Arm® Cortex®-M
32-bit Microcontroller

KM1M4BF02/03/04/05 Series
KM1M4BF52/53/54 Series

Datasheet

The information described in this document is the exclusive intellectual property of Nuvoton Technology Corporation Japan and shall not be reproduced without permission from Nuvoton.

Nuvoton is providing this document only for reference purposes of KM1M4BF02/03/04/05/52/53/54 Series based system design.
Nuvoton assumes no responsibility for errors or omissions.
All data and specifications are subject to change without notice.

For additional information or questions, please contact Nuvoton Technology Corporation Japan.
www.nuvoton.co.jp

Request for your special attention and precautions in using the technical information and semiconductors described in this book

(1) If any of the products or technical information described in this book is to be exported or provided to non-residents, the laws and regulations of the exporting country, especially, those with regard to security export control, must be observed.

(2) The technical information described in this book is intended only to show the main characteristics and application circuit examples of the products. No license is granted in and to any intellectual property right or other right owned by Nuvoton Technology Corporation Japan or any other company. Therefore, no responsibility is assumed by our company as to the infringement upon any such right owned by any other company which may arise as a result of the use of technical information de-scribed in this book.

(3) The products described in this book are intended to be used for general applications (such as office equipment, communications equipment, measuring instruments and household appliances), or for specific applications as expressly stated in this book.
It is to be understood that our company shall not be held responsible for any damage caused as a result of the following special applications:
Special applications (such as for automotive, airplanes, aerospace, transport equipment, traffic signaling equipment, combustion equipment, medical equipment and safety devices) in which exceptional quality and reliability are required, or if the failure or malfunction of the products may directly jeopardize life or harm the human body.
It is to be understood that our company shall not be held responsible for any damage incurred as a result of or in connection with your using the products described in this book for any special application, unless our company agrees to your using the products in this book for any special application.

(4) When designing your equipment, comply with the range of absolute maximum rating and the guaranteed operating conditions (operating power supply voltage and operating environment etc.). Especially, please be careful not to exceed the range of absolute maximum rating on the transient state, such as power-on, power-off and mode-switching. Other-wise, we will not be liable for any defect which may arise later in your equipment.
Even when the products are used within the guaranteed values, take into the consideration of incidence of break down and failure mode, possible to occur to semiconductor products. Measures on the systems such as redundant design, arresting the spread of fire or preventing glitch are recommended in order to prevent physical injury, fire, social damages, for example, by using the products.

(5) Comply with the instructions for use in order to prevent breakdown and characteristics change due to external factors (ESD, EOS, thermal stress and mechanical stress) at the time of handling, mounting or at customer's process. We do not guarantee quality for disassembled products or the product re-mounted after removing from the mounting board. When using products for which damp-proof packing is required, satisfy the conditions, such as shelf life and the elapsed time since first opening the packages.

(6) When reselling products described in this book to other companies without our permission and receiving any claim of request from the resale destination, please understand that customers will bear the burden.

(7) This book may be not reprinted or reproduced whether wholly or partially, without the prior written permission of our company.

1. Overview

1.1 Overview

This LSI is a 32-bit microcontroller with internal Flash memory. It is intended for development of the C programming language with object-oriented program and is easy to use. It has fast feedback processing required for control of motor.

This LSI adopts the Arm Cortex-M4F to the 32-bit microcontroller part and are equipped with internal memory to instruction / data, DMA controller, clock generator, bus controller, interrupt controller, standard peripheral circuits (timer and serial interface and so on), PWM control circuit specialized for motor control, and high accuracy / high speed analog circuit.

As system safety design, this LSI has the various safety mechanisms (Memory-ECC, clock error detection, power supply voltage detection, window watchdog timer, etc.).

1.2 Product Summary

The LSI shown in Table Table 1.2-1 is described in this manual.

Table 1.2-1 Product Summary

LSI series	LSI product name	Pins	ROM [KB]		RAM [KB]	Package
			Instruction	Data	Data	
KM1M4BF0 series	KM1M4BF02K	100	264	32	16	14 mm x 14 mm 0.5 mm pitch
	KM1M4BF02G		136	8		
	KM1M4BF03K	80	264	32		12 mm x 12 mm 0.5 mm pitch
	KM1M4BF03G		136	8		
	KM1M4BF04K	64	264	32		10 mm x 10 mm 0.5 mm pitch
	KM1M4BF04G		136	8		
	KM1M4BF05G	48	136	8		7 mm x 7 mm 0.5 mm ptich
KM1M4BF5 series	KM1M4BF52K	100	264	32	16	14 mm x 14 mm 0.5 mm pitch
	KM1M4BF52G		136	8		
	KM1M4BF53K	80	264	32		12 mm x 12 mm 0.5 mm pitch
	KM1M4BF53G		136	8		
	KM1M4BF54K	64	264	32		10 mm x 10 mm 0.5 mm pitch
	KM1M4BF54G		136	8		

Hint:

In this manual, the product names are classified as follows.

KM1M4BFxyz (x = 0,5 y = 2,3,4,5 z = K,G)

Hint:

The difference between the KM1M4BF0 series and the KM1M4BF5 series is the allocation pins of the debug function (SWDCLK, SWDD).

1.2.1 Function Summary

Table 1.2-2 shows the functions of each product.

Table 1.2-2 The List of Function

Function		100 pins	80 pins	64 pins	48 pins
CPU		Arm Cortex-M4F			
General purpose pin		85	65	51	37
Operation mode	Active mode	NORMAL			
	Standby mode	SLEEP, DEEPSLEEP			
Debugger I/F	Interface	SWD			
DMA	CH number	8			
Interrupt	External interrupt	26			18
Timer	16-bit timer (timer 0 to 7, 10 to 15)	14			
	Power control PWM (GPWM0 to 7)	8			
Noise filter	Target pin	External interrupt, Timer input			
Communication I/F	Clock synchronous/ SPI/UART/IIC (serial 0 to 6)	7			4
12-bit A/D	AD0 CH number	11		9	
	AD1 CH number	12		11	10
	AD2 CH number	14	9	7	5
	Total CH number	23	18	13	10
Programmable gain amplifier(VGA)	Module number/CH number	2 / 6			
Comparator	Module number/CH number	4 / 2			
8-bit D/A	Module number	6			
10-bit D/A	CH number	1			
Safety function	Flash memory	ECC, Data protection			
	RAM	ECC			
	Access area	MPU (Area management, Protection), Register protect (Protection)			
	System	Window watchdog timer			
	Clock	Clock monitoring (External oscillation, PLL error detection)			
	Communication	CRC caluculation function			
	A/D converter	A/D converter error detection			
	Power supply voltage	POR, Power supply voltage detection			
	Reset	Detection of reset factor immediately before by reset factor register			

1.3 Features

The features of this LSI are described.

Functions	Features
CPU	- Arm Cortex-M4F Equipped with FPU: Single precision floating point unit, IEEE754 compliant Equipped with MPU: Memory protect unit, 8 area can be set
Memory	- ROM access I-FLASH: 120 MHz 2 wait access(Min), selectable from 2 to 7 D-FLASH: 120 MHz 5 wait access(Min), selectable from 2 to 7 - RAM access 120 MHz 0 wait access - Swap Function I-Flash: Supports swap function of Boot area and Program area
Clock	- HXOCLK (External oscillation) frequency: 4 to 20 MHz - HRCCLK (Internal high-speed oscillation) frequency : 10 MHz - PLLCLK PLL Input: External high-speed oscillation PLL Input frequency: 4 MHz to 20 MHz PLL Output frequency: 120 MHz to 240 MHz - BASECLK Selectable from HRCCLK/HXOCLK/PLLCLK Start with Internal high-speed oscillation when reset is released Switchable to HRCCLK when a clock error is detected - CPUCLK 1 to 8 dividing of BASECLK - IOCLK 2 to 16 dividing of CPUCLK Clock operation/stop can be selected for each peripheral module
Reset	- Hardware reset Power-On Reset - System Reset Reset by external pin(NRST) Reset by register setting Reset by error detection(WDT overflow, Clock error detection) - CPU Generation Reset Reset by writing to AIRCR - Reset factor can be monitored
Low power consumption	- SLEEP mode: Stop CPU clock only - DEEP SLEEP mode: Stop clocks including BASECLK
Interrupt	- Interrupt level: 16 levels - External interrupt: High/Low level, Rising/Falling/Both edge
DMA	- Transfer mode: Single word transfer mode, Burst transfer mode - Transfer unit: 8 bits/16 bits/32 bits - Maximum transfer count: 65535 words - Transfer factor: External interrupt, Peripheral module factor - Register reload count: Maximum 65535 times - Interrupt: DMA completion, reload count completion, bus error, transfer request overflow, invalid DMA transfer request
Noise filter	- Sampling type noise filter is inserted to external interrupt and timer input. - Select sampling clock

Functions	Features
16-bit timer	- Interval timer count, Event count, Up-down pulse count, Phase difference pulse count - Timer Output, PWM/complement Output(wave mode: saw-tooth waves), 1-shot Output, Chopping waveform Output - Input capture by external input - Timer count start by start trigger - A/D conversion start trigger Output - 32-bit cascade connection - Output protection: H/L/Hi-z Output can be selected, reading edge blanking can be set - Timer interrupt Output control - Task overflow detection function - PWM Output: Dead time insert, Output shift, Duty cut, Period cut
Power control PWM	- Complementary PWM Output (Wave mode: Triangular and saw-tooth waves) - Dead time insert, Output shift, H/L level Output can be set - Synchronous A/D conversion trigger - Interrupt Output control - Output protection: H/L/Hi-z Output can be select - Duty cut, period cut - Double buffer update
Synchronous SIF/SPI	- 2-wire/3-wire/4-wire - Transfer bits(2 bits to 8 bits) - MSB/LSB transfer - Clock polarity selection - Continuous communication - Output level after the final bit transmission(H/L/final data) - Maximum transfer rate: 10 Mbps (at master) / 5 Mbps (at slave)
UART	- 1-wire/2-wire - Character bits(5-bits to 8-bits) - Stop bits(1-bit/2-bit) - Parity bit: Enabled/Disabled, Parity bit type: 0/1/Even parity/Odd parity - MSB/LSB transfer - Maximum transfer rate: 3.3 Mbps
IIC	- Master/Slave communication - Start condition selection: Enable/Disable - MSB/LSB transfer selection - Transfer format: 7-bit address format, 10-bit address format - Maximum transfer rate: Standard Mode: 100 kbps, Fast Mode: 400 kbps
12-bit A/D	- Timer 0 to 7, Timer 10 to 15, GPWM0 to 7 etc can be started synchronously - Conversion error detection - Conversion state Output - Start trigger reduction function
VGA	- Gain selection(2, 3, 4, 5, 6, 8, 10, 20 times) - Set Output reference voltage by 8-bit DAC
Comparator	- Hysteresis ON/OFF - Set reference voltage by 8-bit DAC - Sampling type noise filter is inserted to comparator Output - Detection mode can be selected from 1 level / 2 levels or window detection mode
8-bit D/A	- VGA Output reference voltage can be generated - Comparator reference voltage can be generated
10-bit D/A	- Output the set DC voltage
Multi feedback assist	- Set the start timing of timer 0 to 7, and GPWM 0 to 7 individually - Detect/Automatically avoid the competition of timer 0 to 7 and GPWM 0 to 7 and AD conversion start - Mask(Blanking) the external interrupt detection, comparator of timer 0 to 7 and GPWM 0 to 7 Output
CRC caluculation	- CRC-32/MPEG2, CRC-16-CCITT, CRC-8-ATM symbol can be generated

Functions	Features
Safety function	- ECC function Check area: I-FLASH, D-FLASH, RAM 2 bit random error detection - Flash Erase/Program protect function - Function to protect write access to main register - Clock monitor function - Window watchdog timer(internal oscillation count) - Power supply voltage detection - ADC fault diagnosis function which is used for internal power supply

1.4 Pins

The specifications of pins in this LSI are described as follows.

- Pin configuration
- Pin function

1.4.1 Pin Configuration (KM1M4BF0 Series)

Figure 1.4-1 shows the pin configuration of 100 pins.

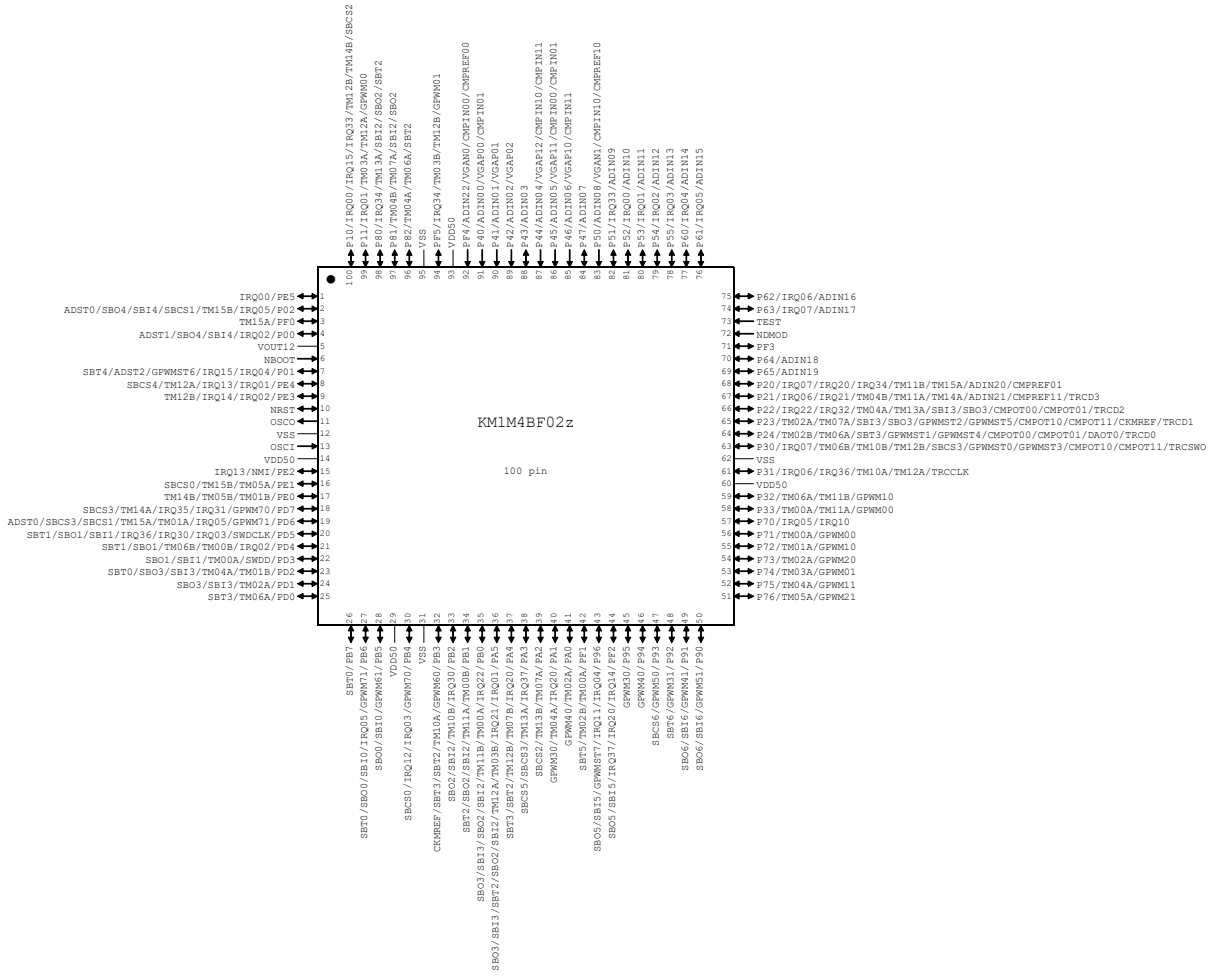


Figure 1.4-1 Pin Configuration Figure of 100 pins (KM1M4BF02z)

Figure 1.4-2 shows the pin configuration of 80 pins.

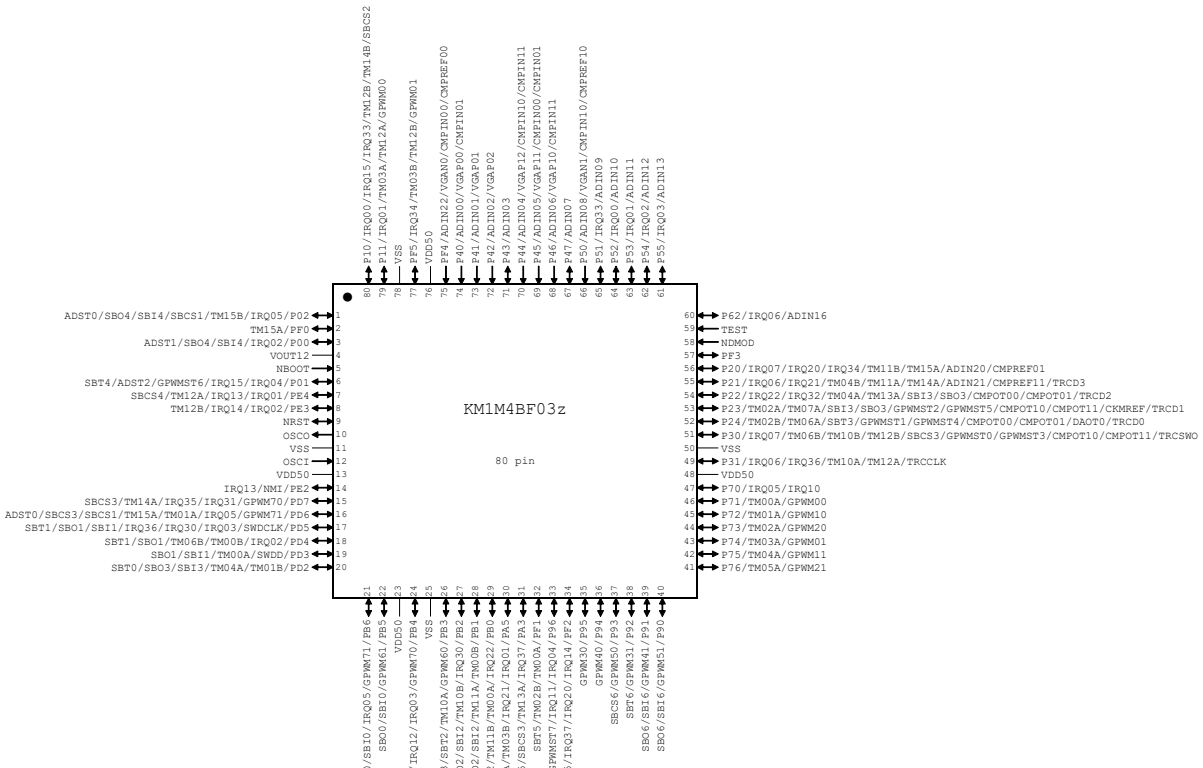


Figure 1.4-2 Pin Configuration Figure of 80 pins (KM1M4BF03z)

Figure 1.4-3 shows the pin configuration of 64 pins.

