Industrial BMIC Product Portfolio

Nuvoton Technology Corporation Japan

April 2026

Our Mission

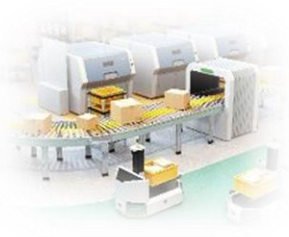
Powering a safer, smarter, carbon-neutral world

Safety — Proven functional safety and exceptional reliability, leveraging decades of automotive expertise

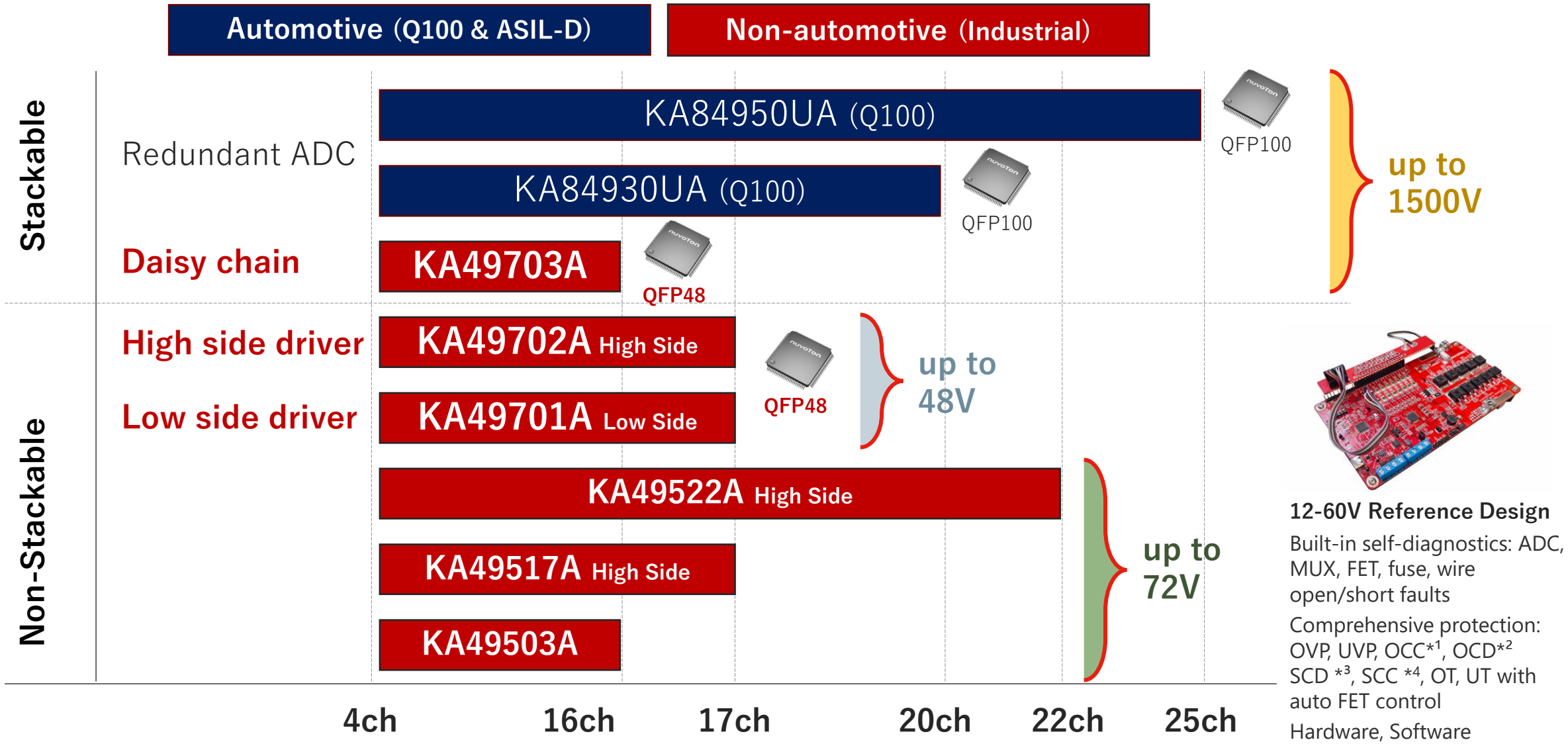
Accuracy — High-precision measurement across wide temperature ranges and demanding battery voltage conditions

Scalability — Comprehensive product lineup covering diverse battery architectures and application needs




Nuvoton BM-IC Product Line up



12-60V Reference Design

Built-in self-diagnostics: ADC, MUX, FET, fuse, wire open/short faults

Comprehensive protection: OVP, UVP, OCC*1, OCD*2 SCD *3, SCC *4, OT, UT with auto FET control

Hardware, Software

Industrial BMIC Portfolio Detailed Features

NEW

Part Number	KA49522	KA49702A	KA49701A	KA49703A
Package	 HQFP64 10mm x10mm 0.5mm pitch	 HQFP48 7mm x7mm 0.5mm pitch	 HQFP48 7mm x7mm 0.5mm pitch	 HQFP48 7mm x7mm 0.5mm pitch
Supply Range	12.5V ~ 110V	12.5V ~ 85V	12.5V ~ 85V	12.5V ~ 76.8V
Temp Range	-40℃~85℃	-40℃~105℃	-40℃~105℃	-40℃~105℃
Cell Channels	22	17	17	16
Cell Measure Accuracy	±5mV @25℃	±2.9mV @25℃	±2.9mV @25℃	±2.5mV @25℃
Supply Current	3.6mA	260μA	260μA	1.2mA
Current Sensor	IADC1: High speed IADC2: Coulomb Count	IADC: Coulomb Count	IADC: Coulomb Count	NO
Temp Sensor	5 CHs	6 CHs	5 CHs	8 CHs (Extendable to 16 CHs)
FET driver	High side DRV	High side DRV +Low side convertible	Low side DRV	NO
Cell Balance (Passive)	Int/External FET Odd/Even CH Balance	Int/External FET Odd/Even CH Balance	Int/External FET Odd/Even CH Balance	Int/External FET Odd/Even CH Balance /All CH adjacent Cell Balance
Voltage Fault Protect	YES	YES	YES	YES
Current Fault protect	YES	YES	YES	NO
Temp Fault Protect	NO	YES	YES	YES
Daisy Chain (Stackable)	NO	NO	NO	Yes
Ring Daisy	NO	NO	NO	Yes
SPI	YES	YES	YES	YES
*Status	MP ready	MP ready	MP Ready	ES ready: Nov'25

ES = Engineering Samples
MP = Mass Production

Nuvoton BMIC Target Markets

Flexible, Safe and Scalable Solutions

1500V

System Voltage

18V

Non-stackable BMICs

- Power tool
- Garden Equipment
- e-Bike
- Portable ESS













Stackable BMIC

- Residential ESS
- Commercial/Industrial ESS

50Whr

System Energy Capacity

100MWhr

Non-Stackable BMIC

KA49702A – Lower Voltage Applications <72V

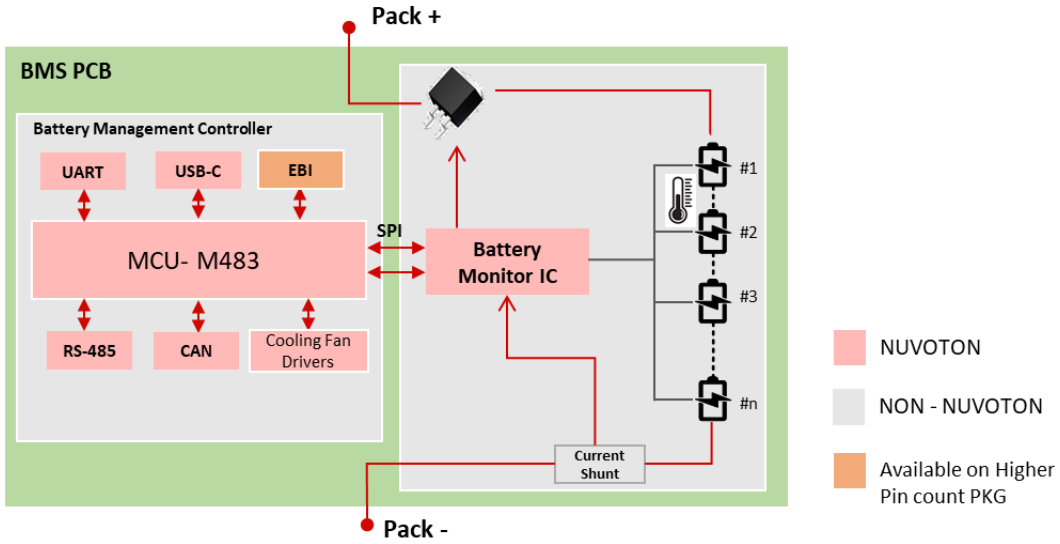
Samples, Eval Board, Reference Design Available Now

48V e-bike/Power Tool/Residential ESS

KA49702A/701A non-stackable 17ch
Available now

Target App / Use Case

Schematic Design



Market Requirement

1) Prevent battery over discharge / charge
2) Minimize standby power consumption

Product Features

KA49702/701A

- **Integrating fault diagnosis and fail-safe functions** into the BMIC enables a safe system without external circuits, reducing BMS costs
- Low Discharge current helps the battery last longer, **operating current of 260uA and shutdown current is low as 0.1uA**

