



Dear customer

ROHM Co., Ltd. ("ROHM"), on the 1st day of April, 2024,
has absorbed into merger with 100%-owned subsidiary of LAPIS Technology Co., Ltd.

Therefore, all references to "LAPIS Technology Co., Ltd.", "LAPIS Technology"
and/or "LAPIS" in this document shall be replaced with "ROHM Co., Ltd."

Furthermore, there are no changes to the documents relating to our products other than
the company name, the company trademark, logo, etc.

Thank you for your understanding.

ROHM Co., Ltd.
April 1, 2024

Dear customer

LAPIS Semiconductor Co., Ltd. ("LAPIS Semiconductor"), on the 1st day of October, 2020, implemented the incorporation-type company split (shinsetsu-bunkatsu) in which LAPIS established a new company, LAPIS Technology Co., Ltd. ("LAPIS Technology") and LAPIS Technology succeeded LAPIS Semiconductor's LSI business.

Therefore, all references to "LAPIS Semiconductor Co., Ltd.", "LAPIS Semiconductor" and/or "LAPIS" in this document shall be replaced with "LAPIS Technology Co., Ltd."

Furthermore, there are no changes to the documents relating to our products other than the company name, the company trademark, logo, etc.

Thank you for your understanding.

LAPIS Technology Co., Ltd.

October 1, 2020

ML620Q131B/2B/3B/4B/5B/6B

16-bit micro controller

GENERAL DESCRIPTION

This LSI is a high performance CMOS 16-bit microcontroller equipped with an 16-bit CPU nX-U16/100 and integrated with rich peripheral functions such as the timer, PWM, comparator, voltage level supervisor, UART, I2C, and successive approximation type A/D converter.

The CPU nX-U16/100 is capable of efficient instruction execution in 1-instruction 1-clock mode by 3-stage pipeline architecture parallel processing. It has the data flash memory area which can be written by software.

In addition, the on-chip debug function that is installed enables software debugging and programming.

FEATURES

- CPU
 - 16-bit RISC CPU (CPU name: nX-U16/100)
 - Instruction system: 16-bit length instruction
 - Instruction set: Transfer, arithmetic operations, comparison, logic operations, multiplication/division, bit manipulations, bit logic operations, jump, conditional jump, call return stack manipulations, arithmetic shift, and so on
 - On-chip debug function built in
 - Minimum instruction execution time
30.5 μ s (at 32.768 KHz system clock)
0.063 μ s (at 16 MHz system clock)
- Internal memory
 - Flash memory* (program area) Rewrite count 100 cycles
ML620Q131B: 8 Kbyte (4K x 16 bits)
ML620Q132B: 16 Kbyte (8K x 16 bits)
ML620Q133B: 24 Kbyte (12K x 16 bits)
ML620Q134B: 8 Kbyte (4K x 16 bits)
ML620Q135B: 16 Kbyte (8K x 16 bits)
ML620Q136B: 24 Kbyte (12K x 16 bits)
 - Flash memory (data area) Rewrite count 10,000 cycles
2 Kbyte (1K x 16 bits)
 - SRAM
2 Kbyte (2K x 8 bits)

*: This product uses SuperFlash® technology licensed from Silicon Storage Technology, Inc. SuperFlash® is a registered trademark of Silicon Storage Technology, Inc.
- Interrupt controller
 - Non-maskable interrupt source: 2 (Internal sources: BACK-UP CLOCK, WDT)
 - Maskable interrupt sources: 30 (Internal sources: 25, External sources: 5)
 - Four interrupt levels and masking function
- Time base counter
 - Low-speed time base counter $\times$ 1 channel
- Watchdog timer
 - Non-maskable interrupt and reset
(The first overflow generates an interrupt, and the second overflow generates a reset)
 - Free running
 - Overflow period: 4 types selectable (125 ms, 500 ms, 2 s, and 8 s at 32.768 kHz)



- Timers
 - 8 bits x 10 ch (16-bit configuration available)
 - Continuous timer mode/one-shot timer mode
 - Timer start/stop function by software/external trigger input
- PWM
 - Resolution 16 bits x 1 ch
 - Continuous PWM mode/one-shot PWM mode
 - PWM start/stop function by software/external trigger input
- Synchronous serial port
 - Master/slave selectable
 - LSB first/MSB first selectable
 - 8-bit length/16-bit length selectable
 - Operation in the SPI mode 0/3
 - Overflow detection function
- UART
 - Full-duplex communication x 1 ch
 - Bit length, parity/no parity, odd parity/even parity, 1 stop bit/2 stop bits
 - Positive logic/negative logic selectable
 - Internal baud rate generator
- I²C bus interface
 - Master x 1ch
Standard mode (100 kbit/s) and fast mode (400 kbit/s) are supported
 - Slave x 1ch
Standard mode (100 kbit/s) and fast mode (400 kbit/s) are supported
- Successive approximation type A/D converter
 - 10-bit A/D converter
 - ML620Q131B/ ML620Q132B/ ML620Q133B : Input 6 ch
 - ML620Q134B/ ML620Q135B/ML620Q136B : Input 8 ch
- Analog Comparator
 - Operation voltage range: VDD = 1.8 to 5.5 V
 - Hysteresis width (only comparator 0): 20 mV (Typ.)
 - Interrupts allow edge selection and sampling selection
- DUTY measurement circuit
 - DUTY ratio measurement by inputting PWM signals with frequencies from 2 KHz to 64 KHz
 - DUTY measurement interrupt: 4 types selectable (64 μ s, 0.51 ms, 1.09 ms, 2.18 ms)
- General-purpose ports (including secondary functions)
 - Input-only port
1 ch (including secondary functions, also used by the on-chip debug pin)
 - I/O port
ML620Q131B/ML620Q132B/ML620Q133B: 10 ch (including secondary functions)
ML620Q134B/ML620Q135B/ML620Q136B: 14 ch (including secondary functions)

- Reset
 - RESET_N pin reset
 - Reset by power-on detection
 - Reset by the watchdog timer (WDT) overflow
 - Reset by RAM parity error (enable/disable can be selected)
 - Reset by voltage level detection 0 (VLS0) (enable/disable can be selected)
 - Reset by voltage level detection 1 (VLS1) (enable/disable can be selected)
 - Reset by prohibition program address change
- Voltage level detect function
 - 2 ch
 - Threshold voltage: 12 values selectable
 - Interrupt generation or reset generation can be selected
- Clock
 - Low-speed clock
 - Internal low-speed RC oscillation (32.768 KHz)
 - High-speed clock
 - PLL oscillation @ internal high-speed RC oscillation (32 MHz*1)
 - High-speed crystal oscillation (4 MHz)
 - PLL oscillation @ high-speed crystal oscillation (32 MHz*1*2)
 - Selection of high-speed clock mode by software
 - PLL oscillation @ internal high-speed RC oscillation mode (16 MHz)
 - High-speed crystal oscillation mode (4 MHz)
 - PLL oscillation @ high-speed crystal oscillation mode (16 MHz)

*1) 32 MHz can be used only as the PWMC clock.
The maximum frequency of the system clock is 16 MHz.

*2) To use the high-speed crystal oscillation and PLL oscillation @ high-speed crystal oscillation, be sure to connect the high-speed crystal (4 MHz).
- Power management
 - HALT mode: Suspends the instruction execution by CPU (peripheral circuits are in operating states)
 - STOP mode: Stops the 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, 1/8, or 1/16 of the oscillation clock)
 - Block Control Function: Powers down (reset registers and stop clock supply) the circuits of unused function blocks

ML620Q131B/2B/3B/4B/5B/6B

- Shipment
 - 16-pin plastic SSOP
 - ML620Q131B-xxxMB (Blank part: ML620Q131B-NNNMB)
 - ML620Q132B-xxxMB (Blank part: ML620Q132B-NNNMB)
 - ML620Q133B-xxxMB (Blank part: ML620Q133B-NNNMB)
 - xxx: ROM code number
 - 16-pin WQFN
 - ML620Q131B-xxxGD (Blank part: ML620Q131B-NNNGD)
 - ML620Q132B-xxxGD (Blank part: ML620Q132B-NNNGD)
 - ML620Q133B-xxxGD (Blank part: ML620Q133B-NNNGD)
 - xxx: ROM code number
 - 20-pin plastic TSSOP
 - ML620Q134B-xxxTD (Blank part: ML620Q134B-NNNTD)
 - ML620Q135B-xxxTD (Blank part: ML620Q135B-NNNTD)
 - ML620Q136B-xxxTD (Blank part: ML620Q136B-NNNTD)
 - xxx: ROM code number
 - 20-pin plastic SSOP
 - ML620Q134B-xxxMB (Blank part: ML620Q134B-NNNMB)
 - ML620Q135B-xxxMB (Blank part: ML620Q135B-NNNMB)
 - ML620Q136B-xxxMB (Blank part: ML620Q136B-NNNMB)
 - xxx: ROM code number
- Guaranteed operating range
 - Operating temperature: -40 to 105 °C
 - Operating voltage: VDD = 1.6 to 5.5 V

The difference of ML620Q130B series is shown below.

Feature	ML620Q131B	ML620Q132B	ML620Q133B	ML620Q134B	ML620Q135B	ML620Q136B
Shipment	16-pin SSOP/ 16-pin WQFN			20-pin TSSOP/ 20-pin SSOP		
FLASH capacity (Program area)	8 KB	16 KB	24 KB	8 KB	16 KB	24 KB
Number of input channels for successive approximation type A/D converter	6 ch			8 ch		
Number of input-only ports	1 (also used by the on-chip debug pin)			1 (also used by the on-chip debug pin)		
Number of I/O ports	10			14		

BLOCK DIAGRAM

ML620Q131B/ML620Q132B/ML620Q133B Block Diagram

“*” indicates the secondary, tertiary or quarternary function.

