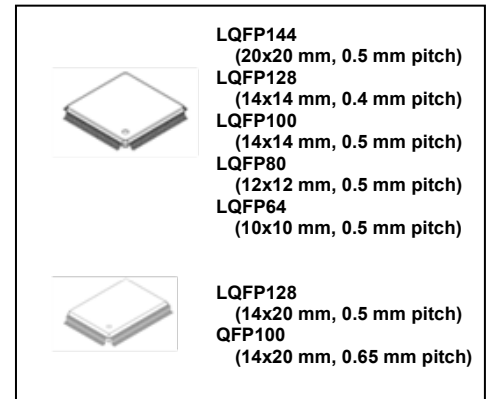


## CMOS Digital Integrated Circuit Silicon Monolithic

# TMPM3H Group(2)

## General Description

- Arm® Cortex®-M3 core
  - Operating frequency: 1 to 120 MHz
  - Operating voltage: 2.7 to 5.5V
  - Code flash: 512KB to 1MB, Data flash: 32KB
- Package: 64-pin to 144-pin, 7 types of packages are available.



## Applications

Widely used for consumer products and industrial products including home appliances, OA equipment, household equipment, AV devices, and motor control devices.

## Features

- Arm Cortex-M3 core
  - Operating frequency: 1 to 120 MHz
  - Memory Protection Unit (MPU)
- Operating voltage and Low-power consumption operation
  - Operating voltage: 2.7 to 5.5V
  - Low-power consumption operation: IDLE, STOP1, STOP2
- Operating temperature: -40 to +105°C
- Internal memory
  - Code flash: 512KB to 1MB, rewritable up to 100,000 times
  - Data flash: 32 KB, rewritable up to 100,000 times
  - A code flash area is rewritable in parallel with instruction execution on another code area (Only the products with 1MB code flash)
  - Data flash is rewritable in parallel with instruction execution
  - RAM: 128KB and Backup RAM: 2 KB  
Both RAMs have parity bit.
- Clock
  - External High-speed Oscillator: 6 MHz to 12 MHz (Ceramic, Crystal)
  - External High-speed clock input: 6 to 20 MHz
  - Internal High-speed Oscillator (IHOSC1): 10 MHz, user trimming function
  - PLL: 120 MHz output
  - External Low-speed Oscillator: 32.768kHz
- Oscillation Frequency Detector (OFD): Abnormal system clock detection
- Voltage Detection circuit (LVD): 8 level, generate interrupts and reset outputs
- Interrupt
  - External factors: 12 to 23  
(External pins: 12 to 34 pins with DNF)
  - Internal factors: 128 to 151
- I/O ports: 56 to 134 (Include Input only: 4, Output only: 1)
  - Pull-up/pull-down resistor, Open-drain, 5V-tolerant
- On Chip Debug (JTAG/SW)
- Trigger Selector (TRGSEL)
  - Expand Trigger request for DMAC, Timer counter and so on.
- DMA Controller (DMAC)
  - DMA requests: 2units, 54 to 64 factors, internal/external triggers
- LCD Display Controller (DLCD)
  - Non-Bias Drive: 40 segments × 4 commons (Max)
- Universal Asynchronous Receiver Transmitter (UART): 7 to 8 channels
  - Up to 2.5Mbps, FIFO (Transmission 9bits × 8, Reception 9bits × 8)
- Serial Peripheral Interface (TSPI): 1 to 5 channels
  - SIO/SPI mode, up to 20MHz, FIFO (Transmission 16bits × 8, Reception 16bits × 8), sector/frame mode
- I<sup>2</sup>C Interface
  - I<sup>2</sup>C interface (I2C): 2 to 4 channels  
Multi Master, Release function for Low Power Mode
  - I<sup>2</sup>C interface Version A (EI2C): 2 to 4 channels  
Multi Master, Support 10-bit Slave Addressing  
Release function for Low Power Mode
- Comparator: 1 channel. EMG signal output to A-PMD
- 8-bit DA Converter (DAC): 2 channels
- 12-bit ADC (ADC): 12 to 21 channels analog inputs
  - Built-in sample-and-hold circuit  
Conversion time: 1.5μs@SCLK = 20MHz,  
1.0μs@SCLK = 30MHz
  - Support self-diagnosis function
- Advanced Programmable Motor Control Circuit (A-PMD): 1 channel
  - 3-phase complementary PWM output, Synchronized with 12-bit ADC
  - Emergency stop function by external inputs (EMG0 pin, OVVO pin)
- Advanced Encoder Input Circuit (32-bit) (A-ENC32): 1 channel
  - Encoder/sensor (3 types)/Timer/Phase counter mode
- 32-bit Timer Event Counter (T32A)
  - 8 channels as 32-bit timer, 16 channels as 16-bit timer
  - Interval timer, event counter, input capture, phase difference input, PPG output, sync start, trigger start
- Real Time Clock (RTC): 1 channel
- Watchdog Timer (SIWDT): 1 channel
  - Clock system other than the system clock can be selected
  - Clear window, interrupts and reset output
- Remote Control Signal Preprocessor (RMC): 1 channel
- CRC Calculation Circuit (CRC): 1channel, CRC32, CRC16

Start of commercial production  
 2023-05

## Products Lists Categorized by Functions

The product under development is contained in this table.  
 For the newest status of each product, please contact your sales representative.

**Table 1.1 Products List (1/2)**

Built-in Functions		TMPM3HQF10BFG	TMPM3HPF10BFG	TMPM3HPF10BDFG
Memory	Code Flash (KB)	1024	1024	1024
	Data Flash (KB)	32	32	32
	RAM (KB)	128	128	128
	Backup RAM (KB)	2	2	2
I/O port	PORT (Pin)	134	118	118
External interrupt	Factor	23	21	21
	Pin	34	31	31
DMA	DMAC (ch)	64	64	64
Timer function	T32A (ch)	8	8	8
	RTC (ch)	1	1	1
Serial communication function	UART (ch)	8	8	8
	I2C/EI2C (ch)	4/4	4/4	4/4
	TSPI (ch)	5	5	5
Analog function	12-bit ADC (ch)	21	19	19
	8-bit DAC (ch)	2	2	2
	Comparator (ch)	1	1	1
Motor Control peripherals	A-ENC32 (ch)	1	1	1
	A-PMD (ch)	1	1	1
Other peripherals	RMC (ch)	1	1	1
	CRC (ch)	1	1	1
	DLCD	40 segments × 4 commons	40 segments × 4 commons	40 segments × 4 commons
System function	RAMP	1	1	1
	LVD (ch)	1	1	1
	SIWDT (ch)	1	1	1
	OFD (ch)	1	1	1
	POR	1	1	1
Debug interface	Debug	JTAG/SW TRACE (4bit)	JTAG/SW TRACE (4bit)	JTAG/SW TRACE (4bit)
Package	Package type	LQFP144 (20 mm x 20 mm, 0.5 mm pitch)	LQFP128 (14 mm x 14 mm, 0.4 mm pitch)	LQFP128 (14 mm x 20 mm, 0.5 mm pitch)

Table 1.2 Products List (2/2)

Built-in Functions		TMPM3HNF10BFG TPM3HNFDBFG	TMPM3HNF10BDFG	TMPM3HMF10BFG	TMPM3HLF10BUG
Memory	Code Flash (KB)	1024 512	1024	1024	1024
	Data Flash (KB)	32	32	32	32
	RAM (KB)	128	128	128	128
	Backup RAM (KB)	2	2	2	2
I/O port	PORT (Pin)	92	92	72	56
External interrupt	Factor	18	18	15	12
	Pin	19	19	15	12
DMA	DMAC (ch)	62	62	62	54
Timer function	T32A (ch)	8	8	8	8
	RTC (ch)	1	1	1	1
Serial communication function	UART (ch)	8	8	7	7
	I2C/EI2C (ch)	3/3	3/3	3/3	2/2
	TSPI (ch)	4	4	4	1
Analog function	12-bit ADC (ch)	17	17	12	12
	8-bit DAC (ch)	2	2	2	2
	Comparator (ch)	1	1	1	1
Motor Control peripherals	A-ENC32 (ch)	1	1	1	1
	A-PMD (ch)	1	1	1	1
Other peripherals	RMC (ch)	1	1	1	1
	CRC (ch)	1	1	1	1
	DLCD	32 segments × 4 commons	32 segments × 4 commons	26 segments × 4 commons	-
System function	RAMP	1	1	1	1
	LVD (ch)	1	1	1	1
	SIWDT (ch)	1	1	1	1
	OFD (ch)	1	1	1	1
	POR	1	1	1	1
Debug interface	Debug	JTAG/SW TRACE (4bit)	JTAG/SW TRACE (4bit)	JTAG/SW TRACE (2bit)	JTAG/SW
Package	Package type	LQFP100 (14 mm x 14 mm, 0.5 mm pitch)	QFP100 (14 mm x 20 mm, 0.65 mm pitch)	LQFP80 (12 mm x 12 mm, 0.5 mm pitch)	LQFP64 (10 mm x 10 mm, 0.5 mm pitch)

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## Preface

### Conventions

- Numeric formats follow the rules as shown below:  
Hexadecimal: 0xABC  
Decimal: 123 or 0d123 – Only when it needs to be explicitly shown that they are decimal numbers.  
Binary: 0b111 – It is possible to omit the "0b" when the number of bits can be distinctly understood from a sentence.
- "\_N" is added to the end of signal names to indicate low active signals.
- It is called "assert" that a signal moves to its active level, "deassert" to its inactive level.
- When two or more signal names are referred, they are described like as [m: n].  
Example: S[3: 0] shows four signal names S3, S2, S1 and S0 together.
- The characters surrounded by *[ ]* defines the register.  
Example: *[ABCD]*
- "n" substitutes suffix number of two or more same kind of registers, fields, and bit names.  
Example: *[XYZ1]*, *[XYZ2]*, *[XYZ3]* → *[XYZn]*
- "x" substitutes suffix number or character of units and channels in the Register List  
In case of unit, "x" means A, B, and C . . .  
Example: *[ADACR0]*, *[ADBCR0]*, *[ADCCR0]* → *[ADxCR0]*  
In case of channel, "x" means 0, 1, and 2 . . .  
Example: *[T32A0RUNA]*, *[T32A1RUNA]*, *[T32A2RUNA]* → *[T32AxRUNA]*
- The bit range of a register is written like as [m: n].  
Example: Bit[3: 0] expresses the range of bit 3 to 0.
- The configuration value of a register is expressed by either the hexadecimal number or the binary number.  
Example: *[ABCD]*<EFG> = 0x01 (hexadecimal), *[XYZn]*<VW> = 1 (binary)
- Word and Byte represent the following bit length.  
Byte: 8 bits  
Half word: 16 bits  
Word: 32 bits  
Double word: 64 bits
- Properties of each bit in a register are expressed as follows:  
R: Read only  
W: Write only  
R/W: Read and Write are possible
- Unless otherwise specified, register access supports only word access.
- The register defined as reserved must not be rewritten. Moreover, do not use the read value.
- The value read from the bit having default value of "-" is unknown.
- When a register containing both of writable bits and read-only bits is written, read-only bits should be written with their default value.  
In the cases that default is "-", follow the definition of each register.
- Reserved bits of the Write-only register should be written with their default value. In the cases that default is "-", follow the definition of each register.
- Do not use read-modified-write processing to the register of a definition which is different by writing and read out.

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**Terms and Abbreviations**

The following words are terms or abbreviations mainly used in this datasheet.

ADC	Analog to Digital Converter
A-ENC32	Advanced Encoder Input Circuit (32-bit)
APB	Advanced Peripheral Bus
A-PMD	Advanced Programmable Motor Control Circuit
CG	Clock control and Operation Mode
COMP	Comparator
CRC	Cyclic Redundancy Check
DAC	Digital to Analog Converter
DMAC	Direct Memory Access Controller
DNF	Digital Noise Filter
ELOSC	External Low-speed Oscillator
EHOSC	External High-speed Oscillator
EI2C	I <sup>2</sup> C Interface Version A
fsys	Frequency of SYSTEM Clock
I2C	Inter-Integrated Circuit
I2CS	Address Match Wakeup Function
IHOSC	Internal High-speed Oscillator
IA (INTIF)	Interrupt control register A
IB (INTIF)	Interrupt control register B
I-Bus	ICode memory interface
IMN	Interrupt Monitor
INT	Interrupt
IO	IO Bus (32bit Peripheral Bus)
DLCD	LCD Display Control Circuit
LVD	Voltage Detection Circuit
NMI	Non-Maskable Interrupt
OFD	Oscillation Frequency Detector
POR	Power-on Reset Circuit
RAMP	RAM Parity Circuit
RLM	Low-speed Oscillation/Power Supply Control/Reset
RMC	Remote Control Signal Preprocessor
RTC	Real Time Clock
S-Bus	System interface
SCOUT	Source Clock Output
SIWDT	Clock Selective Watchdog Timer
TPIU	Trace Port Interface Unit
TRGSEL	Trigger Selection Circuit
TRM	Trimming Circuit
TSPI	Serial Peripheral Interface
T32A	32-bit Timer Event Counter
UART	Asynchronous Serial Communication Circuit

# 1. Block Diagram

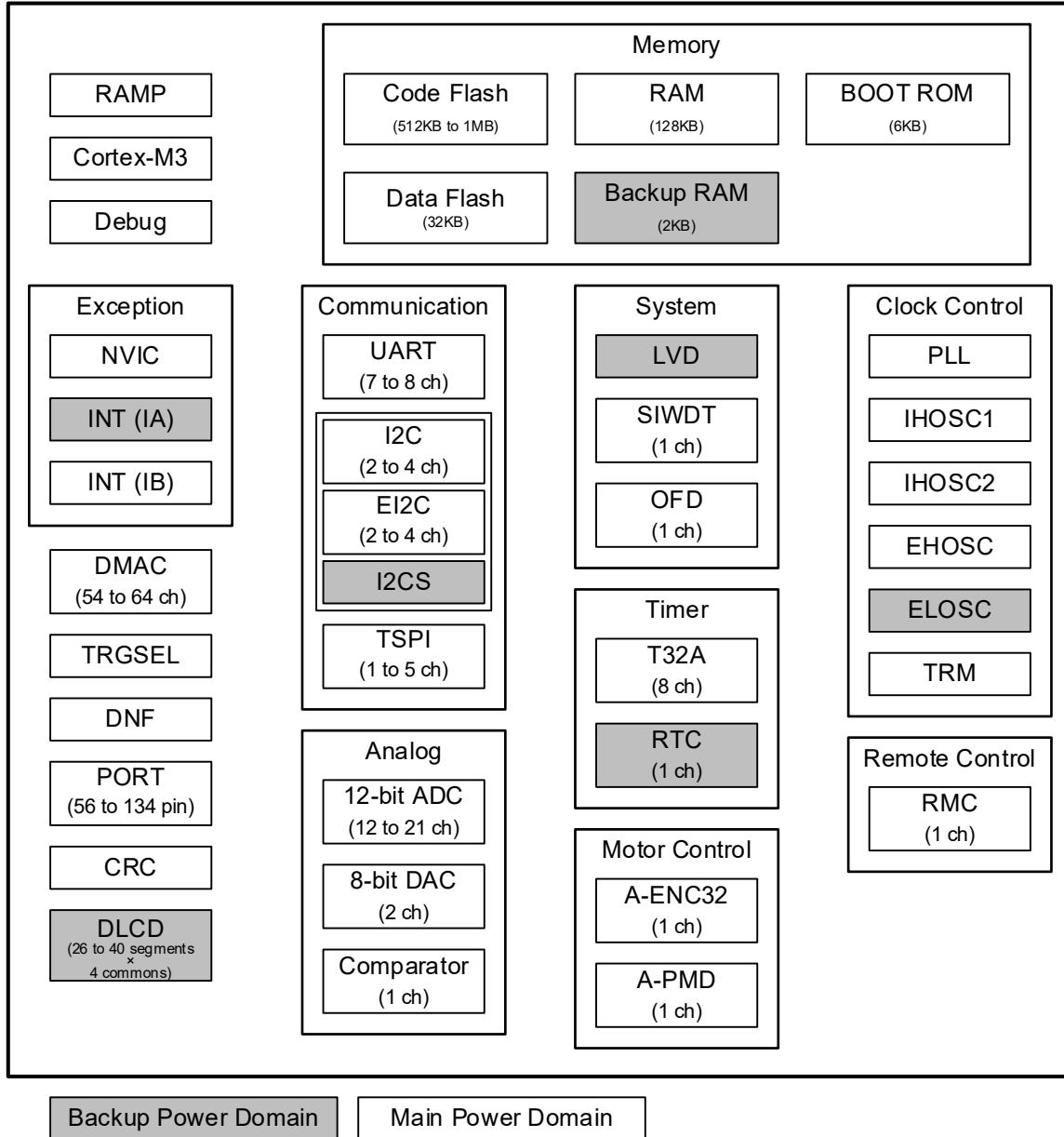


Figure 1.1 Block Diagram of TMPM3H Group(2)

## 2. Pin Assignment

### 2.1. LQFP144

Pin No.	Signal Name	Pin No.	Signal Name
108	P14/INT04/UT1RTS_N/UT1CTS_N/T32A031NB0/IN00/SEG18	72	RESET_N
107	P15/UT1CTS_N/UT1RTS_N/T32A0300TB/IN00/SEG19	71	PHI/X2
106	P16/UT1TRD/UT1TXDA/T32A031NA1/T32A031NC1/IN00/SEG20	70	PH0/X1/EHCLKIN
105	P17/UT1TXDA/UT1RD/T32A031NA0/T32A031NC0/X00/SEG21	69	DVSSA
104	P18/UT1TXDB/T32A0300TA/T32A0300TC/IN00/SEG22	68	REGOUT1
103	P19/UT1RTS_N/UT1CTS_N/T32A0500TA/T32A0500TC/SEG23	67	REGOUT2
102	P19/UT1RTS_N/UT1CTS_N/T32A051NA1/T32A051NC1/SEG25	66	DVDD5A
100	P19/INT10/UT15TXDA/UT15RD/T32A0500TB/TRG1NC2/SEG26	65	PP2/TSP12RXD/T32A011NA1/T32A011NC1
99	P19/UT15TXDB/T32A051NB0/SEG27	64	PP1/TSP12TXD/T32A011NA0/T32A011NC0
98	P19/T32A051NB1/SEG28	63	PP0/TSP12SCK/T32A010TA/T32A010TC
97	PR7/SEG29	62	P10/INT23/I2C3SDA/TSP12CS1/E12C3SDB
96	PR6/SEG30	61	PT1/INT24/I2C3SCL/TSP12CS0/50/E12C3SCL
95	PR6/SEG31	60	PT2/INT25/TSP12SCK/T32A060TB
94	PR4/SEG32	59	PT3/INT26/TSP12TXD/T32A061NB0
93	PR3/SEG33	58	PT4/TSP12RXD/T32A061NB1
92	PR2/UT1TXDB/T32A021NA1/T32A021NC1/SEG34	57	PT5/T32A060TA/T32A060TC
91	PR1/UT1TXDA/UT1RD/T32A021NA0/T32A021NC0/SEG35	56	PT6/T32A061NA0/T32A061NC0
90	PR0/UT1TRD/UT1TXDA/T32A0200TA/T32A0200TC/SEG36	55	PT7/T32A061NA1/T32A061NC1
89	PO6/UT1RTS_N/UT1CTS_N/SEG37	54	PL7/T32A061NA1/T32A061NC1
88	PO5/UT1CTS_N/UT1RTS_N/SEG38	53	PL6/T32A061NA0/T32A061NC0
87	PO4/UT1TRD/UT1TXDA/T32A021NB0/SEG39	52	PL5/T32A060TA/T32A060TC
86	PO3/UT1TXDA/UT1RD/T32A0200TB/DO3M0	51	PL4/INT12/T32A061NB1/TMS/SWD10
85	PO2/INT02/UT14TXDB/T32A021NA1/T32A021NC1/RTOUT/DO3M1	50	PL3/INT08/UT2RTS_N/UT2CTS_N/T32A061NB0/CK/SWCLK
84	PO1/INT01/I2C0SDA/E12C0SDA/T32A021NA0/T32A021NC0/DO3M2	49	PL2/UT2CTS_N/UT2RTS_N/T32A060TB/TDO/SWV
83	PO0/INT00/I2C0SCL/E12C0SCL/T32A0200TA/T32A0200TC/DO3M3	48	PL1/UT2RXD/UT2TXDA/I2C2SDA/E12C2SDB/TD1
82	PV7/UT1TRD/UT1TXDA	47	PLO/UT2TXDA/UT2RXD/I2C2SCL/E12C2SCL/TRST_N
81	PV6/UT1TXDA/UT1RD	46	PUI/INT31
80	PH7/INTZ	45	PU0/INT30
79	PH6/INTZ1/TSP14RD	44	PB7/INT16
78	PH6/INT20/TSP14TXD	43	PB6/TSP11CS1
77	PH4/INT19/TSP14SCK	42	PB5/UT2RTS_N/UT2CTS_N/TSP11CS0/T32A011NB1/TSP11CS1N
76	MODE	41	PB4/UT2CTS_N/UT2RTS_N/TSP11RXD/T32A011NB0
75	PH3/XTZ/INT06	40	PB3/UT2RXD/UT2TXDA/TSP11TXD/T32A010TB
74	PH2/XT1	39	PB2/UT2TXDA/UT2RXD/TSP11SCK/T32A011NA1/T32A011NC1
73		38	PB1/INT03/RX1NO/T32A011NA0/T32A011NC0/TRG1NO
72		37	PB0/BOOT_N/T32A010TA/T32A010TC/SCOUT
110	SEG16/EMG0/UT1TXDB/PK0		
111	SEG15/OVVO/UT1RXD/UT1TXDA/INT05/PK1		
112	SEG14/T32A040UTC/T32A040UTA/UT1TXDA/UT1RXD/PK2		
113	SEG13/T32A041NC0/T32A041NA0/UT1RTS_N/UT1CTS_N/PK3		
114	SEG12/T32A041NC1/T32A041NA1/UT1CTS_N/UT1RTS_N/PK4		
115	SEG11/T32A040TB/UT6TXDA/UT6RXD/PK5		
116	SEG10/T32A041NB0/UT6RXD/UT6TXDA/PK6		
117	SEG09/T32A041NB1/UT6TXDB/INT13/PK7		
118	SEG08/TSP13RXD/INT14/PP3		
119	SEG07/TSP13TXD/PP4		
120	SEG06/TSP13SCK/PP5		
121	SEG05/PMDD0B0/TSP13CSIN/TSP13CS0/PP6		
122	SEG04/TSP13CS1/PP7		
123	SEG03/PV0		
124	SEG02/PV1		
125	SEG01/INT17/PV2		
126	SEG00/INT18/PV3		
127	PV4		
128	DVDD5B		
129	DVSSB		
130	AINA20/PD5		
131	AINA19/PD4		
132	AINA18/PF7		
133	AINA17/PF6		
134	AINA16/PF5		
135	AINA15/PF4		
136	INT32/AINA14/PF3		
137	INT33/AINA13/PF2		
138	AINA12/PF1		
139	AINA11/PF0		
140	AINA10/PE6		
141	AINA09/PE5		
142	AINA08/PE4		
143	AINA07/PE3		
144	AINA06/PE2		
1	AINM06/PE1		
2	AINM04/PE0		
3	AINM03/PD3		
4	AINM02/PD2		
5	AINM01/PD1		
6	AINM00/PD0		
7	AVDD5		
8	AVSS		
9	DAC0/PD0		
10	DAC1/PG1		
11	P15		
12	P14		
13	P13		
14	P12		
15	T32A000UTC/T32A000TA/UT3TXDA/UT3RXD/INT27/PB2		
16	T32A001NC0/T32A001NA0/UT3RXD/UT3TXDA/INT28/PB3		
17	T32A007INC1/T32A007INA1/UT3TXDB/PB4		
18	T32A007OUTB/PB5		
19	T32A007INB0/PB6		
20	T32A007INB1/PB7		
21	UT3RXD/UT3TXDA/INT11/PA7		
22	UT3TXDA/UT3RXD/INT07/PA6		
23	T32A001NB1/E12C1SDA/I2C1SDA/PA5		
24	T32A001NB0/TSP10CS1/E12C1SCL/I2C1SCL/PA4		
25	TRG1NI/T32A000TB/TSP10CS0/TSP10CSIN/PA3		
26	EN02/T32A001NC1/T32A001NA1/TSP10RXD/UT10TXDA/UT0RXD/PA2		
27	EN03/T32A001NC0/T32A001NA0/TSP10TXD/UT0RXD/UT10TXDA/PA1		
28	EN04/T32A000UTC/T32A000TA/TSP10SCK/UT10TXDB/PA0		
29	PH7		
30	INT15/PH6		
31	T32A001NB1/PH5		
32	TRACDATA3/T32A001NB0/TSP10CS1/UT0CTS_N/UT0RTS_N/PH4		
33	TRACDATA2/TSP10CSIN/T32A000TB/TSP10CS0/UT0CTS_N/UT0RTS_N/PH3		
34	TRACDATA1/T32A001NC1/T32A001NA1/TSP10RXD/UT0RXD/INT09/PH2		
35	TRACDATA0/T32A001NC0/T32A001NA0/TSP10TXD/UT0RXD/UT10TXDA/PH1		
36	TRACCLK/T32A000UTC/T32A000TA/TSP10SCK/UT10TXDB/PH0		

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## 2.2. LQFP128-1414

96	P-5/T32A031NB1/Z00/SEG17	97	SEG16/EM60/UT1TXDB/PK0	64	PH3/XT2/INT06
95	P-4/INT04/UT1RTS_N/UT1CTS_N/T32A031NB0/W00/SEG18	98	SEG15/OVVO/UT1RXD/UT1TXDA/INT05/PK1	63 <td>PH2/XT1</td>	PH2/XT1
94	P-3/UT1CTS_N/UT1RTS_N/T32A030OUTB/Y00/SEG19	99	SEG14/T32A040OUTC/T32A040OUTA/UT1TXDA/UT1RXD/PK2	62	RESET_N
93	P-2/UT1RXD/UT1TXDA/T32A031INA1/T32A031INC1/Y00/SEG20	100	SEG13/T32A041INC0/T32A041NA0/UT1RTS_N/UT1CTS_N/PK3	61	PH1/X2
92	P-1/UT1TXDB/UT1RXD/T32A031INA0/T32A031INC0/X00/SEG21	101	SEG12/T32A041INC1/T32A041NA1/UT1CTS_N/UT1RTS_N/PK4	60	PH0/X1/EHCLKIN
91	P-0/UT1TXDB/T32A030OUTA/T32A030UTC/J000/SEG22	102	SEG11/T32A040OUTB/UT6TXDA/UT6RXD/PK5	59	DVSSA
90	PM0/UT1RTS_N/UT1CTS_N/T32A050OUTA/T32A050UTC/SEG23	103	SEG10/T32A041NB0/UT6RXD/UT6TXDA/PK6	58	REGOUT1
89	PM1/UT1CTS_N/UT1RTS_N/T32A051INA0/T32A051INC0/SEG24	104	SEG09/T32A041NB1/UT6TXDB/INT13/PK7	57	REGOUT2
88	PM2/UT1RXD/UT1TXDA/T32A051INA1/T32A051INC1/SEG25	105	SEG08/TSP13RXD/INT14/PP3	56	DVDD5A
87	PM3/INT10/UT1STXDA/UT1SRXD/T32A050OUTB/TRG1NZ/SEG26	106	SEG07/TSP13TXD/PP4	55	PP2/TSP12RXD/T32A011NA1/T32A011INC1
86	PM4/UT1TXDB/T32A051NB0/SEG27	107	SEG06/TSP13SCK/PP5	54	PP1/TSP12TXD/T32A011NA0/T32A011INC0
85	PM5/T32A051NB1/SEG28	108	SEG05/PMDD0B6/TSP13CSIN/TSP13CSO/PP6	53	PP0/TSP12SCK/T32A010OUTA/T32A010UTC
84	PM7/SEG29	109	SEG04/TSP13CS1/PP7	52	PT0/INT23/I2C3SDA/TSP12CS1/E12C3SDA
83	PM6/SEG30	110	SEG03/PV0	51	PT1/INT24/I2C3SCL/TSP12CS0/TSP12CSIN/E12C3SCL
82	PM5/SEG31	111	SEG02/PV1	50	PT2/INT25/TSP12SCK/T32A060OUTB
81	PM4/SEG32	112	SEG01/INT17/PV2	49	PT3/INT26/TSP12TXD/T32A061NB0
80	PM3/SEG33	113	SEG00/INT18/PV3	48	PL7/T32A061INA1/T32A061INC1
79	PM2/UT1TXDB/T32A021INA1/T32A021INC1/SEG34	114	DVDD5B	47	PL6/T32A061INA0/T32A061INC0
78	PM1/UT1TXDA/UT1RXD/T32A021INA0/T32A021INC0/SEG35	115	DVSSB	46	PL5/T32A060OUTA/T32A060UTC
77	PM0/UT1RXD/UT1TXDA/T32A020OUTA/T32A020UTC/SEG36	116	A1NA18/PF7	45	PL4/INT12/T32A061NB1/TMS/SWDIO
76	PM0/UT1RTS_N/UT1CTS_N/SEG37	117	A1NA17/PF6	44	PL3/INT08/UT2RTS_N/UT2CTS_N/T32A061NB0/TCK/SWCLK
75	PM5/UT1CTS_N/UT1RTS_N/T32A021NB1/SEG38	118	A1NA16/PF5	43	PL2/UT2CTS_N/UT2RTS_N/T32A060OUTB/TDO/SWV
74	PM4/UT1RXD/UT1TXDA/T32A021NB0/SEG39	119	A1NA15/PF4	42	PL1/UT2RXD/UT2TXDA/I2C2SDA/E12C2SDA/TD1
73	PM3/UT1TXDA/UT1RXD/T32A020OUTB/D00M0	120	INT32/A1NA14/PF3	41	PL0/UT2TXDA/UT2RXD/I2C2SCL/E12C2SCL/TRST_N
72	PM2/INT02/UT1TXDB/T32A021INA1/T32A021INC1/RT/COU/D00M1	121	INT33/A1NA13/PF2	40	PB7/INT16
71	PM1/INT01/I2C0SDA/E12C0SCL/T32A021INA0/T32A021INC0/D00M2	122	A1NA12/PF1	39	PB6/TSP11CS1
70	PM0/INT00/I2C0SCL/E12C0SCL/T32A020OUTA/T32A020UTC/D00M3	123	A1NA11/PF0	38	PB5/UT2RTS_N/UT2CTS_N/TSP11CS0/T32A011NB1/TSP11CSIN
69	PH7/INT22	124	A1NA10/PE6	37	PB4/UT2CTS_N/UT2RTS_N/TSP11RXD/T32A011NB0
68	PH6/INT21/TSP14RXD	125	A1NA09/PE5	36	PB3/UT2RXD/UT2TXDA/TSP11TXD/T32A010OUTB
67	PH5/INT20/TSP14TXD	126	A1NA08/PE4	35	PB2/UT2TXDA/UT2RXD/TSP11SCK/T32A011INA1/T32A011INC1
66	PH4/INT19/TSP14SCK	127	A1NA07/PE3	34	PB1/INT03/RX1NO/T32A011INA0/T32A011INC0/TRG1NO
65	MODE	128	A1NA06/PE2	33	PB0/BOOT_N/T32A010OUTA/T32A010UTC/SCOUT

### TMPM3HPF10BFG

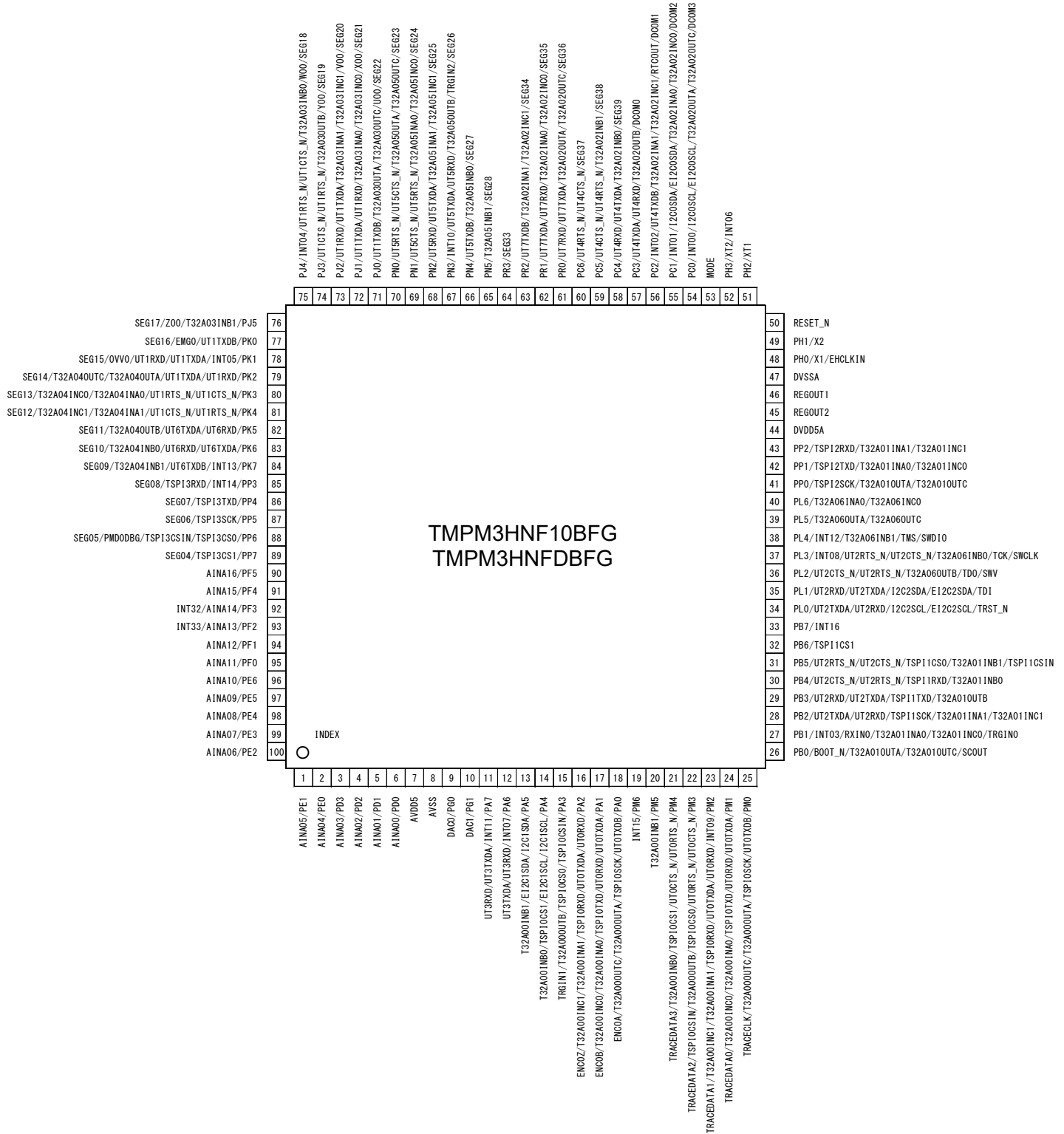
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A1NA04/PE1	A1NA03/PD3	A1NA02/PD2	A1NA01/PD1	A1NA00/PD0	AVD05	AVS5	DAC0/PD0	DAC1/PD1	T32A0700TC/T32A0700TA/UT3TXDA/UT3RXD/INT27/PD2	T32A071INC0/T32A071INC0/UT3TXDA/INT28/PD3	T32A071INC1/T32A071INC1/UT3TXDB/PD4	T32A0700TB/PD5	T32A071NB0/PD6	T32A071NB1/PD7	UT3RXD/UT3TXDA/INT11/PA7	UT3TXDA/UT3RXD/INT07/PA6	T32A001NB1/E12C1SDA/I2C1SDA/PA5	T32A001NB0/TSP10CS1/E12C1SCL/I2C1SCL/PA4	TRG1N1/T32A000OUTB/TSP10CS0/TSP10CS1N/PA3	ENC0Z/T32A001INC1/T32A001INA1/TSP10RXD/UT0TXDA/UT0RXD/PA2	ENC0B/T32A001INC0/T32A001INA0/TSP10TXD/UT0RXD/UT0TXDA/PA1	ENC0A/T32A000UTC/T32A000OUTA/TSP10SCK/UT0TXDB/PA0	PM7	INT15/PM6	T32A001NB1/PM5	TRACEDATA3/T32A001NB0/TSP10CS1/UT0CTS_N/UT0RTS_N/PM4	TRACEDATA2/TSP10CS1N/T32A000OUTB/TSP10CS0/UT0RTS_N/UT0CTS_N/PM3	TRACEDATA1/T32A001INC1/T32A001INA1/TSP10RXD/UT0TXDA/UT0RXD/INT09/PM2	TRACEDATA0/T32A001INC0/T32A001INA0/TSP10TXD/UT0RXD/UT0TXDA/PM1	TRACECLK/T32A000UTC/T32A000OUTA/TSP10SCK/UT0TXDB/PM0	

