





# **Build Compact & Energy-Efficient Systems** at Lower Cost



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With the rapid growth of IoT, the push for energy efficiency, and the increasing number of compact, lightweight, battery-powered devices, embedded systems are now expected to deliver "low power consumption", "high reliability", and "cost efficiency" more than ever before.

To meet these market demands, Renesas introduced the **RL78 Family**, an 8/16-bit microcontroller that has supported countless products for many years.

#### The Reliability and Low-power of Renesas micro

The RL78 Family manages power with exceptional flexibility through its three low-power modes: SN00ZE mode for efficient operation under light loads, HALT mode for instant power reduction, and STOP mode for minimal consumption during long sleep periods. Backed by these technologies, its outstanding reliability and adaptability make the RL78 Family the preferred choice for home appliances, industrial equipment, and automotive systems worldwide. Adopted in a vast range of products, it has achieved 10.6 billion units shipped as of September 2025. Furthermore, its long-term supply policy and a rich suite of development tools ensure peace of mind for designers and manufacturers.

As a symbol of energy efficiency and reliability, the RL78 Family has quietly yet steadfastly fulfilled its role across countless products. Its ability to run for extended periods on minimal power makes it a true partner, supporting the future of manufacturing from behind the scenes.

Supporting the world, out of sight—
The RL78 Family will continue to fulfill this mission.

#### Positioning of the RL78

#### Microcontrollers & Microprocessors, System-on-Chips (SoCs) **Analog and Power Devices** High-end 32/64-bit MPUs Analog products RF products High-resolution HMI, Industrial network & real-time control Clocks & Timing Sensor products Advanced 32-bit MCUs Interface & Connectivity Space & Harsh environment Arm ecosystem, Advanced security, Intelligent IoT Memory & Logic High Power Efficiently 32-bit MCUs Power & Power management Motor control, Capacitive touch, Functional safety, GUI Programmable Mixed-signal, ASIC, & IP products **RISC-V** General-purpose 64-bit MPUs (RZ/Five Group) products Application-specific 32-bit MCUs Ultra-low Energy 8/16-bit MCUs Bluetooth® Low Energy, SubGHz, LoRa®-based Solutions Automotive actuators & sensors, Low-end ECUs Timing Power Management Wireless Power Sensors Automotive 32-bit MCUs Rich functional safety and embedded security features **Battery Management** Video & Display **Power Devices** Automotive SoCs Next generation of automotive computing



## RL78 – TRUE LOW POWER MICROCONTROLLER FAMILY

It enables customers to build compact and energy-efficient systems at lower cost.

The Renesas RL78 contributes to greatly improve power efficiency, BOM cost reduction, and equipment miniaturization with industry-leading low power consumption and various built-in high-performance peripheral functions.

**Low Power** 

#### Worldwide No.1 Low Power MCU

- ULPMark® Peripheral Profile: 190 Operation Current: Min 37.5 µA/MHz
- Advanced low-power modes, including SNOOZE, HALT, and STOP

High **Performance** 

#### **Excellent CPU Performance**

- CoreMark®: 54.95 CoreMark at 32MHz
- Dhrystone: 1.6 DMIPS/MHz
- Efficient Instruction Execution



**Renesas RL78 Family** 

#### Cost Reduction

#### Reduce system cost

- BOM cost reduction by High precision internal oscillator, LVD, POR and Data flash
- Wide operation range up to 5V

**Scalability** 

#### **Broad Scalability**

- Extensive product lineup from 8-pins to 144-pins to meet a broad range of requirements
- Ability to reassign peripheral function pins

Easy of Use

#### Easy of use environment for MCU

- Improve development efficiency with code generation tool and Integrated development
- User friendly development tool to realize Rapid Prototyping in Arduino compatible environment

#### **RL78 Family Product Portfolio**

RL78 Family provides a wide variety of product portfolio to cover a broad range of market requirements. RL78 Family provides five MCU product lines to meet the specific requirements by specifying and optimizing features.

#### **General Purpose**

Featuring a wide selection of options with flash support from 8KB to 768KB, and 8-pins to 128-pins package options.

#### **LCD**

Ultra-low-power LCD MCUs supporting many segment LCD panel types (capacitor split, resistance division, and voltage boost method).

#### Motor & Inverter

Broad device lineup for motor and inverter control by enhanced timer and analog functions as well as hardware accelerators.

#### **ASSP**

Rich peripheral functions targeting specific applications including metering, lighting and power supply.

#### **Automotive**

Includes security and safety, plus hardware and software compatibility with AEC-Q100, CAN/CAN-FD, LIN and I<sup>2</sup>C support.

	General	LCD	Motor/Inverter	ASSP	Automotive
Up to 768KB	RL78/G23 32MHz, New Standard 30-128 Pins				
Up to 512KB	RL78/G13A 32MHz, Standard 44-100 Pins	RL78/L23 32MHz, Touch, Dual-bank 44-100 Pins	RL78/G14 32MHz, Enhanced Timer 30-100 Pins	RL78/I1C 24MHz, Electricity Meter 64-100 Pins	RL78/F25 40MHz, CAN-FD, Touch 48-100 Pins
	RL78/G13 32MHz, Standard 20-128 Pins				RL78/F15 32MHz, CAN, LIN, IEBus 48-144 Pins
	RL78/G1H 32MHz, Sub-GHz 64 Pins				RL78/D1A 32MHz, StepperM, LCD 48-128 Pins
Up to 256KB	RL78/G1D 32MHz Bluetooth LE 48 Pins	RL78/L1C 24MHz, USB 80-100 Pins	RL78/G24 48MHz, High Performance 20-64 Pins	RL78/I1B 24MHz, Electricity Meter 80-100 Pins	<b>RL78/F24</b> 40MHz, CANFD, FuSa, AES 32-100 Pins
		RL78/L1A 24MHz, Rich Analog 80-100 Pins		RL78/H1D 24MHz, Healthcare 48-80 Pins	<b>RL78/F23</b> 40MHz, LIN, FuSa, AES 32-80 Pins
		RL78/L13 24MHz, Standard 64-80 Pins			RL78/F22 40MHz, LIN, Touch 24-48 Pins
					<b>RL78/F14</b> 32MHz, CAN, LIN 20-80 Pins
					RL78/F13 32MHz, CAN, LIN 20-80 Pins
Up to 64KB	RL78/G22 32MHz, Touch 16-48 Pins	RL78/L12 24MHz Small Package 32-64 Pins	RL78/G1F 32MHz, BLDC Motor 24-64 Pins	RL78/I1A 32MHz, Lightning/Power 20-38 Pins	RL78/F12 32MHz, LIN 20-64 Pins
	RL78/G16 16MHz, Touch 10-32 Pins			RL78/I1E 32MHz, Measurement 32-36 Pins	
	RL78/G1C 24MHz, USB 32-48 Pins			RL78/I1D 24MHz, Measurement 20-48 Pins	
	<b>RL78/G1A</b> 32MHz, 12-Bit A/D 25-64 Pins				
Up to 16KB	RL78/G15 16MHz, Low Pin Count 8-20 Pins		RL78/G1G 24MHz, Small Motor 30-44 Pins		
	RL78/G12 24MHz, Small Package 20-30 Pins		RL78/G1M 20MHz, Realtime Output 20 Pins		
	RL78/G11 24MHz, Rich Analog 10-25 Pins				
	RL78/G10 20MHz, Low Pin Count 10-25 Pins				
	RL78/G1P 32MHz, Rich Analog 24-32 Pins				
	RL78/G1N 20MHz, High Current Out 20 Pins				



## **RL78 Family Target Applications**

The RL78 Family is utilized in a wide variety of applications.

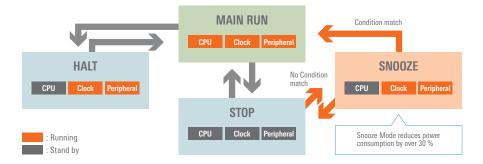
	System (Maii	control n/Sub)	(Capaciti	MI ive touch, , etc)		rive ertor control)	(USB, Bluet Sub-GHz, SI	nications ooth LE, DALI, MBus/PMBus, N-FD, LIN)	(SDADC, Hi	ent/Sensing gh Res ADC, Analog)
Industrial Automation	G2x	L2x	G2x	L2x	G2x	L2x	G2x	L2x	G2x	L2x
	G1x	L1x	G1x	L1x	G1x	L1x	G1x	L1x	G1x	L1x
	F2x	I1x/H1D	F2x	I1x/H1D	F2x	I1x/H1D	F2x	I1x/H1D	F2x	I1x/H1D
Inverter, PLC, Robot machine tools, etc.	F1x	D1A	F1x	D1A	F1x	D1A	F1x	D1A	F1x	D1A
Automotive	G2x	L2x	G2x	L2x	G2x	L2x	G2x	L2x	G2x	L2x
	G1x	L1x	G1x	L1x	G1x	L1x	G1x	L1x	G1x	L1x
	F2x	I1x/H1D	F2x	I1x/H1D	F2x	I1x/H1D	F2x	I1x/H1D	F2x	I1x/H1D
Window Lift, Mirror, NOx Sensor, HVAC, Pump, Light, Switch, Meter, etc.	F1x	D1A	F1x	D1A	F1x	D1A	F1x	D1A	F1x	D1A
Consumer Electronics	G2x	L2x	G2x	L2x	G2x	L2x	G2x	L2x	G2x	L2x
	G1x	L1x	G1x	L1x	G1x	L1x	G1x	L1x	G1x	L1x
	F2x	I1x/H1D	F2x	I1x/H1D	F2x	I1x/H1D	F2x	I1x/H1D	F2x	I1x/H1D
Headset, PC peripheral, Smart home device, Digital devices, etc.	F1x	D1A	F1x	D1A	F1x	D1A	F1x	D1A	F1x	D1A
Home Appliances	G2x	L2x	G2x	L2x	G2x	L2x	G2x	L2x	G2x	L2x
(a).	G1x	L1x	G1x	L1x	G1x	L1x	G1x	L1x	G1x	L1x
W.	F2x	I1x/H1D	F2x	I1x/H1D	F2x	I1x/H1D	F2x	I1x/H1D	F2x	I1x/H1D
Air conditioner, Fridge, Washer, IH cooker, Power tool, kitchen appliances, Lighting etc.	F1x	D1A	F1x	D1A	F1x	D1A	F1x	D1A	F1x	D1A
Medical & Healthcare	G2x	L2x	G2x	L2x	G2x	L2x	G2x	L2x	G2x	L2x
120 78	G1x	L1x	G1x	L1x	G1x	L1x	G1x	L1x	G1x	L1x
	F2x	I1x/H1D	F2x	I1x/H1D	F2x	I1x/H1D	F2x	I1x/H1D	F2x	I1x/H1D
Environmental sensor, Wearable device, Activity monitor, BPM, BGM, etc.	F1x	D1A	F1x	D1A	F1x	D1A	F1x	D1A	F1x	D1A
Metering & Energy	G2x	L2x	G2x	L2x	G2x	L2x	G2x	L2x	G2x	L2x
33332	G1x	L1x	G1x	L1x	G1x	L1x	G1x	L1x	G1x	L1x
	F2x	I1x/H1D	F2x	I1x/H1D	F2x	I1x/H1D	F2x	I1x/H1D	F2x	I1x/H1D
Electricity, Gas, Water, Heat Meter	F1x	D1A	F1x	D1A	F1x	D1A	F1x	D1A	F1x	D1A
Building Automation	G2x	L2x	G2x	L2x	G2x	L2x	G2x	L2x	G2x	L2x
	G1x	L1x	G1x	L1x	G1x	L1x	G1x	L1x	G1x	L1x
	F2x	I1x/H1D	F2x	I1x/H1D	F2x	I1x/H1D	F2x	I1x/H1D	F2x	I1x/H1D
HVAC, Smoke detector, Elevator, Lighting, power supply, etc.	F1x	D1A	F1x	D1A	F1x	D1A	F1x	D1A	F1x	D1A

## **RL78 Family Key Features**

#### **Low Power Consumption**

### **SNOOZE** mode for more power savings

In SNOOZE mode the CPU is halted while A/D conversion and data reception are enabled. By transitioning from STOP mode (clock stopped) to SNOOZE mode, it is possible to start the on-chip oscillator and operate peripheral functions while the CPU remains inactive.



#### **SNOOZE** mode

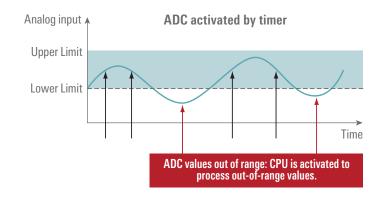
- It is not necessary to activate the CPU for data reception.
- Using the exclusive SNOOZE mode, peripheral functions such as the ADC, UART or CSI can operate when CPU is in standby mode.
- Power consumption is one-tenth of normal operation. SNOOZE mode: 0.5 mA, RUN mode (ADC): 5 mA



- The standby function stops CPU operation, reducing overall microcontroller current consumption by 80%.
- The STOP mode disables the microcontroller's on-chip functions, reducing power consumption to the lowest level possible.

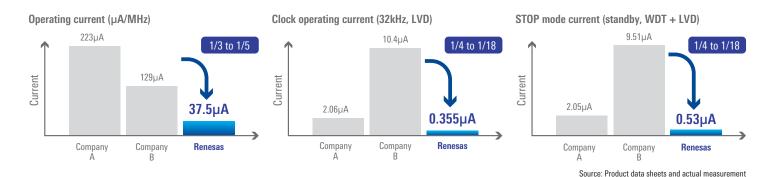


- RL78 is the first MCU family equipped with this function.
- RL78/G23 and RL78/G22 have this function. (as of 2023/Mar.)
- By this function, even lower power consumption than the conventional SNOOZE mode is possible.
- Details are described on page 09.



#### Low-power, high-performance products for lower system power consumption overall

In the most common operating modes, the RL78 Family delivers an operating current of 37.5  $\mu$ A/MHz (while operating at 32 MHz) and a clock operation current of 0.355  $\mu$ A. Also, a developed SN00ZE mode has been added to the previously implemented HALT and STOP low-power operation modes. In SN00ZE mode the CPU is in the standby state while A/D conversion and serial communication are enabled, and the CPU is activated only when required. This mode is excellent for battery-powered systems as it greatly increases battery life.

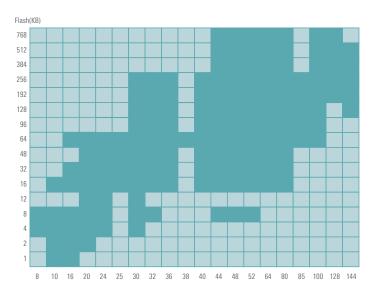




#### **Broad Scalability**

#### **Extensive memory size and package options**

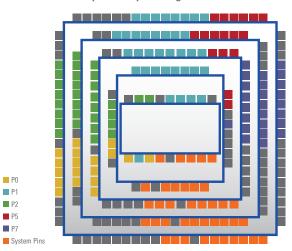
- The extensive lineup includes more than 1500 product versions, with memory sizes from 1 KB to 768 KB and package pin counts from 8 pins to 144 pins. This extensive selection provides support for a broad range of application fields, including consumer, automotive, industrial, and communications.
- The wide range of options means a lot to developers if there are changes made to the specifications or more ROM capacity becomes necessary than originally estimated in the middle of the development process.
- Customers can rely on the same microcontroller series when developing product models ranging from the low-end to the highend. Total development man-hours are reduced.



#### **Excellent pin compatibility**

- Scalability is maintained because the general location of peripheral function pins and input/output pins remains the same even when the pin count changes. Customers can continue to use the RL78 Family of microcontrollers with confidence in the future.
- Customers can use standardized boards for product models ranging from the low-end to the high-end and boost the efficiency of the verification process.

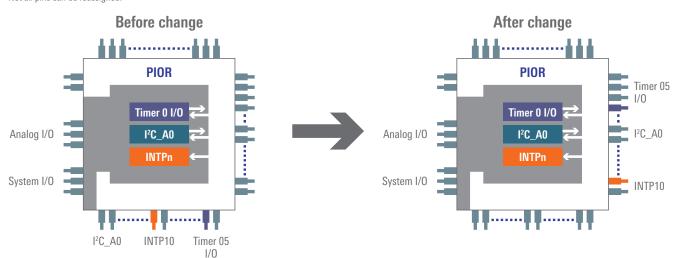
Example of I/O port assignments on RL78/G1x



### Ability to reassign pin functions with PIOR\* register settings

Pin assignments can be changed for added board layout flexibility. The locations of peripheral function pins can be optimized.

Note: \*PIOR: Peripheral I/O Redirection
Not all pins can be reassigned.

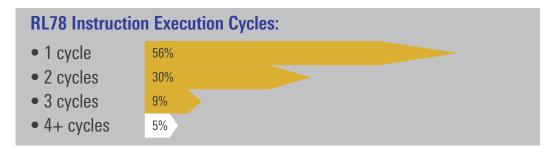


#### **High Performance**

#### RL78 microcontrollers with CPU core employing three-stage pipeline and Harvard architecture

RL78 CPU processing performance is overwhelming other MCU vendors' CPU cores.

- 16-bit CPU Core with Pipelining
- Efficient Instruction Execution -> 86% in 1-2 Cycles
- Single Cycle Multiplication (HW Math Assist)
- DMA Engine (up to 4 channels)



HW Assist for Math	Operation	Clock Cycles
16bit Barrel Shifter for Shift and Rotate	16bit n Shift/Rotate (n = 1 to 15)	1
Multiply Signed & Unsigned	16 × 16 = 32 Bit Result	1
Multiply/Accumulate Signed & Unsigned	16 × 16 + 32 = 32 Bit Result	2

#### **Reduce System Cost**

#### Helping customers reduce system size and cost

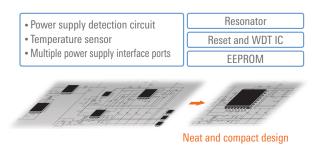
On-chip peripheral functions include a high precision (±1%) high-speed on-chip oscillator, background operation data flash supporting 1 million erase/program cycles, a temperature sensor, and multiple power supply interface ports. The RL78 Family is fabricated that enables customers to achieve reduced system cost and smaller overall system size.

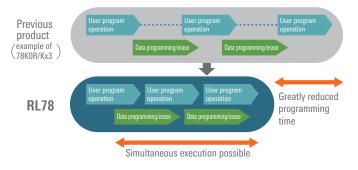
### Data flash with advanced functionality (background operation) for substantially reduced programming time

■ Data access unit: 1 byte

■ Data flash size: 4 KB (erasure unit: 1 KB)

■ Number of overwrites: 1 million (typ.) ■ Dedicated library: Simplifies operations







#### **Reliable Safety Functions**

### Safety functions built into the microcontroller that enhance system reliability

Generally speaking a microcontroller is expected to operate normally even when exposed to noise. The RL78 Family of microcontrollers have a number of safety functions that allow confirmation of normal operation. Customers can use these functions to easily perform self-diagnostics on microcontrollers.

The self-diagnostic functions of the RL78 Family contribute to enhanced system reliability.



#### ■ Error detection

These functions check to make sure that the microcontroller's internal CPU and memory are operating properly. When an error is detected, measures such as an internal reset of the microcontroller can help to prevent the system from malfunctioning.

- · Watchdog timer (WDT) as standard feature
- Flash memory CRC calculation
- RAM parity error detection
- RAM ECC function\*1
- CPU stack pointer monitoring function\*1
- Illegal memory access detection function\*1

#### Memory guard

This function disables writing to selected addresses in the RAM and SFRs\*2. It makes it possible to protect settings in RAM and the SFRs, contributing to improved reliability for the customer's system.

RAM write protection

• SFR write protection

#### Fault detection

This function is for checking the operation of the microcontroller's clock generator circuit, A/D converter, and I/O pins. It simplifies the task of verifying microcontroller operation and makes it easier for customers to ensure safe and reliable operation of their systems.

- Frequency detection
- A/D self-check test
- I/O port output level detection
- Clock monitoring function\*1

#### Votes:

- 1. Available on the RL78/F13, RL78/F14 and RL78/F15.
- SFR (special function register): Registers that store settings related to special functions such as clock control, the low-voltage detection circuit, port control, and interrupts.

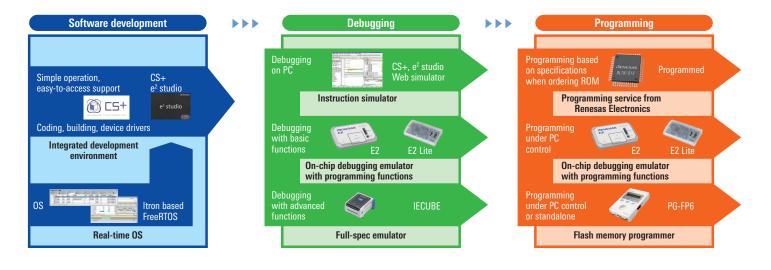
#### ■ Security function

RL78/G23 and RL78/G22 can prevent spoofing by the AES library. This function is installed in RL78/G23 and RL78/G22. Details are described on page 09.

#### **Comprehensive Development Tools**

#### A full lineup of tools that provides powerful support for efficient development

Renesas provides support for all stages of RL78 application development. The Renesas (CS+, e² studio) and IAR integrated development environments are easy to use and learn, helping shorten development cycles. A variety of debugging and programming environments are available to meet specific customer needs. Finally, Renesas partner vendors offer a rich array of tools and services covering a broad range of requirements.



## **General Purpose MCU Products**

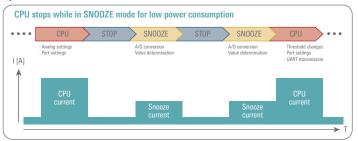
#### **Features of the General Purpose MCU Line**

#### **SNOOZE** mode sequencer

The RL78/G23 and RL78/G22 have the new sequencer which can operate most of peripheral functions while in SNOOZE mode.

The SNOOZE mode sequencer realizes even lower power consumption for applications.

#### Operation in RL78/G13 SNOOZE mode



#### RL78/G23 SN00ZE mode sequencer



#### Logic and event link controller (Only RL78/G23)

- Directly link event signals from up to 94 types of peripheral functions to a specified peripheral function
- Link 8 outputs to peripheral functions, ports, interrupts, or the DTC
- Change the conditions for linking event signals from peripheral functions by passing the signals through logic cells (AND, OR, or EX-OR circuits)
- Start a specified peripheral function by inputting event signals from other peripheral functions to a selector
- Connect event signals from peripheral functions to a specified peripheral function in synchronization with a clock by inputting the signals to a flipflop

#### Secure update and secure boot

The RL78/G23 and RL78/G22 can prevent spoofing by using an AES library.

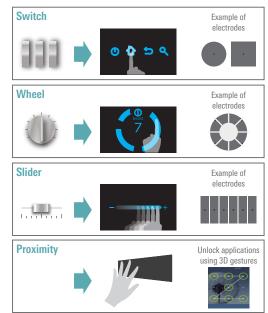
Furthermore, the RL78/G23 and RL78/G22 enable safe flash programming using a boot swap and flash shield window function, as well as program startup from a secured area using a boot cluster 0 rewrite prohibition function.

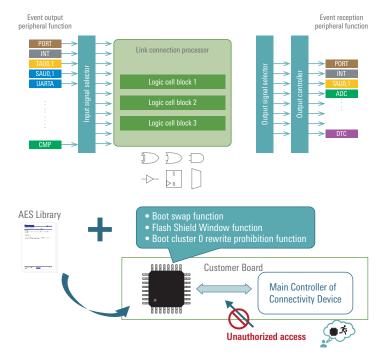
This provides support for secure update and secure boot to prevent spoofing.

In addition, using the AES-GCM library also prevents eavesdropping on communications between the RL78/G23, RL78/G22 and the main MCU.

#### Capacitive touch sensing unit

- 2 to 32 touch sensor channels are available.
- Compatible with self-capacitance and mutual capacitance methods.
   Up to 64 keys are supported when using mutual capacitance.
- Supports keys such as switches, wheels, and sliders. Can also be used as a proximity sensor.
- Supports SNOOZE mode for low-power sensing.







