Rohm Semiconductor - ML610Q412P-NNNTB03A7 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	Obsolete
Core Processor	nX-U8/100
Core Size	8-Bit
Speed	625kHz
Connectivity	I²C, SSP, UART/USART
Peripherals	LCD, POR, PWM, WDT
Number of I/O	14
Program Memory Size	16KB (8K x 16)
Program Memory Type	FLASH
EEPROM Size	-
RAM Size	1K x 8
Voltage - Supply (Vcc/Vdd)	1.1V ~ 3.6V
Data Converters	A/D 2x12b, 2x24b
Oscillator Type	Internal
Operating Temperature	-40°C ~ 85°C (TA)
Mounting Type	Surface Mount
Package / Case	120-TQFP
Supplier Device Package	-
Purchase URL	https://www.e-xfl.com/product-detail/rohm-semi/ml610q412p-nnntb03a7

- Frame frequency selecable (approx. 64 Hz, 73 Hz, 85 Hz, and 102 Hz)
- Bias voltage multiplying clock selectable (8 types)
- Contrast adjustment (32 steps)
- LCD drive stop mode, LCD display mode, all LCDs on mode, and all LCDs off mode selectable

• 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

• Battery Level Detector
  - Threshold voltages: One of 16 levels
  - Accuracy: ±2% (Typ.)

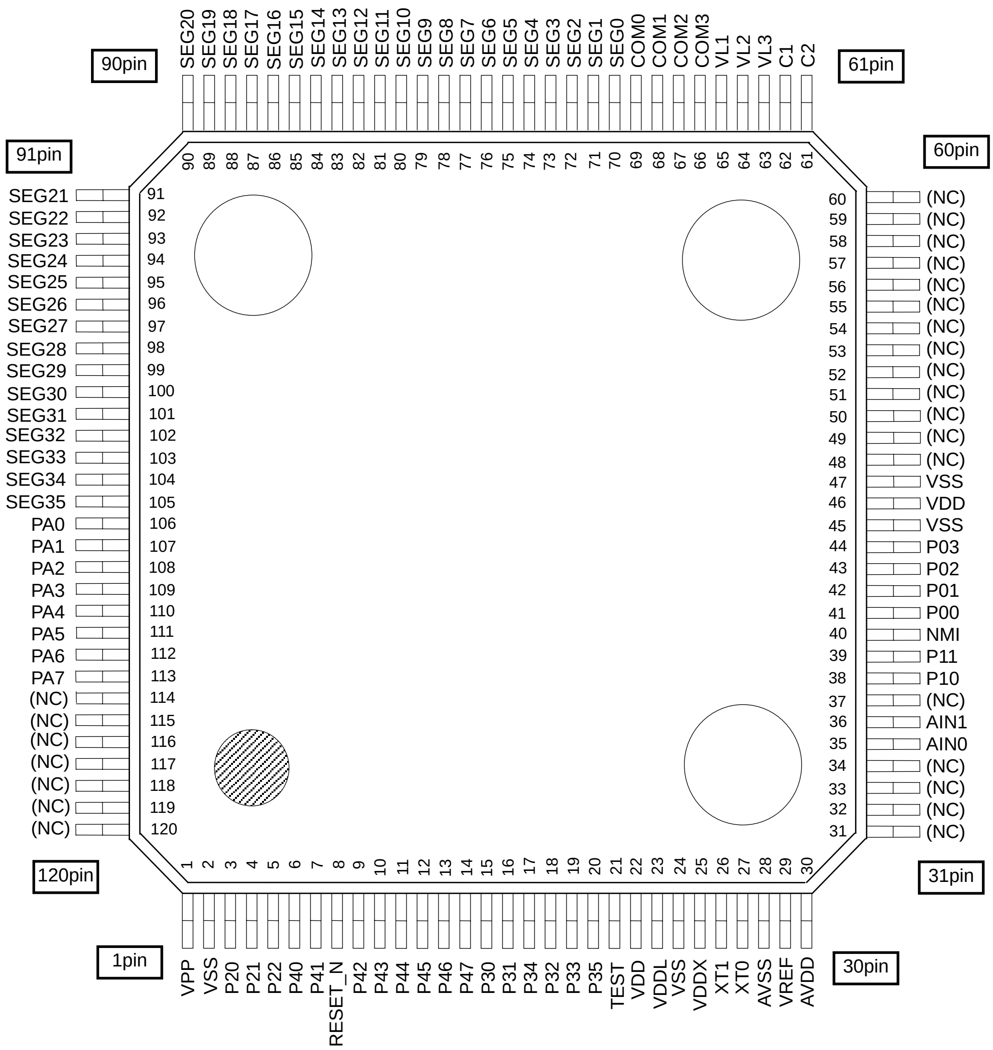
• Clock
  - Low-speed clock: (This LSI can not guarantee the operation withoug low-speed crystal oscillation clock)
    Crystal oscillation (32.768 kHz)
  - High-speed clock:
    Built-in RC oscillation (500 kHz)
    External clock (500kH or less)
  - High-speed Clock gear: 1/2(250kHz), 1/4(125kHz), 1/8(62.5kHz: default)
  - Selection of high-speed clock mode by software:
    Built-in RC 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.)
  - 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} = 1.1V to 3.6V, AV_{DD} = 2.2V to 3.6V

