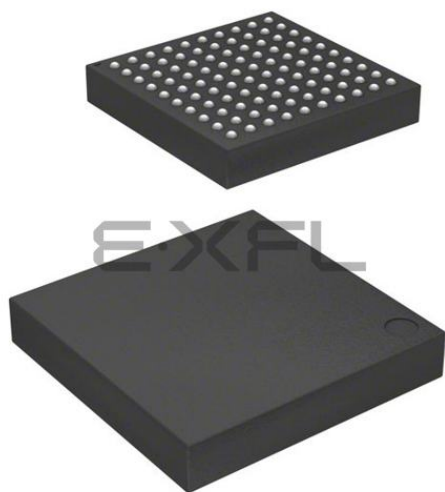




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"[Embedded - Microcontrollers](#)" refer to small, integrated circuits designed to perform specific tasks within larger systems. These microcontrollers are essentially compact computers on a single chip, containing a processor core, memory, and programmable input/output peripherals. They are called "embedded" because they are embedded within electronic devices to control various functions, rather than serving as standalone computers. Microcontrollers are crucial in modern electronics, providing the intelligence and control needed for a wide range of applications.

Applications of "[Embedded - Microcontrollers](#)"

Details

Product Status	Active
Core Processor	RX
Core Size	32-Bit Single-Core
Speed	32MHz
Connectivity	I ² C, IrDA, SCI, SPI, SSI, USB OTG
Peripherals	DMA, LCD, LVD, POR, PWM, WDT
Number of I/O	80
Program Memory Size	128KB (128K x 8)
Program Memory Type	FLASH
EEPROM Size	8K x 8
RAM Size	32K x 8
Voltage - Supply (Vcc/Vdd)	1.8V ~ 3.6V
Data Converters	A/D 17x12b; D/A 2x12b
Oscillator Type	Internal
Operating Temperature	-40°C ~ 85°C (TA)
Mounting Type	Surface Mount
Package / Case	100-TFLGA
Supplier Device Package	100-TFLGA (7x7)
Purchase URL	https://www.e-xfl.com/product-detail/renesas-electronics-america/r5f51135adlj-2a

Table 1.4 Pin Functions (3/4)

Classifications	Pin Name	I/O	Description
Serial communications interface (SCIf)	• Asynchronous mode/clock synchronous mode		
	SCK12	I/O	Input/output pin for the clock.
	RXD12	Input	Input pin for receiving data.
	TXD12	Output	Output pin for transmitting data.
	CTS12#	Input	Input pin for controlling the start of transmission and reception.
	RTS12#	Output	Output pin for controlling the start of transmission and reception.
	• Simple I ² C mode		
	SSCL12	I/O	Input/output pin for the I ² C clock.
	SSDA12	I/O	Input/output pin for the I ² C data.
	• Simple SPI mode		
	SCK12	I/O	Input/output pin for the clock.
	SMISO12	I/O	Input/output pin for slave transmit data.
	SMOSI12	I/O	Input/output pin for master transmit data.
	SS12#	Input	Chip-select input pin.
	• Extended serial mode		
	RXDX12	Input	Input pin for data reception by SCIf.
	TXDX12	Output	Output pin for data transmission by SCIf.
	SIOX12	I/O	Input/output pin for data reception or transmission by SCIf.
I ² C bus interface	SCL0	I/O	Input/output pin for I ² C bus interface clocks. Bus can be directly driven by the N-channel open drain output.
	SDA0	I/O	Input/output pin for I ² C bus interface data. Bus can be directly driven by the N-channel open drain output.
Serial peripheral interface	RSPCKA	I/O	Input/output pin for the RSPI clock.
	MOSIA	I/O	Input/output pin for transmitting data from the RSPI master.
	MISOA	I/O	Input/output pin for transmitting data from the RSPI slave.
	SSLA0	I/O	Input/output pin to select the slave for the RSPI.
	SSLA1 to SSLA3	Output	Output pins to select the slave for the RSPI.
Serial sound interface	SSISCK0	I/O	SSI serial bit clock pin.
	SSIWS	I/O	Word selection pin.
	SSITXD0	Output	Serial data output pin.
	SSIRXD0	Input	Serial data input pin.
	AUDIO_MCLK	Input	Master clock pin for audio.
USB 2.0 host/function module	USB0_DP	I/O	D+ I/O pin of the USB on-chip transceiver.
	USB0_DM	I/O	D- I/O pin of the USB on-chip transceiver.
	USB0_VBUS	Input	USB cable connection monitor pin.
	USB0_EXICEN	Output	Low-power control signal for the OTG chip.
	USB0_VBUSEN	Output	VBUS (5 V) supply enable signal for the OTG chip.
	USB0_OVRCURA, USB0_OVRCURB	Input	External overcurrent detection pins.
	USB0_ID	Input	Mini-AB connector ID input pin during operation in OTG mode.
12-bit A/D converter	AN000 to AN015, AN021	Input	Input pins for the analog signals to be processed by the A/D converter.
	ADTRG0#	Input	Input pin for the external trigger signals that start the A/D conversion.
12-bit D/A converter	DA0, DA1	Output	Output pins for the analog signals to be processed by the D/A converter.

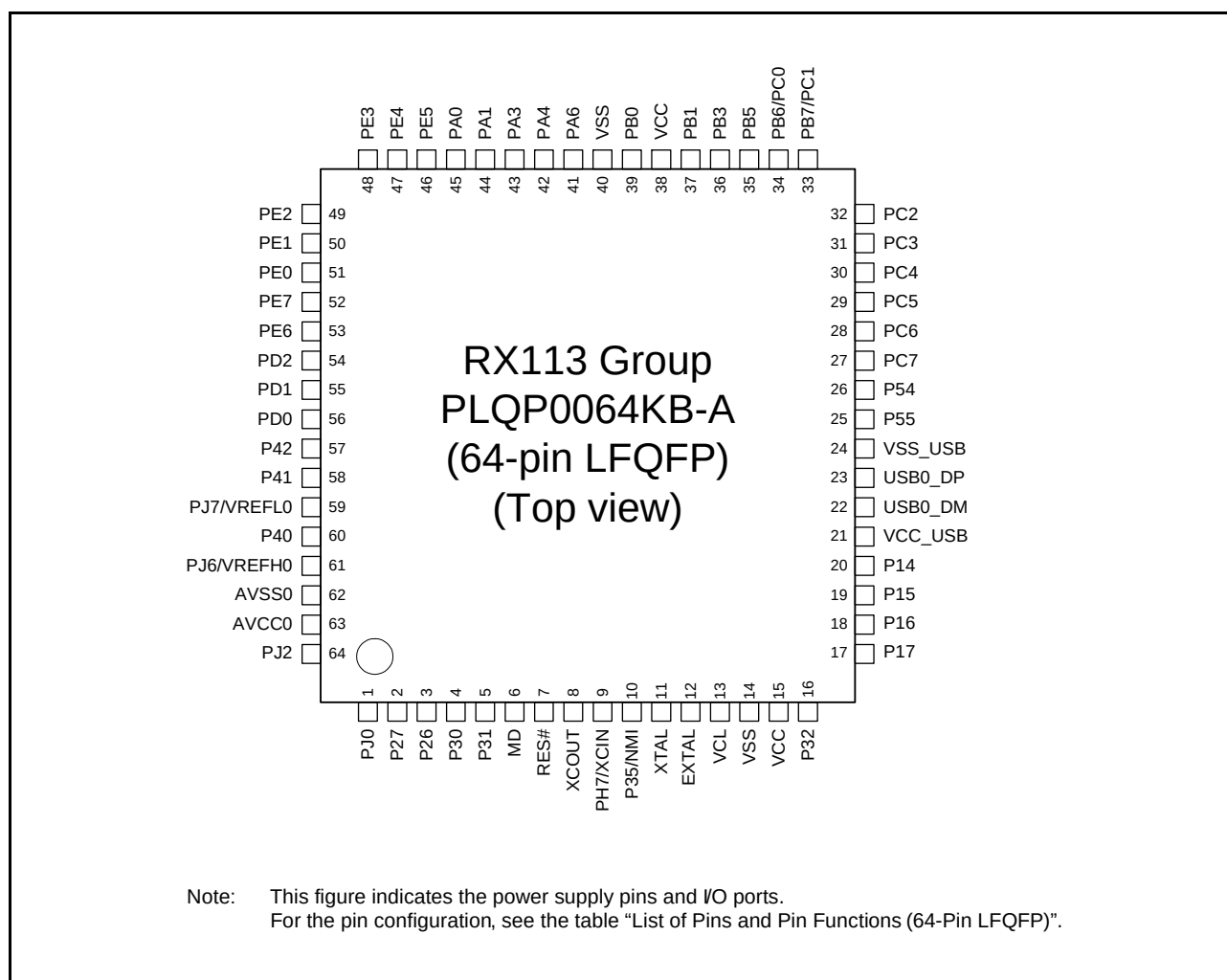


Figure 1.5 Pin Assignments of the 64-Pin LFQFP

Table 1.5 List of Pins and Pin Functions (100-Pin LFQFP) (1/3)

