KA49702A BM-IC AFE Reference Platform

Introduction To KA49702A Reference Platform

2nd Aug 2024

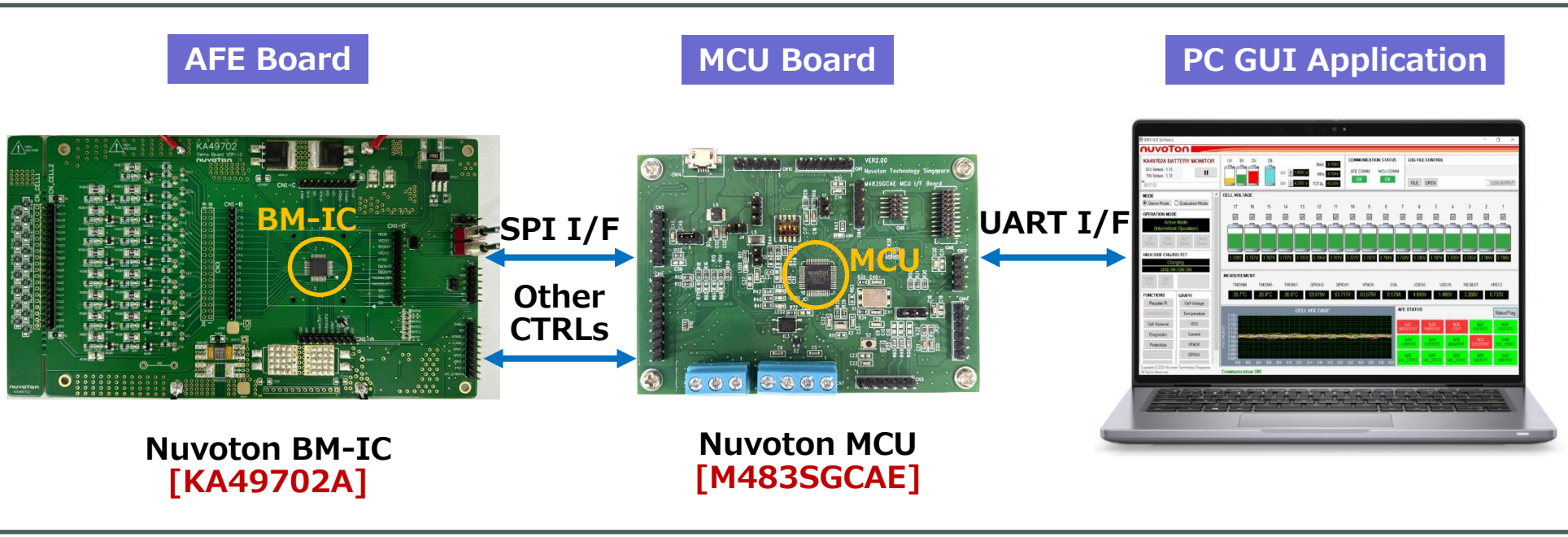
Nuvoton Technology Singapore

Content

Overview of KA49702A Reference Platform

Features

- Consists of 3 main components:
  - **PC GUI Application:** High-level User Interface to access and control AFE (BM-IC).
  - **MCU Board:** Contain System Controller (or CMU) Software Framework with BM-IC Device Driver & Middleware to control BM-IC.
  - **BM-IC Board(AFE Board):** Contain reference design of BM-IC to perform operations such as cell voltage measurement, charging/discharging, cell balancing operation, fault detection etc. with control from MCU Board.
- Hardware & Software reference designs are provided with detailed documentation to facilitate new design-in or adoption in Target System.
- Can be used as a Starter Kit for Application Software Development or Proof-of-Concept (POC) in new Design without fabricating new hardware.



