



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

ML62Q1200A Group

16-bit micro controller

GENERAL DESCRIPTION

ML62Q1200A Group is a high performance CMOS 16-bit microcontroller equipped with an 16-bit CPU nX-U16/100 and integrated with program memory(Flash memory), data memory(RAM), data Flash and rich peripheral functions such as the multiplier/divider, CRC operator, DMA controller, clock generator, timer, UART, synchronous serial port, I²C bus interface unit, buzzer, Voltage Level Supervisor(VSL), successive approximation type A/D converter, D/A converter, analog comparator, safety function and etc.

The CPU nX-U16/100 is capable of efficient instruction execution in 1-instruction 1-clock mode by pipeline architecture parallel processing.

The built-in on-chip debug function enables debugging and programming the software. Also, ISP(In-System Programming) function supports the Flash programming in production line.

The ML62Q1200A Group has five packages (16pin - 32pin) and five kinds of memory sizes(16Kbyte – 64Kbyte).

Table 1 ML62Q1200A Group Product List

Program memory	Data memory (RAM)	Data Flash	16pin SSOP16 WQFN16	20pin TSSOP20	24pin WQFN24	32pin TQFP32
64Kbyte	4Kbyte	2Kbyte	—	—	ML62Q1247A	ML62Q1267A
48Kbyte	4Kbyte	2Kbyte	—	—	ML62Q1246A	ML62Q1266A
32Kbyte	4Kbyte	2Kbyte	—	—	ML62Q1245A	ML62Q1265A
	2Kbyte	2Kbyte	ML62Q1225A	ML62Q1235A	—	—
24Kbyte	2Kbyte	2Kbyte	ML62Q1224A	ML62Q1234A	—	—
16Kbyte	2Kbyte	2Kbyte	ML62Q1223A	ML62Q1233A	—	—

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 (supported by LAPIS on-chip debug emulator EASE1000)
 - ISP (In-System Programming) function built-in
 - Minimum instruction execution time
30.5 μs (at 32.768 KHz system clock)
62.5ns/41.6ns (at 16 MHz/24MHz system clock)
- Coprocessor for multiplication and division
 - Multiplication: 16bit × 16bit (operation time 4 cycles)
 - Division: 32bit / 16bit (operation time 8 cycles)
 - Division: 32bit / 32bit (operation time 16 cycles)
 - Multiply-accumulate (non-saturating): 16bit × 16bit + 32bit (operation time 4 cycles)
 - Multiply-accumulate (saturating): 16bit × 16bit + 32bit (operation time 4 cycles)

- Operating voltage and temperature
 - Operating voltage: VDD = 1.6 to 5.5 V
 - Operating temperature: -40 to +105 °C
- Internal memory
 - Program Flash memory area
 - Rewrite count: 100 cycles
 - Rewrite unit: 32bit(4byte)
 - Erase unit: 16Kbyte/1Kbyte
 - Erase/Rewrite temperature: 0°C to +40°C
 - Data Flash memory area
 - Rewrite count 10,000 cycles
 - Rewrite unit: 8bit(1byte)
 - Erase unit: 2Kbyte/128byte
 - Erase/Rewrite temperature: -40°C to +85°C
 - Back Ground Operation(CPU can work while erasing and rewriting)
 - Data RAM area
 - Rewrite unit: 8bit/16bit(1byte/2byte)
 - Parity check function (Parity error reset is generatable)
- Clock
 - Low-speed clock
 - Internal low-speed RC oscillation (32.768 KHz)
 - High-speed clock
 - PLL oscillation (32MHz/24MHz/16MHz is selectable by flash code option)
 - WDT(Watch Dog Timer) independent clock
 - Internal low-speed RC oscillation (1kHz)
- Reset
 - RESET_N pin reset
 - Reset by power-on detection
 - Reset by the 2nd watchdog timer (WDT) overflow
 - Reset by counter clear during the windows close of watchdog timer (WDT)
 - Reset by RAM parity error
 - Reset by voltage level detection (VLS)
 - Reset by invalid memory access (detecting abnormal program counter)
 - The software reset by BRK instruction (reset CPU only)
- Power management
 - HALT mode: CPU stops executing instruction, clock oscillations and peripheral circuits remain previous states
 - HALT-H mode: CPU stops executing instruction, high-speed clock oscillation stops and peripheral circuits working with low-speed clock remain previous states
 - STOP mode: CPU stops executing instruction, both high-speed oscillation and low-speed oscillation stop.
 - STOP-D mode: CPU stops executing instruction, both high-speed oscillation and low-speed oscillation stop. The internal regulator's output voltage (V_{DDL}) goes down to reduce the current consumption.
 - Clock gear: The frequency of high-speed system clock can be changed by software (1/1, 1/2, 1/4, 1/8, 1/16 or 1/32 of the oscillation clock)
 - Block Control Function: Powers down the circuits of unused function blocks (reset the block or stop supplying the clock)
- Interrupt controller
 - Non-maskable interrupt source: 1 (Internal sources: WDT)
 - Maskable interrupt sources: max.31 (ML62Q126xA/32pin: Internal sources: max.23, External sources: 8)
 - Four step interrupt levels

- Watchdog timer(WDT)
 - Operation clock: 1kHz WDT independent clock or 32.768kHz RC oscillation clock, selectable by code option
 - Overflow period: 8 types selectable (8ms, 16ms, 32ms, 64ms, 125ms, 500ms, 2000ms and 8000ms @32.768kHz)
 - WDT counter clear enable period : 50%, 75% or 100% of overflow period
 - When 100% of overflow period is selected,
The first overflow generates an interrupt, and the second overflow generates a reset.
 - When 50% or 70% of overflow period is selected,
Clearing the WDT counter out of the enable period generates the WDT invalid clear reset.
 - WDT operation : Enable or disable is selectable by code option
 - Readable WDT counter (WDT counter monitor function)
- DMA(Direct Memory Access) controller
 - Channel : 2ch
 - Function mode : Wait mode only
 - Transfer unit: 8bit/16bit
 - Max. transfer count: 1024 time
 - Transfer type: 2 cycle transfer
 - Transfer mode: Single transfer mode
 - Fixed address, address increments and address decrements
 - Transfer target: SFR/RAM $\leftrightarrow$ SFR/RAM (Transfer from/to Flash is not supported)
 - Transfer request: Serial unit interrupt, A/D interrupt and Timer interrupt
- Time base counter
 - Devide the Low-speed clock(LSCLK) and generate 32.768kHz~1Hz internal pulse signals
 - Priodical interrupt $\times$ 3 selectable from 8 frequencies (128Hz, 64Hz, 32Hz, 16Hz, 8Hz, 4Hz, 2Hz and 1Hz)
 - The time base clock output (1Hz or 2Hz) from general purpose ports (TBCOUT1).
- Functional timer(FTM)
 - Channel: 4ch
 - Timer one shot mode and repeat mode, Caputure mode, PWM mode1 and PWM mode 2(complementary output)
 - Same start/stop is avaible with different channels
(This function is not available with 16bit Genral Timer)
 - Event trigger (external interrupts, analog comprator interrupts, 16bit genral timer interrupts and functional timer interrupts)
 - Delay counter (for generating dead time)
 - Available to specify devision ratio of counter clock channel by channel
- 16bit General timers
 - Channel: 6ch
 - 8 bits timer mode and 16-bit timer mode (1ch 16-bit timer is configurable as 2ch 8-bit timer)
 - Same start/stop is avaible with different channels
(This function is not available with Functional Timer)
 - Timer output (toggled by overflow)
 - Available to specify devision ratio of counter clock channel by channel

- Serial communication unit
 - Channel: Max. 2ch
 - Synchronous Serial Port or UART is selectable in each channel
 - < Synchronous Serial Port >
 - Master/slave selectable
 - LSB first/MSB first selectable
 - 8-bit length/16-bit length selectable
 - < UART >
 - Full-duplex communication x 2 ch(One Full-duplexUART is configurable as two half-duplex UARTs)
 - Bit length, parity/no parity, odd parity/even parity, 1 stop bit/2 stop bits
 - Positive logic/negative logic selectable
 - LSB first/MSB first selectable
 - Internal baud rate generator (1bps ~ 2Mbps)
- I²C bus interface unit (Master/Slave)
 - Channel: 1ch
 - Master or Slave mode is selectable
 - < Master function >
 - Standard mode (100 kbit/s), fast mode (400 kbit/s) and 1Mbps mode(1Mbit/s)
 - Handshake (Clock synchronization)
 - 7bit address format (10bit address format is supported)
 - < Slave function >
 - Standard mode (100 kbit/s), fast mode (400 kbit/s) and 1Mbps mode(1Mbit/s)
 - Handshake (Clock synchronization)
 - 7bit address format (10bit address format is supported)
- I²C bus interface (Master only)
 - Channel: 1ch
 - Standard mode (100 kbit/s), fast mode (400 kbit/s) and 1Mbps mode(1Mbit/s)
 - Handshake (Clock synchronization)
 - 7bit address format (10bit address format is supported)
- General-purpose ports (including secondary functions)
 - I/O port: Max. 28 (32pinTQFP, including one pin for on-chip debug)
 - External interrupt function × 8
 - LED driver port : Max. 27 (32pinTQFP)
 - Carrier frequency output function (used for IR communication)
- Successive approximation type A/D converter
 - Channel: Max.8ch (20pinTSSOP, 24pinWQFN and 32pinTQFP)
 - Resolution: 10bit
 - Conversion time: Selectable 2.25μs (min) /channel (When the conversion clock is 8MHz)
 - Selectable reference voltage
 - Voltage input from the VDD pin, Internal reference voltage(approx.1.55V), External reference voltage(VREF pin)
 - Scan function (repeat conversion)
 - One result register for each channel
 - Interrupt by threshold of conversion result
 - Temperature sensor for the Low-speed RC oscillation frequency adjustment
- Voltage level supervisor (VSL)
 - Accuracy: ±4°C
 - Threshold voltage: 12 values selectable (1.85V ~ 4.00V)
 - Voltage level detection reset (VLS reset)
 - Voltage level detection interrupt (VLS0 interrupt)

- Analog comparator
 - Channel: 1ch
 - Interrupts allow edge selection and sampling selection
 - An external or an internal reference voltage is selectable
- D/A converter
 - Channel: 1ch
 - Resolution: 8bit
 - Output impedance: 6k ohm(Typ.)
 - R-2R ladder method
- Buzzer
 - 4 buzzer mode (Repeat sound, Single sound, Intermittent sound 1 and Intermittent sound 2)
 - 8 frequencies (4.096kHz to 293Hz)
 - 15 step duty (1/16 to 15/16)
 - Selectable the logic of buzzer output pin (Positive or Negative logic)
- CRC(Cycle Redundancy Check) operation function
 - Generation equation: $X^{16}+X^{12}+X^5+1$
 - LSB first
 - Automatic CRC mode: Automatic CRC calculation with data of program memory in HALT mode
- Safety Function
 - RAM/SFR guard
 - Automatic CRC calculation with data of program memory
 - RAM parity error detection
 - ROM unused area access reset
 - Clock mutual check
 - WDT counter check
 - Successive approximation type A/D converter test
 - UART test
 - Synchronous serial test
 - I²C test
 - GPIO test
- Shipping package
 - 16-pin plastic SSOP
ML62Q1223A/1224A/1225A-xxxMB (Blank part: ML62Q1223A/1224A/1225A-NNNMB)
 - 16-pin plastic WQFN
ML62Q1223A/1224A/1225A-xxxGD (Blank part: ML62Q1223A/1224A/1225A-NNNGD)
 - 20-pin plastic TSSOP
ML62Q1233A/1234A/1235A-xxxTD (Blank part: ML62Q1233A/1234A/1235A-NNNTD)
 - 24-pin plastic WQFN
ML62Q1245A/1246A/1247A-xxxGD (Blank part: ML62Q1245A/1246A/1247A-NNNGD)
 - 32-pin plastic TQFP
ML62Q1265A/1266A/1267A-xxxTB (Blank part: ML62Q1265A/1266A/1267A-NNNTB)

xxx: ROM code number

ML62Q1200A Group how to read the part number

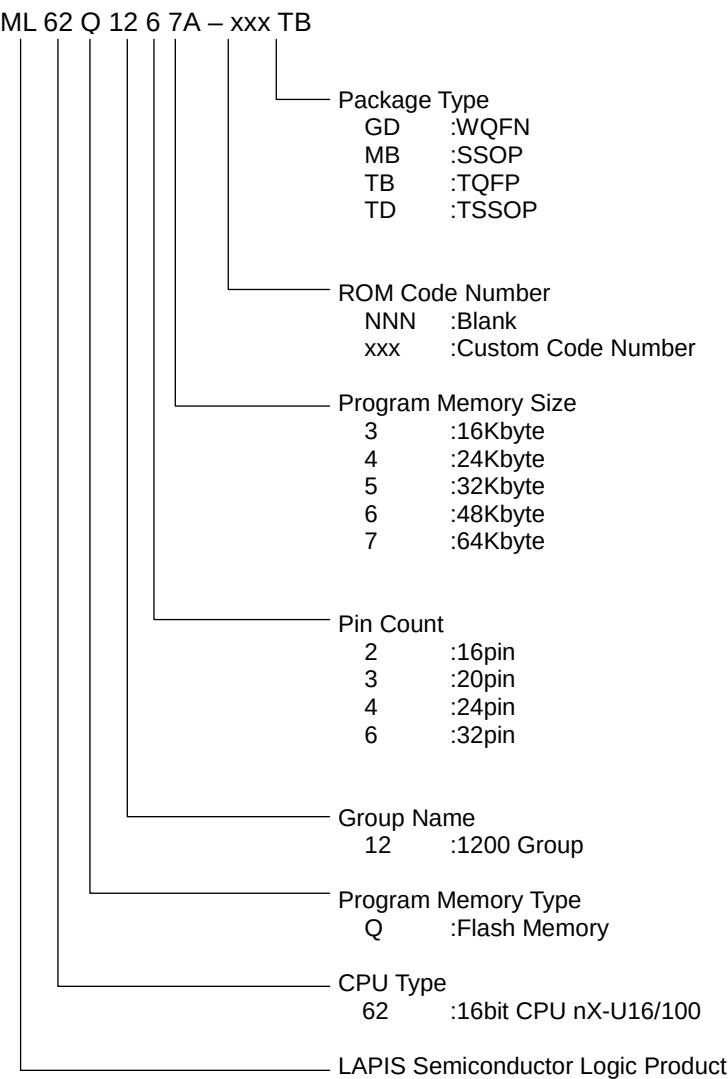


Figure 1 ML62Q1200A Group Part Number

ML62Q1200A Group Main Function List

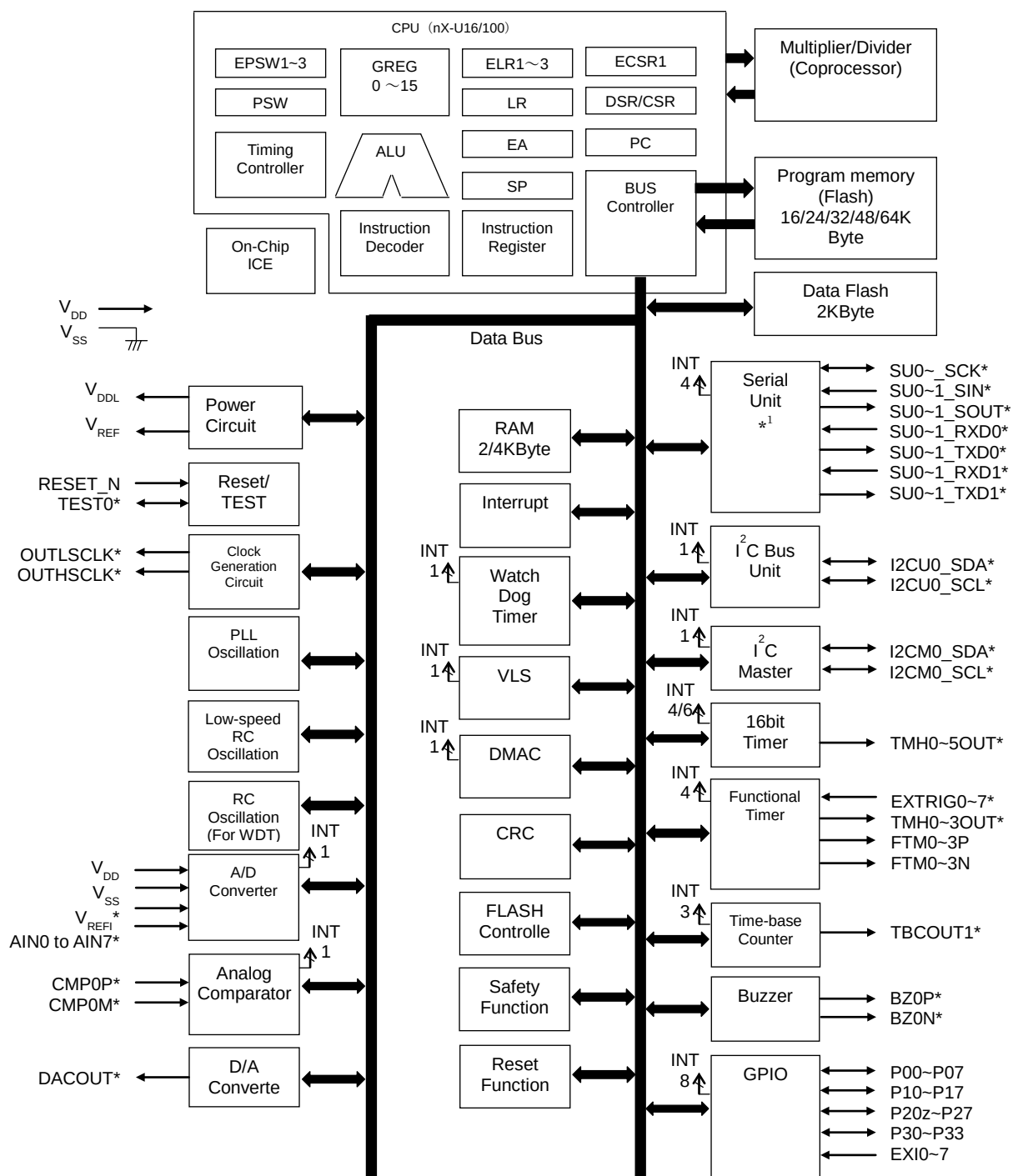
Table 2 ML62Q1200A Group Main Function List

Part number	Pin				Interrupt		Timer		Serial			Analog															
	Total pin-counts	Power pin counts	Input pin [RESET_N]	I/O port	LED drive port	Internal interrupt	External interrupt	Functional Timer [channel]	16bit General I Timer [channel] * ¹	Full-duplex UART or Synchronous serial [channel] * ²	I ² C bus unit (Master/Slave) [channel]	I ² C bus interface (Master only) [channel]	10bit Successive type A/D converter [channel]	Analog comparator [channel]	Analog comparator [input pin]	8bit D/A converter [channel]											
ML62Q1223A	16	3	1	12	11	22	8	4	4	2	1	1	6	1	2	0											
ML62Q1224A				16	15																						
ML62Q1225A																											
ML62Q1233A	20			16	15	24							6														
ML62Q1234A				20	24																						
ML62Q1235A																											
ML62Q1245A	24			20	19																						
ML62Q1246A				24	28																						
ML62Q1247A																											
ML62Q1265A	32			32																							
ML62Q1266A																											
ML62Q1267A																											

*¹ : One 16bit timer is configurable as two 8bit timers

*² : Full-duplex UART and Synchronous Serial Port can not be used simultaneously in the same channel.
One Full-duplexUART is configurable as two half-duplex UARTs.

