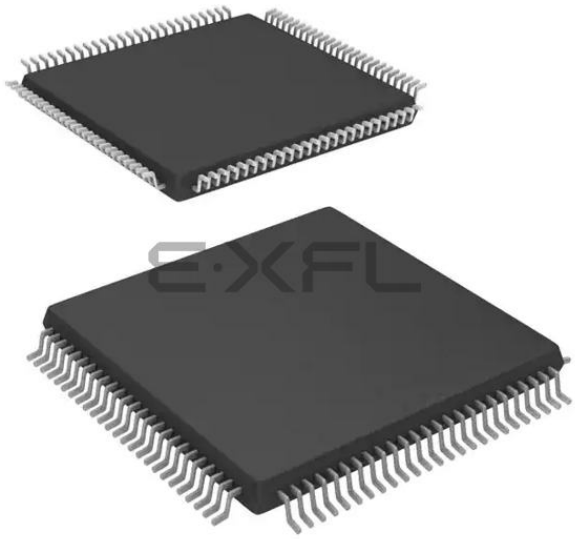
Rohm Semiconductor - ML610Q407P-NNNTB0AAL Datasheet



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"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	2.5MHz
Connectivity	SSP, UART/USART
Peripherals	LCD, Melody Driver, POR, PWM, WDT
Number of I/O	22
Program Memory Size	16KB (8K x 16)
Program Memory Type	FLASH
EEPROM Size	-
RAM Size	1K x 8
Voltage - Supply (Vcc/Vdd)	1.25V ~ 3.6V
Data Converters	A/D 2x16b
Oscillator Type	Internal
Operating Temperature	-40°C ~ 85°C (TA)
Mounting Type	Surface Mount
Package / Case	100-TQFP
Supplier Device Package	100-TQFP (14x14)
Purchase URL	https://www.e-xfl.com/product-detail/rohm-semi/ml610q407p-nnntb0aal

- Capture
  – Time base capture × 2 channels (4096 Hz to 32 Hz)

- PWM
  – Resolution 16 bits × 1 channel

- Synchronous serial port
  – Master/slave selectable × 2 channel
  – LSB first/MSB first selectable
  – 8-bit length/16-bit length selectable

- UART
  – Half-Duplex Communication
  – 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

- Melody driver
  – Scale: 29 types (Melody sound frequency: 508 Hz to 32.768 kHz)
  – Tone length: 63 types
  –Tempo: 15 types
  – Buzzer output mode (4 output modes, 8 frequencies, 16 duty levels)

- RC oscillation type A/D converter
  – 16-bit counter
  – Time division × 2 channels

- General-purpose ports
  – Input-only port × 5 channels (including secondary functions)
  – Output-only port
    ML610Q407: × 12 channels (including secondary functions)
    ML610Q408: × 8 channels (including secondary functions)
    ML610Q409: × 4 channels (including secondary functions)
  – Input/output port × 22 channels (including secondary functions)

- LCD driver
  – The number of segments
    ML610Q407: 145 dots max. (29seg×5com, 30seg×4com, 31seg×3com, and 32seg×2com selectable)
    ML610Q408: 165 dots max. (33seg×5com, 34seg×4com, 35seg×3com, and 36seg×2com selectable)
    ML610Q409: 185 dots max. (37seg×5com, 38seg×4com, 39seg×3com, and 40seg×2com selectable)
  – 1/1 to 1/5 duty
  – 1/2(*), 1/3 bias (built-in bias generation circuit)
  – Frame frequency selecable: approx. 64Hz, 73Hz, 85Hz, and 102Hz
  – Bias voltage multiplying clock selectable (8 types)
  – LCD drive stop mode, LCD display mode, all LCDs on mode, and all LCDs off mode selectable
  – Programmable display allocation function
  (*) 1/2 bias is supported by A version and D version

- 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 (Not supported in A version)
  – Reset by the watchdog timer (WDT) overflow

- Clock
  – Low-speed clock: Crystal oscillation (32.768 kHz)
    (This LSI can not guarantee the operation withoug low-speed crystal oscillation clock)
  – High-speed clock: Built-in RC oscillation (500 kHz, 2MHz)

- 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.)
  – High-speed Clock gear: The frequency of high-speed system clock can be changed by software (1/1, 1/2, 1/4, 1/8 of the oscillation clock)
  – Block Control Function: Resets and completely turns circuits of unused peripherals off.

- Guaranteed operating range
  – Operating temperature: –20°C to +70°C (P version: –40°C to +85°C)
  – Operating voltage: V_{DD} = 1.25V to 3.6V