### 2.3. LQFP128-1420

Pin	Signal	Pin	Signal
1	AIN08/PEA	103	SEG13/T32A04IN00/T32A04INA0/UT1RTS_N/UT1CTS_N/PK3
2	AIN07/PEZ	104	SEG12/T32A04INC1/T32A04INA1/UT1CTS_N/UT1RTS_N/PK4
3	AIN06/PEZ	105	SEG11/T32A04OUTB/UT6TXD/UT6RXD/PK5
4	AIN05/PEI	106	SEG10/T32A04INB0/UT6RXD/UT6TXD/PK6
5	AIN04/PEO	107	SEG09/T32A04INB1/UT6TXD/INT13/PK7
6	AIN03/PD3	108	SEG08/TSP13RXD/INT14/PP3
7	AIN02/PD2	109	SEG07/TSP13TXD/PP4
8	AIN01/PD1	110	SEG06/TSP13SCK/PP5
9	AIN00/PD0	111	SEG05/PMD00B6/TSP13CSIN/TSP13CS0/PP6
10	AVD05	112	SEG04/TSP13CS1/PP7
11	AVSS	113	SEG03/PV0
12	DAC0/PE0	114	SEG02/PV1
13	DAC1/PE1	115	SEG01/INT17/PV2
14	T32A07OUTC/T32A07OUTA/UT3TXD/UT3RXD/INT27/P62	116	SEG00/INT18/PV3
15	T32A07IN02/T32A07IN00/UT3RXD/INT28/P63	117	DVDD5B
16	T32A07IN01/T32A07IN1/T32A07IN1/UT3TXD/P64	118	DVSSB
17	T32A07OUTB/P65	119	A1NA18/PF7
18	T32A07INB0/P66	120	A1NA17/PF6
19	T32A07INB1/P67	121	A1NA16/PF5
20	UT6RXD/UT3TXD/INT11/PAT	122	A1NA15/PF4
21	UT3TXD/UT3RXD/INT07/PAB	123	INT32/A1NA14/PF3
22	T32A00INB1/EI201SBL/T201SCL/PAA	124	INT33/A1NA13/PF2
23	T32A00INB0/TSP10CS1/EI201SCL/T201SCL/PAA	125	A1NA12/PF1
24	TRG1N/T32A00OUTB/TSP10CS0/TSP10CS1N/PAB	126	A1NA11/PF0
25	EMC02/T32A00INC1/T32A00IN1/TSP10RXD/UT0TXD/UT0RXD/PAA	127	A1NA10/PE6
26	EMC08/T32A00IN0/T32A00IN0/TSP10TXD/UT0TXD/UT0RXD/PAA	128	A1NA09/PE5
27	EMC0A/T32A00OUTC/T32A00OUTA/TSP10SCK/UT0TXD/PAB	INDEX	
28	PM7		
29	INT15/PM6		
30	T32A00INB1/PM5		
31	T32A00INB1/PM4		
32	TRACEDATA3/T32A00INB0/TSP10CS1/UT0CTS_N/UT0RTS_N/PM3		
33	TRACEDATA2/TSP10CS1N/T32A00OUTB/TSP10CS0/UT0CTS_N/UT0RTS_N/PM3		
34	TRACEDATA1/T32A00INC1/T32A00IN1/TSP10RXD/UT0TXD/UT0RXD/INT09/PM2		
35	TRACEDATA0/T32A00IN0/T32A00IN0/TSP10TXD/UT0TXD/UT0RXD/UT0TXD/PM1		
36	TRACELK/T32A00OUTC/T32A00OUTA/TSP10SCK/UT0TXD/PM0		
37	SC00/T32A00OUTC/T32A00OUTA/BOOT_N/PE0		
38	TRG1N0/T32A01IN0/T32A01IN0/PA1N0/INT09/PB1		
39	T32A01INC1/T32A01IN1/TSP11SCK/UT2RXD/UT2TXD/PB2		
40		64	PH1/X2
41		63	PH0/X1/EHCLKIN
42		62	DVSSA
43		61	REGOUT1
44		60	REGOUT2
45		59	DVDD5A
46		58	PP2/TSP12RXD/T32A01IN1A1/T32A01INC1
47		57	PP1/TSP12TXD/T32A01IN1A0/T32A01INC0
48		56	PP0/TSP12SCK/T32A01OUTA/T32A01OUTC
49		55	PT0/INT23/I2C3SDA/TSP12CS1/E12C3SDA
50		54	PT1/INT24/I2C3SCL/TSP12CS0/TSP12CS1N/E12C3SCL
51		53	PT2/INT25/TSP12SCK/T32A06OUTB
52		52	PT3/INT26/TSP12TXD/T32A06INB0
53		51	PL7/T32A06IN1A1/T32A06INC1
54		50	PL6/T32A06IN1A0/T32A06IN0
55		49	PL5/T32A06OUTA/T32A06OUTC
56		48	PL4/INT12/T32A06INB1/TMS/SWD10
57		47	PL3/INT08/UT2RTS_N/UT2CTS_N/T32A06INB0/TCK/SWCLK
58		46	PL2/UT2CTS_N/UT2RTS_N/T32A06OUTB/TDO/SW
59		45	PL1/UT2RXD/UT2TXDA/I2C2SDA/E12C2SDA/TD1
60		44	PL0/UT2TXDA/UT2RXD/I2C2SCL/E12C2SCL/TRST_N
61		43	PB7/INT16
62		42	PB6/TSP11CS1
63		41	PB5/UT2RTS_N/UT2CTS_N/TSP11CS0/T32A01INB1/TSP11CS1N
64		40	PB4/UT2CTS_N/UT2RTS_N/TSP11RXD/T32A01INB0
		39	PB3/UT2RXD/UT2TXDA/TSP11TXD/T32A01OUTB

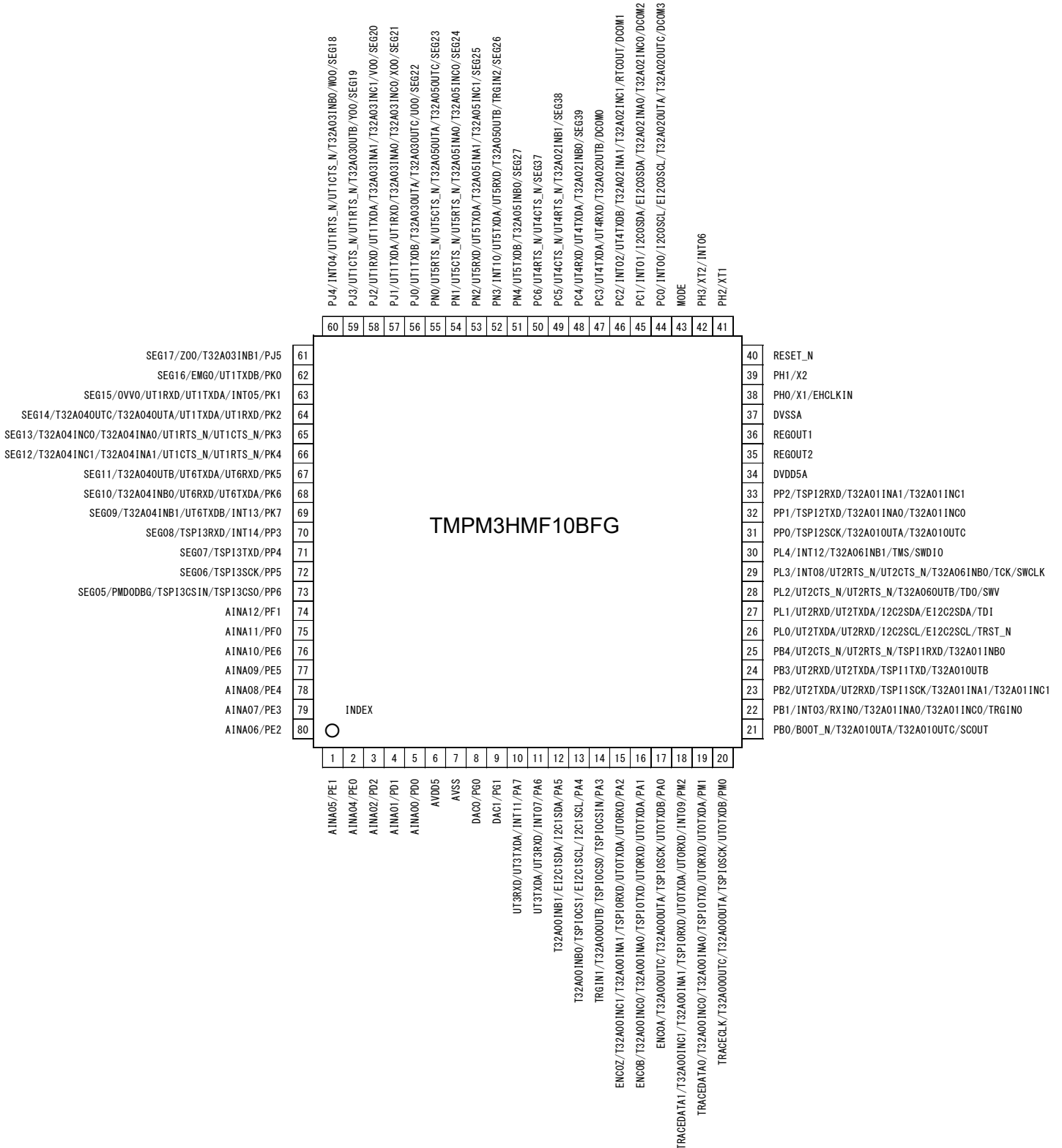
## 2.4. LQFP100



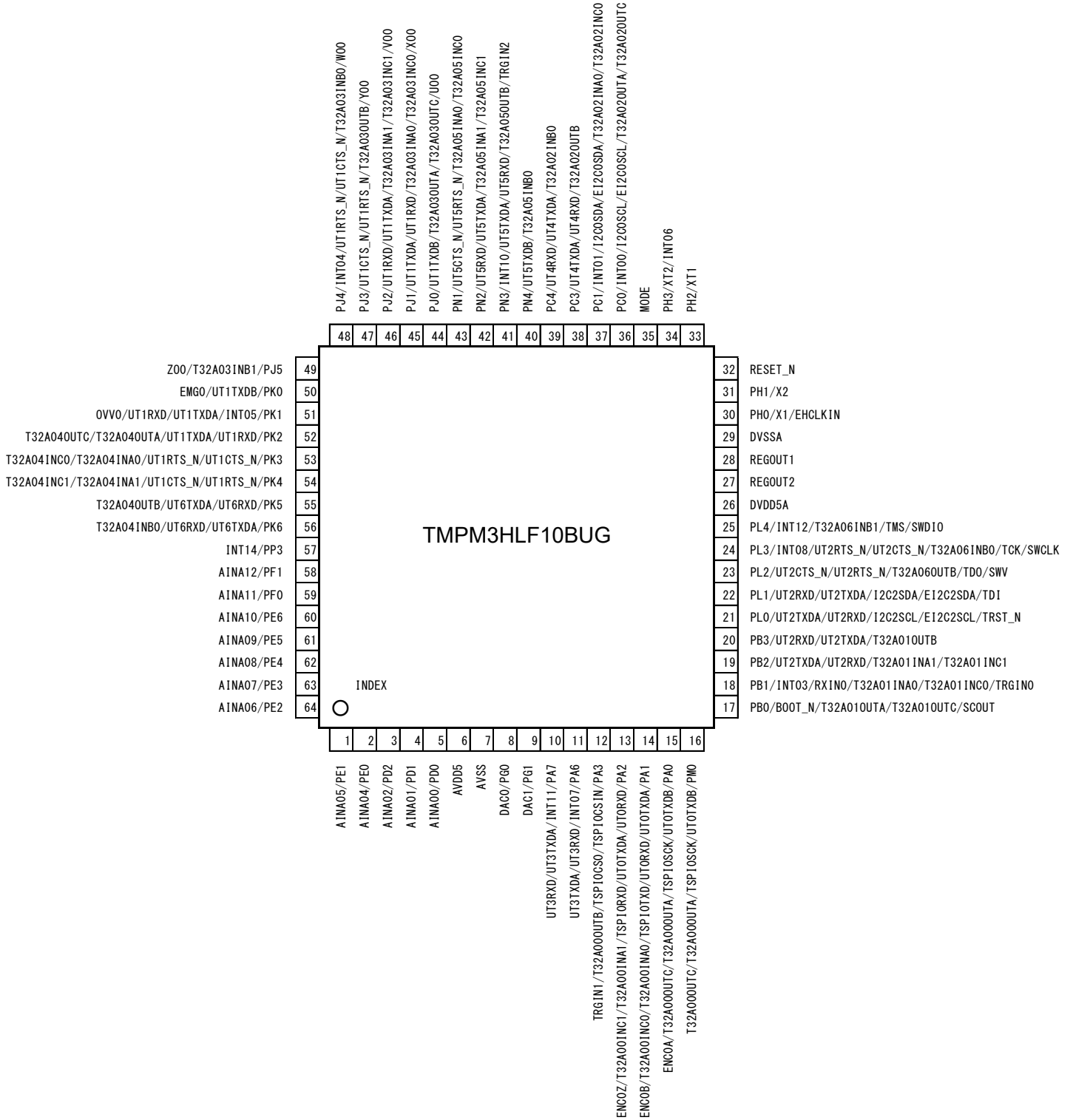




## 2.6. LQFP80



## 2.7. LQFP64



### 3. Memory Map

0xFFFFFFFF	Vendor-Specific	System level	0xFFFFFFFF	Vendor-Specific
0xE0100000	CPU Register Region		0xE0100000	CPU Register Region
0xE0000000	Fault	Peripheral	0xE0000000	Fault
0x5E100000	Code Flash (Mirror 1MB)		0x5E100000	Code Flash (Mirror 1MB)
0x5E000000	SFR		0x5E000000	SFR
0x5DFF0000	Fault		0x5DFF0000	Fault
0x44000000	Bit Band Alias (SFR)		0x44000000	Bit Band Alias (SFR)
0x42000000	Fault		0x42000000	Fault
0x40100000	SFR		0x40100000	SFR
0x4003E000	Fault		0x4003E000	Fault
0x40000000	BOOT ROM		0x40000000	BOOT ROM (Mirror 6KB)
0x3F7F9800	Fault		0x3F7F9800	Fault
0x3F7F8000	Data Flash (32KB)		0x3F7F8000	Data Flash (32KB)
0x30008000	Fault		0x30008000	Fault
0x30000000	Bit Band Alias (RAM/Backup RAM)		0x30000000	Bit Band Alias (RAM/Backup RAM)
0x24000000	Fault		0x24000000	Fault
0x22000000	Fault	0x22000000	Fault	
0x20020800	Backup RAM (2KB)	0x20020800	Backup RAM (2KB)	
0x20020000	RAM (128KB)	0x20020000	RAM (128KB)	
0x20000000	Fault	0x20000000	Fault	
0x00100000	Code Flash (1MB)	Code	0x00001800	BOOT ROM (6KB)
0x00000000			0x00000000	

Single chip mode

Single BOOT mode

**Figure 3.1 Example of TMPM3HQF10BFG**

Note: For detail of Single chip and Single Boot Mode, refer to the reference manual "Flash memory".

## 3.1. List of Memory Sizes

Table 3.1 Memory Sizes and Addresses

Products		TMPM3HQF10BFG TMPM3HPF10BFG TMPM3HPF10BDFG TMPM3HNF10BFG TMPM3HNF10BDFG TMPM3HMF10BFG TMPM3HLF10BUG		TMPM3HNFDBFG
Peripheral region	Code Flash (Mirror)	Size	1MB	512KB
		START	0x5E000000	0x5E000000
		END	0x5E0FFFFFFF	0x5E07FFFF
SRAM region	Data Flash	Size	32KB	
		START	0x30000000	
		END	0x30007FFF	
	Backup RAM	Size	2KB	
		START	0x20020000	
		END	0x200207FF	
	RAM	Size	128KB	
		START	0x20000000	
		END	0x2001FFFF	
Code region	Code Flash	Size	1MB	512KB
		START	0x00000000	0x00000000
		END	0x000FFFFFFF	0x0007FFFF

## 4. Pin Description

### 4.1. Functional Pin Name and Functions

#### 4.1.1. Function Pins of Peripheral

**Table 4.1 Pin Names and Functions of Peripheral Pins**

Peripheral function	Pin name	Input or Output	Function
Clock Control and Operation Mode (CG)	SCOUT	Output	Output pin for the system clock
Interrupt control (IA/IB)	INTx	Input	External interrupt input pin External input pin provides the noise filter (filter width: Typ. 30 ns).
32-bit Timer Event Counter (T32A)	T32AxINA0	Input	16-bit timer-A input capture input pin 0
	T32AxINA1	Input	16-bit timer-A input capture input pin 1
	T32AxOUTA	Output	16-bit timer A output pin
	T32AxINB0	Input	16-bit timer B input capture input pin 0
	T32AxINB1	Input	16-bit timer B input capture input pin 1
	T32AxOUTB	Output	16-bit timer B output pin
	T32AxINC0	Input	32-bit timer input capture input pin 0
	T32AxINC1	Input	32-bit timer input capture input pin 1
	T32AxOUTC	Output	32-bit timer output pin
Serial Peripheral Interface (TSPI)	TSPIxCSIN	Input	TSPI Chip select input pin
	TSPIxCS0	Output	TSPI Chip select output pin 0
	TSPIxCS1	Output	TSPI Chip select output pin 1
	TSPIxRXD	Input	TSPI Data input pin
	TSPIxTXD	Output	TSPI Data output pin
	TSPIxSCK	I/O	TSPI Clock input/output pin
Universal Asynchronous Receiver Transmitter (UART)	UTxRXD	Input	UART Data input pin
	UTxTXDA	Output	UART Data output pin A
	UTxTXDB	Output	UART Data output pin B
	UTxCTS_N	Input	UART Transmission control input pin
	UTxRTS_N	Output	UART Transmission request output pin
I <sup>2</sup> C Interface (I2C/EI2C)	I2CxSDA/ EI2CxSDA	I/O	I <sup>2</sup> C interface Data input/output pin
	I2CxSCL/ EI2CxSCL	I/O	I <sup>2</sup> C interface Clock input/output pin

Peripheral function	Pin name	Input or Output	Function
Advanced Programmable Motor Control Circuit (A-PMD)	EMGx	Input	Emergency state detection input pin
	OVVx	Input	Over voltage detection input
	UOx	Output	U-phase output pin
	VOx	Output	V-phase output pin
	WOx	Output	W-phase output pin
	XOx	Output	X-phase output pin
	YOx	Output	Y-phase output pin
	ZOx	Output	Z-phase output pin
	PMDxDBG	Output	PMD Operation Status output pin
Advanced Encoder Input Circuit (32-bit) (A-ENC32)	ENCxA	Input	Encoder input A
	ENCxB	Input	Encoder input B
	ENCxZ	Input	Encoder input Z
Analog to Digital Converter (ADC)	AINAx	Input	Analog input pin
Digital to Analog Converter (DAC)	DACx	Output	DAC output pin
Trigger input	TRGINx	Input	External trigger input pin
Remote control signal preprocessor (RMC)	RXINx	Input	Remote Signaling Data input pin
Real Time clock (RTC)	RTCOUT	Output	1Hz clock output pin
LCD Display control circuit (DLCD)	DCOMx	Output	Common output pin
	SEGx	Output	Segment output pin

Note: "x" means channel number, unit number or interrupt number.

## 4.1.2. Debug Pins

**Table 4.2 Debug Pin Names and Their Function**

Debug function	Pin name	Input or Output	Function
JTAG	TMS	Input	JTAG test mode selection input pin
	TCK	Input	JTAG serial clock input pin
	TDO	Output	JTAG serial data output pin
	TDI	Input	JTAG serial data input pin
	TRST_N	Input	JTAG test reset input pin
SW	SWDIO	I/O	Serial wire data input/output pin
	SWCLK	Input	Serial wire clock input pin
	SWV	Output	Serial wire viewer output pin
TRACE	TRACECLK	Output	Trace clock output pin
	TRACEDATA0	Output	Trace data output pin 0
	TRACEDATA1	Output	Trace data output pin 1
	TRACEDATA2	Output	Trace data output pin 2
	TRACEDATA3	Output	Trace data output pin 3



## 4.1.3. Control Pins

**Table 4.3 Control Pin Names and Their Function**

	Pin name	Input or Output	Function
Control Pin	X1	Input	High speed oscillator connection pin
	X2	Output	High speed oscillator connection pin
	XT1	Input	Low speed oscillator connection pin
	XT2	Output	Low speed oscillator connection pin
	EHCLKIN	Input	External high speed Clock input pin
	BOOT_N	Input	BOOT mode control pin The BOOT mode control pin is sampled at the rising edge of the RESET_N pin input. It's not sampled by internal Reset factor. If the BOOT mode control pin is "Low" level, the MCU enters the Single Boot Mode. If it is "High", the MCU enters the Single Chip Mode. For details of Single Boot Mode, refer to the reference manual "Flash Memory".
	RESET_N	Input	Reset signal input pin
MODE	Input	Mode pin This pin must be fixed to "Low" level.	

## 4.1.4. Power Supply Pins

**Table 4.4 Power Supply Pin Names and Their Function**

	Pin name	Function
Power Supply	DVDD5A (Note 1) DVDD5B (Note 1)	Power supply pin for digital DVDD5A/B supply the power to the following pins: PA to PC, PG2 to PG7, PH to PV, MODE, RESET_N, BOOT_N A power supply is supplied to an oscillating circuit from a built-in regulator. X1, X2, XT1, XT2
	DVSSA (Note 2) DVSSB (Note 2)	GND pin for digital
	REGOUT1 (Note 3) REGOUT2 (Note 3)	Capacitor for a regulator connection pin (Note 4)
	AVDD5	Power supply pin and reference power pin (VREFH) for analog are combination pins. The AVDD5 supplies the power to the following pins: PD, PE, PF, PG0 to 1
	AVSS	GND pin for analog, reference GND (VREFL) for analog are combination pins.

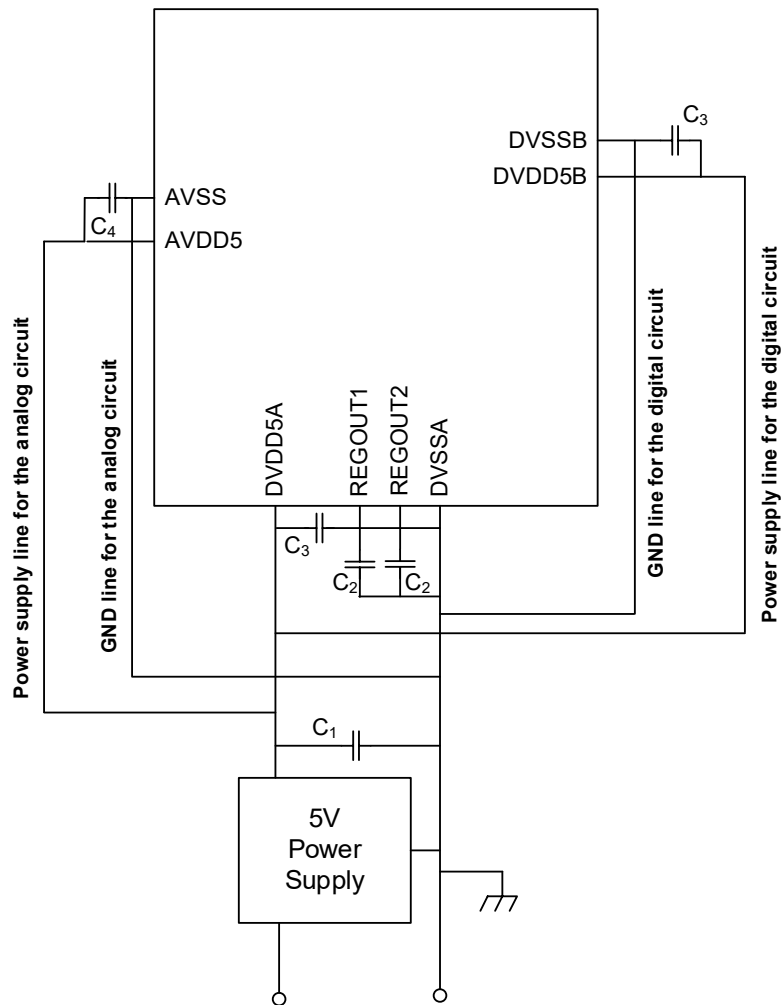
Note 1: Apply the voltage to DVDD5A and DVDD5B at the same potential except the case that the pins are not provided.

Note 2: Apply the external voltage to DVSSA and DVSSB at the same potential except the case that the pins are not provided.

Note 3: For REGOUT1 and REGOUT2, do not cause a short circuit with DVDD5A, DVDD5B; or DVSSA, DVSSB.

Note 4: For the capacitor value, refer to the "7.13 Regulator".

## 4.1.5. Capacitors between Power Supply Pins



**Figure 4.1 Capacitors for Power Supply Pins Connection Circuit**

- Note 1: 5V power supply output capacitor (C<sub>1</sub>) must be placed on the shortest distance from the output pin of 5V power supply. The power gradient with C<sub>1</sub> must be satisfied V<sub>PON</sub> and V<sub>POFF</sub> in "7.7 Characteristics of Internal Processing at RESET".
- Note 2: Bypass capacitor must be placed between the 5V power supply and GND near each MCU power supply pin. (C<sub>3</sub>, C<sub>4</sub>:0.01 to 0.1μF)
- Note 3: Power stabilizing capacitor of REGOUT1 and REGOUT2 for built-in regulators must be the capacity (C<sub>2</sub>), and ceramic capacitor is recommended for C<sub>2</sub>. They must be placed on the shortest distance from DVSSA. For the capacitor value, refer to the "7.13 Regulator".
- Note 4: Separate the analog power supply line and the digital power supply line near the 5V power supply output pin in order to reduce noise mixing into the analog circuit from the digital power supply.
- Note 5: When inserting a filter circuit or pull-up/down resistor at the input/output pin of the analog power supply system to reduce noise mixing from the peripheral circuit to the analog circuit, connect the components that make up these circuits to the analog power supply line.
- Note 6: Do not separate the power supply line and the GND line from each other in order to reduce high frequency noise etc., received by the loop circuit of the power supply line, the GND line, and the capacitor.

## 4.2. Functional Pin and Ports Assignment (Pin Number)

The following table shows a pin number of the port assignment and each product which were seen from the functional pin. "-" means that it does not have a pin or there is no assignment of a function.

**Table 4.5 Signal Connection List (UART ch0, ch1)**

Combination function pin name	Port Name	M3HQ (LQFP144)	M3HP (LQFP128-1414)	M3HP (LQFP128-1420)	M3HN (LQFP100)	M3HN (QFP100)	M3HM (LQFP80)	M3HL (LQFP64)
UT0TXDA	PA1	27	23	26	17	19	16	14
	PA2	26	22	25	16	18	15	13
	PM1	35	31	34	24	26	19	-
	PM2	34	30	33	23	25	18	-
UT0TXDB	PA0	28	24	27	18	20	17	15
	PM0	36	32	35	25	27	20	16
UT0RXD	PA2	26	22	25	16	18	15	13
	PA1	27	23	26	17	19	16	14
	PM2	34	30	33	23	25	18	-
	PM1	35	31	34	24	26	19	-
UT0CTS_N	PM3	33	29	32	22	24	-	-
	PM4	32	28	31	21	23	-	-
UT0RTS_N	PM4	32	28	31	21	23	-	-
	PM3	33	29	32	22	24	-	-
UT1TXDA	PJ1	105	92	95	72	74	57	45
	PJ2	106	93	96	73	75	58	46
	PK1	111	98	101	78	80	63	51
	PK2	112	99	102	79	81	64	52
UT1TXDB	PJ0	104	91	94	71	73	56	44
	PK0	110	97	100	77	79	62	50
UT1RXD	PJ2	106	93	96	73	75	58	46
	PJ1	105	92	95	72	74	57	45
	PK2	112	99	102	79	81	64	52
	PK1	111	98	101	78	80	63	51
UT1CTS_N	PJ3	107	94	97	74	76	59	47
	PJ4	108	95	98	75	77	60	48
	PK3	113	100	103	80	82	65	53
	PK4	114	101	104	81	83	66	54
UT1RTS_N	PJ4	108	95	98	75	77	60	48
	PJ3	107	94	97	74	76	59	47
	PK4	114	101	104	81	83	66	54
	PK3	113	100	103	80	82	65	53

**Table 4.6 Signal Connection List (URAT ch2, ch3)**

Combination function pin name	Port Name	M3HQ (LQFP144)	M3HP (LQFP128-1414)	M3HP (LQFP128-1420)	M3HN (LQFP100)	M3HN (QFP100)	M3HM (LQFP80)	M3HL (LQFP64)
UT2TXDA	PB2	39	35	38	28	30	23	19
	PB3	40	36	39	29	31	24	20
	PL0	47	41	44	34	36	26	21
	PL1	48	42	45	35	37	27	22
UT2RXD	PB3	40	36	39	29	31	24	20
	PB2	39	35	38	28	30	23	19
	PL1	48	42	45	35	37	27	22
	PL0	47	41	44	34	36	26	21
UT2CTS_N	PB4	41	37	40	30	32	25	-
	PB5	42	38	41	31	33	-	-
	PL2	49	43	46	36	38	28	23
	PL3	50	44	47	37	39	29	24
UT2RTS_N	PB5	42	38	41	31	33	-	-
	PB4	41	37	40	30	32	25	-
	PL3	50	44	47	37	39	29	24
	PL2	49	43	46	36	38	28	23
UT3TXDA	PA7	21	17	20	11	13	10	10
	PA6	22	18	21	12	14	11	11
	PG3	16	12	15	-	-	-	-
	PG2	15	11	14	-	-	-	-
UT3TXDB	PG4	17	13	16	-	-	-	-
UT3RXD	PA6	22	18	21	12	14	11	11
	PA7	21	17	20	11	13	10	10
	PG2	15	11	14	-	-	-	-
	PG3	16	12	15	-	-	-	-

**Table 4.7 Signal Connection List (UART ch4 to 7)**

Combination function pin name	Port Name	M3HQ (LQFP144)	M3HP (LQFP128- 1414)	M3HP (LQFP128- 1420)	M3HN (LQFP100)	M3HN (QFP100)	M3HM (LQFP80)	M3HL (LQFP64)
UT4TXDA	PC3	86	73	76	57	59	47	38
	PC4	87	74	77	58	60	48	39
	PV6	81	-	-	-	-	-	-
	PV7	82	-	-	-	-	-	-
UT4TXDB	PC2	85	72	75	56	58	46	-
	PV5	80	-	-	-	-	-	-
UT4RXD	PC4	87	74	77	58	60	48	39
	PC3	86	73	76	57	59	47	38
	PV7	82	-	-	-	-	-	-
	PV6	81	-	-	-	-	-	-
UT4CTS_N	PC5	88	75	78	59	61	49	-
	PC6	89	76	79	60	62	50	-
UT4RTS_N	PC6	89	76	79	60	62	50	-
	PC5	88	75	78	59	61	49	-
UT5TXDA	PN3	100	87	90	67	69	52	41
	PN2	101	88	91	68	70	53	42
UT5TXDB	PN4	99	86	89	66	68	51	40
UT5RXD	PN2	101	88	91	68	70	53	42
	PN3	100	87	90	67	69	52	41
UT5CTS_N	PN1	102	89	92	69	71	54	43
	PN0	103	90	93	70	72	55	-
UT5RTS_N	PN0	103	90	93	70	72	55	-
	PN1	102	89	92	69	71	54	43
UT6TXDA	PK6	116	103	106	83	85	68	56
	PK5	115	102	105	82	84	67	55
UT6TXDB	PK7	117	104	107	84	86	69	-
UT6RXD	PK5	115	102	105	82	84	67	55
	PK6	116	103	106	83	85	68	56
UT7TXDA	PR1	91	78	81	62	64	-	-
	PR0	90	77	80	61	63	-	-
UT7TXDB	PR2	92	79	82	63	65	-	-
UT7RXD	PR0	90	77	80	61	63	-	-
	PR1	91	78	81	62	64	-	-

Table 4.8 Signal Connection List (I2C/EI2C ch0 to 3/TSPI ch0, ch1)

Combination function pin name	Port Name	M3HQ (LQFP144)	M3HP (LQFP128-1414)	M3HP (LQFP128-1420)	M3HN (LQFP100)	M3HN (QFP100)	M3HM (LQFP80)	M3HL (LQFP64)
I2C0SCL	PC0	83	70	73	54	56	44	36
I2C0SDA	PC1	84	71	74	55	57	45	37
I2C1SCL	PA4	24	20	23	14	16	13	-
I2C1SDA	PA5	23	19	22	13	15	12	-
I2C2SCL	PL0	47	41	44	34	36	26	21
I2C2SDA	PL1	48	42	45	35	37	27	22
I2C3SCL	PT1	61	51	54	-	-	-	-
I2C3SDA	PT0	62	52	55	-	-	-	-
EI2C0SCL	PC0	83	70	73	54	56	44	36
EI2C0SDA	PC1	84	71	74	55	57	45	37
EI2C1SCL	PA4	24	20	23	14	16	13	-
EI2C1SDA	PA5	23	19	22	13	15	12	-
EI2C2SCL	PL0	47	41	44	34	36	26	21
EI2C2SDA	PL1	48	42	45	35	37	27	22
EI2C3SCL	PT1	61	51	54	-	-	-	-
EI2C3SDA	PT0	62	52	55	-	-	-	-
TSPI0SCK	PM0	36	32	35	25	27	20	16
	PA0	28	24	27	18	20	17	15
TSPI0TXD	PM1	35	31	34	24	26	19	-
	PA1	27	23	26	17	19	16	14
TSPI0RXD	PM2	34	30	33	23	25	18	-
	PA2	26	22	25	16	18	15	13
TSPI0CS0	PM3	33	29	32	22	24	-	-
	PA3	25	21	24	15	17	14	12
TSPI0CS1	PM4	32	28	31	21	23	-	-
	PA4	24	20	23	14	16	13	-
TSPI0CSIN	PM3	33	29	32	22	24	-	-
	PA3	25	21	24	15	17	14	12
TSPI1SCK	PB2	39	35	38	28	30	23	-
TSPI1TXD	PB3	40	36	39	29	31	24	-
TSPI1RXD	PB4	41	37	40	30	32	25	-
TSPI1CS0	PB5	42	38	41	31	33	-	-
TSPI1CS1	PB6	43	39	42	32	34	-	-
TSPI1CSIN	PB5	42	38	41	31	33	-	-

**Table 4.9 Signal Connection List (TSPI ch2 to 4)**

Combination function pin name	Port Name	M3HQ (LQFP144)	M3HP (LQFP128-1414)	M3HP (LQFP128-1420)	M3HN (LQFP100)	M3HN (QFP100)	M3HM (LQFP80)	M3HL (LQFP64)
TSPI2SCK	PP0	63	53	56	41	43	31	-
	PT2	60	50	53	-	-	-	-
TSPI2TXD	PP1	64	54	57	42	44	32	-
	PT3	59	49	52	-	-	-	-
TSPI2RXD	PP2	65	55	58	43	45	33	-
	PT4	58	-	-	-	-	-	-
TSPI2CS0	PT1	61	51	54	-	-	-	-
TSPI2CS1	PT0	62	52	55	-	-	-	-
TSPI2CSIN	PT1	61	51	54	-	-	-	-
TSPI3SCK	PP5	120	107	110	87	89	72	-
TSPI3TXD	PP4	119	106	109	86	88	71	-
TSPI3RXD	PP3	118	105	108	85	87	70	-
TSPI3CS0	PP6	121	108	111	88	90	73	-
TSPI3CS1	PP7	122	109	112	89	91	-	-
TSPI3CSIN	PP6	121	108	111	88	90	73	-
TSPI4SCK	PH4	76	66	69	-	-	-	-
TSPI4TXD	PH5	77	67	70	-	-	-	-
TSPI4RXD	PH6	78	68	71	-	-	-	-

