Hardware User Manual

KA49703A Reference Platform Hardware User Manual

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1. OUTLINE

1.1 Purpose

The purpose of this manual is to describe the hardware setup of the KA49703A Battery Management System Reference Platform and to help users with configuring the reference platform.

1.2 Reference Platform Components

The reference platform consists of three main boards and supporting accessories, configured for a stacked BMIC setup. The components are:

a) MCU controller board (Main device: MCU M483SGCAE)
b) Communication IC board (Main device: COMM-IC KA84922UA)
c) Analog Front End (AFE) board (Main device: BM-IC KA49703A)
d) Pack Monitoring IC board (Main device: PM-IC KA84917UA)
e) Jumper wire (for Daisy Chain communication)
f) USB Type A to Type C cable
g) Nu-Link Pro Programmer (Optional: For Software Development & Firmware update)

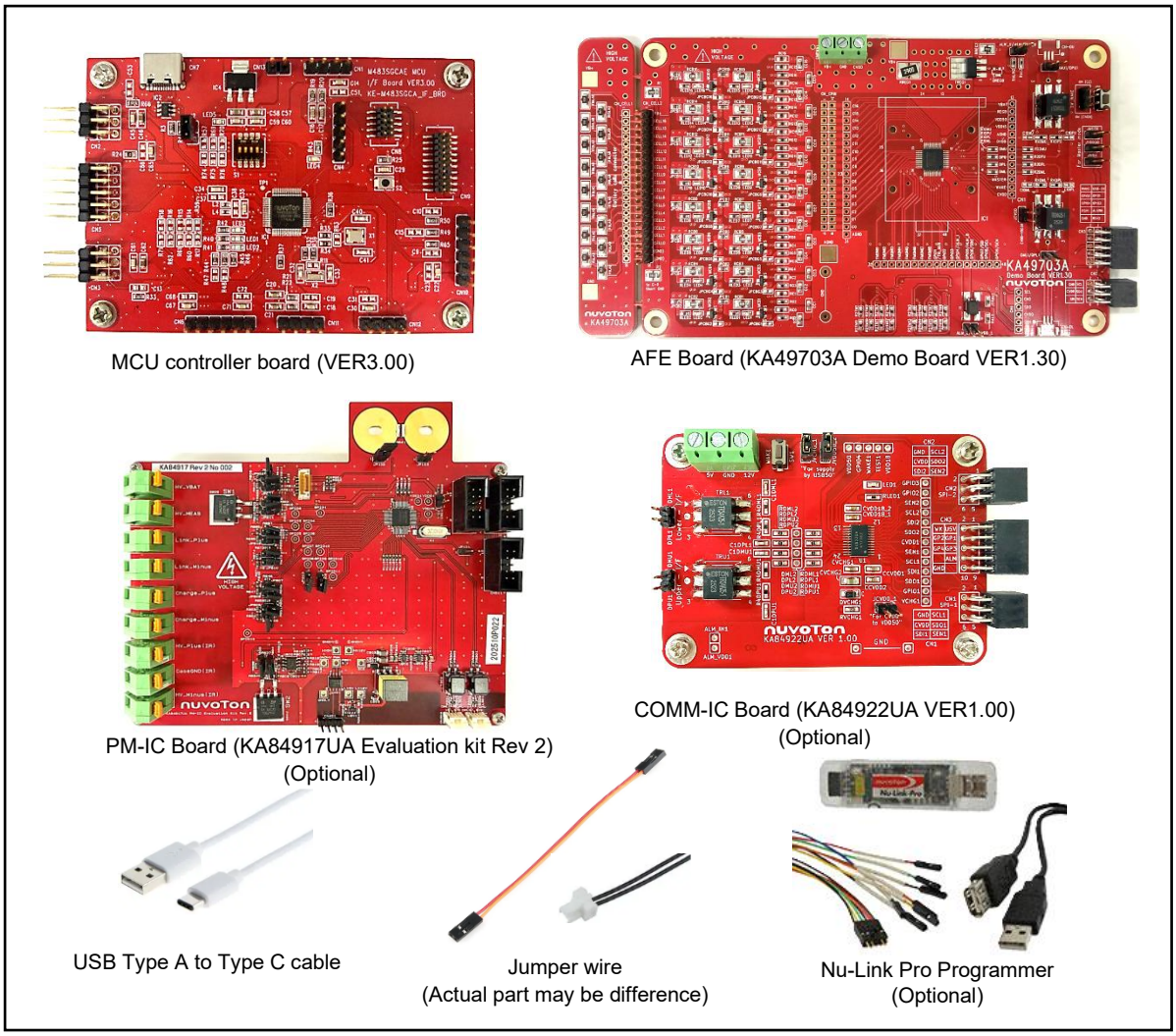


Figure 1-1 Reference Platform Components

2. MCU CONTROLLER BOARD

2.1 Introduction

The MCU controller board manages the BM IC via an onboard MCU, specifically the M483SGCAE. It includes various control circuits and interfaces. Alongside controlling the BM IC, the MCU board can connect with a PC GUI. This GUI enables the user to configure the BM IC and view its status with flexibility.

The MCU controller board has the following functions:

a) MCU circuitry (including software debugging interface)
b) Power management and MCU reset circuitry
c) BM IC and PC GUI communication interface circuitry
d) DIP switch for selecting operation options**
e) LED status indication
f) CAN bus interface**
g) Expansion ports** (such as SPI, UART and IIC for future expansion)

Note: Items marked ** are not supported by the software at this moment.

