



*Energy efficiency comparison conducted by OKI SEMICONDUCTOR's of its low power microcontroller vs. competitor models

Low Power Microcontroller

ML610400/ML610300 Series

SELECT SELECTION CATALOG

Ver.1.0



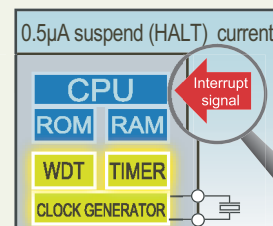
www.okisemi.com/en

Features

1 Low current consumption

0.5µA suspend (HALT) mode and leakage current controlled at high temperatures

Low power equivalent to a mask ROM is achieved. Original low-leak low-power processes are utilized for low current consumption throughout the entire temperature range. As a result battery consumption is optimized, even at high temperatures.



Applicable models :
ML610482, ML610482P, ML610Q482, ML610Q482P, ML610Q411, ML610Q411P, ML610Q412, ML610Q412P, ML610Q421, ML610Q421P, ML610Q422, ML610Q422P, ML610Q428, ML610Q428P, ML610Q429, ML610Q429P, ML610Q431, ML610Q432, ML610Q435, ML610Q436, ML610Q438, ML610Q438P, ML610Q439, ML610Q439P

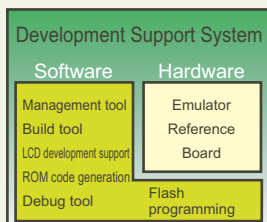
OKI SEMICONDUCTOR's ultra Low Power Microcontroller ML610400 / ML610300 series Ver.1.0

4 Simple tools

On-chip debugging

Repeated program loading and debugging are handled on the chip itself. As a debugging interface, a dedicated test terminal is provided, making it possible to debug all peripheral functions of the microcontroller. In addition, a uniform development environment enables optional settings to be easily made via button operation to a compiler or other application, while an LCD image tool allows viewing of the LCD image on a PC without the need for an LCD panel.

Applicable models :
All products with built-in Flash memory

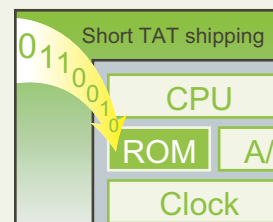


5 Chip writing possible

Flash chip products available

Similar to mask ROM, the customer's program code is written at OKI SEMICONDUCTOR'S facility, then shipped via short TAT.

Applicable models :
All products enabling Chip Support.

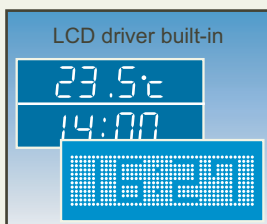


7 LCD driver built in

Integrated LCD driver compatible with both dot matrix and segment displays

OKI SEMICONDUCTOR's versatile lineup supports a wide range of LCDs, from multi-dot displays comprised of 1536 dots to small 55-segment displays. In addition, a boost circuit that generates the required LCD bias is included, eliminating the need for external circuitry.

Applicable models :
All low power microcontrollers with built-in LCD driver

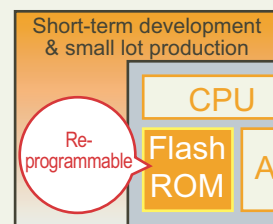


8 Supports Flash memory

Integrated Flash memory for programs

The built-in Flash significantly reduces development and production time compared with mask ROM. Also, reprogramming is possible via serial interface for on-chip debugging.

Applicable models :
Products with built-in Flash memory



2 Low voltage operating

Works on a single 1.5V battery

Most models support low voltage operation from 1.1V, making them compatible with 1.5V battery sets. This contributes to lower power consumption and greater miniaturization.

Applicable models :

ML610482, ML610482P, ML610Q482, ML610Q482P,
ML610Q411, ML610Q411P, ML610Q412, ML610Q412P,
ML610Q421, ML610Q421P, ML610Q422, ML610Q422P, ML610Q428, ML610Q428P, ML610Q429,
ML610Q429P, ML610Q431, ML610Q432, ML610Q435, ML610Q436, ML610Q438, ML610Q438P,
ML610Q439, ML610Q439P

Low operating voltage

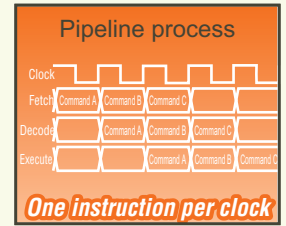
Single 1.5V battery

1.1V Operation

3 High performance

One instruction per clock cycle

Utilizes OKI SEMICONDUCTOR's own RISC 8bit CPU, featuring a pipeline process that enables execution of most instructions in a single clock cycle and delivers 16bit MCU-class performance.



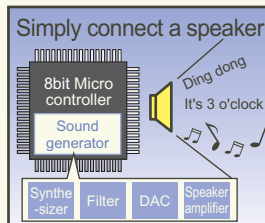
These ultra-low power consumption microcontrollers ensure longer operating times in battery-driven applications.

The increasing concern over global warming demands components and devices that minimize energy consumption. OKI SEMICONDUCTOR meets these needs by offering a low-power microcontroller equipped with Flash memory that enables reading at only 1V and features industry-leading operating, suspend, and stop current levels. In addition, the a high-performance CPU is utilized capable of processing one instruction per clock cycle for high performance operation.

6 Built-in speaker amp offers superior sound and voice playback

Monolithic IC delivers excellent audio and voice reproduction

Proprietary voice synthesis algorithms, together with an integrated low-pass filter, D/A converter, speaker amp, and voice analysis technologies ensure superior audio and voice playback on a single chip.



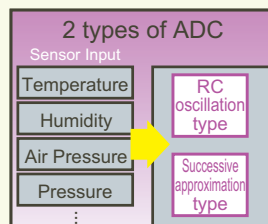
Applicable models :

ML610340, ML610Q340, ML610346, ML610Q346,
ML610347, ML610Q347, ML610348, ML610Q348

9 2 types of A/D converters built-in

2 built-in A/D converters:
RC Oscillation Type +
Successive Approximation Type

The RC oscillation type A/D converter is designed for temperature and humidity measurements while the successive approximation type is used to measure the output voltage. This enables a variety of measurements using a single microcontroller.



Applicable models :

ML610Q411, ML610Q411P, ML610Q412, ML610Q412P, ML610Q415, ML610Q421, ML610Q421P,
ML610Q422, ML610Q422P, ML610Q431, ML610Q432, ML610Q435, ML610Q436,
ML610Q438, ML610Q438P, ML610Q439, ML610Q439P

10 Extensive worldwide sales

Record sales in a variety of fields

OKI SEMICONDUCTOR's low-power microcontrollers have been adopted in a wide range of devices and applications, from low-end consumer equipment to industrial sets requiring high reliability - a testament to their versatility and dependability.



Applicable models : All models currently mass-produced

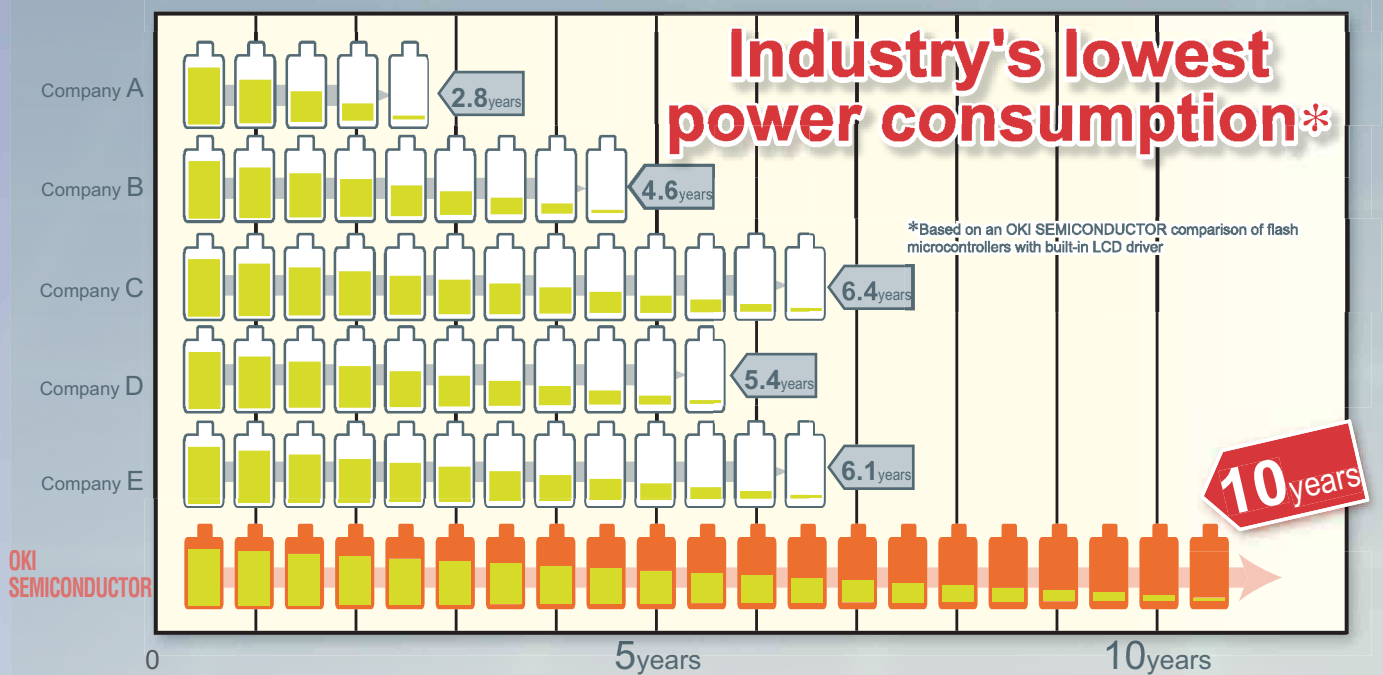


10 years of driving on a single battery

10 years on 1 battery!
Low power microcontroller

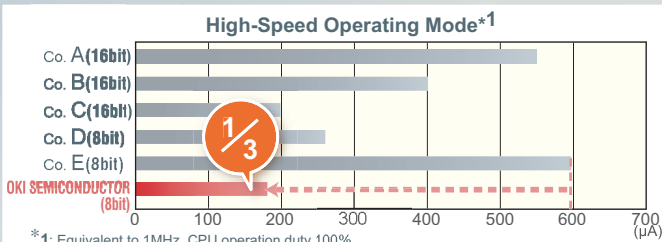
OKI SEMICONDUCTOR's original low-power consumption technology* results in the industry's lowest current consumption during both normal operation and stop. In addition, both dual- (selectable low/high speed) and triple- (selectable low/medium/high speed) clock functionality are offered for longer battery life, while current leakage is prevented for low current consumption throughout the entire temperature range.

* Intermittent operation can reduce the average current consumption of the battery even if a current on the order of mA is required. In this case OKI SEMICONDUCTOR recommends intentionally reducing operating time or increasing the operating frequency.

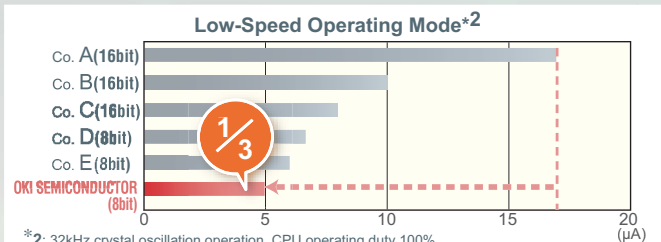


Calculation: Theoretical values when driving via li-ion battery at 3V and performing low-/high-speed/suspend (HALT) operations every 5 seconds in the following order: 1) Low-speed (32kHz) for 1.5s, 2) High-speed (1MHz) operation for 10ms, 3) suspend (HALT) operation for 3.49s.

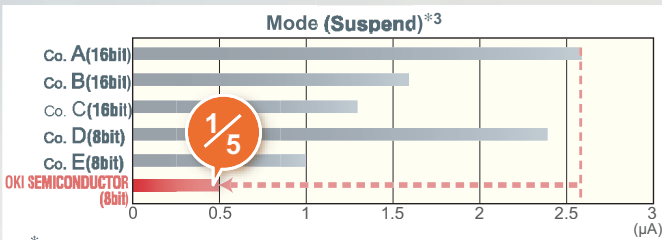
Current Consumption Comparison



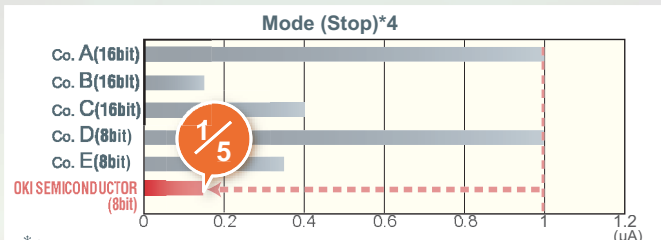
*1: Equivalent to 1MHz, CPU operation duty 100%



*2: 32kHz crystal oscillation operation, CPU operating duty 100%



*3: 32kHz crystal oscillation, CPU operation stopped, RTC/WDT activated.



*4: All clocks stopped, built-in regulators operating, RAM maintained.





Key Features

Ultra-low current consumption

Low current consumption is ensured under all operating modes: normal, suspend, stop
 800µA (@4MHz CPU operation) 5µA (@32kHz CPU operation)
 70µA (@500kHz CPU operation) 0.5µA (during Suspend (HALT) Mode)
 0.15µA (during Stop Mode)

1V Flash ROM operation

The internal Flash ROM can be read using only 1V.
 Microcontroller operating voltage range: 1.1V to 3.6V

High precision

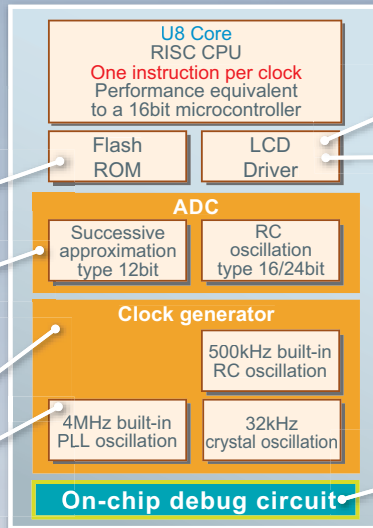
2 types of A/D converters built in for high precision operation (16/24bit RISC oscillation type + 12bit Successive approximation type)

Fewer parts required

Requires no resonator or oscillator for peripheral IC.

Built-in PLL (Phase Locked Loop) oscillation circuit

The internal PLL circuit generates the high-speed 4.096MHz clock by multiplying the 32.768kHz clock.