KA49701/702A Product Overview

KA49702A/701A non-stackable 17ch
Available now

Advanced Features

1 Advanced Safety Architecture

- Equipped with Fault Diagnosis and Fail-Safe Functions, Enabling Safe System Design Without External Protection Circuits

2 Power Savings Features

- Operating Current 260µA
  (Less Than 1/10 of NTCJ Previous Models)
- Shutdown Current Below 0.1µA

3 Efficient Battery Capacity Utilization

- Voltage Measurement Accuracy ±2.9mV

  (Industry-Leading Standard)

Product Highlights

KA49701A/702A
Battery Monitoring IC

Cells per BMIC	17 cells
Rated Voltage	85V
Voltage Accuracy	+/- 2.9mV
Current Measurement Accuracy	+/- 1.0%
Current Consumption	Operating: 260uA Shutdown: 0.1uA or less
Package	48-pin QFP (7mm x7mm)

KA49701A Low Side web page

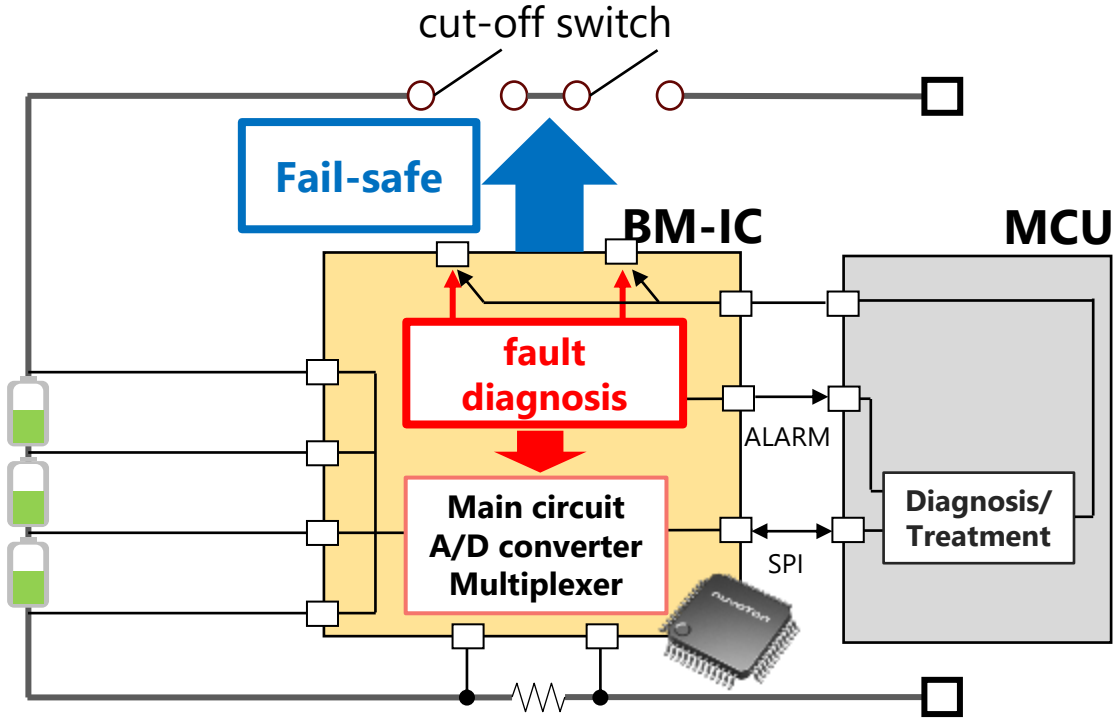
KA49702A High Side web page

Improved safety and reduced system costs

KA49702A/701A non-stackable 17ch
Available now

- Using the BM-IC's high-voltage measurement inputs, external protection circuits can be reduced, enabling a safer and simpler system design.