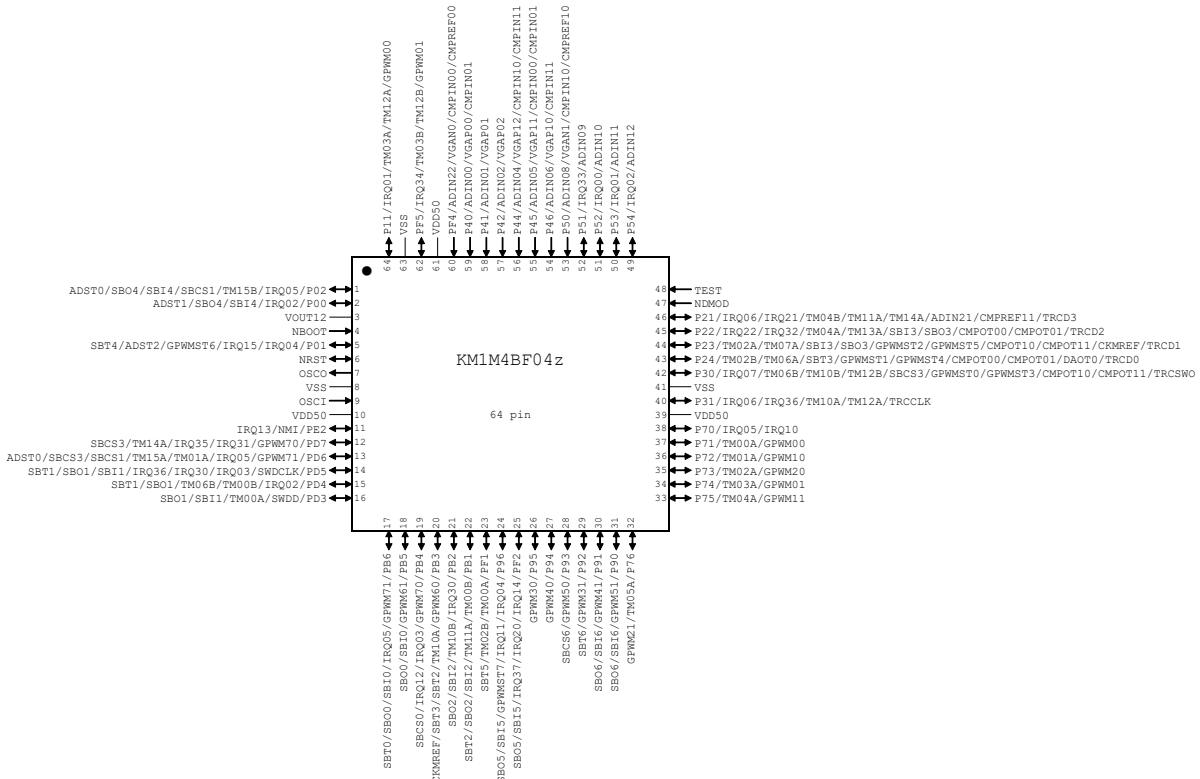


Figure 1.4-3 Pin Configuration Figure of 64 pins (KM1M4BF04z)

Figure 1.4-4 shows the pin configuration of 48 pins.

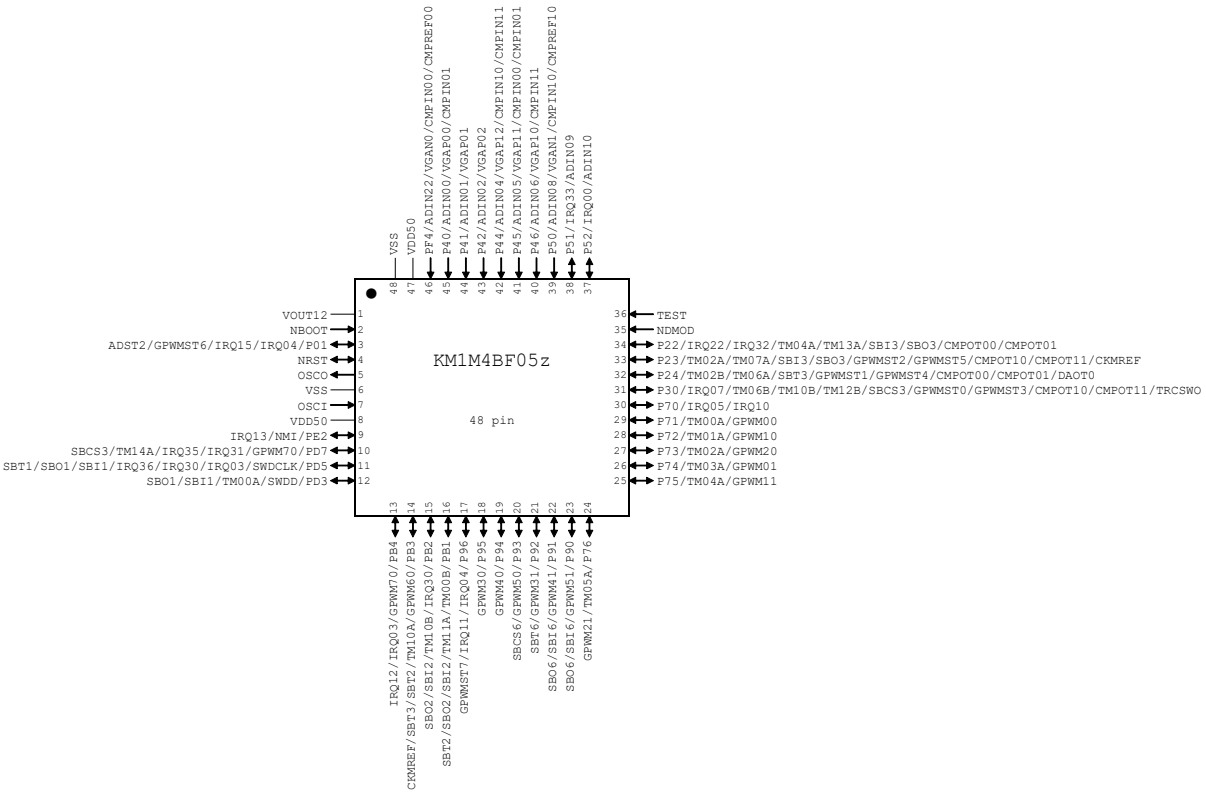


Figure 1.4-4 Pin Configuration Figure of 48 pins (KM1M4BF05z)

1.4.2 Pin Configuration (KM1M4BF5 Series)

Figure 1.4-5 shows the pin configuration of 100 pins.

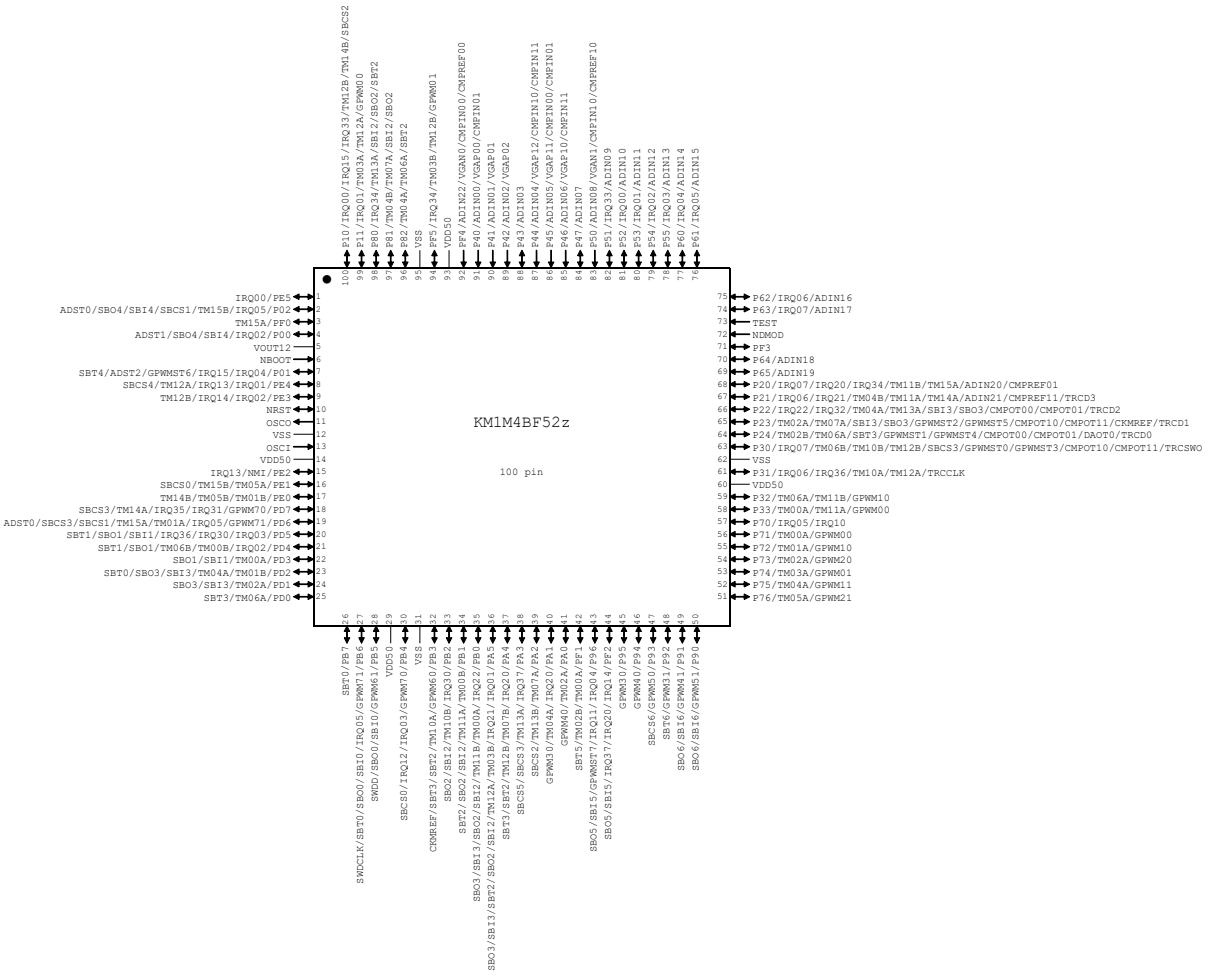


Figure 1.4-5 Pin Configuration Figure of 100 pins (KM1M4BF52z)

Figure 1.4-6 shows the pin configuration of 80 pins.

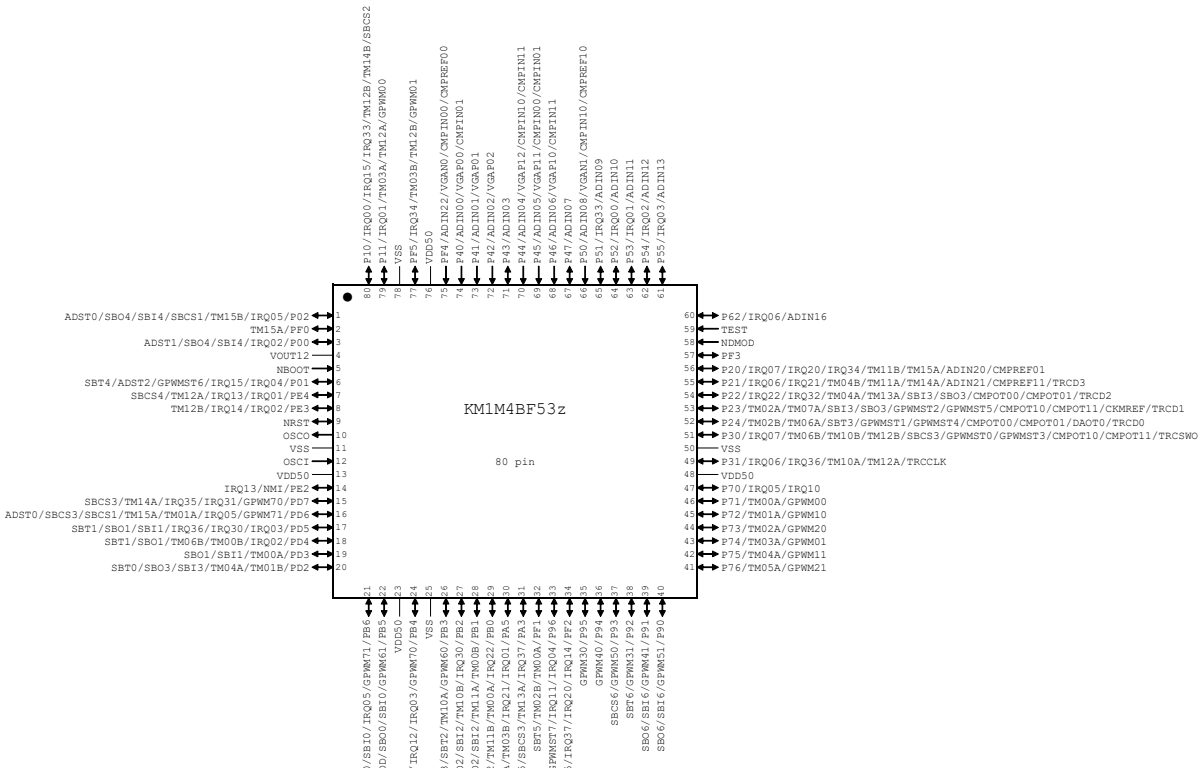


Figure 1.4-6 Pin Configuration Figure of 80 pins (KM1M4BF53z)

Figure 1.4-7 shows the pin configuration of 64 pins.

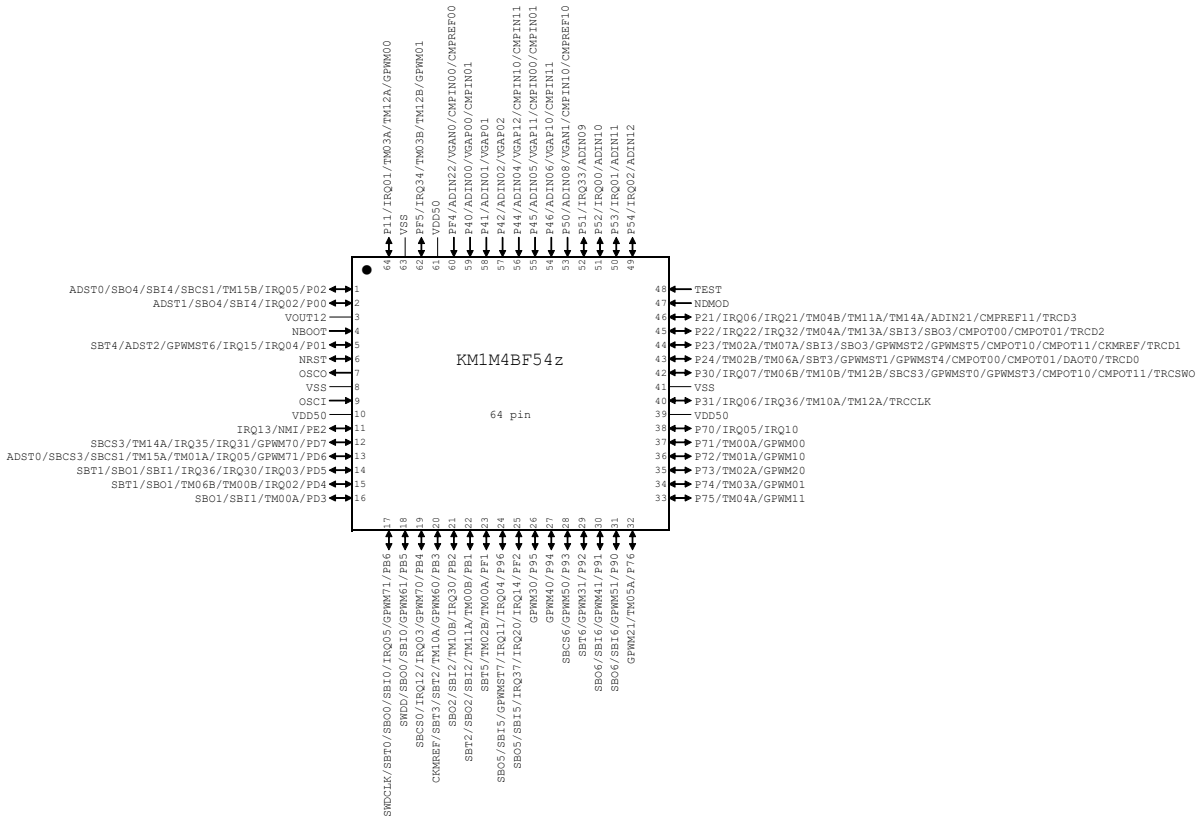


Figure 1.4-7 Pin Configuration Figure of 64 pins (KM1M4BF54z)

1.4.3 Pin Functions (KM1M4BF0 Series)

The pin functions are listed in Table 1.4-1 and Table 1.4-2 .

