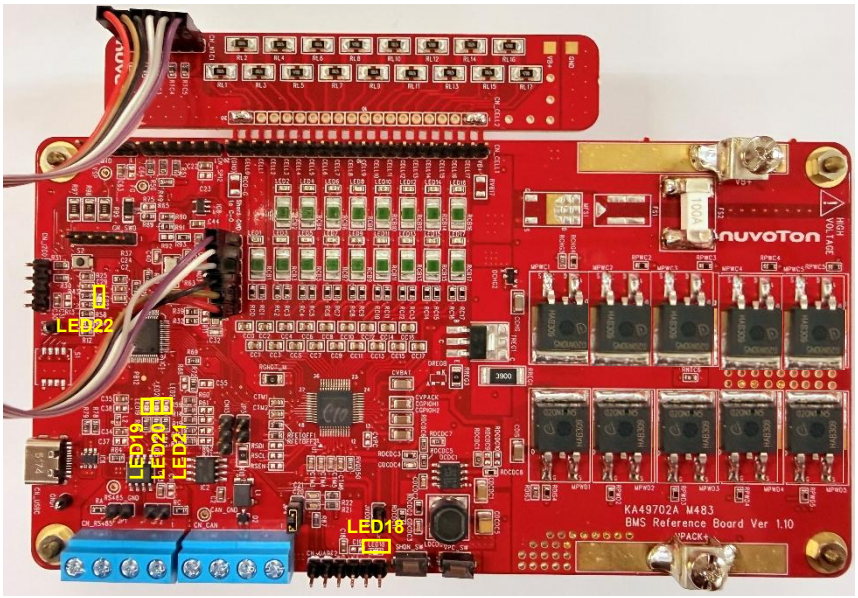


Figure 2.6 LED Indicator

LED	Color	LED status	Notification
LED19	Red	ON	Charging in operation
LED20	Amber	ON	Discharging in operation
LED21	Blue	ON	Cell Balancing in operation
LED22	Green	Flashing	SPI communication with AFE board is working and normal
LED19~22	-	ON	SPI communication error / AFE board wake up error
LED18	Red	ON	5V power supply is applied

3. ANALOG FRONT END (AFE) SECTION

3.1 Introduction

The Analog Front End (AFE) circuit uses KA49702A Battery Management IC as the main device. The AFE circuit performs operations such as battery cell voltage, current and temperature measurement, charging and discharging of the battery cell, cell balancing operation, fault detection etc with the control from the MCU.