Pin No.	Power Supply, Clock, System Control	I/O Port	Timers (MTU, POE, RTC, TMR)	Communication (SCle, SCIf, RSPI, RIIC, USB, SSI)	LCD, Touch	Others
1		P04	MTIOC0A/POE2#/TMC13	SCK6	TS1	
2		PJ0				DA0
3		P02	MTIOC0D/POE3#/TMR13	RXD6/SMISO6/SSCL6	TS2	
4		PJ3	MTIOC3C	CTS6#/RTS6#/SS6#	TS3	
5		P25	MTIOC4C/MTCLKB		TS4	ADTRG0#
6		P24	MTIOC4A/MTCLKA/TMR11		TS5	
7		P23	MTIOC3D/MTCLKD	CTS0#/RTS0#/SS0#	TS6	
8		P22	MTIOC3B/MTCLKC/TMO0	SCK0	TS7	
9		P21	MTIOC1B/TMC10	RXD0/SMISO0/SSCL0	TS8	
10		P20	MTIOC1A/TMR10	TXD0/SMOSI0/SSDA0	TS9	
11		P27	MTIOC2B/TMC13	SCK12/SCK1/RXD6/SMISO6/SSCL6	TS10	IRQ3/ADTRG0#/ CACREF/ CMPA2
12		P26	MTIOC2A/TMO1	TXD1/SMOSI1/SSDA1/ USB0_VBUSEN/TXD6/SMOSI6/ SSDA6	TSCAP	
13		P30	MTIOC4B/POE8#/TMR13	RXD1/SMISO1/SSCL1	CAPH	IRQ0
14		P31	MTIOC4D/TMC12	CTS1#/RTS1#/SS1#	CAPL	IRQ1
15	MD					FINED
16	RES#					
17	XCOUT					
18	XCIN	PH7				
19	UPSEL	P35				NMI
20	XTAL					
21	EXTAL					
22	VCL					
23	VSS					
24	VDD					
25		P32	MTIOC0C/RTCOUT/TMO3	TXD6/SMOSI6/SSDA6/CTS6#/ RTS6#/SS6#	TS11	IRQ2
26		P17	MTIOC0C/MTIOC3A/ MTIOC3B/POE8#/TMO1	SCK1/MISOA/SDA0/RXD12/ RXDX12/SMISO12/SSCL12		IRQ7
27		P16	MTIOC3C/MTIOC3D/ RTCOUT/TMO2	TXD1/SMOSI1/SSDA1/MOSIA/ SCL0/USB0_VBUS/ USB0_VBUSEN/USB0_OVRCURB		IRQ6/ADTRG0#
28		P15	MTIOC0B/MTCLKB/TMC12	RXD1/SMISO1/SSCL1/RSPCKA		IRQ5/CLKOUT/ CACREF
29	UB#	P14	MTIOC0A/MTIOC3A/ MTCLKA/TMR12	CTS1#/RTS1#/SS1#/SSLA0/ TXD12/TXDX12/SIOX12/SMOSI12/ SSDA12/USB0_OVRCURA		IRQ4
30	VCC_USB					
31				USB0_DM		
32				USB0_DP		
33	VSS_USB					
34		P13	MTIOC0B/TMO3	CTS12#/RTS12#/SS12#/CTS0#/ RTS0#/SS0#	SEG00	IRQ3
35		P12	TMC11	SCK12/SCK0	SEG01	IRQ2

4. I/O Registers

This section provides information on the on-chip I/O register addresses and bit configuration. The information is given as shown below. Notes on writing to I/O registers are also given below.

(1) I/O register addresses (address order)

- Registers are listed from the lower allocation addresses.
- Registers are classified according to module symbols.
- Numbers of cycles for access indicate numbers of cycles of the given base clock.
- Among the internal I/O register area, addresses not listed in the list of registers are reserved. Reserved addresses must not be accessed. Do not access these addresses; otherwise, the operation when accessing these bits and subsequent operations cannot be guaranteed.

(2) Notes on writing to I/O registers

While writing to an I/O register, the CPU starts executing subsequent instructions before the I/O register write access is completed. This may cause the subsequent instructions to be executed before the write value is reflected in the operation. The examples below show how subsequent instructions must be executed after a write access to an I/O register is completed.

[Examples of cases requiring special care]

- The subsequent instruction must be executed while an interrupt request is disabled with the IENj bit in IERN of the ICU (interrupt request enable bit) set to 0.
- A WAIT instruction is executed immediately after the preprocessing for causing a transition to the low power consumption state.

In the above cases, after writing to an I/O register, wait until the write operation is completed using the following procedure and then execute the subsequent instruction.

- Write to an I/O register.
- Read the value in the I/O register and write it to a general register.
- Execute the operation using the value read.
- Execute the subsequent instruction.

Example of instructions

- Byte-size I/O registers

```
MOV.L #SFR_ADDR, R1
MOV.B #SFR_DATA, [R1]
CMP [R1].UB, R1
;; Next process
```

- Word-size I/O registers

```
MOV.L #SFR_ADDR, R1
MOV.W #SFR_DATA, [R1]
CMP [R1].W, R1
;; Next process
```

Table 4.1 List of I/O Registers (Address Order) (2/23)

Address	Module Symbol	Register Name	Register Symbol	Number of Bits	Access Size	Number of Access States
0008 240Ch	DTC	DTC Module Start Register	DTCST	8	8	2 ICLK
0008 240Eh	DTC	DTC Status Register	DTCSTS	16	16	2 ICLK
0008 7010h	ICU	Interrupt Request Register 016	IR016	8	8	2 ICLK
0008 701Bh	ICU	Interrupt Request Register 027	IR027	8	8	2 ICLK
0008 701Ch	ICU	Interrupt Request Register 028	IR028	8	8	2 ICLK
0008 701Dh	ICU	Interrupt Request Register 029	IR029	8	8	2 ICLK
0008 701Eh	ICU	Interrupt Request Register 030	IR030	8	8	2 ICLK
0008 701Fh	ICU	Interrupt Request Register 031	IR031	8	8	2 ICLK
0008 7020h	ICU	Interrupt Request Register 032	IR032	8	8	2 ICLK
0008 7021h	ICU	Interrupt Request Register 033	IR033	8	8	2 ICLK
0008 7022h	ICU	Interrupt Request Register 034	IR034	8	8	2 ICLK
0008 7024h	ICU	Interrupt Request Register 036	IR036	8	8	2 ICLK
0008 7025h	ICU	Interrupt Request Register 037	IR037	8	8	2 ICLK
0008 7026h	ICU	Interrupt Request Register 038	IR038	8	8	2 ICLK
0008 702Ch	ICU	Interrupt Request Register 044	IR044	8	8	2 ICLK
0008 702Dh	ICU	Interrupt Request Register 045	IR045	8	8	2 ICLK
0008 702Eh	ICU	Interrupt Request Register 046	IR046	8	8	2 ICLK
0008 702Fh	ICU	Interrupt Request Register 047	IR047	8	8	2 ICLK
0008 7039h	ICU	Interrupt Request Register 057	IR057	8	8	2 ICLK
0008 703Ah	ICU	Interrupt Request Register 058	IR058	8	8	2 ICLK
0008 703Bh	ICU	Interrupt Request Register 059	IR059	8	8	2 ICLK
0008 703Ch	ICU	Interrupt Request Register 060	IR060	8	8	2 ICLK
0008 703Dh	ICU	Interrupt Request Register 061	IR061	8	8	2 ICLK
0008 703Eh	ICU	Interrupt Request Register 062	IR062	8	8	2 ICLK
0008 703Fh	ICU	Interrupt Request Register 063	IR063	8	8	2 ICLK
0008 7040h	ICU	Interrupt Request Register 064	IR064	8	8	2 ICLK
0008 7041h	ICU	Interrupt Request Register 065	IR065	8	8	2 ICLK
0008 7042h	ICU	Interrupt Request Register 066	IR066	8	8	2 ICLK
0008 7043h	ICU	Interrupt Request Register 067	IR067	8	8	2 ICLK
0008 7044h	ICU	Interrupt Request Register 068	IR068	8	8	2 ICLK
0008 7045h	ICU	Interrupt Request Register 069	IR069	8	8	2 ICLK
0008 7046h	ICU	Interrupt Request Register 070	IR070	8	8	2 ICLK
0008 7047h	ICU	Interrupt Request Register 071	IR071	8	8	2 ICLK
0008 7058h	ICU	Interrupt Request Register 088	IR088	8	8	2 ICLK
0008 7059h	ICU	Interrupt Request Register 089	IR089	8	8	2 ICLK
0008 705Ah	ICU	Interrupt Request Register 090	IR090	8	8	2 ICLK
0008 705Ch	ICU	Interrupt Request Register 092	IR092	8	8	2 ICLK
0008 705Dh	ICU	Interrupt Request Register 093	IR093	8	8	2 ICLK
0008 7066h	ICU	Interrupt Request Register 102	IR102	8	8	2 ICLK
0008 7067h	ICU	Interrupt Request Register 103	IR103	8	8	2 ICLK
0008 706Ah	ICU	Interrupt Request Register 106	IR106	8	8	2 ICLK
0008 706Ch	ICU	Interrupt Request Register 108	IR108	8	8	2 ICLK
0008 706Dh	ICU	Interrupt Request Register 109	IR109	8	8	2 ICLK
0008 706Eh	ICU	Interrupt Request Register 110	IR110	8	8	2 ICLK
0008 7072h	ICU	Interrupt Request Register 114	IR114	8	8	2 ICLK
0008 7073h	ICU	Interrupt Request Register 115	IR115	8	8	2 ICLK
0008 7074h	ICU	Interrupt Request Register 116	IR116	8	8	2 ICLK
0008 7075h	ICU	Interrupt Request Register 117	IR117	8	8	2 ICLK
0008 7076h	ICU	Interrupt Request Register 118	IR118	8	8	2 ICLK
0008 7077h	ICU	Interrupt Request Register 119	IR119	8	8	2 ICLK
0008 7078h	ICU	Interrupt Request Register 120	IR120	8	8	2 ICLK
0008 7079h	ICU	Interrupt Request Register 121	IR121	8	8	2 ICLK

Table 4.1 List of I/O Registers (Address Order) (4/23)