2.2 MCU Controller board components and connector layout

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

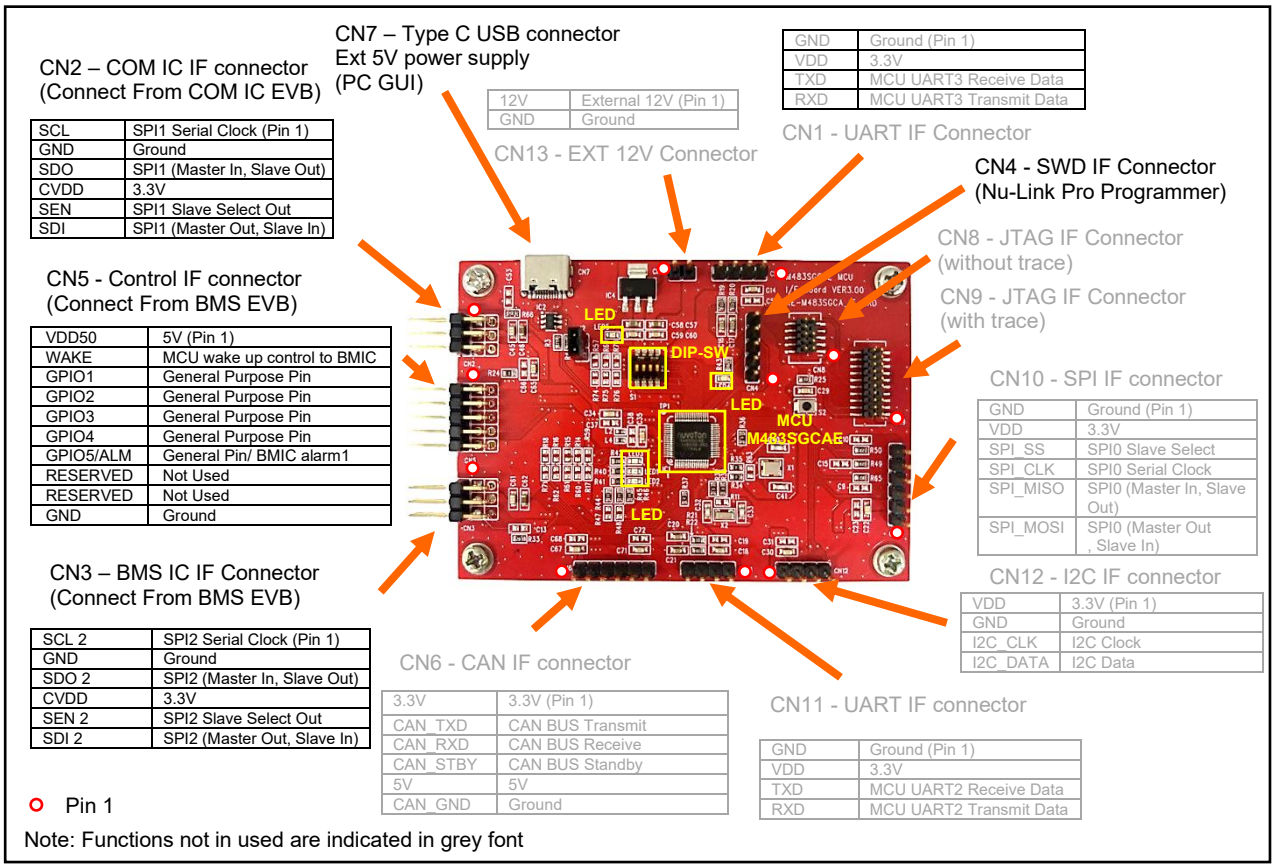


Figure 2-1 Top Side of MCU Controller Board

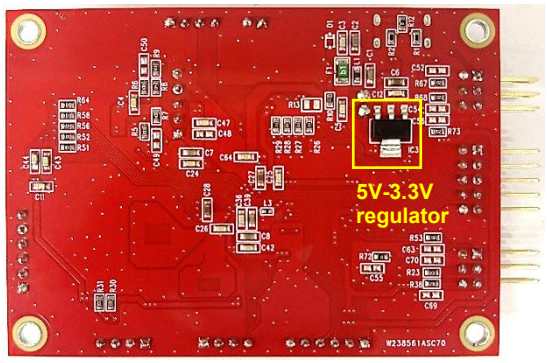


Figure 2-2 Bottom Side of MCU Controller Board

2.3 Power Management

To offer users greater flexibility when using the reference platform for their application, the MCU board supports two external power supply options.

a) External 5V supply via USB Type-C (CN7)

- The MCU operates at 3.3V using an onboard step-down regulator.
- When using this option, J2 must be shorted (default configuration).

b) External 12V supply via connector (CN13)

- Onboard step-down regulators generate 5V and 3.3V for the MCU.
- When using this option, R13 must be mounted and J2 must remain shorted.

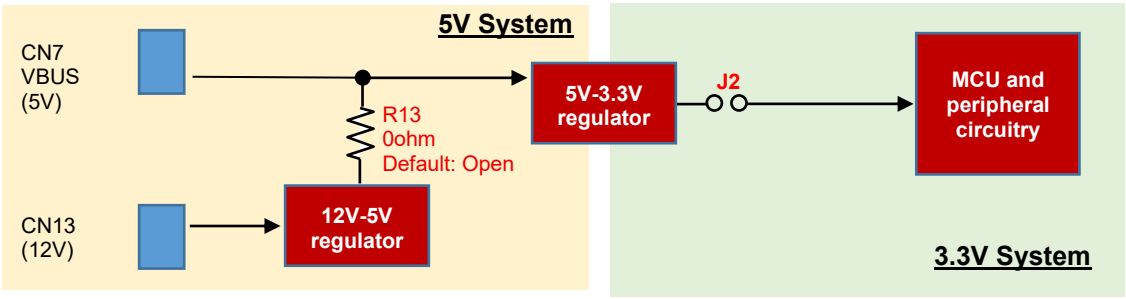


Figure 2-3 Power Distribution Diagram on MCU Controller Board

2.4 MCU Controller Board Power Supply

In the reference platform, the default power supply is the external 5V from the USB Type-C (CN7) port, which is stepped down to 3.3V through an LDO to power the MCU controller board. The MCU begins operation once the internal reset is released after power-on. LEDs on the MCU board indicate the system status.

An optional external 12V supply can be provided through connector CN13. The 12V input is stepped down to 5V by an LDO, then further regulated to 3.3V by another LDO for the MCU controller board.

- When using this option, R13 must be mounted.
- USB Type-C must not be connected simultaneously.

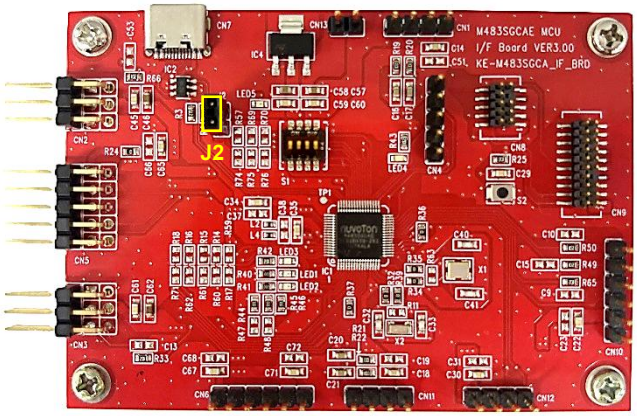


Figure 2-4 Power Distribution Jumper Setting and Location (Front View)

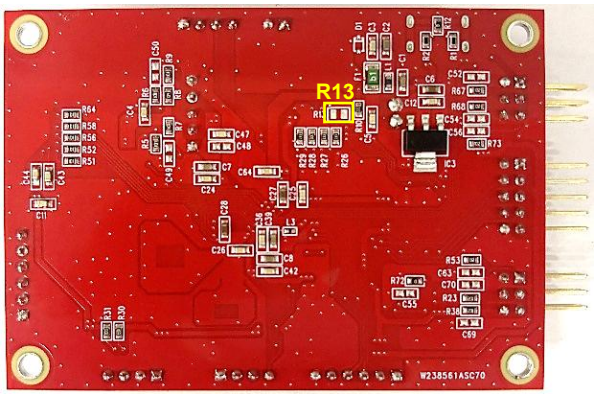


Figure 2-5 Power Distribution Jumper Setting and Location (Back View)

2.5 MCU Manual Reset

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

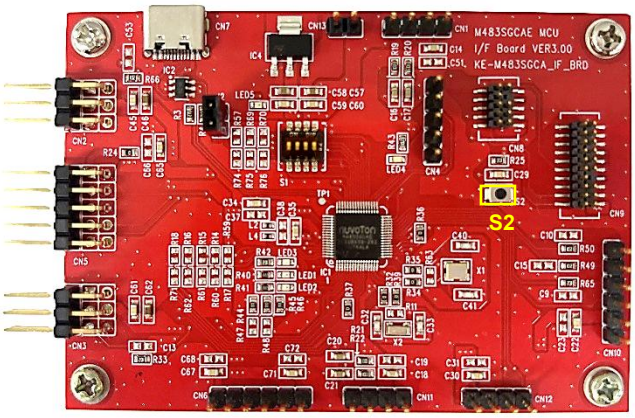


Figure 2-6 Push Button S2 for MCU Manual Reset

2.6 LED Indicator

For ease of operation and status monitoring, the MCU controller board features LED indicators for critical operations and status.