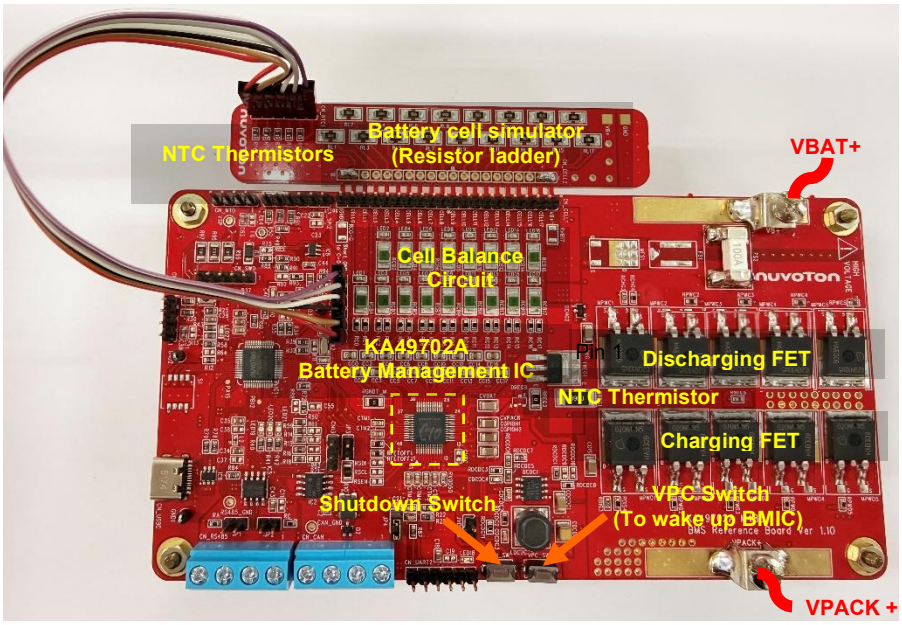


Figure 3.1 Top side of the BMS Reference board – AFE Circuits

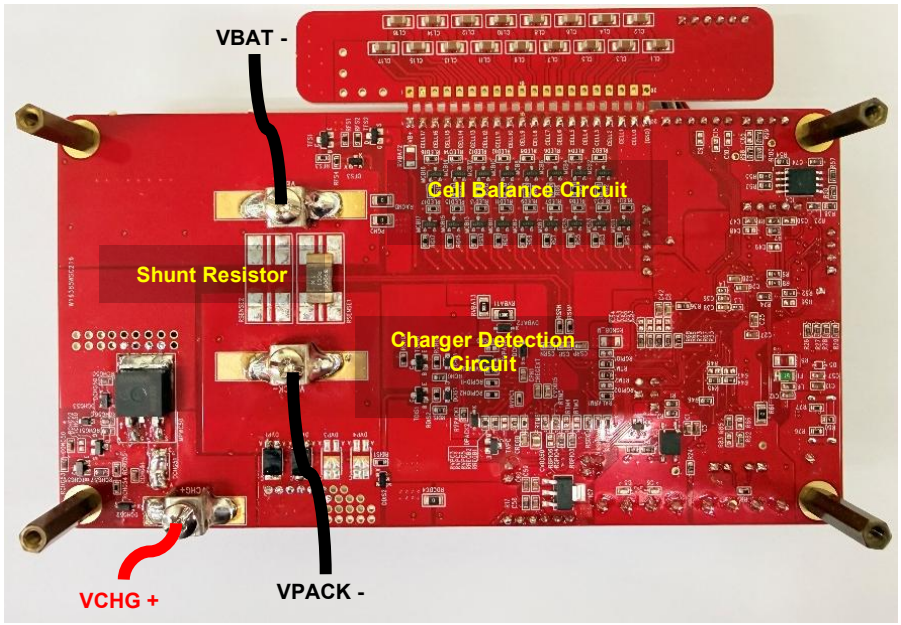


Figure 3.2 Bottom side of the BMS reference board – AFE Circuit

3.2 Power distribution

In the reference board setup, a DC-DC Converter is used to step down the VBAT or VPACK input to provide a 5V output for the CAN transceiver and LDO input.

By default, the MCU is powered by a 3.3V supply provided through the LDO.

To change the MCU power supply to use the BMIC REGEXT voltage, open jumper JP4 and short jumper JP3. Ensure that JVDD50 is open. Placing a jumper at JVDD50 will pull REGEXT to 5V, potentially causing damage to the MCU, which operates at 3.3V.

