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KA49703A BM-IC AFE Reference Platform

Introduction To KA49703A Reference Platform

30th Jun 2026
Nuvoton Technology Singapore



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Overview of BMS Reference Platform

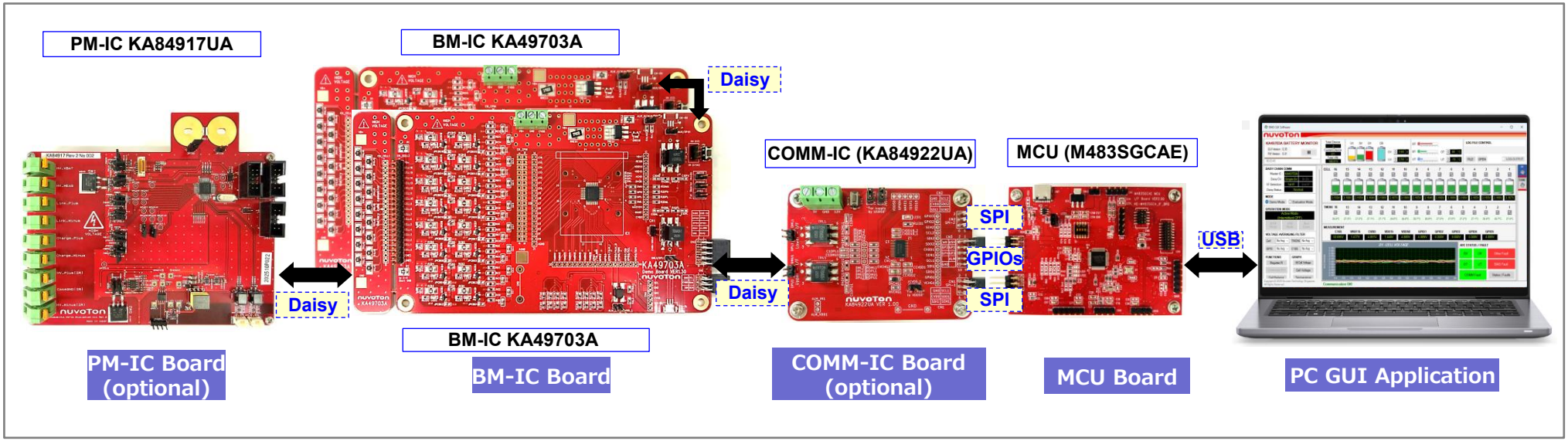
❑ Features

❑ Consists of 5 main components:

- **PC GUI Application:** High-level User Interface to access and control AFE (BM-IC).
- **MCU Board:** System controller managing BM-IC, COMM-IC, and PM-IC via software framework and device drivers.
- **Communication IC Board (COMM-IC):** Provides isolated SPI communication and enables robust daisy-chain interface between MCU and BM-IC/PM-IC devices
- **Battery Monitoring IC Board (BM-IC):** Provides reference schematic and PCB design of the BM-IC, supporting ring daisy-chain communication interface. It performs key functions such as cell voltage measurement, temperature monitoring, cell balancing, and fault detection, etc under the control of the MCU Board.
- **Pack Monitoring IC Board (PM-IC):** Provides battery pack-level monitoring, complementing the BM-IC. It supports pack current, voltage, & temperature measurement for system-level protection and analysis. It also enables Coulomb counting for charge/discharge tracking, along with internal voltage and temperature monitoring for diagnostics.

❑ Both hardware and software reference designs are provided, along with detailed documentation, to support new design-in or adoption into a target system.

❑ Can be used as a starter kit for application software development or proof-of-concept (POC) evaluation without the need to fabricate new hardware.



Target Users & Benefits of BMS Reference Platform

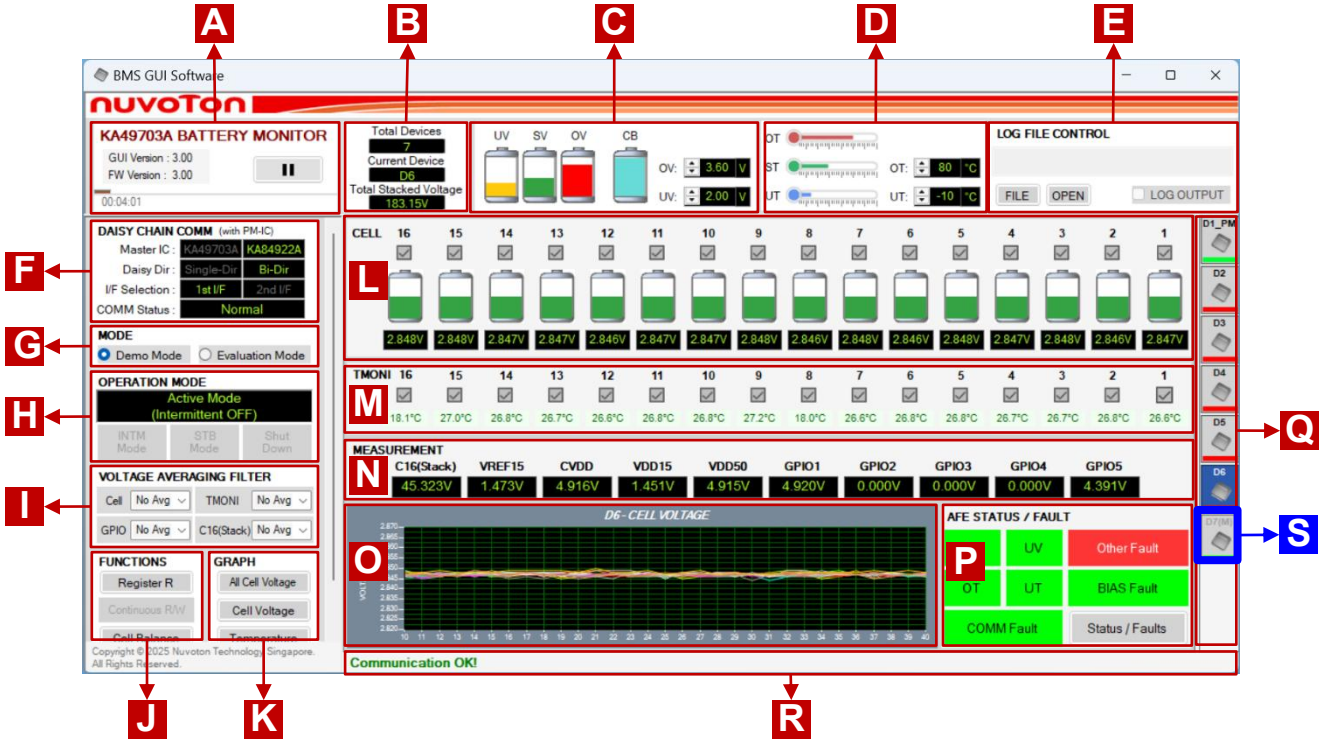
❑ **Reference Platform can be used by each user with the corresponding applications:**