Address	Module Symbol	Register Name	Register Symbol	Number of Bits	Access Size	Number of Access States
0008 70E4h	ICU	Interrupt Request Register 228	IR228	8	8	2 ICLK
0008 70E5h	ICU	Interrupt Request Register 229	IR229	8	8	2 ICLK
0008 70E6h	ICU	Interrupt Request Register 230	IR230	8	8	2 ICLK
0008 70E7h	ICU	Interrupt Request Register 231	IR231	8	8	2 ICLK
0008 70E8h	ICU	Interrupt Request Register 232	IR232	8	8	2 ICLK
0008 70E9h	ICU	Interrupt Request Register 233	IR233	8	8	2 ICLK
0008 70EAh	ICU	Interrupt Request Register 234	IR234	8	8	2 ICLK
0008 70EBh	ICU	Interrupt Request Register 235	IR235	8	8	2 ICLK
0008 70ECh	ICU	Interrupt Request Register 236	IR236	8	8	2 ICLK
0008 70EDh	ICU	Interrupt Request Register 237	IR237	8	8	2 ICLK
0008 70EEh	ICU	Interrupt Request Register 238	IR238	8	8	2 ICLK
0008 70EFh	ICU	Interrupt Request Register 239	IR239	8	8	2 ICLK
0008 70F0h	ICU	Interrupt Request Register 240	IR240	8	8	2 ICLK
0008 70F1h	ICU	Interrupt Request Register 241	IR241	8	8	2 ICLK
0008 70F2h	ICU	Interrupt Request Register 242	IR242	8	8	2 ICLK
0008 70F3h	ICU	Interrupt Request Register 243	IR243	8	8	2 ICLK
0008 70F4h	ICU	Interrupt Request Register 244	IR244	8	8	2 ICLK
0008 70F5h	ICU	Interrupt Request Register 245	IR245	8	8	2 ICLK
0008 70F6h	ICU	Interrupt Request Register 246	IR246	8	8	2 ICLK
0008 70F7h	ICU	Interrupt Request Register 247	IR247	8	8	2 ICLK
0008 70F8h	ICU	Interrupt Request Register 248	IR248	8	8	2 ICLK
0008 70F9h	ICU	Interrupt Request Register 249	IR249	8	8	2 ICLK
0008 711Bh	ICU	DTC Activation Enable Register 027	DTCE027	8	8	2 ICLK
0008 711Ch	ICU	DTC Activation Enable Register 028	DTCE028	8	8	2 ICLK
0008 711Dh	ICU	DTC Activation Enable Register 029	DTCE029	8	8	2 ICLK
0008 711Eh	ICU	DTC Activation Enable Register 030	DTCE030	8	8	2 ICLK
0008 711Fh	ICU	DTC Activation Enable Register 031	DTCE031	8	8	2 ICLK
0008 7124h	ICU	DTC Activation Enable Register 036	DTCE036	8	8	2 ICLK
0008 7125h	ICU	DTC Activation Enable Register 037	DTCE037	8	8	2 ICLK
0008 712Dh	ICU	DTC Activation Enable Register 045	DTCE045	8	8	2 ICLK
0008 712Eh	ICU	DTC Activation Enable Register 046	DTCE046	8	8	2 ICLK
0008 713Ah	ICU	DTC Activation Enable Register 058	DTCE058	8	8	2 ICLK
0008 713Bh	ICU	DTC Activation Enable Register 059	DTCE059	8	8	2 ICLK
0008 713Ch	ICU	DTC Activation Enable Register 060	DTCE060	8	8	2 ICLK
0008 713Dh	ICU	DTC Activation Enable Register 061	DTCE061	8	8	2 ICLK
0008 7140h	ICU	DTC Activation Enable Register 064	DTCE064	8	8	2 ICLK
0008 7141h	ICU	DTC Activation Enable Register 065	DTCE065	8	8	2 ICLK
0008 7142h	ICU	DTC Activation Enable Register 066	DTCE066	8	8	2 ICLK
0008 7143h	ICU	DTC Activation Enable Register 067	DTCE067	8	8	2 ICLK
0008 7144h	ICU	DTC Activation Enable Register 068	DTCE068	8	8	2 ICLK
0008 7145h	ICU	DTC Activation Enable Register 069	DTCE069	8	8	2 ICLK
0008 7146h	ICU	DTC Activation Enable Register 070	DTCE070	8	8	2 ICLK
0008 7147h	ICU	DTC Activation Enable Register 071	DTCE071	8	8	2 ICLK
0008 7166h	ICU	DTC Activation Enable Register 102	DTCE102	8	8	2 ICLK
0008 7167h	ICU	DTC Activation Enable Register 103	DTCE103	8	8	2 ICLK
0008 716Ah	ICU	DTC Activation Enable Register 106	DTCE106	8	8	2 ICLK
0008 716Dh	ICU	DTC Activation Enable Register 109	DTCE109	8	8	2 ICLK
0008 716Eh	ICU	DTC Activation Enable Register 110	DTCE110	8	8	2 ICLK
0008 7172h	ICU	DTC Activation Enable Register 114	DTCE114	8	8	2 ICLK
0008 7173h	ICU	DTC Activation Enable Register 115	DTCE115	8	8	2 ICLK
0008 7174h	ICU	DTC Activation Enable Register 116	DTCE116	8	8	2 ICLK
0008 7175h	ICU	DTC Activation Enable Register 117	DTCE117	8	8	2 ICLK

Table 4.1 List of I/O Registers (Address Order) (6/23)

Address	Module Symbol	Register Name	Register Symbol	Number of Bits	Access Size	Number of Access States
0008 720Fh	ICU	Interrupt Request Enable Register 0F	IER0F	8	8	2 ICLK
0008 7210h	ICU	Interrupt Request Enable Register 10	IER10	8	8	2 ICLK
0008 7211h	ICU	Interrupt Request Enable Register 11	IER11	8	8	2 ICLK
0008 7215h	ICU	Interrupt Request Enable Register 15	IER15	8	8	2 ICLK
0008 7216h	ICU	Interrupt Request Enable Register 16	IER16	8	8	2 ICLK
0008 7217h	ICU	Interrupt Request Enable Register 17	IER17	8	8	2 ICLK
0008 721Ah	ICU	Interrupt Request Enable Register 1A	IER1A	8	8	2 ICLK
0008 721Bh	ICU	Interrupt Request Enable Register 1B	IER1B	8	8	2 ICLK
0008 721Ch	ICU	Interrupt Request Enable Register 1C	IER1C	8	8	2 ICLK
0008 721Dh	ICU	Interrupt Request Enable Register 1D	IER1D	8	8	2 ICLK
0008 721Eh	ICU	Interrupt Request Enable Register 1E	IER1E	8	8	2 ICLK
0008 721Fh	ICU	Interrupt Request Enable Register 1F	IER1F	8	8	2 ICLK
0008 72E0h	ICU	Software Interrupt Activation Register	SWINTR	8	8	2 ICLK
0008 72F0h	ICU	Fast Interrupt Set Register	FIR	16	16	2 ICLK
0008 7300h	ICU	Interrupt Source Priority Register 000	IPR000	8	8	2 ICLK
0008 7303h	ICU	Interrupt Source Priority Register 003	IPR003	8	8	2 ICLK
0008 7304h	ICU	Interrupt Source Priority Register 004	IPR004	8	8	2 ICLK
0008 7305h	ICU	Interrupt Source Priority Register 005	IPR005	8	8	2 ICLK
0008 7306h	ICU	Interrupt Source Priority Register 006	IPR006	8	8	2 ICLK
0008 7307h	ICU	Interrupt Source Priority Register 007	IPR007	8	8	2 ICLK
0008 7320h	ICU	Interrupt Source Priority Register 032	IPR032	8	8	2 ICLK
0008 7321h	ICU	Interrupt Source Priority Register 033	IPR033	8	8	2 ICLK
0008 7322h	ICU	Interrupt Source Priority Register 034	IPR034	8	8	2 ICLK
0008 7324h	ICU	Interrupt Source Priority Register 036	IPR036	8	8	2 ICLK
0008 7325h	ICU	Interrupt Source Priority Register 037	IPR037	8	8	2 ICLK
0008 7326h	ICU	Interrupt Source Priority Register 038	IPR038	8	8	2 ICLK
0008 732Ch	ICU	Interrupt Source Priority Register 044	IPR044	8	8	2 ICLK
0008 7339h	ICU	Interrupt Source Priority Register 057	IPR057	8	8	2 ICLK
0008 733Ah	ICU	Interrupt Source Priority Register 058	IPR058	8	8	2 ICLK
0008 733Bh	ICU	Interrupt Source Priority Register 059	IPR059	8	8	2 ICLK
0008 733Ch	ICU	Interrupt Source Priority Register 060	IPR060	8	8	2 ICLK
0008 733Fh	ICU	Interrupt Source Priority Register 063	IPR063	8	8	2 ICLK
0008 7340h	ICU	Interrupt Source Priority Register 064	IPR064	8	8	2 ICLK
0008 7341h	ICU	Interrupt Source Priority Register 065	IPR065	8	8	2 ICLK
0008 7342h	ICU	Interrupt Source Priority Register 066	IPR066	8	8	2 ICLK
0008 7343h	ICU	Interrupt Source Priority Register 067	IPR067	8	8	2 ICLK
0008 7344h	ICU	Interrupt Source Priority Register 068	IPR068	8	8	2 ICLK
0008 7345h	ICU	Interrupt Source Priority Register 069	IPR069	8	8	2 ICLK
0008 7346h	ICU	Interrupt Source Priority Register 070	IPR070	8	8	2 ICLK
0008 7347h	ICU	Interrupt Source Priority Register 071	IPR071	8	8	2 ICLK
0008 7358h	ICU	Interrupt Source Priority Register 088	IPR088	8	8	2 ICLK
0008 7359h	ICU	Interrupt Source Priority Register 089	IPR089	8	8	2 ICLK
0008 735Ah	ICU	Interrupt Source Priority Register 090	IPR090	8	8	2 ICLK
0008 735Ch	ICU	Interrupt Source Priority Register 092	IPR092	8	8	2 ICLK
0008 735Dh	ICU	Interrupt Source Priority Register 093	IPR093	8	8	2 ICLK
0008 7366h	ICU	Interrupt Source Priority Register 102	IPR102	8	8	2 ICLK
0008 7367h	ICU	Interrupt Source Priority Register 103	IPR103	8	8	2 ICLK
0008 736Ah	ICU	Interrupt Source Priority Register 106	IPR106	8	8	2 ICLK
0008 736Ch	ICU	Interrupt Source Priority Register 108	IPR108	8	8	2 ICLK
0008 7372h	ICU	Interrupt Source Priority Register 114	IPR114	8	8	2 ICLK
0008 7376h	ICU	Interrupt Source Priority Register 118	IPR118	8	8	2 ICLK
0008 7379h	ICU	Interrupt Source Priority Register 121	IPR121	8	8	2 ICLK

Table 4.1 List of I/O Registers (Address Order) (8/23)

