

Low Power Platform for 8-/16-bit Applications

RL78 Microcontrollers



White Goods

Medical

**Industrial
Automation**

**Building
Automation**



RL78

**Small
Appliances**

**Consumer
Electronics**

RL78 – The True Low Power Microcontroller Platform



The RL78 Family of microcontrollers (MCUs) combines advanced low power technology, outstanding performance, and the broadest line-up in its class for the most demanding 8- and 16-bit embedded applications.

The RL78 MCUs' innovative "Snooze" mode achieves ultra-low power by allowing ADC operation and serial communication, all while the CPU is turned off. This makes the RL78 MCUs best in class for low power applications.

Why RL78?

- World's leading low power performance for equivalent MCUs in its class
- Scalability of line-up, including smart pin layout
- System cost saving features

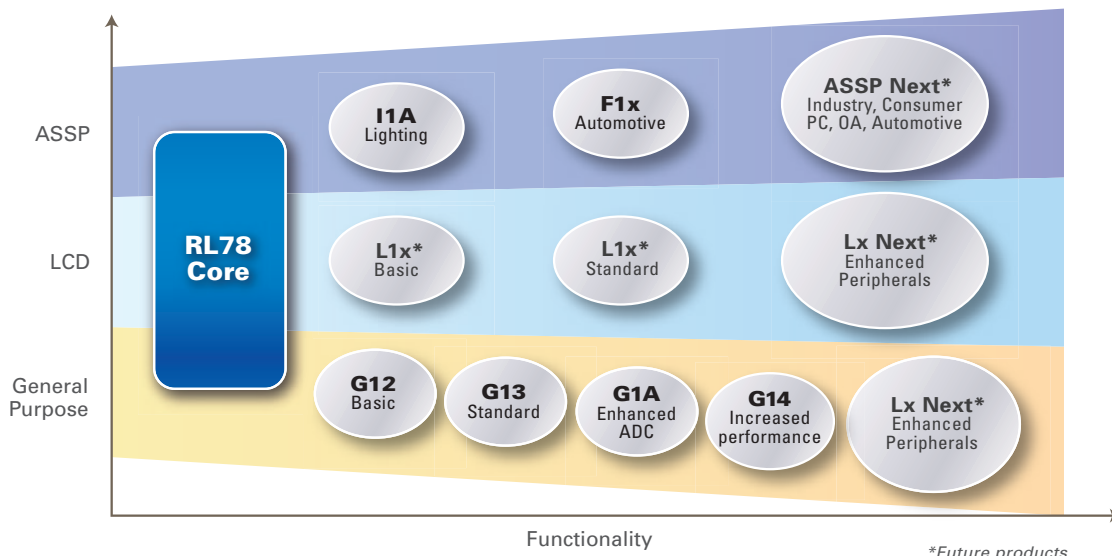
- Wide voltage operation
- Wide temperature operation
- Built-in safety features

An extensive ecosystem and more details of RL78 can be found at www.am.renesas.com/RL78



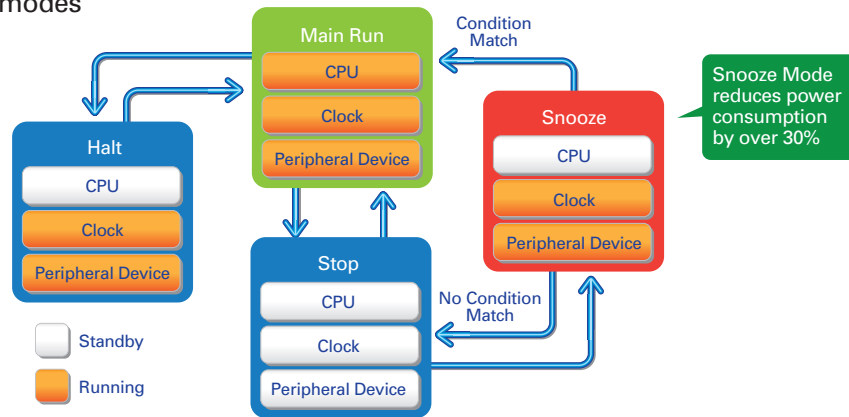
1. RTC: Real Time Clock LVD: Low Voltage Detection

RL78 Roadmap



RL78 Offers Multiple Power Saving Modes

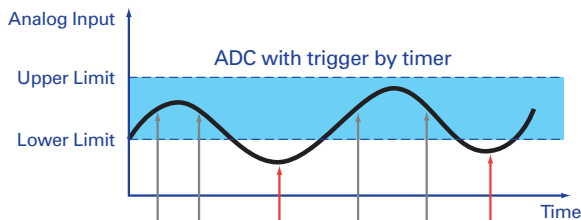
- The RL78's three low power modes maximize battery life by disabling idle CPU features



Snooze Mode reduces power consumption by over 30%

Snooze Mode

- No need to wake up CPU for receiving data
- The unique Snooze Mode allows some peripherals, ADC and UART operation while in standby modes
- Achieves 90% reduction in power consumption; Snooze Mode uses 0.5mA vs. 5mA in Run mode (ADC)

