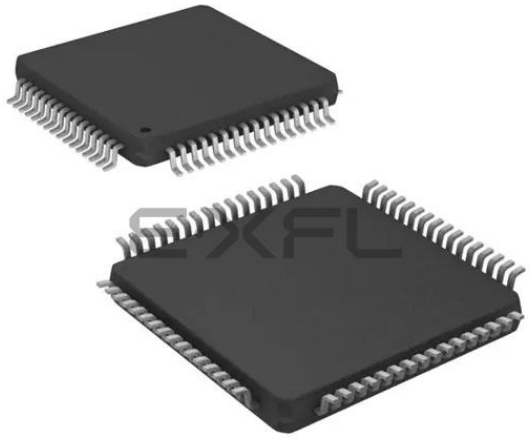

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Applications of "Embedded - Microcontrollers"

Details	
Product Status	Active
Core Processor	78K/0
Core Size	8-Bit
Speed	20MHz
Connectivity	3-Wire SIO, I²C, LINbus, UART/USART
Peripherals	LVD, POR, PWM, WDT
Number of I/O	55
Program Memory Size	60KB (60K x 8)
Program Memory Type	FLASH
EEPROM Size	-
RAM Size	3K x 8
Voltage - Supply (Vcc/Vdd)	1.8V ~ 5.5V
Data Converters	A/D 8x10b
Oscillator Type	Internal
Operating Temperature	-40°C ~ 85°C (TA)
Mounting Type	Surface Mount
Package / Case	64-TQFP
Supplier Device Package	-
Purchase URL	https://www.e-xfl.com/product-detail/renesas-electronics-america/upd78f0535aga-hab-ax

(2) Expanded-specification products (μPD78F05xxA and 78F05xxDA) (2/2)

<3> When high-speed system clock is used (static model of C compiler/assembler)

Library Name	Interrupt Response Time (μs (Max.))			
	RSTOP = 0, RSTS = 1		RSTOP = 1	
	Entry RAM location is outside short direct addressing range	Entry RAM location is in short direct addressing range	Entry RAM location is outside short direct addressing range	Entry RAM location is in short direct addressing range
Block blank check library	136/f_{CPU} + 567	136/f_{CPU} + 246	136/f_{CPU} + 1708	136/f_{CPU} + 569
Block erase library	136/f_{CPU} + 780	136/f_{CPU} + 459	136/f_{CPU} + 1921	136/f_{CPU} + 782
Word write library	272/f_{CPU} + 763	272/f_{CPU} + 443	272/f_{CPU} + 1871	272/f_{CPU} + 767
Block verify library	136/f_{CPU} + 580	136/f_{CPU} + 259	136/f_{CPU} + 1721	136/f_{CPU} + 582
Set information library	72/f_{CPU} + 456	72/f_{CPU} + 200	72/f_{CPU} + 1598	72/f_{CPU} + 459
EEPROM write library[Note]	19/f_{CPU} + 767 268/f_{CPU} + 696	19/f_{CPU} + 447 268/f_{CPU} + 376	19/f_{CPU} + 767 268/f_{CPU} + 1838	19/f_{CPUv} + 447 268/f_{CPU} + 700

Note The longer value of the EEPROM write library interrupt response time becomes the Max. value, depending on the value of f_{CPU}.

Remarks 1. f_{CPU}: CPU operation clock frequency

2. RSTOP: Bit 0 of the internal oscillation mode register (RCM)

3. RSTS: Bit 7 of the internal oscillation mode register (RCM)

3.1.1 Internal program memory space

The internal program memory space stores the program and table data. Normally, it is addressed with the program counter (PC).

78K0/Kx2 microcontrollers incorporate internal ROM (flash memory), as shown below.

Table 3-4. Internal ROM Capacity

78K0/KB2	78K0/KC2		78K0/KD2	78K0/KE2	78K0/KF2	Internal ROM (Flash memory)
30/36 Pins	38/44 Pins	48 Pins	52 Pins	64 Pins	80 Pins	
μPD78F0500, PD78F0500A	–	–	–	–	–	8192 × 8 bits (0000H to 1FFFH)
μPD78F0501, 78F0501A	μPD78F0511, 78F0511A	μPD78F0511, 78F0511A	μPD78F0521, 78F0521A	μPD78F0531, 78F0531A	–	16384 × 8 bits (0000H to 3FFFH)
μPD78F0502, 78F0502A	μPD78F0512, 78F0512A	μPD78F0512, 78F0512A	μPD78F0522, 78F0522A	μPD78F0532, 78F0532A	–	24576 × 8 bits (0000H to 5FFFH)
μPD78F0503D, 78F0503DA	μPD78F0513D, 78F0513DA	μPD78F0513, 78F0513A	μPD78F0523, 78F0523A	μPD78F0533, 78F0533A	–	32768 × 8 bits (0000H to 7FFFH)
μPD78F0503, 78F0503A	μPD78F0513, 78F0513A					
–	–	μPD78F0514, 78F0514A	μPD78F0524, 78F0524A	μPD78F0534, 78F0534A	μPD78F0544, 78F0544A	49152 × 8 bits (0000H to BFFFH)
–	–	μPD78F0515D, 78F0515DA	μPD78F0525, 78F0525A	μPD78F0535, 78F0535A	μPD78F0545, 78F0545A	61440 × 8 bits (0000H to EFFFH)
		μPD78F0515, 78F0515A				
–	–	–	μPD78F0526, 78F0526A	μPD78F0536, 78F0536A	μPD78F0546, 78F0546A	98304 × 8 bits (0000H to 7FFFH (common area: 32 KB) + 8000H to BFFFH (bank area: 16 KB) × 4)
–	–	–	μPD78F0527D, 78F0527DA	μPD78F0537D, 78F0537DA	μPD78F0547D, 78F0547DA	131072 × 8 bits (0000H to 7FFFH (common area: 32 KB) + 8000H to BFFFH (bank area: 16 KB) × 6)
			μPD78F0527, 78F0527A	μPD78F0537, 78F0537A	μPD78F0547, 78F0547A	

The internal program memory space is divided into the following areas.