Target Users & Benefits of Reference Platform

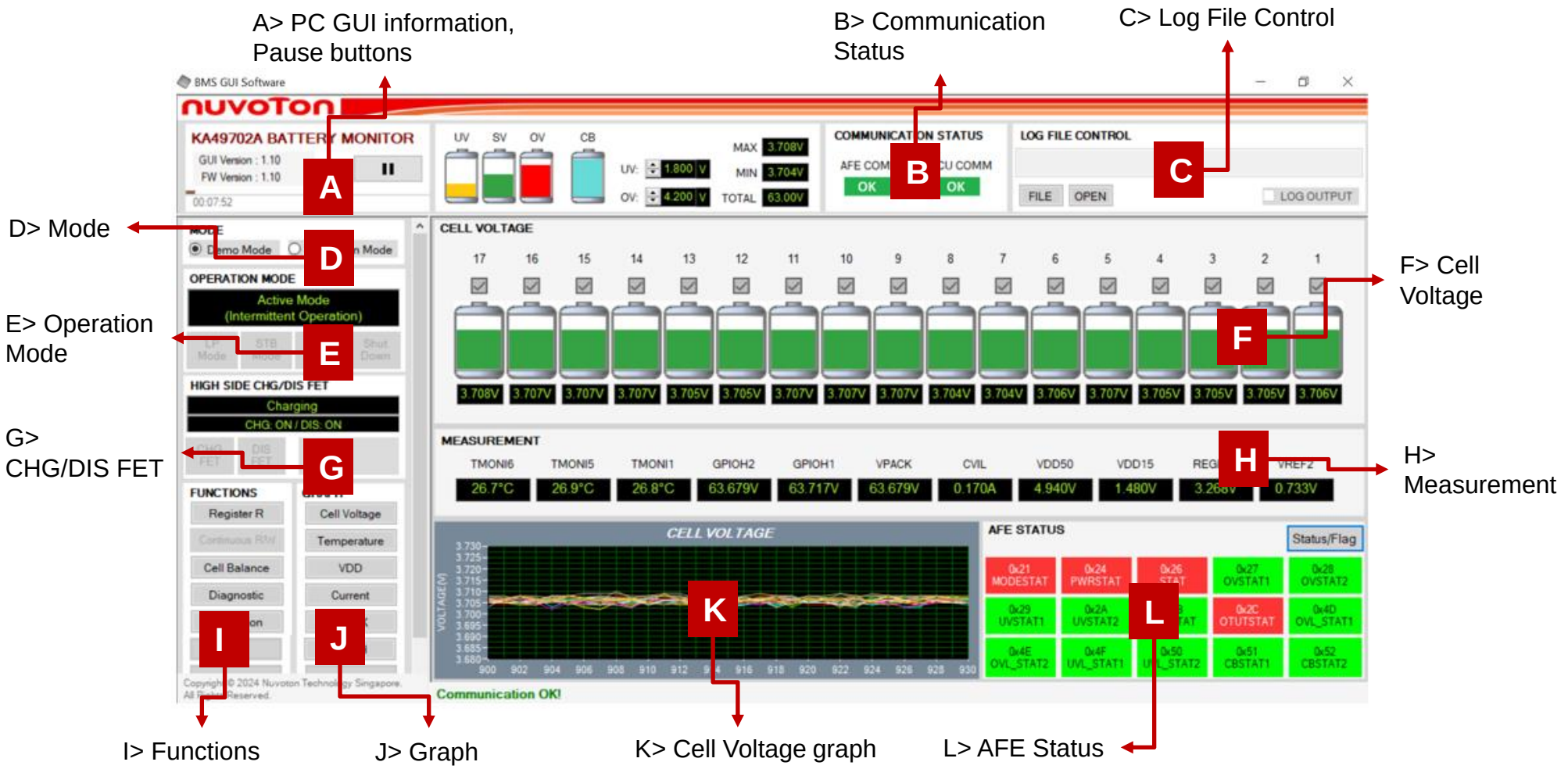
❑ **Reference Platform can be used by each user with the corresponding applications:**

User	Application / Use Case
Sales	For promotion & easy demonstration of BM-IC features such as: 1. Immediately see the converted value of cell voltages, other voltage, temperature, current etc on the PC GUI. 2. Simple control of the BM-IC (e.g. cell select & FET control) & viewing of BM-IC Registers & Status at graphical format.
Customer	1. Early evaluation of BM-IC, 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 AFE Device Driver & Middleware. 3. Immediate Application development environment ready using reference software framework with Nuvoton M483 MCU. 4. Rapid prototyping (when target system is not ready) by re-using the highly configurable AFE-MCU setup. 5. Using the PC GUI to verify developer understanding of the BM-IC specifications, behaviours & verify control sequence etc ***without writing software Test Stub Program***.