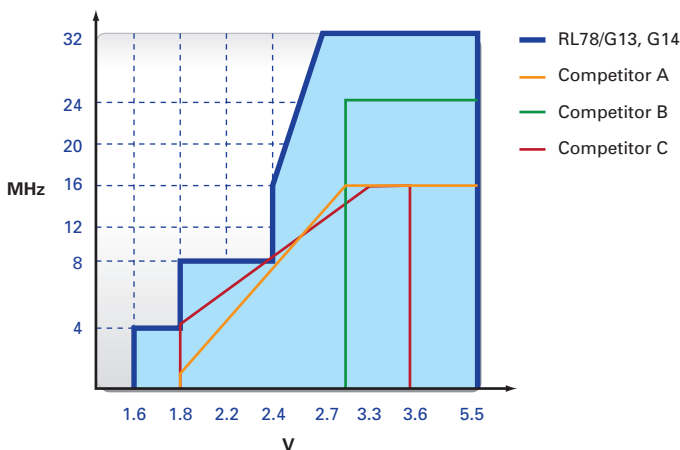


Snooze Mode ADC conversion example

Standby Modes (Halt, Stop)

- RTC with LVD in Halt or Stop Mode consumes as low as 0.57µA
- Stop Mode achieves lowest power consumption by disabling more CPU functions

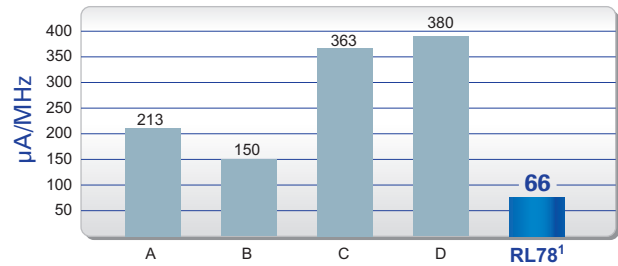
RL78 Wide Operating Voltage



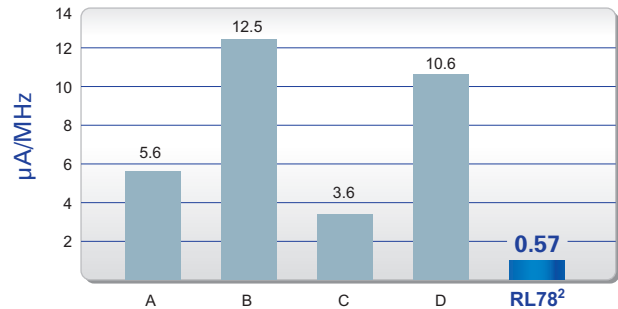
Power Consumption Comparison

- Leading low power in all modes

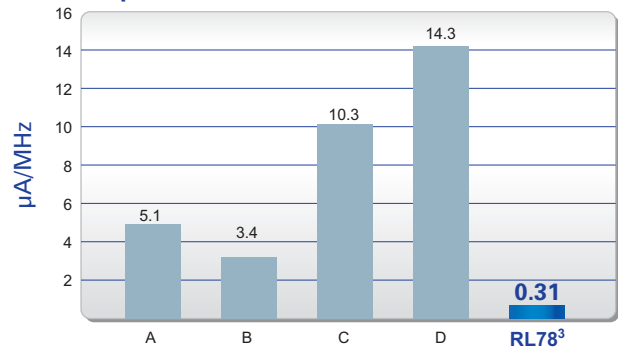
Run Mode



Halt Mode: RTC + LVD



Stop Mode: LVD



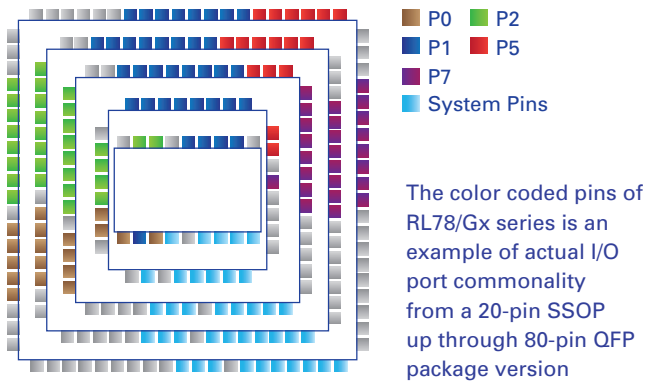
Notes:

- At 32MHz (NOP instructions)
- 0.49µA (RTC only)
- 0.23µA (all stopped, RAM retained) & LVD only 0.08µA

Compatibility

RL78 MCUs Offer Full Pin Compatibility

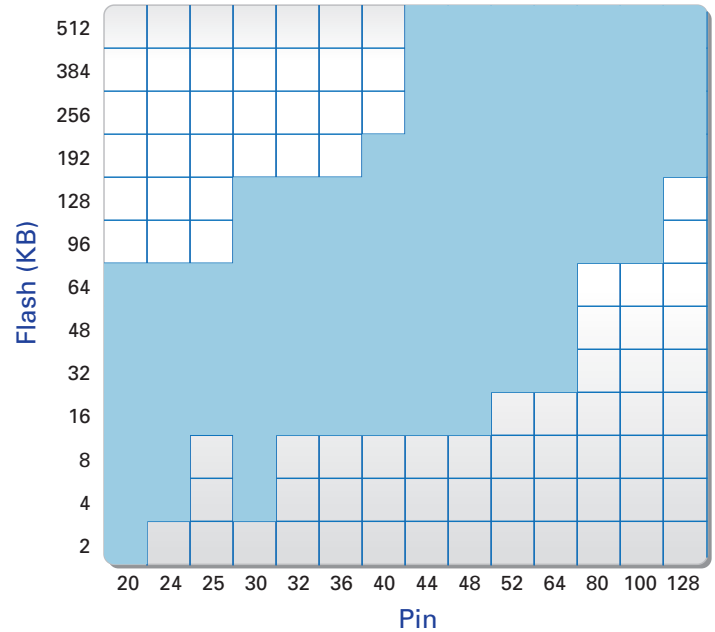
- I/O and peripheral pins scale up
- Easily add I/O and functionality by migrating to a larger pin count
- Keep peripheral pin PCB layout in the same order/position as pin count is increased
- Software code can be reused across the full RL78 family from 20 pins to 128 pins