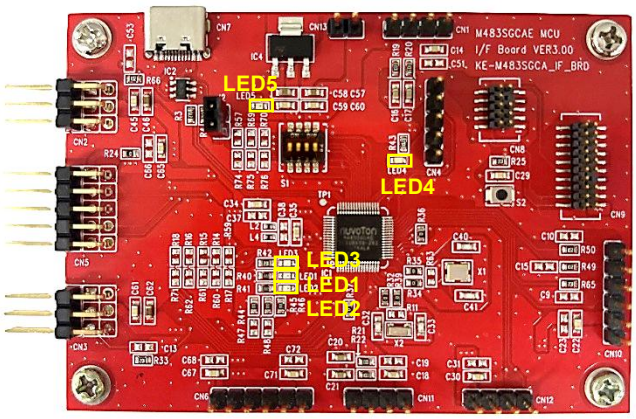
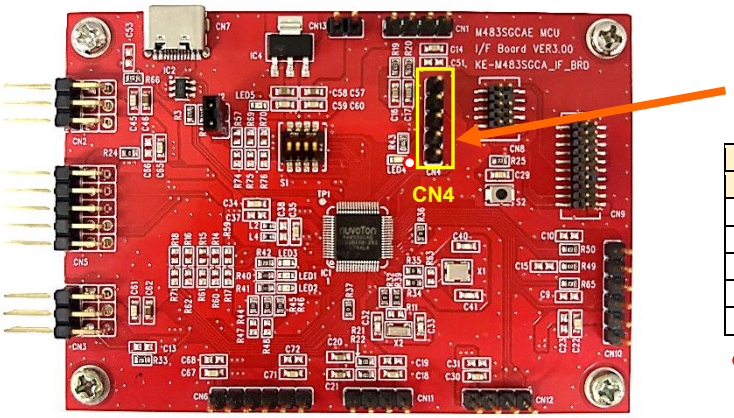


Figure 2-7 LED Indicator

LED	Color	LED status	Notification
LED1	Red	ON/OFF/Blinking combination	Indicate detailed operation modes: Standby, Shutdown, Active, Error, Cell Balancing, Safety Diagnostic (see SW User Manual).
LED2	Amber		
LED3	Blue		
LED4	Green	Blinking	SPI communication with the AFE board is active
		OFF	No SPI communication, or the system is not active
LED5	Red	ON	An external 5V power supply is being used

2.7 Software Debugging Using Nu-Link Pro Programmer

To enable software debugging and updating, a Serial Wire Debug (SWD) interface is prepared (CN4). Connection to the Nu-Link Pro Programmer is shown as follows:



CN4 - SWD IF Connector
(Connection to Nu-Link Pro Programmer)

MCU Board (CN4)		Nu-Link Pro Programmer
Pin No	Description	
1	VCC	VCC (Red)
2	SWDIO	ICE_DAT (Blue)
3	SWCLK	ICE_CLK (Green)
4	RESET	/RESET (Yellow)
5	GND	VSS (Black)

Pin 1

Figure 2-8 Serial Wire Debug (SWD) Interface Connector (CN4)

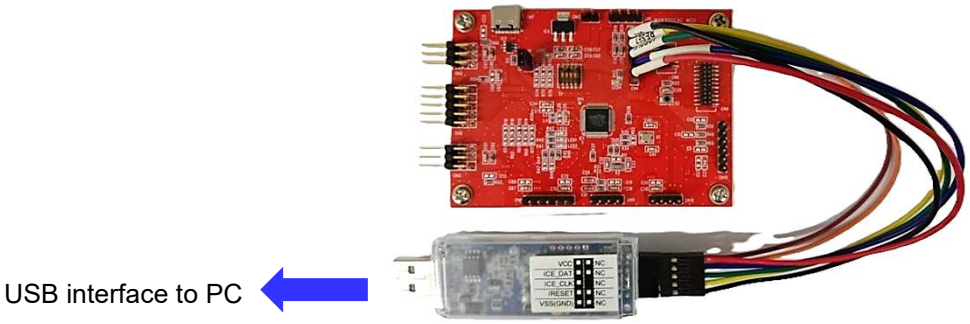
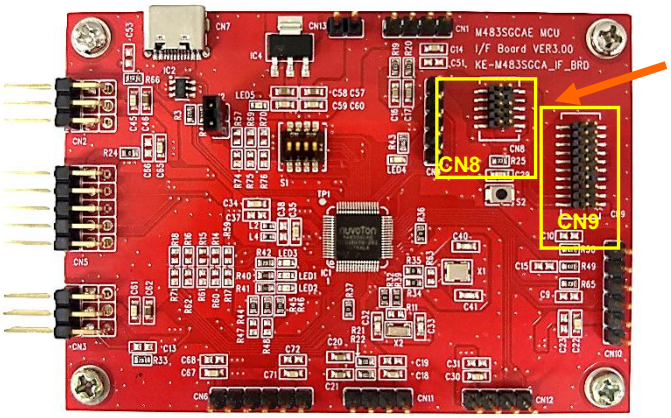


Figure 2-9 Example of Nu-Link Pro Programmer Connection to MCU Board

2.8 Software Debugging Using IAR I-JET

For software debugging and updating, JTAG Debugger interface (CN8/CN9) is also incorporated.



CN8/CN9 – JTAG Debugger interface
(Connection to IAR I-JET)



JTAG Debugger I/F:

CN8 – OBD without Tracer Function (I-Jet)

CN9 – OBD with Tracer Function (I-Jet Trace)

Figure 2-10 JTAG Debugger Interface Connector CN8 or CN9

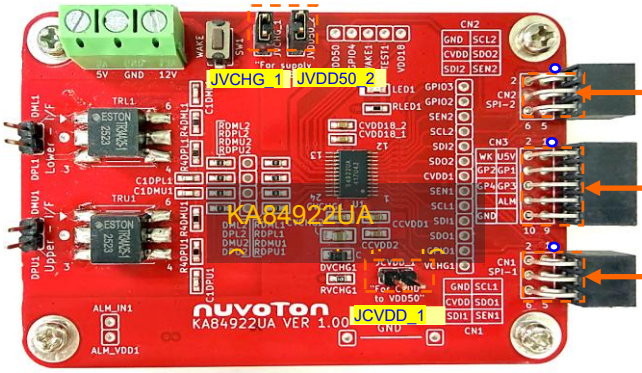
3. COMMUNICATION (COMM-IC) BOARD

3.1 Introduction

The Communication (COMM-IC) board uses the KA84922UA Communication IC to provide isolated SPI and daisy-chain communication between the MCU and battery IC devices.

It supports scalable multi-device system architecture through flexible integration with BM-IC and PM-IC boards.

The board simplifies system setup by enabling direct connection to the MCU board and is powered via the onboard supply, eliminating the need for external power.



CN2 – SPI-2 IF connector
(Interface to MCU board CN2)

SCL2	Clock In (Pin 1)
GND	Ground
SDO2	Data Out
CVDD	3.3V
SEN2	Enable In
SDI2	Data In

CN3 – Control IF connector
(Interface to MCU board CN5)

VDD50	5V (Pin 1)
WAKE	Wake up signal from MCU
GPIO1	General IO1
GPIO2	General IO2
GPIO3	General IO3
GPIO4	General IO4
GPIO5/ALM	BMIC alarm1
RESERVED	Unused Pin
RESERVED	Unused Pin
GND	Ground

CN1 – SPI-1 IF Connector
(Interface to MCU board CN3)

SCL1	Clock In (Pin 1)
GND	Ground
SDO1	Data Out
CVDD	3.3V
SEN1	Enable In
SDI1	Data In

Jumper setting/connection

JVCHG_1	Short
JVDD50_2	Short
JCVDD_1	Open

Figure 3-1Top Side of COMM-IC Board (KA84922UA VER 1.00)

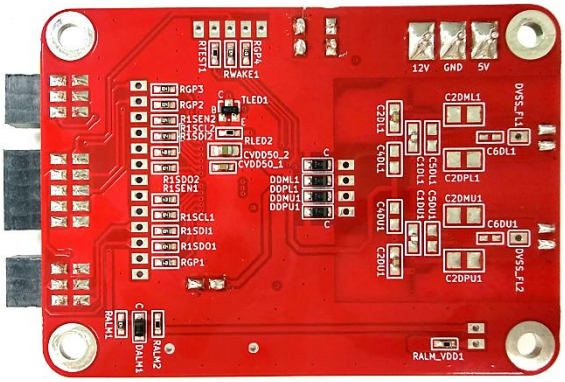


Figure 3-2 Bottom Side of COMM-IC Board (KA84922UA VER 1.00)

3.2 COMM-IC Board 5V Power Supply

The 5V supply from the MCU Board USB power is provided to the VDD50 pin of the master COMM-IC via connector CN3 for digital I/O operation.