Address	Module Symbol	Register Name	Register Symbol	Number of Bits	Access Size	Number of Access States
0008 800Ch	CMT1	Compare Match Timer Constant Register	CMCOR	16	16	2 or 3 PCLKB
0008 8010h	CMT	Compare Match Timer Start Register1	CMSTR1	16	16	2 or 3 PCLKB
0008 8012h	CMT2	Compare Match Timer Control Register	CMCR	16	16	2 or 3 PCLKB
0008 8014h	CMT2	Compare Match Counter	CMCNT	16	16	2 or 3 PCLKB
0008 8016h	CMT2	Compare Match Constant Register	CMCOR	16	16	2 or 3 PCLKB
0008 8018h	CMT3	Compare Match Timer Control Register	CMCR	16	16	2 or 3 PCLKB
0008 801Ah	CMT3	Compare Match Counter	CMCNT	16	16	2 or 3 PCLKB
0008 801Ch	CMT3	Compare Match Constant Register	CMCOR	16	16	2 or 3 PCLKB
0008 8030h	IWDT	IWDT Refresh Register	IWDTRR	8	8	2 or 3 PCLKB
0008 8032h	IWDT	IWDT Control Register	IWDTCR	16	16	2 or 3 PCLKB
0008 8034h	IWDT	IWDT Status Register	IWDTSR	16	16	2 or 3 PCLKB
0008 8036h	IWDT	IWDT Reset Control Register	IWDTRCR	8	8	2 or 3 PCLKB
0008 8038h	IWDT	IWDT Count Stop Control Register	IWDTCTPR	8	8	2 or 3 PCLKB
0008 8040h	R12DA	D/A Data Register 0	DADR0	16	16	2 or 3 PCLKB
0008 8042h	R12DA	D/A Data Register 1	DADR1	16	16	2 or 3 PCLKB
0008 8044h	R12DA	D/A Control Register	DACR	8	8	2 or 3 PCLKB
0008 8045h	R12DA	DADRM Format Select Register	DADPR	8	8	2 or 3 PCLKB
0008 8046h	R12DA	D/A A/D Synchronous Start Control Register	DAADSCR	8	8	2 or 3 PCLKB
0008 8047h	R12DA	D/A VREF Control Register	DAVREFCR	8	8	2 or 3 PCLKB
0008 8200h	TMR0	Timer Control Register	TCR	8	8	2 or 3 PCLKB
0008 8201h	TMR1	Timer Control Register	TCR	8	8	2 or 3 PCLKB
0008 8202h	TMR0	Timer Control/Status Register	TCSR	8	8	2 or 3 PCLKB
0008 8203h	TMR1	Timer Control/Status Register	TCSR	8	8	2 or 3 PCLKB
0008 8204h	TMR0	Time Constant Register A	TCORA	8	8	2 or 3 PCLKB
0008 8205h	TMR1	Time Constant Register A	TCORA	8	8*1	2 or 3 PCLKB
0008 8206h	TMR0	Time Constant Register B	TCORB	8	8	2 or 3 PCLKB
0008 8207h	TMR1	Time Constant Register B	TCORB	8	8*1	2 or 3 PCLKB
0008 8208h	TMR0	Timer Counter	TCNT	8	8	2 or 3 PCLKB
0008 8209h	TMR1	Timer Counter	TCNT	8	8*1	2 or 3 PCLKB
0008 820Ah	TMR0	Timer Counter Control Register	TCCR	8	8	2 or 3 PCLKB
0008 820Bh	TMR1	Timer Counter Control Register	TCCR	8	8*1	2 or 3 PCLKB
0008 820Ch	TMR0	Time Count Start Register	TCSTR	8	8	2 or 3 PCLKB
0008 8210h	TMR2	Timer Control Register	TCR	8	8	2 or 3 PCLKB
0008 8211h	TMR3	Timer Control Register	TCR	8	8	2 or 3 PCLKB
0008 8212h	TMR2	Timer Control/Status Register	TCSR	8	8	2 or 3 PCLKB
0008 8213h	TMR3	Timer Control/Status Register	TCSR	8	8	2 or 3 PCLKB
0008 8214h	TMR2	Time Constant Register A	TCORA	8	8	2 or 3 PCLKB
0008 8215h	TMR3	Time Constant Register A	TCORA	8	8*1	2 or 3 PCLKB
0008 8216h	TMR2	Time Constant Register B	TCORB	8	8	2 or 3 PCLKB
0008 8217h	TMR3	Time Constant Register B	TCORB	8	8*1	2 or 3 PCLKB
0008 8218h	TMR2	Timer Counter	TCNT	8	8	2 or 3 PCLKB
0008 8219h	TMR3	Timer Counter	TCNT	8	8*1	2 or 3 PCLKB
0008 821Ah	TMR2	Timer Control Register	TCCR	8	8	2 or 3 PCLKB
0008 821Bh	TMR3	Timer Control Register	TCCR	8	8*1	2 or 3 PCLKB
0008 821Ch	TMR2	Time Count Start Register	TCSTR	8	8	2 or 3 PCLKB
0008 8280h	CRC	CRC Control Register	CRCCR	8	8	2 or 3 PCLKB
0008 8281h	CRC	CRC Data Input Register	CRCDIR	8	8	2 or 3 PCLKB
0008 8282h	CRC	CRC Data Output Register	CRCDOR	16	16	2 or 3 PCLKB
0008 8300h	RIIC0	I ² C Bus Control Register 1	ICCR1	8	8	2 or 3 PCLKB
0008 8301h	RIIC0	I ² C Bus Control Register 2	ICCR2	8	8	2 or 3 PCLKB
0008 8302h	RIIC0	I ² C Bus Mode Register 1	ICMR1	8	8	2 or 3 PCLKB
0008 8303h	RIIC0	I ² C Bus Mode Register 2	ICMR2	8	8	2 or 3 PCLKB

Table 4.1 List of I/O Registers (Address Order) (11/23)

Address	Module Symbol	Register Name	Register Symbol	Number of Bits	Access Size	Number of Access States
0008 8722h	MTU0	Timer General Register F	TGRF	16	16	2 or 3 PCLKB
0008 8724h	MTU0	Timer Interrupt Enable Register 2	TIER2	8	8	2 or 3 PCLKB
0008 8726h	MTU0	Timer Buffer Operation Transfer Mode Register	TBTM	8	8	2 or 3 PCLKB
0008 8780h	MTU1	Timer Control Register	TCR	8	8	2 or 3 PCLKB
0008 8781h	MTU1	Timer Mode Register	TMDR	8	8	2 or 3 PCLKB
0008 8782h	MTU1	Timer I/O Control Register	TIOR	8	8	2 or 3 PCLKB
0008 8784h	MTU1	Timer Interrupt Enable Register	TIER	8	8	2 or 3 PCLKB
0008 8785h	MTU1	Timer Status Register	TSR	8	8	2 or 3 PCLKB
0008 8786h	MTU1	Timer Counter	TCNT	16	16	2 or 3 PCLKB
0008 8788h	MTU1	Timer General Register A	TGRA	16	16	2 or 3 PCLKB
0008 878Ah	MTU1	Timer General Register B	TGRB	16	16	2 or 3 PCLKB
0008 8790h	MTU1	Timer Input Capture Control Register	TICCR	8	8	2 or 3 PCLKB
0008 8800h	MTU2	Timer Control Register	TCR	8	8	2 or 3 PCLKB
0008 8801h	MTU2	Timer Mode Register	TMDR	8	8	2 or 3 PCLKB
0008 8802h	MTU2	Timer I/O Control Register	TIOR	8	8	2 or 3 PCLKB
0008 8804h	MTU2	Timer Interrupt Enable Register	TIER	8	8	2 or 3 PCLKB
0008 8805h	MTU2	Timer Status Register	TSR	8	8	2 or 3 PCLKB
0008 8806h	MTU2	Timer Counter	TCNT	16	16	2 or 3 PCLKB
0008 8808h	MTU2	Timer General Register A	TGRA	16	16	2 or 3 PCLKB
0008 880Ah	MTU2	Timer General Register B	TGRB	16	16	2 or 3 PCLKB
0008 8880h	MTU5	Timer Counter U	TCNTU	16	16	2 or 3 PCLKB
0008 8882h	MTU5	Timer General Register U	TGRU	16	16	2 or 3 PCLKB
0008 8884h	MTU5	Timer Control Register U	TCRU	8	8	2 or 3 PCLKB
0008 8886h	MTU5	Timer I/O Control Register U	TIORU	8	8	2 or 3 PCLKB
0008 8890h	MTU5	Timer Counter V	TCNTV	16	16	2 or 3 PCLKB
0008 8892h	MTU5	Timer General Register V	TGRV	16	16	2 or 3 PCLKB
0008 8894h	MTU5	Timer Control Register V	TCRV	8	8	2 or 3 PCLKB
0008 8896h	MTU5	Timer I/O Control Register V	TIORV	8	8	2 or 3 PCLKB
0008 88A0h	MTU5	Timer Counter W	TCNTW	16	16	2 or 3 PCLKB
0008 88A2h	MTU5	Timer General Register W	TGRW	16	16	2 or 3 PCLKB
0008 88A4h	MTU5	Timer Control Register W	TCRW	8	8	2 or 3 PCLKB
0008 88A6h	MTU5	Timer I/O Control Register W	TIORW	8	8	2 or 3 PCLKB
0008 88B2h	MTU5	Timer Interrupt Enable Register	TIER	8	8	2 or 3 PCLKB
0008 88B4h	MTU5	Timer Start Register	TSTR	8	8	2 or 3 PCLKB
0008 88B6h	MTU5	Timer Compare Match Clear Register	TCNTCMPCLR	8	8	2 or 3 PCLKB
0008 8900h	POE	Input Level Control/Status Register 1	ICSR1	16	8, 16	2 or 3 PCLKB
0008 8902h	POE	Output Level Control/Status Register 1	OCSR1	16	8, 16	2 or 3 PCLKB
0008 8908h	POE	Input Level Control/Status Register 2	ICSR2	16	8, 16	2 or 3 PCLKB
0008 890Ah	POE	Software Port Output Enable Register	SPOER	8	8	2 or 3 PCLKB
0008 890Bh	POE	Port Output Enable Control Register 1	POECR1	8	8	2 or 3 PCLKB
0008 890Ch	POE	Port Output Enable Control Register 2	POECR2	8	8	2 or 3 PCLKB
0008 890Eh	POE	Input Level Control/Status Register 3	ICSR3	16	8, 16	2 or 3 PCLKB
0008 9000h	S12AD	A/D Control Register	ADCSR	16	16	2 or 3 PCLKB
0008 9004h	S12AD	A/D Channel Select Register A	ADANSA	16	16	2 or 3 PCLKB
0008 9006h	S12AD	A/D Channel Select Register A1	ADANSA1	16	16	2 or 3 PCLKB
0008 9008h	S12AD	A/D-Converted Value Addition Mode Select Register	ADADS	16	16	2 or 3 PCLKB
0008 900Ah	S12AD	A/D-Converted Value Addition Mode Select Register 1	ADADS1	16	16	2 or 3 PCLKB
0008 900Ch	S12AD	A/D-Converted Value Addition Count Select Register	ADADC	8	8	2 or 3 PCLKB
0008 900Eh	S12AD	A/D Control Extended Register	ADCER	16	16	2 or 3 PCLKB
0008 9010h	S12AD	A/D Start Trigger Select Register	ADSTRGR	16	16	2 or 3 PCLKB
0008 9012h	S12AD	A/D Converted Extended Input Control Register	ADEXICR	16	16	2 or 3 PCLKB
0008 9014h	S12AD	A/D Channel Select Register B	ADANSB	16	16	2 or 3 PCLKB

Table 4.1 List of I/O Registers (Address Order) (21/23)