**Table 4.10 Signal Connection List (T32A ch0)**

Combination function pin name	Port Name	M3HQ (LQFP144)	M3HP (LQFP128- 1414)	M3HP (LQFP128- 1420)	M3HN (LQFP100)	M3HN (QFP100)	M3HM (LQFP80)	M3HL (LQFP64)
T32A00OUTA	PA0	28	24	27	18	20	17	15
	PM0	36	32	35	25	27	20	16
T32A00OUTB	PA3	25	21	24	15	17	14	12
	PM3	33	29	32	22	24	-	-
T32A00OUTC	PA0	28	24	27	18	20	17	15
	PM0	36	32	35	25	27	20	16
T32A00INA0	PA1	27	23	26	17	19	16	14
	PM1	35	31	34	24	26	19	-
T32A00INA1	PA2	26	22	25	16	18	15	13
	PM2	34	30	33	23	25	18	-
T32A00INB0	PA4	24	20	23	14	16	13	-
	PM4	32	28	31	21	23	-	-
T32A00INB1	PA5	23	19	22	13	15	12	-
	PM5	31	27	30	20	22	-	-
T32A00INC0	PA1	27	23	26	17	19	16	14
	PM1	35	31	34	24	26	19	-
T32A00INC1	PA2	26	22	25	16	18	15	13
	PM2	34	30	33	23	25	18	-



**Table 4.11 Signal Connection List (T32A ch1, ch2)**

Combination function pin name	Port Name	M3HQ (LQFP144)	M3HP (LQFP128- 1414)	M3HP (LQFP128- 1420)	M3HN (LQFP100)	M3HN (QFP100)	M3HM (LQFP80)	M3HL (LQFP64)
T32A01OUTA	PB0	37	33	36	26	28	21	17
	PP0	63	53	56	41	43	31	-
T32A01OUTB	PB3	40	36	39	29	31	24	20
T32A01OUTC	PB0	37	33	36	26	28	21	17
	PP0	63	53	56	41	43	31	-
T32A01INA0	PB1	38	34	37	27	29	22	18
	PP1	64	54	57	42	44	32	-
T32A01INA1	PB2	39	35	38	28	30	23	19
	PP2	65	55	58	43	45	33	-
T32A01INB0	PB4	41	37	40	30	32	25	-
T32A01INB1	PB5	42	38	41	31	33	-	-
T32A01INC0	PB1	38	34	37	27	29	22	18
	PP1	64	54	57	42	44	32	-
T32A01INC1	PB2	39	35	38	28	30	23	19
	PP2	65	55	58	43	45	33	-
T32A02OUTA	PC0	83	70	73	54	56	44	36
	PR0	90	77	80	61	63	-	-
T32A02OUTB	PC3	86	73	76	57	59	47	38
T32A02OUTC	PC0	83	70	73	54	56	44	36
	PR0	90	77	80	61	63	-	-
T32A02INA0	PC1	84	71	74	55	57	45	37
	PR1	91	78	81	62	64	-	-
T32A02INA1	PC2	85	72	75	56	58	46	-
	PR2	92	79	82	63	65	-	-
T32A02INB0	PC4	87	74	77	58	60	48	39
T32A02INB1	PC5	88	75	78	59	61	49	-
T32A02INC0	PC1	84	71	74	55	57	45	37
	PR1	91	78	81	62	64	-	-
T32A02INC1	PC2	85	72	75	56	58	46	-
	PR2	92	79	82	63	65	-	-

**Table 4.12 Signal Connection List (T32A ch3 to 5)**

Combination function pin name	Port Name	M3HQ (LQFP144)	M3HP (LQFP128-1414)	M3HP (LQFP128-1420)	M3HN (LQFP100)	M3HN (QFP100)	M3HM (LQFP80)	M3HL (LQFP64)
T32A03OUTA	PJ0	104	91	94	71	73	56	44
T32A03OUTB	PJ3	107	94	97	74	76	59	47
T32A03OUTC	PJ0	104	91	94	71	73	56	44
T32A03INA0	PJ1	105	92	95	72	74	57	45
T32A03INA1	PJ2	106	93	96	73	75	58	46
T32A03INB0	PJ4	108	95	98	75	77	60	48
T32A03INB1	PJ5	109	96	99	76	78	61	49
T32A03INC0	PJ1	105	92	95	72	74	57	45
T32A03INC1	PJ2	106	93	96	73	75	58	46
T32A04OUTA	PK2	112	99	102	79	81	64	52
T32A04OUTB	PK5	115	102	105	82	84	67	55
T32A04OUTC	PK2	112	99	102	79	81	64	52
T32A04INA0	PK3	113	100	103	80	82	65	53
T32A04INA1	PK4	114	101	104	81	83	66	54
T32A04INB0	PK6	116	103	106	83	85	68	56
T32A04INB1	PK7	117	104	107	84	86	69	-
T32A04INC0	PK3	113	100	103	80	82	65	53
T32A04INC1	PK4	114	101	104	81	83	66	54
T32A05OUTA	PN0	103	90	93	70	72	55	-
T32A05OUTB	PN3	100	87	90	67	69	52	41
T32A05OUTC	PN0	103	90	93	70	72	55	-
T32A05INA0	PN1	102	89	92	69	71	54	43
T32A05INA1	PN2	101	88	91	68	70	53	42
T32A05INB0	PN4	99	86	89	66	68	51	40
T32A05INB1	PN5	98	85	88	65	67	-	-
T32A05INC0	PN1	102	89	92	69	71	54	43
T32A05INC1	PN2	101	88	91	68	70	53	42

**Table 4.13 Signal Connection List (T32A ch6, ch7)**

Combination function pin name	Port Name	M3HQ (LQFP144)	M3HP (LQFP128-1414)	M3HP (LQFP128-1420)	M3HN (LQFP100)	M3HN (QFP100)	M3HM (LQFP80)	M3HL (LQFP64)
T32A06OUTA	PL5	52	46	49	39	41	-	-
	PT5	57	-	-	-	-	-	-
T32A06OUTB	PL2	49	43	46	36	38	28	23
	PT2	60	50	53	-	-	-	-
T32A06OUTC	PL5	52	46	49	39	41	-	-
	PT5	57	-	-	-	-	-	-
T32A06INA0	PL6	53	47	50	40	42	-	-
	PT6	56	-	-	-	-	-	-
T32A06INA1	PL7	54	48	51	-	-	-	-
	PT7	55	-	-	-	-	-	-
T32A06INB0	PL3	50	44	47	37	39	29	24
	PT3	59	49	52	-	-	-	-
T32A06INB1	PL4	51	45	48	38	40	30	25
	PT4	58	-	-	-	-	-	-
T32A06INC0	PL6	53	47	50	40	42	-	-
	PT6	56	-	-	-	-	-	-
T32A06INC1	PL7	54	48	51	-	-	-	-
	PT7	55	-	-	-	-	-	-
T32A07OUTA	PG2	15	11	14	-	-	-	-
T32A07OUTB	PG5	18	14	17	-	-	-	-
T32A07OUTC	PG2	15	11	14	-	-	-	-
T32A07INA0	PG3	16	12	15	-	-	-	-
T32A07INA1	PG4	17	13	16	-	-	-	-
T32A07INB0	PG6	19	15	18	-	-	-	-
T32A07INB1	PG7	20	16	19	-	-	-	-
T32A07INC0	PG3	16	12	15	-	-	-	-
T32A07INC1	PG4	17	13	16	-	-	-	-

**Table 4.14 Signal Connection List (ADC ch0 to 20/DAC ch0, ch1)**

Combination function pin name	Port Name	M3HQ (LQFP144)	M3HP (LQFP128- 1414)	M3HP (LQFP128- 1420)	M3HN (LQFP100)	M3HN (QFP100)	M3HM (LQFP80)	M3HL (LQFP64)
AINA00	PD0	6	6	9	6	8	5	5
AINA01	PD1	5	5	8	5	7	4	4
AINA02	PD2	4	4	7	4	6	3	3
AINA03	PD3	3	3	6	3	5	-	-
AINA04	PE0	2	2	5	2	4	2	2
AINA05	PE1	1	1	4	1	3	1	1
AINA06	PE2	144	128	3	100	2	80	64
AINA07	PE3	143	127	2	99	1	79	63
AINA08	PE4	142	126	1	98	100	78	62
AINA09	PE5	141	125	128	97	99	77	61
AINA10	PE6	140	124	127	96	98	76	60
AINA11	PF0	139	123	126	95	97	75	59
AINA12	PF1	138	122	125	94	96	74	58
AINA13	PF2	137	121	124	93	95	-	-
AINA14	PF3	136	120	123	92	94	-	-
AINA15	PF4	135	119	122	91	93	-	-
AINA16	PF5	134	118	121	90	92	-	-
AINA17	PF6	133	117	120	-	-	-	-
AINA18	PF7	132	116	119	-	-	-	-
AINA19	PD4	131	-	-	-	-	-	-
AINA20	PD5	130	-	-	-	-	-	-
DAC0	PG0	9	9	12	9	11	8	8
DAC1	PG1	10	10	13	10	12	9	9

Table 4.15 Signal Connection List (INT 00 to 33)

Combination function pin name	Port Name	M3HQ (LQFP144)	M3HP (LQFP128-1414)	M3HP (LQFP128-1420)	M3HN (LQFP100)	M3HN (QFP100)	M3HM (LQFP80)	M3HL (LQFP64)
INT00	PC0	83	70	73	54	56	44	36
INT01	PC1	84	71	74	55	57	45	37
INT02	PC2	85	72	75	56	58	46	-
INT03	PB1	38	34	37	27	29	22	18
INT04	PJ4	108	95	98	75	77	60	48
INT05	PK1	111	98	101	78	80	63	51
INT06	PH3	74	64	67	52	54	42	34
INT07	PA6	22	18	21	12	14	11	11
INT08	PL3	50	44	47	37	39	29	24
INT09	PM2	34	30	33	23	25	18	-
INT10	PN3	100	87	90	67	69	52	41
INT11	PA7	21	17	20	11	13	10	10
INT12	PL4	51	45	48	38	40	30	25
INT13	PK7	117	104	107	84	86	69	-
INT14	PP3	118	105	108	85	87	70	57
INT15	PM6	30	26	29	19	21	-	-
INT16	PB7	44	40	43	33	35	-	-
INT17	PV2	125	112	115	-	-	-	-
INT18	PV3	126	113	116	-	-	-	-
INT19	PH4	76	66	69	-	-	-	-
INT20	PH5	77	67	70	-	-	-	-
INT21	PH6	78	68	71	-	-	-	-
INT22	PH7	79	69	72	-	-	-	-
INT23	PT0	62	52	55	-	-	-	-
INT24	PT1	61	51	54	-	-	-	-
INT25	PT2	60	50	53	-	-	-	-
INT26	PT3	59	49	52	-	-	-	-
INT27	PG2	15	11	14	-	-	-	-
INT28	PG3	16	12	15	-	-	-	-
INT29	PT7	55	-	-	-	-	-	-
INT30	PU0	45	-	-	-	-	-	-
INT31	PU1	46	-	-	-	-	-	-
INT32	PF3	136	120	123	92	94	-	-
INT33	PF2	137	121	124	93	95	-	-

**Table 4.16 Signal Connection List (A-PMD/A-ENC32/SCOUT/TRGIN/RMC/RTC)**

Combination function pin name	Port Name	M3HQ (LQFP144)	M3HP (LQFP128- 1414)	M3HP (LQFP128- 1420)	M3HN (LQFP100)	M3HN (QFP100)	M3HM (LQFP80)	M3HL (LQFP64)
U00	PJ0	104	91	94	71	73	56	44
X00	PJ1	105	92	95	72	74	57	45
VO0	PJ2	106	93	96	73	75	58	46
YO0	PJ3	107	94	97	74	76	59	47
WO0	PJ4	108	95	98	75	77	60	48
ZO0	PJ5	109	96	99	76	78	61	49
EMG0	PK0	110	97	100	77	79	62	50
OVV0	PK1	111	98	101	78	80	63	51
ENC0A	PA0	28	24	27	18	20	17	15
ENC0B	PA1	27	23	26	17	19	16	14
ENC0Z	PA2	26	22	25	16	18	15	13
PMD0DBG	PP6	121	108	111	88	90	73	-
SCOUT	PB0	37	33	36	26	28	21	17
TRGIN0	PB1	38	34	37	27	29	22	18
TRGIN1	PA3	25	21	24	15	17	14	12
TRGIN2	PN3	100	87	90	67	69	52	41
RXIN0	PB1	38	34	37	27	29	22	18
RTCOUT	PC2	85	72	75	56	58	46	-

**Table 4.17 Signal Connection List (JTAG/SW/TRACE/OSC/BOOT)**

Combination function pin name	Port Name	M3HQ (LQFP144)	M3HP (LQFP128-1414)	M3HP (LQFP128-1420)	M3HN (LQFP100)	M3HN (QFP100)	M3HM (LQFP80)	M3HL (LQFP64)
TMS	PL4	51	45	48	38	40	30	25
TCK	PL3	50	44	47	37	39	29	24
TDO	PL2	49	43	46	36	38	28	23
TDI	PL1	48	42	45	35	37	27	22
TRST_N	PL0	47	41	44	34	36	26	21
SWDIO	PL4	51	45	48	38	40	30	25
SWCLK	PL3	50	44	47	37	39	29	24
SWV	PL2	49	43	46	36	38	28	23
TRACECLK	PM0	36	32	35	25	27	20	-
TRACEDATA0	PM1	35	31	34	24	26	19	-
TRACEDATA1	PM2	34	30	33	23	25	18	-
TRACEDATA2	PM3	33	29	32	22	24	-	-
TRACEDATA3	PM4	32	28	31	21	23	-	-
X1	PH0	70	60	63	48	50	38	30
X2	PH1	71	61	64	49	51	39	31
XT1	PH2	73	63	66	51	53	41	33
XT2	PH3	74	64	67	52	54	42	34
EHCLKIN	PH0	70	60	63	48	50	38	30
BOOT_N	PB0	37	33	36	26	28	21	17

Table 4.18 Signal Connection List (DLCD)

Combination function pin name	Port Name	M3HQ (LQFP144)	M3HP (LQFP128-1414)	M3HP (LQFP128-1420)	M3HN (LQFP100)	M3HN (QFP100)	M3HM (LQFP80)	M3HL (LQFP64)
DCOM0	PC3	86	73	76	57	59	47	-
DCOM1	PC2	85	72	75	56	58	46	-
DCOM2	PC1	84	71	74	55	57	45	-
DCOM3	PC0	83	70	73	54	56	44	-
SEG00	PV3	126	113	116	-	-	-	-
SEG01	PV2	125	112	115	-	-	-	-
SEG02	PV1	124	111	114	-	-	-	-
SEG03	PV0	123	110	113	-	-	-	-
SEG04	PP7	122	109	112	89	91	-	-
SEG05	PP6	121	108	111	88	90	73	-
SEG06	PP5	120	107	110	87	89	72	-
SEG07	PP4	119	106	109	86	88	71	-
SEG08	PP3	118	105	108	85	87	70	-
SEG09	PK7	117	104	107	84	86	69	-
SEG10	PK6	116	103	106	83	85	68	-
SEG11	PK5	115	102	105	82	84	67	-
SEG12	PK4	114	101	104	81	83	66	-
SEG13	PK3	113	100	103	80	82	65	-
SEG14	PK2	112	99	102	79	81	64	-
SEG15	PK1	111	98	101	78	80	63	-
SEG16	PK0	110	97	100	77	79	62	-
SEG17	PJ5	109	96	99	76	78	61	-
SEG18	PJ4	108	95	98	75	77	60	-
SEG19	PJ3	107	94	97	74	76	59	-
SEG20	PJ2	106	93	96	73	75	58	-
SEG21	PJ1	105	92	95	72	74	57	-
SEG22	PJ0	104	91	94	71	73	56	-
SEG23	PN0	103	90	93	70	72	55	-
SEG24	PN1	102	89	92	69	71	54	-
SEG25	PN2	101	88	91	68	70	53	-
SEG26	PN3	100	87	90	67	69	52	-
SEG27	PN4	99	86	89	66	68	51	-
SEG28	PN5	98	85	88	65	67	-	-
SEG29	PR7	97	84	87	-	-	-	-
SEG30	PR6	96	83	86	-	-	-	-
SEG31	PR5	95	82	85	-	-	-	-
SEG32	PR4	94	81	84	-	-	-	-



Combination function pin name	Port Name	M3HQ (LQFP144)	M3HP (LQFP128- 1414)	M3HP (LQFP128- 1420)	M3HN (LQFP100)	M3HN (QFP100)	M3HM (LQFP80)	M3HL (LQFP64)
SEG33	PR3	93	80	83	64	66	-	-
SEG34	PR2	92	79	82	63	65	-	-
SEG35	PR1	91	78	81	62	64	-	-
SEG36	PR0	90	77	80	61	63	-	-
SEG37	PC6	89	76	79	60	62	50	-
SEG38	PC5	88	75	78	59	61	49	-
SEG39	PC4	87	74	77	58	60	48	-

**Table 4.19 Signal Connection List (PORT/CONTROL/POWER)**

Combination function pin name	Port Name	M3HQ (LQFP144)	M3HP (LQFP128-1414)	M3HP (LQFP128-1420)	M3HN (LQFP100)	M3HN (QFP100)	M3HM (LQFP80)	M3HL (LQFP64)
-	PM7	29	25	28	-	-	-	-
-	PU2	14	-	-	-	-	-	-
-	PU3	13	-	-	-	-	-	-
-	PU4	12	-	-	-	-	-	-
-	PU5	11	-	-	-	-	-	-
-	PV4	127	-	-	-	-	-	-
RESET_N	-	72	62	65	50	52	40	32
MODE	-	75	65	68	53	55	43	35
AVDD5	-	7	7	10	7	9	6	6
AVSS	-	8	8	11	8	10	7	7
DVDD5A	-	66	56	59	44	46	34	26
DVDD5B	-	128	114	117	-	-	-	-
DVSSA	-	69	59	62	47	49	37	29
DVSSB	-	129	115	118	-	-	-	-
REGOUT1	-	68	58	61	46	48	36	28
REGOUT2	-	67	57	60	45	47	35	27

## 4.3. Ports

The symbols of each table of the port have the following meanings.

The right-hand side of the port shows specification with the symbol.

- Input/Output: Input and/or Output of Port  
Input: Input port  
Output: Output port  
I/O: Input/Output port
- PU/PD: Programmable pull-up/pull-down  
PU: Programmable pull-up is selectable  
PD: Programmable pull-down is selectable
- OD: Programmable open-drain output  
Yes: Support  
No: Non support
- 5V\_T: 5V-tolerant  
Yes: Support  
N/A: Not available
- SMT/CMOS: Input gate  
SMT: Schmitt trigger input  
CMOS: CMOS input
- Under Reset: Port state under Reset  
Hi-Z: High impedance  
PU: Pull-up  
PD: Pull-down
- After Reset: Port state after Reset  
Hi-Z: High impedance  
PU: Pull-up  
PD: Pull-down

## 4.3.1. Port Specifications Table

Table 4.20 Port Names and Specifications of Port A, B, C, D, E

Port name	Input/output	PU/PD	OD	5V_T	SMT/CMOS	Under reset	After reset
PA0	I/O	PU/PD	YES	N/A	SMT	Hi-Z	Hi-Z
PA1	I/O	PU/PD	YES	N/A	SMT	Hi-Z	Hi-Z
PA2	I/O	PU/PD	YES	N/A	SMT	Hi-Z	Hi-Z
PA3	I/O	PU/PD	YES	N/A	SMT	Hi-Z	Hi-Z
PA4	I/O	PU/PD	YES	YES	SMT	Hi-Z	Hi-Z
PA5	I/O	PU/PD	YES	YES	SMT	Hi-Z	Hi-Z
PA6	I/O	PU/PD	YES	N/A	SMT	Hi-Z	Hi-Z
PA7	I/O	PU/PD	YES	N/A	SMT	Hi-Z	Hi-Z
PB0	Output	PU/PD (Note)	YES	N/A	SMT	Hi-Z (Note)	Hi-Z
PB1	I/O	PU/PD	YES	N/A	SMT	Hi-Z	Hi-Z
PB2	I/O	PU/PD	YES	N/A	SMT	Hi-Z	Hi-Z
PB3	I/O	PU/PD	YES	N/A	SMT	Hi-Z	Hi-Z
PB4	I/O	PU/PD	YES	N/A	SMT	Hi-Z	Hi-Z
PB5	I/O	PU/PD	YES	N/A	SMT	Hi-Z	Hi-Z
PB6	I/O	PU/PD	YES	N/A	SMT	Hi-Z	Hi-Z
PB7	I/O	PU/PD	YES	N/A	SMT	Hi-Z	Hi-Z
PC0	I/O	PU/PD	YES	N/A	SMT	Hi-Z	Hi-Z
PC1	I/O	PU/PD	YES	N/A	SMT	Hi-Z	Hi-Z
PC2	I/O	PU/PD	YES	N/A	SMT	Hi-Z	Hi-Z
PC3	I/O	PU/PD	YES	N/A	SMT	Hi-Z	Hi-Z
PC4	I/O	PU/PD	YES	N/A	SMT	Hi-Z	Hi-Z
PC5	I/O	PU/PD	YES	N/A	SMT	Hi-Z	Hi-Z
PC6	I/O	PU/PD	YES	N/A	SMT	Hi-Z	Hi-Z
PD0	I/O	PU/PD	YES	N/A	SMT	Hi-Z	Hi-Z
PD1	I/O	PU/PD	YES	N/A	SMT	Hi-Z	Hi-Z
PD2	I/O	PU/PD	YES	N/A	SMT	Hi-Z	Hi-Z
PD3	I/O	PU/PD	YES	N/A	SMT	Hi-Z	Hi-Z
PD4	I/O	PU/PD	YES	N/A	SMT	Hi-Z	Hi-Z
PD5	I/O	PU/PD	YES	N/A	SMT	Hi-Z	Hi-Z
PE0	I/O	PU/PD	YES	N/A	SMT	Hi-Z	Hi-Z
PE1	I/O	PU/PD	YES	N/A	SMT	Hi-Z	Hi-Z
PE2	I/O	PU/PD	YES	N/A	SMT	Hi-Z	Hi-Z
PE3	I/O	PU/PD	YES	N/A	SMT	Hi-Z	Hi-Z
PE4	I/O	PU/PD	YES	N/A	SMT	Hi-Z	Hi-Z
PE5	I/O	PU/PD	YES	N/A	SMT	Hi-Z	Hi-Z
PE6	I/O	PU/PD	YES	N/A	SMT	Hi-Z	Hi-Z

Note: Combination with BOOT\_N. When RESET\_N pin is "Low" level, pull-up resistor is enabled. When RESET\_N pin is "High" level, the pin state is Hi-Z with internal reset.

**Table 4.21 Port Names and Specifications of Port F, G, H, J, K**

Port name	Input/output	PU/PD	OD	5V_T	SMT/CMOS	Under reset	After reset
PF0	I/O	PU/PD	YES	N/A	SMT	Hi-Z	Hi-Z
PF1	I/O	PU/PD	YES	N/A	SMT	Hi-Z	Hi-Z
PF2	I/O	PU/PD	YES	N/A	SMT	Hi-Z	Hi-Z
PF3	I/O	PU/PD	YES	N/A	SMT	Hi-Z	Hi-Z
PF4	I/O	PU/PD	YES	N/A	SMT	Hi-Z	Hi-Z
PF5	I/O	PU/PD	YES	N/A	SMT	Hi-Z	Hi-Z
PF6	I/O	PU/PD	YES	N/A	SMT	Hi-Z	Hi-Z
PF7	I/O	PU/PD	YES	N/A	SMT	Hi-Z	Hi-Z
PG0	I/O	PU/PD	YES	N/A	SMT	Hi-Z	Hi-Z
PG1	I/O	PU/PD	YES	N/A	SMT	Hi-Z	Hi-Z
PG2	I/O	PU/PD	YES	N/A	SMT	Hi-Z	Hi-Z
PG3	I/O	PU/PD	YES	N/A	SMT	Hi-Z	Hi-Z
PG4	I/O	PU/PD	YES	N/A	SMT	Hi-Z	Hi-Z
PG5	I/O	PU/PD	YES	N/A	SMT	Hi-Z	Hi-Z
PG6	I/O	PU/PD	YES	N/A	SMT	Hi-Z	Hi-Z
PG7	I/O	PU/PD	YES	N/A	SMT	Hi-Z	Hi-Z
PH0	Input	PD	YES	N/A	SMT	Hi-Z	Hi-Z
PH1	Input	PD	YES	N/A	SMT	Hi-Z	Hi-Z
PH2	Input	PD	YES	N/A	SMT	Hi-Z	Hi-Z
PH3	Input	PD	YES	N/A	SMT	Hi-Z	Hi-Z
PH4	I/O	PU/PD	YES	N/A	SMT	Hi-Z	Hi-Z
PH5	I/O	PU/PD	YES	N/A	SMT	Hi-Z	Hi-Z
PH6	I/O	PU/PD	YES	N/A	SMT	Hi-Z	Hi-Z
PH7	I/O	PU/PD	YES	N/A	SMT	Hi-Z	Hi-Z
PJ0	I/O	PU/PD	YES	N/A	SMT	Hi-Z	Hi-Z
PJ1	I/O	PU/PD	YES	N/A	SMT	Hi-Z	Hi-Z
PJ2	I/O	PU/PD	YES	N/A	SMT	Hi-Z	Hi-Z
PJ3	I/O	PU/PD	YES	N/A	SMT	Hi-Z	Hi-Z
PJ4	I/O	PU/PD	YES	N/A	SMT	Hi-Z	Hi-Z
PJ5	I/O	PU/PD	YES	N/A	SMT	Hi-Z	Hi-Z
PK0	I/O	PU/PD	YES	N/A	SMT	Hi-Z	Hi-Z
PK1	I/O	PU/PD	YES	N/A	SMT	Hi-Z	Hi-Z
PK2	I/O	PU/PD	YES	N/A	SMT	Hi-Z	Hi-Z
PK3	I/O	PU/PD	YES	N/A	SMT	Hi-Z	Hi-Z
PK4	I/O	PU/PD	YES	N/A	SMT	Hi-Z	Hi-Z
PK5	I/O	PU/PD	YES	N/A	SMT	Hi-Z	Hi-Z
PK6	I/O	PU/PD	YES	N/A	SMT	Hi-Z	Hi-Z
PK7	I/O	PU/PD	YES	N/A	SMT	Hi-Z	Hi-Z

**Table 4.22 Port Names and Specifications of Port L, M, N, P, R**

Port name	Input/output	PU/PD	OD	5V_T	SMT/CMOS	Under reset	After reset
PL0	I/O	PU/PD	YES	N/A	SMT	PU (Note)	PU (Note)
PL1	I/O	PU/PD	YES	N/A	SMT	PU (Note)	PU (Note)
PL2	I/O	PU/PD	YES	N/A	SMT	Hi-Z (Note)	Hi-Z (Note)
PL3	I/O	PU/PD	YES	N/A	SMT	PD (Note)	PD (Note)
PL4	I/O	PU/PD	YES	N/A	SMT	PU (Note)	PU (Note)
PL5	I/O	PU/PD	YES	N/A	SMT	Hi-Z	Hi-Z
PL6	I/O	PU/PD	YES	N/A	SMT	Hi-Z	Hi-Z
PL7	I/O	PU/PD	YES	N/A	SMT	Hi-Z	Hi-Z
PM0	I/O	PU/PD	YES	N/A	SMT	Hi-Z	Hi-Z
PM1	I/O	PU/PD	YES	N/A	SMT	Hi-Z	Hi-Z
PM2	I/O	PU/PD	YES	N/A	SMT	Hi-Z	Hi-Z
PM3	I/O	PU/PD	YES	N/A	SMT	Hi-Z	Hi-Z
PM4	I/O	PU/PD	YES	N/A	SMT	Hi-Z	Hi-Z
PM5	I/O	PU/PD	YES	N/A	SMT	Hi-Z	Hi-Z
PM6	I/O	PU/PD	YES	N/A	SMT	Hi-Z	Hi-Z
PM7	I/O	PU/PD	YES	N/A	SMT	Hi-Z	Hi-Z
PN0	I/O	PU/PD	YES	N/A	SMT	Hi-Z	Hi-Z
PN1	I/O	PU/PD	YES	N/A	SMT	Hi-Z	Hi-Z
PN2	I/O	PU/PD	YES	N/A	SMT	Hi-Z	Hi-Z
PN3	I/O	PU/PD	YES	N/A	SMT	Hi-Z	Hi-Z
PN4	I/O	PU/PD	YES	N/A	SMT	Hi-Z	Hi-Z
PN5	I/O	PU/PD	YES	N/A	SMT	Hi-Z	Hi-Z
PP0	I/O	PU/PD	YES	N/A	SMT	Hi-Z	Hi-Z
PP1	I/O	PU/PD	YES	N/A	SMT	Hi-Z	Hi-Z
PP2	I/O	PU/PD	YES	N/A	SMT	Hi-Z	Hi-Z
PP3	I/O	PU/PD	YES	N/A	SMT	Hi-Z	Hi-Z
PP4	I/O	PU/PD	YES	N/A	SMT	Hi-Z	Hi-Z
PP5	I/O	PU/PD	YES	N/A	SMT	Hi-Z	Hi-Z
PP6	I/O	PU/PD	YES	N/A	SMT	Hi-Z	Hi-Z
PP7	I/O	PU/PD	YES	N/A	SMT	Hi-Z	Hi-Z
PR0	I/O	PU/PD	YES	N/A	SMT	Hi-Z	Hi-Z
PR1	I/O	PU/PD	YES	N/A	SMT	Hi-Z	Hi-Z
PR2	I/O	PU/PD	YES	N/A	SMT	Hi-Z	Hi-Z
PR3	I/O	PU/PD	YES	N/A	SMT	Hi-Z	Hi-Z
PR4	I/O	PU/PD	YES	N/A	SMT	Hi-Z	Hi-Z
PR5	I/O	PU/PD	YES	N/A	SMT	Hi-Z	Hi-Z
PR6	I/O	PU/PD	YES	N/A	SMT	Hi-Z	Hi-Z
PR7	I/O	PU/PD	YES	N/A	SMT	Hi-Z	Hi-Z

Note: It is assigned to a debug pin in the state of the initial stage.

(PL4: TMS/SWDIO, PL3:TCK/SWCLK, PL2:TDO/SWV, PL1:TDI, PL0:TRST\_N)

**Table 4.23 Port Names and Specifications of Port T, U, V**

Port name	Input/output	PU/PD	OD	5V_T	SMT/CMOS	Under reset	After reset
PT0	I/O	PU/PD	YES	N/A	SMT	Hi-Z	Hi-Z
PT1	I/O	PU/PD	YES	N/A	SMT	Hi-Z	Hi-Z
PT2	I/O	PU/PD	YES	N/A	SMT	Hi-Z	Hi-Z
PT3	I/O	PU/PD	YES	N/A	SMT	Hi-Z	Hi-Z
PT4	I/O	PU/PD	YES	N/A	SMT	Hi-Z	Hi-Z
PT5	I/O	PU/PD	YES	N/A	SMT	Hi-Z	Hi-Z
PT6	I/O	PU/PD	YES	N/A	SMT	Hi-Z	Hi-Z
PT7	I/O	PU/PD	YES	N/A	SMT	Hi-Z	Hi-Z
PU0	I/O	PU/PD	YES	N/A	SMT	Hi-Z	Hi-Z
PU1	I/O	PU/PD	YES	N/A	SMT	Hi-Z	Hi-Z
PU2	I/O	PU/PD	YES	N/A	SMT	Hi-Z	Hi-Z
PU3	I/O	PU/PD	YES	N/A	SMT	Hi-Z	Hi-Z
PU4	I/O	PU/PD	YES	N/A	SMT	Hi-Z	Hi-Z
PU5	I/O	PU/PD	YES	N/A	SMT	Hi-Z	Hi-Z
PV0	I/O	PU/PD	YES	N/A	SMT	Hi-Z	Hi-Z
PV1	I/O	PU/PD	YES	N/A	SMT	Hi-Z	Hi-Z
PV2	I/O	PU/PD	YES	N/A	SMT	Hi-Z	Hi-Z
PV3	I/O	PU/PD	YES	N/A	SMT	Hi-Z	Hi-Z
PV4	I/O	PU/PD	YES	N/A	SMT	Hi-Z	Hi-Z
PV5	I/O	PU/PD	YES	N/A	SMT	Hi-Z	Hi-Z
PV6	I/O	PU/PD	YES	N/A	SMT	Hi-Z	Hi-Z
PV7	I/O	PU/PD	YES	N/A	SMT	Hi-Z	Hi-Z

## 5. Functional Description and Operation Description

### 5.1. Reference Manuals

For more information on the product of TMPM3H Group(2), please refer to Reference Manuals below;

**Table 5.1 Reference Manuals for TMPM3H Group(2)**

Reference manual	IP symbol	Category
Port (TMPM3H Group(2))	PORT-M3H(2)	System
Exception (TMPM3H Group(2))	EXCEPT-M3H(2)	System
Clock Control and operation mode (TMPM3H Group(2))	CG-M3H(2)-D	System
Product Information (TMPM3H Group(2))	PINFO-M3H(2)	System
Flash Memory (Code Flash: 1MB/512KB and Data Flash: 32KB)	FLASH10MUD32-A	Peripheral
Trimming Circuit	TRM-B	Peripheral
Oscillation Frequency Detector	OFD-A	Peripheral
Voltage Detection Circuit	LVD-D	Peripheral
Digital Noise Filter Circuit	DNF-A	Peripheral
Debug Interface	DEBUG-A	Peripheral
DMA Controller	DMAC-B	Peripheral
Universal Asynchronous Receiver Transmitter	UART-C	Peripheral
Serial Peripheral Interface	TSPI-E	Peripheral
I <sup>2</sup> C interface	I2C-B	Peripheral
I <sup>2</sup> C interface Version A	EI2C-A	Peripheral
8-bit Digital to Analog Converter	DAC-B	Peripheral
12-bit Analog to Digital Converter	ADC-G	Peripheral
Comparator	COMP-C	Peripheral
Advanced Programmable Motor Control Circuit	A-PMD-B	Peripheral
Advanced Encoder Input Circuit (32-bit)	A-ENC32-A	Peripheral
LCD Display control Circuit	DLCD-A	Peripheral
32-bit Timer Event Counter	T32A-C	Peripheral
Real Time Clock	RTC-A	Peripheral
Clock Selective Watchdog Timer	SIWDT-A	Peripheral
Remote control signal preprocessor	RMC-A	Peripheral
CRC calculation circuit	CRC-A	Peripheral
RAM Parity	RAMP-A	Peripheral



## 5.2. Processor Core

The TPM3H Group(2) incorporates a high-performance 32-bit processor core (Arm Cortex-M3 core). For the operation of the processor core, refer to the Arm documentation set of the Arm "Cortex-M" series processor. This section explains the product-specific information.

### 5.2.1. Core Information

The Cortex-M3 core revision used in the TPM3H Group(2) is shown as below:  
 For details of the CPU core and the architecture, refer to the Arm documentation on Arm's website.

**Table 5.2 Core Revision**

Group name	Core revision
TPM3H Group(2)	r2p1

### 5.2.2. Configurable Options

In the Cortex-M3 core, some blocks can be selected to implement. The following table shows the configurations of the TPM3H Group(2).

**Table 5.3 Configurable Options and Their Implementations**

Configurable option	Implementation
FPB	Literal comparator: 2 Instruction comparator: 6
DWT	Comparator: 4
ITM	Available
MPU	Available
ETM	Available
AHB-AP	Available
AHB trace Macrocell interface	Not available
TPIU	Available
WIC	Not available
Debug port	JTAG/serial wire
Bit band	Available
Sequential control of AHB	Not available

### 5.3. Clock Control and Operation Mode (CG)

The CG selects a clock gear ratio and the prescaler clock, or warm up time of the oscillator.

There are NORMAL mode and low-power consumption mode as operation modes. Power consumption can be decreased by mode transition.

The outline of the clock control circuit is as follows:

- Internal high-speed oscillation circuit: 10MHz
- Selectable from the external high speed oscillation circuit or internal high-speed oscillation circuit.
- PLL (Clock Multiplication Circuit): Capable of 120 MHz output by changing the multiplication ratio according to the frequency of the high-speed oscillation circuit
- Clock gear: The high-speed clock can be divided by 1, 2, 4, 8, or 16 and the clock is used as the system clock (fsys).
  - Low-power consumption mode:
    - IDLE: Only the CPU is stopped in this mode. Each peripheral circuit can be enabled or disabled operation in the IDLE mode.
    - STOP1: Except some peripheral circuits, all the internal circuits including the internal oscillator are brought to a stop in STOP1 mode. The low frequency clock can be supplied to RTC, RMC and DLCD by corresponding setting.
    - STOP2: This mode halts voltage supply, retaining some peripheral circuits operation. The low frequency clock can be supplied to RTC and DLCD by the corresponding setting. The address match wakeup function on I<sup>2</sup>C interface can be used.