## General Purpose MCU Flash/Pin Lineup

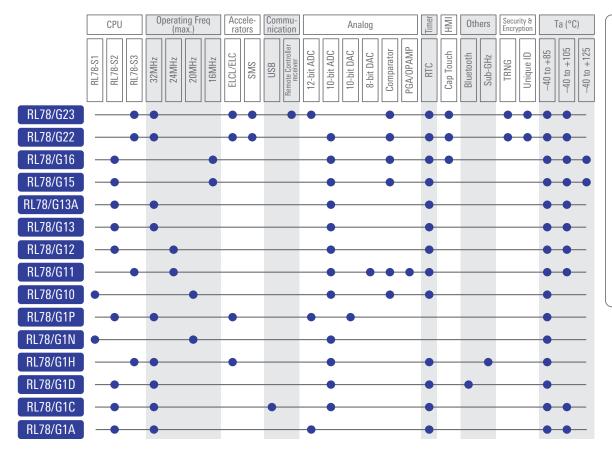
Lineup for pin count: 8-pin to 32-pin

	2		G10		G10				G12																		
	4		G10		G10					G1N																	
	8	G15		G15		G15				G1N	G15																
교	12																										
ASP.	16		G11	G16	G11	G16		G11		G13	G16		G11	G13	G16	G1P	G11	G1A	G13		G13		G1A	G1P	G13	G16	
FLASH Size (KB)	32			G16		G16	G22			G13	G16	G22		G13	G16	G22		G1A	G13	G22	G13	G22	G1A		G13	G16	G2:
8 Z	48									G13				G13				G1A	G13		G13		G1A		G13		
9	64						G22			G13		G22		G13		G22		G1A	G13	G22	G13	G22	G1A		G13		G22
	96																				G13	G23			G13		G23
	128																				G13	G23			G13		G23
	192																					G23					G23
	256																					G23					G23

Lineup for pin count: 36-pin to 128-pin

	768							G23				G23		G23				G23		G23			G23		G23
	512					G13		G23		G13		G23	G13	G23	G1H	G13		G23	G13	G23	G13		G23	G13	G23
	384					G13		G23		G13		G23	G13	G23	G1H	G13		G23	G13	G23	G13		G23	G13	G23
<u>@</u>	256		G23		G23	G13		G23		G13		G23	G13	G23	G1H	G13		G23	G13	G23	G13		G23	G13	G23
(KB)	192		G23	G13	G23	G13		G23		G13		G23	G13	G23		G13		G23	G13	G23	G13		G23	G13	
FLASH Size	128	G13	G23	G13	G23	G13		G23		G13		G23	G13	G23		G13		G23	G13	G23	G13		G23		
ASH	96	G13	G23	G13	G23	G13		G23		G13		G23	G13	G23		G13		G23	G13		G13				
교	64	G13	G22	G13	G22	G13		G22	G1A	G13		G22	G13		G1A	G13									
	48	G13		G13		G13			G1A	G13			G13		G1A	G13									
	32	G13	G22	G13	G22	G13		G22	G1A	G13		G22	G13		G1A	G13									
	16	G13		G13		G13			G1A	G13															
Pir	1	3	6	4	0		44			4	8		5	2		6	4		8	0		100		12	28

#### **General Purpose MCU Products Comparison**



Common functions
5V operation*1
Data flash
On-chip Oscillator
POR
LVD
Timer
WDT
Temp sensor
UART/CSI(SPI)/I2C
DMAC/DTC*2
Standby/Wakeup
Safety functions
OCD

<sup>\*1:</sup> except G1D, G1A, I1D, L1C

<sup>\*2:</sup> except G10

#### RL78/G23: New Generation General-Purpose MCUs with Further Refined Low-Power Performance and Expanded Peripheral Functions



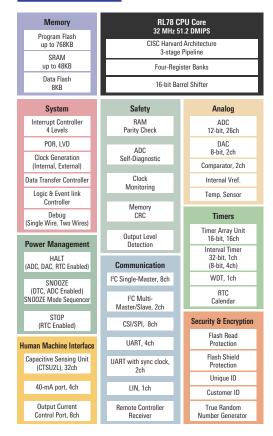
#### **Overview**

The RL78/G23 group features a wide operating voltage range of 1.6V to 5.5V at up to 32MHz, a broad range of package pin counts from 30 pins to 128 pins, and up to 768KB of flash memory. In addition to enhanced analog and security features, it also incorporates logic and event link controllers (ELCL) and the first capacitive touch sensing unit (CTSU2L) in the RL78 family.

#### **Key Features**

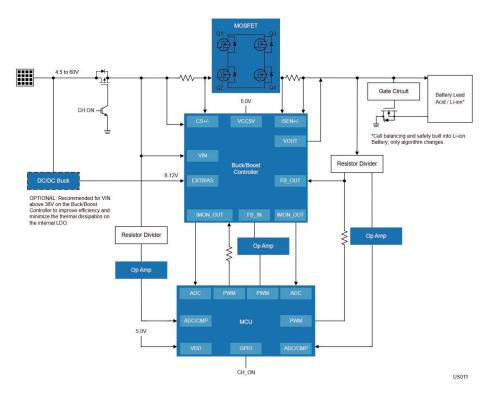
- CPU: RL78 core, Max. 32MHz
- Up to 768kB Flash Memory and 48kB SRAM
- Memory: SRAM up to 48KB, Program Flash up to 768KB
- 8KB Data Flash to store data as in EEPROM
- Scalable from 30-pin to 128-pin packages with a large selection of packages (LQFP, QFN, LGA, BGA, WLCSP)
- Wide operating voltage range of 1.6V to 5.5V
- Enhanced Capacitive Sensing Unit (CTSU2L)
- PWM: PWM Output × 14
- On-chip Oscillator Freq. (MHz): High-Speed: up to 32MHz, Middle-Speed: up to 4MHz, Low-speed: 32.768kHz
- Snooze mode sequencer
- Logic & Event link controller

#### **Block Diagram**



#### **Use Case: Smart Solar Battery Charger**

The smart solar battery charger tackles these issues with advanced features like maximum power point tracking (MPPT) and a versatile buck-boost architecture. RL78/G23 provides intelligent monitoring, while robust power circuits ensure stable operation and protect the battery during charging and usage.





#### RL78/G22: General-Purpose MCUs with Excellent Low-Power Performance and Rich Capacitive Touch Channels



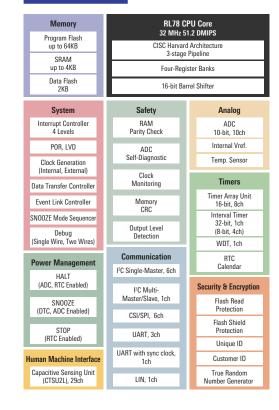
#### **Overview**

The RL78/G22 microcontroller features the industry's lowest current consumption levels of  $37.5\mu\text{A/MHz}$  during CPU operation and 200nA during STOP, as well as a rich array of capacitive touch channels. The lineup of new-generation RL78 general-purpose microcontrollers is extended by offering a variety of 16-pin to 48-pin packages and 32KB to 64KB of flash memory.

#### **Key Features**

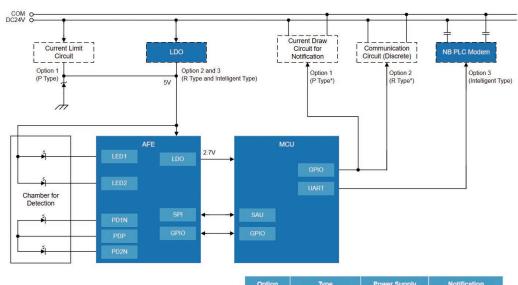
- CPU: RL78 core, Max. 32MHz
- Up to 64KB Flash Memory and 4KB SRAM
- 1KB Data Flash to store data as in EEPROM
- Scalable from 16-pin to 48-pin with a large selection of packages (SSOP, LQFP, HWQFN, WFLGA)
- Wide operating voltage range of 1.6V to 5.5V
- Operating temperature range: up to 105 °C
- Enhanced Capacitive Sensing Unit (CTSU2L)
- PWM: PWM Output × 7
- On-chip Oscillator Freq. (MHz): High-Speed: up to 32MHz, Middle-Speed: up to 4MHz, Low-speed: 32.768kHz
- Snooze mode sequencer
- Event link controller

#### **Block Diagram**



#### **Use Case: Smoke Detector for Commercial Buildings**

This smoke detection system for building fire alarms complies with the UL 268 standard, 8th Edition. It is compatible with both P-type and R-type fire alarms. The system integrates RL78/G22 and a photoelectric smoke detector AFE to create a fire alarm with ultra-low power consumption and simple configuration. High-performance R-type and intelligent-type fire alarms utilizing power line communication (PLC) are also available for this design. Achieves ultra-low power consumption by applying SN00ZE mode sequencer (SMS) operation on the RL78/G22.



Option	Туре	Power Supply	Notification
1	P Type*	Zener diode +Current limit circuit	Current draw circuit
2	R Type*	LDO	Communication circuit (Discrete)
3	Intelligent	LDO	PLC

#### RL78/G16: Compact, Low Pin Count MCUs with Capacitive Touch Sensor Unit



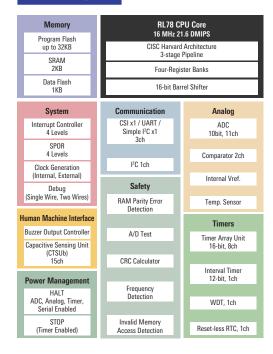
#### **Overview**

The RL78/G16 microcontroller is a general-purpose microcontroller with capacitive touch channels and a 16 MHz operating frequency. There is a broad lineup of touch microcontrollers available, including Renesas' smallest 10-pin package. It is also equipped with functional safety-compliant hardware to support the acquisition of IEC/ UL60730 certification, the safety standard for home appliances. In addition, it has a high precision ( $\pm 1.0\%$ ) high-speed on-chip oscillator, data flash, a rich serial interface, and a comparator built in, making it ideal for compact applications that need space savings.

#### **Key Features**

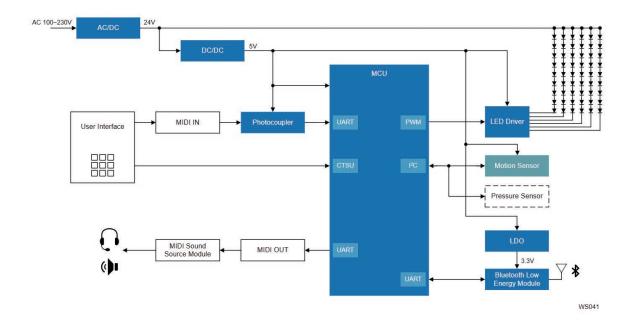
- CPU: RL78 core, Max. 16MHz
- Wide operating voltage of 2.4V to 5.5V
- Package: 10-pin to 32-pin, SSOP, LQFP, QFN
- Memory: Program Flash: 16KB, 32KB, SRAM 2KB, Data Flash 1KB
- Operating temperature range: up to 125°C
- Enhanced Capacitive Sensing Unit (CTSUb)
- PWM: PWM Output × 7ch
- On-chip Oscillator Freq. (MHz): High-speed: up to 16MHz, Low-speed: 15kHz

#### Block Diagram



#### **Use Case: MIDI Linked Illumination Controller**

This system enables RL78/G16 to interpret MIDI messages from electronic musical instruments or sensors, allowing for synchronized LED control with musical scales and channels. It is ideal for illuminating various commercial facilities and providing entertainment lighting for live concerts, among other applications.





#### RL78/G15: Compact, Low Pin Count MCUs with Rich Peripheral Functions for General Purpose Applications



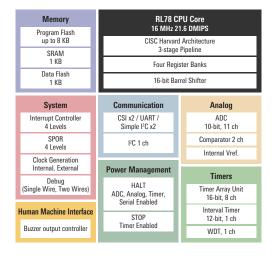
#### **Overview**

The RL78/G15 is a general-purpose microcontroller with a 16MHz operating frequency. There is a wide lineup available, including the smallest 8-pin package in the RL78 Family, and support for a wide range of operating ambient temperatures from -40°C to 125°C. The built-in high-speed on-chip oscillator with high accuracy ( $\pm 1.0\%$ ), the data flash, the rich serial interfaces, and the comparator make it ideal for compact applications where space comes at a premium.

#### **Key Features**

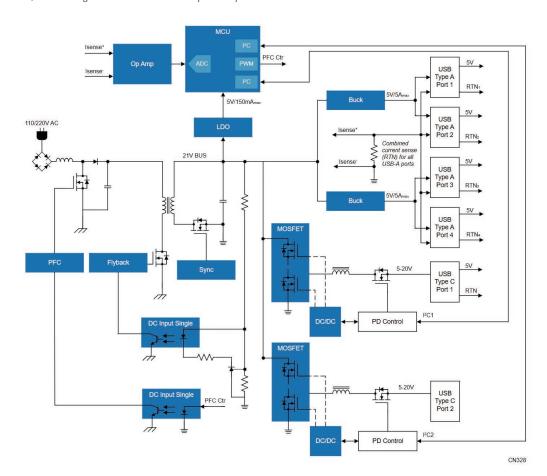
- CPU: RL78 core, Max. 16MHz
- Wide operating voltage of 2.4V to 5.5V
- Package: 8-pin to 20-pin
- Memory: Program Flash: 4-8KB, SRAM 1KB, Data Flash 1KB
- Operating temperature range: up to 125°C
- On-chip Oscillator Freq. (MHz): High-Speed: 1, 2, 4, 8, 16MHz; Low-Speed: 15kHz

#### **Block Diagram**



#### Use Case: 100W Multi-Output USB Power Delivery Adapter

Modern life almost requires us to carry multiple electronic devices such as phones, notebooks, and tablets, each requiring its own charger. Renesas addresses this challenge with a comprehensive IC design, featuring boost power factor correction (PFC), quasi-resonant (QR) flyback controller power, DC/DC buck, USB Power Delivery (PD) controller, and MCU integration. This adapter offers a unified design for efficiently charging various devices, enhancing convenience and compatibility for users.



#### RL78/G13A: Low Power, Lower Operating Current MUCs for General Purpose Applications



#### **Overview**

The General-purpose microcomputer with lower operating current than RL78/G13. The RL78/G13 MCUs can be used in a wide variety of applications from home and consumer appliances to industrial equipment.

#### **Key Features**

• CPU: RL78 core, Max. 32MHz

Voltage: 1.6V to 5.5V

Package: 48 to 100-pin LFQFP, 44-pin LQFP

• Memory: SRAM Max. 32KB, Program Flash Max. 512KB

• PWM: PWM Output × 7

On-chip Oscillator Freq. (MHz): High-Speed: 32, 24, 16, 12, 8, 4, 1MHz

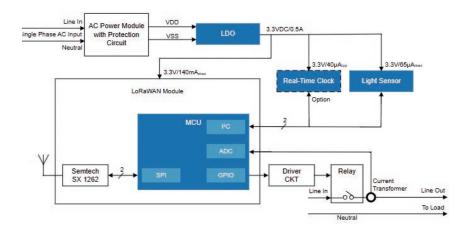
Low-speed: 15kHz

#### **Block Diagram**



#### **Use Case: LoRaWAN Street Light Controller**

This single-phase street light controller operates via a LoRaWAN® network, enabling automatic control and remote monitoring of streetlights. Its communication capabilities make it ideal for smart city deployments, where centralized management of energy consumption, reduced maintenance costs, and improved sustainability are key objectives.





#### RL78/G13: Low Power, High Function MCUs for General Purpose Applications



#### **Overview**

The RL78/G13 microcontrollers balance the industry's lowest level of consumption current (CPU:  $66~\mu\text{A/MHz}$ , standby (STOP): 230 nA) and a high performance of 43.2 DMIPS (32 MHz). They have an on-chip oscillator, data flash, A/D converter, and more. Built-in safety features (function that detects illegal operation of hardware) enable support for the household appliance safety standard (IEC/UL 60730). These microcontrollers can be used in a wide variety of applications from home and consumer appliances to industrial equipment.

#### **Key Features**

CPU: RL78 core, Max. 32MHz

Voltage: 1.6V to 5.5V

 Package: 64-pin HTFQFP, 24 to 48-pin HWQFN, 48 to 128-pin LFQFP, 44 to 100-pin LQFP, 20 to 30-pin LSSOP, 64-pin VFBGA, 25 to 36-pin WFLGA

Memory: SRAM Max. 32KB, Program Flash Max. 512KB

• PWM: PWM Output × 7

 On-chip Oscillator Freq. (MHz): High-Speed: 32, 24, 16, 12, 8, 4, 1MHz Low-speed: 15kHz

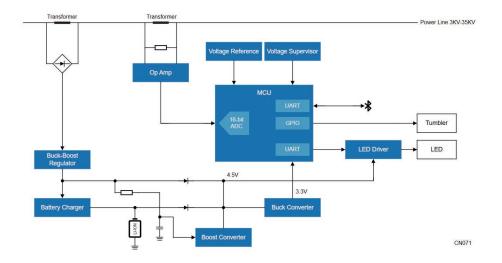
#### **Block Diagram**

Memory		CPU Core 43.2 DMIPS
Program Flash up to 512KB	CISC Harva	ard Architecture
SRAM up to 32KB		ge Pipeline egister Banks
Data Flash up to 8KB	l	Barrel Shifter
System	Safety	Analog
DMA		_
4ch	RAM Parity Check	ADC 10-bit, 26ch
Interrupt Controller 4 Levels, 20pins	ADC Self-diagnostic	Internal Vref.
Clock Generation Internal, External	Clock	Temp. Sensor
POR, LVD	Monitoring	
MUL/DIV/MAC	Memory CRC	Communication
Debug Single-Wire	Timers	8 x I <sup>2</sup> C Master
Power Management	Timer Array Unit 16-bit, 16ch	2 x l <sup>2</sup> C Multi-Master
HALT RTC, DMA Enabled	Interval Timer 12-bit, 1ch	8 x CSI/SPI 7-, 8-bit
SNOOZE Serial, ADC Enabled	WDT 17-bit, 1ch	4 x UART 7-, 8-, 9-bit
STOP SRAM On	RTC Calendar	1 x LIN 1ch

#### **Use Case: Smart Grid Fault Indicator Unit**

This grid fault current indicator is an example of a low-power design system that shows customers the most efficient approach for system implementation.

RL78/G13 is a standard function MCU with low power and an abundant lineup for general-purpose applications. Bluetooth® is used for communication between the two boards.



#### RL78/G12: Compact, Low Power MCUs for General Purpose Applications Ideal for Sub-MCUs



#### **Overview**

RL78/G12 microcontrollers balance the industry's lowest level of consumption current (CPU: 63  $\mu$ A/MHz, standby (STOP): 230 nA) and a high performance of 32.4 DMIPS (24 MHz). They have an on-chip oscillator, data flash, A/D converter, and more. Built-in safety features (function that detects illegal operation of hardware) enable support for the household appliance safety standard (IEC/UL 60730). With a 20 to 30-pin compact package lineup, these microcontrollers are perfect for sub-microcontrollers of small appliances and consumer and industrial equipment.

#### **Key Features**

CPU: RL78 core, Max. 24MHz

Voltage: 1.8V to 5.5V

Package: 24-pin HWQFN, 20 to 30-pin LSSOP

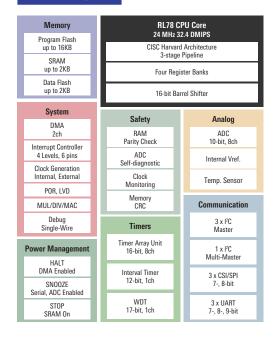
Memory: SRAM Max. 2KB, Program Flash Max. 16KB

• PWM: PWM Output × 7

• On-chip Oscillator Freq. (MHz): High-Speed: 1, 4, 8, 12, 16, 24MHz

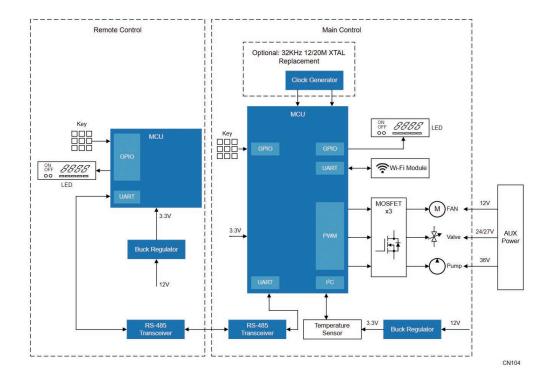
Low-speed: 15kHz

#### **Block Diagram**



#### **Use Case: Tankless Gas Water Heater with Remote Control**

This tankless gas water heater enhances the user experience by incorporating two controllers - one in the kitchen and another in the bathroom - allowing users to remotely control water temperature and volume. The two-chip MCU system ensures a compact and cost-effective design, integrating an MCU and connectivity modules such as Bluetooth® Low Energy (LE) or Wi-Fi.





#### RL78/G11: Low Power, Low Pin Count MCUs for General Purpose Applications



#### **Overview**

The RL78/G11 microcontroller line-up concept is based on small packages like 10 to 25pin, in small 16KB flash memory and rich analog peripherals such as A/D converters, D/A converters, comparators and PGA and these are configurable as PGA+ADC+VBGR, PGA+CMP+DAC/VBGR, or PGA+CMP+DAC/VBGR. Using the smart features like DTC and ELC a lot of peripherals can be connected internally to reduce CPU workload and can save overall power consumption. It also supports very low power operation (100 uA @ 1 MHz) and a high speed 4 $\mu$ s wake up. Available in small 3×3mm² WFLGA, 3×3mm² HWQFN and standard 20pin LSSOP, this MCU line is suitable for sensor application, Lighting/power sources and many small appliances.

#### **Key Features**

• CPU: RL78 core, Max. 24MHz

Voltage: 1.6V to 5.5V

Package: 16 to 24-pin HWQFN, 10 to 20-pin LSSOP, 16-pin SSOP, 25-pin WFLGA

• Memory: SRAM Max. 1.5KB, Program Flash Max. 16KB

• PWM: PWM Output × 4

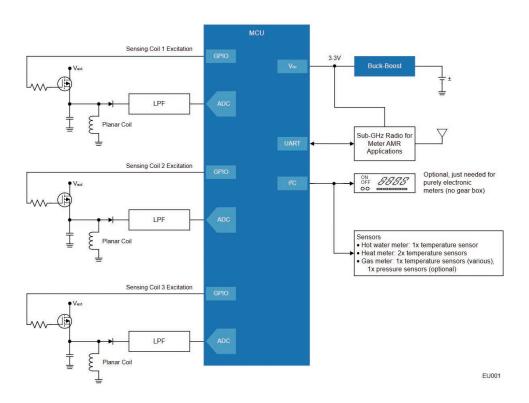
 On-chip Oscillator Freq. (MHz): High-Speed: 1, 2, 3, 4, 6, 8, 12, 16, 24, 48MHz, Middle-Speed: 1, 2, 4MHz, Low-speed: 15kHz

#### **Block Diagram**

Memory		CPU Core 38.4 DMIPS
Program Flash 16KB		AC Instruction
SRAM 1.5KB	Four Reg	jister Banks
Data Flash 2KB	16-bit Ba	arrel Shifter
System	Safety	Analog
DTC 24 sources	RAM Parity Check	ADC 10-bit, 11ch
ELC 18 Events	ADC Self-diagnostic	DAC 8-bit, 2ch
Interrupt Controller 4 Levels	Clock Monitoring	Comparator 2ch
Clock Generation Internal, External	Memory CRC	PGA
POR, LVD	Timers	Internal Vref.
Debug Single-Wire	Timer Array Unit 16-bit, 4ch	Temp. Sensor
Power Management	Timer KB 16-bit, 1ch	Communication
HALT DTC Enabled	Interval Timer 8-bit, 2ch	2 x I <sup>2</sup> C Multi-Master
SNOOZE Serial, ADC Enabled	Interval Timer 12-bit, 1 h	CSI x 2 / UART x 1 / Simple I <sup>2</sup> C x 2
STOP SRAM On	WDT 17-bit, 1ch	CSI x 2 / UART x 1 / Simple I <sup>2</sup> C x 2

#### Use Case: Automated Meter Reader (AMR) Retrofit Module

With increasing demands for automated meter reading (AMR) capabilities in water, heat, and gas meters, many utilities are opting for MID-certified "plug-and-play" retrofit modules for existing mechanical meters. This approach offers a viable alternative to completely replacing them with electronic meters before their lifespan ends.



#### RL78/G10: Low Power, Low Pin Count MCUs for General Purpose Applications



#### **Overview**

RL78/G10 microcontrollers realize the industry's lowest level of consumption current (CPU: 46  $\mu$ A/MHz, standby (STOP): 560 nA). With an on-chip oscillator, A/D converter, comparator, and more, and a 10/16-pin package lineup, they support more compact system size. These low pin count microcontrollers are perfect for small consumer electronics.

#### **Key Features**

• CPU: RL78 core, Max. 20MHz

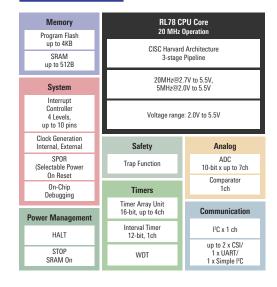
Voltage: 2V to 5.5V

Package: 64-pin HTFQFP, 10-pin LSSOP, 16-pin SSOP
 Memory: SRAM Max. 0.5KB, Program Flash Max. 4KB

• PWM: PWM Output × 3

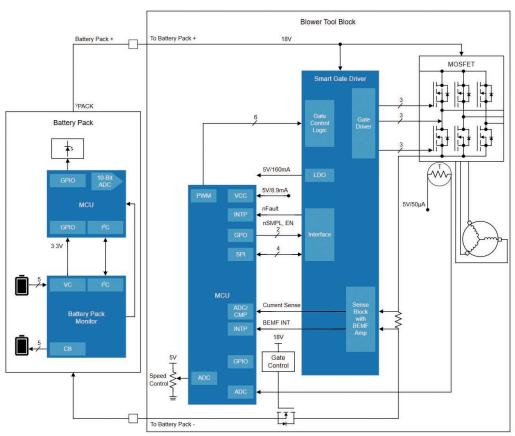
• On-chip Oscillator Freq. (MHz): High-Speed: 20, 10. 5, 2.5 1.25MHz, Low-speed: 15kHz

#### **Block Diagram**



#### **Use Case: Cordless Leaf Blower**

Cordless gardening tools, like leaf blowers, are gaining popularity due to their convenience, environmental benefits, and safety compared to wired versions. They are ideal for both residential and commercial lawn and landscape maintenance. This 20V cordless leaf blower system features a rechargeable battery and smart motor control, offering adjustable speeds to optimize usage and extend battery life. Its versatile design adapts to other cordless gardening tools, such as cordless lawn mowers and string trimmers.