Supports various panel sizes

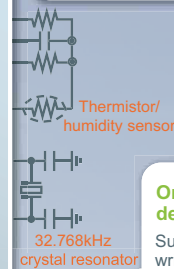
Dot Matrix Type : 144 to 1,536 dots
 Segment Type : 55 to 185 dots

Programmable display allocation function

Compatible with changing LCD designs

On-chip debugging reduces development time

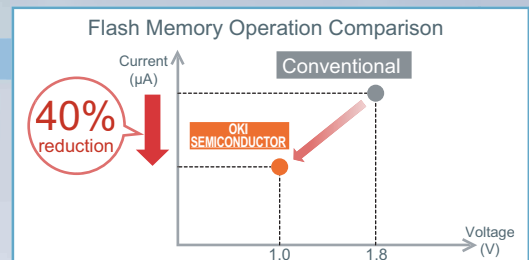
Supports debug and Flash memory writing via OKI SEMICONDUCTOR'S 'µEASE' emulator



1V Flash ROM operation

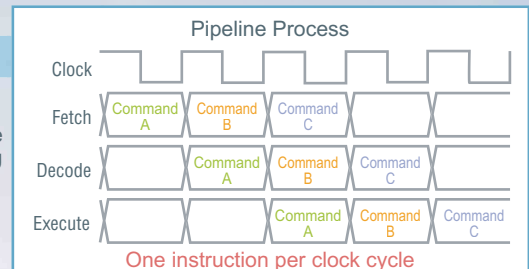
A unique low-power method enables Flash memory reading at only 1V. In addition, reducing the charge/discharge current through bit-line division enables low power consumption equivalent to mask ROMs.

Applicable models: All models except low power microcontrollers with speech capability



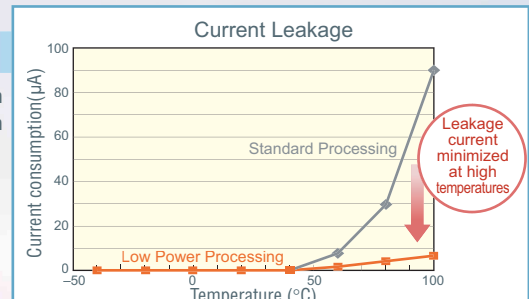
High-speed 1 instruction/clock cycle 8bit RISC CPU 'U8' core

The 8bit RISC CPU utilizes parallel processing via a pipeline architecture for high-speed, 1 instruction/clock cycle operation - reducing CPU operating time significantly.



Few current leakage at high temperature

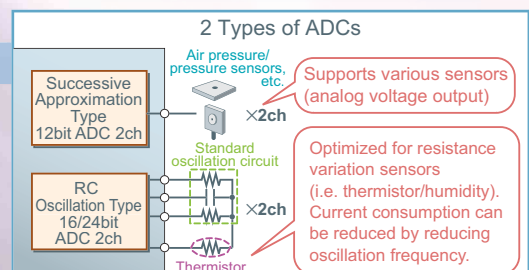
Original low-power processing prevents current leakage at high temperatures, making OKI SEMICONDUCTOR MCUs compatible with even industrial applications.



2 types of A/D converters built in

2 types of A/D converters are built in, a Successive Approximation type requiring analog voltage input and an RC Oscillation type that counts the number of oscillations caused by a resistive sensor (i.e. thermistor, humidity) and external capacitor. Select the optimum sensor based on the characteristics, measurement accuracy, and current consumption.

Applicable models: Low power MCUs with built-in dot matrix LCD driver



Lineup

10 years on battery!
Low power microcontroller

Standard Low Power Microcontrollers

| ROM Capacity (Bytes) | 30pin | 48pin | 64pin | Package Pins |
|----------------------|------------------------------|----------------------------------------------|--------------------------------------------------------------------------------------|------------------------|
| 128K | | | Voice Functionality Type ML610(Q)346 ML610(Q)347 ML610(Q)348 <56pin> | Indoor Fire Alarms |
| 96K | Car Horns ML610(Q)340 | | | |
| 64K | Gas Sensors | Standard Type ML610(Q)482(P) | Remote Controllers for Boilers | |
| 48K | | ML610Q489(P) ML610Q488(P) ML610Q487(P) | Ranges | |
| 32K | | ML610Q486(P) | Electric Bicycles | |

Built-in LCD Driver Low Power Microcontrollers

| ROM Capacity (Bytes) | 64pin | 80pin | 100pin | 120pin | 128pin | 144pin | Package pins |
|----------------------|------------------------------------------------------------|--------------------------------------------------------------------------|-----------------------------------------------------------------------------|------------------------------------------------------------|-----------------------------------------------------------------------------------------------|--------|--------------------|
| 96K | | | | | Performance Weather Stations ML610Q439(P) ML610Q438(P) ML610Q436 ML610Q435 | | Bicycle Meters |
| 64K | | | | | Pedometers with Graph ML610Q432 ML610Q431 | | |
| 48K | | Segment Type Thermostats | Pedometers ML610(Q)429(P) ML610Q428(P) | Dot Matrix Type ML610Q422(P) ML610Q421(P) | | | |
| 32K | | | ML610(Q)409(P) ML610(Q)408(P) ML610(Q)407(P) | ML610Q415 ML610Q412(P) ML610Q411(P) | Electronic Wristwatches Electronic Sports (Multifunction) Watches | | |
| 16K | Clocks ML610403(P) ML610402(P) ML610401(P) | ML610406(P) ML610405(P) ML610404(P) | Token Machines ML610(Q)409(P) ML610(Q)408(P) ML610(Q)407(P) | Temperature Loggers ML610Q422(P) ML610Q421(P) | | | |
| 8K | | Digital Thermometers ML610406(P) ML610405(P) ML610404(P) | | | | | |
| 6K | | | | | | | |



| | | | | | | | | | | | | | | | | | | | | | | | |
|------------|------------------------------------------------------|----------|------------------------|--------|------------------|--------|------------------------|-------|-------------------------|--------|-------------------------|---------|-----------|---------|---------|---------|---------------|----------|--------------------------|----------|------------------------|------|-------------------------|
| FLASH ROM | MASK ROM | ROM type | 6 KB | 8 KB | 16 KB | 32 KB | 48 KB | 64 KB | 96 KB | 128 KB | ROM size | RAM 1KB | RAM 1.5KB | RAM 2KB | RAM 3KB | RAM 4KB | RAM 7KB | RAM 192B | RAM 256B | RAM 512B | RAM type and size | | |
| 55 | 75 | 95 | 105 | 125 | 144 | 145 | 165 | 176 | 185 | 400 | 512 | 800 | 1024 | 1344 | 1392 | 1536 | Max. LCD dots | 500kHz | Built-in 500kHz RC clock | 1MHz | Built-in 1MHz RC clock | 2MHz | 2Built-in 2MHz RC clock |
| SERIAL I/F | I ² C, SSIO, and UART interfaces built-in | BLD | Built-in 2MHz RC clock | OP AMP | Integrated opamp | SP AMP | Integrated speaker amp | SSIO | SSIO interface function | UART | UART interface function | | | | | | | | | | | | |

| | | | | | | | | | | | | | | |
|-----|-----------------|-----------|------------------|------------------|-----------|-----------|-----------|------------|--------|---------------|------------|--------|---------------|-----------|
| ★ | FLASH ROM 32 KB | RAM 1KB | LOW HALT CURRENT | LOW VOLTAGE 1.1V | -20~+70°C | ML610Q486 | -40~+85°C | ML610Q486P | 500kHz | 12-bit SA ADC | SERIAL I/F | BLD | PWM 16bit | |
| ★ | FLASH ROM 48 KB | RAM 1.5KB | LOW HALT CURRENT | LOW VOLTAGE 1.1V | -20~+70°C | ML610Q487 | -40~+85°C | ML610Q487P | 32kHz | 12-bit SA ADC | SERIAL I/F | BLD | PWM 16bit | |
| ★ | FLASH ROM 48 KB | RAM 1.5KB | LOW HALT CURRENT | LOW VOLTAGE 1.1V | -20~+70°C | ML610Q488 | -40~+85°C | ML610Q488P | 32kHz | 12-bit SA ADC | SERIAL I/F | BLD | PWM 16bit | |
| ★ | FLASH ROM 48 KB | RAM 1.5KB | LOW HALT CURRENT | LOW VOLTAGE 1.1V | -20~+70°C | ML610Q489 | -40~+85°C | ML610Q489P | 32kHz | 12-bit SA ADC | SERIAL I/F | BLD | PWM 16bit | |
| ★ | MASK ROM 64 KB | RAM 4KB | LOW HALT CURRENT | LOW VOLTAGE 1.1V | -20~+70°C | ML610482 | -40~+85°C | ML610482P | 32kHz | 12-bit SA ADC | SERIAL I/F | BLD | PWM 16bit | |
| NEW | FLASH ROM 64 KB | RAM 4KB | LOW HALT CURRENT | LOW VOLTAGE 1.1V | -20~+70°C | ML610Q482 | -40~+85°C | ML610Q482P | 32kHz | 500kHz | 4MHz | 4M PLL | 24-bit RC ADC | PWM 16bit |

Voice Functionality Low power microcontrollers P.9

| | | | | | | | | | | | | | |
|--|------------------|----------|-------|---------------------|-----------|-----------|-----------|-------------|-------|---------------|--------|--------|------|
| | MASK ROM 96 KB | RAM 512B | VOICE | PROG. # WIDEN PITCH | -40~+85°C | ML610340 | -40~+85°C | ML610340 * | 4MHz | 12-bit SA ADC | OP AMP | SP AMP | SSIO |
| | FLASH ROM 96 KB | RAM 512B | VOICE | PROG. # WIDEN PITCH | -40~+85°C | ML610Q340 | -40~+85°C | ML610Q340 * | 4MHz | 12-bit SA ADC | OP AMP | SP AMP | SSIO |
| | MASK ROM 128 KB | RAM 1KB | VOICE | PROG. # WIDEN PITCH | -40~+85°C | ML610346 | -40~+85°C | ML610346 * | 32kHz | 12-bit SA ADC | OP AMP | SP AMP | SSIO |
| | FLASH ROM 128 KB | RAM 1KB | VOICE | PROG. # WIDEN PITCH | -40~+85°C | ML610Q346 | -40~+85°C | ML610Q346 * | 32kHz | 12-bit SA ADC | OP AMP | SP AMP | SSIO |
| | MASK ROM 128 KB | RAM 1KB | VOICE | PROG. # WIDEN PITCH | -40~+85°C | ML610347 | -40~+85°C | ML610347 * | 32kHz | 12-bit SA ADC | OP AMP | SP AMP | SSIO |
| | FLASH ROM 128 KB | RAM 1KB | VOICE | PROG. # WIDEN PITCH | -40~+85°C | ML610Q347 | -40~+85°C | ML610Q347 * | 32kHz | 12-bit SA ADC | OP AMP | SP AMP | SSIO |
| | MASK ROM 128 KB | RAM 1KB | VOICE | PROG. # WIDEN PITCH | -40~+85°C | ML610348 | -40~+85°C | ML610348 * | 32kHz | 12-bit SA ADC | OP AMP | SP AMP | SSIO |
| | FLASH ROM 128 KB | RAM 1KB | VOICE | PROG. # WIDEN PITCH | -40~+85°C | ML610Q348 | -40~+85°C | ML610Q348 * | 32kHz | 12-bit SA ADC | OP AMP | SP AMP | SSIO |

* These part numbers (identical to those for consumer devices) are suitable to both industrial and consumer applications

Built-in Dot Matrix LCD Driver Low power microcontrollers P.11

| | | | | | | | | | | | | | | | | |
|-----|-----------------|---------|------------------|------------------|-----------|-----------|-----------|------------|----------|-------|--------|---------------|---------------|---------------|------------|-----------|
| | FLASH ROM 16 KB | RAM 1KB | LOW HALT CURRENT | LOW VOLTAGE 1.1V | -20~+70°C | ML610Q411 | -40~+85°C | ML610Q411P | 144 DOT | 32kHz | 500kHz | 24-bit RC ADC | 12-bit SA ADC | SERIAL I/F | BLD | PWM 16bit |
| | FLASH ROM 16 KB | RAM 1KB | LOW HALT CURRENT | LOW VOLTAGE 1.1V | -20~+70°C | ML610Q412 | -40~+85°C | ML610Q412P | 176 DOT | 32kHz | 500kHz | 24-bit RC ADC | 12-bit SA ADC | SERIAL I/F | BLD | PWM 16bit |
| | FLASH ROM 16 KB | RAM 1KB | LOW HALT CURRENT | LOW VOLTAGE 1.1V | -20~+70°C | ML610Q415 | -40~+85°C | ML610Q415P | 176 DOT | 32kHz | 500kHz | 24-bit RC ADC | 12-bit SA ADC | SERIAL I/F | BLD | PWM 16bit |
| | FLASH ROM 32 KB | RAM 2KB | LOW HALT CURRENT | LOW VOLTAGE 1.1V | -20~+70°C | ML610Q421 | -40~+85°C | ML610Q421P | 400 DOT | 32kHz | 500kHz | 4M PLL | 24-bit RC ADC | 12-bit SA ADC | SERIAL I/F | BLD |
| | FLASH ROM 32 KB | RAM 2KB | LOW HALT CURRENT | LOW VOLTAGE 1.1V | -20~+70°C | ML610Q422 | -40~+85°C | ML610Q422P | 800 DOT | 32kHz | 500kHz | 4M PLL | 24-bit RC ADC | 12-bit SA ADC | SERIAL I/F | BLD |
| NEW | FLASH ROM 48 KB | RAM 4KB | LOW HALT CURRENT | LOW VOLTAGE 1.1V | -20~+70°C | ML610Q428 | -40~+85°C | ML610Q428P | 1392 DOT | 32kHz | 2MHz | 4M PLL | 24-bit RC ADC | 12-bit SA ADC | SERIAL I/F | BLD |
| NEW | FLASH ROM 48 KB | RAM 4KB | LOW HALT CURRENT | LOW VOLTAGE 1.1V | -20~+70°C | ML610Q429 | -40~+85°C | ML610Q429P | 512 DOT | 32kHz | 2MHz | 4M PLL | 24-bit RC ADC | 12-bit SA ADC | SERIAL I/F | BLD |
| | FLASH ROM 64 KB | RAM 3KB | LOW HALT CURRENT | LOW VOLTAGE 1.1V | -20~+70°C | ML610Q431 | -40~+85°C | ML610Q431P | 1024 DOT | 32kHz | 500kHz | 4M PLL | 24-bit RC ADC | 12-bit SA ADC | SERIAL I/F | BLD |
| | FLASH ROM 64 KB | RAM 3KB | LOW HALT CURRENT | LOW VOLTAGE 1.1V | -20~+70°C | ML610Q432 | -40~+85°C | ML610Q432P | 1536 DOT | 32kHz | 500kHz | 4M PLL | 24-bit RC ADC | 12-bit SA ADC | SERIAL I/F | BLD |
| NEW | FLASH ROM 96 KB | RAM 3KB | LOW HALT CURRENT | LOW VOLTAGE 1.1V | -20~+70°C | ML610Q435 | -40~+85°C | ML610Q435P | 1024 DOT | 32kHz | 500kHz | 4M PLL | 24-bit RC ADC | 12-bit SA ADC | SERIAL I/F | BLD |
| NEW | FLASH ROM 96 KB | RAM 3KB | LOW HALT CURRENT | LOW VOLTAGE 1.1V | -20~+70°C | ML610Q436 | -40~+85°C | ML610Q436P | 1536 DOT | 32kHz | 500kHz | 4M PLL | 24-bit RC ADC | 12-bit SA ADC | SERIAL I/F | BLD |
| ★ | FLASH ROM 96 KB | RAM 7KB | LOW HALT CURRENT | LOW VOLTAGE 1.1V | -20~+70°C | ML610Q438 | -40~+85°C | ML610Q438P | 1344 DOT | 32kHz | 2MHz | 4M PLL | 24-bit RC ADC | 12-bit SA ADC | SERIAL I/F | BLD |
| ★ | FLASH ROM 96 KB | RAM 7KB | LOW HALT CURRENT | LOW VOLTAGE 1.1V | -20~+70°C | ML610Q439 | -40~+85°C | ML610Q439P | 1024 DOT | 32kHz | 2MHz | 4M PLL | 24-bit RC ADC | 12-bit SA ADC | SERIAL I/F | BLD |