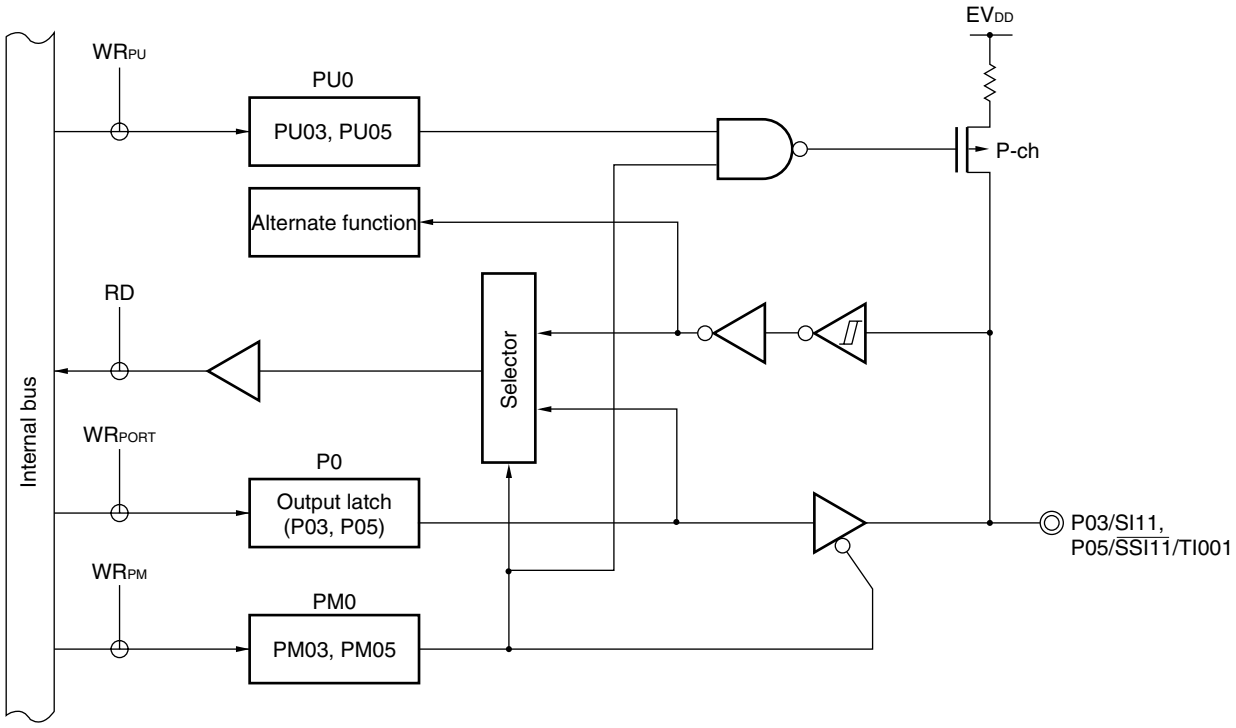
(1) Vector table area

The 64-byte area 0000H to 003FH is reserved as a vector table area. The program start addresses for branch upon reset or generation of each interrupt request are stored in the vector table area.

Of the 16-bit address, the lower 8 bits are stored at even addresses and the higher 8 bits are stored at odd addresses.

Figure 5-4. Block Diagram of P03 and P05 (2/2)

(2) 78K0/KE2 products whose flash memory is at least 48 KB and 78K0/KF2



P0: Port register 0
PU0: Pull-up resistor option register 0
PM0: Port mode register 0
RD: Read signal
WR××: Write signal

Remark With products not provided with an EV_{DD} or EV_{SS} pin, replace EV_{DD} with V_{DD}, or replace EV_{SS} with V_{SS}.

5.2.8 Port 7

	78K0/KB2	78K0/KC2	78K0/KD2	78K0/KE2		78K0/KF2
				Products whose flash memory is less than 32 KB	Products whose flash memory is at least 48 KB	
P70/KR0	–	√	√			
P71/KR1	–	√	√			
P72/KR2	–	√Note 1	√			
P73/KR3	–	√Note 1	√			
P74/KR4	–	P74Note 2	√			
P75/KR5	–	P75Note 2	√			
P76/KR6	–	–	√			
P77/KR7	–	–	√			

Notes 1. This is not mounted onto 38-pin products of the 78K0/KC2. For the 38-pin products, be sure to set bits 2 and 3 of PM7 and P7 to "0".

2. This is not mounted onto 38-pin and 44-pin products of the 78K0/KC2. The 48-pin products are only provided with port functions and not alternate functions.

Remark √: Mounted, –: Not mounted

Port 7 is an I/O port with an output latch. Port 7 can be set to the input mode or output mode in 1-bit units using port mode register 7 (PM7). When the P70 to P77 pins are used as an input port, use of an on-chip pull-up resistor can be specified in 1-bit units by pull-up resistor option register 7 (PU7).

This port can also be used for key return input.

Reset signal generation sets port 7 to input mode.

Figure 5-21 shows a block diagram of port 7.

(7) Oscillation stabilization time counter status register (OSTC)

This is the register that indicates the count status of the X1 clock oscillation stabilization time counter. When X1 clock oscillation starts with the internal high-speed oscillation clock or subsystem clock used as the CPU clock, the X1 clock oscillation stabilization time can be checked.

OSTC can be read by a 1-bit or 8-bit memory manipulation instruction.

When reset is released (reset by $\overline{\text{RESET}}$ input, POC, LVI, and WDT), the STOP instruction and MSTOP (bit 7 of MOC register) = 1 clear OSTC to 00H.

Figure 6-10. Format of Oscillation Stabilization Time Counter Status Register (OSTC)

Address: FFA3H After reset: 00H R

Symbol	7	6	5	4	3	2	1	0
OSTC	0	0	0	MOST11	MOST13	MOST14	MOST15	MOST16

MOST11	MOST13	MOST14	MOST15	MOST16	Oscillation stabilization time status		
						f_X = 10 MHz	f_X = 20 MHz
1	0	0	0	0	$2^{11}/f_X$ min.	204.8 μs min.	102.4 μs min.
1	1	0	0	0	$2^{13}/f_X$ min.	819.2 μs min.	409.6 μs min.
1	1	1	0	0	$2^{14}/f_X$ min.	1.64 ms min.	819.2 μs min.
1	1	1	1	0	$2^{15}/f_X$ min.	3.27 ms min.	1.64 ms min.
1	1	1	1	1	$2^{16}/f_X$ min.	6.55 ms min.	3.27 ms min.

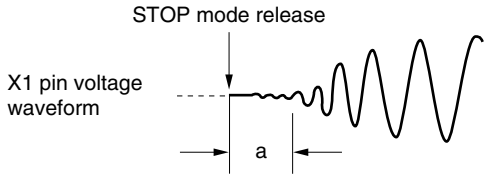
Cautions 1. After the above time has elapsed, the bits are set to 1 in order from MOST11 and remain 1.

2. The oscillation stabilization time counter counts up to the oscillation stabilization time set by OSTS. If the STOP mode is entered and then released while the internal high-speed oscillation clock is being used as the CPU clock, set the oscillation stabilization time as follows.

- **Desired OSTC oscillation stabilization time ≤ Oscillation stabilization time set by OSTS**

Note, therefore, that only the status up to the oscillation stabilization time set by OSTS is set to OSTC after STOP mode is released.

3. The X1 clock oscillation stabilization wait time does not include the time until clock oscillation starts ("a" below).