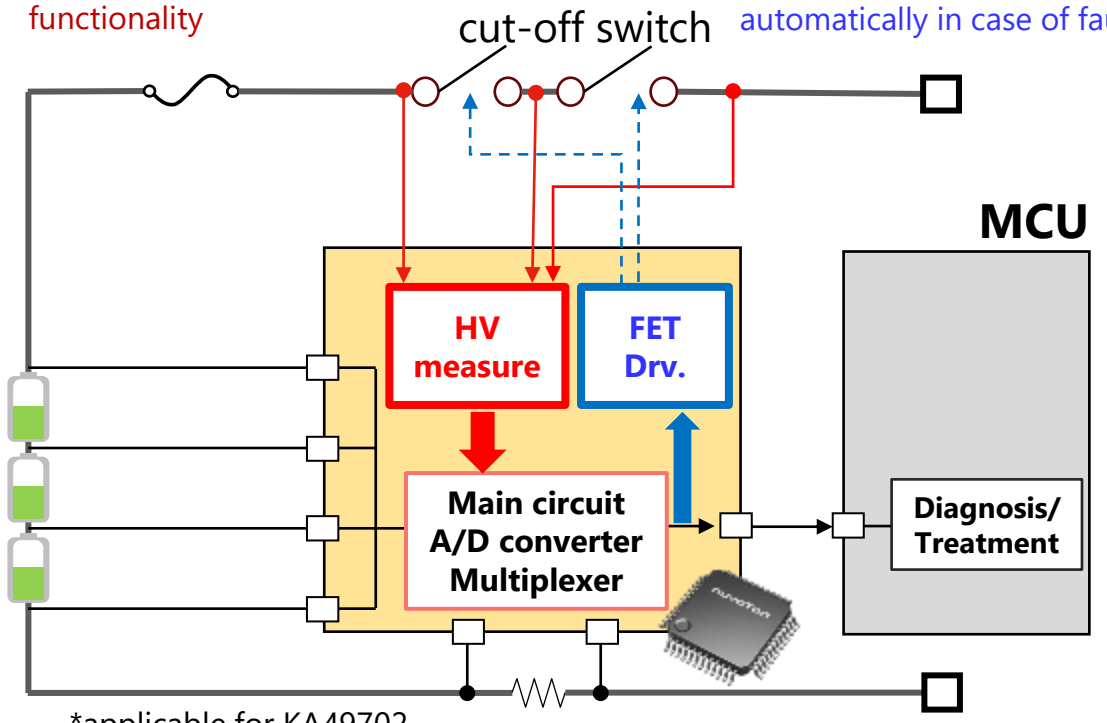
❑ Nuvoton BM-IC with Self Diagnostics



❑ System using NTCJ new product example

Using 3CH HV measurement, able to detect fuse and switch functionality

Using internal BM-IC logic Ctrl to control switch automatically in case of fault



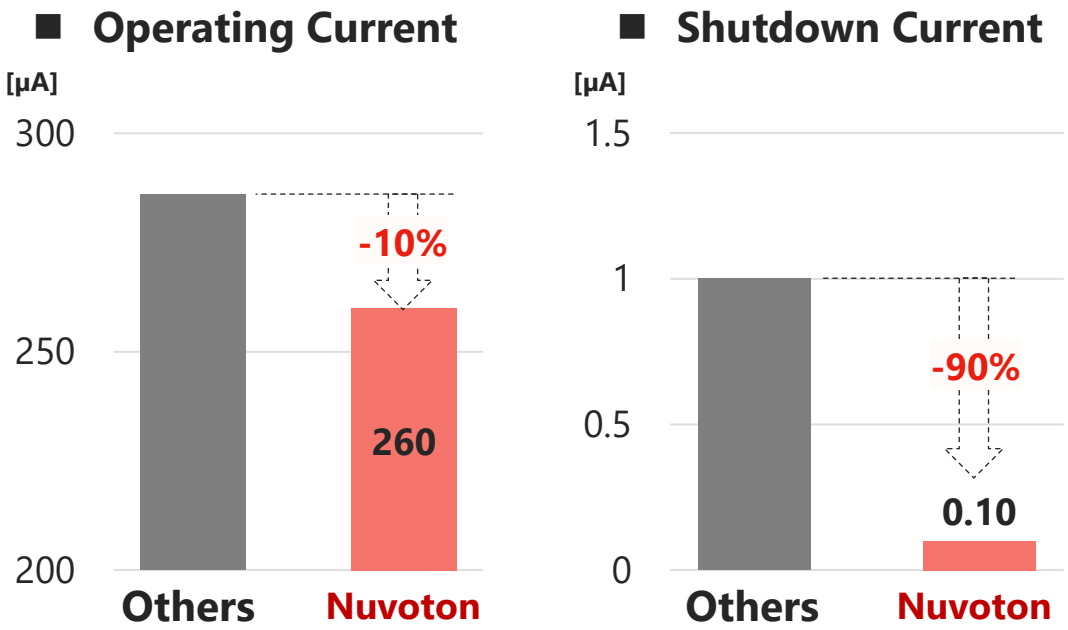
*applicable for KA49702

Long Battery Life

KA49702A/701A non-stackable 17ch
Available now

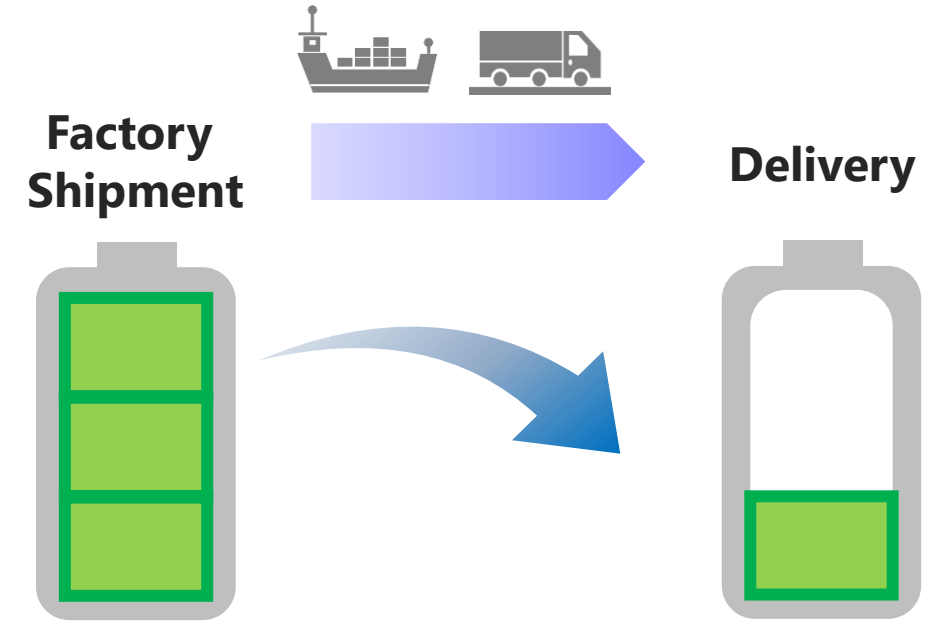
- **By reducing the self-discharge current, long-distance transportation and long-term storage of the battery pack are possible.**

❑ Self-Discharge Current of the IC



Reduce Self-Discharge Current

❑ Long-Distance Transportation of Battery Packs



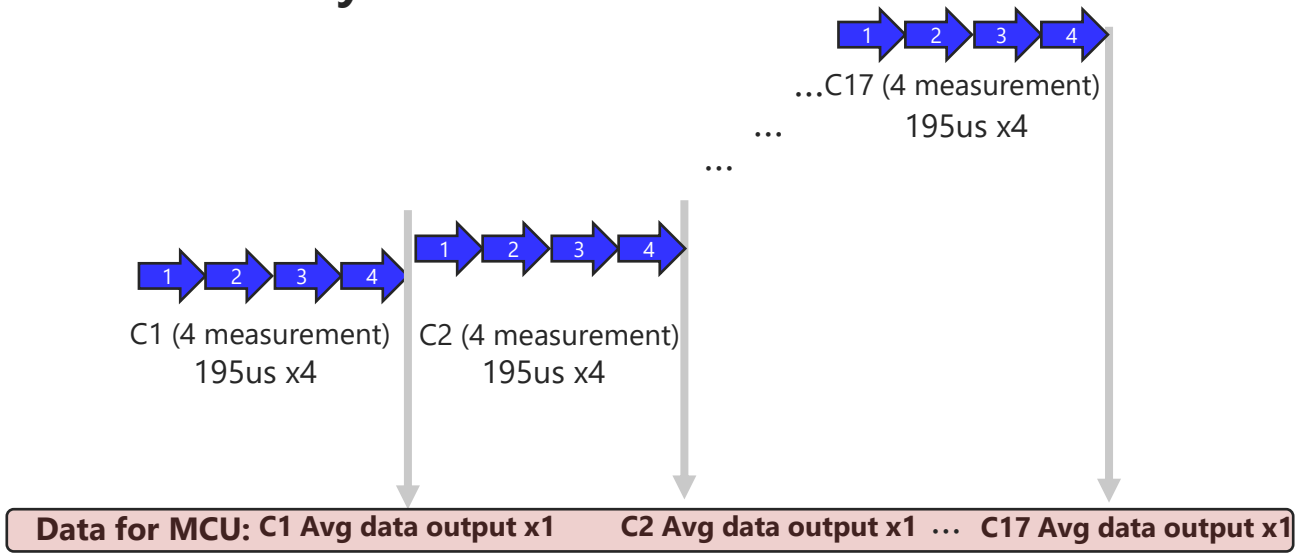
High self-discharge reduces capacity during transport

Voltage measurement averaging function

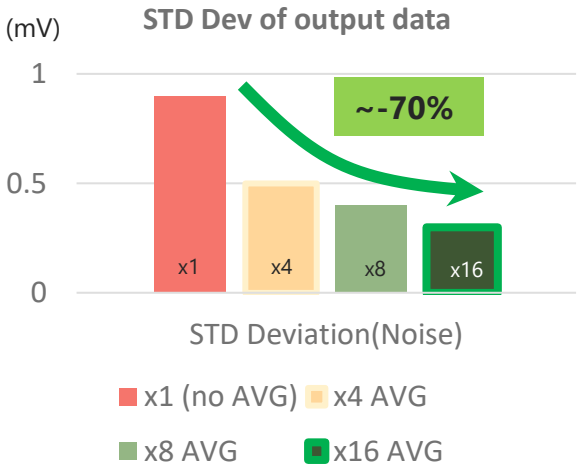
KA49702A/701A non-stackable 17ch
Available now

- **Averaging function can be activated for voltage measurement.**
- **This allows user to obtain highly accurate data with reduction in noise.**

❑ **BM-IC will output average data to MCU when in avg mode. This reduce the influence of noise to the measured data and improve accuracy**



❑ **Avg mode is available for all cells, VPACK and GPIOH measurement. With Avg mode, data standard deviation can be reduced by ~70% to achieve a more accurate data**

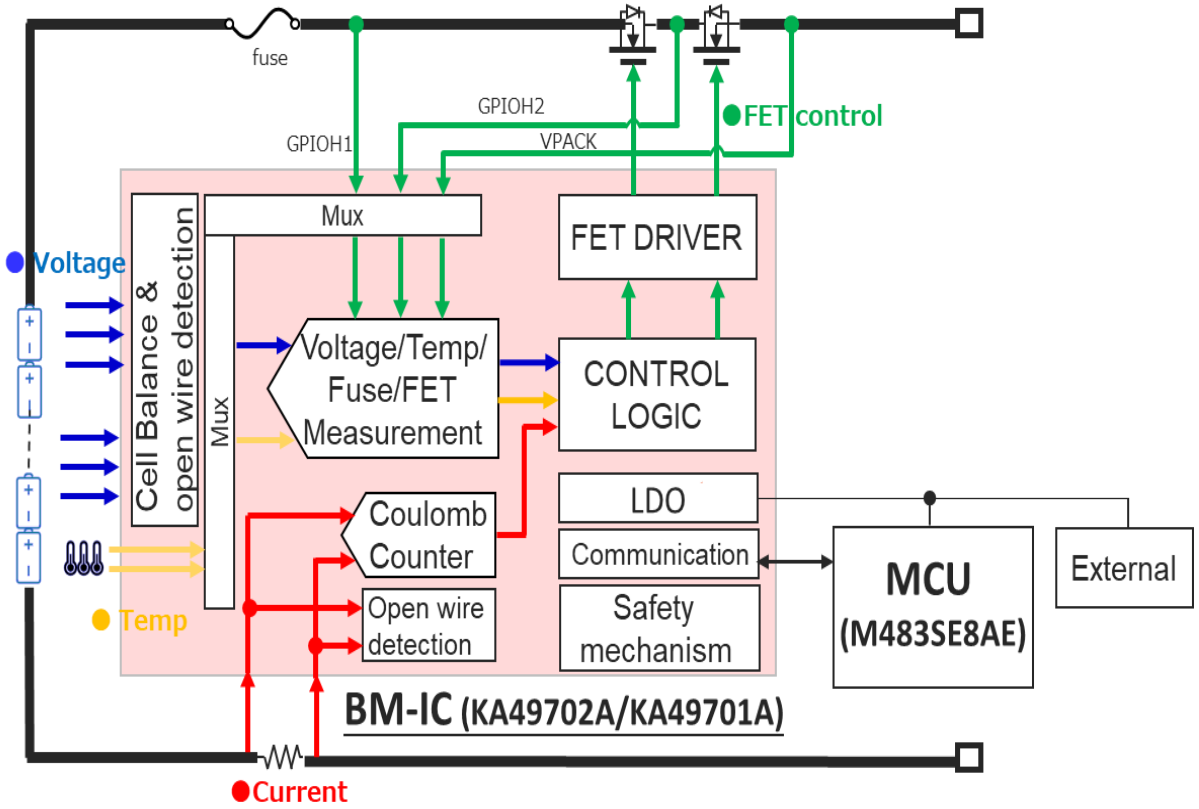


Averaging mode Ftn	
Channels with averaging	Cells, VPACK, GPIOH1,GPIOH2
No. of avg times	x1,x4, x8, x16