BLOCK DIAGRAM



* : indicates the 2nd to 8th functions of GPIO.

Figure 2 ML62Q1200A Group Block Diagram

PIN CONFIGURATION

Pin Layout of ML62Q1223A/1224A/1225A 16pin SSOP Package

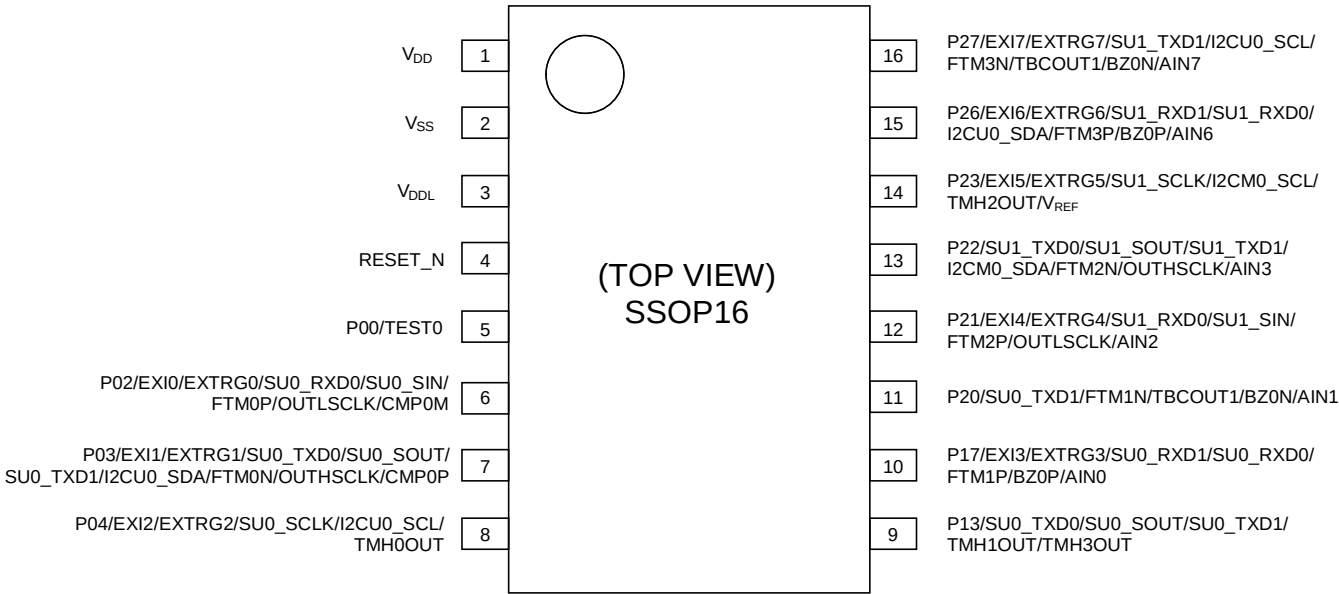


Figure 3 Pin Layout of ML62Q1223A/1224A/1225A 16pin SSOP Package

Pin Layout of ML62Q1223A/1224A/1225A 16pin WQFN Package

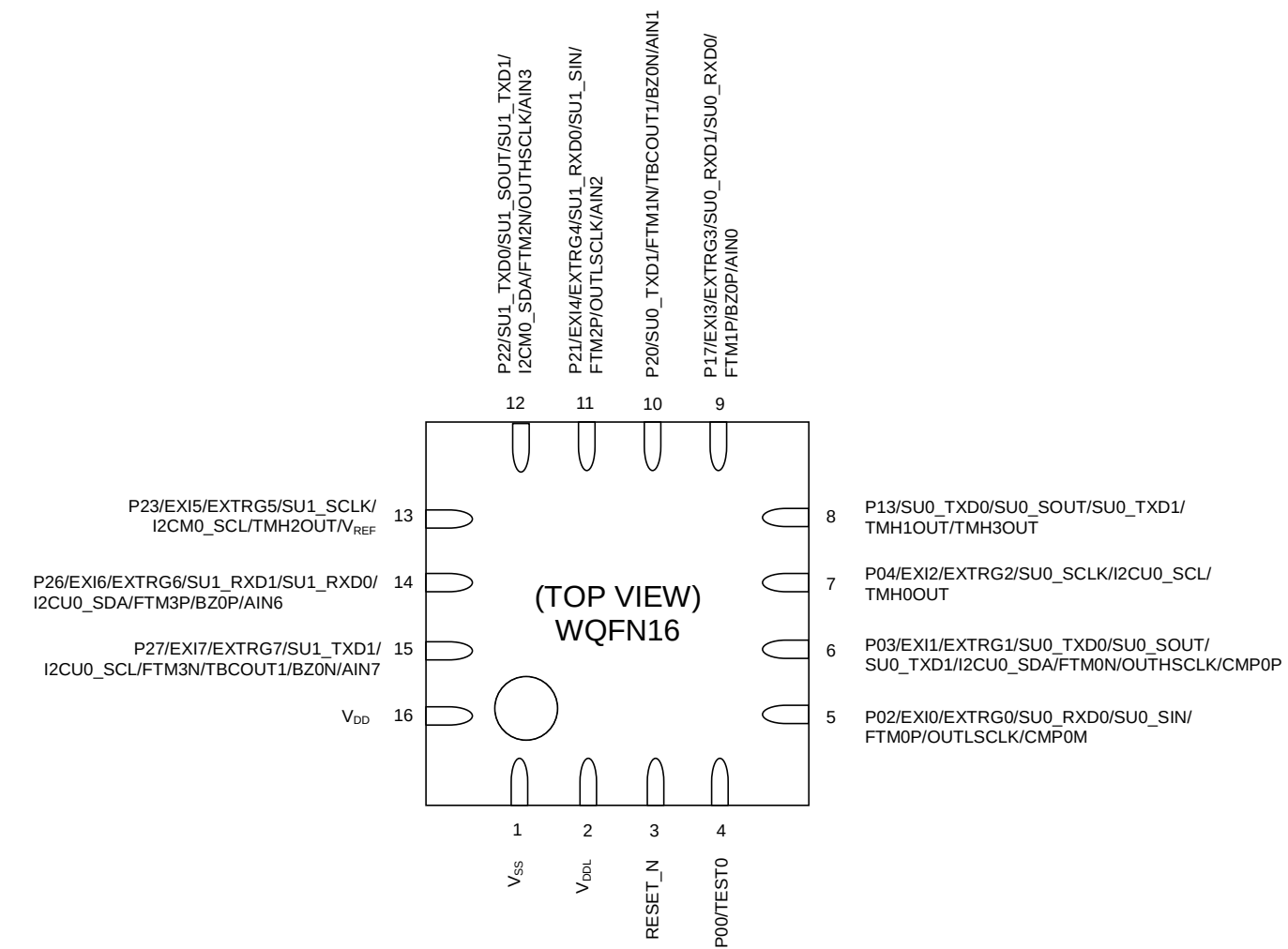


Figure 4 Pin Layout of ML62Q1223A/1224A/1225A 16pin WQFN Package

Pin Layout of ML62Q1233A/1234A/1235A 20pin TSSOP Package

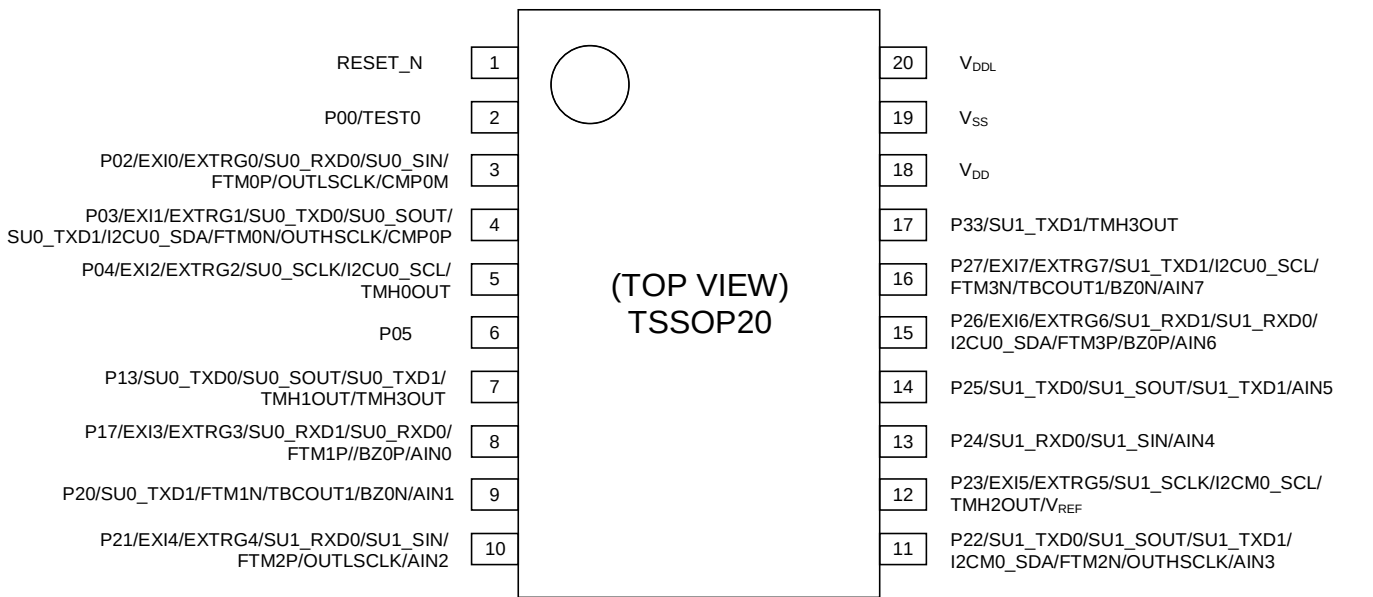


Figure 5 Pin Layout of ML62Q1233A/1234A/1235A 20pin TSSOP Package

Pin Layout of ML62Q1245A/1246A/1247A 24pin WQFN Package

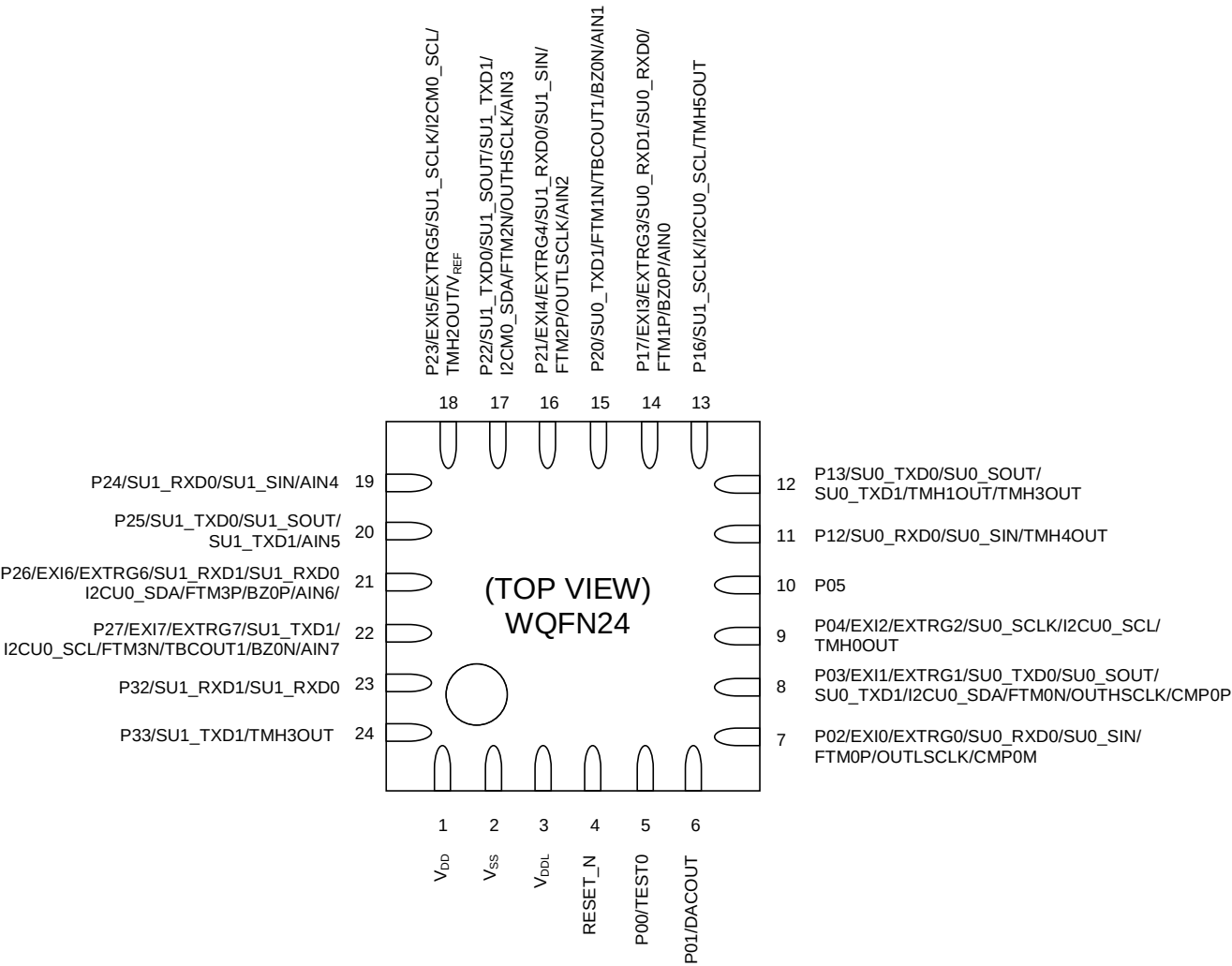


Figure 6 Pin Layout of ML62Q1245A/1246A/1247A 24pin WQFN Package

Pin Layout of ML62Q1265A/1266A/1267A 32pin TQFP Package

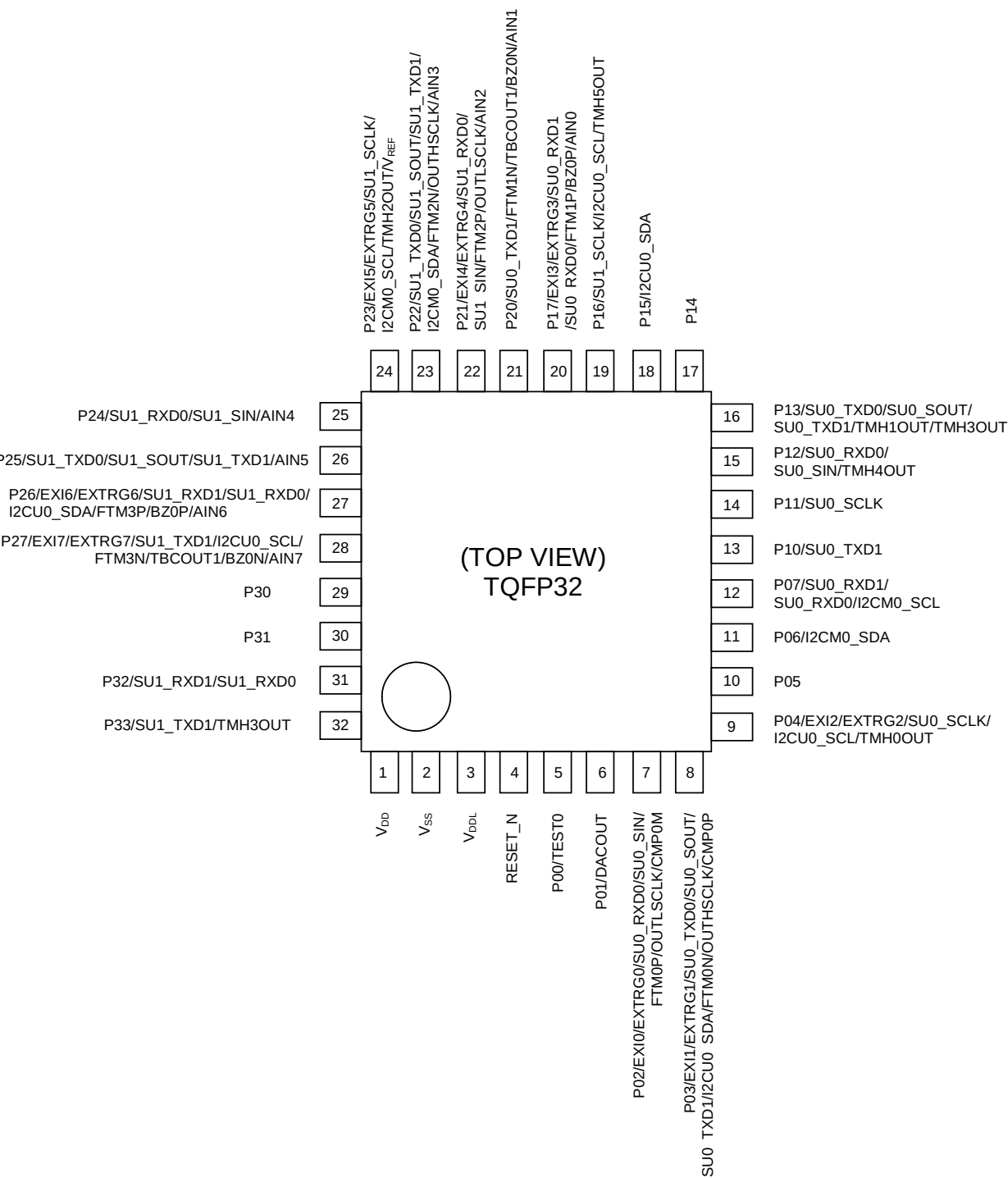


Figure 7 Pin Layout of ML62Q1265A/1266A/1267A 32pin TQFP Package

PIN LIST

Table 3 Pin List (1/5)