Address	Module Symbol	Register Name	Register Symbol	Number of Bits	Access Size	Number of Access States
000A 0036h	USB0	BRDY Interrupt Enable Register	BRDYENB	16	16	9 PCLKB or more
000A 0038h	USB0	NRDY Interrupt Enable Register	NRDYENB	16	16	9 PCLKB or more
000A 003Ah	USB0	BEMP Interrupt Enable Register	BEMPENB	16	16	9 PCLKB or more
000A 003Ch	USB0	SOF Output Configuration Register	SOFCFG	16	16	9 PCLKB or more
000A 0040h	USB0	Interrupt Status Register 0	INTSTS0	16	16	9 PCLKB or more
000A 0042h	USB0	Interrupt Status Register 1	INTSTS1	16	16	9 PCLKB or more
000A 0046h	USB0	BRDY Interrupt Status Register	BRDYSTS	16	16	9 PCLKB or more
000A 0048h	USB0	NRDY Interrupt Status Register	NRDYSTS	16	16	9 PCLKB or more
000A 004Ah	USB0	BEMP Interrupt Status Register	BEMPSTS	16	16	9 PCLKB or more
000A 004Ch	USB0	Frame Number Register	FRMNUM	16	16	9 PCLKB or more
000A 0054h	USB0	USB Request Type Register	USBREQ	16	16	9 PCLKB or more
000A 0056h	USB0	USB Request Value Register	USBVAL	16	16	9 PCLKB or more
000A 0058h	USB0	USB Request Index Register	USBINDX	16	16	9 PCLKB or more
000A 005Ah	USB0	USB Request Length Register	USBLENG	16	16	9 PCLKB or more
000A 005Ch	USB0	DCP Configuration Register	DCPCFG	16	16	9 PCLKB or more
000A 005Eh	USB0	DCP Maximum Packet Size Register	DCPMAXP	16	16	9 PCLKB or more
000A 0060h	USB0	DCP Control Register	DCPCTR	16	16	9 PCLKB or more
000A 0064h	USB0	Pipe Window Select Register	PIPESEL	16	16	9 PCLKB or more
000A 0068h	USB0	Pipe Configuration Register	PIPECFG	16	16	9 PCLKB or more
000A 006Ch	USB0	Pipe Maximum Packet Size Register	PIPEMAXP	16	16	9 PCLKB or more
000A 006Eh	USB0	Pipe Cycle Control Register	PIPEPERI	16	16	9 PCLKB or more
000A 0070h	USB0	PIPE1 Control Register	PIPE1CTR	16	16	9 PCLKB or more
000A 0072h	USB0	PIPE2 Control Register	PIPE2CTR	16	16	9 PCLKB or more
000A 0074h	USB0	PIPE3 Control Register	PIPE3CTR	16	16	9 PCLKB or more
000A 0076h	USB0	PIPE4 Control Register	PIPE4CTR	16	16	9 PCLKB or more
000A 0078h	USB0	PIPE5 Control Register	PIPE5CTR	16	16	9 PCLKB or more
000A 007Ah	USB0	PIPE6 Control Register	PIPE6CTR	16	16	9 PCLKB or more
000A 007Ch	USB0	PIPE7 Control Register	PIPE7CTR	16	16	9 PCLKB or more
000A 007Eh	USB0	PIPE8 Control Register	PIPE8CTR	16	16	9 PCLKB or more
000A 0080h	USB0	PIPE9 Control Register	PIPE9CTR	16	16	9 PCLKB or more
000A 0090h	USB0	PIPE1 Transaction Counter Enable Register	PIPE1TRE	16	16	9 PCLKB or more
000A 0092h	USB0	PIPE1 Transaction Counter Register	PIPE1TRN	16	16	9 PCLKB or more
000A 0094h	USB0	PIPE2 Transaction Counter Enable Register	PIPE2TRE	16	16	9 PCLKB or more
000A 0096h	USB0	PIPE2 Transaction Counter Register	PIPE2TRN	16	16	9 PCLKB or more
000A 0098h	USB0	PIPE3 Transaction Counter Enable Register	PIPE3TRE	16	16	9 PCLKB or more
000A 009Ah	USB0	PIPE3 Transaction Counter Register	PIPE3TRN	16	16	9 PCLKB or more
000A 009Ch	USB0	PIPE4 Transaction Counter Enable Register	PIPE4TRE	16	16	9 PCLKB or more
000A 009Eh	USB0	PIPE4 Transaction Counter Register	PIPE4TRN	16	16	9 PCLKB or more
000A 00A0h	USB0	PIPE5 Transaction Counter Enable Register	PIPE5TRE	16	16	9 PCLKB or more
000A 00A2h	USB0	PIPE5 Transaction Counter Register	PIPE5TRN	16	16	9 PCLKB or more
000A 00B0h	USB0	BC Control Register 0	USBBCTRL0	16	16	9 PCLKB or more
000A 00CCh	USB0	USB Module Control Register	USBMC	16	16	9 PCLKB or more
000A 00D0h	USB0	Device Address 0 Configuration Register	DEVADD0	16	16	9 PCLKB or more
000A 00D2h	USB0	Device Address 1 Configuration Register	DEVADD1	16	16	9 PCLKB or more
000A 00D4h	USB0	Device Address 2 Configuration Register	DEVADD2	16	16	9 PCLKB or more
000A 00D6h	USB0	Device Address 3 Configuration Register	DEVADD3	16	16	9 PCLKB or more
000A 00D8h	USB0	Device Address 4 Configuration Register	DEVADD4	16	16	9 PCLKB or more
000A 00DAh	USB0	Device Address 5 Configuration Register	DEVADD5	16	16	9 PCLKB or more
000A 0800h	LCDC	LCD mode register 0	LCDM0	8	8	1 or 2 PCLKB
000A 0801h	LCDC	LCD mode register 1	LCDM1	8	8	1 or 2 PCLKB
000A 0802h	LCDC	LCD Clock Control Register 0	LCDC0	8	8	1 or 2 PCLKB
000A 0803h	LCDC	LCD Boost Level Control Register	VLCD	8	8	1 or 2 PCLKB

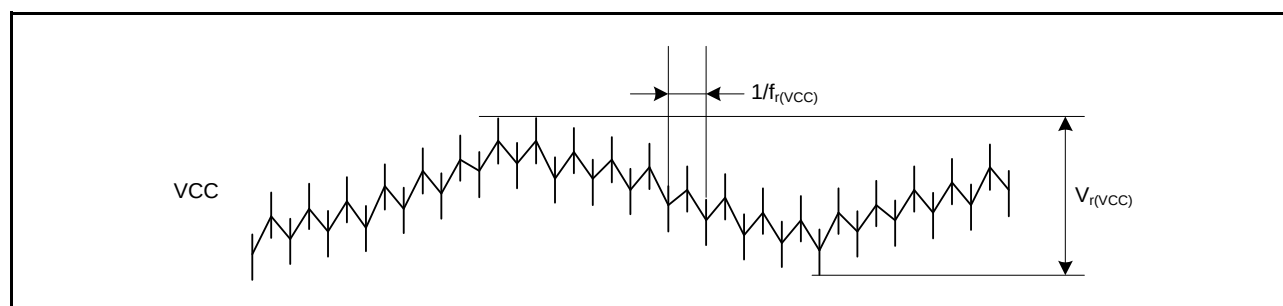
Table 5.13 DC Characteristics (11)

Conditions: $1.8\text{ V} \leq VCC = VCC_USB \leq 3.6\text{ V}$, $1.8\text{ V} \leq AVCC0 \leq 3.6\text{ V}$, $VSS = AVSS0 = VSS_USB = 0\text{ V}$, $T_a = -40\text{ to }+105^\circ\text{C}$

The ripple voltage must meet the allowable ripple frequency $f_{r(VCC)}$ within the range between the VCC upper limit (3.6 V) and lower limit (1.8 V).

When VCC change exceeds $VCC \pm 10\%$, the allowable voltage change rising/falling gradient $dt/dVCC$ must be met.

Item	Symbol	Min.	Typ.	Max.	Unit	Test Conditions
Allowable ripple frequency	$f_{r(VCC)}$	—	—	10	kHz	Figure 5.6 $V_{r(VCC)} \leq VCC \times 0.2$
		—	—	1	MHz	Figure 5.6 $V_{r(VCC)} \leq VCC \times 0.08$
		—	—	10	MHz	Figure 5.6 $V_{r(VCC)} \leq VCC \times 0.06$
Allowable voltage change rising/falling gradient	$dt/dVCC$	1.0	—	—	ms/V	When VCC change exceeds $VCC \pm 10\%$

**Figure 5.6 Ripple Waveform**

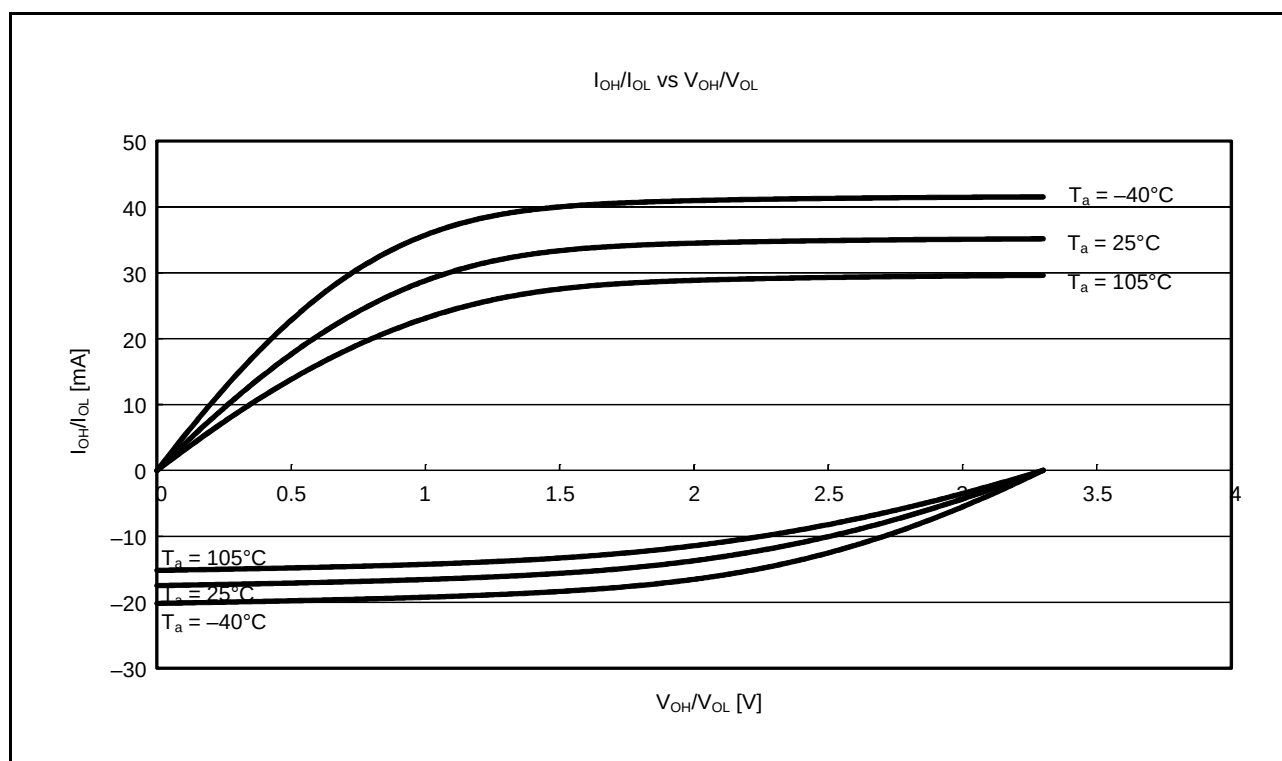


Figure 5.10 V_{OH}/V_{OL} and I_{OH}/I_{OL} Temperature Characteristics of General Ports (Except for RIIC Output Pin, Ports P40 to P44, P46, Ports P90 to P92, Ports PJ6, PJ7) at $V_{CC} = 3.3\text{ V}$ (Reference Data)