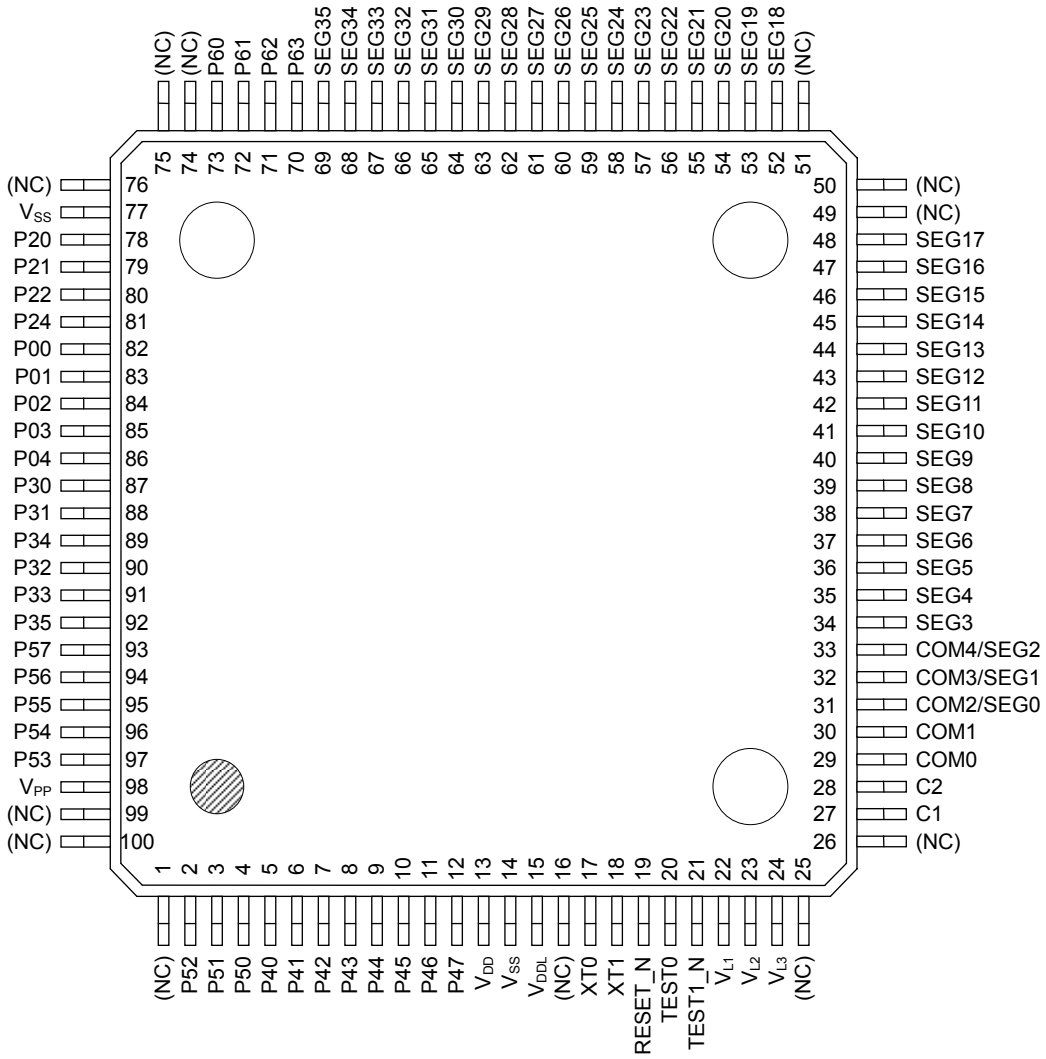
• Product name – Supported Function

- Chip (Die) -	LCD bias		Low-speed oscillation stop detect reset	Operating temperature	Product availability
	1/2	1/3			
ML610Q407-xxxWA	-	Yes	Yes	-20°C to +70°C	Yes
ML610Q408-xxxWA	-	Yes	Yes	-20°C to +70°C	Yes
ML610Q409-xxxWA	-	Yes	Yes	-20°C to +70°C	Yes
ML610Q407P-xxxWA	-	Yes	Yes	-40°C to +85°C	Yes
ML610Q408P-xxxWA	-	Yes	Yes	-40°C to +85°C	Yes
ML610Q409P-xxxWA	-	Yes	Yes	-40°C to +85°C	Yes
ML610Q407A- x x x WA	Yes	Yes	-	-20°C to +70°C	Yes
ML610Q408A-xxxWA	Yes	Yes	-	-20°C to +70°C	-
ML610Q409A-xxxWA	Yes	Yes	-	-20°C to +70°C	Yes
ML610Q407D-xxxWA	Yes	Yes	Yes	-20°C to +70°C	Yes
ML610Q408D-xxxWA	Yes	Yes	Yes	-20°C to +70°C	-
ML610Q409D-xxxWA	Yes	Yes	Yes	-20°C to +70°C	-
ML610Q407PA-xxxWA	Yes	Yes	-	-40°C to +85°C	Yes
ML610Q408PA-xxxWA	Yes	Yes	-	-40°C to +85°C	-
ML610Q409PA-xxxWA	Yes	Yes	-	-40°C to +85°C	-
ML610Q407PD-xxxWA	Yes	Yes	Yes	-40°C to +85°C	-
ML610Q408PD-xxxWA	Yes	Yes	Yes	-40°C to +85°C	-
ML610Q409PD-xxxWA	Yes	Yes	Yes	-40°C to +85°C	-

-100-pin plastic TQFP -	LCD bias		Low-speed oscillation stop detect reset	Operating temperature	Product availability
	1/2	1/3			
ML610Q407-xxxTB	-	Yes	Yes	-20°C to +70°C	Yes
ML610Q408-xxxTB	-	Yes	Yes	-20°C to +70°C	Yes
ML610Q409-xxxTB	-	Yes	Yes	-20°C to +70°C	Yes
ML610Q407P-xxxTB	-	Yes	Yes	-40°C to +85°C	Yes
ML610Q408P-xxxTB	-	Yes	Yes	-40°C to +85°C	Yes
ML610Q409P-xxxTB	-	Yes	Yes	-40°C to +85°C	Yes
ML610Q407A-xxxTB	Yes	Yes	-	-20°C to +70°C	-
ML610Q408A-xxxTB	Yes	Yes	-	-20°C to +70°C	-
ML610Q409A-xxxTB	Yes	Yes	-	-20°C to +70°C	-
ML610Q407D-xxxTB	Yes	Yes	Yes	-20°C to +70°C	-
ML610Q408D-xxxTB	Yes	Yes	Yes	-20°C to +70°C	-
ML610Q409D-xxxTB	Yes	Yes	Yes	-20°C to +70°C	-
ML610Q407PAxxxTB	Yes	Yes	-	-40°C to +85°C	-
ML610Q408PAxxxTB	Yes	Yes	-	-40°C to +85°C	-
ML610Q409PAxxxTB	Yes	Yes	-	-40°C to +85°C	-
ML610Q407PDxxxTB	Yes	Yes	Yes	-40°C to +85°C	-
ML610Q408PDxxxTB	Yes	Yes	Yes	-40°C to +85°C	-
ML610Q409PDxxxTB	Yes	Yes	Yes	-40°C to +85°C	-

xxx: ROM code number (xxx of the blank product is NNN)
Q: MTP version
P: Wide range temperature version (P version)
A: Low-speed clock oscillation stop detection reset is disabled always and LCD 1/2 bias supported version.(A version)
D: LCD 1/2 bias supported version (D version)
WA: Chip (Die), TB: TQFP