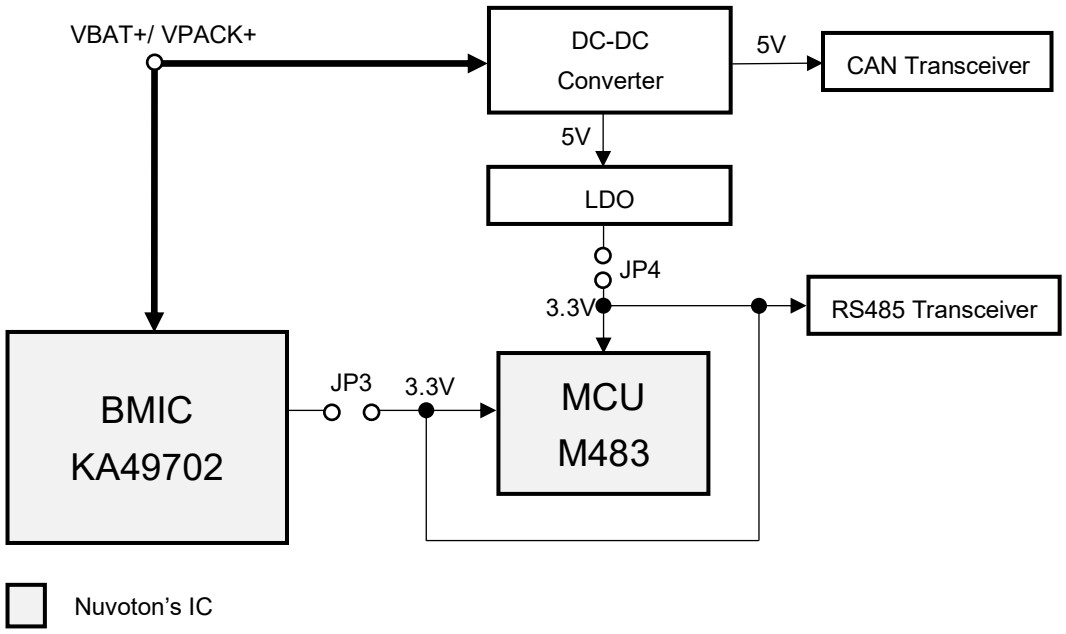


Figure 3.3 Power Distribution Diagram

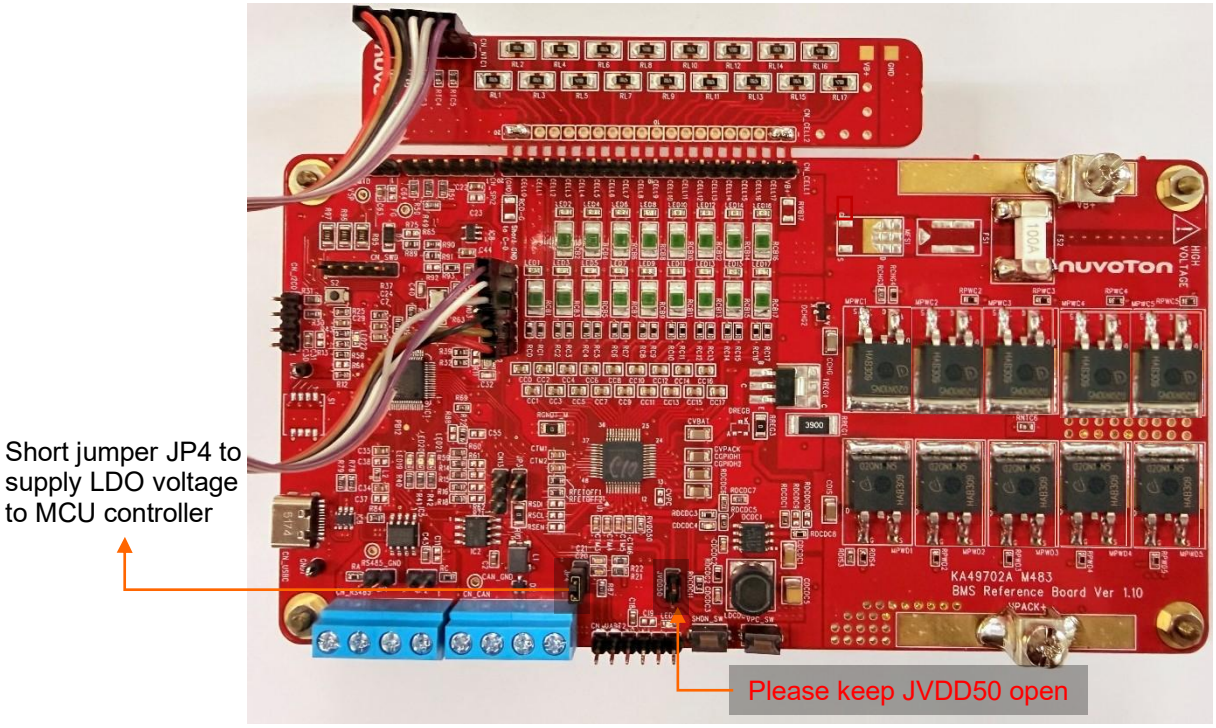


Figure 3.4 Power supplies to MCU

3.3 Charging and Discharging FET

Five pairs of N-channel MOSFETs are placed on the high side of the battery positive as switches for controlling both charging and discharging operations. These MOSFETs are driven by the high-side driver in the KA49702 BMIC. This reference board is designed to support discharge currents up to 50A and charge currents up to 20A. Users may adjust the number of MOSFET pairs in accordance with their current load requirements. User should perform evaluation to validate the setup if adjustment has been made from the original FET configuration on the board. Figure 3.5 below shows the location of the MOSFETs on the reference board.

3.4 Cell Balance Circuit

The reference board features an external cell balance circuit that utilizes 18Ω balancing resistors (RCBn) and N-channel MOSFETs (MCBn) with Rds(ON) of 51mΩ. For 3.6V battery cell, the balancing current is around 200mA. 1kΩ resistor (RCn) and 1uF capacitor (CCn) are included as an RC filter for the input voltage. Figure 3.5 below shows the location of the Cell Balancing components on the reference board.