User	Application / Use Case
Sales	For promotion & easy demonstration of BM-IC, PM-IC and COMM-IC features such as: 1. Instantly view the converted value of cell voltages, other voltages, temperature, current and pack-level PM-IC measurements on the PC GUI. 2. Effortlessly control the BM-IC (e.g., selecting cells and adjusting register settings) while viewing BM-IC registers and status in a graphical format. 3. Quickly monitor PM-IC pack voltage, current and Coulomb count for demonstration purposes. 4. Demonstrate stable isolated SPI and daisy-chain communication via COMM-IC
Customer	1. Early evaluation of BM-IC, PM-IC, COMM-IC communication interface, Device Driver & Middleware from PC GUI without the hassle of complex low-level setup
Developer / Development	1. Minimise Hardware Development Time with reference schematic, PCB Layout, BOM & Application Notes. 2. Minimize Software Development Time with reference to the BM-IC, PM-IC and COMM-IC Device Driver & Middleware. 3. Ready-to-use application development environment based on Nuvoton M483 reference software framework. 4. Enable rapid prototyping by reusing the highly configurable MCU-COMM-IC-AFE platform when the target system is not available 5. Use the PC GUI to verify BM-IC, PM-IC and COMM-IC specifications, behaviours & control sequence etc, ***without writing a software Test Stub Program***.

Functional Operation of PC GUI Application

❑ Overview of PC GUI Functional Features for BMS KA49703A

The PC GUI facilitates the transmission and reception of data to and from the BM-IC through the MCU. Following data retrieval, the PC GUI software performs data conversion and presents the results in both graphical and text formats.



A - Application Info & Play/Pause Control
B - Device Summary
C - Cell Legend & OV/UV Setting
D - Temp legend & OT/UT Setting
E – BM-IC Log File Control
F - Daisy Chain Communication
***S** – Master device button

G - Mode
H - Operation Mode
I - Voltage Averaging Filter
J – BM-IC Functions
K – BM-IC Graph
L - Cell Voltage

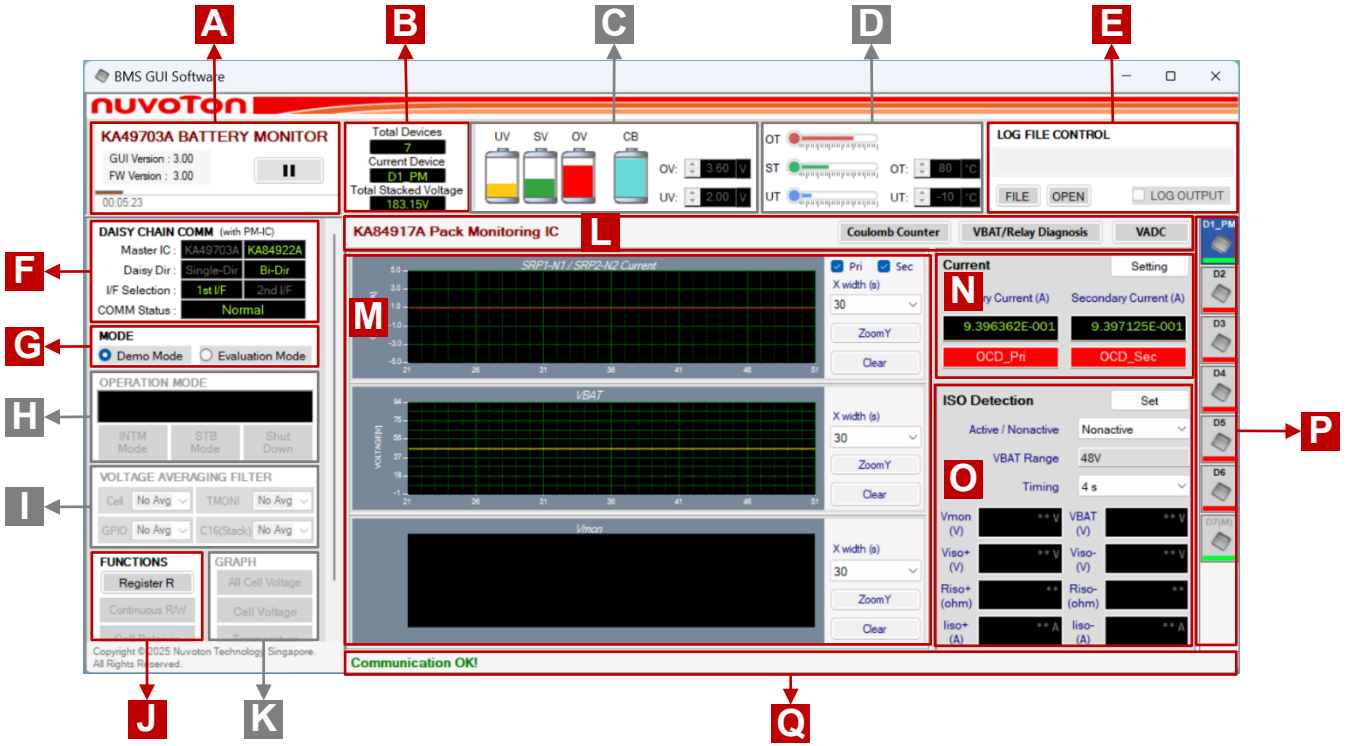
M - TMONI
N - Measurement
O - Cell Voltage Graph
P - BMS Status / Fault
Q - Device Buttons
R - Communication Status

*Note: The label "Dx(M)" identifies the master device. When the master device is a COMM-IC, its corresponding device button is disabled.