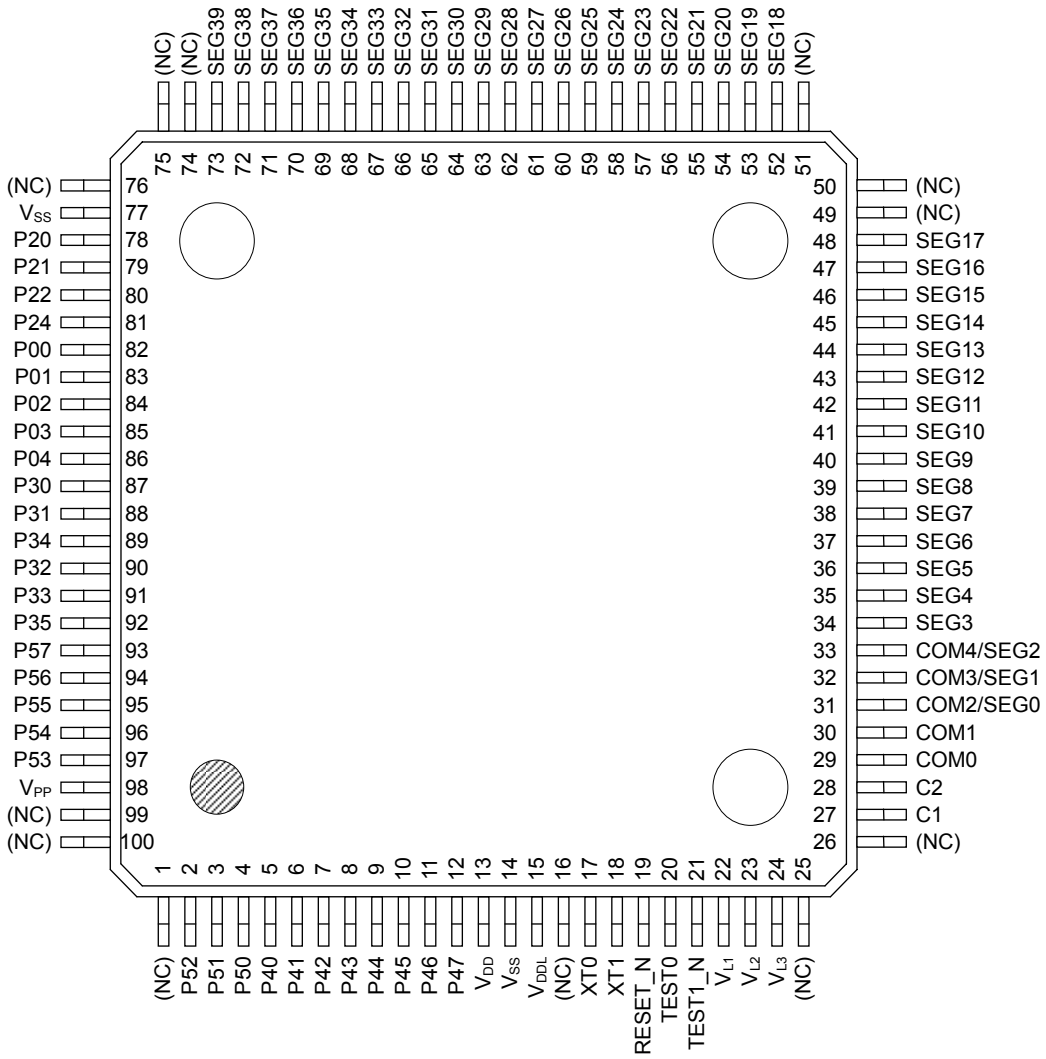
ML610Q408 TQFP100 Pin Layout



Note:
The assignment of the P30 to P35 are not in order.

Figure 3 ML610Q408 TQFP100 Pin Configuration

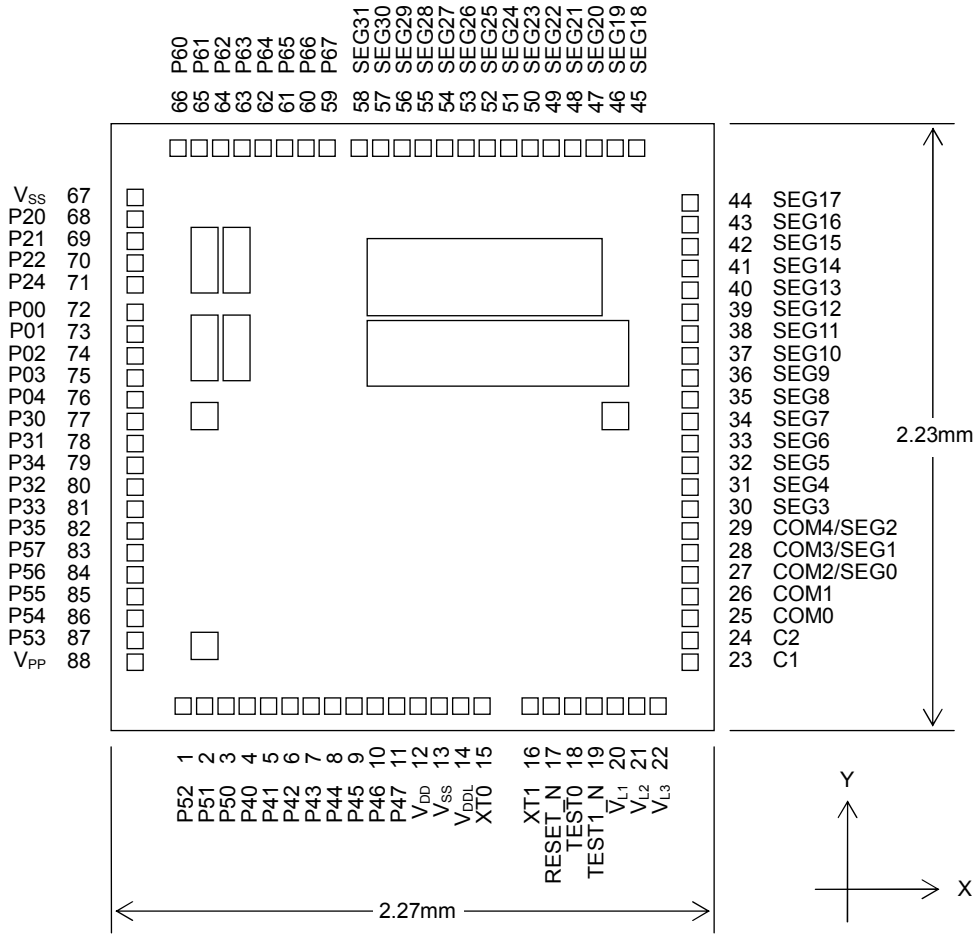
ML610Q409 TQFP100 Pin Layout



Note:
The assignment of the P30 to P35 are not in order.

Figure 4 ML610Q409 TQFP100 Pin Configuration

ML610Q407 Chip Pin Layout & Dimension

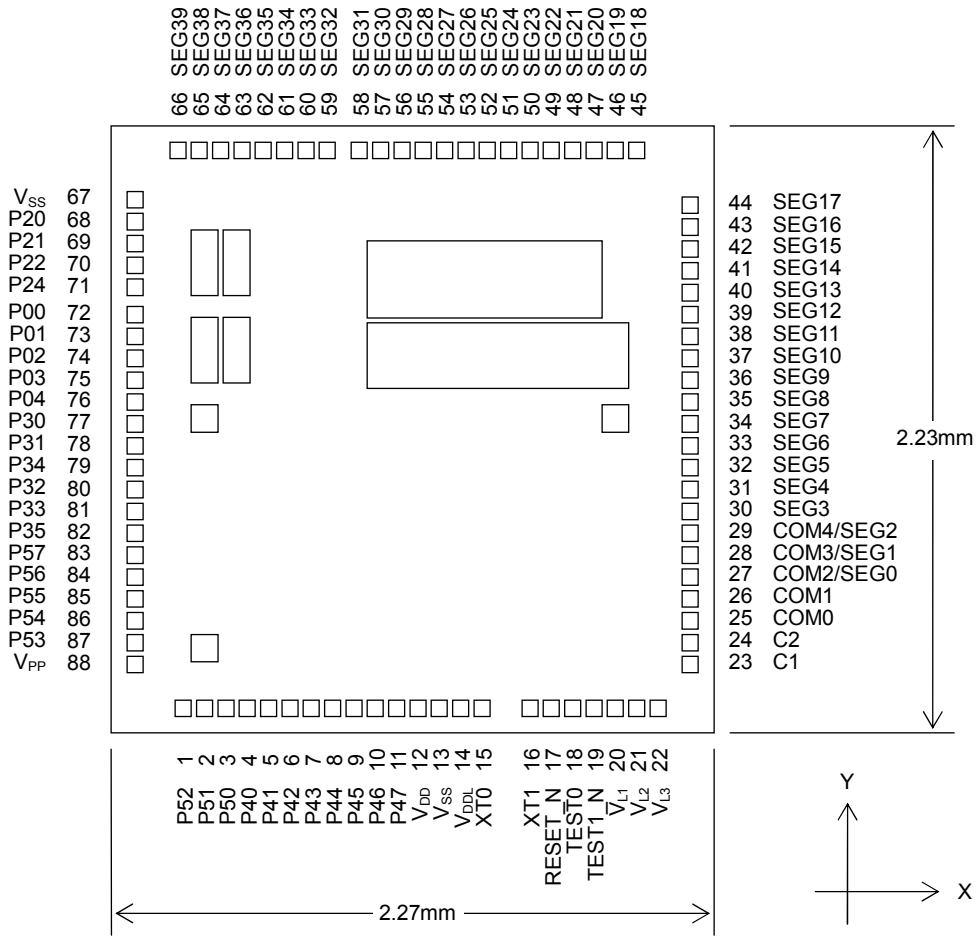


Note:
The assignment of the pads P30 to P35 are not in order.