US086



#### RL78/G1P: Small Pin General-purpose MCUs with 12-bit A/D Converter and 10-bit D/A Converter



#### **Overview**

The RL78/G1P microcontrollers are the only microcontrollers in the general-purpose RL78 lineup that have a 10-bit D/A converter in addition to a 12-bit A/D converter. They are suitable for a wide variety of applications such as sensor applications and optical transceivers.

#### **Key Features**

• CPU: RL78 core, Max. 32MHz

Voltage: 2.7V to 3.6V

• Package: 24-pin HWQFN, 32-pin LQFP

• Memory: SRAM Max. 1.5KB, Program Flash Max. 16KB

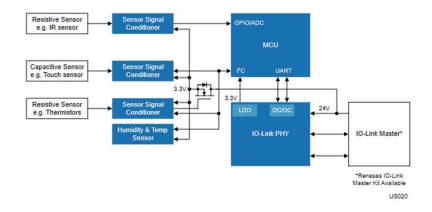
• On-chip Oscillator Freq. (MHz): High-Speed: 32, 24, 16, 12, 8, 6, 4, 3, 2, 1MHz

#### **Block Diagram**

Memory		PU Core 3.2 DMIPS					
Program Flash 16KB	CISC Harvard	Architecture					
SRAM 1.5KB	· ·	Pipeline ster Banks					
Data Flash 2KB							
•	16-bit Bar	rrel Shifter					
System DMA	Safety	Analog					
2ch	RAM	ADC					
Interrupt Controller 4 Levels	Parity Check	12-bit, 6ch/8ch					
Clock Generation Internal, External	ADC Self-diagnostic	Internal Vref.					
POR, LVD	Clock Monitoring	DAC 10-bit, 2ch					
MUL / DIV / MAC	Memory	10 51, 2011					
Debug Single-Wire	CRC	Communication					
Power Management	Timers	UART 1ch					
HALT DMA Enabled	Timer Array Unit 16-bit, 16ch	CSI 1ch					
SNOOZE Serial, ADC Enabled	WDT	1311					
STOP SRAM On	17-bit, 1ch	IIC 1ch (2 slave address)					

#### **Use Case: IO-Link Enabled Sensor System**

10-Link is a worldwide open standard protocol used for communication between devices in industrial settings. It facilitates bi-directional data exchange between a master device, actuators, and sensors. This system supports various IO-Link slave sensors.



#### RL78/G1N: 8-bit General-purpose MCU Equipped with Large Current Output Terminals for LED Drive



#### **Overview**

Even though the RL78/G1N microcontroller has a small pin-count 20-pin package, it is an 8-bit general-purpose microcontroller equipped with large current output terminals for driving LEDs. It allows direct drive of 8-segment 6-digit high brightness LEDs. It is suitable for small appliances, simple lighting fixtures and LED displays for portable batteries, etc.

#### **Key Features**

• CPU: RL78 core, Max. 20MHz

Voltage: 2.0V to 5.5VPackage: 20-pin TSSOP

• Memory: SRAM Max. 1KB, Program Flash Max. 8KB

• PWM Output: 3

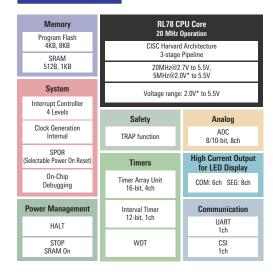
• On-chip Oscillator Freq. (MHz):

1.25MHz-20MHz (VDD=2.7V-5.5V),

1.25MHz-5MHz (VDD=2.0V \*Note)-5.5V)

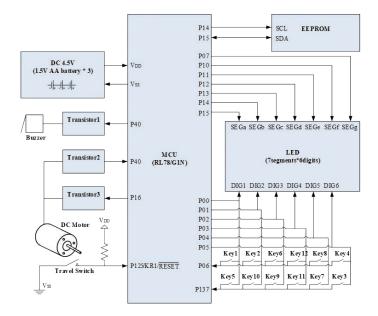
\*Note: Use with a voltage range of 2.25V to 5.5V because it includes detection voltage (VSPOR) for the selectable power-on-reset (SPOR) circuit.

#### **Block Diagram**



#### **Use Case: LED Electronic Safe Box**

An LED electronic safe box has an electronic lock installed in the door which can be locked and unlocked by entering a specific code into the keypad. The LED displays the status of the electronic safe box and the contents input from the keypad.





#### RL78/G1H: Lowest Power Sub-GHz Wireless Communication MCUs

#### **Overview**

The RL78/G1H microcontroller supports IEEE 802.15.4e/g and has the industry's lowest power consumption - min. 5.8 mA (3.3 V) at stand-by mode in RF receipt. The balun circuit and filter circuit make the antenna circuit design easy. It enables fewer external parts to be used, reducing costs. The built-in hardware functions for IEEE 802.15.4e/g compliance and especially Wi-SUN can reduce CPU load and ease development. We also offer the RAA604S00 transceiver conforming to IEEE 802.15.4e/g that can be used in combination with a microcontroller.

#### **Key Features**

• CPU: RL78 core, Max. 32MHz

RF frequency range: 863MHz to 928MHz
 Data rate: 2FSK/GFSK; up to 300kbps

Voltage: 1.8V to 3.6VPackage: 64-pin HVQFN

Memory: SRAM Max. 48KB, Program Flash Max. 512KB

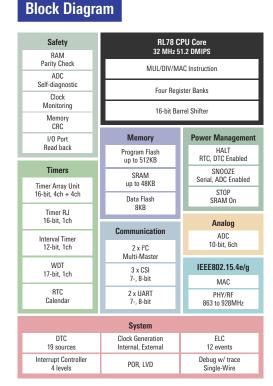
On-chip oscillator frequency (MHz): High-speed: 32, 24, 16, 12, 8, 4, 1MHz,

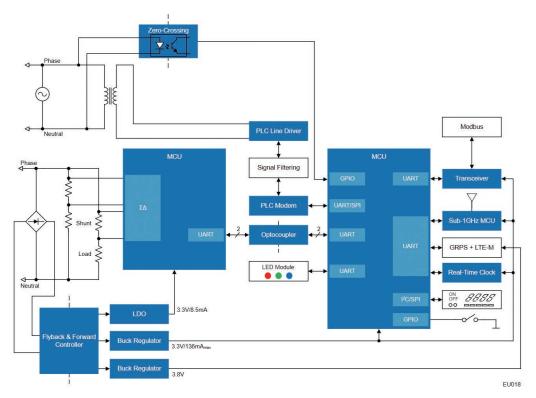
Low-speed: 15kHz

#### Use Case: Smart 1-Ph E-Meter

This flexible metering system supports multiple current sensing methods, such as current transformers (CTs) and Rogowski coils, to meet diverse deployment needs. It is scalable to support 2G or 5G wireless connectivity for remote and rural areas, Sub-1GHz communication via a data logger, or wired connectivity through power line communication (PLC) for urban environments, enabling reliable performance across a wide range of metering scenarios.

RL78/G1H supports proprietary frequency shift keying (FSK) or Wi-SUN® protocols, while PLC modem IC and line drivers support G3-PLC and PRIME specifications.





#### RL78/G1D: Bluetooth Low Energy MCUs for Smart Connectivity

#### **Overview**

RL78/G1D microcontrollers support Bluetooth® Low Energy and realized the lowest level of current consumption in the industry at 4.3mA RF transmission current (0dBm output) and 3.5mA RF receiving current. Since circuit elements necessary for connecting an antenna are built in, not only does this simplify circuit design for the antenna connection, but it also helps reduce the cost of the end product because external parts are not needed.

#### **Key Features**

• CPU: RL78 Core, Max. 32MHz

Voltage: 1.6V to 3.6VPackage: 48-pin HWQFN

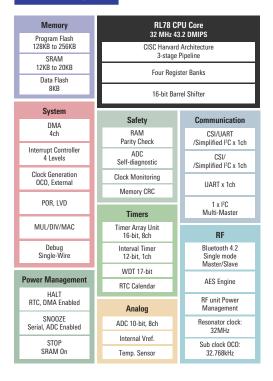
• Memory: SRAM Max. 20KB, Program Flash Max. 256KB

• PWM: PWM Output × 7

• On-chip Oscillator Freq. (MHz): High-Speed: 32, 24, 16, 12, 8, 4, 1MHz,

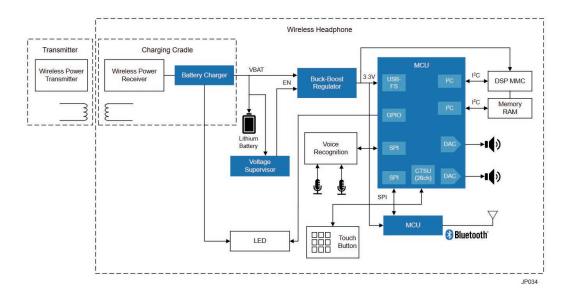
Low-speed: 15kHz

#### **Block Diagram**



#### Use Case: Bluetooth Wireless Headphones with Extended Battery Life

The global market for wireless headphones is experiencing significant growth as consumers increasingly prefer them for their convenience, portability, and improved user experience. This trend drives the demand for products with extended battery life to support longer usage periods without frequent recharging.





#### RL78/G1C: Compact, Low Power MCUs Supporting USB Communications and Rapid Charging



#### **Overview**

In addition to two USB 2.0 (full speed) host channels or one function channel, the RL78/G1C microcontrollers are compliant with Battery Charging Specification 1.2 (BC 1.2) for high-speed battery charging. These microcontrollers are suitable for office equipment that connect via USB such as a printer, mouse, and keyboard, as well as for USB chargers for healthcare devices, mobile batteries, and more.

#### **Key Features**

• CPU: RL78 core, Max. 24MHz

Voltage: 2.4V to 5.5V

Package: 32 to 48-pin HWQFN, 48-pin LFQFP, 32-pin LQFP

• Memory: SRAM Max. 5.5KB, Program Flash Max. 32KB

• PWM: PWM Output × 30n-chip

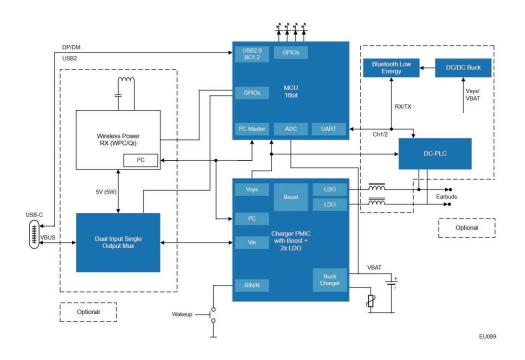
Oscillator Freq. (MHz): High-speed 48M, 24M, Low-speed 15kHz

#### **Block Diagram**

Memory		CPU Core
Program Flash up to 32KB		32.4 DMIPS
SRAM		e Pipeline
up to 5.5KB	Four Re	gister Banks
up to 2KB	16-bit B	arrel Shifter
System		
DMA	Safety	Analog
2ch Interrupt Controller	RAM Parity Check	ADC 10-bit, 8/9ch
4 Levels, 8/10 pins	ADC Self-diagnostic	Internal Vref.
Clock Generation Internal, External	Clock	Temp. Sensor
POR, LVD	Memory	
MUI /DIV/MAC	CRC	Communication
Debug	Timers	2 x I <sup>2</sup> C Master
Single-Wire	2 x Timer Array Unit 16-bit, 4ch	1 x I <sup>2</sup> C Multi-Master
Power Management	Interval Timer	2 x CSI/SPI 7-, 8-bit
HALT RTC, DMA Enabled	12-bit, 1ch	1 x UART
SNOOZE Serial, ADC Enabled	WDT 17-bit, 1ch	7-, 8-, 9-bit USB
STOP SRAM On	RTC Calendar	Host x 2ch or Host+Peripheral x 1ch / Peripheral x 1ch

#### Use Case: True Wireless Stereo (TWS) Earbud Charger Cradle

This True Wireless Stereo (TWS) and hearing aid earbud charger cradle/box design integrates USB-C, USB-A, and wireless power input paths with an optimized charger power management IC (PMIC). The PMIC combines a DC/DC buck charger, reverse boost function, and two LDOs to provide individually controlled voltage levels to the earbuds. Optional UART-based power line communication (PLC) enables charging voltage control and communication of SoC/SoH information.



#### RL78/G1A: Low Power, General Purpose MCUs with Built-in High-resolution A/D Converter



#### **Overview**

RL78/G1A microcontrollers balance the industry's lowest level of consumption current (CPU:  $66~\mu A/MHz$ , standby (STOP): 230 nA) and a high performance of43.2 DMIPS (32 MHz). A built-in high-resolution 12-bit A/D converter, on-chip oscillator, data flash, and safety features (function that detects illegal operation of hardware) enable support for the household appliance safety standard (IEC/UL 60730). With an lineup of 25 to 64-pin LGA/BGA and other small packages, these microcontrollers are perfect for consumer and industrial sensor applications.

#### **Key Features**

CPU: RL78 core, Max. 32MHz

Voltage: 1.6V to 3.6V

Package: 32 to 48-pin HWQFN, 48 to 64-pin LFQFP, 64-pin VFBGA, 25-pin WFLGA

Memory: SRAM Max. 4KB, Program Flash Max. 64KB

• PWM: PWM Output × 6

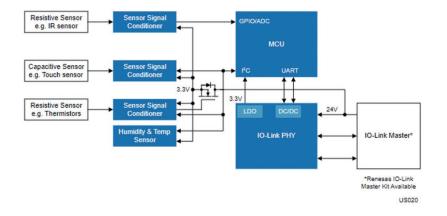
 On-chip Oscillator Freq. (MHz): High-Speed: 32M, 24M, 16M, 12M, 8M, 6M, 4M, 3M, 2M, 1MHz, Low-speed: 15kHz

#### **Block Diagram**

Memory		CPU Core				
Program Flash up to 64KB		43.2 DMIPS				
SRAM	CISC Harvard Architecture 3-stage Pipeline					
up to 4KB	Four Register Banks					
4KB						
System	16-bit B	arrel Shifter				
DMA 2ch	Safety	Analog				
Interrupt Controller 4 Levels, 18 pins	RAM Parity Check	ADC 12-bit, 28ch				
Clock Generation Internal, External	ADC Self-diagnostic	Internal Vref.				
POR, LVD	Clock Monitoring	Temp. Sensor				
MUL/DIV/MAC	Memory CRC	Communication				
Debug Single-Wire	Timers	6 x I <sup>2</sup> C Master				
Power Management	Timer Array Unit 16-bit, 8ch	1 x l <sup>2</sup> C Multi-Master				
HALT RTC, DMA Enabled	Interval Timer 12-bit, 1ch	6 x CSI 7-, 8-bit				
SNOOZE Serial, ADC Enabled	WDT 17-bit, 1ch	3 x UART 7-, 8-, 9-bit				
STOP SRAM On	RTC Calendar	1 x LIN 1ch				

#### **Use Case: IO-Link Enabled Sensor Syste**

IO-Link is a worldwide open standard protocol used for communication between devices in industrial settings. It facilitates bi-directional data exchange between a master device, actuators, and sensors. This system supports various IO-Link slave sensors.

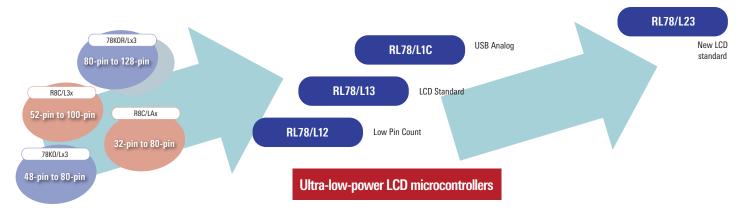




## **LCD MCU Products**

#### **LCD MCU Product Roadmap**

New successor products combining the features of earlier LCD MCUs



#### **LCD MCU Product Concept**

#### Low-power LCD driver

- Capacitor split type for generating LCD drive voltage
- 89% reduction in current consumption compared with previous product

Particularly large reduction in LCD drive current

#### Support for many segment LCD panel types

- Resistance division type suitable for large panels
- Voltage boost type suitable for battery powered
- Capacitor split type suitable for very small currents

#### Return of panels with very large segment counts

■ Max. display segment count: 416

		L12	L13	L1C	L23
	Blood pressure meters	<b>✓</b>	<b>✓</b>	<b>✓</b>	<b>✓</b>
	Composition meters		<b>✓</b>	<b>✓</b>	<b>✓</b>
Healthcare	Blood glucose meter			<b>✓</b>	<b>✓</b>
	Pedometers	<b>✓</b>	<b>✓</b>	<b>✓</b>	<b>✓</b>
	Thermometers	<b>✓</b>			<b>✓</b>
Electric	Rice cookers		<b>✓</b>		<b>✓</b>
household	Microwave ovens	<b>✓</b>	<b>✓</b>	<b>✓</b>	<b>✓</b>
appliances	Hot water pots		<b>✓</b>		<b>✓</b>
Compact	LCD remote controls	<b>✓</b>	<b>✓</b>		<b>✓</b>
electric	Hot water heaters		<b>✓</b>		<b>✓</b>
household	Telephones	<b>✓</b>	<b>✓</b>		<b>✓</b>
appliances	Kitchen tools		<b>✓</b>		<b>✓</b>
	Temperature controllers		<b>✓</b>	<b>✓</b>	<b>✓</b>
Measuring devices	Sensor modules			<b>✓</b>	<b>✓</b>
231.300	Flow meter			<b>✓</b>	<b>✓</b>



#### **LCD MCU Product Lineup**

×	: Supporting	Dual-bank flash	

	32 pin	44 pin	48	pin	52 pin		64	pin				80 pin			85 pin		100 pin	
512KB		<b>★</b> 32K	<b>★</b> 32K	<b>★</b> 32K	<b>★</b> 32K				<b>★</b> 32K		<b>★</b> 32K			<b>≭</b> 32K				<b>★</b> 32K
256KB		<b>≭</b> 32K	<b>★</b> 32K	<b>★</b> 32K	<b>★</b> 32K				<b>★</b> 32K		<b>★</b> 32K		16K	<b>★</b> 32K	16K		16K	<b>★</b> 32K
192KB													16K		16K		16K	
128KB		16K	16K	16K	16K			8K	16K	8K	16K		12K	16K	12K	5.5K	12K	16K
96KB								6K		6K		5.5K	10K		10K	5.5K	10K	
64KB		16K	16K	16K	16K			4K	16K	4K		5.5K	8K		8K	5.5K	8K	
48KB								2K		2K		5.5K						
32KB	1.5K	1.5K	1.5K		1.5K	1.5K	1.5K	1.5K		1.5K								
16KB	1K	1K	1K		1K	1K	1K	1K		1K								
8KB	1K	1K	1K		1K													
4KB																		
Package- Type: Size: Pitch:	LQFP 7x7mm 0.8mm	LQFP 10x10mm 0.8mm	LFQFP 7x7mm 0.5mm	HWQFN 7x7mm 0.50mm	LQFP 10x10mm 0.65mm	HWQFN 8x8mm 0.40mm	LFQFI 10x10m 0.5 mi	nm & 1	LQFP 2x12mm 0.65mm	14x1	DFP 4mm 5mm		LFQFP 12x12mm 0.50mm		VFLGA 7x7mm 0.65mm	LFQFI 14x14m 0.5mr	nm & 1	LQFP 4x20mm 0.65mm

RAM : RL78/L12

RAM : RL78/L13

RAM: RL78/L1A RAM: RL78/L1C

RAM : RL78/L23

#### **Features of the LCD Uses**

#### **LCD Display Seg** × Com Lineup

RL78 LCD MCU supports a wide range of segment counts from 52 to 224 segments (by 4 com) and 144 to 416 segments (by 8 com).

Seg count (4 com)	32	44	48	52	64		80		85	11	00
50 or more								51		56	56
45-49								49		45	
40-44								44	44		
35-39					39						
30-34				30	34	36	32				
25-29			26	25							
20-24		22	22								
15-19		19									
9-14	13										
L23 L13	L12	L1C	L1A								

## Ultra-low standby current consumption (clock counter + LCD display)

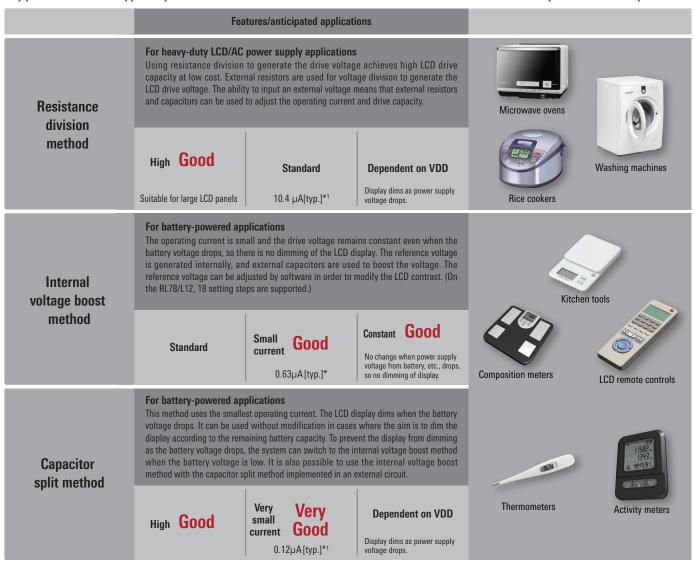
Capacitor split provides extremely low current consumption when driving LCD panels.

		Renesas	Company A	Company B	Company C	Company D
D drive*1	Resistance	11.6 μA	11.7 µA	Not	12.0 µA	Not
	division method*2	(typ.)	(@2.2 V)	implemented	(@1.8 V)	implemented
during LCD	Capacitor split	7.35 µA	Not	Not	Not	Not
	method	(typ.)	implemented	implemented	implemented	implemented
Current during	Voltage boost method	21.19 µA (typ.)	24.5 μΑ	22.9 µA	Not implemented	23.7 μΑ

Notes: 1. Current value including sub-oscillator, RTC operation, LCD operation and current flow to LCD panel. The calculation assumes an LCD panel drive current of 10  $\mu$ A when using the resistance division method. (The value differs depending on the drive method.)

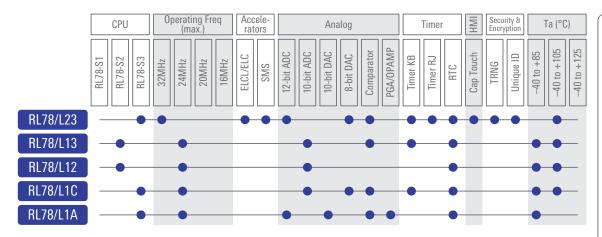
2. Calculated using an external resistance value of 1,000 k $\Omega$  for the external resistance division method.

#### Supports the three typically used LCD drive methods. Enables LCD circuits with ultra-low power consumption.





#### **LCD MCU Products Comparison**



Common functions
5V operation
Data flash
On-chip Oscillator
POR
LVD
Timer
WDT
Temp sensor
UART/CSI(SPI)/I2C
Segment LCD
DMAC/DTC
Standby/Wakeup
Safety functions
OCD

#### RL78/L23: 32MHz Ultra-Low Power LCD MCUs with Capacitive Touch

#### **Overview**

The Renesas RL78/L23 microcontroller has an RL78-S3 CPU core and rich peripheral features to deliver a better design experience that allows high-level system design while reducing power consumption, system cost, and overall footprint through an extensive range of peripheral functions and low-power operation. RL78/L23 is designed to meet the dynamic requirements of human-machine interface (HMI) applications, featuring capabilities such as capacitive touch sensing and segment LCD control.

