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### What is "[Embedded - Microcontrollers](#)"?

"[Embedded - Microcontrollers](#)" refer to small, integrated circuits designed to perform specific tasks within larger systems. These microcontrollers are essentially compact computers on a single chip, containing a processor core, memory, and programmable input/output peripherals. They are called "embedded" because they are embedded within electronic devices to control various functions, rather than serving as standalone computers. Microcontrollers are crucial in modern electronics, providing the intelligence and control needed for a wide range of applications.

### Applications of "[Embedded - Microcontrollers](#)"

#### Details

Product Status	Active
Core Processor	nX-U8/100
Core Size	8-Bit
Speed	4.2MHz
Connectivity	I <sup>2</sup> C, SSP, UART/USART
Peripherals	POR, PWM, WDT
Number of I/O	22
Program Memory Size	64KB (32K x 16)
Program Memory Type	FLASH
EEPROM Size	-
RAM Size	4K x 8
Voltage - Supply (Vcc/Vdd)	1.1V ~ 3.6V
Data Converters	A/D 2x24b
Oscillator Type	Internal
Operating Temperature	-40°C ~ 85°C (TA)
Mounting Type	Surface Mount
Package / Case	48-TQFP
Supplier Device Package	48-TQFP (7x7)
Purchase URL	<a href="https://www.e-xfl.com/product-detail/rohm-semi/ml610q482p-nnntb0arl">https://www.e-xfl.com/product-detail/rohm-semi/ml610q482p-nnntb0arl</a>

- PWM
  - Resolution 16 bits × 1 channel
- Synchronous serial port
  - Master/slave selectable
  - LSB first/MSB first selectable
  - 8-bit length/16-bit length selectable
- UART
  - TXD/RXD × 1 channel
  - Bit length, parity/no parity, odd parity/even parity, 1 stop bit/2 stop bits
  - Positive logic/negative logic selectable
  - Built-in baud rate generator
- I<sup>2</sup>C bus interface
  - Master function only
  - Fast mode (400 kbps@4MHz), standard mode (100 kbps@1MHz, 50kbps@500kHz)
- Buzzer driver
  - 4 output modes, 8 frequencies, 16 duty levels
- RC oscillation type A/D converter
  - 24-bit counter
  - Time division × 2 channels
- Analog Comparator
  - Operating voltage:  $V_{DD}=1.8V\sim3.6V$
  - Common mode input voltage:  $0.2V\sim V_{DD}-1.0V$
  - Input offset voltage: 50mV(max)
  - Interrupt allow edge selection and sampling selection
- General-purpose ports
  - Non-maskable interrupt input port × 1 channel
  - Input-only port × 6 channels (including secondary functions)
  - Output-only port × 4 channels (including secondary functions)
  - Input/output port × 22 channels (including secondary functions)
- Reset
  - Reset through the RESET\_N pin
  - Power-on reset generation when powered on
  - Reset when oscillation stop of the low-speed clock is detected
  - Reset by the watchdog timer (WDT) overflow
- Power supply voltage detect function
  - Judgment voltages: One of 16 levels
  - Judgment accuracy:  $\pm 2\%$  (Typ.)
- Clock
  - Low-speed clock: (This LSI can not guarantee the operation without low-speed clock)  
Crystal oscillation (32.768 kHz/38.4KHz)
  - High-speed clock:  
Built-in RC oscillation (500 kHz)  
Built-in PLL oscillation (8.192 MHz  $\pm 2.5\%$ ), crystal/ceramic oscillation (4.096 MHz), external clock
  - Selection of high-speed clock mode by software:  
Built-in RC oscillation, built-in PLL oscillation, crystal/ceramic oscillation, external clock

- Power management
  - HALT mode: Instruction execution by CPU is suspended (peripheral circuits are in operating states).
  - STOP mode: Stop of low-speed oscillation and high-speed oscillation (Operations of CPU and peripheral circuits are stopped.)
  - Clock gear: The frequency of high-speed system clock can be changed by software (1/1, 1/2, 1/4, or 1/8 of the oscillation clock)
  - Block Control Function: Power down (reset registers and stop clock supply) the circuits of unused peripherals.
  
- Shipment
  - Chip  
ML610Q482P-xxxWA (Blank product: ML610Q482P-NNNWA)
  - 48-pin plastic TQFP  
ML610Q482P-xxxTBZ03A (Blank product: ML610Q482P-NNNTBZ03A)  
xxx: ROM code number
  
- Guaranteed operating range
  - Operating temperature:  $-40^{\circ}\text{C}$  to  $+85^{\circ}\text{C}$
  - Operating voltage:  $V_{\text{DD}} = 1.1\text{V}$  to  $3.6\text{V}$

**BLOCK DIAGRAM****ML610Q482P Block Diagram**

Figure 1 show the block diagram of the ML610Q482P.

"\*" indicates the secondary function of each port.

