RENESAS

BIG IDEAS FOR EVERY SPACE

BATTERY MANAGEMENT SOLUTIONS

Charger ICs, Fuel Gauge ICs, USB PD

2022.02

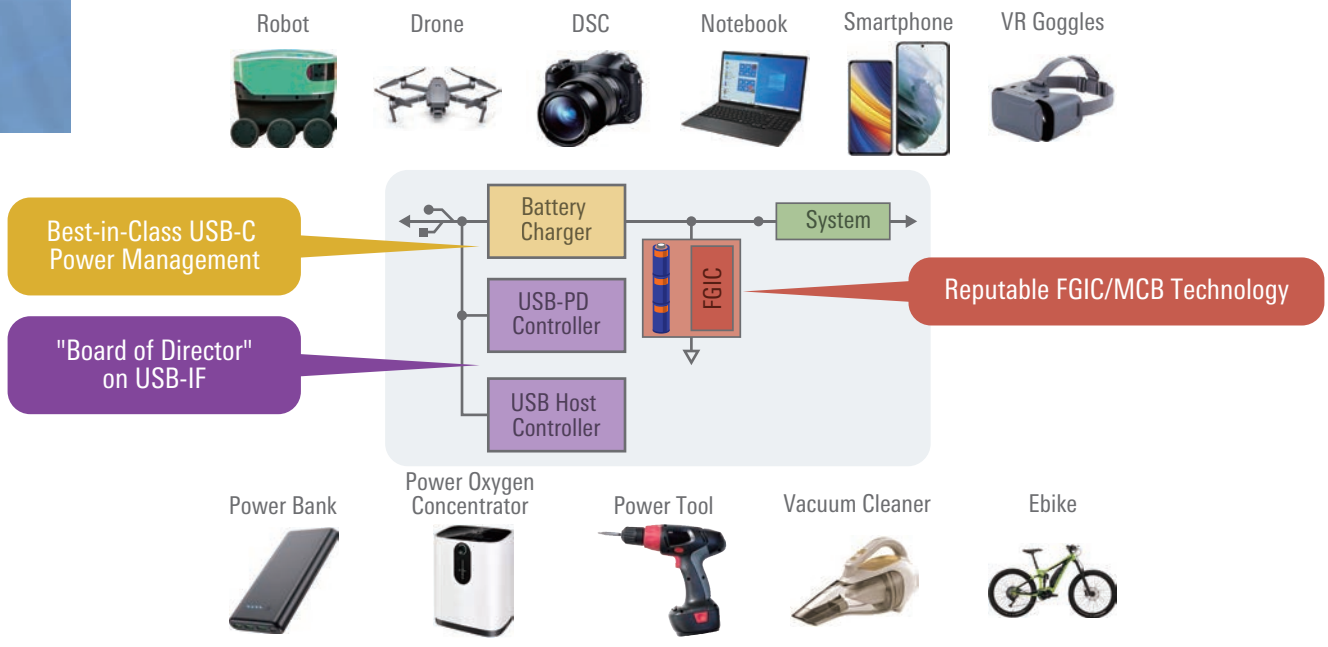
RELIABILITY AND PERFORMANCE

BATTERY MANAGEMENT

CONTENTS

Complete Battery Management Solutions

Renesas offers a complete portfolio of high-performance solutions for Charger ICs, USB-PD solutions, Fuel Gauge ICs, and Battery Front End ICs to cover consumer, computing, and industrial applications for batteries from one cell to many cells. Renesas battery management solutions are backed by tested reference designs and strong applications support. Our products will address your design challenges and increase your battery performance.