Remark f_X: X1 clock oscillation frequency

Figure 7-6. Format of 16-Bit Timer Mode Control Register 00 (TMC00)

Address: FFBAH After reset: 00H R/W

Symbol	7	6	5	4	3	2	1	<0>
TMC00	0	0	0	0	TMC003	TMC002	TMC001	OVF00

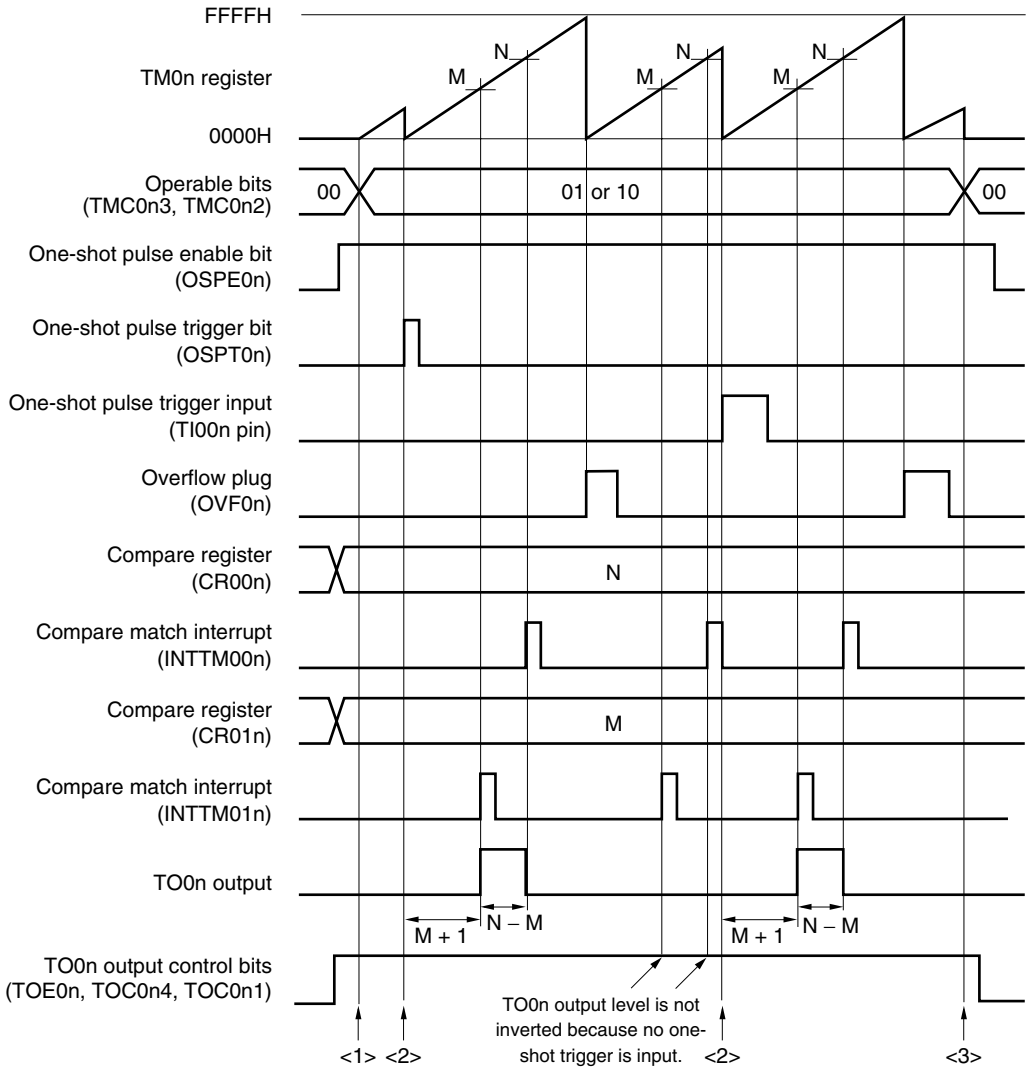
TMC003	TMC002	Operation enable of 16-bit timer/event counter 00
0	0	Disables 16-bit timer/event counter 00 operation. Stops supplying operating clock. Clears 16-bit timer counter 00 (TM00).
0	1	Free-running timer mode
1	0	Clear & start mode entered by TI000 pin valid edge input[Note]
1	1	Clear & start mode entered upon a match between TM00 and CR000

TMC001	Condition to reverse timer output (TO00)
0	• Match between TM00 and CR000 or match between TM00 and CR010
1	• Match between TM00 and CR000 or match between TM00 and CR010 • Trigger input of TI000 pin valid edge

OVF00	TM00 overflow flag
Clear (0)	Clears OVF00 to 0 or TMC003 and TMC002 = 00
Set (1)	Overflow occurs.
OVF00 is set to 1 when the value of TM00 changes from FFFFH to 0000H in all the operation modes (free-running timer mode, clear & start mode entered by TI000 pin valid edge input, and clear & start mode entered upon a match between TM00 and CR000). It can also be set to 1 by writing 1 to OVF00.	

Note The TI000 pin valid edge is set by bits 5 and 4 (ES001, ES000) of prescaler mode register 00 (PRM00).

Figure 7-50. Example of Software Processing for One-Shot Pulse Output Operation (1/2)



- Time from when the one-shot pulse trigger is input until the one-shot pulse is output
  = (M + 1) × Count clock cycle
- One-shot pulse output active level width
  = (N − M) × Count clock cycle

Remark n = 0: 78K0/KE2 products whose flash memory is less than 32 KB, and 78K0/KB2, 78K0/KC2,] 78K0/KD2 products

n = 0, 1: 78K0/KE2 products whose flash memory is at least 48 KB, and 78K0/KF2 products

(7) Operation of OVF0n flag

(a) Setting OVF0n flag (1)

The OVF0n flag is set to 1 in the following case, as well as when TM0n overflows.

Select the clear & start mode entered upon a match between TM0n and CR00n.

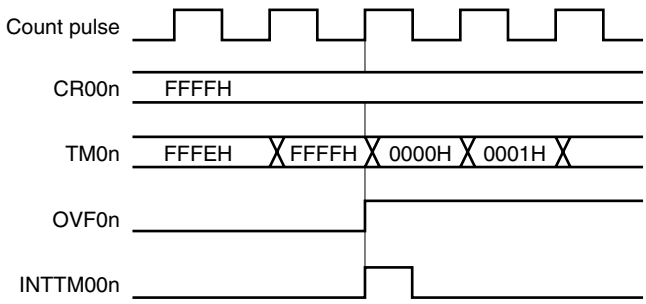
↓

Set CR00n to FFFFH.