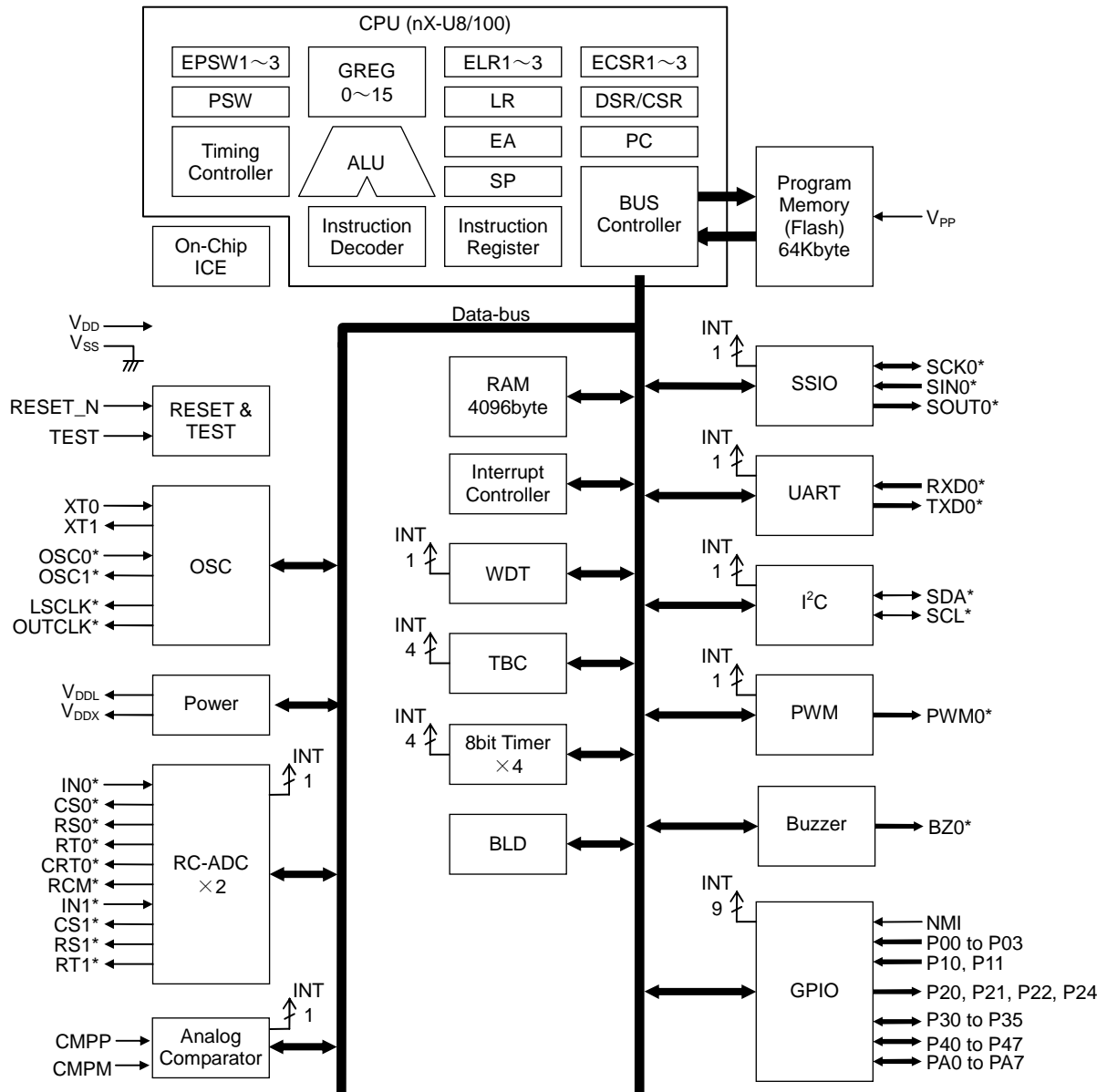


Figure 1 ML610Q482P Block Diagram

## PIN LIST

PAD No.	Primary function			Secondary function			Tertiary function		
	Pin name	I/O	Function	Pin name	I/O	Function	Pin name	I/O	Function
7,21,33,45	V <sub>SS</sub>	—	Negative power supply pin	—	—	—	—	—	—
24,43	V <sub>DD</sub>	—	Positive power supply pin	—	—	—	—	—	—
44	V <sub>DDL</sub>	—	Power supply pin for internal logic (internally generated)	—	—	—	—	—	—
46	V <sub>DDX</sub>	—	Power supply pin for low-speed oscillation (internally generated)	—	—	—	—	—	—
20	V <sub>PP</sub>	—	Power supply pin for Flash ROM	—	—	—	—	—	—
17	TEST	I/O	Input/output pin for testing	—	—	—	—	—	—
18	RESET <sub>N</sub>	I	Reset input pin	—	—	—	—	—	—
47	XT0	I	Low-speed clock oscillation pin	—	—	—	—	—	—
48	XT1	O	Low-speed clock oscillation pin	—	—	—	—	—	—
19	NMI	I	Non-maskable interrupt pin	—	—	—	—	—	—
3	P00/EXI0	I	Input port, External interrupt 0, Capture 0 input	—	—	—	—	—	—
4	P01/EXI1	I	Input port, External interrupt 1, Capture 1 input	—	—	—	—	—	—
5	P02/EXI2/RXD0	I	Input port, External interrupt 2, UART0 receive	—	—	—	—	—	—
6	P03/EXI3	I	Input port, External interrupt 3	—	—	—	—	—	—
1	CMPP	I	Analog comparator non-inverted input	—	—	—	—	—	—
2	CMPM	I	Analog comparator inverted input	—	—	—	—	—	—
22	P10	I	Input port	OSC0	I	High-speed oscillation	—	—	—
23	P11	I	Input port	OSC1	O	High-speed oscillation	—	—	—
34	P20/LED0	O	Output port	LSCLK	O	Low-speed clock output	—	—	—
35	P21/LED1	O	Output port	OUTCLK	O	High-speed clock output	—	—	—
36	P22/LED2	O	Output port	BZ0	O	BZ0 output	—	—	—
8	P24/LED4	O	Output port	PWM0	O	PWM0 output	—	—	—
37	P30	I/O	Input/output port	IN0	I	RC type ADC0 oscillation input pin	—	—	—
38	P31	I/O	Input/output port	CS0	O	RC type ADC0 reference capacitor connection pin	—	—	—
40	P32	I/O	Input/output port	RS0	O	RC type ADC0 reference resistor connection pin	—	—	—
41	P33	I/O	Input/output port	RT0	O	RC type ADC0 resistor sensor connection pin	—	—	—
39	P34	I/O	Input/output port	RCT0	O	RC type ADC0 resistor/capacitor sensor connection pin	PWM0	O	PWM0 output

PAD No.	Primary function			Secondary function			Tertiary function		
	Pin name	I/O	Function	Pin name	I/O	Function	Pin name	I/O	Function
42	P35	I/O	Input/output port	RCM	O	RC type ADC oscillation monitor	—	—	—
9	P40	I/O	Input/output port	SDA	I/O	I <sup>2</sup> C data input/output	SIN0	I	SSIO data input
10	P41	I/O	Input/output port	SCL	I/O	I <sup>2</sup> C clock input/output	SCK0	I/O	SSIO synchronous clock
11	P42	I/O	Input/output port	RXD0	I	UART data input	SOUT0	I	SSIO data output
12	P43	I/O	Input/output port	TXD0	O	UART data output	PWM0	O	PWM output
13	P44/T02 P0CK	I/O	Input/output port, Timer 0/Timer 2/PWM0 external clock input	IN1	I	RC type ADC1 oscillation input pin	SIN0	I	SSIO0 data input
14	P45/T13 P1CK	I/O	Input/output port, Timer 1/Timer 3 external clock input	CS1	O	RC type ADC1 reference capacitor connection pin	SCK0	I/O	SSIO0 synchronous clock
15	P46	I/O	Input/output port	RS1	O	RC type ADC1 reference resistor connection pin	SOUT0	O	SSIO0 data output
16	P47	I/O	Input/output port	RT1	O	RC type ADC1 resistor sensor connection pin	—	—	—
25	PA0	I/O	Input/output port	—	—	—	—	—	—
26	PA1	I/O	Input/output port	—	—	—	—	—	—
27	PA2	I/O	Input/output port	—	—	—	—	—	—
28	PA3	I/O	Input/output port	—	—	—	—	—	—
29	PA4	I/O	Input/output port	—	—	—	—	—	—
30	PA5	I/O	Input/output port	—	—	—	—	—	—
31	PA6	I/O	Input/output port	—	—	—	—	—	—
32	PA7	I/O	Input/output port	—	—	—	—	—	—

## PIN DESCRIPTION

Pin name	I/O	Description	Primary/ Secondary/ Tertiary	Logic
System				
RESET_N	I	Reset input pin. When this pin is set to a “L” level, system reset mode is set and the internal section is initialized. When this pin is set to a “H” level subsequently, program execution starts. A pull-up resistor is internally connected.	—	Negative
XT0	I	Crystal connection pin for low-speed clock.	—	—
XT1	O	A 32.768 kHz crystal oscillator (see measuring circuit 1) is connected to this pin. Capacitors CDL and CGL are connected across this pin and V <sub>SS</sub> as required.	—	—
OSC0	I	Crystal/ceramic connection pin for high-speed clock.	Secondary	—
OSC1	O	A crystal or ceramic is connected to this pin (4.1 MHz max.). Capacitors CDH and CGH (see measuring circuit 1) are connected across this pin and V <sub>SS</sub> . This pin is used as the secondary function of the P10 pin(OSC0) and P11 pin(OSC1).	Secondary	—
LSCLK	O	Low-speed clock output pin. This pin is used as the secondary function of the P20 pin.	Secondary	—
OUTCLK	O	High-speed clock output pin. This pin is used as the secondary function of the P21 pin.	Secondary	—
General-purpose input port				
P00-P03	I	General-purpose input port. Since these pins have secondary functions, the pins cannot be used as a port when the secondary functions are used.	Primary	Positive
P10,P11	I	General-purpose input port. Since these pins have secondary functions, the pins cannot be used as a port when the secondary functions are used.	Primary	Positive
General-purpose output port				
P20,P21, P22,P24	O	General-purpose output port. Since these pins have secondary functions, the pins cannot be used as a port when the secondary functions are used.	Primary	Positive
General-purpose input/output port				
P30-P35	I/O	General-purpose input/output port. Since these pins have secondary functions, the pins cannot be used as a port when the secondary functions are used.	Primary	Positive
P40-P47	I/O	General-purpose input/output port. Since these pins have secondary functions, the pins cannot be used as a port when the secondary functions are used.	Primary	Positive
PA0-PA7	I/O	General-purpose input/output port.	Primary	Positive