16Pin No. (SSOP)	16Pin No. (MOFN)	20Pin No.	24Pin No.	32Pin No.	Pn name	Primary function	Shared function	
1	16	18	1	1	V _{DD}	Positive power pin	—	
2	1	19	2	2	V _{SS}	Negative power pin	—	
3	2	20	3	3	V _{DDL}	Internal regulator output	—	
4	3	1	4	4	RESET_ N (I)	Reset input (w/ Pull-UP) Used for on-chip debug interface	—	
5	4	2	5	5	P00/TES T0 (I/O)	General I/O pin Used for on-chip debug interface (Not available to use as I/O pin when connecting to the on-chip emulator)	—	
-	-	-	6	6	P01 (I/O)	General I/O pin D/A converter output pin	2 nd function	—
							3 rd function	—
							4 th function	—
							5 th function	—
							6 th function	—
							7 th function	—
							8 th function	—
6	5	3	7	7	P02/EXI0 /EXTRG0 (I/O)	General I/O pin External interrupt Functional timer external trigger	2 nd function	SU0_RXD0/SU0_SIN
							3 rd function	—
							4 th function	—
							5 th function	FTM0P
							6 th function	OUTLSCLK
							7 th function	CMP0M
							8 th function	—
7	6	4	8	8	P03/EXI1 /EXTRG1 (I/O)	General I/O pin External interrupt Functional timer external trigger	2 nd function	SU0_TXD0/SU0_SOUT
							3 rd function	SU0_TXD1
							4 th function	I2CU0_SDA
							5 th function	FTM0N
							6 th function	OUTHCLK
							7 th function	CMP0P
							8 th function	—
8	7	5	9	9	P04/EXI2 /EXTRG2 (I/O)	General I/O pin External interrupt Functional timer external trigger	2 nd function	SU0_SCLK
							3 rd function	—
							4 th function	I2CU0_SCL
							5 th function	TMH0OUT
							6 th function	—
							7 th function	—
							8 th function	—
-	-	6	10	10	P05 (I/O)	General I/O pin	2 nd function	—
							3 rd function	—
							4 th function	—
							5 th function	—
							6 th function	—
							7 th function	—
							8 th function	—

Table 3 Pin List (2/5)

16Pin No. (SSOP)	16Pin No. (WQFN)	20Pin No.	24Pin No.	32Pin No.	Pn name	Primary function	Shared function	
-	-	-	-	11	P06 (I/O)	General I/O pin	2 nd function	—
							3 rd function	—
							4 th function	I2CM0_SDA
							5 th function	—
							6 th function	—
							7 th function	—
							8 th function	—
							2 nd function	SU1_RXD1
-	-	-	-	12	P07 (I/O)	General I/O pin	3 rd function	SU1_RXD0
							4 th function	I2CM0_SCL
							5 th function	—
							6 th function	—
							7 th function	—
							8 th function	—
							2 nd function	SU1_TXD1
							3 rd function	—
-	-	-	-	13	P10 (I/O)	General I/O pin	4 th function	—
							5 th function	—
							6 th function	—
							7 th function	—
							8 th function	—
							2 nd function	SU0_SCLK
							3 rd function	—
							4 th function	—
-	-	-	-	14	P11 (I/O)	General I/O pin	5 th function	—
							6 th function	—
							7 th function	—
							8 th function	—
-	-	-	11	15	P12 (I/O)	General I/O pin	2 nd function	SU0_RXD0/SU0_SIN
							3 rd function	—
							4 th function	—
							5 th function	TMH4OUT
							6 th function	—
							7 th function	—
							8 th function	—
9	8	7	12	16	P13 (I/O)	General I/O pin	2 nd function	SU0_TXD0/SU0_SOUT
							3 rd function	SU0_TXD1
							4 th function	—
							5 th function	TMH1OUT
							6 th function	—
							7 th function	TMH3OUT
							8 th function	—
							2 nd function	—
-	-	-	-	17	P14 (I/O)	General I/O pin	3 rd function	—
							4 th function	—
							5 th function	—
							6 th function	—
							7 th function	—
							8 th function	—
							2 nd function	—
							3 rd function	—

Table 3 Pin List (3/5)

16Pin No. (SSOP)	16Pin No. (MOFN)	20Pin No.	24Pin No.	32Pin No.	Pn name	Primary function	Shared function	
-	-	-	-	18	P15 (I/O)	General I/O pin	2 nd function	—
							3 rd function	—
							4 th function	I2CU0_SDA
							5 th function	—
							6 th function	—
							7 th function	—
							8 th function	—
							2 nd function	SU1_SCLK
-	-	-	13	19	P16 (I/O)	General I/O pin	3 rd function	—
							4 th function	I2CU0_SCL
							5 th function	TMH5OUT
							6 th function	—
							7 th function	—
							8 th function	—
							2 nd function	SU0_RXD1
							3 rd function	SU0_RXD0
10	9	8	14	20	P17/EXI3 /EXTRG3 (I/O)	General I/O pin External interrupt Functional timer external trigger	4 th function	—
							5 th function	FTM1P
							6 th function	—
							7 th function	BZ0P
							8 th function	AIN0
							2 nd function	SU0_TXD1
							3 rd function	—
							4 th function	—
11	10	9	15	21	P20 (I/O)	General I/O pin	5 th function	FTM1N
							6 th function	TBCOUT1
							7 th function	BZ0N
							8 th function	AIN1
							2 nd function	SU1_RXD0/SU1_SIN
							3 rd function	—
							4 th function	—
							5 th function	FTM2P
12	11	10	16	22	P21/EXI4 /EXTRG4 (I/O)	General I/O pin External interrupt Functional timer external trigger	6 th function	OUTLSCLK
							7 th function	—
							8 th function	AIN2
							2 nd function	SU1_TXD0/SU1_SOUT
							3 rd function	SU1_TXD1
							4 th function	I2CM0_SDA
							5 th function	FTM2N
							6 th function	OUTHCLK
13	12	11	17	23	P22 (I/O)	General I/O pin	7 th function	—
							8 th function	AIN3
							2 nd function	SU1_SCLK
							3 rd function	—
							4 th function	I2CM0_SCL
							5 th function	TMH2OUT
							6 th function	—
							7 th function	—
14	13	12	18	24	P23/EXI5 /EXTRG5 (I/O)	General I/O pin External interrupt Functional timer external trigger	8 th function	V _{REF}

Table 3 Pin List (4/5)

16Pin No. (SSOP)	16Pin No. (WQFN)	20Pin No.	24Pin No.	32Pin No.	Pn name	Primary function	Shared function	
-	-	13	19	25	P24 (I/O)	General I/O pin	2 nd function	SU1_RXD0/SU1_SIN
							3 rd function	—
							4 th function	—
							5 th function	—
							6 th function	—
							7 th function	—
							8 th function	AIN4
							2 nd function	SU1_TXD0/SU1_SOUT
-	-	14	20	26	P25 (I/O)	General I/O pin	3 rd function	SU1_TXD1
							4 th function	—
							5 th function	—
							6 th function	—
							7 th function	—
							8 th function	AIN5
							2 nd function	SU1_RXD1
							3 rd function	SU1_RXD0
15	14	15	21	27	P26/EXI6 / EXTRG6 (I/O)	General I/O pin External interrupt Functional timer external trigger	4 th function	I2CU0_SDA
							5 th function	FTM3P
							6 th function	—
							7 th function	BZ0P
							8 th function	AIN6
							2 nd function	SU1_TXD1
							3 rd function	—
							4 th function	I2CU0_SCL
16	15	16	22	28	P27/EXI7 / EXTRG7 (I/O)	General I/O pin External interrupt Functional timer external trigger	5 th function	FTM3N
							6 th function	TBCOUT1
							7 th function	BZ0N
							8 th function	AIN7
							2 nd function	—
							3 rd function	—
							4 th function	—
							5 th function	—
-	-	-	-	29	P30 (I/O)	General I/O pin	6 th function	—
							7 th function	—
							8 th function	—
							2 nd function	—
							3 rd function	—
							4 th function	—
							5 th function	—
							6 th function	—
-	-	-	-	30	P31 (I/O)	General I/O pin	7 th function	—
							8 th function	—

Table 3 Pin List (5/5)

16Pin No.(SSOP)	16Pin No.(MQFN)	20Pin No.	24Pin No.	32Pin No.	Pn name	Primary function	Shared function	
							2 nd function	SU1_RXD1
-	-	-	23	31	P32 (I/O)	General I/O pin	3 rd function	SU1_RXD0
							4 th function	—
							5 th function	—
							6 th function	—
							7 th function	—
							8 th function	—
							2 nd function	SU1_TXD1
							3 rd function	—
-	-	17	24	32	P33 (I/O)	General I/O pin	4 th function	—
							5 th function	TMH3OUT
							6 th function	—
							7 th function	—
							8 th function	—

PIN DESCRIPTION

Table 4 Pin Description (1/3)

Function	Signal name	Pin name	I/O	Description	Logic
Power	—	V _{SS}	—	Negative power supply pin (-)	—
	—	V _{DD}	—	Positive power supply pin (+). Connect a capacitor C _V (1μF) between this pin and V _{SS} .	—
	—	V _{DDL}	—	Power supply pin for internal logic (internal regulator's output). Connect a capacitor C _V (1μF) between this pin and V _{SS} .	—
Test	TEST0	P00	I/O	Input pin for testing. Also, used for on-chip debug interface or ISP function. P00 is initialized as pull-up input mode by the system reset (not high-impedance mode).	Positive
System	V _{REF}	P23	—	Reference voltage output. An internal reference voltage in the SA type A/D converter block can be externally used for a reference. The pin is shared with the SA type A/D converter external reference voltage input.	—
	RESET_N	RESET_N	I	Input for reset. Asserting "L" level to this pin enters the MCU into system reset mode and internal circuits are initialized, then releasing it to "H" level make CPU start running the program. Used for on-chip debug interface or ISP function. Internal pull-up resistor is not installed.	Negative
	OUTLSCLK	P02 P21	O	Low-speed clock output.	—
	OUTHCLK	P03 P22	O	Low-speed clock output.	—
General port (GPIO)	P00	P00	I/O	General I/O port - High-impedance - Input with Pull-UP (initial value) - Input without Pull-UP - CMOS output - N-channel open drain output P00 is only initialized as pulled-up input and other ports are initialized as high-impedance Not available to use as I/O pin when using for on-chip debug interface or ISP function.	Positive
	P01 - P07	P01 - P07	I/O	General I/O port - High-impedance (initial value) - Input with Pull-UP - Input without Pull-UP - CMOS output - N-channel open drain output	Positive
	P10 - P17	P10 - P17	I/O		Positive
	P20 - P27	P20 - P27	I/O		Positive
	P30 - P33	P30 - P33	I/O		Positive

Table 4 Pin Description (2/3)

Function	Signal name	Pin name	I/O	Description	Logic
UART	SU0_TXD0	P03	I/O	Serial communication unit0/UART0 data output pin.	Positive
		P13			
	SU0_RXD0	P02	I/O	Serial communication unit0/UART0 data input pin.	Positive
		P07			
		P12			
		P17			
	SU0_TXD1	P03	I/O	Serial communication unit0/UART1 data output pin.	Positive
		P10			
		P13			
		P20			
	SU0_RXD1	P07	I/O	Serial communication unit0/UART1 data input pin.	Positive
		P17			
	SU1_TXD0	P22	I/O	Serial communication unit1/UART0 data output pin.	Positive
		P25			
	SU1_RXD0	P21	I/O	Serial communication unit1/UART0 data input pin.	Positive
		P24			
		P26			
		P32			
	SU1_TXD1	P22	I/O	Serial communication unit1/UART1 data output pin.	Positive
		P25			
		P27			
		P33			
	SU1_RXD1	P26	I/O	Serial communication unit1/UART1 data input pin.	Positive
		P32			
Synchronous Serial Port	SU0_SIN	P02	I	Serial communication unit0/Synchronous serial data input pin.	Positive
		P12			
	SU0_SCK	P04	I/O	Serial communication unit0/Synchronous serial clock I/O pin.	Positive
		P11			
	SU0_SOUT	P03	O	Serial communication unit0/Synchronous serial data output pin.	Positive
		P13			
	SU1_SIN	P21	I	Serial communication unit1/Synchronous serial data input pin.	Positive
		P24			
	SU1_SCK	P16	I/O	Serial communication unit1/Synchronous serial clock I/O pin.	Positive
		P23			
	SU1_SOUT	P22	O	Serial communication unit1/Synchronous serial data output pin.	Positive
		P25			
I ² C Bus	I2CU0_SDA	P03	I/O	I ² C Unit0 (Master and Salve) Data I/O pin / N-ch open drain. Connect a pull-up resistor externally.	Positive
		P15			
		P26			
	I2CU0_SCL	P04	I/O	I ² C Unit0 (Master and Salve) Clock I/O pin / N-ch open drain. Connect a pull-up resistor externally.	Positive
		P16			
		P27			
	I2CM0_SDA	P06	I/O	I ² C Master0 Data I/O pin / N-ch open drain. Connect a pull-up resistor externally.	Positive
		P22			
	I2CM0_SCL	P07	I/O	I ² C Master0 Clock I/O pin / N-ch open drain. Connect a pull-up resistor externally.	Positive
		P23			

Table 4 Pin Description (3/3)

Function	Signal name	Pin name	I/O	Description	Logic
Functional Timer (FTM)	FTM0P	P02	O	Functional Timer0 output.	Positive
	FTM0N	P03	O	Functional Timer0 output.	Negative
	FTM1P	P17	O	Functional Timer1 output.	Positive
	FTM1N	P20	O	Functional Timer1 output.	Negative
	FTM2P	P21	O	Functional Timer2 output.	Positive
	FTM2N	P22	O	Functional Timer2 output.	Negative
	FTM3P	P26	O	Functional Timer3 output.	Positive
	FTM3N	P27	O	Functional Timer3 output.	Negative
	EXTRG0	P02	I	Functional Timer0-3 event trigger input pin.	—
	EXTRG1	P03	I	Functional Timer0-3 event trigger input pin.	—
	EXTRG2	P04	I	Functional Timer0-3 event trigger input pin.	—
	EXTRG3	P17	I	Functional Timer0-3 event trigger input pin.	—
	EXTRG4	P21	I	Functional Timer0-3 event trigger input pin.	—
	EXTRG5	P23	I	Functional Timer0-3 event trigger input pin.	—
	EXTRG6	P26	I	Functional Timer0-3 event trigger input pin.	—
	EXTRG7	P27	I	Functional Timer0-3 event trigger input pin.	—
16bit General Timer	TMH0OUT	P04	O	16bit General Timer 0 output pin	Positive
	TMH1OUT	P13	O	16bit General Timer 1 output pin	Positive
	TMH2OUT	P23	O	16bit General Timer 2 output pin	Positive
	TMH3OUT	P13	O	16bit General Timer 3 output pin	Positive
	TMH4OUT	P12	O	16bit General Timer 4 output pin	Positive
	TMH5OUT	P16	O	16bit General Timer 5 output pin	Positive
Time Base Counter (TBC)	TBCOUT1	P20	O	Time Base Counter 1Hz/2Hz output pin	Positive
		P27			
Buzzer	BZ0P	P17	O	Buzzer output (positive phase)	Positive
		P26			
	BZ0N	P20	O	Buzzer output (negative phase)	Negative
		P27			
External Interrupt	EXI0	P02	I	GPIO maskable external interrupt pin	—
	EXI1	P03	I	GPIO maskable external interrupt pin	—
	EXI2	P04	I	GPIO maskable external interrupt pin	—
	EXI3	P17	I	GPIO maskable external interrupt pin	—
	EXI4	P21	I	GPIO maskable external interrupt pin	—
	EXI5	P23	I	GPIO maskable external interrupt pin	—
	EXI6	P26	I	GPIO maskable external interrupt pin	—
	EXI7	P27	I	GPIO maskable external interrupt pin	—
Successive approximation type A/D converter	V _{REFI}	P23	—	SA type A/D converter external reference voltage input. The voltage provided to the pin is used as the reference voltage for the A/D conversion.	—
	AIN0	P17	I	SA type A/D converter channel 0 input pin	—
	AIN1	P20	I	SA type A/D converter channel 1 input pin	—
	AIN2	P21	I	SA type A/D converter channel 2 input pin	—
	AIN3	P22	I	SA type A/D converter channel 3 input pin	—
	AIN4	P24	I	SA type A/D converter channel 4 input pin	—
	AIN5	P25	I	SA type A/D converter channel 5 input pin	—
	AIN6	P26	I	SA type A/D converter channel 6 input pin	—
Analog comparator	CMP0P	P03	I	Comparator input 0 (noninverting input)	—
	CMP0M	P02	I	Comparator input 0 (inverting input)	—
D/A converter	DACOUT	P01	O	D/A converter output pin	—

TERMINATION OF UNUSED PINS

Table 5 Termination of unused pins

Pin	Recommended pin termination
RESET_N	Connect to V_{DD} through a resistor
P00/TEST0	Open the pin with the internal initial condition of pulled-up input mode.
P01 to P07	Open the pins with the internal initial condition of Hi-impedance mode.
P10 to P17	
P20 to P27	
P30 to P33	

Note:

For unused input ports or unused input/output ports, if an unstable middle level voltage is supplied to the corresponding pins which are configured as inputs without pull-up register or input/output mode, supply current may become excessively large. Therefore, it is recommended to configure those pins as either input mode with a pull-up resistor or output mode.

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 ^{*1}	V
Output voltage	V _{OUT}	Ta = 25°C	-0.3 to V _{DD} +0.3 ^{*1}	V
High level output current	I _{OUTH}	Ta = 25°C	1pin	mA
			Total	
Low level output current	I _{OUTL}	Ta = 25°C	1pin	mA
			Total	
Power dissipation	PD	Ta = 25°C	1	W
Storage temperature	T _{STG}	—	-55 to +150	°C

^{*1} 6.5V or lower^{*2} The current flowing out the LSI through the pin is described in the negative number.

The applicable maximum current is the absolute value.

For example, -1mA means the maximum current 1mA flows out the LSI through the pin.

[Note] Use the product within absolute maximum ratings. The absolute maximum ratings are conditions which may physically deteriorate the quality of product.