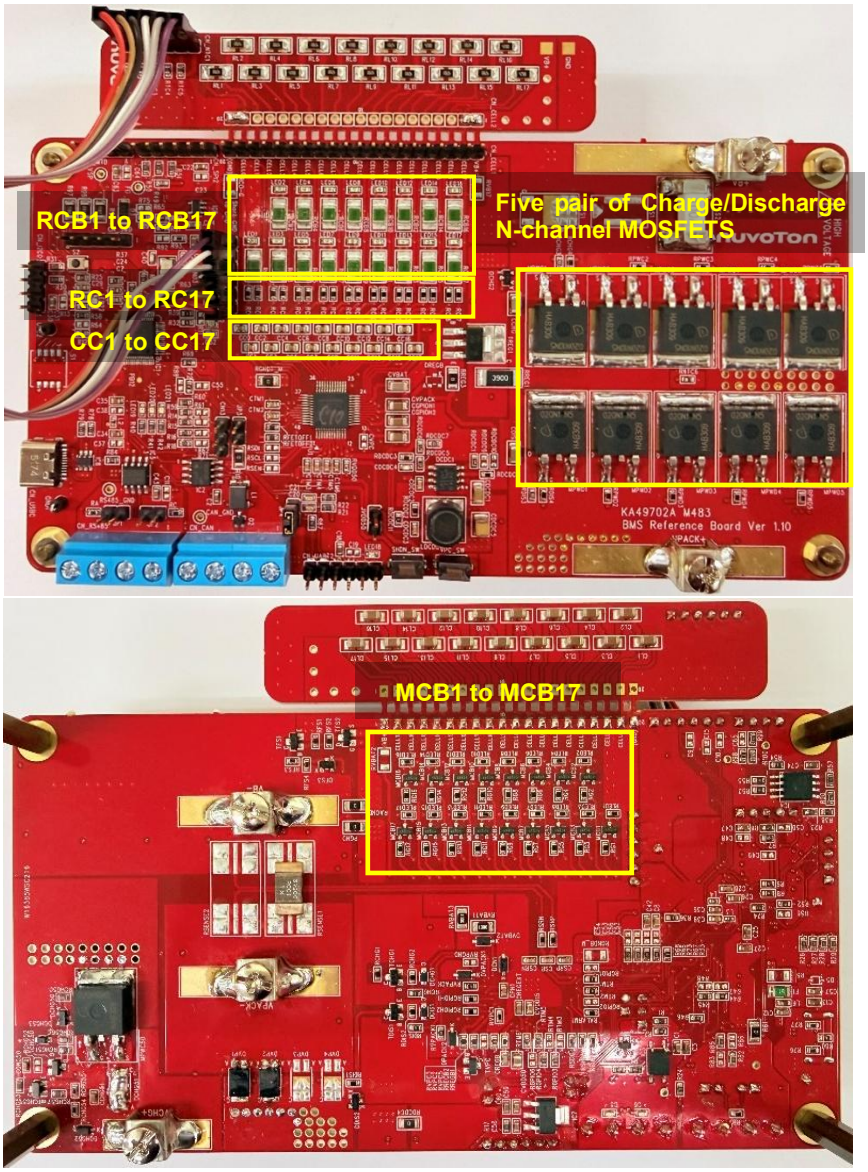


Figure 3.5 MOSFET and Cell Balancing Components

3.5 Thermistor

Six 10kΩ Negative Temperature Coefficient (NTC) thermistors are installed on the reference board for temperature measurement. One NTC is positioned near the MOSFETs to monitor the heat dissipation. The remaining five NTC thermistors are mounted on the Battery cell simulator (Resistor ladder) board and connected to the BMIC TMONI input pins by wires for demonstration