Pin name	I/O	Description	Primary/ Secondary/ Tertiary	Logic
<b>UART</b>				
TXD0	O	UART data output pin. This pin is used as the secondary function of the P43 pin.	Secondary	Positive
RXD0	I	UART data input pin. This pin is used as the secondary function of the P42 or the primary function of the P02 pin.	Primary/Secondary	Positive
<b>I<sup>2</sup>C bus interface</b>				
SDA	I/O	I <sup>2</sup> C data input/output pin. This pin is used as the secondary function of the P40 pin. This pin has an NMOS open drain output. When using this pin as a function of the I <sup>2</sup> C, externally connect a pull-up resistor.	Secondary	Positive
SCL	O	I <sup>2</sup> C clock output pin. This pin is used as the secondary function of the P41 pin. This pin has an NMOS open drain output. When using this pin as a function of the I <sup>2</sup> C, externally connect a pull-up resistor.	Secondary	Positive
<b>Synchronous serial (SSIO)</b>				
SCK0	I/O	Synchronous serial clock input/output pin. This pin is used as the tertiary function of the P41 or P45 pin.	Tertiary	—
SIN0	I	Synchronous serial data input pin. This pin is used as the tertiary function of the P40 or P44 pin.	Tertiary	Positive
SOUT0	O	Synchronous serial data output pin. This pin is used as the tertiary function of the P42 or P46 pin.	Tertiary	Positive
<b>PWM</b>				
PWM0	O	PWM0 output pin. This pin is used as the tertiary function of the P24 or P43 or P34 pin.	Tertiary	Positive
T02P0CK	O	PWM0 external clock input pin. This pin is used as the primary function of the P44 pin.	Primary	—
<b>External interrupt</b>				
NMI	I	External non-maskable interrupt input pin. An interrupt is generated on both edges.	Primary	Positive/negative
EXIO-3	I	External maskable interrupt input pins. Interrupt enable and edge selection can be performed for each bit by software. These pins are used as the primary functions of the P00-P03 pins.	Primary	Positive/negative
<b>Timer</b>				
T02P0CK	I	External clock input pin used for both Timer 0 and Timer 2. The clocks for these timers are selected by software. This pin is used as the primary function of the P44 pin.	Primary	—
T13P1CK	I	External clock input pin used for both Timer 1 and Timer 3. The clocks for these timers are selected by software. This pin is used as the primary function of the P45 pin.	Primary	—
<b>Buzzer</b>				
BZ0	O	Buzzer signal output pin. This pin is used as the secondary function of the P22 pin.	Secondary	Positive/negative
<b>LED drive</b>				
LED0,1,2,4	O	NMOS open drain output pins to drive LED. These pins are used as the primary function of the P20,P21,P22,P24 pins.	Primary	Positive/negative



Pin name	I/O	Description	Primary/ Secondary/ Tertiary	Logic
RC oscillation type A/D converter				
IN0	I	Channel 0 oscillation input pin. This pin is used as the secondary function of the P30 pin.	Secondary	—
CS0	O	Channel 0 reference capacitor connection pin. This pin is used as the secondary function of the P31 pin.	Secondary	—
RS0	O	This pin is used as the secondary function of the P32 pin which is the reference resistor connection pin of Channel 0.	Secondary	—
RT0	O	Resistor sensor connection pin of Channel 0 for measurement. This pin is used as the secondary function of the P34 pin.	Secondary	—
CRT0	O	Resistor/capacitor sensor connection pin of Channel 0 for measurement. This pin is used as the secondary function of the P33 pin.	Secondary	—
RCM	O	RC oscillation monitor pin. This pin is used as the secondary function of the P35 pin.	Secondary	—
IN1	I	Oscillation input pin of Channel 1. This pin is used as the secondary function of the P44 pin.	Secondary	—
CS1	O	Reference capacitor connection pin of Channel 1. This pin is used as the secondary function of the P45 pin.	Secondary	—
RS1	O	Reference resistor connection pin of Channel 1. This pin is used as the secondary function of the P46 pin.	Secondary	—
RT1	O	Resistor sensor connection pin for measurement of Channel 1. This pin is used as the secondary function of the P47 pin.	Secondary	—
Analog comparator				
CMPP	I	Non-inverted input pin.	—	—
CMPM	I	Inverted input pin.	—	—
For testing				
TEST	I/O	Input/output pin for testing. A pull-down resistor is internally connected.	—	—
Power supply				
V <sub>SS</sub>	—	Negative power supply pin.	—	—
V <sub>DD</sub>	—	Positive power supply pin.	—	—
V <sub>DDL</sub>	—	Positive power supply pin (internally generated) for internal logic. Capacitors CL0 and CL1 (see measuring circuit 1) are connected between this pin and V <sub>SS</sub> .	—	—
V <sub>DDX</sub>	—	Plus-side power supply pin (internally generated) for low-speed oscillation. Capacitor Cx (see measuring circuit 1) is connected between this pin and V <sub>SS</sub> .	—	—
V <sub>PP</sub>	—	Power supply pin for programming Flash ROM. A pull-up resistor is internally connected.	—	—

## TERMINATION OF UNUSED PINS

Table 2 shows methods of terminating the unused pins.

**Table 2 Termination of Unused Pins**

Pin	Recommended pin termination
$V_{PP}$	Open
RESET_N	Open
TEST	Open
NMI	Open
P00 to P03	$V_{DD}$ or $V_{SS}$
P10, P11	$V_{DD}$
P20, P21, P22, P24	Open
P30 to P35	Open
P40 to P47	Open
PA0 to PA7	Open
CMPP, CPM	$V_{DD}$

### Note:

It is recommended to set the unused input ports and input/output ports to the inputs with pull-down resistors/pull-up resistors or the output mode since the supply current may become excessively large if the pins are left open in the high impedance input setting.

## ELECTRICAL CHARACTERISTICS

## ABSOLUTE MAXIMUM RATINGS

(V<sub>SS</sub> = 0V)

Parameter	Symbol	Condition	Rating	Unit
Power supply voltage 1	V <sub>DD</sub>	Ta = 25°C	-0.3 to +4.6	V
Power supply voltage 2	V <sub>PP</sub>	Ta = 25°C	-0.3 to +9.5	V
Power supply voltage 3	V <sub>DDL</sub>	Ta = 25°C	-0.3 to +3.6	V
Power supply voltage 4	V <sub>DDX</sub>	Ta = 25°C	-0.3 to +3.6	V
Input voltage	V <sub>IN</sub>	Ta = 25°C	-0.3 to V <sub>DD</sub> +0.3	V
Output voltage	V <sub>OUT</sub>	Ta = 25°C	-0.3 to V <sub>DD</sub> +0.3	V
Output current 1	I <sub>OUT1</sub>	Port3-A, Ta = 25°C	-12 to +11	mA
Output current 2	I <sub>OUT2</sub>	Port2, Ta = 25°C	-12 to +20	mA
Power dissipation	PD	Ta = 25°C	1.16	W
Storage temperature	T <sub>STG</sub>	—	-55 to +150	°C

## RECOMMENDED OPERATING CONDITIONS

(V<sub>SS</sub> = 0V)

Parameter	Symbol	Condition	Range	Unit
Operating temperature	T <sub>OP</sub>	—	-40 to +85	°C
Operating voltage	V <sub>DD</sub>	—	1.1 to 3.6	V
Operating frequency (CPU)	f <sub>OP</sub>	V <sub>DD</sub> = 1.1 to 3.6V	30k to 36k	Hz
		V <sub>DD</sub> = 1.3 to 3.6V	30k to 650k	
		V <sub>DD</sub> = 1.8 to 3.6V	30k to 4.2M	
Low-speed crystal oscillation frequency	f <sub>XTL</sub>	—	32.768k/38.4k	Hz
Low-speed crystal oscillation external capacitor	C <sub>DL</sub>	—	0 to 12	pF
	C <sub>GL</sub>	—	0 to 12	
High-speed crystal/ceramic oscillation frequency	f <sub>XTH</sub>	—	4.0M / 4.096M	Hz
High-speed crystal oscillation external capacitor	C <sub>DH</sub>	—	24	pF
	C <sub>GH</sub>	—	24	
Capacitor externally connected to V <sub>DDL</sub> pin	C <sub>L0</sub>	—	1.0±30%	μF
	C <sub>L1</sub>	—	0.1±30%	
Capacitor externally connected to V <sub>DDX</sub> pin	C <sub>X</sub>	—	0.1±30%	μF