BMIC Safety Feature

KA49702A/701A non-stackable 17ch
Available now

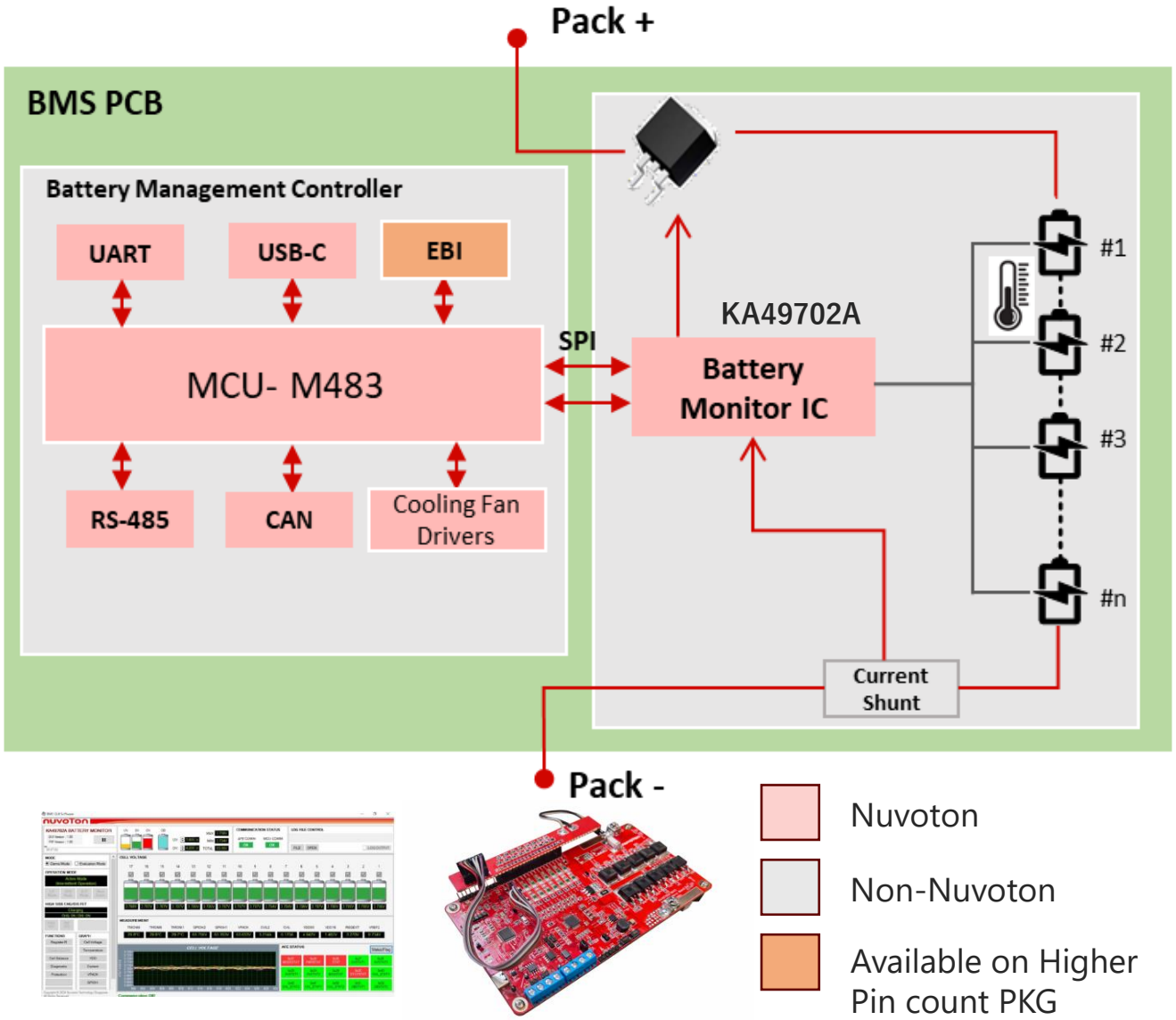
Enhanced Safety features to ensure whole chip safety coverage and meet safety goal



Process	Functions	Safety Mechanism	Purpose
Measurement	● Voltage measurement	**Open wire detection**	Ensure batteries wires to AFE are connected
	● Voltage measurement	**Sequence self check**	Ensure all battery cells are measured in correct sequence
	● Temp measurement	**ADC ref voltage check**	Ensure Voltage ADC operates correctly
	● Current measurement	**Self diagnostic check**	Ensure current ADC and cell current are measured correctly
FET Control	● FET Driver	**FET Short/Open Diagnose**	Ensure no anomaly FET
		FUSE short/Open Diagnose	Ensure no anomaly FUSE

4S-17S (12V-60V) Reference Design

KA49702A non-stackable 17ch
Available now



Nuvoton

Non-Nuvoton

Available on Higher Pin count PKG

Features

- Built-in self-diagnostics: ADC, MUX, FET, fuse, wire open/short faults
- Comprehensive protection: OVP, UVP, OCC*[1], OCD*[2] SCD *[3], SCC *[4], OT, UT with auto FET control
- Cell voltage sensing accuracy:
  - ±2.9mV (25°C)
  - ±5mV (-20°C to 65°C)
- BMIC Operating Temperature up to 105°C
  Reference Board Operating Temperature -20°C to 85°C capable
- Supports charge up to 10A and discharge up to 50A
- 200mA peak cell balancing current
- High-power shunt resistor for current measurement
- Supports UART, CAN, USB-C and RS485 communication
- Controlled fuse circuit for secondary protection

Stackable BMIC

KA49703A – High-Voltage Applications

Samples, Eval Board, Available by Request

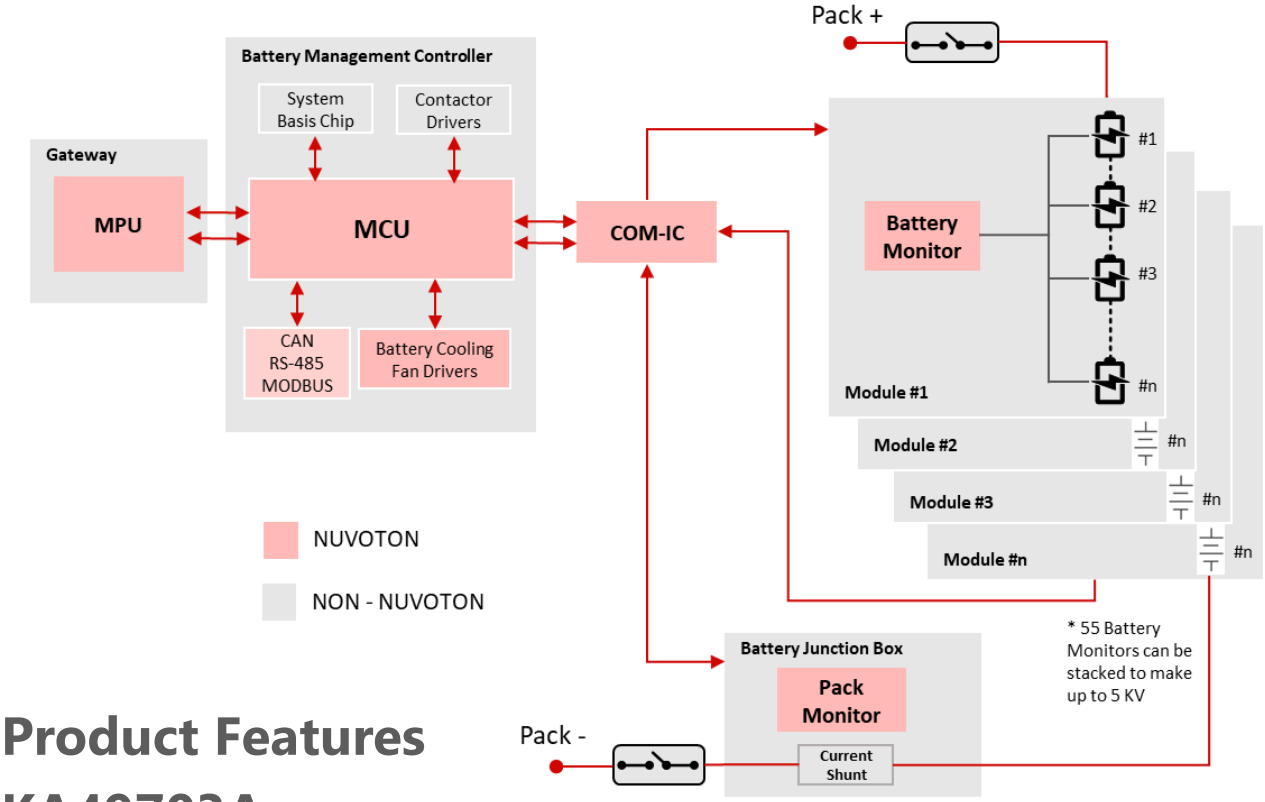
Mass Product = 2Q2026

1500V Power Grid / Industrial ESS

KA49703A Stackable 16ch
Samples & Eval Board Available Now
MP 2Q2026

Target App / Use Case

Schematic Design



Market Requirement

1) High –voltage isolated communication and stackable architecture support
2) Robust safety and protection features

Product Features KA49703A

- 16 Cells with a stackable daisy chain
- Wider thermal sensing coverage with 8ch Temperature monitor per IC