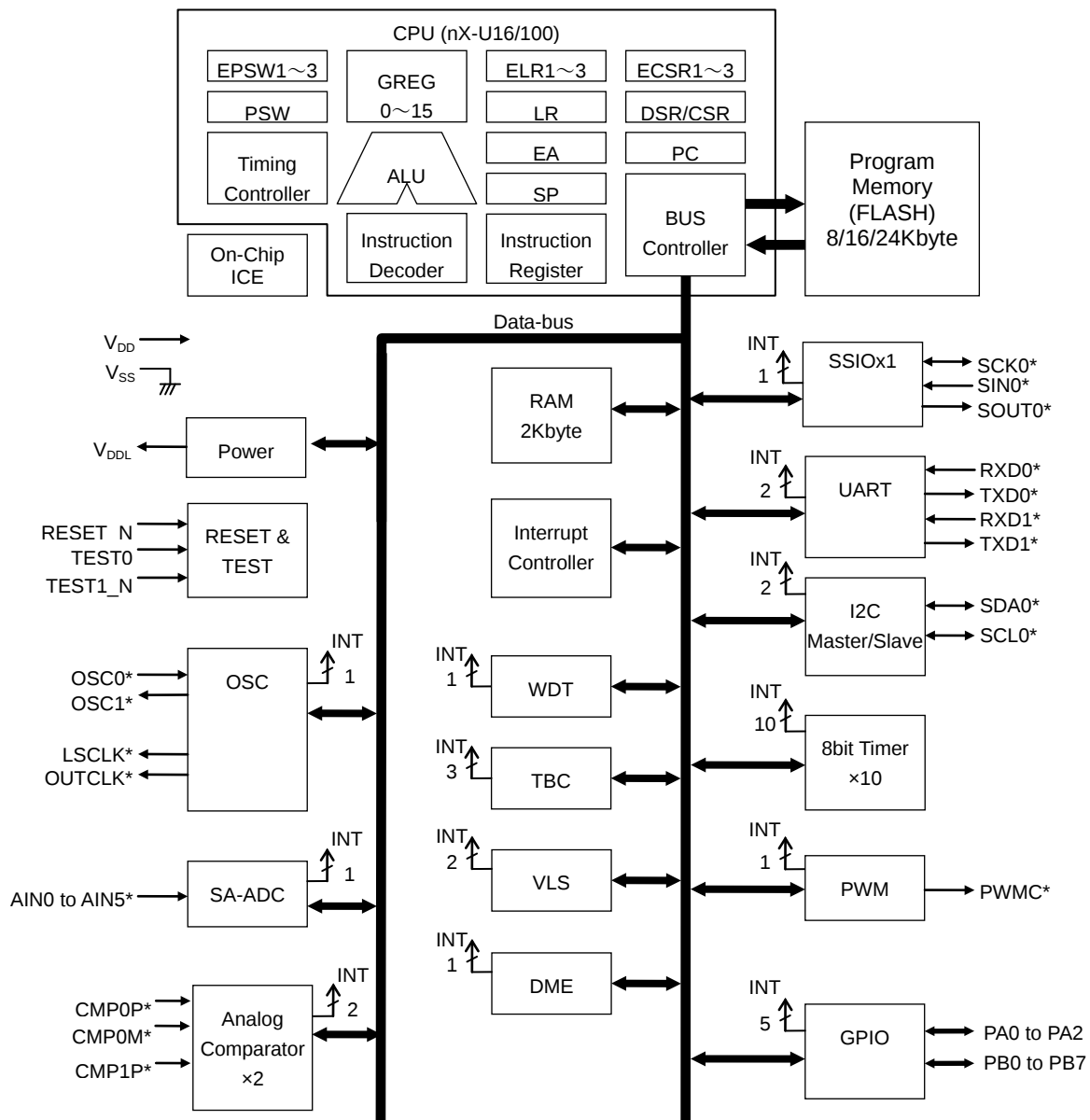


Figure 1-1 ML620Q131B/ML620Q132B/ML620Q133B Block Diagram

ML620Q134B/ML620Q135B/ML620Q136B Block Diagram

“*” indicates the secondary, tertiary or quaternary function.