### 5.4. Flash Memory (Code FLASH, Data FLASH)

The code flash stores instruction code, and CPU read instruction code and executes. The data flash stores data, and even if a power supply is off, data can be kept.

The code flash has two areas, and has the dual mode that possible to write and erase an area while executing instruction on another area. (Only the products with 1MB code flash)

The flash memory has the dual mode that possible to write and erase a data flash while executing instruction on a code flash, and it's also possible to continue executing an application program while writing or erasing data flash.

It has protection function which prohibits write or erase by the block unit and it has the security function which prohibits the reading of the program code by outsiders.

## 5.5. Oscillation Circuit

- External High Speed Oscillator (EHOSC):  
Connect crystal oscillator or ceramic resonator to terminals. Use clock source for System clock.
- External Low Speed Oscillator (ELOSC):  
Connect crystal oscillator (32.768 kHz) to terminals. Use clock source for Real Time Clock or Power consumption mode.
- Internal High Speed Oscillator 1 (IHOSC1):  
Oscillation frequency is 10MHz. Use clock source for System clock.
- Internal High Speed Oscillator 2 (IHOSC2):  
Oscillation frequency is 10MHz. Use clock source for OFD and SIWDT.

**Table 5.4 Built-in Oscillator**

	M3HQ	M3HP	M3HN	M3HM	M3HL
EHOSC	✓	✓	✓	✓	✓
ELOSC	✓	✓	✓	✓	✓
IHOSC1	✓	✓	✓	✓	✓
IHOSC2	✓	✓	✓	✓	✓

Note: ✓: Available, -: N/A

## 5.6. Trimming Circuit (TRM)

The trimming function can adjust the frequency of the internal high-speed oscillator1 (IHOSC1).

**Table 5.5 Built-in TRM**

	M3HQ	M3HP	M3HN	M3HM	M3HL
TRM	✓	✓	✓	✓	✓

Note: ✓: Available, -: N/A

## 5.7. Oscillation Frequency Detector (OFD)

The oscillation frequency detector (OFD) is a function that detects an abnormal state of the clock. It measures the external high-speed oscillation ( $f_{EHOSC}$ ) or high-speed clock ( $f_c$ ) based on the internal reference clock ( $f_{IHOSC2}$ ). If an oscillation or clock frequency is out of the specified range, a reset signal occurs.

The upper limit and the lower limit of detection frequency ranges can be specified.

**Table 5.6 Built-in OFD**

	M3HQ	M3HP	M3HN	M3HM	M3HL
OFD	✓	✓	✓	✓	✓

Note: ✓: Available, -: N/A

## 5.8. Voltage Detection Circuit (LVD)

The LVD is a peripheral function that detects whether a power supply voltage is lower or higher than the preset voltage. When a low voltage or higher voltage than the preset voltage is detected, the LVD generates an interrupt request or reset the MCU.

Setting voltage can be chosen from eight kinds. LVD is set to enable from the Reset state at the Power-on.

**Table 5.7 Built-in LVD**

	M3HQ	M3HP	M3HN	M3HM	M3HL
LVD	✓	✓	✓	✓	✓

Note: ✓: Available, -: N/A

## 5.9. Digital Noise Filter (DNF)

The digital noise filter circuit can eliminate the noise of input signals from external interrupt pins at a certain range. The noise of the "High" level/"Low" level input of the external interrupt signal INTx is removed.

**Table 5.8 Number of External Interrupts (Built-in DNF)**

	M3HQ	M3HP	M3HN	M3HM	M3HL
Number of External Interrupt	34	31	19	15	12

## 5.10. Debug Interface (DEBUG)

TMPM3H Group(2) contains interfaces to connecting debug tool, which are the Serial Wire Debug Port (SWCLK, SWDIO) and the JTAG Debug Port (TDI, TDO, TMS, TCK, TRST\_N). These are connected with the debug tool and used for program development. And also it contains the trace clock (TRACECLK) and data output (TRACEDATA 0 to 3) to reduce the debug process.

**Table 5.9 Built-in Debug Interface**

Debug Pin (Signal Name)	Port	M3HQ	M3HP	M3HN	M3HM	M3HL
SWDIO	PL4	✓	✓	✓	✓	✓
TMS						
SWCLK	PL3	✓	✓	✓	✓	✓
TCK						
SWV	PL2	✓	✓	✓	✓	✓
TDO						
TDI	PL1	✓	✓	✓	✓	✓
TRST_N	PL0	✓	✓	✓	✓	✓
TRACECLK	PM0	✓	✓	✓	✓	-
TRACEDATA0	PM1	✓	✓	✓	✓	-
TRACEDATA1	PM2	✓	✓	✓	✓	-
TRACEDATA2	PM3	✓	✓	✓	-	-
TRACEDATA3	PM4	✓	✓	✓	-	-

Note: ✓: Available, -: N/A

## 5.11. DMA Controller (DMAC)

The DMAC is the peripheral function to move the data between peripheral functions and the memory, or between memories. These operations are performed separately from the CPU control; thus, the Load of CPU can greatly be reduced by using the DMA.

TMPM3H Group(2) have two units DMA controller (DMAC), DMAC has 32 channels of DMA requests per unit.

**Table 5.10 Built-in DMAC**

Unit	M3HQ	M3HP	M3HN	M3HM	M3HL
UNIT A	✓	✓	✓	✓	✓
UNIT B	✓	✓	✓	✓	✓

Note: ✓: Available, -: N/A

## 5.12. Universal Asynchronous Receiver Transmitter (UART)

The UART is asynchronous serial communication function. It can choose the data length of 7, 8 or 9bits, parity existence, and a STOP bit length function. Moreover, selection of the MSB first/LSB first and reversal of data polarity can be performed and Terminal exchanged of TXD/RXD can be performed in a Port setting.

The FIFO buffer supports data communication on 8-stage at transmission, and on 8-stage at reception.

The telecommunication control by CTS/RTS and half clock mode are supported.

**Table 5.11 Built-in UART**

Channel	M3HQ	M3HP	M3HN	M3HM	M3HL
Channel 0	✓	✓	✓	✓	✓
Channel 1	✓	✓	✓	✓	✓
Channel 2	✓	✓	✓	✓	✓
Channel 3	✓	✓	✓	✓	✓
Channel 4	✓	✓	✓	✓	✓
Channel 5	✓	✓	✓	✓	✓
Channel 6	✓	✓	✓	✓	✓
Channel 7	✓	✓	✓	-	-

Note 1: ✓: Available, -: N/A

Note 2: External pins are not the same by the product. Please refer to the section "2 Pin Assignment".

## 5.13. Serial Peripheral Interface (TSPI)

The TSPI supports two communication methods and enables to perform serial communication between this device and other devices at high speed. The SPI bus type, which uses a CS (Chip Select) signal at communications, and SIO bus type, which does not use a CS signal at communications can be selected.

The data length can be changed from 7 bits (with a parity bit) to 32 bits (without a parity bit) in the unit of one bit. There are an 8-stage 16-bit FIFO for reception and transmission, each. The TSPI supports master and slave communications.

It can support frame mode (frame length (8 to 32 bit)) or sector mode (8 to 128 bit of frame length is configured in 2 to 4 sectors).

**Table 5.12 Built-in TSPI**

Channel	M3HQ	M3HP	M3HN	M3HM	M3HL
Channel 0	✓	✓	✓	✓	✓
Channel 1	✓	✓	✓	✓	-
Channel 2	✓	✓	✓	✓	-
Channel 3	✓	✓	✓	✓	-
Channel 4	✓	✓	-	-	-

Note 1: ✓: Available, -: N/A

Note 2: External pins are not the same by product. Please refer to the section "2 Pin Assignment".

## 5.14. I<sup>2</sup>C Interface

The following table shows the List of Built-in I<sup>2</sup>C Interface.

I2C and EI2C assigned to the same channel and they cannot be used simultaneously at the same pin.

**Table 5.13 Built-in I2C**

Channel	M3HQ	M3HP	M3HN	M3HM	M3HL
Channel 0 (Note 2)	✓	✓	✓	✓	✓
Channel 1	✓	✓	✓	✓	-
Channel 2	✓	✓	✓	✓	✓
Channel 3	✓	✓	-	-	-

Note 1: ✓: Available, -: N/A

Note 2: The slave address match wake up function is available.

### 5.14.1. I<sup>2</sup>C Interface (I2C)

I2C is two-wire bi-directional serial communications between Master and Slave device. The mode in which two or more masters can exist on the same bus called a multi-master is supported. It supports STD mode (Max 100kHz), Fast mode (Max 400kHz). 7-bit Slave addressing is supported.

Depending on the setting, the MCU can receive data even in low power consumption mode including IDLE, STOP1, or STOP2 mode.

Channel 0 provides the address match wakeup function. It can return from low power consumption mode to normal mode by the slave address match.

### 5.14.2. I<sup>2</sup>C Interface Version A (EI2C)

I<sup>2</sup>C Interface Version A (EI2C) is two-wire bi-directional serial communications between Master and Slave device. The mode in which two or more masters can exist on the same bus called a multi-master is supported. It supports STD mode (Max 100kHz), Fast mode (Max 400kHz), Fast mode plus (Max 1MHz), and 7-bit slave addressing and more 10-bit slave addressing.

Depending on the setting, the MCU can receive data even in low power consumption mode including IDLE, STOP1, or STOP2 mode.

Channel 0 provides the address match wakeup function. It can return from low power consumption mode to normal mode by the slave address match.

### 5.15. 8-bit Digital to Analog Converter (DAC)

The DAC is an R-2R type 8-bit digital to analog converter that can output the specified voltage. A buffer amplifier is not incorporated.

Channel0 (DAC0) can be used also as the reference voltage (VREFC) of a comparator (COMP).

**Table 5.14 Built-in DAC**

Channel	M3HQ	M3HP	M3HN	M3HM	M3HL
Channel 0	✓	✓	✓	✓	✓
Channel 1	✓	✓	✓	✓	✓

Note: ✓: Available, -: N/A



### 5.16. 12-bit Analog to Digital Converter (ADC)

The ADC is a successive-approximation analog to digital converter. It supports maximum 21 analog inputs. The combination of a conversion result register and analog input can be programmed in each startup trigger of AD conversion. A startup trigger for analog to digital conversion can be selected from software or peripheral functions (A-PMD trigger outputs, timer/event counter outputs, port inputs).

A motor is easily controllable by cooperating especially with A-PMD.

The monitor function is also available and it can generate an interrupt request when the compare conditions are matched. 2 types of Sampling time setting are available and can be selected for each AIN channel.

**Table 5.15 Built-in ADC**

UNIT	M3HQ	M3HP	M3HN	M3HM	M3HL
UNIT A	✓	✓	✓	✓	✓

Note: ✓: Available, -: N/A

**Table 5.16 Number of Analog Inputs for ADC**

	M3HQ	M3HP	M3HN	M3HM	M3HL
Analog Inputs Pin count	21	19	17	12	12

### 5.17. Comparator (COMP)

The comparator compares an Analog Input value with Output value of Built-in 8-bits DAC, and the compared result is outputted to EMG input of A-PMD.

**Table 5.17 Built-in Comparator**

Channel	M3HQ	M3HP	M3HN	M3HM	M3HL
Channel0	✓	✓	✓	✓	✓

Note: ✓: Available, -: N/A

### 5.18. Advanced Programmable Motor Control Circuit (A-PMD)

The advanced programmable motor control circuit (A-PMD) enables users to control brushless DC motors easily. It incorporates the three-phase pulse modulation circuit and dead-time circuit, and easily generates waveforms for motor control by operating with the ADC in a coordinated fashion.

It also provides over-voltage detection input and abnormal detection input to support safety measures.

**Table 5.18 Built-in A-PMD**

Channel	M3HQ	M3HP	M3HN	M3HM	M3HL
Channel 0	✓	✓	✓	✓	✓

Note: ✓: Available, -: N/A

### 5.19. Advanced Encoder Input Circuit (32-bit) (A-ENC32)

The advanced encoder input circuit (A-ENC32) supports an incremental encoder to acquire the motor position easily. The noise canceller is installed in the input pins, so that the signals from an incremental encoder or Hall sensor can be input directly.

The A-ENC32 provides six operation modes: encoder mode, sensor modes (3 kinds), timer mode, and phase counter mode.

**Table 5.19 Built-in A-ENC32**

Channel	M3HQ	M3HP	M3HN	M3HM	M3HL
Channel 0	✓	✓	✓	✓	✓

Note: ✓: Available, -: N/A

### 5.20. LCD Display Control Circuit (DLCD)

The LCD display control circuit (DLCD) is a segment display type LCD display control circuit that supports the non-bias driving system. It can drive up to 40-seg × 4-com LCD panel.

**Table 5.20 Built-in DLCD List**

	M3HQ	M3HP	M3HN	M3HM	M3HL
Segment configuration	40 segments × 4 commons	40 segments × 4 commons	32 segments × 4 commons	26 segments × 4 commons	-
Control type	Non-bias driving system				-

### 5.21. 32-bit Timer Event Counter (T32A)

The T32A is a timer event counter that can operate as a 32-bit Timer or two 16-bit Timers. 16-bit Timer or 32-bit Timer can be selected. In 16-bit Timer, the T32A is comprised of Timer A and Timer B incorporating a 16-bit counter. In 32-bit Timer, the T32A operates as Timer C incorporating a 32-bit counter.

The T32A has an interval timer, event counter, input capture, 2-phase counter input, PPG output, Synchronous Start, and Trigger start/stop functions.

**Table 5.21 Built-in T32A**

Channel	M3HQ	M3HP	M3HN	M3HM	M3HL
Channel 0	✓	✓	✓	✓	✓
Channel 1	✓	✓	✓	✓	✓
Channel 2	✓	✓	✓	✓	✓
Channel 3	✓	✓	✓	✓	✓
Channel 4	✓	✓	✓	✓	✓
Channel 5	✓	✓	✓	✓	✓
Channel 6	✓	✓	✓	✓	✓
Channel 7	✓	✓	✓	✓	✓

Note 1: ✓: Available, -: N/A

Note 2: External pins are not the same by product. Please refer to section "2 Pin Assignment".

### 5.22. Real Time Clock (RTC)

The RTC is a peripheral function that has a second counter, clock function, and leap-year calendar function. It also has the alarm function that generates an interrupt request on a specified time and date.

Since the RTC operates on a low-speed external oscillation clock, it can operate in low-power consumption mode such as IDLE, STOP1 or STOP2 mode according to the setting. In addition, the MCU can be returned from low-power consumption mode by an interrupt request of the RTC.

The RTC easily corrects a gain/loss of the clock caused by an error of low-speed oscillation frequency using the clock correction function.

**Table 5.22 Built-in RTC**

	M3HQ	M3HP	M3HN	M3HM	M3HL
RTC	✓	✓	✓	✓	✓

Note: ✓: Available, -: N/A

### 5.23. Clock Selective Watchdog Timer (SIWDT)

The SIWDT is a peripheral function that detects an overflow of the binary counter and generates an interrupt request or resets the MCU. This state occurs when a binary counter cannot be cleared within the preset detection time.

The count clock can be selected from three clocks: system clock ( $f_{sys}/4$ ), internal oscillator1 ( $f_{IHOSC1}$ ), or internal oscillator2 ( $f_{IHOSC2}$ ).

It also provides the count-clear window function that can clear the count only for the specified period.

Moreover, the change of a register can be forbidden until the reset starts by setting to protected mode. (the count-clear function is possible)

**Table 5.23 Built-in SIWDT**

	M3HQ	M3HP	M3HN	M3HM	M3HL
SIWDT	✓	✓	✓	✓	✓

Note: ✓: Available, -: N/A

## 5.24. Remote Control Signal Preprocessor (RMC)

The RMC is a peripheral function that receives signals excluding carrier signal from remote control reception signals. The RMC detects a leader signal to receive 72 bits data in a lump. Two data formats can be received: synchronous format and fixed-synchronous phase format.

In addition, it contains a digital noise canceller to avoid external noise.

Since the RMC operates on a low-frequency clock, it can operate in low power consumption mode, such as IDLE or STOP1 mode according to the setting (except STOP2). The MCU can also be returned from low-power consumption mode by an interrupt request of the RMC.

**Table 5.24 Built-in RMC**

Channel	M3HQ	M3HP	M3HN	M3HM	M3HL
Channel0	✓	✓	✓	✓	✓

Note: ✓: Available, -: N/A

## 5.25. CRC Calculation Circuit (CRC)

This product has the Hardware calculation circuit for CRC32 and CRC16.

It can be used for detecting a memory and communication data error.

**Table 5.25 Built-in CRC**

Channel	M3HQ	M3HP	M3HN	M3HM	M3HL
Channel 0	✓	✓	✓	✓	✓

Note: ✓: Available, -: N/A

## 5.26. RAM Parity (RAMP)

A RAM parity function generates and (8-bit unit) stores even parity data at the time of the writing to RAM, and performs a parity judging at the time of reading from RAM.

The interrupt is generated when it becomes an error by judgment. The Status and Address which the error generated are known.

A parity error is detectable in real time, since parity generating/judgment is hardware.

**Table 5.26 Built-in RAMP**

	M3HQ	M3HP	M3HN	M3HM	M3HL
RAMP	✓	✓	✓	✓	✓

Note: ✓: Available, -: N/A

## 5.27. Measures for Security Risk

### 5.27.1. Outline

TMPM3H Group(2) contains two measures for security risk to prevent unauthorized access. Table 5.27, Table 5.28 and Figure 5.1 show the assumed access paths and protection targets for each operation mode.

For more information, refer to the reference manual "Flash Memory".

(1) Security Function

The security function prohibits communication with debugging tools. It also prohibits flash writers from reading and writing to flash memory.

**Table 5.27 Access Paths and Protection Targets (1)**

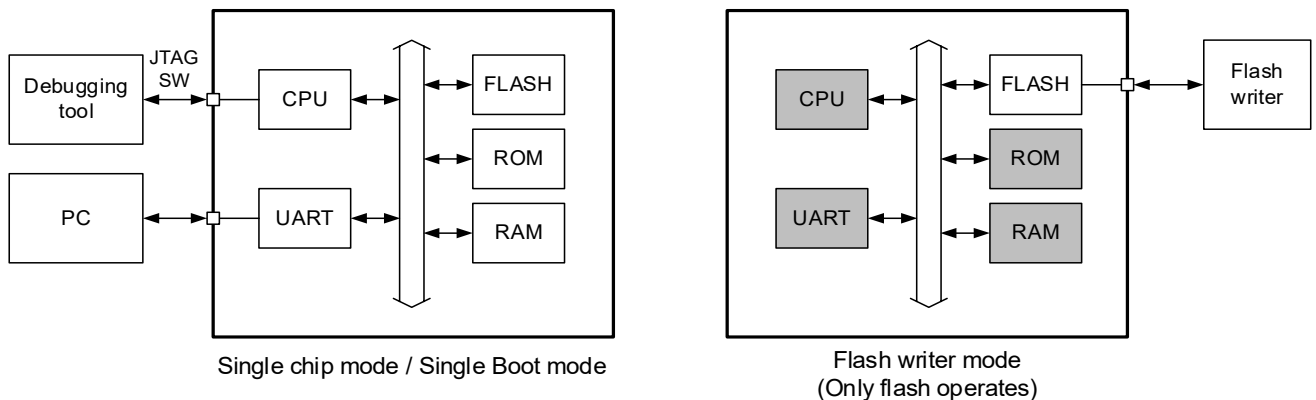
Operation mode	Access path	Protected object
Single chip mode Single Boot mode	JTAG/SW	CPU FLASH/ROM/RAM
Flash writer mode	Flash writer	FLASH

(2) Password in RAM Transfer Command

Single boot mode is operated by sending a command via UART communication. The RAM transfer command is authenticated by the password.

**Table 5.28 Access Paths and Protection Targets (2)**

Operation mode	Access path	Protected object
Single Boot mode	UART	CPU FLASH/ROM/RAM



**Figure 5.1 Measures for Security Risk**

Note) The security function does not prohibit Non Break Debug Interface (NBDIF) communication. Prohibit it with `[NBDCR0]<NB DEN>`. (It's applicable to the products with NBDIF.)

### 5.27.2. Disclaimer

Refer to "RESTRICTIONS ON PRODUCT USE" at the end of this manual.

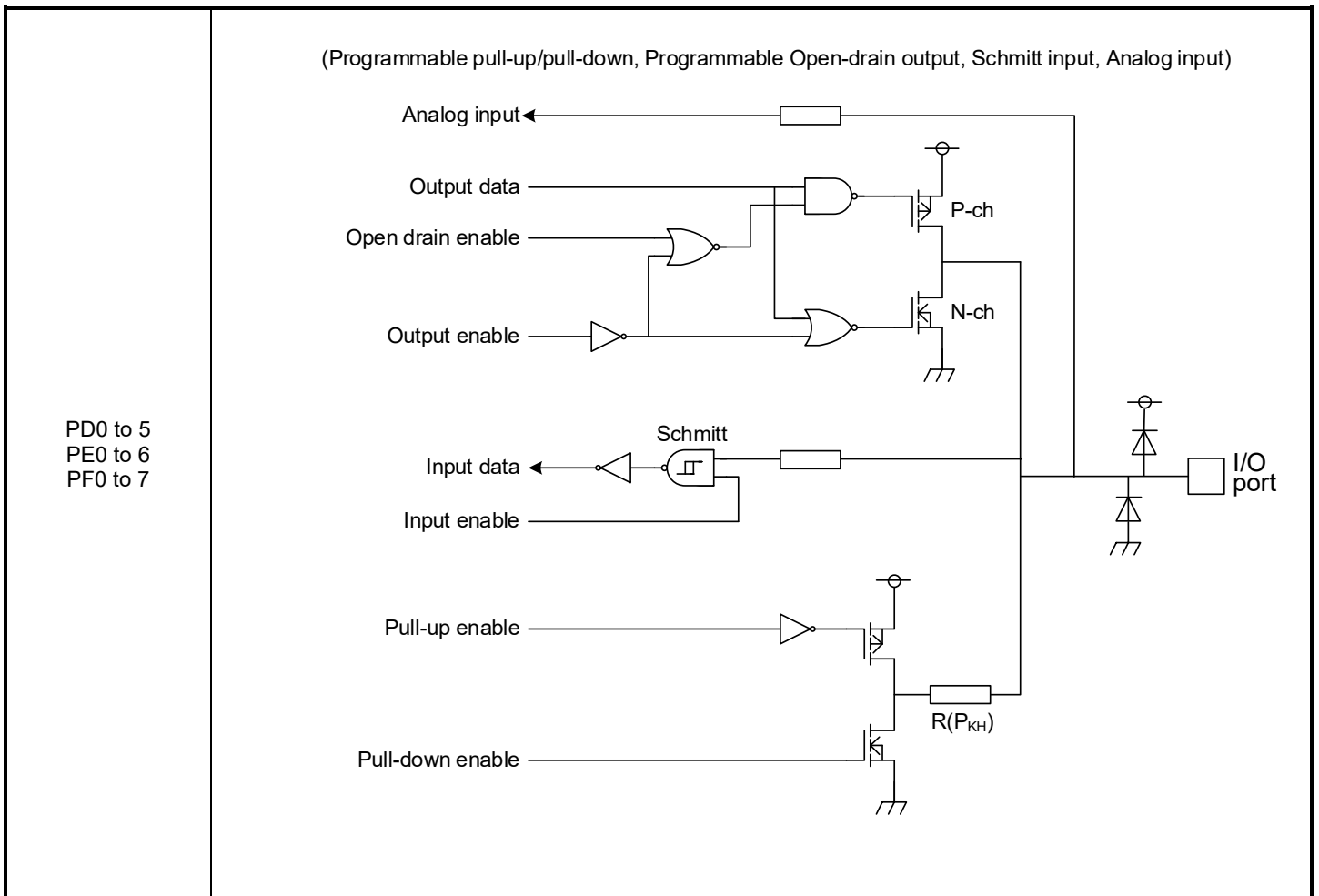
## 6. Equivalent Circuit

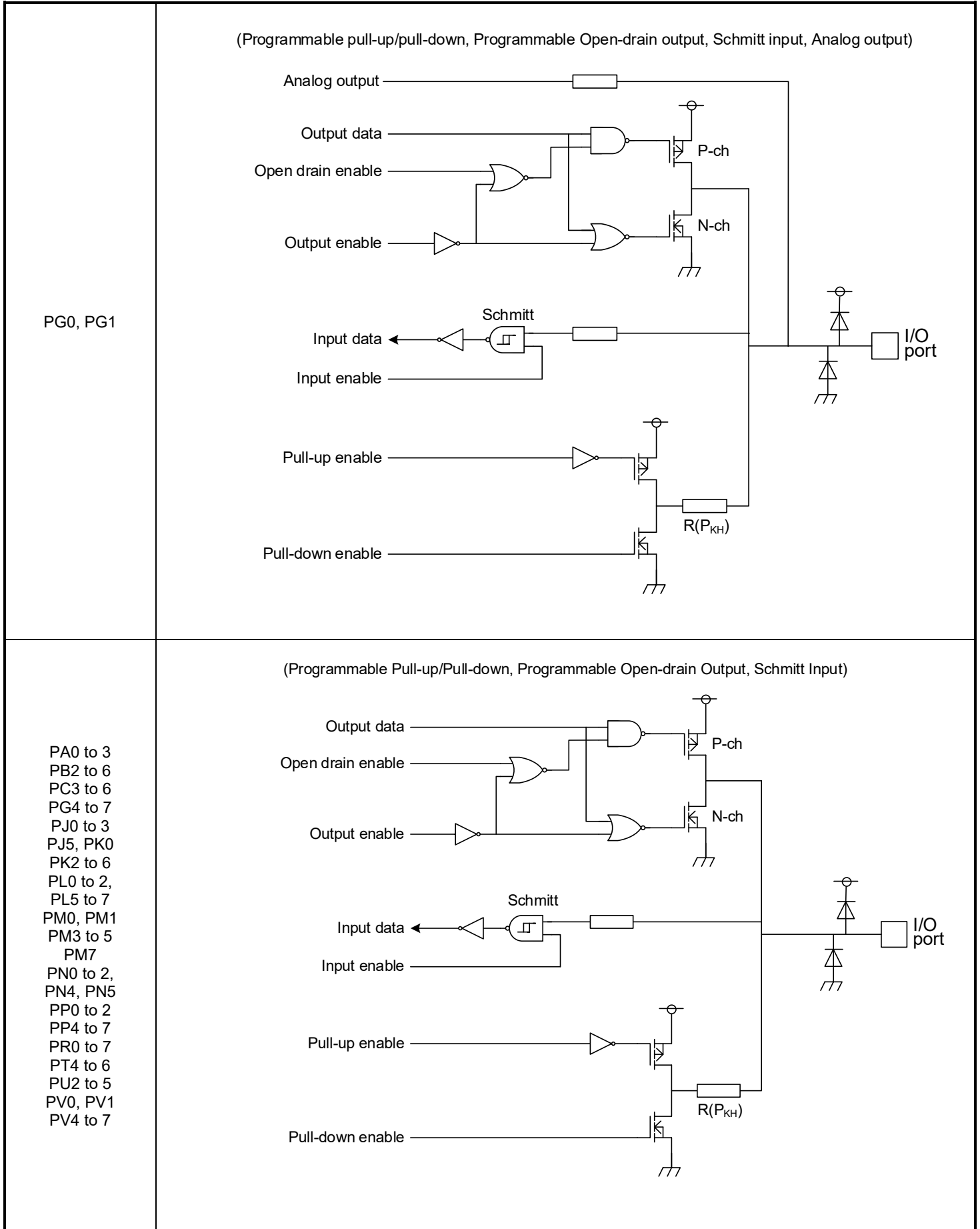
The port equivalent circuit diagram is basically written using the same gate symbol as the standard CMOS logic IC [74HCxx] series.

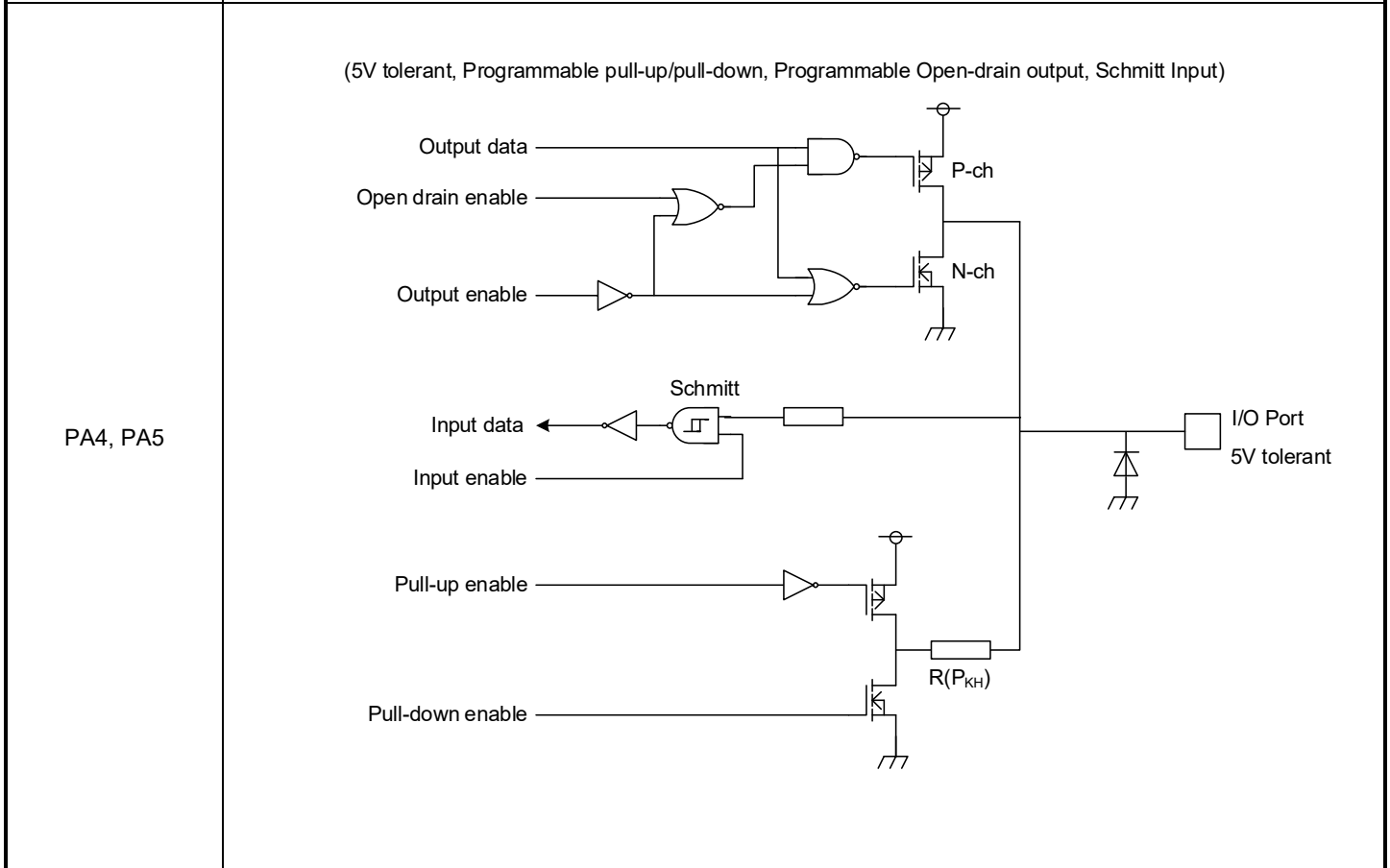
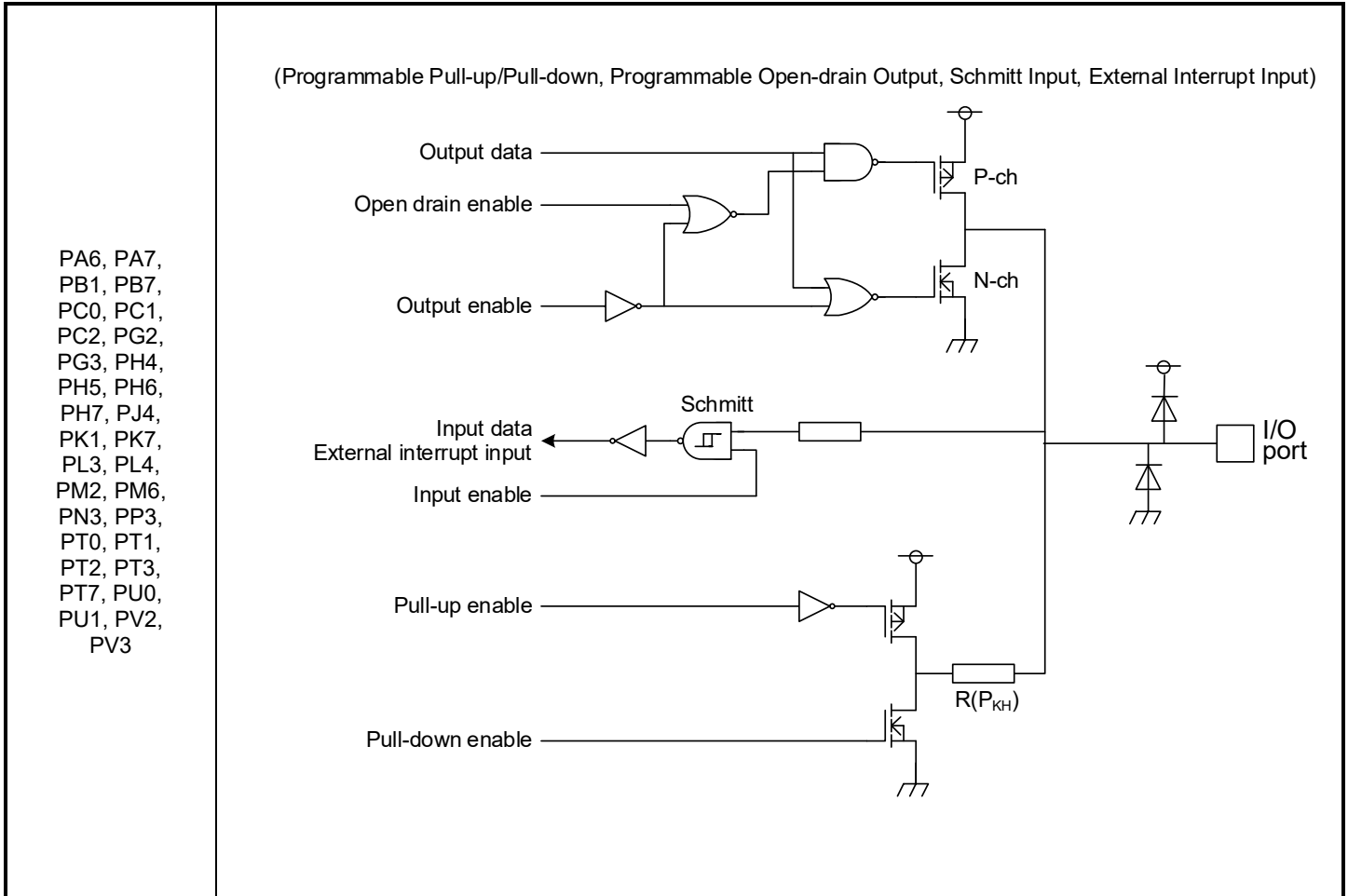
The input protection resistance ranges from several tens of  $\Omega$  to several hundred of  $\Omega$ . Damping resistor are shown with a typical value.

Note: The resistance without the statement of the numerical value in the figure shows input protection resistance.

