Pb Free ROHM Electronic Components

RoHS Directive Compliance

LAPIS SEMICONDUCTOR

Selection Guide

Low Power Microcontrollers

ML610400 Series

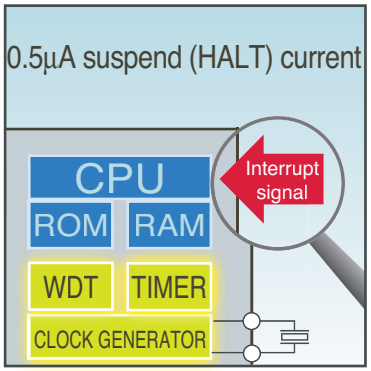
Ver.1.1

LAPIS Semiconductor Co.,Ltd.

Key Features

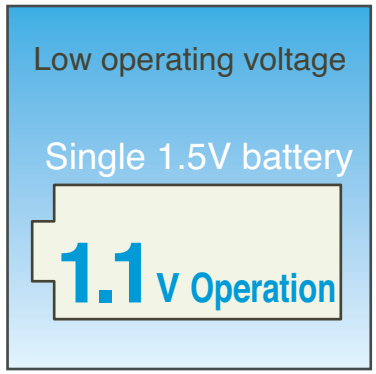
Feature 1

Low current consumption prolongs battery life



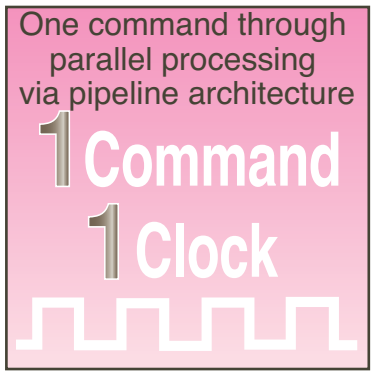
Feature 2

Low voltage operation contributes to smaller system size



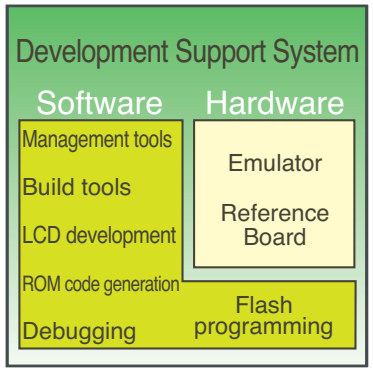
Feature 3

High performance CPU core reduces system power requirements



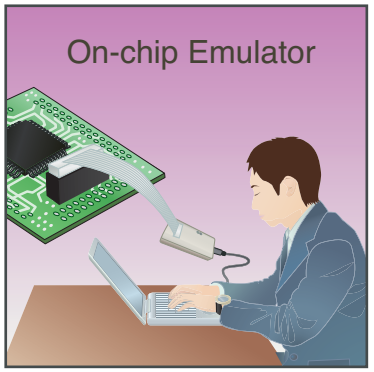
Feature 4

Comprehensive development environment



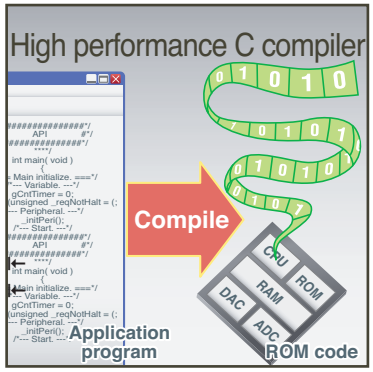
Feature 5

Simple, easy-to-use debugger and on-chip emulator



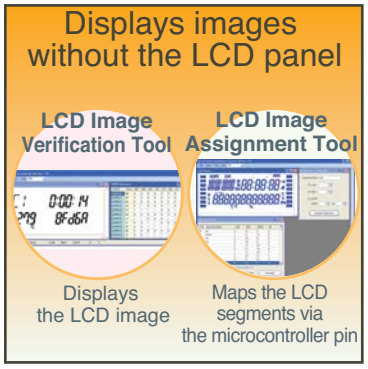
Feature 6

Software development with code-efficient C compiler



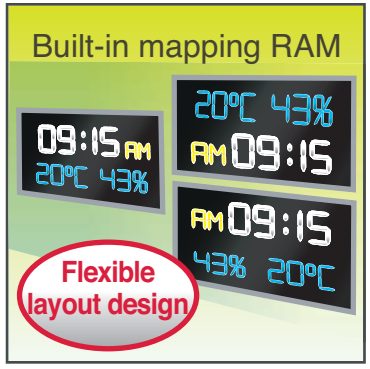
Feature 7

LCD tool simplifies LCD control program development



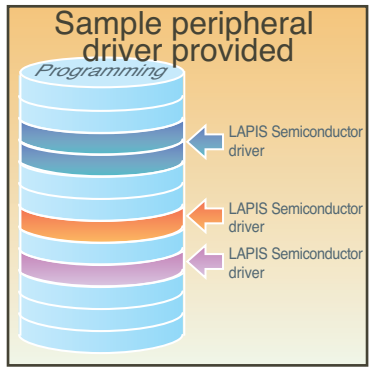
Feature 8

Troublesome software changes no longer required when changing the LCD panel



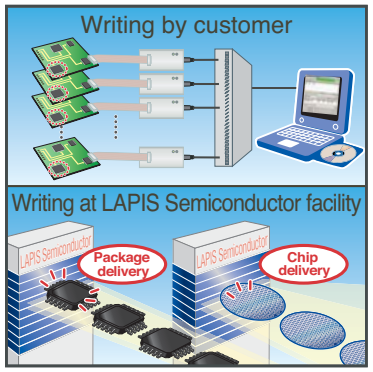
Feature 9

Multiple sample peripheral drivers provided for easy integration



Feature 10

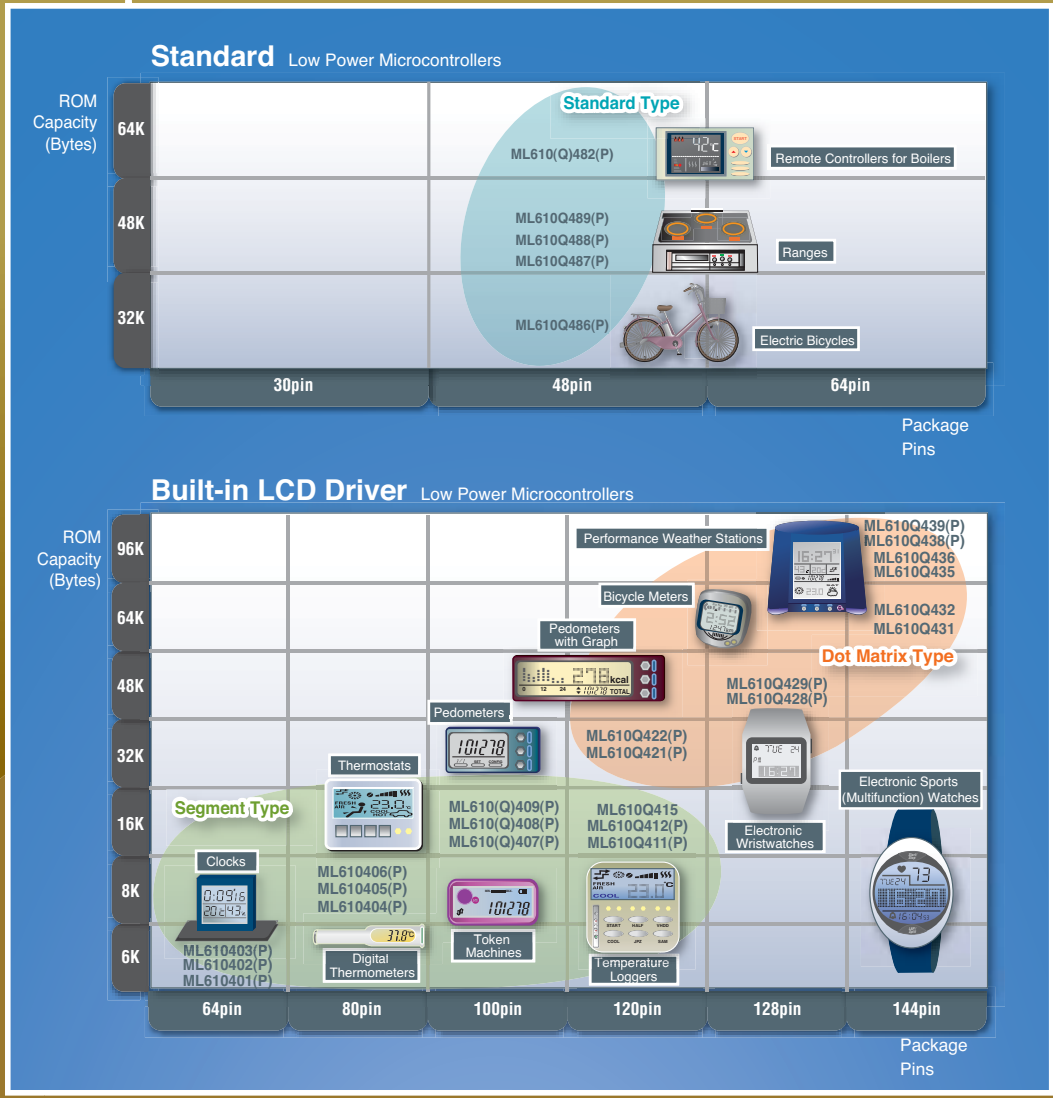
Flexible writing process



ML610400 Series Overview

This series is equipped with Flash memory for application code storage readable at only 1.1V and features industry-leading operating, halt, and sleep current consumption. In addition, a high performance CPU core is included, capable of processing one instruction per clock cycle. The result is high performance and ultra-low power consumption. Pin- and function-compatible Mask ROM models are also offered featuring identical characteristics. The products can be delivered in either packaged or die format. Customers can also opt to have programming performed by LAPIS Semiconductor as part of the standard manufacturing process or at their site using a multiwriter.

Lineup



Standard
Low power microcontrollers

These low power microcontrollers are ideal for compact, battery-driven systems without an LCD.

- Program memory (32KByte to 64KByte), RAM (1KByte to 4KByte)
- Low speed clock : 32.768kHz, High-speed clock : 500kHz to 4.096MHz
- 3 types of serial communication ports (I²C, SSIO, UART)
- 8bit / 16bit Timer,16bit PWM
- Available in bare die / TQFP48 package formats

Built-in Dot Matrix LCD Driver
Low power microcontrollers

These low power microcontrollers integrate a boost circuit for driving LCDs, eliminating the need for an external LCD power supply.

- Supports 400 to 1536 dot LCDs (1/24 to 1/2 duty, 1/4 to 1/3 bias)
- 32-128KByte program memory, 2 to 7KByte RAM
- Low speed clock : 32.768kHz, High-speed clock : 500kHz to 4.096MHz
- 2 A/D converters (24bit RC oscillation, 12bit successive approximation)
- Integrated LCD display allocation RAM and LCD drive voltage step-up circuit
- Available in bare die / TQFP120 to LQFP144 package formats

Built-in Segment LCD Driver
Low power microcontrollers

These low power microcontrollers with segment LCD driver integrates a boost circuit for driving an LCD.