purposes. Users can install these NTC thermistors in other areas of the system, such as the battery cell area, and connect to the TMONI pins connector (CN_NTC) on the board. Figure 3.6 below shows the location of the NTC and the TMONI pins connector.

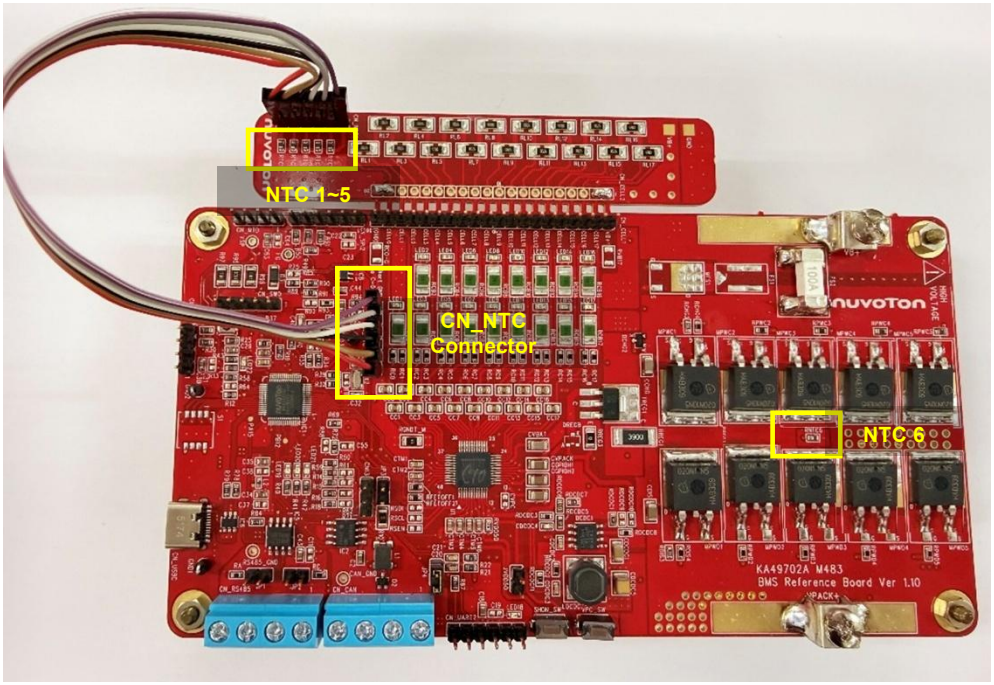


Figure 3.6 NTC and TMONI pins location

3.6 Shunt Resistor

The reference board uses one 1-mΩ, 5-W, 50-PPM shunt resistor for current measurement. The shunt is mounted at the bottom of the board.