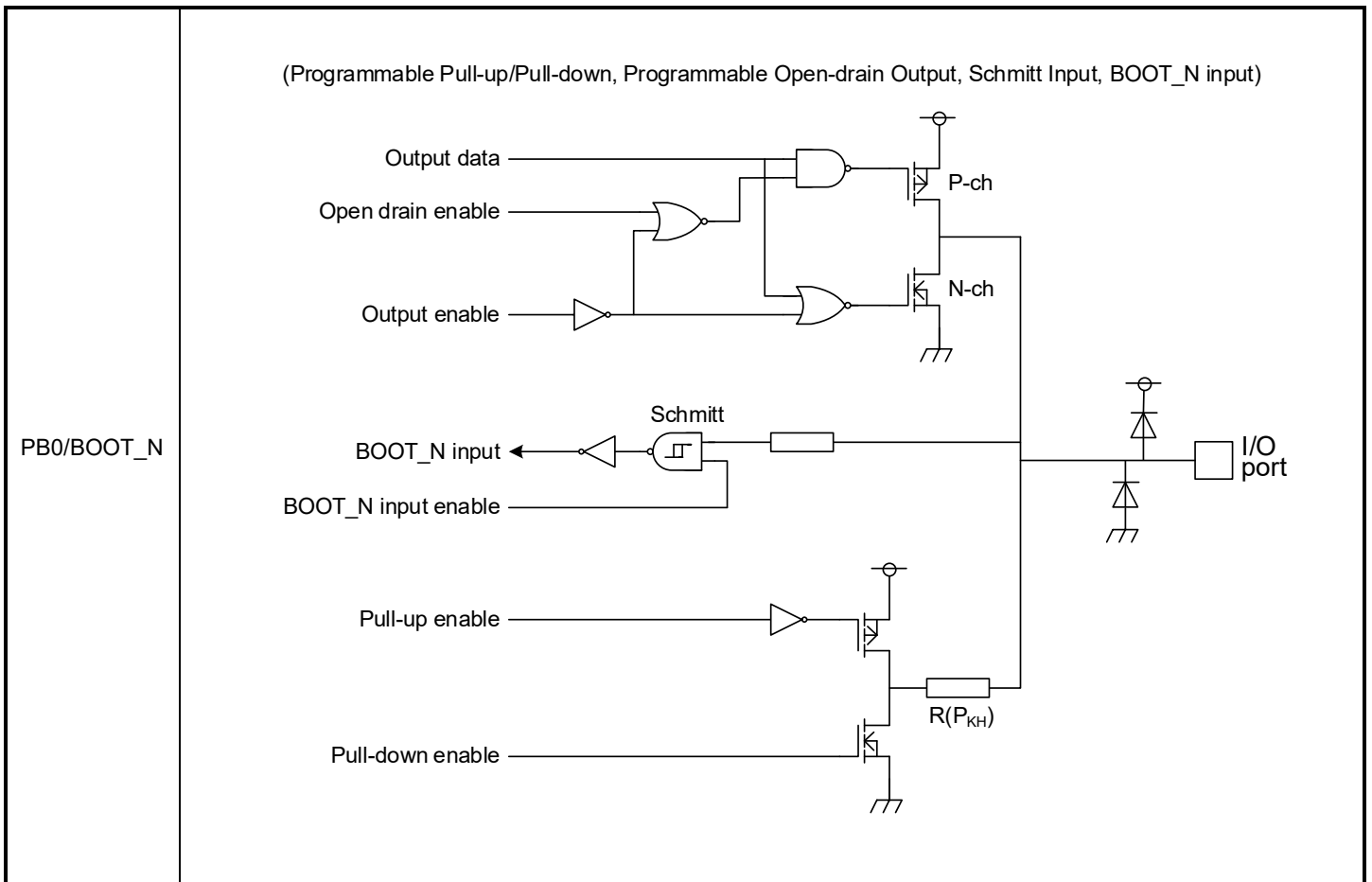
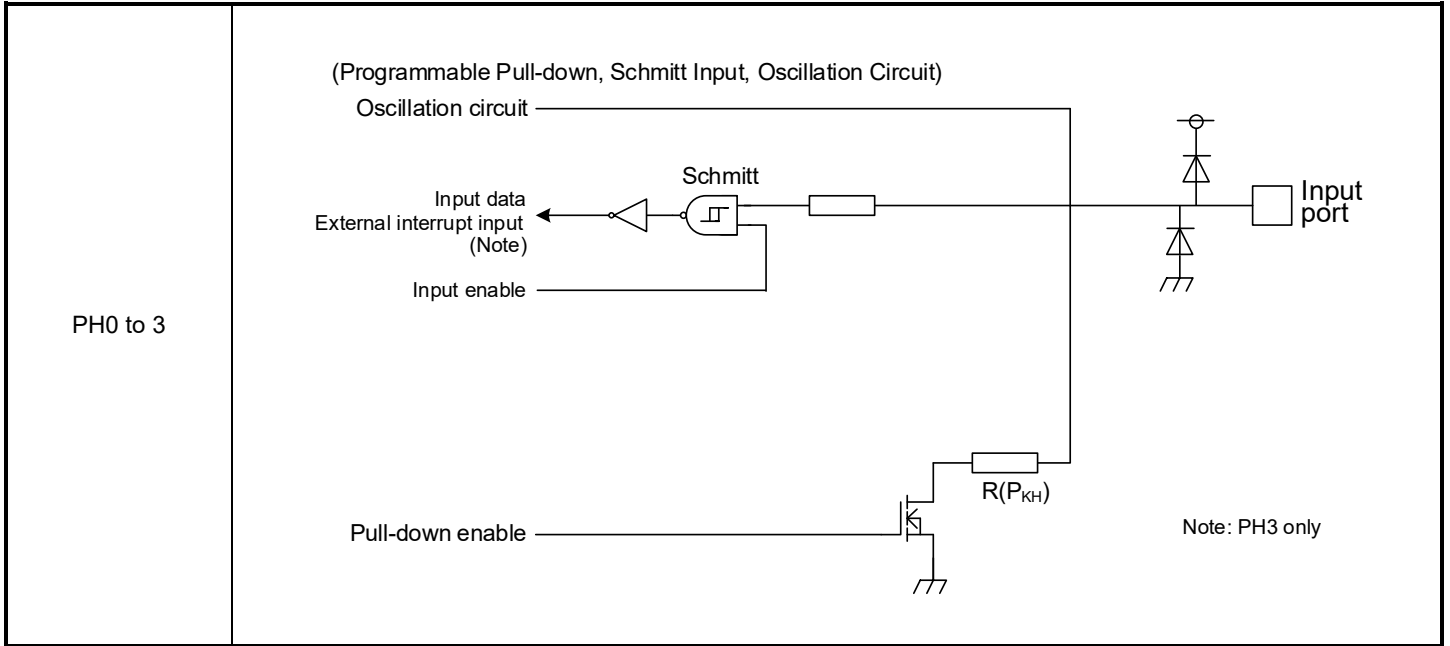
### 6.1. Port



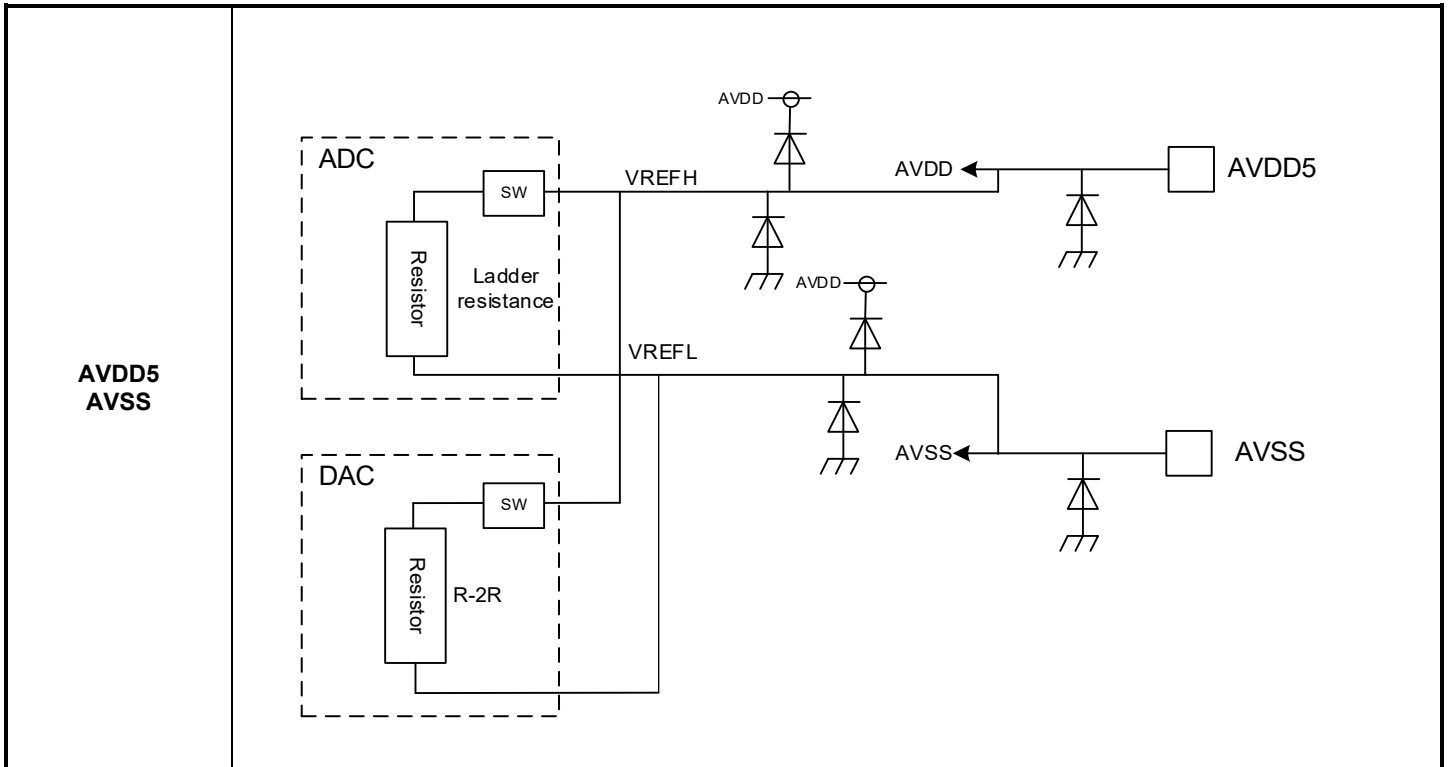






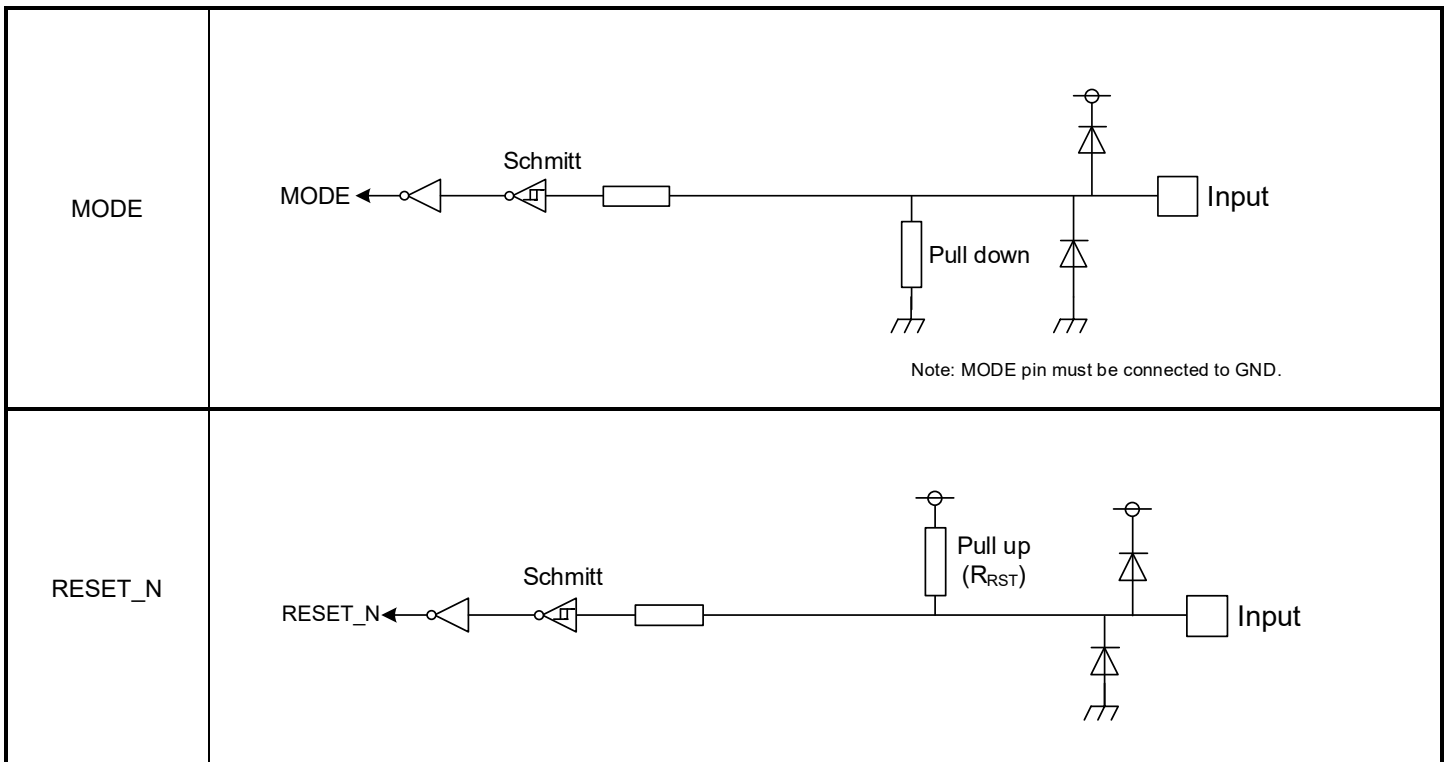


## 6.2. Analog Power Pin



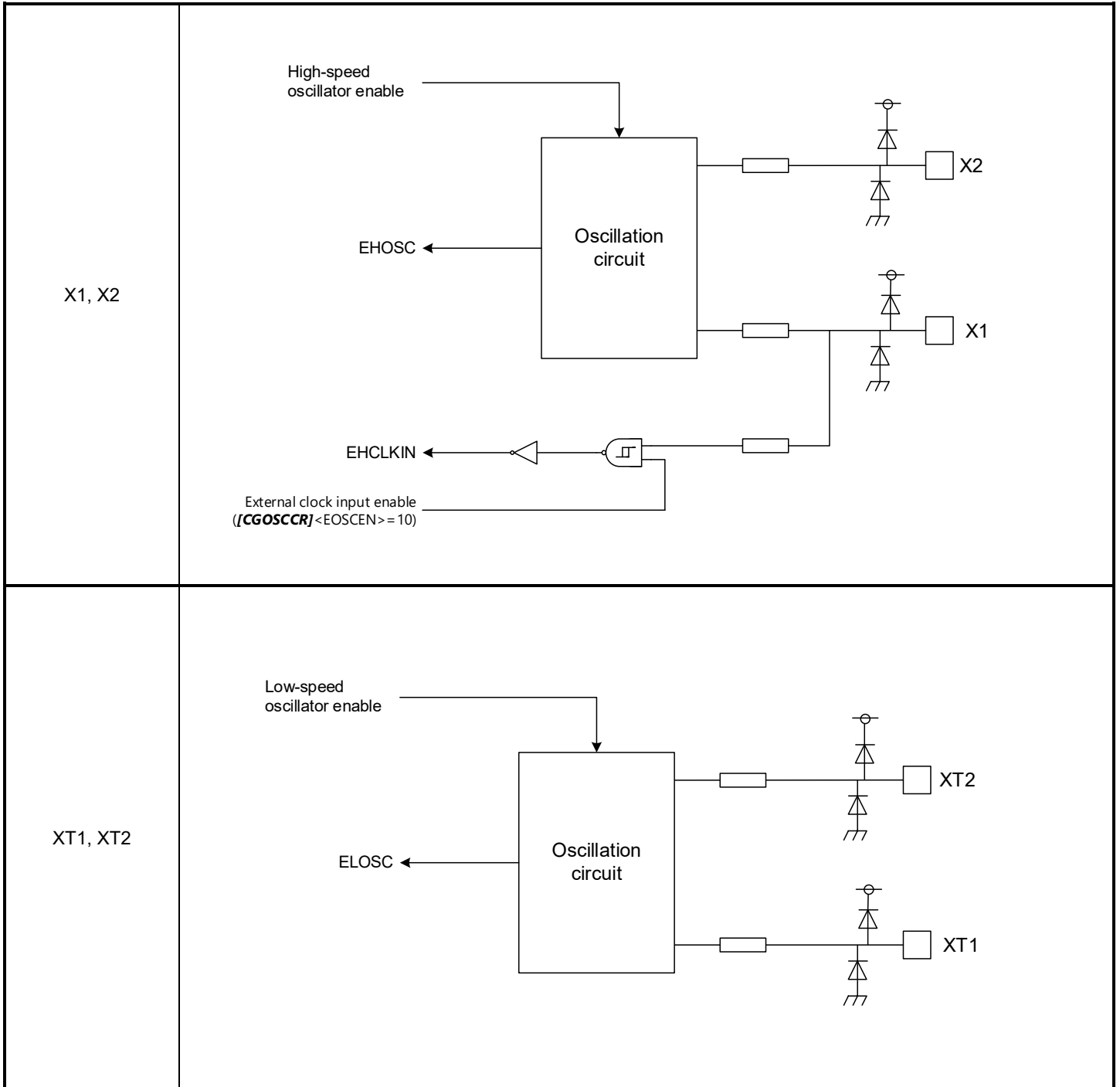
Note: SW: ON/OFF Switch Circuit

## 6.3. Control Pin



Note: MODE pin must be connected to GND.

**6.4. Clock Control**



## 7. Electrical Characteristics

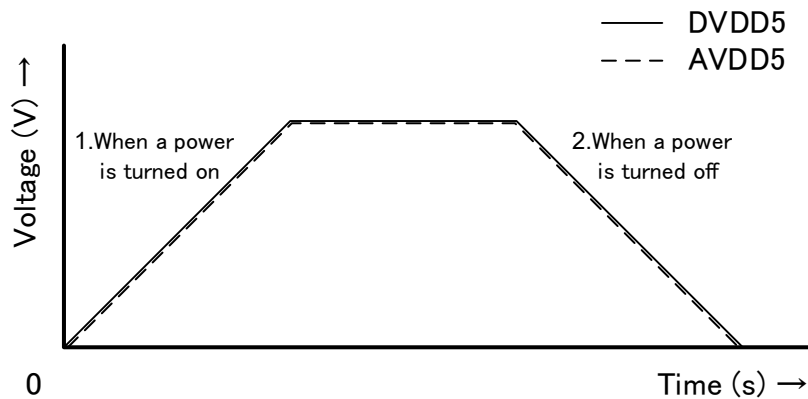
### 7.1. Absolute Maximum Ratings

Table 7.1 Absolute Maximum Ratings

Parameter		Symbol	Rating	Unit
Power supply voltage		DVDD5A DVDD5B	-0.3 to 6.0	V
		AVDD5	-0.3 to DVDD5 (Note 2)	
Capacitor pin voltage for voltage maintenance		REGOUT1	-0.3 to 1.4	V
		REGOUT2	-0.3 to 3.9	
Input voltage	PC0 to 6, PH0 to 7, PJ0 to 5, PK0 to 7, PN0 to 5, PR0 to 7, PV0 to 7, PA0 to 3, PA6, PA7, PB1 to 7, PG2 to 7, PL0 to 7, PM0 to 7, PP0 to 7, PT0 to 7, PU0 to 5, MODE, RESET_N, BOOT_N	$V_{IN1}$ $V_{IN2}$	-0.3 to DVDD5+0.3 ( $\leq 6.0V$ ) (Note 2)	V
	PD0 to 5, PE0 to 6, PF0 to 7, PG0, PG1	$V_{IN3}$	-0.3 to AVDD5+0.3 ( $\leq 6.0V$ ) (Note 2)	
	PA4 to 5	$V_{IN4}$	-0.3 to 6.0	
Low level output current	Per Pin PC0 to 6, PH4 to 7, PJ0 to 5, PK0 to 7, PN0 to 5, PR0 to 7, PV0 to 7, PA0 to 3, PA6, PA7, PB0 to 7, PG2 to 7, PL0 to 7, PM0 to 7, PP0 to 7, PT0 to 7, PU0 to 5, PD0 to 5, PE0 to 6, PF0 to 7, PG0 to 1	$I_{OL}$	5	mA
	Per Pin PA4 to 5	$I_{OL4}$	25	
	Total	$\Sigma I_{OL}$	50	
High level output current	Per pin PC0 to 6, PH4 to 7, PJ0 to 5, PK0 to 7, PN0 to 5, PR0 to 7, PV0 to 7, PA0 to 7, PB0 to 7, PG2 to 7, PL0 to 7, PM0 to 7, PP0 to 7, PT0 to 7, PU0 to 5, PD0 to 5, PE0 to 6, PF0 to 7, PG0, PG1	$I_{OH}$	-5	mA
	Total	$\Sigma I_{OH}$	-50	
Power consumption ( $T_a = 105^\circ C$ )		PD	600	mW
Soldering temperature		$T_{SOLDER}$	260	$^\circ C$
Storage temperature		$T_{STG}$	-55 to 125	$^\circ C$
Operating temperature		$T_{OPR}$	-40 to 105	$^\circ C$

Note 1: Absolute maximum ratings are limiting values of operating and environmental conditions which should not be exceeded under the worst possible conditions. The equipment manufacturer should design so that no Absolute maximum rating value is exceeded with respect to current, voltage, power consumption, temperature, etc. Exposure to conditions beyond those listed above may cause permanent damage to the device or affect device reliability, which could increase potential risks of personal injury due to IC blow up and/or burning.

Note 2: DVDD5 is a generic name for DVDD5A, DVDD5B. DVSS is a generic name for DVSSA, DVSSB. Apply the same voltage to DVDD5 and AVDD5. And refer to following description for turning-on and turning-off a power.



**Figure 7.1 Notice When Power is Turned On and Off**

1. When a power is turned on  
 Note the following:
  - A) Even if DVDD5 and AVDD5 are supplied a voltage from a same power supply, the voltage between DVDD5 and AVDD5 may have a difference by the capacity of the capacitors which are connected between DVDD5 and DVSS, and between AVSS5 and AVSS, and by the stray capacitances and inductance of PCB patterns.
  
2. When a power is turned off  
 Note the following:
  - A) Because capacitors and PCB patterns still have a residual electric charge, the voltage between DVDD5 and AVDD5 may have a difference.
  - B) A power is re-turned on in above situation.

## 7.2. DC Electrical Characteristics (1/2)

$$4.5V \leq DVDD5 = AVDD5 \leq 5.5V$$

$$DVSS = AVSS = 0V$$

$$T_a = -40 \text{ to } 105^\circ\text{C}$$

Parameter		Symbol	Conditions	Min	Typ.	Max	Unit
Power supply voltage	DVDD5A, DVDD5B, AVDD5	VDD	f <sub>osc</sub> = 6 to 12MHz f <sub>sys</sub> = 1 to 120MHz f <sub>s</sub> = 30 to 34kHz	4.5	-	5.5	V
Low level Input voltage	PC0 to 6, PH0 to 7, PJ0 to 5, PK0 to 7, PN0 to 5, PP3 to 7, PR0 to 7, PV0 to 7, MODE, RESET_N	V <sub>IL1</sub>	-	-0.3	-	DVDD5×0.25	V
	PA0 to 3, PA6 to 7, PB1 to 7, PG2 to 7, PL0 to 7, PM0 to 7, PP0 to 2, PT0 to 7, PU0 to 5, BOOT_N	V <sub>IL2</sub>					
	PD0 to 5, PE0 to 6, PF0 to 7, PG0, PG1	V <sub>IL3</sub>					
	PA4, PA5	V <sub>IL4</sub>					
High level Input voltage	PC0 to 6, PH0 to 7, PJ0 to 5, PK0 to 7, PN0 to 5, PP3 to 7, PR0 to 7, PV0 to 7, MODE, RESET_N,	V <sub>IH1</sub>	-	-	-	DVDD5×0.75	V
	PA0 to 3, PA6 to 7, PB1 to 7, PG2 to 7, PL0 to 7, PM0 to 7, PP0 to 2, PT0 to 7, PU0 to 5, BOOT_N	V <sub>IH2</sub>					
	PD0 to 5, PE0 to 6, PF0 to 7, PG0, PG1	V <sub>IH3</sub>					
	PA4, PA5	V <sub>IH4</sub>					
Low level output voltage	PC0 to 6, PH4 to 7, PJ0 to 5, PK0 to 7, PN0 to 5, PP0 to 7, PR0 to 7, PV0 to 7, PA0 to 3, PA6 to 7, PB0 to 7, PG2 to 7, PL0 to 7, PM0 to 7, PT0 to 7, PU0 to 5	V <sub>OL1</sub> V <sub>OL2</sub>	DVDD5 = 4.5V I <sub>OL</sub> = 1.6mA	-	-	0.4	V
	PD0 to 5, PE0 to 6, PF0 to 7, PG0, PG1	V <sub>OL3</sub>	AVDD5 = 4.5V I <sub>OL</sub> = 1.6mA	-	-	0.4	
	PA4, PA5	V <sub>OL4</sub>	DVDD5 = 4.5V I <sub>OL</sub> = 8mA	-	-	1.0	
High level output voltage	PC0 to 6, PH4 to 7, PJ0 to 5, PK0 to 7, PN0 to 5, PP0 to 7, PR0 to 7, PV0 to 7, PA0 to 7, PB0 to 7, PG2 to 7, PL0 to 7, PM0 to 7, PT0 to 7, PU0 to 5	V <sub>OH1</sub> V <sub>OH2</sub>	DVDD5 = 4.5V I <sub>OH</sub> = -1.6mA	DVDD5-0.4	-	-	V
	PD0 to 5, PE0 to 6, PF0 to 7, PG0, PG1	V <sub>OH3</sub>	AVDD5 = 4.5V I <sub>OH</sub> = -1.6mA	AVDD5-0.4	-	-	

Note 1: DVDD5 is a generic name for DVDD5A, DVDD5B.

Note 2: Typ. value is in T<sub>a</sub> = 25 °C, DVDD5 = AVDD5 = 5.0V, unless otherwise noted.

Note 3: Apply the same voltage to DVDD5 and AVDD5.

$$4.5V \leq DVDD5 = AVDD5 \leq 5.5V$$

$$DVSS = AVSS = 0V$$

$$T_a = -40 \text{ to } 105^\circ\text{C}$$

Parameter		Symbol	Conditions	Min	Typ.	Max	Unit
Input leak current		$I_{LI}$	$0.0V \leq V_{IN} \leq DVDD5$ $0.0V \leq V_{IN} \leq AVDD5$	-5	$\pm 0.05$	5	$\mu\text{A}$
Output leak current		$I_{LO}$	$0.2 \leq V_{IN} \leq DVDD5-0.2$ $0.2 \leq V_{IN} \leq AVDD5-0.2$	-10	$\pm 0.05$	10	
Schmitt trigger Input width		$V_{TH}$	$DVDD5 = AVDD5 = 5V$	-	1	-	V
Reset pull-up resistor		$R_{RST}$	-	25	50	100	$k\Omega$
Programmable pull-up/-down resistor		$P_{KH}$	Pull-up	25	50	100	$k\Omega$
			Pull-down	25	50	100	
Pin capacity (except power supply pin)		$C_{IO}$	$f_c = 1\text{MHz}$	-	-	10	pF
Low level output current	Per pin except below ports	$I_{OL}$	$DVDD5 = 5V$ $AVDD5 = 5V$	-	-	2 (Note 4)	mA
	Per pin PA4 to 5	$I_{OL4}$	$DVDD5 = 5V$	-	-	12 (Note 4)	
	Total of PC0 to 6, PH4 to 7, PJ0 to 5, PK0 to 7, PN0 to 5, PP3 to 7, PR0 to 7, PV0 to 7	$\sum I_{OL1}$	$DVDD5 = 5V$	-	-	35 (Note 5)	
	Total of PA0 to 7, PB0 to 7, PG2 to 7, PL0 to 7, PM0 to 7, PP0 to 2, PT0 to 7, PU0 to 5	$\sum I_{OL2}$	$DVDD5 = 5V$	-	-	35 (Note 5)	
	Total of PD0 to 5, PE0 to 6, PF0 to 7, PG0 to 1	$\sum I_{OL3}$	$AVDD5 = 5V$	-	-	20 (Note 5)	
High level output current	Per pin	$I_{OH}$	$DVDD5 = 5V$ $AVDD5 = 5V$	-2 (Note 4)	-	-	mA
	Total of PC0 to 6, PH4 to 7, PJ0 to 5, PK0 to 7, PN0 to 5, PP3 to 7, PR0 to 7, PV0 to 7	$\sum I_{OH1}$	$DVDD5 = 5V$	-35 (Note 5)	-	-	
	Total of PA0 to 7, PB0 to 7, PG2 to 7, PL0 to 7, PM0 to 7, PP0 to 2, PT0 to 7, PU0 to 5	$\sum I_{OH2}$	$DVDD5 = 5V$	-35 (Note 5)	-	-	
	Total of PD0 to 5, PE0 to 6, PF0 to 7, PG0 to 1	$\sum I_{OH3}$	$AVDD5 = 5V$	-20 (Note 5)	-	-	

Note 1: DVDD5 is a generic name for DVDD5A, DVDD5B.

Note 2: Typ. value is in  $T_a = 25^\circ\text{C}$ ,  $DVDD5 = AVDD5 = 5.0V$ , unless otherwise noted

Note 3: Apply the same voltage to DVDD5 and AVDD5.

Note 4: The current sum total of a terminal should not exceed the sum total of each group current.

Note 5: The sum total of each group current should not exceed the absolute maximum rating.

$$2.7V \leq DVDD5 = AVDD5 < 4.5V$$

$$DVSS = AVSS = 0V$$

$$T_a = -40 \text{ to } 105^\circ\text{C}$$

Parameter		Symbol	Conditions	Min	Typ.	Max	Unit		
Power supply voltage	DVDD5A, DVDD5B, AVDD5	VDD	f <sub>osc</sub> = 6 to 12MHz f <sub>sys</sub> = 1 to 120MHz f <sub>s</sub> = 30 to 34kHz	2.7	-	4.5	V		
Low level Input voltage	PC0 to 6, PH0 to 7, PJ0 to 5, PK0 to 7, PN0 to 5, PP3 to 7, PR0 to 7, PV0 to 7, MODE, RESET_N,	V <sub>IL1</sub>	-	-0.3	-	DVDD5×0.25	V		
	PA0 to 3, PA6 to 7, PB1 to 7, PG2 to 7, PL0 to 7, PM0 to 7, PP0 to 2, PT0 to 7, PU0 to 5, BOOT_N	V <sub>IL2</sub>							
	PD0 to 5, PE0 to 6, PF0 to 7, PG0, PG1	V <sub>IL3</sub>						AVDD5×0.25	
	PA4, PA5	V <sub>IL4</sub>						DVDD5×0.3	
High level Input voltage	PC0 to 6, PH0 to 7, PJ0 to 5, PK0 to 7, PN0 to 5, PP3 to 7, PR0 to 7, PV0 to 7, MODE, RESET_N	V <sub>IH1</sub>	-	DVDD5×0.75	-	DVDD5+0.3	V		
	PA0 to 3, PA6 to 7, PB1 to 7, PG2 to 7, PL0 to 7, PM0 to 7, PP0 to 2, PT0 to 7, PU0 to 5, BOOT_N	V <sub>IH2</sub>							
	PD0 to 5, PE0 to 6, PF0 to 7, PG0, PG1	V <sub>IH3</sub>						AVDD5×0.75	AVDD5+0.3
	PA4, PA5	V <sub>IH4</sub>						DVDD5×0.7	DVDD5+0.3
Low level output voltage	PC0 to 6, PH4 to 7, PJ0 to 5, PK0 to 7, PN0 to 5, PP0 to 7, PR0 to 7, PV0 to 7, PA0 to 3, PA6 to 7, PB0 to 7, PG2 to 7, PL0 to 7, PM0 to 7, PT0 to 7, PU0 to 5	V <sub>OL1</sub> V <sub>OL2</sub>	DVDD5 = 2.7V I <sub>OL</sub> = 0.8mA	-	-	0.4	V		
	PD0 to 5, PE0 to 6, PF0 to 7, PG0, PG1	V <sub>OL3</sub>	AVDD5 = 2.7V I <sub>OL</sub> = 0.8mA	-	-	0.4			
	PA4, PA5	V <sub>OL4</sub>	DVDD5 = 2.7V I <sub>OL</sub> = 4mA	-	-	1.0			
High level output voltage	PC0 to 6, PH4 to 7, PJ0 to 5, PK0 to 7, PN0 to 5, PP0 to 7, PR0 to 7, PV0 to 7, PA0 to 7, PB0 to 7, PG2 to 7, PL0 to 7, PM0 to 7, PT0 to 7, PU0 to 5	V <sub>OH1</sub> V <sub>OH2</sub>	DVDD5 = 2.7V I <sub>OH</sub> = -0.8mA	DVDD5-0.4	-	-	V		
	PD0 to 5, PE0 to 6, PF0 to 7, PG0, PG1	V <sub>OH3</sub>	AVDD5 = 2.7V I <sub>OH</sub> = -0.8mA	AVDD5-0.4	-	-			

Note 1: DVDD5 is a generic name for DVDD5A, DVDD5B.

Note 2: Typ. value is in T<sub>a</sub> = 25 °C, DVDD5 = AVDD5 = 3.0V, unless otherwise noted.

Note 3: Apply the same voltage to DVDD5 and AVDD5.



$$2.7V \leq DVDD5 = AVDD5 < 4.5V$$

$$DVSS = AVSS = 0V$$

$$T_a = -40 \text{ to } 105^\circ\text{C}$$

Parameter		Symbol	Conditions	Min	Typ.	Max	Unit
Input leak current		$I_{LI}$	$0.0V \leq V_{IN} \leq DVDD5$ $0.0V \leq V_{IN} \leq AVDD5$	-5	$\pm 0.05$	5	$\mu\text{A}$
Output leak current		$I_{LO}$	$0.2 \leq V_{IN} \leq DVDD5-0.2$ $0.2 \leq V_{IN} \leq AVDD5-0.2$	-10	$\pm 0.05$	10	
Schmitt trigger Input width		$V_{TH}$	$DVD\ D5 = AVDD5 = 3V$	-	0.5	-	V
Reset pull-up resistor		$R_{RST}$	-	25	100	200	k $\Omega$
Programmable pull-up/-down resistor		$P_{KH}$	Pull-up	25	100	200	
			Pull-down	25	100	200	
Pin capacity (except power supply pin)		$C_{IO}$	$f_c = 1\text{MHz}$	-	-	10	pF
Low level output current	Per pin (except PA4 and PA5)	$I_{OL}$	$DVDD5 = 3V$ $AVDD5 = 3V$	-	-	1 (Note 4)	mA
	Per pin PA4, PA5	$I_{OL4}$	$DVDD5 = 3V$	-	-	6 (Note 4)	
	Total of PC0 to 6, PH4 to 7, PJ0 to 5, PK0 to 7, PN0 to 5, PP3 to 7, PR0 to 7, PV0 to 7	$\sum I_{OL1}$	$DVDD5 = 3V$	-	-	18 (Note 5)	
	Total of PA0 to 7, PB0 to 7, PG2 to 7, PL0 to 7, PM0 to 7, PP0 to 2, PT0 to 7, PU0 to 5	$\sum I_{OL2}$	$DVDD5 = 3V$	-	-	18 (Note 5)	
	Total of PD0 to 5, PE0 to 6, PF0 to 7, PG0, PG1	$\sum I_{OL3}$	$AVDD5 = 3V$	-	-	10 (Note 5)	
High level output current	Per pin	$I_{OH}$	$DVDD5 = 3V$ $AVDD5 = 3V$	-1 (Note 4)	-	-	mA
	Total of PC0 to 6, PH4 to 7, PJ0 to 5, PK0 to 7, PN0 to 5, PP3 to 7, PR0 to 7, PV0 to 7	$\sum I_{OH1}$	$DVDD5 = 3V$	-18 (Note 5)	-	-	
	Total of PA0 to 7, PB0 to 7, PG2 to 7, PL0 to 7, PM0 to 7, PP0 to 2, PT0 to 7, PU0 to 5	$\sum I_{OH2}$	$DVDD5 = 3V$	-18 (Note 5)	-	-	
	Total of PD0 to 5, PE0 to 6, PF0 to 7, PG0, PG1	$\sum I_{OH3}$	$AVDD5 = 3V$	-10 (Note 5)	-	-	

Note 1: DVDD5 is a generic name for DVDD5A, DVDD5B.

Note 2: Typ. value is in  $T_a = 25^\circ\text{C}$ ,  $DVDD5 = AVDD5 = 3.0V$ , unless otherwise noted.

Note 3: Apply the same voltage to DVDD5 and AVDD5.

Note 4: The current sum total of a terminal should not exceed the sum total of each group current.

Note 5: The sum total of each group current should not exceed the absolute maximum rating.