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 4M	Hz
		V _{DD} = 1.8 to 5.5V	30k to 25M	
V _{DDL} pin external capacitance	C _L	—	1.0 (±30%)	μF

Current Consumption

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

Parameter	Symbol	Condition	Min.	Typ. (3.0V)	Max.	Unit	Meas uring circuit
Supply current 0	IDD0	CPU is in STOP-D state. Low-speed oscillation and PLL oscillation are stopped.	Ta = -40 to +85 °C	—	0.45	16	μA
			Ta = -40 to +105 °C	—	0.45	34	
Supply current 1	IDD1	CPU is in STOP state. Low-speed oscillation and PLL oscillation are stopped.	Ta = -40 to +85 °C	—	0.60	18	μA
			Ta = -40 to +105 °C	—	0.60	37	
Supply current 2	IDD2	Internal RC Oscillating. CPU is in HALT state (LTBC and WDT are operating ^{*1}). PLL oscillation is stopped.	Ta = -40 to +85 °C	—	2.8	21	μA
			Ta = -40 to +105 °C	—	2.8	41	
Supply current 3	IDD3	CPU: Running with 32kHz RC oscillation clock ^{*1*2} PLL oscillation is stopped.	Ta = -40 to +105 °C	—	12	49	μA
Supply current 4	IDD4	CPU: Running with 16MHz PLL oscillating clock ^{*2} V _{DD} =1.8 to 5.5V	Ta = -40 to +105 °C	—	4.5	5	mA
Supply current 5	IDD5	CPU: Running with 24MHz PLL oscillating clock ^{*2} V _{DD} =1.8 to 5.5V	Ta = -40 to +105 °C	—	6.8	7.3	

^{*1} LTBC and WDT is operating, Significant bits of BLKCON0-3 and BRECON0-3 registers are all "1"

^{*2} CPU running in wait mode

On-chip Oscillator

(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	Measur ing circuit
Low-speed RC oscillator frequency accuracy 1	f _{RCL1}	Ta= +25°C V _{DD} = 1.8 to 5.5V Without software adjustment *1	Typ -1.0%	32.768	Typ +1.0%	kHz	1
		Ta= -40 to +85°C V _{DD} = 1.8 to 5.5V Without software adjustment *1	Typ -2.5%	32.768	Typ +2.5%		
		Ta= -40 to +105°C V _{DD} = 1.8 to 5.5V Without software adjustment *1	Typ -3.0%	32.768	Typ +3.0%		
		V _{DD} = 1.6 to 1.8V Without software adjustment *1	Typ -3.5%	32.768	Typ +3.5%		
Low-speed RC oscillator frequency accuracy 2	f _{RCL2}	Ta= -40 to +85°C V _{DD} = 1.8 to 5.5V With software adjustment *1	Typ -1.0%	32.768	Typ +1.0%		
		Ta= -40 to +105°C V _{DD} = 1.8 to 5.5V With software adjustment *1	Typ -1.5%	32.768	Typ +1.5%		
PLL oscillation frequency accuracy 1	f _{PLL1}	Ta= -40 to +85°C V _{DD} = 1.8 to 5.5V Without software adjustment *1	Typ -2.5%	16/24/32	Typ +2.5%	MHz	
		Ta= -40 to +105°C V _{DD} = 1.8 to 5.5V Without software adjustment *1	Typ -3.0%	16/24/32	Typ +3.0%		
		V _{DD} = 1.6 to 1.8V Without software adjustment *1	Typ -3.5%	16/24/32	Typ +3.5%		
PLL oscillation frequency accuracy 2	f _{PLL2}	Ta= -40 to +85°C V _{DD} = 1.8 to 5.5V With software adjustment *1	Typ -1.0%	16/24/32	Typ +1.0%		
		Ta= -40 to +105°C V _{DD} = 1.8 to 5.5V With software adjustment *1	Typ -1.5%	16/24/32	Typ +1.5%		
PLL oscillation start time	T _{PLL}	V _{DD} = 1.6 to 5.5V	—	—	2	ms	
1kHz Low-speed RC oscillator (for WDT) frequency accuracy	f _{RC1K}	Ta= -40 to +105°C V _{DD} = 1.6 to 5.5V	0.5	1	2	kHz	

^{*1} Adjust the frequency by using temperature sensor in ADC and a Specific Function Register (LRCADJ register)

Input / Output pin

(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		
High/Low level output voltage1 (P00-P07) (P10-P17) (P20-P27) (P30-P33)	VOH1	IOH1=-1mA		V _{DD} -0.5	—	—	V	2		
	VOL1	IOL1=+1mA		—	—	0.5				
Low level output voltage2 (P01-P07) (P10-P17) (P20-P27) (P30-P33)	VOL2	When Nch open drain output mode is selected	IOL2=+10mA V _{DD} ≥5.0V	—	—	0.5				
			IOL2=+8mA V _{DD} ≥3.0V	—	—	0.5				
			IOL2=+3mA V _{DD} ≥2.0V	—	—	0.4				
			IOL2=+2mA 2.0V>V _{DD} ≥1.6V	—	—	0.4				
High level output current1 *1	IOH1	1pin VOH≥VDD-0.5		-1*3*5	—	—			mA	3
		Total of P00-P07 and P10-P13		-10*5	—	—				
		Total of P14-P17, P20-P27 and P30-P33		-10*5	—	—				
		All pin total		-20*5	—	—				
Low level output current1 *2	IOL1	1pin (CMOS output mode)		—	—	1*3				
Low level output current2 *2	IOL2	1pin (Nch open drain output mode)		—	—	10*3				
Low level output current Total *2 *4	IOL3	Total of P00-P07 and P10-P13 (duty≤50%*4)	V _{DD} ≥5.0V	—	—	60				
			V _{DD} ≥3.0V	—	—	40				
			V _{DD} ≥2.0V	—	—	15				
			2.0V>V _{DD} ≥1.6V	—	—	10				
		Total of P14-P17, P20-P27 and P30-P33 (duty≤50%*4)	V _{DD} ≥5.0V	—	—	60				
			V _{DD} ≥3.0V	—	—	40				
			V _{DD} ≥2.0V	—	—	15				
			2.0V>V _{DD} ≥1.6V	—	—	10				
All pin total (duty≤50%*4)			—	—	120					
Output leak (P00~P07) (P10~P17) (P20~P27) (P30~P33)	IOOH	VOH=V _{DD} (High impedance mode)		—	—	+1	μA			
	IOOL	VOL=V _{SS} (High impedance mode)		-1*5	—	—				

*1 Sink-out current from V_{DD} to the output pin, which can guarantee the device operation.*2 Sink-in current from the output pin to V_{SS}, which can guarantee the device operation.

*3 Do not exceed total current.

*4 The total current is on the condition of Duty≤50%

When the duty >50% the total current is calculated by following formula.

Total current = IOL3 × 50/n (When the duty is n%)

<For an example> When IOL3=100mA and n=80%,

Total current = IOL3 × 50/80 = 62.5mA

Current allowed per 1pin is independent of the duty and specified as IOL1 and IOL2.

Do not apply current larger than Absolute Maximum Ratings.

*5 The current flowing out the LSI through the pin is described in the negative number.

The applicable maximum current is the absolute value.

For example, -1mA means the maximum current 1mA flows out the LSI through the pin.

(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 current1 (RESET_N)	I _{IH1}	V _{IH1} =V _{DD}	—	—	1	μA	4
	I _{IL1}	V _{IL1} =V _{SS}	-1* ¹	—	—		
Input current2 (P00/TEST0)	I _{IL2}	V _{IL2} =V _{SS} (pull-up mode)	-1500* ¹	-300* ¹	-20* ¹	kΩ	
	V/I _{IL2}	V _{IL2} =V _{SS} (pull-up mode)	3.7	10	80		
	I _{IH2Z}	V _{IH2} =V _{DD} (High impedance mode)	—	—	1	μA	
	I _{IL2Z}	V _{IL2} =V _{SS} (High impedance mode)	-1* ¹	—	—		
Input current3 (P01-P07) (P10-P17) (P20-P27) (P30-P33)	I _{IL3}	V _{IL3} =V _{SS} (pull-up mode)	-250* ¹	-30* ¹	-2* ¹	kΩ	
	V/I _{IL3}	V _{IL3} =V _{SS} (pull-up mode)	22	100	800		
	I _{IH3Z}	V _{IH3} =V _{DD} (High impedance mode)	—	—	1	μA	
	I _{IL3Z}	V _{IL3} =V _{SS} (High impedance mode)	-1* ¹	—	—		
Input voltage1 (RESET_N) (P00/TEST0) (P01-P07) (P10-P17) (P20-P27) (P30-P33)	V _{IH1}	—	0.7 x V _{DD}	—	V _{DD}	V	5
	V _{IL1}	—	0	—	0.3 x V _{DD}		
Pin capacitance (RESET_N) (P00/TEST0) (P01-P07) (P10-P17) (P20-P27) (P30-P33)	C _{PIN}	f = 10kHz Ta = +25°C	—	—	10	pF	—

^{*1} The current flowing out the LSI through the pin is described in the negative number.

The applicable maximum current is the absolute value.

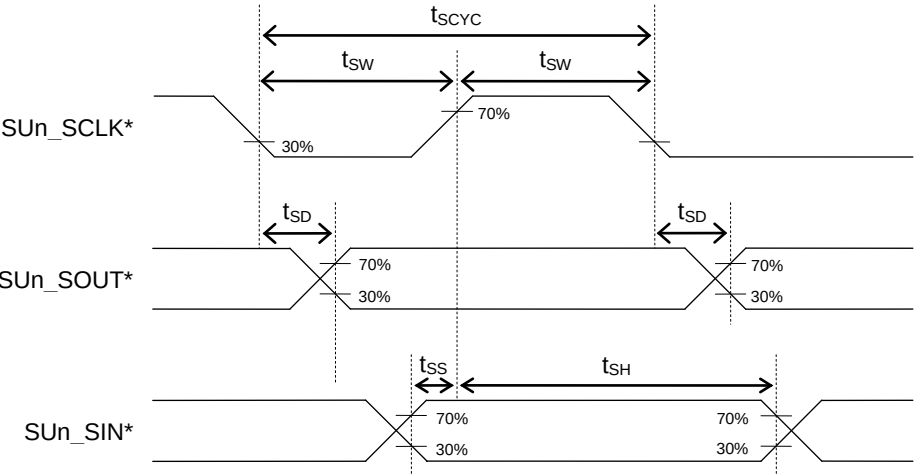
For example, -1mA means the maximum current 1mA flows out the LSI through the pin.

Synchronous Serial Port
Slave mode

(V_{DD}=1.8 to 5.5V, V_{SS}=0V, Ta=-40 to +105°C, unless otherwise specified)

Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit
SCK input cycle	t _{SCYC}	—	1 ^{*2}	—	—	μs
SCK input pulse width	t _{SW}	—	0.5 ^{*3}	—	—	μs
SOUT output delay time	t _{SD}	V _{DD} =2.4 to 5.5V	—	—	100+ HCLK ^{*1} ×3	ns
		V _{DD} =1.8 to 5.5V	—	—	200+ HCLK ^{*1} ×3	ns
SIN input setup time	t _{SS}	—	HCLK ^{*1}	—	—	ns
SIN input hold time	t _{SH}	—	80+ HCLK ^{*1} ×3	—	—	ns

^{*1} Cycle of high speed clock
^{*2} Need input cycles of HSLCK x8 or longer
^{*3} Need input cycles of HSLCK x4 or longer

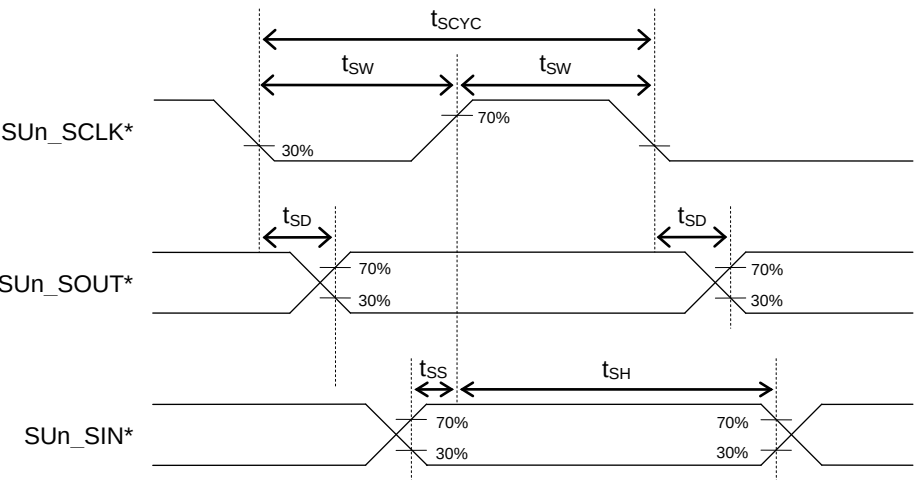


* 2nd to 8th function of port

Master mode

(V _{DD} =1.8 to 5.5V, V _{SS} =0V, Ta=-40 to +105°C, unless otherwise specified)						
Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit
SCK output cycle	t _{SCYC}	—	—	SCLK* ¹	—	ns
SCK output pulse width	t _{SW}	—	SCLK* ¹ ×0.4	SCLK* ¹ ×0.5	SCLK* ¹ ×0.6	ns
SOUT output delay time	t _{SD}	V _{DD} =2.4 to 5.5V	—	—	100	ns
		V _{DD} =1.8 to 5.5V	—	—	160	ns
SIN input setup time	t _{SS}	V _{DD} =2.4 to 5.5V	120	—	—	ns
		V _{DD} =1.8 to 5.5V	180	—	—	ns
SIN input hold time	t _{SH}	V _{DD} =2.4 to 5.5V	80	—	—	ns
		V _{DD} =1.8 to 5.5V	100	—	—	

*¹ Clock cycle selected by bit12~8(SnCK4~0) of the serial port n mode register (SIO_nMOD)
V_{DD}≥2.4V: min250ns , V_{DD}≥1.8V: min500ns



* 2nd to 8th function of port

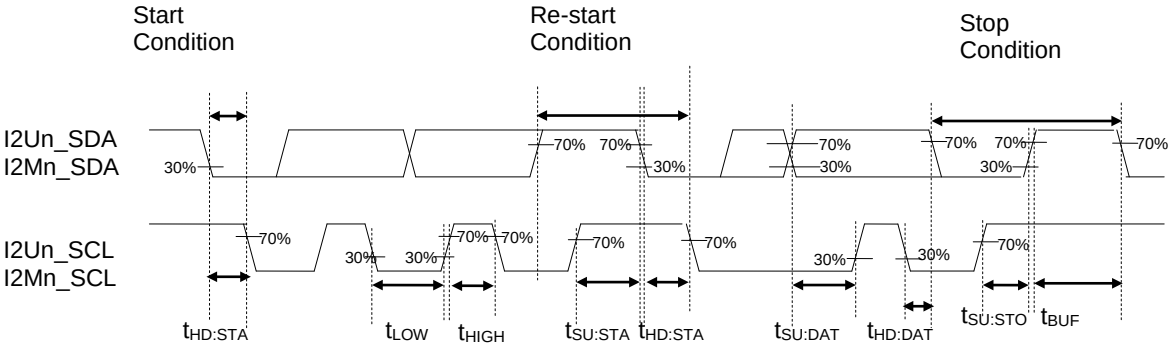
I²C Bus Interface

Standard Mode 100kHz

(V_{DD}=1.8 to 5.5V, V_{SS}=0V, Ta=-40 to +105°C, unless otherwise specified)

Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit
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

When using the I²C as the master, configure the I²C master n mode register(I2MnMOD) and I²C bus 0 mode register (master side, I2UM0MOD) so that meet these specifications.

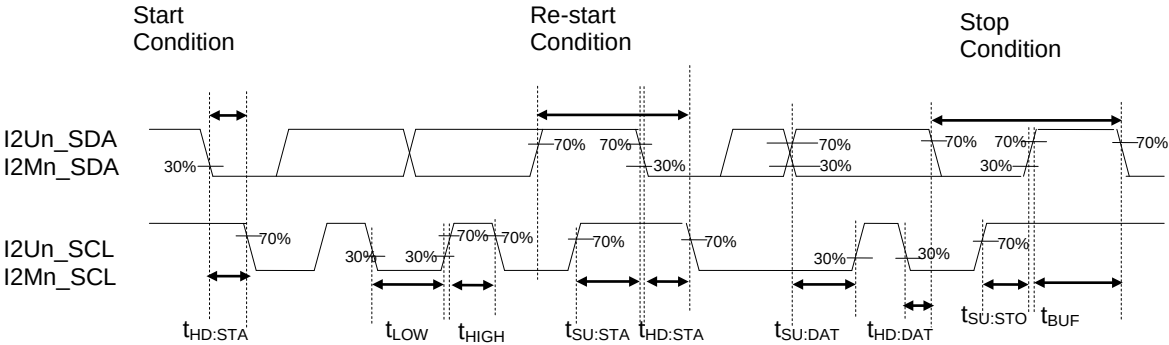


Fast Mode 400kHz

(V_{DD}=1.8 to 5.5V, V_{SS}=0V, Ta=-40 to +105°C, unless otherwise specified)

Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit
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

When using the I²C as the master, configure the I²C master n mode register(I2MnMOD) and I²C bus 0 mode register (master side, I2UM0MOD) so that meet these specifications.

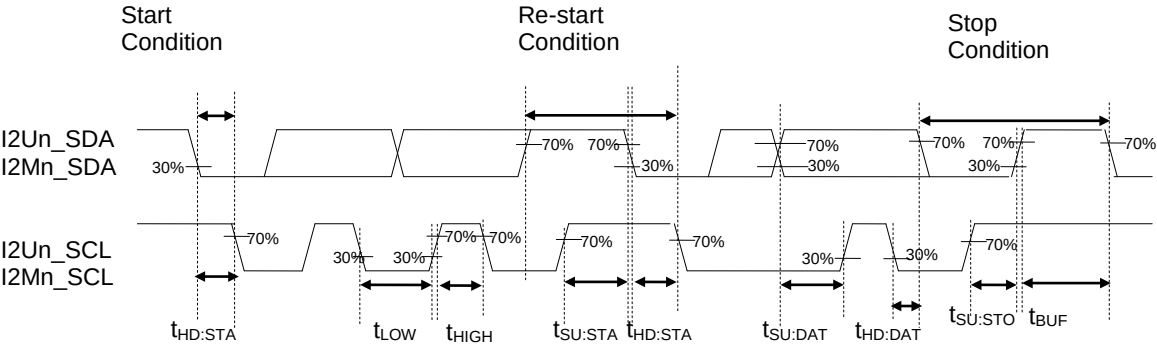


1Mbps Mode

(V_{DD}=2.7 to 5.5V, V_{SS}=0V, Ta=-40 to +105°C, unless otherwise specified)

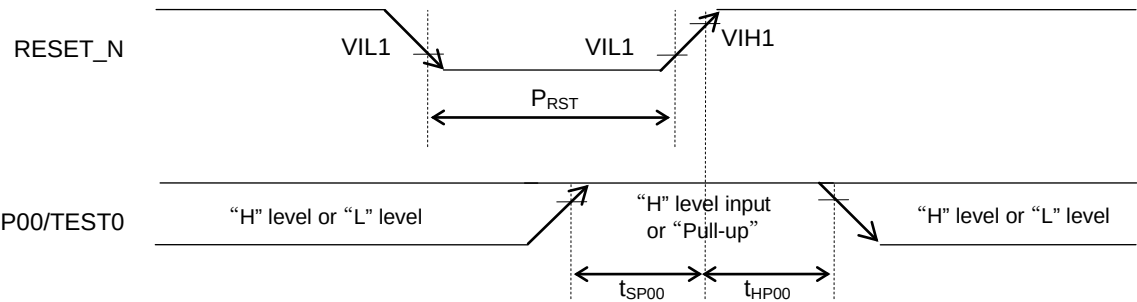
Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit
SCL clock frequency	f _{SCL}	—	0	—	1000	kHz
SCL hold time (start/restart condition)	t _{HD:STA}	—	0.26	—	—	μs
SCL "L" level time	t _{LOW}	—	0.5	—	—	μs
SCL "H" level time	t _{HIGH}	—	0.26	—	—	μs
SCL setup time (restart condition)	t _{SU:STA}	—	0.26	—	—	μs
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}	—	0.26	—	—	μs
Bus-free time	t _{BUF}	—	0.5	—	—	μs

When using the I²C as the master, configure the I²C master n mode register(I2MnMOD) and I²C bus 0 mode register (master side, I2UM0MOD) so that meet these specifications.