Scalability

RL78 Offers an Unprecedented Line-up

- Over 300 devices
- Available in 20- to 128-pin packages and 2KB to 512KB Flash

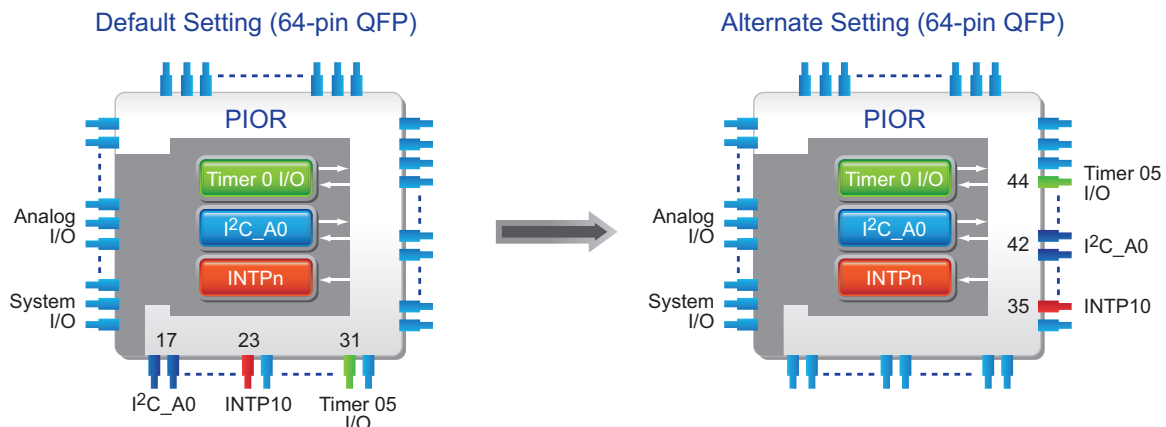


Flexibility

Peripheral I/O Redirection (PIOR) Capability Remaps Functions to Alternate Ports

- Optimize peripheral pin functionality by easing function bottlenecks on a pin
- Maximize usable peripheral set by remapping the physical pin's connectivity to a chosen peripheral

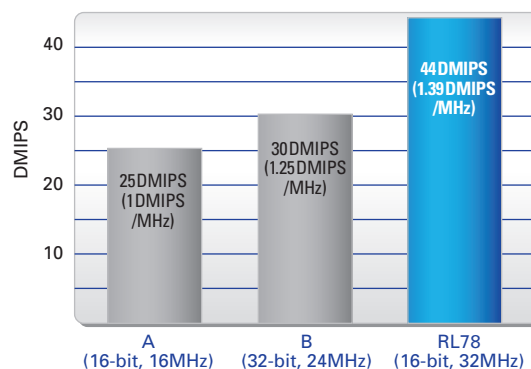
PIOR capability can help ease a bottleneck, as shown in this example, by remapping to alternate pins



High Efficiency

RL78/G14 Offers up to 44DMIPS Performance at 32MHz

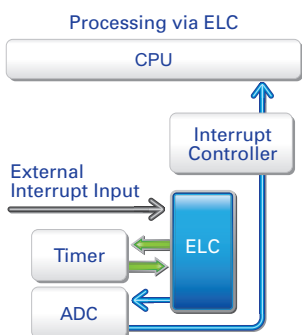
- Unrivalled power consumption/performance ratio (1/3 that of competitors)
- Higher DMIPS rating and lower power consumption than a popular 32-bit competitor technology
- 85% instructions executed in one clock cycle



Advanced Features

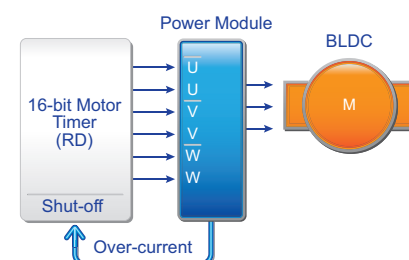
Event Link Controller (ELC)*

- Improves real time function and reduces program size by eliminating interrupt processing
- Supports up to 26 event signals, including external and internal interrupts
- CPU-independent operation enables lower power consumption



Specialized Motor Timers*

- 16-bit and up to 64MHz operation
- Supports 5 operating modes including 6-channel complementary PWM
- Programmable 16-bit dead-time control
- Selectable buffer operation for fast timer reload
- Shut-off function for over current detection



* RL78/G14

Safety Features

Hardware for IEC/UL 60730 Safety Compliance

CRC

Two types of CRC hardware

- Flash Memory
- Serial Interface

RAM

Parity / Write Protection

- Parity: Internal reset when parity error generated on Read or Write
- Write Protection: Select from: ~ 128B/ ~ 256B/ ~ 512B