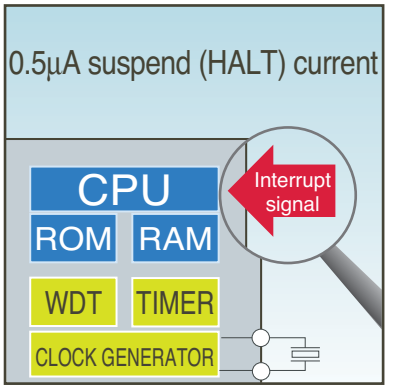
- Supports 55 to 185 segment LCDs (1/5 to 1/2 duty, 1/3 to 1/2 bias)
- 6 to 16KByte program memory, 192Byte to 1KByte RAM
- Low speed clock : 32.768kHz, High-speed clock : 500kHz to 2MHz
- 16bit or 24bit RC oscillation type A/D converter for temperature / humidity measurement
- 12bit successive approximation type A/D converter
- Integrated LCD display allocation RAM and LCD drive voltage step-up circuit
- Available in bare die / TQFP64 to LQFP120 package formats

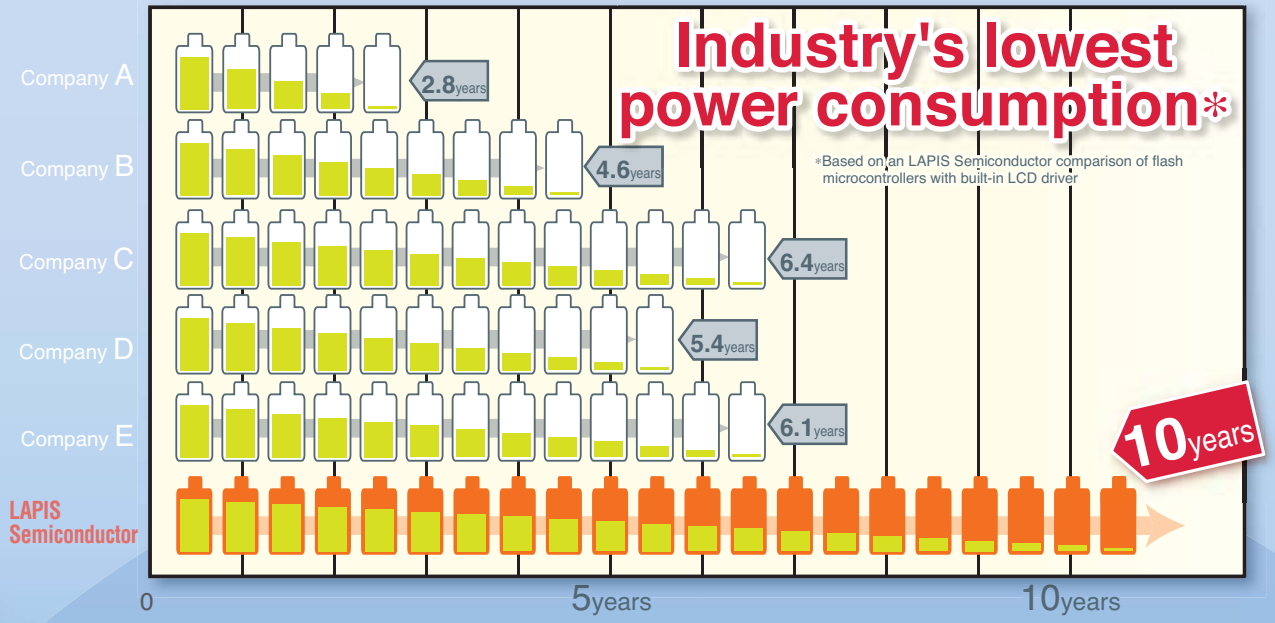
Feature 1

Low current consumption prolongs battery life

10 years on 1 battery!
Low power microcontroller

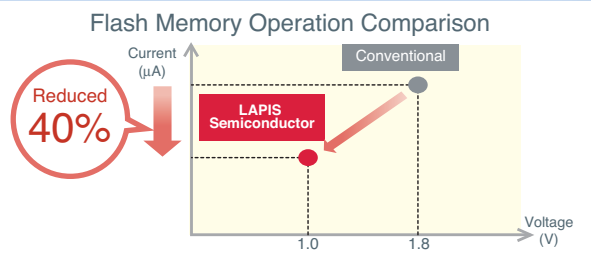
Original design technology and low power processes ensure low current consumption in all modes. In addition, a dual-clock system is utilized, enabling intermittent operation in low-power mode and selection of the optimum clock frequency, making operation possible for 10 years on just a single battery.



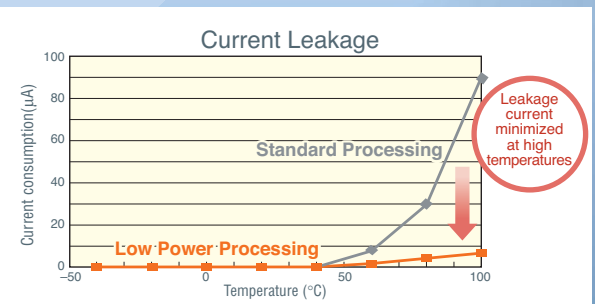


LAPIS Semiconductor has achieved
industry-leading low power consumption in all modes
Microcontroller with Built-In Flash Memory (ML610Q431)

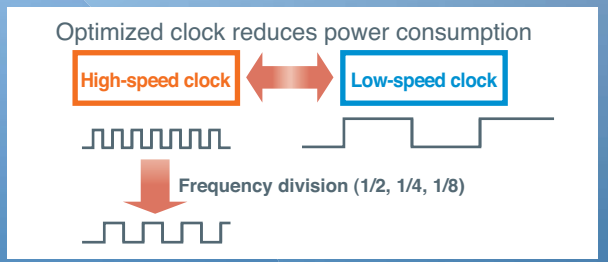
・CPU Operation (Built-in 4MHz PLL oscillator: 800µA)	→**180µA at 1MHz**
・CPU Operation (External 32kHz oscillator: 5µA)	→**Only 5µA with crystal oscillation clock**
・CPU Operation (Built-in 500kHz RC oscillator: 70µA)	→**Uses even less current at lower speeds**
・HALT Operation (32kHz crystal oscillator + RTC + WDT: 0.5µA)	→**Timing at low current**
・STOP Operation (No oscillation: 0.15µA)	→**Reduce current leakage**



Unique process minimizes current leakage at high temperatures, reducing power consumption over a wider range.



Internal Flash memory capable of reading at only 1.1V, enabling operation from a single 1.5V battery.



Optimum clock selected via control software.

Feature 2

Low voltage operation contributes to smaller system size

10 years on 1 battery! Low power microcontroller

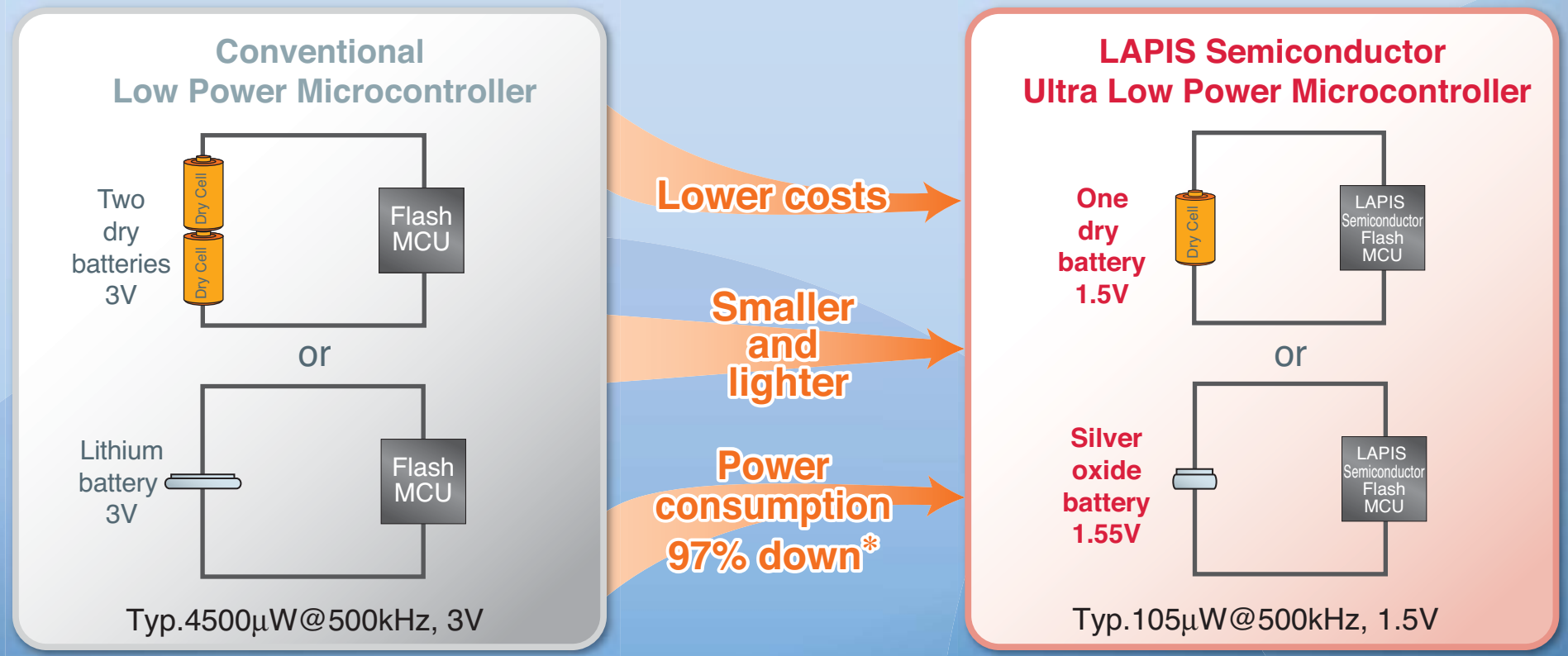
Low operating voltage

Single 1.5V battery

1.1 V Operation

Only 1.1V is required, making operation possible using only a single 1.5V battery. This contributes to more compact, lightweight devices while reducing costs.

The low minimum operation voltage, combined with 32.768kHz crystal oscillation clock and extremely low current consumption (in low-power mode) results in longer battery life and enables the use of double layer capacitors for (a low-cost) backup.



*Compared with standard LAPIS Semiconductor products

Feature 3

High performance CPU core reduces system power requirements

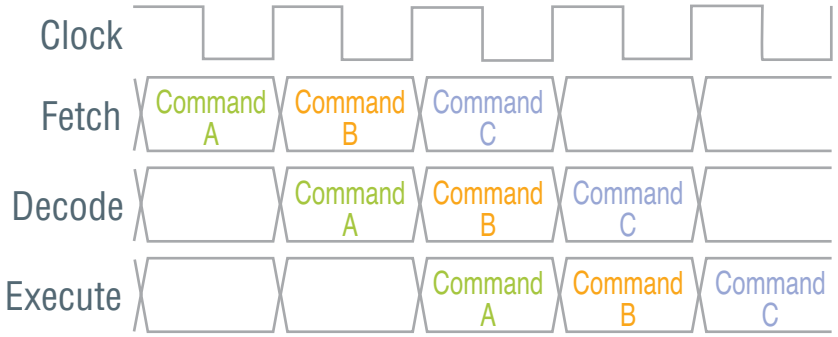
10 years on 1 battery!
Low power microcontroller

One command through parallel processing via pipeline architecture
1 Command
1 Clock

These 8bit microcontrollers feature one instruction per clock cycle operation and deliver high performance - comparable to 16bit microcontrollers. In addition, RISC-based processing utilizing a rich instruction set for efficient bit/multi-byte operation, combined with intermittent firmware operation, enable high-performance operation even at slow clock cycles for reduced CPU processing time and lower system power consumption.

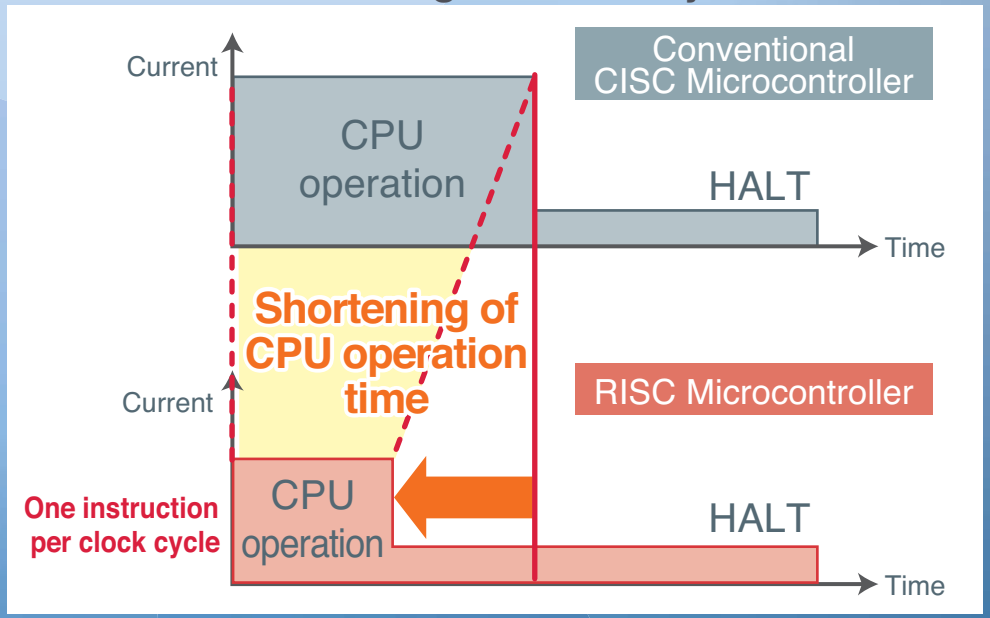
Minimum instruction execution time : 250ns@4MHz 30.5µs@32.768kHz

Efficient CPU capable of processing one instruction per clock cycle



One instruction per clock cycle

Command processing performed quickly before entering into standby mode

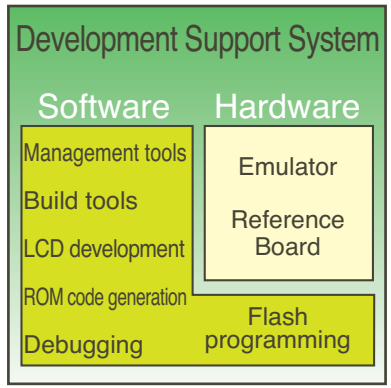


Feature 4

Comprehensive development environment

10 years on 1 battery!
Low power microcontroller

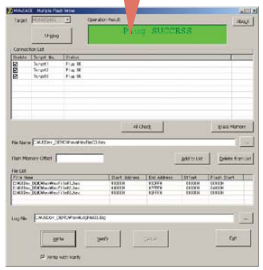
Support for all phases of software development is provided to the customer, from program builds, debugging, and Flash programming, to compact, lightweight on-chip debug emulators and reference boards with microcontrollers.
Build tool setup (Compiler, Assembler, and Linker) and debug tool setup (DTU8 debugger/simulator) are initiated in the integrated IDEU8 environment. The DTU8 debugger (running on a PC) is connected to the microcontroller through an on-chip debugger port controlled by a µEASE debugger pod. The debugger controls and analyzes the execution of code on the microcontroller. The FWµEASE Flash Writer and MWµEASE Flash Multi-Writer are software tools used to write application code to the Flash memory. Multiple devices can be written to simultaneously. The LCD tools (part of the development suite), simulate LCD operation and provides several options for controlling an LCD.