Table 1.4-1 Pin Functions (for each pin)

100 pins Pin No.	80 pins Pin No.	64 pins Pin No.	48 pins Pin No.	Power, Clock, System	Port	Timer	Communica-tion	Other
1	-	-	-	-	PE5	-	-	IRQ00
2	1	1	-	-	P02	TM15B	SBCS1, SBI4, SBO4	IRQ05, ADST0
3	2		-	-	PF0	TM15A	-	-
4	3	2	-	-	P00	-	SBI4, SBO4	IRQ02, ADST1
5	4	3	1	VOUT12	-	-	-	-
6	5	4	2	NBOOT	-	-	-	-
7	6	5	3	-	P01	GPWMST6	SBT4(*)	IRQ04, IRQ15, ADST2
8	7	-	-	-	PE4	TM12A	SBCS4	IRQ01, IRQ13
9	8	-	-	-	PE3	TM12B	-	IRQ02, IRQ14
10	9	6	4	NRST	-	-	-	-
11	10	7	5	OSCO	-	-	-	-
12	11	8	6	VSS	-	-	-	-
13	12	9	7	OSCI	-	-	-	-
14	13	10	8	VDD50	-	-	-	-
15	14	11	9	-	PE2	-	-	NMI, IRQ13
16	-	-	-	-	PE1	TM05A, TM15B	SBCS0	-
17	-	-	-	-	PE0	TM01B, TM05B, TM14B	-	-
18	15	12	10	-	PD7	GPWM70, TM14A	SBCS3	IRQ31, IRQ35
19	16	13	-	-	PD6	GPWM71, TM01A, TM15A	SBCS1, SBCS3	IRQ05, ADST0
20	17	14	11	-	PD5	-	SBI1, SBO1, SBT1	IRQ03, IRQ30, IRQ36, SWDCLK
21	18	15	-	-	PD4	TM00B, TM06B	SBO1, SBT1	IRQ02
22	19	16	12	-	PD3	TM00A	SBI1, SBO1	SWDD

100 pins Pin No.	80 pins Pin No.	64 pins Pin No.	48 pins Pin No.	Power, Clock, System	Port	Timer	Communica-tion	Other
23	20	-	-	-	PD2	TM01B, TM04A	SBI3, SBO3, SBT0	-
24	-	-	-	-	PD1	TM02A	SBI3, SBO3	-
25	-	-	-	-	PD0	TM06A	SBT3	-
26	-	-	-	-	PB7		SBT0	-
27	21	17	-	-	PB6	GPWM71	SBI0, SBO0, SBT0	IRQ05
28	22	18	-	-	PB5	GPWM61	SBI0, SBO0	-
29	23	-	-	VDD50	-	-	-	-
30	24	19	13	-	PB4	GPWM70	SBCS0(*)	IRQ03, IRQ12
31	25	-	-	VSS	-	-	-	-
32	26	20	14	-	PB3	GPWM60, TM10A	SBT2, SBT3	CKMREF
33	27	21	15	-	PB2	TM10B	SBI2, SBO2	IRQ30
34	28	22	16	-	PB1	TM00B, TM11A	SBI2, SBO2, SBT2	-
35	29	-	-	-	PB0	TM00A, TM11B	SBI2, SBO2, SBI3, SBO3	IRQ22
36	30	-	-	-	PA5	TM03B, TM12A	SBI2, SBO2, SBT2, SBI3, SBO3	IRQ01, IRQ21
37	-	-	-	-	PA4	TM07B, TM12B	SBT2, SBT3	IRQ20
38	31	-	-	-	PA3	TM13A	SBCS3, SBCS5	IRQ37
39	-	-	-	-	PA2	TM07A, TM13B	SBCS2	-
40	-	-	-	-	PA1	TM04A, GPWM30	-	IRQ20
41	-	-	-	-	PA0	TM02A, GPWM40	-	-
42	32	23	-	-	PF1	TM00A, TM02B	SBT5	-
43	33	24	17	-	P96	GPWMST7	SBI5(*), SBO5(*)	IRQ04, IRQ11
44	34	25	-	-	PF2	-	SBI5, SBO5	IRQ14, IRQ20, IRQ37

100 pins Pin No.	80 pins Pin No.	64 pins Pin No.	48 pins Pin No.	Power, Clock, System	Port	Timer	Communica-tion	Other
45	35	26	18	-	P95	GPWM30	-	-
46	36	27	19	-	P94	GPWM40	-	-
47	37	28	20	-	P93	GPWM50	SBCS6	-
48	38	29	21	-	P92	GPWM31	SBT6	-
49	39	30	22	-	P91	GPWM41	SBI6, SBO6	-
50	40	31	23	-	P90	GPWM51	SBI6, SBO6	-
51	41	32	24	-	P76	TM05A, GPWM21	-	-
52	42	33	25	-	P75	TM04A, GPWM11	-	-
53	43	34	26	-	P74	TM03A, GPWM01	-	-
54	44	35	27	-	P73	TM02A, GPWM20	-	-
55	45	36	28	-	P72	TM01A, GPWM10	-	-
56	46	37	29	-	P71	TM00A, GPWM00	-	-
57	47	38	30	-	P70	-	-	IRQ05, IRQ10
58	-	-	-	-	P33	TM00A, TM11A, GPWM00	-	-
59	-	-	-	-	P32	TM06A, TM11B, GPWM10	-	-
60	48	39	-	VDD50	-	-	-	-
61	49	40	-	-	P31	TM10A, TM12A	-	IRQ06, IRQ36, TRCCLK
62	50	41	-	VSS	-	-	-	-
63	51	42	31	-	P30	TM06B, TM10B, TM12B	SBCS3	IRQ07, GPWMST0, GPWMST3, CMPOT10, CMPOT11, TRCSWO
64	52	43	32	-	P24	TM02B, TM06A	SBT3	GPWMST1, GPWMST4, CMPOT00, CMPOT01, DAOT0, TRCD0(*)

100 pins Pin No.	80 pins Pin No.	64 pins Pin No.	48 pins Pin No.	Power, Clock, System	Port	Timer	Communica-tion	Other
65	53	44	33	-	P23	TM02A, TM07A	SBI3, SBO3	GPWMST2, GPWMST5, CMPOT10, CMPOT11, CKMREF, TRCD1(*)
66	54	45	34	-	P22	TM04A, TM13A	SBI3, SBO3	IRQ22, IRQ32, CMPOT00, CMPOT01, TRCD2(*)
67	55	46	-	-	P21	TM04B, TM11A, TM14A	-	IRQ06, IRQ21, ADIN21, CMPREF11, TRCD3(*)
68	56	-	-	-	P20	TM11B, TM15A	-	IRQ07, IRQ20, IRQ34, ADIN20, CMPREF01
69	-	-	-	-	P65	-	-	ADIN19
70	-	-	-	-	P64	-	-	ADIN18
71	57	-	-	-	PF3	-	-	-
72	58	47	35	NDMOD	-	-	-	-
73	59	48	36	TEST	-	-	-	-
74	-	-	-	-	P63	-	-	IRQ07, ADIN17
75	60	-	-	-	P62	-	-	IRQ06, ADIN16
76	-	-	-	-	P61	-	-	IRQ05, ADIN15
77	-	-	-	-	P60	-	-	IRQ04, ADIN14
78	61	-	-	-	P55	-	-	IRQ03, ADIN13
79	62	49	-	-	P54	-	-	IRQ02, ADIN12
80	63	50	-	-	P53	-	-	IRQ01, ADIN11(*)
81	64	51	37	-	P52	-	-	IRQ00, ADIN10
82	65	52	38	-	P51	-	-	IRQ33, ADIN09
83	66	53	39	-	P50	-	-	ADIN08, VGAN1, CMPIN10, CMPREF10
84	67	-	-	-	P47	-	-	ADIN07

100 pins Pin No.	80 pins Pin No.	64 pins Pin No.	48 pins Pin No.	Power, Clock, System	Port	Timer	Communica-tion	Other
85	68	54	40	-	P46	-	-	ADIN06, VGAP10, CMPIN11
86	69	55	41	-	P45	-	-	ADIN05, VGAP11, CMPIN00, CMPIN01
87	70	56	42	-	P44	-	-	ADIN04, VGAP12, CMPIN10, CMPIN11
88	71	-	-	-	P43	-	-	ADIN03
89	72	57	43	-	P42	-	-	ADIN02, VGAP02
90	73	58	44	-	P41	-	-	ADIN01, VGAP01
91	74	59	45	-	P40	-	-	ADIN00, VGAP00, CMPIN01
92	75	60	46	-	PF4	-	-	ADIN22, VGAN0, CMPIN00, CMPREF00
93	76	61	47	VDD50	-	-	-	-
94	77	62	-	-	PF5	TM03B, TM12B, GPWM01	-	IRQ34
95	78	63	48	VSS	-	-	-	-
96	-	-	-	-	P82	TM04A, TM06A	SBT2	-
97	-	-	-	-	P81	TM04B, TM07A	SBI2, SBO2	-
98	-	-	-	-	P80	TM13A	SBI2, SBO2, SBT2	IRQ34
99	79	64	-	-	P11	TM03A, TM12A, GPWM00	-	IRQ01
100	80	-	-	-	P10	TM12B, TM14B	SBCS2	IRQ00, IRQ15, IRQ33

Note:

* Only 100pins, 80pins and 64pins are included

Table 1.4-2 Pin Functions (for each function)

Functions	Pin name	100 pins Pin No.	80 pins Pin No.	64 pins Pin No.	48 pins Pin No.	I/O
External power pin	VDD50	14, 29, 60, 93	13, 23, 48, 76	10, 39, 61	8, 47	Input
Power pin for internal circuit	VOUT12	5	4	3	1	Output
GND	VSS	12, 31, 62, 95	11, 25, 50, 78	8, 41, 63	6, 48	Input
Debugger	SWDCLK	20	17	14	11	Input
	SWDD	22	19	16	12	I/O
	TRCCLK	61	49	40	-	Output
	TRCSWO	63	51	42	31	Output
	TRCD0	64	52	43	-	Output
	TRCD1	65	53	44	-	Output
	TRCD2	66	54	45	-	Output
	TRCD3	67	55	46	-	Output
External oscillation	OSCI	13	12	9	7	Input
	OSCO	11	10	7	5	Output
Reset	NRST	10	9	6	4	Input
Mode pin	NBOOT	6	5	4	2	Input
	NDMOD	72	58	47	35	Input
	TEST	73	59	48	36	Input
Clock Monitoring	CKMREF	32, 65	26, 53	20, 44	14, 33	Input
External interrupt	NMI	15	14	11	9	Input
	IRQ00	1, 81, 100	64, 80	51	37	Input
	IRQ01	8, 36, 80, 99	7, 30, 63, 79	50, 64	-	Input
	IRQ02	4, 9, 21, 79,	3, 8, 18, 62	2, 15, 49	-	Input
	IRQ03	20, 30, 78	17, 24, 61	14, 19	11, 13	Input
	IRQ04	7, 43, 77	6, 33	5, 24	3, 17	Input
	IRQ05	2, 19, 27, 57, 76	1, 16, 21, 47	1, 13, 17, 38	30	Input
	IRQ06	61, 67, 75	49, 55, 60	40, 46	-	Input
	IRQ07	63, 68, 74	51, 56	42	31	Input
	IRQ10	57	47	38	30	Input
	IRQ11	43	33	24	17	Input
	IRQ12	30	24	19	13	Input
	IRQ13	8, 15	7, 14	11	9	Input
	IRQ14	9, 44	8, 34	25	-	Input
	IRQ15	7, 100	6, 80	5	3	Input
	IRQ20	37, 40, 44, 68	34, 56	25	-	Input
	IRQ21	36, 67	30, 55	46	-	Input

Functions	Pin name	100 pins Pin No.	80 pins Pin No.	64 pins Pin No.	48 pins Pin No.	I/O
External interrupt	IRQ22	35, 66	29, 54	45	34	Input
	IRQ30	20, 33	17, 27	14, 21	11, 15	Input
	IRQ31	18	15	12	10	Input
	IRQ32	66	54	45	34	Input
	IRQ33	82, 100	65, 80	52	38	Input
	IRQ34	68, 94, 98	56, 77	62	-	Input
	IRQ35	18	15	12	10	Input
	IRQ36	20, 61	17, 49	14, 40	11	Input
	IRQ37	38, 44	31, 34	25	-	Input
16-bit timer	TM00A	22, 35, 42, 56, 58	19, 29, 32, 46	16, 23, 37	12, 29	I/O
	TM00B	21, 34,	18, 28	15, 22	16	I/O
	TM01A	19, 55	16, 45	13, 36	28	I/O
	TM01B	17, 23	20	-	-	I/O
	TM02A	24, 41, 54, 65	44, 53	35, 44	27, 33	I/O
	TM02B	42, 64	32, 52	23, 43	32	I/O
	TM03A	53, 99	43, 79	34, 64	26	I/O
	TM03B	36, 94	30, 77	62	-	I/O
	TM04A	23, 40, 52, 66, 96	20, 42, 54	33, 45	25, 34	I/O
	TM04B	67, 97	55	46	-	I/O
	TM05A	16, 51	41	32	24	I/O
	TM05B	17	-	-	-	I/O
	TM06A	25, 59, 64, 96	52	43	32	I/O
	TM06B	21, 63	18, 51	15, 42	31	I/O
	TM07A	39, 65, 97	53	44	33	I/O
	TM07B	37	-	-	-	I/O
	TM10A	32, 61	26, 49	20, 40	14	I/O
	TM10B	33, 63	27, 51	21, 42	15, 31	I/O
	TM11A	34, 58, 67	28, 55	22, 46	16	I/O
	TM11B	35, 59, 68	29, 56	-	-	I/O
	TM12A	8, 36, 61, 99	7, 30, 49, 79	40, 64	-	I/O
	TM12B	9, 37, 63, 94, 100	8, 51, 77, 80	42, 62	31	I/O
	TM13A	38, 66, 98	31, 54	45	34	I/O
	TM13B	39	-	-	-	I/O
	TM14A	18, 67	15, 55	12, 46	10	I/O
	TM14B	17, 100	80	-	-	I/O
	TM15A	3, 19, 68	2, 16, 56	13	-	I/O
	TM15B	2, 16	1	1	-	I/O

Functions	Pin name	100 pins Pin No.	80 pins Pin No.	64 pins Pin No.	48 pins Pin No.	I/O
Power control PWM output	GPWM00	56, 58, 99	46, 79	37, 64	29	Output
	GPWM01	53, 94	43, 77	34, 62	26	Output
	GPWM10	55, 59	45	36	28	Output
	GPWM11	52	42	33	25	Output
	GPWM20	54	44	35	27	Output
	GPWM21	51	41	32	24	Output
	GPWM30	40, 45	35	26	18	Output
	GPWM31	48	38	29	21	Output
	GPWM40	41, 46	36	27	19	Output
	GPWM41	49	39	30	22	Output
	GPWM50	47	37	28	20	Output
	GPWM51	50	40	31	23	Output
	GPWM60	32	26	20	14	Output
	GPWM61	28	22	18	-	Output
	GPWM70	18, 30	15, 24	12, 19	10, 13	Output
	GPWM71	19, 27	16, 21	13, 17	-	Output
Power control PWM monitor	GPWMST0	63	51	42	31	Output
	GPWMST1	64	52	43	32	Output
	GPWMST2	65	53	44	33	Output
	GPWMST3	63	51	42	31	Output
	GPWMST4	64	52	43	32	Output
	GPWMST5	65	53	44	33	Output
	GPWMST6	7	6	5	3	Output
	GPWMST7	43	33	24	17	Output

Functions	Pin name	100 pins Pin No.	80 pins Pin No.	64 pins Pin No.	48 pins Pin No.	I/O
Serial interface	SBCS0	16, 30	24	19	-	I/O
	SBI0	27, 28	21, 22	17, 18	-	Input
	SBO0	27, 28	21, 22	17, 18	-	I/O
	SBT0	23, 26, 27	20, 21	17	-	I/O
	SBCS1	2, 19	1, 16	1, 13	-	I/O
	SBI1	20, 22	17, 19	14, 16	11, 12	Input
	SBO1	20, 21, 22	17, 18, 19	14, 15, 16	11, 12	I/O
	SBT1	20, 21	17, 18	14, 15	11	I/O
	SBCS2	39, 100	80	-	-	I/O
	SBI2	33, 34, 35, 36, 97, 98	27, 28, 29, 30	21, 22	15, 16	Input
	SBO2	33, 34, 35, 36, 97, 98	27, 28, 29, 30	21, 22	15, 16	I/O
	SBT2	32, 34, 36, 37, 96, 98	26, 28, 30	20, 22	14, 16	I/O
	SBCS3	18, 19, 38, 63	15, 16, 31, 51	12, 13, 42	10, 31	I/O
	SBI3	23, 24, 35, 36, 65, 66	20, 29, 30, 53, 54	44, 45	33, 34	Input
	SBO3	23, 24, 35, 36, 65, 66	20, 29, 30, 53, 54	44, 45	33, 34	I/O
	SBT3	25, 32, 37, 64	26, 52	20, 43	14, 32	I/O
	SBCS4	8	7	-	-	I/O
	SBI4	2, 4	1, 3	1, 2	-	Input
	SBO4	2, 4	1, 3	1, 2	-	I/O
	SBT4	7	6	5	-	I/O
	SBCS5	38	31	-	-	I/O
	SBI5	43, 44	33, 34	24, 25	-	Input
	SBO5	43, 44	33, 34	24, 25	-	I/O
	SBT5	42	32	23	-	I/O
	SBCS6	47	37	28	20	I/O
	SBI6	49, 50	39, 40	30, 31	22, 23	Input
	SBO6	49, 50	39, 40	30, 31	22, 23	I/O
	SBT6	48	38	29	21	I/O