SFR

Write Protection

- Write protection for: Port setting, interrupt setting, clock setting, LVI setting
- RAM Parity setting

CPU

Illegal memory access detection

- Illegal memory access: generates "internal reset"
- Trap instruction: "FF" instruction generates "internal reset"

Clock

Stop Detection / Frequency check

- Stop detection: Possible to detect by WWDT
- Frequency check: Possible to check by timer function

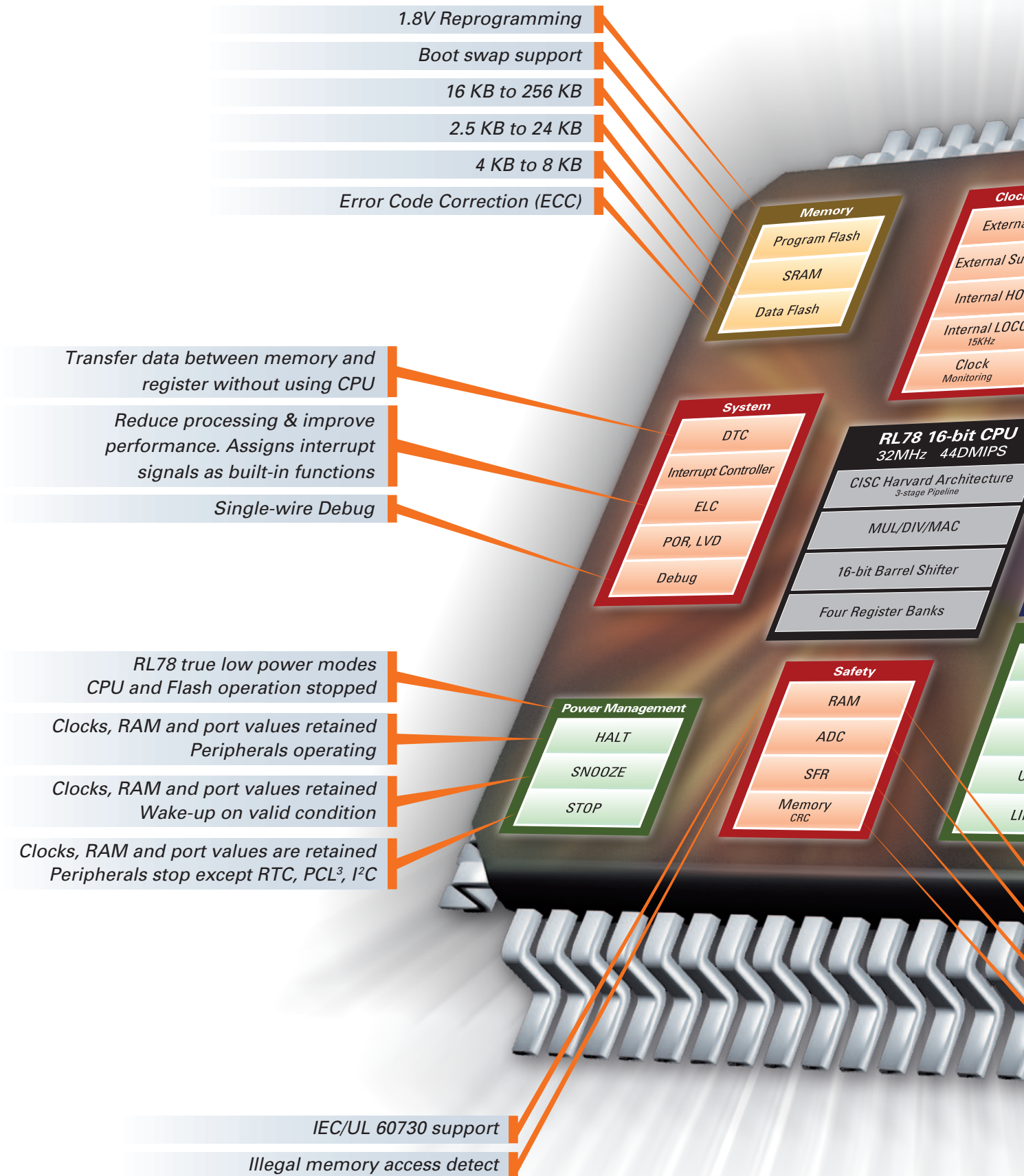
ADC

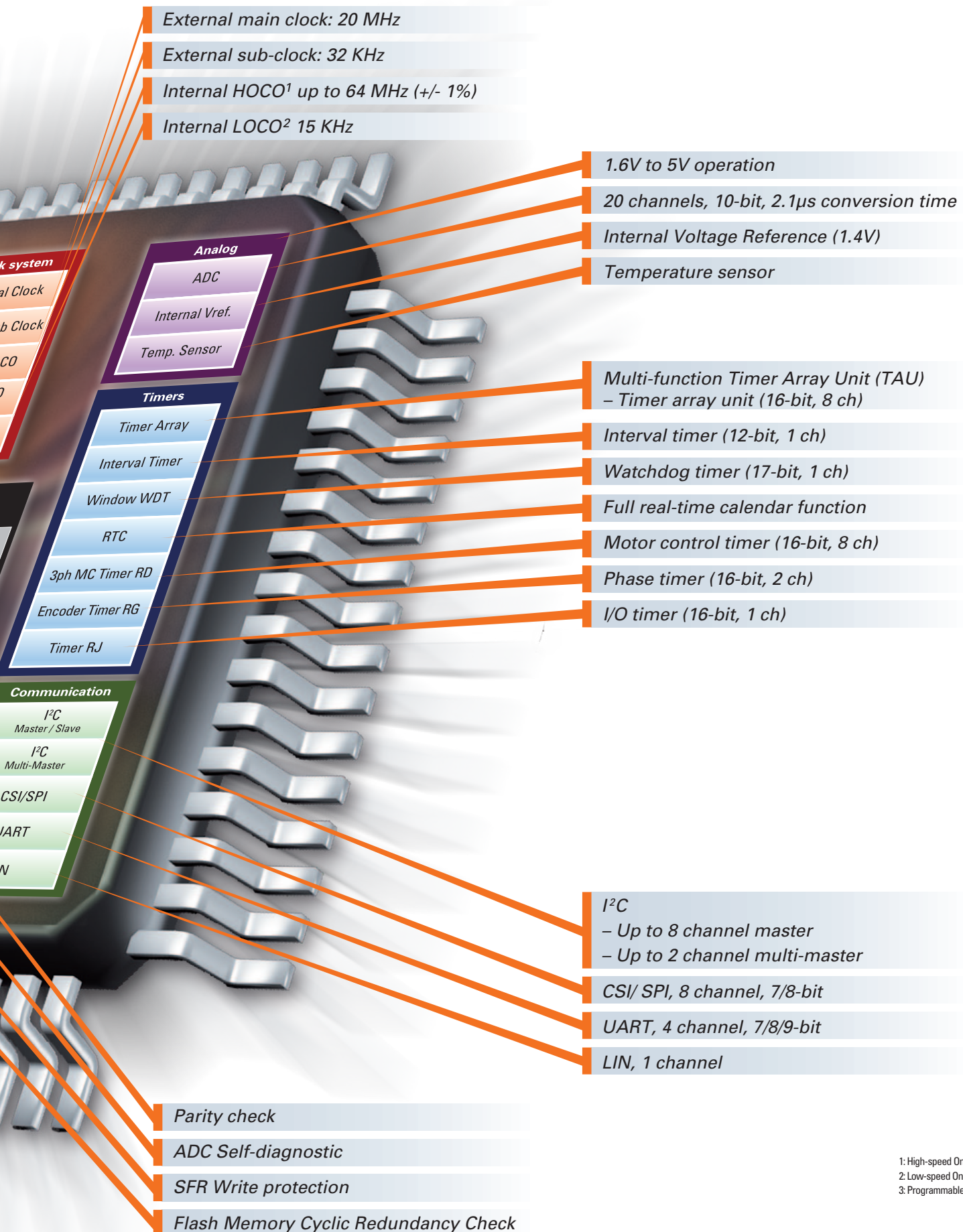
Multiple Reference Signals

- External / Internal AVref sources
- Internal Vref (1.44V)
- Temperature sensor

RL78 Integration

RL78/G14





1: High-speed On-chip Oscillator
 2: Low-speed On-chip Oscillator
 3: Programmable Clock Output/Buzzer

Extensive Renesas Development Ecosystem

Renesas Electronics and selected partners offer a comprehensive suite of hardware and software tools for the rapid evaluation and development of embedded systems built with RL78.

Explore → Evaluate → Develop → Manufacture



Renesas Promotion Board



Renesas Starter Kit



Emulators: E1 (OCD), IECUBE (Full ICE)



Programmer PG-FP5-EA, Renesas Factory

Compiler/IDE



IAR Embedded Workbench (EWRL78)
Full C and C++ support,
MISRA C compliance checker

Code Generator



Royalty-free
Windows®-based
code generator

Real Time OS

Micrium

μC/OS-II and μC/OS-III



RTX



embOS