Reset

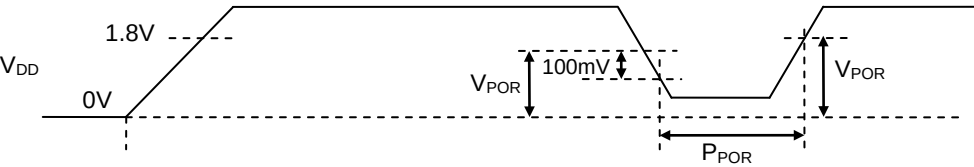
(V _{DD} =1.6 to 5.5V, V _{SS} =0V, Ta=−40 to +105°C, unless otherwise specified)							
Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit	Measur ing circuit
Reset pulse width	P _{RST}	—	2	—	—	ms	1
P00 "H" level setup time	t _{SP00}	—	1	—	—	ms	
P00 "L" level hold time	t _{HP00}	—	1	—	—	ms	



Power On Reset

(V _{SS} =0V, Ta=−40 to +105°C, unless otherwise specified)							
Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit	Measur ing circuit
POR detect voltage	V _{POR}	Power down(falling)	1.44	1.5	1.58	V	1
		Power up(rising)	1.45	1.53	1.8	V	
Power on rising slope	R _{POR} ^{*1}	—	0.009	—	60	V/ms	
POR response time	P _{POR}	*2	200	—	—	μs	

^{*1}: Rise the V_{DD} to 1.8V or higher when powering on.
^{*2}: This is the time from the V_{DD} gets 100mV lower than V_{POR} to the Power-On-Reset internally genertes.
Make the power down falling slope 2V/ms or lower(i.e. slower).



[Note for in case of instantaneous power failure]
In case of instantaneous power failure and a pulse shorter than the response time of VLS or POR is asserted to V_{DD}, it is possible to make the MCU cannot get the reset and make erroneous operation. In that case, please have countermeasures such as preventing the voltage down using bypass capacitor or making reset pin reset.

VLS

(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
		VLS0LV * ¹						
VLS threshold voltage * ²	V _{VLSR}	00H	Rising	3.86	4.06	4.26	V	1
	V _{VLSF}		Falling	3.84	4.00	4.16		
	V _{VLSR}	01H	Rising	3.57	3.76	3.95		
	V _{VLSF}		Falling	3.55	3.70	3.85		
	V _{VLSR}	02H	Rising	2.94	3.11	3.28		
	V _{VLSF}		Falling	2.92	3.05	3.18		
	V _{VLSR}	03H	Rising	2.85	3.01	3.17		
	V _{VLSF}		Falling	2.83	2.95	3.07		
	V _{VLSR}	04H	Rising	2.75	2.91	3.07		
	V _{VLSF}		Falling	2.73	2.85	2.97		
	V _{VLSR}	05H	Rising	2.66	2.81	2.96		
	V _{VLSF}		Falling	2.64	2.75	2.86		
	V _{VLSR}	06H	Rising	2.56	2.71	2.86		
	V _{VLSF}		Falling	2.54	2.65	2.76		
	V _{VLSR}	07H	Rising	2.46	2.61	2.76		
	V _{VLSF}		Falling	2.44	2.55	2.66		
	V _{VLSR}	08H	Rising	2.37	2.51	2.65		
	V _{VLSF}		Falling	2.35	2.45	2.55		
	V _{VLSR}	09H	Rising	1.98	2.11	2.24		
	V _{VLSF}		Falling	1.96	2.05	2.14		
	V _{VLSR}	0AH	Rising	1.89	2.01	2.13		
	V _{VLSF}		Falling	1.87	1.95	2.03		
	V _{VLSR}	0BH	Rising	1.79	1.91	2.03		
	V _{VLSF}		Falling	1.77	1.85	1.93		
VLS Current	I _{VLS}	—		—	50	—	nA	

*¹ Bit3~Bit0 of voltage level detection circuit 0 level register (VLS0LV).*² The Data VLS0LV = 0CH~0FH is not available to use, if the data is specified it will the same spec as that 0BH is specified.

Analog Comparator

(V_{DD}=1.8 to 5.5V, V_{SS}=0V, Ta=-40 to +105°C, unless otherwise specified)

Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit	Measuring circuit
Comparator same phase input voltage range	V _{CMR}	—	0.1	—	V _{DD} -1.5	V	1
Comparator input offset	V _{CMOF}	Ta= +25 °C, V _{DD} =5.0V	—	5	—	mV	
Comparator Reference Voltage	V _{CMREF}	—	0.75	0.8	0.85	V	

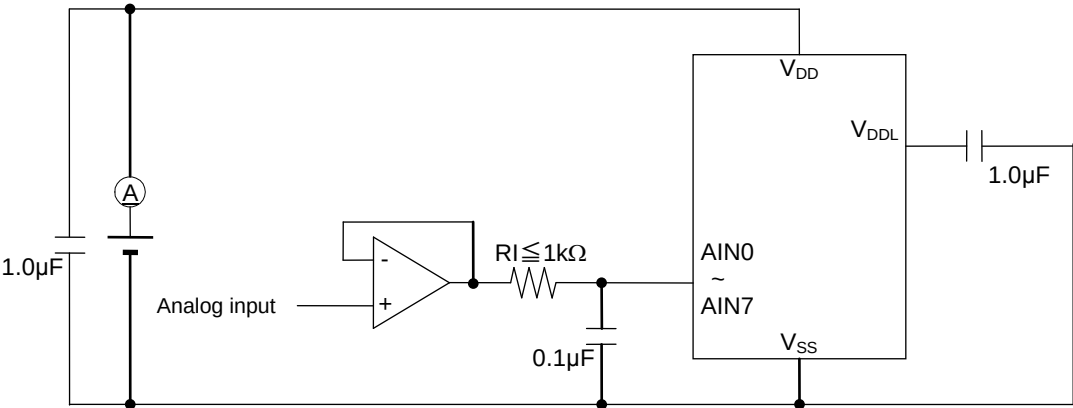
Successive Approximation Type A/D Converter

(VDD=1.8 to 5.5V, VSS =0V, Ta=-40 to +105°C, unless otherwise specified)

Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit
Resolution	n _{AD}	—	—	—	10	bit
Integral non-linearity error	INL _{AD}	2.7V ≤ V _{REFP} ^{*1} ≤ 5.5V	-4	—	4	LSB
		2.2V ≤ V _{REFP} ^{*1} < 2.7V	-6	—	6	
		1.8V ≤ V _{REFP} ^{*1} < 2.2V	-10	—	10	
		V _{REFP} =Internal reference voltage	-15	—	15	
Differential non-linearity error	DNL _{AD}	2.7V ≤ V _{REFP} ^{*1} ≤ 5.5V	-3	—	3	
		2.2V ≤ V _{REFP} ^{*1} < 2.7V	-5	—	5	
		1.8V ≤ V _{REFP} ^{*1} < 2.2V	-9	—	9	
		V _{REFP} =Internal reference voltage	-14	—	14	
Zero-scale error	ZSE	RI ≤ 1kΩ	-6	—	6	V
Full-scale error	FSE	RI ≤ 1kΩ	-6	—	6	
A/D reference voltage	V _{REFX}	—	1.8	—	V _{DD}	
Internal reference voltage	V _{REFI}	—	1.5	1.55	1.6	μs
Conversion time	t _{CONV}	4.5V ≤ V _{DD} ≤ 5.5V	2.25	—	427	
		2.2V ≤ V _{DD} ≤ 5.5V	4.5	—	427	
		1.8V ≤ V _{DD} ≤ 5.5V	18	—	427	

^{*1} : VDD or P23/V_{REF} is selected for the reference voltage of Successive Approximation Type A/D Converter by setting bit5(VREFP1) and bit4(VREFP0) of SA-ADC TEMP/VREF control register(VREFCON).

During ADC Sampling, a charge current flows to capacitor. In order to obtain ADC result precisely, analog source output inpedance less than 1kΩ is recommended. And additional approx.0.1μF capacitor is recommended for noise reduction.



D/A Converter

(VDD=1.8 to 5.5V, VSS =0V, Ta=-40 to +105°C, unless otherwise specified)

Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit
Resolution	n_{DA}	—	—	—	8	bit
Conversion cycle	tc	—	10	—	—	μs
Integral non-linearity error	INL _{DA}	RL=4MΩ	-2	—	2	LSB
Differential non-linearity error	DNL _{DA}	RL=4MΩ	-1	—	1	
Output impedance	Ro	DACEN bit of D/A converter enable register =1	3	6	9	kΩ

Reference Voltage Output

(VDD=1.8 to 5.5V, VSS =0V, Ta=-40 to +105°C, unless otherwise specified)

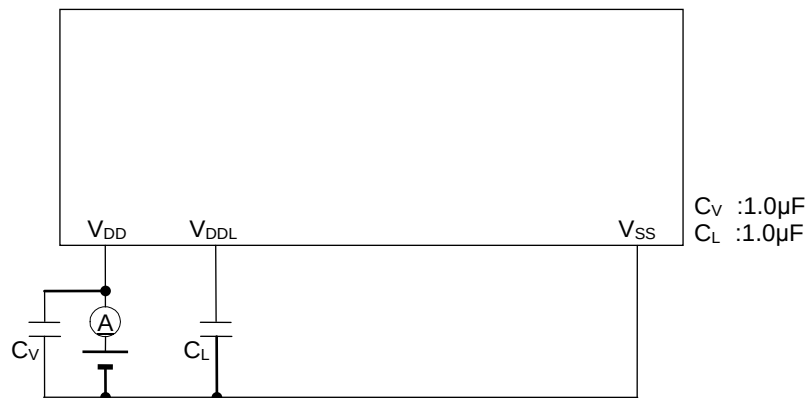
Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit
Output voltage	V _{REFOUT}	—	1.5	1.55	1.6	V
Output impedance	R _{VREFOUT}	—	—	—	500	kΩ

Flash Memory

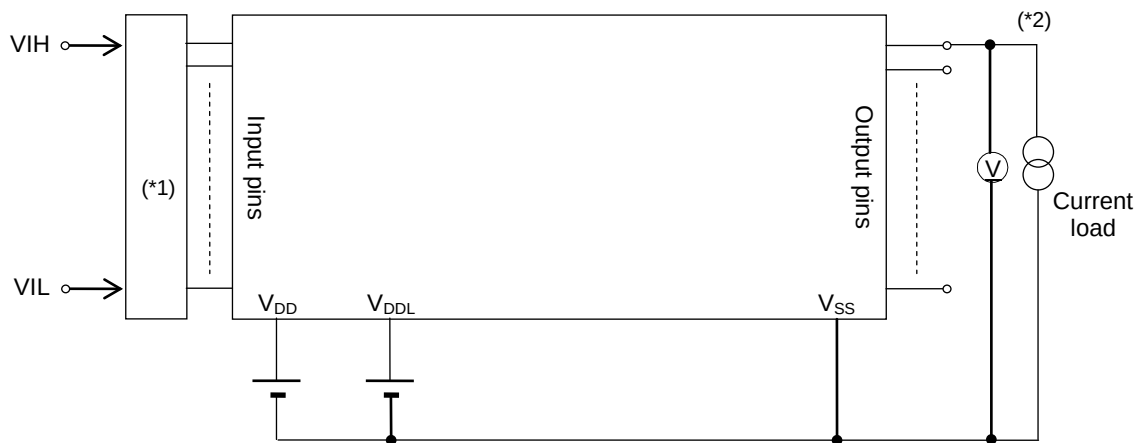
(V_{SS}= 0V)

Parameter	Symbol	Condition		Range	Unit
Operating temperature	T _{OP}	Data flash memory, At write/erase		-40 to +85	°C
		Flash ROM, At write/erase		0 to +40	
Operating voltage	V _{DD}	At write/erase		+1.8 to +5.5	V
Maximum rewrite count	CEPD	Data Flash (1024Byte x2)		10000	times
	CEPP	Program Flash		100	
Erase unit	—	Block erase	Program Flash	16K	B
			Data Flash	2K	
	—	Sector erase	Program Flash	1K	B
			Data Flash	128	
Erase time (Max.)	—	Block erase / Sector erase		85	ms
Write unit	—	Program Flash		4	B
		Data Flash		1	
Write time (Max.)	—	Program Flash		80	μs
	—	Data Flash		40	
Data retention period	YDR	—		15	years

Measuring circuit 1

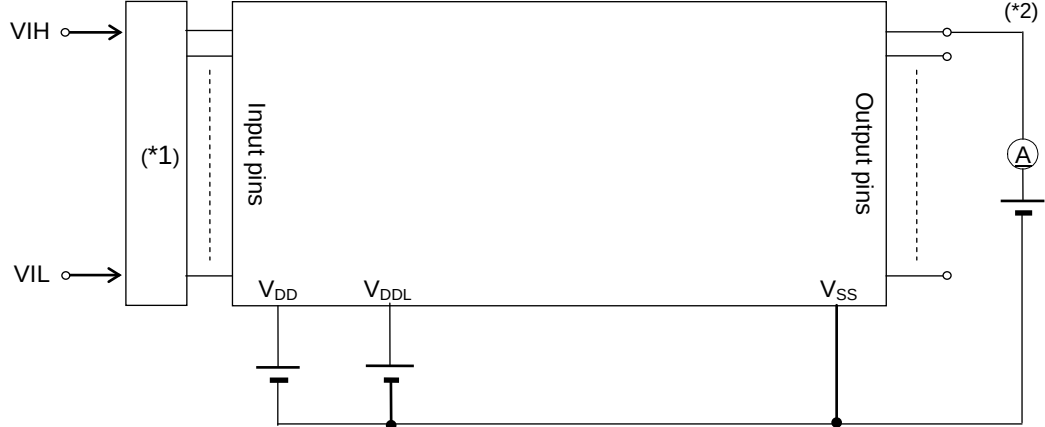


Measuring circuit 2



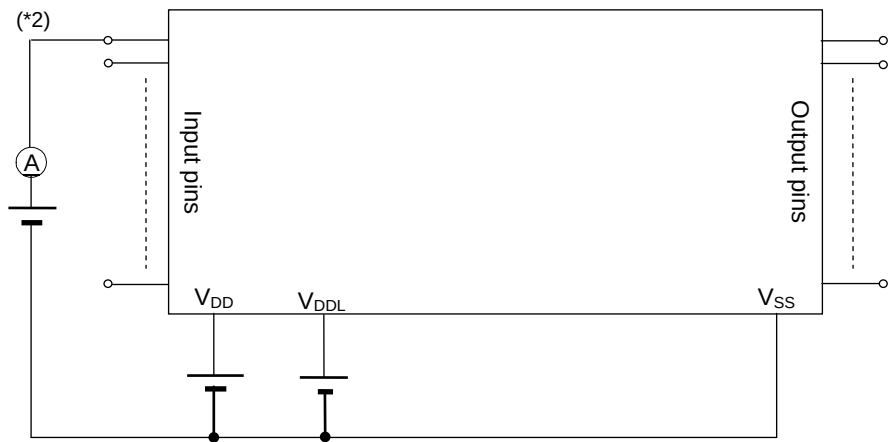
(*1) Input logic circuit to determine the specified measuring conditions
(*2) Measured connecting specified pins

Measuring circuit 3



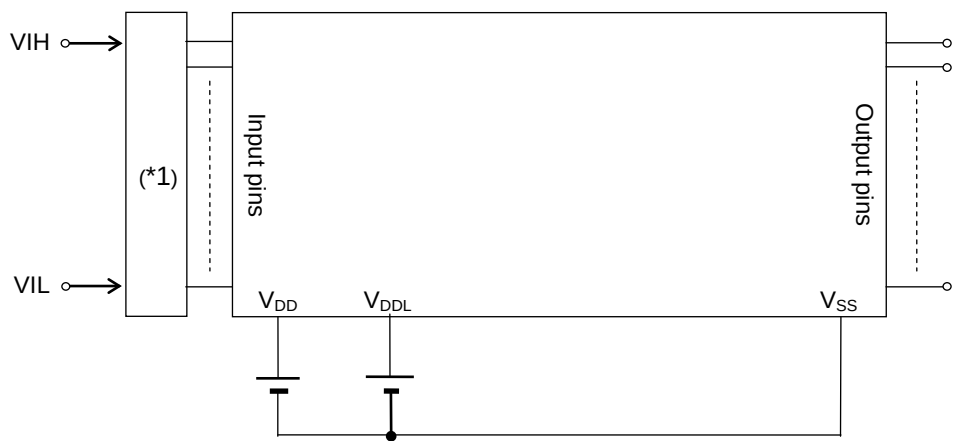
(*1) Input logic circuit to determine the specified measuring conditions
(*2) Measured connecting specified pins

Measuring circuit 4



(*2) Measured connecting specified pins

Measuring circuit 5

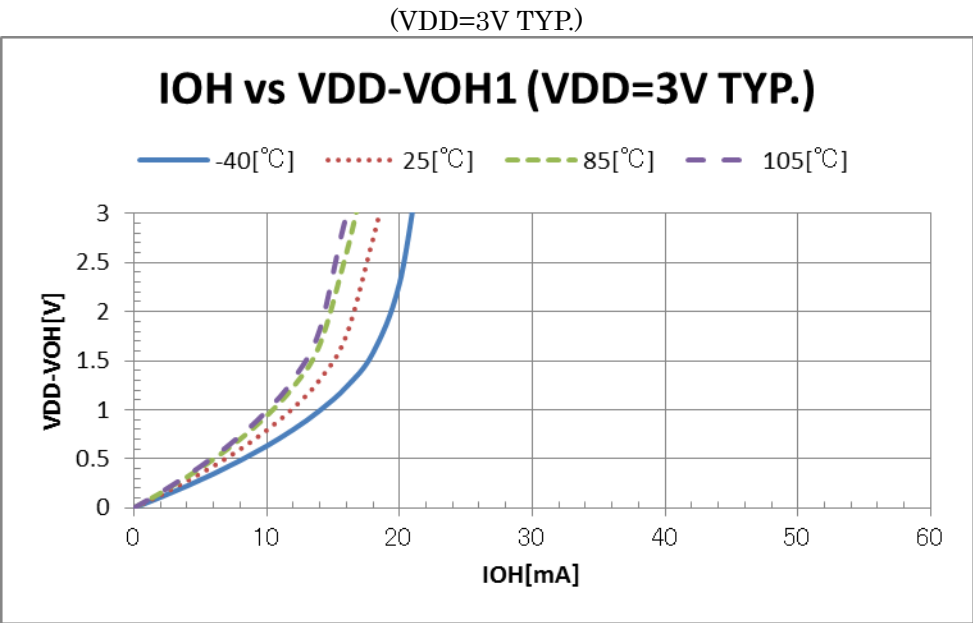
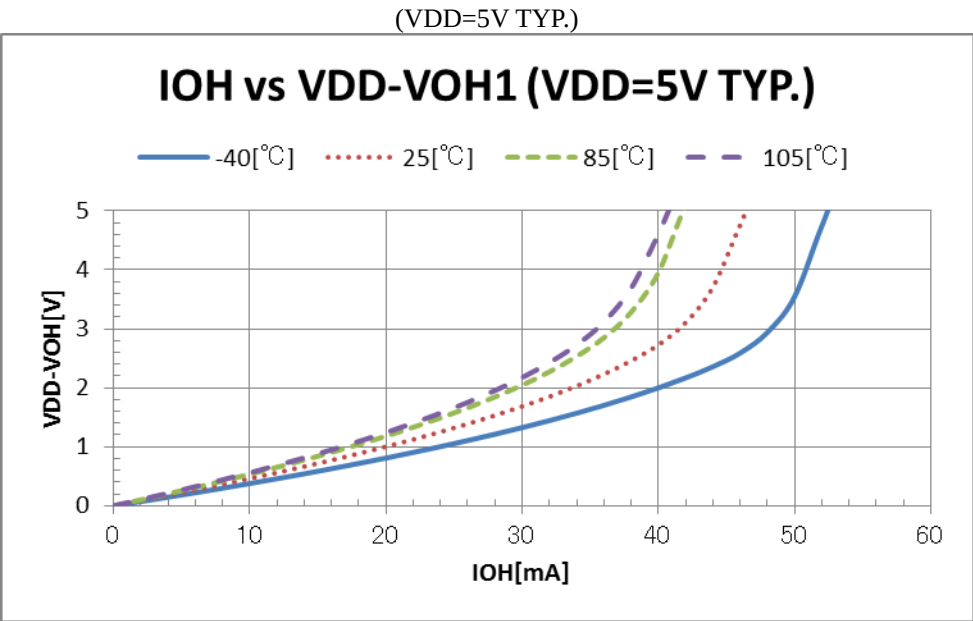