★ Under development

Built-in Segment LCD Driver Low power microcontrollers P.15

| | | | | | | | | | | | | | |
|-----|-----------------|----------|------------------|-------------------|-----------|-----------|-----------|------------|---------|-------|--------|---------------|-------------|
| ★ | MASK ROM 6 KB | RAM 192B | LOW HALT CURRENT | LOW VOLTAGE 1.25V | -20~+70°C | ML610401 | -40~+85°C | ML610401P | 55 DOT | 32kHz | 500kHz | 16-bit RC ADC | MAPPING RAM |
| ★ | MASK ROM 6 KB | RAM 192B | LOW HALT CURRENT | LOW VOLTAGE 1.25V | -20~+70°C | ML610402 | -40~+85°C | ML610402P | 75 DOT | 32kHz | 500kHz | 16-bit RC ADC | MAPPING RAM |
| ★ | MASK ROM 6 KB | RAM 192B | LOW HALT CURRENT | LOW VOLTAGE 1.25V | -20~+70°C | ML610403 | -40~+85°C | ML610403P | 95 DOT | 32kHz | 500kHz | 16-bit RC ADC | MAPPING RAM |
| ★ | MASK ROM 8 KB | RAM 256B | LOW HALT CURRENT | LOW VOLTAGE 1.25V | -20~+70°C | ML610404 | -40~+85°C | ML610404P | 105 DOT | 32kHz | 2MHz | 16-bit RC ADC | SSIO |
| ★ | MASK ROM 8 KB | RAM 256B | LOW HALT CURRENT | LOW VOLTAGE 1.25V | -20~+70°C | ML610405 | -40~+85°C | ML610405P | 125 DOT | 32kHz | 2MHz | 16-bit RC ADC | SSIO |
| ★ | MASK ROM 8 KB | RAM 256B | LOW HALT CURRENT | LOW VOLTAGE 1.25V | -20~+70°C | ML610406 | -40~+85°C | ML610406P | 145 DOT | 32kHz | 2MHz | 16-bit RC ADC | SSIO |
| ★ | MASK ROM 16 KB | RAM 1KB | LOW HALT CURRENT | LOW VOLTAGE 1.25V | -20~+70°C | ML610407 | -40~+85°C | ML610407P | 145 DOT | 32kHz | 2MHz | 16-bit RC ADC | SSIO |
| ★ | MASK ROM 16 KB | RAM 1KB | LOW HALT CURRENT | LOW VOLTAGE 1.25V | -20~+70°C | ML610408 | -40~+85°C | ML610408P | 165 DOT | 32kHz | 2MHz | 16-bit RC ADC | SSIO |
| ★ | MASK ROM 16 KB | RAM 1KB | LOW HALT CURRENT | LOW VOLTAGE 1.25V | -20~+70°C | ML610409 | -40~+85°C | ML610409P | 185 DOT | 32kHz | 2MHz | 16-bit RC ADC | SSIO |
| NEW | FLASH ROM 16 KB | RAM 1KB | LOW HALT CURRENT | LOW VOLTAGE 1.25V | -20~+70°C | ML610Q407 | -40~+85°C | ML610Q407P | 145 DOT | 32kHz | 2MHz | 16-bit RC ADC | SSIO |
| NEW | FLASH ROM 16 KB | RAM 1KB | LOW HALT CURRENT | LOW VOLTAGE 1.25V | -20~+70°C | ML610Q408 | -40~+85°C | ML610Q408P | 165 DOT | 32kHz | 2MHz | 16-bit RC ADC | SSIO |
| NEW | FLASH ROM 16 KB | RAM 1KB | LOW HALT CURRENT | LOW VOLTAGE 1.25V | -20~+70°C | ML610Q409 | -40~+85°C | ML610Q409P | 185 DOT | 32kHz | 2MHz | 16-bit RC ADC | SSIO |

★ Under development

Low power microcontroller development support system P.15

IDU8 integrated development environment (source editor, code generation tool, debugger), on-chip debug emulator, Flash writing software, LCD tool, reference board with microcontroller, demo kit

| | | | | |
|-------------------------------------------------------------------|----------------------------------------------|----------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------|
| Current consumption at during Suspend (HALT) mode: 0.5µA to 0.9µA | Low supply voltage (VDD) operation | Speech output functions built-in | Operating temperature range -20~+85°C | 0.65mm pin pitch easy to mount |
| Integrated 32.768kHz RC clock | 32.768kHz crystal resonator clock | Internal 4.096MHz PLL clock | Easy-to-mount 0.65mm pitch Internal 12bit Successive Approximation-type A/D converter ideal for voltage output sensors (e.g. thermocouples) | Built-in 16/24bit RC oscillation type A/D converters ideal for temperature/humidity measurement |
| Built-in RTC (Real Time Clock) for sets with calendar function | 16bit PWM output for backlight dimming, etc. | Display allocation RAM | Melody output | Selectable audio compression method |

Standard Type



10 years on 1 battery!
Low power microcontroller

These low power microcontrollers are ideal for compact, battery-driven systems without an LCD. The units integrate program memory (32kB-64kB), RAM (1kB-4kB), 3 types of serial communication ports (I²C, SSIO, UART), a battery voltage detection circuit, 2 types of A/D converters (24bit RC, 12bit successive approximation), timer, PWM, general-purpose port, and LED driver terminal into a single chip.

LINEUP

Consumer Grade Industrial Grade

Package

| LINEUP | Consumer Grade | Industrial Grade | Package |
|----------------------------------------------------------------------|--------------------------|---------------------------|-----------------------------------------------------------------------------------------------|
| ★ FLASH ROM 32 KB RAM 1KB | -20°C ML610Q486 +70°C | -40°C ML610Q486P +85°C |  TQFP48 |
| ★ FLASH ROM 48 KB RAM 1.5KB | -20°C ML610Q487 +70°C | -40°C ML610Q487P +85°C | |
| ★ FLASH ROM 48 KB RAM 1.5KB | -20°C ML610Q488 +70°C | -40°C ML610Q488P +85°C | |
| ★ FLASH ROM 48 KB RAM 1.5KB | -20°C ML610Q489 +70°C | -40°C ML610Q489P +85°C | |
| ★ MASK ROM 64 KB RAM 4KB LOW HALT CURRENT LOW VOLTAGE 1.1V | -20°C ML610482 +70°C | -40°C ML610482P +85°C | |
| NEW FLASH ROM 64 KB RAM 4KB LOW HALT CURRENT LOW VOLTAGE 1.1V | -20°C ML610Q482 +70°C | -40°C ML610Q482P +85°C | |

★ Under development

Please refer to pages 5 and 6 for icon descriptions

Actual size shown

System Diagram

Flash/Mask ROM (Driveable from 1V)

Pin-compatible mask ROM available (1.1V to 3.6V operation)

Supports a variety of serial interfaces

I²C, SSIO, and UART interfaces are provided for broad compatibility

Triple clock functionality contributes to low power consumption designs

Current consumption can be controlled by adjusting the clock speed:
Low (32kHz)
Medium (500kHz)
High (4MHz)

ML610(Q)482P

U8 Core RISC CPU

Flash or Mask ROM 8bit Timer 16bit PWM

I²C (Master), SSIO (SPI), UART

Clock generator

32kHz (External) Crystal Oscillator

500kHz (Internal) RC Oscillator

4MHz (Internal) PLL Oscillator

Buzzer

Battery voltage detection

RC-Type 24bit ADC

On-chip Debugging Circuit

High speed RISC CPU "U8" Core

This high-speed processor executes one instruction per clock cycle via parallel processing utilizing pipeline architecture

Battery voltage detection

The built-in A/D converter enables precise voltage measurement ($\pm 2\%$) with low power consumption

Built-in 2ch ADC enables both temperature and humidity measurements

The integrated RC-type ADC is capable of measuring the temperature and humidity with high accuracy

On-chip debugging shortens development time

OKI SEMICONDUCTOR's μ EASE provides support for debugging and Flash memory writing

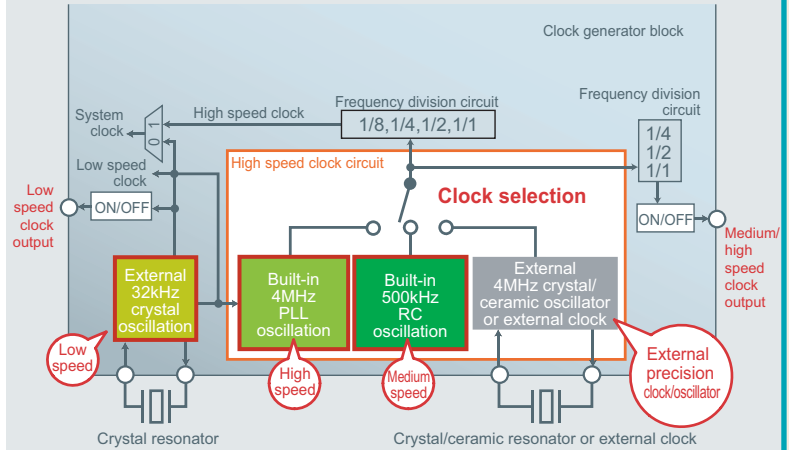
Triple clock system facilitates low power design

Three different clocks can be selected for CPU operation: low-speed (external) 32kHz crystal oscillation, medium-speed (internal) 500kHz RC oscillation, and high-speed (internal) 4MHz PLL oscillation. The medium- and high-speed clocks can be divided into 1/8ths in order to minimize current consumption. In addition, the units are compatible with external 4MHz precision oscillators for applications requiring greater accuracy.

| Speed | Frequency | Current Consumption |
|--------------|----------------------------------------|---------------------|
| Low speed | 32kHz (External Crystal Oscillator) | 5 μ A |
| Medium speed | 500kHz (Internal RC Oscillator) | 70 μ A |
| High speed | 4MHz (Internal PLL Oscillator) | 800 μ A |

Applicable models : ML610482, ML610482P, ML610Q482, ML610Q482P

Power management via clock selection



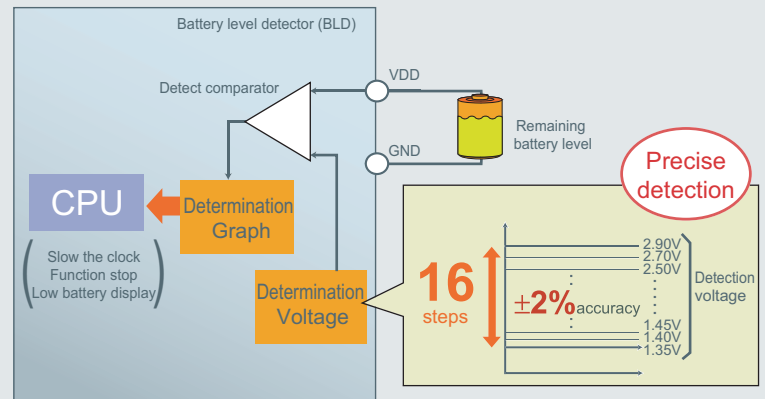
Battery voltage detection function (BLD) accurately detects remaining charge

Precise ($\pm 2\%$) battery voltage detection makes it possible to manage operation and performance based on the remaining battery level.

In addition, 16-step voltage detection is performed between 1.35V and 2.9V, with a voltage accuracy of $\pm 2\%$.

Applicable models : ML610Q486, ML610Q486P, ML61048, ML610482P, ML610Q482, ML610Q482P

Precise battery voltage detection

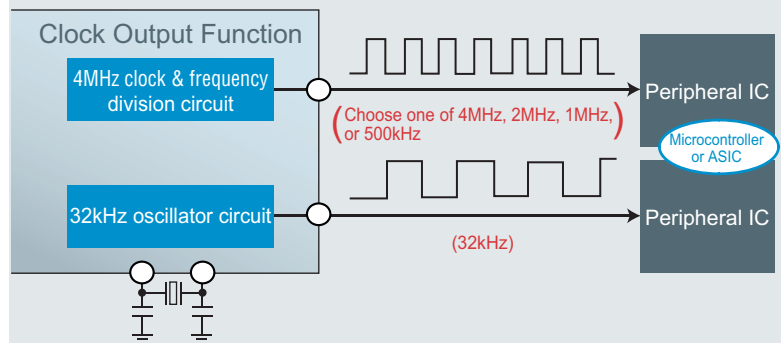


Clock output reduces system costs

Both the low and high speed clocks can be output, eliminating the need for an oscillator for the external peripheral IC, reducing system costs.

Applicable models : All models except ML610Q486, ML610Q486P, ML610Q489, ML610Q489P

Low-/high-speed clock output simplifies system configuration



*1: 4MHz generated via internal PLL/ceramic/crystal oscillation, 500kHz via RC oscillation, 32kHz via crystal oscillation

*3: Only the Master function is compatible with Fast Mode (400kbps)/Standard Mode (100kbps)

*5: The test area comprises 1Kbyte

*2: Current consumption during Suspend (HALT) mode at low-speed 32kHz oscillation

*4: Only the Master function supports Standard Mode (50kbps)

*6: No compatible chip select signals exist for 8bit/16bit SPI bus

Specifications

| Part No. | Operating Conditions | | | | ROM/RAM | | Function/Feature | | | | | Package | Chip Support |
|--------------------------|-----------------------|------------------------------------------------------------|-----------------------------------------------|----------------------------|-------------------------|---------------------|------------------|--------------------|------------------|-------------------|------|---------|--------------|
| | Operating voltage (V) | Operating frequency ⁺¹ | Current consumption (Typ.@HALT) ⁺² | Operating temperature (°C) | ROM capacity (Byte) | RAM capacity (Byte) | WDT | ADC(method) | i ² C | SSIO ⁵ | UART | | |
| ★ ML610Q486 / ML610Q486P | 1.6 to 3.6 | 500kHz | 15 μ A | -20 to +70 / -40 to +85 | Flash 32K ⁺⁵ | 1K | 1 | 4 (Sequential) | 1 ⁺⁴ | 1 | 1 | TQFP48 | ○ |
| ★ ML610Q487 / ML610Q487P | 1.8 to 3.8 | 1MHz 32.768kHz | 1.7 μ A | -20 to +70 / -40 to +85 | Flash 48K ⁺⁵ | 1.5K | 1 | - | 1 | 1 | 2 | TQFP48 | ○ |
| ★ ML610Q488 / ML610Q488P | 1.8 to 3.8 | 4MHz 32.768kHz | 1.7 μ A | -20 to +70 / -40 to +85 | Flash 48K ⁺⁵ | 1.5K | 1 | - | 1 | 1 | 2 | TQFP48 | ○ |
| ★ ML610Q489 / ML610Q489P | 1.8 to 3.8 | 4MHz 31.25kHz 32.768kHz (4MHz frequency division) | - | -20 to +70 / -40 to +85 | Flash 48K ⁺⁵ | 1.5K | 1 | - | 1 | 1 | 2 | TQFP48 | ○ |
| ★ ML610482 / ML610482P | 1.1 to 3.6 | 4.096MHz 500kHz 32.768kHz | 0.5 μ A | -20 to +70 / -40 to +85 | Mask 64K ⁺⁵ | 4K | 1 | 2 (RC oscillation) | 1 ⁺³ | 1 | 1 | TQFP48 | ○ |
| ★ ML610Q482 / ML610Q482P | 1.1 to 3.6 | 4.096MHz 500kHz 32.768kHz | 0.5 μ A | -20 to +70 / -40 to +85 | Flash 64K ⁺⁵ | 4K | 1 | 2 (RC oscillation) | 1 ⁺³ | 1 | 1 | TQFP48 | ○ |

NEW

★ Under development

Voice Functionality Type



OKI SEMICONDUCTOR low power microcontrollers with voice output function feature program memory (96kB to 128kB), RAM (512B/1kB), successive approximation A/D converter, UART/SSIO interface, timer, general-use port, voice synthesis, digital filter, 16bit D/A converter, and speaker amplifier.