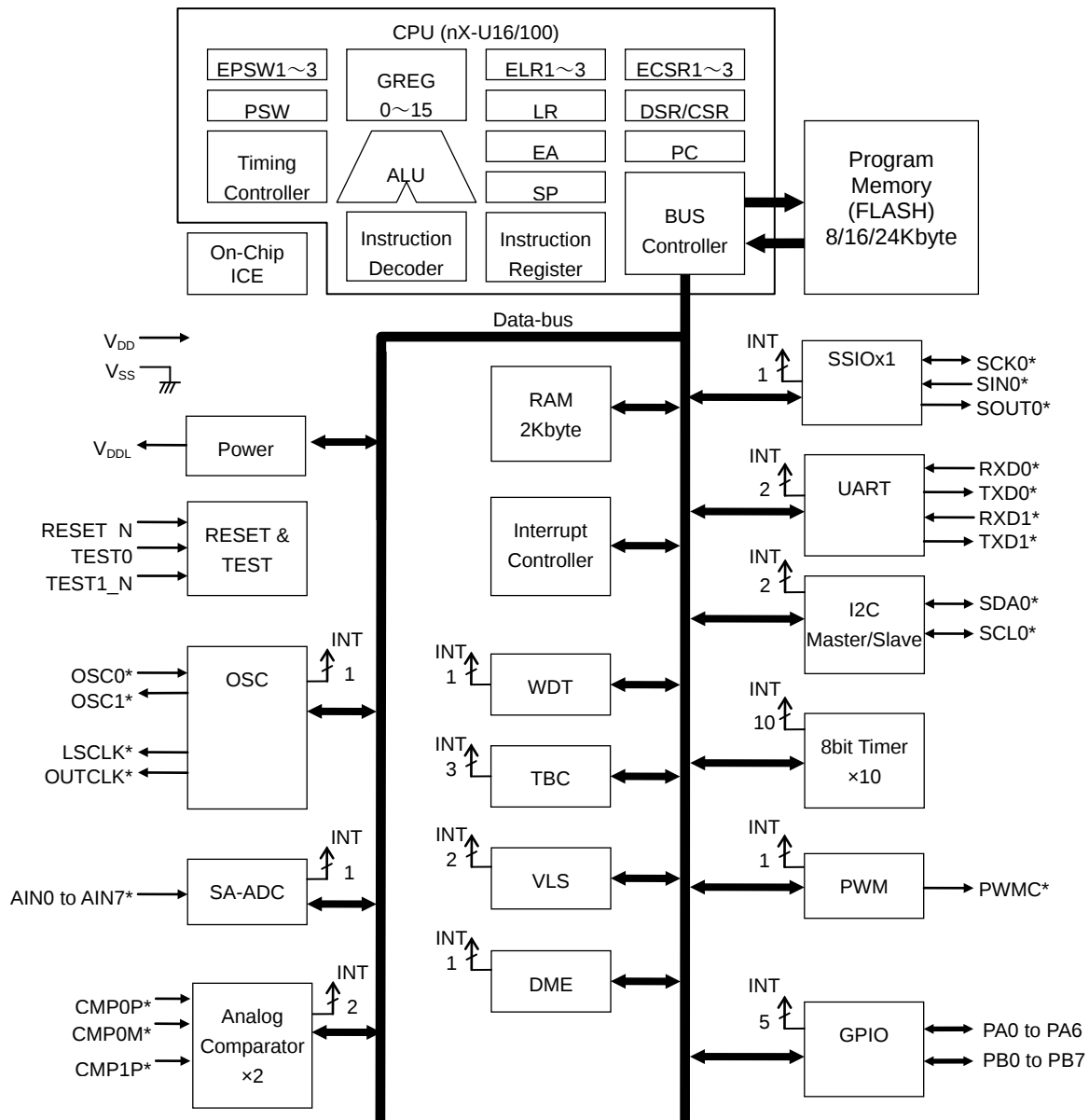


Figure 1-2 ML620Q134B/ML620Q135B/ML620Q136B Block Diagram

PIN CONFIGURATION

Pin Layout of ML620Q131B/ML620Q132B/ML620Q133B 16pin SSOP Package

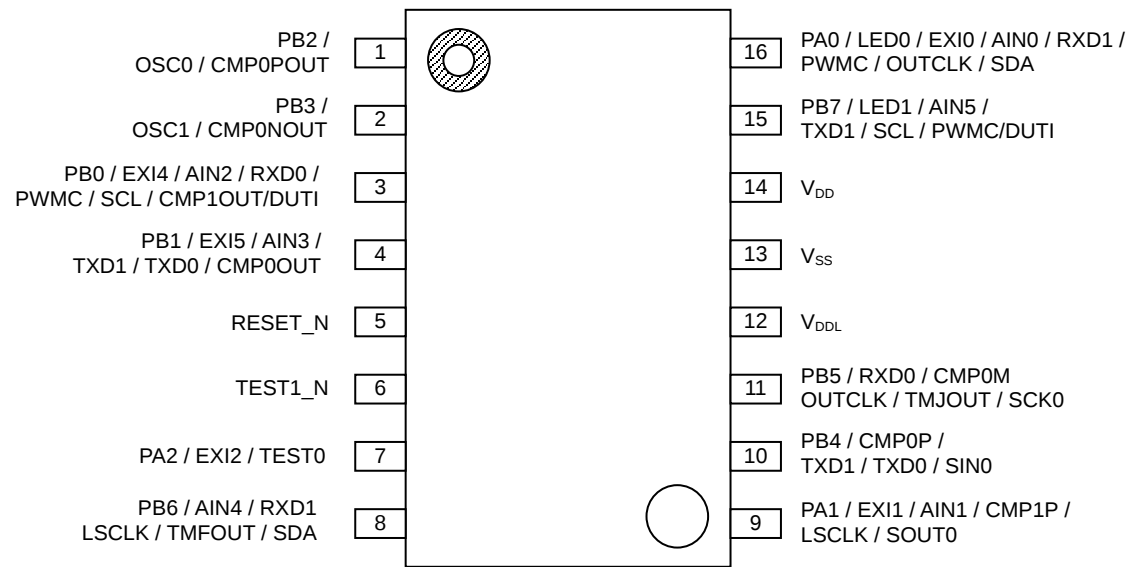


Figure 2 Pin Layout of ML620Q131B/ML620Q132B/ML620Q133B 16pin SSOP Package

Pin Layout of ML620Q131B/ML620Q132B/ML620Q133B 16pin WQFN Package

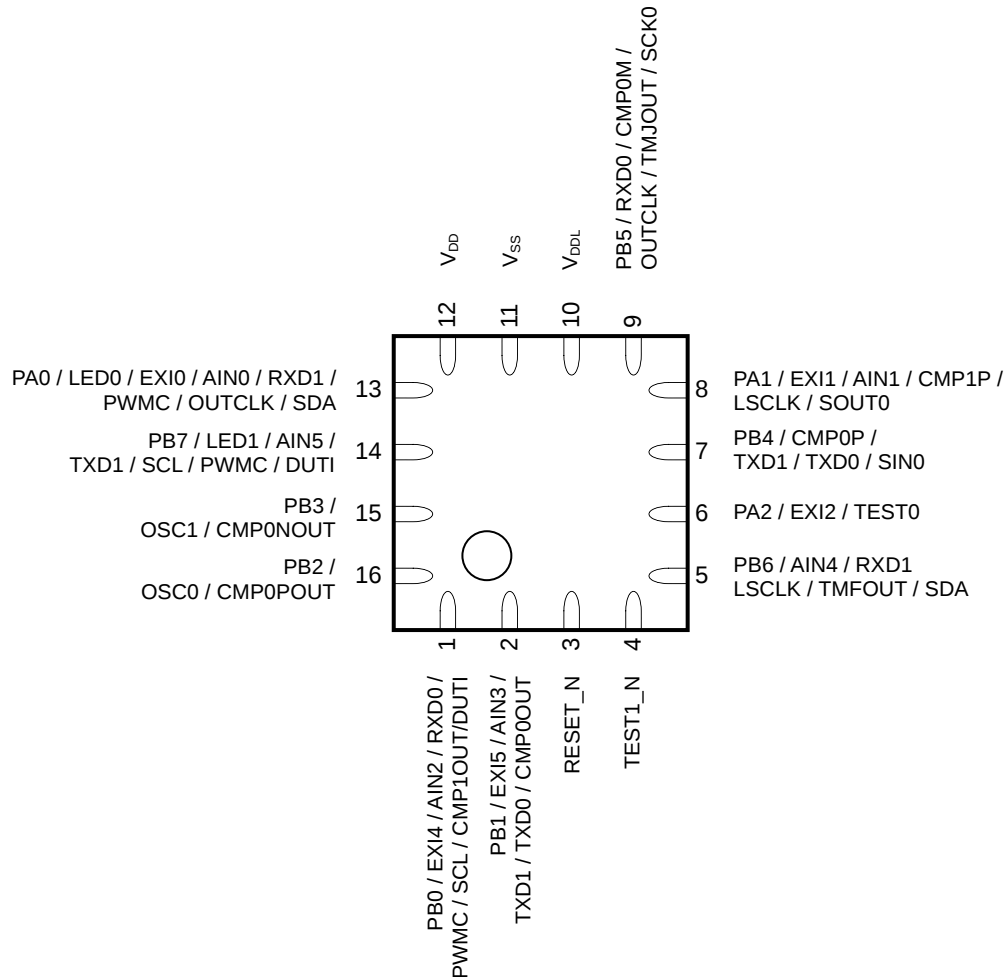


Figure 3 Pin Layout of ML620Q131B/ML620Q132B/ML620Q133B 16pin WQFN Package

Pin Layout of ML620Q134B/ML620Q135B/ML620Q136B 20pin TSSOP/SSOP Package

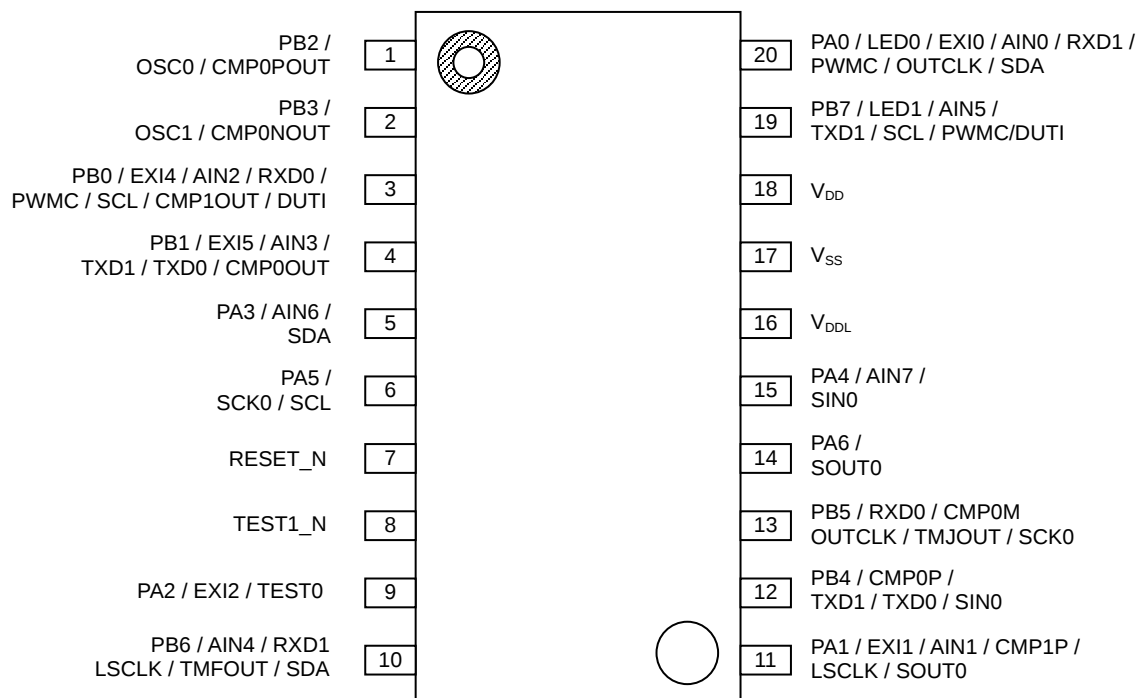


Figure 4 Pin Layout of ML620Q134B/ML620Q135B/ML620Q136B 20pin TSSOP/SSOP Package

PIN LIST

Table 1 Pin List

PAD No. (16pin SSOP)	PAD No. (16pin WQFN)	PAD No. (20pin TSSOP/ SSOP)	Primary function			Secondary function			Tertiary function			Quartic function		
			Pin name	I/O	Feature	Pin name	I/O	Feature	Pin name	I/O	Feature	Pin name	I/O	Feature
14	12	18	V _{DD}	I/O	Positive power supply pin input/output	—	—	—	—	—	—	—	—	—
12	10	16	V _{DDL}	I/O	Power supply pin for internal logic (Internal generation)	—	—	—	—	—	—	—	—	—
13	11	17	V _{SS}	I/O	Negative power supply pin input/output	—	—	—	—	—	—	—	—	—
5	3	7	RESET_N	I	Reset input pin	—	—	—	—	—	—	—	—	—
6	4	8	TEST1_N	I	Input pin for testing	—	—	—	—	—	—	—	—	—
16	13	20	PA0/ LED0/ EXI0/ AIN0/ RXD1	I/O	I/O port/ LED drive External interrupt 0/ AD input 0/ UART1 reception	PWMC	O	PWMC output	OUTCLK	O	High-speed clock output	SDA	I/O	I ² C data I/O
9	8	11	PA1/ EXI1/ AIN1/ CMP1P	I/O	I/O port/ External interrupt 1/ AD input 1/ Comparator 1 Non-inverting input	—	—	—	LSCLK	O	Low-speed clock output	SOUT0	O	SSIO data output
7	6	9	PA2/ EXI2/ TEST0	I	input port/ External interrupt 2/ Input pin for testing	—	—	—	—	—	—	—	—	—
—	—	5	PA3/ AIN6	I/O	I/O port/ AD input 6	—	—	—	SDA	I/O	I ² C data I/O	—	—	—
—	—	15	PA4/ AIN7	I/O	I/O port/ AD input 7	SIN0	I	SSIO data input	—	—	—	—	—	—
—	—	6	PA5	I/O	I/O port	SCK0	I/O	SSIO clock I/O	SCL	I/O	I ² C clock I/O	—	—	—
—	—	14	PA6	I/O	I/O port	SOUT0	O	SSIO data output	—	—	—	—	—	—
3	1	3	PB0/ EXI4/ AIN2/ RXD0/ DUTI	I/O	I/O port/ External interrupt 4/ AD input 2/ UART0 reception/ DUTY measurement	PWMC	O	PWMC output	SCL	I/O	I ² C clock I/O	CMP1OUT	O	CMP1 output
4	2	4	PB1/ EXI5/ AIN3	I/O	I/O port/ External interrupt 5/ AD input 3	TXD1	O	UART1 transmission	TXD0	O	UART0 transmission	CMP0OUT	O	CMP0 output
1	16	1	PB2	I/O	I/O port	OSC0	I	High-speed oscillation	—	—	—	CMP0POUT	O	CMP0P output
2	15	2	PB3	I/O	I/O port	OSC1	O	High-speed oscillation	—	—	—	CMP0NOUT	O	CMP0N output

ML620Q131B/2B/3B/4B/5B/6B

PAD No. (16pin SSOP)	PAD No. (16pin WQFN)	PAD No. (20pin TSSOP/SSOP)	Primary function			Secondary function			Tertiary function			Quartic function		
			Pin name	I/O	Feature	Pin name	I/O	Feature	Pin name	I/O	Feature	Pin name	I/O	Feature
10	7	12	PB4/ CMP0P	I/O	I/O port/ Comparator 0 Non-inverting input	TXD1	O	UART1 transmission	TXD0	O	UART0 transmission	SIN0	I	SSIO data input
11	9	13	PB5/ RXD0/ CMP0M	I/O	I/O port/ UART0 reception/ Comparator 0 Inverting input	OUTCLK	O	High-speed clock output	TMJOUT	O	Timer J output	SCK0	I/O	SSIO clock I/O
8	5	10	PB6/ AIN4/ RXD1	I/O	I/O port/ AD input 4/ UART1 reception	LSCLK	O	Low-speed clock output	TMFOUT	O	Timer F output	SDA	I/O	I ² C data I/O
15	14	19	PB7/ LED1/ AIN5/ DUTI	I/O	I/O port/ LED drive AD input 5/ DUTY measurement	TXD1	O	UART1 transmission	SCL	I/O	I ² C clock I/O	PWMC	O	PWMC output

PIN DESCRIPTION

Table 2 Pin Description (1/4)

Pin name	I/O	Description	Primary/ Secondary/ Tertiary/ Quartic	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. The RESET_N pin does not have an internal pull-up resistor.	—	Negative
OSC0	I	Crystal connection pin for the high-speed clock.	Secondary	—
OSC1	O	A crystal oscillator is connected to this pin (4 MHz max.), and capacitors C_{DH} and C_{GH} (see measurement circuit 1) are connected between this pin and V_{SS} . This pin is used as the secondary function of the PB2 and PB3 pins.	Secondary	—
LSCLK	O	Low-speed clock output. This pin is used as the tertiary function of the PA1 pin or the secondary function of the PB6 pin.	Secondary/ Tertiary	—
OUTCLK	O	High-speed clock output pin. This pin is used as the tertiary function of the PA0 pin or the secondary function of the PB5 pin.	Tertiary	—
General-purpose input port				
PA2	I	General-purpose input port.	—	Positive
General-purpose input/output port				
PA0 to PA1 PB0~PB7	I/O	General-purpose input/output port. This cannot be used as the general input/output port when used as the secondary to quartic functions.	—	Positive
PA3 to PA6	I/O	General-purpose input/output port. This cannot be used as the general input/output port when used as the secondary to quartic functions. Not available in ML620Q131B/ML620Q132B/ML620Q133B.	—	Positive
Serial (UART)				
TXD0	O	UART0 transmit pin. This pin is used as the tertiary function of the PB1 and PB4 pins.	Tertiary	Positive
TXD1	O	UART1 transmit pin. This pin is used as the secondary function of the PB1, PB4, and PB7 pins.	Secondary	Positive
RXD0	I	UART0 receive pin. This pin is used as the primary function of the PB0 and PB5 pins.	Primary	Positive
RXD1	I	UART1 receive pin. This pin is used as the primary function of the PA0 and PB6 pins.	Primary	Positive
I ² C Bus Interface				
SDA	I/O	NMOS open drain pin for I ² C data input/output. This pin is used as the quartic function of the PA0 pin, the tertiary function of the PA3 pin, or the quartic function of the PB6 pin. A pull-up resistor is connected externally.	Tertiary/ Quartic	Positive
SCL	I/O	NMOS open drain pin for I ² C clock input/output. This pin is used as the tertiary function of the PA5 pin, the tertiary function of the PB0 pin, or the tertiary function of the PB7 pin. A pull-up resistor is connected externally.	Tertiary	Positive

Table 2 Pin Description (2/4)

Pin name	I/O	Description	Primary/ Secondary/ Tertiary/ Quartic	Logic
Synchronous serial (SSIO)				
SIN	I	Synchronous serial data input pin. This pin is used as the secondary function of the PA4 pin or the quartic function of the PB4 pin.	Secondary/ Quartic	Positive
SCK0	I/O	High-speed clock input pin. This pin is used as the secondary function of the PA5 pin or the quartic function of the PB5 pin.	Secondary/ Quartic	—
SOUT0	O	High-speed clock output pin. This pin is used as the quartic function of the PA1 pin or the secondary function of the PA6 pin.	Secondary/ Quartic	Positive
PWM				
PWMC	O	PWMC output pin. This pin is used as the secondary function of the PA0 and PB0 pins or the quartic function of the PB7 pin.	Secondary/ Quartic	Positive/ negative
External interrupt				
EXI0 to 2	I	External maskable interrupt input pins. Interrupt enable and edge selection can be performed for each bit by software. This pin is used as the primary function of the PA0 to PA2 pins.	Primary	Positive/ negative
EXI4,5	I	External maskable interrupt input pins. Interrupt enable and edge selection can be performed for each bit by software. This pin is used as the primary function of the PB0 and PB1 pins.	Primary	Positive/ negative
Timer				
TnTG	I	External trigger input pin of the timer 0, timer 1, timer E, timer F, timer G, timer H, timer I, timer J, timer K, or timer L. This pin is used as the primary function of the PA0 to PA2 and PB0 to PB7 pins.	Primary	—
TMJOUT	O	Timer J output pin. This pin is used as the tertiary function of PB5.	Tertiary	Positive
TMFOUT	O	Timer F output pin. This pin is used as the tertiary function of PB6.	Tertiary	Positive
LED drive				
LED0, 1	O	Pins for LED driving. Allocated to the primary function of the PA0 and PB7 pins.	Primary	Positive/ negative