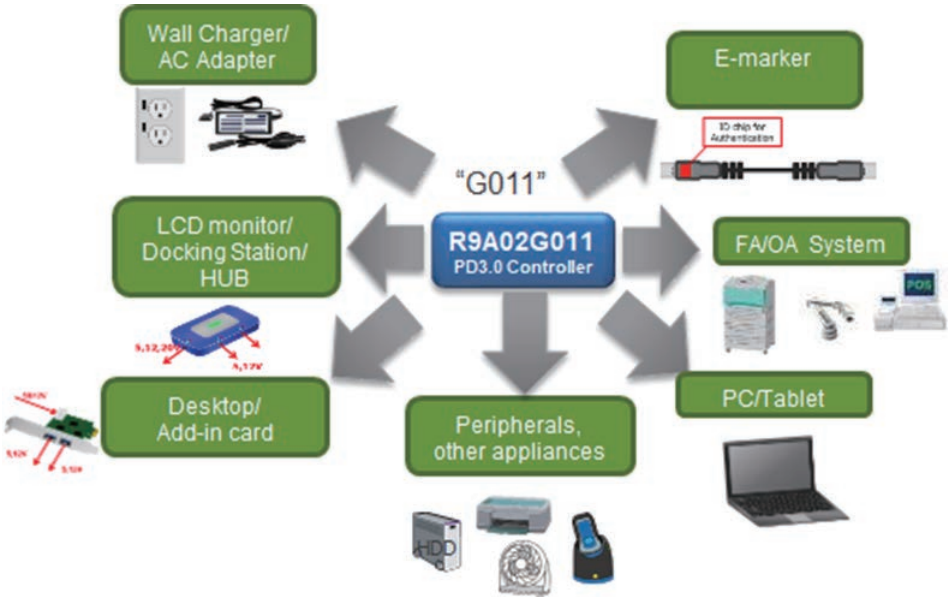


USB-C™ POWER DELIVERY

USB-C Power Delivery (USB PD) enables flexible power delivery and data over a single cable via the ubiquitous USB connections supported by the USB Ecosystem.

Benefits and Key Features

- USB-PD Compliant supporting power delivery up to 20V
- Flexible controller for applications implementing different USB-PD power roles (e.g. source only, sink only, Dual-Role-Power DRP)
- Easy firmware update for fine tuning USB-PD behavior
- Advanced feature support (e.g. Programmable Power Supply PPS, Fast Role Swap FRS)



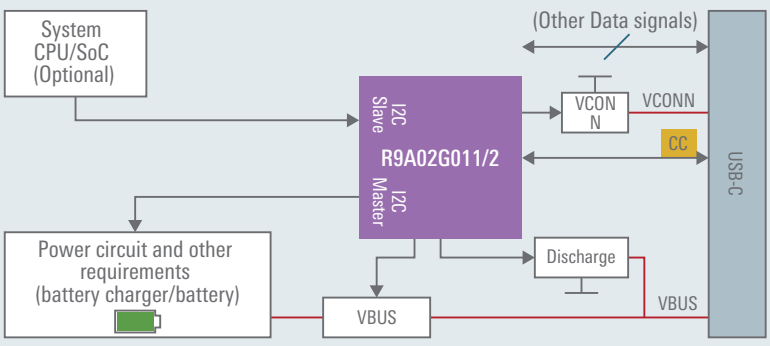
R9A02G011 USB-PD Controller

- USB Type-C™ & USB-PD compliant
- Controls power circuit (via I2C)
- Built-in authentication mechanism
- Need external authentication MCU
- Firmware Control of VBUS, MUX Retimer, Alt Mode
- Firmware Updates via USB-C or I2C, Support for FR_SWAP
- 32ld QFN package

R9A02G012 RA9A02G011 + Secure MCU

- "Secure" to prevent cracking for obtaining private key
- Support USB-C Authentication
- 40pin QFN & 42pin BGA