For debugging (i.e. block erase, address designation)

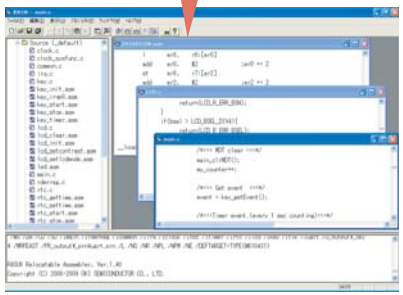
FWµEASE Flash Writer with intuitive GUI

Simplifies writing to multiple devices during mass production



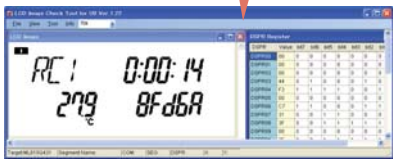
MWµEASE Flash Multi-Writer offers simultaneous writing to up to 32 targets

Allows project management of multiple operations, including header/source file linking and C compiler/assembler/ linker option setting

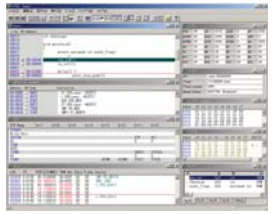


Integrated environment IDEU8 incorporates development work from program editing to build

Develop a display control program without an actual LCD panel

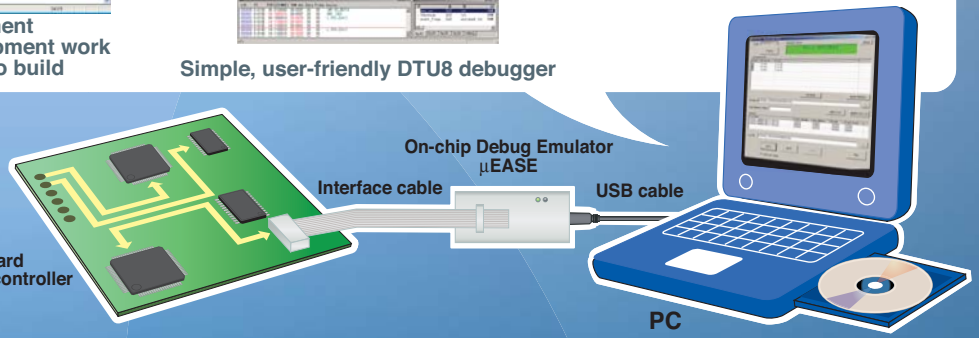


LCD image tool provides LCD simulation



Enables source-level debugging, including breakpoint setting and step execution

Simple, user-friendly DTU8 debugger

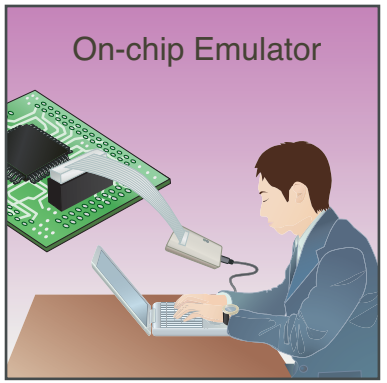


Feature 5

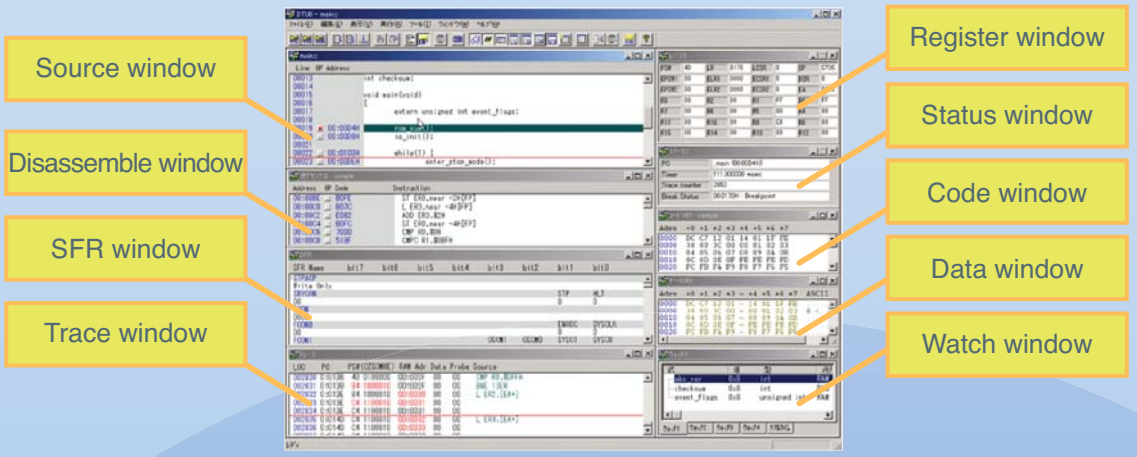
Simple, easy-to-use debugger and on-chip emulator

10 years on 1 battery!
Low power microcontroller

The simple graphical user interface of the debugger is used to display multiple windows that contain a variety of information, such as C/assembly language, register data, and status. In addition, a single-step/subroutine function is included to check the behavior of the software one line (or subroutine) at a time. Enhanced break functions are also available that suspends software execution at a certain point in the code or to access a register or data location. Break functions are critical to real-time debugging and maximize system debugging performance.



DTU8 Debugger



Key Features of DTU8 / µEASE

- Hardware break point enables pass count setting
- RAM data/address match break can detect data changes within a program
- Flash memory allows unlimited software break point settings
- Refer/register C language variables using the memory watch window

On-chip Debug Emulator µEASE

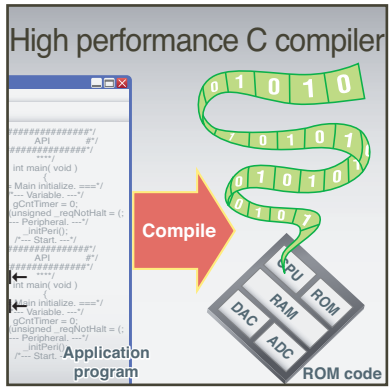
On-chip Debug Emulator µEASE Specifications

Applicable devices	ML610400 series and other LSIs with on-chip debug functionality
Host interface	USB2.0 (High speed, Full speed)
Flash writing function	Program download to flash memory integrated in the target MCU (MCU with built-in flash memory)
Emulation function	Real-time emulation, Single step emulation
Break function	Hardware break points (program memory) : 3 points (2 points in source window, 1 point with address specification/counting function in another menu) RAM address data match break/counting function : 1 point Software break points : Entire program area (models with built-in flash memory only)
Memory / register control	Display/change the contents of program memory, data memory, general-purpose register, and SFR
Dimensions	50.0(W) × 90.0(D) × 9.0(H)
Weight	50g
Power supply	Supply from USB VBUS port

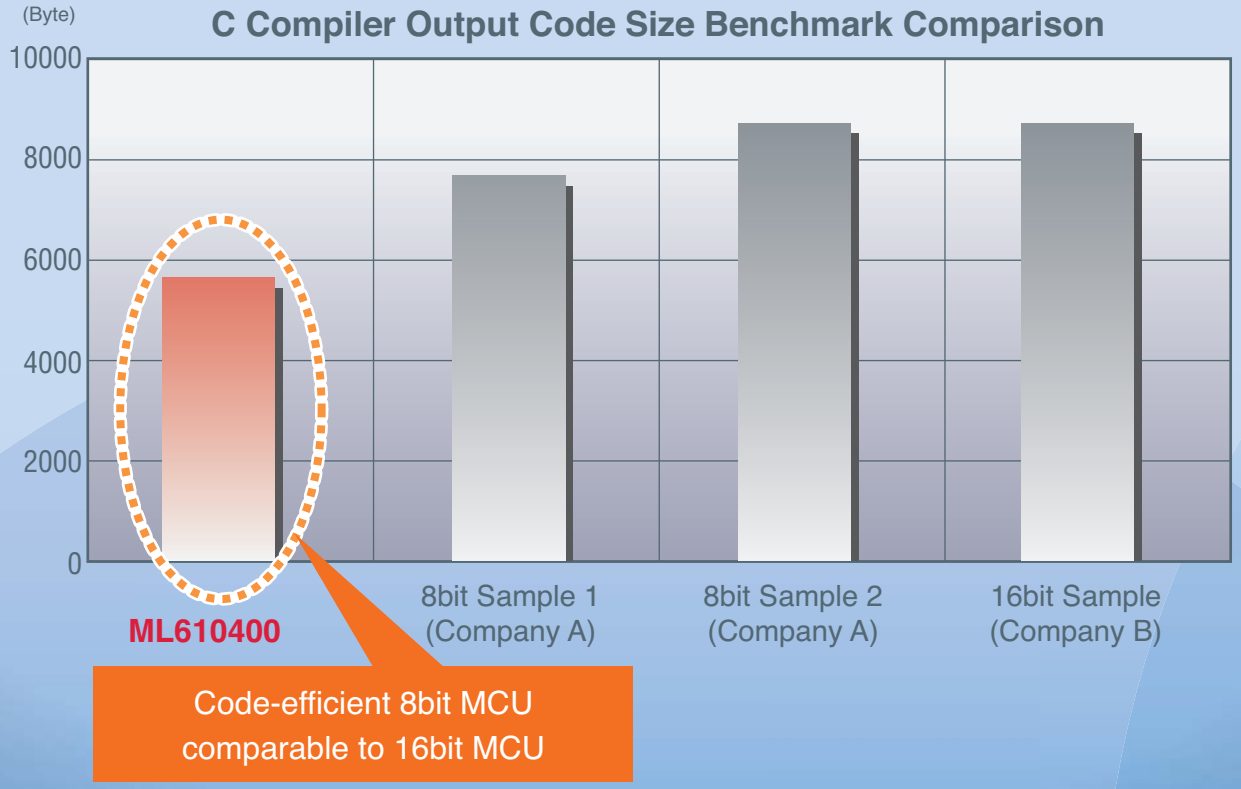
Feature 6

Software development with code-efficient C compiler

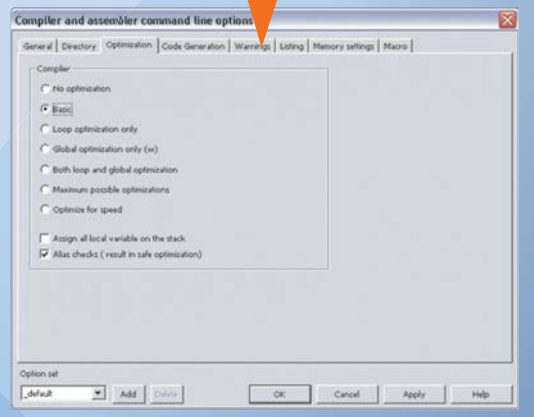
10 years on 1 battery!
Low power microcontroller



A high performance C compiler is utilized that minimizes ROM code and maximizes processing speed for optimum microcontroller operation. The 8bit CPU features a code efficiency equivalent to 16bit CPUs, resulting in the ideal program memory size.
The CCU8 C compiler offers a variety of configurable options, such as optimization (minimizing program size and execution time of subroutines), setting the program stack size, and selecting the characteristics of the output files - including documentation for error checking. In addition, 'pragma' is available to handle interrupt processing routines and architecture-dependent functions for smooth development of application programs. The CCU8 C compiler is ANSI C language compliant, making it easy to port projects from other microcontrollers.