KA49703A 16channel BMIC Overview

(>60V to 2kV+)

KA49703A Stackable 16ch

Samples & Eval Board Available Now

MP 2Q2026

Features

High Accuracy

Good thermal Protection coverage

- **ADC Measurement:**
  - ✓ Supports up-to 16 battery cells series measurement with ±2.5mV(typ) accuracy
  - ✓ 8 temp monitoring channels with option to extend to 16 using integrated TMONI_MUX ctrl pin
  - ✓ Targeted channels measurement sequence according to user's selection

Enhance Safety

- **Safety Diagnostic Features**
  - ✓ Open wire detection function
  - ✓ Alarm function for detecting various errors
    - Overcharging (OV), Over-discharging (UV)
    - Over/Under temperature (OT/UT)

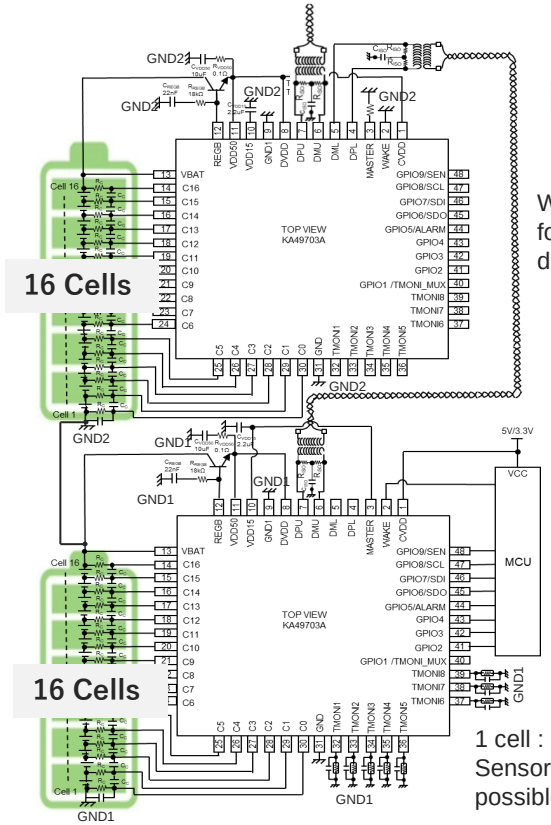
Efficient CB

- **Cell Balancing (CB):**
  - ✓ Enhanced CB with adjacent simultaneous CB feature
  - ✓ Internal and external cell balance with PWM duty control
  - ✓ Measurement oriented CB function

Stackable

- **Communication**
  - ✓ High speed SPI serial communication interface with MCU
  - ✓ Supports Ring Daisy Chain interface for stackable design (up-to 55 devices)

Circuit Diagram



Simple BOM

With Daisy Chain for stackable design,

1 cell : 1 Temp Sensor coverage possible

Package

HQFP48L-7mm□ 0.5mm pitch

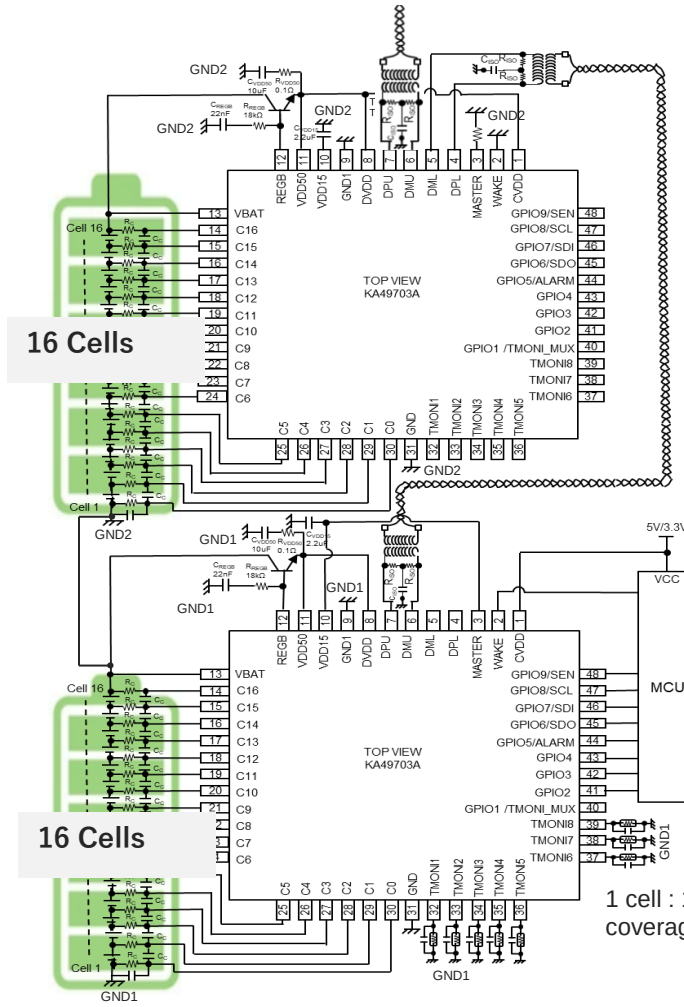
Small size

*Sample available from Nov 2025

Stackable up to 55 BMICs (880 cells)