USB-PD System Block Diagram

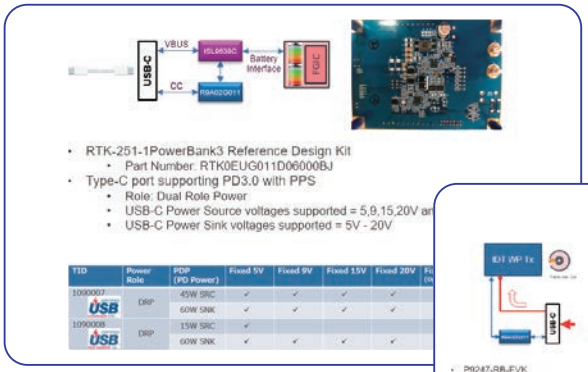


USB-C Power Delivery : Reference Designs

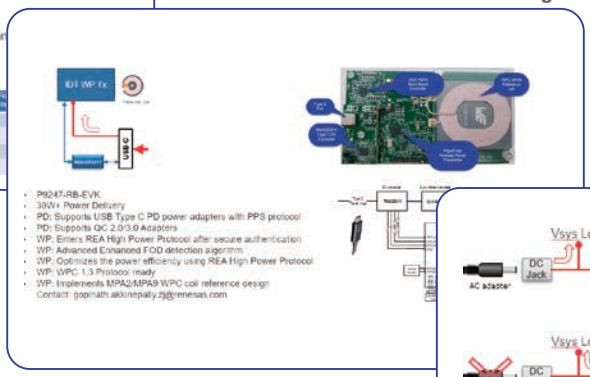
Product ready schematic, layout, F/W reference designs

1. Power Bank Reference Design
2. USB-PD + WP Tx Reference Design
3. Dual Role Power Reference Design

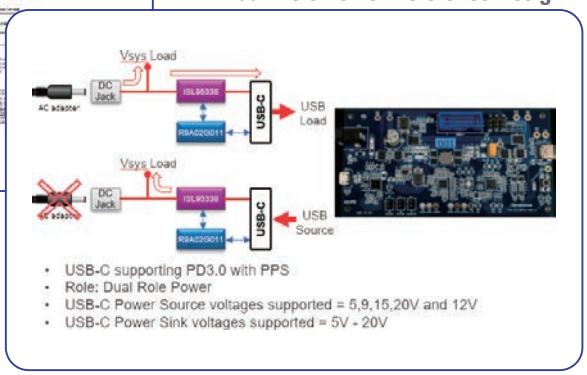
USB-IF Certified Power Bank Reference Design



USB-PD + WP Tx Ref Design



Dual-Role Power Reference Design



USB 2.0, USB 3.2 Gen 1 Data Products

	Part Number	Description	Ta	Package	EVK P/N
USB 3.2 Gen 1 Host Controller	μPD720201K8-701-BAC-A	USB 3.0 Host Controller (4-port)	0 to +85°C	68-pin QFN (8mm x 8mm, 0.4mm pitch)	YET-D720201-0014 or RTKA720201DE0000BU (Model N)
	μPD720201K8-711-BAC-A	USB 3.0 Host Controller (4-port)	-40 to +85°C	68-pin QFN (8mm x 8mm, 0.4mm pitch)	YET-D720201-0014 or RTKA720201DE0000BU (Model N) (use -701)
	μPD720202K8-701-BAA-A	USB 3.0 Host Controller (2-port)	0 to +85°C	48-pin QFN (7mm x 7mm, 0.5mm pitch)	YET-D720202-0014 or RTKA720202DE0000BU (Model N) (use -701)
	μPD720202K8-711-BAA-A	USB 3.0 Host Controller (2-port)	-40 to +85°C	48-pin QFN (7mm x 7mm, 0.5mm pitch)	YET-D720202-0014 or RTKA720202DE0000BU (Model N) (use -701)
USB 3.2 Gen 1 Hub Controller	μPD720210K8-BAF-A	USB 3.0 Hub Controller (4-port)	0 to +70°C	76-pin QFN (9mm x 9mm)	YET-D720210-0004 (Model N) ET-D720210-0001 (Contact Product Line)
	μPD720211K8-611-BAL-A	USB 3.0 Hub Controller (2-port)	0 to +70°C	56-pin QFN (8mm x 8mm)	ET-D7202011-0002 (Contact Product Line)
	μPD720211K8-711-BAL-A	USB 3.0 Hub Controller (2-port)	-40 to +70°C	56-pin QFN (8mm x 8mm)	ET-D7202011-0002 (Contact Product Line) (use -611)
USB 2.0 Hub Controller	μPD720115K8-611-BAK-A	USB 2.0 Hub Controller (4-port)	0 to +85°C	40-pin QFN (6mm × 6mm)	ET-D720115-0002-B (Contact Product Line)
	μPD720115K8-711-BAK-A	USB 2.0 Hub Controller (4-port)	-40 to +85°C	40-pin QFN (6mm × 6mm)	ET-D720115-0002-B (Contact Product Line) (use -611)