Functions	Pin name	100 pins Pin No.	80 pins Pin No.	64 pins Pin No.	48 pins Pin No.	I/O
A/D input	ADIN00	91	74	59	45	Input
	ADIN01	90	73	58	44	Input
	ADIN02	89	72	57	43	Input
	ADIN03	88	71	-	-	Input
	ADIN04	87	70	56	42	Input
	ADIN05	86	69	55	41	Input
	ADIN06	85	68	54	40	Input
	ADIN07	84	67	-	-	Input
	ADIN08	83	66	53	39	Input
	ADIN09	82	65	52	38	Input
	ADIN10	81	64	51	37	Input
	ADIN11	80	63	50	-	Input
	ADIN12	79	62	49	-	Input
	ADIN13	78	61	-	-	Input
	ADIN14	77	-	-	-	Input
	ADIN15	76	-	-	-	Input
	ADIN16	75	60	-	-	Input
	ADIN17	74	-	-	-	Input
	ADIN18	70	-	-	-	Input
	ADIN19	69	-	-	-	Input
	ADIN20	68	56	-	-	Input
	ADIN21	67	55	46	-	Input
	ADIN22	92	75	60	46	Input
A/D monitor	ADST0	2, 19	1, 16	1, 13	-	Output
	ADST1	4	3	2	-	Output
	ADST2	7	6	5	3	Output
VGA input	VGAP00	91	74	59	45	Input
	VGAP01	90	73	58	44	Input
	VGAP02	89	72	57	43	Input
	VGAN0	92	75	60	46	Input
	VGAP10	85	68	54	40	Input
	VGAP11	86	69	55	41	Input
	VGAP12	87	70	56	42	Input
	VGAN1	83	66	53	39	Input
Comarator input	CMPIN00	86, 92	69, 75	55, 60	41, 46	Input
	CMPIN01	86, 91	69, 74	55, 59	41, 45	Input
	CMPREF00	92	75	60	46	Input
	CMPREF01	68	56	-	-	Input
	CMPIN10	83, 87	66, 70	53, 56	39, 42	Input
	CMPIN11	85, 87	68, 70	54, 56	40, 42	Input
	CMPREF10	83	66	53	39	Input
	CMPREF11	67	55	46	-	Input

Functions	Pin name	100 pins Pin No.	80 pins Pin No.	64 pins Pin No.	48 pins Pin No.	I/O
Comarator output	CMPOT00	64, 66	52, 54	43, 45	32, 34	Output
	CMPOT01	64, 66	52, 54	43, 45	32, 34	Output
	CMPOT10	63, 65	51, 53	42, 44	31, 33	Output
	CMPOT11	63, 65	51, 53	42, 44	31, 33	Output
D/A output	DAOT0	64	52	43	32	Output
I/O port	P00	4	3	2	-	I/O
	P01	7	6	5	3	I/O
	P02	2	1	1	-	I/O
	P10	100	80	-	-	I/O
	P11	99	79	64	-	I/O
	P20	68	56	-	-	I/O
	P21	67	55	46	-	I/O
	P22	66	54	45	34	I/O
	P23	65	53	44	33	I/O
	P24	64	52	43	32	I/O
	P30	63	51	42	31	I/O
	P31	61	49	40	-	I/O
	P32	59	-	-	-	I/O
	P33	58	-	-	-	I/O
	P40	91	74	59	45	Input
	P41	90	73	58	44	Input
	P42	89	72	57	43	Input
	P43	88	71	-	-	I/O
	P44	87	70	56	42	Input
	P45	86	69	55	41	Input
	P46	85	68	54	40	Input
	P47	84	67	-	-	I/O
	P50	83	66	53	39	Input
	P51	82	65	52	38	I/O
	P52	81	64	51	37	I/O
	P53	80	63	50	-	I/O
	P54	79	62	49	-	I/O
	P55	78	61	-	-	I/O
	P60	77	-	-	-	I/O
	P61	76	-	-	-	I/O
	P62	75	60	-	-	I/O
	P63	74	-	-	-	I/O
	P64	70	-	-	-	I/O
	P65	69	-	-	-	I/O

Functions	Pin name	100 pins Pin No.	80 pins Pin No.	64 pins Pin No.	48 pins Pin No.	I/O
I/O port	P70	57	47	38	30	I/O
	P71	56	46	37	29	I/O
	P72	55	45	36	28	I/O
	P73	54	44	35	27	I/O
	P74	53	43	34	26	I/O
	P75	52	42	33	25	I/O
	P76	51	41	32	24	I/O
	P80	98	-	-	-	I/O
	P81	97	-	-	-	I/O
	P82	96	-	-	-	I/O
	P90	50	40	31	23	I/O
	P91	49	39	30	22	I/O
	P92	48	38	29	21	I/O
	P93	47	37	28	20	I/O
	P94	46	36	27	19	I/O
	P95	45	35	26	18	I/O
	P96	43	33	24	17	I/O
	PA0	41	-	-	-	I/O
	PA1	40	-	-	-	I/O
	PA2	39	-	-	-	I/O
	PA3	38	31	-	-	I/O
	PA4	37	-	-	-	I/O
	PA5	36	30	-	-	I/O
	PB0	35	29	-	-	I/O
	PB1	34	28	22	16	I/O
	PB2	33	27	21	15	I/O
	PB3	32	26	20	14	I/O
	PB4	30	24	19	13	I/O
	PB5	28	22	18	-	I/O
	PB6	27	21	17	-	I/O
	PB7	26	-	-	-	I/O
	PD0	25	-	-	-	I/O
	PD1	24	-	-	-	I/O
	PD2	23	20	-	-	I/O
	PD3	22	19	16	12	I/O
	PD4	21	18	15	-	I/O
	PD5	20	17	14	11	I/O
	PD6	19	16	13	-	I/O
	PD7	18	15	12	10	I/O

Functions	Pin name	100 pins Pin No.	80 pins Pin No.	64 pins Pin No.	48 pins Pin No.	I/O
I/O port	PE0	17	-	-	-	I/O
	PE1	16	-	-	-	I/O
	PE2	15	14	11	9	I/O
	PE3	9	8	-	-	I/O
	PE4	8	7	-	-	I/O
	PE5	1	-	-	-	I/O
	PF0	3	2	-	-	I/O
	PF1	42	32	23	-	I/O
	PF2	44	34	25	-	I/O
	PF3	71	57	-	-	I/O
	PF4	92	75	60	46	Input
	PF5	94	77	62	-	I/O

Note:

For pins to which multiple functions can be assigned, set only one to be valid.

Example: For 100 pins, it is prohibited to select No.27 and No.28 as SBO0 pin at the same time.

1.4.4 Pin Functions (KM1M4BF5 Series)

The pin functions are listed in Table 1.4-3 and Table 1.4-4 .

Table 1.4-3 Pin Functions (for each pin)

100 pins Pin No.	80 pins Pin No.	64 pins Pin No.	Power, Clock, System	Port	Timer	Communica-tion	Other
1	-	-	-	PE5	-	-	IRQ00
2	1	1	-	P02	TM15B	SBCS1, SBI4, SBO4	IRQ05, ADST0
3	2		-	PF0	TM15A	-	-
4	3	2	-	P00	-	SBI4, SBO4	IRQ02, ADST1
5	4	3	VOUT12	-	-	-	-
6	5	4	NBOOT	-	-	-	-
7	6	5	-	P01	GPWMST6	SBT4	IRQ04, IRQ15, ADST2
8	7	-	-	PE4	TM12A	SBCS4	IRQ01, IRQ13
9	8	-	-	PE3	TM12B	-	IRQ02, IRQ14
10	9	6	NRST	-	-	-	-
11	10	7	OSCO	-	-	-	-
12	11	8	VSS	-	-	-	-
13	12	9	OSCI	-	-	-	-
14	13	10	VDD50	-	-	-	-
15	14	11	-	PE2	-	-	NMI, IRQ13
16	-	-	-	PE1	TM05A, TM15B	SBCS0	-
17	-	-	-	PE0	TM01B, TM05B, TM14B	-	-
18	15	12	-	PD7	GPWM70, TM14A	SBCS3	IRQ31, IRQ35
19	16	13	-	PD6	GPWM71, TM01A, TM15A	SBCS1, SBCS3	IRQ05, ADST0
20	17	14	-	PD5	-	SBI1, SBO1, SBT1	IRQ03, IRQ30, IRQ36
21	18	15	-	PD4	TM00B, TM06B	SBO1, SBT1	IRQ02
22	19	16	-	PD3	TM00A	SBI1, SBO1	

100 pins Pin No.	80 pins Pin No.	64 pins Pin No.	Power, Clock, System	Port	Timer	Communica-tion	Other
23	20	-	-	PD2	TM01B, TM04A	SBI3, SBO3, SBT0	-
24	-	-	-	PD1	TM02A	SBI3, SBO3	-
25	-	-	-	PD0	TM06A	SBT3	-
26	-	-	-	PB7		SBT0	-
27	21	17	-	PB6	GPWM71	SBI0, SBO0, SBT0	IRQ05, SWDCLK
28	22	18	-	PB5	GPWM61	SBI0, SBO0	SWDD
29	23	-	VDD50	-	-	-	-
30	24	19	-	PB4	GPWM70	SBCS0	IRQ03, IRQ12
31	25	-	VSS	-	-	-	-
32	26	20	-	PB3	GPWM60, TM10A	SBT2, SBT3	CKMREF
33	27	21	-	PB2	TM10B	SBI2, SBO2	IRQ30
34	28	22	-	PB1	TM00B, TM11A	SBI2, SBO2, SBT2	-
35	29	-	-	PB0	TM00A, TM11B	SBI2, SBO2, SBI3, SBO3	IRQ22
36	30	-	-	PA5	TM03B, TM12A	SBI2, SBO2, SBT2, SBI3, SBO3	IRQ01, IRQ21
37	-	-	-	PA4	TM07B, TM12B	SBT2, SBT3	IRQ20
38	31	-	-	PA3	TM13A	SBCS3, SBCS5	IRQ37
39	-	-	-	PA2	TM07A, TM13B	SBCS2	-
40	-	-	-	PA1	TM04A, GPWM30	-	IRQ20
41	-	-	-	PA0	TM02A, GPWM40	-	-
42	32	23	-	PF1	TM00A, TM02B	SBT5	-
43	33	24	-	P96	GPWMST7	SBI5, SBO5	IRQ04, IRQ11
44	34	25	-	PF2	-	SBI5, SBO5	IRQ14, IRQ20, IRQ37

100 pins Pin No.	80 pins Pin No.	64 pins Pin No.	Power, Clock, System	Port	Timer	Communica-tion	Other
45	35	26	-	P95	GPWM30	-	-
46	36	27	-	P94	GPWM40	-	-
47	37	28	-	P93	GPWM50	SBCS6	-
48	38	29	-	P92	GPWM31	SBT6	-
49	39	30	-	P91	GPWM41	SBI6, SBO6	-
50	40	31	-	P90	GPWM51	SBI6, SBO6	-
51	41	32	-	P76	TM05A, GPWM21	-	-
52	42	33	-	P75	TM04A, GPWM11	-	-
53	43	34	-	P74	TM03A, GPWM01	-	-
54	44	35	-	P73	TM02A, GPWM20	-	-
55	45	36	-	P72	TM01A, GPWM10	-	-
56	46	37	-	P71	TM00A, GPWM00	-	-
57	47	38	-	P70	-	-	IRQ05, IRQ10
58	-	-	-	P33	TM00A, TM11A, GPWM00	-	-
59	-	-	-	P32	TM06A, TM11B, GPWM10	-	-
60	48	39	VDD50	-	-	-	-
61	49	40	-	P31	TM10A, TM12A	-	IRQ06, IRQ36, TRCCLK
62	50	41	VSS	-	-	-	-
63	51	42	-	P30	TM06B, TM10B, TM12B	SBCS3	IRQ07, GPWMST0, GPWMST3, CMPOT10, CMPOT11, TRCSWO
64	52	43	-	P24	TM02B, TM06A	SBT3	GPWMST1, GPWMST4, CMPOT00, CMPOT01, DAOT0, TRCD0

100 pins Pin No.	80 pins Pin No.	64 pins Pin No.	Power, Clock, System	Port	Timer	Communica-tion	Other
65	53	44	-	P23	TM02A, TM07A	SBI3, SBO3	GPWMST2, GPWMST5, CMPOT10, CMPOT11, CKMREF, TRCD1
66	54	45	-	P22	TM04A, TM13A	SBI3, SBO3	IRQ22, IRQ32, CMPOT00, CMPOT01, TRCD2
67	55	46	-	P21	TM04B, TM11A, TM14A	-	IRQ06, IRQ21, ADIN21, CMPREF11, TRCD3
68	56	-	-	P20	TM11B, TM15A	-	IRQ07, IRQ20, IRQ34, ADIN20, CMPREF01
69	-	-	-	P65	-	-	ADIN19
70	-	-	-	P64	-	-	ADIN18
71	57	-	-	PF3	-	-	-
72	58	47	NDMOD	-	-	-	-
73	59	48	TEST	-	-	-	-
74	-	-	-	P63	-	-	IRQ07, ADIN17
75	60	-	-	P62	-	-	IRQ06, ADIN16
76	-	-	-	P61	-	-	IRQ05, ADIN15
77	-	-	-	P60	-	-	IRQ04, ADIN14
78	61	-	-	P55	-	-	IRQ03, ADIN13
79	62	49	-	P54	-	-	IRQ02, ADIN12
80	63	50	-	P53	-	-	IRQ01, ADIN11
81	64	51	-	P52	-	-	IRQ00, ADIN10
82	65	52	-	P51	-	-	IRQ33, ADIN09
83	66	53	-	P50	-	-	ADIN08, VGAN1, CMPIN10, CMPREF10
84	67	-	-	P47	-	-	ADIN07

100 pins Pin No.	80 pins Pin No.	64 pins Pin No.	Power, Clock, System	Port	Timer	Communica-tion	Other
85	68	54	-	P46	-	-	ADIN06, VGAP10, CMPIN11
86	69	55	-	P45	-	-	ADIN05, VGAP11, CMPIN00, CMPIN01
87	70	56	-	P44	-	-	ADIN04, VGAP12, CMPIN10, CMPIN11
88	71	-	-	P43	-	-	ADIN03
89	72	57	-	P42	-	-	ADIN02, VGAP02
90	73	58	-	P41	-	-	ADIN01, VGAP01
91	74	59	-	P40	-	-	ADIN00, VGAP00, CMPIN01
92	75	60	-	PF4	-	-	ADIN22, VGAN0, CMPIN00, CMPREF00
93	76	61	VDD50	-	-	-	-
94	77	62	-	PF5	TM03B, TM12B, GPWM01	-	IRQ34
95	78	63	VSS	-	-	-	-
96	-	-	-	P82	TM04A, TM06A	SBT2	-
97	-	-	-	P81	TM04B, TM07A	SBI2, SBO2	-
98	-	-	-	P80	TM13A	SBI2, SBO2, SBT2	IRQ34
99	79	64	-	P11	TM03A, TM12A, GPWM00	-	IRQ01
100	80	-	-	P10	TM12B, TM14B	SBCS2	IRQ00, IRQ15, IRQ33

Table 1.4-4 Pin Functions (for each function)

Functions	Pin name	100 pins Pin No.	80 pins Pin No.	64 pins Pin No.	I/O
External power pin	VDD50	14, 29, 60, 93	13, 23, 48, 76	10, 39, 61	Input
Power pin for internal circuit	VOUT12	5	4	3	Output
GND	VSS	12, 31, 62, 95	11, 25, 50, 78	8, 41, 63	Input
Debugger	SWDCLK	27	21	17	Input
	SWDD	28	22	18	I/O
	TRCCLK	61	49	40	Output
	TRCSWO	63	51	42	Output
	TRCD0	64	52	43	Output
	TRCD1	65	53	44	Output
	TRCD2	66	54	45	Output
	TRCD3	67	55	46	Output
External oscillation	OSCI	13	12	9	Input
	OSCO	11	10	7	Output
Reset	NRST	10	9	6	Input
Mode pin	NBOOT	6	5	4	Input
	NDMOD	72	58	47	Input
	TEST	73	59	48	Input
Clock Monitoring	CKMREF	32, 65	26, 53	20, 44	Input
External interrupt	NMI	15	14	11	Input
	IRQ00	1, 81, 100	64, 80	51	Input
	IRQ01	8, 36, 80, 99	7, 30, 63, 79	50, 64	Input
	IRQ02	4, 9, 21, 79,	3, 8, 18, 62	2, 15, 49	Input
	IRQ03	20, 30, 78	17, 24, 61	14, 19	Input
	IRQ04	7, 43, 77	6, 33	5, 24	Input
	IRQ05	2, 19, 27, 57, 76	1, 16, 21, 47	1, 13, 17, 38	Input
	IRQ06	61, 67, 75	49, 55, 60	40, 46	Input
	IRQ07	63, 68, 74	51, 56	42	Input
	IRQ10	57	47	38	Input
	IRQ11	43	33	24	Input
	IRQ12	30	24	19	Input
	IRQ13	8, 15	7, 14	11	Input
	IRQ14	9, 44	8, 34	25	Input
	IRQ15	7, 100	6, 80	5	Input
	IRQ20	37, 40, 44, 68	34, 56	25	Input
	IRQ21	36, 67	30, 55	46	Input

Functions	Pin name	100 pins Pin No.	80 pins Pin No.	64 pins Pin No.	I/O
External interrupt	IRQ22	35, 66	29, 54	45	Input
	IRQ30	20, 33	17, 27	14, 21	Input
	IRQ31	18	15	12	Input
	IRQ32	66	54	45	Input
	IRQ33	82, 100	65, 80	52	Input
	IRQ34	68, 94, 98	56, 77	62	Input
	IRQ35	18	15	12	Input
	IRQ36	20, 61	17, 49	14, 40	Input
	IRQ37	38, 44	31, 34	25	Input
16-bit timer	TM00A	22, 35, 42, 56, 58	19, 29, 32, 46	16, 23, 37	I/O
	TM00B	21, 34,	18, 28	15, 22	I/O
	TM01A	19, 55	16, 45	13, 36	I/O
	TM01B	17, 23	20	-	I/O
	TM02A	24, 41, 54, 65	44, 53	35, 44	I/O
	TM02B	42, 64	32, 52	23, 43	I/O
	TM03A	53, 99	43, 79	34, 64	I/O
	TM03B	36, 94	30, 77	62	I/O
	TM04A	23, 40, 52, 66, 96	20, 42, 54	33, 45	I/O
	TM04B	67, 97	55	46	I/O
	TM05A	16, 51	41	32	I/O
	TM05B	17	-	-	I/O
	TM06A	25, 59, 64, 96	52	43	I/O
	TM06B	21, 63	18, 51	15, 42	I/O
	TM07A	39, 65, 97	53	44	I/O
	TM07B	37	-	-	I/O
	TM10A	32, 61	26, 49	20, 40	I/O
	TM10B	33, 63	27, 51	21, 42	I/O
	TM11A	34, 58, 67	28, 55	22, 46	I/O
	TM11B	35, 59, 68	29, 56	-	I/O
	TM12A	8, 36, 61, 99	7, 30, 49, 79	40, 64	I/O
	TM12B	9, 37, 63, 94, 100	8, 51, 77, 80	42, 62	I/O
	TM13A	38, 66, 98	31, 54	45	I/O
	TM13B	39	-	-	I/O
	TM14A	18, 67	15, 55	12, 46	I/O
	TM14B	17, 100	80	-	I/O
	TM15A	3, 19, 68	2, 16, 56	13	I/O
	TM15B	2, 16	1	1	I/O