Hardware Development Tools



RL78/G13 Renesas Promotion Board (RPB) Part No: YRPBRL78G13

- Demo the high performance of RL78
- Evaluate and measure the low power modes
- PC software included (GUI, drivers)
- IAR KickStart (16KB code limited)
- Applilet device code generator



RL78/G13 Renesas Starter Kit (RSK) Part No: YR0K50100LS000BE

- CPU board with target microcontroller
- LCD panel for user diagnostic interaction
- E1 on-chip debugger
- Trial C compiler
- Applilet device code generator
- Sample code for peripherals



RL78/G13 Renesas Demo Kit (RDk) Part No: YRDKRL78G13

- RL78 MCU board with integrated debugger (USB-powered)
- Sample project exercising peripherals using sensors, display and audio speaker
- IAR Embedded Workbench for RL78 (16KB KickStart edition) including C/C++ compiler and powerful debugger



E1 on-chip debugging emulator Part No: R0E000010KCE00

- Universal Renesas on-chip debugger
- Debugger or Flash programmer interface
- Single wire connection to RL78 device
- Assembler and C source stepping
- Software and hardware breakpoints
- Real-time memory access during run time
- Direct access to memory, SFR and general registers



IECUBE full in-circuit emulator Part No: QB-RL78xxx¹

- USB 2.0 interface
- Break functions
- Trace functions
- Real-time RAM monitor function
- Time measurement
- Full integration into IAR Systems EWRL78 C-Spy debugger