Document Link https://www.renesas.com/in/en/products/usb-assp.html
(Requires "My Renesas" Account, also request "Secure Content" for full documentation access)

CHARGER ICs

Renesas' highly versatile battery charger ICs support devices with rechargeable 2, 3 or 4-cell batteries and include configurations such as a hybrid power boost (HPB), narrow output voltage DC (NVDC), buck-boost NVDC, and SMBus Level 2

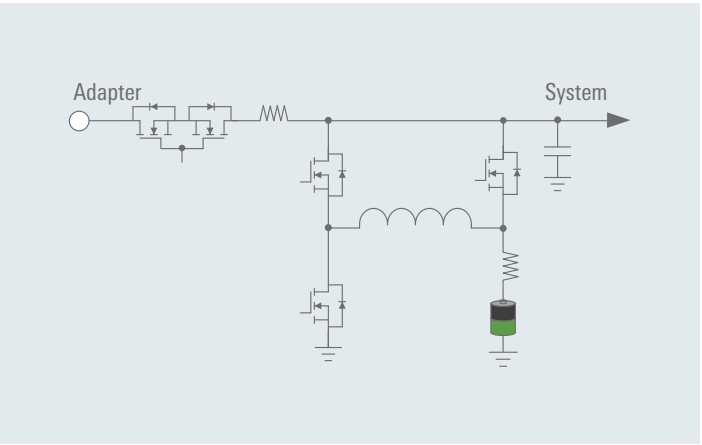
Benefits and Key Features

- High efficiency
- Fast transient response
- High accuracy voltage/current control
- Robustness to noise

Part Number	Vin Range(V)	Vout Range (V)	Function	Control Type	Package Type
ISL95522A	Up to 23.4V	2.048V ~ 18.432V	Buck charger	Robust Ripple Regulator (R3)	4x4 32Ld QFN
ISL9238C	3.9V ~ 23.4V	2.4V ~ 18.304V	Buck-Boost charger	Robust Ripple Regulator (R3)	4x4 32Ld TQFN
RAA489000	3.9V ~ 23.4V	3.9V ~ 18.304V	Buck-Boost charger + TCPC	Robust Ripple Regulator (R3)	5x5 40Ld QFN
RAA489800	3.8V ~ 23V	Up to 21V	Buck-Boost VR	Robust Ripple Regulator (R3)	4x4 32Ld TQFN

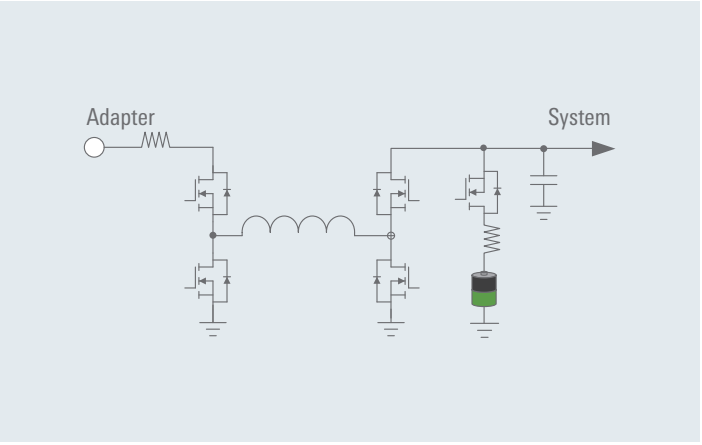
ISL95522A Combo Buck Charger

- Buck HPB/NVDC charger for 2 to 4-cell Li-ion batteries
- Current monitor AMON/BMON output, IMVP compliant
- Trickle charging depleted battery
- Optional ASGATE FET control
- Uses NFET for all switches
- Ideal diode control in Turbo mode
- Two-level adapter current limit available
- SMBus and auto-increment I2C compatible