Functional Operation of PC GUI Application (For PM-IC KA84917UA)

❑ Overview of PC GUI Functional Features for PM-IC KA84917UA

Similar to KA49703A, the PC GUI enables data transmission and reception between the PM-IC and MCU. Retrieved data is processed and displayed in both graphical and text formats. The GUI also supports coulomb counting, relay diagnosis, and insulation detection for system monitoring and evaluation.



A - Application Info & Play/Pause Control
B - Device Summary
C - Cell Legend & OV/UV Setting
D - Temp legend & OT/UT Setting
E – PM-IC Log File Control
F - Daisy Chain Communication
G - Mode
H - Operation Mode
I - Voltage Averaging Filter
J – PM-IC Registers
K – BM-IC Graph
L – PM-IC Functions
M – PM-IC Graph
N – Current Measurement
O – Insulation Detection
P – Device Buttons
Q - Communication

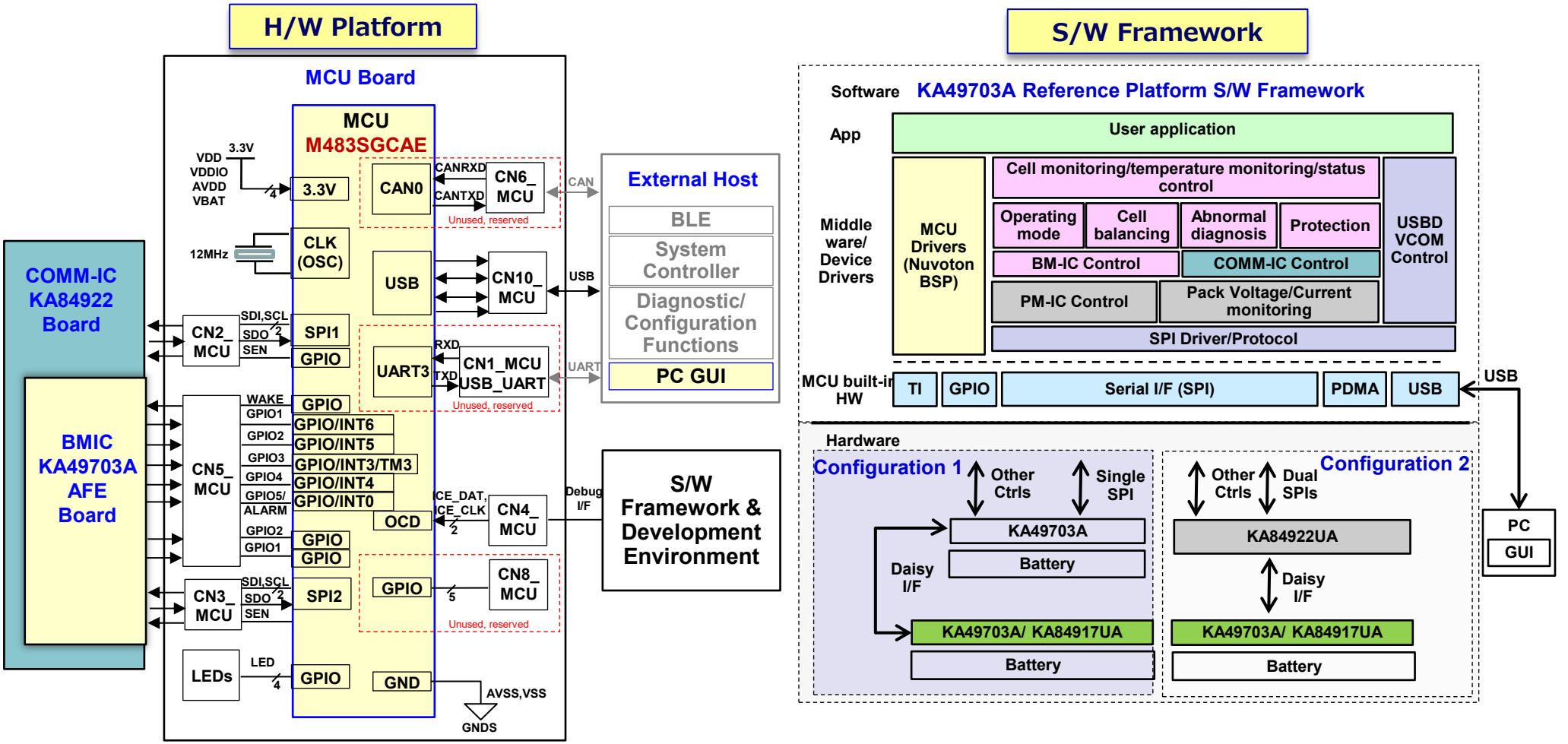
Note: Functions indicated in grey font are disabled or not relevant to the PM-IC

Reference Platform: Hardware + Software System Overview

❑ Starter Kit For S/W Development & Rapid Prototyping

- H/W & S/W platforms readily available for customers to start prototyping & S/W Development.
- H/W: Reference board supports two configurations: (1) Direct SPI with BM-IC as master for simple evaluation, or (2) COMM-IC-based daisy chain for scalable and isolated communication supporting BM-IC and PM-IC.
- S/W: Provides Device Driver & S/W framework supporting both BM-IC, PM-IC and COMM-IC.