Chip size: 2.27 mm × 2.23 mm
PAD count: 88 pins
Minimum PAD pitch: 80μm
PAD aperture: 70μm×70μm
Chip thickness: 350μm
Voltage of the rear side of chip: V_{SS} level.

Figure 5 ML610Q407 Chip Layout & Dimension

ML610Q409 Chip Pin Layout & Dimension



Note:
The assignment of the pads P30 to P35 are not in order.

Chip size: 2.27 mm × 2.23 mm
PAD count: 88 pins
Minimum PAD pitch: 80 μm
PAD aperture: 70 μm×70 μm
Chip thickness: 350 μm
Voltage of the rear side of chip: V_{SS} level.

Figure 7 ML610Q409 Chip Layout & Dimension

PIN No.	PAD No.	Primary function			Secondary function or Tertiary function			
		Pin name	I/O	Function	Secondary /Tertiary	Pin name	I/O	Function
5	4	P40	I/O	Input/output port	Secondary	—	—	—
					Tertiary	SIN0	I	SSIO0 data input
6	5	P41	I/O	Input/output port	Secondary	—	—	—
					Tertiary	SCK0	I/O	SSIO0 synchronous clock input/output
7	6	P42	I/O	Input/output port	Secondary	RXD0	I	UART data input
					Tertiary	SOUT0	O	SSIO0 data output
8	7	P43	I/O	Input/output port	Secondary	TXD0	O	UART data output
					Tertiary	PWM0	O	PWM0 output
9	8	P44/ T02P0CK	I/O	Input/output port, Timer 0/Timer 2/PWM0 external clock input	Secondary	IN1	I	RC type ADC1 oscillation input pin
					Tertiary	SIN0	I	SSIO0 data input
10	9	P45/T13CK	I/O	Input/output port, Timer 1/Timer 3 external clock input	Secondary	CS1	O	RC type ADC1 reference capacitor connection pin
					Tertiary	SCK0	I/O	SSIO0 synchronous clock input/output
11	10	P46	I/O	Input/output port	Secondary	RS1	O	RC type ADC1 reference resistor connection pin
					Tertiary	SOUT0	O	SSIO0 data output
12	11	P47	I/O	Input/output port	Secondary	RT1	O	RC type ADC1 measurement resistor sensor connection pin
4	3	P50/EXI8	I/O	Input/output port, External interrupt	Secondary	MD0	O	Melody 0 output
					Tertiary	SIN1	I	SSIO1 data input
3	2	P51/EXI8	I/O	Input/output port, External interrupt	Secondary	—	—	—
					Tertiary	SCK1	I/O	SSIO1 synchronous clock input/output
2	1	P52/EXI8	I/O	Input/output port, External interrupt	Secondary	—	—	—
					Tertiary	SOUT1	O	SSIO1 data output
97	87	P53/EXI8	I/O	Input/output port, External interrupt	—	—	—	—
96	86	P54/EXI8	I/O	Input/output port, External interrupt	Secondary	—	—	—
					Tertiary	SIN1	I	SSIO1 data input
95	85	P55/EXI8	I/O	Input/output port, External interrupt	Secondary	—	—	—
					Tertiary	SCK1	I/O	SSIO1 synchronous clock input/output
94	84	P56/EXI8	I/O	Input/output port, External interrupt	Secondary	—	—	—
					Tertiary	SOUT1	O	SSIO1 data output
93	83	P57/EXI8	I/O	Input/output port, External interrupt	—	—	—	—

PIN No.	PAD No.	Primary function			Secondary function or Tertiary function			
		Pin name	I/O	Function	Secondary/ Tertiary	Pin name	I/O	Function
29	25	COM0	O	LCD common pin	—	—	—	—
30	26	COM1	O	LCD common pin	—	—	—	—
31	27	COM2/ SEG0	O	LCD common/segment pin	—	—	—	—
32	28	COM3/ SEG1	O	LCD common/segment pin	—	—	—	—
33	29	COM4/ SEG2	O	LCD common/segment pin	—	—	—	—
34	30	SEG3	O	LCD segment pin	—	—	—	—
35	31	SEG4	O	LCD segment pin	—	—	—	—
36	32	SEG5	O	LCD segment pin	—	—	—	—
37	33	SEG6	O	LCD segment pin	—	—	—	—
38	34	SEG7	O	LCD segment pin	—	—	—	—
39	35	SEG8	O	LCD segment pin	—	—	—	—
40	36	SEG9	O	LCD segment pin	—	—	—	—
41	37	SEG10	O	LCD segment pin	—	—	—	—
42	38	SEG11	O	LCD segment pin	—	—	—	—
43	39	SEG12	O	LCD segment pin	—	—	—	—
44	40	SEG13	O	LCD segment pin	—	—	—	—
45	41	SEG14	O	LCD segment pin	—	—	—	—
46	42	SEG15	O	LCD segment pin	—	—	—	—
47	43	SEG16	O	LCD segment pin	—	—	—	—
48	44	SEG17	O	LCD segment pin	—	—	—	—
52	45	SEG18	O	LCD segment pin	—	—	—	—
53	46	SEG19	O	LCD segment pin	—	—	—	—
54	47	SEG20	O	LCD segment pin	—	—	—	—
55	48	SEG21	O	LCD segment pin	—	—	—	—
56	49	SEG22	O	LCD segment pin	—	—	—	—
57	50	SEG23	O	LCD segment pin	—	—	—	—
58	51	SEG24	O	LCD segment pin	—	—	—	—
59	52	SEG25	O	LCD segment pin	—	—	—	—
60	53	SEG26	O	LCD segment pin	—	—	—	—
61	54	SEG27	O	LCD segment pin	—	—	—	—
62	55	SEG28	O	LCD segment pin	—	—	—	—
63	56	SEG29	O	LCD segment pin	—	—	—	—
64	57	SEG30	O	LCD segment pin	—	—	—	—
65	58	SEG31	O	LCD segment pin	—	—	—	—
66	59	P67(*2)	O	Output port	—	—	—	—
		SEG32(*3)	O	LCD segment pin	—	—	—	—
67	60	P66(*2)	O	Output port	—	—	—	—
		SEG33(*3)	O	LCD segment pin	—	—	—	—
68	61	P65(*2)	O	Output port	—	—	—	—
		SEG34(*3)	O	LCD segment pin	—	—	—	—
69	62	P64(*2)	O	Output port	—	—	—	—
		SEG35(*3)	O	LCD segment pin	—	—	—	—
70	63	P63(*4)	O	Output port	—	—	—	—
		SEG36(*5)	O	LCD segment pin	—	—	—	—
71	64	P62(*4)	O	Output port	—	—	—	—
		SEG37(*5)	O	LCD segment pin	—	—	—	—
72	65	P61(*4)	O	Output port	—	—	—	—
		SEG38(*5)	O	LCD segment pin	—	—	—	—
73	66	P60(*4)	O	Output port	—	—	—	—
		SEG39(*5)	O	LCD segment pin	—	—	—	—

(*1) Internally generated, or connect to either positive power supply pin (V_{DD}) or power supply pin for internal logic (V_{DDL}). For details, see “Chapter 22 LCD Drivers. In the user’s manual”
(*2) Pin for ML610Q407/ML610Q408.
(*3) Pin for ML610Q409.
(*4) Pin for ML610Q407.
(*5) Pin for ML610Q408/ML610Q409.