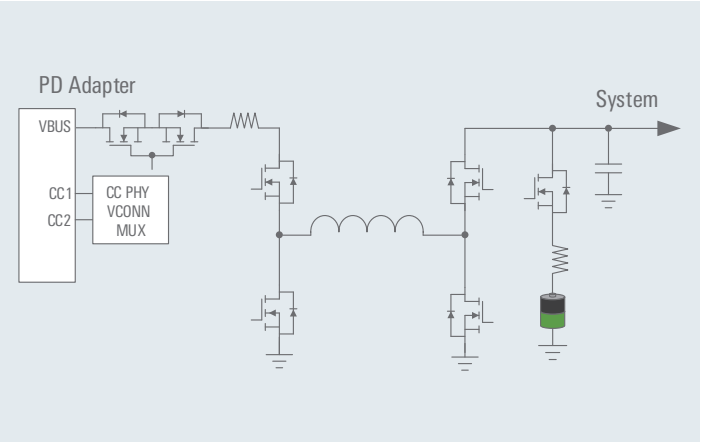
ISL9238C Buck Boost Charger

- Buck –boost NVDC charger for 2 to 4-cell Li-ion batteries
- Autonomous charging option (automatic charging completion)
- Pass-through mode in forward direction
- System power monitor PSYS output, IMVP compliant
- PROCHOT# open-drain output, IMVP compliant
- Trickle charging of depleted battery
- Adapter current and battery current monitor (AMON/BMON)
- Ideal diode control in Turbo mode
- Reverse buck, boost, and buck-boost operation from battery
- Two-level adapter current limit available
- Battery Ship mode option
- SMBus and auto-increment I2C compatible



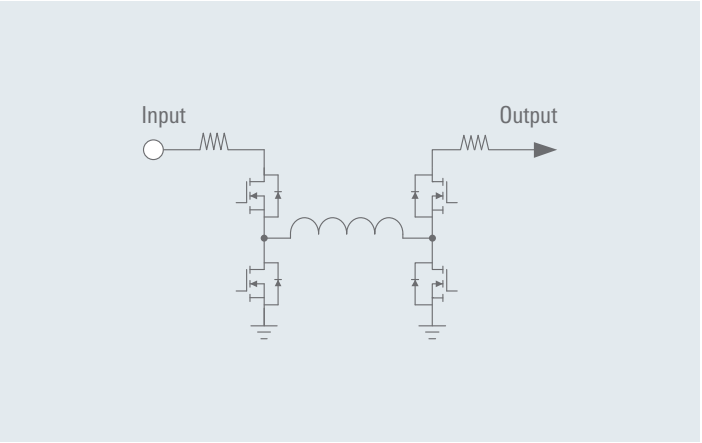
RAA489000 BB Charger + TCPC

- Buck –boost NVDC charger for 2 to 4-cell Li-ion batteries using all NFET transistors
- USB-C Port Controller (TCPC) with integrated TCPC PHY, CC-Logic
- Dual SMBus/I2C Ports for charger programming and CC line traffic
- Internal 500mOhm VCONN MUX for up to 1.6A
- Input voltage range 3.9V to 23. 4V (no dead zone)
- System/battery output voltage: 3.0V to 18.304V
- 28V protection for CC1/CC2/VBUS
- Adapter Crash Prevention with adapter current and battery current regulation
- Adapter current and battery current monitor (AMON/BMON)
- Internal 8-bit ADC for charger operation telemetry
- Software configurable for DFP, UFP, or DRP
- USB-C PD Sink Fast Role Swap (FRS) and PPS support
- Pass-through mode (PTM) in forward direction
- Trickle charging depleted battery
- PROCHOT# open-drain output, IMVP compliant
- Battery Ship mode option – IC ultra-low power state
- JEITA compliant autonomous charging
- Dynamic Voltage Compensation (DVC) for multi-port charging
- USB Power Delivery (PD) 3.0 and Programmable Power Supply (PPS) certified
- UL 2367, IEC 62368-1: File No. E520109



RAA489800 BB Voltage Regulator

- Bidirectional buck, boost, and buck –boost operation
- Configurable for 4-switch buck-boost or 2-switch buck operation
- Input voltage range: 3.8V to 23V (no dead zone)
- Output Voltage up to 21V
- Up to 1MHz switching frequency
- Pin programmable soft-start time
- LDO output for VDD and VDDP
- System FAULT and ALERT function
- Input/output internal discharge function
- Active switching for negative voltage transitions
- Pass-through mode in both directions
- Forward and Reverse mode enable pins
- OCP, OVP, UVP, and OTP protection
- Absolute overvoltage protection
- SMBus and auto-increment I2C compatible
- UL 2367, IEC 62368-1: File No. E520109