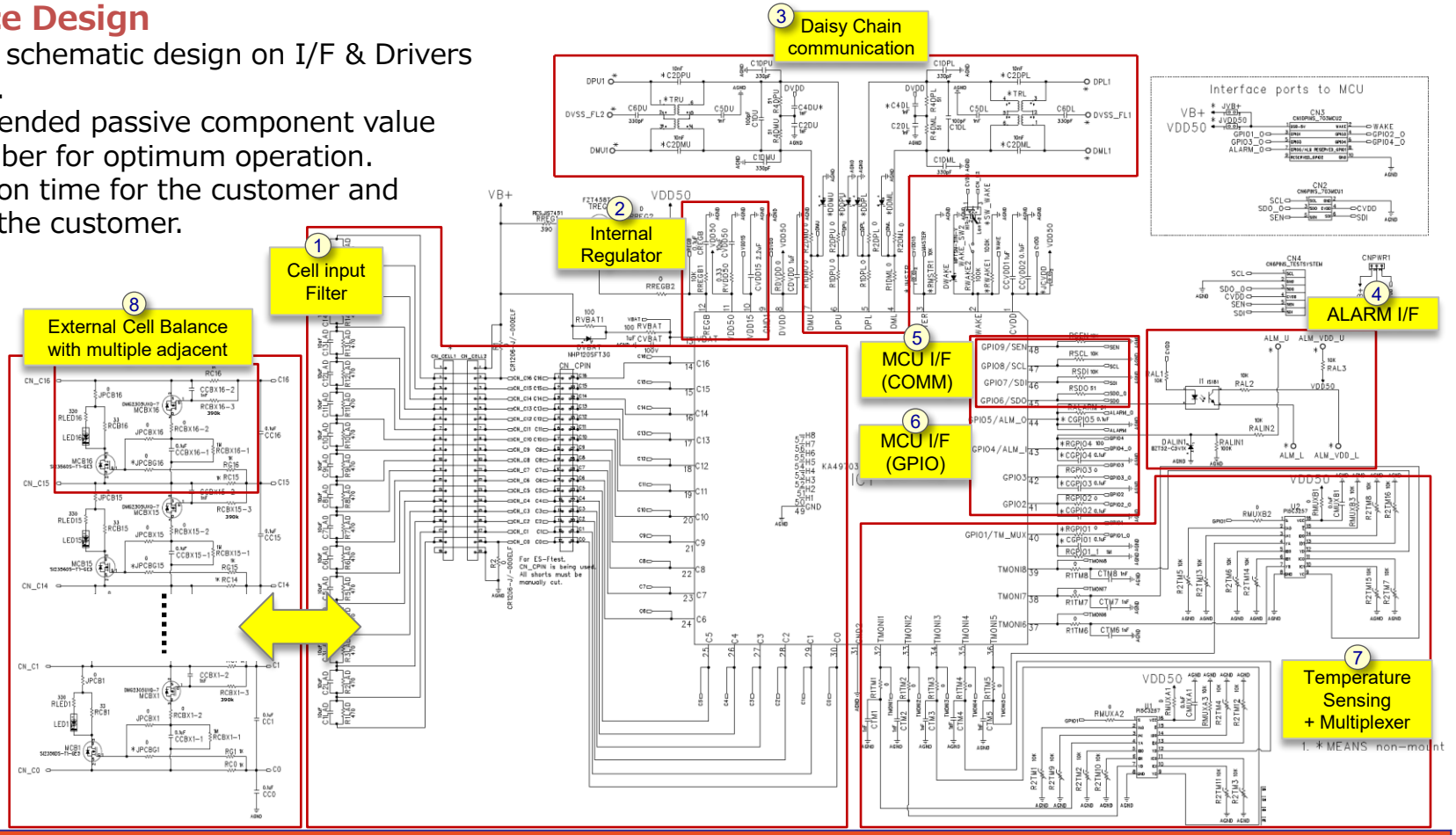
➢ Customer can verify the design and start S/W Development before the target platform is ready.



BMS Reference Design (KA49703A)

BM-IC Reference Design

- Provide reference schematic design on I/F & Drivers for easy adoption.
- Provided recommended passive component value (RC) & parts number for optimum operation.
- Minimizing adoption time for the customer and supporting effort the customer.