KA49703A Stackable 16ch
Samples & Eval Board Available Now
MP 2Q2026

✓ 55 devices can be stacked with **Daisy Chain** & **Ring Chain**

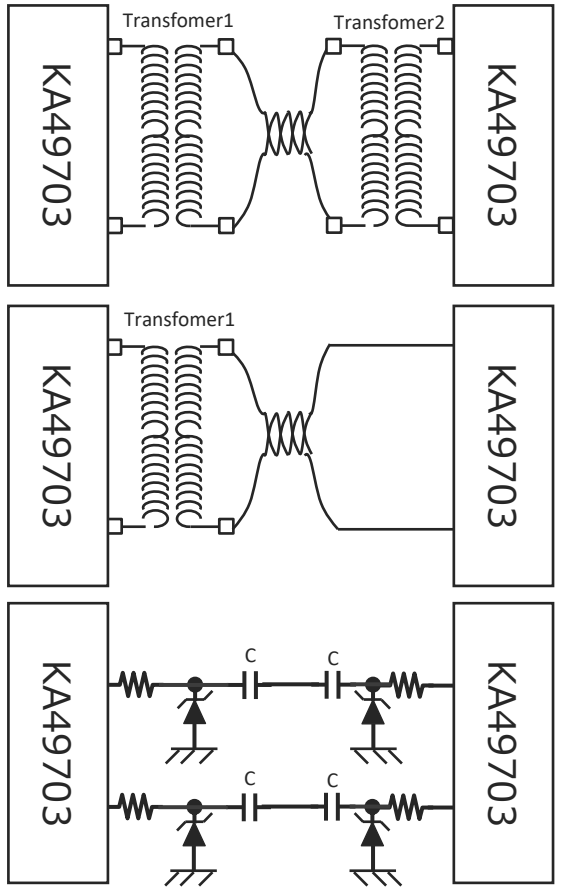


With Daisy Chain for stackable design,

1 cell : 1 Temp Sensor coverage possible

✓ **True isolation** support and implementation flexibility

Supported Isolation



✓ **2 transformers** type daisy chain

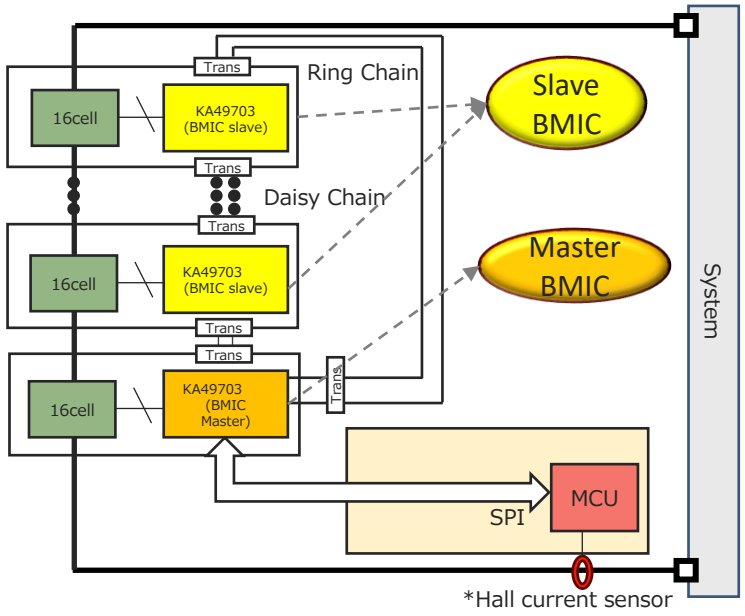
✓ **1 transformer** type daisy chain

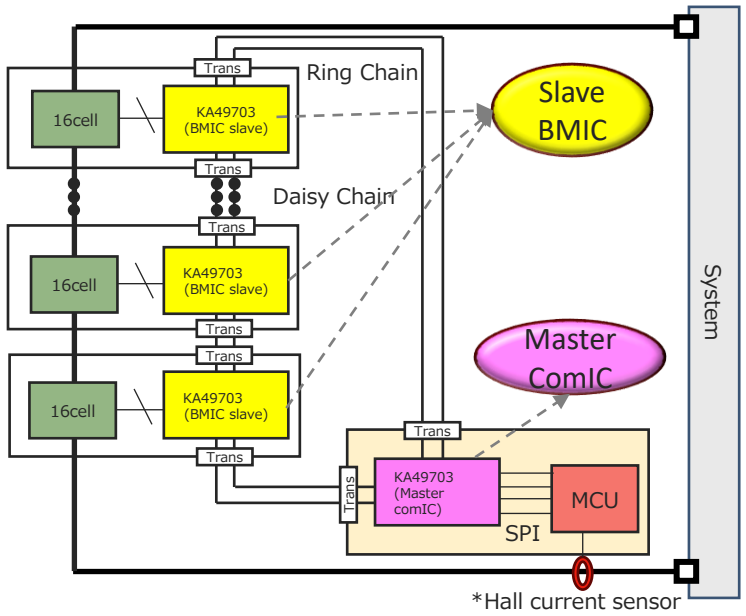
✓ **Capacitor type** daisy chain

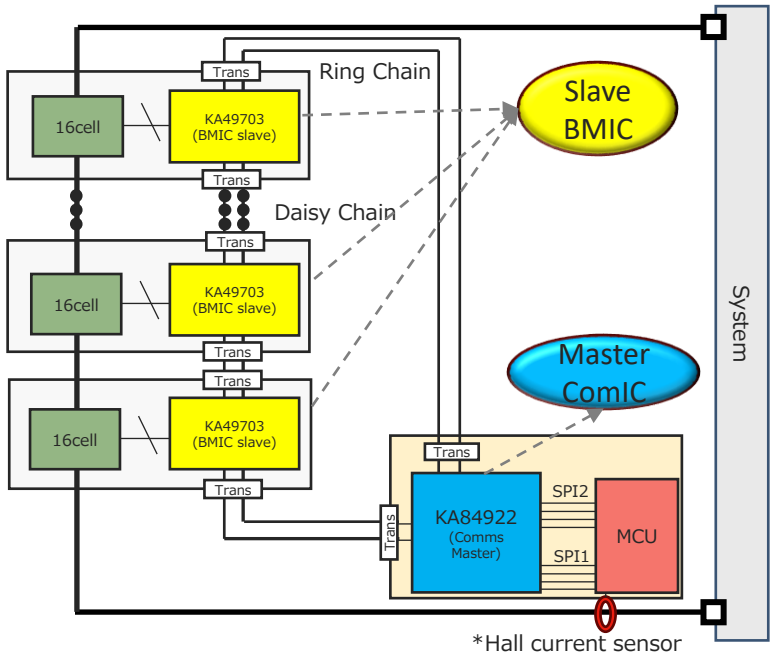
Module Configuration Flexibility

KA49703A Stackable 16ch
Samples & Eval Board Available Now
MP 2Q2026

Flexible Master/Slave and Master Communication IC Architecture Configuration Options







Reduced System BOM

- ✓ **KA49703A as Master BMIC with single SPI**
- ✓ **KA49703 as Slave BMIC**
- Simplifies overall system architecture
- Minimizes external components
- Ideal for cost-optimized module designs

Fully Isolated Architecture

- ✓ **KA49703A as Master Comms IC with single SPI**
- ✓ **KA49703A as Slave BMIC**
- Provides complete main MCU isolation
- Enhances system safety and noise immunity
- Suitable for high-reliability ESS & mobile systems

Fully Isolated System with Dual-SPI Safety

- ✓ **KA84922 as Master Comms IC with dual SPI**
- ✓ **KA49703A as Slave BMIC**
- Adds redundant SPI interfaces for enhanced safety
- Optimized for ASIL-focused, safety critical applications

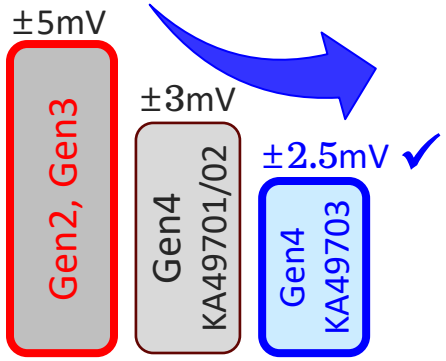
*Can also use Nuvoton's KA84917 in the daisy chain configuration for sense resistor system if not using Hall current sensor.

Extended Battery Utilization

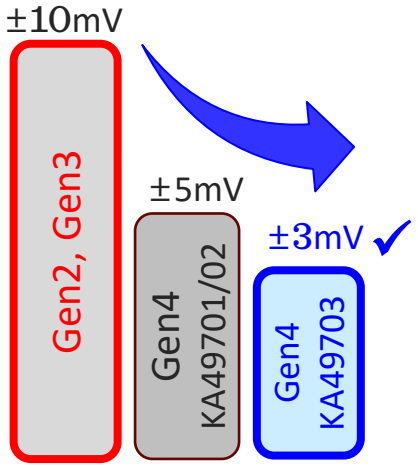
KA49703A Stackable 16ch
Samples & Eval Board Available Now
MP 2Q2026

Improvement in ADC measurement accuracy resulting in better battery usage range

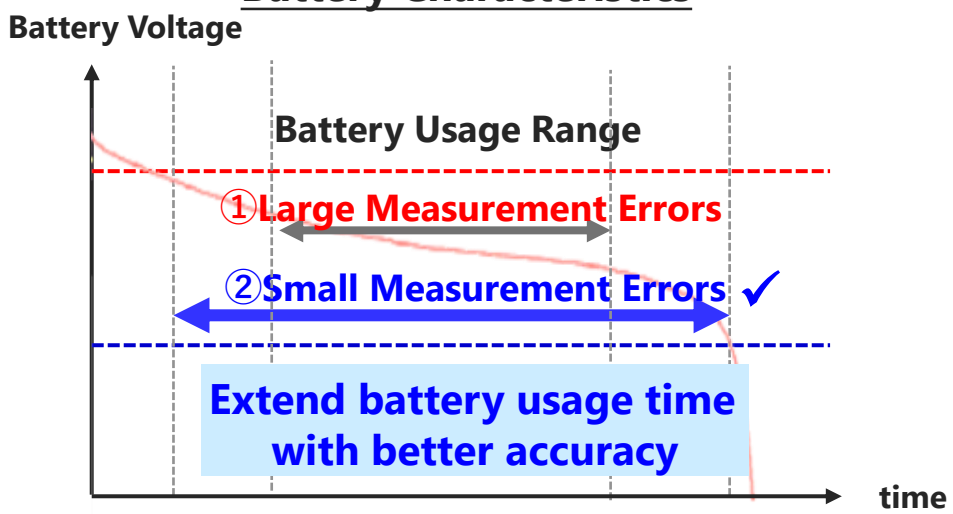
Measurement accuracy (Room Temp)



Measurement accuracy (High/Low Temp)



Battery Characteristics



KA49703 ADC modes	Purpose	Benefit
Continuous mode	Real-time, continuous data logging	✓ Full-speed monitoring with safe, stable operation
Intermittent mode	Adjustable gaps between measurements	✓ MCU- controlled logging interval ✓ Lower overall current consumption
Averaging mode (x4/x8/x16)	Reduce noise	✓ Higher accuracy under noisy conditions ✓ More robust measurement quality ✓ Built-in averaging – no need for custom firmware measurement loop
Targeted measurement mode	Focused, selective data acquisition	✓ Enables targeted monitoring (cell-only, temperature-only, GPIO-only) ✓ Reduced power consumption for specific diagnostics

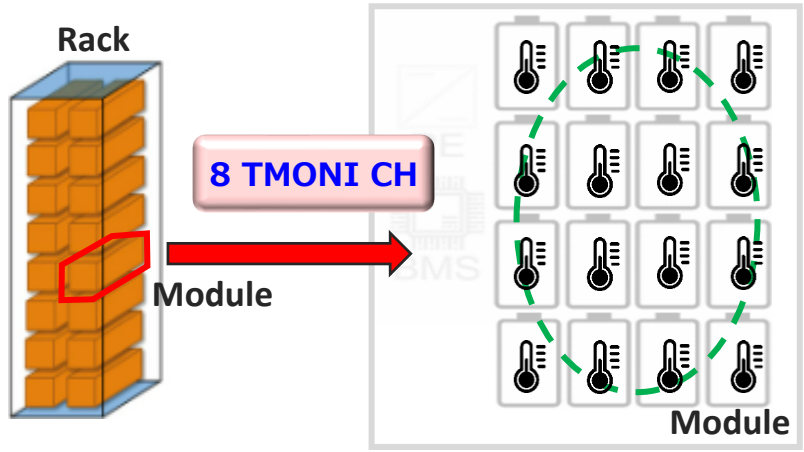
Enhanced Thermal Sensing

KA49703A Stackable 16ch
Samples & Eval Board Available Now
MP 2Q2026

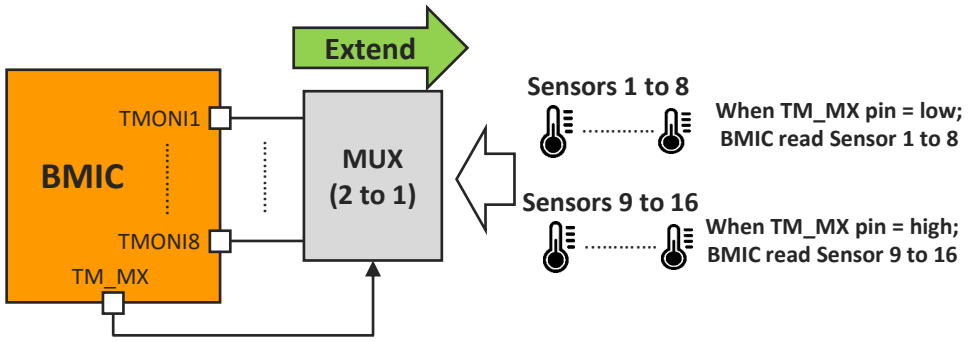
1:1 Thermal sensing (TMONI) per cell with synchronize measurement timing*