Functions	Pin name	100 pins Pin No.	80 pins Pin No.	64 pins Pin No.	I/O
Power control PWM output	GPWM00	56, 58, 99	46, 79	37, 64	Output
	GPWM01	53, 94	43, 77	34, 62	Output
	GPWM10	55, 59	45	36	Output
	GPWM11	52	42	33	Output
	GPWM20	54	44	35	Output
	GPWM21	51	41	32	Output
	GPWM30	40, 45	35	26	Output
	GPWM31	48	38	29	Output
	GPWM40	41, 46	36	27	Output
	GPWM41	49	39	30	Output
	GPWM50	47	37	28	Output
	GPWM51	50	40	31	Output
	GPWM60	32	26	20	Output
	GPWM61	28	22	18	Output
	GPWM70	18, 30	15, 24	12, 19	Output
	GPWM71	19, 27	16, 21	13, 17	Output
Power control PWM monitor	GPWMST0	63	51	42	Output
	GPWMST1	64	52	43	Output
	GPWMST2	65	53	44	Output
	GPWMST3	63	51	42	Output
	GPWMST4	64	52	43	Output
	GPWMST5	65	53	44	Output
	GPWMST6	7	6	5	Output
	GPWMST7	43	33	24	Output

Functions	Pin name	100 pins Pin No.	80 pins Pin No.	64 pins Pin No.	I/O
Serial interface	SBCS0	16, 30	24	19	I/O
	SBI0	27, 28	21, 22	17, 18	Input
	SBO0	27, 28	21, 22	17, 18	I/O
	SBT0	23, 26, 27	20, 21	17	I/O
	SBCS1	2, 19	1, 16	1, 13	I/O
	SBI1	20, 22	17, 19	14, 16	Input
	SBO1	20, 21, 22	17, 18, 19	14, 15, 16	I/O
	SBT1	20, 21	17, 18	14, 15	I/O
	SBCS2	39, 100	80	-	I/O
	SBI2	33, 34, 35, 36, 97, 98	27, 28, 29, 30	21, 22	Input
	SBO2	33, 34, 35, 36, 97, 98	27, 28, 29, 30	21, 22	I/O
	SBT2	32, 34, 36, 37, 96, 98	26, 28, 30	20, 22	I/O
	SBCS3	18, 19, 38, 63	15, 16, 31, 51	12, 13, 42	I/O
	SBI3	23, 24, 35, 36, 65, 66	20, 29, 30, 53, 54	44, 45	Input
	SBO3	23, 24, 35, 36, 65, 66	20, 29, 30, 53, 54	44, 45	I/O
	SBT3	25, 32, 37, 64	26, 52	20, 43	I/O
	SBCS4	8	7	-	I/O
	SBI4	2, 4	1, 3	1, 2	Input
	SBO4	2, 4	1, 3	1, 2	I/O
	SBT4	7	6	5	I/O
	SBCS5	38	31	-	I/O
	SBI5	43, 44	33, 34	24, 25	Input
	SBO5	43, 44	33, 34	24, 25	I/O
	SBT5	42	32	23	I/O
	SBCS6	47	37	28	I/O
	SBI6	49, 50	39, 40	30, 31	Input
	SBO6	49, 50	39, 40	30, 31	I/O
	SBT6	48	38	29	I/O

Functions	Pin name	100 pins Pin No.	80 pins Pin No.	64 pins Pin No.	I/O
A/D input	ADIN00	91	74	59	Input
	ADIN01	90	73	58	Input
	ADIN02	89	72	57	Input
	ADIN03	88	71	-	Input
	ADIN04	87	70	56	Input
	ADIN05	86	69	55	Input
	ADIN06	85	68	54	Input
	ADIN07	84	67	-	Input
	ADIN08	83	66	53	Input
	ADIN09	82	65	52	Input
	ADIN10	81	64	51	Input
	ADIN11	80	63	50	Input
	ADIN12	79	62	49	Input
	ADIN13	78	61	-	Input
	ADIN14	77	-	-	Input
	ADIN15	76	-	-	Input
	ADIN16	75	60	-	Input
	ADIN17	74	-	-	Input
	ADIN18	70	-	-	Input
	ADIN19	69	-	-	Input
	ADIN20	68	56	-	Input
	ADIN21	67	55	46	Input
	ADIN22	92	75	60	Input
A/D monitor	ADST0	2, 19	1, 16	1, 13	Output
	ADST1	4	3	2	Output
	ADST2	7	6	5	Output
VGA input	VGAP00	91	74	59	Input
	VGAP01	90	73	58	Input
	VGAP02	89	72	57	Input
	VGAN0	92	75	60	Input
	VGAP10	85	68	54	Input
	VGAP11	86	69	55	Input
	VGAP12	87	70	56	Input
	VGAN1	83	66	53	Input
Comarator input	CMPIN00	86, 92	69, 75	55, 60	Input
	CMPIN01	86, 91	69, 74	55, 59	Input
	CMPREF00	92	75	60	Input
	CMPREF01	68	56	-	Input
	CMPIN10	83, 87	66, 70	53, 56	Input
	CMPIN11	85, 87	68, 70	54, 56	Input
	CMPREF10	83	66	53	Input
	CMPREF11	67	55	46	Input

Functions	Pin name	100 pins Pin No.	80 pins Pin No.	64 pins Pin No.	I/O
Comarator output	CMPOT00	64, 66	52, 54	43, 45	Output
	CMPOT01	64, 66	52, 54	43, 45	Output
	CMPOT10	63, 65	51, 53	42, 44	Output
	CMPOT11	63, 65	51, 53	42, 44	Output
D/A output	DAOT0	64	52	43	Output
I/O port	P00	4	3	2	I/O
	P01	7	6	5	I/O
	P02	2	1	1	I/O
	P10	100	80	-	I/O
	P11	99	79	64	I/O
	P20	68	56	-	I/O
	P21	67	55	46	I/O
	P22	66	54	45	I/O
	P23	65	53	44	I/O
	P24	64	52	43	I/O
	P30	63	51	42	I/O
	P31	61	49	40	I/O
	P32	59	-	-	I/O
	P33	58	-	-	I/O
	P40	91	74	59	Input
	P41	90	73	58	Input
	P42	89	72	57	Input
	P43	88	71	-	I/O
	P44	87	70	56	Input
	P45	86	69	55	Input
	P46	85	68	54	Input
	P47	84	67	-	I/O
	P50	83	66	53	Input
	P51	82	65	52	I/O
	P52	81	64	51	I/O
	P53	80	63	50	I/O
	P54	79	62	49	I/O
	P55	78	61	-	I/O
	P60	77	-	-	I/O
	P61	76	-	-	I/O
	P62	75	60	-	I/O
	P63	74	-	-	I/O
	P64	70	-	-	I/O
	P65	69	-	-	I/O

Functions	Pin name	100 pins Pin No.	80 pins Pin No.	64 pins Pin No.	I/O
I/O port	P70	57	47	38	I/O
	P71	56	46	37	I/O
	P72	55	45	36	I/O
	P73	54	44	35	I/O
	P74	53	43	34	I/O
	P75	52	42	33	I/O
	P76	51	41	32	I/O
	P80	98	-	-	I/O
	P81	97	-	-	I/O
	P82	96	-	-	I/O
	P90	50	40	31	I/O
	P91	49	39	30	I/O
	P92	48	38	29	I/O
	P93	47	37	28	I/O
	P94	46	36	27	I/O
	P95	45	35	26	I/O
	P96	43	33	24	I/O
	PA0	41	-	-	I/O
	PA1	40	-	-	I/O
	PA2	39	-	-	I/O
	PA3	38	31	-	I/O
	PA4	37	-	-	I/O
	PA5	36	30	-	I/O
	PB0	35	29	-	I/O
	PB1	34	28	22	I/O
	PB2	33	27	21	I/O
	PB3	32	26	20	I/O
	PB4	30	24	19	I/O
	PB5	28	22	18	I/O
	PB6	27	21	17	I/O
	PB7	26	-	-	I/O
	PD0	25	-	-	I/O
	PD1	24	-	-	I/O
	PD2	23	20	-	I/O
	PD3	22	19	16	I/O
	PD4	21	18	15	I/O
	PD5	20	17	14	I/O
	PD6	19	16	13	I/O
	PD7	18	15	12	I/O

Functions	Pin name	100 pins Pin No.	80 pins Pin No.	64 pins Pin No.	I/O
I/O port	PE0	17	-	-	I/O
	PE1	16	-	-	I/O
	PE2	15	14	11	I/O
	PE3	9	8	-	I/O
	PE4	8	7	-	I/O
	PE5	1	-	-	I/O
	PF0	3	2	-	I/O
	PF1	42	32	23	I/O
	PF2	44	34	25	I/O
	PF3	71	57	-	I/O
	PF4	92	75	60	Input
	PF5	94	77	62	I/O

Note:

For pins to which multiple functions can be assigned, set only one to be valid.

Example: For 100 pins, it is prohibited to select No.27 and No.28 as SBO0 pin at the same time.

1.5 Block Diagram

Figure 1.5-1 shows the block diagram.

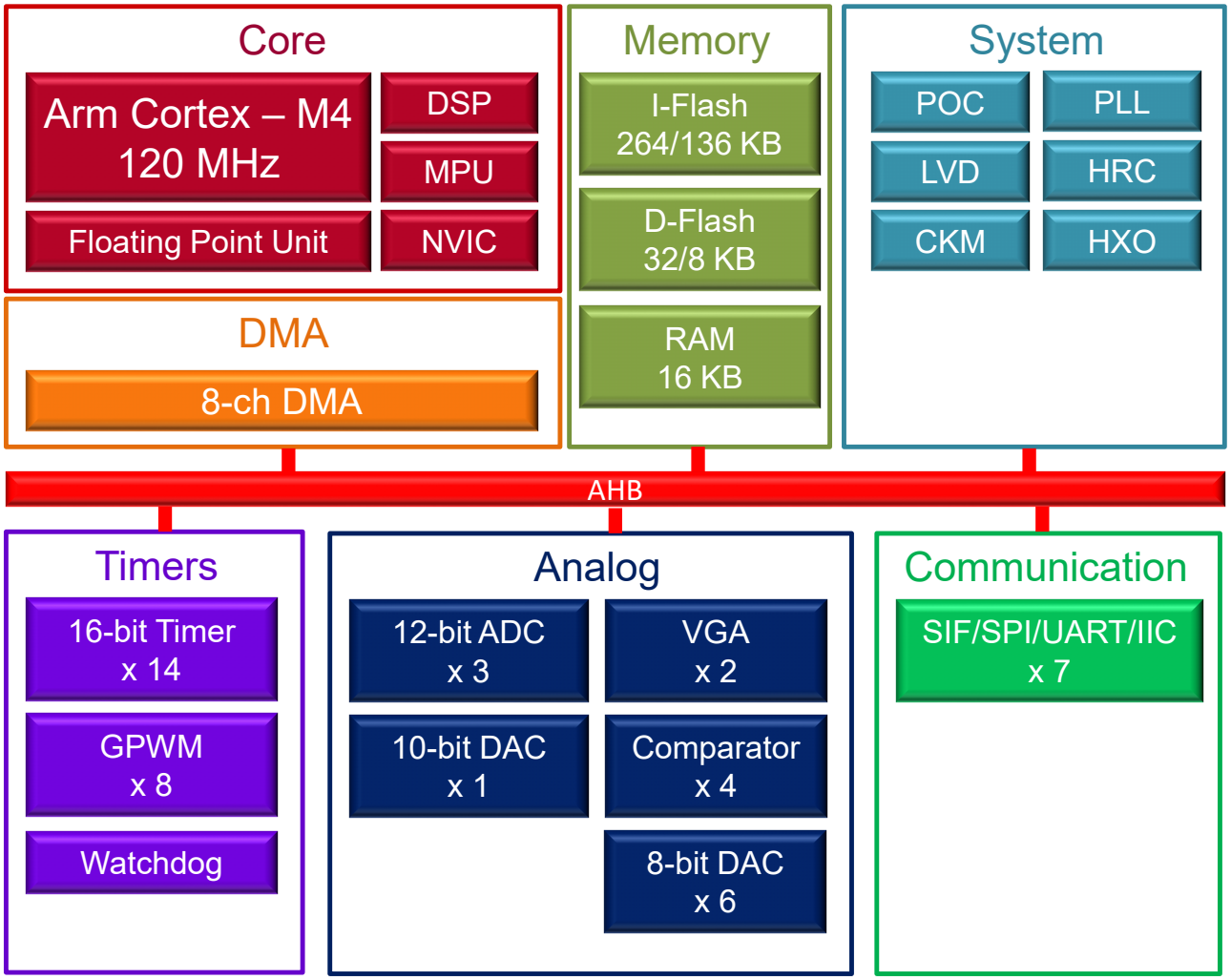


Figure 1.5-1 Block Diagram

1.6 Electrical Characteristics

About electrical specifications, standard specifications are described in the manual of this LSI. When using this LSI, consult the staff in our sales offices for the product specifications.

1.6.1 Absolute Maximum Ratings

Parameter			Symbol	Rating	Unit
A1	Power supply voltage		V_{DD50A}	-0.3 to 7.0	V
A2	Internal power supply voltage		V_{OUT12A}	-0.3 to 1.6	V
A3	Input pin voltage		V_{I1}	-0.3 to V_{DD50} +0.3 (Upper limit: 7.0)	V
A4	VGA input pin voltage		V_{I2}	-2.0 to V_{DD50} +0.3 (Upper limit: 7.0)	V
A5	I/O pin voltage		V_{I3}	-0.3 to V_{DD50} +0.3 (Upper limit: 7.0)	V
A6	Average Output current	I/O pin 1, 2 (*1)	I_{O1}(avg)	±12	mA
A7		I/O pin 3 (*2)	I_{O2}(avg)	±24	mA
A8		Total of all pins	I_{O3}	±70	mA
A9	Average injection current	By a I/O pin	I_{INJ1}	±2	mA
A10		By a total I/O pin	I_{INJ}	±20	mA
A11	Power dissipation		P_D	800	mW
A12	Operating case temperature		T_{copr}	-40 to +110	°C
A13	Operating junction temperature		T_j	-40 to +125	°C
A14	Storage temperature		T_{stg}	-40 to +125	°C

Note:

Although this LSI has internal ESD protection circuit, it may still sustain permanent damage if not handled properly. Therefore, proper ESD precautions are recommended to avoid electrostatic damage to the MOS gate.

This LSI may sustain permanent damage if it gets stress which is higher than the above stated absolute maximum rating even only for a second. This rating is the maximum rating and device operating at this range is not guaranteed as it is higher than our stated recommended operating range.

Note:

*1 I/O pins 1 and 2 is I/O pins 1 and 2 of 1.6.3 DC Characteristics.

Note:

*2 I/O pin 3 is I/O pin 3 of 1.6.3 DC Characteristics.

1.6.2 Operation Conditions

Power supply voltage during operation					V_{SS} = 0.0 V Tc = -40 °C to 110 °C	
Parameter		Symbol	Rating			Unit
			MIN	TYP	MAX	
B1	External power supply voltage	V_{DD50}	V_{RST5N}	5.0	5.5	V
B2	Internal power supply voltage	V_{OUT12}	-	1.25	-	

Oscillation pin					V_{DD50} = V_{RST5N} to 5.5 V, V_{SS} = 0.0 V Tc= -40 °C to 110 °C	
Parameter		Symbol	Rating			Unit
			MIN	TYP	MAX	
B3	External oscillation frequency (Ceramic/Crystal)	F_{OSC}	4.0	-	20.0	MHz
B4	External oscillation Feedback resistor	R_{FB}	-	1.0	-	MΩ

Note:

Oscillation circuit characteristics and peripheral parts(load capacity, damping resister, and feedback resister) are different by each oscillator and substrate. To decide appropriate capacity value for circuit constant, please consult the oscillator manufacturer.

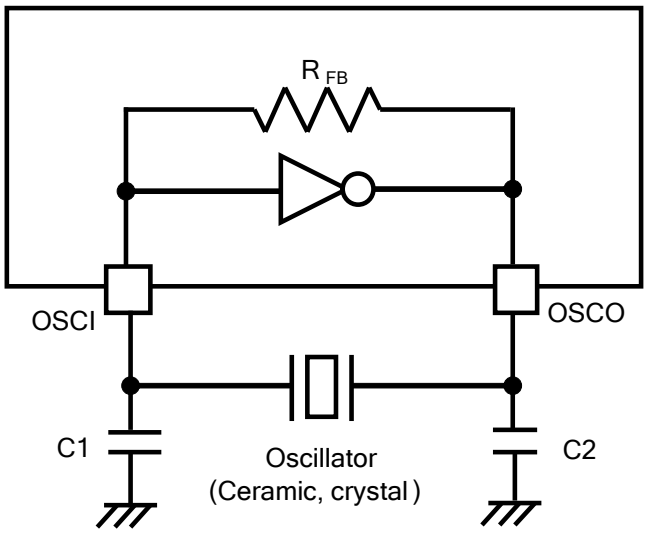


Figure 1.6-1 Oscillation Circuit

External clock input OSCI (OSCO left open)			V_{DD50} = V_{RST5N} to 5.5 V, V_{SS} = 0.0 V Tc= -40 °C to 110 °C			
Parameter		Symbol	Rating			Unit
			MIN	TYP	MAX	
B5	Clock frequency	F_{CP}	4.0	-	20.0	MHz
B6	High level pulse width	t_{wh1}	20	-	-	ns
B7	Low level pulse width	t_{wl1}	20	-	-	
B8	Rising time	t_{wr1}	-	-	5	
B9	Falling time	t_{wf1}	-	-	5	

Note:
It is necessary to set clock duty ratio from 45 % to 55 %.