Table 2 Pin Description (3/4)

Pin name	I/O	Description	Primary/ Secondary/ Tertiary/ Quartic	Logic
Successive approximation type A/D converter				
AIN0	I	Ch0 analog input for successive approximation type A/D converter. This pin is used as the primary function of the PA0 pin.	Primary	—
AIN1	I	Ch1 analog input for successive approximation type A/D converter. This pin is used as the primary function of the PA1 pin.	Primary	—
AIN2	I	Ch2 analog input for successive approximation type A/D converter. This pin is used as the primary function of the PB0 pin.	Primary	—
AIN3	I	Ch3 analog input for successive approximation type A/D converter. This pin is used as the primary function of the PB1 pin.	Primary	—
AIN4	I	Ch4 analog input for successive approximation type A/D converter. This pin is used as the primary function of the PB6 pin.	Primary	—
AIN5	I	Ch5 analog input for successive approximation type A/D converter. This pin is used as the primary function of the PB7 pin.	Primary	—
AIN6	I	Ch6 analog input for successive approximation type A/D converter. This pin is used as the primary function of the PA3 pin. Not available in ML620Q131B/ML620Q132B/ML620Q133B.	Primary	—
AIN7	I	Ch7 analog input for successive approximation type A/D converter. This pin is used as the primary function of the PA4 pin. Not available in ML620Q131B/ML620Q132B/ML620Q133B.	Primary	—
Comparator				
CMP0P	I	Comparator 0 non-inverting input. This pin is used as the primary function of the PB4 pin.	Primary	—
CMP0M	I	Comparator 0 inverting input. This pin is used as the primary function of the PB5 pin.	Primary	—
CMP0OUT	O	Comparator 0 output pin. This pin is used as the quartic function of the PB1 pin.	Quartic	—
CMP0POUT	O	Comparator 0 output pin. This pin is used as the quartic function of the PB2 pin.	Quartic	—
CMP0NOUT	O	Comparator 0 output pin. This pin is used as the quartic function of the PB3 pin.	Quartic	—
CMP1P	I	Comparator 1 non-inverting input. This pin is used as the primary function of the PA1 pin.	Primary	—
CMP1OUT	O	Comparator 1 output pin. This pin is used as the quartic function of the PB0 pin.	Quartic	—
DUTY measurement circuit				
DUTI	I	PWM waveform input for the DUTY measurement circuit. This pin is used as the primary function of the PB0 and PB7 pins.	Primary	—

Table 2 Pin Description (4/4)

Pin name	I/O	Description	Primary/ Secondary/ Tertiary/ Quartic	Logic
For testing				
TEST0	I	Input pin for testing. This pin is used as the primary function of the PA2 pin.	—	Positive
TEST1_N	I	Input pin for testing. A pull-up resistor is internally connected.	—	Negative
Power supply				
V _{SS}	—	Negative power supply pin.	—	—
V _{DD}	—	Positive power supply pin.	—	—
V _{DDL}	—	Power supply pin for internal logic (internally generated). Capacitor C _L (see measurement circuit 1) is connected between this pin and V _{SS} .	—	—

TERMINATION OF UNUSED PINS

Table 3 Termination of unused pins

Pin	Recommended pin termination
RESET_N	Pull up to V_{DD} , or V_{DD}
TEST1_N	open
PA0 to PA1	open
PA2/TEST0	V_{SS}
PA3 to PA6	open
PB0 to PB7	open

Note:

The unused input ports or unused input/output ports should not be configured as high-impedance inputs and left open. If the corresponding pins are configured as high-impedance inputs and left open, because the input buffer of both Nch and Pch MOS transistor turn on, the supply current may become excessively large. Therefore, it is recommended to configure those pins as either inputs with a pull-down resistor/pull-up resistor or outputs.

ELECTRICAL CHARACTERISTICS

Absolute Maximum Ratings

(V_{SS} = 0V)

Parameter	Symbol	Condition	Rating	Unit
Power supply voltage 1	V _{DD}	Ta = 25°C	-0.3 to +6.5	V
Power supply voltage 2	V _{DDL}	Ta = 25°C	-0.3 to +2.0	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 (PA0 to PA1) (PA3 to PA6)* (PB0 to PB7)	I _{OUT1}	Ta = 25°C	-12 to +11	mA
Output current 2 (PA0) (PB7)	I _{OUT2}	Ta = 25°C When N-channel open drain output mode is selected	-12 to +20	mA
Power dissipation	PD	Ta = 25°C	1	W
Storage temperature	T _{STG}	—	-55 to +150	°C

* : ML620Q131B/ ML620Q132B/ ML620Q133B do not have the peripherals.

Recommended Operating Conditions

(V_{SS} = 0V)

Parameter	Symbol	Condition	Range	Unit
Operating temperature	T _{OP}	—	-40 to +105	°C
Operating voltage	V _{DD}	—	1.6 to 5.5	V
Operating frequency (CPU)	f _{OP}	V _{DD} = 1.6 to 5.5V	30k to 32.768k	Hz
		V _{DD} = 1.8 to 5.5V	30k to 16M	
High-speed crystal oscillation frequency	f _{XTH}	V _{DD} = 1.8 to 5.5V	4.0M	Hz
High-speed crystal oscillation external capacitor	C _{DH}	Use NX8045GE (NIHON DEMPA KOGYO CORP.)	16	pF
	C _{GH}		16	
Capacitor externally connected to V _{DD} pin	C _V	—	2.2±30% or more	μF
Capacitor externally connected to V _{DDL} pin	C _L	—	2.2±30%	μF

Flash Memory Operating Conditions

(V_{SS} = 0V)

Parameter	Symbol	Condition	Range	Unit
Operating temperature	T _{OP}	Data flash memory, At write/erase	-40 to +105	°C
		Flash ROM, At write/erase	0 to +40	
Operating voltage	V _{DD}	At write/erase	1.6 to 5.5	V
Maximum rewrite count *1	C _{EPD}	Data Flash	10,000	times
	C _{EPP}	Program Flash	100	
Erase unit	—	Chip erase	All area	—
	—	Block erase	Program Flash	4
			Data Flash	2
	—	Sector erase	1	KB
Erase time	—	Chip erase, Block erase, Sector erase	100	ms
Write unit	—	—	1 word (2 Bytes)	—
Write time (Max.)	—	1 word (2 Bytes)	40	μs
Data retention period	Y _{DR}	—	15	years

*1: One rewrite cycle includes both one time erase and one time write, it counts as one even if the erase is aborted.

DC Characteristics (Supply Current)

(V_{DD}=1.6 to 5.5V, V_{SS}=0V, Ta=-40 to +105°C, unless otherwise specified)

Parameter	Symbol	Condition		Min.	Typ.	Max.	Unit	Measuring circuit	
Supply current 1	IDD1	CPU is in STOP state. Low-speed oscillation is stopped. V _{DD} =5.0V	Ta = -40 to +105°C	—	1	22	μA	1	
			Ta = -40 to +85°C	—	1	9			
Supply current 2	IDD2	Internal RC Oscillating. CPU is in HALT state (LTBC,WBC: Operating ^{*1}). High-speed oscillation is stopped. V _{DD} =3.0V		—	3.5	26			
Supply current 3	IDD3	CPU: Running at 32kHz ^{*2} High-speed oscillation is stopped. V _{DD} =3.0V		—	13	42			
Supply current 4	IDD4	CPU: Running at 16MHz PLL oscillating mode used High-speed crystal oscillation ^{*2} VDD=5.0V		—	4.5	5.5			mA
Supply current 5	IDD5	CPU: Running at 16MHz PLL oscillating mode used High-speed RC oscillation ^{*2} VDD=5.0V		—	4.5	5.5			

^{*1} : LTBC and WDT is operating, Significant bits of BLKCON0 to BLKCON7 registers are all "1"^{*2} : CPU running rate is 100%

ML620Q131B/2B/3B/4B/5B/6B

DC Characteristics (VOHL, IOHL)

(V_{DD}=1.6 to 5.5V, V_{SS}=0V, Ta=-40 to +105°C, unless otherwise specified)

Parameter	Symbol	Condition		Min.	Typ.	Max.	Unit	Measuring circuit
Output voltage 1 (PA0 to PA1) (PA3 to PA6)* (PB0 to PB7)	VOH1	IOH1 = -0.5mA		V _{DD} -0.5	—	—	V	2
	VOL1	IOL1 = +0.5mA		—	—	0.5		
Output voltage 2 (PA0) (PB7)	VOL2	When N-channel open drain output mode is selected	IOL2 = +10mA V _{DD} ≥ 5.0V	—	—	0.5		
			IOL2 = +8mA V _{DD} ≥ 3.0V	—	—	0.5		
			IOL3 = +3mA V _{DD} ≥ 2.0V	—	—	0.4		
			IOL3 = +2mA 2.0V > V _{DD} ≥ 1.8V	—	—	V _{DD} * 0.2		
Output leakage current (PA0 to PA1) (PA3 to PA6)* (PB0 to PB7)	IOOH	VOH = V _{DD} (in high-impedance state)		—	—	1	μA	3
	IOOL	VOL = V _{SS} (in high-impedance state)		-1	—	—		

*: ML620Q131B/ ML620Q132B/ ML620Q133B do not have the peripherals.

DC Characteristics (IIHL)

(V_{DD}=1.6 to 5.5V, V_{SS}=0V, Ta=-40 to +105°C, unless otherwise specified)

Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit	Measuring circuit
Input current 1 (RESET_N)	IIH1	VIH1 = V _{DD}	—	—	1	μA	4
	IIL1	VIL1 = V _{SS}	-1	—	—		
Input current 2 (TEST1_N)	IIH2	VIH2 = V _{DD}	—	—	1		
	IIL2	VIL2 = V _{SS}	-1500	-300	-20		
Input current 3 (PA0 to PA1) (PA2/TEST0) (PA3 to PA6)* (PB0 to PB7)	IIH3	VIH3 = V _{DD} (when pulled down)	2	30	250		
	IIL3	VIL3 = V _{SS} (when pulled up)	-250	-30	-2		
	IIH3Z	VIH3 = V _{DD} (in high-impedance state)	—	—	1		
	IIL3Z	VIL3 = V _{SS} (in high-impedance state)	-1	—	—		

*: ML620Q131B/ ML620Q132B/ ML620Q133B do not have the peripherals.