#### **Key features**

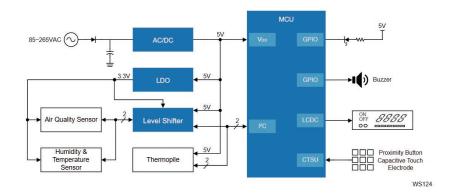
- 32MHz Renesas RL78-S3 CPU core
- 512KB flash (dual bank) and 32KB SRAM
- 8KB data flash memory (100,000 program/erase (P/E) cycles)
- 44-pin to 100-pin package lineup with a wide variety of package options including LQFP, LFQFP, and HWQFN
- Built-in LCD controller supporting 19 to 56 segment signal outputs and 4 to 8 common signal outputs
- Capacitive sensing unit supports up to 36ch

#### Block Diagram

Memory		CPU Core 51.2 DMIPS					
Program Flash up to 512KB (512KB, 256KB in 2banks)	CISC Harva	rd Architecture					
SRAM up to 32KB	Four-Re	Four-Register Banks					
Data Flash 8KB	16-bit Barrel Shifter						
System	Safety	Analog					
Interrupt Controller	RAM Parity Check	ADC 12-bit, 13ch					
POR, LVD	ADC Self-Diagnostic	DAC 8-bit, 2ch					
Clock Generation (Internal, External)	Clock Monitoring	Comparator, 2ch					
Data Transfer Controller	Memory	Internal Vref.					
Logic & Event link Controller	Output Level	Temp. Sensor					
Debug	Detection	Timers					
(Single Wire, Two Wires)	Communication	Timer Array Unit 16-bit, 8ch					
Power Management HALT	I <sup>2</sup> C Single-Master, 8ch	Interval Timer 32-bit, 1ch (8-bit, 4ch) 16-bit, 8ch (8-bit, 16ch					
(ADC, DAC, RTC Enabled) SNOOZF	Master/Slave, 2ch	Timer RJ 16-bit, 2ch					
(DTC, ADC Enabled) SNOOZE Mode Sequencer	CSI/SPI, 8ch	Timer KB 16-bit, 3ch					
STOP	UART, 4ch UART with sync clock,	WDT, 1ch					
(RTC Enabled)	4ch	RTC Calendar					
luman Machine Interface	LIN, 1ch	External Signal Sample					
LCD Controller 56 seg x 4com		Security & Encryption					
52 seg x 8 com Capacitive Sensing Unit		Flash Read Protection					
(CTSU2La), 36ch 40-mA port, 4ch		Flash Shield Protection					
Output Current		Unique ID					
Control Port, 8ch		Customer ID					

#### **Use Case: Smart Touch Panel**

The smart touch panel system features an ultra-low power MCU to manage a capacitive touch interface and display. It integrates an I<sup>2</sup>C air quality sensor (e.g., CO2 and TVOC), a humidity and temperature sensor, and a thermopile for non-contact temperature measurement. The MCU collects sensor data, processes it, and updates the UI on an LCD or TFT display. Optional Bluetooth Low Energy or Wi-Fi connectivity enables remote monitoring, while the system is powered through an AC input. Designed for efficiency, it supports low-power modes and provides real-time environmental feedback with user interaction through touch controls.





#### RL78/L13: Standard LCD MCUs with Low Power Consumption

#### **Overview**

RL78/L13 microcontrollers have a built-in segment LCD driver. Three LCD driving voltage generation methods (external resistance division, capacitive split, and internal voltage boost) are supported, corresponding to a variety of segment LCD panels. They realize low current consumption, external resistance division: 1.61  $\mu$ A, and internal voltage boost: 1.42  $\mu$ A, and capacitive split: 0.77  $\mu$ A. With a lineup of 64/80-pin products supporting up to 376 segments, these microcontrollers are perfect for devices with built-in LCD panels such as home appliances and healthcare devices.

#### **Key Features**

CPU: RL78 core, Max. 24MHz

Voltage: 1.6V to 5.5VPackage: 64 to 80-pin QFP

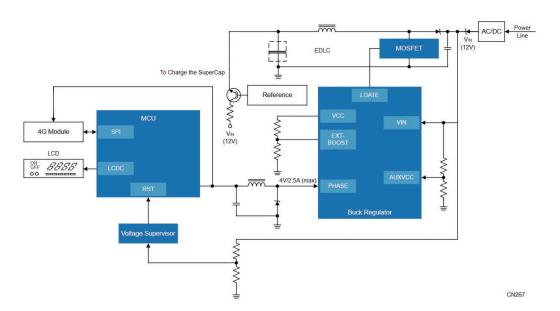
Memory: SRAM Max. 8KB, Program Flash Max. 128KB

#### **Block Diagram**

Memory		RL78 CPU Core 24 MHz 32.4 DMIPS					
Program Flash up to 128KB	CISC Harva	ard Architecture					
SRAM up to 8KB		ge Pipeline gister Banks					
Data Flash 4KB							
	16-bit E	Barrel Shifter					
System	Safety	Analog					
2ch	RAM Parity Check	ADC 10-bit, 12ch					
Interrupt Controller 4 Levels	ADC Self-diagnostic	Internal Vref.					
Clock Generation Internal, External	Clock Monitoring	Temp. Sensor					
POR, LVD	Memory CRC	Comparator 2ch					
MUL/DIV/MAC	Unc	ZCII					
Debug	Timers	Communication					
Single-Wire	Timer Array Unit 16-bit 6ch, 16/8-bit 2ch	1 x I <sup>2</sup> C Multi-Master					
Power Management	Interval Timer 12-bit, 1ch	1 x CSI/UART/ Simplified I <sup>2</sup> C					
HALT RTC, DTC Enabled	WDT 17-bit. 1ch	1 x CSI/UART/ Simplified I <sup>2</sup> C					
SNOOZE Serial, ADC Enabled	RTC Calendar	1 x UART					
STOP SRAM On	1 x IH Timer	1 x UART					
LCD 47 seg x 8 co	m Internal Boost	Split Cap.					

#### Use Case: Power System for Smart Power Meter with 4G Module

Renesas' smart power meter system integrates 4G communication and EDLC technology to enable smart control and always-on functionality. The buck-boost regulator enables self-cycling EDLC backup and can discharge the EDLC voltage down to 0.1V (theoretically), maximizing efficiency and reducing system cost. Additionally, the ultra-low-power RL78/L13 MCU is ideal for measurement devices and power meters, featuring a built-in segment LCD driver for enhanced functionality.



#### RL78/L12: Compact LCD MCUs with Low Power Consumption

#### **Overview**

RL78/L12 microcontrollers have a built-in segment LCD driver. Three LCD driving voltage generation methods (external resistance division, capacitive split, and internal voltage boost) are supported, corresponding to a variety of segment LCD panels. They realize low current consumption, external resistance division: 1.60  $\mu$ A, internal voltage boost: 1.19  $\mu$ A, and capacitive split: 0.68  $\mu$ A. With a lineup of 32 to 64-pin products supporting up to 280 segments, these microcontrollers are perfect for small devices with built-in LCD panels such as small appliances and healthcare devices.

#### **Key Features**

CPU: RL78 core, Max. 24MHz

Voltage: 1.6V to 5.5V

• Package: 64-pin QFN, 32 to 64-pin QFP

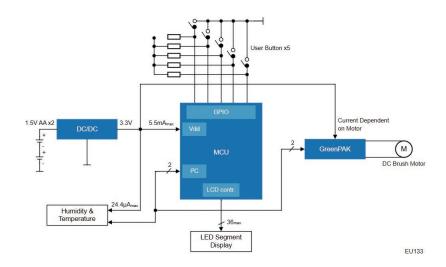
Memory: SRAM Max. 1.5KB, Program Flash Max. 32KB

#### **Block Diagram**



#### **Use Case: Programmable Radiator Thermostat**

This programmable radiator thermostat enables customized heating and zonal control for homes, optimizing energy usage while maintaining comfort for occupants. The design features a compact RL78/L12 MCU with low power consumption to drive an LED segment display, and a GreenPAK<sup>TM</sup> device interfacing with a motor for the radiator.





#### RL78/L1C: High-Function LCD MCUs with USB 2.0/Rapid Charging Support



#### **Overview**

RL78/L1C microcontrollers have a built-in segment LCD driver and USB 2.0 function. Three LCD driving voltage generation methods (external resistance division, capacitive split, and internal voltage boost) are supported, corresponding to a variety of segment LCD panels. They realize low current consumption: external resistance division: 1.76 $\mu$ A, internal voltage boost: 1.23 $\mu$ A, and capacitive split: 0.74 $\mu$ A. They support USB high-speed battery charging (Battery Charging Specification 1.2) and come in a lineup of 80/100-pin, maximum 416 segment products. These microcontrollers can be used in sensor modules and healthcare devices as well as home appliances and measurement devices.

#### **Key Features**

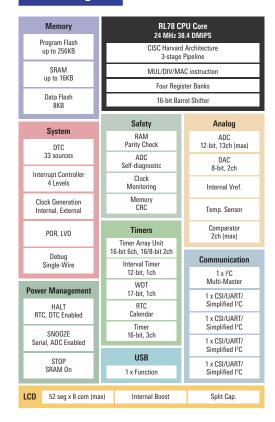
• CPU: RL78 core, Max. 24MHz

Voltage: 1.6V to 3.6V

Package: 85-pin LGA, 80-pin to 100-pin QFP

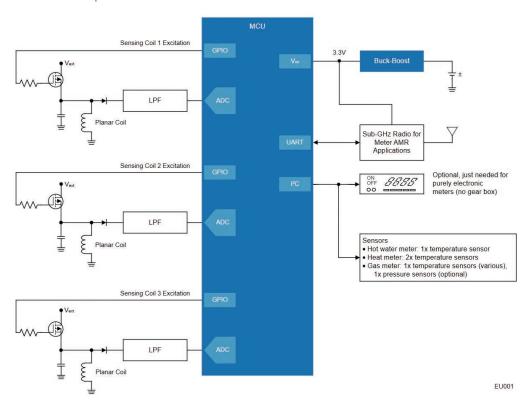
Memory: SRAM Max. 16KB, Program Flash Max. 256KB

#### **Block Diagram**



#### Use Case: Automated Meter Reader (AMR) Retrofit Module

With increasing demands for automated meter reading (AMR) capabilities in water, heat, and gas meters, many utilities are opting for MID-certified "plug-and-play" retrofit modules for existing mechanical meters. This approach offers a viable alternative to completely replacing them with electronic meters before their lifespan ends.



#### RL78/L1A: Ultra-Low Power MCUs with Enhanced Analog Peripherals

#### **Overview**

The ultra-low power RL78/L1A microcontroller family with embedded LCD has enhanced analog peripherals such as 12-bit A/D converters, 12-bit D/A converters, comparators, high accuracy rail-to-rail operational amplifiers with switch fabrics and comes with memory up to 128kb flash. Using the smart features like DTC and ELC a lot of peripherals can be connected internally to reduce CPU workload and can save overall power consumption.

#### **Key Features**

• CPU: RL78 core, Max. 24MHz

Voltage: 1.8V to 3.6V

• Package: 80-pin to 100-pin QFP

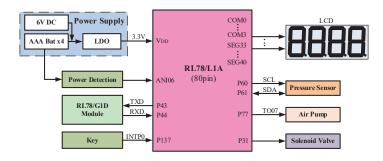
• Memory: SRAM Max. 5.5KB, Program Flash Max. 128KB

#### **Block Diagram**

	Memory		RL78 CPU Core 24 MHz 38.4 DMIPS					
	rogram Flash up to 128KB	Г	CISC Harvard Architecture 3-stage Pipeline					
	SRAM 5.5KB	H	MUL/DIV/N					
	Data Flash 8KB	L	Four Re	gist	er Banks			
			16-bit B	arre	el Shifter			
	System			ī				
	DTC/ELC		Safety		Analog			
Inte	errupt Controller		RAM Parity Check		ADC 12-bit, 14ch			
	4 Levels  Clock Generation Internal, External		ADC Self-diagnostic		DAC 12-bit, 2ch			
Int			Clock Monitoring		Op-Amp 3ch			
	POR, LVD Debug	Г	Memory CRC		Comparator 1ch			
	Single-Wire			Н	Internal Vref			
			Timers		iliterilai viei.			
Powe	er Management		Timer Array Unit		Temp. Sensor			
RT	HALT C, DTC Enabled	H	Interval Timer	li	Communication			
	SNOOZE		16-bit/8-bit, 1ch/2ch		I <sup>2</sup> C.			
S	Serial Enabled		Interval Timer 12-bit. 1ch		Multi-Master			
STOP SRAM On		r	RTC Calendar		CSI/UART/ Simplified I <sup>2</sup> C 4ch			
45 seg x 4 com 41 seg x 8 com			Internal Boost		Split Cap.			

#### **Use Case: Smart-Blood-Pressure-Monitor**

Renesas' Smart Blood Pressure Monitor device can check systolic pressure, diastolic pressure and pulse rate data, and confirm the results and battery percentage with an LCD display and smartphone application. Simply press the button on the smart blood pressure monitor or application to start the measurement process automatically. With the RL78/L1A ultra-low power consumption LCD MCU, you can operate various sensors and sync your readings to your smartphone using the RL78/G1D MCU's BLE function. The built-in rich peripheral functions realize cost reduction of the set.





## **Automotive MCU Products**

#### Features of RL78/F1x, F2x Series

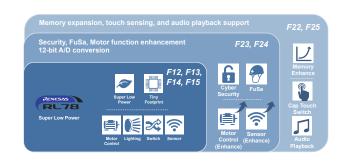
RL78/F1x, F2x series 16-bit MCUs are AEC-Q100 automotive qualified and provide ultra-low power consumption.

The large product portfolio, scalable from 8KB to 512KB Flash/0.5KB to 40KB RAM, and from 20 to 144 pins (QFN, LQFP, SSOP packages), enables optimal application demand coverages.

Further key features are high-temperature support up to 150 °C ambient (optionally for RL78/F13, F14, F23 and 24), BLDC/field-oriented control (F0C) motor control, CAN/CAN FD, LIN, UART, CSI, and I²C interfaces and hardware and software compatibility across the series, as well as an extensive ecosystem.

For RL78/F22, F23, F24 and F25, additional hardware (Application Accelerator Unit) is built in to improve motor control performance further.

For RL78/F22 and F25, capacitive touch is built in to support touch HMI.



	20pin	24pin	30pin	32pin		48pin	64pin	80pin	100pin	144pin
512KB					32	32 40	32 40	32 40	32 40	32
384KB					26	26	26	26	26	26
256KB				24	20	20 24	20 24	20 24	20 20 24	20
192KB					16	16	16	16	16 16	16
128KB		12	8	8 12 12	8810	8 8 10 12 12	8 8 10 12	8 8 10 12	10 10	10
96KB			6	6	668	668	668	668	8	
64KB	44		446	4446	446	4446	4446	4 4 6	6	
48KB	3 3		3 3 3 4	3334	334	3 3 3 4	3 3 3			
32KB	2 2		222	222	22	222	222			
24KB	1.5		1.5	1.5		1.5	1.5		(F12)(F13)(F1	3 F14 F15
16KB	11		11	11	1	11	1			23 F24 F25
8KB	0.5								The circle cont	ains RAM size
Package	SSOP (200mil)	QFN	SSOP (200mil)	QFN (Eve)	QFN (7×7)	QFP	QFP (10×10)	QFP	QFP (14×14)	QFP
	(300mil)	(4x4)	(300mil)	(5x5)	(7x7)	(7x7)	(10x10)	(12x12)	(14x14)	(20x20)

#### Features of RL78/D1A

	48pin	64pin	80pin	100pin	128pin
512KB				24	24
384KB				20	20
256KB			16	16 16	16
128KB			8	8	
96KB			6	6	
64KB	4	4	44	4	
48KB	33	33	33		
32KB	22			(D1A)	(D1A)
24KB	2			The circle con	tains RAM size
Package	QFP (7v7)	QFP (10×10)	QFP	QFP (14v14)	QFP
	(7x7)	(10x10)	(12x12)	(14x14)	(14x20)

RL78/D1A 16-bit MCUs are AEC-Q100 automotive qualified and provide ultra-low power consumption.

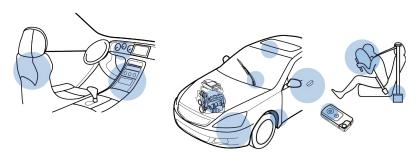
The large product portfolio, scalable from 24KB to 512KB Flash/2KB to 24KB RAM, and from 48 to 128 pins (LQFP packages), enables optimal application demand coverages. Further key features are LCD controller, stepper motor drivers, CAN, LIN, UART, CSI, and I<sup>2</sup>C interfaces and hardware and software compatibility across the series, as well as an extensive ecosystem.

#### **Target Applications**

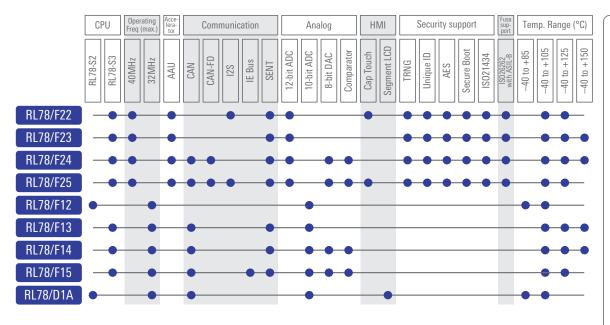
■ Various types of motor control



■ Various types of body control



#### **Automotive MCU Products Comparison**



Common functions
COMMINION TUNICUOMS
5V operation
Data flash
On-chip Oscillator
POR
LVD
Timer
WDT
RTC
CSI/UART
SPI
I2C
LIN
DMAC/DTC
Standby/Wakeup
Safety functions
OCD



#### **RL78/F12: Simplest Automotive MCU**



#### **Overview**

RL78/F12 microcontrollers are available in a 20 to 64-pin, 8 to 64 KB flash memory lineup, and realize the industry's lowest level of consumption current. They have a built-in LIN module as an automotive interface. With various built-in functions for realizing functional safety including flash memory CRC calculation, illegal memory access detection, RAM guard, A/D converter testing, and SFR guard, a highly reliable system can be built, so these microcontrollers can be used for industrial applications and of course automotive applications.

#### **Key Features**

CPU: RL78 core, Max. 32MHz

Voltage: 1.8V to 5.5V

Package: 32 to 48-pin HWQFN, 48 to 64-pin LFQFP, 20 to 30-pin LSSOP

Memory: SRAM Max. 4KB, Program Flash Max. 64KB

• Timer: 16-bit Timer (ch)  $\times$  8, Watchdog Timer (ch)  $\times$  1, Interval Timer  $\times$  1 ch, Wakeup Timer  $\times$  1ch

• PWM: PWM Output × 4

Analog function: 10-bit A/D Converter (ch) × 8

 On-chip Oscillator Freq. (MHz): 32M, 24M, 16M, 12M, 8M, 4M, 1M Low-speed Oscillator 15kHz

• Others: RTC, Power-On Reset, Low Voltage Detection

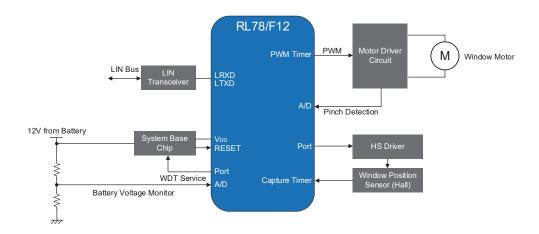
#### **Application**

Body, Car audio, Chassis & Safety

#### Block Diagram



#### **Use Case: Window Lift Control**



#### RL78/F13: Standard Automotive MCU (LIN, CAN & LIN)



#### **Overview**

RL78/F13 microcontrollers are successors to the 78K0R and R8C, are available in a 20 to 80-pin, 16KB to 128KB flash memory lineup and realize the industry's lowest level of consumption current. They have a built-in CAN module and LIN module for automotive interfaces, and in addition to the functional safety features, a RAM ECC function, PLL lock function, port output state monitoring, stack overflow detection, dedicated WDT oscillator and more have also been added. Since a more highly reliable system can be built, these microcontrollers can be used for industrial applications and of course automotive applications.

#### **Key Features**

- CPU: RL78 core, Max. 32MHz
- Voltage: 2.7V to 5.5V
- Package: 32 to 48-pin HVQFN, 48 to 80-pin LFQFP, 20 to 30-pin LSSOP
- Memory: SRAM Max. 8KB, Program Flash Max. 128KB
- PWM: PWM Output × 16, 3-phase PWM Output Function
- Analog function: 10-bit A/D Converter (ch) × 8
- On-chip Oscillator Freq. (MHz): 64M, 48M, 32M, 24M, 16M, 12M, 8M, 4M, 1M Low-speed Oscillator 15kHz
- Others: PLL, RTC, Power-On Reset, Low Voltage Detection

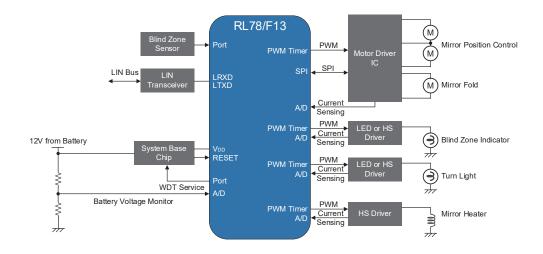
#### **Application**

Body, Car audio, Chassis & Safety, Motor control

#### **Block Diagram**



#### **Use Case: Exterior Mirror Control**





#### RL78/F14: Standard Automotive MCU (CAN & LIN)



#### **Overview**

RL78/F14 microcontrollers are positioned as the upper-level product of the RL78 series, are available in a 30 to 100-pin, 48 to 256KB flash memory lineup and realize the industry's lowest level of consumption current. They have a built-in CAN module and LIN module for automotive interfaces and also support BLDC motor control using the RL78/F14's functional safety features, timer RD, comparator and D/A converter. Since a highly reliable system can be built, these microcontrollers can be used for industrial and automotive applications.

#### **Key Features**

CPU: RL78 core, Max. 32MHz

Voltage: 2.7V to 5.5V

Package: 32 to 48-pin HVQFN, 48 to 100-pin LFQFP, 30-pin LSSOP

Memory: SRAM Max. 20KB, Program Flash Max. 256KB
 NAMA BIAMA Control of the Control of t

PWM: PWM Output × 20, 3-phase PWM Output Function

Analog function: 10-bit A/D Converter (ch) × 31, 8-bit D/A Converter (ch) × 1

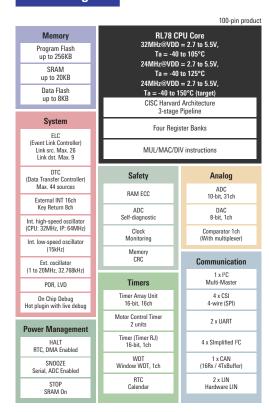
 On-chip Oscillator Freq. (MHz): 64M, 48M, 32M, 24M, 16M, 12M, 8M, 4M, 1M Low-speed Oscillator 15kHz

• Others: PLL, RTC, Power-On Reset, Low Voltage Detection

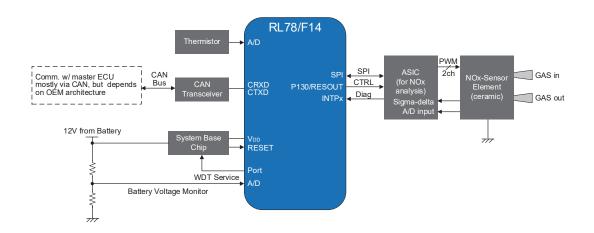
#### **Application**

Body, Car audio, Chassis & Safety, Motor control

#### **Block Diagram**



#### **Use Case: NOx Sensor System**



#### RL78/F15: Enhanced Standard Automotive MCU (CAN & LIN, IEBus)



#### **Overview**

RL78/F15 automotive microcontrollers employ the RL78 core, which realizes high processing performance while delivering the lowest power consumption in its class. A high-speed on-chip oscillator provides 32MHz CPU operation. An enhanced motor control functionality is offered by the motor control timer (Timer RD). For easy migration, RL78/F15 is pin and software upwards compatible with RL78/F14. The RL78/F15 Group even supports 125 °C (target) operation, whereby a CPU clock of 24 MHz can be reached. In addition, an abundance of functions to support functional safety, like ECC on RAM and a stack pointer monitor as well as an A/D converter testing function are available. With packages from 48 to 144-pin, a memory range from 128KB to 512KB flash, and advanced IPs for LIN and 2 channels of CAN communication and IEBus, these products are very well suited for a broad range of cost-sensitive automotive applications like DC and BLDC motor control, HVAC, lighting and many kinds of body applications.

#### **Key Features**

- CPU: RL78 core, Max. 32MHz
- Voltage: 2.7V to 5.5V
- Package: 48-pin HVQFN, 48 to 144-pin LFQFP
- Memory: SRAM Max. 32KB, Program Flash Max. 512KB
- PWM: PWM Output × 24, 3-phase PWM Output Function
- Analog function: 10-bit A/D Converter (ch) × 31, 8-bit D/A Converter (ch) × 1
- On-chip Oscillator Freq. (MHz): 64M, 48M, 32M, 24M, 16M, 12M, 8M, 4M, 1M Low-speed Oscillator 15kHz
- Others: PLL, RTC, Power-On Reset, Low Voltage Detection

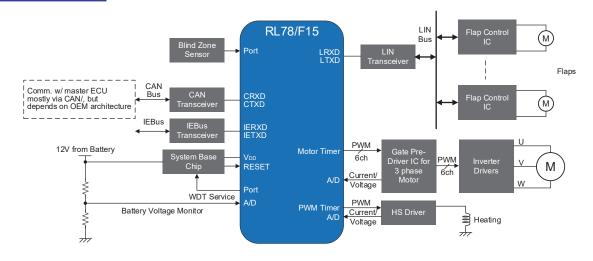
#### **Application**

Body, Car audio, Chassis & Safety, Motor control

#### **Block Diagram**

Memory RL78 CPU Core 32MHz@VDD = 2.7 to 5.5V.Program Flash up to 512KB Ta = -40 to 105°C 24MHz@VDD = 2.7 to 5.5V,  $Ta = -40 \text{ to } 125^{\circ}C$ SRAM up to 32KB CISC Harvard Architecture Data Flash up to 16KB 3-stage Pipeline Four Register Banks System MUI /MAC/DIV instructions ELC (Event Link Controller) DTC (Data Transfer Controller) Max. 52 sources Safety Analog ADC 10-bit, 33ch RAM ECC External INT 22ch Key Return 8ch ADC Self-diagnostic DAC 8-bit, 1ch Int. high-speed oscillator (CPU: 32MHz, IP: 64MHz) Clock Monitoring Comparator 1ch (With multiplexer) Int. low-speed oscillator (15kHz) Memory CRC Communication Ext. oscillator (1 to 20MHz, 32.768kHz) 1 x I<sup>2</sup>C Multi-Master Timers PLL (X3, X4, X6, X8) Timer Array Unit 16-bit 8ch, 3 units POR. I VD Motor Control Timer 1 unit, 2ch On Chip Debug Hot plugin with live debug 3 x UART Timer (Timer RJ) 4 x SImplified I<sup>2</sup>C **Power Management** WDT Window WDT, 1ch IEBus HALT RTC, DMA Enabled 2 x CAN (32Rx / 2 x 4TxBuffer) SNIOOZE Serial, ADC Enabled 3 x LIN Hardware LIN STOP SRAM On

#### **Use Case: HVAC System**





#### RL78/F22: Automotive MCU with Cap. Touch supporting Security & Safety (LIN)



#### **Overview**

The RL78/F22 next-generation super-low power automotive microcontrollers are ideal for realizing future highly reliable smart actuators and sensors, as well as low-end body electronic control units (ECUs). As an innovative prolongation of the known RL78/F1x MCUs, the RL78/F22 can cover prospective market requirements. With its increased CPU performance, high-temperature capability, and enhanced peripheral feature set, the RL78/F22 is a perfect fit for various applications.