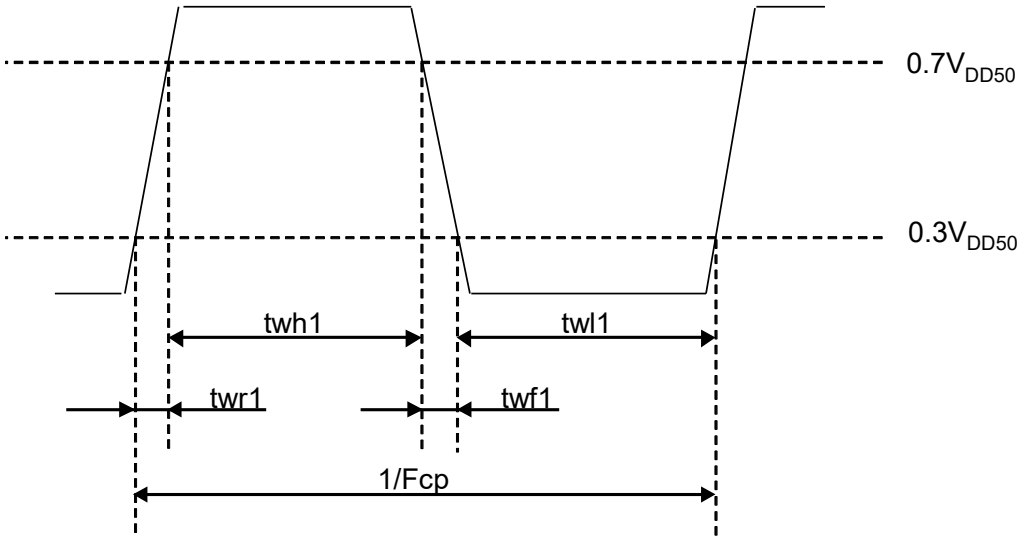


Figure 1.6-2 OSCI Timing Chart

1.6.3 DC Characteristics

Power supply current during operation			V_{DD50} = 5.0 V, V_{SS} = 0.0 V Tc = -40 °C to 110 °C Output pins left open			
Parameter		Sym-bol	Conditions	Rating		Unit
				TYP	MAX	
C1	NORMAL mode	I_{DD1}	HXOCLK = 10 MHz, PLL is used, CPUCLK = 120 MHz, IOCLK = 60 MHz CPU and Peripheral circuits are operating. Analog circuits are stopped.	60	85	mA
C2	SLEEP mode	I_{DD2}	HXOCLK = 10 MHz, PLL is used, CPUCLK = 120 MHz, IOCLK = 60 MHz CPU is stopped, Peripheral circuits are operating. Analog circuits are stopped.	50	75	
C3	DEEP SLEEP mode	I_{DD3}	HXOCLK = 10 MHz, PLLCLK is stopped, CPUCLK, IOCLK is stopped, CPU and Peripheral circuits are stopped. Analog circuits are stopped.	10	35	
C4		I_{DD4}	HXOCLK, PLLCLK, CPUCLK, IOCLK is stopped	9	32	

Note:
The measurement conditions are as follows.
- All I/O pins are output state. (No load)

Input pin 1 NDMOD				V_{DD50} = 5.0 V, V_{SS} = 0.0 V Tc = -40 °C to 110 °C			
Parameter		Sym-bol	Conditions	Rating			Unit
				MIN	TYP	MAX	
C5	Input voltage "High level"	V_{IH1}		V_{DD50} × 0.7	-	V_{DD50}	V
C6	Input voltage "Low level"	V_{IL1}		V_{SS}	-	V_{DD50} × 0.3	
C7	Internal pull-up resistor	R_{IO1}	V_{IN} = 0 V	15	30	60	kΩ

Input pin 2 TEST				V_{DD50} = 5.0 V, V_{SS} = 0.0 V Tc = -40 °C to 110 °C			
Parameter		Sym-bol	Conditions	Rating			Unit
				MIN	TYP	MAX	
C8	Input voltage "High level"	V_{IH2}		V_{DD50} × 0.7	-	V_{DD50}	V
C9	Input voltage "Low level"	V_{IL2}		V_{SS}	-	V_{DD50} × 0.3	
C10	Internal pull-down resistor	R_{IO2}	V_{IN} = V_{DD50}	15	30	60	kΩ

Input pin 3 NBOOT				V_{DD50} = 5.0 V, V_{SS} = 0.0 V Tc = -40 °C to 110 °C			
Parameter		Sym-bol	Conditions	Rating			Unit
				MIN	TYP	MAX	
C11	Input voltage "High level"	V_{IH3}		V_{DD50} × 0.7	-	V_{DD50}	V
C12	Input voltage "Low level"	V_{IL3}		V_{SS}	-	V_{DD50} × 0.3	
C13	Input leakage current	I_{LK3}	V_{IN} = 0 V to V_{DD50}	-	-	±10	µA

Input pin 4 P40～P42, P44～P46, P50, PF4				V_{DD50} = 5.0 V, V_{SS} = 0.0 V Tc = -40 °C to 110 °C			
Parameter		Sym-bol	Conditions	Rating			Unit
				MIN	TYP	MAX	
C14	Input voltage "High level"	V_{IH4}	VGA is not used	V_{DD50} × 0.7	-	V_{DD50}	V
C15	Input voltage "Low level"	V_{IL4}	VGA is not used	V_{SS}	-	V_{DD50} × 0.3	
C16	Input leakage current	I_{LK4}	V_{IN} = 0 V to V_{DD50}	-	-	±10	µA
C17	Input voltage range	V_{IN4}	VGA is used	-1.5	-	V_{DD50}	V

I/O pin 1 NRST				V_{DD50} = 5.0 V, V_{SS} = 0.0 V Tc = -40 °C to 110 °C			
Parameter		Sym-bol	Conditions	Rating			Unit
				MIN	TYP	MAX	
C18	Input voltage "High level"	V_{IH5}		V_{DD50} × 0.7	-	V_{DD50}	V
C19	Input voltage "Low level"	V_{IL5}		V_{SS}	-	V_{DD50} × 0.3	
C20	Internal pull-up resistor	R_{IO5}	V_{IN} = 0 V	15	30	60	kΩ
C21	Output voltage "Low level"	V_{OL5}	V_{DD5} = V_{RST5P} I_{OL} = 3.0 mA	-	-	0.5	V

I/O pin 2 P00～P02, P10, P11, P20～P24, P30～P33, P43, P47, P51～P55, P60～P65, P70, P80, P82, P96, PA2, PA3, PA5, PB0～PB4, PB6, PB7, PD0～PD2, PD4～PD7, PE0～PE5, PF0, PF2, PF3, PF5			V_{DD50} = 5.0 V, V_{SS} = 0.0 V Tc = -40 °C to 110°C				
Parameter		Sym-bol	Conditions	Rating			Unit
				MIN	TYP	MAX	
C22	Input voltage "High level"	V_{IH6}		V_{DD50} × 0.7	-	V_{DD50}	V
C23	Input voltage "Low level"	V_{IL6}		V_{SS}	-	V_{DD50} × 0.3	
C24	Input leakage current	I_{LK6}	V_{IN} = 0 V to V_{DD50}	-	-	±5	µA
C25	Internal pull-up resistor	R_{IO6}	V_{IN} = 0 V	15	30	60	kΩ
C26	Output voltage "High level"	V_{OH6}	I_{OH} = -3.0 mA	4.5	-	-	V
C27	Output voltage "Low level"	V_{OL6}	I_{OL} = 3.0 mA	-	-	0.5	

I/O pin 3 P71～P76, P81, P90～P95, PA0, PA1, PA4, PB5, PD3, PF1			V_{DD50} = 5.0 V, V_{SS} = 0.0 V Tc = -40 °C to 110 °C				
Parameter		Sym-bol	Conditions	Rating			Unit
				MIN	TYP	MAX	
C28	Input voltage "High level"	V_{IH7}		V_{DD50} × 0.7	-	V_{DD50}	V
C29	Input voltage "Low level"	V_{IL7}		V_{SS}	-	V_{DD50} × 0.3	
C30	Input leakage current	I_{LK7}	V_{IN} = 0 V to V_{DD50}	-	-	±5	µA
C31	Internal pull-up resistor	R_{IO7}	V_{IN} = 0 V	15	30	60	kΩ
C32	Output voltage "High level"	V_{OH7}	I_{OH} = -6.0 mA	4.5	-	-	V
C33	Output voltage "Low level"	V_{OL7}	I_{OL} = 6.0 mA	-	-	0.5	

1.6.4 Analog Characteristics

The electrical characteristics of analog are shown below.

1.6.4.1 12-bit A/D Converter

ADC0, ADC1, ADC2				V_{DD50} = 5.0 V, V_{SS} = 0.0 V Tc = -40 °C to 110 °C			
Parameter		Symbol	Conditions	Rating			Unit
				MIN	TYP	MAX	
D1	Resolution	-		-	-	12	Bits
D2	Conversion clock	-		10	-	40	MHz
D3	Integral non-linearity error	$INLE_{AD}$	Sampling time ≥ 150 ns Conversion clock = 40 MHz	-	-	±3	LSB
D4	Differential non-linearity error	$DNLE_{AD}$		-	-	±3	LSB
D5	Zero transition voltage	-		-20	-	20	mV
D6	Full-scale transition voltage	-		4980	-	5020	mV
D7	A/D conversion time	-		0.5	-	-	µs
D8	Input dynamic range	V_{IA}		V_{SS}	-	V_{DD50}	V
D9	Power supply current during operation	I_{AD}	Conversion clock = 40 MHz	-	2.5	-	mA/ unit

1.6.4.2 Programmable Gain Amplifier (VGA)

VGA0, VGA1				V_{DD50} = 5.0 V, V_{SS} = 0.0 V Tc = -40 °C to 110 °C			
Parameter		Symbol	Conditions	Rating			Unit
				MIN	TYP	MAX	
D10	Gain	G_{VGA}		2	-	20	Times
D11	Gain error	G_{ERR}		-	±0.5	±2.0	%
D12	Output offset voltage	V_{OFFG1}	G_{VGA}=2 to 10 times	-	±80	±180	mV
D13		V_{OFFG2}	G_{VGA}=20 times	-	±80	±195	
D14	Output reference voltage range	V_{REFG}		1.0	-	4.0	V
D15	Output dynamic range	V_{OG}		1.0	-	4.0	
D16	Input dynamic range	V_{IG1}	G_{VGA}=2 times	-1.5	-	1.5	
		V_{IG2}	G_{VGA}=3 times	-1.0	-	1.0	
		V_{IG3}	G_{VGA}=4 times	-0.75	-	0.75	
		V_{IG4}	G_{VGA}=5 times	-0.6	-	0.6	
		V_{IG5}	G_{VGA}=6 times	-0.5	-	0.5	
		V_{IG6}	G_{VGA}=8 times	-0.375	-	0.375	
		V_{IG7}	G_{VGA}=10 times	-0.3	-	0.3	
		V_{IG8}	G_{VGA}=20 times	-0.15	-	0.15	
D17	Power supply current during operation	I_G	G_{VGA}=10 times, V_{INP}=V_{INN}=0.0 V	-	2.6	-	mA/ Unit

1.6.4.3 Comparator

CMP00, CMP01, CMP10, CMP11				V_{DD50} = 5.0 V, V_{SS} = 0.0 V Tc = -40 °C to 110 °C			
Parameter		Symbol	Conditions	Rating			Unit
				MIN	TYP	MAX	
D18	Input offset voltage	V_{OFFC}		-	-	±20	mV
D19	Input dynamic range	V_{IC}		50	-	4950	
D20	Input hysteresis width	V_{HYSC}	Reference voltage = 2.5 V	-	30	50	
D21	Minimum comparison voltage	V_{MINC}		20	-	-	
D22	Power supply current during operation	I_C		-	0.3	-	mA/ Unit

1.6.4.4 D/A Converter

8-bit D/A Converter DACI00, DACI01, DACI10, DACI11, DACV0, DACV1				V_{DD50} = 5.0 V, V_{SS} = 0.0 V Tc = -40 °C to 110 °C			
Parameter		Symbol	Conditions	Rating			Unit
				MIN	TYP	MAX	
D23	Resolution			-	-	8	Bits
D24	Integral non-linearity error	$INLE_{DA1}$		-	-	±1	LSB
D25	Differential linearity error	$DNLE_{DA1}$		-	-	±1	
D26	Zero scale voltage	-		-20	-	20	mV
D27	Full scale voltage	-		4960	-	5020	
D28	Power supply current during operation	I_{DA1}		-	0.5	-	mA/ Unit

10-bit D/A Converter DACP0				V_{DD50} = 5.0 V, V_{SS} = 0.0 V Tc = -40 °C to 110 °C			
Parameter		Symbol	Conditions	Rating			Unit
				MIN	TYP	MAX	
D29	Resolution			-	-	10	Bits
D30	Integral non-linearity error	$INLE_{DA2}$		-	-	±3	LSB
D31	Differential linearity error	$DNLE_{DA2}$		-	-	±3	
D32	Zero scale voltage	-		-20	-	20	mV
D33	Full scale voltage	-		4980	-	5035	
D34	Power supply current during operation	I_{DA2}		-	0.5	-	mA/ Unit

1.6.4.5 Power Supply Voltage Detection (LVD)

				V_{SS} = 0.0 V Tc= -40 °C to110 °C			
Parameter		Symbol	Conditions	Rating			Unit
				MIN	TYP	MAX	
D35	Power supply voltage detection level	V_{LVDP}	At rising	4.0	4.2	4.4	V
D36		V_{LVDN}	At falling	3.9	4.1	4.3	
D37	Change rate of power supply voltage	$\triangle V_{DD5P}$	At rising			5	V/ms
D38		$\triangle V_{DD5N}$	At falling			1	

1.6.4.6 Power-On Reset

				V_{SS} = 0.0 V Tc= -40 °C to 110 °C			
Parameter		Symbol	Conditions	Rating			Unit
				MIN	TYP	MAX	
D39	Power supply voltage detection level	V_{RST5P}	At rising	2.90	2.95	3.00	V
D40		V_{RST5N}	At falling	2.80	2.85	2.90	
D41	Change rate of power supply voltage	$\triangle V_{DD5P}$	At rising	-	-	5	V/ms
D42		$\triangle V_{DD5N}$	At falling	-	-	1	

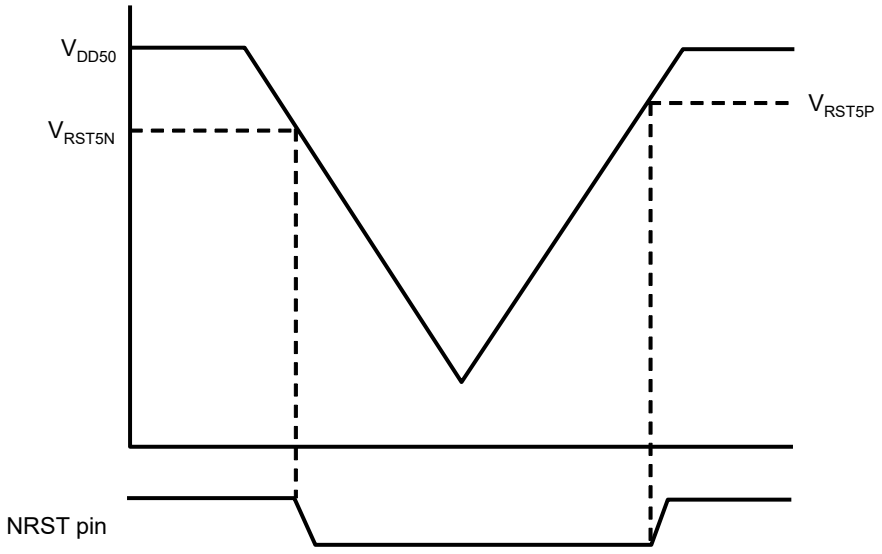


Figure 1.6-3 Characteristics of Power-On Reset Circuit

1.6.4.7 Internal Oscillation

Parameter		Symbol	Conditions	V_{DD50} = V_{RST5N} to 5.5 V, V_{SS} = 0.0 V Tc = -40 °C to 110 °C			Unit
				MIN	TYP	MAX	
D43	Oscillation frequency	F_{RC}		9.5	10	10.5	MHz

Note:
Factory calibrated, parts not soldered.

1.6.5 AC Characteristics

Parameter		Symbol	Conditions	V_{DD50} = V_{RST5N} to 5.5 V, V_{SS} = 0.0 V Tc = -40 °C to 110 °C			Unit
				MIN	TYP	MAX	
E1	Reset signal pulse width	t_{NRSTW}		1	-	-	µs

1.6.6 Flash EEPROM Characteristics

Parameter		Symbol	Conditions	V_{DD50}= V_{RST5N} to 5.5 V, V_{SS} = 0.0 V Tc = -40 °C to 110 °C			Unit
				MIN	TYP	MAX	
F1	Allowable time of rewriting: 1	E_{MAX1}	I-Flash, when the ECC function is enabled	10,000	-	-	times
F2	Allowable time of rewriting: 2	E_{MAX2}	D-Flash, when the ECC function is enabled	100,000	-	-	
F3	Data retention period 1 (*1)	T_{HLD1}	I-Flash After rewriting EMAX1 (MIN) times	20	-	-	years
F4	Data retention period 2 (*1)	T_{HLD2}	D-Flash After rewriting EMAX2 (MIN) times	5	-	-	
F5	Data retention period 3 (*1)	T_{HLD3}	D-Flash After rewriting 1,000 times	10	-	-	

Note:
*1 This includes the time when the power is off.

1.7 Package Dimension

The package dimension is shown in the following order.