ML620Q131B/2B/3B/4B/5B/6B**DC Characteristics (VIHL)**(V_{DD}=1.6 to 5.5V, V_{SS}=0V, Ta=-40 to +105°C, unless otherwise specified)

Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit	Measuring circuit
Input voltage 1 (RESET_N) (TEST1_N) (PA0 to PA1) (PA2/TEST0) (PA3 to PA6)* (PB0 to PB7)	VIH1	—	0.7× V _{DD}	—	V _{DD}	V	5
	VIL1	—	0	—	0.3× V _{DD}		
Input pin capacitance (RESET_N) (TEST1_N) (PA0 to PA1) (PA2/TEST0) (PA3 to PA6)* (PB0 to PB7)	CIN	f = 10kHz Ta = 25°C	—	—	10	pF	—

* : ML620Q131B/ ML620Q132B/ ML620Q133B do not have the peripherals.

ML620Q131B/2B/3B/4B/5B/6B

DC Characteristics (Voltage Level Supervisor)

(V_{DD}=1.6 to 5.5V, V_{SS}=0V, Ta=-40 to +105°C, unless otherwise specified)

Parameter	Symbol	Condition		Min.	Typ.	Max.	Unit	Measuring circuit
Voltage Level Supervisor 0 (VLS0) threshold voltage	V _{VLS0}	VLS03 to 0 = 00H	Rise	1.64	1.67	1.70	V	1
			Fall	1.60	1.63	1.66		
		VLS03 to 0 = 01H	Rise	1.74	1.77	1.81		
			Fall	1.70	1.73	1.77		
		VLS03 to 0 = 02H	Rise	1.84	1.88	1.91		
			Fall	1.80	1.84	1.87		
		VLS03 to 0 = 03H	Rise	1.94	1.98	2.02		
			Fall	1.90	1.94	1.98		
		VLS03 to 0 = 04H	Rise	2.05	2.09	2.13		
			Fall	2.00	2.04	2.08		
		VLS03 to 0 = 05H	Rise	2.45	2.50	2.55		
			Fall	2.40	2.45	2.50		
		VLS03 to 0 = 06H	Rise	2.56	2.61	2.66		
			Fall	2.50	2.55	2.60		
		VLS03 to 0 = 07H	Rise	2.66	2.71	2.76		
			Fall	2.60	2.65	2.70		
		VLS03 to 0 = 08H	Rise	2.76	2.81	2.87		
			Fall	2.70	2.75	2.81		
		VLS03 to 0 = 09H	Rise	2.86	2.92	2.97		
			Fall	2.80	2.86	2.91		
		VLS03 to 0 = 0AH	Rise	2.96	3.02	3.08		
			Fall	2.90	2.96	3.02		
		VLS03 to 0 = 0BH	Rise	4.01	4.09	4.17		
			Fall	3.90	3.98	4.06		
Voltage Level Supervisor 0 (VLS1) threshold voltage	V _{VLS1}	VLS13 to 0 = 00H		1.60	1.63	1.66		
		VLS13 to 0 = 01H		1.70	1.73	1.77		
		VLS13 to 0 = 02H		1.80	1.84	1.87		
		VLS13 to 0 = 03H		1.90	1.94	1.98		
		VLS13 to 0 = 04H		2.00	2.04	2.08		
		VLS13 to 0 = 05H		2.40	2.45	2.50		
		VLS13 to 0 = 06H		2.50	2.55	2.60		
		VLS13 to 0 = 07H		2.60	2.65	2.70		
		VLS13 to 0 = 08H		2.70	2.75	2.81		
		VLS13 to 0 = 09H		2.80	2.86	2.91		
		VLS13 to 0 = 0AH		2.90	2.96	3.02		
		VLS13 to 0 = 0BH		3.90	3.98	4.06		

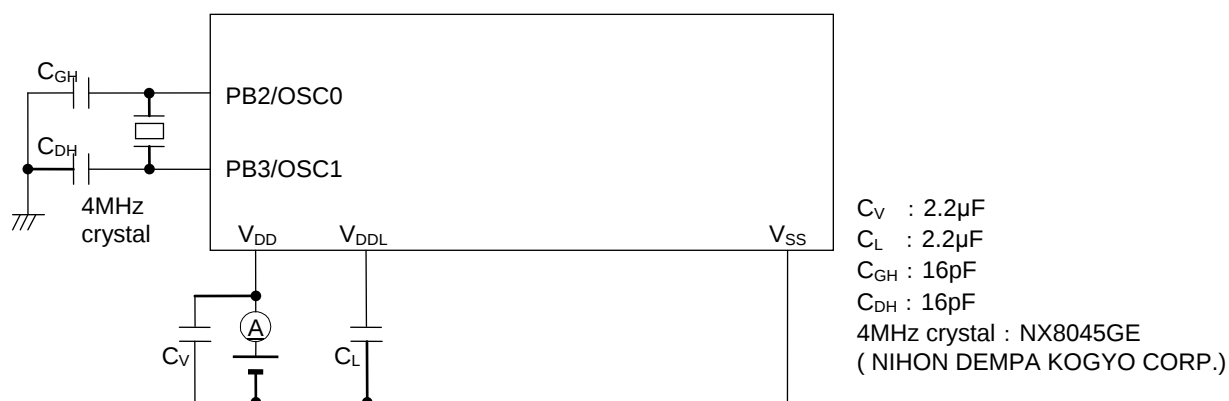
ML620Q131B/2B/3B/4B/5B/6B**DC Characteristics (Analog Comparator)**(V_{DD}=1.6 to 5.5V, V_{SS}=0V, Ta=-40 to +105°C, unless otherwise specified)

Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit	Meas uring circuit
Comparator0 Comparator1 Operating voltage	V _{DD}	—	1.8	—	5.5	V	—
Comparator0 same phase input voltage range	V _{CMR}	V _{DD} = 1.8 to 5.5V	0.1	—	V _{DD} -1.5	V	1
Comparator0 Hysteresis	V _{HYS}	Ta = 25°C, V _{DD} = 5.0V	10	20	30	mV	
		V _{DD} = 5.0V	5	20	35		
Comparator0 input offset	V _{CMOF}	Ta = 25°C, V _{DD} = 5.0V	—	—	7		
Comparator reference voltage error * ¹	V _{CMREF}	Ta = 25°C V _{DD} = 1.8 to 5.5V	-25	—	25		
		V _{DD} = 1.8 to 5.5V	-50	—	50		

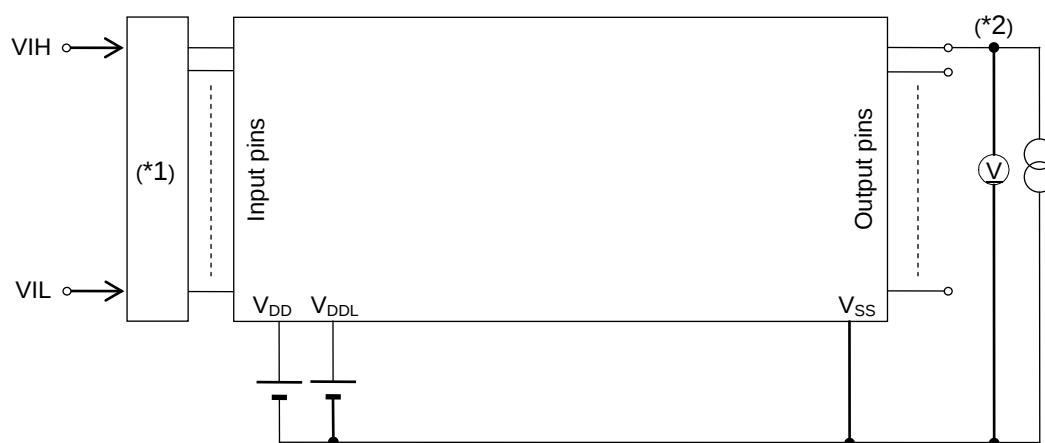
*¹ : Including comparator input offset voltage

Measuring circuit

Measuring circuit 1



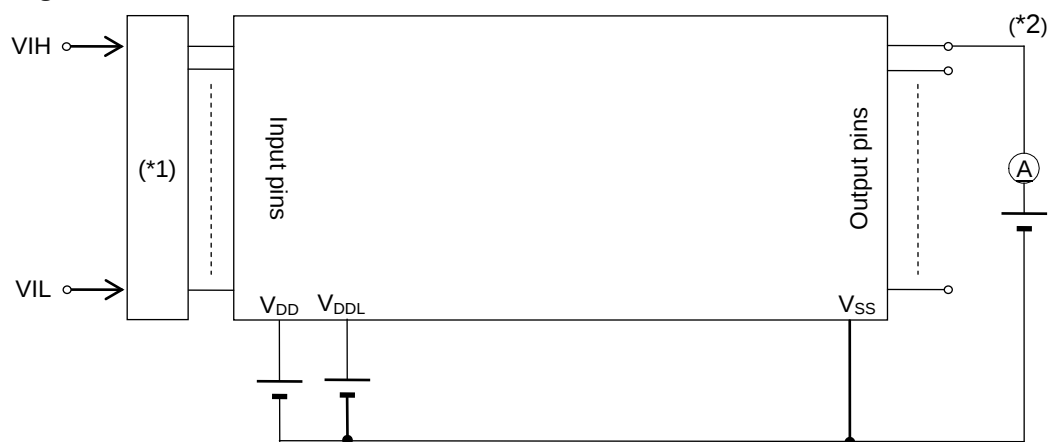
Measuring circuit 2



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

(*2) Measured at the specified output pins.

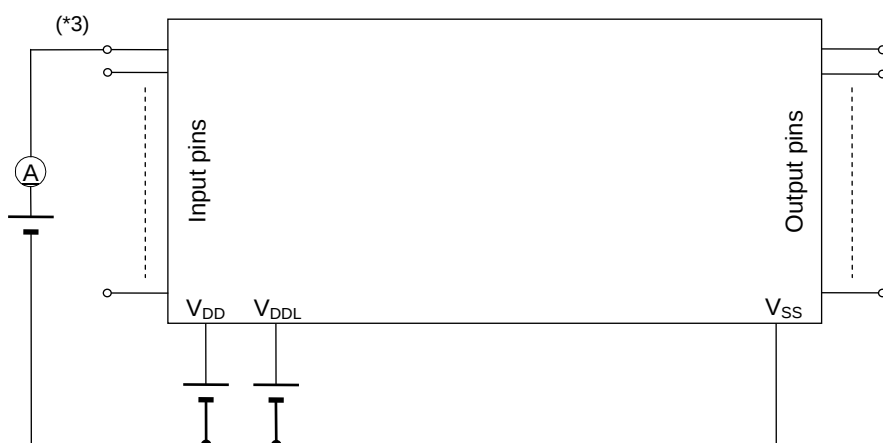
Measuring circuit 3



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

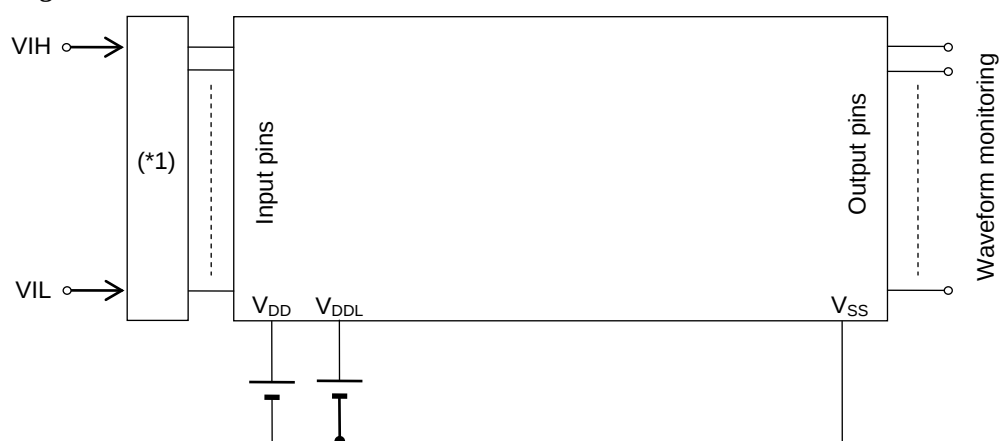
(*2) Measured at the specified output pins.