Software Development Tools



www.iar.com/ewrl78

IAR Embedded Workbench

- Integrated development environment and optimized C/C++ compiler for RL78
- Includes instruction set simulator and full support for hardware tools
- Project management tools and editor
- Configuration files for all RL78 devices
- Emulator debugger support
- Run-time libraries
- Example projects for RL78 and code templates

Coming Soon!

e² studio

Renesas e² studio IDE

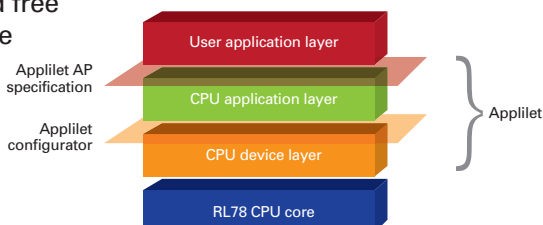
- New Eclipse-based IDE from Renesas providing C/C++ cross development support
- Enhanced project creation wizards for embedded development
- Integration of new KPIT GNURL78 toolchain
- Advanced debugging capabilities via Renesas E1 debugger and IECUBE emulator
- Free IDE & compiler solution including support from Renesas

BUILT ON
eclipse

Applilet[®]

Applilet

- Renesas software tool generates device driver code to initialize and use on-chip peripherals
- Full code generation for IAR EWRL78
- Integrated project wizard guides user to create a new project
- Supplied free of charge



www.cmx.com

CMX RTOS

- Small footprint
- Fast context switching time
- Truly pre-emptive scheduler
- Nested interrupts
- User configurable

Micrium

www.micrium.com

Micrium RTOS

- μ C/OSII & μ C/OSIII RTOS
- Numerous helpful features for writing multi-task applications
- Highly efficient
- Popular choice for safety-critical designs



www.freertos.org

Free RTOS

- Free of charge RTOS for download to deploy RL78 designs
- Fully supported commercial versions available as OpenRTOS, code compatible



www.segger.com

Segger embOS

- Priority controlled RTOS based on zero interrupt latency, high-performance architecture
- Optimized for minimum memory consumption in both RAM and ROM



RL78 Applications



RL78 offers system designers key advantages for next generation designs, reducing system power, enhancing integration and providing a cost-effective platform approach.



Industrial Automation

- RL78 offers an extensive range of small packages
- RL78 has standard and extended temperature range devices from -40°C to +85°C
- Renesas is renowned for high-quality, long-life MCUs



Home Automation

- For long battery life, RL78 offers class-leading low power, including the unique Snooze mode
- Battery operation down to 1.6V



Consumer

- RL78 MCUs offer a full calendar function
- RL78 has an integrated temperature sensor
- Future families of RL78 will have display drive and USB drive integrated



Power Tools

- RL78 is available in multiple packages and scalable for the platform design approach
- Renesas MCUs integrate extensive safety features, adding to the quality and safety of the device



Medical

- When a small package MCU with long product life is required, RL78 is your first choice
- Renesas has provided solutions for major medical manufacturers and is part of the Continua Alliance



White Goods

- RL78 offers integrated safety compliance for white goods (IEC 60730)
- RL78 offers high temperature support
- RL78's integrated peripherals make it the ideal choice for cost sensitive white goods



Metering

- RL78's low power modes make the MCU ideal to meet industry power consumption requirements
- RL78 is analog rich, ideal for smart metering applications
- Renesas has decades of experience providing high-quality and long-product life MCUs for metering applications



Lighting

- RL78/I1A offers dedicated DALI and Power Factor control
- RL78/IA integrates high resolution PWM timers
- RL78's free Windows-based Applilet software makes it easy for designers to turn around a lighting design with little design experience



Motor Control

- RL78/G14 family is ideal for motor control applications with integrated MC timers
- RL78's on-chip oscillators with 1% accuracy provide an integrated low cost solution for timing critical applications