Functional Operation from PC GUI

Overview of PC GUI Functional Features

The PC GUI facilitates the transmission and reception of data to and from the BMIC through the MCU. Following data retrieval, the PC GUI software undertakes data conversion and presents it in both graphical and text formats.

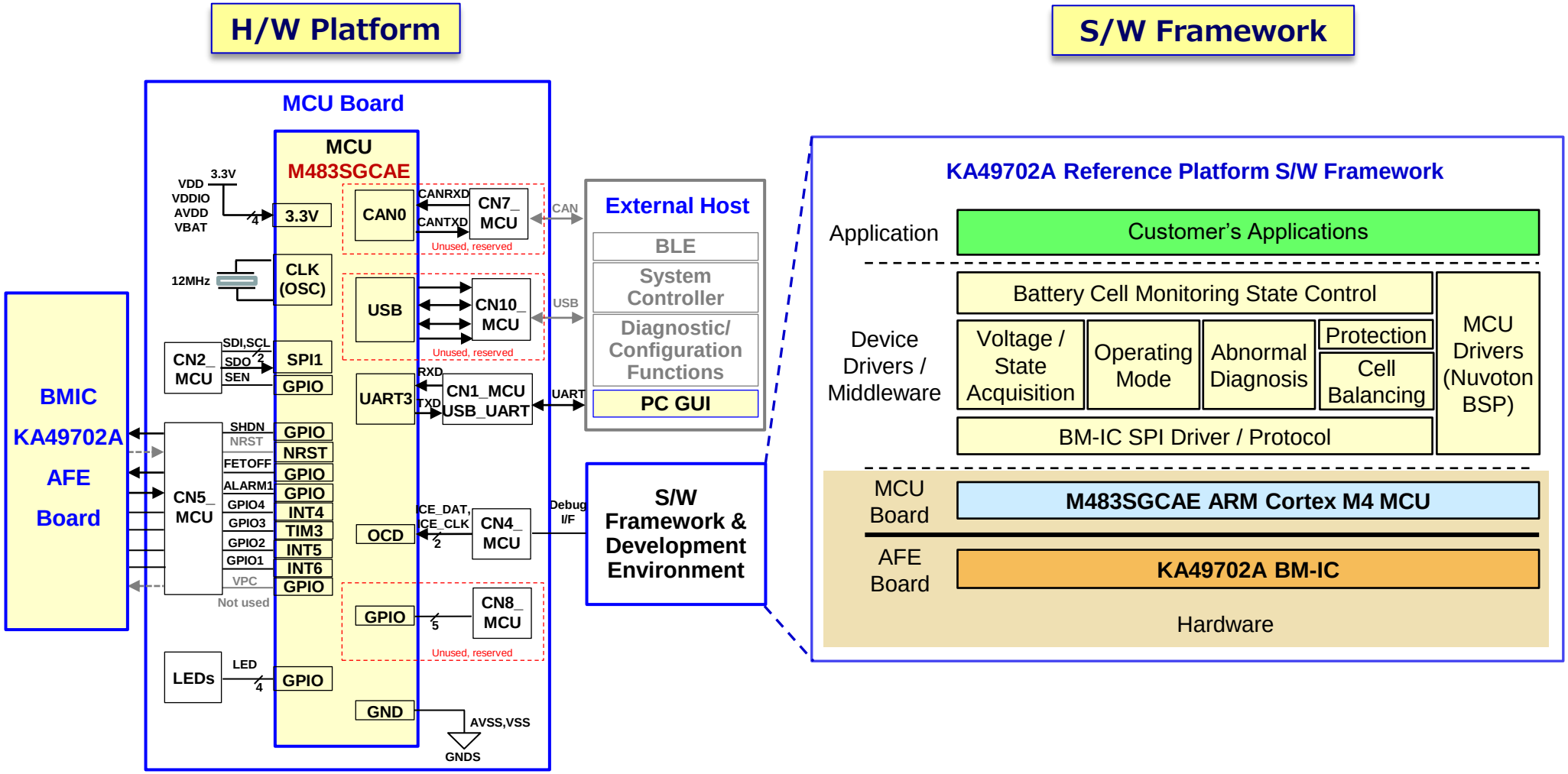


Reference Platform: Hardware + Software System Overview