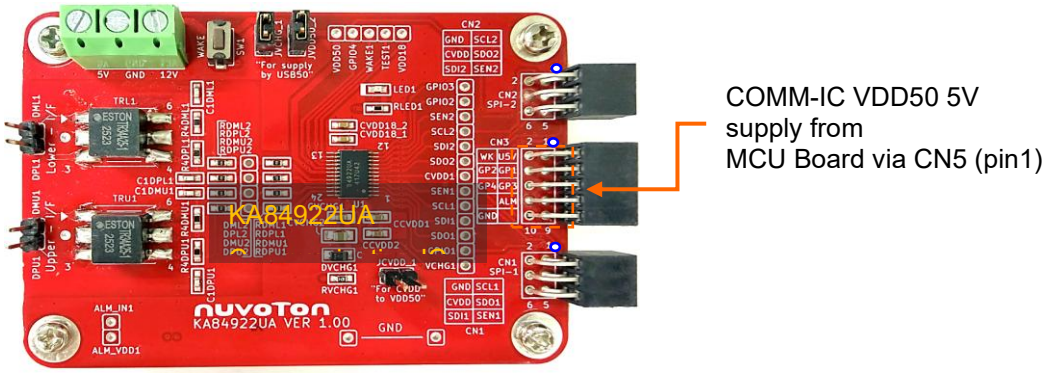


Figure 3-3 MCU Board 5V USB Power Supply to COMM-IC board (KA84922UA VER 1.00)

4. ANALOG FRONT END (AFE) BOARD

4.1 Introduction

The Analog Front End (AFE) board uses KA49703A Battery Management IC as the primary device. The AFE board performs operations such as battery cell voltage measurement, cell balancing operation, fault detection etc, with the control from the MCU board.

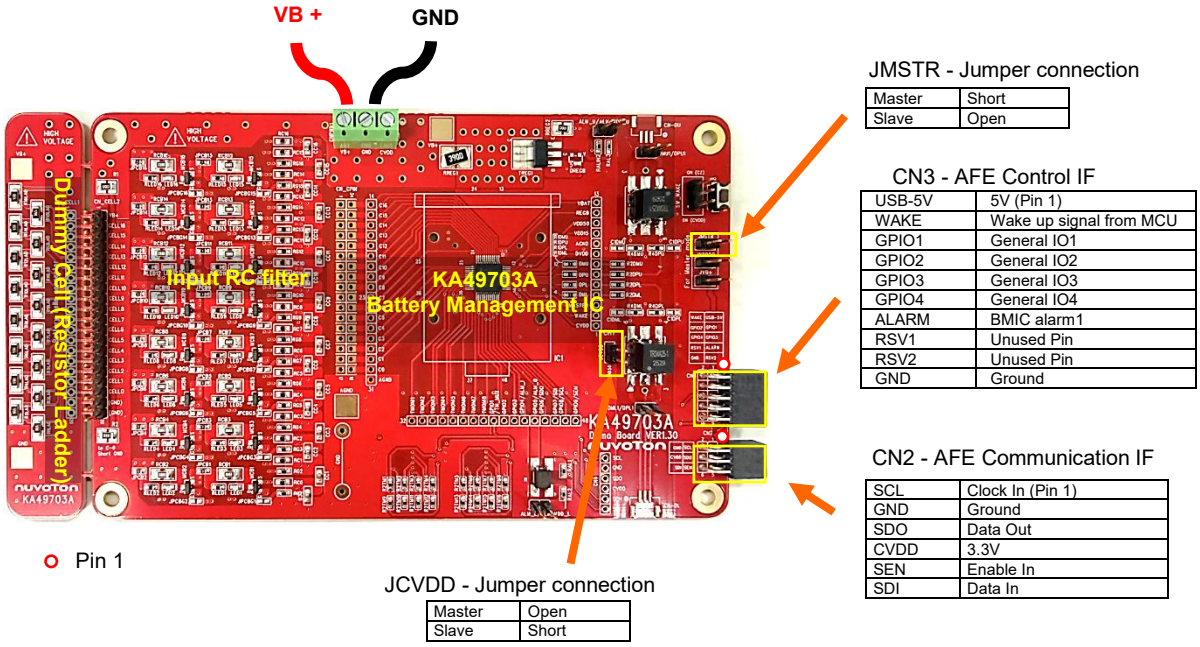


Figure 4-1 Top Side of AFE Board (KA49703A Demo Board)

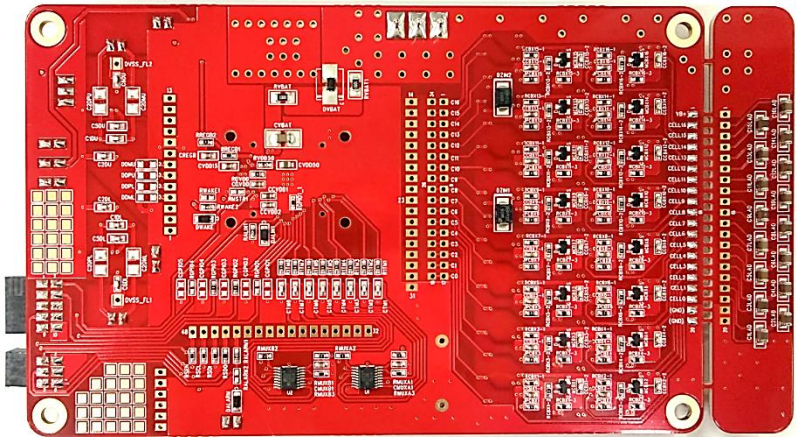


Figure 4-2 Bottom Side of AFE Board (KA49703A Demo Board)

4.2 AFE Board 3.3V Power Supply

The 3.3V power supply from the MCU Board is supplied to the Master BMIC CVDD pin through connector CN2 for digital I/O voltage.

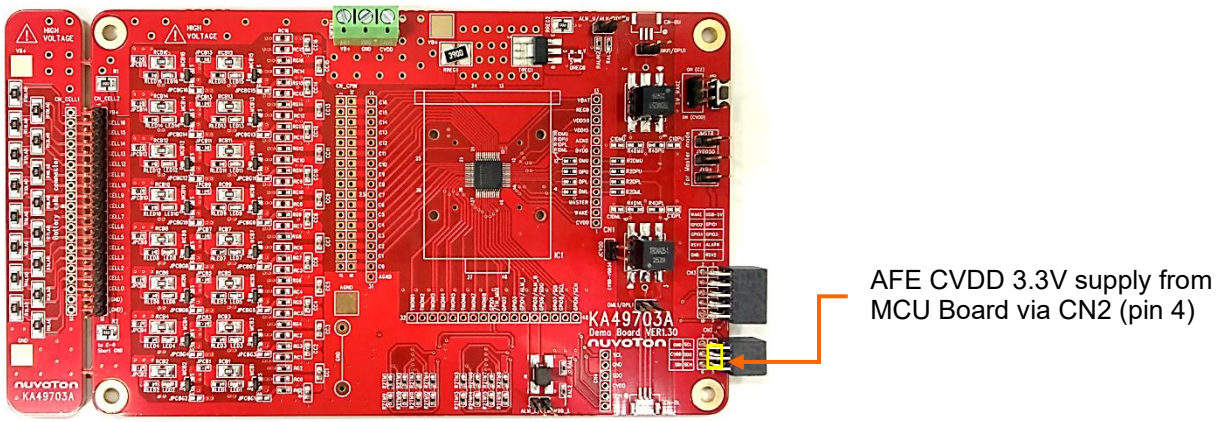


Figure 4-3 MCU Board 3.3V Supplies to AFE board (KA49703A Demo Board)

5. PACK MONITORING (PM-IC) BOARD

5.1 Introduction

The Pack Monitoring (PM-IC) board uses the KA84917UA as the primary device. It measures charging and discharging current by sensing the voltage drop across a shunt resistor, complementing the BMIC in monitoring pack voltage and current.