RL78 Selector Guide



| Group | Pins | Base Part No. ¹ | Flash (KB) | RAM (KB) | Data Flash (KB) | Freq (MHz) | Voltage (V) | I/O | DMA (ch)/DTC (sets) | ELC (Links) | A/D (ch) | D/A (ch) | Comp. (ch) | PGA (ch) | Serial Com. (ch) ² | DALI (ch) | 16-bit Timers (ch) | Motor Timers (ch) | Lighting Timers (ch) |
|-------|----------|----------------------------|------------|----------|-----------------|------------|-------------|-----|---------------------|-------------|-----------------|----------|------------|----------|-------------------------------|-----------|--------------------|-------------------|----------------------|
| G12 | 20 | R5F1026x | 2-16 | 0.25-1.5 | 2 | 24 | 1.8-5.5 | 18 | 2 | – | 11 | – | – | – | 6 | – | 4 | – | – |
| | 24 | R5F1027x | 4-16 | 0.5-1.5 | 2 | 24 | 1.8-5.5 | 22 | 2 | – | 11 | – | – | – | 6 | – | 4 | – | – |
| | 30 | R5F102Ax | 4-16 | 0.5-2 | 2 | 24 | 1.8-5.5 | 26 | 2 | – | 8 | – | – | – | 11 | – | 8 | – | – |
| G13 | 20 | R5F1006x | 16-64 | 2-4 | 4 | 32 | 1.6-5.5 | 16 | 2 | – | 6 | – | – | – | 6 | – | 8 | – | – |
| | 24 | R5F1007x | 16-64 | 2-4 | 4 | 32 | 1.6-5.5 | 20 | 2 | – | 6 | – | – | – | 7 | – | 8 | – | – |
| | 25 | R5F1008x | 16-64 | 2-4 | 4 | 32 | 1.6-5.5 | 21 | 2 | – | 6 | – | – | – | 7 | – | 8 | – | – |
| | 30 | R5F100Ax | 16-128 | 2-12 | 4-8 | 32 | 1.6-5.5 | 26 | 2 | – | 8 | – | – | – | 11 | – | 8 | – | – |
| | 32 | R5F100Bx | 16-128 | 2-12 | 4-8 | 32 | 1.6-5.5 | 28 | 2 | – | 8 | – | – | – | 11 | – | 8 | – | – |
| | 36 | R5F100Cx | 16-128 | 2-12 | 4-8 | 32 | 1.6-5.5 | 32 | 2 | – | 8 | – | – | – | 13 | – | 8 | – | – |
| | 40 | R5F100Ex | 16-192 | 2-16 | 4-8 | 32 | 1.6-5.5 | 36 | 2 | – | 9 | – | – | – | 13 | – | 8 | – | – |
| | 44 | R5F100Fx | 16-512 | 2-32 | 4-8 | 32 | 1.6-5.5 | 40 | 2 | – | 10 | – | – | – | 13 | – | 8 | – | – |
| | 48 | R5F100Gx | 16-512 | 2-32 | 4-8 | 32 | 1.6-5.5 | 44 | 2 | – | 10 | – | – | – | 15 | – | 8 | – | – |
| | 52 | R5F100Jx | 32-512 | 2-32 | 4-8 | 32 | 1.6-5.5 | 48 | 2 | – | 12 | – | – | – | 15 | – | 8 | – | – |
| | 64 | R5F100Lx | 32-512 | 2-32 | 4-8 | 32 | 1.6-5.5 | 58 | 2 | – | 12 | – | – | – | 17 | – | 8 | – | – |
| | 80 | R5F100Mx | 96-512 | 8-32 | 8 | 32 | 1.6-5.5 | 74 | 4 | – | 17 | – | – | – | 23 | – | 12 | – | – |
| | 100 | R5F100Px | 96-512 | 8-32 | 8 | 32 | 1.6-5.5 | 92 | 4 | – | 20 | – | – | – | 23 | – | 12 | – | – |
| 128 | R5F100Sx | 192-512 | 16-32 | 8 | 32 | 1.6-5.5 | 120 | 4 | – | 26 | – | – | – | 23 | – | 16 | – | – | |
| G14 | 30 | R5F104Ax | 16-128 | 2.5-16 | 4-8 | 32 | 1.6-5.5 | 26 | 24 | 20 | 8 | 1 | 0-2 | – | 11 | – | 8 | 2 | – |
| | 32 | R5F104Bx | 16-128 | 2.5-16 | 4-8 | 32 | 1.6-5.5 | 28 | 24 | 20 | 8 | 2 | 0-2 | – | 11 | – | 8 | 2 | – |
| | 36 | R5F104Cx | 16-128 | 2.5-16 | 4-8 | 32 | 1.6-5.5 | 32 | 24 | 20 | 8 | 2 | 0-2 | – | 13 | – | 8 | 2 | – |
| | 40 | R5F104Ex | 16-192 | 2.5-20 | 4-8 | 32 | 1.6-5.5 | 36 | 24 | 20 | 9 | 2 | 0-2 | – | 13 | – | 8 | 2 | – |
| | 44 | R5F104Fx | 16-256 | 2.5-24 | 4-8 | 32 | 1.6-5.5 | 40 | 24 | 20 | 10 | 2 | 0-2 | – | 13 | – | 8 | 2 | – |
| | 48 | R5F104Gx | 16-256 | 2.5-24 | 4-8 | 32 | 1.6-5.5 | 44 | 24 | 20 | 10 | 2 | 0-2 | – | 15 | – | 8 | 2 | – |
| | 52 | R5F104Jx | 32-256 | 4-24 | 4-8 | 32 | 1.6-5.5 | 48 | 24 | 20 | 12 | 2 | 0-2 | – | 15 | – | 8 | 2 | – |
| | 64 | R5F104Lx | 32-256 | 4-24 | 4-8 | 32 | 1.6-5.5 | 58 | 24 | 20 | 12 | 2 | 0-2 | – | 17 | – | 8 | 2 | – |
| | 80 | R5F104Mx | 96-256 | 12-24 | 8 | 32 | 1.6-5.5 | 74 | 24 | 26 | 17 | 2 | 2 | – | 23 | – | 12 | 2 | – |
| I1A | 20 | R5F1076x | 32 | 2 | 4 | 32 | 2.7-5.5 | 16 | 2 | – | 6 | – | 4 | 4 | 3 | 1 | 11 | – | 2 |
| | 30 | R5F107Ax | 32-64 | 2-4 | 4 | 32 | 2.7-5.5 | 26 | 2 | – | 11 | – | 6 | 6 | 5 | 1 | 12 | – | 3 |
| | 32 | R5F107Bx | 32 | 2 | 4 | 32 | 2.7-5.5 | 28 | 2 | – | 9 | – | 5 | 5 | 4 | 1 | 12 | – | 3 |
| | 38 | R5F107Dx | 64 | 4 | 4 | 32 | 2.7-5.5 | 34 | 2 | – | 11 | – | 6 | 6 | 6 | 1 | 12 | – | 3 |
| G1A | 25 | R5F10E8x | 16-64 | 2-4 | 4 | 32 | 1.6 to 3.6 | 19 | 2 | – | 13 ³ | – | – | – | 7 | – | 8 | – | – |
| | 32 | R5F10EBx | 16-64 | 2-4 | 4 | 32 | 1.6 to 3.6 | 26 | 2 | – | 18 ³ | – | – | – | 11 | – | 8 | – | – |
| | 48 | R5F10EGx | 16-64 | 2-4 | 4 | 32 | 1.6 to 3.6 | 42 | 2 | – | 24 ³ | – | – | – | 15 | – | 8 | – | – |
| | 64 | R5F10ELx | 32-64 | 2-4 | 4 | 32 | 1.6 to 3.6 | 56 | 2 | – | 28 ³ | – | – | – | 17 | – | 8 | – | – |