## OPERATING CONDITIONS OF FLASH ROM

(V<sub>SS</sub> = 0V)

Parameter	Symbol	Condition	Range	Unit
Operating temperature	T <sub>OP</sub>	At write/erase	0 to +40	°C
Operating voltage	V <sub>DD</sub>	At write/erase <sup>*1</sup>	2.75 to 3.6	V
	V <sub>DDL</sub>	At write/erase <sup>*1</sup>	2.5 to 2.75	
	V <sub>PP</sub>	At write/erase <sup>*1</sup>	7.7 to 8.3	
Write cycles	C <sub>EP</sub>	—	10	cycles
Data retention	Y <sub>DR</sub>	—	10	years

<sup>\*1</sup>: Those voltages must be supplied to V<sub>DDL</sub> pin and V<sub>PP</sub> pin when programming and erasing Flash ROM.  
V<sub>PP</sub> pin has an internal pulldown resistor.

**CONDITIONS OF ANALOG COMPARATOR**(V<sub>DD</sub> = 1.1 to 3.6V, V<sub>SS</sub> = 0V, Ta = -40 to +85°C, unless otherwise specified) (2/4)

Parameter	Symbol	Condition	Rating			Unit	Measuring circuit
			Min.	Typ.	Max.		
Common mode Input voltage	CMV <sub>IN</sub>	V <sub>DD</sub> = 1.8 to 3.6V	0.2	—	V <sub>DD</sub> - 1	V	1
Input offset voltage	V <sub>CMPOF</sub>	V <sub>DD</sub> = 1.8 to 3.6V, Ta = 25°C	—	—	50	mV	
Response time	T <sub>CMP</sub>	V <sub>DD</sub> = 1.8 to 3.6V, Ta = 25°C Over drive = 100mV	—	—	100	μs	
Wake-up time	T <sub>CMPW</sub>		—	—	3	ms	
Circuit current (during operation)	I <sub>CMP</sub>	V <sub>DD</sub> = 1.8 to 3.6V, Ta = 25°C	—	2	4	μA	

**DC CHARACTERISTICS (1/4)**(V<sub>DD</sub> = 1.1 to 3.6V, V<sub>SS</sub> = 0V, Ta = -40 to +85°C, unless otherwise specified) (1/4)

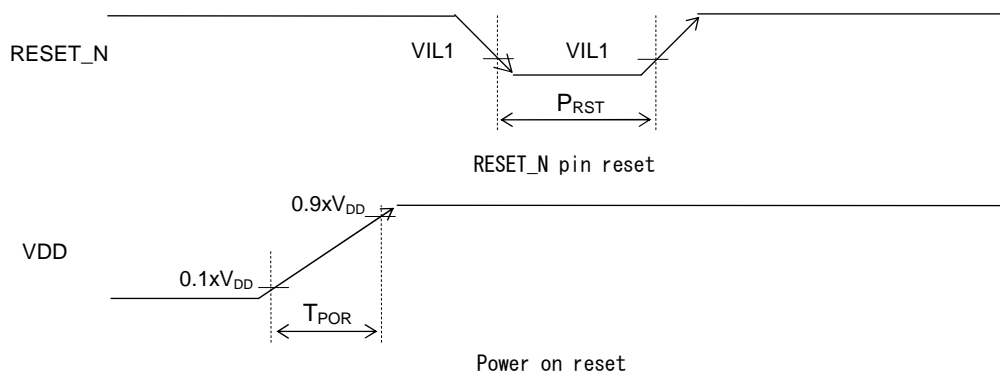
Parameter	Symbol	Condition		Rating			Unit	Measuring circuit
				Min.	Typ.	Max.		
500kHz RC oscillation frequency	f <sub>RC</sub>	V <sub>DD</sub> = 1.3 to 3.6V	Ta = 25°C	Typ. −10%	500	Typ. +10%	kHz	1
			Ta = −40 to +85°C	Typ. −35%	500	Typ. +35%	kHz	
PLL oscillation frequency*4	f <sub>PLL</sub>	LSCLK = 32.768kHz V <sub>DD</sub> = 1.8 to 3.6V		−2.5%	8.192	+2.5%	MHz	
Low-speed crystal oscillation start time*2	T <sub>XTL</sub>	—		—	0.3	2	s	
500kHz RC oscillation start time	T <sub>RC</sub>	—		—	50	500	μs	
High-speed crystal oscillation start time*3	T <sub>XTH</sub>	V <sub>DD</sub> = 1.8 to 3.6V		—	2	20	ms	
PLL oscillation start time	T <sub>PLL</sub>	V <sub>DD</sub> = 1.8 to 3.6V		—	1	10		
Low-speed oscillation stop detect time*1	T <sub>STOP</sub>	—		0.2	3	20		
Reset pulse width	P <sub>RST</sub>	—		200	—	—	μs	
Reset noise elimination pulse width	P <sub>NRST</sub>	—		—	—	0.3		
Power-on reset activation power rise time	T <sub>POR</sub>	—		—	—	10	ms	

\*1: When low-speed crystal oscillation stops for a duration more than the low-speed oscillation stop detect time, the system is reset to shift to system reset mode.

\*2: Use 32.768KHz Crystal Oscillator C-001R (Epson Toyocom) with capacitance C<sub>GL</sub>/C<sub>DL</sub> = 0pF.

\*3: Use 4.096MHz Crystal Oscillator CHC49SFWB (Kyocera).

\*4: 1024 clock average.

**RESET**

## DC CHARACTERISTICS (2/4)

(V<sub>DD</sub> = 1.1 to 3.6V, V<sub>SS</sub> = 0V, Ta = -40 to +85°C, unless otherwise specified) (2/4)

Parameter	Symbol	Condition		Rating			Unit	Measuring circuit
				Min.	Typ.	Max.		
BLD threshold voltage	V <sub>BLD</sub>	V <sub>DD</sub> = 1.35 to 3.6V	LD2-0 = 0H	Typ. -2%	1.35	Typ. +2%	V	
			LD2-0 = 1H		1.4			
			LD2-0 = 2H		1.45			
			LD2-0 = 3H		1.5			
			LD2-0 = 4H		1.6			
			LD2-0 = 5H		1.7			
			LD2-0 = 6H		1.8			
			LD2-0 = 7H		1.9			
			LD2-0 = 8H		2.0			
			LD2-0 = 9H		2.1			
			LD2-0 = 0AH		2.2			
			LD2-0 = 0BH		2.3			
			LD2-0 = 0CH		2.4			
			LD2-0 = 0DH		2.5			
			LD2-0 = 0EH		2.7			
			LD2-0 = 0FH		2.9			
BLD threshold voltage temperature deviation	ΔV <sub>BLD</sub>	V <sub>DD</sub> = 1.35 to 3.6V		—	0	—	%/°C	
Supply current 1	IDD1	CPU: In STOP state. Low-speed/high-speed oscillation: stopped.	Ta=25°C	—	0.2	0.5	μA	1
			Ta=-40 to + 85°C	—	—	5		
Supply current 2	IDD2	CPU: In HALT state (LTBC,WDT:Operating* <sup>3</sup> ).High-speed oscillation: Stopped.	Ta=25°C	—	0.5	1.3	μA	
			Ta=-40 to + 85°C	—	—	6		
Supply current 3	IDD3	CPU: In 32.768kHz operating state.* <sup>1</sup> High-speed oscillation: Stopped.	Ta=25°C	—	5	7	μA	
			Ta=-40 to + 85°C	—	—	12		
Supply current 4	IDD4	CPU: In 500kHz CR operating state.	Ta=25°C	—	70	85	μA	
			Ta=-40 to + 85°C	—	—	100		
Supply current 5	IDD5	CPU: In 4.096MHz operating state.PLL: In oscillating state.V <sub>DD</sub> = 1.8 to 3.6V	Ta=25°C	—	0.83	1	mA	
			Ta=-40 to + 85°C	—	—	1.2		
Supply current 6	IDD6	CPU: In 4.096MHz operating state.Crystal/ceramic: In oscillating state. *1*2 V <sub>DD</sub> = 3.0V	Ta=25°C	—	1.3	1.4	mA	
			Ta=-40 to + 85°C	—	—	2.0		