10 years on battery!
Low power microcontroller

LINEUP

| | | Consumer/Industrial Grade | | | | | | |
|-----------|--------|---------------------------|------|-------|--------------|-----------|--------------------------------------------------------|--------|
| MASK ROM | 96 KB | RAM | 512B | VOICE | -40c +85c | ML610340 | 4MHz, 4MHz, SP AMP, SSIO | SSOP30 |
| FLASH ROM | 96 KB | RAM | 512B | VOICE | -40c +85c | ML610Q340 | 4MHz, 4MHz, SP AMP, SSIO | |
| MASK ROM | 128 KB | RAM | 1KB | VOICE | -40c +85c | ML610346 | 32kHz, 4MHz, 12-bit SA ADC, OP AMP, SP AMP, SSIO, UART | |
| FLASH ROM | 128 KB | RAM | 1KB | VOICE | -40c +85c | ML610Q346 | 32kHz, 4MHz, 12-bit SA ADC, OP AMP, SP AMP, SSIO, UART | |
| MASK ROM | 128 KB | RAM | 1KB | VOICE | -40c +85c | ML610347 | 32kHz, 4MHz, 12-bit SA ADC, SP AMP, SSIO, UART | TQFP64 |
| FLASH ROM | 128 KB | RAM | 1KB | VOICE | -40c +85c | ML610Q347 | 32kHz, 4MHz, 12-bit SA ADC, SP AMP, SSIO, UART | |
| MASK ROM | 128 KB | RAM | 1KB | VOICE | -40c +85c | ML610348 | 32kHz, 4MHz, 12-bit SA ADC, OP AMP, SP AMP, SSIO, UART | |
| FLASH ROM | 128 KB | RAM | 1KB | VOICE | -40c +85c | ML610Q348 | 32kHz, 4MHz, 12-bit SA ADC, OP AMP, SP AMP, SSIO, UART | QFP56 |

Please refer to pages 5 and 6 for icon descriptions.

Actual size shown

System Diagram

Low current consumption

Low voltage operation (2.2V to 5.5V) and low current consumption during Suspend (HALT) Mode (1.5µA)

Large internal memory

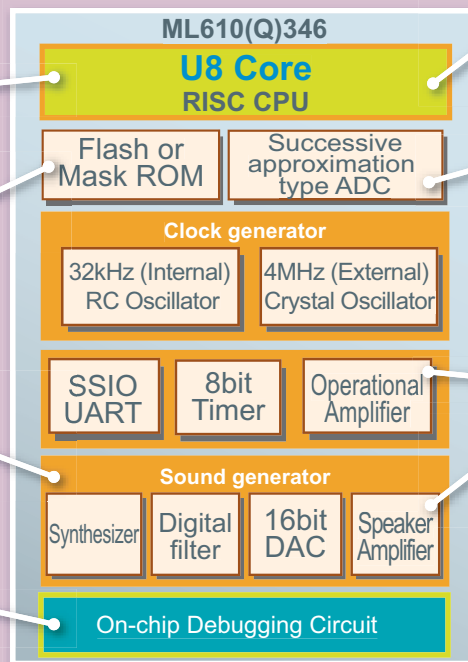
96kB/128kB Flash/mask ROM enables voice playback for 30 to 40 seconds

High quality, high output voice playback

A 16bit DAC, low-pass filter, 1W speaker amp, and high compression/high fidelity HQ-ADPCM are implemented using hardware

On-chip debugging reduces development time

OKI SEMICONDUCTOR's µEASE provides support for debugging and Flash memory writing



High speed RISC CPU "U8" Core

This high-speed processor executes one instruction per clock cycle via parallel processing utilizing pipeline architecture

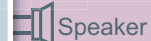
3ch ADC built-in

The 3ch ADC is suitable for voltage output sensor input

4.096MHz
Crystal Resonator

Fewer parts

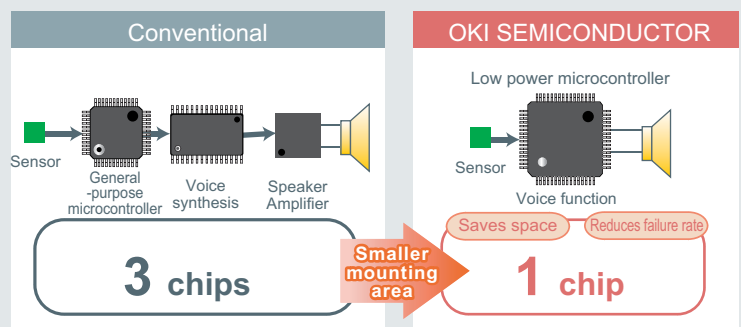
A number of components are built in for analog processing, such as an opamp and speaker amp, reducing the number of parts required



For consumer and industrial equipment

Many of the required features are built in, from a voice synthesis engine to a speaker amplifier, reducing the number of external parts. This increase integration reduces the susceptibility to failures and breakdowns.

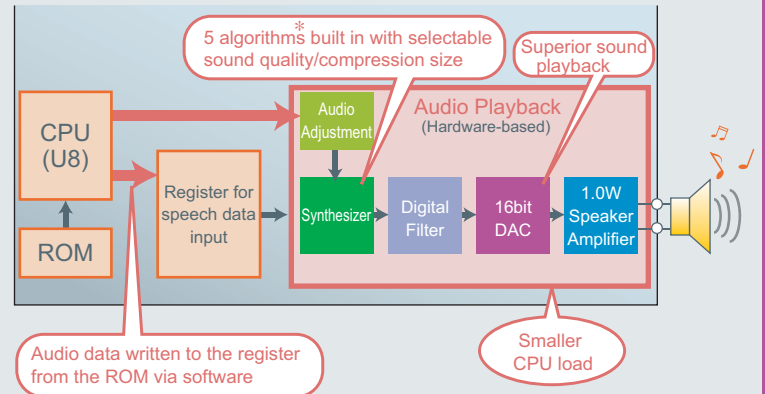
Monolithic design with voice functionality



Loud, high-fidelity audio playback

OKI SEMICONDUCTOR's audio microcontrollers feature hardware-based sound functionality. A high-fidelity sound circuit, comprised of a synthesizer, digital filter, 1W speaker amp, and 16bit DAC, is integrated, resulting in higher sound quality than competitors' middleware systems under the same conditions. In addition, 4 different compression methods can be selected: 4bit ADPCM2, HQ-ADPCM, 8bit non-linear PCM, and 8bit/16bit PCM). The sampling frequency is adjustable as well, from 6.4 to 32kHz, to meet set requirements. The result is superior audio playback of high compression audio.

High fidelity playback through dedicated hardware

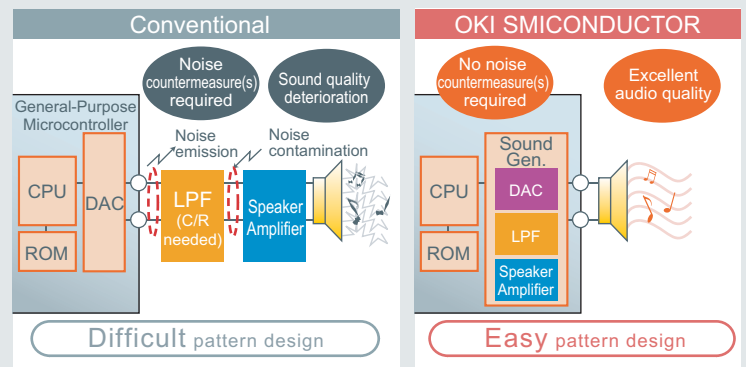


*4bit ADPCM2, HQ-ADPCM, 8bit non-linear PCM, 8/16bit PCM

Built-in LPF and speaker amplifier minimize noise

Enabling audio playback utilizing middleware requires an external LPF (Low Pass Filter) and speaker amp. However, sound quality is adversely affected by the occurrence of noise between the microcontroller and speaker amp, necessitating countermeasures. Conversely, OKI SEMICONDUCTOR's audio microcontroller is equipped with both an LPF and speaker amp, eliminating the need for troublesome analog circuit and pattern designs while minimizing sound deterioration, noise mixing, and noise emission.

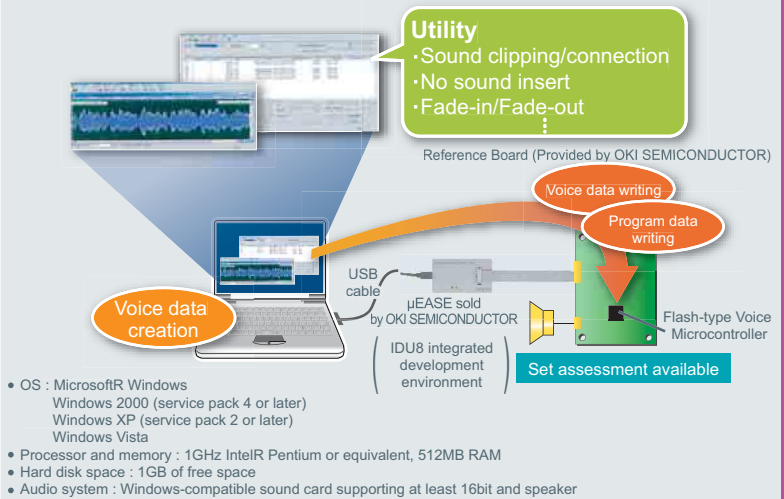
No noise-induced deterioration



Voice synthesis utility simplifies editing and data creation

OKI SEMICONDUCTOR's voice synthesis utility, along with a reference board and audio microcontroller, enable easy editing of the voice data and ROM data generation while listening to the actual audio. In addition, the application program is developed using a program development support system, while a Flash programming software (FWμEASE or MWμEASE), along with the μEASE on-chip debugging emulator, enable evaluation of application ROM codes and voice ROM data in the user's actual set.

Easy development with OKI SEMICONDUCTOR's voice synthesis utility



- OS : Microsoft® Windows
Windows 2000 (service pack 4 or later)
Windows XP (service pack 2 or later)
Windows Vista
- Processor and memory : 1GHz Intel® Pentium or equivalent, 512MB RAM
- Hard disk space : 1GB of free space
- Audio system : Windows-compatible sound card supporting at least 16bit and speaker

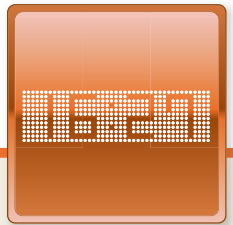
*Program data should be developed under "IDEU8 integrated development environment" separately.

Specifications

*1:4MHz generated via internal PLL/ceramic/crystal oscillation, 500kHz via RC oscillation, 32kHz via crystal oscillation *2: Current consumption during Suspend (HALT) mode at low-speed 32kHz oscillation *3: No compatible chip select signals exist for 8bit/16bit SPI bus

| Part No. | Operating Conditions | | | | ROM/RAM | | Functions/Features | | | | | Package |
|-----------|-----------------------|---------------------|---------------------------------|----------------------------|---------------------|---------------------|--------------------|---------------------------|-----------------------|------------------------------------------------|---|---------|
| | Operating voltage (V) | Operating frequency | Current consumption (Typ.@HALT) | Operating temperature (°C) | ROM capacity (Byte) | RAM capacity (Byte) | WDT | ADC (method) | Operational Amplifier | Serial port SSI ¹ UART ³ | | |
| ML610340 | 2.2 to 5.5 | 4.096MHz | - | -40 to +85 | Mask 96K | 512 | 1 | - | - | 1 | - | SSOP30 |
| ML610Q340 | 2.2 to 5.5 | 4.096MHz | - | -40 to +85 | Flash 96K | 512 | 1 | - | - | 1 | - | SSOP30 |
| ML610346 | 2.2 to 5.5 | 4.096MHz 32kHz | 1.5μA | -40 to +85 | Mask 128K | 1K | 1 | 12bit × 3ch (Sequential) | 3 | 1 | 1 | TQFP64 |
| ML610Q346 | 2.2 to 5.5 | 4.096MHz 32kHz | 1.5μA | -40 to +85 | Flash 128K | 1K | 1 | 12bit × 3ch (Sequential) | 3 | 1 | 1 | TQFP64 |
| ML610347 | 2.2 to 5.5 | 4.096MHz 32kHz | 1.5μA | -40 to +85 | Mask 128K | 1K | 1 | 12bit × 12ch (Sequential) | - | 1 | 1 | TQFP64 |
| ML610Q347 | 2.2 to 5.5 | 4.096MHz 32kHz | 1.5μA | -40 to +85 | Flash 128K | 1K | 1 | 12bit × 12ch (Sequential) | - | 1 | 1 | TQFP64 |
| ML610348 | 2.2 to 3.6 | 4.096MHz 32kHz | 1.5μA | -40 to +85 | Mask 128K | 1K | 1 | 12bit × 3ch (Sequential) | 2 | 1 | 1 | QFP56 |
| ML610Q348 | 2.2 to 3.6 | 4.096MHz 32kHz | 1.5μA | -40 to +85 | Flash 128K | 1K | 1 | 12bit × 3ch (Sequential) | 2 | 1 | 1 | QFP56 |

Dot Matrix Type with Built-in LCD Driver



These low-power microcontrollers integrate a boost circuit for driving LCDs, eliminating the need for an external LCD power supply. The lineup covers a wide range of dot counts, from 144 to 1,536. In addition, program memory (16kB-96kB), RAM (1kB-7kB), 3 types of serial communication interfaces (I²C, SSIO, UART), a battery voltage detection circuit, 2 A/D converters (24bit RC oscillation, 12bit successive approximation), melody, buzzer, capture, timer, and general-purpose ports are all integrated into a single chip, making them ideal for compact, battery-driven LCD applications.