Numerous compiler options maximize microcontroller performance



Option settings for the CCU8 C compiler

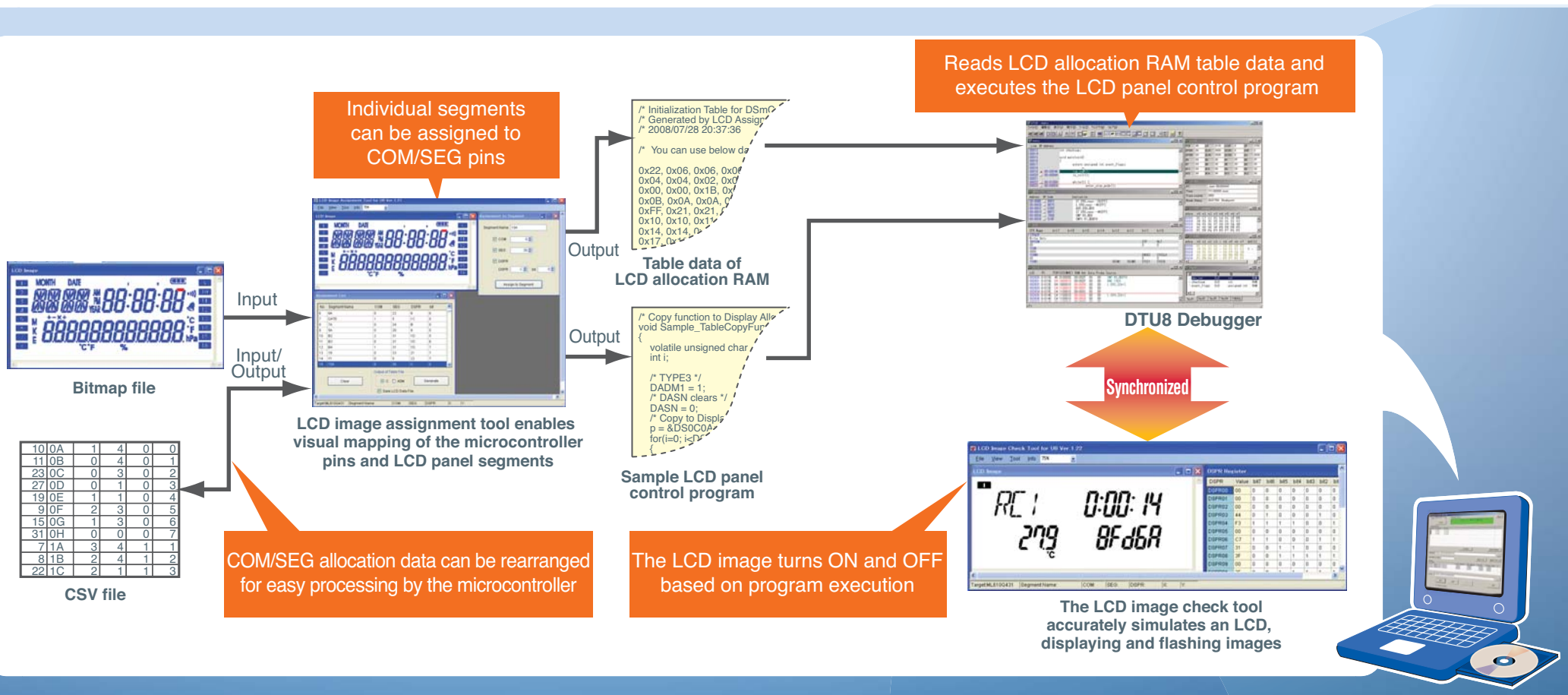
Feature 7

LCD tool simplifies LCD control program development

10 years on 1 battery!
Low power microcontroller

The LCD image tool includes an LCD image assignment tool and LCD image check tool. The LCD image assignment tool uses a bitmap file of the LCD and allows users to map the microcontroller COM and SEG pins to the LCD visually. It also automatically creates a data table for the LCD allocation RAM and LCD control program. The settings of the COM/SEG pins related to the LCD can be saved to or read from a CSV file to enhance work efficiency. The LCD image check tool can be used to check the operation of an LCD even without an LCD present. It simulates an LCD image on a PC based on the output of the simulator or while debugging in real time under the control of the DTU8 and µEASE.

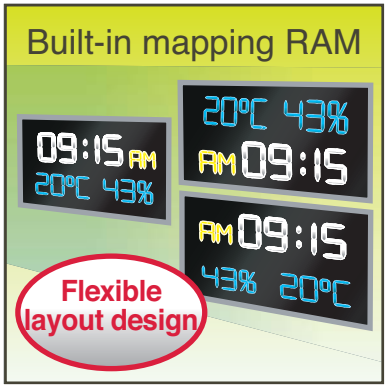
Displays images without the LCD panel



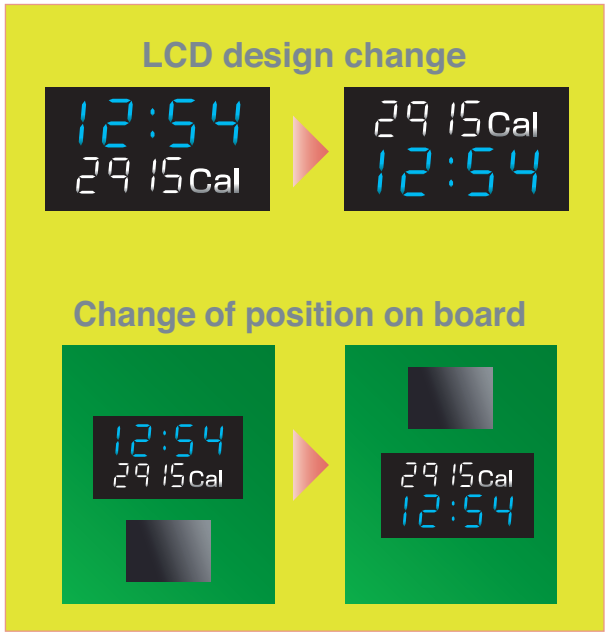
Feature 8

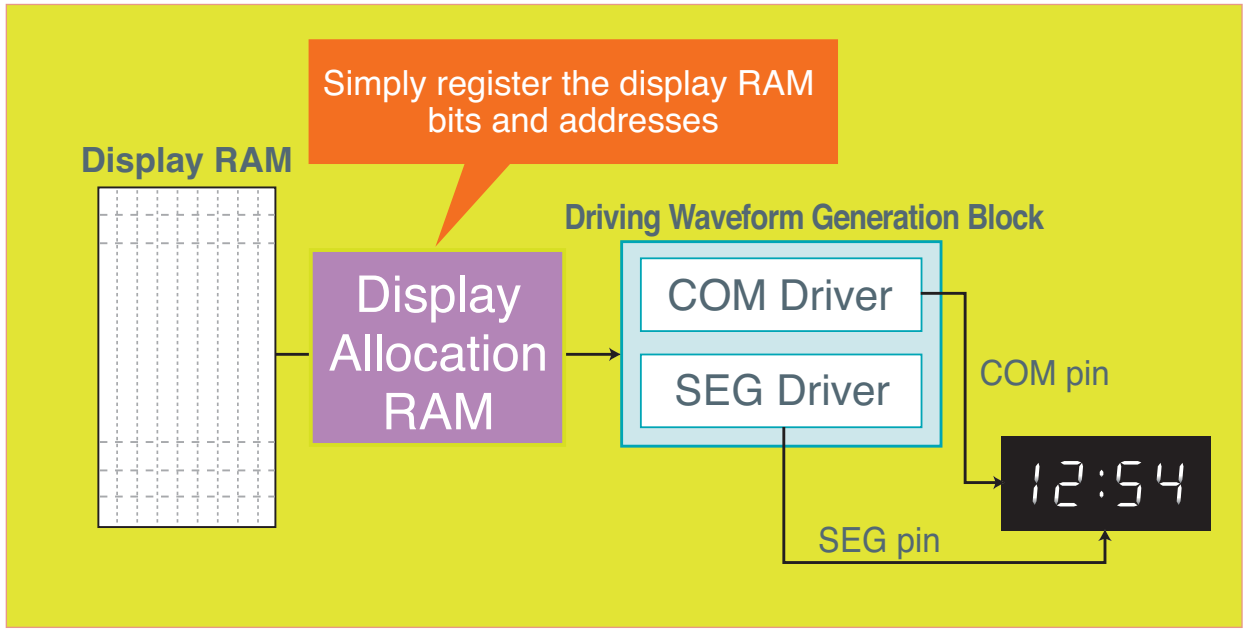
Troublesome software changes no longer required when changing the LCD panel

10 years on 1 battery!
Low power microcontroller



A display allocation RAM is integrated between the display RAM and COM/SEG pins that enables easy pin mapping. This feature is important when changing the pinout assignments of the display. Remapping an LCD is complicated and time-consuming and can take up to several days. However, this time can be shortened to only hours with display allocation RAM.
Data creation and operation verification can also be performed by the LCD tools, facilitating user development.





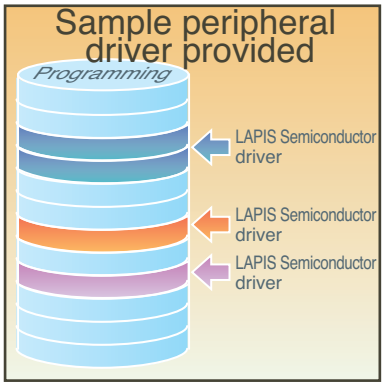
Requires only changes to the data settings in the display allocation RAM.
No complicated changes to display RAM control needed.

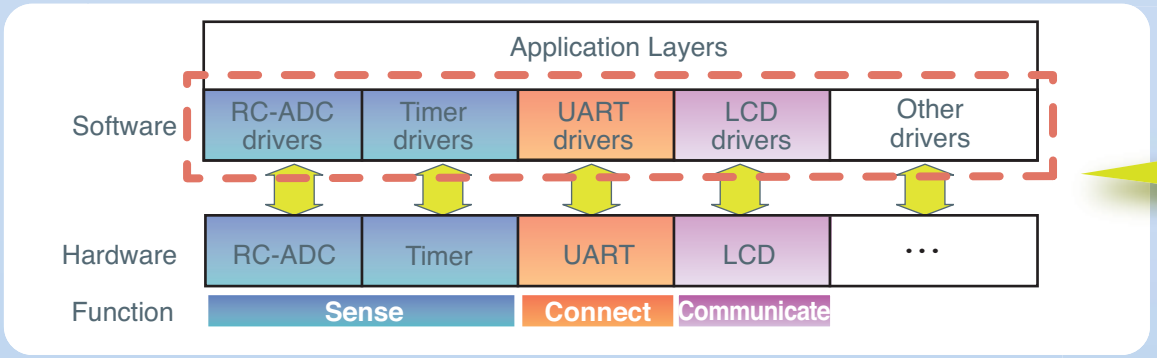
Feature 9

Multiple sample peripheral drivers provided for easy integration

10 years on 1 battery!
Low power microcontroller

Sample drivers for configuring and operating peripheral circuits are provided to the the customer for application code development. These drivers are presented as software modules that allow the customer to integrate only those modules necessary, shortening development time considerably.