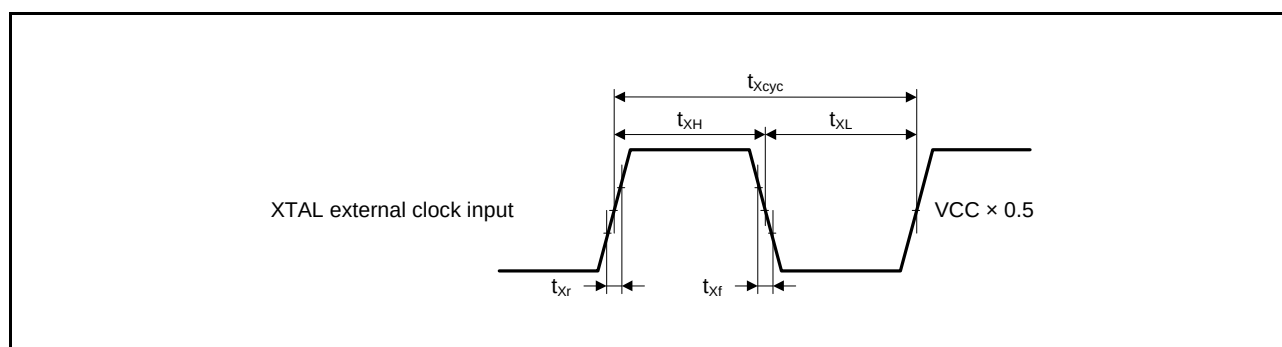


Figure 5.18 XTAL External Clock Input Timing

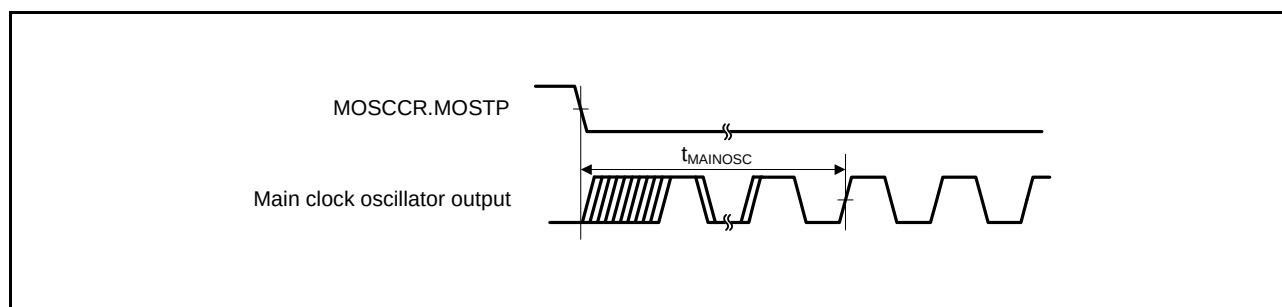


Figure 5.19 Main Clock Oscillation Start Timing

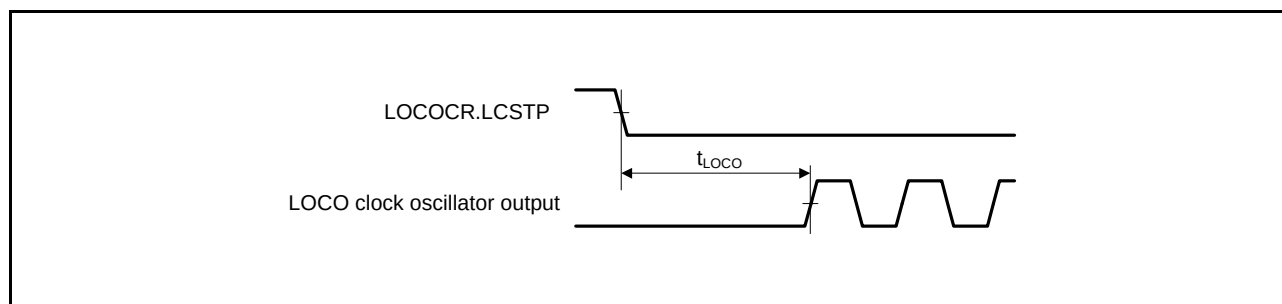


Figure 5.20 LOCO Clock Oscillation Start Timing

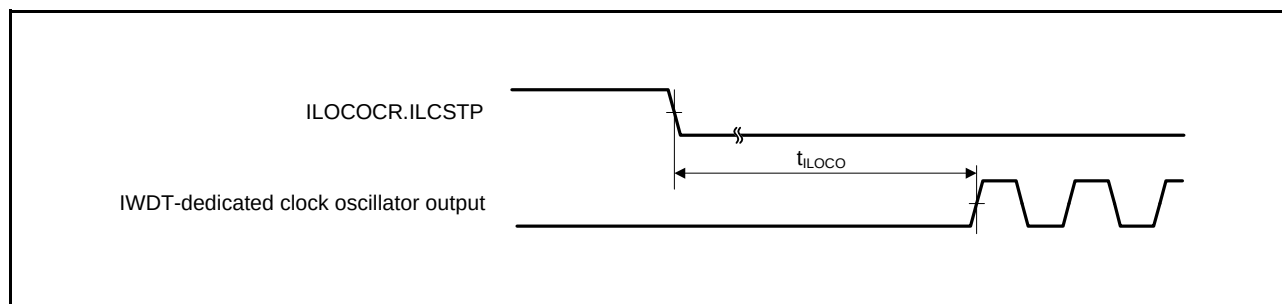


Figure 5.21 IWDT-Dedicated Clock Oscillation Start Timing

Table 5.33 Timing of On-Chip Peripheral Modules (4)

Conditions: $2.7\text{ V} \leq VCC = VCC_USB \leq 3.6\text{ V}$, $2.7\text{ V} \leq AVCC0 \leq 3.6\text{ V}$, $VSS = AVSS0 = VSS_USB = 0\text{ V}$, $fPCLKB \leq 32\text{ MHz}$,
 $T_a = -40\text{ to }+105^\circ\text{C}$

Item		Symbol	Min.*1	Max.	Unit	Test Conditions
RIIC (Standard mode, SMBus)	SCL0 input cycle time	t_{SCL}	$6 (12) \times t_{IICcyc} + 1300$	—	ns	Figure 5.49
	SCL0 input high pulse width	t_{SCLH}	$3 (6) \times t_{IICcyc} + 300$	—	ns	
	SCL0 input low pulse width	t_{SCLL}	$3 (6) \times t_{IICcyc} + 300$	—	ns	
	SCL0, SDA0 input rise time	t_{Sr}	—	1000	ns	
	SCL0, SDA0 input fall time	t_{Sf}	—	300	ns	
	SCL0, SDA0 input spike pulse removal time	t_{SP}	0	$1 (4) \times t_{IICcyc}$	ns	
	SDA0 input bus free time	t_{BUF}	$3 (6) \times t_{IICcyc} + 300$	—	ns	
	START condition input hold time	t_{STAH}	$t_{IICcyc} + 300$	—	ns	
	Repeated START condition input setup time	t_{STAS}	1000	—	ns	
	STOP condition input setup time	t_{STOS}	1000	—	ns	
	Data input setup time	t_{SDAS}	$t_{IICcyc} + 50$	—	ns	
	Data input hold time	t_{SDAH}	0	—	ns	
	SCL0, SDA0 capacitive load	C_b	—	400	pF	
RIIC (Fast mode)	SCL0 input cycle time	t_{SCL}	$6 (12) \times t_{IICcyc} + 600$	—	ns	Figure 5.49
	SCL0 input high pulse width	t_{SCLH}	$3 (6) \times t_{IICcyc} + 300$	—	ns	
	SCL0 input low pulse width	t_{SCLL}	$3 (6) \times t_{IICcyc} + 300$	—	ns	
	SCL0, SDA0 input rise time	t_{Sr}	—*2	300	ns	
	SCL0, SDA0 input fall time	t_{Sf}	—*2	300	ns	
	SCL0, SDA0 input spike pulse removal time	t_{SP}	0	$1 (4) \times t_{IICcyc}$	ns	
	SDA0 input bus free time	t_{BUF}	$3 (6) \times t_{IICcyc} + 300$	—	ns	
	START condition input hold time	t_{STAH}	$t_{IICcyc} + 300$	—	ns	
	Repeated START condition input setup time	t_{STAS}	300	—	ns	
	STOP condition input setup time	t_{STOS}	300	—	ns	
	Data input setup time	t_{SDAS}	$t_{IICcyc} + 50$	—	ns	
	Data input hold time	t_{SDAH}	0	—	ns	
	SCL0, SDA0 capacitive load	C_b	—	400	pF	

Note: t_{IICcyc} : RIIC internal reference count clock (IIC ϕ) cycle

Note 1. The value in parentheses is used when the ICMR3.NF[1:0] bits are set to 11b while a digital filter is enabled with the ICFER.NFE bit = 1.

Note 2. The minimum t_{sr} and t_{sf} specifications for fast mode are not set.