- 100 pins 14mm * 14mm 0.5mm pitch Figure 1.7-1

Unit: mm

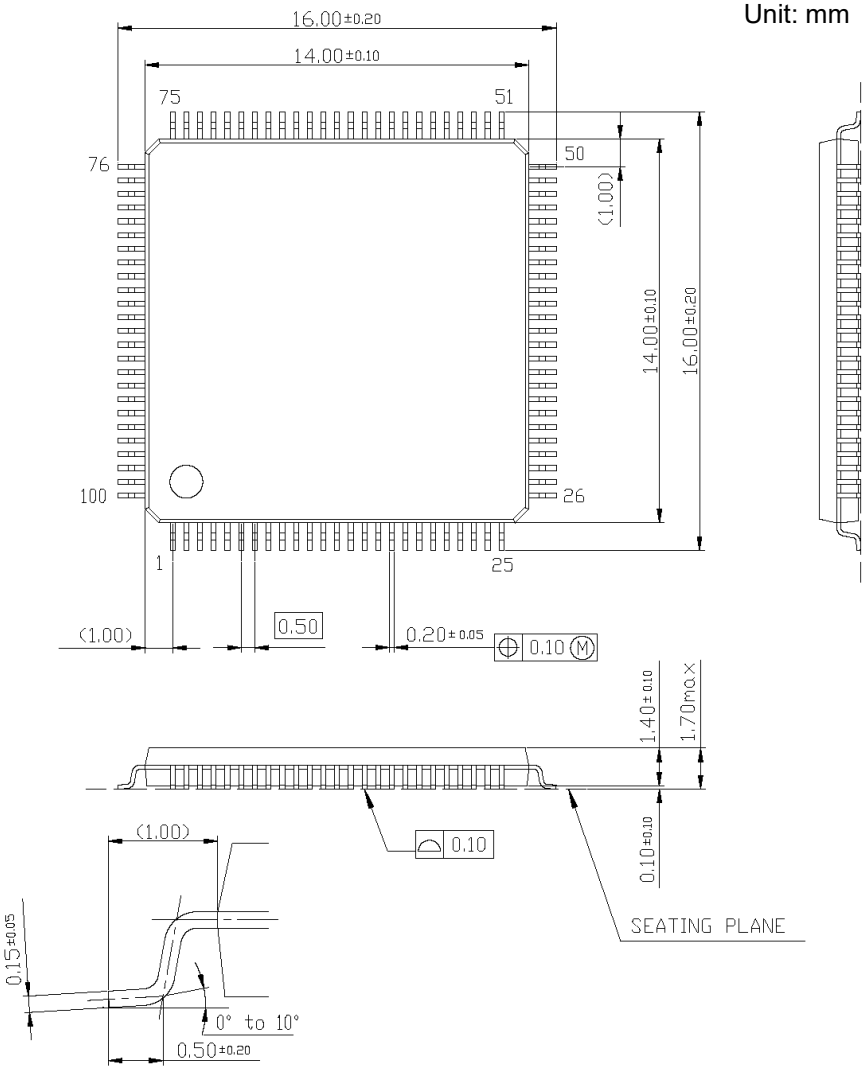


Figure 1.7-1 Package Dimension of 100 pins 14mm * 14mm 0.5mm pitch

- 80 pins 12mm * 12mm 0.5mm pitch Figure 1.7-2

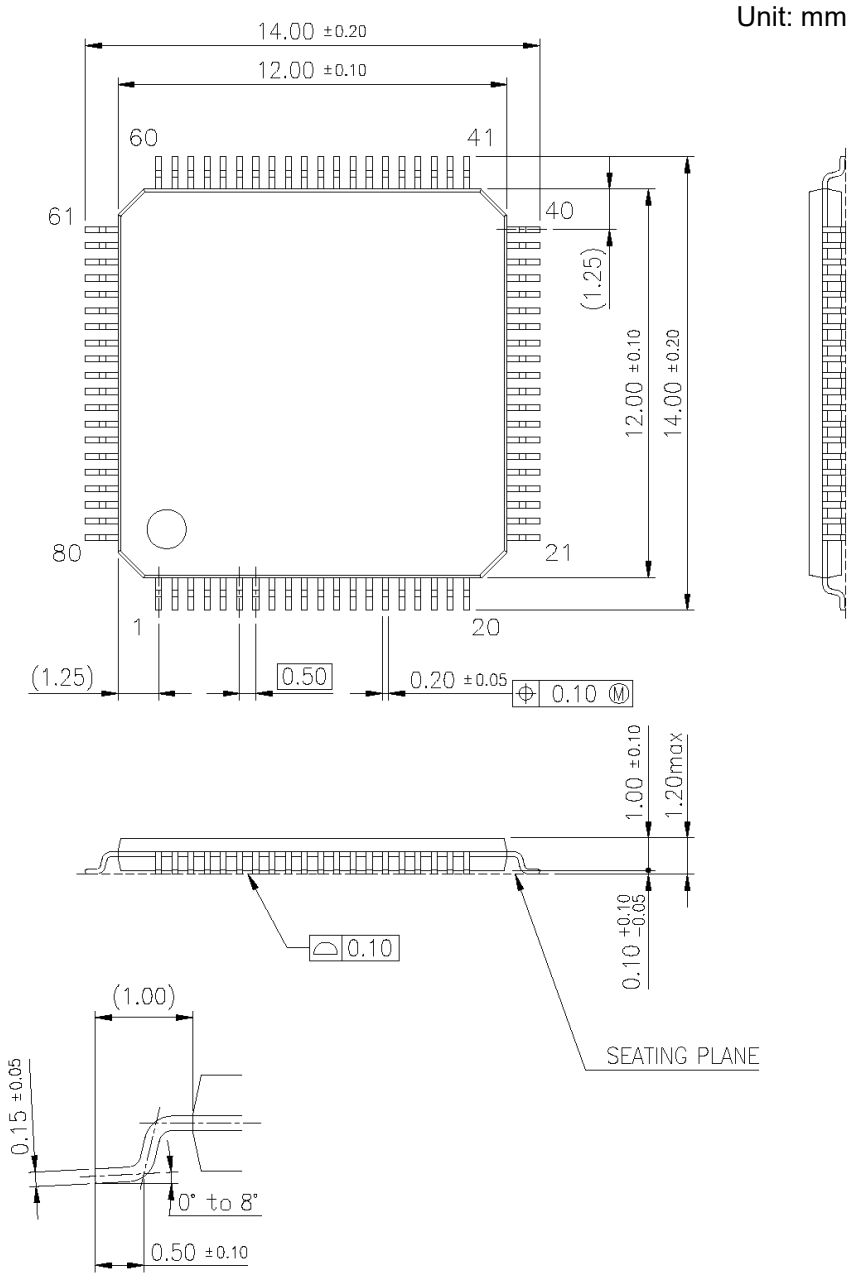
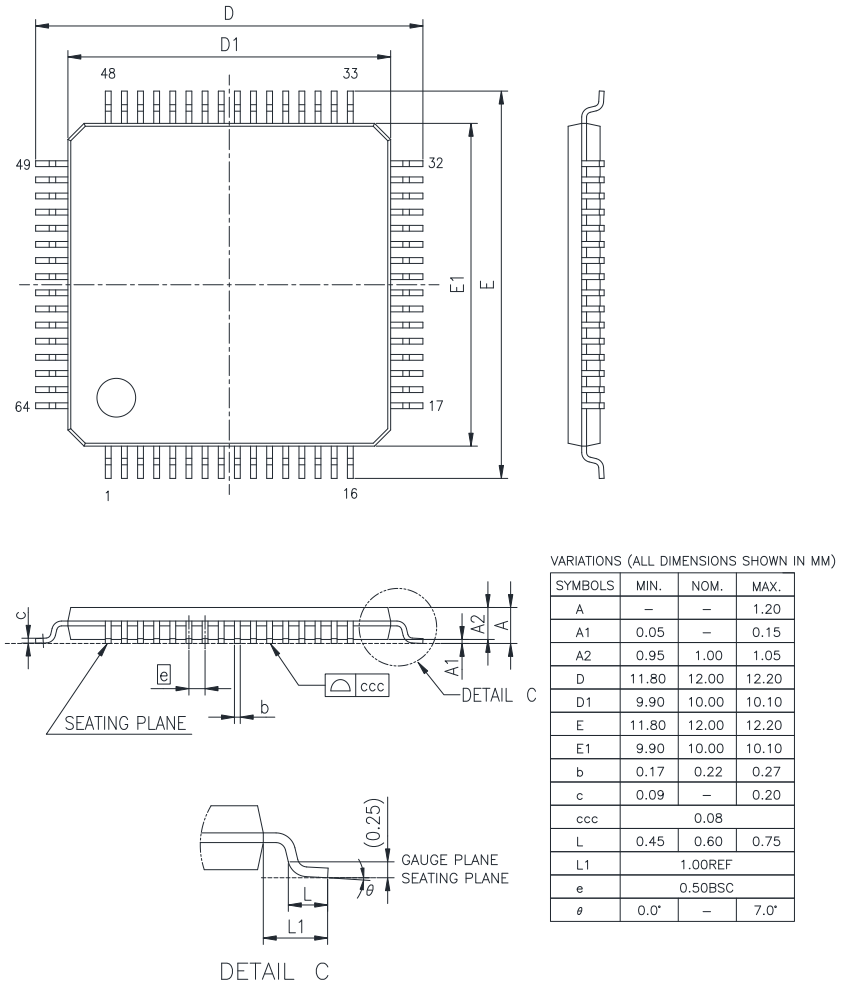


Figure 1.7-2 Package Dimension of 80 pins 12mm * 12mm 0.5mm pitch

- 64 pins 10mm * 10mm 0.5mm pitch Figure 1.7-3



VARIATIONS (ALL DIMENSIONS SHOWN IN MM)

SYMBOLS	MIN.	NOM.	MAX.
A	–	–	1.20
A1	0.05	–	0.15
A2	0.95	1.00	1.05
D	11.80	12.00	12.20
D1	9.90	10.00	10.10
E	11.80	12.00	12.20
E1	9.90	10.00	10.10
b	0.17	0.22	0.27
c	0.09	–	0.20
ccc		0.08	
L	0.45	0.60	0.75
L1		1.00REF	
e		0.50BSC	
θ	0.0°	–	7.0°

Figure 1.7-3 Package Dimension of 64 pins 10mm * 10mm 0.5mm pitch

- 48 pins 7mm * 7mm 0.5mm pitch Figure 1.7-4

Unit: mm

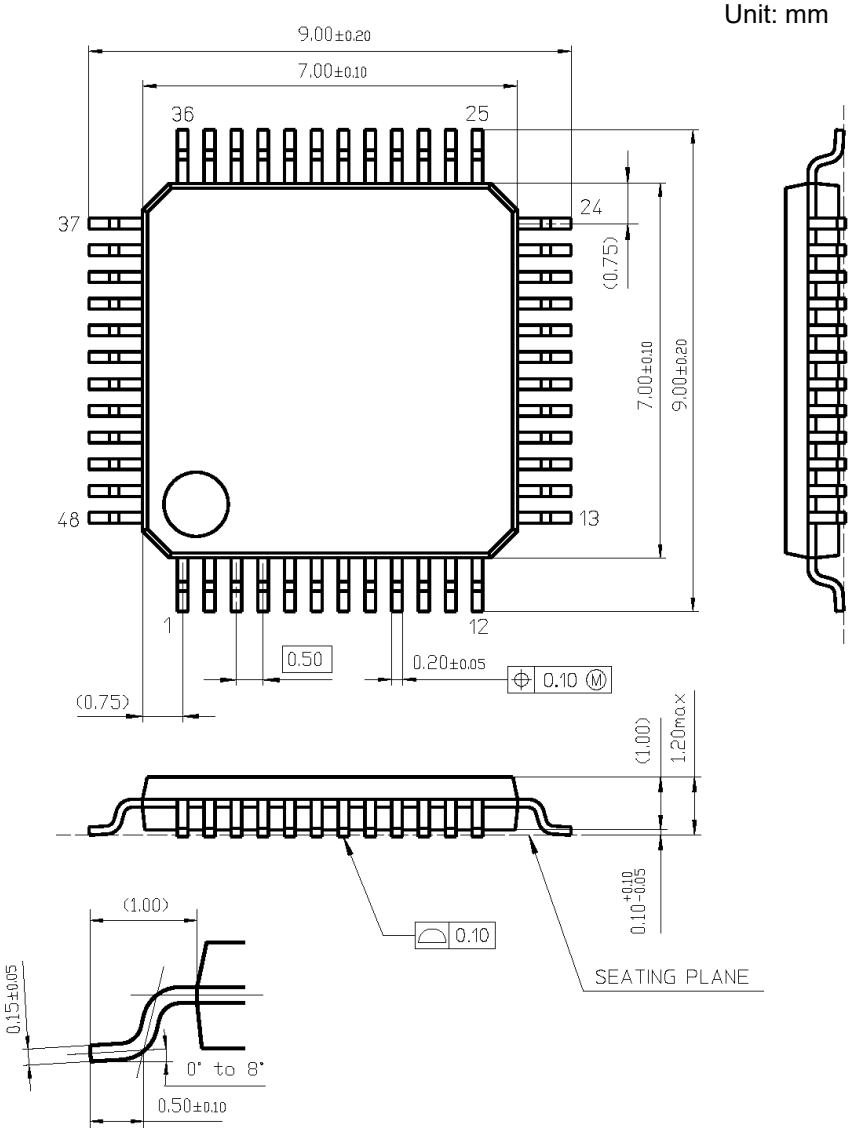


Figure 1.7-4 Package Dimension of 64 pins 7mm * 7mm 0.5mm pitch

Note:

The external dimensions of the package are subject to change. Before using this product, please obtain product specifications from the sales offices.

1.8 Cautions for Circuit Setup

The cautions for circuit setup are described as follows.

- Cautions of Usage
- Pin Connections
- Unused Pin Connection
- Cautions of Power Supply
- Example of Oscillator Connection

1.8.1 Cautions of Usage

When using this LSI, obey the following cautions.

1. Operation temperature should be well considered. If the operation temperature is over the condition, improper operation can occur.
2. Operation voltage should be also well considered.

   - If the operation voltage is over the operating range, duration of the product can be shortened (e.g. the lifetime warranty of a transistor due to the change over time).

   - If the operation voltage is below the operating range, it may operate improperly.
3. If you install the product close to high electrical fields (just below the cathode ray tube, etc.), shield the package surface to ensure normal performance.

1.8.2 Pin Connections

Each pin connection is listed in Table 1.8-1 .

Table 1.8-1 Pin Connections

Pin name	Input/Output	Connection details
VDD50	Input	Connect to 5 V external power supply. Connect the bypass capacitors of 0.1 μF and the decoupling capacitor of 10 μF or more between each pin and VSS pins. (Put the capacitor near the pins)
VSS	Input	Short circuit with common GND.
VOUT12	Output	Connect the bypass capacitors of 0.1 μF and the used capacitor of 1 μF to 50 μF for stabilization between each pin and VSS pins. (Put the capacitor near the pins)
OSCI, OSCO	I/O pin	HXOCLK is generated by connecting the oscillator to OSCI and OSCO pins and starting external oscillation(HXO).
SWDCLK, SWDD	Input	Insert a 100 Ω limit resistor between this pin and the external connector. Pull-up connect toV_{DD50} with the resistor of 10 kΩ.
TRCSWO	Output	Insert a 100 Ω limit resistor between this pin and the external connector.
NBOOT	Input	Insert a 100 Ω limit resistor between this pin and the external connector. Pull-up connect to V_{DD50} with the resistor of 2 kΩ.
TEST	Input	Pull-down connect to V_{SS} with the resistor of 2 kΩ.
NDMOD	Input	Insert a 100 Ω limit resistor between this pin and the external connector. Pull-up connect to V_{DD50} with the resistor of 2 kΩ.
NRST	I/O pin	Insert a 100 Ω limit resistor between this pin and the external connector. Connect the capacitor of 0.1 μF or more between each pin and VSS pins. (Put the capacitor near the pins)
P40～P42, P44～P46, P50, PF4	Input	When inserting a limit resistor while using VGA function, set it to 200 Ω or less.

Note:
Determine the processing method of each pin by evaluating enough in consideration of the effect of external noise.

Note:
VOUT12 is a pin to connect a capacity for the internal power supply stabilization.

Note:
For pins not listed in Table 1.8-1 , inserting a 100 Ω limit resistor is effetive for noise resistance.

Figure 1.8-1 shows the MCU peripheral recommended circuit. Table 1.8-2 shows the recommended external circuit constants.

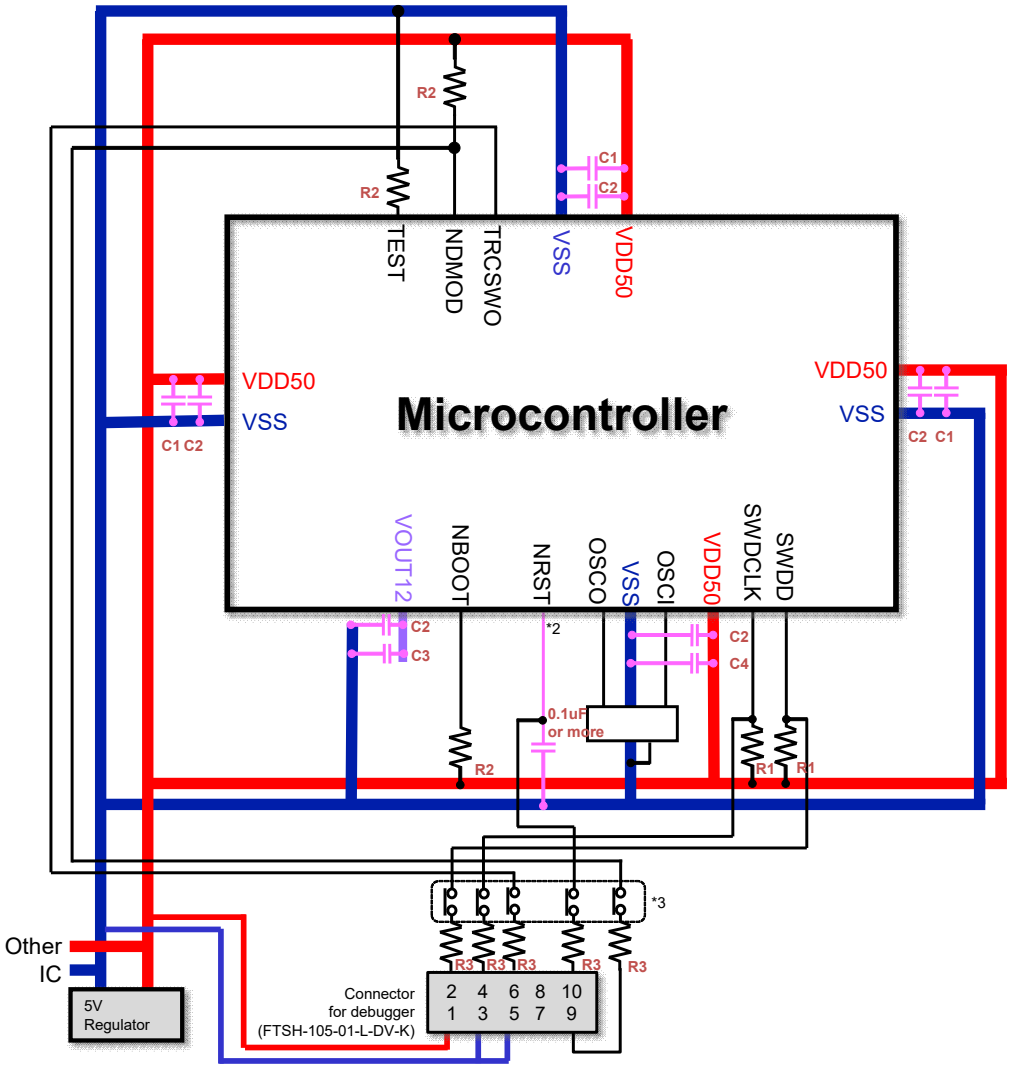


Figure 1.8-1 MCU Peripheral Recommended Circuit

Table 1.8-2 Recommended External Circuit Constants

Sign	Recommended Value	Objective
C1	10 μF	For noise filtering (*1)
C2	0.1 μF	
C3	10 μF	For the stabilization of internal regulator
C4	C3 or more	
R1	10 kΩ	For setting mode pin
R2	2 kΩ	
R3	100 Ω	For preventing noise of communication line

Note:

*1 Because the most suitable capacity value changes according to the frequency of noise, determine the value by the evaluation enough.