3.7 Charger Detection and Protection Circuits

The reference board includes a charger detection circuit with a protection mechanism. For charger detection to operate, the input voltage at the VCHG+ port must be higher than the VBAT voltage, and both the charging and discharging MOSFETs need to be turned off.

Under normal conditions, the VCHG+ port is either connected to a charger or left open. If a short-circuit occurs at VCHG+ port, the protection circuit will be triggered and will switch off the Charging FET to disconnect VCHG+ port to the VBAT.

4. REFERENCE BOARD HARDWARE SETUP

4.1 PC GUI Interface Connection

Using USB Type-C data cable, the BMS reference board can be interfaced with PC GUI, referring to Figure 4.1 below:

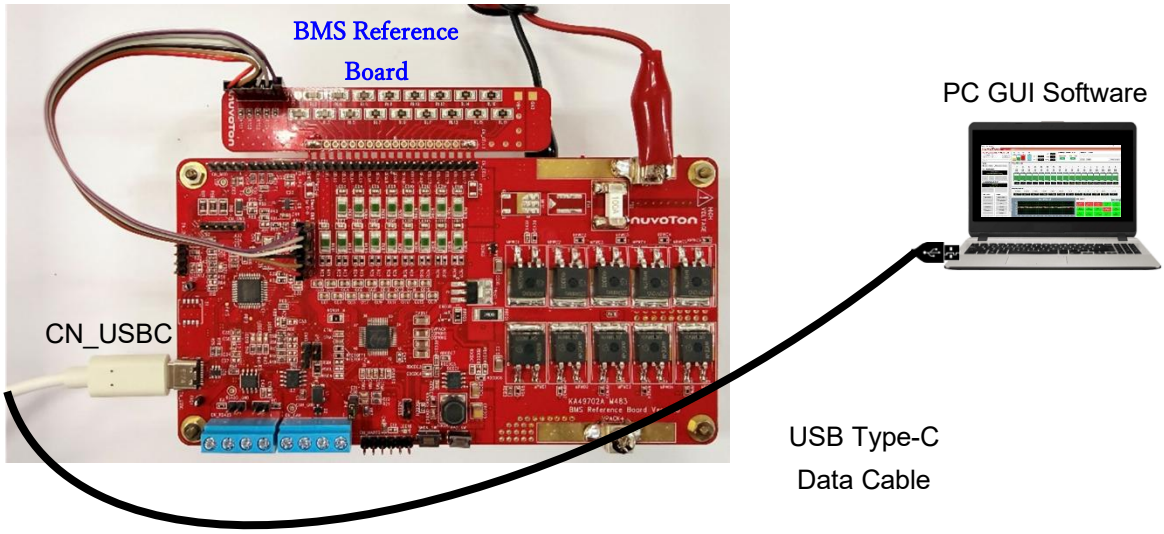


Figure 4.1 PC GUI connection using USB Type-C Data Cable

5. REFERENCE BOARD OPERATION

5.1 System Start up / Wake up

(1) Connect VBAT input with minimum voltage of 12.5V and maximum voltage of 40V*. MCU will start to operate once the VBAT voltage is applied. Before VPC button switch (VPC_SW) is pressed, the BMIC is in Shutdown mode.

(2) To start up/wake up the BMIC, press the VPC_SW button. This generates a wake-up pulse to the BMIC. Once the BMIC is active, the MCU will establish communication with the BMIC. Green LED22 will flash to indicate the reference board is operating normally. For other system status, please refer to chapter 2.5 – LED Indicator.