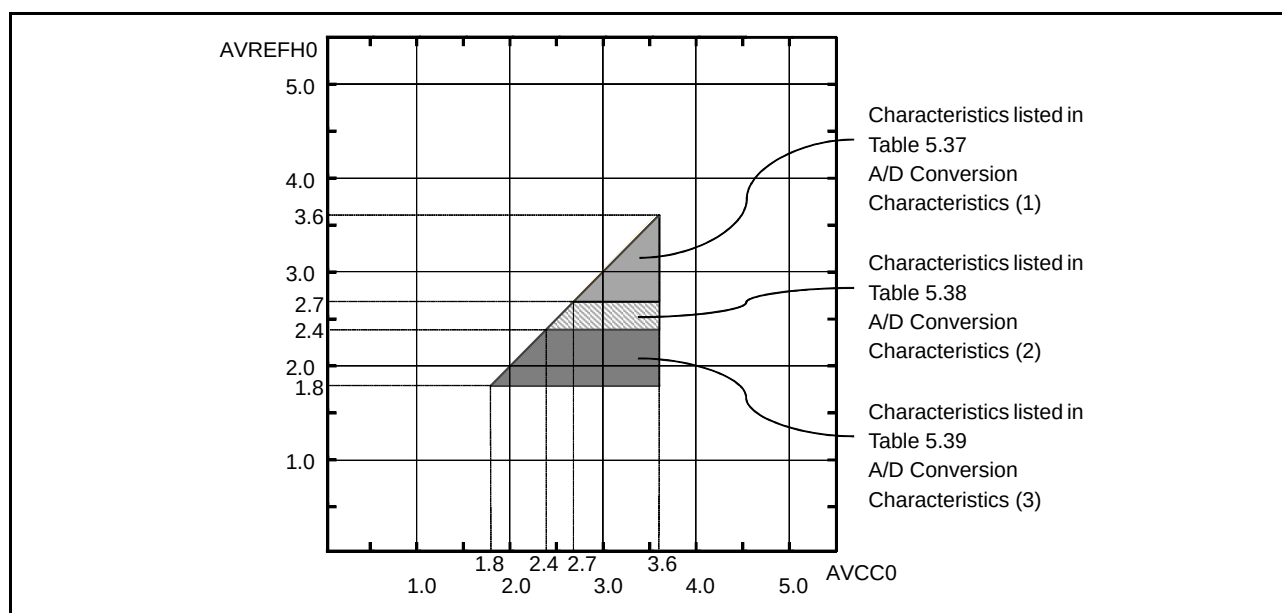


Figure 5.56 AVCC0 to AVREFH0 Voltage Range

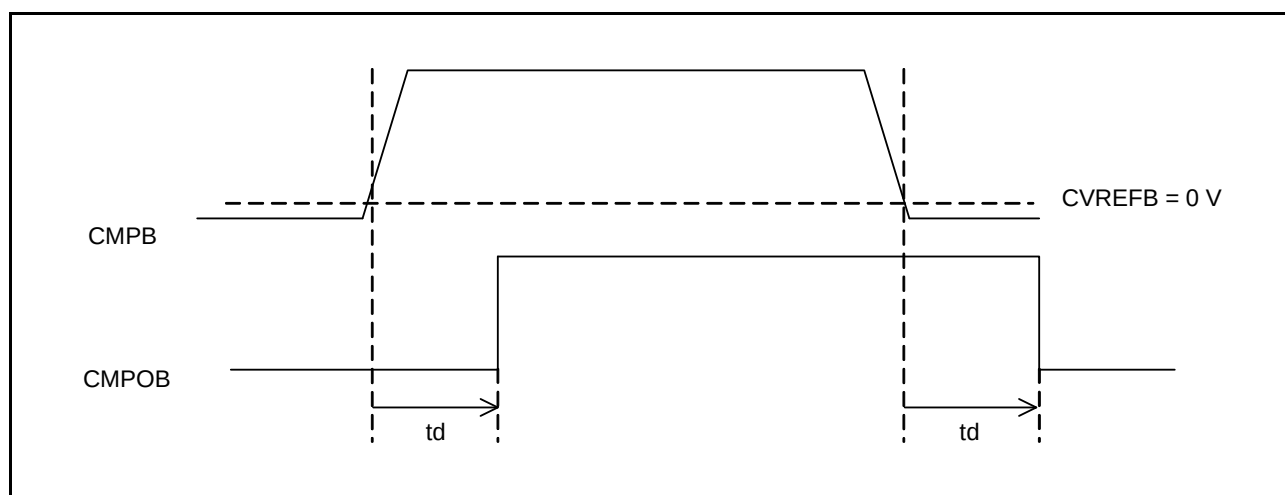


Figure 5.59 Comparator Output Delay Time in Comparator High-Speed Mode and Low-Speed Mode

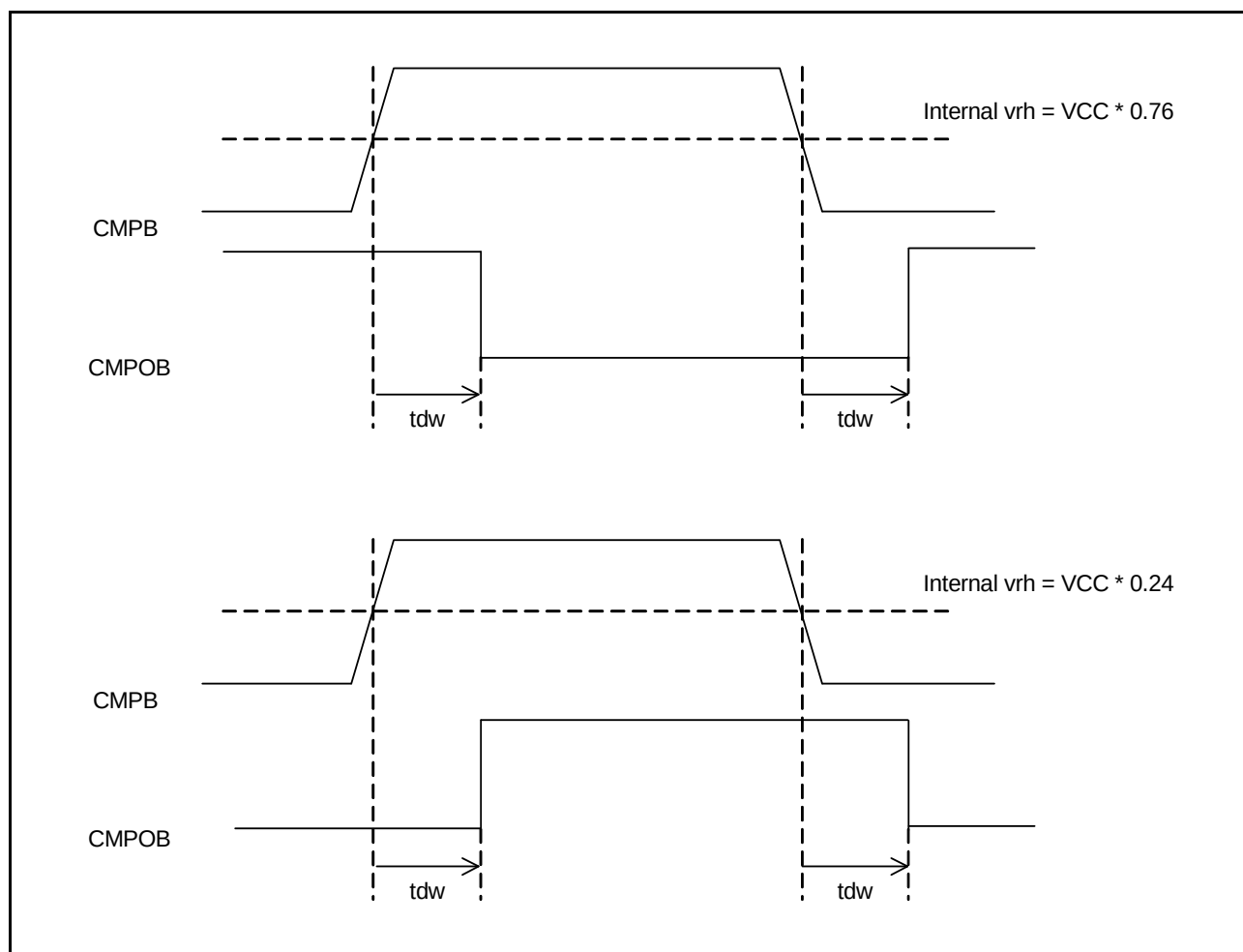


Figure 5.60 Comparator Output Delay Time in High-Speed Mode with Window Function Enabled

5.9.2 Internal Voltage Boosting Method

Table 5.51 Internal Voltage Boosting MethodConditions: $1.8\text{ V} \leq \text{VCC} = \text{VCC_USB} \leq 3.6\text{ V}$, $1.8\text{ V} \leq \text{AVCC0} \leq 3.6\text{ V}$, $\text{VSS} = \text{AVSS0} = \text{VSS_USB} = 0\text{ V}$, $T_a = -40\text{ to }+105^\circ\text{C}$

Item	Symbol	Min.	Typ.	Max.	Unit	Test Conditions
External capacitance connected between CAPH and CAPL pins	C1	0.33	0.47	0.61	μF	
External capacitor connected to V_{L1} pin	C2	0.33	0.47	0.61	μF	
External capacitor connected to V_{L2} pin	C3	0.33	0.47	0.61	μF	
External capacitor connected to V_{L3} pin	C4	0.33	0.47	0.61	μF	
External capacitor connected to V_{L4} pin	C5	0.33	0.47	0.61	μF	

(1) 1/3 Bias Method

Table 5.52 Internal Voltage Boosting Method LCD CharacteristicsConditions: $1.8\text{ V} \leq \text{VCC} = \text{VCC_USB} \leq 3.6\text{ V}$, $1.8\text{ V} \leq \text{AVCC0} \leq 3.6\text{ V}$, $\text{VSS} = \text{AVSS0} = \text{VSS_USB} = 0\text{ V}$, $T_a = -40\text{ to }+105^\circ\text{C}$

Item	Symbol	Conditions		Min.	Typ.	Max.	Unit	Test Conditions
LCD output voltage variation range	V _{L1}	C1 to C4 connected	VLCD = 04h	0.9	1.0	1.08	V	
			VLCD = 05h	0.95	1.05	1.13	V	
			VLCD = 06h	1	1.1	1.18	V	
			VLCD = 07h	1.05	1.15	1.23	V	
			VLCD = 08h	1.1	1.2	1.28	V	
			VLCD = 09h	1.15	1.25	1.33	V	
			VLCD = 0Ah	1.2	1.3	1.38	V	
			VLCD = 0Bh	1.25	1.35	1.43	V	
			VLCD = 0Ch	1.3	1.4	1.48	V	
			VLCD = 0Dh	1.35	1.45	1.53	V	
			VLCD = 0Eh	1.4	1.5	1.58	V	
			VLCD = 0Fh	1.45	1.55	1.63	V	
			VLCD = 10h	1.5	1.6	1.68	V	
			VLCD = 11h	1.55	1.65	1.73	V	
			VLCD = 12h	1.6	1.70	1.78	V	
			VLCD = 13h	1.65	1.75	1.83	V	
Doubler output voltage	V _{L2}	C1 to C3, C5 connected		2V _{L1} - 0.10	2V _{L1}	2V _{L1}	V	
Tripler output voltage	V _{L3}	C1 to C5 connected		3V _{L1} - 0.15	3V _{L1}	3V _{L1}	V	
Reference voltage setup time*1	t _{VL1S}			5	—	—	ms	
LCD output voltage variation range*2	t _{VLWT}	C1 to C4 connected		500	—	—	ms	

Note 1. This is the required wait time from when the reference voltage is specified by the VLCD register (or when the internal voltage boosting method is selected (LCDM0.MDSET1 and MDSET0 = 01b) if the default reference voltage value is used) until voltage boosting starts (VLCON = 1).

