

# A Review on RL78 Microcontroller

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## ABSTRACT

A microcontroller is a compact integrated circuit designed to govern a specific operation in an embedded system. A typical microcontroller includes a processor, memory and input/output (I/O) peripherals on a single chip. Sometimes referred to as an embedded controller or microcontroller unit (MCU), microcontrollers are found in vehicles, robots, office machines, medical devices, mobile radio transceivers, vending machines and home appliances among other devices. A microcontroller's processor will vary by application. Options range from the simple 4-bit, 8-bit or 16-bit processors to more complex 32-bit or 64-bit processors. Common MCUs include the Intel MCS-51, often referred to as an 8051 microcontroller, the AVR microcontroller, the programmable interface controller (PIC) from Microchip Technology; and various licensed ARM microcontrollers. In this paper we discuss about the advantages and applications of Renesas RL78 microcontroller. Renesas RL78 microcontrollers consists of both general-purpose and application-specific devices. These increasingly popular MCUs make possible ultralow-power applications by giving system designers advanced power-saving features and high-performance operation.

**Keywords:** RL78, MCUs, Applications

## I. INTRODUCTION

A **microcontroller** is a small computer on a single integrated circuit. In modern terminology, it is similar to, but less sophisticated than, a system on a chip or SoC; a SoC may include a microcontroller as one of its components. A microcontroller contains one or more CPUs (processor cores) along with memory and programmable input/output peripherals. Program memory in the form of ferroelectric RAM, NOR flash or OTP ROM is also often included on chip, as well as a small amount of RAM. Microcontrollers are designed for embedded applications, in contrast to the microprocessors used in personal computers or other general purpose applications consisting of various discrete chips. Microcontrollers are used in automatically controlled products and devices, such as automobile engine

control systems, implantable medical devices, Remote controls, office machines, appliances, power tools, toys and other embedded systems.

The RL78/G1x (general purpose group) is a true low power MCU series within the RL78 Family. The CPU core in the RL78 microcontroller employs the Harvard architecture which has independent instruction fetch bus, address bus and data bus. In addition, through the adoption of three-stage pipeline control of fetch, decode, and memory access, the operation efficiency is remarkably improved over the conventional CPU core. The CPU core features high performance and highly functional instruction processing, and can be suited for use in various applications that require high speed and highly functional processing.

## II. FEATURES OF RL78

The main features of the RL78 microcontroller are as follows.

The RL78 microcontroller is classified into three types of cores according to the types of instructions, the number of clocks, and the performance: RL78-S1 core, RL78-S2 core, and RL78-S3 core.

- ✓ 3-stage pipeline CISC architecture
- ✓ Address space: 1 Mbyte
- ✓ Minimum instruction execution time: One instruction execution per one clock cycle
- ✓ General-purpose register: Eight 8-bit registers
- ✓ Types of instructions: 74 (RL78-S1 core), 75 (RL78-S2 core), 81 (RL78-S3 core)
- ✓ Data allocation: Little endian

## III. ADVANTAGES

### i) RL-78 low power modes maximize battery life.

- Three low-power modes maximize battery life – either by putting on-chip functions such as the CPU, clock and peripherals in standby – or by turning them off when they aren't being used.
- RUN MODE In Run mode, RL78 devices offer substantial savings in current consumed when compared to competitors.
- HALT MODE Halt mode disables CPU operation, saving as much as 80% of total MCU current, while allowing a fast CPU wake-up time.
- STOP MODE Stop mode achieves the lowest RL78 power consumption; it disables the CPU and on-chip functions that run on the CPU clock

### ii) High efficiency

The rl78 family provides up to 44 dmips performance at 32 mhz The devices achieve an unrivaled ratio of power consumption to performance – 1/3 of other devices, enabling significant power savings. RL78 devices offer important design advantages. They

have a higher DMIPS rating and consume less power than popular 32-bit technology.

### iii) Built in features help reduce system cost

With many added features built in, the RL78 family can help you lower system cost and accelerate time to market

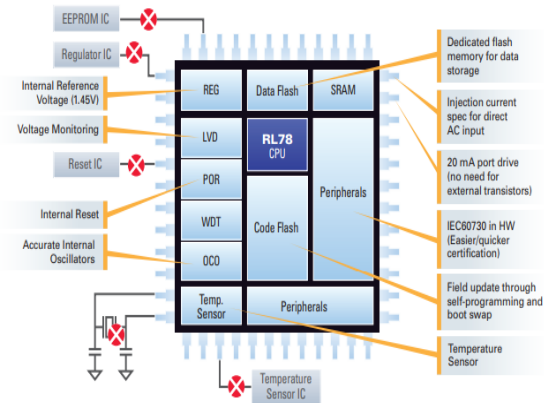


Fig.1 Block diagram of RL78 Microcontroller

### iv) Noise immunity :

The 5.0V operation and internal regulator system of RL78 MCUs give the devices inherently high levels of noise immunity, allowing savings in overall system costs. Noise immunity for – Analog inputs, digital I/O – CPU, peripherals Low noise emission – CPU digital noise is encapsulated in a short wiring of REGC System designs can eliminate or minimize external noise-reduction filters.

## IV. APPLICATIONS

### RL78 FOR SEGMENT DISPLAY APPLICATIONS

**Metering :** RL78 MCUs are ideal for smart metering applications with their lower power Active mode and Standby mode, including LCD and RTC current.

**Medical** RL78 MCUs offer true low-power consumption and their rich features are ideal for portable health and fitness devices.

Home Automation For long battery life and operation down to 1.6V, the RL78 is the top choice.

### RL78 FOR LIGHTING APPLICATIONS

Devices in the RL78/I1A product group offer dedicated lighting-communication features and power-stage control capabilities. They can communicate with a host controller for altering lighting intensity and/or color.

High-resolution PWM timers enable excellent lighting control performance. Support for the DALI/DMX512 communication standard aids system integration. Features of the power stage control include the 64 MHz Timer KB, which provides dithering (0.98 nsec quasi resolution), soft-start turn-on, comparator triggered stop, zero-current detection and timer restart options. Free Windows based Applilet software facilitates designs for remotely controllable lighting installations. High-temperature support (105°C and 125°C).

#### RL78 FOR BLUETOOTH APPLICATIONS

True low-power RL78 microcontroller and Bluetooth Low Energy (BLE) wireless technology increases battery life and accelerates Bluetooth connected device development.

RF Adaptable Technology automatically optimizes power consumption versus communication range. Industry-leading support tools shorten time to market.

Firmware-over-the-air (FOTA) capability enables convenient application upgrades in the field.

#### RL78 FOR SENSOR APPLICATIONS

The RL78/I1E MCU is an intelligent, flexible analog MCU suitable for countless industrial and medical sensing applications such as flow measurement, strain gauges, pressure or temperature sensing. With enhanced analog features such as configurable OpAmps with programmable gain, supporting inverting, non-inverting topologies, or instrumentation amplifiers, the RL78/I1E can be a platform for different types of sensors.

## V. CONCLUSION

The devices achieve an unrivalled ratio of power consumption to performance – one third of other devices, enabling significant power savings.

RL78 devices offer important design advantages. They have a higher DMIPS rating and consume less power than popular 32-bit technology.

- ✓ Maximum operating frequency 32 MHz.
- ✓ High-speed and high-performance 1.39 DMIPS/MHz
- ✓ Power supply voltage 1.6V to 5.5V Power-down state 46µA/MHz
- ✓ Built in temperature Sensor and low-voltage detection circuits

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