PIN CONFIGURATION

ML610Q411 TQFP120 Pin Layout



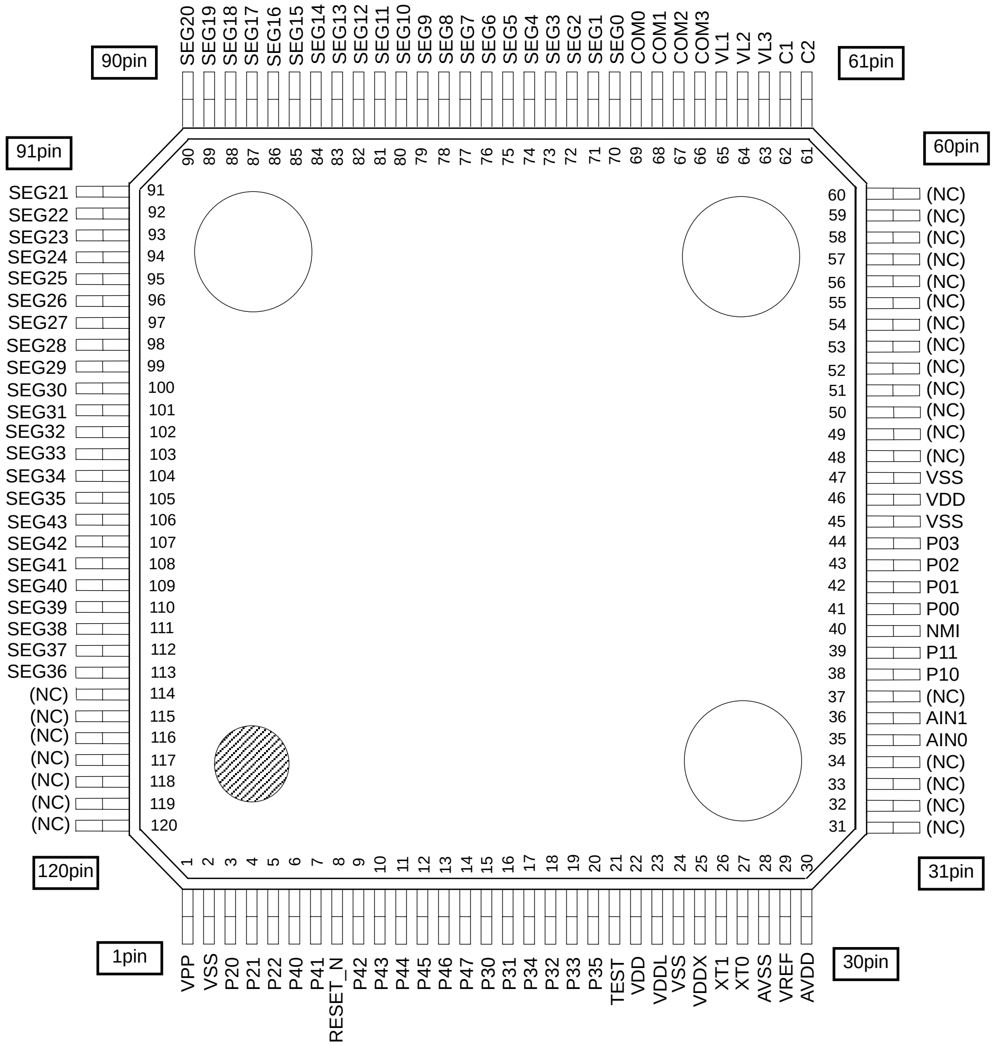
(NC): No Connection

Note:

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

Figure 3 ML610Q411 TQFP120 Pin Configuration

ML610Q412 TQFP120 Pin Layout

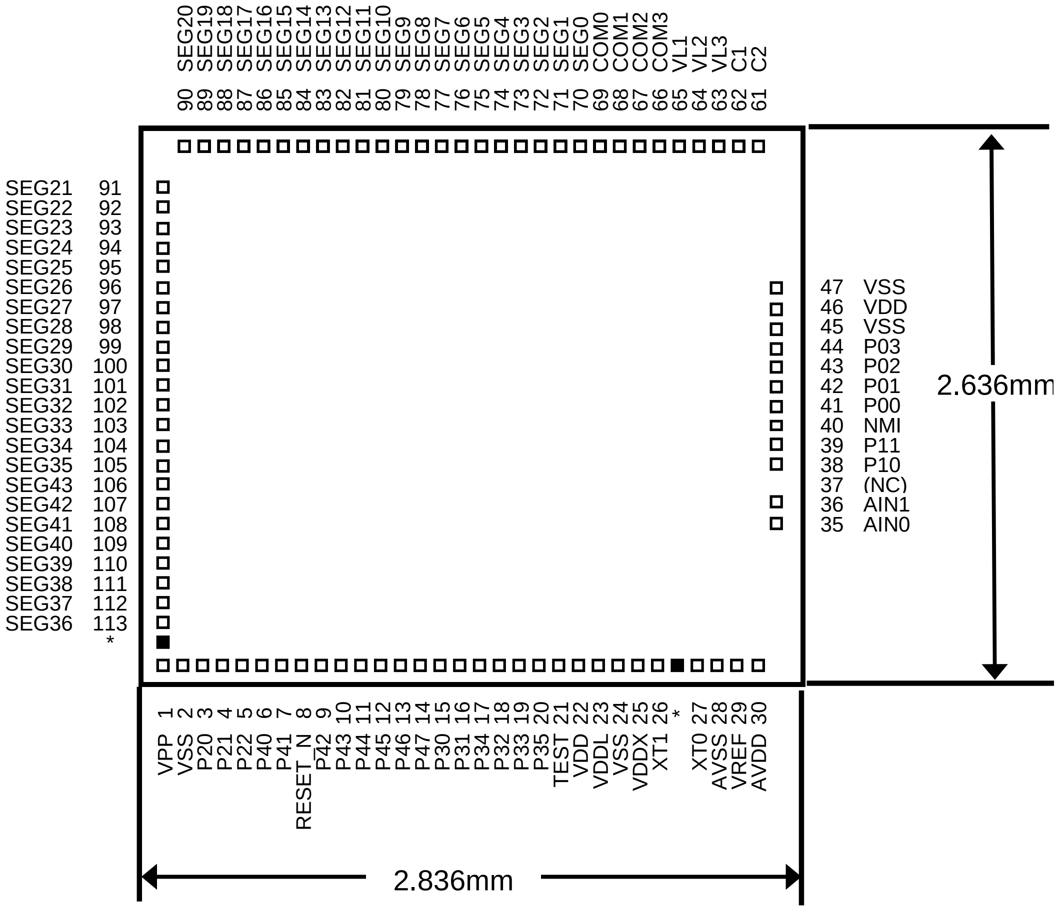


(NC): No Connection

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

Figure 4 ML610Q412 TQFP120 Pin Configuration

ML610Q412 Chip Pin Layout & Dimension



* Dummy pad
Note: These dummy pads are visible and do have any function, they are placed for a mechanical evaluation in LAPIS Semiconductor. Please do NOT implement wire-bonding to the dummy pad.