RL78/F2x products are designed according to ISO 26262 and support functional safety (FuSa) up to ASIL B. They support up to the EVITA-Light security standard or more. An AES crypto module can handle key lengths of up to 256 bits and supports secure boot and authentication. To further boost the calculation performance for BLDC field-oriented control (FOC) motor control and DC/DC control systems, RL78/F2x is equipped with the unique application accelerator IP to offload complex trigonometric and arithmetic processing. RL78/F22 is equipped with the capacitive touch sensing unit (CTSU2SLa).

RL78/F2x MCUs are fully hardware and software upwards compatible to RL78/F1x, enabling software reuse.

#### **Key Features**

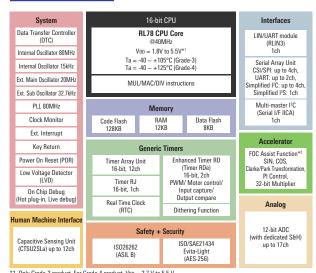
- RL78 core, Max. 40MHz, 128KB Flash, 12KB RAM
- 12-bit A/D converter
- Motor control: DC and BLDC
  - Field Oriented Control
- Application accelerator unit
- Optimized DC/DC converter support
- Super low-power consumption
- State-of-the-Art Interfaces LIN, UART, SPI, I<sup>2</sup>C, SENT

Capacitive sensing unit (Max. 12ch)

 $16 \times PWM$  output

- Support for FuSa and Security ISO/SAE21434 full compliant Security module with Evita-Light support ISO26262 ASIL B
- Extensive ecosystem supporting the latest standards concerning tools, hardware and software

#### **Block Diagram**

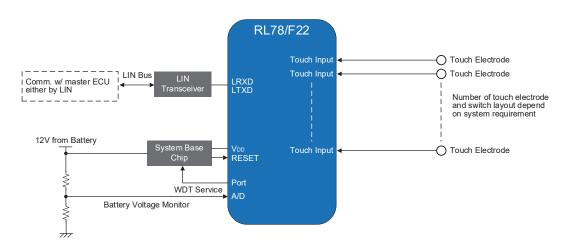


\*1. Only Grade-3 product. For Grade-4 product, Vop = 2.7 V to 5.5 V. \*2. FOC: Field Oriented Control (BLDC motor vector control method)

#### **Application**

Smart Actuators, Sensors ECUs, Low-end body

#### **Use Case: Interior Light Switch**



#### RL78/F23: Standard Automotive MCU supporting Security & Safety (LIN)



#### **Overview**

The RL78/F23 next-generation super low-power automotive microcontrollers are ideal for realizing future highly reliable smart actuators and sensors, as well as low-end body ECUs. As an innovative prolongation of the known RL78/F1x MCUs, the RL78/F23 can cover prospective market requirements. With its increased CPU performance, high-temperature capability, and enhanced peripheral feature set, RL78/F23 is a perfect fit for various applications.

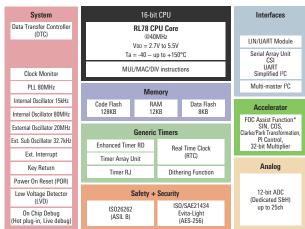
RL78/F2x products are designed according to ISO 26262 and provide functional safety (FuSa) support up to ASIL B. They support up to the EVITA-Light security standard or more. An AES crypto module can handle key lengths of up to 256 bits and supports secure boot and authentication. To further boost the calculation performance for BLDC (FOC) motor control and DC/DC control systems, RL78/F2x is equipped with the unique application accelerator IP, to off-load complex trigonometric and arithmetic processing.

RL78/F2x MCUs are fully hardware and software upwards compatible to RL78/F1x, enabling software reuse.

#### **Key Features**

- RL78 core, Max. 40MHz, 128KB Flash, 12KB RAM
- 12-bit A/D converter
- Motor control: DC and BLDC
  - Field Oriented Control
- Application accelerator unit
- Optimized DC/DC converter support
- High-temperature support: up to Ta = 150°C
- Super low-power consumption
- State-of-the-Art Interfaces LIN, UART, SPI, I<sup>2</sup>C, SENT 16 × PWM output
- Support for FuSa and Security ISO/SAE21434 partial compliant Security module with Evita-Light support ISO26262 ASIL B
- Extensive ecosystem supporting the latest standards concerning tools, hardware and software

#### **Block Diagram**

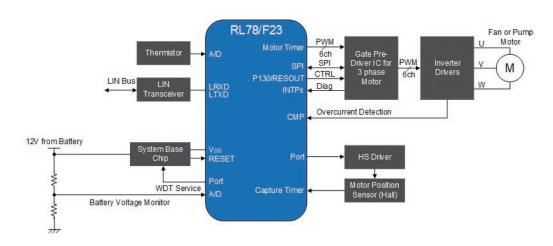


\* FOC: Field Oriented Control (BLDC motor vector control method)

#### **Application**

Smart Actuators, Sensors ECUs, Low-end body

#### **Use Case: Pump Control for Engine Accessories**





#### RL78/F24: Standard Automotive MCU supporting Security & Safety (CAN/CAN FD & LIN)



#### **Overview**

The RL78/F24 next-generation super-low power automotive microcontrollers are ideal for realizing future highly reliable smart actuators and sensors, as well as low-end body ECUs. As an innovative prolongation of the known RL78/F1x MCUs, the RL78/F24 can cover prospective market requirements. With its increased CPU performance, high-temperature capability, and enhanced peripheral feature set, the RL78/F24 is a perfect fit for various applications.

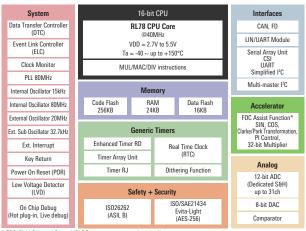
RL78/F2x products are designed according to ISO 26262 and support functional safety (FuSa) up to ASIL B. They support up to the EVITA-Light security standard or more. An AES crypto module can handle key lengths of up to 256 bits and supports secure boot and authentication. To further boost the calculation performance for BLDC field-oriented control (FOC) motor control and DC/DC control systems, RL78/F2x is equipped with the unique application accelerator IP to offload complex trigonometric and arithmetic processing.

To respond to the E/E automotive architecture trend, the RL78/F24 is equipped with a CAN FD interface. RL78/F2x MCUs are fully hardware and software compatible with RL78/F1x, enabling software reuse.

#### **Key Features**

- RL78 core, Max. 40MHz, 256KB Flash, 24KB RAM
- 12-bit A/D converter, 8-bit D/A converter
- Comparator with 4-fold multiplexer
- Motor control: DC and BLDC
  - Field Oriented Control
- Application accelerator unit
- Optimized DC/DC converter support
- High-temperature support: up to Ta = 150°C
- Super low-power consumption
- State-of-the-Art Interfaces CAN FD, LIN, UART, SPI, I<sup>2</sup>C, SENT 20 × PWM output
- Support for FuSa and Security ISO/SAE21434 partial compliant Security module with Evita-Light support ISO26262 ASIL B

#### **Block Diagram**



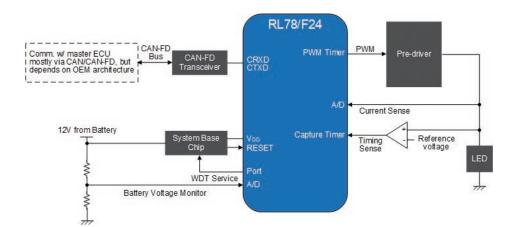
\* FOC: Field Oriented Control (BLDC motor vector control method)

Extensive ecosystem supporting the latest standards concerning tools, hardware and software

#### **Application**

Smart Actuators, Sensors ECUs, Low-end body

#### **Use Case: Exterior Lighting Control**



#### RL78/F25: Automotive MCU with Cap. Touch supporting Security & Safety (CAN/CAN FD & LIN)



#### **Overview**

The RL78/F25 next-generation super-low power automotive microcontrollers are ideal for realizing future highly reliable smart actuators and sensors, as well as low-end body electronic control units (ECUs). As an innovative prolongation of the known RL78/F1x MCUs, the RL78/F25 can cover prospective market requirements. With its increased CPU performance, high-temperature capability, and enhanced peripheral feature set, the RL78/F25 is a perfect fit for various applications.

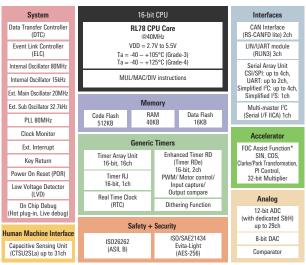
RL78/F2x products are designed according to ISO 26262 and support functional safety (FuSa) up to ASIL B. They support up to the EVITA-Light security standard or more. An AES crypto module can handle key lengths of up to 256 bits and supports secure boot and authentication. To further boost the calculation performance for BLDC field-oriented control (FOC) motor control and DC/DC control systems, RL78/F2x is equipped with the unique application accelerator IP to offload complex trigonometric and arithmetic processing. The RL78/F25 is also the first capacitive touch sensing unit (CTSU2SLa) in the RL78 automotive product.

To respond to the E/E automotive architecture trend, the RL78/F25 is equipped with a CAN FD interface (2ch). RL78/F2x MCUs are fully hardware and software compatible with RL78/F1x, enabling software reuse.

#### **Key Features**

- RL78 core, Max. 40MHz, 512KB Flash, 40KB RAM
- 12-bit A/D converter, 8-bit D/A converter
- Comparator with 4-fold multiplexer
- Motor control: DC and BLDC
  - Field Oriented Control
- Application accelerator unit
- Optimized DC/DC converter support
- Super low-power consumption
- State-of-the-Art Interfaces
   CAN/CAN FD × 2ch, LIN × 3ch, UART, SPI, I<sup>2</sup>C, SENT
   Capacitive sensing unit (Max. 31ch)
   20 × PWM output
- Support for FuSa and Security ISO/SAE21434 full compliant Security module with Evita-Light support ISO26262 ASIL B
- Extensive ecosystem supporting the latest standards concerning tools, hardware and software

#### **Block Diagram**

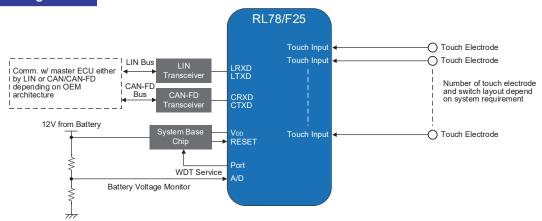


FOC: Field Oriented Control (BLDC motor vector control method)

#### **Application**

Smart Actuators, Sensors ECUs, Low-end body

#### **Use Case: Steering Switch**





#### RL78/D1A: Automotive MCU for Low-end Instrument Clusters



#### **Overview**

RL78/D1A microcontrollers have a built-in sound generator which can set a volume level and tone frequency of 100 Hz to 6 kHz and has an automatic volume decrement function, up to four channels of stepper motor controller/driver which can set an 8-bit precision (pseudo 9-bit precision using a 1-bit addition function) pulse width (PWM output), and an LCD controller/driver which supports up to 216 segments. The 128-pin version has a built-in LCD bus interface and two channels of CAN, and expanded flash memory/RAM up to a maximum of 512 KB/24 KB, making these microcontrollers ideal for low-end instrument cluster.

#### **Key Features**

• CPU: RL78 core, Max. 32MHz

• Voltage: 2.7V to 5.5V

Package: 48 to 128-pin LFQFP

Memory: SRAM Max. 24KB, Program Flash Max. 512KB

• Timer: 16-bit Timer (ch)  $\times$  24, Watchdog Timer (ch)  $\times$  1, Interval Timer  $\times$  1 ch, Wakeup Timer  $\times$  1ch

PWM: PWM Output × 21

Analog function: 10-bit A/D Converter (ch) × 9

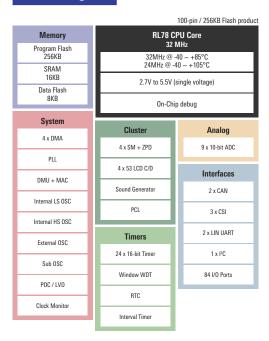
 On-chip Oscillator Freq. (MHz): 32M, 24M, 16M, 12M, 8M, 4M Low-speed Oscillator 15kHz

• Others: PLL, RTC, Power-On Reset, Low Voltage Detection

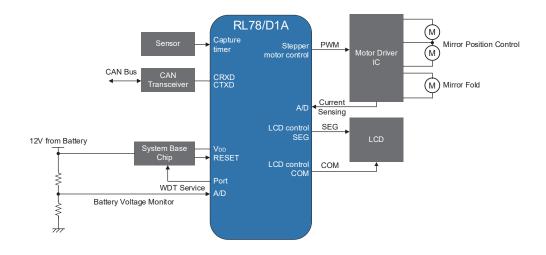
#### **Application**

Instrument Cluster

#### **Block Diagram**



#### **Use Case: Meter for Motorcycles**



#### **Motor/Inverter MCU Products**

#### Features of the Motor/Inverter Uses

The RL78/G24/G14/G1F/G1G and G1M are MCUs for motor and inverter control equipped with Renesas' RL78-S3/S1 CPU core. Featuring motor/inverter control PWM timers and other built-in functions, they are suitable for both general purpose and motor/power control applications. With 5V power supply support that is widely required in many industrial/consumer systems, and a comprehensive set of analog functions such as 12-bit analog-to-digital (A/D), 3-channel simultaneous sample-and-hold circuits, programmable gain amplifier (PGA), and comparator, these MCUs enable various motor control methods and flexible system designs.

#### **Broad lineup**

20MHz to 48MHz 20 to100-pins Highly compatible pin assignments

#### Specialized motor/ inverter control functions

3-phase complementary PWM output Timer output emergency stop PWM output for power control

## Analog functions for enhanced performance

ADC (3 channels sample & hold)

Comparator

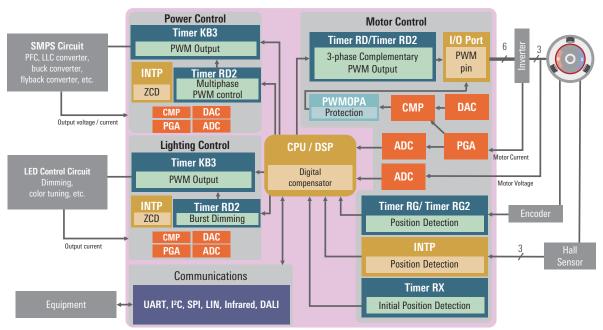
PGA

DAC

## Wide operating voltage and temperature range

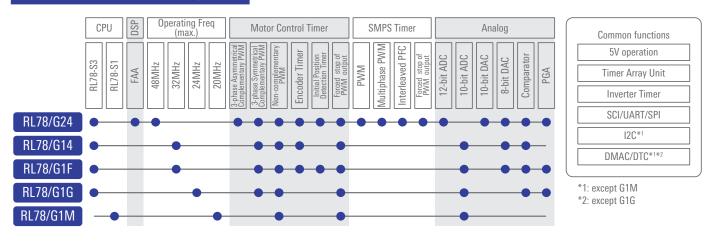
5V power supply support 125°C support

#### **Specialized Resources for Motor and Inverter Control**



#### \*Note: Peripheral support varies by product.

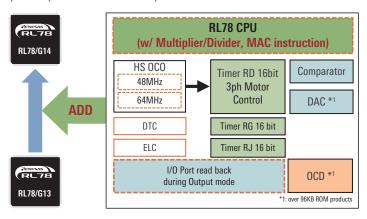
#### **Motor/Inverter Products Comparison**





#### RL78/G14: Low-Power, High-Function MCU

The RL78/G14 Group offers high-performance peripheral functions while keeping pin compatibility with RL78/G13 Group.



#### Multiplier/Divider, MAC instruction

 Enable high-speed operation via direct CPU execution, without relying on library functions

#### Timer RD (complementary PWM mode)

 High-resolution three-phase complementary PWM output ideal for driving DC brushless motor

#### Timer RG (phase counting mode)

Ideal counting function for two-phase encoder

#### **Data transfer controller (DTC)**

• Transfer data from one memory location to another, without using the CPU

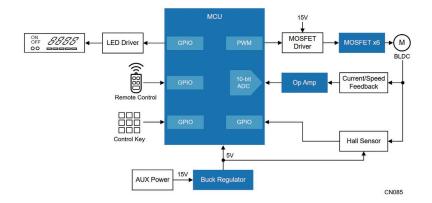


#### **Block Diagram**

Safety RL78 CPU Core 32 MHz 51.2 DMIPS						
RAM Parity Check	MUL/DIV/MAC Instruction					
ADC Self-diagnostic	Four-Register Banks					
Clock Monitoring	16-bit Barrel Shifter					
Memory CRC	Memory	Power Management				
I/O Port Read back	Program Flash up to 512KB	HALT RTC, DTC, Enabled				
Timers	SRAM up to 48KB	SNOOZE Serial, ADC, Enabled				
Timer Array Unit 16-bit, 8ch	Data Flash 8KB	STOP SRAM On				
Timer RD 16-bit, 2ch	Communication	Analog				
Timer RG 16-bit, 1ch	8 x I <sup>2</sup> C Master	ADC 10-bit, 20ch				
Timer RJ 16-bit, 1ch	2 x I <sup>2</sup> C Multi-Master	Internal Vref.				
Interval Timer 12-bit, 1ch	8 x CSI / SPI 7-, 8-bit	Temp. Sensor				
WDT 17-bit, 1ch	4 x UART 7-, 8-, 9-bit	D/A 8-bit, 2ch				
RTC Calendar	1 x LIN 1ch	Comparator 2ch				
System						
DTC 24ch	Clock Generation Internal, External	ELC 26 events				
Interrupt Controller 4 Levels	POR, LVD	Debug w/ trace Single-Wire				

#### **Use Case: High-end Electric Fan with BLDC Control**

Brushless DC (BLDC) motor fans overcome the challenges of regular (AC induction motor) fans, such as overheating, speed fluctuation and inefficiency. They offer higher energy efficiency, a longer service life, lower power consumption and quieter operation, while supporting flexible speed control with more than 10 levels of multi-stage speed control or stepless speed regulation. This design incorporates the RL78/G14 MCU, featuring three-phase complementary PWM outputs optimized for BLDC motor control, along with built-in support for remote control functionality.



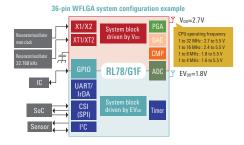
#### **RL78/G1F**: Enhanced Functionality for Motor Control

The RL78/G1F Group has enhanced peripheral functions and greater flexibility, while maintaining the same ROM sizes as the RL78/G14. In particular, analog functions have been strengthened, and the on-chip functions are ideal for motor control.

Main improvements to peripheral functions compared to RL78/G14:

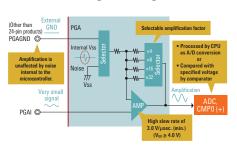
- Programmable-gain amplifier (PGA) with high slew rate of 3.0 V/µs(min.)
- 2-channel comparator with fast response time of 70 ns (typ.) (1/8 that of RL78/G14)
- High-resolution input capture timer (Timer RX) with high-speed comparator function linkage for rotor Initial Position Detection (IPD)
- PWM output forced cutoff function (PWMOPA) for immediate cutoff of PWM output upon overcurrent detection
- D/A converter (1 or 2 channels)
- IrDA communication function
- Debug functions including real-time trace

#### 36-pin LGA package $(4 \times 4 \text{ mm})$ suitable for mobile devices





#### Programmable-gain amplifier (PGA) for boosting sensor signals



#### **Block Diagram**

Timer RX 16-bit. 1ch

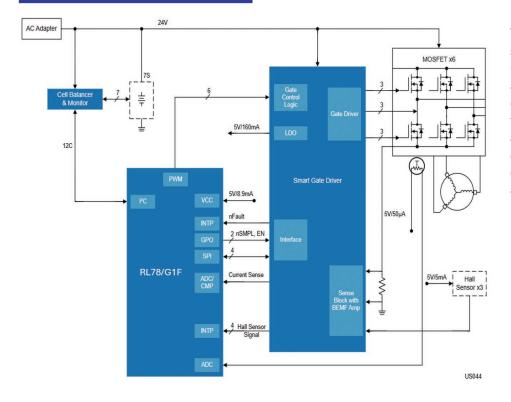
Safety	RL78 CPU Core 32 MHz 51.2 DMIPS					
RAM Parity Check	MUL/DIV/MAC Instruction					
ADC Self-diagnostic						
Clock Monitoring	Four Register Banks					
Memory CRC	10-DIL DA	rrei Stillter				
I/O Port	Memory	Power Management				
Read back	Program Flash up to 64KB	HALT RTC, DTC Enabled				
Timers Timer Array Unit	SRAM 5.5KB	SNOOZE Serial, ADC Enabled				
16-bit, 4ch	Data Flash 4KB	STOP SRAM On				
Timer RD 16-bit, 2ch	4KB	SKAWI UN				
Timer RG	Communication	Analog				
16-bit, 1ch	6 x I <sup>2</sup> C Master	ADC 10-bit, 17ch				
Timer RJ 16-bit, 1ch	1 x I <sup>2</sup> C	1 x I <sup>2</sup> C Multi-Master	Internal Vref.			
Interval Timer 12-bit, 1ch	6 x CSI/SPI	Temp. Sensor				
WDT	7-, 8-bit	DAC 8-bit, 2ch				
17-bit, 1ch	3 x UART 7-, 8-, 9-bit	Comparator				
RTC Calendar	1 x LIN	Input Selectable				

System					
DTC 33 sources	Clock Generation Internal, External Sub-clock	ELC 22 events			
Interrupt Controller 4 levels	POR, LVD	Debug w/ trace Single-Wire			

IrDA

PGA

#### **Use Case: Cordless Vacuum Cleaner**



The continuously growing demand for smaller, more efficient products has led to a rapid increase in brushless DC (BLDC) motor applications. One such application is the cordless vacuum cleaner, a household staple that requires convenience, energy-efficiency, and ease of use. The RL78/G1F serves as an energy-efficient solution, forming the core of BLDC motor design with a safe control algorithm.





#### **RL78/G1G: Motor Control MCU for Consumer Applications**

The RL78/G1G Group is ideal for Brushless DC (BLDC) motor control applications with the following features:

#### **Dedicated Motor Control Timer**

- Three-phase complementary PWM: 6 channels (supports 48 MHz operation)
- PWM output forced cutoff function: Configurable output state (Hi-Z, High, Low)

#### **Supports High-Speed Overcurrent Detection**

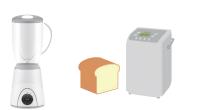
- Programmable-gain amplifier: 1 channel (on-chip amplifying resistor)
- Comparator: 2 channels (response time: 0.15 µs [max.])
- Comparator reference voltage: 8-bit DAC or internal reference voltage of 1.45 V.

#### **Supports Functional Safety**

Compliant with European safety standard for household appliances (IEC/UL 60730)

#### **Other Functions**

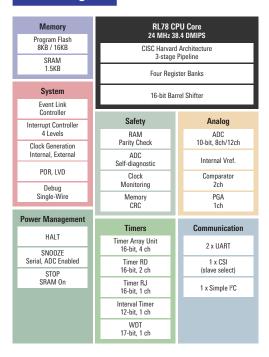
- Operating current: 75 µA/MHz
- STOP current: 240 nA (SRAM contents retained)
- On-chip oscillator:  $24MHz \pm 2\%$  (Ta =  $-40 \text{ to } +85^{\circ}\text{C}$ )





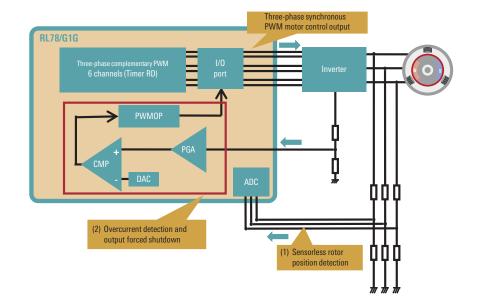


### Block Diagram



#### **Use Case: Sensorless 120-degree Conduction Control**

Home appliances such as table fans and air purifiers require motor control, where power efficiency maintenance-free motor operation and cost effectiveness are key design requirements. The built-in motor control functions in RL78/G1G enable easier motor control and contribute to system cost reduction by eliminating the need for external parts for overcurrent detection.