	Module Name	Functions
Sense	SA-ADC module	Initializes the successive approximation ADC module (i.e. conversion count, operating mode, secondary amp. settings), conversion start/stop, obtain conversion results, and measure the voltage
	RC-ADC module	Performs A/D conversion by digitalizing the ratio of the oscillation frequency between the reference resistor (or capacitor) and resistive sensor like thermistor (or capacitive sensor)
	Temperature calculation module	Calculates the temperature from the RC-ADC conversion results based on the thermistor 103AT frequency ratio - temperature conversion table
	Humidity calculation module	Calculates the humidity from the RC-ADC conversion results and measured temperature based on the C10-M53R humidity sensor frequency ratio (humidity ratio) - humidity conversion table
	Celsius ↔ Fahrenheit conversion module	Performs Celsius ⇔ Fahrenheit conversion
	Air pressure calculation module	Calculates the barometric pressure by measuring the output of a bridge-type sensor (barometer) using the input of SA-ADC differential amplifier
	Real-time clock control module	Sets the counting function of the real-time clock
	Timer control module	Controls the 8bit/16bit timer operation
	Clock control module	Controls the clock (i.e. system clock settings)
	Time-based counter control module	Controls the high-speed time-based counter
	1kHz timer control module	Counts time (1/1000sec)
	Stopwatch module	Utilizes the 1kHz Timer Control Module to initialize the stopwatch and perform ON/OFF operation and data reading
Connect	UART module	Controls the UART (asynchronous serial interface)
	UART baud rate timer correction module	Measures the high-speed clock frequency in order to correct the UART baud rate timer value to maintain UART communication
	I²C module	Controls the I²C BUS interface (master)
	SSIO module	Controls the 8bit/16bit synchronous serial port (SSIO). It can be used to control a device with SPI interface when using one of the GPIO pins for chip enable
	EEPROM module	Performs EEPROM writing/reading via I²C/SSIO
Communicate	LCD display module	Performs initialization (i.e. bias, duty, frame frequency), contrast/display mode setting, and 7SEG/16SEG display
	Key input module	Utilizes a port with interrupt function to perform initialization (input mode), key capture start/stop, and key event acquisition
	Melody module	Controls the melody/buzzer output of the melody driver
	BLD control module	Utilizes the battery level detection function to measure the MCU supply voltage

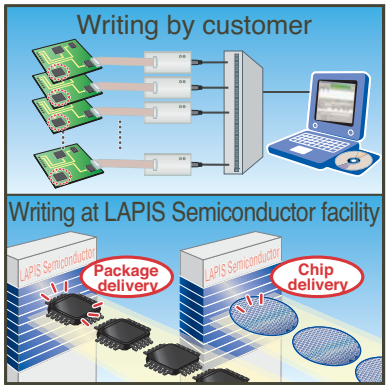
Feature 10

Flexible writing process

10 years on 1 battery!
Low power microcontroller

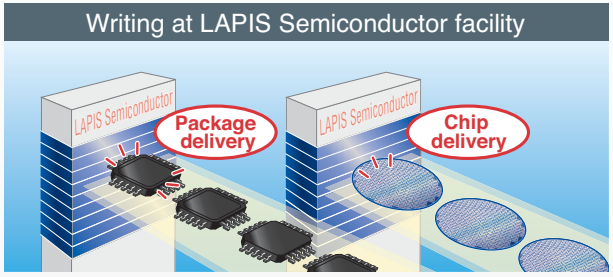
Users can opt for performing writing at their facility utilizing multi-writing software or at LAPIS Semiconductor's site, providing a greater level of flexibility.

Mass Production Method and Device Selection	Advantages/Disadvantages: Reduced Writing Costs at the Customer's Site	Flexible, Comprehensive Testing at the Customer's Site	Prompt Response to Software Problems	Microcontroller Delivery	Microcontroller Unit Price	Customer Responsibilities	LAPIS Semiconductor Responsibilities
Type 1 Writing to Flash ROM microcontrollers at LAPIS Semiconductor's facility	◎	△	△	○	△	Order ROM code products and provide the ROM code (software)	Deliver the Flash ROM products after writing the ROM code
Type 2 Writing to blank Flash ROM microcontrollers onboard and testing it at the customer's site	△	○	◎	◎	○	Order blanks, create a writing jig, and write the ROM code	Deliver blank Flash ROM products
Type 3 Writing to Flash ROM microcontrollers at LAPIS Semiconductor's facility then testing it onboard and performing final writing at the customer's site	△	◎	◎	○	△	Order ROM code products, provide the ROM code (software), create a writing jig, and write the ROM code	Deliver the Flash ROM products after writing the ROM code
Type 4 Manufacturing Mask ROM microcontrollers at LAPIS Semiconductor's facility (ES shipment included)	△	△	△	△	◎	Order ROM code products and provide the ROM code (software)	Deliver Mask ROM products after masking the ROM

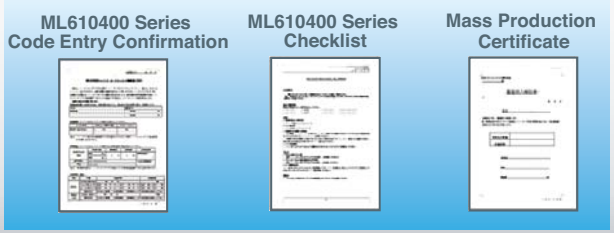


Provides flexible support the customer's mass production process

Writing at LAPIS Semiconductor's facility

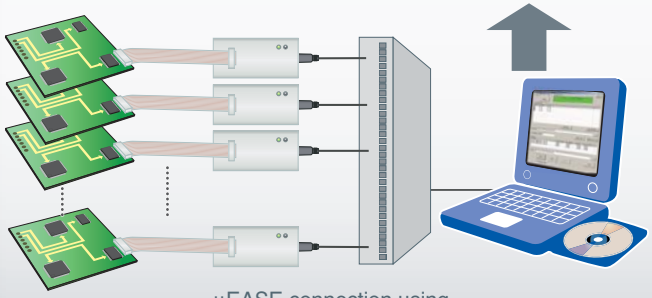


ROM Code Entry Format



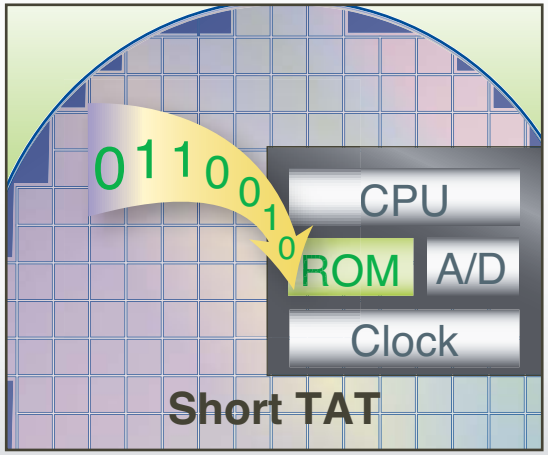
Writing by the customer using MWμEASE software

The MWμEASE Flash Multi-Writer is capable of writing to up to 32 devices simultaneously



μEASE connection using the MWμEASE Flash Multi-Writer

Chip writing and shipment also available



Standard Type
ML610Q482 / ML610Q482P

10 years on battery!
Low power microcontroller

Package

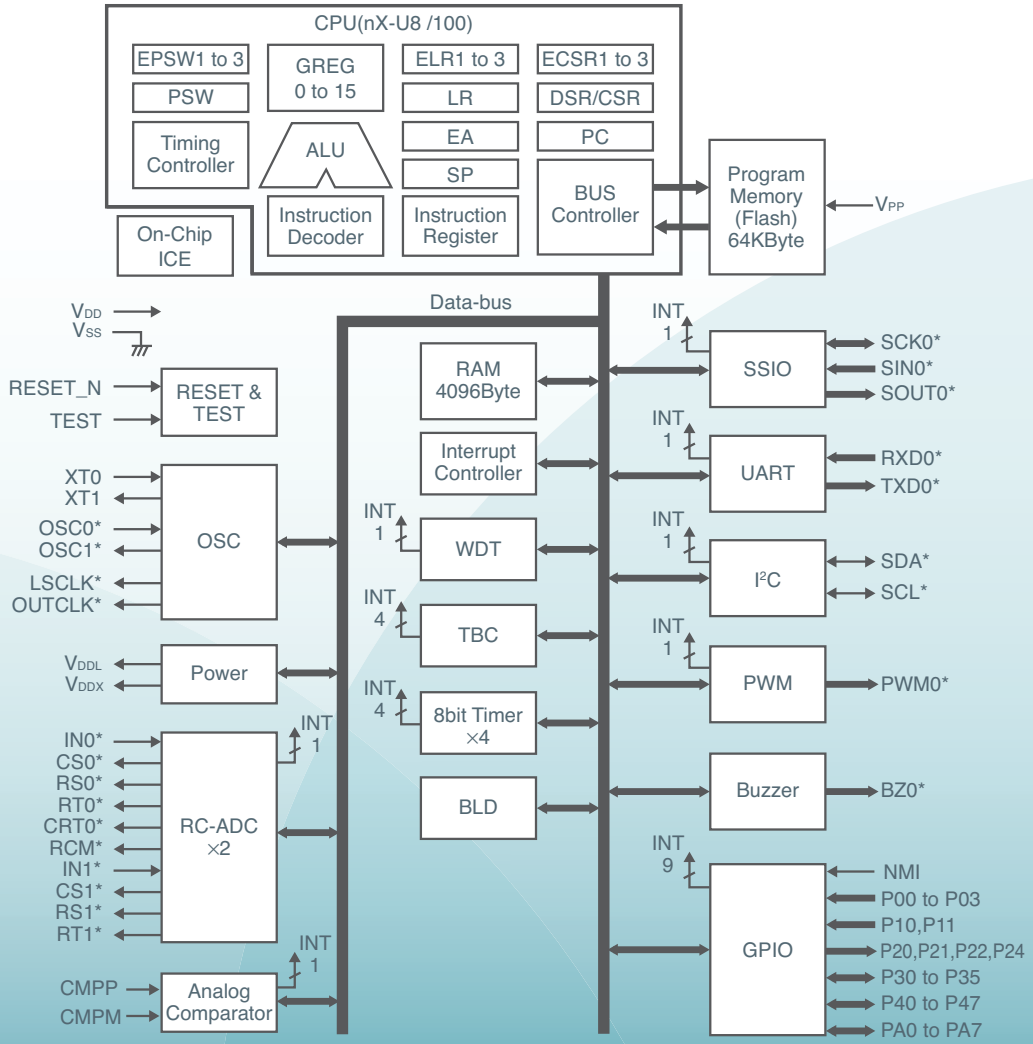
TQFP48

Actual size shown

Features

ROM		64KByte (Flash) (includes 1KByte test area)
RAM		4KByte
Ports (Includes Secondary Function)	Input	6
	Output	4
	Input/Output	22
A/D Converter		24bit RC oscillation type×2ch
Analog Comparator		Common mode input : 0.2V to VDD-1.0V Input offset : 50mV(typ.)
Serial I/F		UART×1, SSIO(SPI)×1, I²C(master)×1
Timer	8bit Timer	4
	16bit PWM	1
	Others	TBC(Time Base Counter)×1, WDT×1
External Interrupt		5
Other Functions		Battery level detection, clock output, and more
Operating Frequency	High Speed	4.096MHz (internal PLL or external crystal/ceramic oscillator), 500kHz (internal RC oscillation)
	Low Speed	32.768kHz (crystal oscillation)
Operating Voltage		1.1V to 3.6V
Operating Temperature		ML610Q482 : –20°C to +70°C ML610Q482P : –40°C to +85°C
Current Consumption (Typ.)	At Standby	STOP mode : 0.2µA, HALT mode : 0.5µA
	During Operation	32kHz : 5µA (100% duty) 500kHz : 70µA (Internal RC oscillation) 4.096MHz : 830µA (Internal PLL)
Supply Form		Chip or TQFP48