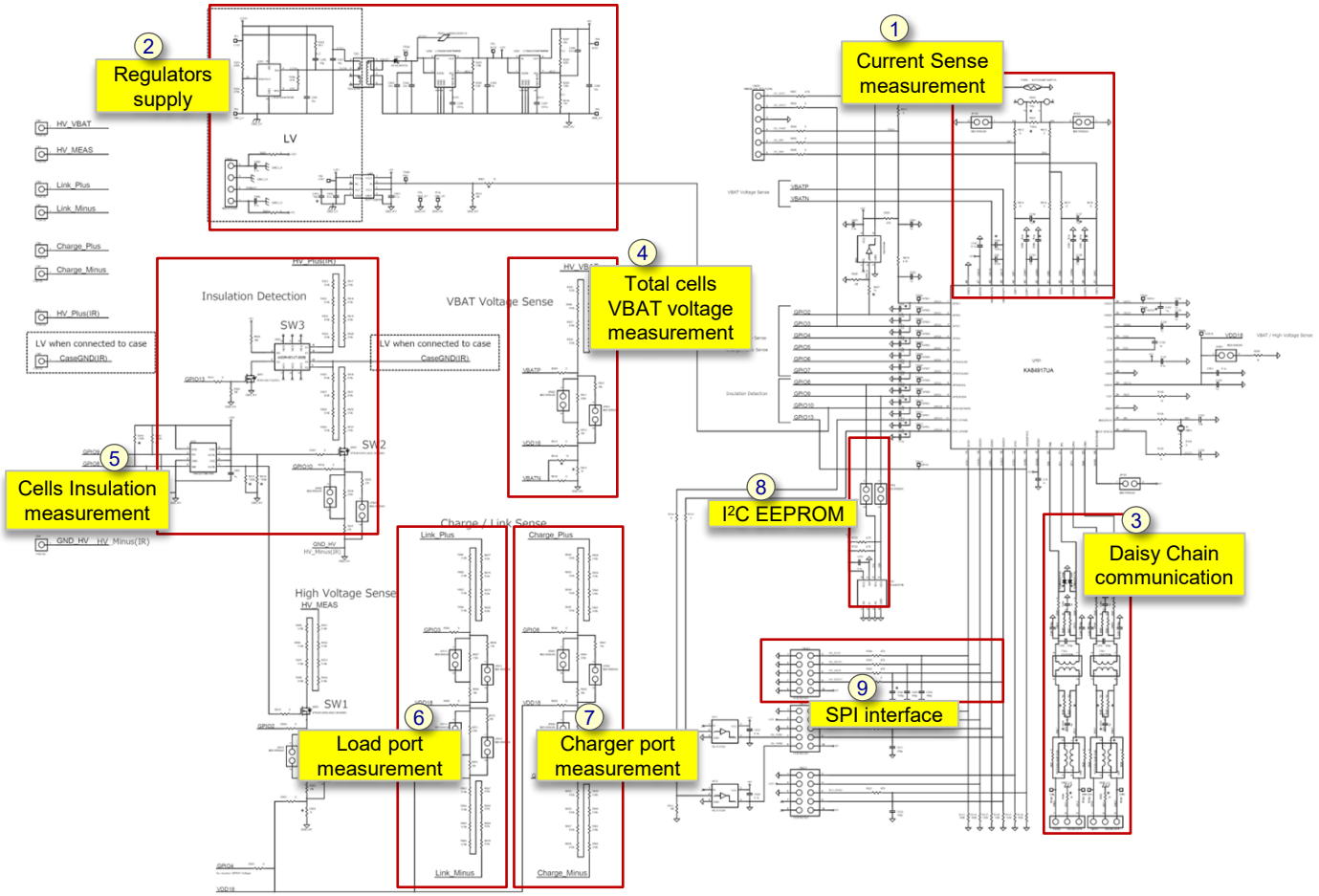


S/N	Hardware Reference Items Provided		
1	Cell Input Filter circuit	2	Internal Regulator circuit
3	Daisy Chain Communication circuit	4	Alarm Interface Circuit to MCU and Other BMIC
5	MCU Interface (Communication): SPI	6	MCU Interface (GPIO): GPIO circuit
7	Temperature Sensing with external Multiplexer circuit	8	External Cell Balancing Circuit with multiple adjacent channels supported
Components: Transistor part number & RC value are provided.			

BMS Reference Design (KA84917UA)

PM-IC Reference Design

- Provide reference schematic design on I/F & Drivers for easy adoption.
- Provided recommended passive component value (RC) & parts number for optimum operation.
- Minimizing adoption time for the customer and supporting effort the customer.

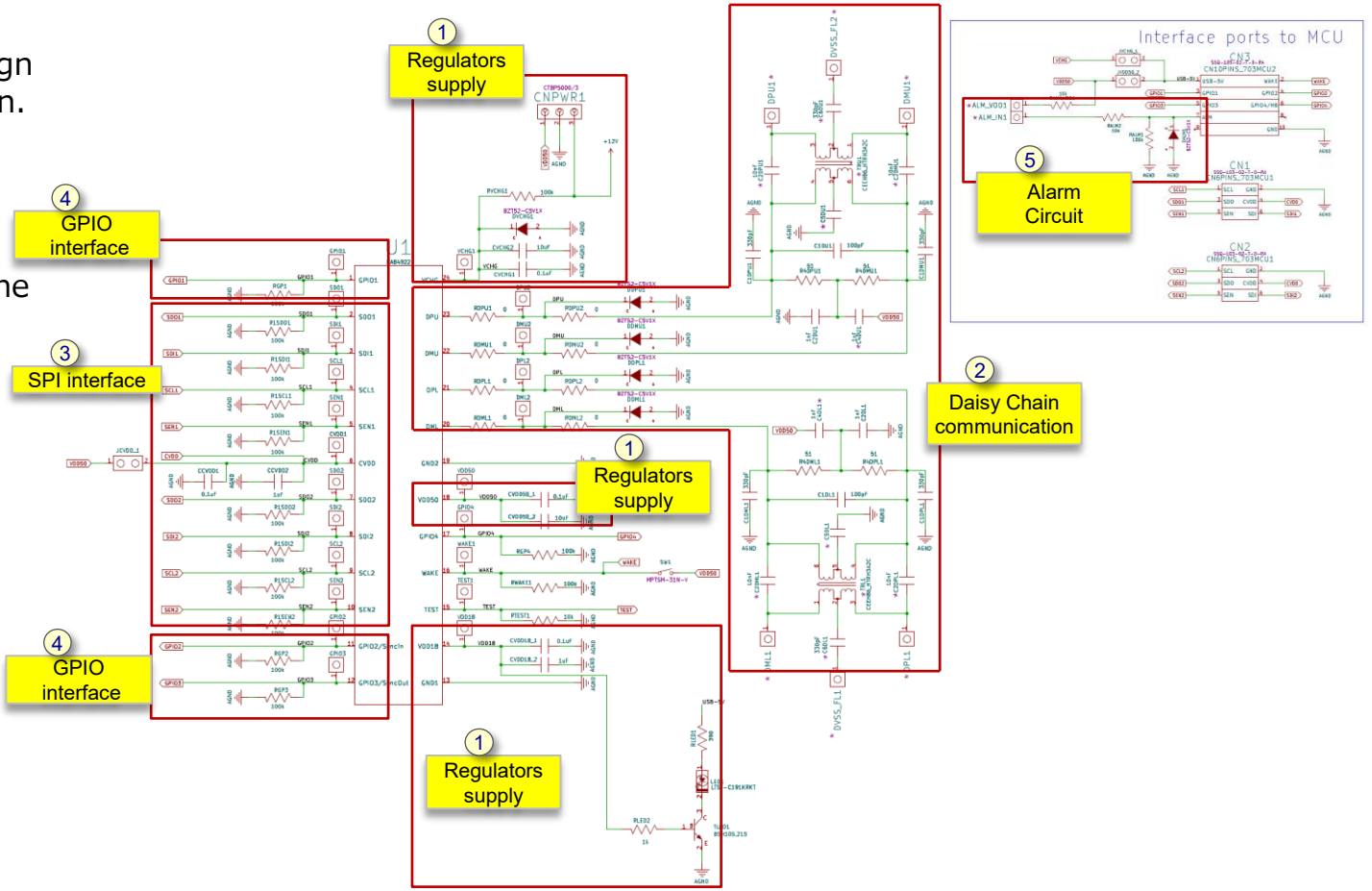


S/N	Hardware Reference Items Provided		
1	Current Sense measurement filter circuit	2	Regulators circuit
3	Bi-directional Daisy Chain Communication circuit	4	VBAT Voltage measurement for total stacked battery cells
5	Battery pack insulation measurement	6	Load connection port measurement for relay (contactor) diagnostic
7	Charger connection port measurement for relay (contactor) diagnostic	8	I^2C communication for data storage to EEPROM
9	SPI communication interface		
Components: Transistor part number & RC value are provided.			

BMS Reference Design (KA84922UA)

COMM-IC Reference Design

- Provide reference schematic design on I/F & Drivers for easy adoption.
- Provided recommended passive component value (RC) & parts number for optimum operation.
- Minimizing adoption time for the customer and supporting effort the customer.