10 years on battery!
Low power microcontroller

| LINEUP | Consumer Grade | | | | Industrial Grade | | | | Package | | | | | | | | |
|--------|-----------------|---------|------------------|------------------|------------------|------------|----------------|-------------|--------------|--------------|--------------|---------------|---------------|---------------|------------|-----------|-------------------|
| | FLASH ROM 16 KB | RAM 1KB | LOW HALT CURRENT | LOW VOLTAGE 1.1V | -20°C +70°C | ML6100Q411 | -40°C +85°C | ML6100Q411P | LCD 144 DOT | RC ADC 32kHz | SA ADC 50kHz | 24-bit RC ADC | 12-bit SA ADC | SERIAL I/F | BLD | PWM 16bit | TQFP120 |
| | FLASH ROM 16 KB | RAM 1KB | LOW HALT CURRENT | LOW VOLTAGE 1.1V | -20°C +70°C | ML6100Q412 | -40°C +85°C | ML6100Q412P | LCD 176 DOT | RC ADC 32kHz | SA ADC 50kHz | 24-bit RC ADC | 12-bit SA ADC | SERIAL I/F | BLD | PWM 16bit | |
| | FLASH ROM 16 KB | RAM 1KB | LOW HALT CURRENT | LOW VOLTAGE 1.1V | -20°C +70°C | ML6100Q415 | -40°C +85°C | ML6100Q415P | LCD 144 DOT | RC ADC 32kHz | SA ADC 50kHz | 24-bit RC ADC | 12-bit SA ADC | SERIAL I/F | BLD | PWM 16bit | TQFP128 |
| | FLASH ROM 32 KB | RAM 2KB | LOW HALT CURRENT | LOW VOLTAGE 1.1V | -20°C +70°C | ML6100Q421 | -40°C +85°C | ML6100Q421P | LCD 400 DOT | RC ADC 32kHz | SA ADC 50kHz | 4M PLL | 24-bit RC ADC | 12-bit SA ADC | SERIAL I/F | BLD | |
| | FLASH ROM 32 KB | RAM 2KB | LOW HALT CURRENT | LOW VOLTAGE 1.1V | -20°C +70°C | ML6100Q422 | -40°C +85°C | ML6100Q422P | LCD 800 DOT | RC ADC 32kHz | SA ADC 50kHz | 4M PLL | 24-bit RC ADC | 12-bit SA ADC | SERIAL I/F | BLD | MAPPING RAM 16bit |
| NEW | FLASH ROM 48 KB | RAM 4KB | LOW HALT CURRENT | LOW VOLTAGE 1.1V | -20°C +70°C | ML6100Q428 | -40°C +85°C | ML6100Q428P | LCD 1392 DOT | RC ADC 32kHz | SA ADC 50kHz | 4M PLL | 24-bit RC ADC | 12-bit SA ADC | SERIAL I/F | BLD | MAPPING RAM 16bit |
| NEW | FLASH ROM 48 KB | RAM 4KB | LOW HALT CURRENT | LOW VOLTAGE 1.1V | -20°C +70°C | ML6100Q429 | -40°C +85°C | ML6100Q429P | LCD 512 DOT | RC ADC 32kHz | SA ADC 50kHz | 4M PLL | 24-bit RC ADC | 12-bit SA ADC | SERIAL I/F | BLD | MAPPING RAM 16bit |
| | FLASH ROM 64 KB | RAM 3KB | LOW HALT CURRENT | LOW VOLTAGE 1.1V | -20°C +70°C | ML6100Q431 | -40°C +85°C | ML6100Q431P | LCD 1024 DOT | RC ADC 32kHz | SA ADC 50kHz | 4M PLL | 24-bit RC ADC | 12-bit SA ADC | SERIAL I/F | BLD | MAPPING RAM 16bit |
| NEW | FLASH ROM 64 KB | RAM 3KB | LOW HALT CURRENT | LOW VOLTAGE 1.1V | -20°C +70°C | ML6100Q432 | -40°C +85°C | ML6100Q432P | LCD 1536 DOT | RC ADC 32kHz | SA ADC 50kHz | 4M PLL | 24-bit RC ADC | 12-bit SA ADC | SERIAL I/F | BLD | MAPPING RAM 16bit |
| NEW | FLASH ROM 96 KB | RAM 3KB | LOW HALT CURRENT | LOW VOLTAGE 1.1V | -20°C +70°C | ML6100Q435 | -40°C +85°C | ML6100Q435P | LCD 1024 DOT | RC ADC 32kHz | SA ADC 50kHz | 4M PLL | 24-bit RC ADC | 12-bit SA ADC | SERIAL I/F | BLD | MAPPING RAM 16bit |
| ★ | FLASH ROM 96 KB | RAM 3KB | LOW HALT CURRENT | LOW VOLTAGE 1.1V | -20°C +70°C | ML6100Q436 | -40°C +85°C | ML6100Q436P | LCD 1536 DOT | RC ADC 32kHz | SA ADC 50kHz | 4M PLL | 24-bit RC ADC | 12-bit SA ADC | SERIAL I/F | BLD | MAPPING RAM 16bit |
| ★ | FLASH ROM 96 KB | RAM 7KB | LOW HALT CURRENT | LOW VOLTAGE 1.1V | -20°C +70°C | ML6100Q438 | -40°C +85°C | ML6100Q438P | LCD 1344 DOT | RC ADC 32kHz | SA ADC 50kHz | 4M PLL | 24-bit RC ADC | 12-bit SA ADC | SERIAL I/F | BLD | MAPPING RAM 16bit |
| | FLASH ROM 96 KB | RAM 7KB | LOW HALT CURRENT | LOW VOLTAGE 1.1V | -20°C +70°C | ML6100Q439 | -40°C +85°C | ML6100Q439P | LCD 1024 DOT | RC ADC 32kHz | SA ADC 50kHz | 4M PLL | 24-bit RC ADC | 12-bit SA ADC | SERIAL I/F | BLD | MAPPING RAM 16bit |

★ Under development

Please refer to pages 5 and 6 for icon descriptions

Actual size shown

Single-battery drive with remarkably low current consumption

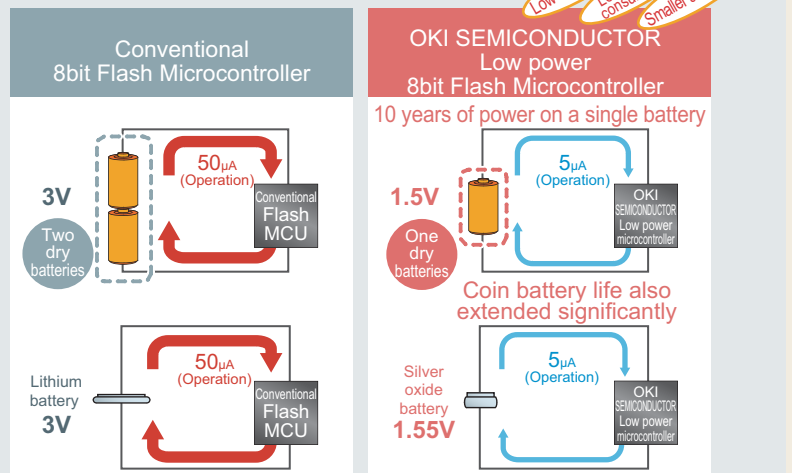
This entire series features low operating voltage (1.1V to 3.6V) and a suspend (HALT) current of 0.5μA, making it OKI SEMICONDUCTOR's lowest power lineup. Operating current is reduced by up to 86% over conventional models, enabling operation from a single battery, reducing both costs and waster.

| | Conventional 8bit Flash Microcontroller | OKI SEMICONDUCTOR Low power 8bit Flash Microcontroller |
|-----------------------|--------------------------------------------------------|---------------------------------------------------------|
| Operating voltage | 1.8V to 3.6V | 1.1V to 3.6V |
| Suspend(HALT) current | 2.0μA | 0.5μA |
| Standby(STOP) current | 0.8μA | 0.15μA |
| Operating current | 50μA (32kHz CPU operation) 6mA (4MHz CPU operation) | 5μA (32kHz CPU operation) 0.8mA (4MHz CPU operation) |

*OKI SEMICONDUCTOR survey

Applicable models : All models except ML6100Q415

Low current consumption/ Low voltage operation

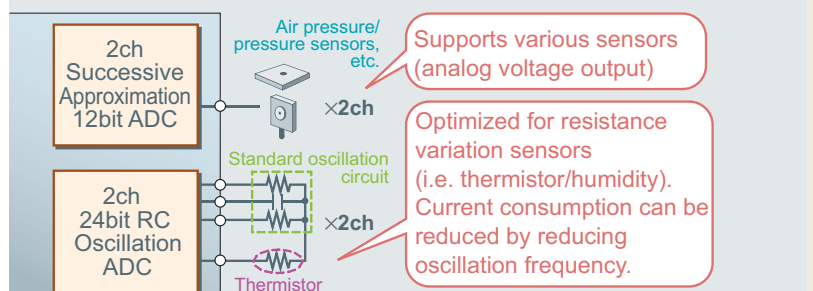


2 types of A/D converters enable a variety of measurements

2 types of A/D converters are built in, a Successive Approximation type requiring analog voltage input and an RC Oscillation type that counts the number of oscillations caused by a resistive sensor (i.e. thermistor, humidity) and external capacitor. Select the optimum sensor based on the characteristics, measurement accuracy, and current consumption.

Applicable models : All models except ML6100Q428, ML6100Q428P, ML6100Q429, ML6100Q429P

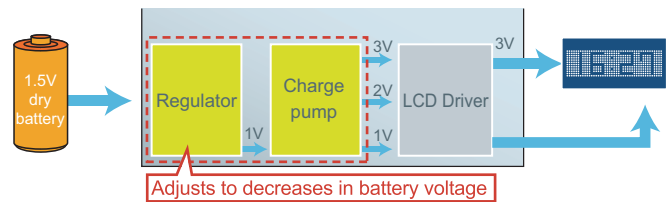
2 types of ADC



Stable LCD operation - even at low battery levels

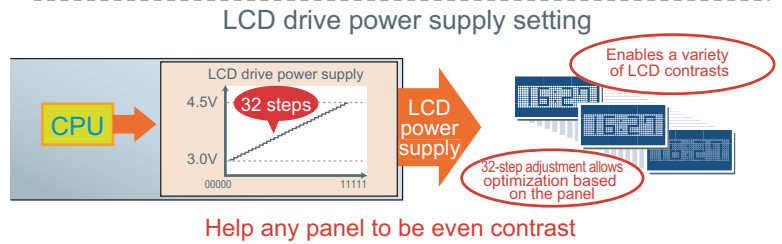
A boost circuit is built in that generates all voltages required to drive the LCD, preventing the battery level from affecting the display quality. In addition, no regulator is required, reducing both parts and costs.

Stable power supply circuit for driving LCD without depending on battery voltage



32-step contrast control eliminates display fluctuations

The LCD drive voltage is adjustable in 32 steps (at 1/3 bias) via software control, enabling precision contrast adjustment.



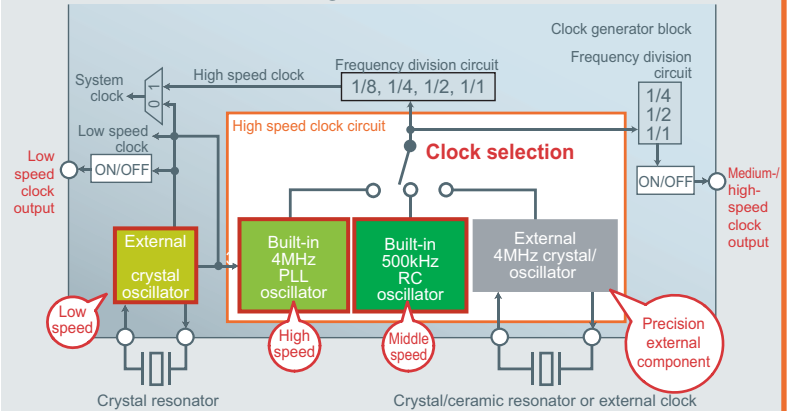
Triple clock capability facilitates low power consumption designs

Three clocks are selectable for optimum performance: a low-speed 32kHz clock (crystal), a medium-speed 500kHz clock (RC), and a high-speed 4MHz type (PLL). Both the medium- and high-speed clocks feature adjustable frequency division to maximize energy efficiency. In addition, support for an external 4MHz precision oscillator is enabled for applications requiring high reliability, such as communications circuits.

| Speed | Frequency | Current consumption |
|--------|---------------------------------|---------------------|
| Low | 32kHz, crystal oscillation | 5μA |
| Medium | 500kHz built-in, RC oscillation | 70μA |
| High | 4MHz built-in, PLL oscillation | 800μA |

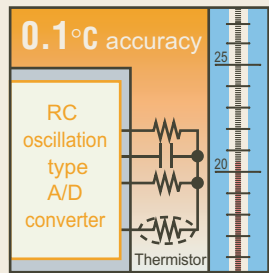
Applicable models : All models except ML610Q411, ML610Q411P, ML610Q412, ML610Q412P, ML610Q415

Power management via clock selection



Precision RC oscillation-type A/D converter built in for 0.1°C temperature measurement accuracy

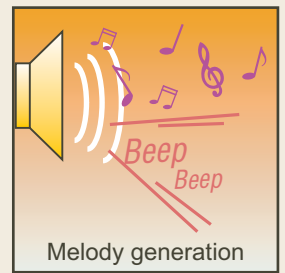
0.1°C temperature precision is possible through a combination of software correction and RC oscillation principles with thermistor. The RC oscillation A/D converted is considered the best method for temperature measurement since it is easy to adjust component costs and current consumption based on target precision and measurement time.



Applicable models: All models except ML610Q415

Easily play a variety of melodies

Melody generation is possible based on musical score using a maximum of 29 scales, 63 sound lengths, and 5 tempos, simply via register setting. In addition, the output waveform (digital) is generated from a hardware circuit, making it easy to control using software.