Chip size:	2.836mm x 2.636mm
PAD count:	95 pins
Minimum PAD pitch:	80 μm
PAD aperture:	70 μm $\times$ 70 μm
Chip thickness:	350 μm
Voltage of the rear side of chip:	V_{SS} level

Figure 6 ML610Q412 Chip Layout & Dimension

ML610Q411 Pad Coordinates

Table 1 ML610Q411 Pad Coordinates

Chip Center: X=0,Y=0

PAD No.	Pad Name	X (µm)	Y (µm)
1	VPP	-1230	-1212
2	VSS	-1150	-1212
3	P20	-1070	-1212
4	P21	-990	-1212
5	P22	-910	-1212
6	P40	-830	-1212
7	P41	-750	-1212
8	RESET_N	-670	-1212
9	P42	-590	-1212
10	P43	-510	-1212
11	P44	-430	-1212
12	P45	-350	-1212
13	P46	-270	-1212
14	P47	-190	-1212
15	P30	-110	-1212
16	P31	-30	-1212
17	P34	50	-1212
18	P32	130	-1212
19	P33	210	-1212
20	P35	290	-1212
21	TEST	370	-1212
22	VDD	450	-1212
23	VDDL	530	-1212
24	VSS	610	-1212
25	VDDX	690	-1212
26	XT1	770	-1212
-	Dummy	850	-1212
27	XT0	930	-1212
28	AVSS	1030	-1212
29	VREF	1110	-1212
30	AVDD	1190	-1212
31	(NC)	-	-
32	(NC)	-	-
33	(NC)	-	-
34	(NC)	-	-
35	AIN0	1312	-522
36	AIN1	1312	-350
37	(NC)	-	-
38	P10	1312	-210
39	P11	1312	-130
40	NMI	1312	-50
41	P00	1312	30
42	P01	1312	110
43	P02	1312	190
44	P03	1312	270
45	VSS	1312	350
46	VDD	1312	430
47	VSS	1312	510
48	(NC)	-	-
49	(NC)	-	-
50	(NC)	-	-

PAD No.	Pad Name	X (µm)	Y (µm)
51	(NC)	-	-
52	(NC)	-	-
53	(NC)	-	-
54	(NC)	-	-
55	(NC)	-	-
56	(NC)	-	-
57	(NC)	-	-
58	(NC)	-	-
59	(NC)	-	-
60	(NC)	-	-
61	C2	1220	1212
62	C1	1140	1212
63	VL3	1060	1212
64	VL2	980	1212
65	VL1	900	1212
66	COM3	820	1212
67	COM2	740	1212
68	COM1	660	1212
69	COM0	580	1212
70	SEG0	500	1212
71	SEG1	420	1212
72	SEG2	340	1212
73	SEG3	260	1212
74	SEG4	180	1212
75	SEG5	100	1212
76	SEG6	20	1212
77	SEG7	-60	1212
78	SEG8	-140	1212
79	SEG9	-220	1212
80	SEG10	-300	1212
81	SEG11	-380	1212
82	SEG12	-460	1212
83	SEG13	-540	1212
84	SEG14	-620	1212
85	SEG15	-700	1212
86	SEG16	-780	1212
87	SEG17	-860	1212
88	SEG18	-940	1212
89	SEG19	-1020	1212
90	SEG20	-1100	1212
91	SEG21	-1312	960
92	SEG22	-1312	880
93	SEG23	-1312	800
94	SEG24	-1312	720
95	SEG25	-1312	640
96	SEG26	-1312	560
97	SEG27	-1312	480
98	SEG28	-1312	400
99	SEG29	-1312	320
100	SEG30	-1312	240

PAD No.	Pad Name	X (µm)	Y (µm)
101	SEG31	-1312	160
102	SEG32	-1312	80
103	SEG33	-1312	0
104	SEG34	-1312	-80
105	SEG35	-1312	-160
106	PA0	-1312	-240
107	PA1	-1312	-320
108	PA2	-1312	-400
109	PA3	-1312	-480
110	PA4	-1312	-560
111	PA5	-1312	-640
112	PA6	-1312	-720
113	PA7	-1312	-800
--	Dummy	-1312	-908

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
2, 24,45,47	V_{SS}	—	Negative power supply pin	—	—	—	—	—	—
22, 46	V_{DD}	—	Positive power supply pin	—	—	—	—	—	—
23	V_{DDL}	—	Power supply pin for internal logic (internally generated)	—	—	—	—	—	—
25	V_{DDX}	—	Power supply pin for low-speed oscillation (internally generated)	—	—	—	—	—	—
1	V_{PP}	—	Power supply pin for Flash ROM	—	—	—	—	—	—
28	AV_{SS}	—	Negative power supply pin for successive approximation type ADC	—	—	—	—	—	—
30	AV_{DD}	—	Positive power supply pin for successive approximation type ADC	—	—	—	—	—	—
65	V_{L1}	—	Power supply pin for LCD bias (internally generated)	—	—	—	—	—	—
64	V_{L2}	—	Power supply pin for LCD bias (internally generated)	—	—	—	—	—	—
63	V_{L3}	—	Power supply pin for LCD bias (internally generated)	—	—	—	—	—	—
62	C1	—	Capacitor connection pin for LCD bias generation	—	—	—	—	—	—
61	C2	—	Capacitor connection pin for LCD bias generation	—	—	—	—	—	—
21	TEST	I/O	Input/output pin for testing	—	—	—	—	—	—
8	RESET_N	I	Reset input pin	—	—	—	—	—	—
27	XT0	I	Low-speed clock oscillation pin	—	—	—	—	—	—
26	XT1	O	Low-speed clock oscillation pin	—	—	—	—	—	—
29	V_{REF}	—	Reference power supply pin for successive approximation type ADC	—	—	—	—	—	—

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} as required.	—	—
XT1	O		—	—
OSC0	I	High-speed external clock input pin. This pin is used as the secondary function of the P10.	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-P22	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. These pins are for the ML610Q411, but are not provided in the ML610Q412.	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	—
Successive approximation type A/D converter				
AV_{SS}	—	Negative power supply pin for successive approximation type A/D converter.	—	—
AV_{DD}	—	Positive power supply pin for successive approximation type A/D converter.	—	—
V_{REF}	—	Reference power supply pin for successive approximation type A/D converter.	—	—
AIN0	I	Channel 0 analog input for successive approximation type A/D converter.	—	—
AIN1	I	Channel 1 analog input for successive approximation type A/D converter.	—	—
LCD drive signal				
COM0-3	O	Common output pins.	—	—
SEG0-35	O	Segment output pins.	—	—
SEG36-43	O	Segment output pin. These pins are for the ML610Q412, but are not provided in the ML610Q411.	—	—
LCD driver power supply				
V_{L1}	—	Power supply pins for LCD bias (internally generated). Capacitors Ca, Cb, and Cc (see measuring circuit 1) are connected between V_{SS} and V_{L1}, V_{L2}, and V_{L3}, respectively.	—	—
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. Capacitors CL0 and CL1 (see measuring circuit 1) are connected between this pin and V_{SS}.	—	—
V_{DDX}	—	Positive power supply pin (internally generated) for low-speed oscillation. When using ML610Q411 and ML610Q412, connect capacitor Cx (see measuring circuit 1) between this pin and V_{SS}.	—	—
V_{PP}	—	Power supply pin for programming Flash ROM. A pull-down resistor is internally connected.	—	—