#### Key benefits:

- (1) Sensorless rotor position detection
- ADC can be used to perform position detection (zero-cross detection) during rotational control without using an external comparator.
- (2) Overcurrent detection and output forced cutoff
- The built-in PGA can be used to amplify overcurrent without using an external amplifier.
- The built-in comparator allows overcurrent detection, and 2-step overcurrent detection is also possible using 2 channels.
- The PWM option unit (PWMOP) allows forced cutoff of the Timer RD PWM output by using the coinciding signals of the built-in comparator as a trigger.



#### **RL78/G1M: 8-bit MCU for Simple Motor Control Applications**

The RL78/G1M Group is an 8-bit MCU designed for cost-sensitive applications, targeting small home appliances, toys and office automation (OA) equipment.

#### **Realtime Output Controller**

- Enables motor drive through TAU PWM output
- Allows timer output cutoff through interrupt INTPO as a trigger
- Supports DC motor, stepper motors, BLDC (120-degree conduction control)

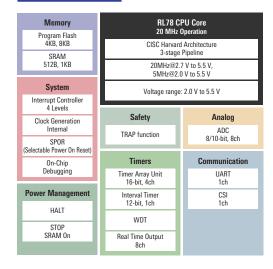
#### **Compact Design**

- RL78-S1 core 8-bit MCU
- Small Pin Count (20pin TSSOP)
- Small ROM (4KB or 8KB)



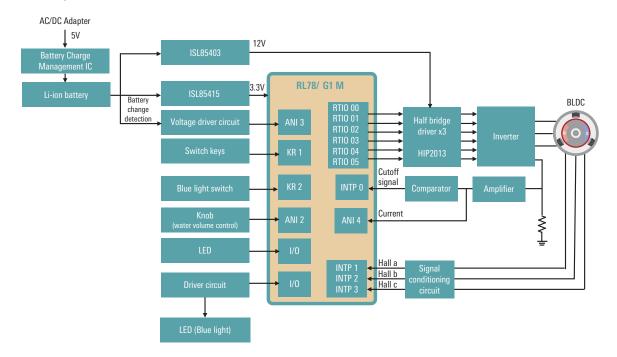


#### **Block Diagram**



#### **Use Case: Portable Spray Disinfection Device**

Portable spray disinfection device provides a convenient way to sanitize surfaces in our daily life. This application offers adjustable water volume control through knobs, blue light functionality, LED light status indication, and battery monitoring (low lithium-ion battery levels and charging status). This system utilizes RL78/G1M features especially its lower power consumption and real-time output terminal for motor drive, achieving excellent cost-efficiency.





#### RL78/G24: Highest Processing Performance and Enhanced Analog / Timers



Fast specific calculation speed and enhanced analog for moving to the new system

- Inverter (motor/lighting/power supply)
- 20-pin to 64-pin, 64KB and 128KB

#### Improvement of Inverter control performance

- 48MHz operation, integrated Co-Processor (FAA)
- $-1 \times 12$ -bit ADC, 3ch simultaneous sampling
- $-4 \times \text{High speed comparators (} < 50 \text{ns})$
- $-2 \times 12$ -bit D/A converter
- 96MHz PWM Clock
- Improvement of timers for Motor/Power supply.

#### **System cost reduction**

- PGA, CMP, 10-bit DAC, 1.0% accuracy OCO
- DALI-2 communication H/W support

#### Integration and Downsizing (Motor + control unit, Motor + power unit)

- Small PKG
- Hight temperature support ; 125 degrees
- Timer for power supply

#### **Succession from existing products**

- Flexible pin assignment
- Succession of peripheral functions

#### True easy to use

Quick and easy to use by Smart configurator (Upgradable libraries of peripherals)









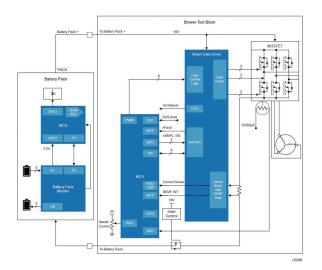


#### **Block Diagram**



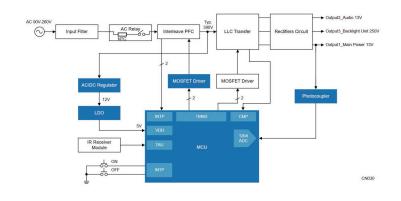
#### **Use Case: Cordless Leaf Blower**

Cordless gardening tools are popular for their convenience, safety, and eco-friendliness. This 20V cordless leaf blower has a rechargeable battery, smart motor control, and adjustable speeds to extend battery life. Its design is compatible with other cordless tools like mowers and trimmers.



#### **Use Case: High Efficiency Digital Power Supply**

This design features the first interleaved CrM PFC + LLC power supply using RL78/G24, delivering main, audio, and backlight power. With full digital control, it achieves higher efficiency than analog TV supplies while keeping ultra-low power, making it ideal for home theater and consumer electronics.



#### **ASSP MCU Products**

#### **Features of the ASSP Uses**

#### **RL78 ASSP MCUs**

This series of microcontrollers provides functionality ideal for use in products for Building Automation and Industrial Application. It is particularly well suited for applications involving Meter, Sensing, Detector, Healthcare, Motor, Inverter and Lighting.

#### **Main Features**

Feature 1: Powerful analog functions

Integrated  $\Delta\Sigma$  ADC, CMP, PGA, DAC etc., for reduced total cost

Feature 2: Ultimate motor / inverter timer

High Freq. High resolution timer for motor (vector control), PFC and DC/DC

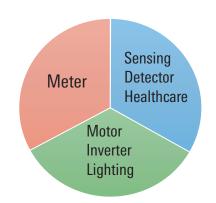
Feature 3: Reduced power consumption

The most advanced low-power functionality in the RL78 Family

Feature 4: Dedicated communication support function PMBus, SMBus, DALI-2, DMX512, AES for DLMS

Feature 5: High-temperature tolerance

Operation up to 125°C



#### **ASSP MCU Product Comparison**

Each ASSP MCU and its targeted application are as below.

RL78/G1x and G24: Motor control application

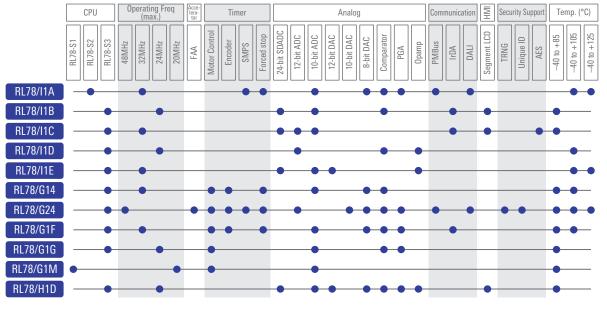
RL78/I1A and G24: Inverter (PFC, DC/DC) application including lighting

RL78/H1D : Healthcare

RL78/I1B and I1C: 1chip meter application

RL78/I1D and I1E: Commercial detector and industrial sensing application

Please refer below table as quick review of function on each MCUs.



- \*1: except I1D \*2: except I1B, G1G, G1M
- \*3: except G1M
- \*4: except G1G, G1M



#### RL78/I1A: High-resolution PWM Control for Lighting/Power Supply

#### Basic peripheral function for lighting and power supply applications

- Timers for LED control and PFC, DC/DC control
- Analog feedback functions (10-bit ADC, PGA, comparator)
- Operating temperature up to 105°C or 125°C

#### **Robust connectivity functions**

Communication functions (DALI, PMBus, SMBUs, DMX512, UART, I<sup>2</sup>C, CSI)

#### Low current consumption

- LED power supply control: 3.3 mA (main operation), CPU clock: 16 MHz,
   Timer KB clock: 64 MHz, PLL: on
- UART (DALI) receive standby: 0.23 µA (STOP current)

#### Peripheral functions specifically for intelligent and highly efficient operation

- Dithering function (0.98 ns pseudo-resolution), software start function, maximum frequency limit function, single/interleaved PFC function, standby communication function
- Linked operation of Timer KB and INTP comparator enables PFC control and protection functions

#### **Block Diagram**

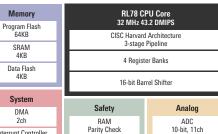
In

Power Management

HALT

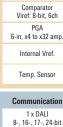
RTC, DMA Enabled

SNOOZE Serial, ADC Enabled



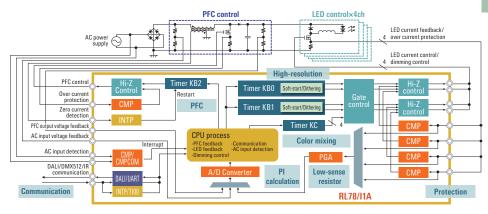
DMA	Safety
2ch	RAM
terrupt Controller	Parity Check
11 int., 30 ext.	ADC
Clock Generation	Self-diagnostic
nternal, External	Clock
000 1110	Monitoring
POR, LVD	Memory
MIII /DII/ /MAA	CRC
MUL/DIV/MAC	
Debug	Timers
Single-Wire	3 x Timer KB

Timers
3 x Timer KB 16-bit, 6-out
1 x Timer KC 16-bit, 6-out
1 x Timer Array 16-bit, 8ch
Interval Timer 12-bit, 1ch
WDT 17-bit, 1ch
RTC Calendar

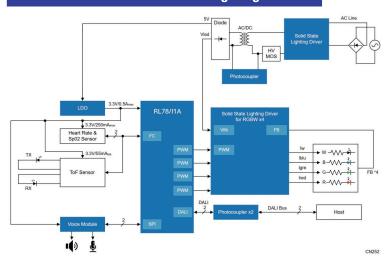


# 1 x PC Master 1 x CSI / SPI 7-, 8-bit 3 x UART 7-, 8-, 9-bit 1 x LIN

#### System configuration example: PFC control + LED constant current control



#### **Use Case: Voice Activated DALI Lighting Controls**



Digital Addressable Lighting Interface (DALI) is a dedicated lighting control protocol for intelligent lighting systems that is widely used in commercial and building lighting control applications. RL78/I1A serves as a one-chip solution with built-in DALI communication and high-resolution PWM for fine dimming and toning of LED lighting control.

#### RL78/I1B: MCU for Low-end Smart Energy Meter as 1-chip Solution

#### **Suitable for Low-end Smart Energy Meters**

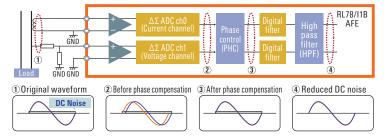
- The RL78/I1B microcontroller integrates functions required for the metrology of smart electricity meters. It includes 24-bit  $\Delta\Sigma$  A/D converters, segment LCD driver supporting up to 8 com.
- RL78/I1B lineup is the following.

ROM Pins	80	100
128KB	8KB	8KB
64KB	6KB	6KB

RAM size

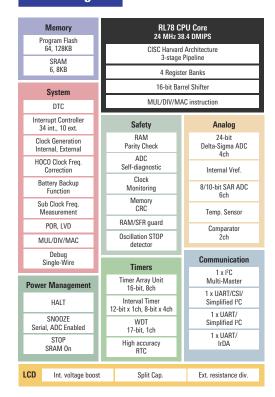
#### 24-bit $\Delta\Sigma$ A/D converters for Energy Meter

- RL78/I1B has 4-channel 24-bit ΔΣ A/D converters that suitable for AC power measurement is installed. It supports up to 32 times pre-amp on 24-bit ΔΣ A/D converter inputs, and convertible up to 4ksps.
- This product reduced CPU operating frequency that contributes to lower power



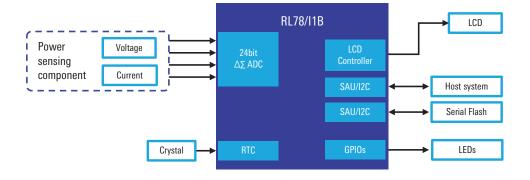


#### **Block Diagram**



#### **Use Case: Energy Meter**

RL78/I1C uses 24-bit  $\Delta\Sigma$  A/D converters (max. 4-channel) to measure the power of single-phase two-wire meters, single-phase three-wire meters and three-phase three-wire meters.







#### Integrated with peripheral functions suitable for Energy Meters

- The RL78/I1C microcontroller integrates functions required for the metrology of smart electricity meters. It includes 24-bit ΔΣ A/D converters, 32-bit multiply-accumulator, independent power supply real-time clock, segment LCD driver supporting up to 8 com, and AES hardware engine that supports the DLMS standard.
- RL78/I1C lineup is the following.

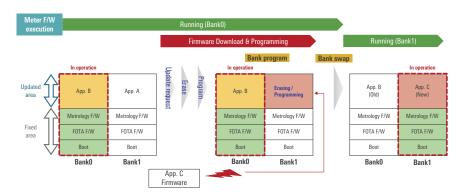
ROM Pins	64	80	100
<b>512KB</b> (256KB × 2 bank)		32KB	32KB
256KB		16KB	16KB
128KB	8KB	8KB	8KB
64KB	6KB	6KB	
RAM size			

**Dual bank** 

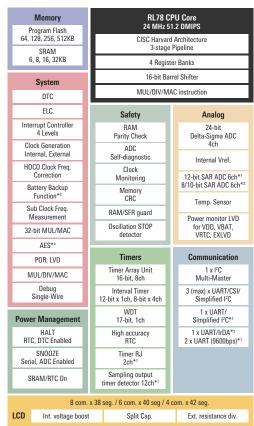
#### Continuous Metrology FOTA\* solution that solves the problem of power meter operation stopping during firmware updates. The RL78/I1C's bank programming and bank swapping functions and improved 32-bit multiply-accumulator enable

continuous power meter operation during firmware updates.

- \*: Firmware update Over The Air
- User firmware can be updated only in the state that the MCU continues to operate or in the reset time of 1 second or less.



#### **Block Diagram**

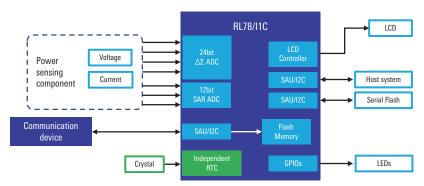


\*1. Built in I1C (512KB) only
\*2. Built in 80/100-pin products
\*3. Not built in I1C (512KB)
\*4. Not built in R5F11Txxx

#### **Use Case: Energy Meter**

RL78/I1C uses 24-bit  $\Delta\Sigma$  A/D converters (max. 4-channel) and 12-bit SAR A/D converters (max. 6ch) to measure the power of single-phase two-wire meters, single-phase three-wire meters, three-phase three-wire meters and three-phase four-wire meters. This product supports to sense current and voltage to achieve highly accurate power metrology.

RL78/I1C has 4-channel 24-bit  $\Delta\Sigma$  A/D converters that suitable for AC power measurement is installed. It supports up to 32 times pre-amp on 24-bit  $\Delta\Sigma$  A/D converter inputs, and convertible up to 8ksps.



#### RL78/I1D: Low Power and Analog Integration for Sensors and Detectors

#### Low power consumption for extended operation on battery power

- Fast recovery from STOP mode in 3.4µs, and low 124µA operating current at 1MHz
- Support for peripheral circuit operation (sensor activation, signal amplification, obtaining A/D conversion results) without CPU intervention. CPU activation is determined based on the A/D conversion result.

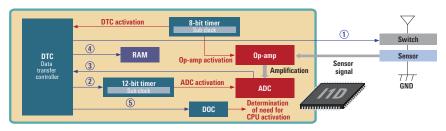
#### On-chip analog function integration for security and emergency applications

 On-chip general-purpose operational amplifiers, 12-bit A/D converter, comparators (window mode)

#### **Supports Functional Safety**

Compliant with European safety standard for household appliances (IEC/UL 60730)

#### **SNOOZE** mode operation example



Operation procedure

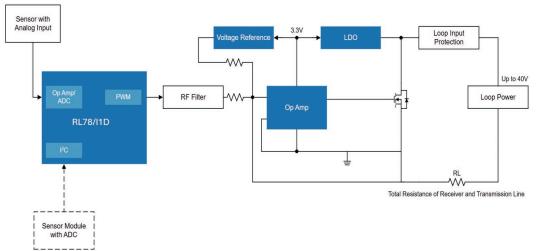
- 1 sensor activation
- ②ADC activation
- 3 obtaining A/D conversion results
- 4 storing A/D conversion results in RAM
- ⑤transmission of A/D conversion results to DOC (determination of need for CPU activation)

#### **Block Diagram**

Memory	24 MU- 2			
Program Flash up to 32KB		.7V to 3.6V		
SRAM		6V to 3.6V		
up to 3KB		AC Instruction rrel Shifter		
Data Flash 2KB	-40 to 105°C operation			
System				
DOC (Data Operation	Safety	Analog		
Circuit) ELC (Event Link	RAM Parity Check	ADC 12-bit, up to 17ch		
Controller)  DTC (Data Transfer	ADC Self-diagnostic	Comparator 2ch		
Controller)	Clock Monitoring	Op-Amp		
OCD (Single-wire On-chip debugger)	Memory	up to 4ch		
POR (Power On Reset)	CRC I/O port	internal vrer.		
LVD (Low Voltage	Read Back	Temp. Sensor		
Detector) Interrupt Controller	Timers	Communication		
4 Levels	Timer Array Unit	CSI		
	16-bit, 4ch (1ch: 2 x 8-bit)	up to 2ch		
Power Management	Interval Timer	UART 1ch		
Fast wake up 4µs	12-bit, 1ch	I <sup>2</sup> C		
HALT RTC, DTC Enabled	Interval Timers 8-bit, 4ch	up to 2ch, Master		
SNOOZE Serial, ADC Enabled	Window WDT 17-bit, 1ch			
STOP SRAM On	RTC Calendar			
2				

#### **Use Case: 4-20mA Current Loop Transmitter**

The 4-20mA current loop is the dominant standard for sensor systems across many industries due to its simplicity and efficiency. It is easy to configure and connect, requiring less wiring and fewer connections than other signal types, which helps reduce overall system costs. Additionally, it is ideal for large locations, as the current remains stable over long distances, unlike voltage signals that degrade. This current loop transmitter design utilizes a precision digital power monitor (DPM), a stable power source, and the low-power, analog-rich capabilities of the RL78/I1D.



#### System Benefits:

- Analog and ultra-low power MCU optimized for detector and sensor applications.
- High-voltage, adjustable VOUT, low quiescent current linear regulator suitable for "always-on" applications
- Renesas' NanoPower voltage reference featuring low supply voltage operation at 310nA typical.

US199



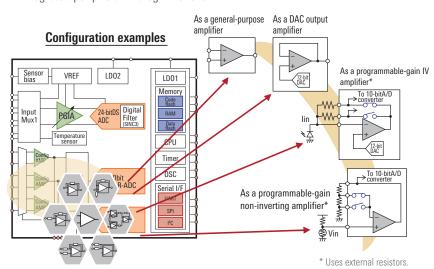
#### RL78/I1E: Smart Analog MCU for High-precision Sensing

#### 24-bit $\Delta\Sigma$ A/D converter

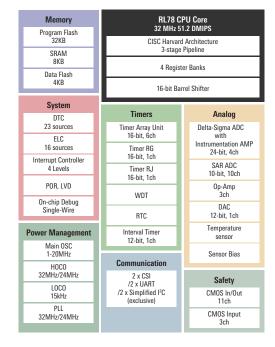
- Integrated Analog Front End (AFE) circuits support multiple sensor types including pressure sensors, load cells, and thermocouples
- Ability to use common sensor power supply and ADC reference voltage, minimizing ratiometric error

#### **Configurable amplifier**

- General-purpose analog I/O ports and configurable switches enable configuration of a variety of op-amp circuits
- Integrated peripheral analog functions

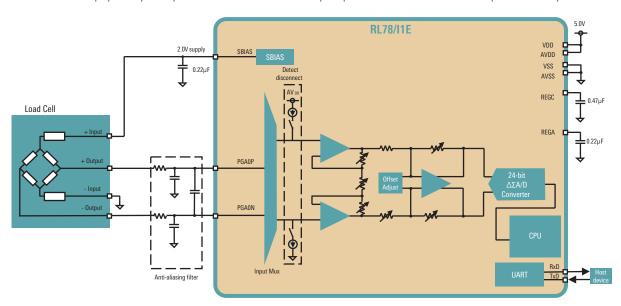


#### **Block Diagram**



#### **Use Case: Strain Gauge**

This example shows weight measurement using a load cell as the strain gauge, which work as a sensor that generates resistance change caused by applied force. The RL78/I1E's built-in 24-bit  $\Delta\Sigma$  A/D converter with programmable gain instrumentation amplifier is used to amplify the minute voltage difference and then convert the difference to a digital value. A digital noise filter is used to remove noise from the retrieved digital value, which is then converted to a physical quantity. The measured value is finally output to a host device such as a personal computer.



#### RL78/H1D: For Sensing Transducers in Healthcare/Electricity Meter

Optimized with rich analog functions and timers, the RL78/H1D microcontroller is ideal for healthcare and flow meter applications.

#### **High precision analog functions**

- Delta-Sigma A/D converter
- SAR A/D converter
- Programmable Gain amplifiers
- Operational amplifier
- 8-bit/12-bit D/A converter

#### **Integrated Display Control**

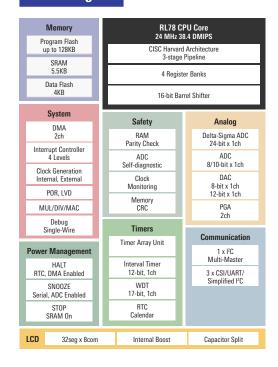
Built-in LCD controller/driver



**Blood Pressure Monitoring Evaluation Kit for RL78/H1D** 

Part Name: RTK0EH0003S02001BR

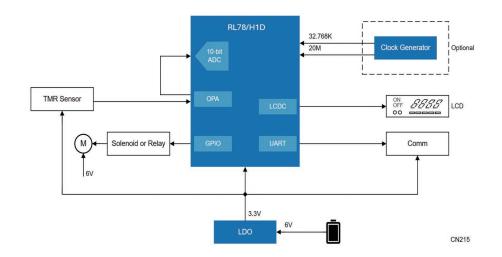
#### **Block Diagram**



#### **Use Case: TMR Sensor-Based Flow Meter**

Water meter technology is advancing rapidly, shifting from mechanical-based systems to electronic sensors like Hall sensors and ultrasound for improved measurement and precision. A notable innovation is automated meter reading (AMR) technology, which integrates with communication standards such as LoRa, Bluetooth® Low Energy (LE), and NB-IoT.

This flow meter design is based on a tunnel magnetoresistance (TMR) sensor, which enables lower power consumption and extends battery life to 5-7 years, meeting market demands. This approach combines enhanced accuracy with long-term reliability, addressing the evolving needs of modern water metering systems



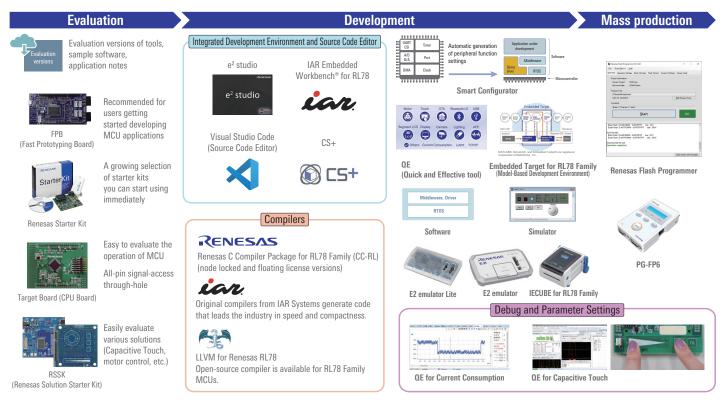
#### System Benefits:

- Ultra-low power consumption due to TMR and the RL78/H1D's ability to directly drive sensors without CPU wakeup.
- Electronic design eliminates mechanical components, improving overall system durability and accuracy.
- Supports integration of additional control features and monitoring capabilities, enhancing meter versatility.



# **Development Environment**

Renesas supports customers through all stages of the development of their applications by supplying integrated development environments, RTOS, middleware, and programming tools that dramatically enhance the development process. These development tools, combined with evaluation kits and assistance tools specifically for the RL78 Family, enable you to accomplish coding, building, and debugging tasks quickly and easily, while helping to reduce system development time.



RL78 has prepared videos explaining each development environment.

Click here for details

Link: RL78 Family Software & Tool

In these videos, you will learn about solutions, software, and tools for the Renesas RL78 family of MCUs. these videos introduce the Renesas development environment in an easy-to-understand manner to start your development.



Quick Start Guide - Tool & Software Introduction for RL78 | Renesas



Renesas Emulator Selection Guide for RL78 | Renesas



Flash Programmer Quick Start Guide - Comparison of Renesas Flash Programmer and PG-FP6 | Renesas



e<sup>2</sup> studio Quick Start Guide (1/3)
- Installation for RX and RL78 |
Renesas



How To Use Smart Configurator
- Walkthrough the Settings of
Clocks and Components | Renesas



OE Solution for Reducing Effort and Cost in Application Development | Renesas

#### **Evaluation Board**

The RL78 family general-purpose kit offers an optimal environment to evaluate the RL78 MCU performance and accelerate embedded system development. With diverse lineup from entry level, they are suitable for a wide range of use cases including educational purposes and prototype development. Additionally, all evaluation kits work with Renesas IDEs "e² studio" and "CS+", as well as IAR Systems' "IAR Embedded Workbench", to support development need globally.