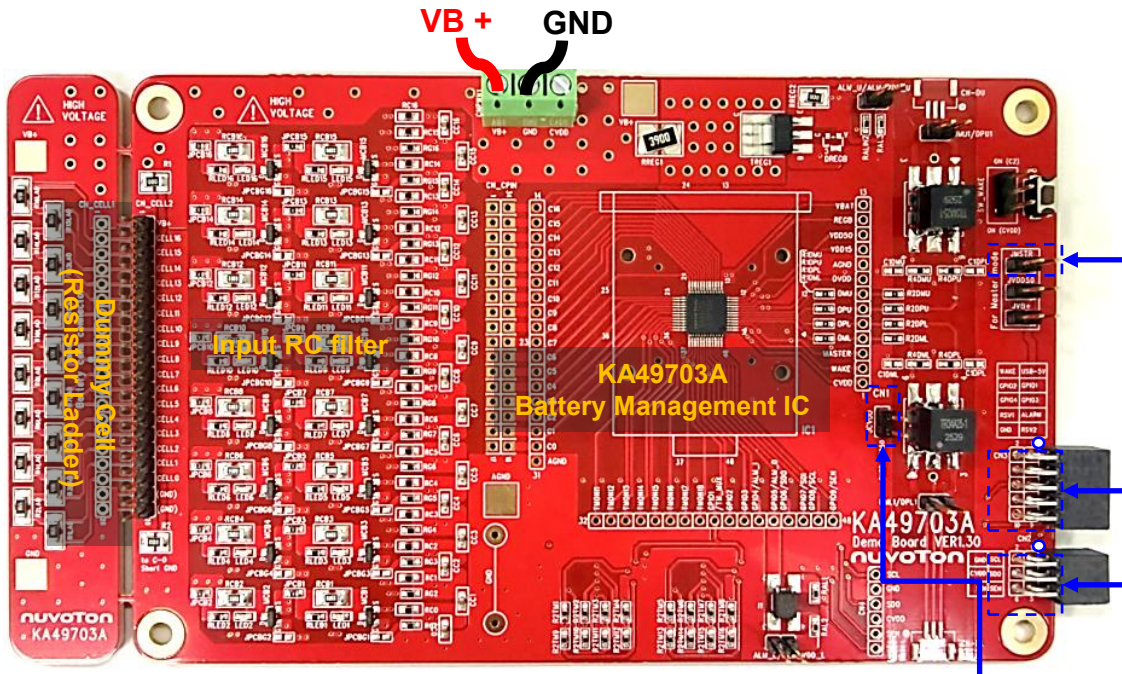


S/N	Hardware Reference Items Provided		
1	Regulators circuit	2	Bi-directional Daisy Chain Communication circuit
3	MCU Interface (Communication): SPI communication x 2 set	4	MCU Interface (GPIO): GPIO circuit
5	Alarm Circuit (link between BM-IC board and MCU board)		
Components: Transistor part number & RC value are provided.			

KA49703A Battery Monitoring (BM-IC) Board

- **BM-IC Board is designed with the flexibility to interface with the customer's own System Controller / CMU or PM-IC Board for pack current monitoring**
  - Enables early evaluation and software development with target system
  - Supports connection to real battery cells via detachable dummy cell PCB
  - Scalable design with daisy-chain support for multiple AFE boards

KA49703A Demo Board VER1.30



Pin 1

JCVDD – Jumper connection

Master	Open
Slave	Short

JMSTR - Jumper connection

Master	Short
Slave	Open

CN3 - AFE Control Interface

USB-5V	5V (Pin 1)
WAKE	Wake up signal from MCU
GPIO1	General IO1
GPIO2	General IO2
GPIO3	General IO3
GPIO4	General IO4
ALARM	BMIC alarm1
RSV1	Unused Pin
RSV2	Unused Pin
GND	Ground

CN2 - AFE Communication Interface

SCL	Clock In (Pin 1)
GND	Ground
SDO	Data Out
CVDD	3.3V
SEN	Enable In
SDI	Data In

KA84917UA Pack Monitoring (PM-IC) Board

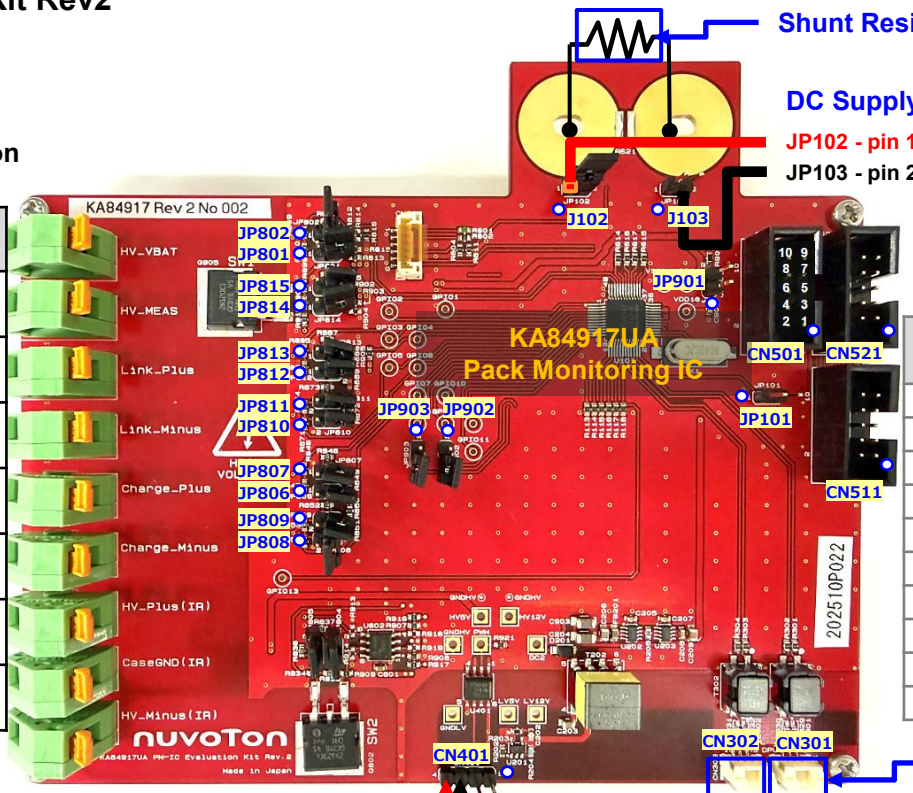
❑ Pack Monitoring IC Board Overview

- ➢ Designed to monitor pack current, voltage, and temperature, complementing the BM-IC for a complete battery monitoring solution
- ➢ Enables early evaluation and software development with the target system
- ➢ Supports Coulomb counting for charge/discharge tracking and system analysis
- ➢ Flexible integration with BM-IC via daisy-chain

KA84917UA PM-IC Evaluation Kit Rev2

Connection Configuration for Voltage Measurement/Relay Diagnosis/Insulation Detection

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



❑ **Without Shunt Resistor:**
Connect +/− to JP102(1)/JP103(2), and short JP103(2) to JP103(1) GND.
(Alternatively, connect +/− to JP103(2)/JP102(1) and short JP102(1) to JP102(2) GND.)