(*1) Input logic circuit to determine the specified measuring conditions

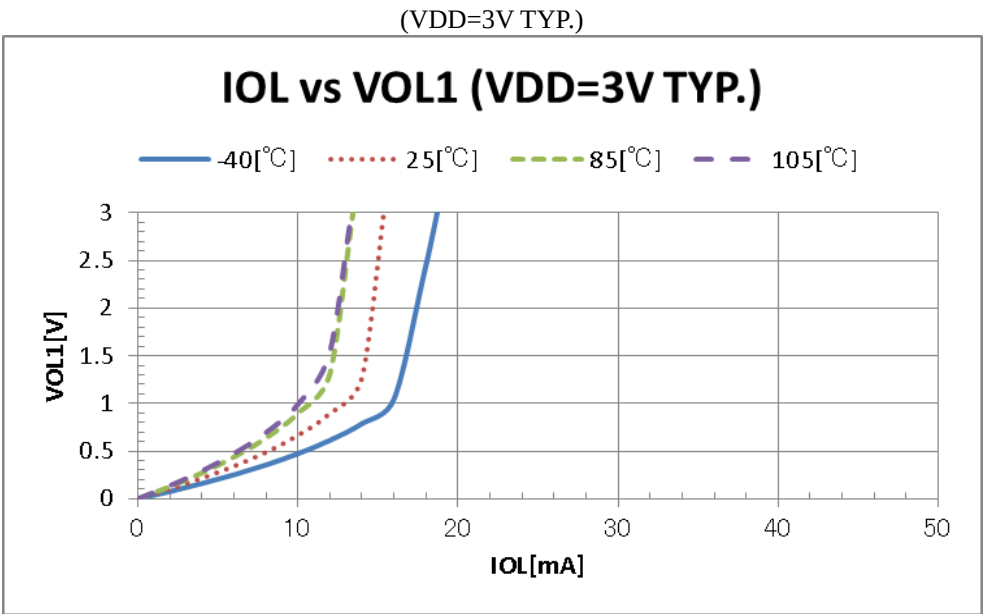
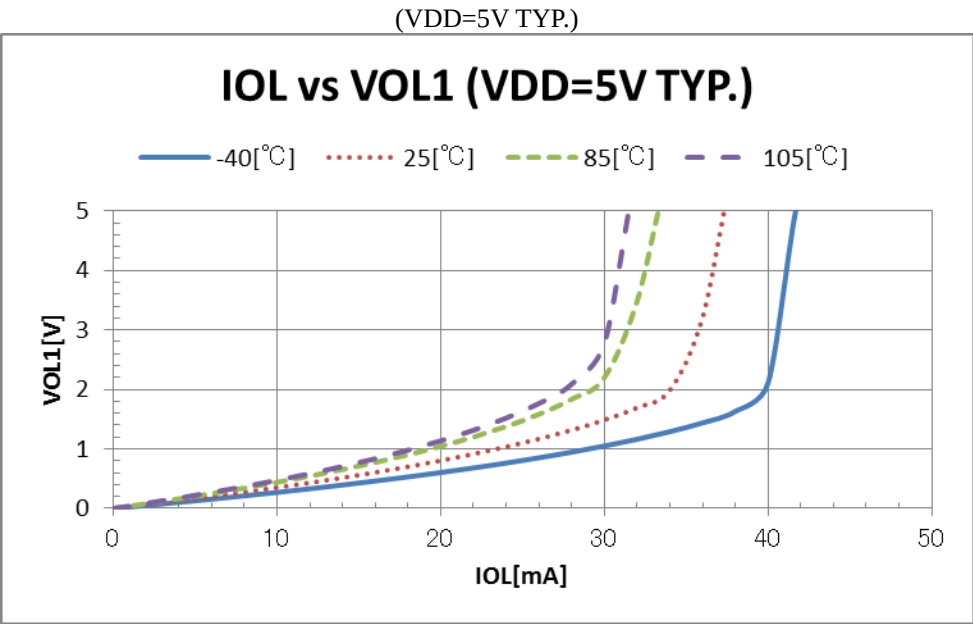
●ML62Q1200 1400 1600 electrical characteristic graph

These Graphs are reference for designing an application.

IOH VS VDD-VOH1

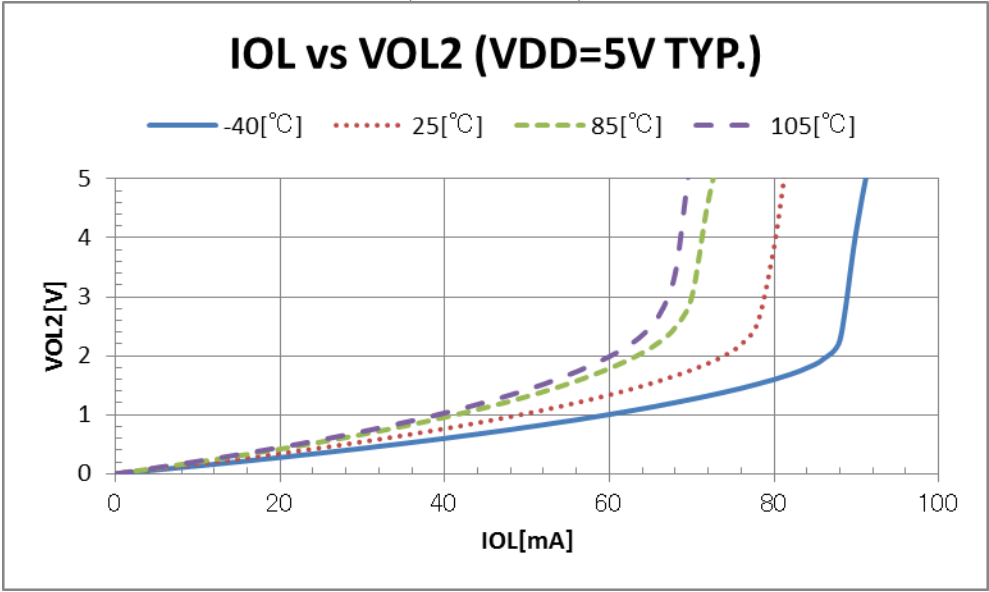


IOL VS VOL1

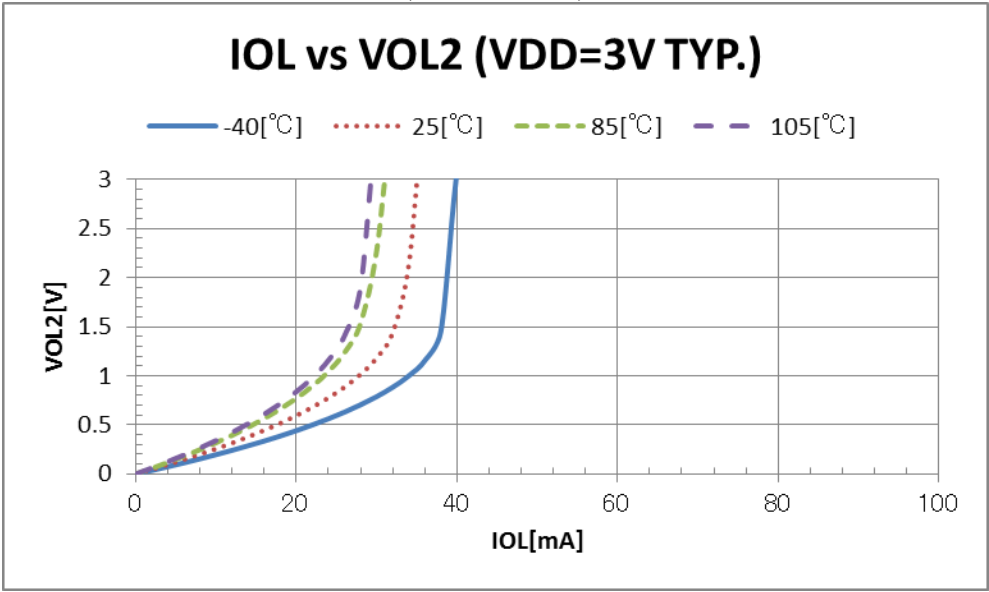


IOL VS VOL2

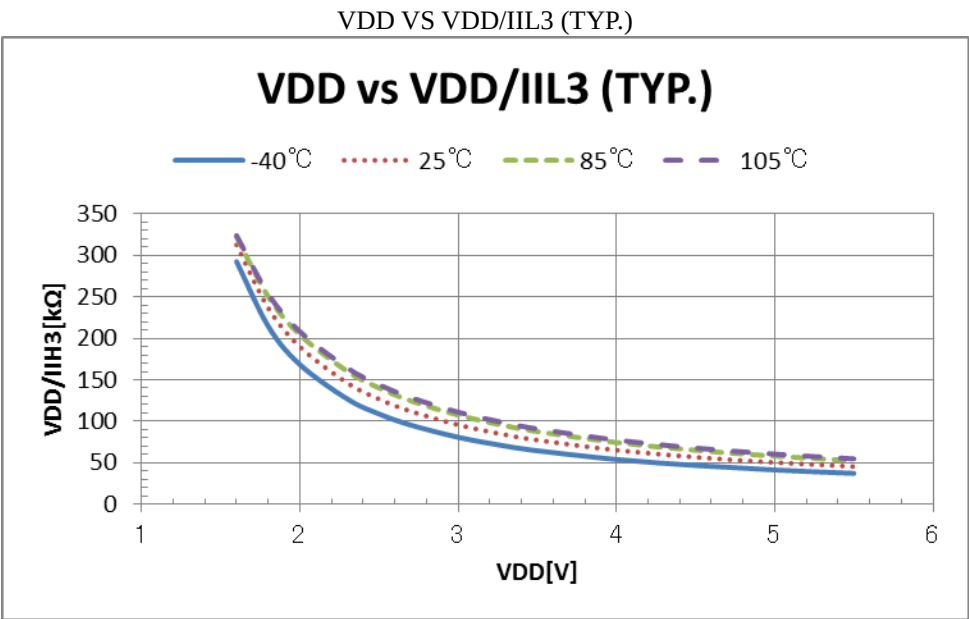
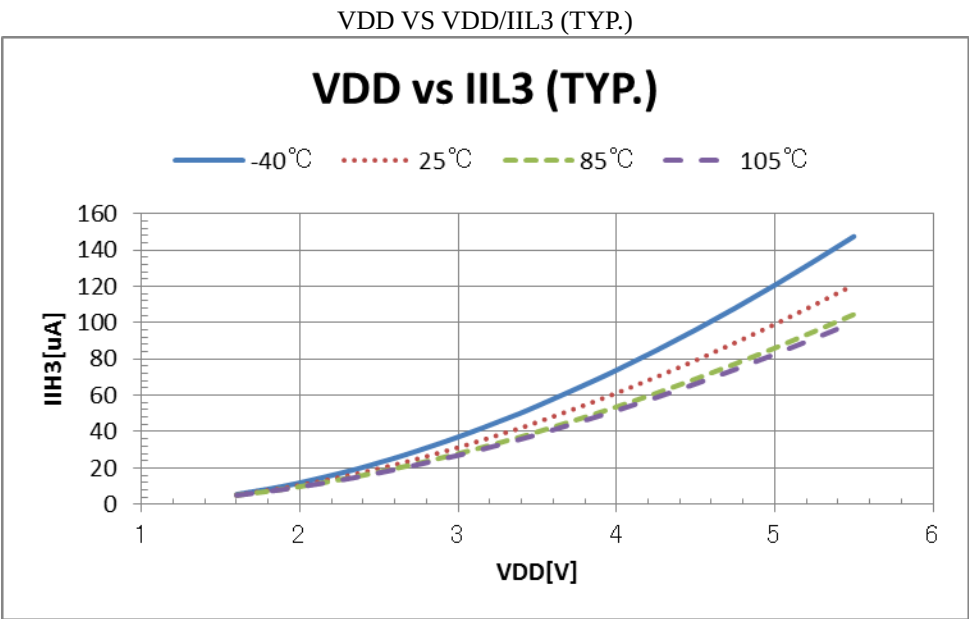
(VDD=5V TYP.)



(VDD=3V TYP.)

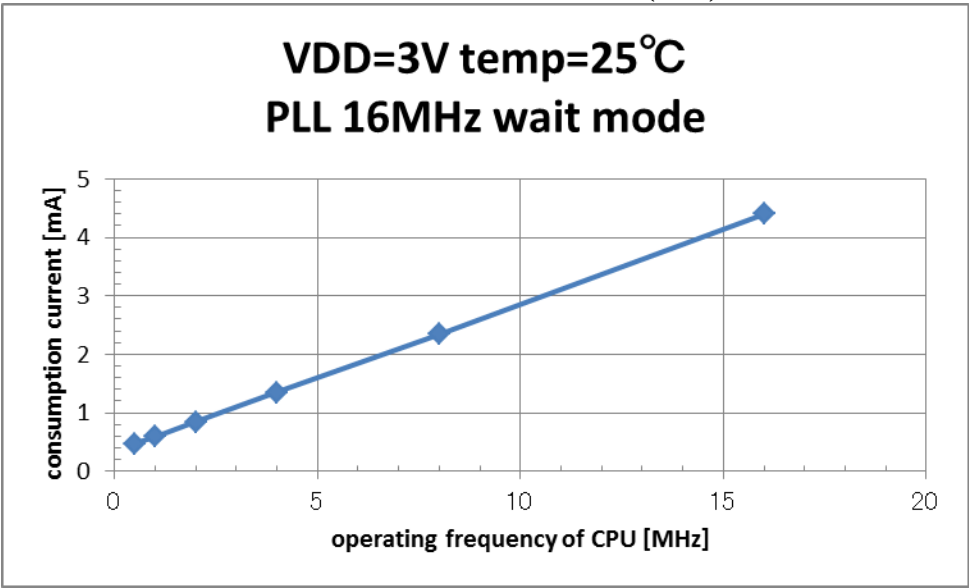


Pull-up resistor

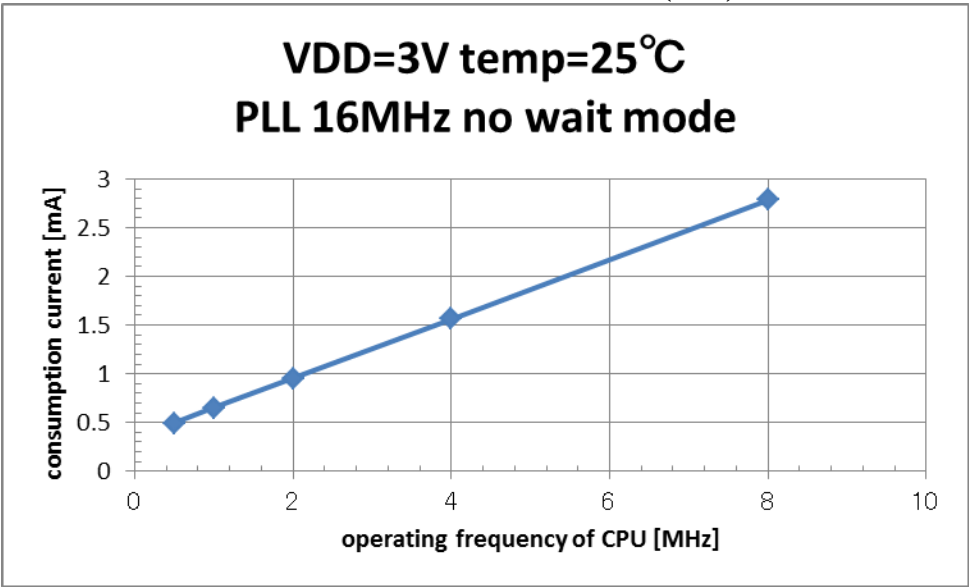


Current consumption VS operating frequency of CPU

VDD=3V, temp=25 °C, stop the clock supply to peripherals.
PLL 16MHz mode, CPU Wait mode (TYP.)

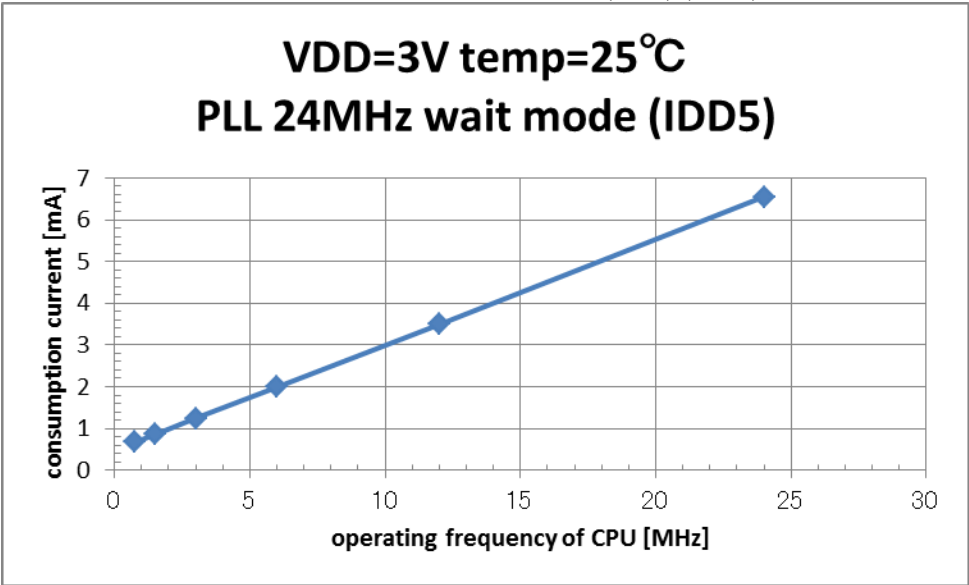


PLL 16MHz mode, CPU no Wait mode (TYP.)