## 7.3. DC Electrical Characteristics (2/2) (Current Consumption)

Ta = -40 to 105°C

Parameter	Symbol	Conditions					Min	Typ. (Note 2)	Max	Unit
		Supply voltage	High-speed oscillator	Low-speed oscillator	Operating condition	f <sub>sys</sub>				
Normal	I <sub>DD</sub>	DVDD5 = AVDD5 = 5.5V	Refer to Table 7.2 and Table 7.3 for detail.			80MHz	-	20	32	mA
						120MHz	-	28	43	
IDLE			Oscillation	Oscillation	Refer to Table 7.2 and Table 7.3 for detail.	80MHz	-	3.7	15.5	
						120MHz	-	5	19	
STOP1			Stop	Oscillation		-	-	230	9550	μA
STOP2		Stop	-	-		4	300			
						3	300			

Note 1: DVDD5 is a generic name for DVDD5A, DVDD5B.

Note 2: Typ. value is in Ta = 25 °C, DVDD5 = AVDD5 = 5V, unless otherwise noted.

Note 3: Apply the same voltage to DVDD5 and AVDD5.

Note 4: Input pin is fixed level, Output pin is open.

**Table 7.2 IDD Measurement Condition (Pin Setting, Oscillation Circuit)**

		NORMAL	IDLE	STOP1	STOP2		
					ELOSC run		ELOSC stop
Pin setting	DVDD5 = AVDD5	5.0V (Typ.), 5.5V (max)					
	X1, X2	Oscillator connected (10MHz)					
	XT1, XT2	Oscillator connected (32.768kHz)					
	Input pins	Fixed					
	Output pins	Open					
Operating condition (Oscillation Circuit)	System clock (f <sub>sys</sub> )	80MHz, 120MHz	Stop				
	External High speed frequency oscillator (EHOSC)	Oscillation	Stop				
	Internal High speed frequency oscillator (IHOSC1)	Stop					
	PLL	run (8 or 12 times)	Stop				
	External Low speed oscillator (ELOSC)	Oscillation				Stop	

**Table 7.3 IDD Measurement Condition (CPU, Peripheral)**

Peripheral	unit number	NORMAL	IDLE	STOP1	STOP2
				LOSC oscillation	LOSC stop
CPU	1	Run (Dhrystone Ver.2.1)		Stop	
DMAC	1	(Request from UARTch0 Transmission, destination: RAM)		Stop	
ADC	1	Run (1.5 $\mu$ s, Repeated conversion)		Stop	
DAC	2	Run		Stop	
T32A	6	All ch: Run		Stop	
A-PMD	1	Run		Stop	
A-ENC32	1	Run		Stop	
RTC	1	Run			
SIWDT	1	Run		Stop	
UART	8	All ch: Transmission (2.5Mbps)		Stop	
I2C/EI2C	4/4	Stop			
TSPI	5	Ch0, ch1: Transmission, 20MHz		Stop	
RMC	1	Run		Stop	
DLCD	1	Stop			
LVD	1	Stop			
OFD	1	Stop			
Input Output Port	-	Run		Stop	

## 7.4. 12-bit AD Converter Characteristics

$$DVDD5 = AVDD5 = 2.7 \text{ to } 5.5\text{V}$$

$$DVSS = AVSS = 0\text{V}$$

$$T_a = -40 \text{ to } 105^\circ\text{C}$$

Parameter	Symbol	Conditions	Min	Typ.	Max	Unit
Analog reference voltage (+)	VREFH (AVDD5)		-	AVDD5	-	V
Analog input voltage	VAIN		AVSS (VREFL)	-	AVDD5 (VREFH)	V
Integral nonlinearity error (INL)	-	2.7V ≤ AVDD5 ≤ 5.5V AIN load resistor = 600Ω AIN load capacity ≥ 0.1μF Conversion time = 1.0 to 16.65μs	-5.0	-	+5.0	LSB
Differential nonlinearity error (DNL)			-2.0	-	+4.0	
Zero-scale error			-5.0	-	+3.0	
Full-scale error			-4.5	-	+3.0	
Total errors			-7.0	-	+6.0	
Stable time	t <sub>sta</sub>	After [ADM00]<DACON> is set to "1".	3	-	-	μs
Conversion time	t <sub>conv</sub>	4.5V ≤ AVDD5 ≤ 5.5V SCLK = 30MHz (Note 3)	1.0	-	10.87	
		4.5V ≤ AVDD5 ≤ 5.5V SCLK = 20MHz (Note 3)	1.5	-	16.3	
		2.7V ≤ AVDD5 < 4.5V SCLK = 20MHz (Note 3)	2.05	-	16.65	

Note 1: 1LSB = (AVDD5 (VREFH) - AVSS (VREFL)) / 4096[V]

Note 2: The characteristic when a single unit AD converter operates only.

Note 3: For detail of setting, refer to the reference manual "Analog to Digital Converter".

## 7.5. 8-bit DA Converter Characteristics

$$DVDD5 = AVDD5 = 2.7 \text{ to } 5.5\text{V}$$

$$DVSS = AVSS = 0\text{V}$$

$$T_a = -40 \text{ to } 105^\circ\text{C}$$

Parameter	Symbol	Conditions	Min	Typ.	Max	Unit
Analog reference voltage (+)	VREFH (AVDD5)		-	AVDD5	-	V
Integral nonlinearity error (INL)	-	4.5V ≤ AVDD5 ≤ 5.5V Rload = 10MΩ	-1	-	+1	LSB
Differential nonlinearity error (DNL)			-1	-	+1	
Total errors			-1	-	+1	
Integral nonlinearity error (INL)	-	2.7V ≤ AVDD5 < 4.5V Rload = 10MΩ	-2	-	+2	LSB
Differential nonlinearity error (DNL)			-1	-	+1	
Total errors			-2	-	+2	
Stable time	t <sub>sta</sub>	Cload = 20pF	4.7	-	-	μs

Note 1: DVDD5 is a generic name for DVDD5A, DVDD5B.

Note 2: Typ. value is in T<sub>a</sub> = 25 °C, DVDD5 = AVDD5 = 5.0V or T<sub>a</sub> = 25 °C, DVDD5 = AVDD5 = 3.0V, unless otherwise noted.

Note 3: 1LSB = (AVDD5 (VREFH) - AVSS (VREFL)) / 256 [V]

Note 4: This is the characteristic in case only DA converter is operating.

Note 5: When using DAC0 as the reference voltage of Comparator, DAC0 pin should be open.

## 7.6. Comparator Characteristics

$$DVDD5 = AVDD5 = 2.7 \text{ to } 5.5\text{V}$$

$$DVSS = AVSS = 0\text{V}$$

$$T_a = -40 \text{ to } 105^\circ\text{C}$$

Parameter	Symbol	Conditions	Min	Typ.	Max	Unit
AIN Input voltage Range	VINC	-	VREFC - 1.5	-	VREFC + 1.5	V
Reference Voltage Range (Note 1)	VREFC		0.2	-	AVDD5-0.5	V
Response time (Note 2)	-		-	-	0.5	μs
Comparator Start-up time	T <sub>sta</sub>		-	-	5	μs

Note 1: Output of On-chip 8-bit DA converter (DAC0)

Note 2: In case of the VINC change from VREFC - 100mV to VREFC + 100mV, or from VREFC + 100mV to VREFC - 100mV.

Note 3: This is the characteristic in case only Comparator is operation.

## 7.7. Characteristics of Internal Processing at RESET

DVSS = AVSS = 0V

Ta = -40 to 105°C

Parameter	Symbol	Conditions	Min	Typ.	Max	Unit	
Internal initialization time	t <sub>INIT</sub>	Power-on	-	-	1.96	ms	
Internal processing time for Reset	t <sub>IRST</sub>	STOP2 released by RESET with RESET_N or LVD.	-	-	1.65		
		STOP2 released by Interrupt	-	-	1.06		
Waiting time till CPU running (Note)	t <sub>CPUWT</sub>	Reset operation except STOP2 releasing	0.15	-	0.18	μs	
		Power-on Reset operation by LVD in STOP1 or STOP2 mode Reset operation by RESET_N pin in STOP1 or STOP2 mode	12	-	15		
Power gradient	V <sub>PON</sub>	Rising slope	0.3	-	100		mV/μs
	V <sub>POFF</sub>	Falling slope	-	-	10		

Note: Except reset operation by WDT, OFD, LOCKUP, or SYSRESET, when reset factor continues, t<sub>CPUWT</sub> (Waiting time till CPU running) starts measuring elapse time after releasing this factor.

## 7.8. Characteristics of Power-on Reset

DVSS = AVSS = 0V

Ta = -40 to 105°C

Parameter	Symbol	Conditions	Min	Typ.	Max	Unit
Detection voltage	V <sub>PREL</sub>	Power-up	2.22	2.33	2.44	V
	V <sub>PDET</sub>	Power-down	2.17	2.28	2.39	
Detection pulse width	T <sub>PDET</sub>	-	200	-	-	μs

## 7.9. Characteristics of PORF

DVSS = AVSS = 0V

Ta = -40 to 105°C

Parameter	Symbol	Conditions	Min	Typ.	Max	Unit
Detection voltage	V <sub>PORFL</sub>	Power-up	2.57	2.64	2.71	V
	V <sub>PORFD</sub>	Power-down	2.52	2.59	2.66	
Detection pulse width	T <sub>PDET</sub>	-	200	-	-	μs

## 7.10. Characteristics of Voltage Detection Circuit

DVDD5 = AVDD5 = 2.7 to 5.5V

DVSS = AVSS = 0V

Ta = -40 to 105°C

Parameter	Symbol	Conditions	Min	Typ.	Max	Unit	
Detection voltage	V <sub>LVL0</sub>	Power-up (releasing)	2.63	2.70	2.77	V	
		Power-down (detecting)	2.58	2.65	2.72		
	V <sub>LVL1</sub>	Power-up (releasing)	2.68	2.75	2.82	V	
		Power-down (detecting)	2.63	2.70	2.77		
	V <sub>LVL2</sub>	Power-up (releasing)	2.78	2.85	2.92	V	
		Power-down (detecting)	2.73	2.80	2.87		
	V <sub>LVL3</sub>	Power-up (releasing)	2.88	2.95	3.02	V	
		Power-down (detecting)	2.83	2.90	2.97		
	V <sub>LVL4</sub>	Power-up (releasing)	3.96	4.05	4.14	V	
		Power-down (detecting)	3.91	4.00	4.09		
	V <sub>LVL5</sub>	Power-up (releasing)	4.16	4.25	4.34	V	
		Power-down (detecting)	4.11	4.20	4.29		
	V <sub>LVL6</sub>	Power-up (releasing)	4.36	4.45	4.54	V	
		Power-down (detecting)	4.31	4.40	4.49		
	V <sub>LVL7</sub>	Power-up (releasing)	4.56	4.65	4.74	V	
		Power-down (detecting)	4.51	4.60	4.69		
	Detection response time	t <sub>VDDT1</sub>	Power-down	-	-	100	μs
	Detection release time	t <sub>VDDT2</sub>	Power-up	-	-	100	
Setup time	t <sub>LV DEN</sub>		-	-	100		
Detection minimum pulse width	t <sub>LVDPW</sub>		200	-	-		

## 7.11. AC Electrical Characteristics

### 7.11.1. Serial Peripheral Interface (TSPI)

#### 7.11.1.1. AC Measurement Conditions

The AC characteristics are the result under the measurement conditions below:

- DVDD5 = AVDD5 = 2.7 to 5.5V
- Ta = -40 to 105°C
- Output level: High =  $0.8 \times DVDD5$ , Low =  $0.2 \times DVDD5$
- Input level: High =  $0.75 \times DVDD5$ , Low =  $0.25 \times DVDD5$
- Load capacity: CL = 30pF

Note: DVDD5 is a generic name for DVDD5A, DVDD5B.

#### 7.11.1.2. AC Electrical Characteristics

"T" indicates an operation clock cycle of the TSPI. This operation clock has the same cycle of the system clock (fsys). This cycle depends on the clock gear setting.

The number of cycles can be 1 to 16. It is specified with TSPIxSCK. The value of k1 is specified with  $[TSPIxFMTR0]<CSSCKDL[3:0]>$ ; the value of k2 is specified with  $[TSPIxFMTR0]<SCKCSDL[3:0]>$ .

<RXDLY> is added setting value of  $[TSPIxCR2]<RXDLY[2:0]>$  with 1.

- <RXDLY> = 1 when  $[TSPIxCR2]<RXDLY[2:0]> = 000$
- <RXDLY> = 2 when  $[TSPIxCR2]<RXDLY[2:0]> = 001$
- <RXDLY> = 3 when  $[TSPIxCR2]<RXDLY[2:0]> = 010$



(1) Master in SPI mode (TSPI1/2/3/4)

4.5V ≤ DVDD5 = AVDD5 ≤ 5.5V

Parameter	Symbol	Equation		fsys = 80MHz k1 = k2 = 1		Unit
		Min	Max	Min	Max	
TSPIxSCK output frequency	f <sub>CYC</sub>	-	20	-	20	MHz
TSPIxSCK output cycle	t <sub>CYC</sub>	50	-	50	-	ns
TSPIxSCK low level output pulse width	t <sub>WL</sub>	(t <sub>CYC</sub> /2)-13	-	12	-	
TSPIxSCK high level output pulse width	t <sub>WH</sub>	(t <sub>CYC</sub> /2)-13	-	12	-	
TSPIxCSn output ← TSPIxSCK rise/fall time	t <sub>CSU</sub>	(t <sub>CYC</sub> ×k1)-20	(t <sub>CYC</sub> ×k1)+9	30	59	
TSPIxSCK rise/fall → TSPIxCSn hold time	t <sub>CHD</sub>	(t <sub>CYC</sub> ×(k2+0.5))-20	-	55	-	
TSPIxRXD Input ← TSPIxSCK rise/fall time	t <sub>DSU</sub>	35-<RXDLY>×T	-	10	-	
TSPIxSCK rise/fall → TSPIxRXD hold time	t <sub>DHD</sub>	<RXDLY>×T-10.5	-	14.5	-	
TSPIxSCK rise/fall → TSPIxTXD delay time	t <sub>ODLY1</sub>	-18	-	-18	-	
TSPIxSCK rise/fall → TSPIxTXD delay time	t <sub>ODLY2</sub>	-	16	-	16	
TSPIxCSn fall → TSPIxTXD delay time	t <sub>ODLY3</sub>	(t <sub>CYC</sub> ×(k1-0.5))-25	(t <sub>CYC</sub> ×(k1-0.5))+9	0	34	

2.7V ≤ DVDD5 = AVDD5 < 4.5V

Parameter	Symbol	Equation		fsys = 80MHz k1 = k2 = 1		Unit
		Min	Max	Min	Max	
TSPIxSCK output frequency	f <sub>CYC</sub>	-	20	-	20	MHz
TSPIxSCK output cycle	t <sub>CYC</sub>	50	-	50	-	ns
TSPIxSCK low level output pulse width	t <sub>WL</sub>	(t <sub>CYC</sub> /2)-16	-	9	-	
TSPIxSCK high level output pulse width	t <sub>WH</sub>	(t <sub>CYC</sub> /2)-16	-	9	-	
TSPIxCSn output ← TSPIxSCK rise/fall time	t <sub>CSU</sub>	(t <sub>CYC</sub> ×k1)-20	(t <sub>CYC</sub> ×k1)+11	30	61	
TSPIxSCK rise/fall → TSPIxCSn hold time	t <sub>CHD</sub>	(t <sub>CYC</sub> ×(k2+0.5))-22.5	-	52.5	-	
TSPIxRXD Input ← TSPIxSCK rise/fall time	t <sub>DSU</sub>	45-<RXDLY>×T	-	20	-	
TSPIxSCK rise/fall → TSPIxRXD hold time	t <sub>DHD</sub>	<RXDLY>×T-10.5	-	14.5	-	
TSPIxSCK rise/fall → TSPIxTXD delay time	t <sub>ODLY1</sub>	-18	-	-18	-	
TSPIxSCK rise/fall → TSPIxTXD delay time	t <sub>ODLY2</sub>	-	16	-	16	
TSPIxCSn fall → TSPIxTXD delay time	t <sub>ODLY3</sub>	(t <sub>CYC</sub> ×(k1-0.5))-25	(t <sub>CYC</sub> ×(k1-0.5))+13	0	38	

(2) Master in SPI mode (TSPI0)

$$4.5V \leq DVDD5 = AVDD5 \leq 5.5V$$

Parameter	Symbol	Equation		fsys = 80MHz k1 = k2 = 1		Unit
		Min	Max	Min	Max	
TSPIxSCK output frequency	f <sub>CYC</sub>	-	5.88	-	5.88	MHz
TSPIxSCK output cycle	t <sub>CYC</sub>	170	-	170	-	ns
TSPIxSCK low level output pulse width	t <sub>WL</sub>	(t <sub>CYC</sub> /2)-13	-	72	-	
TSPIxSCK high level output pulse width	t <sub>WH</sub>	(t <sub>CYC</sub> /2)-13	-	72	-	
TSPIxCSn output ← TSPIxSCK rise/fall time	t <sub>CSU</sub>	(t <sub>CYC</sub> ×k1)-140	(t <sub>CYC</sub> ×k1)+9	30	179	
TSPIxSCK rise/fall → TSPIxCSn hold time	t <sub>CHD</sub>	(t <sub>CYC</sub> ×(k2+0.5))-20	-	235	-	
TSPIxRXD Input ← TSPIxSCK rise/fall time	t <sub>DSU</sub>	35-<RXDLY>×T	-	10	-	
TSPIxSCK rise/fall → TSPIxRXD hold time	t <sub>DHD</sub>	<RXDLY>×T-10.5	-	14.5	-	
TSPIxSCK rise/fall → TSPIxTXD delay time	t <sub>ODLY1</sub>	-18	-	-18	-	
TSPIxSCK rise/fall → TSPIxTXD delay time	t <sub>ODLY2</sub>	-	16	-	16	
TSPIxCSn fall → TSPIxTXD delay time	t <sub>ODLY3</sub>	(t <sub>CYC</sub> ×(k1-0.5))-145	(t <sub>CYC</sub> ×(k1-0.5))+9	-60	94	

$$2.7V \leq DVDD5 = AVDD5 < 4.5V$$

Parameter	Symbol	Equation		fsys = 80MHz k1 = k2 = 1		Unit
		Min	Max	Min	Max	
TSPIxSCK output frequency	f <sub>CYC</sub>	-	4.34	-	4.34	MHz
TSPIxSCK output cycle	t <sub>CYC</sub>	230	-	230	-	ns
TSPIxSCK low level output pulse width	t <sub>WL</sub>	(t <sub>CYC</sub> /2)-16	-	99	-	
TSPIxSCK high level output pulse width	t <sub>WH</sub>	(t <sub>CYC</sub> /2)-16	-	99	-	
TSPIxCSn output ← TSPIxSCK rise/fall time	t <sub>CSU</sub>	(t <sub>CYC</sub> ×k1)-200	(t <sub>CYC</sub> ×k1)+9	30	239	
TSPIxSCK rise/fall → TSPIxCSn hold time	t <sub>CHD</sub>	(t <sub>CYC</sub> ×(k2+0.5))-20	-	325	-	
TSPIxRXD Input ← TSPIxSCK rise/fall time	t <sub>DSU</sub>	45-<RXDLY>×T	-	20	-	
TSPIxSCK rise/fall → TSPIxRXD hold time	t <sub>DHD</sub>	<RXDLY>×T-10.5	-	14.5	-	
TSPIxSCK rise/fall → TSPIxTXD delay time	t <sub>ODLY1</sub>	-18	-	-18	-	
TSPIxSCK rise/fall → TSPIxTXD delay time	t <sub>ODLY2</sub>	-	16	-	16	
TSPIxCSn fall → TSPIxTXD delay time	t <sub>ODLY3</sub>	(t <sub>CYC</sub> ×(k1-0.5))-211	(t <sub>CYC</sub> ×(k1-0.5))+13	-96	128	

(3) Slave in SPI mode (TSPI0/1/2/3/4)

4.5V ≤ DVDD5 = AVDD5 ≤ 5.5V

Parameter	Symbol	Equation		fsys = 80MHz		Unit
		Min	Max	Min	Max	
TSPIxSCK input frequency	f <sub>CYC</sub>	-	10	-	10	MHz
TSPIxSCK input cycle	t <sub>CYC</sub>	100	-	100	-	ns
TSPIxSCK low level input pulse width	t <sub>WL</sub>	37	-	37	-	
TSPIxSCK high level input pulse width	t <sub>WH</sub>	37	-	37	-	
TSPIxCSIN input (1st edge) ← TSPIxSCK rise/fall time	t <sub>CSU1</sub>	170	-	170	-	
TSPIxCSIN input (2nd edge) ← TSPIxSCK rise/fall time	t <sub>CSU2</sub>	80	-	80	-	
TSPIxSCK rise/fall → TSPIxCSIN hold time (1st edge)	t <sub>CHD</sub>	80	-	80	-	
TSPIxSCK rise/fall → TSPIxCSIN hold time (2nd edge)		7	-	7	-	
TSPIxRXD Input ← TSPIxSCK rise/fall time	t <sub>DSU</sub>	7	-	7	-	
TSPIxSCK rise/fall → TSPIxRXD hold time	t <sub>DHD</sub>	10	-	10	-	
TSPIxSCK rise/fall → TSPIxTXD delay time	t <sub>ODLY1</sub>	0	-	0	-	
TSPIxSCK rise/fall → TSPIxTXD delay time	t <sub>ODLY2</sub>	-	49	-	49	
TSPIxCSIN fall → TSPIxTXD delay time	t <sub>ODLY3</sub>	-	55	-	55	
TSPIxCSIN high level input pulse width (1st edge)	t <sub>WDIS</sub>	T×5+20	-	82.5	-	
TSPIxCSIN high level input pulse width (2nd edge)		T×2+20	-	45	-	

2.7V ≤ DVDD5 = AVDD5 < 4.5V

Parameter	Symbol	Equation		fsys = 80MHz		Unit
		Min	Max	Min	Max	
TSPIxSCK input frequency	f <sub>CYC</sub>	-	10	-	10	MHz
TSPIxSCK input cycle	t <sub>CYC</sub>	100	-	100	-	ns
TSPIxSCK low level input pulse width	t <sub>WL</sub>	37	-	37	-	
TSPIxSCK high level input pulse width	t <sub>WH</sub>	37	-	37	-	
TSPIxCSIN input (1st edge) ← TSPIxSCK rise/fall time	t <sub>CSU1</sub>	170	-	170	-	
TSPIxCSIN input (2nd edge) ← TSPIxSCK rise/fall time	t <sub>CSU2</sub>	80	-	80	-	
TSPIxSCK rise/fall → TSPIxCSIN hold time (1st edge)	t <sub>CHD</sub>	80	-	80	-	
TSPIxSCK rise/fall → TSPIxCSIN hold time (2nd edge)		7	-	7	-	
TSPIxRXD Input ← TSPIxSCK rise/fall time	t <sub>DSU</sub>	7	-	7	-	
TSPIxSCK rise/fall → TSPIxRXD hold time	t <sub>DHD</sub>	10	-	10	-	
TSPIxSCK rise/fall → TSPIxTXD delay time	t <sub>ODLY1</sub>	0	-	0	-	
TSPIxSCK rise/fall → TSPIxTXD delay time	t <sub>ODLY2</sub>	-	55	-	55	
TSPIxCSIN fall → TSPIxTXD delay time	t <sub>ODLY3</sub>	-	55	-	55	
TSPIxCSIN high level input pulse width (1st edge)	t <sub>WDIS</sub>	T×5+20	-	82.5	-	
TSPIxCSIN high level input pulse width (2nd edge)		T×2+20	-	45	-	

(4) Master in SIO Mode (TSPI0/1/2/3/4)

4.5V ≤ DVDD5 = AVDD5 ≤ 5.5V

Parameter	Symbol	Equation		fsys = 80MHz		Unit
		Min	Max	Min	Max	
TSPIxSCK output frequency	f <sub>CYC</sub>	-	20	-	20	MHz
TSPIxSCK output cycle	t <sub>CYC</sub>	50	-	50	-	ns
TSPIxSCK low level output pulse width	t <sub>WL</sub>	(t <sub>CYC</sub> /2)-13	-	12	-	
TSPIxSCK high level output pulse width	t <sub>WH</sub>	(t <sub>CYC</sub> /2)-13	-	12	-	
TSPIxRXD input ← TSPIxSCK rise/fall time	t <sub>DSU</sub>	35-<RXDLY>×T	-	10	-	
TSPIxSCK rise/fall → TSPIxRXD hold time	t <sub>DHD</sub>	<RXDLY>×T-10.5	-	14.5	-	
TSPIxSCK rise/fall → TSPIxTXD delay time	t <sub>ODLY1</sub>	-18	-	-18	-	
TSPIxSCK rise/fall → TSPIxTXD delay time	t <sub>ODLY2</sub>	-	16	-	16	

2.7V ≤ DVDD5 = AVDD5 < 4.5V

Parameter	Symbol	Equation		fsys = 80MHz		Unit
		Min	Max	Min	Max	
TSPIxSCK output frequency	f <sub>CYC</sub>	-	20	-	20	MHz
TSPIxSCK output cycle	t <sub>CYC</sub>	50	-	50	-	ns
TSPIxSCK low level output pulse width	t <sub>WL</sub>	(t <sub>CYC</sub> /2)-16	-	9	-	
TSPIxSCK high level output pulse width	t <sub>WH</sub>	(t <sub>CYC</sub> /2)-16	-	9	-	
TSPIxRXD input ← TSPIxSCK rise/fall time	t <sub>DSU</sub>	45-<RXDLY>×T	-	20	-	
TSPIxSCK rise/fall → TSPIxRXD hold time	t <sub>DHD</sub>	<RXDLY>×T-10.5	-	14.5	-	
TSPIxSCK rise/fall → TSPIxTXD delay time	t <sub>ODLY1</sub>	-18	-	-18	-	
TSPIxSCK rise/fall → TSPIxTXD delay time	t <sub>ODLY2</sub>	-	16	-	16	

(5) Slave in SIO mode (TSPI0/1/2/3/4)

4.5V ≤ DVDD5 = AVDD5 ≤ 5.5V

Parameter	Symbol	Equation		fsys = 80MHz		Unit
		Min	Max	Min	Max	
TSPIxSCK input frequency	f <sub>CYC</sub>	-	10	-	10	MHz
TSPIxSCK input cycle	t <sub>CYC</sub>	100	-	100	-	ns
TSPIxSCK low level input pulse width	t <sub>WL</sub>	37	-	37	-	
TSPIxSCK high level input pulse width	t <sub>WH</sub>	37	-	37	-	
TSPIxSCK rise/fall → TSPIxCSIN hold time	t <sub>CHD</sub>	7	-	7	-	
TSPIxRXD input ← TSPIxSCK rise/fall time	t <sub>DSU</sub>	7	-	7	-	
TSPIxSCK rise/fall → TSPIxRXD hold time	t <sub>DHD</sub>	10	-	10	-	
TSPIxSCK rise/fall → TSPIxTXD delay time	t <sub>ODLY1</sub>	0	-	0	-	
TSPIxSCK rise/fall → TSPIxTXD delay time	t <sub>ODLY2</sub>	-	49	-	49	

2.7V ≤ DVDD5 = AVDD5 < 4.5V

Parameter	Symbol	Equation		fsys = 80MHz		Unit
		Min	Max	Min	Max	
TSPIxSCK input frequency	f <sub>CYC</sub>	-	10	-	10	MHz
TSPIxSCK input cycle	t <sub>CYC</sub>	100	-	100	-	ns
TSPIxSCK low level input pulse width	t <sub>WL</sub>	37	-	37	-	
TSPIxSCK high level input pulse width	t <sub>WH</sub>	37	-	37	-	
TSPIxSCK rise/fall → TSPIxCSIN hold time	t <sub>CHD</sub>	7	-	7	-	
TSPIxRXD input ← TSPIxSCK rise/fall time	t <sub>DSU</sub>	7	-	7	-	
TSPIxSCK rise/fall → TSPIxRXD hold time	t <sub>DHD</sub>	10	-	10	-	
TSPIxSCK rise/fall → TSPIxTXD delay time	t <sub>ODLY1</sub>	0	-	0	-	
TSPIxSCK rise/fall → TSPIxTXD delay time	t <sub>ODLY2</sub>	-	55	-	55	

(1) 1st clock edge sampling (Master)

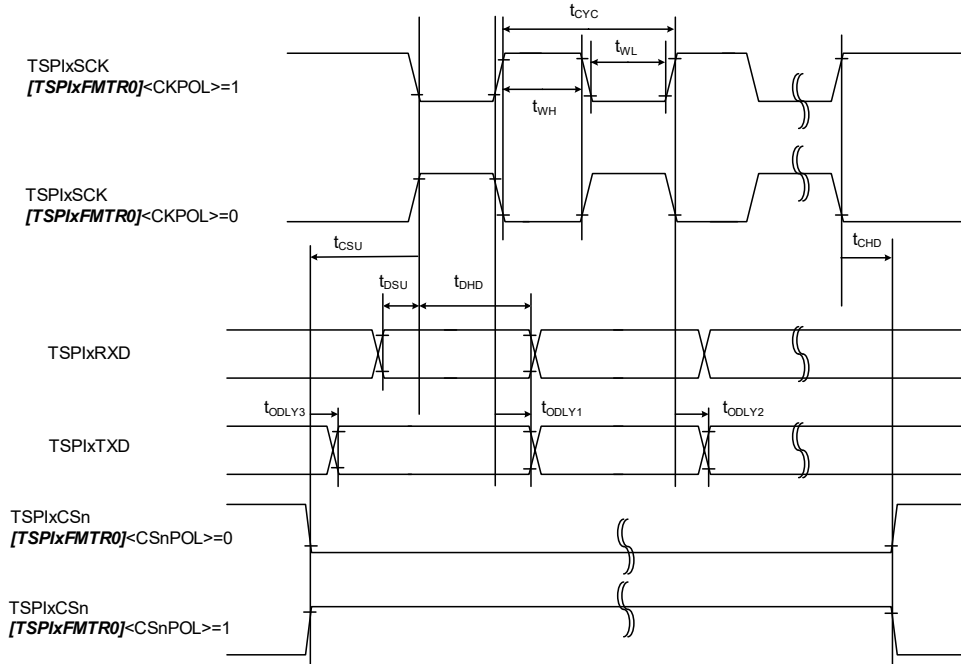


Figure 7.2 1st Clock Edge Sampling (Master)

(2) 2nd clock edge sampling (Master)

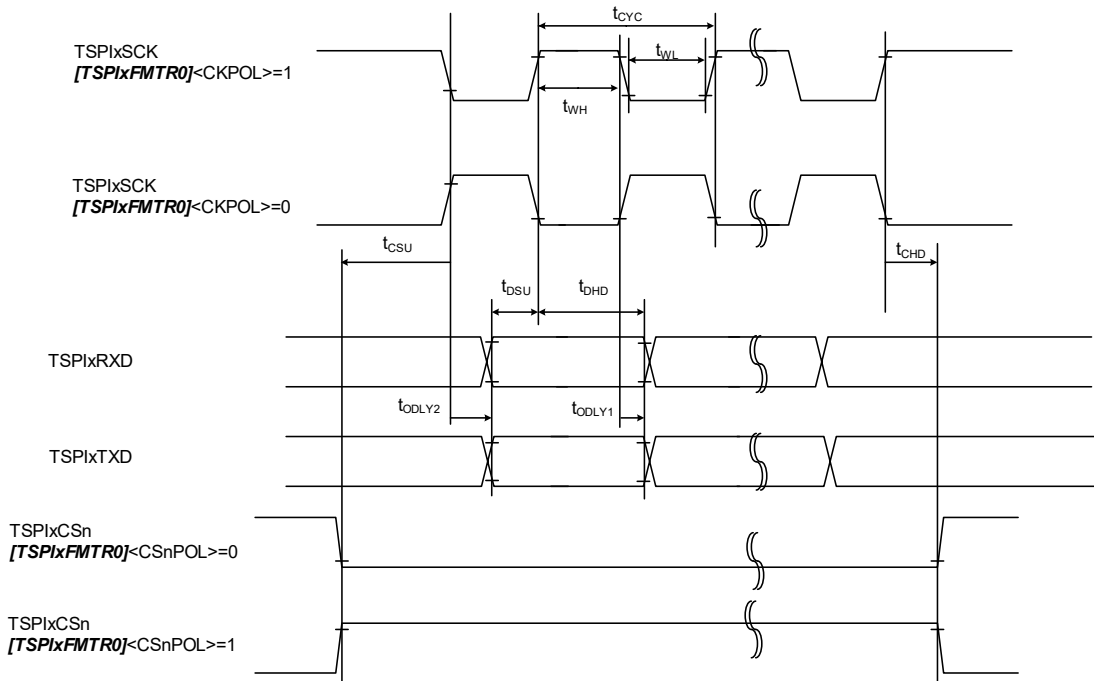


Figure 7.3 2nd Clock Edge Sampling (Master)

(3) 1st clock edge sampling (Slave)

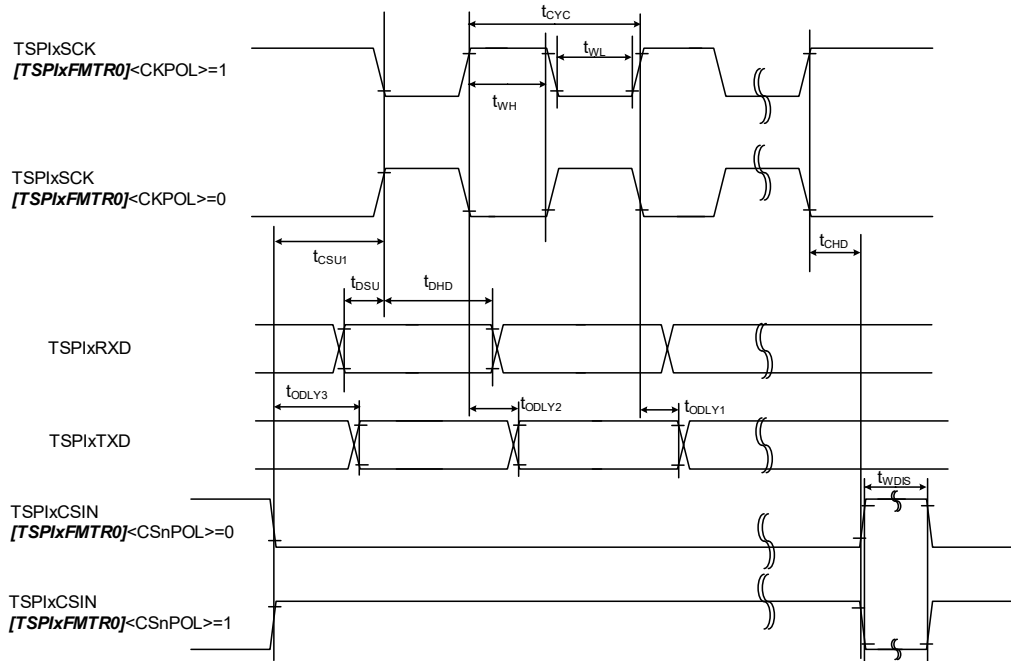


Figure 7.4 1st Clock Edge Sampling (Slave)

(4) 2nd clock edge sampling (Slave)

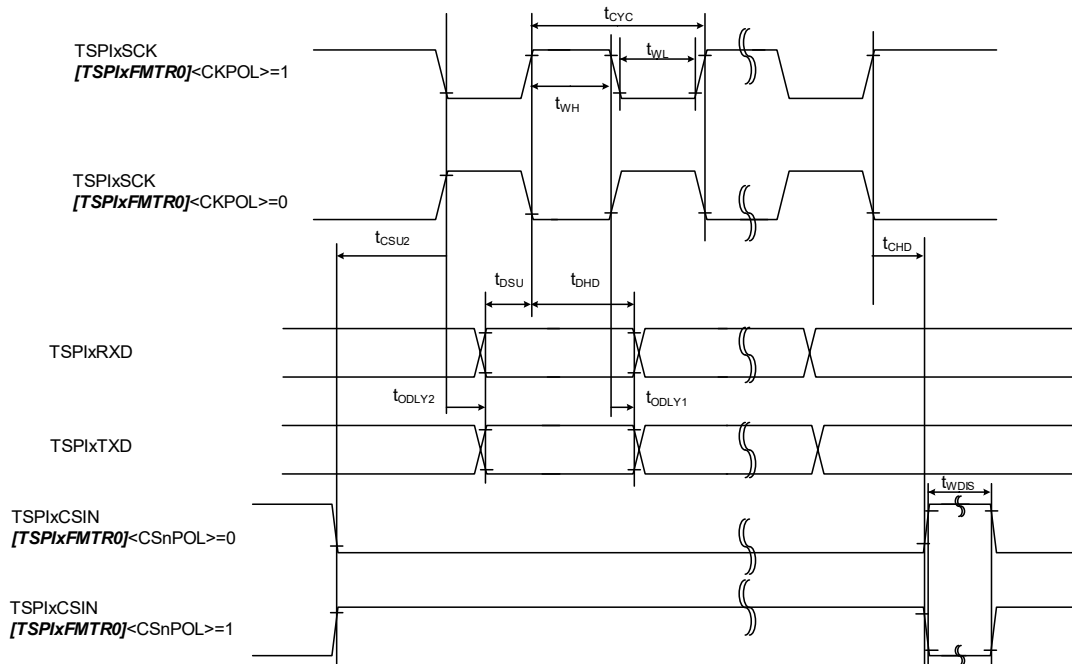


Figure 7.5 2nd Clock Edge Sampling (Slave)



## 7.11.2. I<sup>2</sup>C Interface (I2C)

### 7.11.2.1. AC Measurement Conditions

The AC characteristics are the result under the measurement conditions below:

- DVDD5 = AVDD5 = 2.7 to 5.5V
- Ta = -40 to 105°C
- Output level: Low = 0.4V
- Input level: High = 0.7 × DVDD5, Low = 0.3 × DVDD5
- Load capacity: CL = 30pF
- External pull-up resistor R<sub>p</sub> = 2.2kΩ

Note: DVDD5 is a generic name for DVDD5A, DVDD5B.