\*<sup>1</sup> : Use 32.768KHz Crystal Oscillator C-001R (Epson Toyocom) with capacitance C<sub>GL</sub>/C<sub>DL</sub>=0pF.\*<sup>2</sup> : Use 4.096MHz Crystal Oscillator CHC49SFWB (Kyocera).\*<sup>3</sup> : Significant bits of BLKCON0~BLKCON4 registers are all "1".

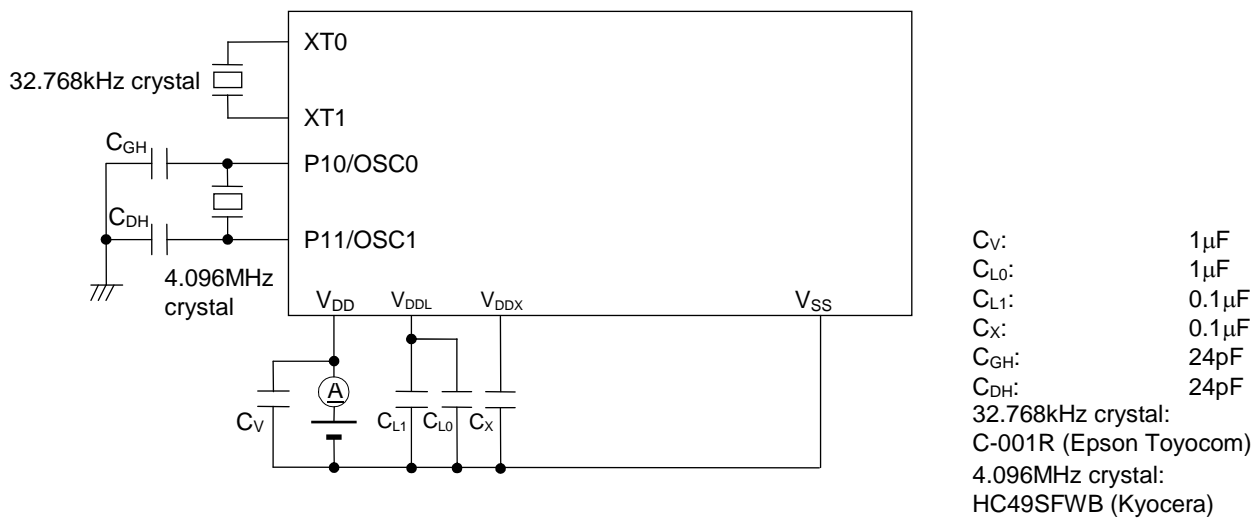
## DC CHARACTERISTICS (3/4)

(V<sub>DD</sub> = 1.1 to 3.6V, V<sub>SS</sub> = 0V, Ta = -40 to +85°C, unless otherwise specified) (3/4)

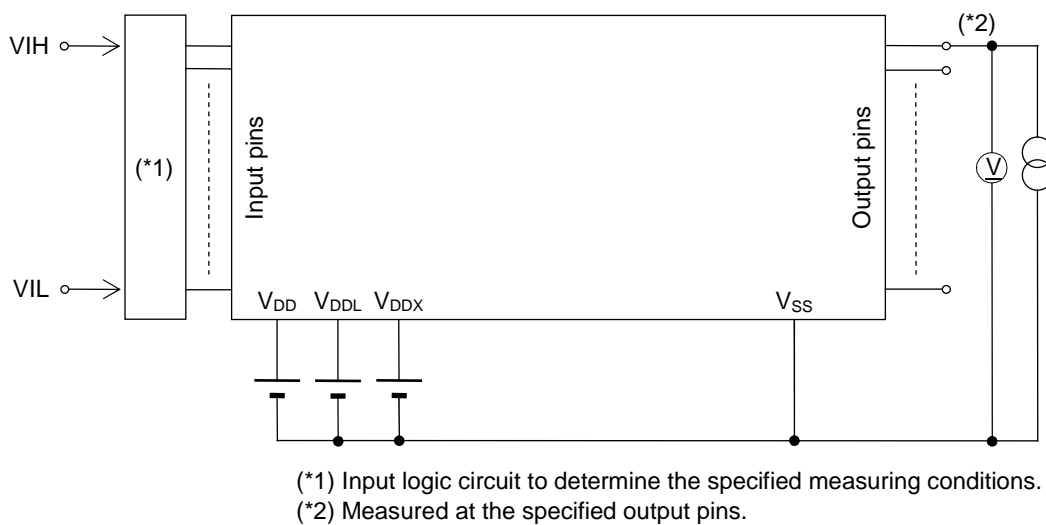
Parameter	Symbol	Condition		Rating			Unit	Measuring circuit		
				Min.	Typ.	Max.				
Output voltage 1 (P20, P21, P22, P24/2 <sup>nd</sup> function is selected) (P30–P35) (P40–P47) (PA0–PA7)	VOH1	IOH1 = −0.5mA, V <sub>DD</sub> = 1.8 to 3.6V		V <sub>DD</sub> −0.5	—	—	V	2		
		IOH1 = -0.1mA, V <sub>DD</sub> = 1.3 to 3.6V		V <sub>DD</sub> −0.3	—	—				
		IOH1 = -0.03mA, V <sub>DD</sub> = 1.1 to 3.6V		V <sub>DD</sub> −0.3						
	VOL1	IOL1 = +0.5mA, V <sub>DD</sub> = 1.8 to 3.6V		—	—	0.5				
		IOL1 = +0.1mA, V <sub>DD</sub> = 1.3 to 3.6V		—	—	0.5				
		IOL1 = +0.03mA, V <sub>DD</sub> = 1.1 to 3.6V		—	—	0.3				
Output voltage 2 (P20, P21, P22, P24/2 <sup>nd</sup> function is Not selected)	VOL2	IOL2 = +5mA, V <sub>DD</sub> = 1.8 to 3.6V		—	—	0.5				
Output voltage 3 (P40, P41)	VOL3	IOL3 = +3mA, V <sub>DD</sub> = 2.0 to 3.6V (when I <sup>2</sup> C mode is selected)		—	—	0.4				
Output leakage (P20, P21, P22, P24) (P30–P35) (P40–P47) (PA0–PA7) <sup>*1</sup>	IOOH	VOH = V <sub>DD</sub> (in high-impedance state)		—	—	1	μA	3		
	IOOL	VOL = V <sub>SS</sub> (in high-impedance state)		−1	—	—				
	IIH1	VIH1 = V <sub>DD</sub>		0	—	1				
Input current 1 (RESET_N)	IIL1	VIL1 = V <sub>SS</sub>	V <sub>DD</sub> = 1.8 to 3.6V	−600	−300	−20				
			V <sub>DD</sub> = 1.3 to 3.6V	−600	−300	−10				
			V <sub>DD</sub> = 1.1 to 3.6V	−600	−300	−2				
Input current 1 (TEST)	IIH1	VIH1 = V <sub>DD</sub>	V <sub>DD</sub> = 1.8 to 3.6V	20	300	600				
			V <sub>DD</sub> = 1.3 to 3.6V	10	300	600				
			V <sub>DD</sub> = 1.1 to 3.6V	2	300	600				
	IIL1	VIL1 = V <sub>SS</sub>		−1	—	—				
Input current 2 (NMI) (P00–P03) (P10, P11) (P30–P35) (P40–P47) (PA0–PA7)	IIH2	VIH2 = V <sub>DD</sub> (when pulled-down)	V <sub>DD</sub> = 1.8 to 3.6V	2	30	200	μA	4		
			V <sub>DD</sub> = 1.3 to 3.6V	0.2	30	200				
			V <sub>DD</sub> = 1.1 to 3.6V	0.01	30	200				
	IIL2	VIL2 = V <sub>SS</sub> (when pulled-up)	V <sub>DD</sub> = 1.8 to 3.6V	−200	−30	−2				
			V <sub>DD</sub> = 1.3 to 3.6V	−200	−30	−0.2				
			V <sub>DD</sub> = 1.1 to 3.6V	−200	−30	−0.01				
	IIH2Z	VIH2 = V <sub>DD</sub> (in high-impedance state)		—	—	1				
IIL2Z	VIL2 = V <sub>SS</sub> (in high-impedance state)		−1	—	—					