The PM-IC board operates in a daisy-chain configuration with BMIC boards and functions as a slave board, communicating with the master board through the daisy chain.

Connector and Jumper Configuration:

The KA84917UA provides SPI interface to connect up to two slaves through connectors CN501, CN511, and CN521. However, this SPI interface is **not supported by the MCU Firmware** in the current system configuration.

The jumper settings for various HV_VBAT modes are shown below:

Connection Point	48V mode	400V mode	800V mode
HV_VBAT	No short	JP802 (short)	JP802, JP801 (short)
HV_MEAS	No short	JP815 (short)	JP815, JP814 (short)
Link_Plus	No short	JP813 (short)	JP813, JP812 (short)
Link_Minus	No short	JP811 (short)	JP811, JP810 (short)
Charge_Plus	No short	JP807 (short)	JP807, JP806 (short)
Charge_Minus	No short	JP809 (short)	JP809, JP808 (short)
HV_Plus (IR)	No short	JP805 (short)	JP805, JP804 (short)

In addition to the HV configuration, the board supports diagnostic testing functions.

Set jumpers JP903 and JP902 to enable GPIO8 and GPIO9 pull-up control of SW1 and SW2, respectively, for relay diagnosis or insulation detection testing.

Please refer to **Figure 4-1** for detailed pin descriptions and jumper assignments.

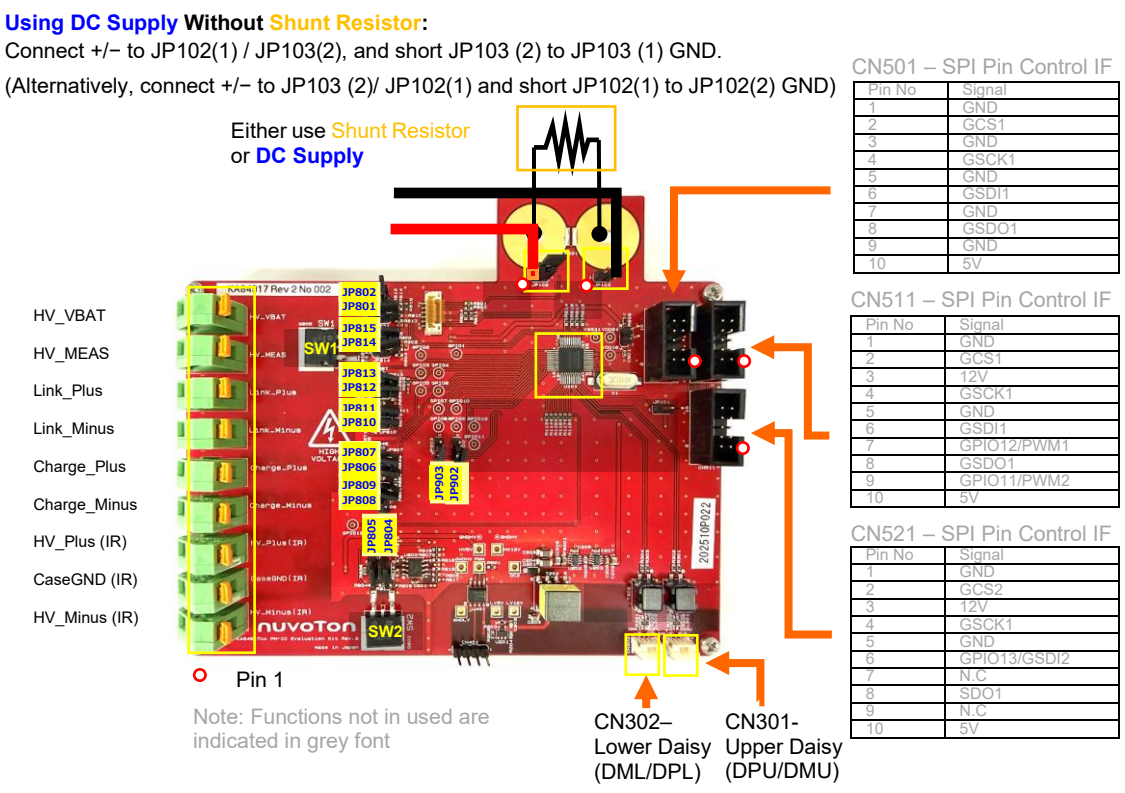


Figure 5-1 Top Side of PM-IC Board (KA84917UA Evaluation Kit Rev2)

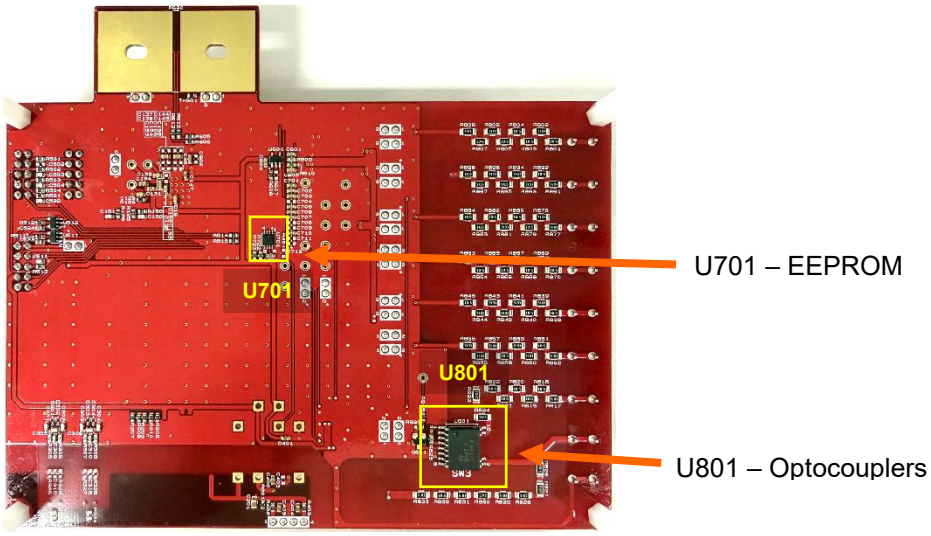


Figure 5-2 Bottom Side of PM-IC Board (KA84917UA Evaluation Kit Rev2)

5.2 PM-IC Board 12V Power Supply

External 12V power supply is supplied to the PM-IC through 12V Pin 4 and Ground Pin 3 of Connector CN401