ELECTRICAL CHARACTERISTICS

ABSOLUTE MAXIMUM RATINGS

(V_{SS} = AV_{SS} = 0V)

Parameter	Symbol	Condition	Rating	Unit
Power supply voltage 1	V_{DD}	Ta = 25°C	–0.3 to +4.6	V
Power supply voltage 2	AV_{DD}	Ta = 25°C	–0.3 to +4.6	V
Power supply voltage 3	V_{PP}	Ta = 25°C	–0.3 to +9.5	V
Power supply voltage 4	V_{DDL}	Ta = 25°C	–0.3 to +3.6	V
Power supply voltage 5	V_{DDX}	Ta = 25°C	–0.3 to +3.6	V
Power supply voltage 6	V_{L1}	Ta = 25°C	–0.3 to +1.75	V
Power supply voltage 7	V_{L2}	Ta = 25°C	–0.3 to +3.5	V
Power supply voltage 8	V_{L3}	Ta = 25°C	–0.3 to +5.25	V
Input voltage	V_{IN}	Ta = 25°C	–0.3 to V_{DD}+0.3	V
Output voltage	V_{OUT}	Ta = 25°C	–0.3 to V_{DD}+0.3	V
Output current 1	I_{OUT1}	Port3–A, Ta = 25°C	–12 to +11	mA
Output current 2	I_{OUT2}	Port2, Ta = 25°C	–12 to +20	mA
Power dissipation	PD	Ta = 25°C	1.25	W
Storage temperature	T_{STG}	—	–55 to +150	°C

RECOMMENDED OPERATING CONDITIONS

(V_{SS} = AV_{SS} = 0V)

Parameter	Symbol	Condition	Range	Unit
Operating temperature	T_{OP}	ML610Q411, ML610Q412,	–20 to +70	°C
		ML610Q411P, ML610Q411PA, ML610Q412P	–40 to +85	
Operating voltage	V_{DD}	—	1.1 to 3.6	V
	AV_{DD}	—	2.2 to 3.6	
Operating frequency (CPU)	f_{OP}	V_{DD} = 1.1 to 3.6V	30k to 36k 46.9k to 78.1k	Hz
		V_{DD} = 1.3 to 3.6V	30k to 625k	
			23k to 625k	
Capacitor externally connected to V_{DDL} pin	C_{L0}	—	1.0±30%	μF
	C_{L1}	—	0.1±30%	
Capacitor externally connected to V_{DDX} pin	C_X	—	0.1±30%	μF
Capacitors externally connected to $V_{L1, 2, 3}$ pins	$C_{1, 2, 3}$	—	1.0±30%	μF
Capacitors externally connected across C1 and C2 pins	C_{12}	—	1.0±30%	μF

CLOCK GENERATION CIRCUIT OPERATING CONDITIONS

(V_{SS} = 0V)

Parameter	Symbol	Condition	Rating			Unit
			Min.	Typ.	Max.	
Low-speed crystal oscillation frequency	f_{XTL}	—	—	32.768k	—	Hz
Recommended equivalent series resistance value of low-speed crystal oscillation	R_L	—	—	—	40k	Ω
Low-speed crystal oscillation external capacitor [*1]	C_{DL}/C_{GL}	C_L=6pF of crystal oscillation [*2]	—	0	—	pF
		C_L=9pF of crystal oscillation	—	6	—	
		C_L=12pF of crystal oscillation	—	12	—	
	C_{GH}	—	—	24	—	

[*1]: The external C_{DL} and C_{GL} need to be adjusted in consideration of variation of internal loading capacitance C_D and C_G, and other additional capacitance such as PCB layout.

[*2]: When using a crystal oscillator C_L = 6pF, there is a possibility that can not be adjusted by external C_{DL} and C_{GL}.

OPERATING CONDITIONS OF FLASH ROM

(V_{SS} = AV_{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	
Write 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} = 1.1 to 3.6V, AV_{DD} = 2.2 to 3.6V, V_{SS} = AV_{SS} = 0V, Ta = –20 to +70°C, Ta = –40 to +85°C for P version, unless otherwise specified) (1/5)

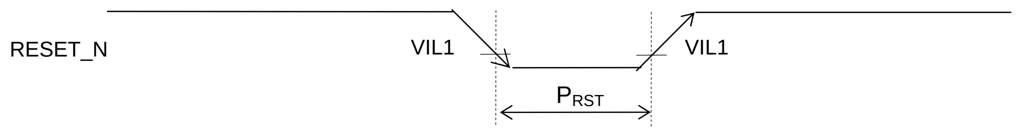
Parameter	Symbol	Condition		Rating Min.	Rating Typ.	Rating Max.	Unit	Measuring circuit
500kHz RC oscillation frequency	f_{RC}	V_{DD} = 1.3 to 3.6V	Ta = 25°C	Typ. –10%	500	Typ. +10%	kHz	1
			*3	Typ. –25%	500	Typ. +25%	kHz	
Low-speed crystal oscillation start time*2	T_{XTL}	—		—	0.3	2	s	
500kHz RC oscillation start time	T_{RC}	—		—	50	500	µs	
Low-speed oscillation stop detect time*1	T_{STOP}	—		0.2	3	20	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 : Use 32.768KHz Crystal Oscillator C-001R (Epson Toyocom) with capacitance C_{GL}/C_{DL}＝0pF.

*3 : Recommended operating temperature (Ta = –40 to +85°C for P version, Ta = –20 to +70°C for non-P version)

[Reset pulse width]



Reset pulse width (P_{RST})

[Power-on reset activation power rise time]

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

DC CHARACTERISTICS (2/5)

(V_{DD} = 1.1 to 3.6V, AV_{DD} = 2.2 to 3.6V, V_{SS} = AV_{SS} = 0V, Ta = −20 to +70°C, Ta = −40 to +85°C for P version, unless otherwise specified) (2/5)