1: Check User's manual for complete part numbers.
 2: Covers all available communication types (CSI/UART/I2C/LIN)
 3: 12-bit

Part Number Guide

Example shown here: RL78/G13 (20-pin), Part number R5F1006EASP#V0

R5 F 10 0 6 E A SP #V 0

Renesas MCU ROM Type (F = Flash) RL78 Series

| Product Group | Group | Data Flash |
|---------------|-------|---------------|
| 0 | G13 | Data Flash |
| 1 | G13 | No Data Flash |
| 2 | G12 | Data Flash |
| 3 | G12 | No Data Flash |
| 4 | G14 | Data Flash |
| 7 | I1A | Data Flash |
| E | G1A | Data Flash |

| Pin Count | Count |
|-----------|-------|
| 6 | 20 |
| 7 | 24 |
| 8 | 25 |
| A | 30 |
| B | 32 |
| C | 36 |
| E | 40 |
| F | 44 |
| G | 48 |
| J | 52 |
| L | 64 |
| M | 80 |
| P | 100 |
| S | 128 |

| ROM Size (KB) | Count |
|---------------|-------|
| 6 | 2 |
| 7 | 4 |
| 8 | 8 |
| 9 | 12 |
| A | 16 |
| C | 32 |
| D | 48 |
| E | 64 |
| F | 96 |
| G | 128 |
| H | 192 |
| J | 256 |
| K | 384 |
| L | 512 |

Rev. (Optional)

Production Level

| | |
|---|-------------------------|
| W | WS (Working Sample) |
| E | ES (Engineering Sample) |
| C | CS (Consumer Sample) |
| 0 | MP (Mass Production) |

Packaging, Material (Pb-free)

| | | | |
|----|------|-----------------|--------|
| #Y | Tray | – | Pre-MP |
| #V | Tray | Sn (Tin) only | MP |
| #U | Tray | SnCu and others | MP |
| #X | T&R | Sn (Tin) only | MP |
| #W | T&R | SnCu and others | MP |

Package

| | | | |
|----|-----------|----|------------|
| SP | SSOP | FP | QFP |
| NA | QFN | FB | QFP 0.5mm |
| LA | LGA | FA | QFP 0.65mm |
| BG | BGA 0.4mm | FC | QFP 0.4mm |

Temperature & Quality Grade

| | | |
|---|-----------------|-----------------|
| A | -40°C to +85°C | Q3 (consumer) |
| D | -40°C to +85°C | Q2 (industrial) |
| J | -40°C to +85°C | Q1 (automotive) |
| K | -40°C to +125°C | Q1 (automotive) |

Getting Started with RL78 is Easy



Renesas Electronics has made embedded design with the RL78 microcontroller family as easy as possible. An extensive ecosystem for RL78, including training, free evaluation boards (Renesas Promotion Boards), low-cost starter kits and multiple application notes, aids the embedded system designer with developing the world's lowest power designs.

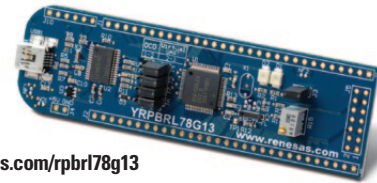


Scalable



Low Power

Efficient



www.renesas.com/rpbri78g13

www.renesas.com/RL78

- Keep up to date with the RL78 Family
- RL78 MCU search facility
- Full data and application notes
- Hardware and software guides and free downloads
- Sales and support information

RL78 Promotion Board

- Learn about RL78 key features
- A complete GUI based control
- Software examples
- Development environment

The Renesas Ecosystem



- > The Alliance Partner Program allows you to connect instantly with hundreds of qualified design consulting and contracting professionals.

am.renesas.com/Alliance



- > Gain the technical knowledge you need. Evaluate, research and learn at your own pace, where you want, when you want, for free.

www.RenesasInteractive.com

Renesas *Rulz*.com

Think it. Build it. Post it.

- > A forum and community site to share technical information, questions and opinions with others who use Renesas MCUs and MPUs.

www.RenesasRulz.com



- > For educators and students. Teach with professional grade tools. Learn MCUs with a modern architecture.

www.RenesasUniversity.com

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Software Library – Free SW

am.renesas.com/softwarelibrary

Free Samples

am.renesas.com/samples

Technical Support

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