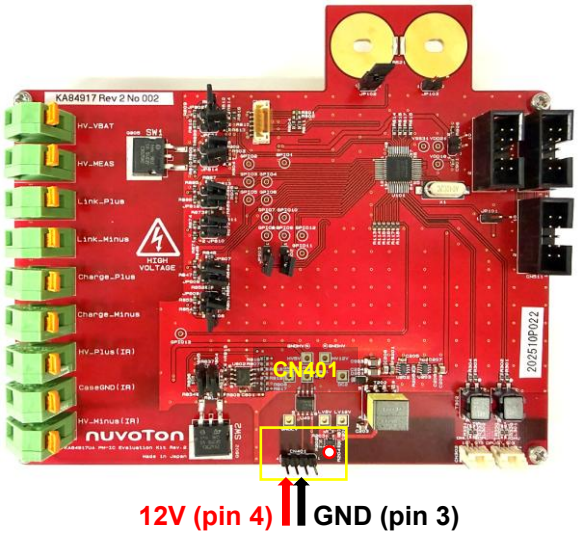


Figure 5-3 External 12V Supplies to PM-IC Board (KA84917UA Evaluation Kit Rev2)

6. REFERENCE PLATFORM HARDWARE SETUP

6.1 Overview of System Configuration

The reference platform supports two system configurations:

- **Configuration 1**: BM-IC as Master (Direct SPI)
  - MCU directly interfaces with BM-IC
  - Simple setup for evaluation

- **Configuration 2**: COMM-IC as Master (Daisy Chain)
  - MCU interface with COMM-IC
  - Enables isolated and scalable multi-device communication (BM-IC and PM-IC)

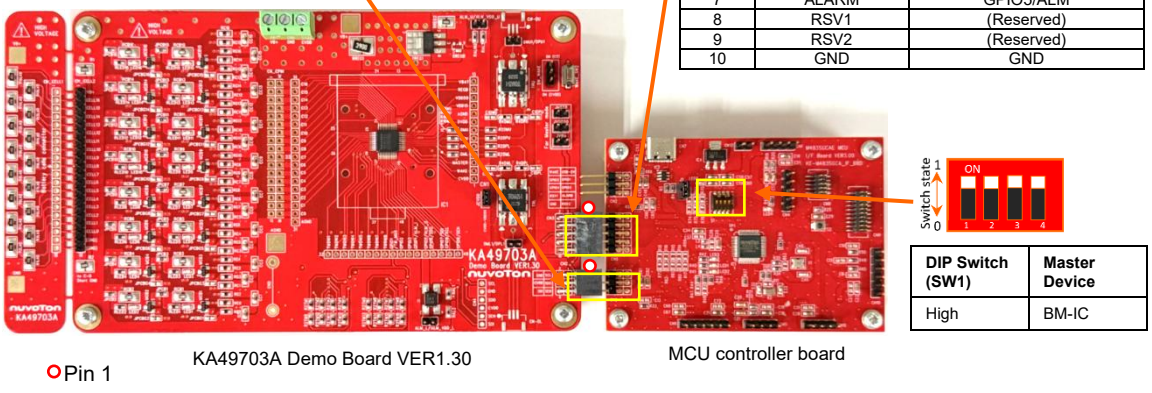
To set up the reference platform, the AFE board or COMM-IC board is connected to the MCU control board via pin-to-pin compatible connectors, as shown in Figure 6-1 (Configuration 1) and Figure 6-2 (Configuration 2). The master device is selected using the MCU board DIP switch (SW1).

Communication IF board connector (6-pin)

Pin No	AFE Board (CN2)	MCU controller board (CN3)
1	SCL	SPI1_CLK
2	GND	GND
3	SDO	SPI1_MISO
4	CVDD	CVDD
5	SEN	SPI1_SS
6	SDI	SPI1_MOSI

Control IF board connector (10-pin)

Pin No	AFE Board (CN3)	MCU controller board (CN5)
1	USB-5V	VDD50
2	WAKE	Wake
3	GPIO1	GPIO1
4	GPIO2	GPIO2
5	GPIO3	GPIO3
6	GPIO4	GPIO4
7	ALARM	GPIO5/ALM
8	RSV1	(Reserved)
9	RSV2	(Reserved)
10	GND	GND



DIP Switch (SW1)	Master Device
High	BM-IC

Figure 6-1 Configuration 1 Board Connection (BM-IC as Master)

Communication IF board connector (6-pin)

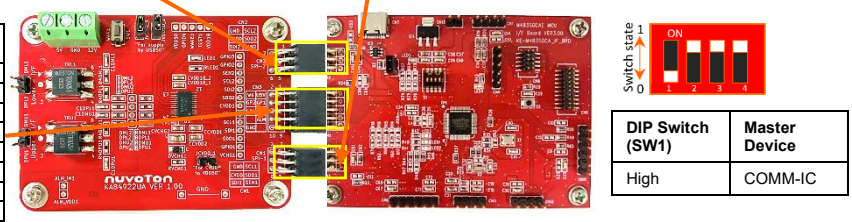
Pin No	COMM-IC Board (CN2)	MCU controller board (CN2)
1	SCL2	SPI1_CLK
2	GND	GND
3	SDO2	SPI1_MISO
4	CVDD	CVDD
5	SEN2	SPI1_SS
6	SDI2	SPI1_MOSI

Communication IF board connector (6-pin)

Pin No	COMM-IC Board (CN1)	MCU controller board (CN3)
1	SCL1	SPI2_CLK
2	GND	GND
3	SDO1	SPI2_MISO
4	CVDD	CVDD
5	SEN1	SPI2_SS
6	SDI1	SPI2_MOSI

Control IF board connector (10-pin)

Pin No	COMM-IC Board (CN3)	MCU controller board (CN5)
1	USB-5V	VDD50
2	WAKE	Wake
3	GPIO1	GPIO1
4	GPIO2	GPIO2
5	GPIO3	GPIO3
6	GPIO4	GPIO4
7	ALARM	GPIO5/ALM
8	RSV1	(Reserved)
9	RSV2	(Reserved)
10	GND	GND



DIP Switch (SW1)	Master Device
High	COMM-IC

Figure 6-2 Configuration 2 Board Connection (COMM-IC as Master)

6.2 PC GUI Interface Connection

Using a USB Type-C cable, the MCU controller board can be connected to the PC GUI through the MCU's USB interface for serial data communication.

This USB connection is common for both system configurations (BM-IC as master and COMM-IC as master). In addition to enabling PC GUI communication, the USB interface also provides a 5V (VDD50) power supply to the MCU board.

The 5V supply is further distributed from the MCU board (CN5, pin 1) to the connected AFE board or COMM-IC board, eliminating the need for an external power source.

CN5 - Control IF connector

VDD50	5V (Pin 1)
WAKE	MCU wake up control to BMIC
GPIO1	General Purpose Pin
GPIO2	General Purpose Pin
GPIO3	General Purpose Pin
GPIO4	General Purpose Pin
GPIO5/ALM	General Pin/ BMIC alarm1
RESERVED	Not Used
RESERVED	Not Used
GND	Ground

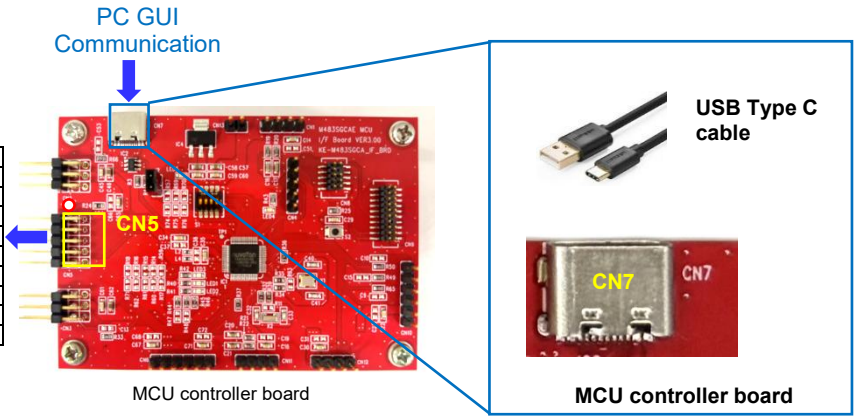


Figure 6-3 PC GUI Connection using USB Type-C Cable

6.3 Configuration 1: BM-IC as Master (Direct SPI)

Multiple AFE boards can be configured in a daisy-chain topology. In a typical setup, one AFE board is configured as the master and one or more AFE boards are configured as slaves. A PM-IC board can be added to the daisy chain to extend pack monitoring capability.