Extended Thermal Sensor Coverage

- KA49703A supports **8 native TMON channels**
- With a simple **2:1 multiplexer**, coverage extends to **16 thermal sensors**
- Enables **true 1:1 cell-to-sensor mapping** for improved module safety and diagnostics



* With 2:1 External MUX



KA49703A Thermal Sensor Multiplex Control

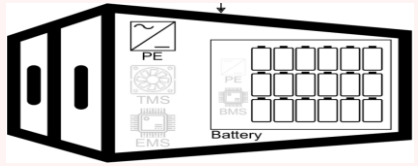
- ✓ Expands thermal sensing from 8 → 16 channels with only one external MUX
- ✓ Provides accurate per-cell thermal coverage for higher safety and faster thermal response
- ✓ Automatic MUX control simplifies firmware and eliminates manual switching logic
- ✓ MCU always knows which sensor group is active and can read data directly from internal registers → simplifies system design and ease of use

Enhanced Cell Balancing

KA49703A Stackable 16ch
Samples & Eval Board Available Now
MP 2Q2026

Adjacent cell PWM-controlled balancing for faster, more reliable equalization

Market Needs: Fast, Effective Balancing



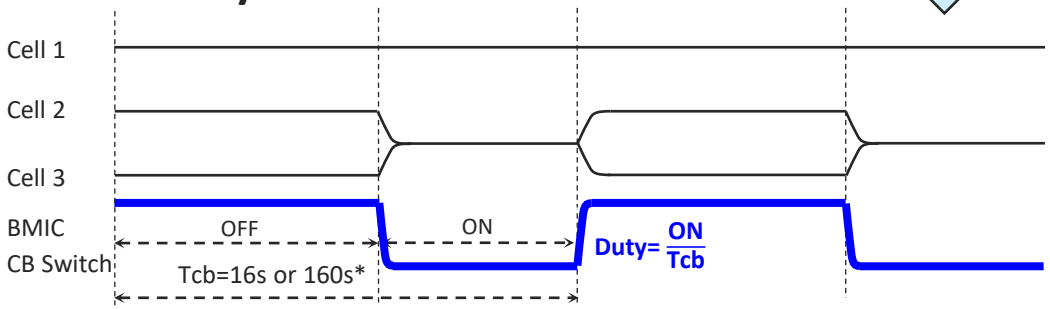
>100 cells
Series, parallel

All cells must be balanced to maintain:
- **System Performance**
- **Energy Utilization**
- **Safety and Lifetime**

solution

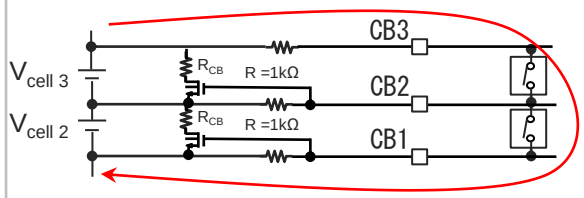
solution

PWM Duty control

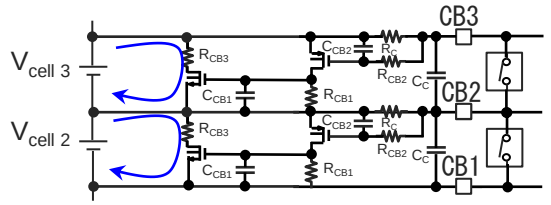


PWM Duty Control Registers in the BMIC:
- ✓ More robust and predictable balancing across all cells
- ✓ **Reduce MCU resource** for manual switching

Traditional:
SW Controlled CB

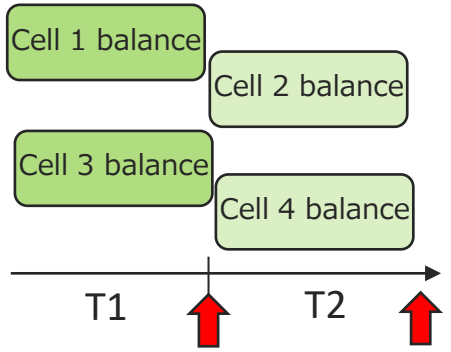


KA49703A:
Enhance CB Drive



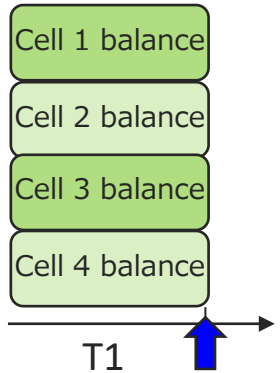
- ✓ **Use Sample and hold CB** with internal IC's refresh clock to achieve adjacent CB function

Alternate Odd → Even CB



Long total CB time

Simultaneous Odd + Even CB

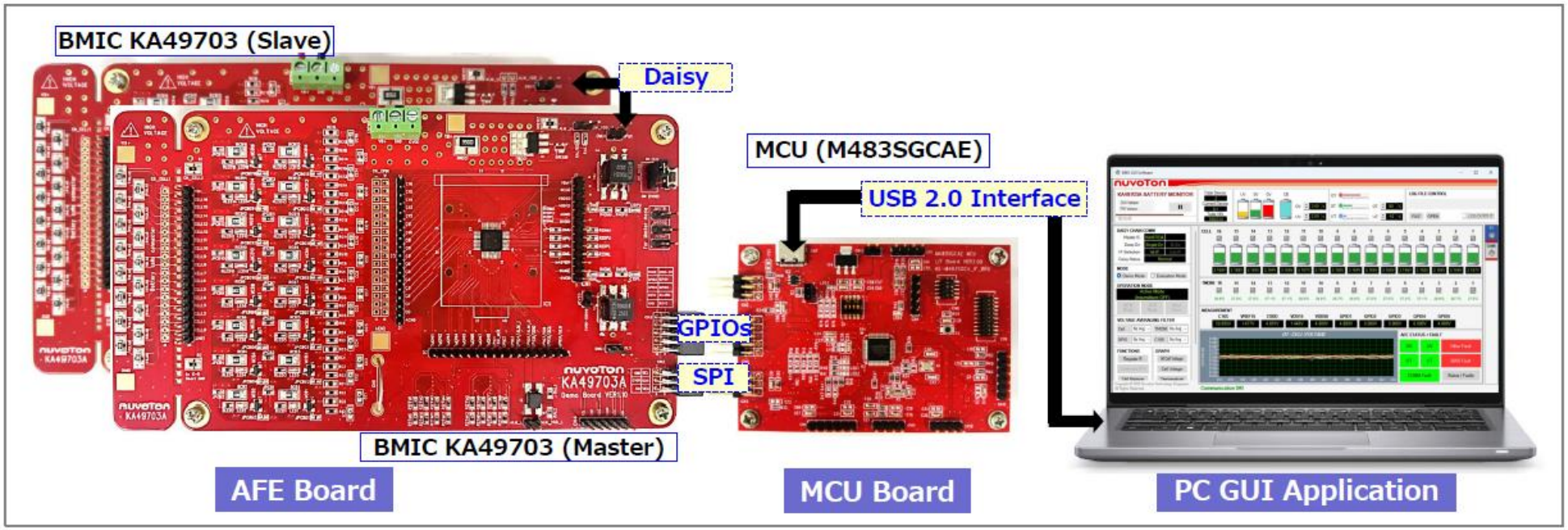


Reduce CB time by half

- ✓ **50% Reduction** in total balancing time

KA49703A Evaluation Platform

KA49703A Stackable 16ch
Samples & Eval Board Available Now
MP 2Q2026



- 2x Boards: 1x Master, 1x Slave
- Reference schematic + PCB files
- Supports ring/daisy-chain communication
- Performs:
  - Cell voltage measurement
  - Temperature monitoring
  - Cell balancing
  - Fault detection and reporting

- Cortex-M4 MCU based
- Hosts the System Controller software framework
- Includes BMIC device driver and middleware for full control of the AFE

- High-level user interface for monitoring and controlling the BMIC
- Provides visualization of:
  - Cell voltages
  - Cell temperature
  - Balancing states
  - System status