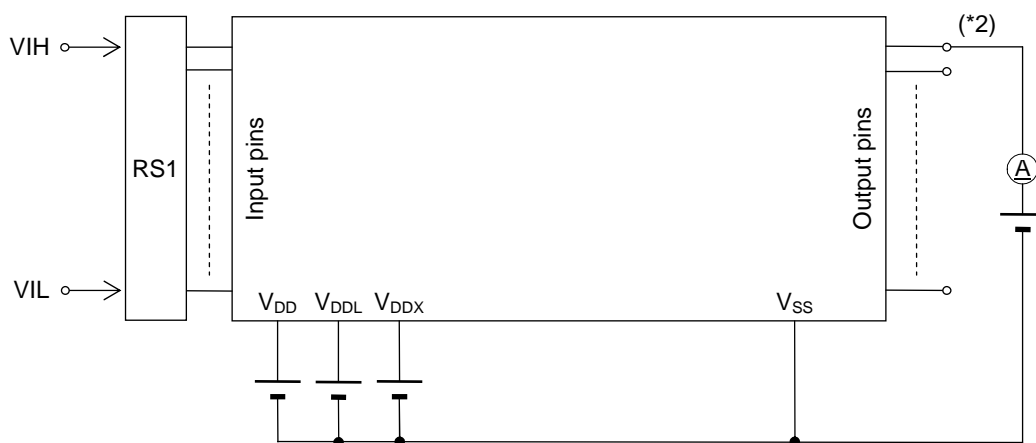
## MEASURING CIRCUITS

### MEASURING CIRCUIT 1



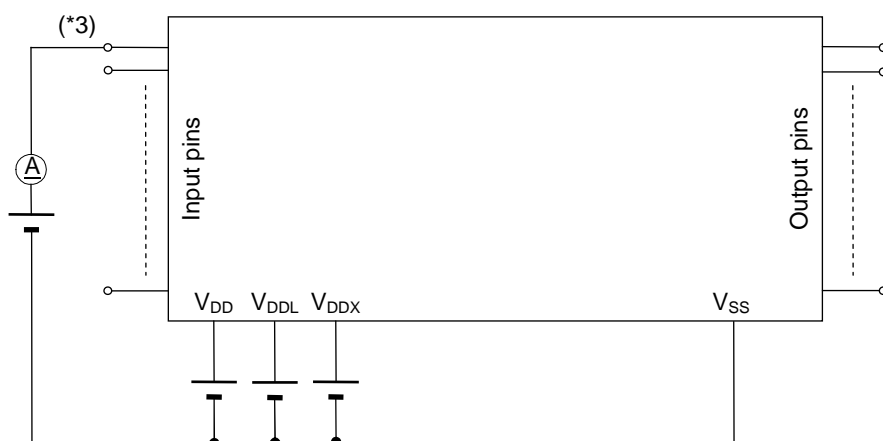
### MEASURING CIRCUIT 2



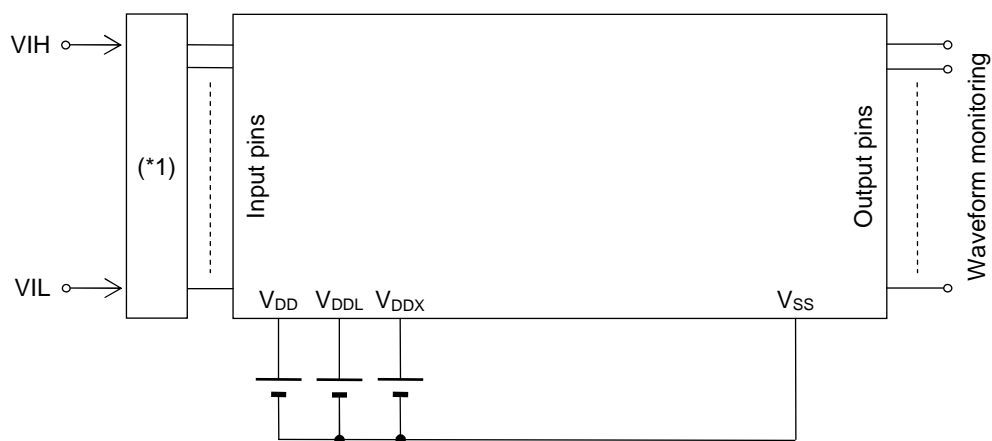
**MEASURING CIRCUIT 3**

\*1: Input logic circuit to determine the specified measuring conditions.

\*2: Measured at the specified output pins.

**MEASURING CIRCUIT 4**

\*3: Measured at the specified output pins.

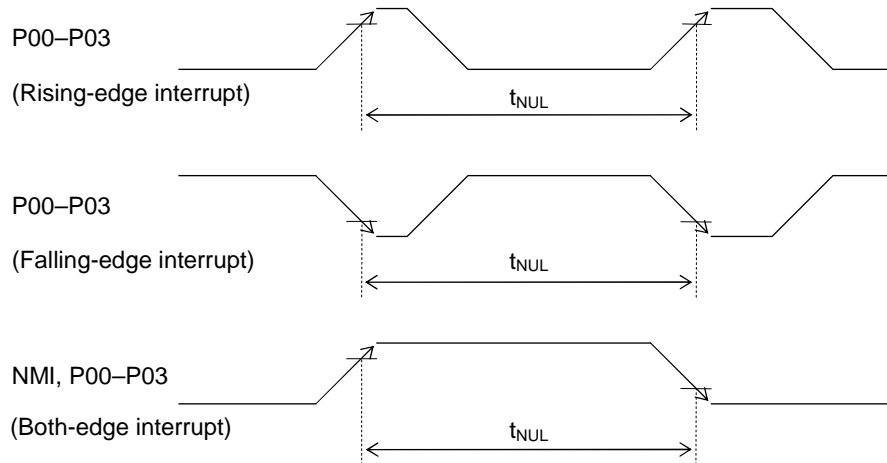
**MEASURING CIRCUIT 5**

\*1: Input logic circuit to determine the specified measuring conditions.