- Board Setup:
  - Master AFE board: Short JMSTR, open JCVDD
  - Slave AFE board: Short JCVDD, open JMSTR
- Daisy Chain Connection:
  AFE Master → AFE Slave:
  - DMU (Master) → DML (Slave)
  - DPU (Master) → DPL (Slave)

  AFE Slave → PM-IC:
  - DMU (Slave) → DML
  - DPU (Slave) → DPL

  PM-IC → AFE Master (loopback connection):
  - DMU → DML (Master)
  - DPU → DPL (Master)
- Daisy Chain Configuration:
  - Connect Daisy Upper (DU) of one board to Daisy Lower (DL) of the next board.
  - The order of BM-IC and PM-IC boards in the daisy chain is configurable
  - The example shown (1 Master AFE + 1 Slave AFE + 1 PM-IC) is for reference only
  - Additional AFE boards can be added as required

Please refer to the figure below for a visual connection reference.

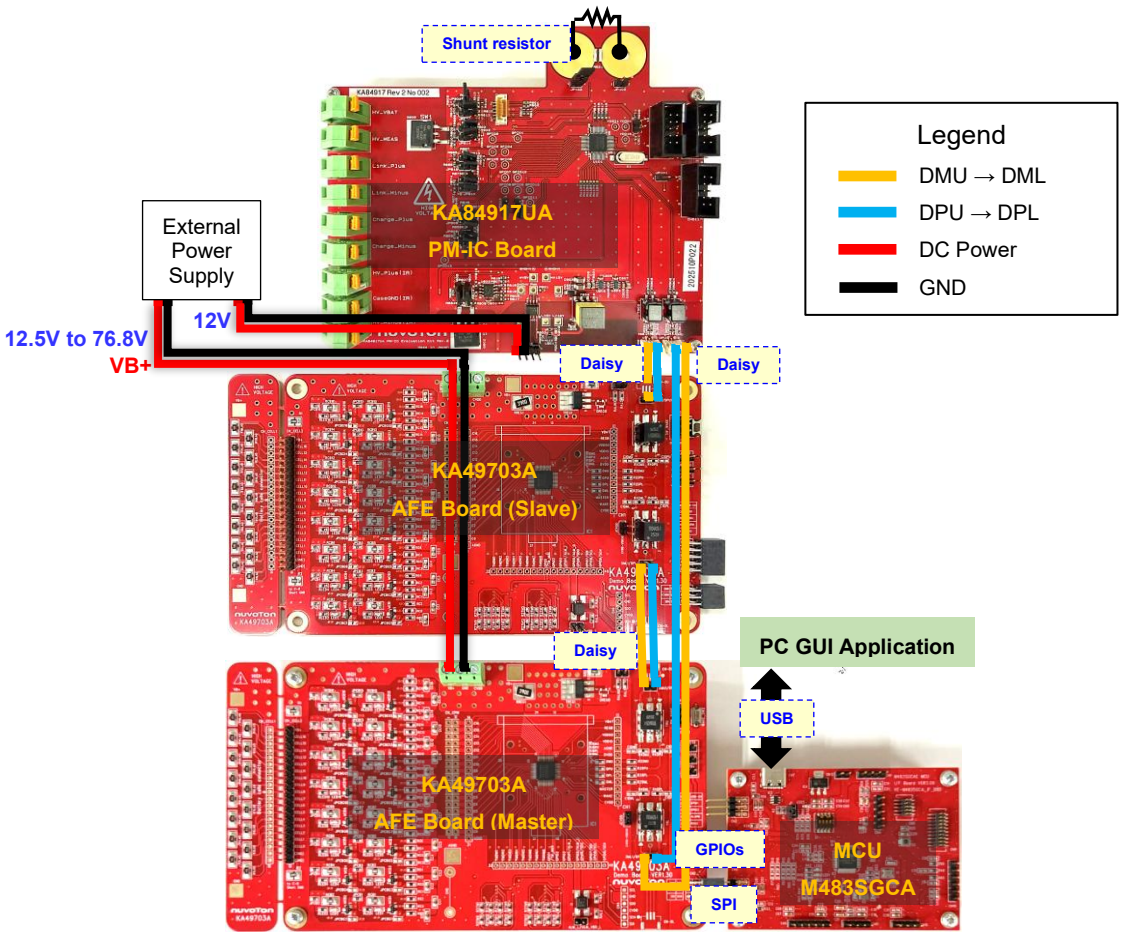


Figure 6-4 Daisy Chain Master & Slave Configuration

6.4 Configuration 2: COMM-IC as Master (Daisy Chain)

Multiple AFE boards can be configured in a daisy-chain topology. In this configuration, the COMM-IC acts as the master device, while one or more AFE boards are configured as slaves. A PM-IC board can be added to the daisy chain to extend pack monitoring capability.

- Board Setup:
  - Slave AFE board: Short JCVDD, open JMSTR
- Daisy Chain Connection:
  COMM-IC (Master) → BMS (Slave):
  - DMU → DML
  - DPU → DPL

  BMS → BMS (Slave – to – Slave):
  - DMU → DML
  - DPU → DPL

  PM-IC → COMM-IC (Master) [loopback]:
  - DMU → DML
  - DPU → DPL
- Daisy Chain Configuration:
  - Connect Daisy Upper (DU) of one board to Daisy Lower (DL) of the next board.
  - The order of BM-IC and PM-IC boards in the daisy chain is configurable
  - The example shown (1 COMM-IC + 2 Slave AFE + 1 PM-IC) is for reference only
  - Additional AFE boards can be added as required

Please refer to the figure below for a visual connection reference.