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. 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_{SS} .	—	—
XT1	O		—	—
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-P04	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-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
P50-P57	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
P60-P63	O	General-purpose input/output port. These pins are for the ML610Q407/ ML610Q408, but are not provided in the ML610Q409.	Primary	Positive
P64-P67	O	General-purpose input/output port. These pins are for the ML610Q407, but are not provided in the ML610Q409.	Primary	Positive

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	—
RCT0	O	Resistor/capacitor sensor connection pin of Channel 0 for measurement. This pin is used as the secondary function of the P33 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	—
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	—
LCD drive signal				
COM0-4	O	Common output pins.	—	—
SEG0-31	O	Segment output pins.	—	—
SEG32-35	O	Segment output pin. These pins are for the ML610Q408/ML610Q409, but are not provided in the ML610Q407.	—	—
SEG36-39	O	Segment output pin. These pins are for the ML610Q409, but are not provided in the ML610Q407/ML610Q408.	—	—
LCD driver power supply				
V_{L1}	—	Power supply pins for LCD bias (internally generated or positive power supply pin connected). Depending on LCD Bias setting and V_{DD} voltage level, V_{DD} or V_{DDL} or capacitor is connected. For details of the connection method, see user's manual.	—	—
V_{L2}	—		—	—
V_{L3}	—		—	—
C1	—	Power supply pins for LCD bias (internally generated). Capacitors C12 is connected between C1 and C2.	—	—
C2	—		—	—
For testing				
TEST	I/O	Input/output pin for testing. A pull-down resistor is internally connected.	—	—
Power supply				
V_{SS}	—	Negative power supply pin.	—	—
V_{DD}	—	Positive power supply pin for I/O, internal regulator, battery low detector, and power-on reset.	—	—
V_{DDL}	—	Positive power supply pin (internally generated) for internal logic. Capacitor CL (see Appendix C measuring circuit 1) is connected between this pin and V_{SS}.	—	—
V_{PP}	—	Power supply pin for programming Flash ROM. A pull-down resistor is internally connected.	—	—

OPERATING CONDITIONS OF FLASH ROM

(V_{SS} = 0V)

Parameter	Symbol	Condition	Range	Unit
Operating temperature	T_{OP}	At write/erase	0 to +40	°C
Operating voltage	V_{DD}	At write/erase*1	2.75 to 3.6	V
	V_{DDL}	At write/erase*1	2.5 to 2.75	
	V_{PP}	At write/erase*1	7.7 to 8.3	
erase/program cycles	C_{EP}	—	80	cycles
Data retention	Y_{DR}	—	10	years

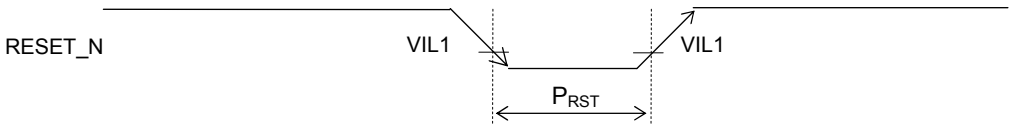
*1: Those voltages must be supplied to V_{DDL} pin and V_{PP} pin when programming and eraseing Flash ROM. V_{PP} pin has an internal pulldown resister.

DC CHARACTERISTICS (1/5)

(V_{DD} = 1.25 to 3.6V, V_{SS} = 0V, Ta = –20 to +70°C, Ta = –40 to +85°C for P version, unless otherwise specified)

Parameter	Symbol	Condition		Rating Min.	Rating Typ.	Rating Max.	Unit	Measuring circuit
500kHz/2MHz RC oscillation frequency	f_{RC}	V_{DD} = 1.25 to 3.6V	Ta = 25°C	Typ. –10%	500	Typ. +10%	kHz	1
			*3	Typ. –25%	500	Typ. +25%		
		V_{DD} = 1.80 to 3.6V	Ta = 25°C	Typ. –10%	2.0	Typ. +10%	MHz	
			*3	Typ. –25%	2.0	Typ. +25%		
Low-speed crystal oscillation start time*2	T_{XTL}	—		—	0.6	2	s	
500kHz/2MHz RC oscillation start time	T_{RC}	—		—	—	0.3	µs	
Low-speed oscillation stop detect time*1	T_{STOP}	—		12	16.4	41	ms	
Reset pulse width	P_{RST}	—		200	—	—	µs	
Reset noise elimination pulse width	P_{NRST}	—		—	—	0.3		
Power-on reset activation power rise time	T_{POR}	—		—	—	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 : 32.768KHz Crystal resonator DT-26 (Load capacitance 6pF) (made by KDS:DAISHINKU CORP.) is used (C_{GL}=C_{DL}=6pF).
*3 : Recommended operating temperature (Ta = –20 to +70°C, Ta = –40 to +85°C for P version)



Reset pulse width (P_{RST})

Power-on reset activation power rise time (T_{POR})

DC CHARACTERISTICS (3/5)

(V_{DD} = 3.0V, V_{SS} = 0V, Ta = –20 to +70°C, Ta = –40 to +85°C for P version)

Parameter	Symbol	Condition		Rating Min.	Rating Typ.	Rating Max.	Unit	Measuring circuit
Supply current 1	IDD1	CPU: In STOP state. Low-speed/high-speed RC500kHz/2MHz oscillation: stopped.	Ta= 25°C	—	0.4	0.8	µA	1
			*5	—	—	8		
Supply current 2	IDD2	CPU: In HALT state (LTBC and WDT are Operating).*3*4 High-speed 500kHz/2MHz oscillation: Stopped. LCD and BIAS circuits: Operating. *6	Ta= 25°C	—	0.9	1.8	µA	
			*5	—	—	9		
Supply current 3	IDD3	CPU: In 32.768kHz operating state.*1*3 High-speed 500kHz/2MHz oscillation: Stopped. LCD and BIAS circuits: Operating. *2	Ta= 25°C	—	5	8	µA	
			*5	—	—	15		
Supply current 4-1	IDD4-1	CPU: In RC 500kHz operating state. LCD and BIAS circuits: Operating. *2	Ta= 25°C	—	70	100	µA	
			*5	—	—	120		
Supply current 4-2	IDD4-2	CPU: In RC 2MHz operating state. LCD and BIAS circuits: Operating. *2	Ta= 25°C	—	280	350	µA	
			*5	—	—	400		

*1: When the CPU operating rate is 100% (No HALT state).
*2: All SEGs: off waveform, No LCD panel load, 1/3 bias, 1/3 duty, Frame frequency: Approx. 64 Hz, Bias voltage multiplying clock: 1/128 LSCLK (256Hz)
*3 : 32.768KHz Crystal resonator DT-26 (Load capacitance 6pF) (made by KDS:DAISHINKU CORP.) is used (C_{GL}=C_{DL}=6pF)
*4 : Significant bits of BLKCON0~BLKCON4 registers except DLCD bit on BLKCON4 are all “1”.
*5 : Recommended operating temperature (Ta = –20 to +70°C, Ta = –40 to +85°C for P version)
*6: LCD Stop mode, 1/3 bias, Bias voltage multiplying clock: 1/128 LSCLK (256Hz)