❑ Starter Kit For S/W Development & Rapid Prototyping

- H/W & S/W platforms readily available customer to start prototyping & S/W Development.
- H/W: Reference Board & Design for CMU to interface to AFE BM-IC.
- S/W: Provides Device Driver & framework for CMU S/W Development.

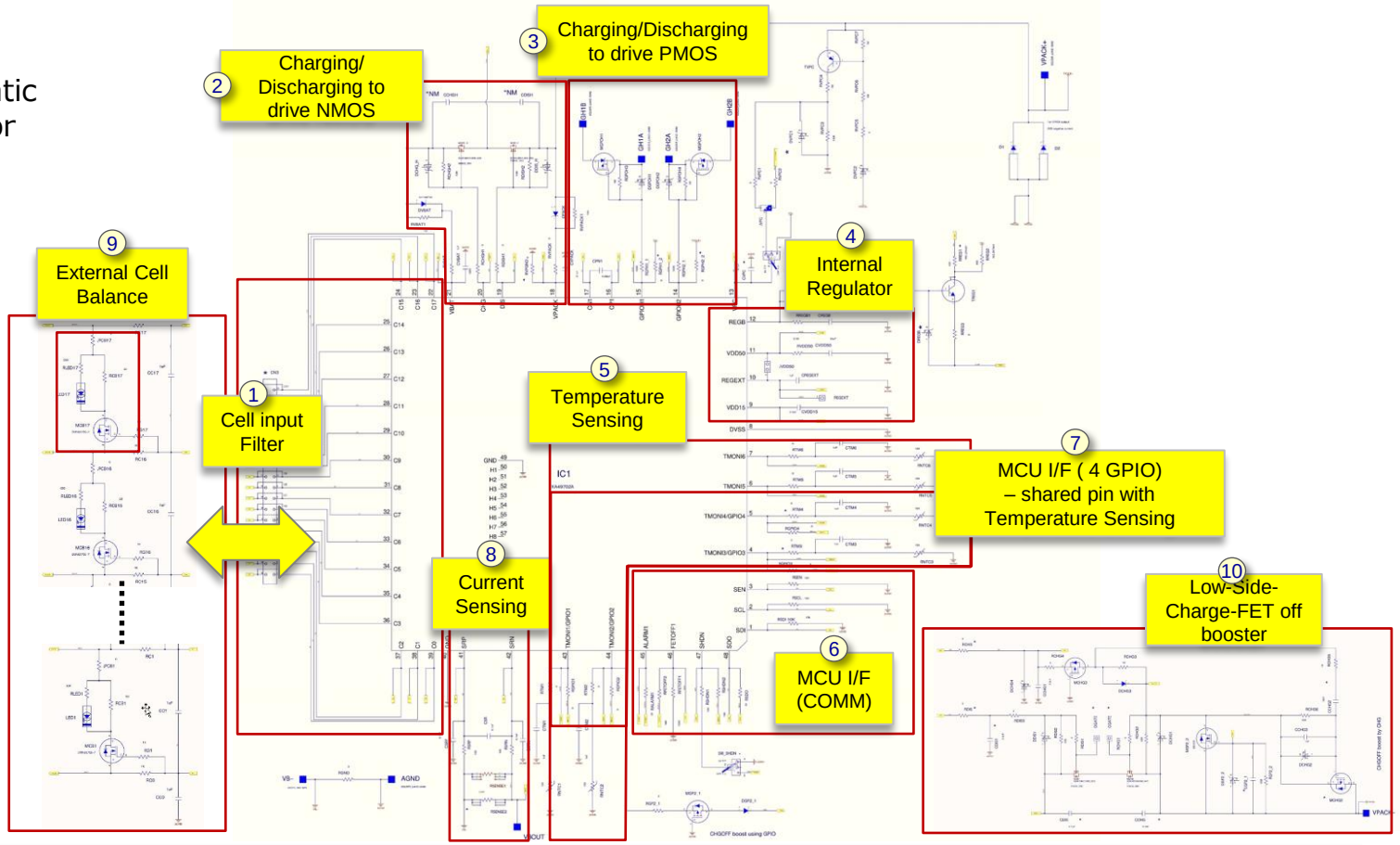
➢ Customer can verify design and start S/W Development before target platform is ready.