Parameter	Symbol	Condition		Rating Min.	Rating Typ.	Rating Max.	Unit	Measuring circuit
V_{L1} voltage	V_{L1}	V_{DD} = 3.0V, Tj = 25°C	CN4–0 = 00H	0.89	0.94	0.99	V	1
			CN4–0 = 01H	0.91	0.96	1.01		
			CN4–0 = 02H	0.93	0.98	1.03		
			CN4–0 = 03H	0.95	1.00	1.05		
			CN4–0 = 04H	0.97	1.02	1.07		
			CN4–0 = 05H	0.99	1.04	1.09		
			CN4–0 = 06H	1.01	1.06	1.11		
			CN4–0 = 07H	1.03	1.08	1.13		
			CN4–0 = 08H	1.05	1.10	1.15		
			CN4–0 = 09H	1.07	1.12	1.17		
			CN4–0 = 0AH	1.09	1.14	1.19		
			CN4–0 = 0BH	1.11	1.16	1.21		
			CN4–0 = 0CH	1.13	1.18	1.23		
			CN4–0 = 0DH	1.15	1.20	1.25		
			CN4–0 = 0EH	1.17	1.22	1.27		
			CN4–0 = 0FH	1.19	1.24	1.29		
			CN4–0 = 10H	1.21	1.26	1.31		
			CN4–0 = 11H	1.23	1.28	1.33		
			CN4–0 = 12H	1.25	1.30	1.35		
			CN4–0 = 13H	1.27	1.32	1.37		
			CN4–0 = 14H	1.29	1.34	1.39		
			CN4–0 = 15H	1.31	1.36	1.41		
			CN4–0 = 16H	1.33	1.38	1.43		
			CN4–0 = 17H	1.35	1.40	1.45		
			CN4–0 = 18H	1.37	1.42	1.47		
			CN4–0 = 19H	1.39	1.44	1.49		
			CN4–0 = 1AH	1.41	1.46	1.51		
			CN4–0 = 1BH	1.43	1.48	1.53		
			CN4–0 = 1CH	1.45	1.50	1.55		
			CN4–0 = 1DH	1.47	1.52	1.57		
			CN4–0 = 1EH	1.49	1.54	1.59		
			CN4–0 = 1FH	1.51	1.56	1.61		
V_{L1} temperature deviation *1	ΔV_{L1}	V_{DD} = 3.0V		—	−1.5	—	mV/°C	
V_{L1} voltage dependency *1	ΔV_{L1}	V_{DD} = 1.3 to 3.6V		—	5	20	mV/V	
V_{L2} voltage	V_{L2}	V_{DD} = 3.0V, Tj = 25°C 1MΩ load (V_{L3}–V_{SS})		Typ. −10%	V_{L1}×2	Typ. +4%	V	
V_{L3} voltage	V_{L3}			Typ. −10%	V_{L1}×3	Typ. +4%		
LCD bias voltage generation time	T_{BIAS}	—		—	—	600	ms	

*1: V_{L1} can not exceed V_{DD} level. The maximum V_{L1} becomes V_{DD} level when the V_{L1} calculated by the temperature deviation and voltage dependency is going to exceed the V_{DD} level.

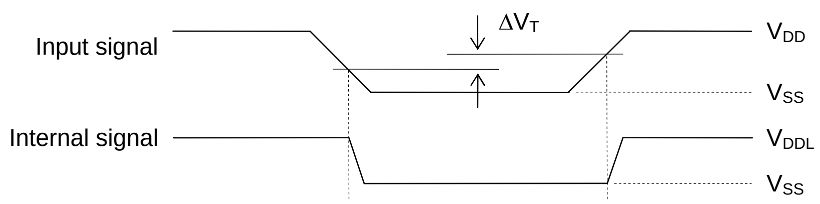
DC CHARACTERISTICS (5/5))

(V_{DD} = 1.1 to 3.6V, AV_{DD} = 2.2 to 3.6V, V_{SS} = AV_{SS} = 0V, Ta = –20 to +70°C, Ta = –40 to +85°C for P version, unless otherwise specified) (5/5)

Parameter	Symbol	Condition	Rating			Unit	Measuring circuit
			Min.	Typ.	Max.		
Input voltage 1 (RESET_N) (TEST) (NMI) (P00–P03) (P10–P11) (P31–P35) (P40–P43) (P45–P47) (PA0–PA7)[*1]	VIH1	V_{DD} = 1.3 to 3.6V	0.7 $\times V_{DD}$	—	V_{DD}	V	5
		V_{DD} = 1.1 to 3.6V	0.7 $\times V_{DD}$	—	V_{DD}		
	VIL1	V_{DD} = 1.3 to 3.6V	0	—	0.3 $\times V_{DD}$		
		V_{DD} = 1.1 to 3.6V	0	—	0.2 $\times V_{DD}$		
Hysteresis width (RESET_N) (TEST_N) (NMI) (P00–P03) (P10–P11) (P31–P35) (P40–P43) (P45–P47) (PA0–PA7)[*1]	ΔVT	V_{DD} = 2.0 to 3.6V	0.05 $\times V_{DD}$	0.18 $\times V_{DD}$	0.4 $\times V_{DD}$		
		V_{DD} = 1.1 to 3.6V	0.02 $\times V_{DD}$	0.18 $\times V_{DD}$	0.4 $\times V_{DD}$		
Input voltage 2 (P30, P44)	VIH2	—	0.7 $\times V_{DD}$	—	V_{DD}		
	VIL2	—	0	—	0.3 $\times V_{DD}$		
Input pin capacitance (NMI) (P00–P03) (P10–P11) (P30–P35) (P40–P47) (PA0–PA7)[*1]	CIN	f = 10kHz, V_{rms} = 50mV, Ta = 25°C	—	—	5	pF	—