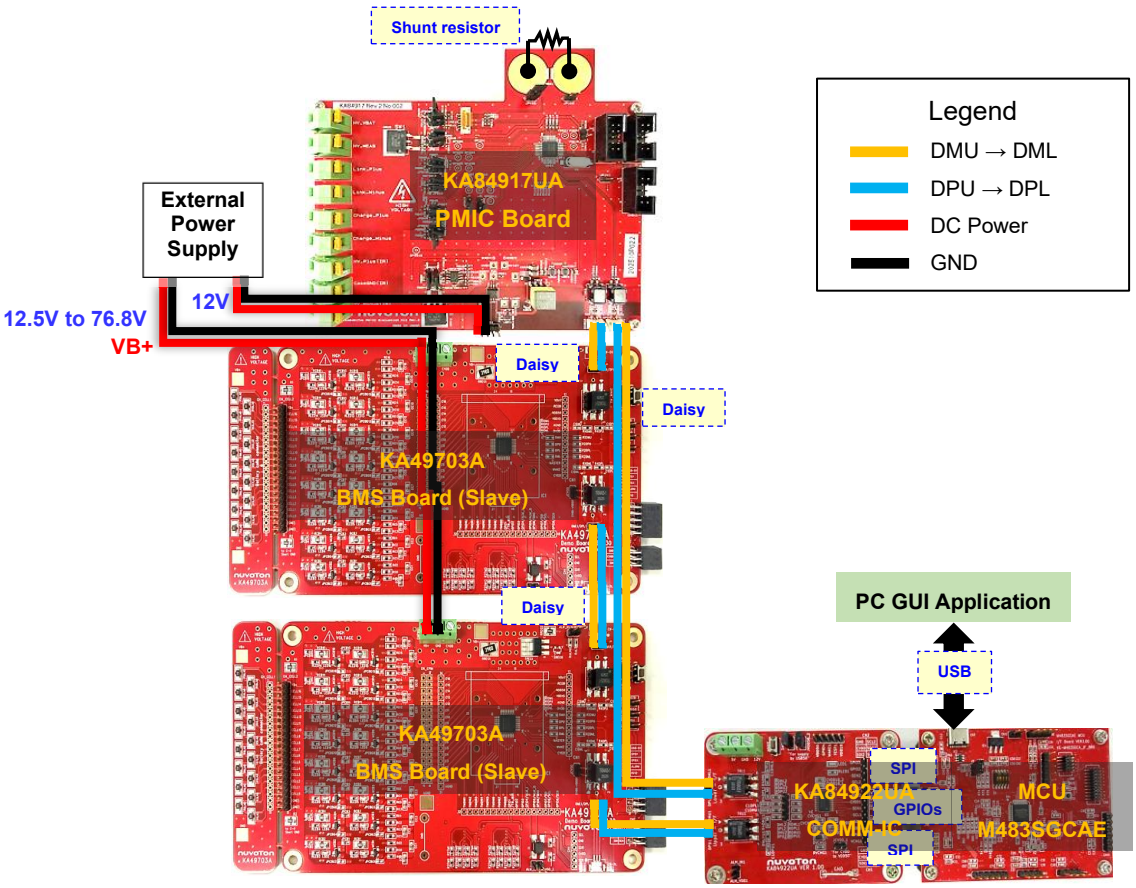


Figure 6-5 Daisy Chain Master & Slave Configuration (With PM-IC KA84917 Board)

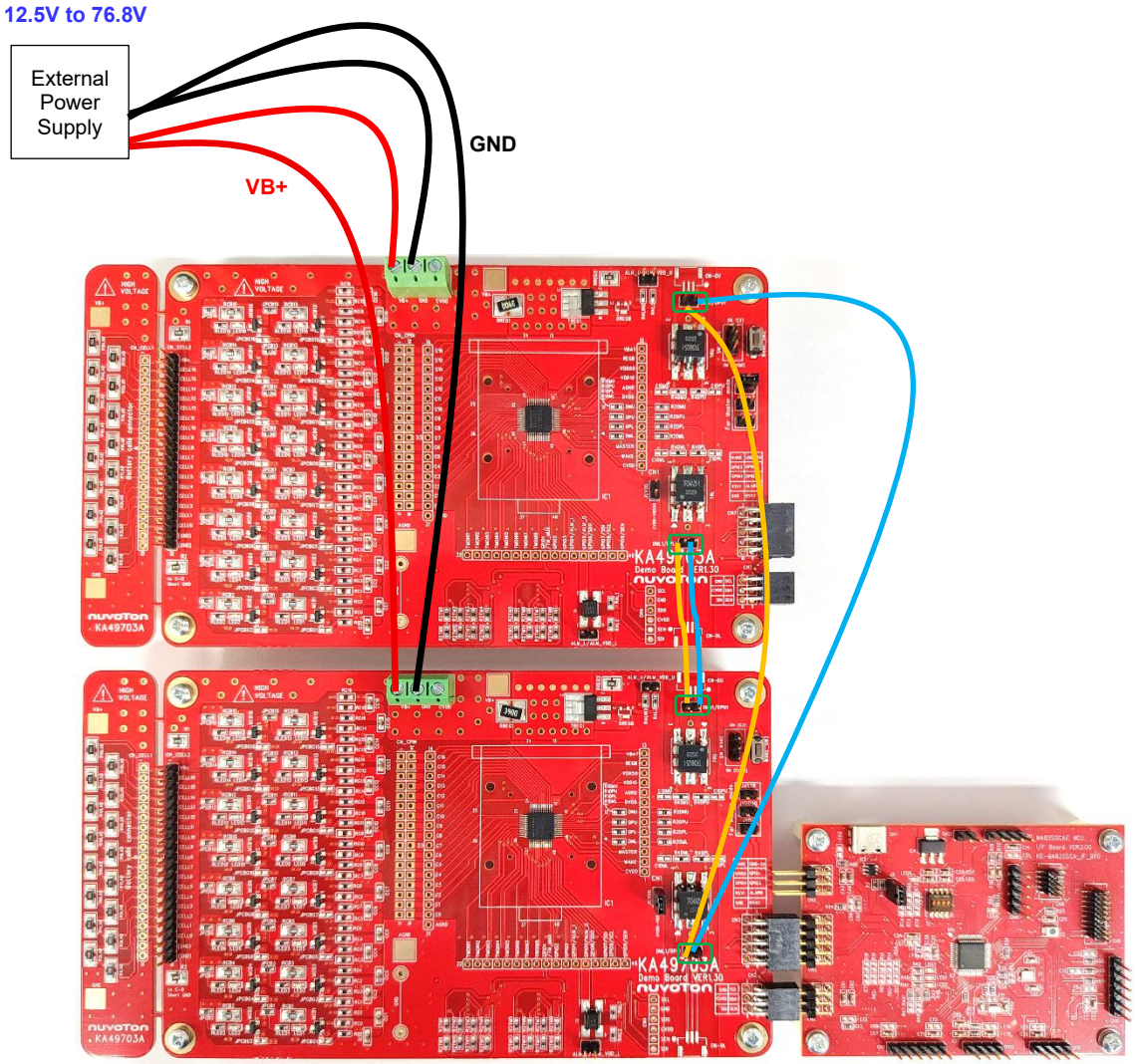
7. REFERENCE PLATFORM OPERATION

7.1 System Start-up / Wake-up (General)

At the initial stage, when VB+ is just supplied and the default WAKE signal is being set to “Low”, the system is in Shutdown mode.

To start or wake up the system, the MCU sets the master BMIC’s WAKE signal to “High” and sends a wake-up command. The Master BMIC then generates a wake-up pulse through the daisy chain to wake the slave BMICs.

This will wake up the BMIC Board. Once the BM IC is started, the internal power-on sequence will be executed.



7.2 AFE and PM-IC Board Power-Up (With KA84917UA Board)

The reference platform supports two system configurations:

- Configuration 1: BM-IC as Master (refer to Figure 6.4 in Chapter 6)
- Configuration 2: COMM-IC as Master (refer to Figure 6.5 in Chapter 6)

For both configurations, the general startup behavior is similar. The AFE board VB+ is supplied with 12.5 V–76.8 V and the PM-IC board with 12 V, with the WAKE signal initially set to “Low”.

To power up the system, connect the MCU board USB connector (CN7) to a PC. The MCU then initiates the wake-up sequence by setting the WAKE signal to “High” and issuing a wake-up command.

In Configuration 1 (BM-IC as Master), the wake-up signal is applied to the Master AFE board, which propagates the wake-up signal to the Slave AFE boards and PM-IC through the daisy-chain connection.

In Configuration 2 (COMM-IC as Master), the wake-up signal is applied to the COMM-IC, which acts as the master device and propagates the wake-up signal through the daisy chain to the connected AFE boards and PM-IC.

The MCU then performs device initialization starting from the master device:

- In Configuration 1, initialization begins from the Master AFE board
- In Configuration 2, initialization begins from the COMM-IC, followed by the connected AFE and PM-IC boards

Each initialized device executes its internal power-on sequence. Upon successful startup, LED1–LED4 on the MCU board will blink at 1 s intervals.

To complete initialization of all connected boards, launch the PC GUI to perform system configuration. For detailed instructions, refer to the KA49703A Reference Platform PC GUI User Manual.

7.3 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 your eyes.







8. REVISION HISTORY

Date	Revision	Description
2025.09.30	1.00	1. Initially issued.
2026.03.18	1.10	2. To include PM-IC KA84917UA board configuration
2026.06.30	1.20	3. To include COMM-IC KA84922UA board configuration

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