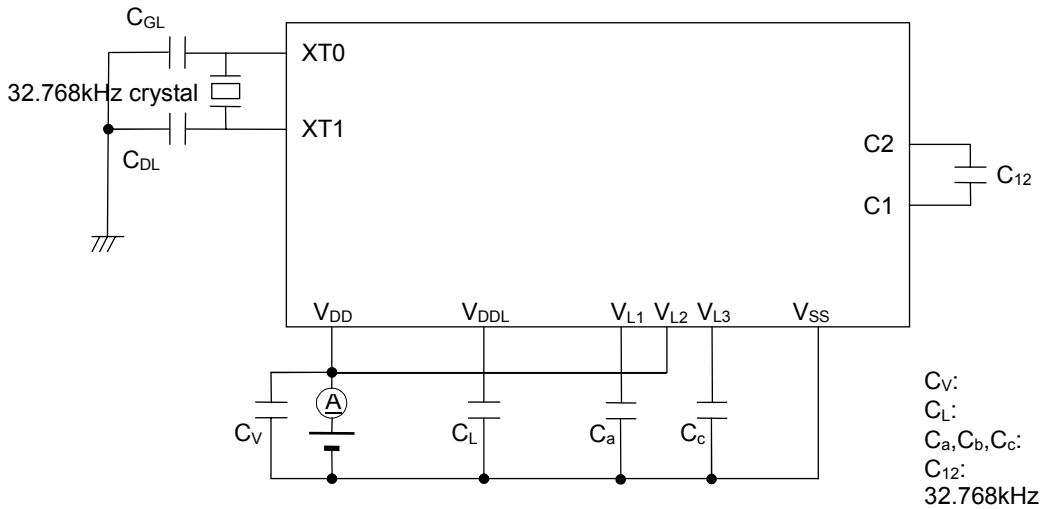
DC CHARACTERISTICS (5/5))

(V_{DD} = 1.25 to 3.6V, V_{SS} = 0V, Ta = –20 to +70°C, Ta = –40 to +85°C for P version, unless otherwise specified)

Parameter	Symbol	Condition	Rating			Unit	Measuring circuit
			Min.	Typ.	Max.		
Input voltage 1 (RESET_N) (TEST0, TEST1_N) (P00–P04) (P30–P35) (P40–P47) (P50–P57)	VIH1	—	0.7 ×V_{DD}	—	V_{DD}	V	5
	VIL1	V_{DD} = 1.8 to 3.6V	0	—	0.3 ×V_{DD}		
		V_{DD} = 1.25 to 3.6V	0	—	0.2 ×V_{DD}		
Input pin capacitance (P00–P04) (P30–P35) (P40–P47) (P50–P57)	CIN	f = 10kHz V_{rms} = 50mV Ta = 25°C	—	—	5	pF	—

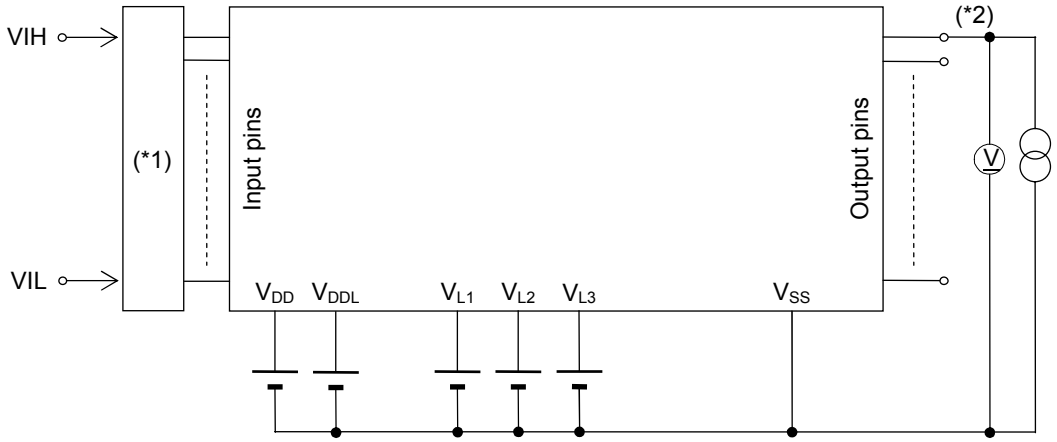
MEASURING CIRCUITS

MEASURING CIRCUIT 1



C_V:	1μF
C_L:	0.47μF
C_a,C_b,C_c:	0.1μF
C_{12}:	0.47μF
32.768kHz crystal:	DT-26 (Load capacitance 6pF) (made by KDS:DAISHINKU CORP.)
C_{GL}, C_{DL}:	6pF

MEASURING CIRCUIT 2

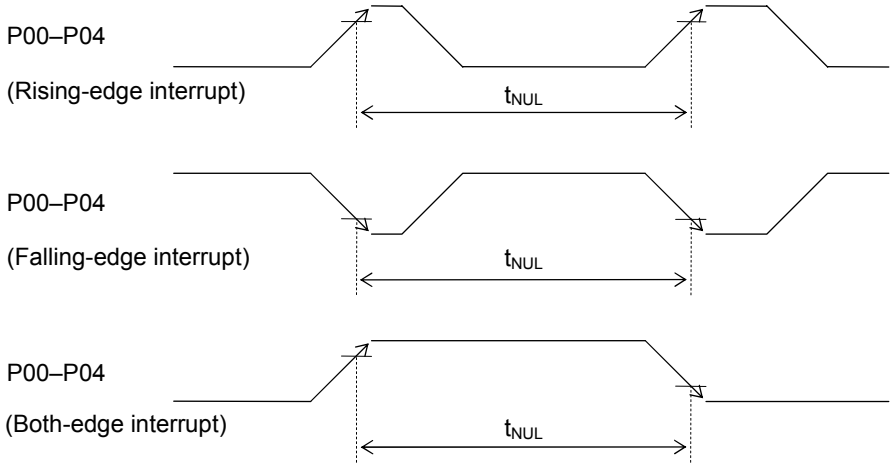


(*1) Input logic circuit to determine the specified measuring conditions.
(*2) Measured at the specified output pins.

AC CHARACTERISTICS (External Interrupt)

(V_{DD} = 1.25 to 3.6V, V_{SS} = 0V, Ta = –20 to +70°C, Ta = –40 to +85°C for P version, unless otherwise specified)

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

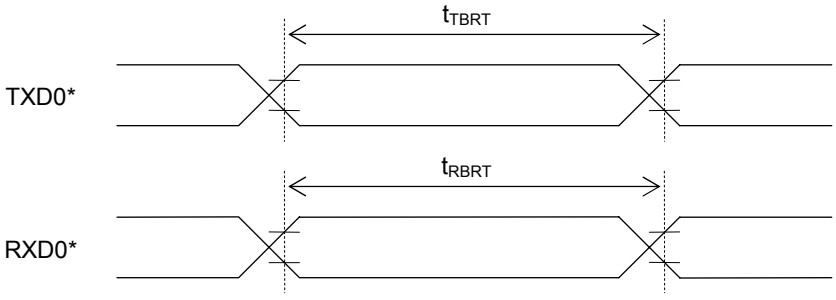


AC CHARACTERISTICS (Serial Port)

(V_{DD} = 1.25 to 3.6V, V_{SS} = 0V, Ta = –20 to +70°C, Ta = –40 to +85°C for P version, unless otherwise specified)

Parameter	Symbol	Condition	Rating			Unit
			Min.	Typ.	Max.	
Transmit baud rate	t_{TBRT}	—	—	BRT*1	—	s
Receive baud rate	t_{RBRT}	—	BRT*1 –3%	BRT*1	BRT*1 +3%	s

*1: Baud rate period (including the error of the clock frequency selected) set with the serial port baud rate register (SIOBRTL,H) and the serial port mode register 0 (SIOMOD0).