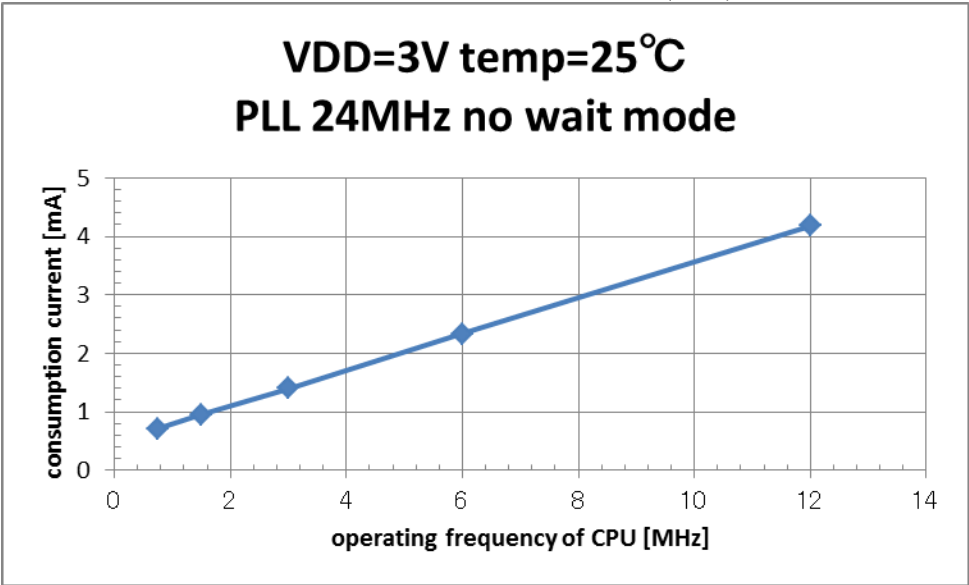


VDD=3V, temp=25°C, stop the clock supply to peripherals.

PLL 24MHz mode, CPU Wait mode (TYP.) (IDD5)

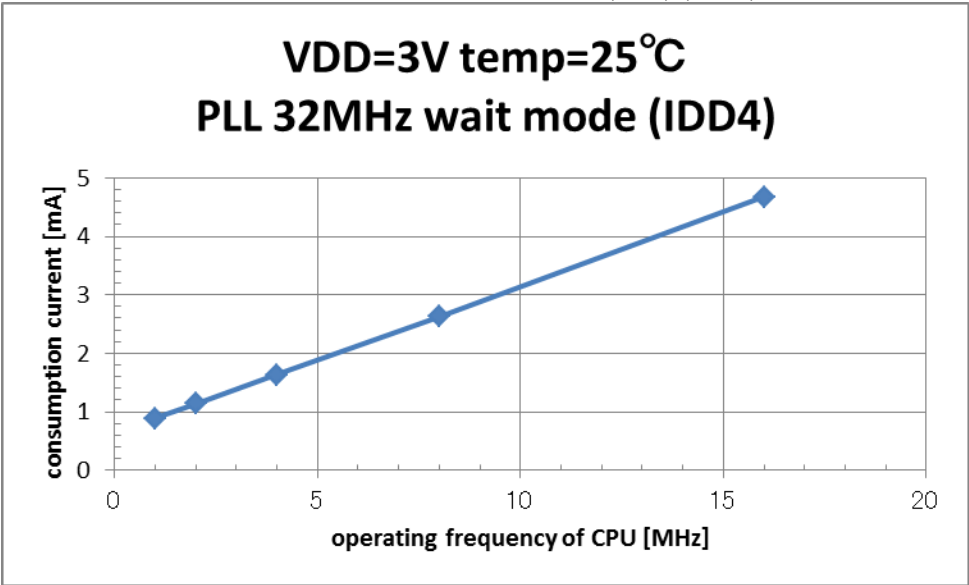


PLL 24MHz mode, CPU no Wait mode (TYP.)

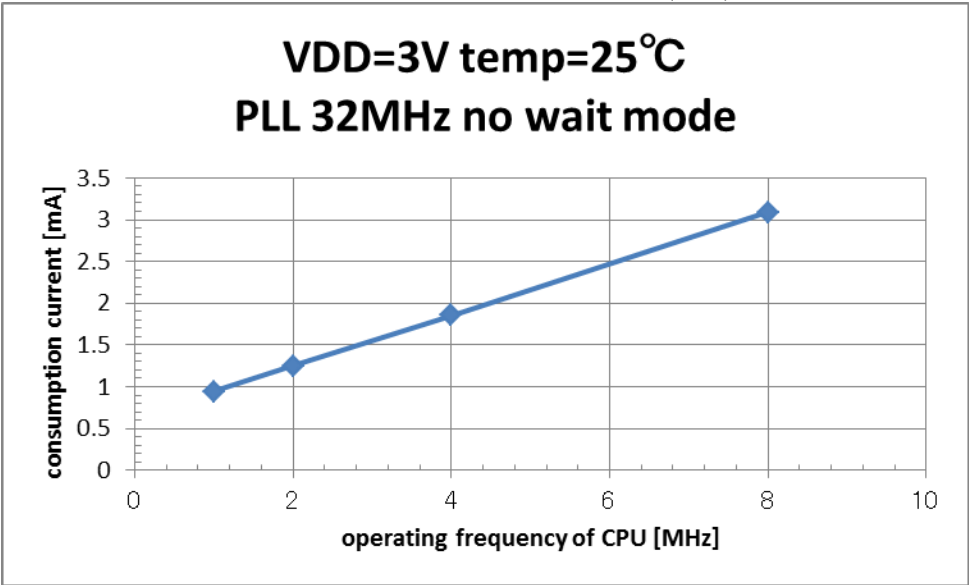


VDD=3V, temp=25°C, stop the clock supply to peripherals.

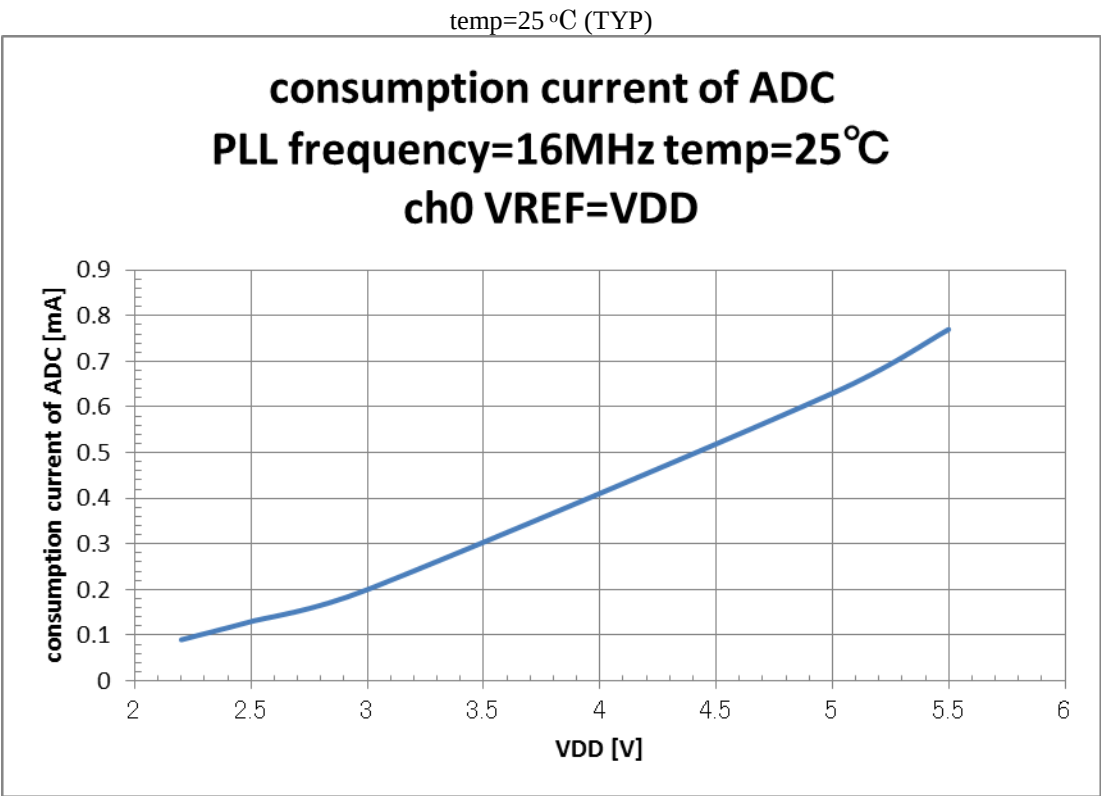
PLL 32MHz mode, CPU Wait mode (TYP) (IDD4)



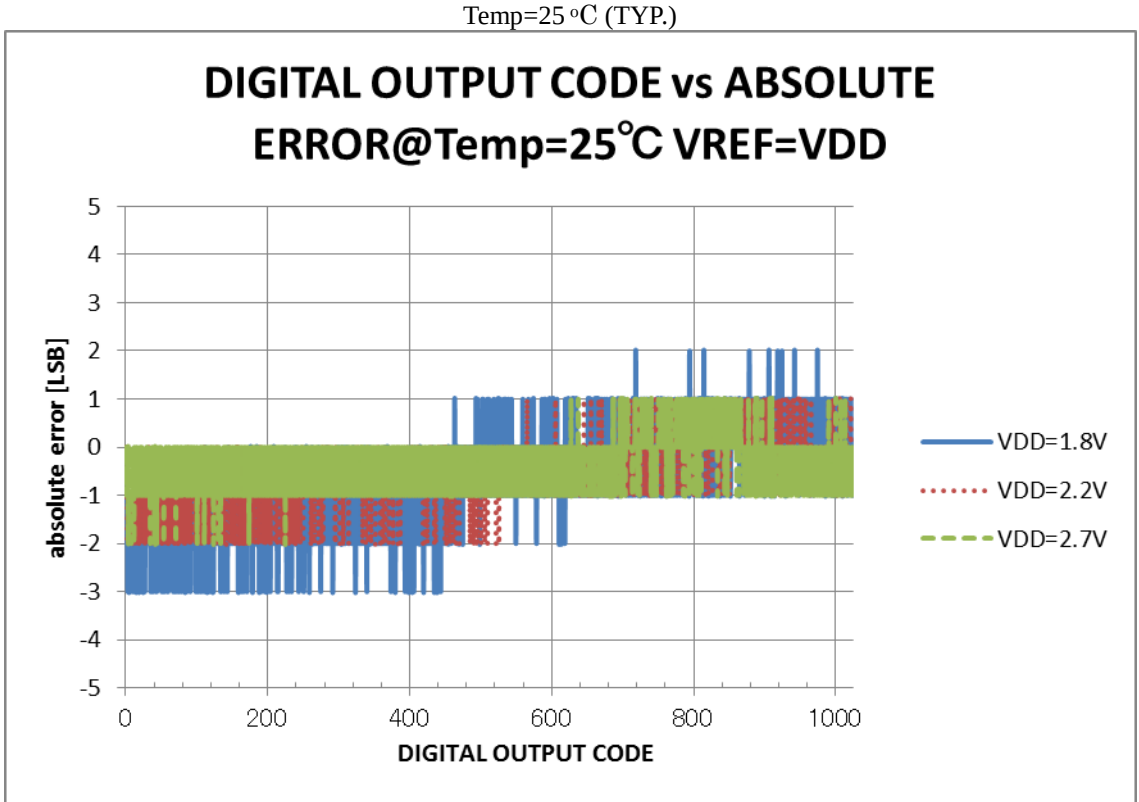
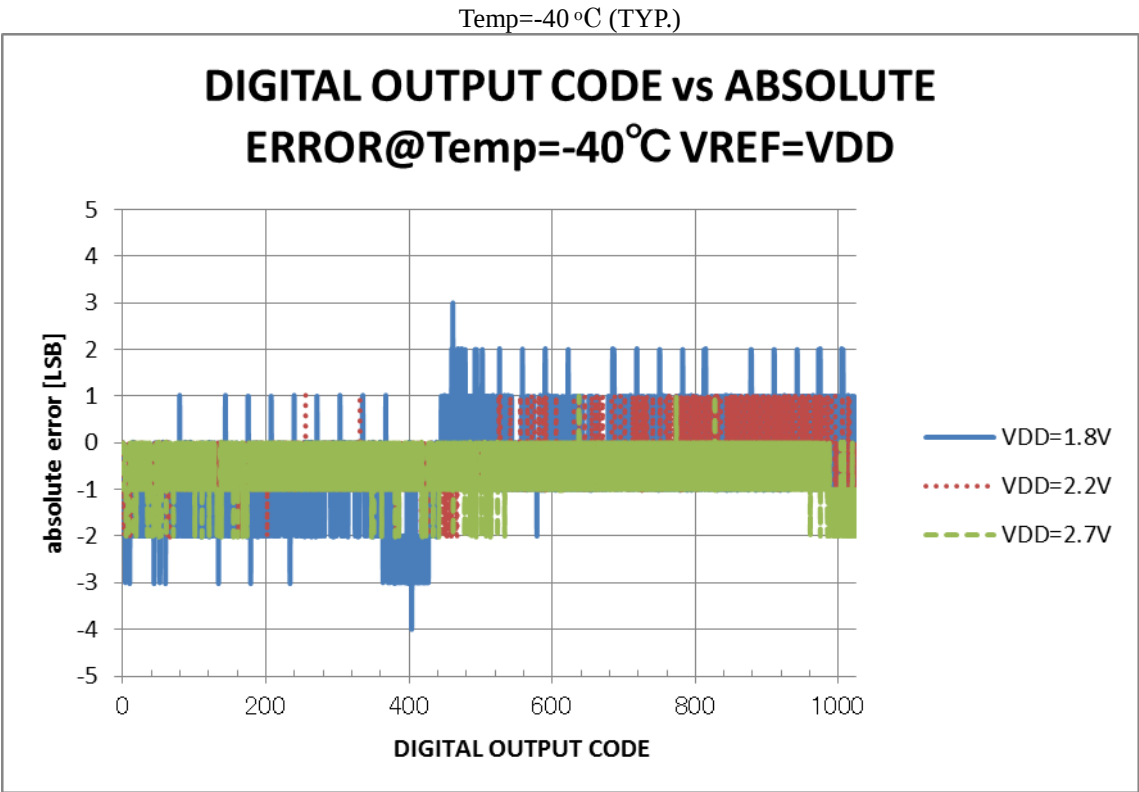
PLL 32MHz mode, CPU no Wait mode (TYP)



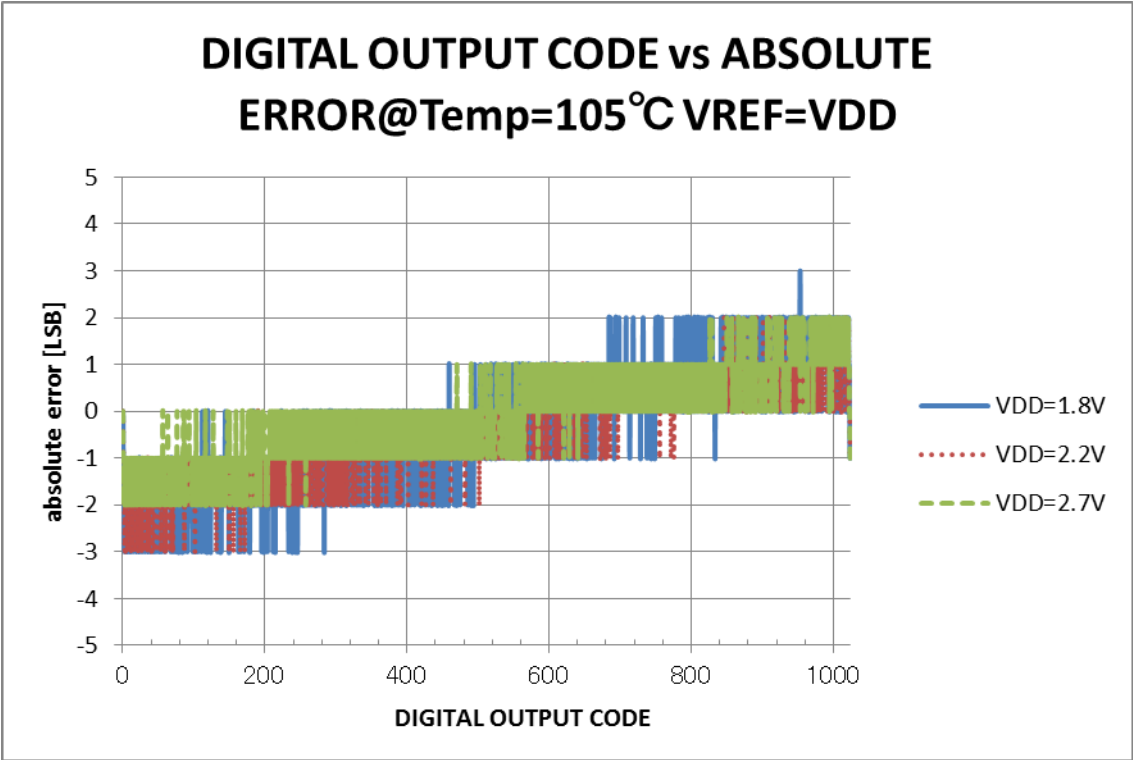
Consumption current of ADC VS operating voltage



DIGITAL OUTPUT CODE vs absolute error of ADC

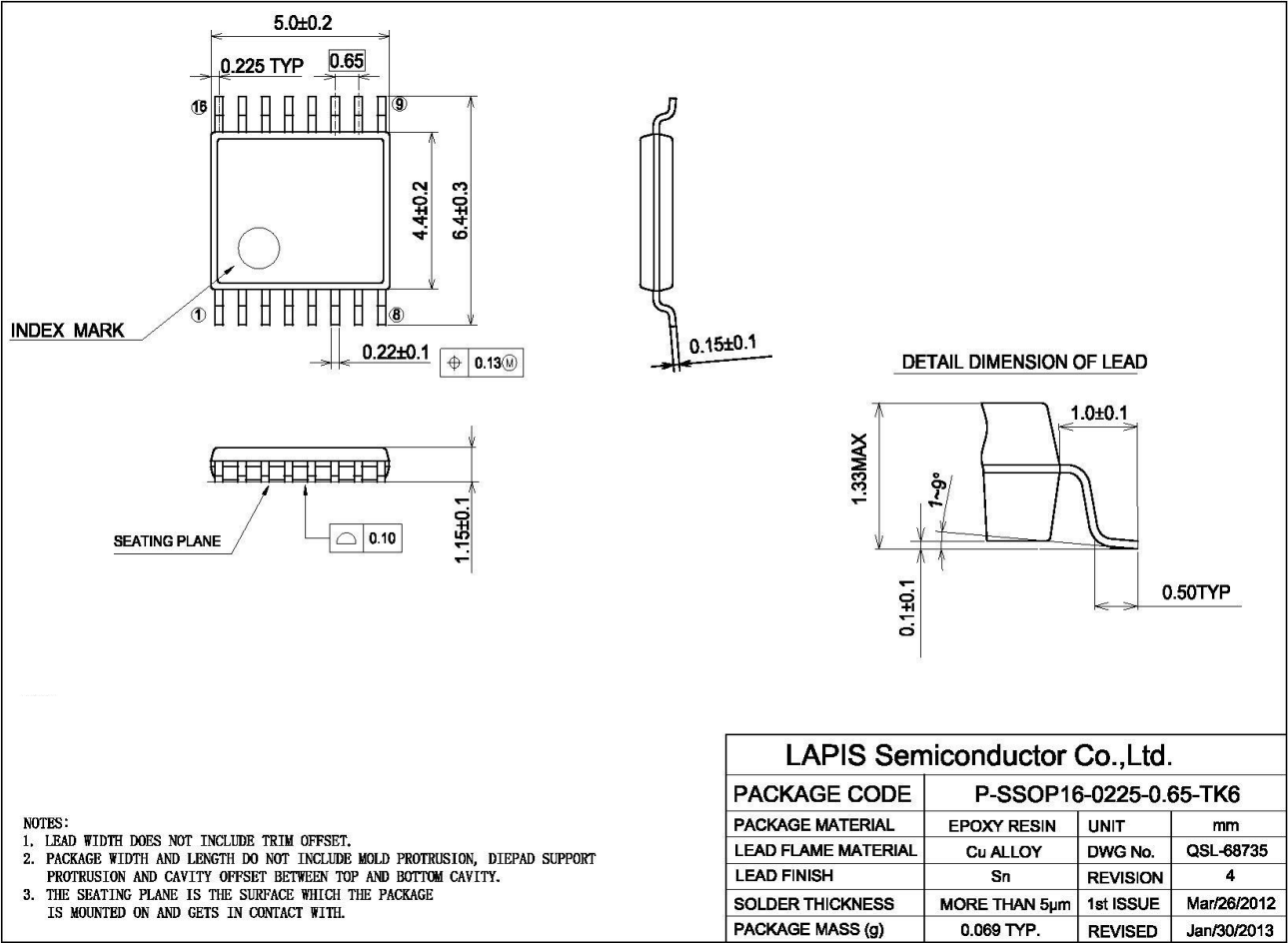


Temp=105 °C (TYP.)