Block diagram



* : Secondary function of port

Dot Matrix Type
ML610Q439 / ML610Q439P

10 years on battery!
Low power microcontroller

Package

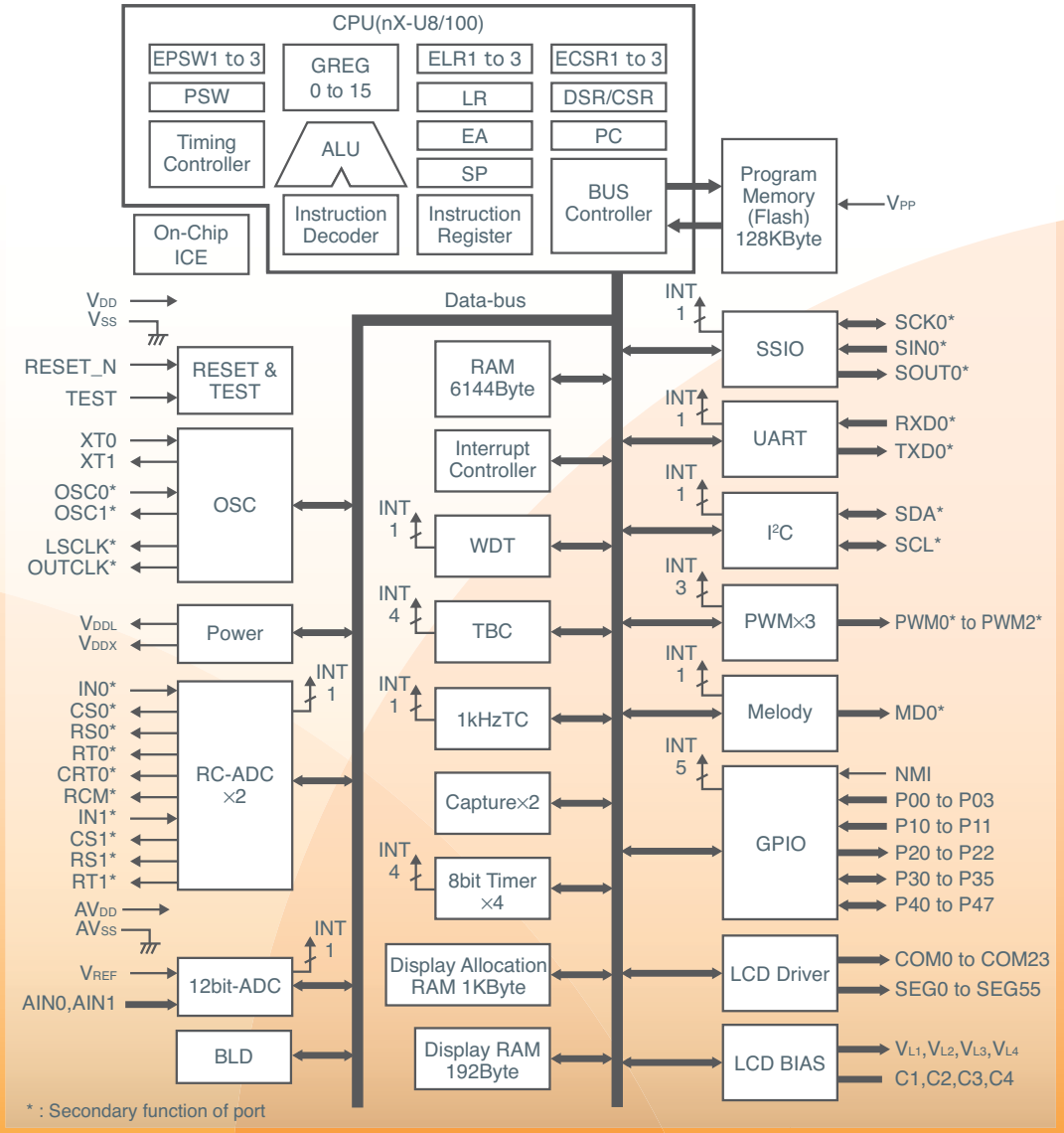
LQFP144

Actual size shown

Features

ROM		128KByte (Flash) (includes 1KByte test area)
RAM		7KByte (includes 1KByte LCD allocation register)
LCD Driver		Max.1024dot 64seg.×16com.
Ports (Includes Secondary Function)	Input	10
	Output	3
	Input/Output	20
A/D Converter		24bit RC oscillation type×2, 12bit successive approximation type×2
Serial I/F		UART×1, SSIO(SPI)×1, I²C(master)×1
Timer	8bit Timer	4
	16bit PWM	16bit-PWM×3
	Others	TBC(Time Base Counter)×1, WDT×1, 1kHz Timer×1, Capture×2
External Interrupt		9
Other Functions		Buzzer/melody, clock output, battery level detection, and more
Operating Frequency	High Speed	4.096MHz (internal PLL or external crystal/ceramic oscillator), 2M/1M/500kHz (internal RC oscillation, option selection)
	Low Speed	32.768kHz (external crystal oscillation)
Operating Voltage		1.1V to 3.6V
Operating Temperature		ML610Q439 : –20°C to +70°C ML610Q439P : –40°C to +85°C
Current Consumption (Typ.)	At Standby	STOP mode : 0.15µA, HALT mode : 0.5µA
	During Operation	32kHz : 5µA (100% duty) 500kHz : 70µA (Internal RC oscillation) 4MHz : 800µA (Internal PLL)
Supply Form		Chip or LQFP144

Block diagram



Segment Type
ML610Q409 / ML610Q409P

10 years on 1 battery!
Low power microcontroller

Package

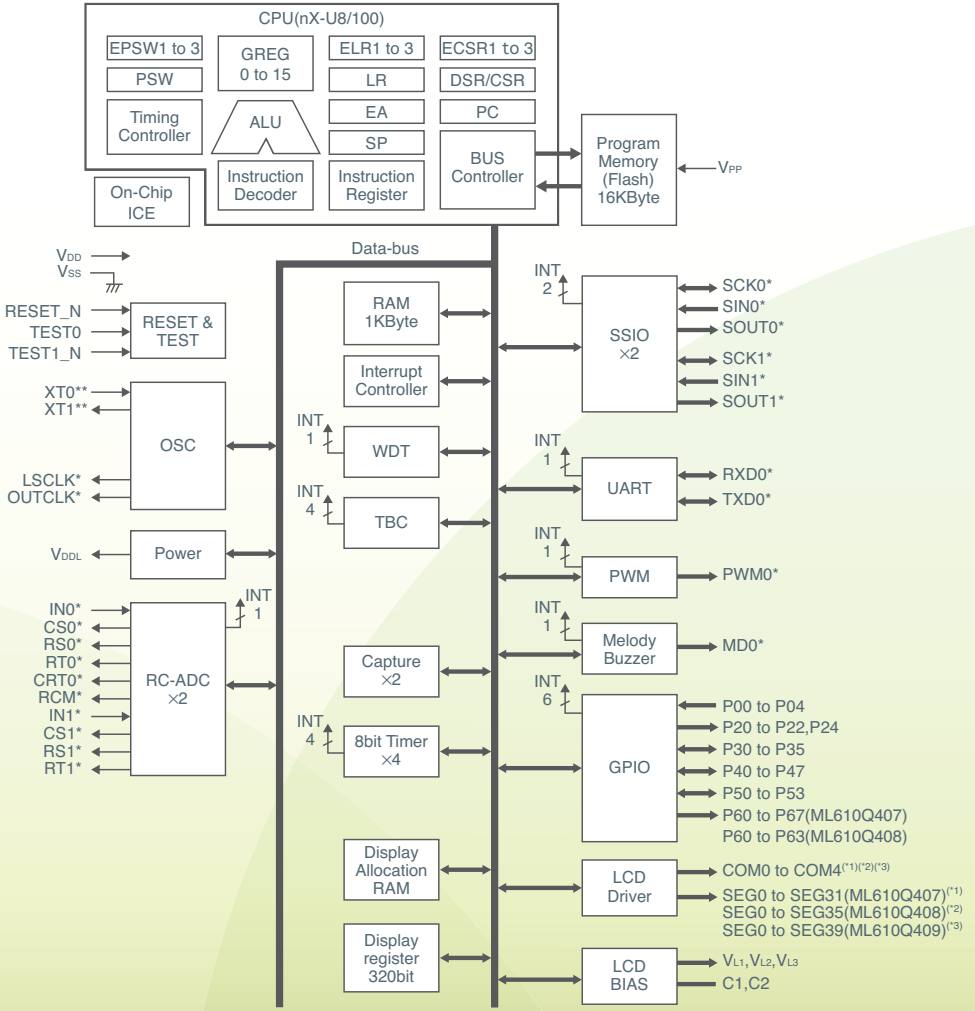
TQFP100

Actual size shown

Features

ROM		16KByte (Flash) (includes 1KByte test area)
RAM		1KByte
LCD Driver		Max.185dot 37seg.×5com.
Ports (Includes Secondary Function)	Input	5
	Output	4
	Input/Output	22
A/D Converter		16bit RC oscillation type×2
Serial I/F		UART×1, SSIO(SPI)×2
Timer	8bit Timer	4
	16bit PWM	16bit-PWM×1
	Others	TBC(Time Base Counter)×1, WDT×1, Capture×2
External Interrupt		13 (include 8bit-OR input)
Other Functions		Buzzer/melody, low-speed oscillation frequency correction (0.48ppm accuracy), clock output
Operating Frequency	High Speed	500kHz or 2MHz (internal RC oscillation)
	Low Speed	32.768kHz(crystal oscillation)
Operating Voltage		500kHz : 1.25V to 3.6V, 2MHz : 1.8V to 3.6V
Operating Temperature		ML610Q409 : –20°C to +70°C ML610Q409P : –40°C to +85°C
Current Consumption (Typ.)	At Standby	STOP mode : 0.4µA, HALT mode : 0.9µA
	During Operation	32kHz : 5µA, 500kHz : 70µA, 2MHz : 280µA
Supply Form		Chip or TQFP100

Block diagram



* : Secondary or tertiary function of port

(*1) : Select between 29SEG × 5COM, 30SEG × 4COM, 31SEG × 3COM, or 32SEG × 2COM (via software)

(*2) : Select between 33SEG × 5COM, 34SEG × 4COM, 35SEG × 3COM, or 36SEG × 2COM (via software)

(*3) : Select between 37SEG × 5COM, 38SEG × 4COM, 39SEG × 3COM, or 40SEG × 2COM (via software)

Segment Type
ML610401 / ML610401P

10 years on battery!
Low power microcontroller

Package

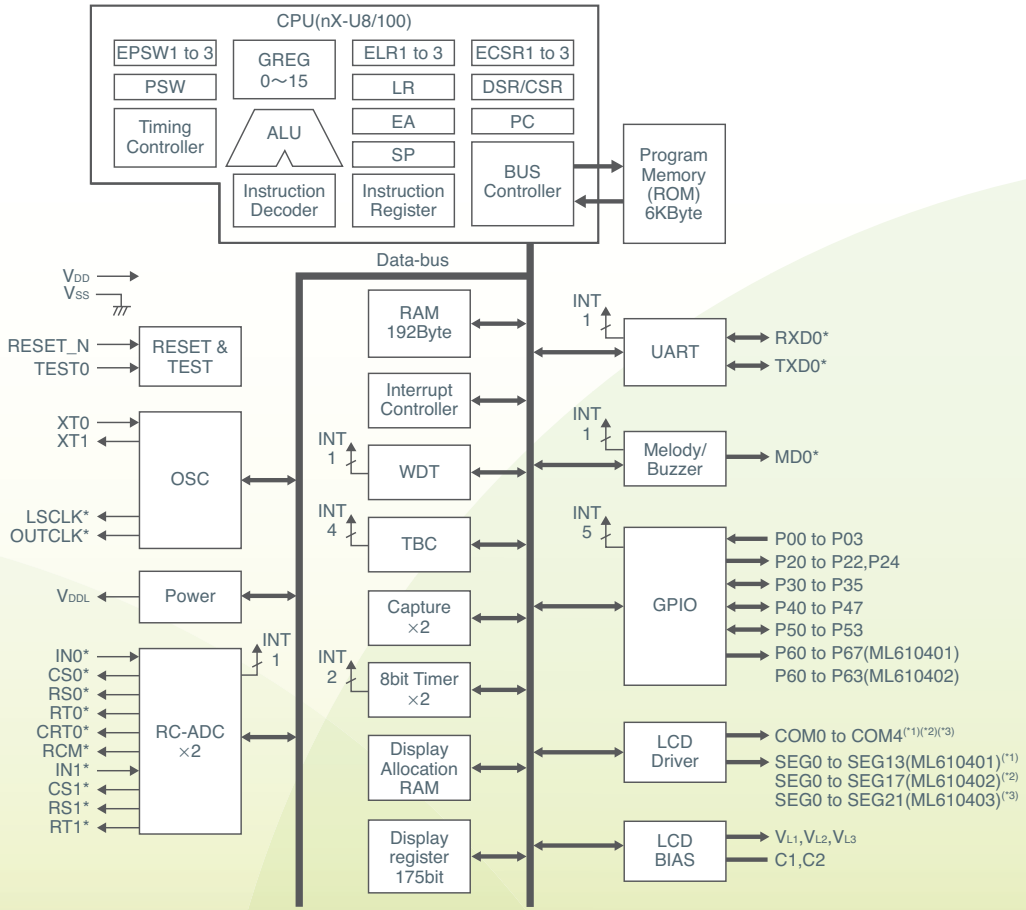
TQFP64

Actual size shown

Features

ROM		6KByte (Mask) (includes 1KByte test area)
RAM		192Byte
LCD Driver		Max.55dot 11seg.×5com.
Ports (Includes Secondary Function)	Input	4
	Output	12
	Input/Output	18
A/D Converter		16bit RC oscillation type×2ch
Serial I/F		UART×1
Timer	8bit Timer	2
	Others	TBC(Time Base Counter)×1, WDT×1, Capture×2
External Interrupt		8 (include 4bit-OR input)
Other Functions		Buzzer/melody, low-speed oscillation frequency correction (0.48ppm accuracy), clock output
Operating Frequency	High Speed	500kHz(internal RC oscillation)
	Low Speed	32.768kHz(crystal oscillation)
Operating Voltage		1.25V to 3.6V
Operating Temperature		ML610401 : –20°C to +70°C ML610401P : –40°C to +85°C
Current Consumption (Typ.)	At Standby	STOP mode : 0.3µA, HALT mode : 0.9µA
	During Operation	32kHz : 3µA, 500kHz : 50µA
Supply Form		Chip or TQFP64

Block diagram



* : Secondary function of port
(*1) : Select between 11SEG × 5COM, 12SEG × 4COM, 13SEG × 3COM, 14SEG × 2COM (via software)
(*2) : Select between 15SEG × 5COM, 16SEG × 4COM, 17SEG × 3COM, 18SEG × 2COM (via software)
(*3) : Select between 19SEG × 5COM, 20SEG × 4COM, 21SEG × 3COM, 22SEG × 2COM (via software)

Specifications

*1 : 4MHz generated via internal PLL / ceramic / crystal oscillation,
500kHz and 2MHz via RC oscillation,
32.768kHz via crystal oscillation, and 32kHz via RC oscillation
*2 : Low current consumption during Suspend (HALT) Mode via low-speed 32kHz crystal oscillation
Suspend (HALT) Mode : Low-speed oscillation - only a time-based counter and watchdog timer are active.
The CPU, LCD bias circuit, and high-speed operation are stopped. The internal regulator is ON.