Applicable models : All models except ML610Q411, ML610Q411P, ML610Q412, ML610Q412P, ML610Q415

*1: 4MHz generated via internal PLL/ceramic/crystal oscillation, 500kHz via RC oscillation, 32kHz via crystal oscillation

*2: Current consumption during Suspend (HALT) mode at low-speed 32kHz oscillation
*3: Only the Master function is compatible with Fast Mode (400kbps)/Standard Mode (100kbps)
*4: Only the Master Function supports standard mode (50kbps)

*5: No compatible chip select signals exist for 8bit/16bit SPI bus
*6: includes 1KByte test area
*7: includes 1KByte LCD allocation RAM

Specifications

| Part No. | Operating Conditions | | | | ROM/RAM | | Functions/Features | | | | | Package | Chip Support | |
|-----------------------------------|----------------------|---------------------------------|---------------------------------|----------------------------|-------------------------|---------------------|--------------------|--------------------------------------|------------------|-----------------------------------|------|-------------------------------|--------------|------------|
| | Operating voltage(V) | Operating frequency | Current consumption (Typ.@HALT) | Operating temperature(°C) | ROM capacity (Byte) | RAM capacity (Byte) | WDT | ADC(Method) | i ² C | Serial port SSIO ^{†5} | UART | | | LCD driver |
| ML610Q411 / ML610Q411P | 1.1 to 3.6 | 500kHz 32.768kHz | 0.5μA | -20 to +70 / -40 to +85 | Flash 16K ^{†6} | 1K | 1 | 2 (RC oscillation) 2 (Sequential) | 1 ^{†4} | 1 | 1 | Max.144dot 36seg × 4com. | TQFP120 | ○ |
| ML610Q412 / ML610Q412P | 1.1 to 3.6 | 500kHz 32.768kHz | 0.5μA | -20 to +70 / -40 to +85 | Flash 16K ^{†6} | 1K | 1 | 2 (RC oscillation) 2 (Sequential) | 1 ^{†4} | 1 | 1 | Max.176dot 44seg × 4com. | TQFP120 | ○ |
| ML610Q415 | 1.1 to 3.6 | 500kHz | 5.5μA | -20 to +70 | Flash 16K ^{†6} | 1K | 1 | 2 (RC oscillation) 2 (Sequential) | 1 ^{†4} | 1 | 1 | Max.144dot 36seg × 4com. | TQFP120 | ○ |
| ML610Q421 / ML610Q421P | 1.1 to 3.6 | 4.096MHz 500kHz 32.768kHz | 0.5μA | -20 to +70 / -40 to +85 | Flash 32K ^{†6} | 2K ^{†7} | 1 | 2 (RC oscillation) 2 (Sequential) | 1 ^{†3} | 1 | 1 | Max.400dot 50seg × 8com. | TQFP120 | ○ |
| ML610Q422 / ML610Q422P | 1.1 to 3.6 | 4.096MHz 500kHz 32.768kHz | 0.5μA | -20 to +70 / -40 to +85 | Flash 32K ^{†6} | 2K ^{†7} | 1 | 2 (RC oscillation) 2 (Sequential) | 1 ^{†3} | 1 | 1 | Max.800dot 50seg × 16com. | TQFP120 | ○ |
| NEW ML610Q428 / ML610Q428P | 1.1 to 3.6 | 4.096MHz 2MHz 32.768kHz | 0.5μA | -20 to +70 / -40 to +85 | Flash 48K ^{†6} | 4K ^{†7} | 1 | 2 (RC oscillation) | 1 ^{†3} | 1 | 1 | Max.1392dot 58seg × 24com. | TQFP128 | ○ |
| NEW ML610Q429 / ML610Q429P | 1.1 to 3.6 | 4.096MHz 2MHz 32.768kHz | 0.5μA | -20 to +70 / -40 to +85 | Flash 48K ^{†6} | 4K ^{†7} | 1 | 2 (RC oscillation) | 1 ^{†3} | 1 | 1 | Max.512dot 64seg × 8com. | TQFP128 | ○ |
| ML610Q431 | 1.1 to 3.6 | 4.096MHz 500kHz 32.768kHz | 0.5μA | -20 to +70 | Flash 64K ^{†6} | 3K ^{†7} | 1 | 2 (RC oscillation) 2 (Sequential) | 1 ^{†3} | 1 | 1 | Max.1024dot 64seg × 16com. | LQFP144 | ○ |
| ML610Q432 | 1.1 to 3.6 | 4.096MHz 500kHz 32.768kHz | 0.5μA | -20 to +70 | Flash 64K ^{†6} | 3K ^{†7} | 1 | 2 (RC oscillation) 2 (Sequential) | 1 ^{†3} | 1 | 1 | Max.1536dot 64seg × 24com. | LQFP144 | ○ |
| NEW ML610Q435 | 1.1 to 3.6 | 4.096MHz 500kHz 32.768kHz | 0.5μA | -20 to +70 | Flash 96K ^{†6} | 3K ^{†7} | 1 | 2 (RC oscillation) 2 (Sequential) | 1 ^{†3} | 1 | 1 | Max.1024dot 64seg × 16com. | LQFP144 | ○ |
| NEW ML610Q436 | 1.1 to 3.6 | 4.096MHz 500kHz 32.768kHz | 0.5μA | -20 to +70 | Flash 96K ^{†6} | 3K ^{†7} | 1 | 2 (RC oscillation) 2 (Sequential) | 1 ^{†3} | 1 | 1 | Max.1536dot 64seg × 24com. | LQFP144 | ○ |
| ★ ML610Q438 / ML610Q438P | 1.1 to 3.6 | 4.096MHz 2MHz 32.768kHz | 0.5μA | -20 to +70 / -40 to +85 | Flash 96K ^{†6} | 7K ^{†7} | 1 | 2 (RC oscillation) 2 (Sequential) | 1 ^{†3} | 1 | 1 | Max.1344dot 56seg × 24com. | LQFP144 | ○ |
| ★ ML610Q439 / ML610Q439P | 1.1 to 3.6 | 4.096MHz 2MHz 32.768kHz | 0.5μA | -20 to +70 / -40 to +85 | Flash 96K ^{†6} | 7K ^{†7} | 1 | 2 (RC oscillation) 2 (Sequential) | 1 ^{†3} | 1 | 1 | Max.1024dot 64seg × 16com. | LQFP144 | ○ |

★ Under development

Segment Type with Built-in LCD Driver



These low-power microcontrollers with segment LCD driver integrates a boost circuit for driving an LCD. The lineup ranges from 55 to 185 segments. Additional features include built-in program memory (6kB-16kB) and RAM (192B-1kB), 2 types of serial communication interfaces (SSIO, UART), 16bit RC A/D converter, melody, buzzer, timer, and general-purpose port, making them ideal for compact, LCD-equipped devices.

10 years on battery!
Low power microcontroller

LINEUP

| | | Consumer Grade | | | | Industrial Grade | | | | | | | | Package | | | |
|-----|-----------|----------------|----------|------------------|-------------------|------------------|------------------|-------|-------------------|-------------|-------|--------|--------------|-------------|-------------|-----------|--------|
| ★ | MASK ROM | 6 KB | RAM 192B | LOW HALT CURRENT | LOW VOLTAGE 1.25V | -20°C | ML610401 | -40°C | ML610401P | LCD 55 DOT | 32kHz | 500kHz | 16bit RC ADC | MAPPING RAM | TQFP64 | | |
| ★ | MASK ROM | 6 KB | RAM 192B | LOW HALT CURRENT | LOW VOLTAGE 1.25V | -20°C | ML610402 | -40°C | ML610402P | LCD 75 DOT | 32kHz | 500kHz | 16bit RC ADC | MAPPING RAM | | | |
| ★ | MASK ROM | 6 KB | RAM 192B | LOW HALT CURRENT | LOW VOLTAGE 1.25V | -20°C | ML610403 | -40°C | ML610403P | LCD 95 DOT | 32kHz | 500kHz | 16bit RC ADC | MAPPING RAM | | | |
| ★ | MASK ROM | 8 KB | RAM 256B | LOW HALT CURRENT | LOW VOLTAGE 1.25V | -20°C | ML610404 | -40°C | ML610404P | LCD 105 DOT | 32kHz | 2MHz | 16bit SSIO | UART | MAPPING RAM | PWM 16bit | MELODY |
| ★ | MASK ROM | 8 KB | RAM 256B | LOW HALT CURRENT | LOW VOLTAGE 1.25V | -20°C | ML610405 | -40°C | ML610405P | LCD 125 DOT | 32kHz | 2MHz | 16bit SSIO | UART | MAPPING RAM | PWM 16bit | MELODY |
| ★ | MASK ROM | 8 KB | RAM 256B | LOW HALT CURRENT | LOW VOLTAGE 1.25V | -20°C | ML610406 | -40°C | ML610406P | LCD 145 DOT | 32kHz | 2MHz | 16bit SSIO | UART | MAPPING RAM | PWM 16bit | MELODY |
| ★ | MASK ROM | 16 KB | RAM 1KB | LOW HALT CURRENT | LOW VOLTAGE 1.25V | -20°C | ML610407 | -40°C | ML610407P | LCD 145 DOT | 32kHz | 2MHz | 16bit SSIO | UART | MAPPING RAM | PWM 16bit | MELODY |
| ★ | MASK ROM | 16 KB | RAM 1KB | LOW HALT CURRENT | LOW VOLTAGE 1.25V | -20°C | ML610408 | -40°C | ML610408P | LCD 165 DOT | 32kHz | 2MHz | 16bit SSIO | UART | MAPPING RAM | PWM 16bit | MELODY |
| ★ | MASK ROM | 16 KB | RAM 1KB | LOW HALT CURRENT | LOW VOLTAGE 1.25V | -20°C | ML610409 | -40°C | ML610409P | LCD 185 DOT | 32kHz | 2MHz | 16bit SSIO | UART | MAPPING RAM | PWM 16bit | MELODY |
| NEW | FLASH ROM | 16 KB | RAM 1KB | LOW HALT CURRENT | LOW VOLTAGE 1.25V | -20°C | ML610Q407 | -40°C | ML610Q407P | LCD 145 DOT | 32kHz | 2MHz | 16bit SSIO | UART | MAPPING RAM | PWM 16bit | MELODY |
| NEW | FLASH ROM | 16 KB | RAM 1KB | LOW HALT CURRENT | LOW VOLTAGE 1.25V | -20°C | ML610Q408 | -40°C | ML610Q408P | LCD 165 DOT | 32kHz | 2MHz | 16bit SSIO | UART | MAPPING RAM | PWM 16bit | MELODY |
| NEW | FLASH ROM | 16 KB | RAM 1KB | LOW HALT CURRENT | LOW VOLTAGE 1.25V | -20°C | ML610Q409 | -40°C | ML610Q409P | LCD 185 DOT | 32kHz | 2MHz | 16bit SSIO | UART | MAPPING RAM | PWM 16bit | MELODY |

★ Under development

Please refer to pages 5 and 6 for icon descriptions.

Actual size shown

System Diagram

Low current consumption

Low voltage operation (1.25V to 3.6V) with low current consumption during Suspend (HALT) Mode (0.9µA)

Flash/Mask ROM (Driveable from 1V)

Pin-compatible mask ROM available (1.25V to 3.6V operation)

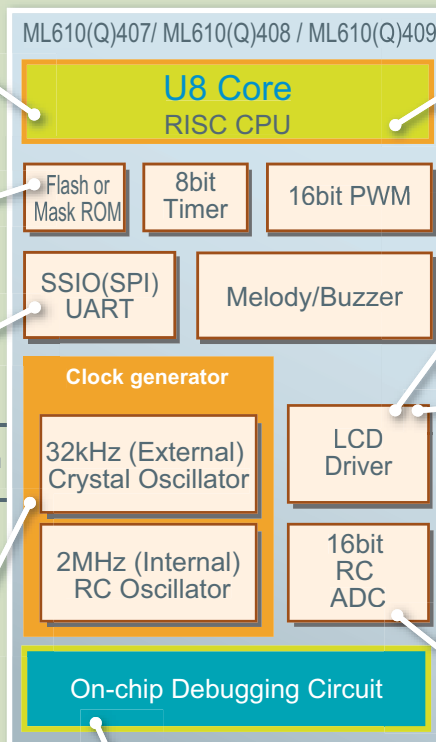
2 types of serial I/F

Both SSIO and UART interfaces are included for testing or connection with external memory

Dual-clock functionality

Control current consumption by adjusting the clock speed:
Low (32kHz)
High (2MHz)

32.768kHz
Crystal Resonator



High speed RISC CPU "U8" Core

This high-speed processor executes one instruction per clock cycle via parallel processing utilizing pipeline architecture

Segment type LCD display

Supports a maximum of 185 segments (37seg x 5com)

Accommodates LCD design changes

Built-in display allocation RAM makes extremely easy to changes programmably the LCD design

Built-in 2ch ADC enables both temperature and humidity measurements

OKI SEMICONDUCTOR's µEASE provides support for debugging and Flash memory writing

On-chip debugging reduces development time

OKI SEMICONDUCTOR's µEASE provides support for debugging and Flash memory writing

Stable LCD operation - even at low battery levels

A boost circuit is built in that generates all voltages required to drive the LCD, preventing the battery level from affecting the display quality. In addition, no regulator is required, reducing both parts and costs.

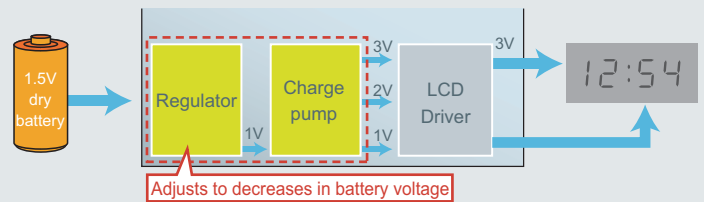
Applicable models : All models

Easily supports changing LCD designs

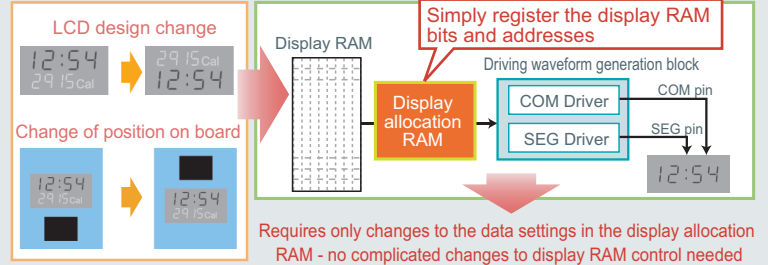
Display allocation RAM for mapping separated from the display RAM, making it easy to change software when changing the LCD design. In addition, data creation and operation verification tools are available to facilitate development for the user.

Applicable models : All models

Stable LCD drive regardless of battery voltage level



Internal display allocation RAM easily modified via software

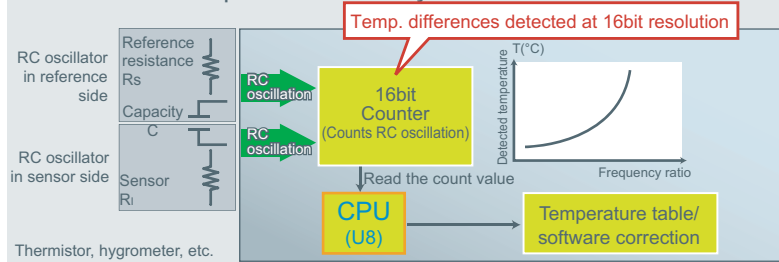


Integrated high precision RC oscillation A/D converter ideal for measuring temperature and humidity

Using thermistor and humidity sensor, with a small number of parts, it can measure the temperature and humidity precisely. It has many bits of counter and can improve the preciseness by making the measurement time longer.

Applicable models : All models

Oscillation A/D converter ideal for temperature/humidity measurement

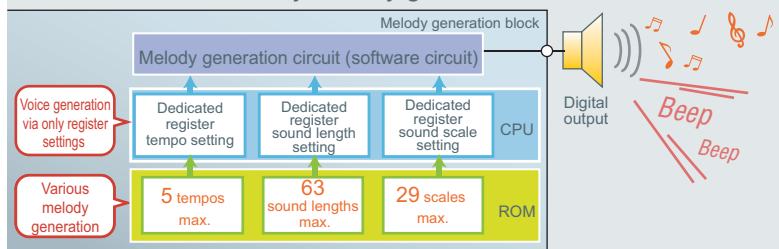


Easily play a variety of melodies

29 scales, 63 sound lengths, and 5 tempos are integrated, making it easy to create melodies based on a musical score via software.