*: Indicates the secondary function of the port.

AC CHARACTERISTICS (RC Oscillation A/D Converter)

Condition for V_{DD}=1.8 to 3.6V

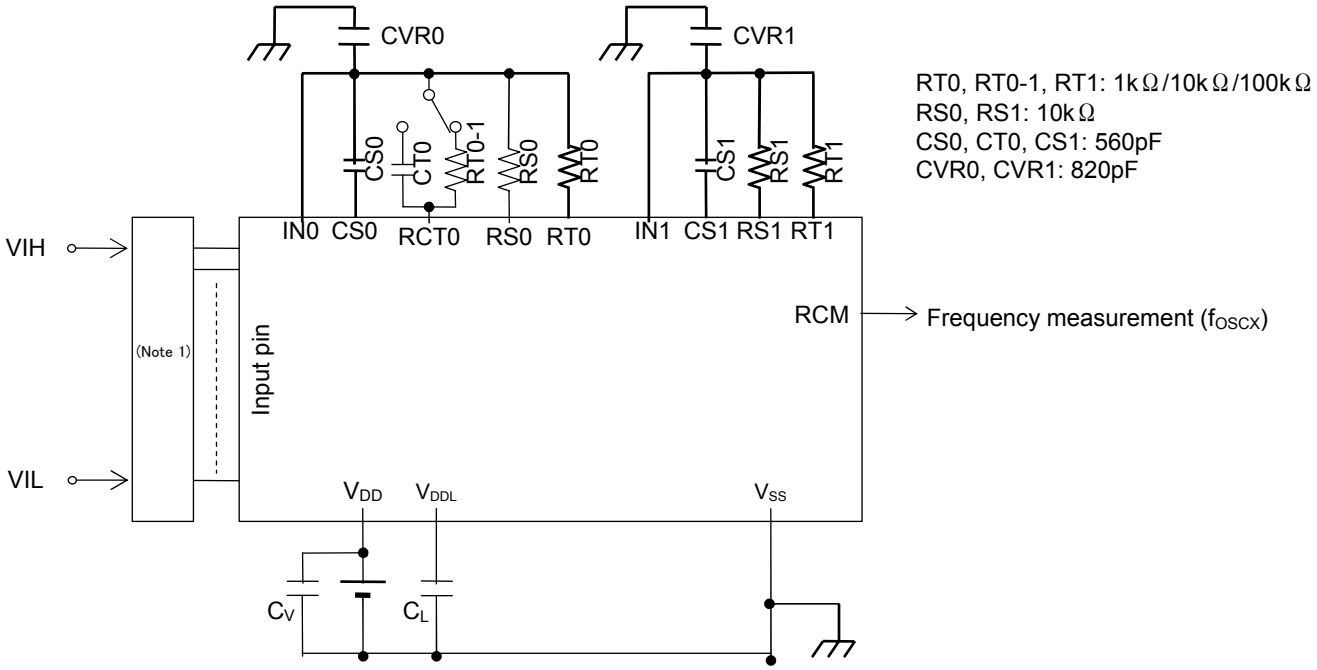
(V_{DD}=1.8 to 3.6V, V_{SS}=0V, Ta=-20 to +70°C, Ta=-40 to +85°C for P version, unless otherwise specified)

Parameter	Symbol	Condition	Rating			Unit
			Min.	Typ.	Max.	
Oscillation resistor	RS0,RS1,RT0, RT0-1,RT1	CS0, CT0, CS1≥740pF	1	—	—	kΩ
Oscillation frequency V_{DD} = 3.0V	f_{OSC1}	Resistor for oscillation=1kΩ	457.3	525.2	575.1	kHz
	f_{OSC2}	Resistor for oscillation=10kΩ	53.48	58.18	62.43	kHz
	f_{OSC3}	Resistor for oscillation=100kΩ	5.43	5.89	6.32	kHz
RS to RT oscillation frequency ratio *1 V_{DD} = 3.0V	Kf1	RT0, RT0-1, RT1=1kΩ	7.972	9.028	9.782	—
	Kf2	RT0, RT0-1, RT1=10kΩ	0.981	1	1.019	—
	Kf3	RT0, RT0-1, RT1=100kΩ	0.099	0.101	0.104	—

*1: Kfx is the ratio of the oscillation frequency by the sensor resistor to the oscillation frequency by the reference resistor on the same conditions.

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

(x = 1, 2, 3)



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

Condition for V_{DD}=1.25 to 3.6V

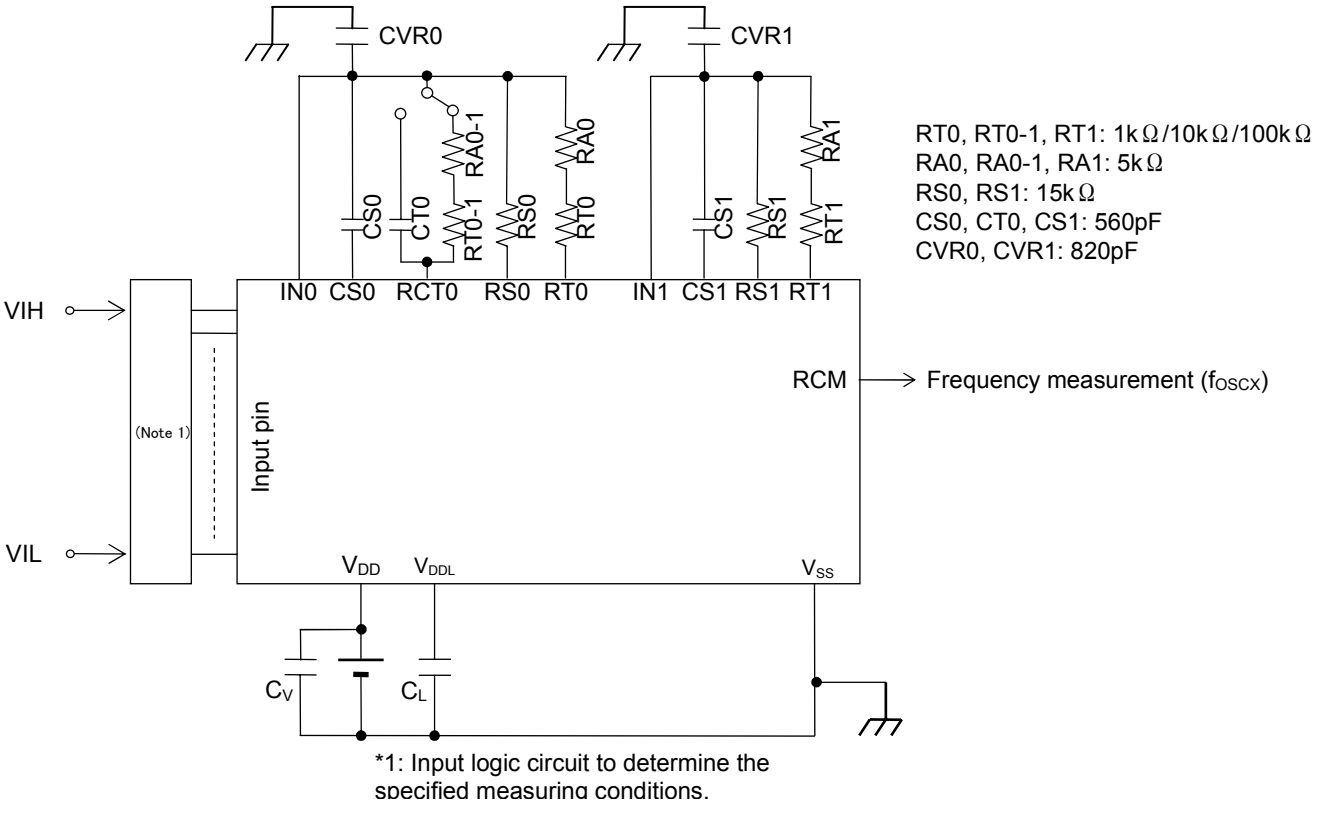
(V_{DD}=1.25 to 3.6V, V_{SS}=0V, Ta=-20 to +70°C, Ta=-40 to +85°C for P version, unless otherwise specified)