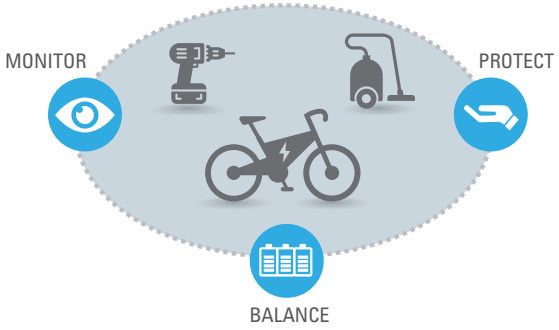


BATTERY MANAGEMENT

Management and Protection of Lithium-ion Batteries

Protect, Monitor & Balance Rechargeable Battery Packs

Renesas' Li-ion battery pack monitoring, protection, and balancing ICs are specifically designed to meet the stringent safety, reliability, and performance requirements of portable and battery powered applications such as consumer, computing and industrial products.



Battery Front End (BFE), Battery Management ICs

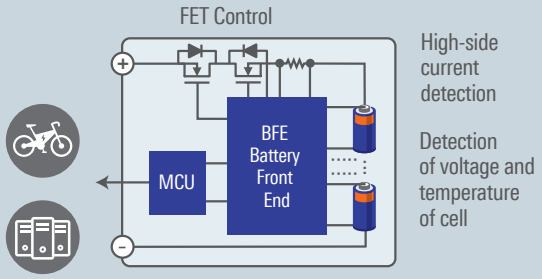
Benefits and Key Features

Protection and Cell Balancing

- Hot plug tolerant
- Over/under voltage
- Charge/discharge current
- FET control when error detected
- Open-wire detection
- Auto-cell balancing

Host Controlled Features

- Current measurement
- Cell voltage measurement
- Pack voltage measurement
- Temperature measurement
- LED indication by GPIO
- Power supply for MCU



BFE Battery Pack System Diagram

RAA489206

Industrial Battery Front End Protects, Monitors, and Balances High Voltage Battery Packs

- Up to 16 cell inputs
- Highly integrated, includes charge pump, high side FET drivers, current measurement, LDO, wake-up logic, internal and external balancing circuits, and LED drivers
- Hot plug tested and proven via random connection trials
- Reference circuit, sample code, and high degree of integration accelerates battery pack design, test and verification

RAA489204

- Up to 14 cell inputs
- Daisy Chainable up to 30 ICs
- 1Mbps differential SPI communications
- Reference circuit, sample code, GUI accelerates module design

Battery Front End, Multi-Cell Li-Ion Battery Management ICs

Cells	Pack Voltage (V)	Part Number	Cell Balance	Current Sense	Charge/ Discharge FET	Internal ADC	Features	Package
4 to 16	12 to 60 (60V available Q2'2022)	RAA489206	Both Internal and External	Low Side	N-channel, High side and Low side	Yes	LDO, LED Drivers	64QFN
4 to 6	4 to 26.4	ISL94208	Both Internal and External	Low Side	N-channel, Low Side	No	Simplicity, internal cell balancing	32QFN
6 to 14 (and Daisy Chain)	10 to 65	RAA489204	Both Internal and External	No	N/A	Yes	Daisy chain	64TQFP
3 to 8	4 to 36	ISL94202	External	High Side	N-channel, High Side	Yes	High-side current sense, standalone capable	48TQFN

Battery Fuel Gauge ICs (FGIC)

Dedicated single-package solution with MCU and AFE provides an intelligent, programmable system for battery management that constantly monitors and protects the battery.