AFE System Reference Design With KA49702A

AFE 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 customer and supporting effort to customer.

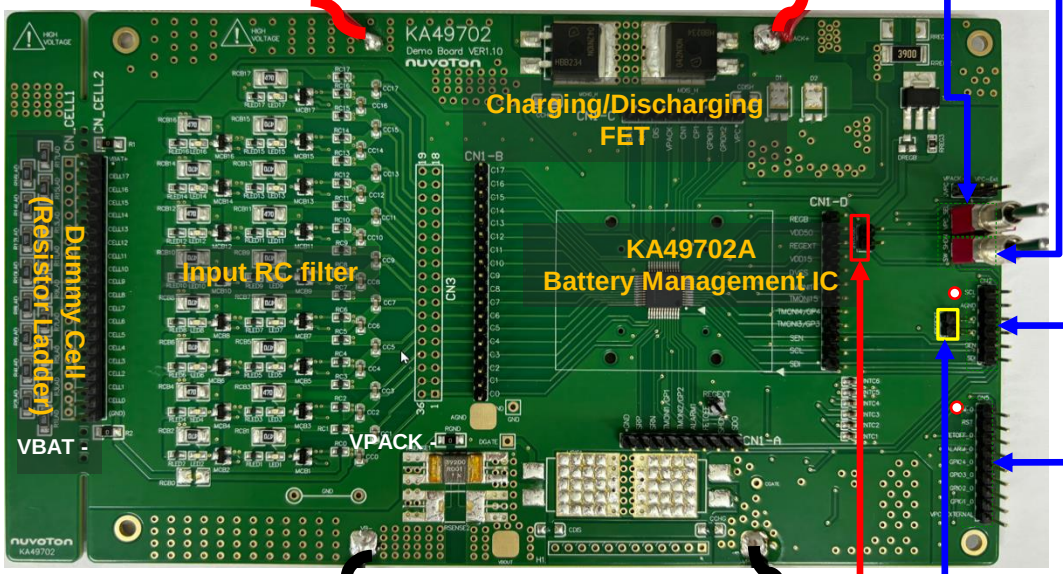


S/N	Hardware Reference Items Provided		
1	Cell Input Filter Circuit	2	FETs Charging/Dis-charging Circuit (NMOS)
3	FETs Charging/Dis-charging Circuit (PMOS)	4	Internal Regulator Circuit
5	Temperature Sensing Circuit	6	MCU Interface (COMM): SPI, Alarm, FETOFF Circuit
7	MCU Interface (GPIO): GPIO Circuit	8	Current Sensing Circuit
9	External Cell Balancing Circuit	10	Low-Side-Charge-FET Off booster Circuit
Components: Transistor part number & RC value are provided.			

KA49702A AFE Board

❑ AFE Board is designed with the flexibility to interface with customer own System Controller / CMU

- ➢ Customer can hook up AFE Board to own target system for evaluation / development.
- ➢ Dummy cell sub-PCB can be break-off to connect to actual battery cell.