Measuring circuit 4



*3: Measured at the specified input pins.

Measuring circuit 5



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

AC Characteristics (Oscillation Circuit)

(V_{DD}=1.6 to 5.5V, V_{SS}=0V, Ta=-40 to +105°C, unless otherwise specified)

Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit	Measuring circuit
Low-speed RC oscillator frequency	f _{RCL}	Ta= +25°C	Typ -1%	32.768k	Typ +1%	Hz	1
		Ta= -40 to 85°C	Typ -2.5%	32.768k	Typ +2.5%	Hz	
		Ta= -40 to 105°C	Typ -3%	32.768k	Typ +3%	Hz	
PLL oscillation frequency* ¹	f _{PLL}	Ta= -20 to 85°C, V _{DD} = 1.8 to 5.5V	Typ -1%	32	Typ +1%	MHz	
		Ta= -40°C to +105°C, V _{DD} = 1.8 to 5.5V	Typ -1.5%	32	Typ +1.5%	MHz	
Low-speed RC oscillation start time* ¹	T _{RCL}	—	—	—	65	μs	
High-speed RC oscillation start time* ¹	T _{RCH}	V _{DD} = 1.8 to 5.5V	—	—	5	μs	
High-speed crystal oscillation start time* ¹	T _{XTH}	V _{DD} = 1.8 to 5.5V	—	2	20	ms	
PLL oscillation start time	T _{PLL}	V _{DD} = 1.8 to 5.5V	—	—	2	ms	

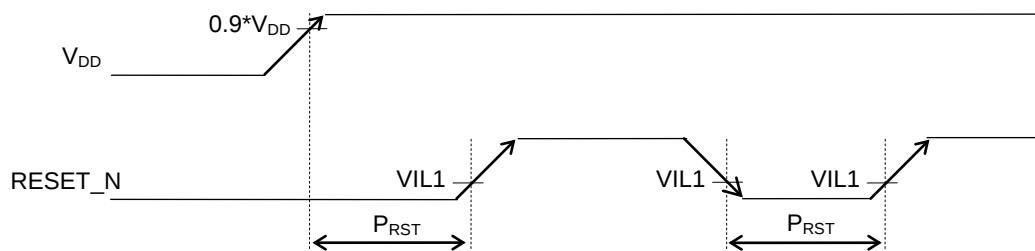
*¹: 4096 clock average. The CPU clock is max. f_{PLL}/2.*²: Use 4MHz Crystal Oscillator NX8045GE (NIHON DENPA KOGYO CORP.)

AC Characteristics (Power On Reset Sequence)

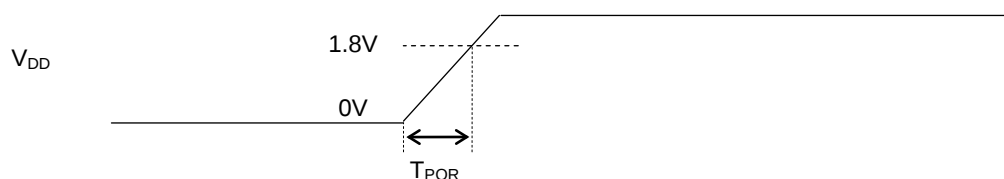
(V_{DD}=1.6 to 5.5V, V_{SS}=0V, Ta=-40 to +105°C, unless otherwise specified)

Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit	Measuring circuit
Reset pulse width	P _{RST}	—	100	—	—	μs	1
Reset noise rejection pulse width	P _{NRST}	—	—	—	0.4		
Power On Reset rising time	T _{POR}	—	—	—	10	ms	

When using RESET_N pin

P_{RST}: Reset pulse width

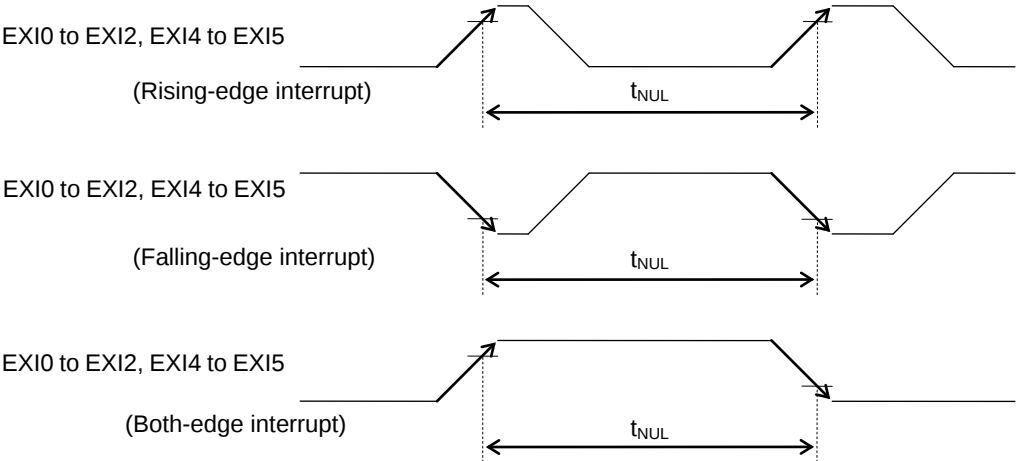
When using power on reset

T_{POR}: Power On Reset V_{DD} Rising Time

AC Characteristics (External Interrupt)

(V_{DD}=1.6 to 5.5V, V_{SS}=0V, Ta=-40 to +105°C, unless otherwise specified)

Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit
External interrupt disable period	T _{NUL}	Interrupt: Enabled (MIE = 1), CPU is executing NOP instruction	2.5 × LSCLK	—	3.5 × LSCLK	μs

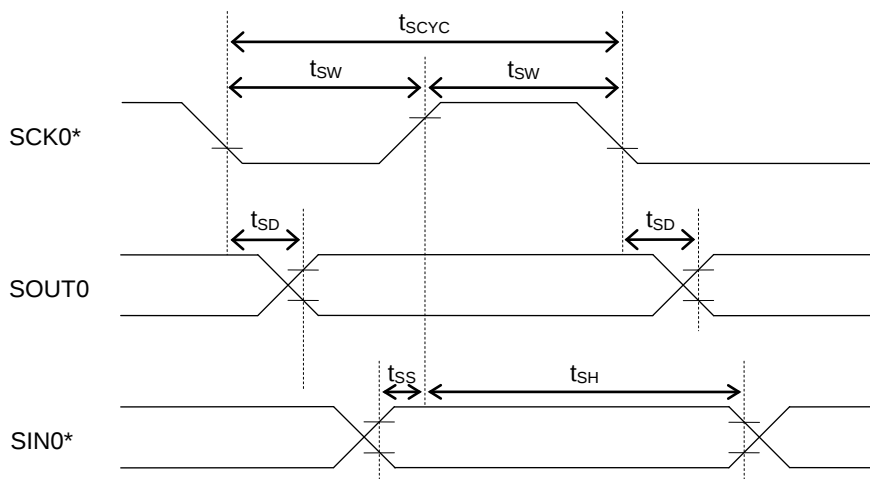


AC Characteristics (Synchronous Serial Port)

(V_{DD}=1.6 to 5.5V, V_{SS}=0V, Ta=-40 to +105°C, unless otherwise specified)

Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit
SCK input cycle (slave mode)	t _{SCYC}	—	1	—	—	μs
SCK output cycle (master mode)	t _{SCYC}	—	—	SCK ^(*1)	—	sec
SCK input pulse width (slave mode)	t _{SW}	—	200	—	—	ns
SCK output pulse width (master mode)	t _{SW}	—	SCK ^(*1) ×0.4	SCK ^(*1) ×0.5	SCK ^(*1) ×0.6	sec
SOUT output delay time (slave mode)	t _{SD}	—	—	—	360	ns
SOUT output delay time (master mode)	t _{SD}	—	—	—	160	ns
SIN input setup time (slave mode)	t _{SS}	—	80	—	—	ns
SIN input setup time (Master mode)	t _{SS}	—	180	—	—	ns
SIN input hold time	t _{SH}	—	80	—	—	ns

*1: Clock period selected by S0CK3-0 of the serial port n mode register (SIO0MOD1)



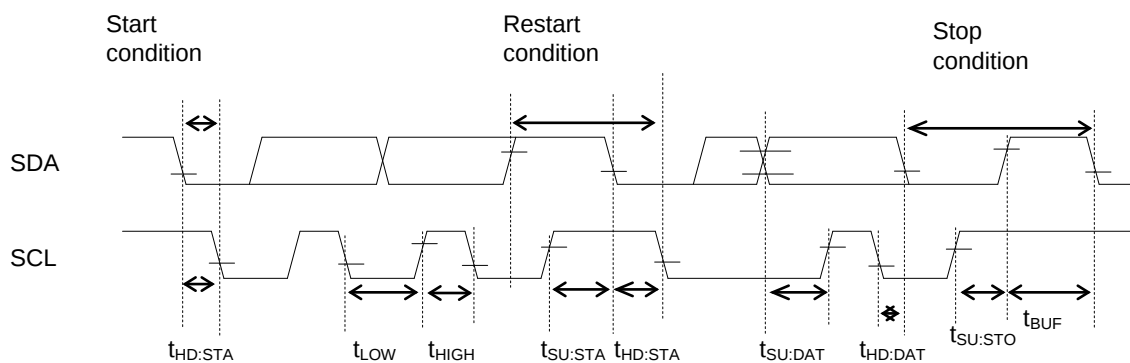
*: Indicates the secondary function of the corresponding port.

AC Characteristics (I2C Bus Interface: Standard Mode 100kHz)(V_{DD}=1.6 to 5.5V, V_{SS}=0V, Ta=-40 to +105°C, unless otherwise specified)

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

AC Characteristics (I2C Bus Interface: Fast Mode 400kHz)(V_{DD}=1.6 to 5.5V, V_{SS}=0V, Ta=-40 to +105°C, unless otherwise specified)

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

**Note:**

Current drive ability of PA3, PA5, PB0 and PB6 in N-ch open drain mode is lower than that of PA0 and PB7.

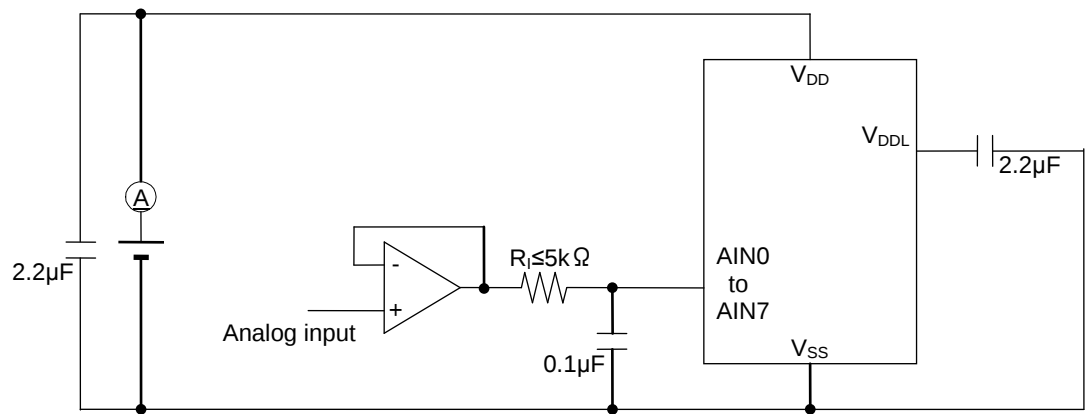
Therefore, the fast mode (400kbps) cannot be available when PA5 or PB0 is set as SCL function and when PA3 or PB6 is set as SDA function.