Applicable models : All models except ML610401, ML610401P, ML610402, ML610402P, ML610403, ML610403P

Easy melody generation



Specifications

*1: 500kHz generated via RC oscillation, 32kHz via crystal oscillation

*2: Current consumption during Suspend (HALT) mode at low-speed 32kHz oscillation

*3: No compatible chip select signals exist for 8bit/16bit SPI bus

*4: includes 256Byte test area
*5: includes 1KByte test area

| Part No. | Operating condition | | | | ROM/RAM | | Function/Feature | | | | Package | In chip | |
|-----------------------------------|----------------------|---------------------|---------------------------------|----------------------------|-------------------------|---------------------|------------------|-------------------|-------------------|------|------------------------------|---------|------------|
| | Operating voltage(V) | Operating frequency | Current consumption (Typ.@HALT) | Operating temperature (°C) | ROM capacity (Byte) | RAM capacity (Byte) | WDT | ADC(method) | Serial port | | | | LCD driver |
| | | | | | | | | | SSIO ³ | UART | | | |
| ★ ML610401 / ML610401P | 1.25 to 3.6 | 500kHz 32.768kHz | 0.9μA | -20 to +70 / -40 to +85 | Mask 6K ^{*4} | 192 | 1 | 2(RC oscillation) | - | - | Max. 55dot 11seg × 5com. | TQFP64 | ○ |
| ★ ML610402 / ML610402P | 1.25 to 3.6 | 500kHz 32.768kHz | 0.9μA | -20 to +70 / -40 to +85 | Mask 6K ^{*4} | 192 | 1 | 2(RC oscillation) | - | - | Max. 75dot 15seg × 5com. | TQFP64 | ○ |
| ★ ML610403 / ML610403P | 1.25 to 3.6 | 500kHz 32.768kHz | 0.9μA | -20 to +70 / -40 to +85 | Mask 6K ^{*4} | 192 | 1 | 2(RC oscillation) | - | - | Max. 95dot 19seg × 5com. | TQFP64 | ○ |
| ★ ML610404 / ML610404P | 1.25 to 3.6 | 2MHz 32.768kHz | 0.9μA | -20 to +70 / -40 to +85 | Mask 8K ^{*4} | 256 | 1 | 2(RC oscillation) | 2 | 1 | Max. 105dot 21seg × 5com. | TQFP80 | ○ |
| ★ ML610405 / ML610405P | 1.25 to 3.6 | 2MHz 32.768kHz | 0.9μA | -20 to +70 / -40 to +85 | Mask 8K ^{*4} | 256 | 1 | 2(RC oscillation) | 2 | 1 | Max. 125dot 25seg × 5com. | TQFP80 | ○ |
| ★ ML610406 / ML610406P | 1.25 to 3.6 | 2MHz 32.768kHz | 0.9μA | -20 to +70 / -40 to +85 | Mask 8K ^{*4} | 256 | 1 | 2(RC oscillation) | 2 | 1 | Max. 145dot 29seg × 5com. | TQFP80 | ○ |
| ★ ML610407 / ML610407P | 1.25 to 3.6 | 2MHz 32.768kHz | 0.9μA | -20 to +70 / -40 to +85 | Mask 16K ^{*5} | 1K | 1 | 2(RC oscillation) | 2 | 1 | Max. 145dot 29seg × 5com. | TQFP100 | ○ |
| ★ ML610408 / ML610408P | 1.25 to 3.6 | 2MHz 32.768kHz | 0.9μA | -20 to +70 / -40 to +85 | Mask 16K ^{*5} | 1K | 1 | 2(RC oscillation) | 2 | 1 | Max. 165dot 33seg × 5com. | TQFP100 | ○ |
| ★ ML610409 / ML610409P | 1.25 to 3.6 | 2MHz 32.768kHz | 0.9μA | -20 to +70 / -40 to +85 | Mask 16K ^{*5} | 1K | 1 | 2(RC oscillation) | 2 | 1 | Max. 185dot 37seg × 5com. | TQFP100 | ○ |
| NEW ML610Q407 / ML610Q407P | 1.25 to 3.6 | 2MHz 32.768kHz | 0.9μA | -20 to +70 / -40 to +85 | Flash 16K ^{*5} | 1K | 1 | 2(RC oscillation) | 2 | 1 | Max. 145dot 29seg × 5com. | TQFP100 | ○ |
| NEW ML610Q408 / ML610Q408P | 1.25 to 3.6 | 2MHz 32.768kHz | 0.9μA | -20 to +70 / -40 to +85 | Flash 16K ^{*5} | 1K | 1 | 2(RC oscillation) | 2 | 1 | Max. 165dot 33seg × 5com. | TQFP100 | ○ |
| NEW ML610Q409 / ML610Q409P | 1.25 to 3.6 | 2MHz 32.768kHz | 0.9μA | -20 to +70 / -40 to +85 | Flash 16K ^{*5} | 1K | 1 | 2(RC oscillation) | 2 | 1 | Max. 185dot 37seg × 5com. | TQFP100 | ○ |

★ Under development

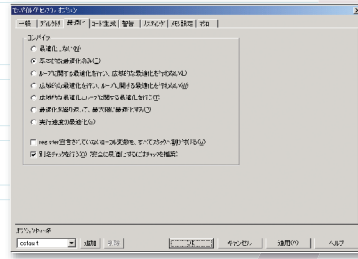
Development Support System

Overview

OKI SEMICONDUCTOR's development support system consists of hardware and software tools that aid in program development for the ML610400/ML610300 series. The software tool utilizes an easy-to-understand GUI and facilitates the debugging operation from program creation.

- Integrated software simplifies repeated work during software development, including programming, building (object creation), and debugging
- User-friendly graphical user interface
- Optimized C compiler maximizes microcontroller performance (minimizing ROM code/increasing processing speed)
- Cost-effective, lightweight, compact debugging emulator

Optimized C Compiler

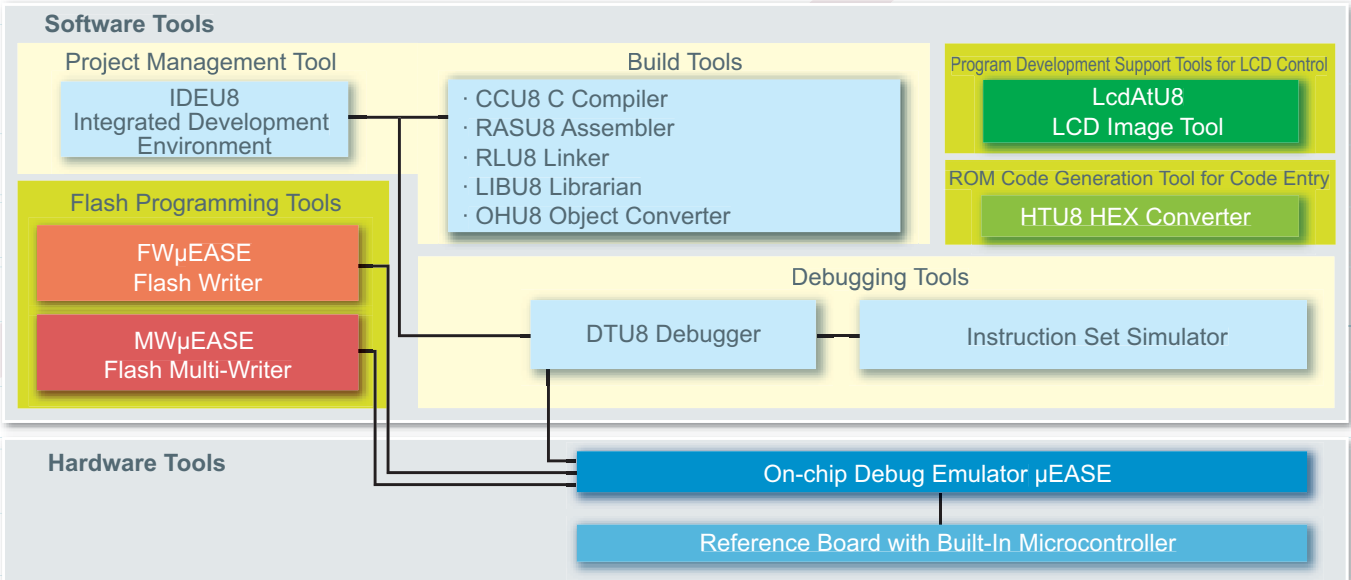


Compact, lightweight debugging emulator μEASE (50mm×90mm×9mm 50g)



Program Development System Details

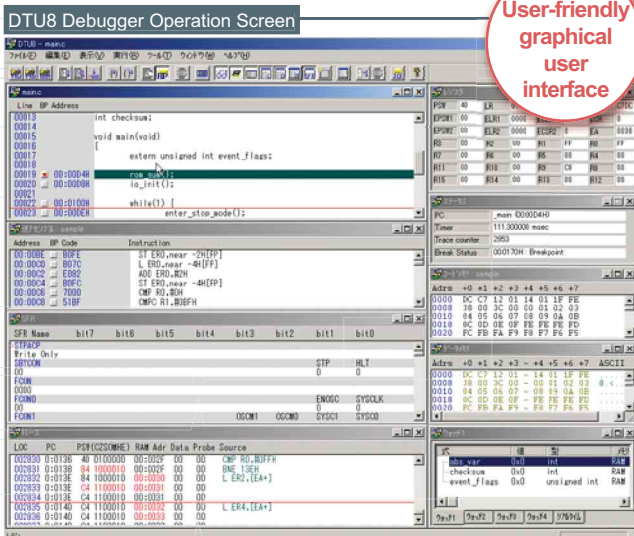
OKI SEMICONDUCTOR provides software tools for program building, Flash writing, and debugging. Build tool design and debugging startup is performed in an integrated IDEU8 environment. In addition, built-in project management and editor functions make software development more user-friendly. On the hardware side an emulator and reference board are offered that allows for on-chip debugging and writing to Flash memory while connected to the actual device.



Tool Screen and Connection Examples

On-chip Debug Emulator μEASE

This compact, cost-saving emulator supports onboard debugging and writing to Flash memory by utilizing on-chip debugging functions when connected to the actual device.



User-friendly graphical user interface

LcdAtU8 LCD Image Tool

Inputting a bitmap file of an LCD panel image and LCD panel layout information automatically generates table data for LCD allocation RAM along with a sample control program.

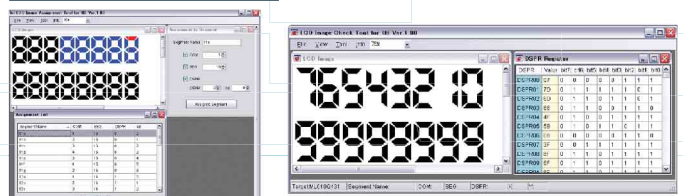
The LCD image tools simplifies complicated mapping operation.

The LCD image tool is divided into 2 tools, one for LCD image assignment and the other for LCD image verification.

The LCD image assignment tool facilitates LCD panel image mapping with the microcontroller terminal using the LCD image displayed on the PC.

The image verification tool aids in checking that the mapping was correctly performed.

LCD Image Tool Screenshots



LCD Image Assignment Tool

Reference board with built-in microcontroller

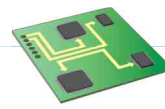
μEASE Connection Method

The reference board contains the microcontroller and the minimum number of parts required. Connection with μEASE allows evaluation of the operation of ML610400/ML610300 series products. Software development and Flash programming are possible.



Reference board

OR



Customer's development board

Interface cable

μEASE

USB

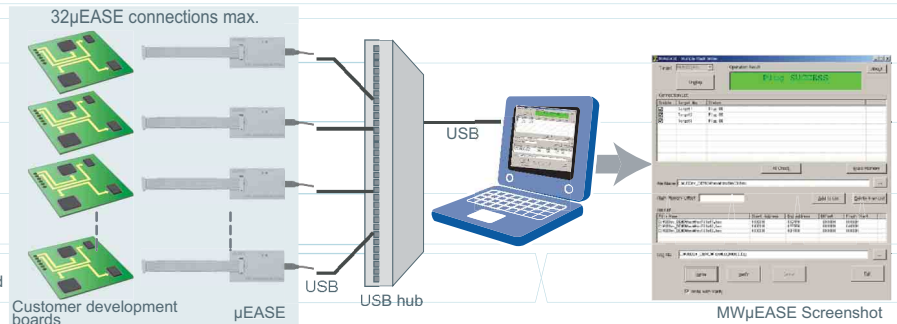


Software tools

MWμEASE Multi-Writer^{*1}

Supports simultaneous Flash programming of multiple boards of the same type.

μEASE Connection Method Using MWμEASE



*1: The requisite number of μEASE units must be purchased to use MWμEASE.

HTU8 HEX Converter

A tool for creating ROM code data when writing the customer's code into the Flash memory (performed at OKI SEMICONDUCTOR's facility)

FWμEASE Flash writer

A software tool that acts a Flash writer for controlling the on-chip debugging emulator μEASE.

Demo Kit Connection Method



μEASE



Software tool

The demo kit allows confirmation of the melody output, stopwatch, signal, temperature/humidity measurements, LCD display, and debugging operation.

The demo kit contains an ML610Q431 reference board, a demo board, and sample program^{*2}, and enables users to verify a host of parameters/functions, including temperature/humidity measurements, LCD display, UART signals, melody output, and the stopwatch. Connecting to μEASE enables confirmation of the included sample program via the DTU8 debugger.

ML610Q431 reference board + demonstration board

*2 The demo kit includes the ML610Q431 reference board with integrated temperature and humidity sensors. For other types of reference boards, OKI SEMICONDUCTOR recommends that the user prepare all required parts after purchasing the desired reference board.