#### **Extensive Development Support**

 Comprehensive documents and samples, from basic settings to application examples, supporting evaluation and development smoothly

#### **Reference Design Data**

 Circuit diagrams, BOM lists, and design data available as reference for customization and application development.

#### **Low Power Consumption Evaluation**

 Easy evaluate the low power consumption performance of RL78 MCU, accelerating the development of energy-efficient applications.

#### **High Expandability**

 Access to all MCU signal pins, making functional expansion and application development easy.

#### **Flexible Application Development**

 Compatible with Renesas sensors and communication modules, enabling quick proof-of-concept assemble of a wide range of applications such as IoT and industrial equipment.

#### **Product Lineup**

DI 70 Vis Dansfalla	Supported MCU Groups						
RL78 Kit Portfolio	General	LCD	Motor/Inverter	ASSP	Automotive		
Fast Prototyping Board (FPB)  ■ Includes an emulator circuit, allowing for writing and debugging simply by connecting a USB cable. ■ Includes Arduino and Pmod™ interfaces, offering high expandability. ■ Full access all the functions of MCU.	FPB-RL78G23 (64/128pin) FPB-RL78G22 FPB-RL78G16 FPB-RL78G15 FPB-RL78G1P FPB-RL78G1N	FPB-RL78L23	FPB-RL78G14 FPB-RL78G24 FPB-RL78G1M	FPB-RL78I1C			
Target Board (TB) ■ Easy evaluation by connecting with Emulator E2 and E2 lite. ■ Full access all the functions of the MCU.	TB-RL78G13A TB-RL78G13 TB-RL78G1C TB-RL78G1A TB-RL78G12 TB-RL78G11 TB-RL78G10	TB-RL78L1C TB-RL78L13 TB-RL78L12	TB-RL78G14 TB-RL78G1F TB-RL78G1G	TB-RL78I1B TB-RL78I1A TB-RL78I1D	TB-RL78/F25 TB-RL78/F24 TB-RL78/F22 TB-RL78/F15 TB-RL78/F14 TB-RL78/F13 TB-RL78/F12		
Renesas Starter Kit  Offer one-stop development environments for evaluation and feasibility study.					Y-ASK-RL78/F15 Y-ASK-RL78/F24 Y-ASK-RL78/F14 Y-ASK-RL78/F13 Y-ASK-RL78/F12		
Other Boards	RL78/G1D Evaluation Board						

#### **Board Image**











FPB-RL78G23

FPB-RL78L23

TB-RL78I1B

Y-ASK-RL78/F24

Fast Prototyping Board

Target Board

Renesas Starter Kit (Board & E2 emulator Lite)

A full lineup of all kits including solution kits is available. Click <u>here</u> for details



#### **Integrated Development Environment**

Renesas have prepared an integrated development environment that strongly supports the entire embedded system development. You can choose from an open source-based environment with various expansion functions, an original Renesas development environment, or a partner-made environment according to your usage scenario.

# e<sup>2</sup> studio e<sup>2</sup> studio

This development environment based on Eclipse provides a large number of functions and is a popular choice among users developing for RL78 the world over. A variety of compilers are supported, and you can create projects using simple operations.





This package provides access to basic software tools with a single install. Recommended for users looking for a convenient way to make use of basic functions.

#### IAR Embedded Workbench® for RL78



This is the C/C++ integrated development environment most broadly used internationally as a high-performance and highly reliable commercial tool for embedded software development. All functions are integrated seamlessly to maximize development efficiency. The static response analysis add-on provide a low-cost way for developers to dramatically increase the quality of their code.

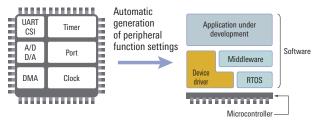
#### **Visual Studio Code (Source Code Editor)**



<u>Visual Studio Code</u> from Microsoft, available on <u>Microsoft Visual Marketplace</u>, provides build and debug functions (extensions) for developing applications using Renesas MCUs.

Renesas offers Solution Toolkits to provide for more efficient development. Each Solution Toolkit includes a variety of plug-ins that will assist in coding and the development of applications.

#### Smart configurator/Code generation plugin



QE (Quick and Effective tool)

# Quick and Effective tool solution

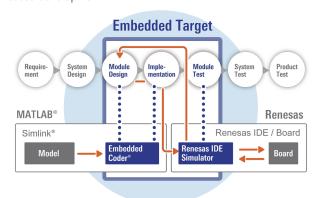
QE tools allow you to just make simple setting to start developing your applications.



Tools that automatically generate code for device drivers, the software that controls microcontroller peripheral functions, based on settings entered via a GUI. A pin table can be displayed to check the settings of multiplexed pins. Also, Smart Configurator provides a quick and smart way of combining and configuring software to meet your needs, such as by configuring peripheral pins and importing middleware and drivers.

# Embedded Target for RL78 Family (Model-Based Development Environment)

Links e<sup>2</sup> studio or CS+ with MATLAB® or Simulink® to assist customers with model-based development.



MATLAB®, Simulink®, and Embedded Coder® are registered trademarks of MathWorks, Inc.

#### **Compiler**

Renesas is preparing a range of compilers to maximize the performance of RL78, from its own compilers to open source compilers from its partners.



#### Renesas C Compiler Package for RL78 Family (CC-RL)

(node locked and floating license versions)

Provides powerful optimized features that help you realize the full performance potential of Renesas' proprietary RL78 CPU cores and boost development efficiency. A selection of compiler license formats are available.



#### IAR C/C++ Compiler for RL78

Original compilers from IAR Systems generate code that leads the industry in speed and compactness.



#### **LLVM for Renesas RL78**

Open-source compiler, provided for free. This can be used in combination with the e<sup>2</sup> studio IDE.

#### **Simulator**

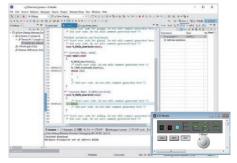
#### Debugging on a PC [CS+ simulator, e<sup>2</sup> studio simulator]

Simulator enabling source-level debugging of applications in the CS+ and e2 studio integrated development environment before the target system exists

- Ability to evaluate software modules in a manner very similar to evaluation on the actual device
- Rich break functions and coverage measurement functions



Simulator for CS+



e<sup>2</sup> studio simulator

#### **Emulator**

Renesas provides E2 emulator Lite, E2 emulator and IECUBE to meet the debugging requirements of customers.

Lineup		Features	Trace Function	Time Measurement Function	Coverage Function	Flash Programming Function	Device Equivalence	Extended Function	
E2 Emulator Lite Entry model		An on-chip debugging emulator and flash programmer that provides standard debugging functions at low cost.	Voc*1 1*2		functions at low cost.				No
E2 Emulator Correspondence to extended functions	RENESAS	An advanced on-chip debugging emulator and flash programmer developed based on a concept of "improvement of development efficiency".	Yes*1	1"	No	Yes	<b>○*</b> 4	Yes*6	
IECUBE Support for powerful debugging functions		Advanced debugging functions including tracing of all instructions, measurement of time between events, and coverage.	Yes	2*3	Yes	No	O*5	No	

Notes: 1. Microcontrollers with on-chip trace support only 2. Capable of measuring run-break duration 3. Capable of measuring time between events 4. Actual device operating 5. Emulation of device operation for FPGA, etc 6. Current consumption tuning solution



#### Real-time OS

#### RI78V4 V2 real-time OS compliant with µITRON standard

A high-quality real-time multitasking environment for embedded systems

- Complies with worldwide standard µITRON 4.0 specification
- Compact design suitable for ROM storage
- Full complement of service calls
- Excellent real-time performance (interrupt response time, task switching time)
- Support for convenient functions when used in conjunction with the CS+ integrated development environment (automatic setting of options required to build the OS, display of the state of objects managed by the OS such as tasks and semaphores, graphical display of task operation history and service call issue history)
- Supports the RL78 family C compiler package (CC-RL)
- Provide a trial version

System		ory Area			Extended S···  Data Queue	Mailbox	Timer Que	
Object	Name	ID	Status	Wait Factor	Wait Data	Time Left	Interrupt	Ci -
1.8	. ID_TASK1	0x01	Dormant	-	-	-	Enable	1
. 9	ID_TASK2	0x02	Waiting	FLG(ID_FLG1) ORW FIFO	0x1	TMO_FEVR	Enable	3
- 9	ID_TASK3	0x03	Waiting	MBX(ID_MBX1) FIFO	-	TMO_FEVR	Enable	3
. 9	ID_TASK4	0x04	Dormant	-	-	-	Enable	7
. 9	ID_TASK5	0x05	Dormant.	-	-	-	Enable	5



Illustration of function screens in conjunction with CS+

#### Middleware, Driver

Renesas provides various middleware and drivers for applications of the RL78 Family. The concept of common interface design provides flexible compatibility with many product types of the RL78 Family. Middleware and drivers for the RL78 family are available in two formats: bundled with sample programs and the RL78 Software Integration System (SIS), supporting efficient design to shorten the time to market.

The RL78 Software Integration System can be easily integrated into a project using e<sup>2</sup> studio or Smart Configurator.

#### Middleware, Driver **RL78 Software Integration System** USB Audio ADPCM encoder / decoder USB driver Capacitive touch sensor Signal Processing Memory drivers Touch module MIDI interface module · Digital filters (FIR and IIR) · SPI mode multi-media card driver · CTSU module Memory Drive FFT library SPI serial flash driver Serial NOR Flash Memory control Various Drivers Crypto / Security · SPI single-master driver . IR Receiver Driver module module · Renesas SPI serial EEPROM driver AES library Reality Al DMX512 Receive module · Renesas I2C serial EEPROM driver . SHA hash function library PMBus Slave module • UART Communication module RSA library I<sup>2</sup>C single-master driver PMBus Master module Data Collector Control module Protocol stacks File system US159-DA14531EVZ BLE Control · Data Shipper Control module Open-source FAT file system • Sub-GHz/Wi-SUN protocol stack US159-DA16XXXMEVZ Wi-Fi On-chip Flash memory (TFAT) Bluetooth® Low Energy protocol stack Control Module Renesas Flash Driver On-chip Flash memory Software development environment RLIN3 module Self-programming libraries · (DALI protocol stack) · RS-CANED lite module · PTX NFC control module

#### Flash Self-programming

The custom driver software and the software libraries for flash programming can be used to write programs or data to microcontrollers that require programming in the field after shipment.

- Driver
- Renesas Flash Driver (RFD) RL78
- EEPROM Emulation Software (EES) RL78
- Sample Program
- Renesas Flash Sample Program
- Library
- RL78 family Flash Self-Programming Library (FSL)
- RL78 family Data Flash Library (FDL)
- RL78 family EEPROM Emulation Library (EEL)

The flash memory programming software provided for RL78 family depends on MCU group. For detailed information, please refer to the product page below.

Code flash library

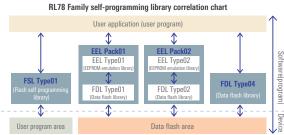
www.renesas.com/flash\_libraries/self\_prg

Data flash library

www.renesas.com/flash\_libraries/data\_flash

# Example illustration Flash self-programming Updating the RL78 firmware in a camera

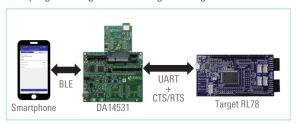
# Renesas Flash Driver correlation chart User Application (User Program) EEPROM Emulation Software (EES) RFD RL78 Component for Code Flash for Data Flash Memory Data Flash Memory



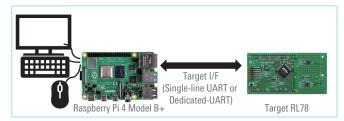
Note: EEL Pack01 and Pack02 each include a own custom data flash library (FDL).

#### Flash Reprogramming Solution

Renesas offers various application notes and sample programs that showcase reference implementations for post-shipment field updates using either Self-programming or Serial Programming.



Flash reprogramming example using Self-programming



Flash reprogramming example using Serial Programming

#### **QE** (Quick and Effective) Tools Tailored for Many Application Types

#### Renesas Solutions and Tools that Lighten the Application Development Workload

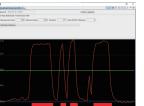
#### **QE** (Quick and Effective tool)

QE development support tools add development knowhow (functionality) to applications within the integrated development environment, helping to minimize the application development workload.

# QE for Capacitive Touch: Development Support Tool for Capacitive Touch Sensor Applications

This tool simplifies making initial touch interface settings and tuning sensitivity, reducing the time required for development.





# **QE** for Motor Development Support Tool for Motor Applications This tool works in conjunction with Renesas Motor Workbench and

This tool works in conjunction with Renesas Motor Workbench and uses its Analyzer function to monitor the operation status of motor control programs, enabling verification of motor control systems.





#### **QE for Segment LCD: Development Assistance Tool for Segment LCD**

This tool assists throughout the entire development flow for solutions using segment LCD, covering functions such as LCD pin configuration, wiring verification, display pattern creation, and sample program generation. Using this tool makes the development of the segment LCD solution simple, quick, and efficient.





#### **QE for OTA: Development Assistance Tool for Firmware Update**

This tool lets you easily try out the over the air (OTA) functions of leading cloud services such as AWS. You can use it to evaluate everything from creating firmware updates, uploading them to the cloud, and executing OTA updates. It is now possible to update the firmware of a Secondary MCU connected to the Primary MCU via UART, and to update the firmware without using the cloud.

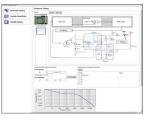




# QE for Lighting & Power: Development Assistance Tool for Lighting System

This tool assists smart lighting system solution development, which seamlessly integrates with Renesas' lighting system libraries, solution programs, various compilers, and evaluation boards. Using this tool, you can configure lighting communication setting, and adjust the power control parameters in real-time. Therefore, it makes the development of the smart lighting solution simple, quick, and efficient.







#### **Embedded Target for RL78 Family (Model-Based Development Environment)**

#### Implementation from model to Renesas MCU is automated to streamline software development

Embedded Target (evaluation version) verifies algorithms to aid customers' model-based development by linking a Renesas integrated development environment (CS+ or e² studio) with MATLAB® or Simulink® from MathWorks.

Software development can be streamlined by automatically porting code for an embedded MCU and ensuring the state in which buildand debug is performed in order to perform Processor-In-the-Loop simulation. The advanced analysis function of the Renesas integrated development environment is also useful for improving a model.

#### Seamless development, from building an environment to verifying a model's performance

#### Automatically building a PILS\* environment

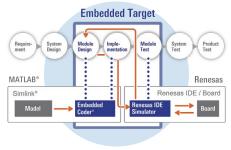
\*Processor In the Loop Simulation

Generate models for PILS from Simulink®models with one click.

A channel for communication between MATLAB® and the Renesas integrated development environment is built automatically.

#### Automatically generating a projectfor the Renesas integrated development environment

Embedded Coder®incorporates code generated from a verification model and automatically generates buildable/debuggableprojects for CS+/e² studio.



MATLAB®, Simulink®, and Embedded Coder® are registered trademarks of MathWorks. Inc.

#### Verifying a model's performance using a Renesas MCU or simulator

The actual equipment debugger or simulator function of CS+ or e² studio can be used for PIL simulation, and the analysis functions of CS+ or e² studio (including the execution time measurement function) can be used for model performance verification.

#### **Programming Tools**

#### Programming controlled by a PC [Renesas Flash Programmer flash programming software]

- Simple GUI specialized for programming
- Batch processing efficiently for programming large quantities at mass production
- PC-controlled programming using E2 emulator Lite, E2 emulator or serial
- Ability to embed unique code



#### Programming controlled by a PC or stand-alone programming [PG-FP6 flash programmer]

- Stand-alone programming
- Programming controlled by a PC using a dedicated GUI
- Ability to store settings for up to eight environments
- Ideal for use on the production line (command control, remote control)
- Ability to embed unique code

#### Ordering pre-programmed ROM\*1

■ Pre-programmed flash memory products from Renesas Electronics

Note: 1. The support status differs depending on the product. Please contact a Renesas sales company or agent for details





# Winning Combinations 2

#### **Speeding Up Application Design for Customers**

#### More Than 400 Winning Combinations for a Variety of Applications

Renesas offers comprehensive full-system solutions, featuring Winning Combinations of devices across our embedded processing, power, analog, and connectivity portfolios, to meet your application needs. With these engineering-vetted designs, you can take advantage of an elevated platform for your design ideas, accelerate your product development cycle, and lower overall risk to bring your designs to market.

Renesas continues to make available new Winning Combinations, including many featuring RL78 Family MCUs, one after another.

#### **Key Technologies**



Artificial Intelligence (AI)
Functional Safety
Gallium Nitride (GaN) Power
Human Machine Interface (HMI)

Motor Control Security Tracking & Locationing USB

#### **Consumer Electronics**



Cameras Computing Home Entertainment

Power Adapters & Chargers Wearables

#### Industrial



Appliances
Building Automation
Industrial Automation
Medical & Healthcare

Metering Motor Drives & Robotics Renewable Energy & Grid Retail, Automation & Payment

#### **Communications Infrastructure**



Cloud & Enterprise Memory

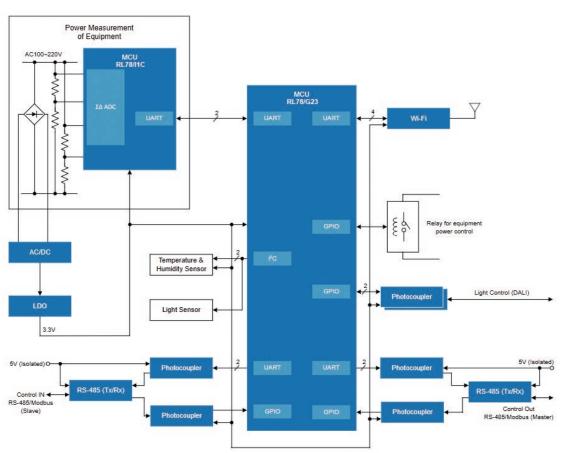
Networking & Fixed Access Wireless Infrastructure

#### **Example Winning Combination: Smart Home Central Control Box**



Easy-to-read block diagram

Easy access to related Renesas product pages





# Renesas Enabling Intelligence from the Cloud to the Edge and Endpoint Sustainably

Our comprehensive AI/ML developer stack transforms Vision, Voice, and Real-time Analytics applications. The extensive portfolios in sensing, connectivity, computing, and actuation, we cover all IoT layers. Our rich software, tools, solution offerings, and partner ecosystem provide the essential elements to accelerate your AloT designs.





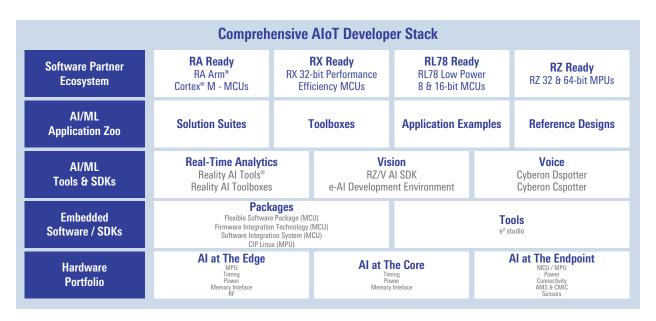


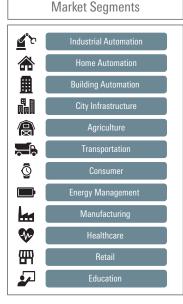
#### Why Choose Renesas?

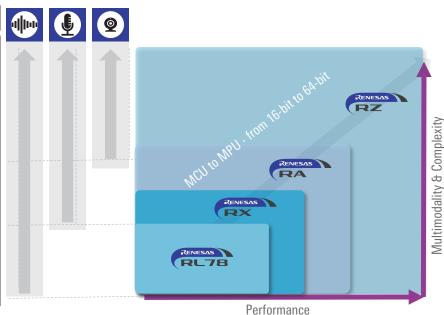
Comprehensive AI/ML developer stack for vision, voice, and real-time analytics use cases. Tools and workflows for multiple developer journeys (bring-your-own-model, transfer learning, bespoke consulting and more). Rich library of easy-to-find solutions (application examples, toolboxes, solution suites, hardware reference kits). Broad ecosystem of trusted partners offering commercial-grade building blocks.

#### **SIDE NOTE: Why Decentralize Intelligence?**

Traditionally, the IoT has been built on a cloud-centric intelligence architecture. To truly scale and enable intelligence at all levels of the network, a decentralized intelligence architecture is needed. This means running cloud-independent inference engines on power-efficient or tiny computers within the edge and endpoints.





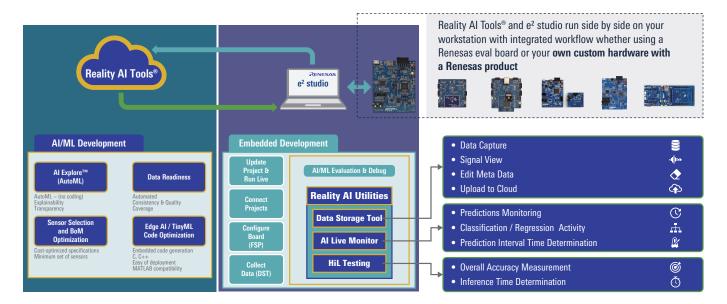


#### **Application Zoo**

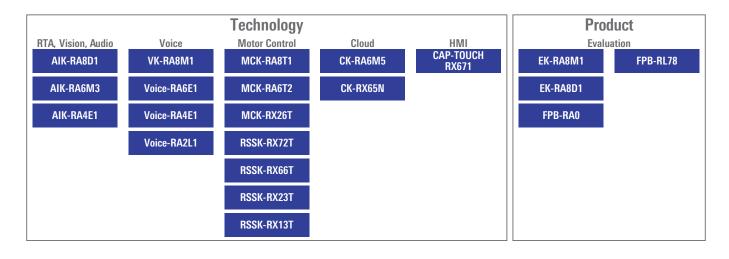
Real-life application examples supported across the wide range of Renesas MCU/MPU and reference/demonstration kits. Pretrained models for vision, voice and realtime analytics.



#### **Reality AI Tools**



#### **Reference Kits & Develooment Boards**





# **Motor Control Solution**

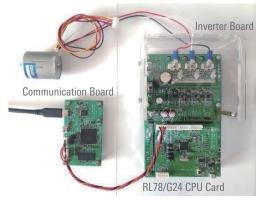
Motor Control Development Kits for RL78 Family enable easy evaluation of motor control with permanent magnet synchronous motors (brushless DC motors). This kit is configured to run sample code, which are downloaded from webpage. In addition, development support tools such as Renesas Motor Workbench and QE for Motor encourage easy analyzing and tuning for motor control, so you can immediately start evaluation using RL78 Family MCU.

#### MCEK-RL78/G24

#### Features

- Equipped with 16-bit RL78/G24 microcontroller.
- Controlled by Hall sensor and Encoder with BLDC motor, or Sensorless control by phase voltage or sensing current.
- Supports 1-shunt 2-shunt and 3-shunt current sensing.
- Zero-crossing detection with built-in comparator.
- Supports Motor Control Development Support Tool Renesas Motor Workbench and QE for Motor.
- Compatible with RL78/G1F CPU card.

'				
MCU	RL78/G24			
Product ID	MCEK-RL78/G24			
Kit Name	RL78/G24 Motor Control Evaluation Kit			
Part Name	RTK0EMG24SS00000BJ			
Bundled items	<ul> <li>Inverter Board (RTK0EMGPLVB00000BJ)</li> <li>RL78/G24 CPU Card (RTK0EMG240C00000BJ)</li> <li>Communication Board (RTK0EMXC90Z00000BJ)</li> <li>Permanent Magnet Synchronous Motor (TG-55L-KA)</li> <li>Various cables, screws, spacers</li> </ul>			
Inverter	Rated voltage	50V (Input voltage: 12~50V)		
specifications	Rated current	30A (Peak current of each phase)		
	Protect functions	Overcurrent detection, etc.		
Sample Code	RL78/G24 120-degree conducting control of permanent magnetic synchronous motor     RL78/G24 Sensorless vector control for permanent magnetic synchronous motor     RL78/G24 Sensorless vector control for permanent magnetic synchronous motor FAA Library			
Resources	RL78/G24 Motor Control Evaluation Kit User's Manual     Schematics, BOM			



MCEK-RL78G24

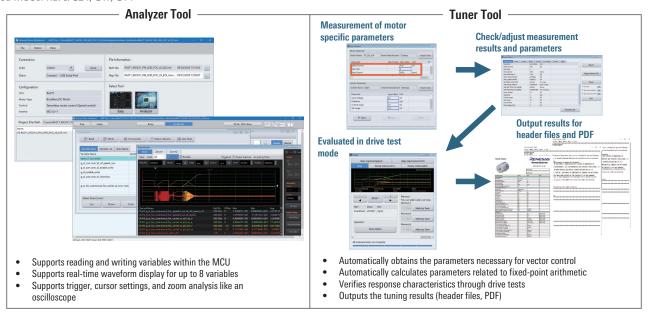
#### **Renesas Motor Workbench**

Renesas Motor Workbench is a development support tool for debugging, analyzing and tuning motor control programs. With user friendly GUI, visually engaging experience while providing variable monitoring as real time waveform.