↓

When TM0n matches CR00n and TM0n is cleared from FFFFH to 0000H

Figure 7-62. Operation Timing of OVF0n Flag



(b) Clearing OVF0n flag

Even if the OVF0n flag is cleared to 0 after TM0n overflows and before the next count clock is counted (before the value of TM0n becomes 0001H), it is set to 1 again and clearing is invalid.

(8) One-shot pulse output

One-shot pulse output operates correctly in the free-running timer mode or the clear & start mode entered by the TI00n pin valid edge. The one-shot pulse cannot be output in the clear & start mode entered upon a match between TM0n and CR00n.

Remark n = 0: 78K0/KE2 products whose flash memory is less than 32 KB, and 78K0/KB2, 78K0/KC2, 78K0/KD2 products

n = 0, 1: 78K0/KE2 products whose flash memory is at least 48 KB, and 78K0/KF2 products

Figure 8-8. Format of 8-Bit Timer Mode Control Register 51 (TMC51)

Address: FF43H After reset: 00H R/W[Note]

Symbol	<7>	6	5	4	<3>	<2>	1	<0>
TMC51	TCE51	TMC516	0	0	LVS51	LVR51	TMC511	TOE51

TCE51	TM51 count operation control
0	After clearing to 0, count operation disabled (counter stopped)
1	Count operation start

TMC516	TM51 operating mode selection
0	Mode in which clear & start occurs on a match between TM51 and CR51
1	PWM (free-running) mode

LVS51	LVR51	Timer output F/F status setting
0	0	No change
0	1	Timer output F/F clear (0) (default value of TO51 output: low)
1	0	Timer output F/F set (1) (default value of TO51 output: high)
1	1	Setting prohibited

TMC511	In other modes (TMC516 = 0)	In PWM mode (TMC516 = 1)
	Timer F/F control	Active level selection
0	Inversion operation disabled	Active-high
1	Inversion operation enabled	Active-low

TOE51	Timer output control
0	Output disabled (TO51 output is low level)
1	Output enabled

Note Bits 2 and 3 are write-only.

Cautions 1. The settings of LVS5n and LVR5n are valid in other than PWM mode.

2. Perform <1> to <4> below in the following order, not at the same time.

<1> Set TMC5n1, TMC5n6: Operation mode setting

<2> Set TOE5n to enable output: Timer output enable

<3> Set LVS5n, LVR5n (see Caution 1): Timer F/F setting

<4> Set TCE5n

3. When TCE5n = 1, setting the other bits of TMC5n is prohibited.

4. The actual TO50/TI50/P17 and TO51/TI51/P33/INTP4 pin outputs are determined depending on PM17 and P17, and PM33 and P33, besides TO5n output.

Remarks 1. In PWM mode, PWM output is made inactive by clearing TCE5n to 0.

2. If LVS5n and LVR5n are read, the value is 0.

3. The values of the TMC5n6, LVS5n, LVR5n, TMC5n1, and TOE5n bits are reflected at the TO5n output regardless of the value of TCE5n.

4. n = 0, 1

CHAPTER 9 8-BIT TIMERS H0 AND H1

9.1 Functions of 8-Bit Timers H0 and H1

8-bit timers H0 and H1 are mounted onto all 78K0/Kx2 microcontroller products.
8-bit timers H0 and H1 have the following functions.

- Interval timer
- Square-wave output
- PWM output
- Carrier generator (8-bit timer H1 only)

9.2 Configuration of 8-Bit Timers H0 and H1

8-bit timers H0 and H1 include the following hardware.

Table 9-1. Configuration of 8-Bit Timers H0 and H1

Item	Configuration
Timer register	8-bit timer counter Hn
Registers	8-bit timer H compare register 0n (CMP0n) 8-bit timer H compare register 1n (CMP1n)
Timer output	TOHn, output controller
Control registers	8-bit timer H mode register n (TMHMDn) 8-bit timer H carrier control register 1 (TMCYC1)Note Port mode register 1 (PM1) Port register 1 (P1)

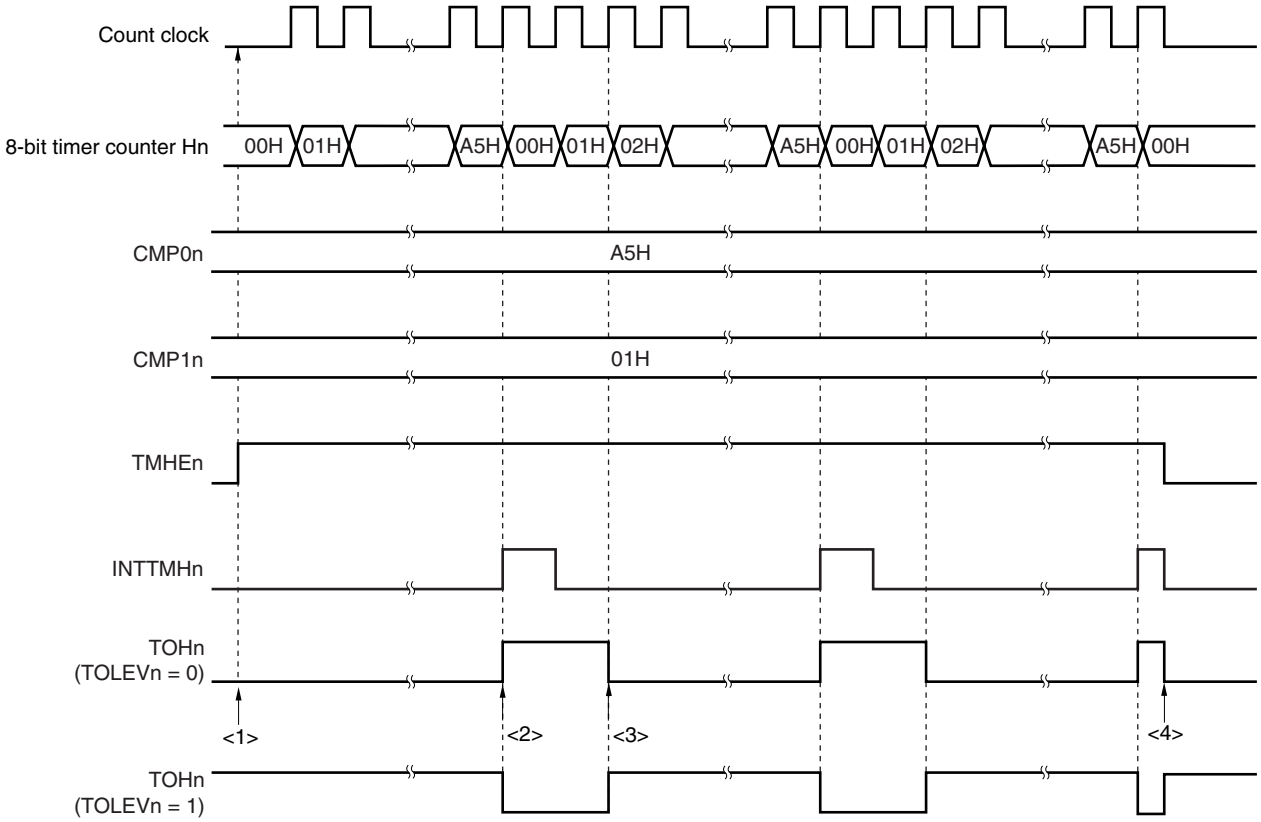
Note 8-bit timer H1 only

Remark n = 0, 1

Figures 9-1 and 9-2 show the block diagrams.