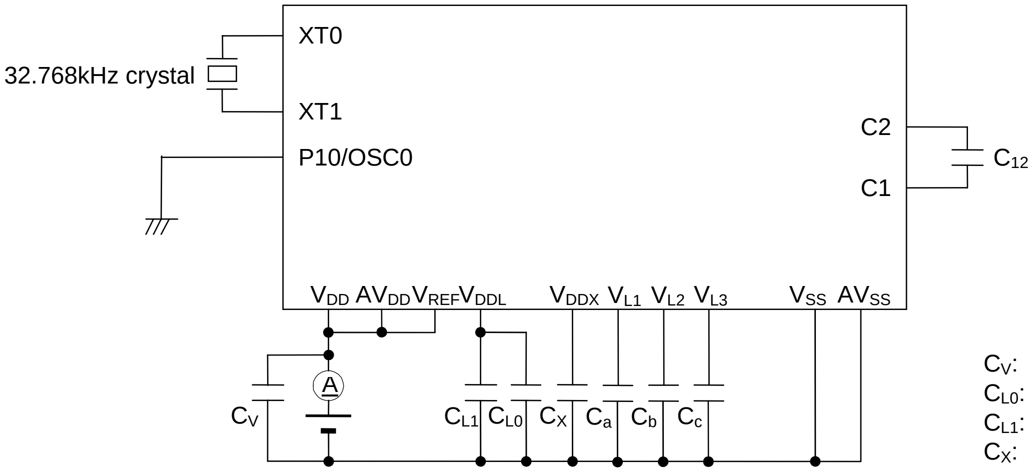
*1: ML610Q411

HYSTERESIS WIDTH



MEASURING CIRCUITS

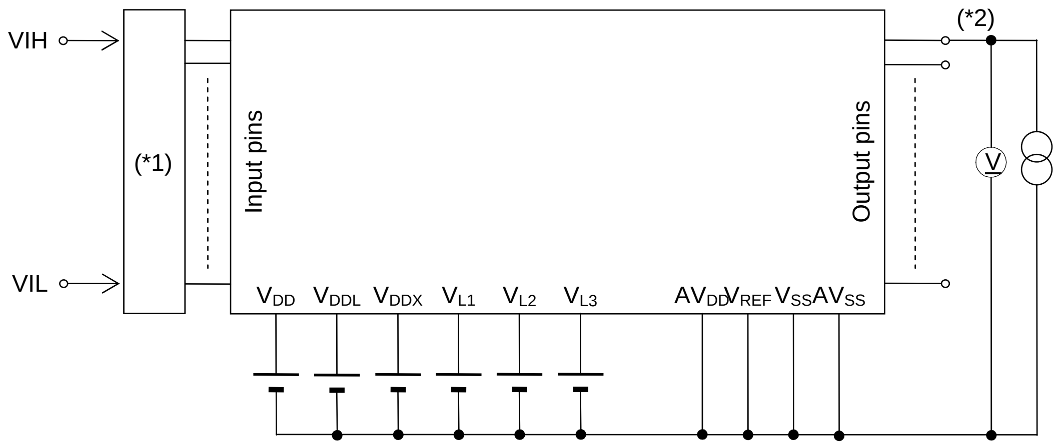
MEASURING CIRCUIT 1



C_V:	1μF
C_{L0}:	1μF
C_{L1}:	0.1μF
C_X:	0.1μF
C_a,C_b,C_c,C_d:	1μF
C_{12},C_{34}:	1μF

32.768kHz crystal:
C-001R (Epson Toyocom)

MEASURING CIRCUIT 2

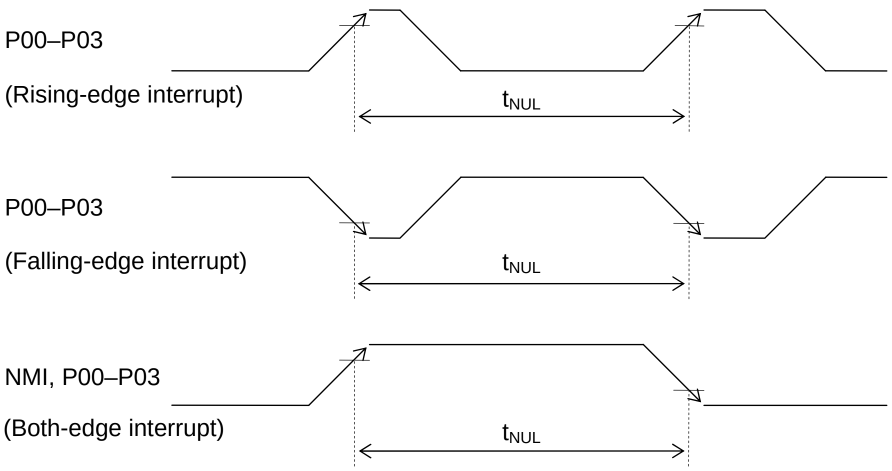


(*1) Input logic circuit to determine the specified measuring conditions.
(*2) Measured at the specified output pins.

AC CHARACTERISTICS (External Interrupt)

(V_{DD} = 1.1 to 3.6V, AV_{DD} = 2.2 to 3.6V, V_{SS} = AV_{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

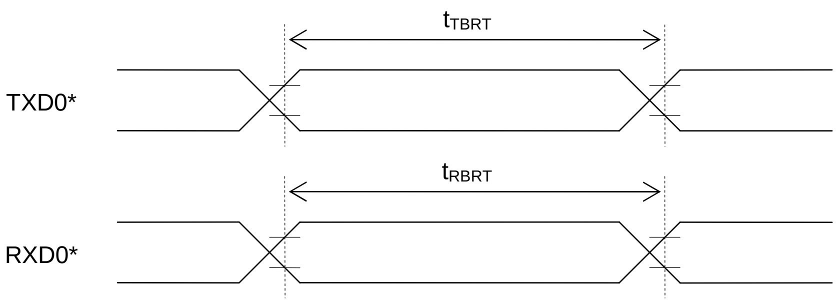


AC CHARACTERISTICS (Serial Port)

(V_{DD} = 1.3 to 3.6V, AV_{DD} = 2.2 to 3.6V, V_{SS} = AV_{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).



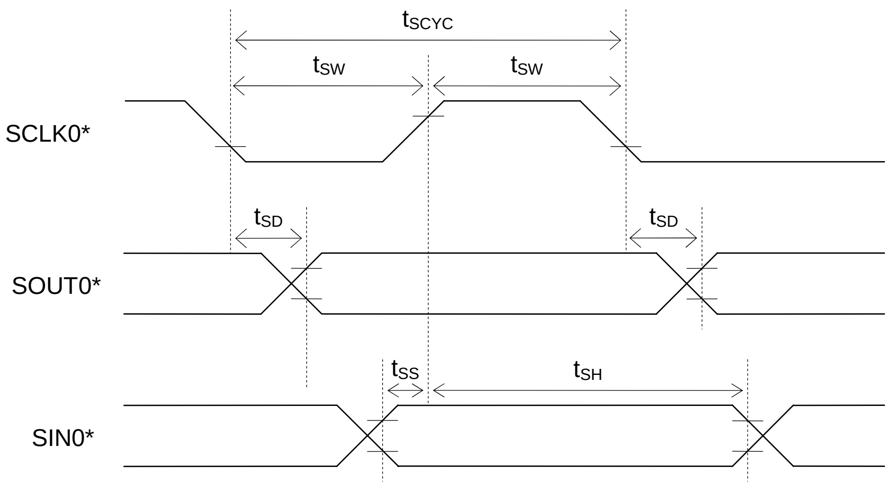
*: Indicates the secondary function of the port.