#### Features

- With use of motor included to Motor Control Kit, testing and confirming the operation of motor
- Motor Specific parameter measurement for various motor as well as debugging and adjusting the parameters.
- With motor embedded to final application, RMW can confirm the motor operation.

Supported MCUs: RL78/G24, G1F, G14

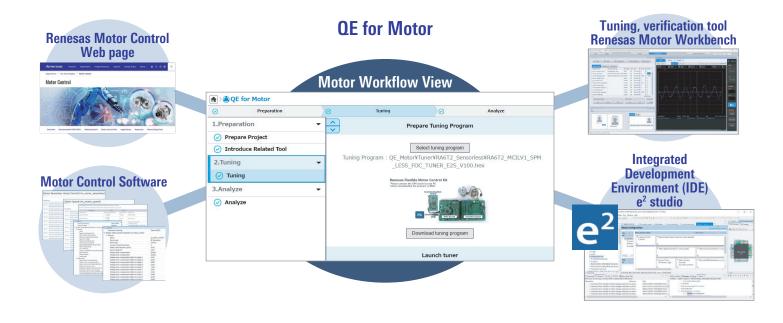


#### **QE** for Motor

<u>QE for Motor</u> is a software development support tool for motors that enables easy implementation of Renesas motor solutions by simply following a guided workflow. It is provided as a plug-in extension for the Renesas IDE "e² studio".

#### Features

- Simply follow the workflow to develop motor software
- Help configure motor middleware and drivers easily
- Linked to Renesas Motor Workbench for tuning and analysis of motors





#### RTK7F124FGS00000BJ

12V Motor Control Evaluation System for RL78/F24 allows users to quick and easy start of motor evaluation using RL78/F24. Motor Control Peripheral Blockset useable in MATLAB®/Simulink® is also supported.

#### Features

- Equipped with 16-bit RL78/F24 microcontroller.
- Controlled by Sensorless control with BLDC motor by phase voltage or sensing current.
- Supports 1-shunt 2-shunt and 3-shunt current sensing.

		<del>o</del>		
MCU	RL78/F24			
Product ID	RTK7F124FGS00000BJ			
Kit Name	12 V Motor Control Evaluation System for RL78/F24			
Part Name	RTK7F124FGS00000BJ			
Bundled items	RL78/F24 CPU + Inverter Board: (RTK7F124FGS00000BJ)  OCD Conversion Board  Permanent Magnet Synchronous Motor (TG-55N-KA)  Various cables, screws, spacers			
Inverter	Rated voltage	12V (Operating voltage: 8~19V)		
specifications	Rated current	5 Arms		
	Protect functions DC Bus Voltage Detection, Three-phase Current Detection, Overcurrent Detection, PCB Temperature Detection			
Sample Code	RL78/F24 Sensorless Trapezoidal Control of BLDC Motor by MCU     RL78/F24 Single-Shunt Sensorless Vector Control for PMSM by MCU     RL78/F24 Three-Shunt Sensorless Vector Control for PMSM by MCU			
Resources	Renesas Solution Starter Kit 12 V Motor Control Evaluation System for RL78/F24 User's     Manual     Circuit Diagram, Parts List, PWB Pattern Diagram			



#### **RL78 Motor Control Peripheral Blockset**

<u>RL78 Motor Control Peripheral Blockset</u> is Renesas motor control Model Based Design (MBD) solution that enables system-level simulation and evaluation in MATLAB®/Simulink®.

#### Simulink® library that reflects MCU peripheral functions behavior

- Blockset created based on circuit design information
- Enables simulation that reflects actual MCU operation timing

#### Configurable peripheral functions within the model

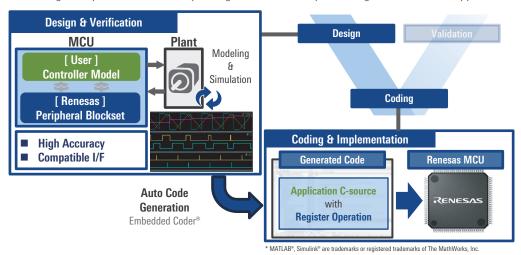
- Configure operations using blocks equivalent to MCU registers
- Perform system evaluation on the user model equivalent to the actual hardware

#### **Target MCU and Peripheral Function**

MCU	RL78/F24
Timers	Timer RDe (TRD)
Analog	12-bit A/D Converter (ADC)
Accelerator	Application Accelerator Unit (AAU)

#### MCU implementation via automatic code generation

Automatically generates register operation code corresponding to the blocks, implementing to MCU without application code modification



# **Capacitive Touch Sensing Solution**

Renesas offers a capacitive touch solution that supports creating a user-friendly environment to lower hurdles in capacitive touch sensor application development, proposing revolutionary designs for switching devices and equipment.

The capacitive touch evaluation system includes a CPU board and a self-capacitance evaluation board for use as a touch application board. It has everything you'll need to get started evaluating applications incorporating buttons, sliders, and wheels.

#### **Capacitive Touch Evaluation Systems**

MCU	RL78/F25	RL78/F22	RL78/L23	RL78/G23	RL78/G22	RL78/G16
Product ID	RSSK-RL78F25	RSSK-RL78F22	RSSK-RL78L23	RSSK-RL78G23	RSSK-RL78G22	RSSK-RL78G16
Kit name	Capacitive Touch Evaluation System for RL78/F25	Capacitive Touch Evaluation System for RL78/F22	Capacitive Touch Evaluation System for RL78/L23	Capacitive Touch Evaluation System for RL78/G23	Capacitive Touch Evaluation System for RL78/G22	Capacitive Touch Evaluation System for RL78/G16
Part No.	RTK7F125FPST0000BJ	RTK7F122FGST0000BJ	RTK0EG0063S01001BJ	RTK0EG0030S01001BJ	RTK0EG0042S01001BJ	RTK0EG0047S01001BJ
Board Image						
MCU	R7F125FPL3AFB-C	R7F122FGG3AFB	R7F100LPL3CFB	R7F100GSN2DFB	R7F102GGE2DFB	R5F121BCAFP
Package	100-pin LFQFP	48-pin LFQFP	100-pin LFQFP	128-pin LFQFP	48-pin LFQFP	32-pin LQFP
ROM/RAM	512KB/40KB	128KB/12KB	512KB/32KB	768KB/48KB	64KB/4KB	32KB/2KB
Number of Touch pins	31	12	36	32	29	15
Bundled items	Evaluation board     RL78F25 CPU board     Self-capacitance     electrode board     (buttons, slider and     wheel)     First Step Guide	Evaluation board     RL78/F22 CPU board     Self-capacitance     electrode board     (buttons, slider and wheel)     First Step Guide	Evaluation board     RL78/L23 CPU board     Self-capacitance     electrode board     (buttons, slider and wheel)     First Step Guide	Evaluation board     RL78/G23 CPU board     Self-capacitance     electrode board     (buttons, slider and     wheel)     First Step Guide	Evaluation board     RL78/G22 CPU board     Self-capacitance     electrode board     (buttons, slider and     wheel)     First Step Guide	Evaluation board     RL78/G16 CPU board     Self-capacitance     electrode board     (buttons, slider and     wheel)     First Step Guide

#### **QE** for Capacitive Touch: Development Assistance Tool for Capacitive Touch Sensors

<u>QE for Capacitive Touch</u> is a solution toolkit for assisting in the development of embedded systems that include the use of capacitive touch. It supports the initial settings of the touch user interface and the tuning of the sensitivity. It can be developed with a simple GUI according to the workflow.

#### **Monitoring Function:**

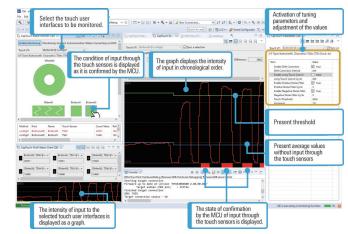
- This function displays waveforms of measurement values as capacitance changes over time.
- You can adjust a variety of tuning parameters while monitoring the capacitance waveforms.
- Supports saving displayed waveforms to a log.

#### **Tuning Function:**

- Automatic tuning performs configuration of parameter settings to match the board under development.
- Manual tuning and <u>advanced mode tuning</u> allow fine-grained customization.

Tutorial videos will help you develop the touch sensor function.

- QE for Capacitive Touch Tutorial —<u>Settings for RL78</u>-
- QE for Capacitive Touch Tutorial —Tuning for RL78-
- QE for Capacitive Touch Tutorial -Monitoring RL78-



Monitoring and parameter adjustment functions



#### Reference Design

#### **Touchless-Button Reference Design**

It can detect the approach of fingers and hands without physical contact. The electrode detects the proximity of the fingers or hands via self-capacitance and turns the LED on/off.

Resource information	Title
Web	Capacitive Touch Proximity Touch Reference Design
Video	Touchless Button Demo
Sample code	RL78/G23 Touchless Button Demo Solution Sample Software
Document	RL78/G23 Touchless Button Demo Solution Sample Software Application Note



#### **Low Power Consumption Solution**

The automatic detection function and multiple electrode connection function enable low power consumption standby.

#### **Automatic Judgment Function\*:**

This function enable to operate from measurement to touch judgment without the need to activate the CPU. It is not necessary to periodically wake the CPU, allowing for reduced power consumption.

#### **Multiple Electrode Connection (MEC) Function:**

It is a function of connecting self-capacitance type electrodes inside CTSU to measure them as a single electrode.

It used to be necessary to use a particular button, such as the power button, to wake the MCU from the low-power mode, but the multiple electrode connection function enables wakeup from low-power mode by touching any button.

\* Achieved when used with SNOOZE Mode Sequencer (SMS) in RL78/L23, RL78/G22 and RL78/G23.

Resource information	Title
Sample code	RL78/L23 Low power consumption Smart Wakeup Solution
Document	RL78/L23 Low Power Consumption Smart Wakeup Solution Application Note
Sample code	RL78/F25 Low power consumption Smart Wakeup Solution
Document	RL78/F25 Low Power Consumption Smart Wakeup Solution Application Note
Sample code	RL78/G22 Capacitive Touch Low Power Guide (SMS / MEC function)
Document	RL78/G22 Capacitive Touch Low Power Guide (SMS / MEC function) Application Note

#### **Appliance UI Demo Solution**

Offering excellent touch UI with functionality & design by high-sensitivity sensing of capacitive touch sensor & low power.

- Smart switching between proximity sensor and touch button without changing the electrode.
- New generation RL78 Family MCUs standby function (ex. SMS) and MEC functions reduce the power consumption in standby.

Resource information	Title
Video	RL78/G22 Appliance UI Demo -Contributing to The Innovative UI of Kitchen Appliances
Sample code	RL78/G22 Sample S/W for Home Appliance Panel UI Demo Using MEC Function
Document	RL78/G22 Sample S/W for Home Appliance Panel UI Demo Using MEC Function Application Note



# **IoT Cloud Over-the-Air (OTA) Solutions**



#### IoT Cloud Over-the-Air (OTA) Solutions to Support IoT Development

#### **Development Platforms for Cloud (IoT) Devices**

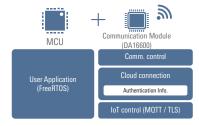
Expedite solution development with quick evaluation and proof of concept development

#### **AWS Certified Hardware Environment**



AWS Certified for RL78/G23 MCU Evaluation Board and Wi-Fi + Bluetooth LE Combo Pmod Board

#### Sample software



Providing Getting Started Guide for Connecting
Amazon Web Services in Wi-Fi

(Sample Software: iot-reference-r178)

# Development Environment that Simplifies and Facilitates IoT Development



e<sup>2</sup> studio integrated development environment from Renesas

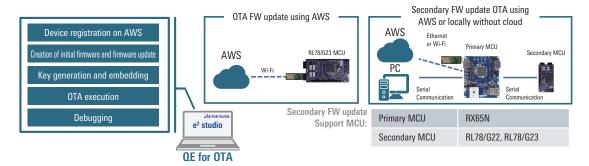
- Smart configuration: Setting configuration for peripheral functions and pins
- QE for OTA Development Assistance Tool

OTA with cloud RL78/G23

#### "QE for OTA" Development Assistance Tool for Firmware update

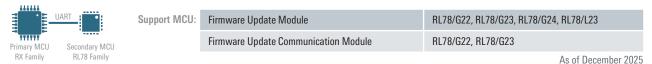
QE for OTA is development support tool that is available free of charge for developers to implement over-the-air (OTA) firmware updates with a simple and easy graphical user interface. It allows you to reduce the time required until OTA execution by 90% compared with configuring setting manually.

QE for OTA also supports firmware update of secondary MCU via primary MCU as well as firmware updates for MCUs that are not connected to the cloud.



#### Secure firmware update solution with secure boot <a>I</a>

The "Firmware Update module" is a software that allows you to easily incorporate firmware update and secure boot functions into your system. In addition, when the firmware of the secondary MCU is updated, the software "Firmware Update Communication module" is provided to control the communication between the microcontrollers and the primary MCU.





#### **BA Solutions**

Building Automation (BA) is growing to bring comfort, safety, and energy savings to people, buildings, and communities with solutions to connect, protect, and conserve.

Renesas offers solutions for building systems (fire & safety and lighting) to enable buildings more convenient, secure, and energy efficient.

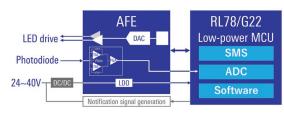


#### Fire & Safety Solution

A high-accuracy smoke detection solution using multiple LEDs (infrared LED, blue LED) and photodiode. By adopting the ultra-low power RL78/G22 with built-in SN00ZE mode sequencer (SMS) and combining it with an AFE IC that integrates the necessary AFE functions for dual-wavelength systems, the solution achieves reduced system costs and long-term operation.

#### Features & Benefits

- High Accuracy: Utilizing the principle that different wavelengths of light have different scattering efficiencies for different sizes of smoke particles, using blue LED and IR LED to detect smoke.
- Reduce BOM Cost: The MCU and optical smoke detector AFE IC configuration can be simplified, minimizing external components and reducing PCB size.
- Low Power Consumption: Using the RL78 MCU, which achieves the industry's lowest power consumption, and further utilizing the SN00ZE mode sequencer to provide an ultra-low power smoke detector solution.



Block Diagram

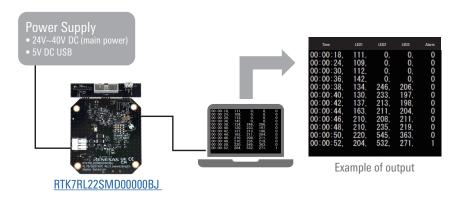


Standby Current Comparison

#### **Use Cases**

When smoke is detected, the board activates the indicator LED as an alarm.

The measurement result are obtained as A/D conversion values. By connecting the USB serial converter between the board and PC, the terminal software can display the A/D conversion values.





#### **Documents List**

- Quick Start Guide
   URL: Board Quick Start Guide
- Software User's Manual URL: Software User's Manual
- Design Application Note <u>URL: Design Application Note</u>

#### **Lighting Solutions**

#### **Overview of Lighting Systems**

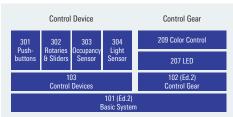
Building lighting is increasingly expected to meet key needs: energy saving, low maintenance, and comfort.

To meet these needs, lighting system have advanced step by step: Networking  $\to$  Task & Ambient  $\to$  Dimming & Color tuning  $\to$  Digital Power

In this progression, DALI has emerged as the open standard for lighting, enabling precise, flexible, and interoperable control.

#### **Definition of DALI and DALI Stacks**

- DALI (Digital Addressable Lighting Interface) is an international communication protocol standard for building lighting applications that defined by IEC62386.
- The communication consists of a Control Device and Control Gear.



DALI Stacks

#### **Strengths of Renesas DALI**

#### • Ensure compatibility:

✓ Provide protocol stack confirmed by official tester. Control Gear: 102, 207, 209 Control Device: 103, 301, 302, 303, 304

#### • Improved development efficiency:

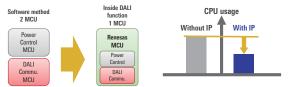
✓ Eliminates the need for coding and validation of basic DALI communication, reducing development effort.



✓ Includes a software update function, enabling remote updates without removing the device

#### • Low Cost with High Value

- √ Traditionally required two MCUs (control MCU + communication MCU), but Renesas integrates both into a single chip.
- ✓ Provides products with dedicated IP/functions, advantageous in terms of CPU load and software scale



#### **Renesas Solutions to Support Lighting Needs**

# DALI Solutions (Defined by IEC62386) Central Tablet/Smart Phone Application Control Phone Master LED 1 (100%) LED 2 (55%) LED 3 (0%) LED 4 (85%) For Inaster LED 4 (65%) LED 5 (20%) LED 64 (failure) Failure data Control Device Communication LED Emergency light, Color mix, etc

#### **Evaluation board & Specification**

	<u>Lighting Communication Master</u>	DC/DC LED Control
P/N	RTK7RL23LMP00000BJ	RTK7RLG240P00000BJ
Device	RL78/G23	RL78/G24
Input	DC5V or USB	DC5V
Purpose	Touch type HMI for DALI input device	Basic Evaluation for Digital power and DALI
AC/DC	-	_
DC/DC	-	Buck (High side)
Output	-	350mA, 3ch
Dimming Method	-	DC dimming
Interface	DALI-2/DMX512/IR/Switch	DALI-2 /IR/DMX512/PMBus/SMBus
DALI Stack	103, 301, 302, 303, 304	102, 207, 209

#### **Tools & Documents Support**

#### **Support Tools**





- **QE** for Lighting
- ✓ GUI support wide range standards, easy to confirm operation
- √ QE for Lighting can quickly develop softer for use with DALI control gear

#### **Documents**



Users Manuals, Application Notes, etc.



# **Security Solution**

The RL78/F24 Security RSSK is an ideal kit for evaluating and developing the security features of the RL78/F24, as well as for beginners learning about security. It enables easy execution of functions such as encryption and decryption, secure boot, key registration, random number generation, and challenge-response using embedded software and the GUI tools. The kit includes three GUI tools, making it simple to verify and develop security features.

#### RTK7F124FPSS0000BJ

#### Features

- Evaluate RL78/F24 security functions
- Supports security data generation with the GUI tools
- NDA authentication with challenge and response
- Users who have not signed an NDA can use it for security study purposes with limited functionality.
- Equipped with CAN transceiver and LIN transceiver

MCU	RL78/F24
Product ID	RTK7F124FPSS0000BJ
Kit Name	RL78/F24 Security RSSK
Part Name	RTK7F124FPSS0000BJ
Bundled items	RL78/F24 Security RSSK board USB cable USB memory (documentation, GUI tools, software)
Manual/APN	RL78/F24 Security RSSK Board User's Manual RL78/F24 Security RSSK Installation Guide RL78/F24 Security RSSK User's Manual* The documents intended for NDA users are included in the kit and protected by a password.
Sample Code	RL78/F24 OTA Sample Software



RL78/F24 Security RSSK (RTK7F124FPSS0000BJ)

#### **GUI TOOL**

The Boot Loader Setting Tool can generate a MAC for Secure Boot (Hardware) and write the generated code to the RL78/F24 Flash memory. The tool is used by connecting an NDA-authenticated RL78/F24 Security RSSK to a PC. Note: NDA is required for use.

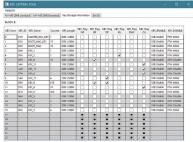
The Key Setting Tool is a user-friendly utility for securely registering keys based on the SHE standard. It enables easy execution of M1 to M5 calculations, key registration, and verification of registered key information through a simple GUI. Complex processes, such as the Key Derivation Function (KDF), can be performed with a single click. The tool supports key lengths of 128, 192, and 256 bits for added convenience. Note: NDA is required for use.

The Challenge and Response GUI Tool is a simple and effective utility for handling authentication processes for RL78/F24 Security RSSK. It enables easy generation and verification of the necessary data and can be used without an NDA.



**Boot Loader Setting Tool** 





**Key Setting Tool** 

[mode s	elect] • Response Generation C Response Verifica	ation
CHALLENGE[HEX]>>	0d19512f64fc08879c3f21c3f739e85f	Get RND
UID(120bit)[HEX]>>	0000002508220fee8026f30000d849	
KEY[HEX]>>	e4b7645b2f7d63b4674cd01970c9d1ec	
RESPONSE>>	693026b39f74f67f061ba6b6eca7a449	

Challenge and Response GUI Tool

# **RL78 Family Ecosystem Partners**





Renesas is enabling a comprehensive partner ecosystem to deliver an array of software and hardware building blocks that will work out-of-the-box with Renesas RX Family MCUs. The Renesas RL78 ecosystem will help accelerate the development of IoT applications, including core technologies such as security, safety, connectivity, and HMI among others.



# **Expansive Third Party Solutions Portfolio**

- 200+ partners, 300+ solutions and growing
- Coverage across all key IoT technologies
- Robust GTM and strong digital drumbeat



# Commercial Grade Building Block Solutions

- Commercial grade software
- Work out-of-box with Renesas products
- Bundling options for select solutions



#### **Problem Solving at Heart**

- Address specific design problems
- Address specific skill-set gaps
- Customer-centric approach

#### **Partner Overview**

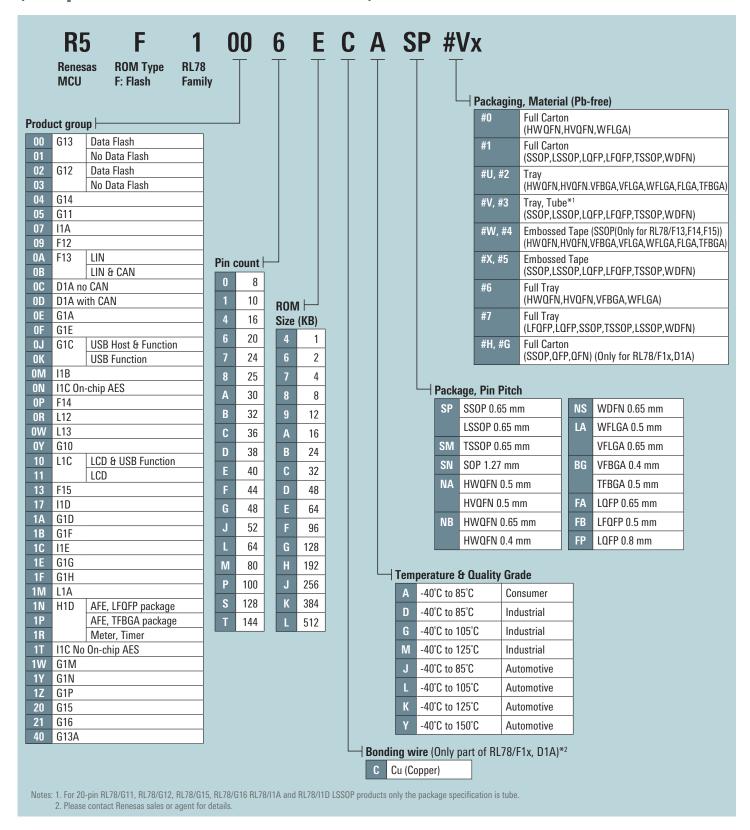
The partner overview shown might not be complete since the partner network is extending almost daily. For best reference and latest data, we recommend checking our webpage at: RL78 Partner Ecosystem Solutions





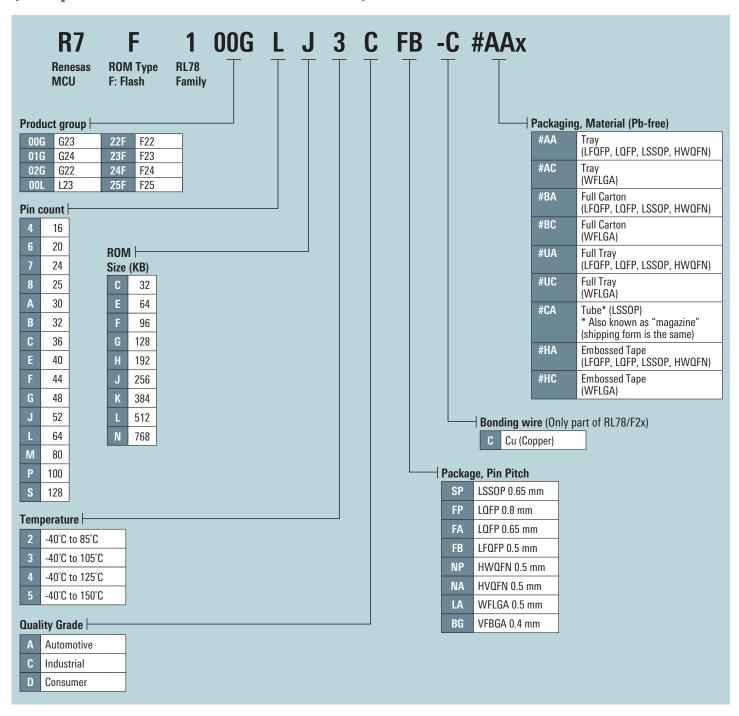
#### **EXPLANATION OF ORDERABLE PART NUMBERS**

(For part numbers start with R5F)



#### **EXPLANATION OF ORDERABLE PART NUMBERS**

(For part numbers start with R7F)





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