Figure 9-12. Operation Timing in PWM Output Mode (1/4)

(a) Basic operation



<1> The count operation is enabled by setting the TMHEn bit to 1. Start the 8-bit timer counter Hn by masking one count clock to count up. At this time, PWM output outputs an inactive level.

<2> When the values of the 8-bit timer counter Hn and the CMP0n register match, an active level is output. At this time, the value of the 8-bit timer counter Hn is cleared, and the INTTMHn signal is output.

<3> When the values of the 8-bit timer counter Hn and the CMP1n register match, an inactive level is output. At this time, the 8-bit timer counter value is not cleared and the INTTMHn signal is not output.

<4> Clearing the TMHEn bit to 0 during timer Hn operation sets the INTTMHn signal to the default and PWM output to an inactive level.

Remark n = 0, 1

11.2 Configuration of Watchdog Timer

The watchdog timer includes the following hardware.

Table 11-1. Configuration of Watchdog Timer

Item	Configuration
Control register	Watchdog timer enable register (WDTE)

How the counter operation is controlled, overflow time, and window open period are set by the option byte.

Table 11-2. Setting of Option Bytes and Watchdog Timer

Setting of Watchdog Timer	Option Byte (0080H)
Window open period	Bits 6 and 5 (WINDOW1, WINDOW0)
Controlling counter operation of watchdog timer	Bit 4 (WDTON)
Overflow time of watchdog timer	Bits 3 to 1 (WDCS2 to WDCS0)

Remark For the option byte, see **CHAPTER 26 OPTION BYTE**.

Figure 11-1. Block Diagram of Watchdog Timer

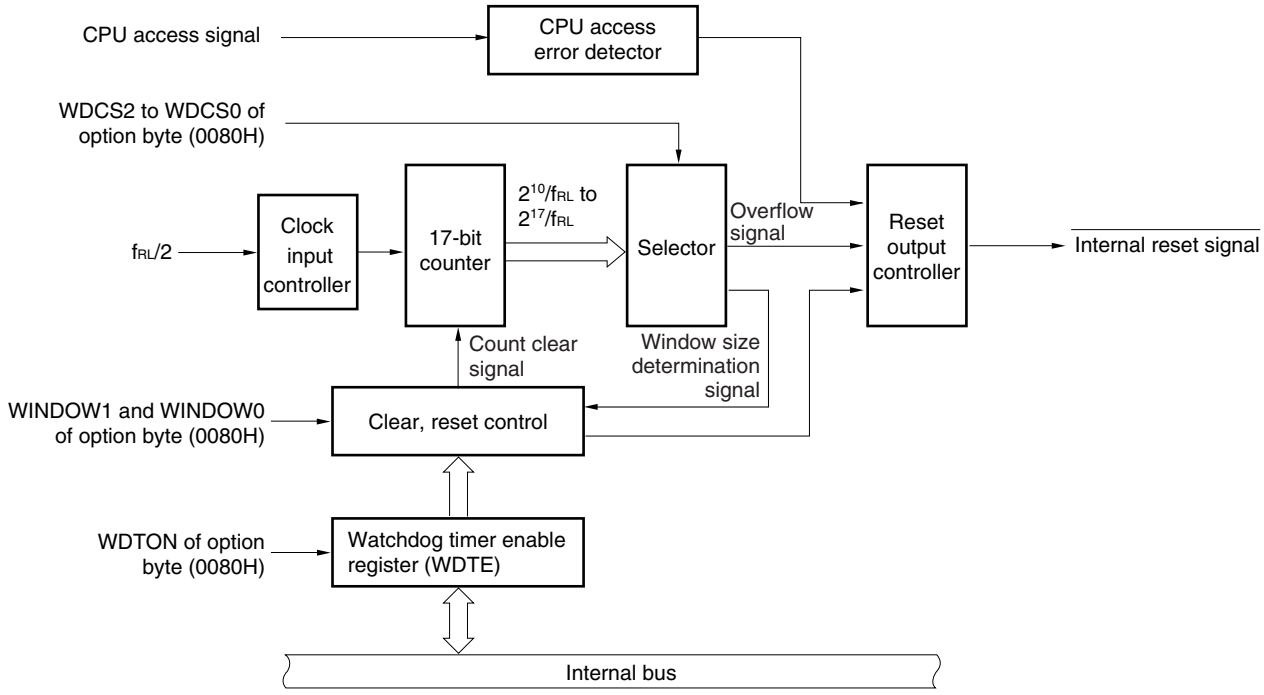


Figure 12-3. Format of Clock Output Selection Register (CKS) (78K0/KD2, 48-pin Products of 78K0/KC2)

Address: FF40H After reset: 00H R/W

Symbol	7	6	5	<4>	3	2	1	0
CKS	0	0	0	CLOE	CCS3	CCS2	CCS1	CCS0

CLOE	PCL output enable/disable specification
0	Clock division circuit operation stopped. PCL fixed to low level.
1	Clock division circuit operation enabled. PCL output enabled.

CCS3	CCS2	CCS1	CCS0	PCL output clock selection[Note 1]			
					f_{SUB} = 32.768 kHz	f_{PRS} = 10 MHz	f_{PRS} = 20 MHz
0	0	0	0	f_{PRS}[Note 2]	–	10 MHz	Setting prohibited[Note 3]
0	0	0	1	$f_{PRS}/2$		5 MHz	10 MHz
0	0	1	0	$f_{PRS}/2^2$		2.5 MHz	5 MHz
0	0	1	1	$f_{PRS}/2^3$		1.25 MHz	2.5 MHz
0	1	0	0	$f_{PRS}/2^4$		625 kHz	1.25 MHz
0	1	0	1	$f_{PRS}/2^5$		312.5 kHz	625 kHz
0	1	1	0	$f_{PRS}/2^6$		156.25 kHz	312.5 kHz
0	1	1	1	$f_{PRS}/2^7$		78.125 kHz	156.25 kHz
1	0	0	0	f_{SUB}	32.768 kHz	–	
Other than above				Setting prohibited			

Notes 1. The frequency that can be used for the peripheral hardware clock (f_{PRS}) differs depending on the power supply voltage and product specifications.