CN2_MCU Communication Interface

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)

CN5_MCU Control Interface

SHDN	Shut Down Control (Pin 1)
NRST	WDT reset signal to MCU
FETOFF	CHG/DIS FET Control
ALARM1	BMIC alarm1 signal
GPIO4	General Purpose Pin
GPIO3	General Purpose Pin
GPIO2	General Purpose Pin
GPIO1	General Purpose Pin
VPC	Wake Up – Not Used

M483SGCAE MCU Board – Flexibility For Rapid Hardware Prototyping

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

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

CN14_Micro USB connector
Ext 5V power supply only
(Default: No use)

CN10 – USB FS IF Connector

VBUS	5V (Pin 1)
D+	USB +
D-	USB -
ID	USB Identification
GND	GND

CN1 – UART IF Connector (PC GUI)

GND	Ground (Pin 1)
CTS#	NC
VDD	3.3V (Not used)
RXD	Receive Data from Cable
TXD	Transmit Data to Cable
RTS#	NC

CN4 – SWD IF Connector
(Nu-Link Pro Programmer)

CN2_SPI IF connector
(Connect From BMS EVB)

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)

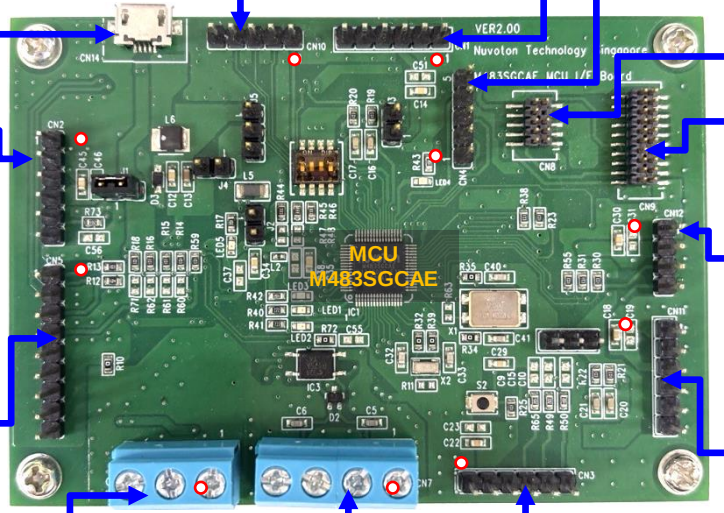
CN8 – JTAG IF Connector
(without trace)
CN9 – JTAG IF Connector
(with trace)

CN12_I2C IF Connector

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

CN5_Control IF connector
(Connect From BMS EVB)

SHDN	Shut Down Control (Pin 1)
NRST	WDT reset signal from BMIC
FETOFF	CHG/DIS FET Control
ALARM1	BMIC alarm1 signal
GPIO4	General Purpose Pin
GPIO3	General Purpose Pin
GPIO2	General Purpose Pin
GPIO1	General Purpose Pin
VPC	Not Used



CN11_UART IF Connector

GND	Ground (Pin 1)
CTS#	NC
VDD	5V supply to board
TXD	MCU Transmit Data
RXD	MCU Receive Data
RTS#	NC

CN6_CAN digital IF Connector

CAN_TXD	CAN Transmit (Pin 1)
CAN_RXD	CAN Receive
CAN_GND	CAN Ground

CN7_CAN IF Connector

CAN_GND	CAN bus Ground (Pin 1)
CAN_H	CAN bus H signal
CAN_L	CAN bus L signal
CAN_GND	CAN bus Ground

CN3_SPI IF Connector

GND	Ground (Pin 1)
VDD	3.3V from board
SPI_SS	SPI2 Slave Select
SPI_CLK	SPI2 Serial Clock
SPI_MISO	SPI2 (Master In, Slave Out)
SPI_MOSI	SPI2 (Master Out, Slave In)