72V Low Speed EV / Industrial ESS

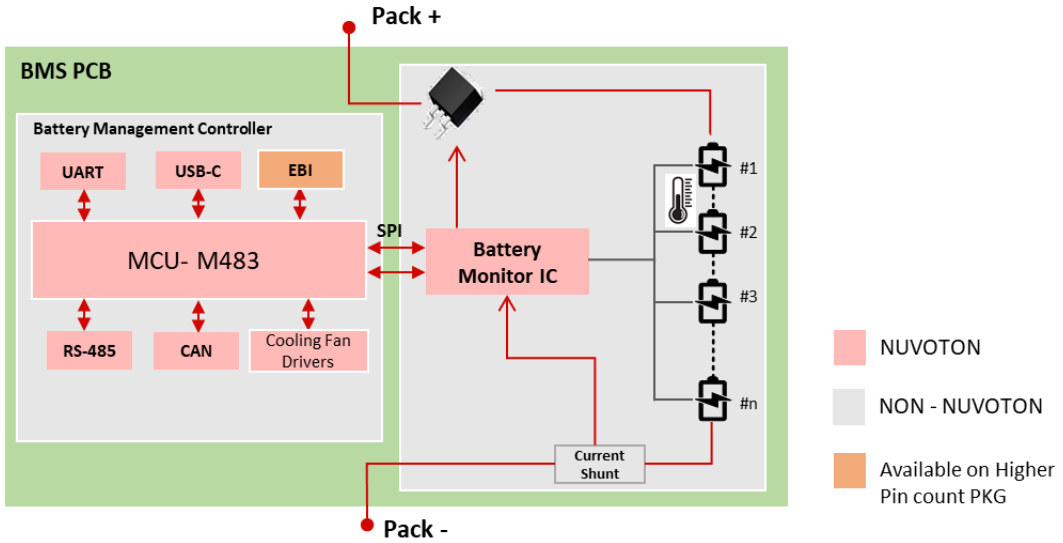
KA495xxA non-stackable
Available now

Target App / Use Scene

Schematic Design

[KA49517A 17-ch High Side web page]

[KA49522A 22-ch High Side web page]



Market Requirement

1) Support for 10-20cell voltage monitoring
2) Highly flexible design

Product Features

KA49517A/522A

- KA49522A supports up to 22 cells per IC
- Compatible with KA49517A & KA49522A in pin, package, and software.

MCU Options

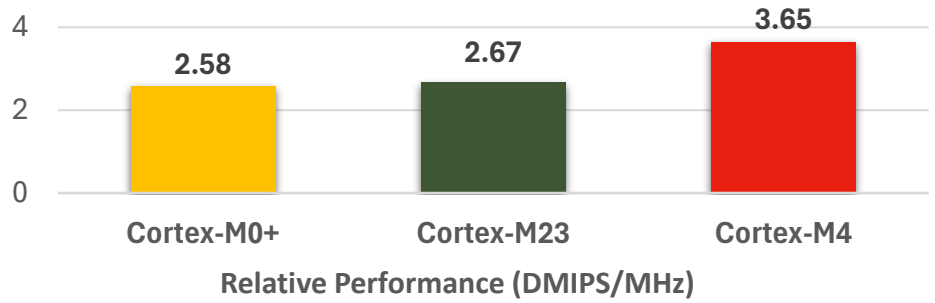
For BMS MCU

Nuvoton Scalable MCU Solutions for Battery Management System (BMS)

1. Product Portfolio & Performance

Cortex-M23 Series — Low Dynamic Power MCU
- Up to 72 MHz operating frequency
- Flash / SRAM: up to 512 KB / 168 KB
- High-speed DSP for fast numeric computation

Cortex-M4 Series — High-Performance MCU
- Up to 200 MHz operating frequency
- Flash / SRAM: up to 2048 KB / 512 KB
- High-speed DSP and FPU for precise real-time control



2. Key Advantages for BMS Application

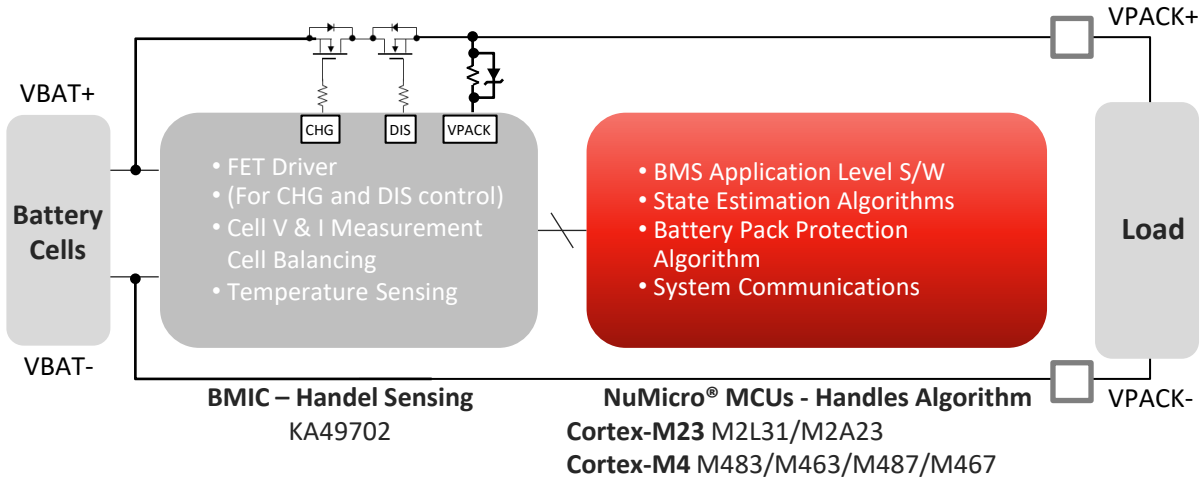
Designed for Reliability and Scalability in Battery Control

Delivering scalable performance from **ultra-low power Cortex-M23** to **high-performance Cortex-M4**, the Nuvoton MCU portfolio provides flexible and ideal options for BMS MCU.

Wide Operating Voltage & Temperature
- Operating Voltage: 1.7 to 3.6 / 5.5 V
- Operating Temperature: −40 °C to 105/125 °C
- AEC-Q100 Grade 1 Qualification (*M2A23)

Package Options
- Compact QFN33 (5 × 5 mm, 26 I/O)
- High-pin LQFP176 (24 × 24 mm, 146 I/O)

3. System Architecture & Functions



Function Blocks	Key Features
Functional Safety	• Dual bank on-chip Application ROM for Over-The-Air (OTA) upgrade • Supports IEC60730 Class B MCU self-test library (certified)
BMS Software	• Support battery management sample code (*M483)
SOH/SOC/Fuel Gauge calculation	• Combining high-speed DSP and IEEE 754 FPU for accurate SoC/SoH computation and real-time control • Supports MAC (Multiply-Accumulate) and hardware division for high-speed filtering, FFT, and control loops • Ideal for voltage/current RMS, averaging, and efficiency calculations in control systems
Communication Interface	• UART / SPI / I2C / CAN (J1939) / CAN FD / USB / Ethernet

BMS – Suggested MCU Product Series

	M2L31	M5531	M333x/5x	M483	M467 / M487
Core	**Cortex-M23**	**Cortex-M55**	**Cortex-M33**	**Cortex-M4**	**Cortex-M4**
Speed (MHz)	Up to 72	Up to 220	Up to 180	Up to 192	★ Up to 200
Flash (KB)	Up to 512	★ **Up to 2MB** **1.5MB SRAM**	Up to 1MB	Up to 512	★ **Up to 2048**
Communication I/F	UART, I2C, SPI, CAN FD, USB FS OTG	UART, I2C, SPI, CAN FD, 10/100 Ethernet, USB FS/HS OTG w/PHY	UART, I2C, QSPI, CAN, USB FS/HS OTG	UART, I2C, QSPI, CAN, USB FS/HS OTG	★ UART, I2C, QSPI, CAN FD, USB FD/HS OTG, **10/100 Ethernet**
Dynamic Power Consumption	★ **60 µA/MHz**	90.5 uA/MHz	150 µA/MHz	175 µA/MHz	175 µA/MHz
Operating Voltage (V)	1.71 ~ 3.6	1.7 ~ 3.6	1.8 ~ 3.6 / 2.5V ~ 5.5V	1.8 ~ 3.6	1.8 ~ 3.6
Operating Temp. (°C)	-40 ~ 105	-40 ~ 105	-40 ~ 105	-40 ~ 105	-40 ~ 105
Packages	★ **QFN33**/48 LQFP48/64/128	LQFP64/128/176	QFN33/LQFP64/128	★ LQFP64/128	★ QFN48 (*M487) **LQFP**64/128/144/**176**
Key Features	• DSP (Hardware Multiplier & Divider) • **ReRAM** • Dual bank flash	• **ARM Helium Extension** ★ • Trustzone, Crypto Accel., Secure Boot, TRNG, KDF • 2D Graphics • 2x 12-bit SAR ADCs	• DSP (Hardware Multiplier & Divider) • FPU (Hardware Floating-point Unit) • Dual bank flash	• DSP (Hardware Multiplier & Divider) • FPU (Hardware Floating-point Unit) • Dual bank flash	• DSP (Hardware Multiplier & Divider) • FPU (Hardware Floating-point Unit) • Dual bank flash

Joy of innovation

NUVOTON

Thank You

Danke

Merci

ありがとう

Gracias

Kiitos

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