*3 : Including secondary functions
*4 : Only master function can support fast mode (400kbps) / standard mode (100kbps)
*5 : Only the Master function supports Standard Mode (50kbps)
*6 : No compatible chip select signals exist for 8bit / 16bit SPI BUS
*7 : Includes 256Byte test area
*8 : Includes 1KByte test area
*9 : 1KByte LCD RAM allocation included

Standard Type

Part No.	Operating Conditions					ROM/RAM		Functions/Features																Package	Chip Support
	Operating voltage (V)	Operating frequency *1	Minimum instruction execution time	Current *2 consumption (Typ.@HALT)	Operating temperature (°C)	ROM capacity (Byte)	RAM capacity (Byte)	Port *3			8bit timer	1kHz timer	PWM	Capture	WDT	ADC(method)	Serial port			Supply voltage detection	LCD driver	Interrupt sources internal : external	Others		
								Input	Output	Input/ Output							I^2C	SSIO *6	UART						
★ ML610Q486 / ML610Q486P	1.6 to 3.6	500kHz	2µs	15µA	–20 to +70 / –40 to +85	Flash 32K *7	1K	6	5	21	4 (16bit×2)	–	16bit×1	–	1	4 (Sequential)	1 *5	1	1	1	–	14 : 5	–	TQFP48-P-0707-0.50-K	○
★ ML610Q487 / ML610Q487P	1.8 to 3.8	1MHz / 32.768kHz	1µs 30.5µs	1.7µA	–20 to +70 / –40 to +85	Flash 48K *7	1.5K	8	4	24	8 (16bit×4)	–	16bit×2	–	1	–	1	1	2	–	–	19 : 6	Low speed frequency correction	TQFP48-P-0707-0.50-K	○
★ ML610Q488 / ML610Q488P	1.8 to 3.8	4MHz / 32.768kHz	0.25µs 30.5µs	1.7µA	–20 to +70 / –40 to +85	Flash 48K *7	1.5K	8	4	24	8 (16bit×4)	–	16bit×2	2	1	–	1	1	2	–	–	19 : 6	Low speed frequency correction	TQFP48-P-0707-0.50-K	○
★ ML610Q489 / ML610Q489P	1.8 to 3.8	4MHz / 31.25kHz (4MHz frequency division)	0.25µs 30.5µs	–	–20 to +70 / –40 to +85	Flash 48K *7	1.5K	8	4	24	8 (16bit×4)	–	16bit×2	2	1	–	1 *4	1	2	–	–	19 : 6	Low speed frequency correction	TQFP48-P-0707-0.50-K	○
NEW ML610482 / ML610482P	1.1 to 3.6	4.096MHz / 500kHz / 32.768kHz	0.244µs / 2µs / 30.5µs	0.5µA	–20 to +70 / –40 to +85	Mask 64K *7	4K	6	4	22	4 (16bit×2)	–	16bit×1	2	1	2 (RC oscillation)	1 *4	1	1	1	–	15 : 5	Low speed frequency correction/ Buzzer	TQFP48-P-0707-0.50-K	○
NEW ML610482 / ML610482P	1.1 to 3.6	4.096MHz / 500kHz / 32.768kHz	0.244µs / 2µs / 30.5µs	0.5µA	–20 to +70 / –40 to +85	Flash 64K *7	4K	6	4	22	4 (16bit×2)	–	16bit×1	2	1	2 (RC oscillation)	1	1	1	1	–	15 : 5	Low speed frequency correction/ Buzzer	TQFP48-P-0707-0.50-K	○

★ Under development

Dot Matrix Type

Part No.	Operating Conditions					ROM/RAM		Functions/Features																Package	Chip Support
	Operating voltage (V)	Operating frequency *1	Minimum instruction execution time	Current *2 consumption (Typ.@HALT)	Operating temperature (°C)	ROM capacity (Byte)	RAM capacity (Byte)	Port *3			8bit timer	1kHz timer	PWM	Capture	WDT	ADC(method)	Serial port			Supply voltage detection	LCD driver	Interrupt sources internal : external	Others		
								Input	Output	Input/ Output							I^2C	SSIO *6	UART						
ML610Q421 / ML610Q421P	1.1 to 3.6	4.096MHz / 500kHz / 32.768kHz	0.244µs / 2µs / 30.5µs	0.5µA	–20 to +70 / –40 to +85	Flash 32K *7	2K *9	6	3	22	4 (16bit×2)	1	16bit×1	2	1	2(RC oscillation) 2 (Sequential)	1 *4	1	1	1	Max. 400dot 50seg × 8com.	17 : 5	Low speed frequency correction/ Melody : Buzzer	TQFP120-P-1414-0.40-K	○
ML610Q422 /	1.1 to 3.6	4.096MHz / 500kHz / 32.768kHz	0.244µs / 2µs / 30.5µs	0.5µA	–20 to +70 / –40 to +85	Flash 32K *7	2K *9	6	3	14	4 (16bit×2)	1	16bit×1	2	1	2(RC oscillation) 2 (Sequential)	1 *4	1	1	1	Max. 800dot 50seg × 16com.	17 : 5	Low speed frequency correction/ Melody : Buzzer	TQFP120-P-1414-0.40-K	○
NEW ML610Q428P	1.1 to 3.6	4.096MHz / 2MHz / 32.768kHz	0.244µs / 2µs(@2MHz) / 30.5µs	0.5µA	–20 to +70 / –40 to +85	Flash 48K *7	4K *9	6	3	14	2 (16bit×1)	1	16bit×3	–	1	2(RC oscillation)	1 *4	1	1	1	Max. 1392dot 58seg × 24com.	20 : 5	RTC / Low speed frequency correction/ Melody : Buzzer	TQFP128-P-1414-0.40-K	○
NEW ML610Q429 / ML610Q429P	1.1 to 3.6	4.096MHz / 2MHz / 32.768kHz	0.244µs / 2µs(@2MHz) / 30.5µs	0.5µA	–20 to +70 / –40 to +85	Flash 48K *7	4K *9	10	3	20	2 (16bit×1)	1	16bit×3	–	1	2(RC oscillation)	1 *4	1	1	1	Max. 512dot 64seg × 8com.	20 : 9	RTC / Low speed frequency correction/ Melody : Buzzer	TQFP128-P-1414-0.40-K	○
ML610Q431	1.1 to 3.6	4.096MHz / 500kHz / 32.768kHz	0.244µs / 2µs / 30.5µs	0.5µA	–20 to +70	Flash 64K *7	3K *9	6	3	22	4 (16bit×2)	1	16bit×1	2	1	2(RC oscillation) 2 (Sequential)	1 *4	1	1	1	Max. 1024dot 64seg × 16com.	20 : 5	RTC / Low speed frequency correction/ Melody : Buzzer	LQFP144-P-2020-0.50-ZK	○
ML610Q432	1.1 to 3.6	4.096MHz / 500kHz / 32.768kHz	0.244µs / 2µs / 30.5µs	0.5µA	–20 to +70	Flash 64K *7	3K *9	6	3	14	4 (16bit×2)	1	16bit×1	2	1	2(RC oscillation) 2 (Sequential)	1 *4	1	1	1	Max. 1536dot 64seg × 24com.	20 : 5	RTC / Low speed frequency correction/ Melody : Buzzer	LQFP144-P-2020-0.50-ZK	○
NEW ML610Q435	1.1 to 3.6	4.096MHz / 500kHz / 32.768kHz	0.244µs / 2µs / 30.5µs	0.5µA	–20 to +70	Flash 96K *7	3K *9	6	3	22	4 (16bit×2)	1	16bit×1	2	1	2(RC oscillation) 2 (Sequential)	1 *4	1	1	1	Max. 1024dot 64seg × 16com.	20 : 5	RTC / Low speed frequency correction/ Melody : Buzzer	LQFP144-P-2020-0.50-ZK	○
NEW ML610Q436	1.1 to 3.6	4.096MHz / 500kHz / 32.768kHz	0.244µs / 2µs / 30.5µs	0.5µA	–20 to +70	Flash 96K *7	3K *9	6	3	14	4 (16bit×2)	1	16bit×1	2	1	2(RC oscillation) 2 (Sequential)	1 *4	1	1	1	Max. 1536dot 64seg × 24com.	20 : 5	RTC / Low speed frequency correction/ Melody : Buzzer	LQFP144-P-2020-0.50-ZK	○
NEW ML610Q438 / ML610Q438P	1.1 to 3.6	4.096MHz / 2MHz / 32.768kHz	0.244µs / 2µs(@2MHz) / 30.5µs	0.5µA	–20 to +70 / –40 to +85	Flash 128K *7	7K *9	10	3	20	4 (16bit×2)	1	16bit×3	2	1	2(RC oscillation) 2 (Sequential)	1 *4	1	1	1	Max. 1344dot 56seg × 24com.	23 : 9	Low speed frequency correction/ Melody : Buzzer	LQFP144-P-2020-0.50-ZK	○
NEW ML610Q439 / ML610Q439P	1.1 to 3.6	4.096MHz / 2MHz / 32.768kHz	0.244µs / 2µs(@2MHz) / 30.5µs	0.5µA	–20 to +70 / –40 to +85	Flash 128K *7	7K *9	10	3	20	4 (16bit×2)	1	16bit×3	2	1	2(RC oscillation) 2 (Sequential)	1 *4	1	1	1	Max. 1024dot 64seg × 16com.	23 : 9	Low speed frequency correction/ Melody : Buzzer	LQFP144-P-2020-0.50-ZK	○