Note:

*2 When external reset IC is unused, do not add pull-up resistor to NRST pin.

Note:

*3 By attaching a jumper etc. near the microcontroller, it is possible to prevent noise coming from the connector and the wiring on the PCB.

Note:

Set the communication speed so that the time constant of the load on the communication path is less than half the communication cycle.

1.8.3 Unused pins

It is recommended to use the following procedure to set unused I/O pins to general purpose port function.

First, set unused I/O pins to general purpose port function. Then, set the pins either to I/O disabled state(both input enable and output enable are OFF) or to output state(input enable is OFF and output enable is ON). After that, open the pins. The pins(only for input) which have general purpose port function are also recommended to be set like unused I/O pins. The details are shown in Figure 1.8-2 and Table 1.8-3 .

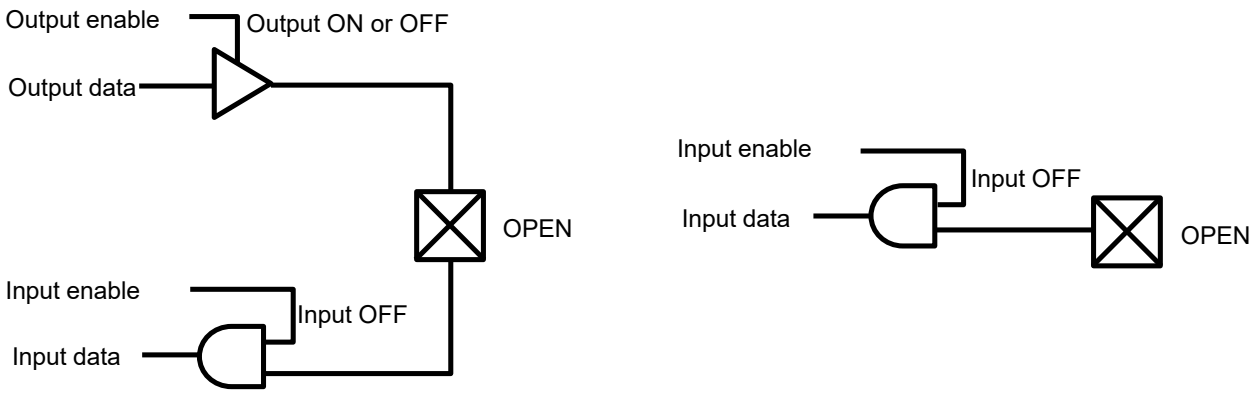


Figure 1.8-2 Unused I/O Pins

Table 1.8-3 Recommended Method of Unused I/O Pins

Pin	Input/ Output	Recommended method of unused pins
P40 to P42, P44 to P46, P50, P51	Input	Set it as general-purpose port function and perform one of the following processing. - Set pins to open in the state of Input/Output prohibition with port control. - Connect the resistor for pull-down in VSS in the state of input with port control. - Connect the resistor for pull-up in VDD5 in the state of input with port control.
Other I/O pin	I/O pin	Set it as general-purpose port function and perform one of the following processing. - Set pins to open in the state of Input/Output prohibition with port control. - Set pins to open in the state of "High-level" Output or "Low-level" Output with port control. - Connect the resistor for pull-down in VSS in the state of input with port control. - Connect the resistor for pull-up in VDD5 in the state of input with port control.

Note:
Determine how to process each pin by evaluating enough in consideration of the effect of external noise.

1.8.4 Cautions of Power Supply

The cautions of power supply are described as follows.

- Relations between Power Supply and Input Pin Voltage
- Restriction in Power-on
- Power Supply Circuit for LSI

1.8.4.1 Relations between Power Supply and Input Pin Voltage

Input pin voltage should be supplied only after power supply is on. If this order is reversed, a latch up occurs inside of the LSI and the destruction of the LSI by a large current flow can occur.

Relations between power supply and input pin voltage are shown in Figure 1.8-3 .

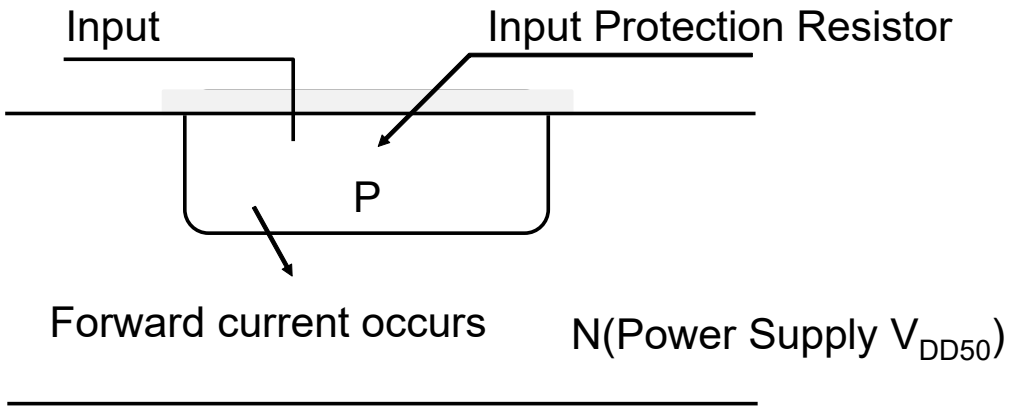


Figure 1.8-3 Relations between Power Supply and Input Pin Voltage

1.8.4.2 Restriction in Power-on

This LSI generates reset when power is applied by Power-On Reset and operates with the internal power supply generated by internal regulator. Therefore, design the circuit board so that the relations of NRST voltage, power supply voltage(VDD50), and internal power supply voltage(VOUT12) will comply with the following conditions.

- $\Delta V_{DD50P} \leq 5$ V/ms
- $t_{VOUT12} < t_{VRST}$
- $t_{NRSTW} \geq 1$ µs

ΔV_{DD50P} : The change rate of power supply voltage VDD50

t_{VOUT12} : The time when power supply voltage reaches 1.08 V

t_{VRST} : The time when power supply voltage reaches the lower limit of power supply voltage level (V_{RST5P})

t_{NRSTW} : The time that NRST pin maintains "L" level

Figure 1.8-4 shows the relations between power supply voltage and NRST voltage.

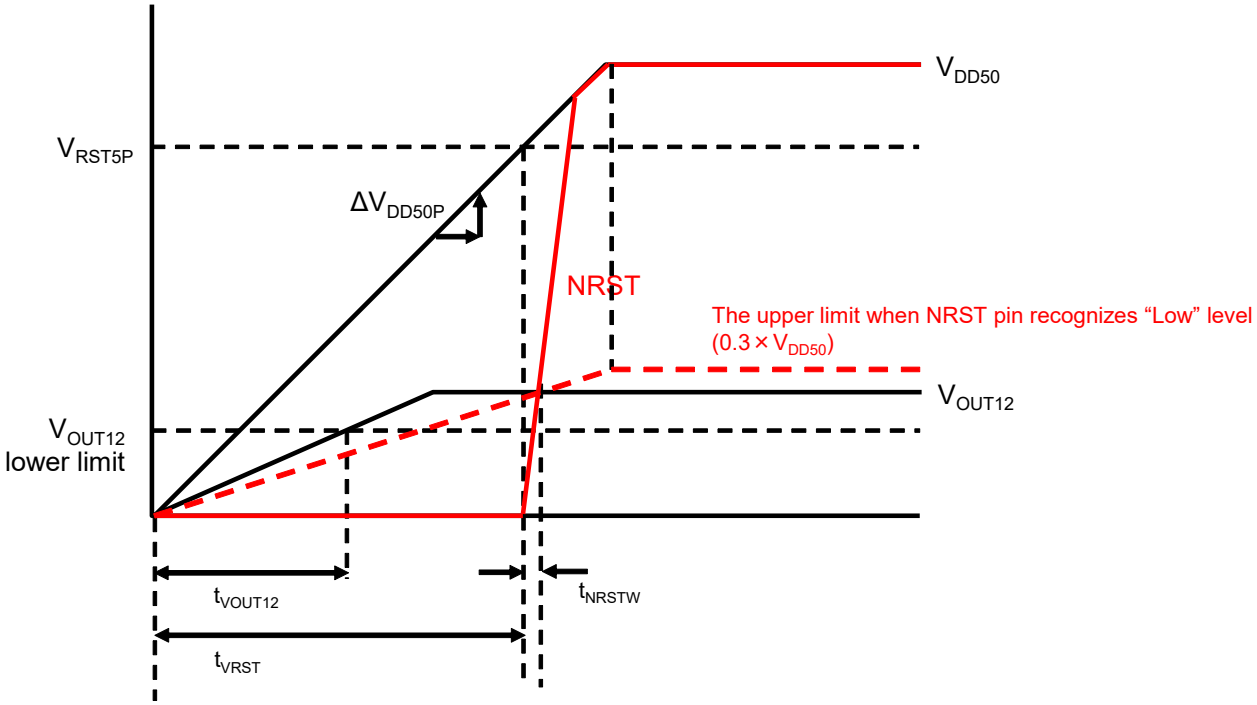


Figure 1.8-4 The Relations between LSI Power Supply and Reset Input Voltage

1.8.4.3 Power Supply Circuit for LSI

The power supply circuit should be designed with a sufficient margin, after checking AC line noise evaluation, and confirming the ripple when driving an LED and considering the power supply system.

Figure 1.8-5 shows an example for a power supply circuit. (Emitter follower type).

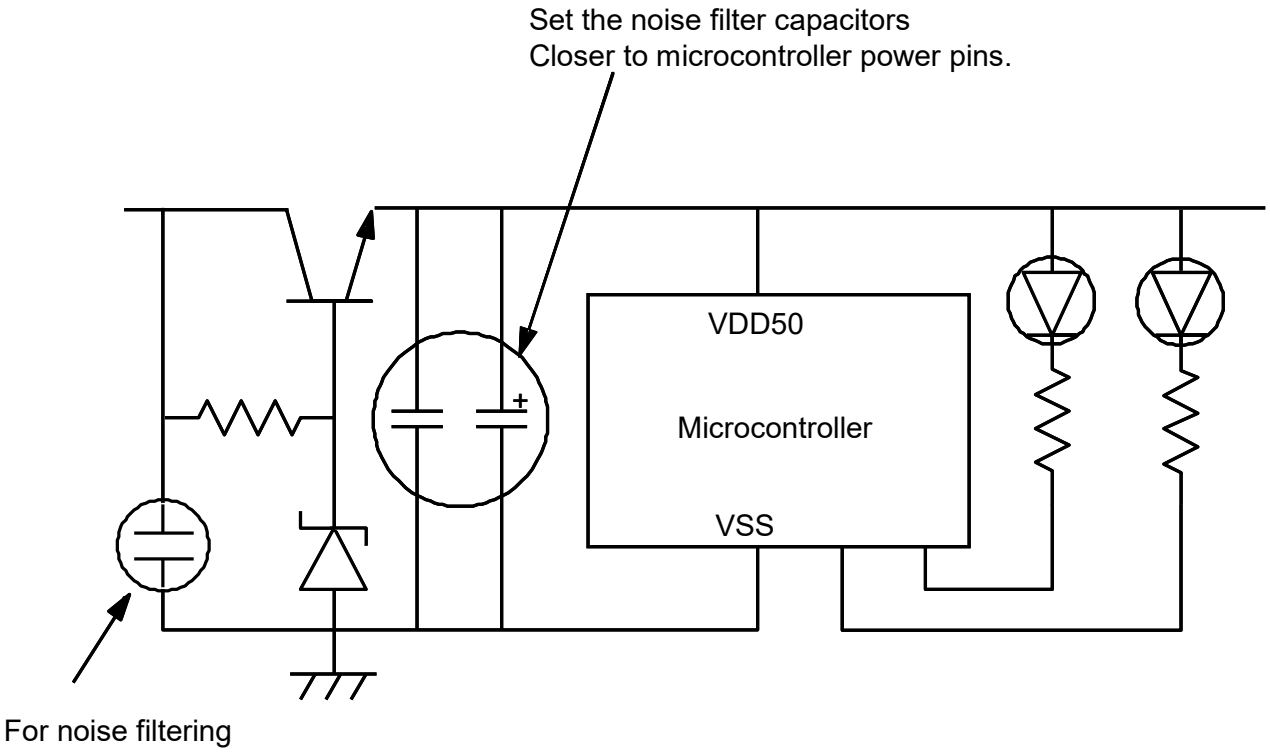


Figure 1.8-5 Power Supply Circuit Example(Emitter Follower Type)

1.8.5 Example of Oscillator Connection

Figure 1.8-6 shows the example of oscillator connection, and Table 1.8-4 shows recommended oscillators and the circuit constants.

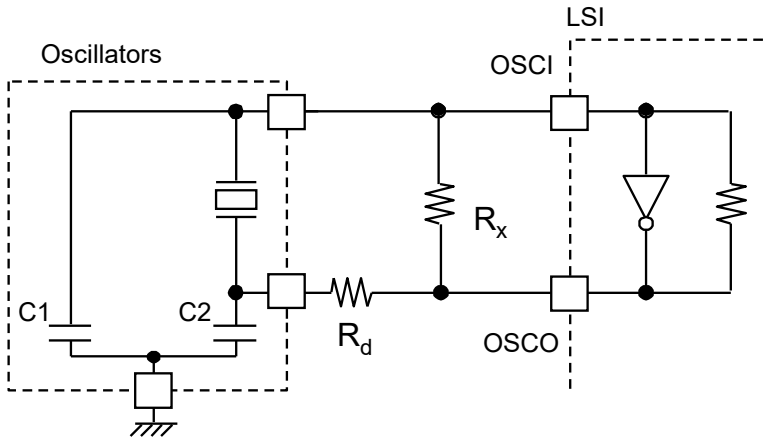


Figure 1.8-6 Example of Oscillator Connection

Table 1.8-4 Recommended Oscillators and The Circuit Constants

Oscillator maker	Frequency [MHz]	Type	Oscillator Product Number	Recommended circuit constant		
				Load capacity C1 = C2 [pF]	External feedback resistor R_X [Ω]	Dumping resistor R_d [Ω]
Murata	20	SMD	CSTNE20M0V530000R0	15	Open	150
		Lead	CSTLS20M0X53-B0	15	Open	0
	16	SMD	CSTNE16M0V530000R0	15	Open	150
		Lead	CSTLS16M0X53-B0	15	Open	0
	10	SMD	CSTNE10M0G550000R0	33	Open	220
		Lead	CSTLS10M0G56-B0	47	Open	220
	8	SMD	CSTNE8M00G550000R0	33	Open	330
		Lead	CSTLS8M00G56-B0	47	Open	330
	4	SMD	CSTCR4M00G55-R0	39	Open	330
		Lead	CSTLS4M00G56-B0	47	Open	330
Kyocera	20	Quartz Crystal Unit	CX3225CA	8	Open	1000
	16				Open	1500
	12				Open	1000
	10		CX5032GA	10	Open	0
	8			12	Open	330
	4		CX8045GA	20	Open	470

The recommended values above are based on the evaluation result of oscillator for a single unit of this LSI.

Note:

Consult the oscillator maker for the appropriate circuit constant because circuit constant of each oscillator, which is connected to OSCI/OSCO, depends on stray capacitance of the oscillator or on the mounting circuit.

Inquiries

If you have questions regarding technical information on this manual, please visit the following URL.

Nuvoton Technology Corporation Japan

URL: https://www.nuvoton.co.jp/en/contact/

- Microcomputer Home Page
  https://www.nuvoton.co.jp/en/products/

KM1M4BF02/03/04/05 Series KM1M4BF52/53/54 Series Datasheet

April 23.2025

Issued by
Nuvoton Technology Corporation Japan

©Nuvoton Technology Corporation Japan 2023

Important Notice

Nuvoton Products are neither intended nor warranted for usage in systems or equipment, any malfunction or failure of which may cause loss of human life, bodily injury or severe property damage. Such applications are deemed, "Insecure Usage".

Insecure usage includes, but is not limited to: equipment for surgical implementation, atomic energy control instruments, airplane or spaceship instruments, the control or operation of dynamic, brake or safety systems designed for vehicular use, traffic signal instruments, all types of safety devices, and other applications intended to support or sustain life.

All Insecure Usage shall be made at customer's risk, and in the event that third parties lay claims to Nuvoton as a result of customer's Insecure Usage, customer shall indemnify the damages and liabilities thus incurred by Nuvoton.

Please note that all data and specifications are subject to change without notice.
All the trademarks of products and companies mentioned in this datasheet belong to their respective owners.