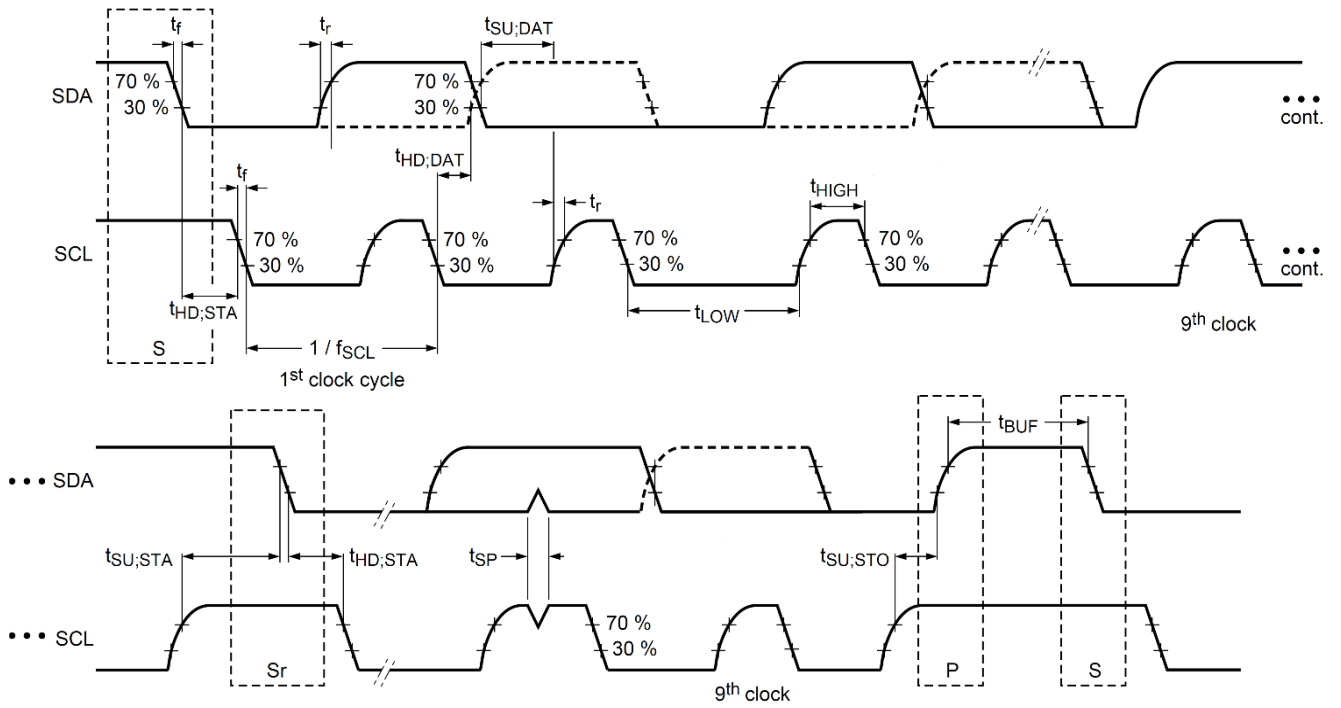
### 7.11.2.2. AC Electrical Characteristics

Parameter	Symbol	Standard mode		Fast mode		Unit	
		Min	Max	Min	Max		
SCL clock frequency	f <sub>SCL</sub>	0	100	0	400	kHz	
Start condition hold time	t <sub>HD;STA</sub>	4.0	-	0.6	-		
SCL clock Low width (Input) (Note 1)	t <sub>LOW</sub>	4.7	-	1.3	-	μs	
SCL clock High width (Input) (Note 1)	t <sub>HIGH</sub>	4.0	-	0.6	-		
Re-start condition setup time	t <sub>SU;STA</sub>	<SREN> = 0	4.7 (Note 3)	-	0.6 (Note 3)		-
		<SREN> = 1	4.7 (Note 3)	-	0.6		-
Data hold time (Input) (Note 2)	t <sub>HD;DAT</sub>	0	-	0	-	ns	
Data setup time	t <sub>SU;DAT</sub>	250	-	100	-		
Stop condition setup time	t <sub>SU;STO</sub>	4.0	-	0.6	-	μs	
Bus free time between stop condition and start condition (Note 3)	t <sub>BUF</sub>	4.7	-	1.3	-		
Pulse width of spikes that must be suppressed by the input filter	t <sub>SP</sub>	-	-	0	50	ns	
Rise time of both SDA and SCL signals	t <sub>r</sub>	-	1000	20	300		
Fall time of both SDA and SCL signals	t <sub>f</sub>	-	300	20 × (VDD/5.5V)	300		

Note 1: On I<sup>2</sup>C bus standard, the maximum speed of standard mode/fast mode is 100kHz/400kHz, respectively. For the frequency setting of the internal SCL clock, refer to the calculation formula in 3.3.2. of reference manual "I<sup>2</sup>C Interface".

Note 2: On I<sup>2</sup>C bus standard, it is described that a data internal hold time should be set at least 300 ns to avoid unstable condition on the falling of the SCL when the SDA is input; however, this precaution is not supported in this MCU. Also, the edge slope control function for the SCL is not available. Therefore, when the customer designs the MCU, make sure to follow the data hold time (input) in the table above. Note that tr/tf on the SCL/SDA should be included in the data hold time.

Note 3: To keep the time by software.



**Figure 7.6 AC Timing of I2C**

## 7.11.3. I<sup>2</sup>C Interface Version A (EI2C)

### 7.11.3.1. AC Measurement Conditions

The AC characteristics are the result under the measurement conditions below:

- DVDD5 = AVDD5 = 2.7 to 5.5V
- Ta = -40 to 105°C
- Output level: Low = 0.4V
- Input level: High = 0.7 × DVDD5, Low = 0.3 × DVDD5
- Load capacity: CL = 30pF
- External pull-up resistor: R<sub>p</sub> = 2.2kΩ

Note: DVDD5 is a generic name for DVDD5A, DVDD5B.

### 7.11.3.2. AC Electrical Characteristics

Parameter	Symbol	Standard mode		Fast mode		Fast mode plus		Unit
		Min	Max	Min	Max	Min	Max	
SCL clock frequency	f <sub>SCL</sub>	0	100	0	400	0	1000	kHz
Start condition hold time	t <sub>HD;STA</sub>	4.0	-	0.6	-	0.26	-	μs
SCL clock Low width (Input) (Note 1)	t <sub>LOW</sub>	4.7	-	1.3	-	0.5	-	
SCL clock High width (Input) (Note 1)	t <sub>HIGH</sub>	4.0	-	0.6	-	0.26	-	
Re-start condition setup time	t <sub>SU;STA</sub>	4.7	-	0.6	-	0.26	-	
Data hold time (Input) (Note 2)	t <sub>HD;DAT</sub>	0	-	0	-	0	-	ns
Data setup time	t <sub>SU;DAT</sub>	250	-	100	-	50	-	μs
Stop condition setup time	t <sub>SU;STO</sub>	4.0	-	0.6	-	0.26	-	
Bus free time between stop condition and start condition (Note 3)	t <sub>BUF</sub>	4.7	-	1.3	-	0.5	-	ns
Pulse width of spikes that must be suppressed by the input filter	t <sub>SP</sub>	-	-	0	50	0	50	
Rise time of both SDA and SCL signals	t <sub>r</sub>	-	1000	20	300	-	120	
Fall time of both SDA and SCL signals	t <sub>f</sub>	-	300	20 × (VDD/5.5V)	300	20 × (VDD/5.5V)	120	

Note 1: On I<sup>2</sup>C bus standard, the maximum speed of standard mode/fast mode/fast mode plus is 100kHz/400kHz/1000kHz, respectively. For the frequency setting of the internal SCL clock, refer to the calculation formula in 3.3.1. of reference manual "I<sup>2</sup>C Interface Version A".

Note 2: On I<sup>2</sup>C bus standard, it is described that a data internal hold time should be set at least 300 ns to avoid unstable condition on the falling of the SCL when the SDA is input; however, this precaution is not supported in this MCU. Also, the edge slope control function for the SCL is not available. Therefore, when the customer designs the MCU, make sure to follow the data hold time (input) in the table above. Note that t<sub>r</sub>/t<sub>f</sub> on the SCL/SDA should be included in the data hold time.

Note 3: To keep the time by software.

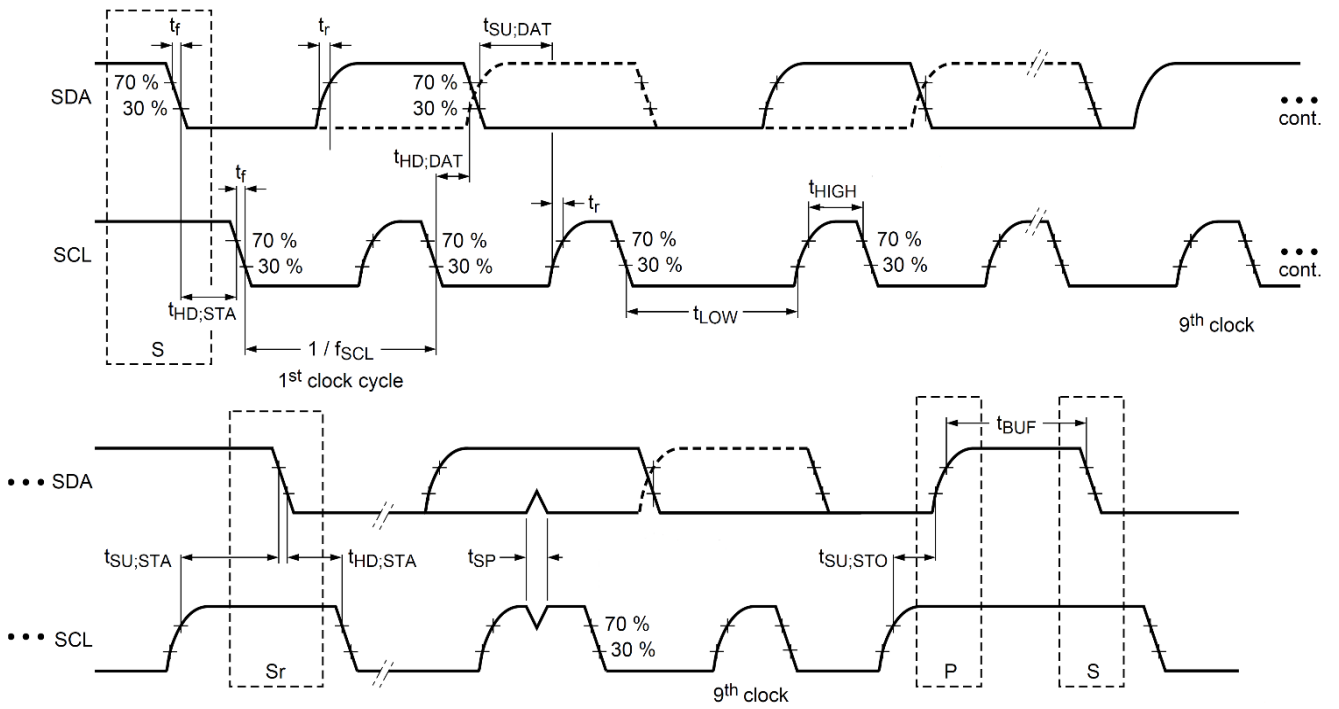


Figure 7.7 AC Timing of EI2C

## 7.11.4. 32-bit Timer Event Counter (T32A)

This section describes the AC characteristics of T32AxINA0/A1, T32AxINB0/B1, and T32AxINC0/C1.

### 7.11.4.1. AC Measurement Conditions

The AC characteristics are the result under the measurement conditions below:

- DVDD5 = AVDD5 = 2.7 to 5.5V
- Ta = -40 to 105°C
- Input level: High = 0.75 × DVDD5, Low = 0.25 × DVDD5
- Load capacity: CL = 30pF

Note: DVDD5 is a generic name for DVDD5A, DVDD5B.

### 7.11.4.2. AC Characteristics

"T" in the table below indicates the operation clock cycle of the T32A. The operation clock of the T32A is the same cycle as the ΦT0 clock. This cycle depends on the Prescaler Clock setting.

(1) Operation other than the pulse count

Parameter	Symbol	Equation		ΦT0 = 80MHz		Unit
		Min	Max	Min	Max	
Low level pulse width	t <sub>VCKL</sub>	2T + 20	-	45	-	ns
High level pulse width	t <sub>VCKH</sub>	2T + 20	-	45	-	

(2) At the pulse count

Parameter	Symbol	Equation		ΦT0 = 80MHz NF = 4		Unit
		Min	Max	Min	Max	
Pulse cycle	t <sub>DCYC</sub>	1000	-	1000	-	ns
Low level pulse width	t <sub>PWL</sub>	500	-	500	-	
High level pulse width	t <sub>PWH</sub>	500	-	500	-	
Input setup	t <sub>ABS</sub>	(NF+1)×T+20	-	82.5	-	
Input hold	t <sub>ABH</sub>	(NF+1)×T+20	-	82.5	-	

NF Value depends on the  $[T32AxPLSCR]<NF[1:0]>$  setting as follows.

$[T32AxPLSCR]<NF[1:0]>$	NF Value of Formula
00	0
01	2
10	4
11	8

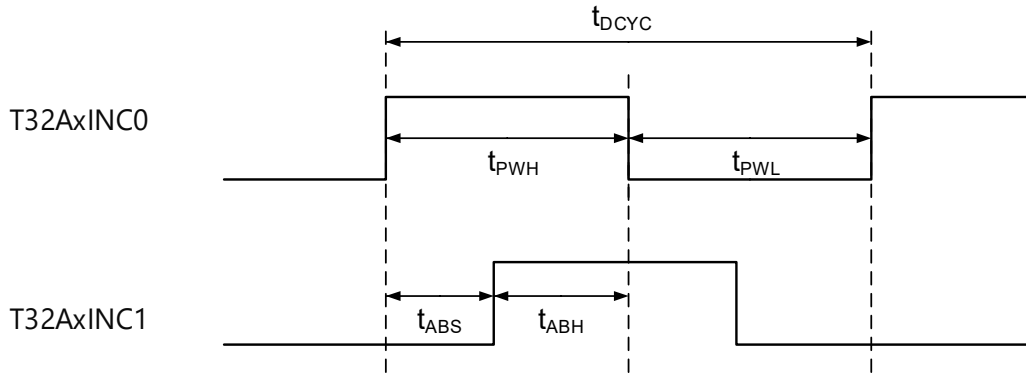


Figure 7.8 Count Pulse Input

## 7.11.5. External Interrupt

### 7.11.5.1. AC Measurement Conditions

The AC characteristics are the result under the measurement conditions below:

- DVDD5 = AVDD5 = 2.7 to 5.5V
- Ta = -40 to 105°C
- Input level: High =  $0.75 \times DVDD5$ , Low =  $0.25 \times DVDD5$
- Load capacity: CL = 30pF

Note: DVDD5 is a generic name for DVDD5A, DVDD5B.

### 7.11.5.2. AC Electrical Characteristics

"T" in the table below indicates the cycle of the system clock  $f_{sys}$ .

(1) NORMAL, IDLE mode

Parameter	Symbol	Equation		f <sub>sys</sub> = 80MHz		Unit
		Min	Max	Min	Max	
Low level pulse width	$t_{INTAL1}$	T + 100	-	112.5	-	ns
High level pulse width	$t_{INTAH1}$	T + 100	-	112.5	-	

(2) STOP1, STOP2 mode

Parameter	Symbol	Equation		f <sub>sys</sub> = 80MHz		Unit
		Min	Max	Min	Max	
Low level pulse width	$t_{INTCL2}$	125	-	125	-	ns
High level pulse width	$t_{INTCH2}$	125	-	125	-	

## 7.11.6. Trigger Input (TRGINx)

### 7.11.6.1. AC Measurement Conditions

The AC characteristics are the result under the measurement conditions below:

- DVDD5 = AVDD5 = 2.7 to 5.5V
- Ta = -40 to 105°C
- Input level: High =  $0.75 \times DVDD5$ , Low =  $0.25 \times DVDD5$
- Load capacity: CL = 30pF

Note: DVDD5 is a generic name for DVDD5A, DVDD5B.

### 7.11.6.2. AC Electrical Characteristics

"T" in the table below indicates the cycle of the system clock fsys.

Parameter	Symbol	Equation		fsys = 80MHz		Unit
		Min	Max	Min	Max	
Low level pulse width	t <sub>ADL</sub>	2T + 20	-	45	-	ns
High level pulse width	t <sub>ADH</sub>	2T + 20	-	45	-	

## 7.11.7. Debug Communication

### 7.11.7.1. AC Measurement Conditions

The AC characteristics are the result under the measurement conditions below:

- DVDD5 = AVDD5 = 2.7 to 5.5V
- Ta = -40 to 105°C
- Output level: High =  $0.8 \times DVDD5$ , Low =  $0.2 \times DVDD5$
- Input level: High =  $0.75 \times DVDD5$ , Low =  $0.25 \times DVDD5$
- Load capacity: CL = 30pF

Note: DVDD5 is a generic name for DVDD5A, DVDD5B.

### 7.11.7.2. SWD Interface

$$4.5V \leq DVDD5 = AVDD5 \leq 5.5V$$

Parameter	Symbol	Min	Max	Unit
CLK high level width	$t_{dckh}$	50	-	ns
CLK low level width	$t_{dckl}$	50	-	
Output data hold time from the rising edge of CLK	$t_{d1}$	1	-	
Output data valid time from the rising edge of CLK	$t_{d2}$	-	35	
Rising edge of CLK time from the input data valid	$t_{ds}$	20	-	
Input data hold time from the rising edge of CLK	$t_{dh}$	15	-	

$$2.7V \leq DVDD5 = AVDD5 < 4.5V$$

Parameter	Symbol	Min	Max	Unit
CLK high level width	$t_{dckh}$	50	-	ns
CLK low level width	$t_{dckl}$	50	-	
Output data hold time from the rising edge of CLK	$t_{d1}$	1	-	
Output data valid time from the rising edge of CLK	$t_{d2}$	-	45	
Rising edge of CLK time from the input data valid	$t_{ds}$	20	-	
Input data hold time from the rising edge of CLK	$t_{dh}$	15	-	



### 7.11.7.3. JTAG Interface

$4.5V \leq DVDD5 = AVDD5 \leq 5.5V$

Parameter	Symbol	Min	Max	Unit
CLK high level width	$t_{dckh}$	50	-	ns
CLK low level width	$t_{dckl}$	50	-	
Output data hold time from the falling edge of CLK	$t_{d3}$	0	-	
Output data valid time from the falling edge of CLK	$t_{d4}$	-	35	
Rising edge of CLK time from the input data valid	$t_{ds}$	20	-	
Input data hold time from the rising edge of CLK	$t_{dh}$	15	-	

$2.7V \leq DVDD5 = AVDD5 < 4.5V$

Parameter	Symbol	Min	Max	Unit
CLK high level width	$t_{dckh}$	50	-	ns
CLK low level width	$t_{dckl}$	50	-	
Output data hold time from the falling edge of CLK	$t_{d3}$	0	-	
Output data valid time from the falling edge of CLK	$t_{d4}$	-	45	
Rising edge of CLK time from the input data valid	$t_{ds}$	20	-	
Input data hold time from the rising edge of CLK	$t_{dh}$	15	-	

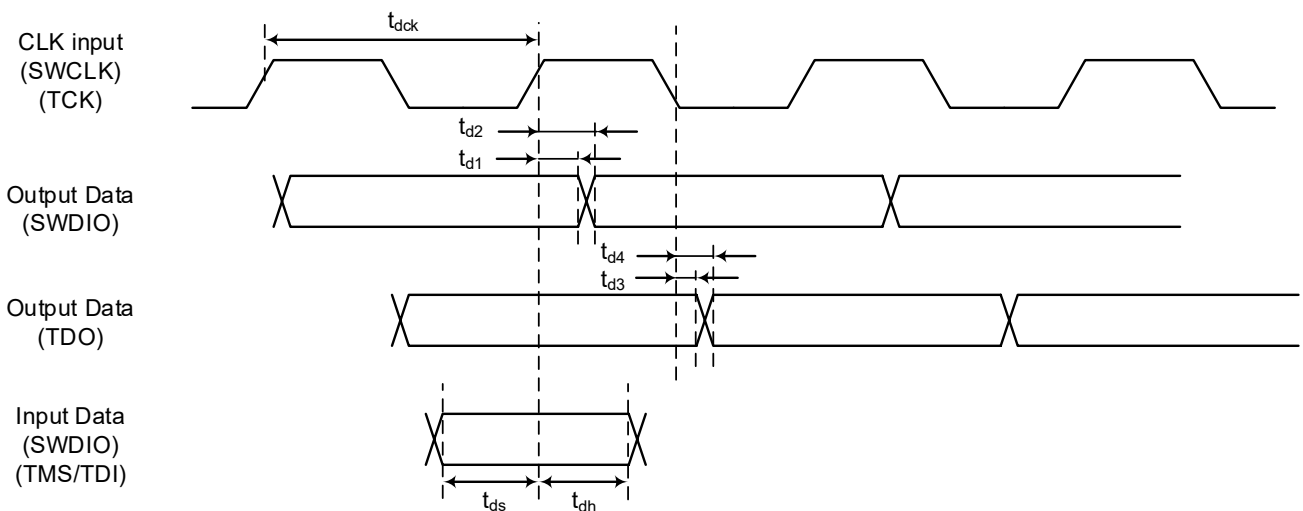


Figure 7.9 JTAG/SWD Waveform

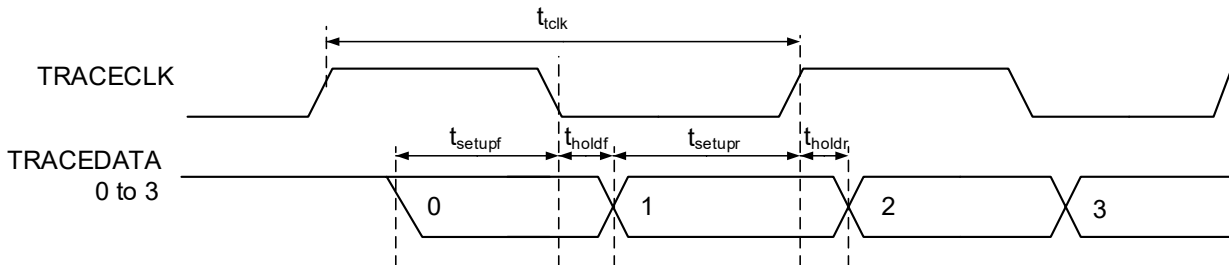
**7.11.7.4. ETM Trace**

$4.5V \leq DVDD5 = AVDD5 \leq 5.5V$

Parameter	Symbol	Min	Max	Unit
TRACECLK cycle	$t_{clk}$	50	-	ns
Rising edge of TRACECLK time from the TRACEDATA valid	$t_{setupr}$	2	-	
TRACEDATA hold time from the rising edge of TRACECLK	$t_{holdr}$	1	-	
Falling edge of TRACECLK time from the TRACEDATA valid	$t_{setupf}$	2	-	
TRACEDATA hold time from the falling edge of TRACECLK	$t_{holdf}$	1	-	

$2.7V \leq DVDD5 = AVDD5 < 4.5V$

Parameter	Symbol	Min	Max	Unit
TRACECLK cycle	$t_{clk}$	100	-	ns
Rising edge of TRACECLK time from the TRACEDATA valid	$t_{setupr}$	2	-	
TRACEDATA hold time from the rising edge of TRACECLK	$t_{holdr}$	1	-	
Falling edge of TRACECLK time from the TRACEDATA valid	$t_{setupf}$	2	-	
TRACEDATA hold time from the falling edge of TRACECLK	$t_{holdf}$	1	-	



**Figure 7.10 Trace Signal Waveform**

## 7.11.8. SCOUT Pin

### 7.11.8.1. AC Measurement Conditions

The AC characteristics are the result under the measurement conditions below:

- DVDD5 = AVDD5 = 2.7 to 5.5V
- Ta = -40 to 105°C
- Output level: High =  $0.8 \times DVDD5$ , Low =  $0.2 \times DVDD5$
- Load capacity: CL = 30pF

Note: DVDD5 is a generic name for DVDD5A, DVDD5B.

### 7.11.8.2. AC Electrical Characteristics

"T" in the table indicates the cycle of the SCOUT output waveform.

Parameter	Symbol	Equation		SCOUT = 20MHz		Unit
		Min	Max	Min	Max	
Low level pulse width	t <sub>SCL</sub>	0.5T - 10	-	15	-	ns
High level pulse width	t <sub>SCH</sub>	0.5T - 10	-	15	-	

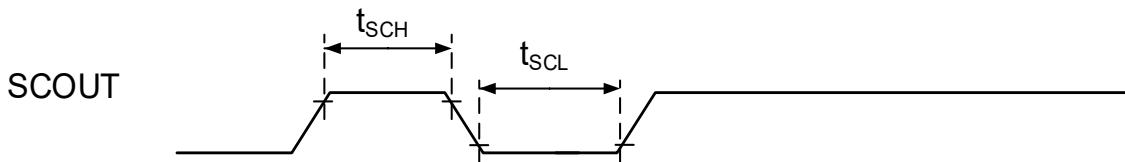


Figure 7.11 SCOUT Wave Output

### 7.11.9. Noise Filter Characteristics

Parameter	Condition	Min	Typ.	Max	Unit
Noise cancel width	-	15	30	60	ns

## 7.11.10. External Clock Input

### 7.11.10.1. AC Measurement Conditions

The AC characteristics are the result under the measurement conditions below:

- DVDD5 = AVDD5 = 2.7 to 5.5V
- Ta = -40 to 105°C
- Input level: High =  $0.75 \times DVDD5$ , Low =  $0.25 \times DVDD5$
- Load capacity: CL = 30pF

Note: DVDD5 is a generic name for DVDD5A, DVDD5B.

### 7.11.10.2. AC Electrical Characteristics

Parameter	Symbol	Min	Typ.	Max	Unit
Clock frequency ( $1/t_{ehcin}$ )	$f_{EHCLKIN}$	6	-	20	MHz
Clock duty	-	45	-	55	%
Clock rise time	$t_r$	-	-	10	ns
Clock fall time	$t_f$	-	-	10	ns

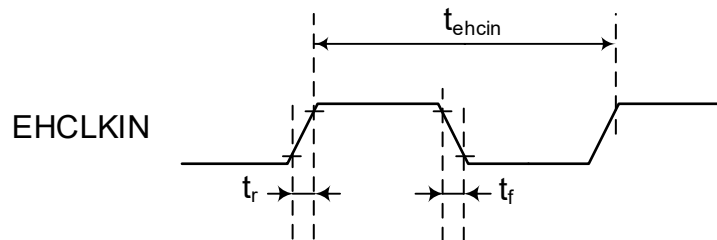


Figure 7.12 External Clock Input Waveform

## 7.12. Flash Memory Characteristics

### 7.12.1. Code Flash

DVDD5 = 2.7V to 5.5V

Ta = -40 to 105°C

Parameter	Condition	Min	Typ.	Max	Unit
Endurance	-	-	-	100,000	cycles
Programming time	Word Program time	-	22.6	-	μs
Erase time	Page Erase time	1.1	-	4.2	ms
	Block Erase time	8.4	-	33.6	
	Area Erase time (Note 2)	-	9.1	-	

Note 1: DVDD5 is a generic name for DVDD5A, DVDD5B.

Note 2: When Erase command executes, no block with effective protection.

### 7.12.2. Data Flash

DVDD5 = 2.7V to 5.5V

Ta = -40 to 105°C

Parameter	Condition	Min	Typ.	Max	Unit
Endurance	-	-	-	100,000	cycles
Programing time	-	-	78	-	μs
Erase time	Page Erase time	1.1	-	4.2	ms
	Block Erase time	16.2	-	64.6	
	Area Erase time (Note 2)	-	9.1	-	

Note 1: DVDD5 is a generic name for DVDD5A, DVDD5B.

Note 2: When Erase command executes, no block with effective protection.

### 7.12.3. Chip Erase

DVDD5 = 2.7V to 5.5V

Ta = -40 to 105°C

Parameter	Condition	Min	Typ.	Max	Unit
Chip Erase time	Code flash Data flash Protect Bits (Code) Protect Bits (Data) Security Bits	30.4	-	39.8	ms

Note 1: DVDD5 is a generic name for DVDD5A, DVDD5B.

Note 2: Total execution time of automatic chip erasing, automatic protect bit erasing (code and data) and automatic security bit erasing. An execution time of automatic chip erasing is when no blocks are protected.

## 7.13. Regulator

Parameter	Condition	Min	Typ.	Max	Unit
Capacitance of REGOUT1 and REGOUT2 capacitor	DVDD5 = 2.7 to 5.5V Ta = -40 to 105°C	0.8	4.7	5.64	μF

Note: DVDD5 is a generic name for DVDD5A, DVDD5B.

## 7.14. Oscillation Circuit

### 7.14.1. Internal Oscillator

DVDD5 = 2.7 to 5.5V

Ta = -40 to 105°C

Parameter	Symbol	Condition	Min	Typ.	Max	Unit
Oscillation frequency	f <sub>IHOSC1</sub>	-	9.9	10	10.1	MHz
	f <sub>IHOSC2</sub>	-	-	10	-	

Note 1: DVDD5 is a generic name for DVDD5A, DVDD5B.

Note 2: Please execute IHOSC1 oscillator adjustment by the trimming register, if it is required.  
IHOSC2 oscillator cannot be adjusted.

### 7.14.2. External Oscillator

DVDD5 = 2.7 to 5.5V

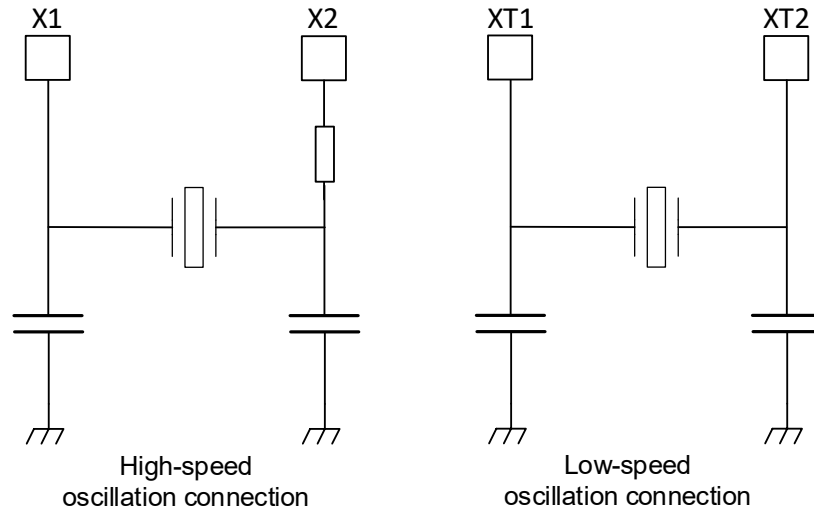
Ta = -40 to 105°C

Parameter	Symbol	Condition	Min	Typ.	Max	Unit
Oscillation frequency	f <sub>EHOSC</sub>	-	6	-	12	MHz
	f <sub>ELOSC</sub>	-	30	-	34	kHz

Note 1: DVDD5 is a generic name for DVDD5A, DVDD5B.

Note 2: Please contact the oscillator vendor, regarding the matching data of the device and the oscillator.

### 7.14.3. Oscillation Circuit Sample



**Figure 7.13 Oscillation Circuit Sample**

To obtain a stable oscillation, load capacity and the position of the oscillator must be configured properly. Since these factors are strongly affected by substrate patterns, please evaluate oscillation stability using the substrate you use.

This product has been evaluated by the oscillator vendor below. Please refer to this information when selecting external parts.

### 7.14.4. Ceramic Resonator

This product has been evaluated by the ceramic resonator by Murata Manufacturing Co., Ltd. Please refer to the Murata Website for details.

### 7.14.5. Crystal Unit

This product has been evaluated by the crystal unit by KYOCERA Corporation. Please refer to the KYOCERA Website for details.

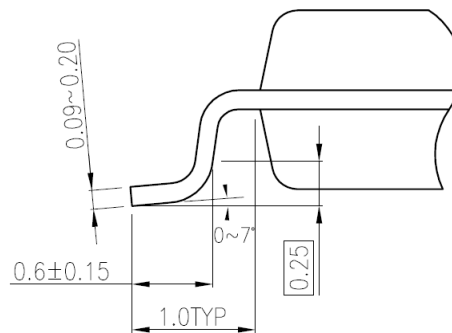
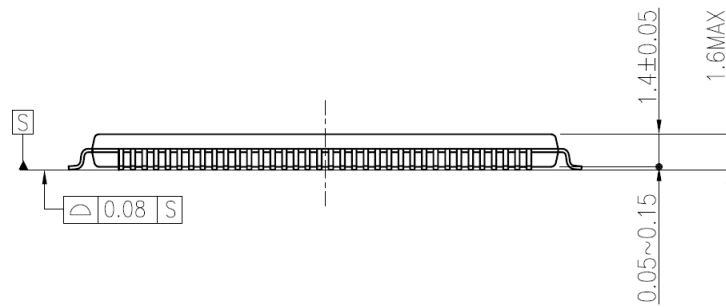
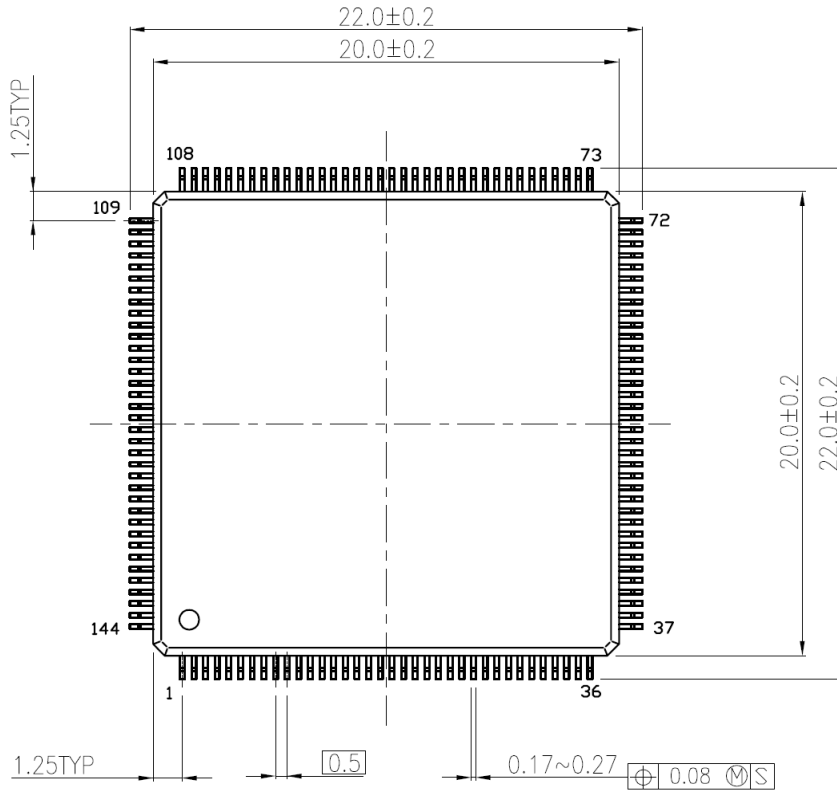
### 7.14.6. Precautions for Designing Printed Circuit Board

Be sure to design printed circuit board patterns that connect a crystal unit with other oscillation elements so that the length of such patterns become shortest possible to prevent deterioration of characteristics due to stray capacitances and wiring inductance. For multi-layer circuit boards, it is important not to wire the ground and other signal patterns right beneath the oscillation circuit. For more information, please refer to the URL of the oscillator vendor.