For more details, see the characteristics of VOL1 and VOL2 in DC Characteristics (VOHL, IOHL).

Successive Approximation Type A/D Converter

Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit
Resolution	n	—	—	—	10	bits
Integral non-linearity error	INL	$2.7V \leq V_{DD} \leq 5.5V$	-4	—	+4	LSB
		$2.2V \leq V_{DD} < 2.7V$	-6	—	+6	
		$1.8V \leq V_{DD} < 2.2V$ SACK bit ^{*1} = 1	-10	—	+10	
Differential non-linearity error	DNL	$2.7V \leq V_{DD} \leq 5.5V$	-3	—	+3	
		$2.2V \leq V_{DD} < 2.7V$	-5	—	+5	
		$1.8V \leq V_{DD} < 2.2V$ SACK bit ^{*1} = 1	-9	—	+9	
Zero-scale error	V _{OFF}	$R_I \leq 5k\Omega$	-6	—	+6	Ω
Full-scale error	FSE	$R_I \leq 5k\Omega$	-6	—	+6	
Input impedance	R _I	—	—	—	5k	Ω
A/D operating voltage	V _{DD}	—	1.8	—	5.5	V
Conversion time	t _{CONV}	SACK bit ^{*1} = 0	—	13.67	—	μs
		SACK bit ^{*1} = 1	—	41.26	—	

^{*1}: Bit 1 of SA-ADC control register 0 (SADCON0)



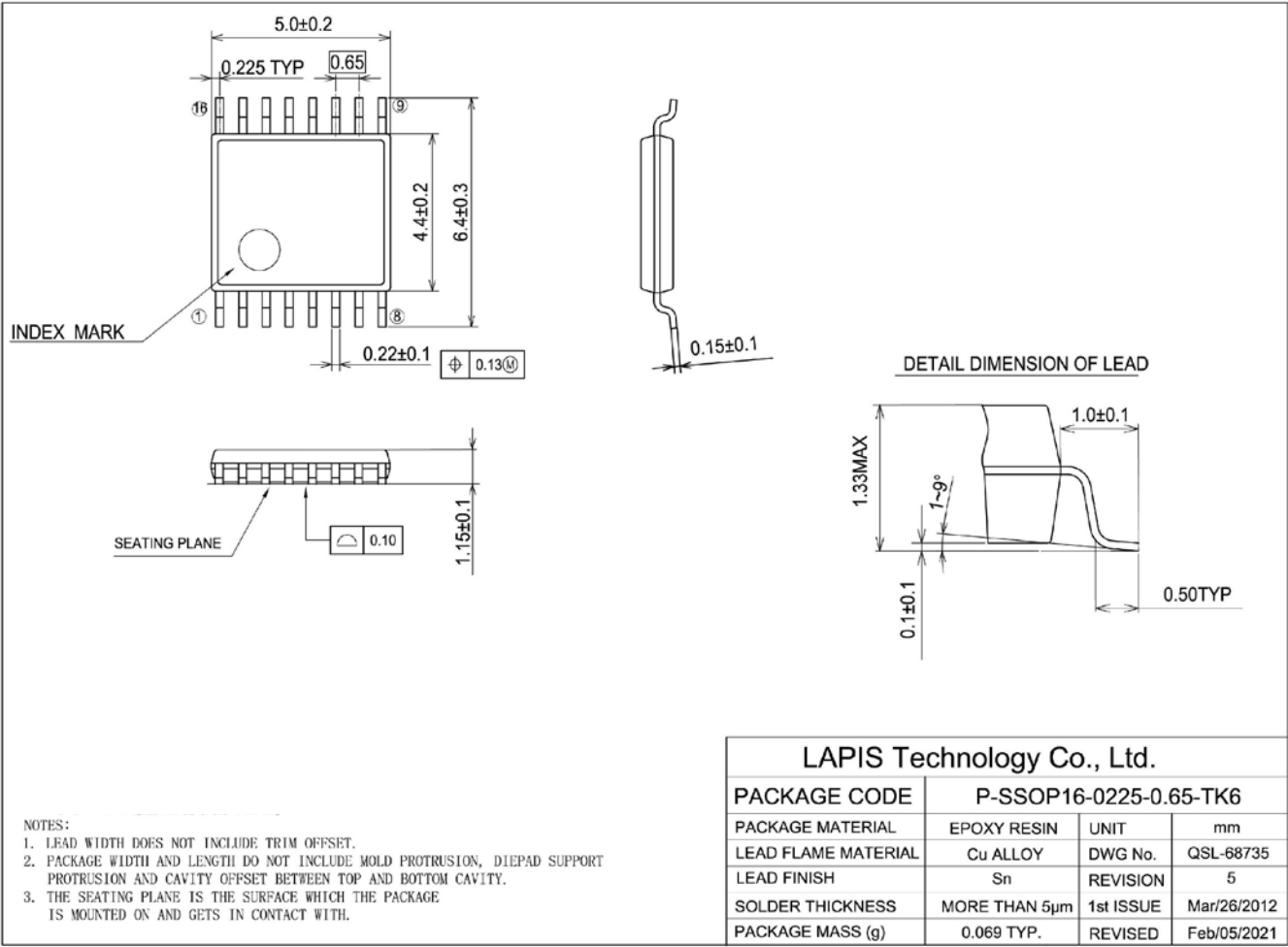
Note:
ML620Q131B/ML620Q132B/ML620Q133B do not have AIN7 and AIN6.

PACKAGE DIMENSIONS

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 LAPIS Technology’s responsible sales person for the product name, package name, pin number, package code and desired mounting conditions (reflow method, temperature and times).

ML620Q131B/ML620Q132B/ML620Q133B Package Dimensions (SSOP16)

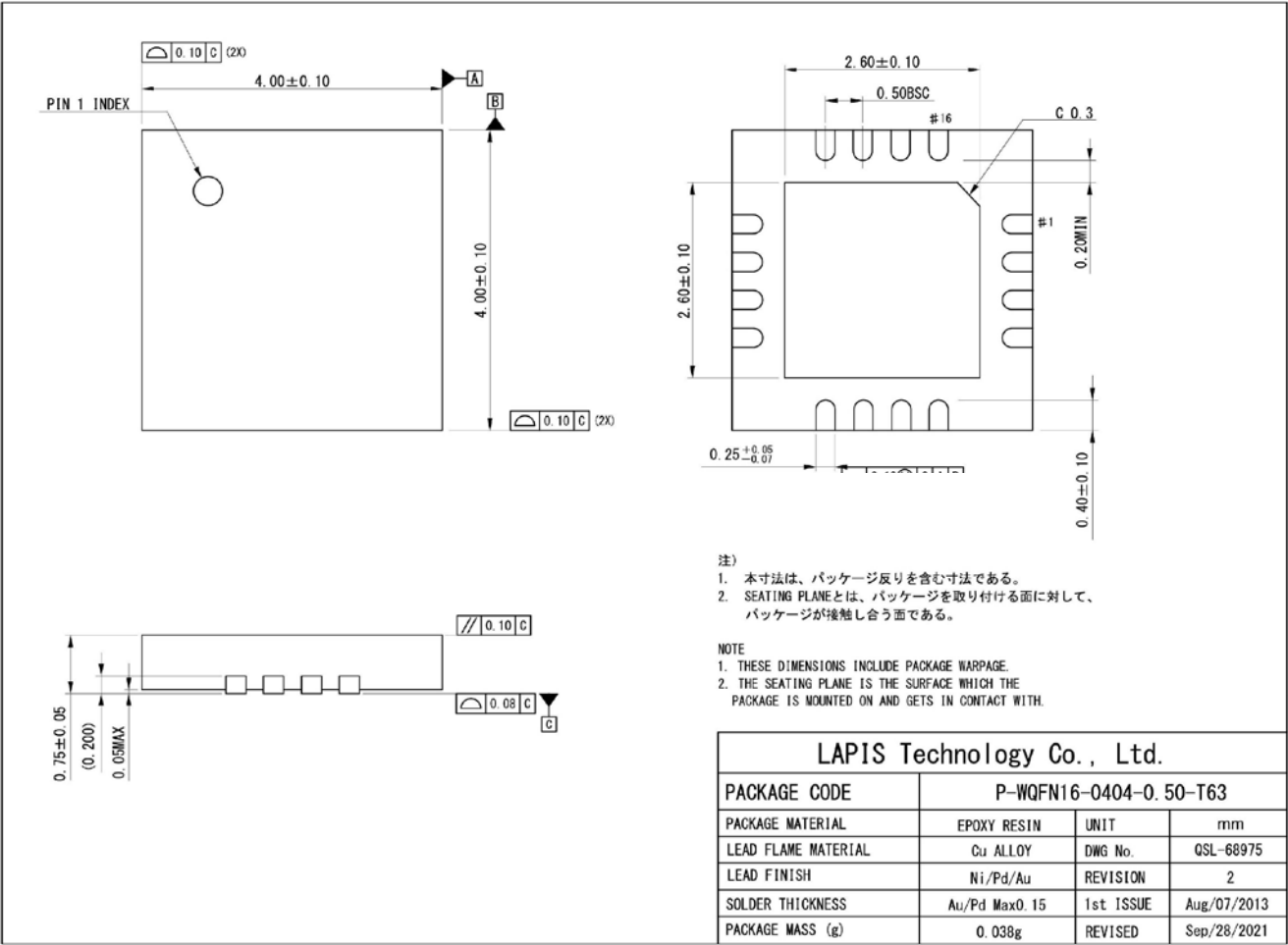


(Unit: mm)

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

ML620Q131B/ML620Q132B/ML620Q133B Package Dimensions (WQFN16)