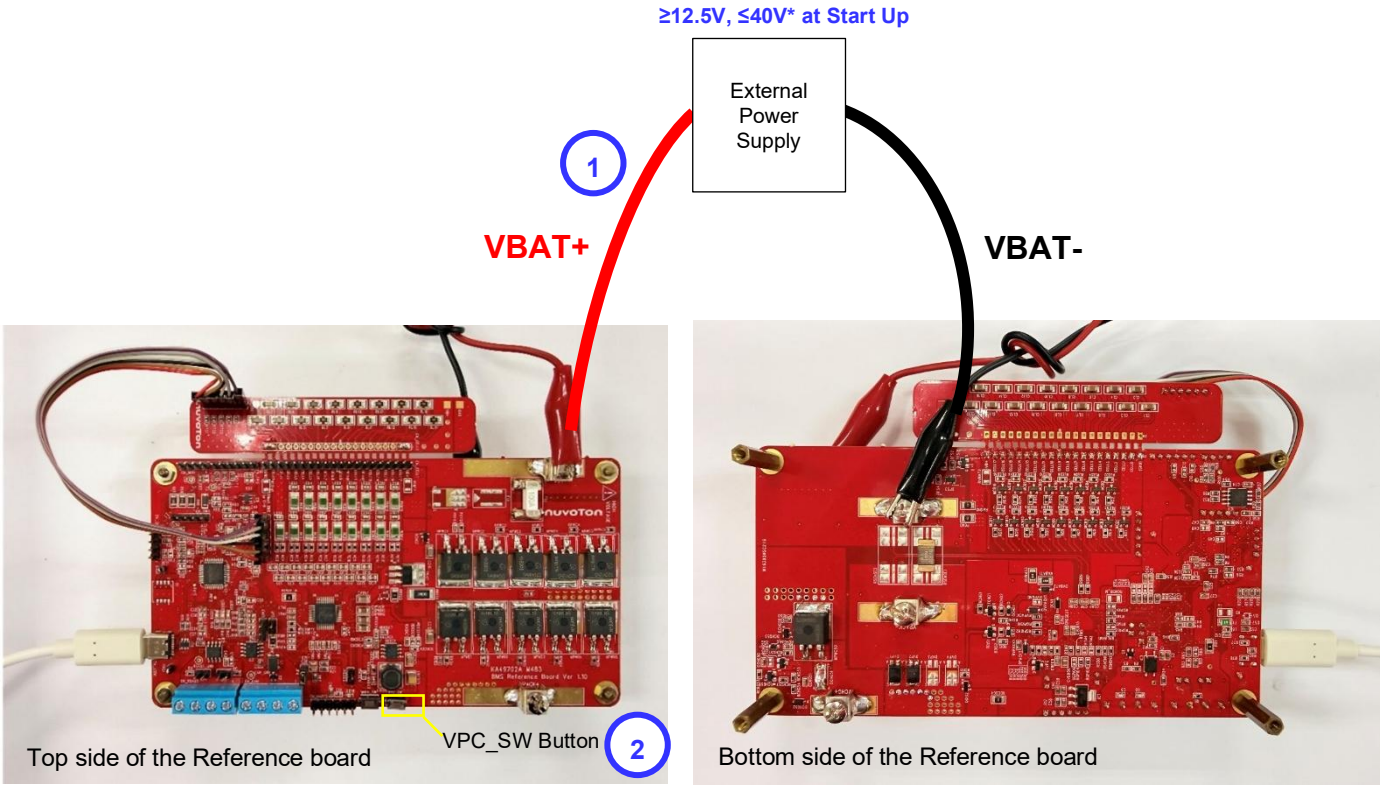


Figure 5.1 System Start up / Wake up

*Note 1: Ensure power supply voltage is less than 40V during power up, you may increase the voltage gradually after power up.

5.2 Safety Precautions

Please note the following safety precautions when operating the Evaluation Board with a high-voltage Lithium-Ion Battery

With the presence of high voltage, hazards include electric shock and fire due to short circuits.

Always cover the Evaluation Board with an acrylic box when conducting an evaluation. Always wear goggles to protect the eyes.

6. REVISION HISTORY

Date	Revision	Description
2025.10.16	1.00	1. Initially issued.
2025.1.20	1.10	1. All pages – Update picture to V2 board 2. Page 13 – Add note and description for <40V at power up.

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