SPI connector pin assignment

Pin No.	Signal Name		
	CN501	CN511	CN521
1	GND	GND	GND
2	GCS1	GCS1	GCS2
3	GND	+12V	+12V
4	GSCK1	GSCK1	GSCK1
5	GND	GND	GND
6	GSDI1	GSDI1	GPIO13/GSDI2
7	GND	GPIO12/PWM1	N.C
8	GSDO1	GSDO1	SDO1
9	GND	GPIO11/PWM2	N.C
10	+5V	+5V	+5V

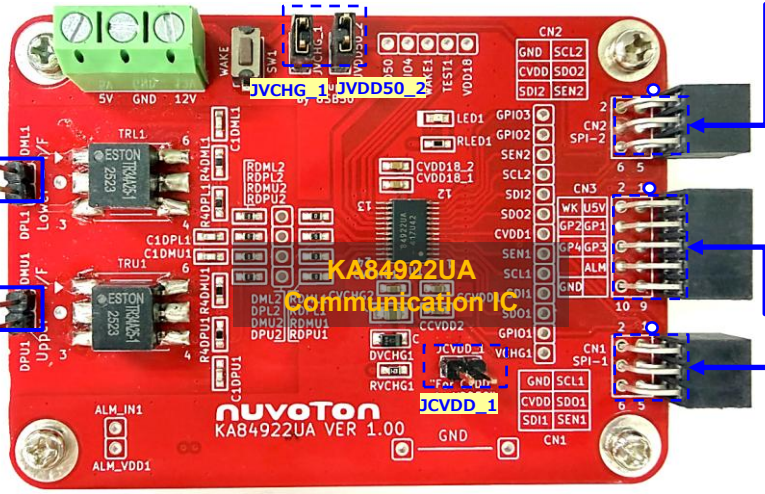
○ Pin 1
Note: Functions not in used are indicated in grey font

KA84922UA Communication (COMM-IC) board Overview

❑ Communication IC Board Overview

- ➢ Provides isolated SPI interface and daisy-chain communication between MCU and battery IC devices
- ➢ Supports scalable multi-device system architecture through flexible integration with BM-IC and PM-IC boards
- ➢ Simplifies system setup via direct connection to MCU board, powered through onboard supply (no external power required)

KA84922UA Communication (COMM-IC) board (VER1.00)



Jumper setting/connection

JVCHG_1	Short
JVDD50_2	Short
JCVDD_1	Open

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

SCL	Clock In (Pin 1)
GND	Ground
SDO	Data Out
CVDD	3.3V
SEN	Enable In
SDI	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 – BMS IC IF Connector
(Interface to MCU board CN3)

SCL 2	Clock In (Pin 1)
GND	Ground
SDO 2	Data Out
CVDD	3.3V
SEN 2	Enable In
SDI 2	Data In