Note 2. This is the wait time from when voltage boosting is started (VLCON = 1) until display is enabled (LCDON = 1).

5.14 E2 DataFlash Characteristics

Table 5.63 E2 DataFlash Characteristics (1)

Item		Symbol	Min.	Typ.	Max.	Unit	Conditions
Reprogramming/erasure cycle*1		N _{DPEC}	100000	1000000	—	Times	
Data hold time	After 10000 times of N _{DPEC}	t _{DDRP}	20*2, *3	—	—	Year	T _a = +85°C
	After 100000 times of N _{DPEC}		5*2, *3	—	—	Year	
	After 1000000 times of N _{DPEC}		—	1*2, *3	—	Year	T _a = +25°C

Note 1. The reprogram/erase cycle is the number of erasing for each block. When the reprogram/erase cycle is n times (n = 100000), erasing can be performed n times for each block. For instance, when 1-byte programming is performed 1000 times for different addresses in 1-Kbyte block and then the entire block is erased, the reprogram/erase cycle is counted as one. However, programming the same address for several times as one erasing is not enabled (overwriting is prohibited).

Note 2. Characteristic when using the flash memory programmer and the self-programming library provided from Renesas Electronics.

Note 3. These results are obtained from reliability testing.

**Table 5.64 E2 DataFlash Characteristics (2)
: high-speed operating mode**

Conditions: 2.7 V ≤ VCC ≤ 3.6 V, 2.7 V ≤ AVCC0 ≤ 3.6 V, VSS = AVSS0 = VSS_USB = 0 V

Temperature range for the programming/erasure operation: T_a = −40 to +105°C

Item		Symbol	FCLK = 1 MHz			FCLK = 32 MHz			Unit
			Min.	Typ.	Max.	Min.	Typ.	Max.	
Programming time	1-byte	t _{DP1}	—	86	761	—	40.5	374	μs
Erasure time	1-Kbyte	t _{DE1K}	—	17.4	456	—	6.15	228	ms
	8-Kbyte	t _{DE8K}	—	60.4	499	—	9.3	231	ms
Blank check time	1-byte	t _{DBC1}	—	—	48	—	—	15.9	μs
	1-Kbyte	t _{DBC1K}	—	—	1.58	—	—	0.127	ms
Erase operation forcible stop time		t _{DSER}	—	—	21.5	—	—	12.8	μs
DataFlash STOP recovery time		t _{DSTOP}	5	—	—	5	—	—	μs

Note: Does not include the time until each operation of the flash memory is started after instructions are executed by software.

Note: The lower-limit frequency of FCLK is 1 MHz during programming or erasing of the flash memory. When using FCLK at below 4 MHz, the frequency can be set to 1 MHz, 2 MHz, or 3 MHz. A non-integer frequency such as 1.5 MHz cannot be set.

Note: The frequency accuracy of FCLK should be ±3.5%. Confirm the frequency accuracy of the clock source.

**Table 5.65 E2 DataFlash Characteristics (3)
: middle-speed operating mode**

Conditions: 1.8 V ≤ VCC ≤ 3.6 V, 1.8 V ≤ AVCC0 ≤ 3.6 V, VSS = AVSS0 = VSS_USB = 0 V

Temperature range for the programming/erasure operation: T_a = −40 to +85°C

Item		Symbol	FCLK = 1 MHz			FCLK = 8 MHz			Unit
			Min.	Typ.	Max.	Min.	Typ.	Max.	
Programming time	1-byte	t _{DP1}	—	126	1160	—	85.4	818	μs
Erasure time	1-Kbyte	t _{DE1K}	—	17.5	457	—	7.76	259	ms
	8-Kbyte	t _{DE8K}	—	60.5	500	—	16.7	267.6	ms
Blank check time	1-byte	t _{DBC1}	—	—	78	—	—	50	μs
	1-Kbyte	t _{DBC1K}	—	—	1.61	—	—	0.369	ms
Erase operation forcible stop time		t _{DSER}	—	—	33.5	—	—	25.5	μs
DataFlash STOP recovery time		t _{DSTOP}	720	—	—	720	—	—	ns

Note: Does not include the time until each operation of the flash memory is started after instructions are executed by software.

Note: The lower-limit frequency of FCLK is 1 MHz during programming or erasing of the flash memory. When using FCLK at below 4 MHz, the frequency can be set to 1 MHz, 2 MHz, or 3 MHz. A non-integer frequency such as 1.5 MHz cannot be set.

Note: The frequency accuracy of FCLK should be ±3.5%. Confirm the frequency accuracy of the clock source.

5.15 Usage Notes

5.15.1 Connecting VCL Capacitor and Bypass Capacitors

This MCU integrates an internal voltage-down circuit, which is used for lowering the power supply voltage in the internal MCU to adjust automatically to the optimum level. A 4.7- μ F capacitor needs to be connected between this internal voltage-down power supply (VCL pin) and VSS pin. Figure 5.67 to Figure 5.68 shows how to connect external capacitors. Place an external capacitor close to the pins. Do not apply the power supply voltage to the VCL pin. Insert a multilayer ceramic capacitor as a bypass capacitor between each pair of the power supply pins. Implement a bypass capacitor to the MCU power supply pins as close as possible. Use a recommended value of 0.1 μ F as the capacitance of the capacitors. For the capacitors related to crystal oscillation, see section 9, Clock Generation Circuit in the User's Manual: Hardware. For the capacitors related to analog modules, also see section 36, 12-Bit A/D Converter (S12ADb) in the User's Manual: Hardware.

For notes on designing the printed circuit board, see the descriptions of the application note "Hardware Design Guide" (R01AN1411EJ). The latest version can be downloaded from Renesas Electronics Website.

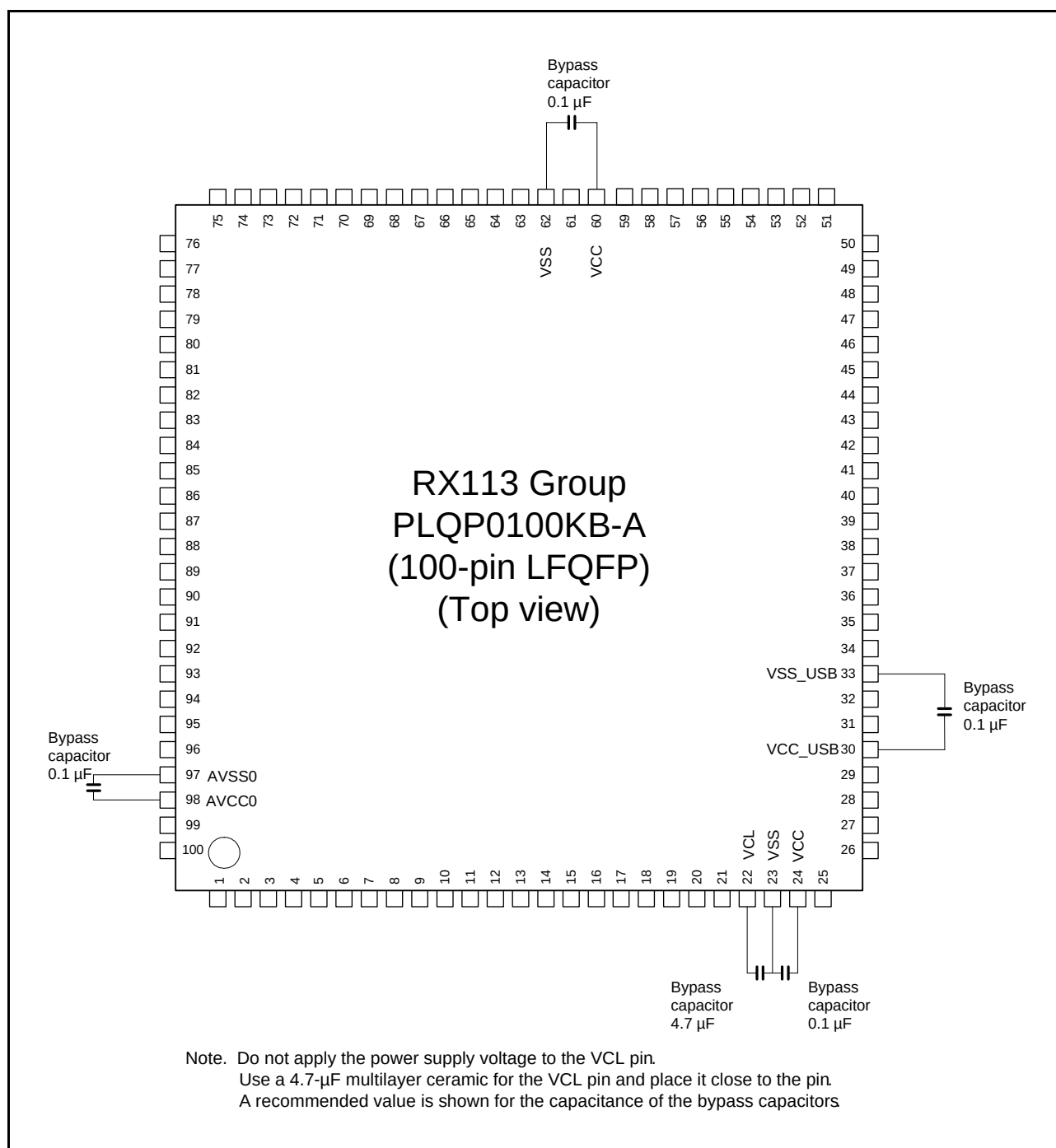


Figure 5.67 Connecting Capacitors (100-pin LFQFP)