○ 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

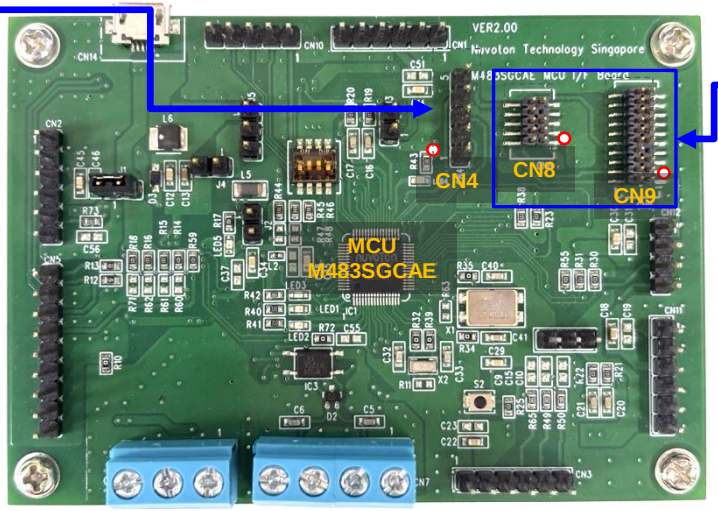
To enable M483 MCU Software Development / updating, use of either Serial Wire Debug (SWD) interface CN4 *OR* JTAG Debugger interface (CN8/CN9) is incorporated.

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

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

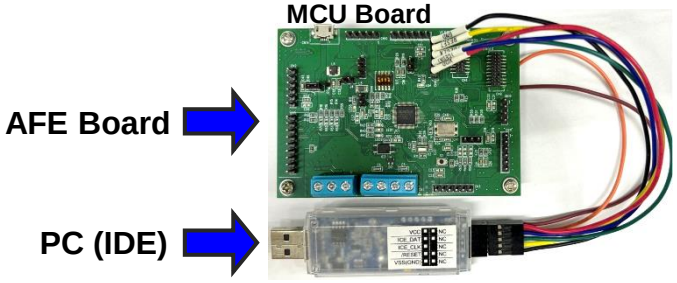
MCU Board (CN4)		Nu-Link Pro Programmer
Pin No	Description	
1	VCC	VCC (Red)
2	SWDIO	ICE_DAT (Blue)
3	SWCLK	ICE_CLK (Green)
4	RESET	/RESET (Yellow)
5	GND	VSS (Black)

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 KA49702A Reference Platform Package consists of the following parts:

Part	Description
Hardware Board	1. KA49702A AFE Board
	2. M483SGCAE MCU Board
Accessories	1. USB to TTL level serial converter cable (TTL-232R-3V3)
	2. Board connection Wire (6pin x1 and 9pin x1)
	3. Nu-Link Pro Programmer (Optional)
Software	1. PC GUI Application (for Windows 10) and Industrial BMS Firmware Update Tools
	2. MCU Software Framework with AFE Device Drivers & Middleware (source code available upon request)
Documentation	1. Hardware User Manual
	2. MCU Software User Manual
	3. KA49702A Device Driver API List
	4. PC GUI User Manual and Firmware Update Tools User Manual
	5. Schematic, PCB Layout, BOM for MCU and AFE Boards
	6. Application note

REVISION HISTORY

Ver.	Date	Revised Contents
V1.00	6th Jun 2024	1. Initially issued. The AFE board referred to in the manual is “KA49702A Demo Board VER1.00”. The MCU controller board referred to in the manual is “VER2.00”.
V1.10	24th Jul 2024	Page 7: CN5 Pin 2 has been changed from N.C to NRST for WDT reset signal to MCU Page 10: Under Software, added Industrial BMS Firmware Update Tools as part of PC GUI release package. Also included the Firmware Update Tools User Manual in the documentation
V1.10	2nd Aug 2024	Page 2 & 7 : Update AFE EVB V1.10 image, Page 2 & 4 update GUI image

Joy of innovation

NUVOTON

Thank You

Danke

Merci

ありがとう

Gracias

Kiitos

감사합니다

धन्यबाद

شكرا لك

הדות