AC CHARACTERISTICS (Synchronous Serial Port)

(V_{DD} = 1.3 to 3.6V, AV_{DD} = 2.2 to 3.6V, V_{SS} = AV_{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.	
SCLK input cycle (slave mode)	t_{SCYC}	When high-speed oscillation is not active	10	—	—	μs
SCLK output cycle (master mode)	t_{SCYC}	—	—	SCLK*[1]	—	s
SCLK input pulse width (slave mode)	t_{SW}	When high-speed oscillation is not active	4	—	—	μs
SCLK output pulse width (master mode)	t_{SW}	—	SCLK*[1] ×0.4	SCLK*[1] ×0.5	SCLK*[1] ×0.6	s
SOUT output delay time (slave mode)	t_{SD}	—	—	—	500	ns
SOUT output delay time (master mode)	t_{SD}	—	—	—	500	ns
SIN input setup time (slave mode)	t_{SS}	—	80	—	—	ns
SIN input setup time (master mode)	t_{SS}	—	500	—	—	ns
SIN input hold time	t_{SH}	—	300	—	—	ns

*1: Clock period selected with S0CK3–0 of the serial port 0 mode register (SIO0MOD1)



*: Indicates the secondary function of the port.

AC CHARACTERISTICS (RC Oscillation A/D Converter)

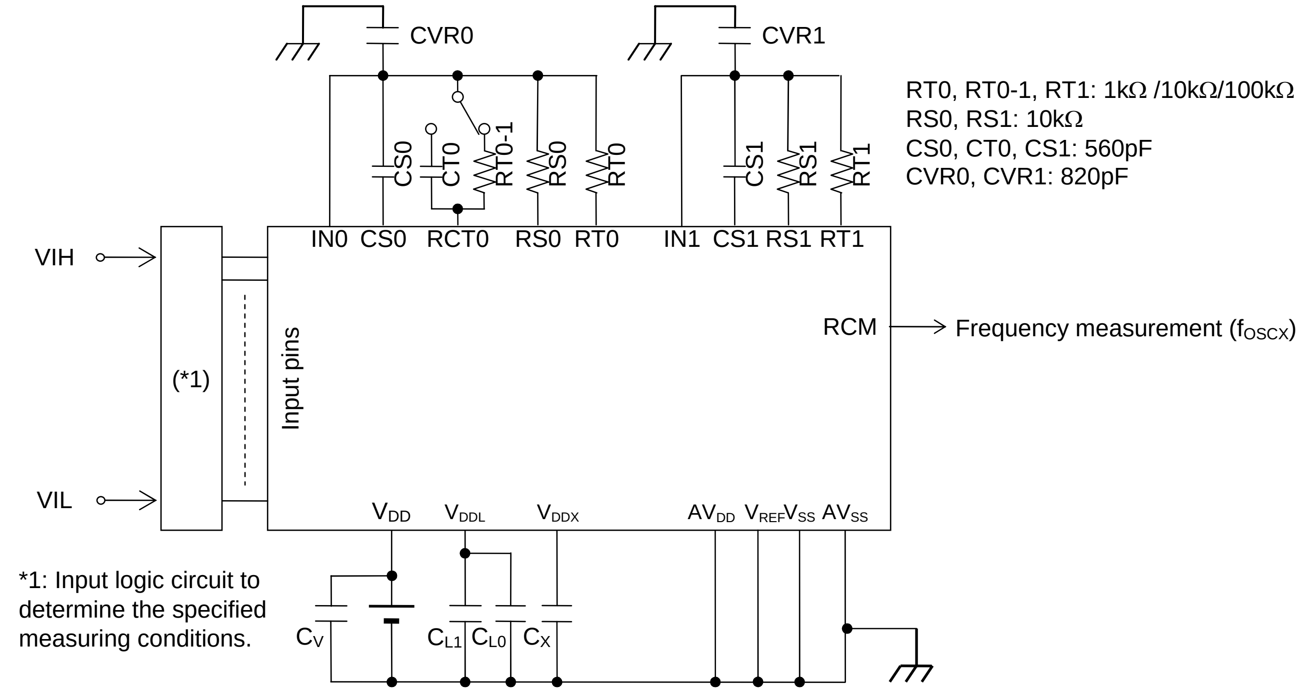
(V_{DD} = 1.3 to 3.6V, AV_{DD} = 2.2 to 3.6V, V_{SS} = AV_{SS} = 0V, Ta = –20 to +70°C, Ta = –40 to +85°C for P version, unless otherwise specified)

Parameter	Symbol	Condition	Rating			Unit
			Min.	Typ.	Max.	
Resistors for oscillation	RS0, RS1, RT0, RT0-1,RT1	CS0, CT0, CS1 ≥ 740pF	1	—	—	kΩ
Oscillation frequency VDD = 1.5V	f_{OSC1}	Resistor for oscillation = 1kΩ	209.4	330.6	435.1	kHz
	f_{OSC2}	Resistor for oscillation = 10kΩ	41.29	55.27	64.16	kHz
	f_{OSC3}	Resistor for oscillation = 100kΩ	4.71	5.97	7.06	kHz
RS to RT oscillation frequency ratio *1 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_{OSC1}	Resistor for oscillation = 1kΩ	407.3	486.7	594.6	kHz
	f_{OSC2}	Resistor for oscillation = 10kΩ	49.76	59.28	72.76	kHz
	f_{OSC3}	Resistor for oscillation = 100kΩ	5.04	5.993	7.04	kHz
RS to RT oscillation frequency ratio *1 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	—

*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.

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

(x = 1, 2, 3)



Note:

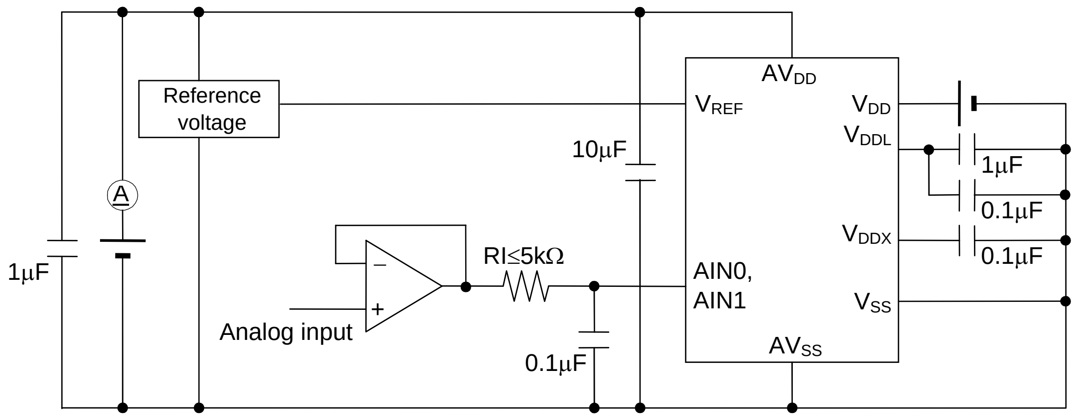
- Please have the shortest layout for the common node (wiring patterns which are connected to the external capacitors, resistors and IN0/IN1 pin), including CVR0/CVR1. Especially, do not have long wire between IN0/IN1 and RS0/RS1. The coupling capacitance on the wires may occur incorrect A/D conversion. 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, resisteor 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.