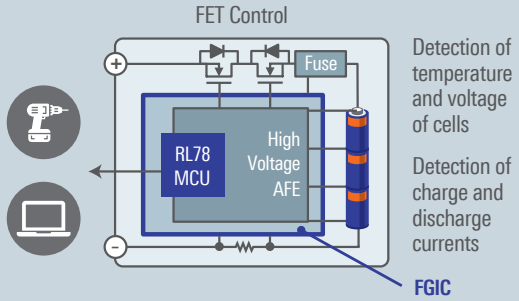
Benefits and Key Features

Safety and Protection Control

- Over/under voltage
- Charge/discharge current
- FET control when error detected
- Self Control Protector (SCP) drive
- Cell balancing

Remaining Capacity Management

- Current/voltage/temperature measurement
- High precision coulomb counter
- Battery degradation monitor
- Calculation and learning of battery capacity
- Current/voltage calibration
- Fault detection/history management



FGIC Battery Pack System Diagram

FGIC Block Diagram

Voltage and Current Measurement by Independent A/D Converters

- Current measurement: 153 µA/LSB resolution (18-bit ΔΣ ADC 5 mΩ shunt resistor) supporting simultaneous measurement
- Voltage/temperature measurement: 15-bit ΔΣ ADC

High Reliability & High Integration

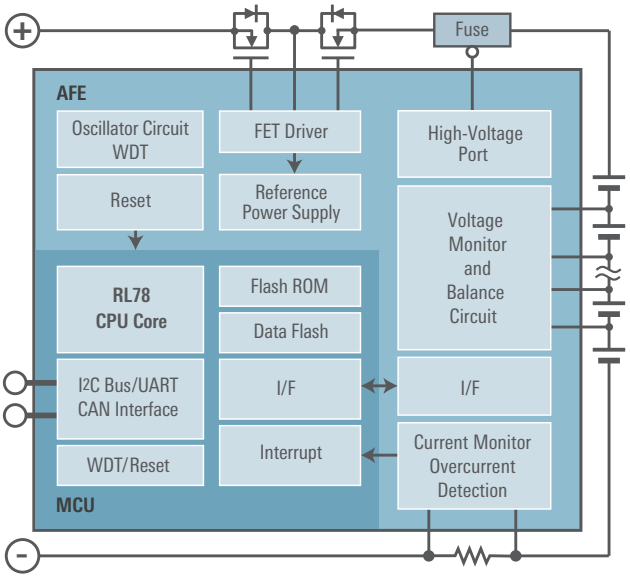
- Built-in FET protection for overcurrent and short circuit conditions
- Redundant fault detection by both MCU and AFE
- Ability to set lifecycle related limits and maintain battery parameter and operation history using data flash guaranteed for 100,000 erase/write cycles
- Integrated CAN interface and RTC (Real Time Clock) circuit for industrial apps; ICs can manage date and time in a single device (RAJ240090 and RAJ240100)

Few Parts, Low System Cost

- Supports large-current discharge with N-channel FET drivers
- Integrated pull-up resistors for thermistor

Extended Battery Life

- Low power mode with consumption of 25 µA or less and cell balance circuit to maximize battery capacity (RAJ240090 and RAJ240100)



Internal Block Diagram of FGIC

Battery Fuel Gauge ICs

Cells	Pack Voltage (V)	Part Number	Flash ROM	RAM	Charge/ Discharge FET Control	Serial I/F	I/O	Features	Package
2 to 4	4 to 25	RAJ240045	64 KB	4.0 KB	High side	I²C, UART	12	Compact package (4mm x 4mm)	32QFN
		RAJ240047	128 KB	5.5 KB					
2 to 5	4 to 25	RAJ240071	32 KB	1.5 KB	High side	I²C, UART	11	Compact package (4mm x 4mm) 5 cell support	32QFN
		RAJ240075	64 KB	4.0 KB					
3 to 7	4 to 40	RAJ240301	64 KB	5.5 KB	Low side	I²C, UART	21	GPIO: I/O x 17, Input x 2, HVIO x 2	48QFP
3 to 8	4 to 50	RAJ240090	128 KB	7 KB	High / Low side	I²C, UART, CAN	31	High voltage tolerance, on-chip CAN, low power consumption (25 µA)	64LQFP
3 to 10	4 to 50	RAJ240100	128 KB	7 KB	High / Low side	I²C, UART, CAN	31	High voltage tolerance, on-chip CAN, low power consumption (25 µA)	64LQFP
3 to 10	4 to 50	RAJ240310	64KB	4.0KB	Low side	I²C, UART	15	Compact package (5mm x 5mm) 10 cell support	40QFN

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