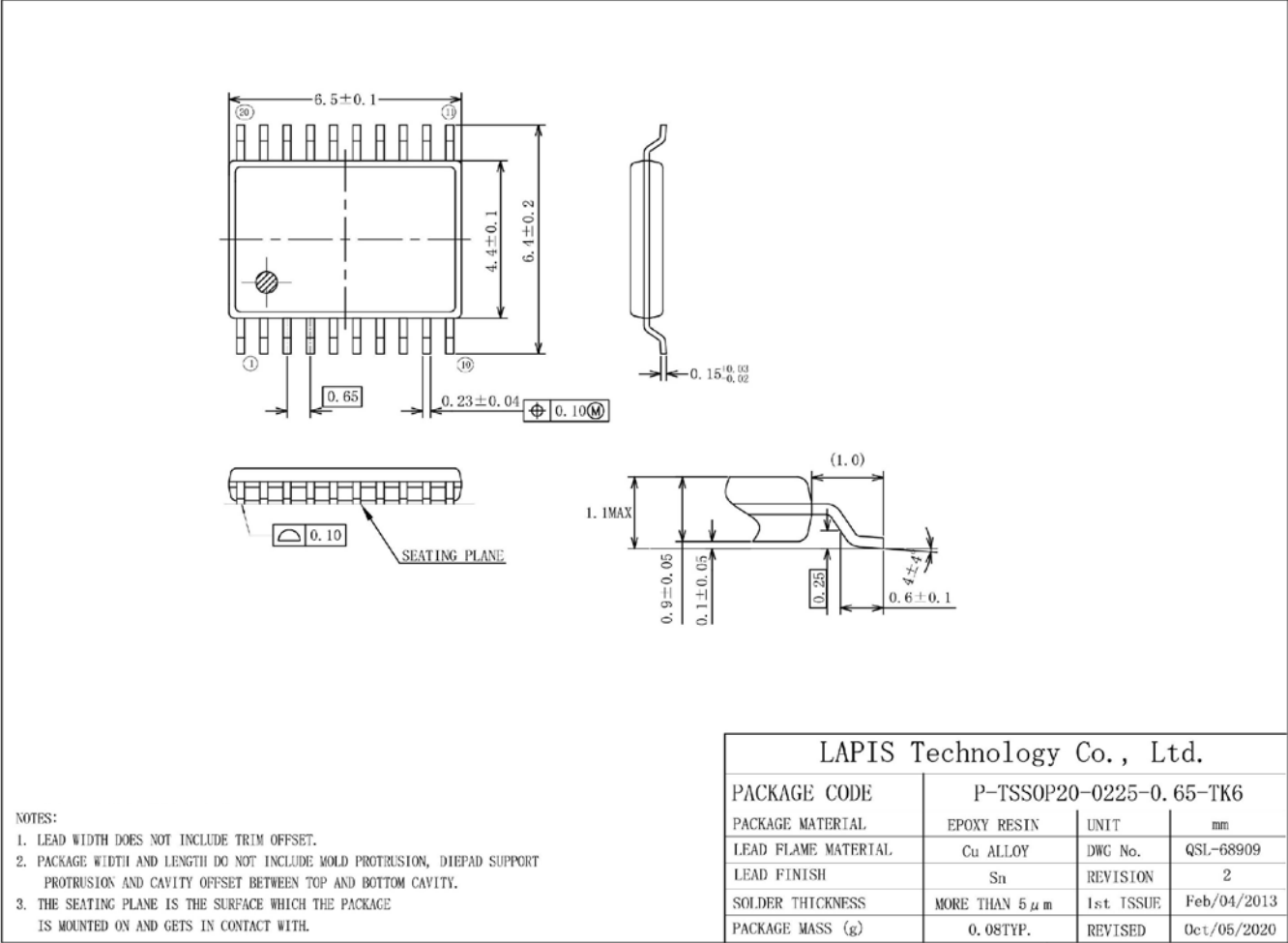


(Unit: mm)

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

ML620Q134B/ML620Q135B/ML620Q136B Package Dimensions (TSSOP20)

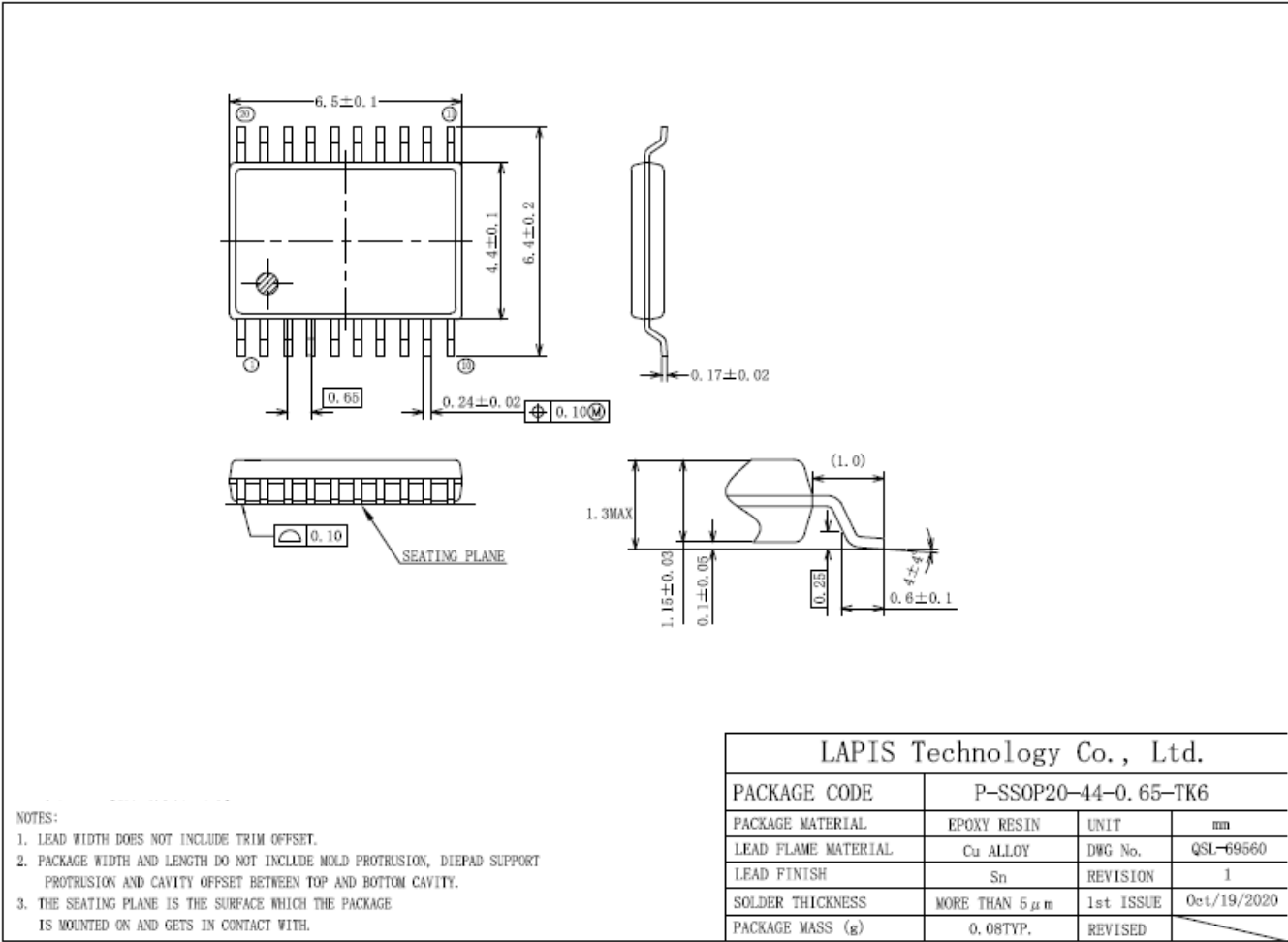


(Unit: mm)

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

ML620Q134B/ML620Q135B/ML620Q136B Package Dimensions (SSOP20)



(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 a ROHM sales office 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	
FEDL620Q130B-01	Mar. 30, 2017	–	–	1 st revision
FEDL620Q130B-02	–	–	–	Skipped 2 nd revision of English edition
FEDL620Q130B-03	Sep. 28, 2021	–	–	The Company name in the document header, Notes, and PACKAGE DIMENSIONS is changed due to company name change to "LAPIS Technology Co., Ltd."
		–	4	Added 20-pin plastic SSOP in "Shipment" and "The difference of ML620Q130B series"
		–	9	Added 20pin SSOP package pin layout
		–	10	Added 20pin SSOP PAD No. in the "PIN LIST"
		16	16	Revised the description of Note in "TERMINATION OF UNUSED PINS"
		–	33	Added 20pin SSOP package dimensions
		34	35	Revised the description of "Notes"

Notes

- 1) The information contained herein is subject to change without notice.
- 2) When using LAPIS Technology Products, refer to the latest product information (data sheets, user's manuals, application notes, etc.), and ensure that usage conditions (absolute maximum ratings, recommended operating conditions, etc.) are within the ranges specified. LAPIS Technology disclaims any and all liability for any malfunctions, failure or accident arising out of or in connection with the use of LAPIS Technology Products outside of such usage conditions specified ranges, or without observing precautions. Even if it is used within such usage conditions specified ranges, semiconductors can break down and malfunction due to various factors. Therefore, in order to prevent personal injury, fire or the other damage from break down or malfunction of LAPIS Technology Products, please take safety at your own risk measures such as complying with the derating characteristics, implementing redundant and fire prevention designs, and utilizing backups and fail-safe procedures. You are responsible for evaluating the safety of the final products or systems manufactured by you.
- 3) Descriptions of circuits, software and other related information in this document are provided only to illustrate the standard operation of semiconductor products and application examples. You are fully responsible for the incorporation or any other use of the circuits, software, and information in the design of your product or system. And the peripheral conditions must be taken into account when designing circuits for mass production. LAPIS Technology disclaims any and all liability for any losses and damages incurred by you or third parties arising from the use of these circuits, software, and other related information.
- 4) No license, expressly or implied, is granted hereby under any intellectual property rights or other rights of LAPIS Technology or any third party with respect to LAPIS Technology Products or the information contained in this document (including but not limited to, the Product data, drawings, charts, programs, algorithms, and application examples, etc.). Therefore LAPIS Technology shall have no responsibility whatsoever for any dispute, concerning such rights owned by third parties, arising out of the use of such technical information.
- 5) The Products are intended for use in general electronic equipment (AV/OA devices, communication, consumer systems, gaming/entertainment sets, etc.) as well as the applications indicated in this document. For use of our Products in applications requiring a high degree of reliability (as exemplified below), please be sure to contact a LAPIS Technology representative and must obtain written agreement: transportation equipment (cars, ships, trains, etc.), primary communication equipment, traffic lights, fire/crime prevention, safety equipment, medical systems, servers, solar cells, and power transmission systems, etc. LAPIS Technology disclaims any and all liability for any losses and damages incurred by you or third parties arising by using the Product for purposes not intended by us. Do not use our Products in applications requiring extremely high reliability, such as aerospace equipment, nuclear power control systems, and submarine repeaters, etc.
- 6) The Products specified in this document are not designed to be radiation tolerant.
- 7) LAPIS Technology has used reasonable care to ensure the accuracy of the information contained in this document. However, LAPIS Technology does not warrant that such information is error-free and LAPIS Technology shall have no responsibility for any damages arising from any inaccuracy or misprint of such information.
- 8) Please use the Products in accordance with any applicable environmental laws and regulations, such as the RoHS Directive. LAPIS Technology shall have no responsibility for any damages or losses resulting non-compliance with any applicable laws or regulations.
- 9) When providing our Products and technologies contained in this document to other countries, you must abide by the procedures and provisions stipulated in all applicable export laws and regulations, including without limitation the US Export Administration Regulations and the Foreign Exchange and Foreign Trade Act..
- 10) Please contact a ROHM sales office if you have any questions regarding the information contained in this document or LAPIS Technology's Products.
- 11) This document, in part or in whole, may not be reprinted or reproduced without prior consent of LAPIS Technology.

(Note) "LAPIS Technology" as used in this document means LAPIS Technology Co., Ltd.

Copyright 2017-2021 LAPIS Technology Co., Ltd.

LAPIS Technology Co., Ltd.

2-4-8 Shinyokohama, Kouhoku-ku,
Yokohama 222-8575, Japan
<http://www.lapis-tech.com/en/>