Electrical Characteristics of Successive Approximation Type A/D Converter

(V_{DD} = 1.8 to 3.6V, AV_{DD} = 2.2 to 3.6V, V_{SS} = AV_{SS} = 0V, Ta = –20 to +70°C, Ta = –40 to +85°C for P version, unless otherwise specified)

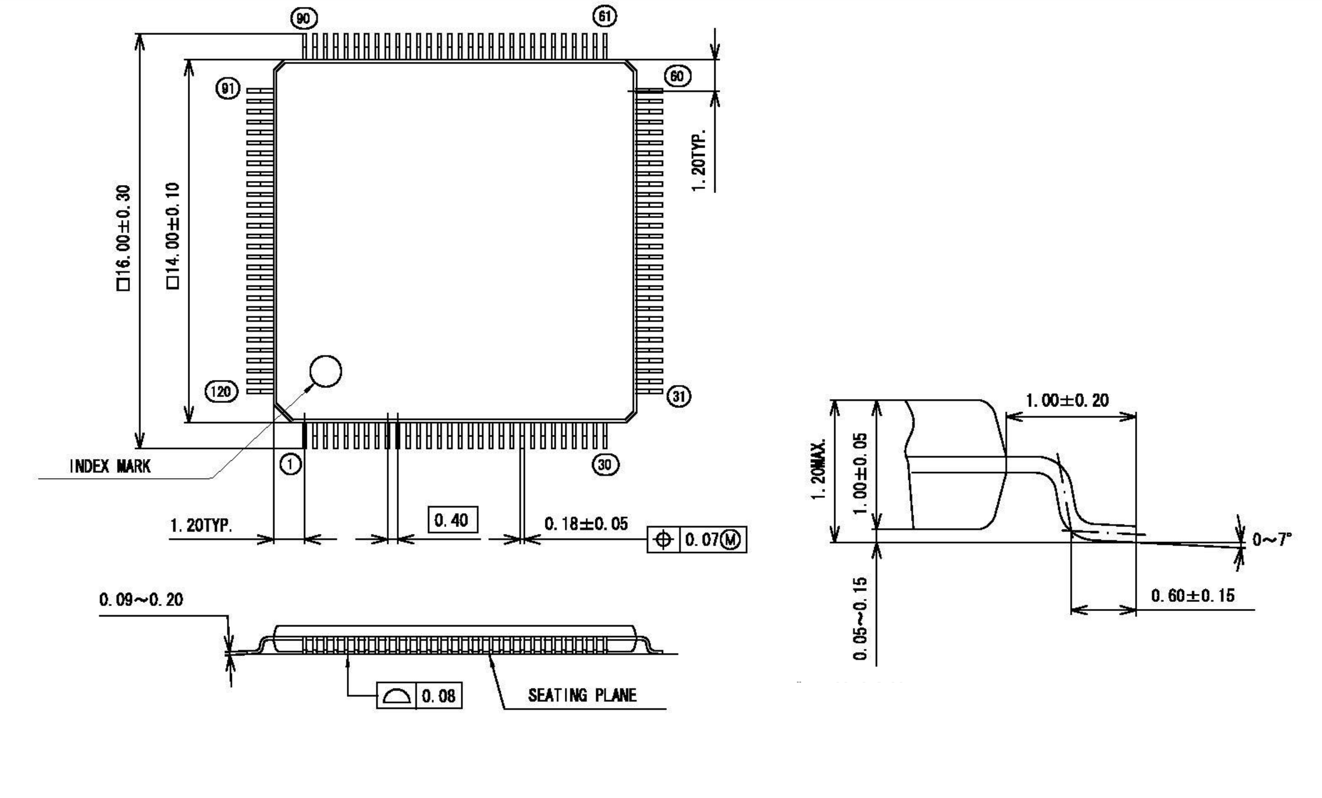
Parameter	Symbol	Condition	Rating			Unit
			Min.	Typ.	Max.	
Resolution	n	—	—	—	12	bit
Integral non-linearity error	IDL	$2.7V \le V_{REF} \le 3.6V$	–4	—	+4	LSB
		$2.2V \le V_{REF} \le 2.7V$	–6	—	+6	
Differential non-linearity error	DNL	$2.7V \le V_{REF} \le 3.6V$	–3	—	+3	
		$2.2V \le V_{REF} \le 2.7V$	–5	—	+5	
Zero-scale error	V_{OFF}	—	–6	—	+6	
Full-scale error	FSE	—	–6	—	+6	
Reference voltage	V_{REF}	—	2.2	—	AV_{DD}	V
Conversion time	t_{CONV}	—	—	23*[1]	—	ϕ/CH

ϕ: Period of high-speed clock (HSCLK)
*[1]: 2ϕ / CH is required as an interval time for each conversion in the case of consecutive A/D conversion.



PACKAGE DIMENSIONS

(Unit: mm)



NOTES:
1. LEAD WIDTH DOES NOT INCLUDE TRIM OFFSET.
2. PACKAGE WIDTH AND LENGTH DO NOT INCLUDE MOLD PROTRUSION, DIEPAD SUPPORT PROTRUSION AND CAVITY OFFSET BETWEEN TOP AND BOTTOM CAVITY.
3. THE SEATING PLANE IS THE SURFACE WHICH THE PACKAGE IS MOUNTED ON AND GETS IN CONTACT WITH.

LAPIS Semiconductor Co., Ltd.			
PACKAGE CODE	P-TQFP120-1414-0.40-UK6		
PACKAGE MATERIAL	EPOXY RESIN	UNIT	mm
LEAD FLAME MATERIAL	Cu ALLOY	DWG No.	QSL-68861
LEAD FINISH	Sn 100%	REVISION	1
SOLDER THICKNESS	MORE THAN 5μm	1st ISSUE	Aug/01/2014
PACKAGE MASS (g)	0.55TYP.	REVISED	

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 a ROHM sales office for the product name, package name, pin number, package code and desired mounting conditions (reflow method, temperature and times).

<u>Notes</u>

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