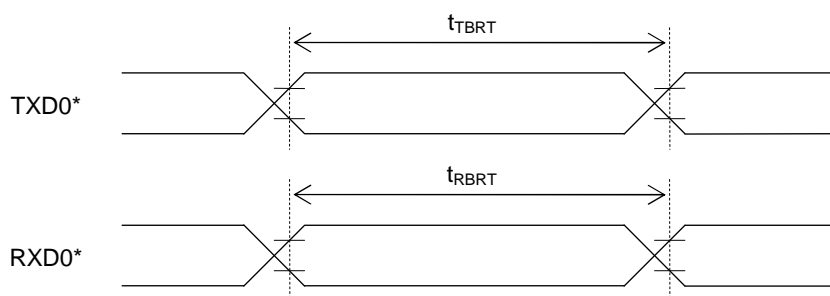
**AC CHARACTERISTICS (External Interrupt)**(V<sub>DD</sub> = 1.1 to 3.6V, V<sub>SS</sub> = 0V, Ta = -40 to +85°C, unless otherwise specified)

Parameter	Symbol	Condition	Rating			Unit
			Min.	Typ.	Max.	
External interrupt disable period	T <sub>NUL</sub>	Interrupt: Enabled (MIE = 1), CPU: NOP operation System clock: 32.768kHz	76.8	—	106.8	μs

**AC CHARACTERISTICS (UART)**(V<sub>DD</sub> = 1.3 to 3.6V, V<sub>SS</sub> = 0V, Ta = -40 to +85°C, unless otherwise specified)

Parameter	Symbol	Condition	Rating			Unit
			Min.	Typ.	Max.	
Transmit baud rate	t <sub>TBRT</sub>	—	—	BRT <sup>*1</sup>	—	s
Receive baud rate	t <sub>RBRT</sub>	—	BRT <sup>*1</sup> -3%	BRT <sup>*1</sup>	BRT <sup>*1</sup> +3%	s

<sup>\*1</sup>: Baud rate period (including the error of the clock frequency selected) set with the UART0 baud rate register (UA0BRTL,H) and the UART0 mode register 0 (UA0MOD0).



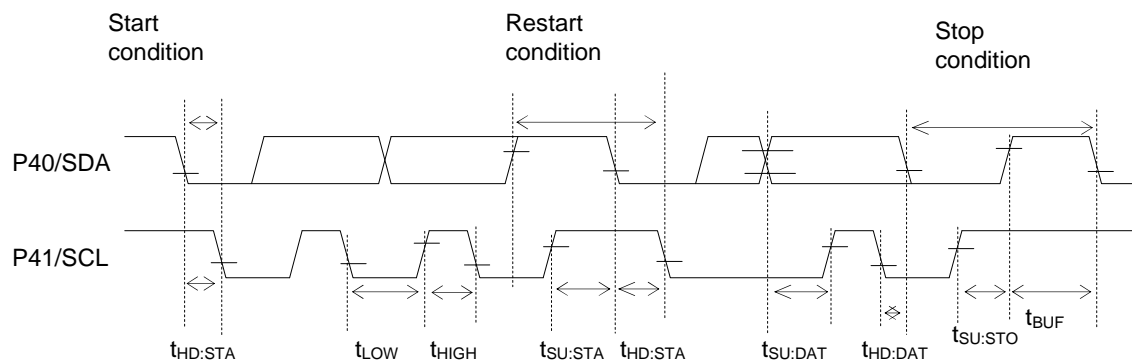
\*: Indicates the secondary function of the port.

**AC CHARACTERISTICS (I<sup>2</sup>C Bus Interface: Standard Mode 100kbit/s)**(V<sub>DD</sub> = 1.8 to 3.6V, V<sub>SS</sub> = 0V, Ta = -40 to +85°C, unless otherwise specified)

Parameter	Symbol	Condition	Rating			Unit
			Min.	Typ.	Max.	
SCL clock frequency	f <sub>SCL</sub>	—	0	—	100	kHz
SCL hold time (start/restart condition)	t <sub>HD:STA</sub>	—	4.0	—	—	μs
SCL "L" level time	t <sub>LOW</sub>	—	4.7	—	—	μs
SCL "H" level time	t <sub>HIGH</sub>	—	4.0	—	—	μs
SCL setup time (restart condition)	t <sub>SU:STA</sub>	—	4.7	—	—	μs
SDA hold time	t <sub>HD:DAT</sub>	—	0	—	—	μs
SDA setup time	t <sub>SU:DAT</sub>	—	0.25	—	—	μs
SDA setup time (stop condition)	t <sub>SU:STO</sub>	—	4.0	—	—	μs
Bus-free time	t <sub>BUF</sub>	—	4.7	—	—	μs

**AC CHARACTERISTICS (I<sup>2</sup>C Bus Interface: Fast Mode 400kbit/s)**(V<sub>DD</sub> = 1.8 to 3.6V, V<sub>SS</sub> = 0V, Ta = -40 to +85°C, unless otherwise specified)

Parameter	Symbol	Condition	Rating			Unit
			Min.	Typ.	Max.	
SCL clock frequency	f <sub>SCL</sub>	—	0	—	400	kHz
SCL hold time (start/restart condition)	t <sub>HD:STA</sub>	—	0.6	—	—	μs
SCL "L" level time	t <sub>LOW</sub>	—	1.3	—	—	μs
SCL "H" level time	t <sub>HIGH</sub>	—	0.6	—	—	μs
SCL setup time (restart condition)	t <sub>SU:STA</sub>	—	0.6	—	—	μs
SDA hold time	t <sub>HD:DAT</sub>	—	0	—	—	μs
SDA setup time	t <sub>SU:DAT</sub>	—	0.1	—	—	μs
SDA setup time (stop condition)	t <sub>SU:STO</sub>	—	0.6	—	—	μs
Bus-free time	t <sub>BUF</sub>	—	1.3	—	—	μs



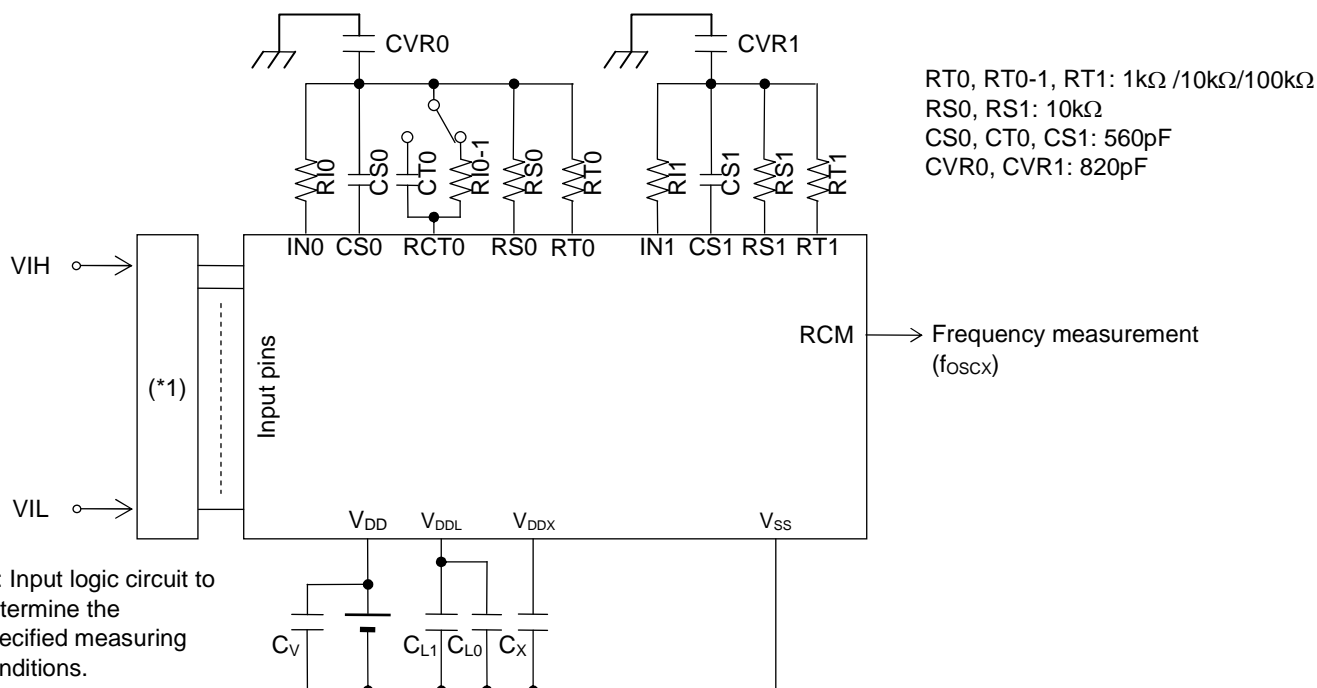
**AC CHARACTERISTICS (RC Oscillation A/D Converter)**(V<sub>DD</sub> = 1.3 to 3.6V, V<sub>SS</sub> = 0V, Ta = -20 to +70°C, unless otherwise specified)