## 8. Package Dimensions

### 8.1. P-LQFP144-2020-0.50-002

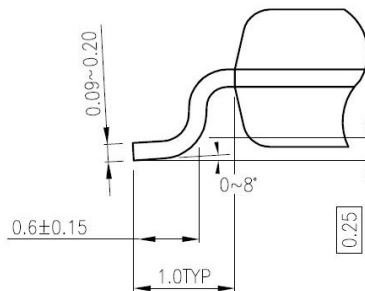
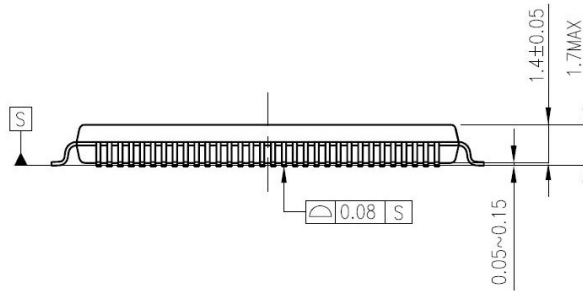
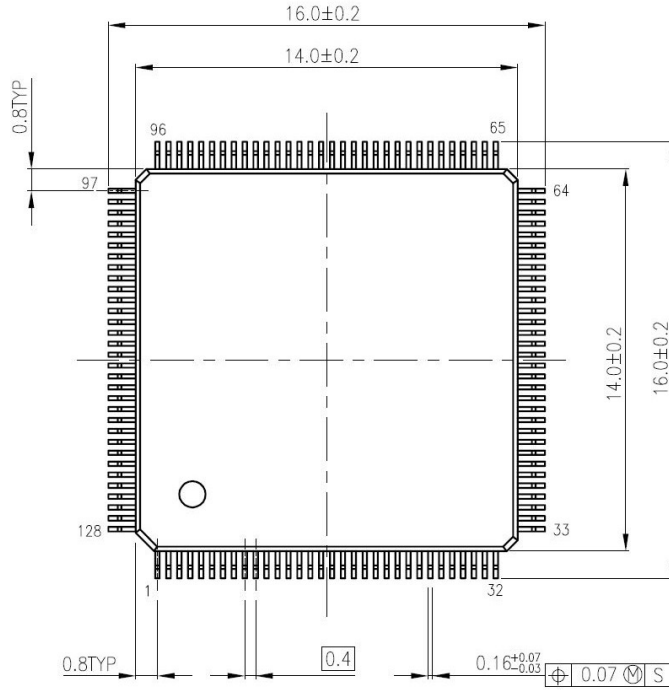
Unit: mm





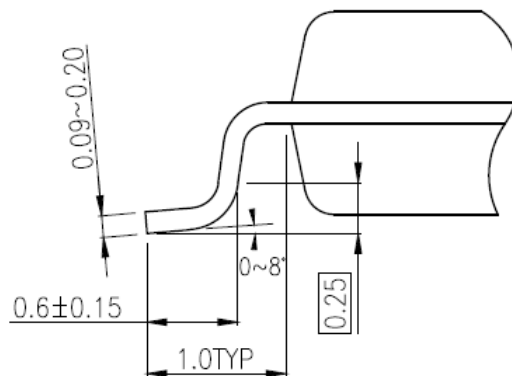
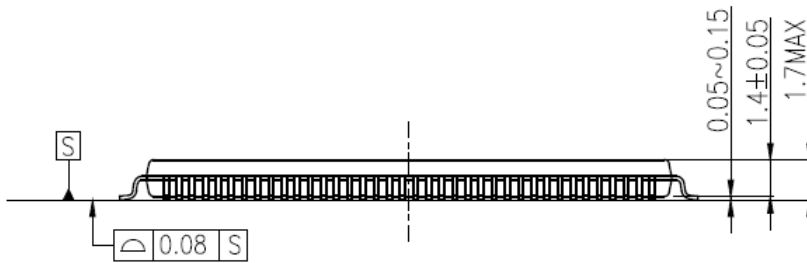
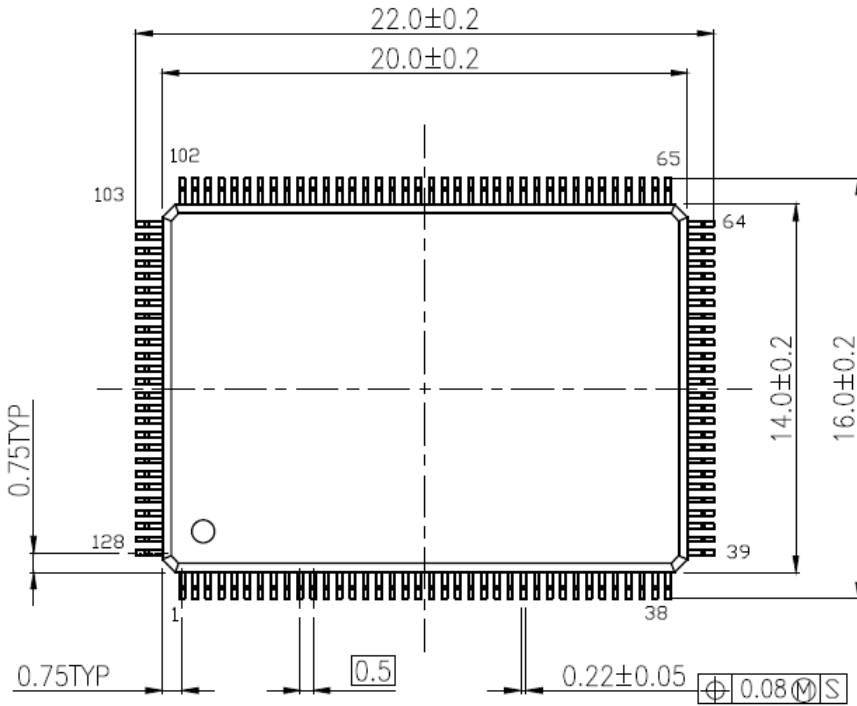
**8.2. P-LQFP128-1414-0.40-001**

Unit: mm



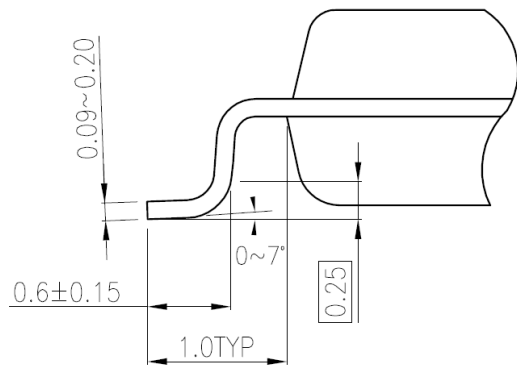
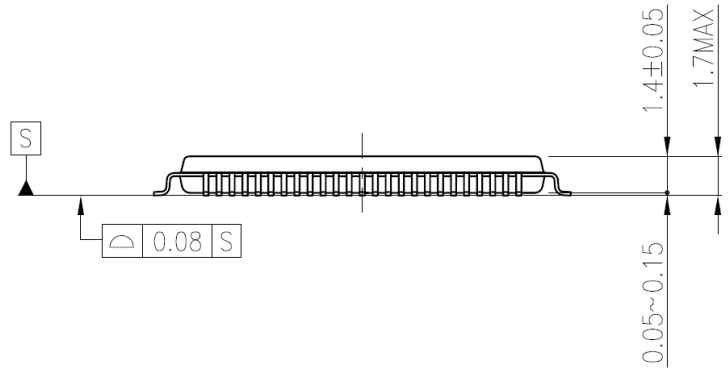
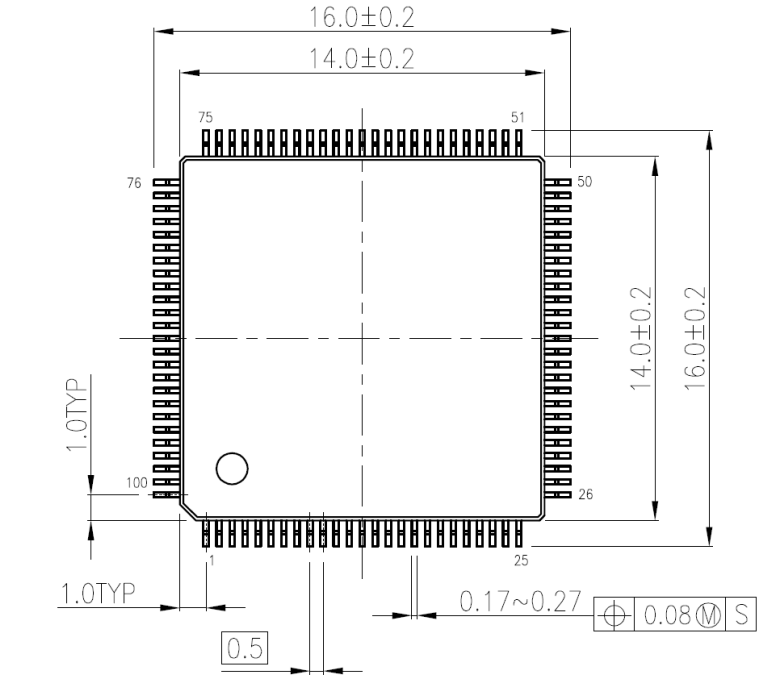
8.3. P-LQFP128-1420-0.50-001

Unit: mm



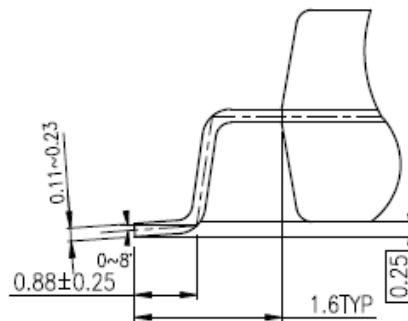
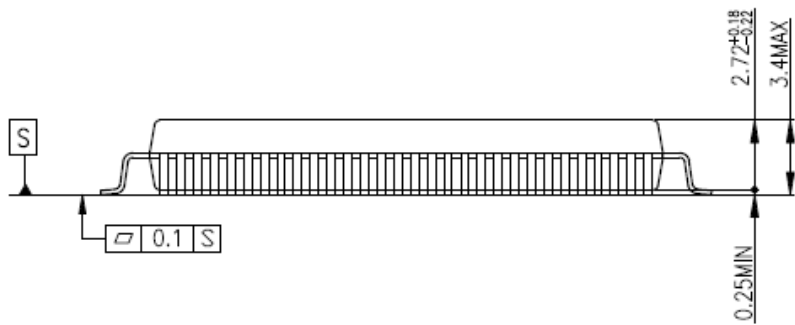
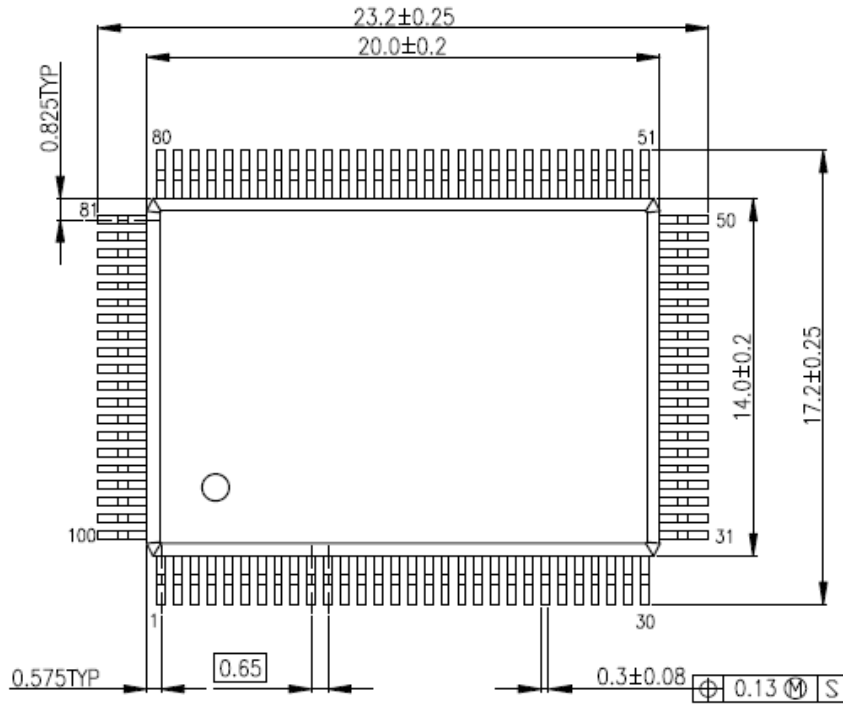
8.4. P-LQFP100-1414-0.50-002

Unit: mm



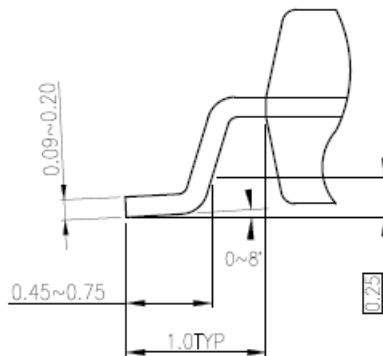
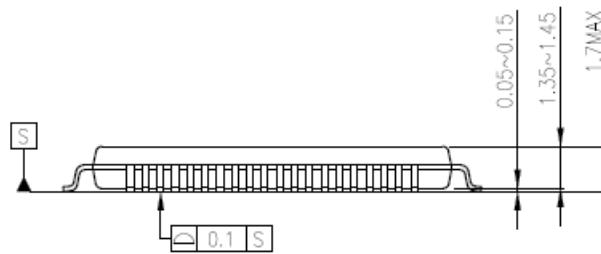
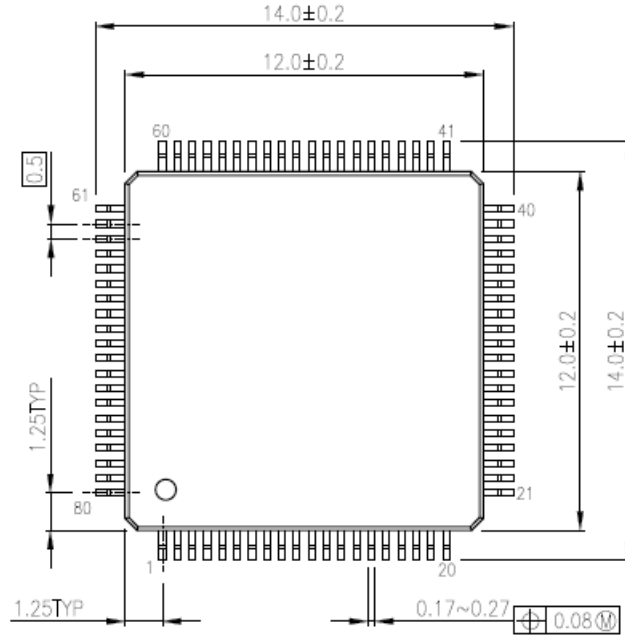
## 8.5. P-QFP100-1420-0.65-003

Unit: mm



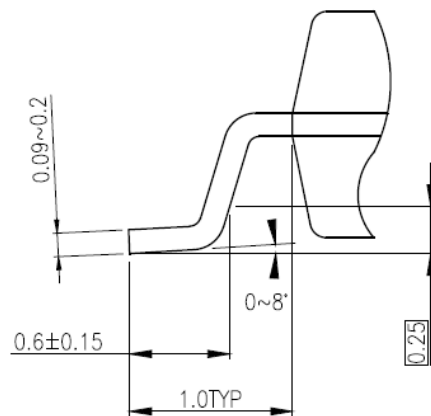
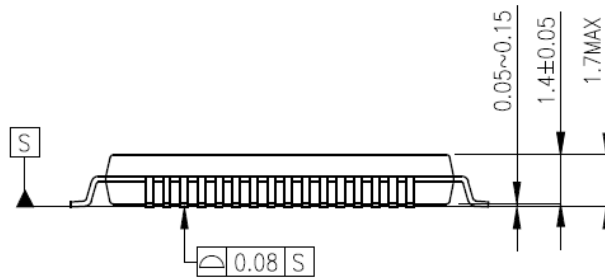
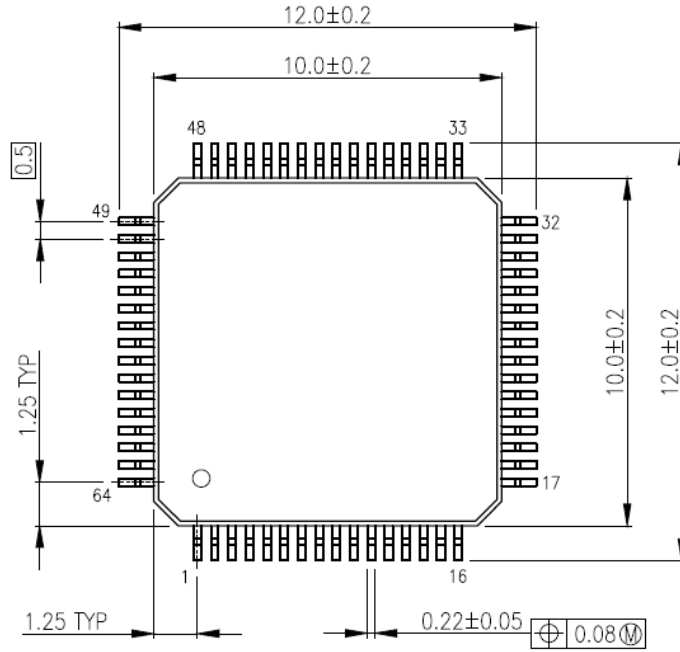
**8.6. P-LQFP80-1212-0.50-005**

Unit: mm



## 8.7. P-LQFP64-1010-0.50-003

Unit: mm



## 9. Precautions

This Page explains general precautions on the use of Toshiba MCUs.

Note that if there is a difference between the general precautions and the description in the body of the document, the description in the body of the document has higher priority.

(1) The MCUs' operation at power-on

At power-on, the internal state of the MCUs is unstable. Therefore, the state of the pins is undefined until the reset operation is started and valid.

When a reset is performed by an external reset pin, pins of the MCUs that use the reset pin are undefined until reset operation by the external pin is started and valid.

Also, when a reset is performed by the internal power-on reset, pins of the MCUs that use the internal power-on reset are undefined until power supply voltage reaches the voltage at which power-on reset is started and valid.

(2) Unused pins

Unused input/output ports of the MCUs are prohibited to use. The pins are high-impedance.

Generally, if MCUs operate while the high-impedance pins left open, electrostatic damage or latch-up may occur in the internal LSI due to induced voltage influenced from external noise.

We recommend that each unused pin should be connected to the power supply pins or GND pins via resistors.

(3) Clock oscillation stability

A reset state must be released after the clock oscillation becomes stable. If the clock is changed to another clock while the program is in progress, wait until the destination clock is stable.

## 10. Revision History

**Table 10.1 Revision History**

Revision	Date	Description
1.0	2023-04-28	First release
1.1	2025-02-21	- Appearance update -5.27. Measures for Security Risk Description is changed. Note is added. - 6.4. Clock Control Figure of X1, X2 is changed. - 8.6 P-LQFP80-1212-0.50-005 Package name and figure are changed.
1.2	2025-08-01	- Appearance update





### List of All pins (2)

M3HQ (LQFP144)	M3HP (LQFP128-144)	M3HP (LQFP128-142)	M3HN (LQFP100)	M3HN (QFP100)	Pin Name	Combination Function A	Combination Function B	Combination Function 1	Combination Function 2	Combination Function 3	Combination Function 4	Combination Function 5	Combination Function 6	Input/Output	Pull-up/ Pull-down	SV_T	SMT/ CMOS	Under Reset	After Reset
104	91	94	71	73	PJ0			UT1TXDB		T32A03OUTA	T32A03OUTC	U00	SEG22	Input/Output	PUPD	NA	SMT	Hi-Z	Hi-Z
105	92	95	72	74	PJ1			UT1TXDA	UT1RXD	T32A03INA0	T32A03INC0	X00	SEG21	Input/Output	PUPD	NA	SMT	Hi-Z	Hi-Z
106	93	96	73	75	PJ2			UT1RXD	UT1TXDA	T32A03INA1	T32A03INC1	V00	SEG20	Input/Output	PUPD	NA	SMT	Hi-Z	Hi-Z
107	94	97	74	76	PJ3			UT1CTS N	UT1RTS N	T32A03OUTB		Y00	SEG19	Input/Output	PUPD	NA	SMT	Hi-Z	Hi-Z
108	95	98	75	77	PJ4		INT04	UT1RTS N	UT1CTS N	T32A03INB0		W00	SEG18	Input/Output	PUPD	NA	SMT	Hi-Z	Hi-Z
109	96	99	76	78	PJ5			UT1TXDB		T32A03INB1		Z00	SEG17	Input/Output	PUPD	NA	SMT	Hi-Z	Hi-Z
110	97	100	77	79	PK0			UT1TXDA	UT1RXD			EMG0	SEG16	Input/Output	PUPD	NA	SMT	Hi-Z	Hi-Z
111	98	101	78	80	PK1		INT05	UT1TXDA	UT1RXD			OVV0	SEG15	Input/Output	PUPD	NA	SMT	Hi-Z	Hi-Z
112	99	102	79	81	PK2			UT1RXD	UT1TXDA	T32A04OUTA	T32A04INC0		SEG14	Input/Output	PUPD	NA	SMT	Hi-Z	Hi-Z
113	100	103	80	82	PK3			UT1CTS N	UT1RTS N	T32A04INA0	T32A04INC0		SEG13	Input/Output	PUPD	NA	SMT	Hi-Z	Hi-Z
114	101	104	81	83	PK4			UT1RTS N	UT1CTS N	T32A04INA1	T32A04INC1		SEG12	Input/Output	PUPD	NA	SMT	Hi-Z	Hi-Z
115	102	105	82	84	PK5			UT6RXD	UT6TXDA	T32A04OUTB			SEG11	Input/Output	PUPD	NA	SMT	Hi-Z	Hi-Z
116	103	106	83	85	PK6			UT6TXDA	UT6RXD	T32A04INB0			SEG10	Input/Output	PUPD	NA	SMT	Hi-Z	Hi-Z
117	104	107	84	86	PK7		INT13	UT6TXDB		T32A04INB1			SEG09	Input/Output	PUPD	NA	SMT	Hi-Z	Hi-Z
118	105	108	85	87	PP3		INT14	TSPI3RXD					SEG08	Input/Output	PUPD	NA	SMT	Hi-Z	Hi-Z
119	106	109	86	88	PP4			TSPI3TXD					SEG07	Input/Output	PUPD	NA	SMT	Hi-Z	Hi-Z
120	107	110	87	89	PP5			TSPI3SCK					SEG06	Input/Output	PUPD	NA	SMT	Hi-Z	Hi-Z
121	108	111	88	90	PP6			TSPI3CS0	TSPI3CSIN	PMD0DBG			SEG05	Input/Output	PUPD	NA	SMT	Hi-Z	Hi-Z
122	109	112	89	91	PP7			TSPI3CS1					SEG04	Input/Output	PUPD	NA	SMT	Hi-Z	Hi-Z
123	110	113	-	-	PV0								SEG03	Input/Output	PUPD	NA	SMT	Hi-Z	Hi-Z
124	111	114	-	-	PV1								SEG02	Input/Output	PUPD	NA	SMT	Hi-Z	Hi-Z
125	112	115	-	-	PV2		INT17						SEG01	Input/Output	PUPD	NA	SMT	Hi-Z	Hi-Z
126	113	116	-	-	PV3								SEG00	Input/Output	PUPD	NA	SMT	Hi-Z	Hi-Z
127	-	-	-	-	PV4									Input/Output	-	-	SMT	Hi-Z	Hi-Z
128	114	117	-	-	DVDD05B									-	-	-	-	-	-
129	115	118	-	-	DVSSB									-	-	-	-	-	-
130	-	-	-	-	PDS	AINA20								Input/Output	PUPD	NA	SMT	Hi-Z	Hi-Z
131	-	-	-	-	PD4	AINA19								Input/Output	PUPD	NA	SMT	Hi-Z	Hi-Z
132	116	119	-	-	PF7	AINA18								Input/Output	PUPD	NA	SMT	Hi-Z	Hi-Z
133	117	120	-	-	PF6	AINA17								Input/Output	PUPD	NA	SMT	Hi-Z	Hi-Z
134	118	121	90	92	PF5	AINA16								Input/Output	PUPD	NA	SMT	Hi-Z	Hi-Z
135	119	122	91	93	PF4	AINA15								Input/Output	PUPD	NA	SMT	Hi-Z	Hi-Z
136	120	123	92	94	PF3	AINA14	INT32							Input/Output	PUPD	NA	SMT	Hi-Z	Hi-Z
137	121	124	93	95	PF2	AINA13	INT33							Input/Output	PUPD	NA	SMT	Hi-Z	Hi-Z
138	122	125	94	96	PF1	AINA12								Input/Output	PUPD	NA	SMT	Hi-Z	Hi-Z
139	123	126	95	97	PF0	AINA11								Input/Output	PUPD	NA	SMT	Hi-Z	Hi-Z
140	124	127	96	98	PE9	AINA10								Input/Output	PUPD	NA	SMT	Hi-Z	Hi-Z
141	125	128	97	99	PE8	AINA09								Input/Output	PUPD	NA	SMT	Hi-Z	Hi-Z
142	126	1	98	100	PE4	AINA08								Input/Output	PUPD	NA	SMT	Hi-Z	Hi-Z
143	127	2	99	1	PE3	AINA07								Input/Output	PUPD	NA	SMT	Hi-Z	Hi-Z
144	128	3	100	2	PE2	AINA06								Input/Output	PUPD	NA	SMT	Hi-Z	Hi-Z



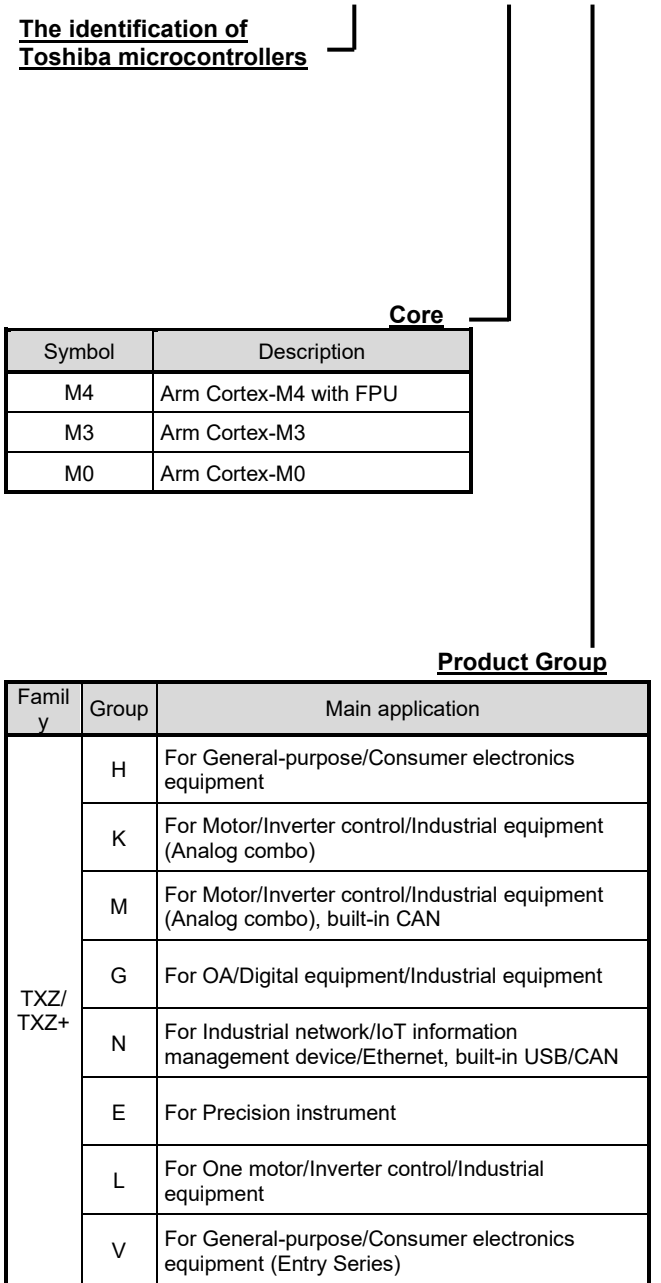
## List of All Pins (4)

M3HM (LQFP96)	M3HL (LQFP64)	Pin Name	Combination Function A	Combination Function B	Combination Function 1	Combination Function 2	Combination Function 3	Combination Function 4	Combination Function 5	Combination Function 6	Input/Output	Pull-up/ Pull-down	5V_T	SMT/ CMOS	Under Reset	After Reset
56	44	PJ0			UT1TXDB		T32A03OUTA	T32A03OUTC	U00	SEG22	Input/Output	PUPD	N/A	SMT	Hi-Z	Hi-Z
57	45	PJ1			UT1TXDA	UT1RXD	T32A03INA0	T32A03INC0	X00	SEG21	Input/Output	PUPD	N/A	SMT	Hi-Z	Hi-Z
58	46	PJ2			UT1RXD	UT1TXDA	T32A03INA1	T32A03INC1	Y00	SEG20	Input/Output	PUPD	N/A	SMT	Hi-Z	Hi-Z
59	47	PJ3			UT1CTS N	UT1RTS N	T32A03OUTB		Y00	SEG19	Input/Output	PUPD	N/A	SMT	Hi-Z	Hi-Z
60	48	PJ4			UT1RTS N	UT1CTS N	T32A03INB0		W00	SEG18	Input/Output	PUPD	N/A	SMT	Hi-Z	Hi-Z
61	49	PJ5		INT04			T32A03INB1		Z00	SEG17	Input/Output	PUPD	N/A	SMT	Hi-Z	Hi-Z
62	50	PK0			UT1TXDB				EMG0	SEG16	Input/Output	PUPD	N/A	SMT	Hi-Z	Hi-Z
63	51	PK1		INT05	UT1TXDA	UT1RXD			OV00	SEG15	Input/Output	PUPD	N/A	SMT	Hi-Z	Hi-Z
64	52	PK2			UT1RXD	UT1TXDA	T32A04OUTA	T32A04OUTC		SEG14	Input/Output	PUPD	N/A	SMT	Hi-Z	Hi-Z
65	53	PK3			UT1CTS N	UT1RTS N	T32A04INA0	T32A04INC0		SEG13	Input/Output	PUPD	N/A	SMT	Hi-Z	Hi-Z
66	54	PK4			UT1RTS N	UT1CTS N	T32A04INA1	T32A04INC1		SEG12	Input/Output	PUPD	N/A	SMT	Hi-Z	Hi-Z
67	55	PK5			UT6RXD	UT6TXDA	T32A04OUTB			SEG11	Input/Output	PUPD	N/A	SMT	Hi-Z	Hi-Z
68	56	PK6			UT6TXDA	UT6RXD	T32A04INB0			SEG10	Input/Output	PUPD	N/A	SMT	Hi-Z	Hi-Z
69	-	PK7		INT13	UT6TXDB		T32A04INB1			SEG09	Input/Output	PUPD	N/A	SMT	Hi-Z	Hi-Z
70	57	PP3		INT14	TSP3RXD					SEG08	Input/Output	PUPD	N/A	SMT	Hi-Z	Hi-Z
71	-	PP4			TSP3TXD					SEG07	Input/Output	PUPD	N/A	SMT	Hi-Z	Hi-Z
72	-	PP5			TSP3SCK					SEG06	Input/Output	PUPD	N/A	SMT	Hi-Z	Hi-Z
73	-	PP6			TSP3CS0	TSP3CSIN	PM00DBG			SEG05	Input/Output	PUPD	N/A	SMT	Hi-Z	Hi-Z
-	-	PP7			TSP3CS1					SEG04	Input/Output	PUPD	N/A	SMT	Hi-Z	Hi-Z
-	-	PV0								SEG03	Input/Output	PUPD	N/A	SMT	Hi-Z	Hi-Z
-	-	PV1								SEG02	Input/Output	PUPD	N/A	SMT	Hi-Z	Hi-Z
-	-	PV2		INT17						SEG01	Input/Output	PUPD	N/A	SMT	Hi-Z	Hi-Z
-	-	PV3		INT18						SEG00	Input/Output	PUPD	N/A	SMT	Hi-Z	Hi-Z
-	-	PV4									Input/Output	PUPD	N/A	SMT	Hi-Z	Hi-Z
-	-	DV0DSB									-	-	-	-	-	-
-	-	DVSSB									-	-	-	-	-	-
-	-	PD5	AINA20								Input/Output	PUPD	N/A	SMT	Hi-Z	Hi-Z
-	-	PD4	AINA19								Input/Output	PUPD	N/A	SMT	Hi-Z	Hi-Z
-	-	PF7	AINA18								Input/Output	PUPD	N/A	SMT	Hi-Z	Hi-Z
-	-	PF6	AINA17								Input/Output	PUPD	N/A	SMT	Hi-Z	Hi-Z
-	-	PF5	AINA16								Input/Output	PUPD	N/A	SMT	Hi-Z	Hi-Z
-	-	PF4	AINA15								Input/Output	PUPD	N/A	SMT	Hi-Z	Hi-Z
-	-	PF3	AINA14	INT32							Input/Output	PUPD	N/A	SMT	Hi-Z	Hi-Z
-	-	PF2	AINA13	INT33							Input/Output	PUPD	N/A	SMT	Hi-Z	Hi-Z
74	58	PF1	AINA12								Input/Output	PUPD	N/A	SMT	Hi-Z	Hi-Z
75	59	PF0	AINA11								Input/Output	PUPD	N/A	SMT	Hi-Z	Hi-Z
76	60	PE6	AINA10								Input/Output	PUPD	N/A	SMT	Hi-Z	Hi-Z
77	61	PE5	AINA09								Input/Output	PUPD	N/A	SMT	Hi-Z	Hi-Z
78	62	PE4	AINA08								Input/Output	PUPD	N/A	SMT	Hi-Z	Hi-Z
79	63	PE3	AINA07								Input/Output	PUPD	N/A	SMT	Hi-Z	Hi-Z
80	64	PE2	AINA06								Input/Output	PUPD	N/A	SMT	Hi-Z	Hi-Z

## Part Naming Conventions

# TMP M3 H Q F 10 x FG

The identification of  
Toshiba microcontrollers



### Revision

### Package

Symbol	Description
QG	Plastic shrink quad outline non-leaded package, dry-packed
UG, DUG, FG,DFG	Plastic quad flat package, dry-packed
MG,DMG	Plastic small outline package, dry-packed
XBG	Plastic ball grid array, dry-packed

### ROM size

Symbol	Size [KB]
M	32
P	48
S	64
U	96
W	128
Y	256
Z	384
D	512
E	768
10	1,024
15	1,536
20	2,048

### Product Group

Family	Group	Main application
TXZ/ TXZ+	H	For General-purpose/Consumer electronics equipment
	K	For Motor/Inverter control/Industrial equipment (Analog combo)
	M	For Motor/Inverter control/Industrial equipment (Analog combo), built-in CAN
	G	For OA/Digital equipment/Industrial equipment
	N	For Industrial network/IoT information management device/Ethernet, built-in USB/CAN
	E	For Precision instrument
	L	For One motor/Inverter control/Industrial equipment
	V	For General-purpose/Consumer electronics equipment (Entry Series)

### Pin Count

Symbol	Pin count	Symbol	Pin count		
0	G	32pin 以下	7	P	101pin to 128pin
1	H	33pin to 44pin	8	Q	129pin to 144pin
2	J	45pin to 48pin	9	R	145pin to 176pin
3	K	49pin to 52pin	A	S	177pin to 200pin
4	L	53pin to 64pin	B	T	201pin to 224pin
5	M	65pin to 80pin	C	U	225pin to 250pin
6	N	81pin to 100pin	D	V	251pin to 300pin

### ROM type

Symbol	Type
F	Flash

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