Supply Voltage	Conventional-specification Products (μPD78F05xx and 78F05xxD)	Expanded-specification Products (μPD78F05xxA and 78F05xxDA)
4.0 V ≤ V_{DD} ≤ 5.5 V	f_{PRS} ≤ 20 MHz	f_{PRS} ≤ 20 MHz
2.7 V ≤ V_{DD} < 4.0 V	f_{PRS} ≤ 10 MHz	
1.8 V ≤ V_{DD} < 2.7 V (Standard products and (A) grade products only)	f_{PRS} ≤ 5 MHz	f_{PRS} ≤ 5 MHz

(The values shown in the table above are those when f_{PRS} = f_{XH} (XSEL = 1).)

2. If the peripheral hardware clock operates on the internal high-speed oscillation clock when 1.8 V ≤ V_{DD} < 2.7 V, setting CCS3 = CCS2 = CCS1 = CCS0 = 0 (output clock of PCL: f_{PRS}) is prohibited.

3. The PCL output clock prohibits settings if they exceed 10 MHz.

Caution Set CCS3 to CCS0 while the clock output operation is stopped (CLOE = 0).

Remarks 1. f_{PRS}: Peripheral hardware clock frequency

2. f_{SUB}: Subsystem clock frequency

(2) Generation of serial clock

A serial clock to be generated can be specified by using baud rate generator control register 0 (BRGC0).

Select the clock to be input to the 5-bit counter by using bits 7 and 6 (TPS01 and TPS00) of BRGC0.

Bits 4 to 0 (MDL04 to MDL00) of BRGC0 can be used to select the division value ($f_{XCLK0}/8$ to $f_{XCLK0}/31$) of the 5-bit counter.

14.4.4 Calculation of baud rate

(1) Baud rate calculation expression

The baud rate can be calculated by the following expression.

- Baud rate = $\frac{f_{XCLK0}}{2 \times k}$ [bps]

f_{XCLK0}: Frequency of base clock selected by the TPS01 and TPS00 bits of the BRGC0 register

k: Value set by the MDL04 to MDL00 bits of the BRGC0 register (k = 8, 9, 10, ..., 31)

Table 14-4. Set Value of TPS01 and TPS00

TPS01	TPS00	Base clock (f_{XCLK0}) selection[Note 1]				
			f_{PRS} = 2 MHz	f_{PRS} = 5 MHz	f_{PRS} = 10 MHz	f_{PRS} = 20 MHz
0	0	TM50 output[Note 2]				
0	1	$f_{PRS}/2$	1 MHz	2.5 MHz	5 MHz	10 MHz
1	0	$f_{PRS}/2^3$	250 kHz	625 kHz	1.25 MHz	2.5 MHz
1	1	$f_{PRS}/2^5$	62.5 kHz	156.25 kHz	312.5 kHz	625 kHz

Notes 1. The frequency that can be used for the peripheral hardware clock (f_{PRS}) differs depending on the power supply voltage and product specifications.

Supply Voltage	Conventional-specification Products (μPD78F05xx and 78F05xxD)	Expanded-specification Products (μPD78F05xxA and 78F05xxDA)
4.0 V ≤ V_{DD} ≤ 5.5 V	f_{PRS} ≤ 20 MHz	f_{PRS} ≤ 20 MHz
2.7 V ≤ V_{DD} < 4.0 V	f_{PRS} ≤ 10 MHz	
1.8 V ≤ V_{DD} < 2.7 V (Standard products and (A) grade products only)	f_{PRS} ≤ 5 MHz	f_{PRS} ≤ 5 MHz

(The values shown in the table above are those when $f_{PRS} = f_{XH}$ (XSEL = 1).)

2. Note the following points when selecting the TM50 output as the base clock.

- Mode in which the count clock is cleared and started upon a match of TM50 and CR50 (TMC506 = 0)
  Start the operation of 8-bit timer/event counter 50 first and then enable the timer F/F inversion operation (TMC501 = 1).
- PWM mode (TMC506 = 1)
  Start the operation of 8-bit timer/event counter 50 first and then set the count clock to make the duty = 50%.

It is not necessary to enable (TOE50 = 1) TO50 output in any mode.

(2) 1-byte transmission/reception communication operation

(a) 1-byte transmission/reception

When bit 7 (CSIAE0) and bit 6 (ATE0) of serial operation mode specification register 0 (CSIMA0) = 1, 0, respectively, if communication data is written to serial I/O shift register 0 (SIOA0), the data is output via the SOA0 pin in synchronization with the $\overline{\text{SCKA0}}$ falling edge, and stored in the SIOA0 register in synchronization with the rising edge 1 clock later.

Data transmission and data reception can be performed simultaneously.

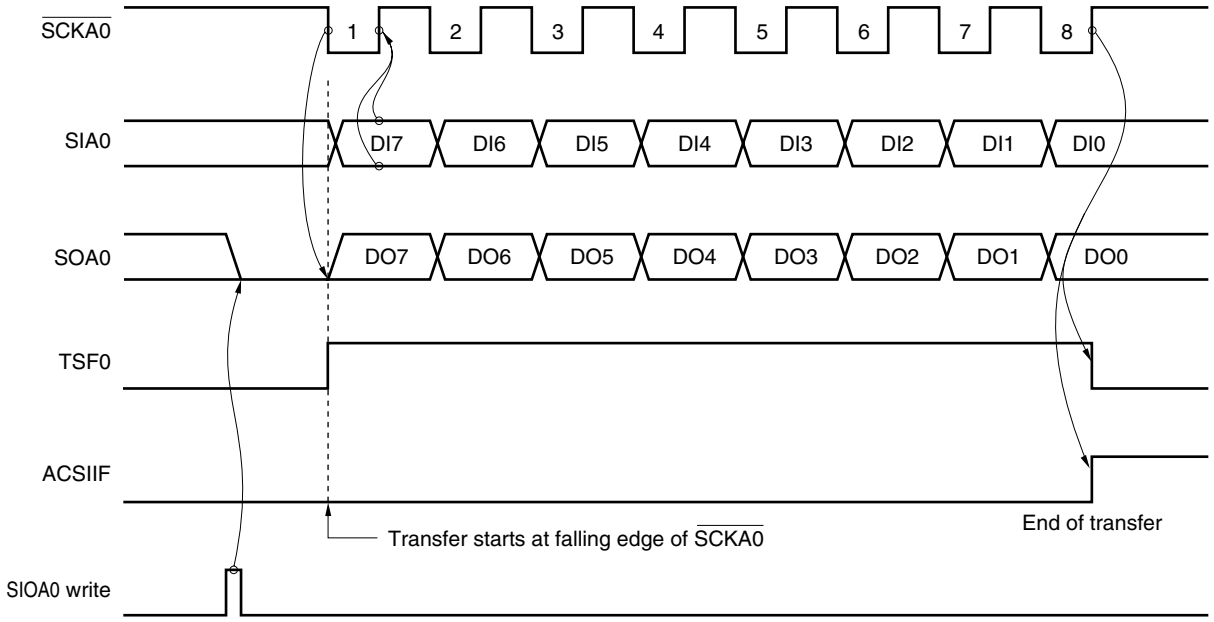
If only reception is to be performed, communication can only be started by writing a dummy value to the SIOA0 register.