Parameter	Symbol	Condition	Rating			Unit
			Min.	Typ.	Max.	
Resistors for oscillation	RS0, RS1, RT0, RT0-1, RT1	CS0, CT0, CS1 ≥ 740pF	1	—	—	kΩ
Oscillation frequency VDD = 1.5V	f <sub>OSC1</sub>	Resistor for oscillation = 1kΩ	209.4	330.6	435.1	kHz
	f <sub>OSC2</sub>	Resistor for oscillation = 10kΩ	41.29	55.27	64.16	kHz
	f <sub>OSC3</sub>	Resistor for oscillation = 100kΩ	4.71	5.97	7.06	kHz
RS to RT oscillation frequency ratio <sup>*1</sup> VDD = 1.5V	Kf1	RT0, RT0-1, RT1 = 1kHz	5.567	5.982	6.225	—
	Kf2	RT0, RT0-1, RT1 = 10kHz	0.99	1	1.01	—
	Kf3	RT0, RT0-1, RT1 = 100kHz	0.104	0.108	0.118	—
Oscillation frequency VDD = 3.0V	f <sub>OSC1</sub>	Resistor for oscillation = 1kΩ	407.3	486.7	594.6	kHz
	f <sub>OSC2</sub>	Resistor for oscillation = 10kΩ	49.76	59.28	72.76	kHz
	f <sub>OSC3</sub>	Resistor for oscillation = 100kΩ	5.04	5.993	7.04	kHz
RS to RT oscillation frequency ratio <sup>*1</sup> VDD = 3.0V	Kf1	RT0, RT0-1, RT1 = 1kHz	8.006	8.210	8.416	—
	Kf2	RT0, RT0-1, RT1 = 10kHz	0.99	1	1.01	—
	Kf3	RT0, RT0-1, RT1 = 100kHz	0.100	0.108	0.115	—

<sup>\*1</sup>: Kfx is the ratio of the oscillation frequency by the sensor resistor to the oscillation frequency by the reference resistor on the same conditions.

$$Kfx = \frac{f_{OSCx}(RT0-CS0 \text{ oscillation})}{f_{OSCx}(RS0-CS0 \text{ oscillation})}, \quad \frac{f_{OSCx}(RT0-1-CS0 \text{ oscillation})}{f_{OSCx}(RS0-CS0 \text{ oscillation})}, \quad \frac{f_{OSCx}(RT1-CS1 \text{ oscillation})}{f_{OSCx}(RS1-CS1 \text{ oscillation})}$$

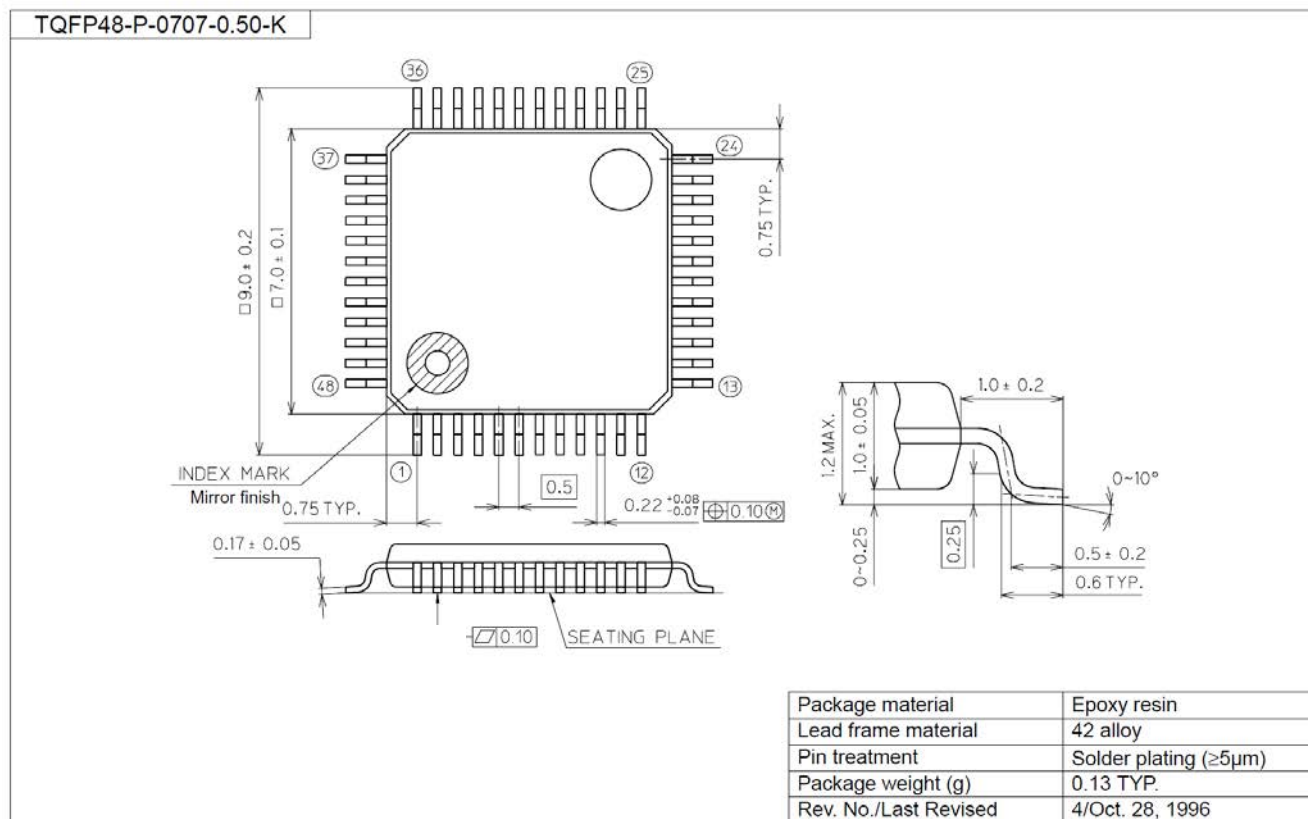
(x = 1, 2, 3)

**Note:**

- Please have the shortest layout for the common node (wiring patterns which are connected to the external capacitors, resistors and IN0/IN1 pin), including CVR0/CVR1. Especially, do not have long wire between IN0/IN1 and RS0/RS1. The coupling capacitance on the wires may occur incorrect A/D conversion. Also, please do not have signals which may be a source of noise around the node.
- When RT0/RT1 (Thermistor and etc.) requires long wiring due to the restricted placement, please have VSS(GND) trace next to the signal.
- Please make wiring to components (capacitor, resistor and etc.) necessary for objective measurement. Wiring to reserved components may affect to the A/D conversion operation by noise the components itself may have.

## Package Dimensions

(Unit: mm)



### Notes for Mounting the Surface Mount Type Package

The surface mount type packages are very susceptible to heat in reflow mounting and humidity absorbed in storage. Therefore, before you perform reflow mounting, contact our responsible sales person for the product name, package name, pin number, package code and desired mounting conditions (reflow method, temperature and times).

**REVISION HISTORY**

Document No.	Date	Page		Description
		Previous Edition	Current Edition	
FEDL610Q482P-01	Dec.9, 2009	–	–	Formally edition 1