Part No.	Operating Conditions					ROM/RAM		Functions/Features																Package	Chip Support
	Operating voltage (V)	Operating frequency *1	Minimum instruction execution time	Current *2 consumption (Typ.@HALT)	Operating temperature (°C)	ROM capacity (Byte)	RAM capacity (Byte)	Port *3			8bit timer	1kHz timer	PWM	Capture	WDT	ADC(method)	Serial port			Supply voltage detection	LCD driver	Interrupt sources internal : external	Others		
								Input	Output	Input/ Output							I²C	SSIO *6	UART						
NEW ML610401 / ML610401P	1.25 to 3.6	500kHz / 32.768kHz	2µs / 30.5µs	0.9µA	–20 to +70 / –40 to +85	Mask 6K *7	192	4	12	18	2 (16bit×1)	–	–	2	1	2 (RC oscillation)	–	–	1	–	Max. 55dot 11seg × 5com.	10 : 8 (include 4bit-OR input)	Low speed frequency correction/ Melody : Buzzer	P-TQFP64-1010-0.50-ZK1	○
NEW ML610402 / ML610402P	1.25 to 3.6	500kHz / 32.768kHz	2µs / 30.5µs	0.9µA	–20 to +70 / –40 to +85	Mask 6K *7	192	4	8	18	2 (16bit×1)	–	–	2	1	2 (RC oscillation)	–	–	1	–	Max. 75dot 15seg × 5com.	10 : 8 (include 4bit-OR input)	Low speed frequency correction/ Melody : Buzzer	P-TQFP64-1010-0.50-ZK1	○
NEW ML610403 / ML610403P	1.25 to 3.6	500kHz / 32.768kHz	2µs / 30.5µs	0.9µA	–20 to +70 / –40 to +85	Mask 6K *7	192	4	4	18	2 (16bit×1)	–	–	2	1	2 (RC oscillation)	–	–	1	–	Max. 95dot 19seg × 5com.	10 : 8 (include 8bit-OR input)	Low speed frequency correction/ Melody : Buzzer	P-TQFP64-1010-0.50-ZK1	○
ML610404 / ML610404P	1.25 to 3.6	2MHz / 32.768kHz	0.5µs / 30.5µs	0.9µA	–20 to +70 / –40 to +85	Mask 8K *7	256	5	12	22	4 (16bit×2)	–	16bit×1	2	1	2 (RC oscillation)	–	2	1	–	Max. 105dot 21seg × 5com.	15 : 13 (include 8bit-OR input)	Low speed frequency correction/ Melody : Buzzer	P-TQFP80-1414-0.65-ZK	○
ML610405 / ML610405P	1.25 to 3.6	2MHz / 32.768kHz	0.5µs / 30.5µs	0.9µA	–20 to +70 / –40 to +85	Mask 8K *7	256	5	8	22	4 (16bit×2)	–	16bit×1	2	1	2 (RC oscillation)	–	2	1	–	Max. 125dot 25seg × 5com.	15 : 13 (include 8bit-OR input)	Low speed frequency correction/ Melody : Buzzer	P-TQFP80-1414-0.65-ZK	○
ML610406 / ML610406P	1.25 to 3.6	2MHz / 32.768kHz	0.5µs / 30.5µs	0.9µA	–20 to +70 / –40 to +85	Mask 8K *7	256	5	4	22	4 (16bit×2)	–	16bit×1	2	1	2 (RC oscillation)	–	2	1	–	Max. 145dot 29seg × 5com.	15 : 13 (include 8bit-OR input)	Low speed frequency correction/ Melody : Buzzer	P-TQFP80-1414-0.65-ZK	○
NEW ML610407 / ML610407P	1.25 to 3.6	2MHz / 32.768kHz	0.5µs / 30.5µs	0.9µA	–20 to +70 / –40 to +85	Mask 16K *8	1K	5	12	22	4 (16bit×2)	–	16bit×1	2	1	2 (RC oscillation)	–	2	1	–	Max. 145dot 29seg × 5com.	15 : 13 (include 8bit-OR input)	Low speed frequency correction/ Melody : Buzzer	P-TQFP100-1414-0.50-ZK	○
NEW ML610408 / ML610408P	1.25 to 3.6	2MHz / 32.768kHz	0.5µs / 30.5µs	0.9µA	–20 to +70 / –40 to +85	Mask 16K *8	1K	5	8	22	4 (16bit×2)	–	16bit×1	2	1	2 (RC oscillation)	–	2	1	–	Max. 165dot 33seg × 5com.	15 : 13 (include 8bit-OR input)	Low speed frequency correction/ Melody : Buzzer	P-TQFP100-1414-0.50-ZK	○
NEW ML610409 / ML610409P	1.25 to 3.6	2MHz / 32.768kHz	0.5µs / 30.5µs	0.9µA	–20 to +70 / –40 to +85	Mask 16K *8	1K	5	4	22	4 (16bit×2)	–	16bit×1	2	1	2 (RC oscillation)	–	2	1	–	Max. 185dot 37seg × 5com.	15 : 13 (include 8bit-OR input)	Low speed frequency correction/ Melody : Buzzer	P-TQFP100-1414-0.50-ZK	○
NEW ML610Q407 / ML610Q407P	1.25 to 3.6	2MHz / 32.768kHz	0.5µs / 30.5µs	0.9µA	–20 to +70 / –40 to +85	Flash 16K *8	1K	5	12	22	4 (16bit×2)	–	16bit×1	2	1	2 (RC oscillation)	–	2	1	–	Max. 145dot 29seg × 5com.	15 : 13 (include 8bit-OR input)	Low speed frequency correction/ Melody : Buzzer	P-TQFP100-1414-0.50-ZK	○
NEW ML610Q408 / ML610Q408P	1.25 to 3.6	2MHz / 32.768kHz	0.5µs / 30.5µs	0.9µA	–20 to +70 / –40 to +85	Flash 16K *8	1K	5	8	22	4 (16bit×2)	–	16bit×1	2	1	2 (RC oscillation)	–	2	1	–	Max. 165dot 33seg × 5com.	15 : 13 (include 8bit-OR input)	Low speed frequency correction/ Melody : Buzzer	P-TQFP100-1414-0.50-ZK	○
NEW ML610Q409 / ML610Q409P	1.25 to 3.6	2MHz / 32.768kHz	0.5µs / 30.5µs	0.9µA	–20 to +70 / –40 to +85	Flash 16K *8	1K	5	4	22	4 (16bit×2)	–	16bit×1	2	1	2 (RC oscillation)	–	2	1	–	Max. 185dot 37seg × 5com.	15 : 13 (include 8bit-OR input)	Low speed frequency correction/ Melody : Buzzer	P-TQFP100-1414-0.50-ZK	○
ML610Q411 / ML610Q411P	1.1 to 3.6	500kHz / 32.768kHz	2µs / 30.5µs	0.5µA	–20 to +70 / –40 to +85	Flash 16K *7	1K	6	3	22	4 (16bit×2)	1	16bit×1	2	1	2 (RC oscillation) 2 (Sequential)	1 *5	1	1	1	Max. 144dot 36seg × 4com.	16 : 5	Low speed frequency correction/ Buzzer	TQFP120-P-1414-0.40-K	○
ML610Q412 / ML610Q412P	1.1 to 3.6	500kHz / 32.768kHz	2µs / 30.5µs	0.5µA	–20 to +70 / –40 to +85	Flash 16K *7	1K	6	3	14	4 (16bit×2)	1	16bit×1	2	1	2 (RC oscillation) 2 (Sequential)	1 *5	1	1	1	Max. 176dot 44seg × 4com.	16 : 5	Low speed frequency correction/ Buzzer	TQFP120-P-1414-0.40-K	○
ML610Q415	1.1 to 3.6	500kHz	2µs	5.5µA	–20 to +70	Flash 16K *7	1K	6	3	22	4 (16bit×2)	1	16bit×1	2	1	2 (RC oscillation) 2(Sequential)	1 *5	1	1	1	Max. 144dot 36seg × 4com.	16 : 5	Low speed frequency correction/ Buzzer	TQFP120-P-1414-0.40-K	○

Target Products and Compatible Product Development Support Systems

	Target Products	Software Tools	Hardware Tools: Development Tool	Hardware Tools: Reference Board
Standard Type	ML610Q486 / ML610Q486P	· Project management tool (IDEU8 integrated development environment) · Build tool · Debugging tool · Flash programming tool *11 · ROM code generation tool for code entry <Required environment> · Windows® 2000/XP · Graphic adapter and display of SVGA (800×600) or more · At least 20MB of free hard disk space	µEASE *10	ML610Q486 Reference board
	ML610Q487 / ML610Q487P			ML610Q487 Reference board
	ML610Q488 / ML610Q488P			ML610Q488 Reference board
	ML610Q489 / ML610Q489P			ML610Q489 Reference board
	ML610482 / ML610482P			ML610Q482 Reference board
	ML610Q482 / ML610Q482P			ML610Q482 Reference board
Dot Matrix Type with Built-In LCD Driver	ML610Q421 / ML610Q421P	· Project management tool (IDEU8 integrated development environment) · Build tool · Debugging tool · Flash programming tool *11 · Program development support tool for LCD control · ROM code generation tool for code entry	µEASE *10	ML610Q421 Reference board
	ML610Q422 / ML610Q422P			ML610Q422 Reference board
	ML610Q428 / ML610Q428P			ML610Q428 Reference board
	ML610Q429 / ML610Q429P			ML610Q429 Reference board
	ML610Q431			ML610Q431 Reference board
	ML610Q432			ML610Q432 Reference board
	ML610Q435			ML610Q435 Reference board
	ML610Q436			ML610Q436 Reference board
	ML610Q438 / ML610Q438P			ML610Q438 Reference board
	ML610Q439 / ML610Q439P			ML610Q439 Reference board
Segment Type with Built-In LCD Driver	ML610401 / ML610401P	<Required environment> · Windows® 2000/XP · Graphic adapter and display of SVGA (800×600) or more · At least 20MB of free hard disk space	µEASE *10	ML610Q407 Reference board *12
	ML610402 / ML610402P			ML610Q407 Reference board *13
	ML610403 / ML610403P			ML610Q407 Reference board *14
	ML610404 / ML610404P			ML610Q407 Reference board *15
	ML610405 / ML610405P			ML610Q407 Reference board *16
	ML610406 / ML610406P			ML610Q407 Reference board *17
	ML610407 / ML610407P / ML610Q407 / ML610Q407P			ML610Q407 Reference board
	ML610408 / ML610408P / ML610Q408 / ML610Q408P			ML610Q408 Reference board
	ML610409 / ML610409P / ML610Q409 / ML610Q409P			ML610Q409 Reference board
	ML610Q411 / ML610Q411P			ML610Q411 Reference board
	ML610Q412 / ML610Q412P			ML610Q412 Reference board
	ML610Q415			ML610Q415 Reference board

*10 : All software except for MWµEASE is bundled in µEASE
*11 : All required µEASE units must be purchased when using MWµEASE
*12 : Setting the ML610Q407 reference board to ML610Q401 mode enables operation equivalent to the ML610401 Mask version.
*13 : Setting the ML610Q407 reference board to ML610Q402 mode enables operation equivalent to the ML610402 Mask version.
*14 : Setting the ML610Q407 reference board to ML610Q403 mode enables operation equivalent to the ML610403 Mask version.
*15 : Setting the ML610Q407 reference board to ML610Q404 mode enables operation equivalent to the ML610404 Mask version.
*16 : Setting the ML610Q407 reference board to ML610Q405 mode enables operation equivalent to the ML610405 Mask version.
*17 : Setting the ML610Q407 reference board to ML610Q406 mode enables operation equivalent to the ML610406 Mask version.

●U8 Core, nX-U8/100 Core is an LAPIS Semiconductor's original 8bit CPU of RISC method. ●IDEU8 is an LAPIS Semiconductor's project management tool for program development. ●CCU8 is an LAPIS Semiconductor's C compiler for program development. ●RASU8 is an LAPIS Semiconductor's assembler for program development. ●RLU8 is an LAPIS Semiconductor's linker for program development. ●LIBU8 is an LAPIS Semiconductor's librarian (library generation tool) for program development. ●OHU8 is an LAPIS Semiconductor's object converter for program development. ●FWμEASE is an LAPIS Semiconductor's flash writing tool. ●HTU8 is an LAPIS Semiconductor's ROM code generation tool for code entry (flash writing). ●DTU8 is an LAPIS Semiconductor's debug tool for program development. ●μEASE is an LAPIS Semiconductor's on-chip debug emulator. ●MWμEASE is an LAPIS Semiconductor's flash writing tool (for multi-writing). ●MACU8 is an LAPIS Semiconductor's assemble package for program development. ●Windows® 2000 / Windows® XP / Windows® Vista are registered trademarks of Microsoft Corporation USA in the US and other countries.

R1091A

ROHM Sales Offices

Contact us for further information about the products.

San Diego	+1-858-625-3600	**Mexico**	+52-33-3123-2001	**Hungary**	+361-4719338	**Philippines**	+63-2-807-6872
Atlanta	+1-770-754-5972	**Dusseldorf**	+49-2154-921-0	**Russia**	+74 95 739 4174	**Thailand**	+66-2-254-4890
Boston	+1-978-371-0382	**Stüttgart**	+49-711-7272370	**Seoul**	+82-2-8182-700	**Malaysia**	+60-3-7958-8355
Chicago	+1-847-368-1006	**France**	+33 (0) 1 40 60 87 30	**Dalian**	+86-411-8230-8549	**India**	+91-44-4352-0008
Dallas	+1-972-473-3748	**United Kingdom**	+44-1-908-272400	**Shanghai**	+86-21-6279-2727	**Kyoto**	+81-75-365-1218
Denver	+1-303-708-0908	**Espoo**	+358-9-7255-4491	**Shenzhen**	+86-755-8307-3008	**Yokohama**	+81-45-476-2121
Detroit	+1-248-348-9920	**Salo**	+358-2-7332234	**Hong Kong**	+852-2-740-6262		
Nashville	+1-615-620-6700	**Oulu**	+358-400-726 124	**Taiwan**	+886-2-2500-6956		
Sunnyvale	+1-408-720-1900	**Spain**	+34-9375-24320	**Singapore**	+65-6332-2322		

Catalog No.54BG6523E 10.2011 ROHM / LAPIS Semiconductor © PDF

LAPIS SEMICONDUCTOR

LAPIS Semiconductor Co.,Ltd.
550-1 Higashiasakawa-cho, Hachioji-shi,
Tokyo 193-8550 Japan
TEL : +81-42-663-1111 FAX : +81-42-662-0840
www.lapis-semi.com/en/

ROHM SEMICONDUCTOR