When communication of 1 byte is complete, an interrupt request signal (INTACSI) is generated.

In 1-byte transmission/reception, the setting of bit 5 (ATM0) of CSIMA0 is invalid.

Be sure to read data after confirming that bit 0 (TSF0) of serial status register 0 (CSIS0) = 0.

Figure 17-10. 3-Wire Serial I/O Mode Timing



Caution The SOA0 pin becomes low level by an SIOA0 write.

Figure 20-11. Format of Interrupt Mask Flag Registers (MK0L, MK0H, MK1L, MK1H) (78K0/KF2)

Address: FFE4H After reset: FFH R/W

Symbol	<7>	<6>	<5>	<4>	<3>	<2>	<1>	<0>
MK0L	SREMK6	PMK5	PMK4	PMK3	PMK2	PMK1	PMK0	LVIMK

Address: FFE5H After reset: FFH R/W

Symbol	<7>	<6>	<5>	<4>	<3>	<2>	<1>	<0>
MK0H	TMMK010	TMMK000	TMMK50	TMMKH0	TMMKH1	DUALMK0 CSIMK10 STMK0	STMK6	SRMK6

Address: FFE6H After reset: FFH R/W

Symbol	<7>	<6>	<5>	<4>	<3>	<2>	<1>	<0>
MK1L	PMK7	PMK6	WTMK	KRMK	TMMK51	WTIMK	SRMK0	ADMK

Address: FFE7H After reset: FFH R/W

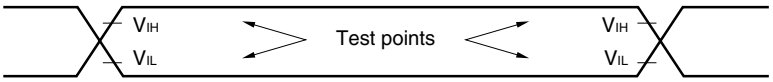
Symbol	7	6	5	<4>	<3>	<2>	<1>	<0>
MK1H	1	1	1	ACSIMK	TMMK011	TMMK001	CSIMK11	IICMK0 DMUMK

XXMKX	Interrupt servicing control
0	Interrupt servicing enabled
1	Interrupt servicing disabled

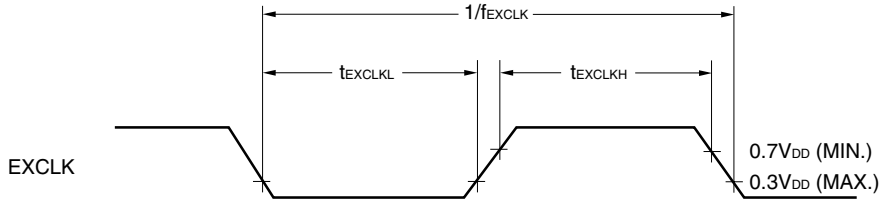
Caution Be sure to set bits 5 to 7 of MK1H to 1.

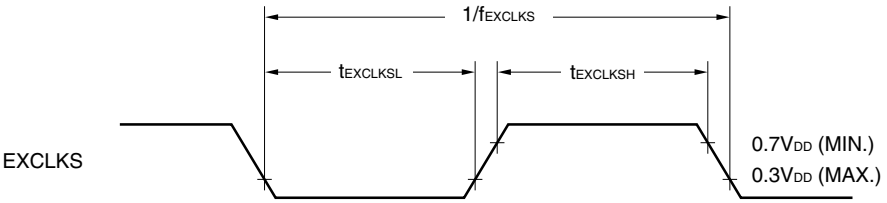
Caution The pins mounted depend on the product. Refer to Caution 2 at the beginning of this chapter.

AC Timing Test Points

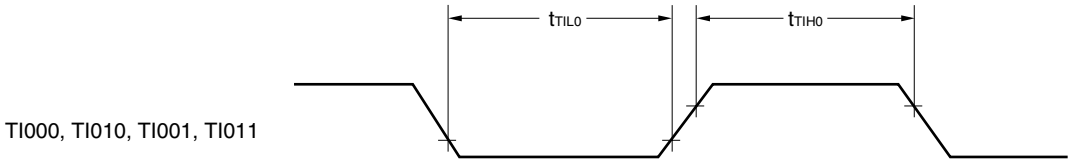


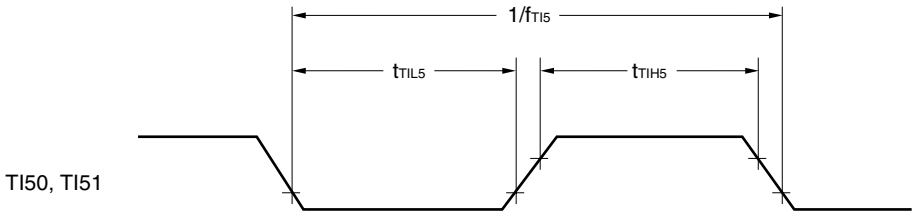
External Main System Clock Timing, External Subsystem Clock Timing



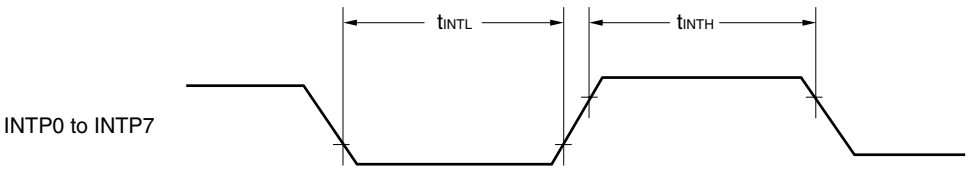


TI Timing





Interrupt Request Input Timing



Notes 1. Total current flowing into the internal power supply (V_{DD}, EV_{DD}), including the peripheral operation current and the input leakage current flowing when the level of the input pin is fixed to V_{DD} or V_{SS}. However, the current flowing into the pull-up resistors and the output current of the port are not included.

2. Not including the operating current of the 8 MHz internal oscillator, 240 kHz internal oscillator, and XT1 oscillator, and the current flowing into the A/D converter, watchdog timer and LVI circuit.

3. When AMPH (bit 0 of clock operation mode select register (OSCCTL)) = 0.

4. Not including the operating current of the X1 oscillator, XT1 oscillator, and 240 kHz internal oscillator, and the current flowing into the A/D converter, watchdog timer and LVI circuit.

5. Not including the operating current of the X1 oscillation, 8 MHz internal oscillator and 240 kHz internal oscillator, and the current flowing into the A/D converter, watchdog timer and LVI circuit.