Target Products and Compatible Product Development Support Systems

| | Target Products | Software Tools | Hardware Tools | |
|-----------------------------------------------|-----------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|------------------------------------------|
| | | | Development Tool | Reference Board |
| Standard Type | ML610Q486 / ML610Q486P | <ul style="list-style-type: none"> Project management tool (IDEU8 integrated development environment) Build tool Debugging tool Flash programming tool^{*4} ROM code generation tool for code entry | μEASE ^{*3} | ML610Q486 Reference board |
| | ML610Q487 / ML610Q487P | | | ML610Q487 Reference board |
| | ML610Q488 / ML610Q488P | | | ML610Q488 Reference board |
| | ML610Q489 / ML610Q489P | | | ML610Q489 Reference board |
| | ML610Q482 / ML610Q482P | | | ML610Q482 Reference board |
| | ML610Q482 / ML610Q482P | | | ML610Q482 Reference board |
| Voice Functionality | ML610340 / ML610Q340 | <Required environment> <ul style="list-style-type: none"> Windows2000/XP Graphic adapter and display of SVGA (800×600) or more At least 20MB of free hard disk space | μEASE ^{*3} | ML610Q340 Reference board |
| | ML610346 / ML610Q346 / ML610348 / ML610Q348 | | | ML610Q346 Reference board |
| | ML610347 / ML610Q347 | | | ML610Q347 Reference board |
| Dot Matrix Type with Built-In LCD Driver | ML610Q411 / ML610Q411P | <ul style="list-style-type: none"> Project management tool (IDEU8 integrated development environment) Build tool Debugging tool Flash programming tool^{*4} Program development support tool for LCD control ROM code generation tool for code entry | μEASE ^{*3} | ML610Q411 Reference board |
| | ML610Q412 / ML610Q412P | | | ML610Q412 Reference board |
| | ML610Q415 | | | ML610Q415 Reference board |
| | ML610Q421 / ML610Q421P | | | 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 |
| Segment Type with Built-In LCD Driver | ML610Q438 / ML610Q438P | <Required environment> <ul style="list-style-type: none"> Windows2000/XP Graphic adapter and display of SVGA (800×600) or more At least 20MB of free hard disk space | μEASE ^{*3} | ML610Q438 Reference board |
| | ML610Q439 / ML610Q439P | | | ML610Q439 Reference board |
| | ML610401 / ML610401P | | | ML610Q407 Reference board ^{*5} |
| | ML610402 / ML610402P | | | ML610Q407 Reference board ^{*6} |
| | ML610403 / ML610403P | | | ML610Q407 Reference board ^{*7} |
| | ML610404 / ML610404P | | | ML610Q407 Reference board ^{*8} |
| | ML610405 / ML610405P | | | ML610Q407 Reference board ^{*9} |
| | ML610406 / ML610406P | | | ML610Q407 Reference board ^{*10} |
| | ML610407 / ML610407P / ML610Q407 / ML610Q407P | | | ML610Q407 Reference board |
| | ML610408 / ML610408P / ML610Q408 / ML610Q408P | | | ML610Q408 Reference board |
| ML610409 / ML610409P / ML610Q409 / ML610Q409P | ML610Q409 Reference board | | | |

^{*3} All software except for MWμEASE is bundled in μEASE
^{**} All required μEASE units must be purchased when using MWμEASE

^{*5} Setting the ML610Q407 reference board to ML610Q401 mode enables operation equivalent to the ML610401 Mask version.
^{*6} Setting the ML610Q407 reference board to ML610Q402 mode enables operation equivalent to the ML610402 Mask version.
^{*7} Setting the ML610Q407 reference board to ML610Q403 mode enables operation equivalent to the ML610403 Mask version.
^{*8} Setting the ML610Q407 reference board to ML610Q404 mode enables operation equivalent to the ML610404 Mask version.
^{*9} Setting the ML610Q407 reference board to ML610Q405 mode enables operation equivalent to the ML610405 Mask version.
^{*10} Setting the ML610Q407 reference board to ML610Q406 mode enables operation equivalent to the ML610406 Mask version.

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.

Standard Type

| Part No. | Operating Conditions | | | | ROM/RAM | | |
|-----------------------------------|-----------------------|------------------------------------------|------------------------------------|-----------------------------------------------|----------------------------|-------------------------|---------------------|
| | Operating voltage (V) | Operating frequency ^{*1} | Minimum instruction execution time | Current consumption (Typ.@HALT) ^{*2} | Operating temperature (°C) | ROM capacity (Byte) | RAM capacity (Byte) |
| ★ ML610Q486 / ML610Q486P | 1.6 to 3.6 | 500kHz | 2μs | 15μA | -20 to +70 / -40 to +85 | Flash 32K ^{*7} | 1K |
| ★ 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 |
| ★ 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 |
| ★ 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 |
| ★ 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 |
| NEW ML610Q482 / ML610Q482P | 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 |

★ Under development

Voice Functionality Type

| Part No. | Operating Conditions | | | | ROM/RAM | | |
|-----------|-----------------------|-----------------------------------|------------------------------------|-----------------------------------------------|----------------------------|---------------------|---------------------|
| | Operating voltage (V) | Operating frequency ^{*1} | Minimum instruction execution time | Current consumption (Typ.@HALT) ^{*2} | Operating temperature (°C) | ROM capacity (Byte) | RAM capacity (Byte) |
| ML610340 | 2.2 to 5.5 | 4.096MHz | 0.25μs | - | -40 to +85 | Mask 96K | 512 |
| ML610Q340 | 2.2 to 5.5 | 4.096MHz | 0.25μs | - | -40 to +85 | Flash 96K | 512 |
| ML610346 | 2.2 to 5.5 | 4.096MHz / 32kHz | 0.25μs / 31μs | 1.5μA | -40 to +85 | Mask 128K | 1K |
| ML610Q346 | 2.2 to 5.5 | 4.096MHz / 32kHz | 0.25μs / 31μs | 1.5μA | -40 to +85 | Flash 128K | 1K |
| ML610347 | 2.2 to 5.5 | 4.096MHz / 32kHz | 0.25μs / 31μs | 1.5μA | -40 to +85 | Mask 128K | 1K |
| ML610Q347 | 2.2 to 5.5 | 4.096MHz / 32kHz | 0.25μs / 31μs | 1.5μA | -40 to +85 | Flash 128K | 1K |
| ML610348 | 2.2 to 3.6 | 4.096MHz / 32kHz | 0.25μs / 31μs | 1.5μA | -40 to +85 | Mask 128K | 1K |
| ML610Q348 | 2.2 to 3.6 | 4.096MHz / 32kHz | 0.25μs / 31μs | 1.5μA | -40 to +85 | Flash 128K | 1K |

Dot Matrix Type

| Part No. | Operating Conditions | | | | ROM/RAM | | |
|-----------------------------------|-----------------------|-----------------------------------|------------------------------------|-----------------------------------------------|----------------------------|-------------------------|---------------------|
| | Operating voltage (V) | Operating frequency ^{*1} | Minimum instruction execution time | Current consumption (Typ.@HALT) ^{*2} | Operating temperature (°C) | ROM capacity (Byte) | RAM capacity (Byte) |
| 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 |
| 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 |
| ML610Q415 | 1.1 to 3.6 | 500kHz | 2μs | 5.5μA | -20 to +70 | Flash 16K ^{*7} | 1K |
| 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} |
| ML610Q422 / ML610Q422P | 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} |
| NEW ML610Q428 / 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} |
| 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} |
| 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} |
| 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} |
| 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} |
| 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} |
| ★ 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 96K ^{*7} | 7K ^{*9} |
| ★ 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 96K ^{*7} | 7K ^{*9} |

★ Under development

Segment Type

| Part No. | Operating Conditions | | | | ROM/RAM | | |
|-----------------------------------|-----------------------|-----------------------------------|------------------------------------|-----------------------------------------------|----------------------------|-------------------------|---------------------|
| | Operating voltage (V) | Operating frequency ^{*1} | Minimum instruction execution time | Current consumption (Typ.@HALT) ^{*2} | Operating temperature (°C) | ROM capacity (Byte) | RAM capacity (Byte) |
| ★ ML610401 / ML610401P | 1.2 to 3.6 | 500kHz / 32.768kHz | 2μs / 30.5μs | 0.9μA | -20 to +70 / -40 to +85 | Mask 6K ^{*7} | 192 |
| ★ 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 |
| ★ 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 |
| ★ 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 |
| ★ 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 |
| ★ 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 |
| ★ 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 |
| ★ 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 |
| ★ 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 |
| 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 |
| 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 |
| 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 |

★ Under development

| Port ^{*3} | | | Functions/Features | | | | | | | | | | Package | Chip Support | | | | |
|--------------------|--------|--------------|--------------------|------------|---------|---------|-----|--------------------|------------------|--------------------|------|--------------------------|---------|--------------|------------|----------------------------------------|--------|---|
| Input | Output | Input/Output | 8bit timer | 1kHz timer | PWM | Capture | WDT | ADC(method) | Serial port | | | Supply voltage detection | | | LCD driver | Interrupt sources internal: external | Others | |
| | | | | | | | | | I ² C | SSIO ^{*6} | UART | | | | | | | |
| 6 | 5 | 21 | 4(16bit×2) | – | 16bit×1 | – | 1 | 4 (Sequential) | 1 ⁵ | 1 | 1 | 1 | – | – | 14 : 5 | – | TQFP48 | ○ |
| 8 | 4 | 24 | 8(16bit×4) | – | 16bit×2 | – | 1 | – | 1 | 1 | 2 | – | – | – | 19 : 6 | Low speed frequency correction | TQFP48 | ○ |
| 8 | 4 | 24 | 8(16bit×4) | – | 16bit×2 | 2 | 1 | – | 1 | 1 | 2 | – | – | – | 19 : 6 | Low speed frequency correction | TQFP48 | ○ |
| 8 | 4 | 24 | 8(16bit×4) | – | 16bit×2 | 2 | 1 | – | 1 | 1 | 2 | – | – | – | 19 : 6 | Low speed frequency correction | TQFP48 | ○ |
| 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 | ○ |
| 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 | ○ |

| Port ^{*3} | | | Functions/Features | | | | | | | | | | Package | Chip Support | | | | |
|--------------------|--------|--------------|--------------------|------------|-----|---------|-----|-------------------------|------------------|--------------------|------|--------------------------|---------|--------------|------------|------------------------------------------------------------------------------------------------|--------|---|
| Input | Output | Input/Output | 8bit timer | 1kHz timer | PWM | Capture | WDT | ADC(method) | Serial port | | | Supply voltage detection | | | LCD driver | Interrupt sources internal: external | Others | |
| | | | | | | | | | I ² C | SSIO ^{*6} | UART | | | | | | | |
| 4 | 4 | 4 | 2(16bit×1) | – | – | – | 1 | – | – | 1 | – | – | – | – | 9 : 5 | Speech function / ADPCM decoder Built-in Speaker Amplifier | SSOP30 | – |
| 4 | 4 | 4 | 2(16bit×1) | – | – | – | 1 | – | – | 1 | – | – | – | – | 9 : 5 | Speech function / ADPCM decoder Built-in Speaker Amplifier | SSOP30 | – |
| 8 | 4 | 16 | 2(16bit×1) | – | – | – | 1 | 12bit×3ch (Sequential) | – | 1 | 1 | – | – | – | 11 : 9 | Speech function / ADPCM decoder Built-in Speaker Amplifier/ Built-in 3ch Operational Amplifier | TQFP64 | – |
| 8 | 4 | 16 | 2(16bit×1) | – | – | – | 1 | 12bit×3ch (Sequential) | – | 1 | 1 | – | – | – | 11 : 9 | Speech function / ADPCM decoder Built-in Speaker Amplifier/ Built-in 3ch Operational Amplifier | TQFP64 | – |
| 8 | 4 | 16 | 2(16bit×1) | – | – | – | 1 | 12bit×12ch (Sequential) | – | 1 | 1 | – | – | – | 11 : 9 | Speech function / ADPCM decoder Built-in Speaker Amplifier | TQFP64 | – |
| 8 | 4 | 16 | 2(16bit×1) | – | – | – | 1 | 12bit×12ch (Sequential) | – | 1 | 1 | – | – | – | 11 : 9 | Speech function / ADPCM decoder Built-in Speaker Amplifier | TQFP64 | – |
| 4 | 4 | 8 | 2(16bit×1) | – | – | – | 1 | 12bit×3ch (Sequential) | – | 1 | 1 | – | – | – | 11 : 5 | Speech function / ADPCM decoder Built-in Speaker Amplifier/ Built-in 2ch Operational Amplifier | QFP56 | – |
| 4 | 4 | 8 | 2(16bit×1) | – | – | – | 1 | 12bit×3ch (Sequential) | – | 1 | 1 | – | – | – | 11 : 5 | Speech function / ADPCM decoder Built-in Speaker Amplifier/ Built-in 2ch Operational Amplifier | QFP56 | – |

| Port ^{*3} | | | Functions/Features | | | | | | | | | | Package | Chip Support | | | |
|--------------------|--------|--------------|--------------------|------------|---------|---------|-----|-----------------------------------|------------------|--------------------|------|--------------------------|-----------------------------|--------------|-------------------------------------------------------|--------------------------------------|--------|
| Input | Output | Input/Output | 8bit timer | 1kHz timer | PWM | Capture | WDT | ADC(method) | Serial port | | | Supply voltage detection | | | LCD driver | Interrupt sources internal: external | Others |
| | | | | | | | | | I ² C | SSIO ^{*6} | UART | | | | | | |
| 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 | ○ |
| 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 | ○ |
| 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 | ○ |
| 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 | ○ |
| 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 | ○ |
| 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 | ○ |
| 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 | ○ |
| 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 | ○ |
| 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 | ○ |
| 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 | ○ |
| 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 | ○ |
| 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 | ○ |
| 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 | ○ |

| Port ^{*3} | | | Functions/Features | | | | | | | | | | Package | Chip Support | | | |
|--------------------|--------|--------------|--------------------|------------|---------|---------|-----|--------------------|------------------|--------------------|------|--------------------------|---------------------------|---------------------------------|-------------------------------------------------|--------------------------------------|--------|
| Input | Output | Input/Output | 8bit timer | 1kHz timer | PWM | Capture | WDT | ADC(method) | Serial port | | | Supply voltage detection | | | LCD driver | Interrupt sources internal: external | Others |
| | | | | | | | | | I ² C | SSIO ^{*6} | UART | | | | | | |
| 4 | 12 | 18 | 2(16bit×1) | – | – | 2 | 1 | 2 (RC oscillation) | – | – | – | – | Max. 55dot 11seg × 5com. | 8 : 9 (include 4bit-OR input) | Low speed frequency correction/ Buzzer | TQFP64 | ○ |
| 4 | 8 | 18 | 2(16bit×1) | – | – | 2 | 1 | 2 (RC oscillation) | – | – | – | – | Max. 75dot 15seg × 5com. | 8 : 9 (include 4bit-OR input) | Low speed frequency correction/ Buzzer | TQFP64 | ○ |
| 4 | 4 | 18 | 2(16bit×1) | – | – | 2 | 1 | 2 (RC oscillation) | – | – | – | – | Max. 95dot 19seg × 5com. | 8 : 9 (include 8bit-OR input) | Low speed frequency correction/ Buzzer | TQFP64 | ○ |
| 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 | TQFP80 | ○ |
| 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 | TQFP80 | ○ |
| 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 | TQFP80 | ○ |
| 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 | TQFP100 | ○ |
| 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 | TQFP100 | ○ |
| 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 | TQFP100 | ○ |
| 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 | TQFP100 | ○ |
| 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 | TQFP100 | ○ |
| 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 | TQFP100 | ○ |

●U8 Core is an OKI SEMICONDUCTOR's original 8bit CPU of RISC method. ●IDEU8 is an OKI SEMICONDUCTOR's project management tool for program development. ●CCU8 is an OKI SEMICONDUCTOR's C compiler for program development. ●RASU8 is an OKI SEMICONDUCTOR's assembler for program development. ●RLU8 is an OKI SEMICONDUCTOR's linker for program development. ●LIBU8 is an OKI SEMICONDUCTOR's librarian (library generation tool) for program development. ●OHU8 is an OKI SEMICONDUCTOR's object converter for program development. ●LcdAtU8 is an OKI SEMICONDUCTOR's program development support tool for LCD control. ●FWμEASE is an OKI SEMICONDUCTOR's flash writing tool. ●HTU8 is an OKI SEMICONDUCTOR's ROM code generation tool for code entry (flash writing). ●DTU8 is an OKI SEMICONDUCTOR's debug tool for program development. ●μEASE is an OKI SEMICONDUCTOR's on-chip debug emulator. ●MWμEASE is an OKI SEMICONDUCTOR's flash writing tool (for multi-writing). ●HQ-ADPCM is Ky's high-quality, high-compression audio technology. "Ky's" is a registered trademark of Kyushu Institute of Technology. ●Windows 2000/Windows XP/Windows Vista are registered trademarks of Microsoft Corporation USA in the US and other countries.

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