Parameter	Symbol	Condition	Rating			Unit
			Min.	Typ.	Max.	
Oscillation resistor	RS0,RS1,RT0, RT0-1,RT1	CS0, CT0, CS1≥740pF	1	—	—	kΩ
Oscillation frequency V_{DD} = 1.5V	f_{OSC1}	Resistor for oscillation=6kΩ	81.93	93.16	101.2	kHz
	f_{OSC2}	Resistor for oscillation=15kΩ	35.32	38.75	41.48	kHz
	f_{OSC3}	Resistor for oscillation=105kΩ	5.22	5.65	6.03	kHz
RS to RT oscillation frequency ratio *1 V_{DD} = 1.5V	Kf1	RT0, RT0-1, RT1=1kΩ	2.139	2.381	2.632	—
	Kf2	RT0, RT0-1, RT1=10kΩ	0.973	1	1.028	—
	Kf3	RT0, RT0-1, RT1=100kΩ	0.142	0.147	0.152	—
Oscillation frequency V_{DD} = 3.0V	f_{OSC1}	Resistor for oscillation=6kΩ	85.28	94.58	103.3	kHz
	f_{OSC2}	Resistor for oscillation=15kΩ	35.72	38.87	41.78	kHz
	f_{OSC3}	Resistor for oscillation=105kΩ	5.189	5.622	6.012	kHz
RS to RT oscillation frequency ratio *1 V_{DD} = 3.0V	Kf1	RT0, RT0-1, RT1=1kΩ	2.227	2.432	2.626	—
	Kf2	RT0, RT0-1, RT1=10kΩ	0.982	1	1.018	—
	Kf3	RT0, RT0-1, RT1=100kΩ	0.141	0.145	0.149	—

*1: Kfx is the ratio of the oscillation frequency by the sensor resistor to the oscillation frequency by the reference resistor on the same conditions.

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

(x = 1, 2, 3)



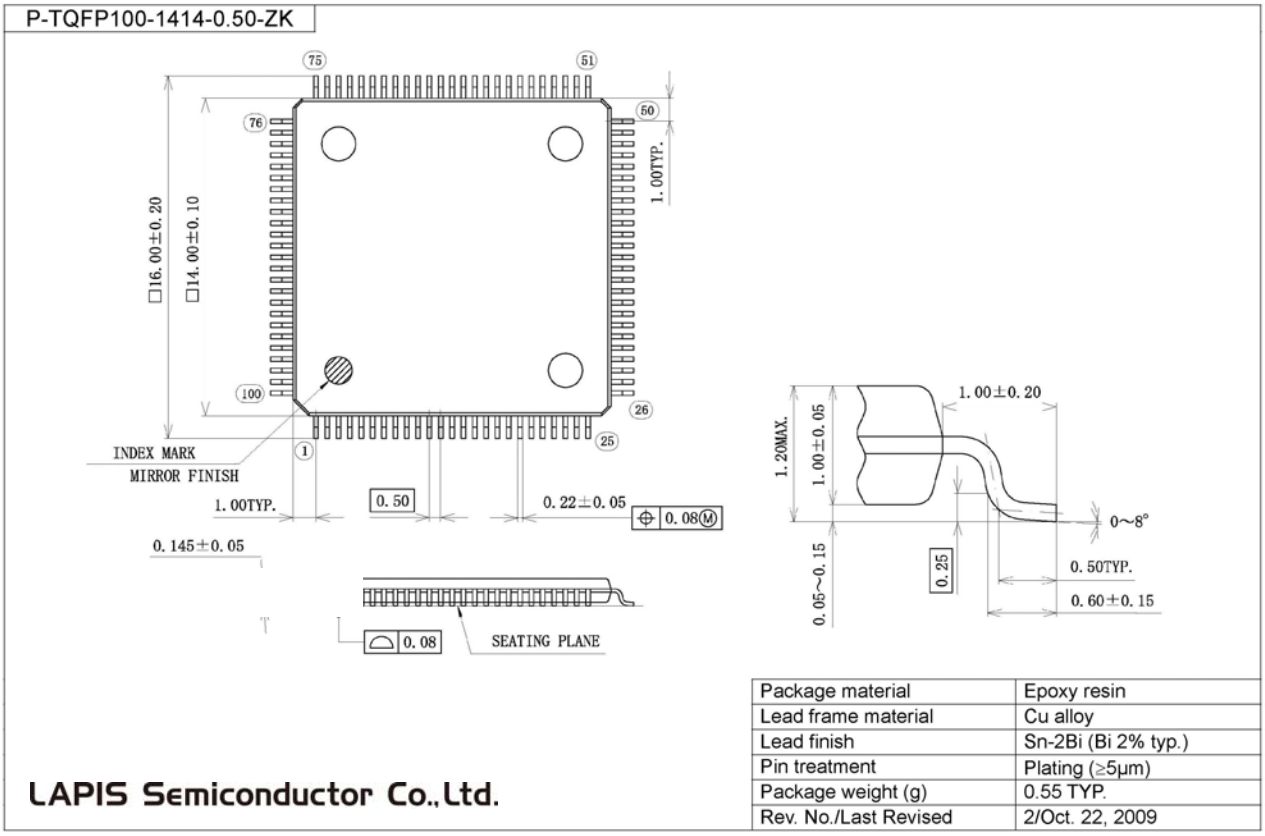
*1: Input logic circuit to determine the specified measuring conditions.

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, resisteor and etc.) necessory 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)



Package material	Epoxy resin
Lead frame material	Cu alloy
Lead finish	Sn-2Bi (Bi 2% typ.)
Pin treatment	Plating (≥5μm)
Package weight (g)	0.55 TYP.
Rev. No./Last Revised	2/Oct. 22, 2009

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).

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