6. Not including the operating current of the 240 kHz internal oscillator and XT1 oscillation, and the current flowing into the A/D converter, watchdog timer and LVI circuit.

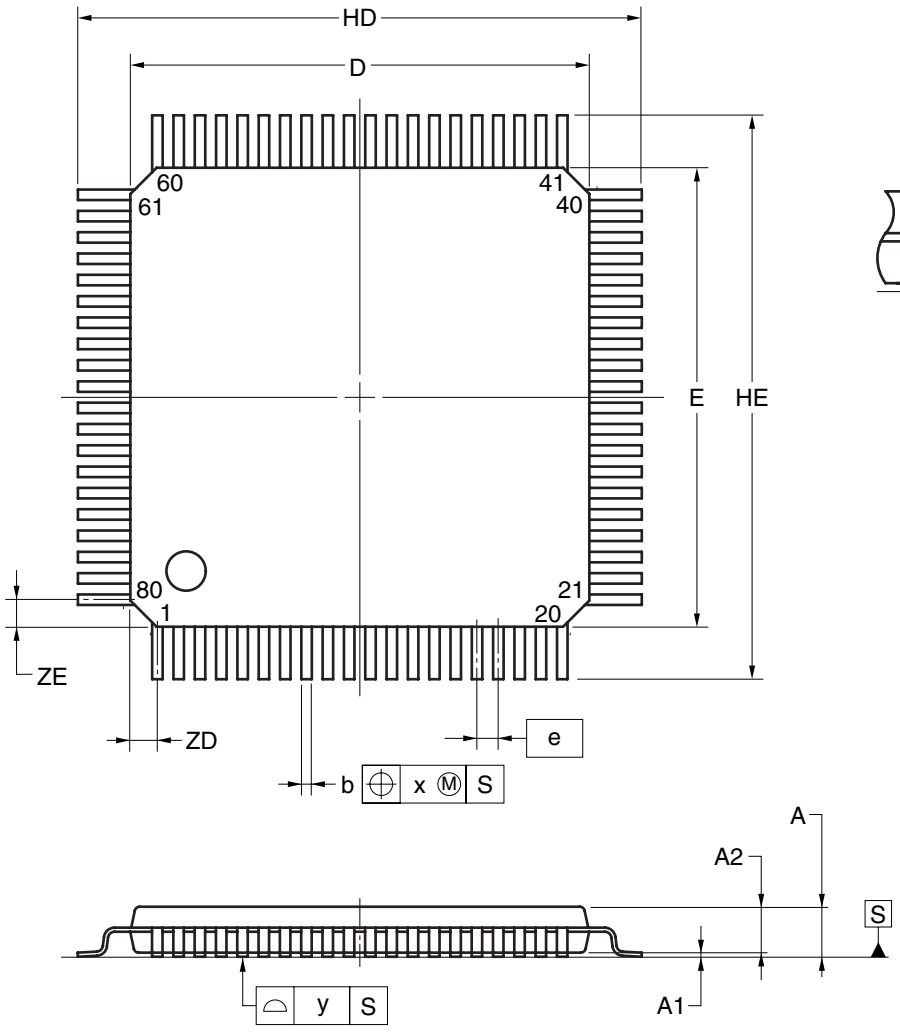
7. Current flowing only to the A/D converter (AV_{REF}). The current value of the 78K0/Kx2 microcontrollers is the sum of I_{DD1} or I_{DD2} and I_{ADC} when the A/D converter operates in an operation mode or the HALT mode.

8. Current flowing only to the watchdog timer (including the operating current of the 240 kHz internal oscillator). The current value of the 78K0/Kx2 microcontrollers is the sum of I_{DD1}, I_{DD2} or I_{DD3} and I_{WDT} when the watchdog timer operates.

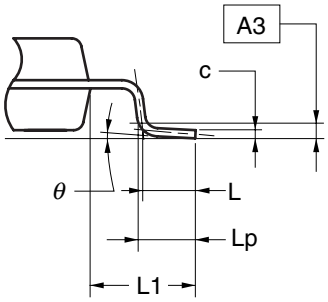
9. Current flowing only to the LVI circuit. The current value of the 78K0/Kx2 microcontrollers is the sum of I_{DD1}, I_{DD2} or I_{DD3} and I_{LVI} when the LVI circuit operates.

- μPD78F0544GC(A)-GAD-AX, 78F0545GC(A)-GAD-AX, 78F0546GC(A)-GAD-AX, 78F0547GC(A)-GAD-AX
- μPD78F0544GC(A2)-GAD-AX, 78F0545GC(A2)-GAD-AX, 78F0546GC(A2)-GAD-AX, 78F0547GC(A2)-GAD-AX
- μPD78F0544AGC-GAD-AX, 78F0545AGC-GAD-AX, 78F0546AGC-GAD-AX, 78F0547AGC-GAD-AX, 78F0547DAGC-GAD-AX
- μPD78F0544AGCA-GAD-G, 78F0545AGCA-GAD-G, 78F0546AGCA-GAD-G, 78F0547AGCA-GAD-G
- μPD78F0544AGCA2-GAD-G, 78F0545AGCA2-GAD-G, 78F0546AGCA2-GAD-G, 78F0547AGCA2-GAD-G

80-PIN PLASTIC LQFP(14x14)



detail of lead end



(UNIT:mm)

ITEM	DIMENSIONS
D	14.00±0.20
E	14.00±0.20
HD	17.20±0.20
HE	17.20±0.20
A	1.70 MAX.
A1	0.125±0.075
A2	1.40±0.05
A3	0.25
b	$0.30^{+0.08}_{-0.04}$
c	$0.125^{+0.075}_{-0.025}$
L	0.80
Lp	0.886±0.15
L1	1.60±0.20
θ	$3^{\circ}{}^{+5^{\circ}}_{-3^{\circ}}$
e	0.65
x	0.13
y	0.10
ZD	0.825
ZE	0.825

P80GC-65-GAD

NOTE
Each lead centerline is located within 0.13 mm of its true position at maximum material condition.

CHAPTER 36 CAUTIONS FOR WAIT

36.1 Cautions for Wait

This product has two internal system buses.

One is a CPU bus and the other is a peripheral bus that interfaces with the low-speed peripheral hardware.

Because the clock of the CPU bus and the clock of the peripheral bus are asynchronous, unexpected illegal data may be passed if an access to the CPU conflicts with an access to the peripheral hardware.

When accessing the peripheral hardware that may cause a conflict, therefore, the CPU repeatedly executes processing, until the correct data is passed.

As a result, the CPU does not start the next instruction processing but waits. If this happens, the number of execution clocks of an instruction increases by the number of wait clocks (for the number of wait clocks, see **Tables 36-1** and **36-2**). This must be noted when real-time processing is performed.