PACKAGE DIMENSIONS

ML62Q1223A/1224A/1225A 16pin SSOP

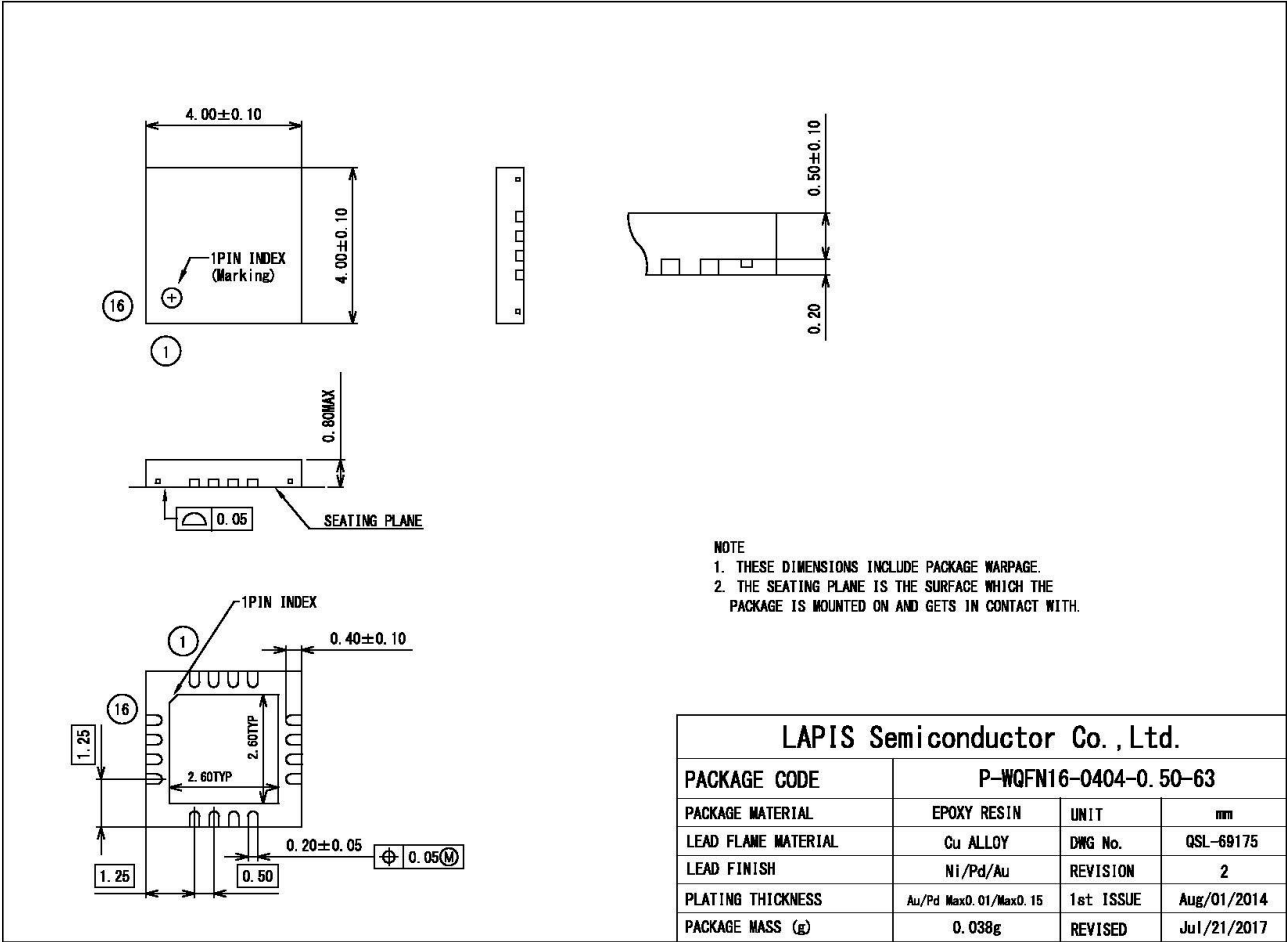


(Unit: mm)

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).

ML62Q1223A/1224A/1225A 16pin WQFN

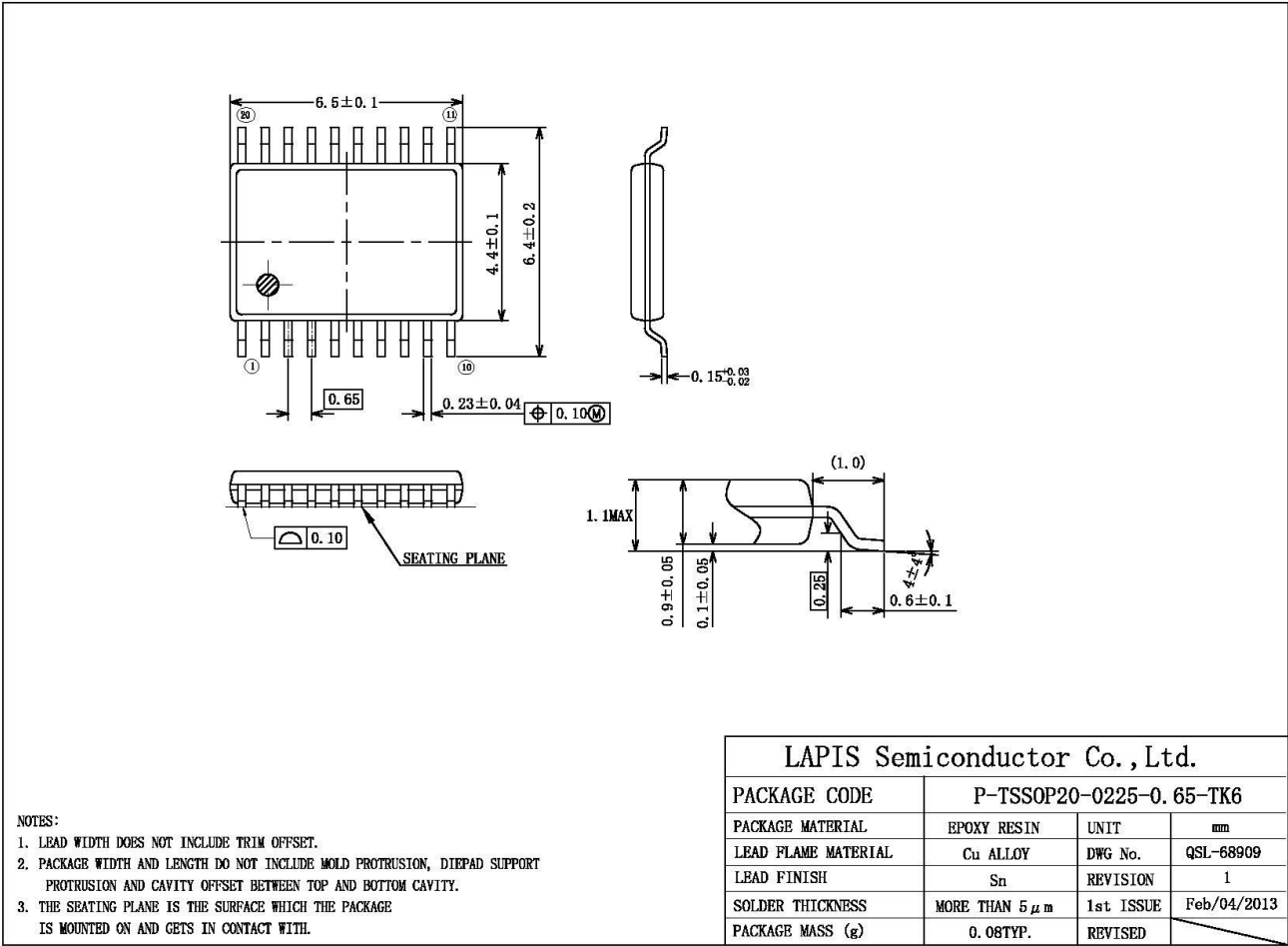


(Unit: mm)

Notes for Mounting the Surface Mount Type Package

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ML62Q1233A/1234A/1235A 20pin TSSOP

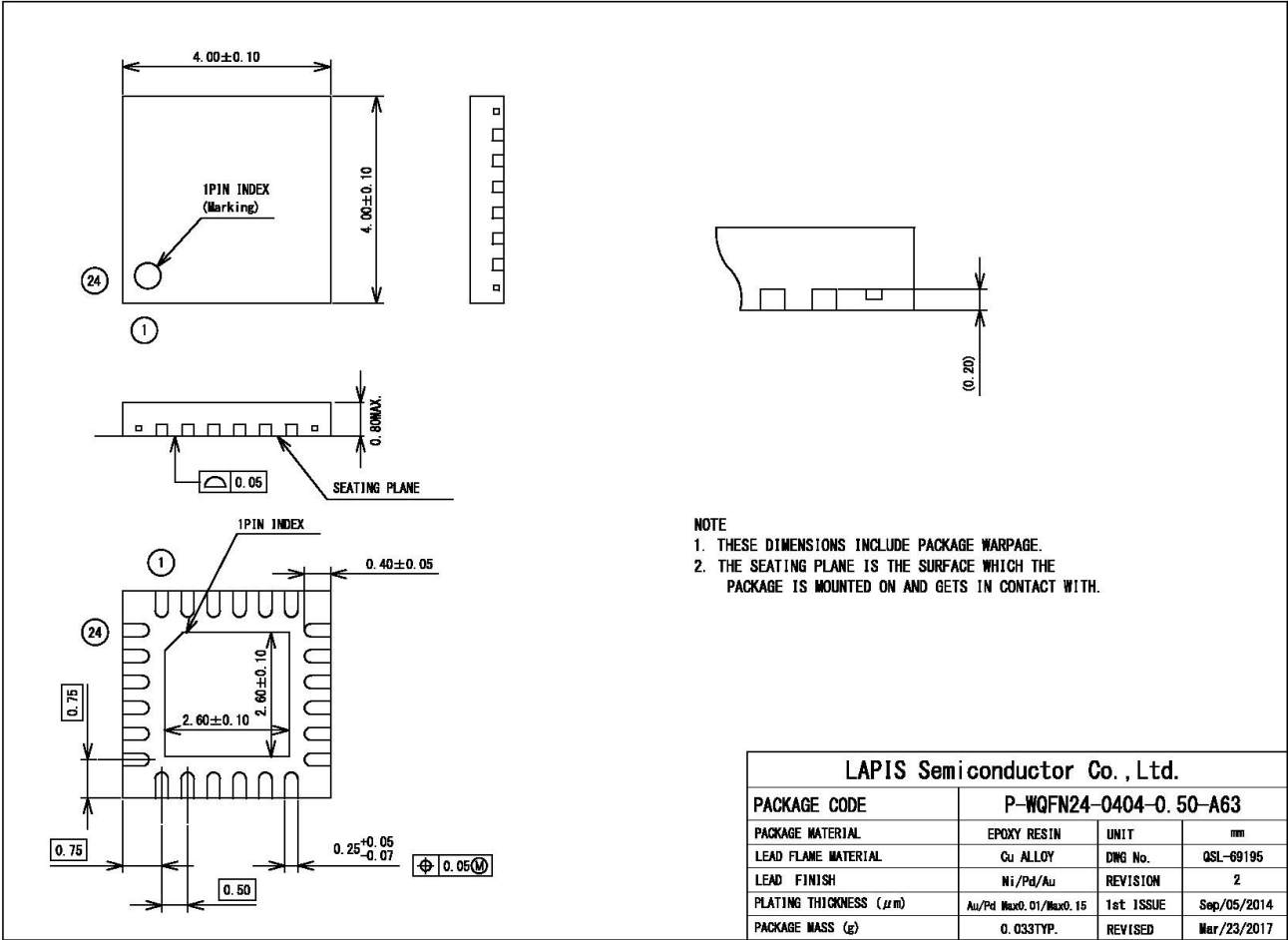


(Unit: mm)

Notes for Mounting the Surface Mount Type Package

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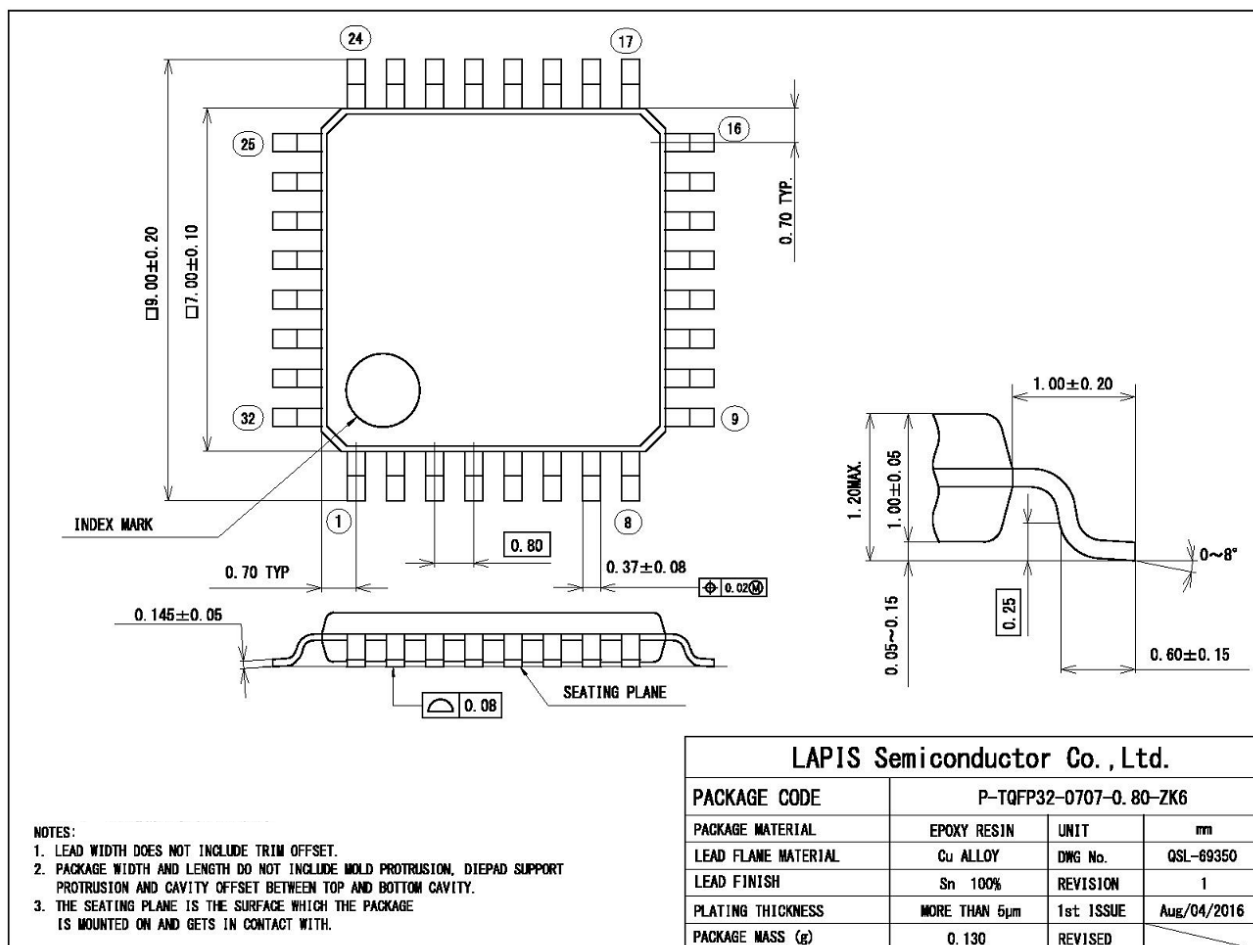
ML62Q1245A/1246A/1247A 24pin WQFN



(Unit: mm)

Notes for Mounting the Surface Mount Type Package

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ML62Q1265A/1266A/1267A 32pin TQFP

(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	
FEDL62Q1200A-01	Oct 19, 2017	-	-	Formal 1 st Revision
FEDL62Q1200A-02	Nov 24, 2017	23,26,27	23,26,27	Added the following explanations "The current flowing out the LSI through the pin is described in the negative number. The applicable maximum current is the absolute value. For example, -1mA means the maximum current 1mA flows out the LSI through the pin."
FEDL62Q1200A-03	Dec 21, 2017	26	26	Added IOH1 condition " $V_{OH} \geq V_{DD}-0.5$ "
FEDL62Q1200A-04	Mar 5, 2018	2,24,25, 27,34	2,24,25, 27,34	Unified descriptions of temperature
		3	3	Added DMA description
		4	4	Corrected ADC reference voltage descriptions
		23,26	23,26	Corrected an expression
		24	24	Added IDD4/IDD5 conditions
		26	26	Added P00 on IOL
		26,45	26,45	Corrected an expression
		27	27	Added V/IIL2,3
		28-32	28-32	Corrected a description of Ch
		32	32	Changed 1Mbps mode SDA setup time MIN spec
		33	33	Added P00 AC characteristics on reset characteristics
		33	33	Specified min spec of rise inclination defining source voltage
		35,36	35,36	Distinguished between ADC and DAC symbol
		35	35	Added descriptions of ADC Measuring circuit external components
		36	36	Specified MIN/MAX reference voltage
		—	39-49	Added electronical characteristics graph
		51.53	51,53	Correct WQFN package notifications

Notes

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