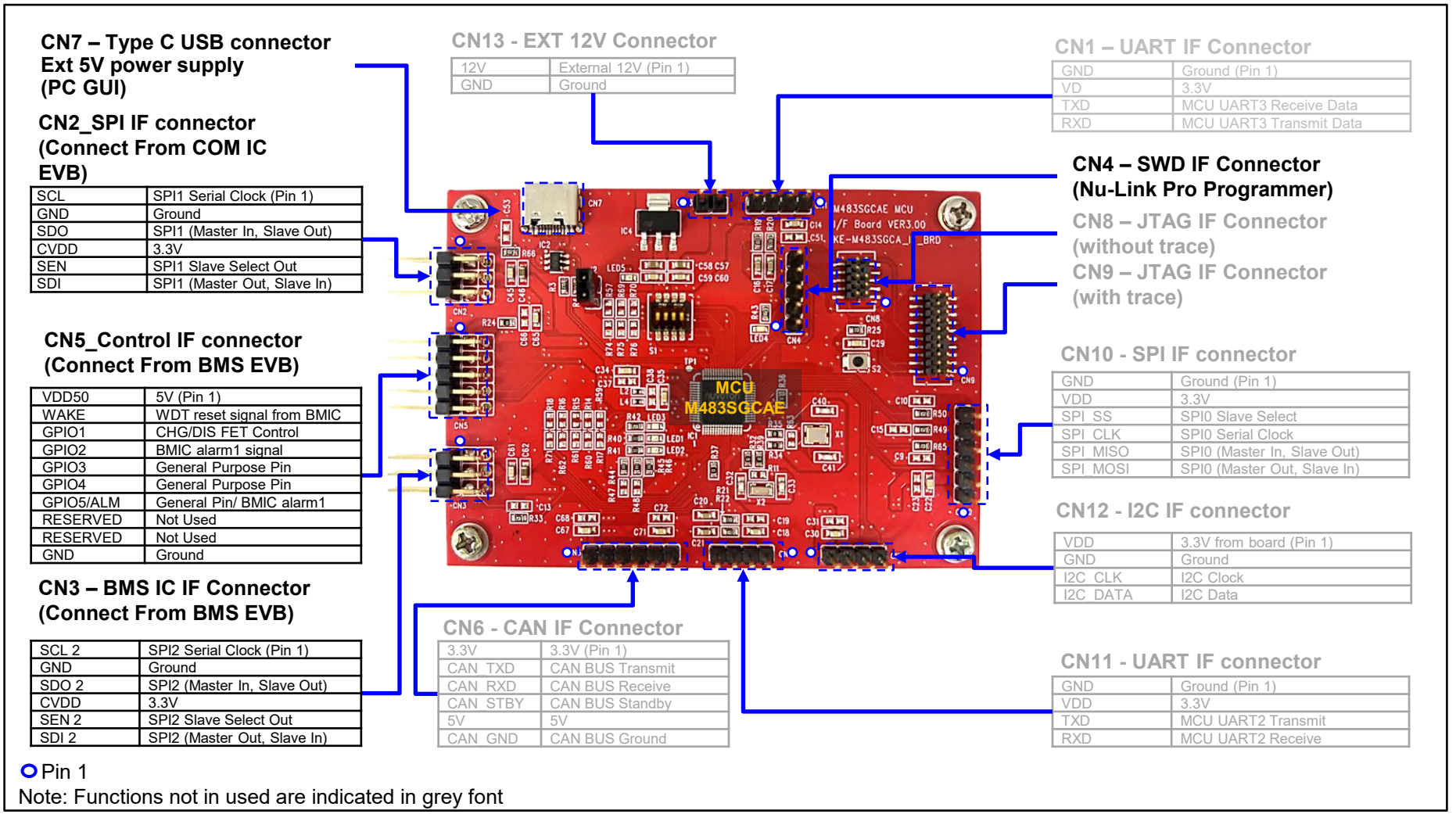
○ Pin 1

Note: Ensure correct jumper setting before use

M483SGCAE MCU Board – Flexibility For Rapid Hardware Prototyping

- **MCU Board is designed with Expansion connectors, offering flexibility to connect to other system devices in Rapid Hardware Prototyping.**

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



SCL	SPI1 Serial Clock (Pin 1)
GND	Ground
SDO	SPI1 (Master In, Slave Out)
CVDD	3.3V
SEN	SPI1 Slave Select Out
SDI	SPI1 (Master Out, Slave In)

VDD50	5V (Pin 1)
WAKE	WDT reset signal from BMIC
GPIO1	CHG/DIS FET Control
GPIO2	BMIC alarm1 signal
GPIO3	General Purpose Pin
GPIO4	General Purpose Pin
GPIO5/ALM	General Pin/ BMIC alarm1
RESERVED	Not Used
RESERVED	Not Used
GND	Ground

SCL 2	SPI2 Serial Clock (Pin 1)
GND	Ground
SDO 2	SPI2 (Master In, Slave Out)
CVDD	3.3V
SEN 2	SPI2 Slave Select Out
SDI 2	SPI2 (Master Out, Slave In)

12V	External 12V (Pin 1)
GND	Ground

GND	Ground (Pin 1)
VD	3.3V
TXD	MCU UART3 Receive Data
RXD	MCU UART3 Transmit Data

GND	Ground (Pin 1)
VDD	3.3V
SPI_SS	SPI0 Slave Select
SPI_CLK	SPI0 Serial Clock
SPI_MISO	SPI0 (Master In, Slave Out)
SPI_MOSI	SPI0 (Master Out, Slave In)

VDD	3.3V from board (Pin 1)
GND	Ground
I2C_CLK	I2C Clock
I2C_DATA	I2C Data

3.3V	3.3V (Pin 1)
CAN_TXD	CAN BUS Transmit
CAN_RXD	CAN BUS Receive
CAN_STBY	CAN BUS Standby
5V	5V
CAN_GND	CAN BUS Ground

GND	Ground (Pin 1)
VDD	3.3V
TXD	MCU UART2 Transmit
RXD	MCU UART2 Receive

Pin 1

Note: Functions not in used are indicated in grey font

M483SGCAE MCU Board – Supporting Debugger Connection

❑ Software Development / F/W Update with Nu-Link Pro Programmer *OR* IAR I-JET

To enable M483 MCU software development/updates, the board supports either the Serial Wire Debug (SWD) interface (CN4, default) or the JTAG Debugger interface (CN8/CN9, alternate option).

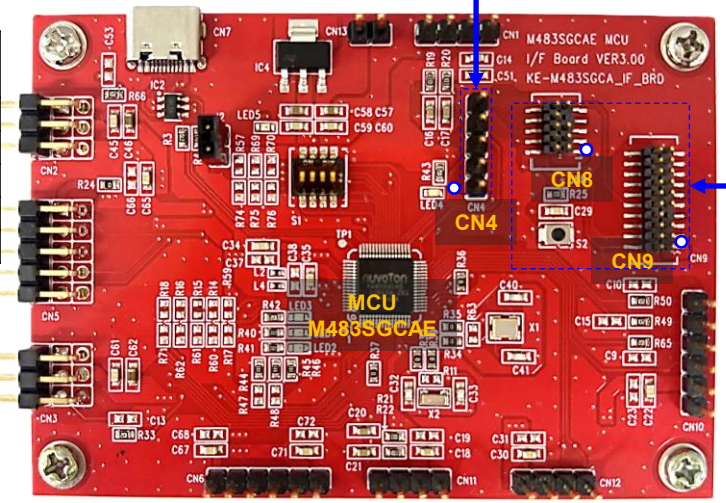
Connection to either the Nu-Link Pro *OR* the IAR I-JET is as shown below:

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





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



JTAG Debugger I/F:
CN8 – OBD without Tracer Fn (I-Jet)
CN9 – OBD with Tracer Fn (I-Jet Trace)

Reference Platform Package Inventory List

❑ The BMS Reference Platform Package consists of the following parts:

Part	Description
Hardware Board	1. KA49703A BM-IC Board x 2
	2. M483SGCAE MCU Board
	3. KA84917UA PM-IC Board (optional)
	4. KA84922UA COMM-IC Board (optional)
Accessories	1. USB Type A to Type C cable
	2. Jumper wire (for Daisy Chain communication)
	3. Nu-Link Pro Programmer (Optional)
Software	1. PC GUI Application (for Windows 11) inclusive of Industrial BMS Firmware Update Tools
	2. MCU Software Framework with BM-IC and PM-IC Device Drivers & Middleware (source code available upon request)
Documentation	1. Hardware User Manual
	2. MCU Software User Manual
	3. KA49703A Device Driver API List
	4. PC GUI User Manual
	5. Schematic, PCB Layout, BOM for MCU, BM-IC and PM-IC Boards
	6. Application note

REVISION HISTORY

Ver.	Date	Revised Contents
V1.00	30th Sep 2025	1. Initially issued.
V2.00	23rd Mar 2026	Addition of Pack Monitoring-IC in the BMS Reference Platform to complement the BM-IC in term of providing battery pack level monitoring of current, voltage and temperature
V3.00	30th Jun 2026	Addition of Communication-IC in the BMS Reference to provide isolated SPI interface and daisy-chain communication between MCU and battery IC devices

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Thank You

Danke

Merci

ありがとう

Gracias

Kiitos

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