NEC

MOS INTEGRATED CIRCUI

μPD78062(A), 78063(A), 78064(A

8-BIT SINGLE-CHIP MICROCONTROLLERS

DESCRIPTION

The μPD78062(A), 78063(A), 78064(A) are 8-bit single-chip microcontrollers based on the μPD78062, 78063, and 78064, respectively. The two device groups differ only in the quality assurance program defined by NEC, with the assurance program applied for the μPD78062(A), 78063(A), and 78064(A) (called special grade) being stricter than that for the other devices (standard grade).

The μPD78062(A), 78063(A), and 78064(A) are members of the μPD78064 subseries in the 78K/0 series. These devices contain an LCD controller/driver, 8-bit resolution A/D converters, timers, serial interface units, an interrupt controller, and other powerful peripheral hardware.

A one-time PROM version, an EPROM version, and various development tools for these devices are also available. The one-time PROM and EPROM versions operate in the same power supply voltage range for accurate evaluation.

For detailed descriptions of functions, refer to the following user's manuals.

μPD78064 78064Y Subseries User's Manual : IEU-1364

78K/0 Series User's Manual (Instruction) : IEU-1372

FEATURES

- Large on-chip ROM & RAM

Item / Part Number	Program Memory (ROM)	Data Memory		Package
		Internal High-Speed RAM	LCD Display RAM	
μPD78062(A)	16 Kbytes	512 bytes	40 x 4 bits	100-pin plastic QFP (fine pitch) (14 x 14 mm, 0.5-mm pitch) 100-pin plastic QFP (14 x 20 mm, 0.65-mm pitch)
μPD78063(A)	24 Kbytes	1024 bytes		
μPD78064(A)	32 Kbytes			

- Instruction execution time can be varied from high speed (0.4 μs) to ultra-low speed (122 μs)
- I/O ports: 57 (including segment signal output dual-function pins)
- LCD controller/driver

  Supply voltages V_{DD} = 2.0 to 6.0 V (Static display mode)
  V_{DD} = 2.5 to 6.0 V (1/3 bias)
  V_{DD} = 2.7 to 6.0 V (1/2 bias)
- 8-bit resolution A/D converter : 8 channels
- Serial interface : 2 channels
- Timer: 5 channels
- Supply voltage : V_{DD} = 2.0 to 6.0 V

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APPLICATIONS

Control devices of transport system, gas detector circuit-breakers, safety devices, sphygmomanometer, etc.

ORDERING INFORMATION

Part Number	Package	Quality Grade
μPD78062GC (A)-xxx-7EA	100-pin plastic QFP (Fine pitch) (14 x 14 mm)	Special
μPD78062GF (A)-xxx-3BA	100-pin plastic QFP (14 x 20 mm)	Special
μPD78063GC (A)-xxx-7EA	100-pin plastic QFP (Fine pitch) (14 x 14 mm)	Special
μPD78063GF (A)-xxx-3BA	100-pin plastic QFP (14 x 20 mm)	Special
μPD78064GC (A)-xxx-7EA	100-pin plastic QFP (Fine pitch) (14 x 14 mm)	Special
μPD78064GF (A)-xxx-3BA	100-pin plastic QFP (14 x 20 mm)	Special

Remark xxx is the ROM code suffix.

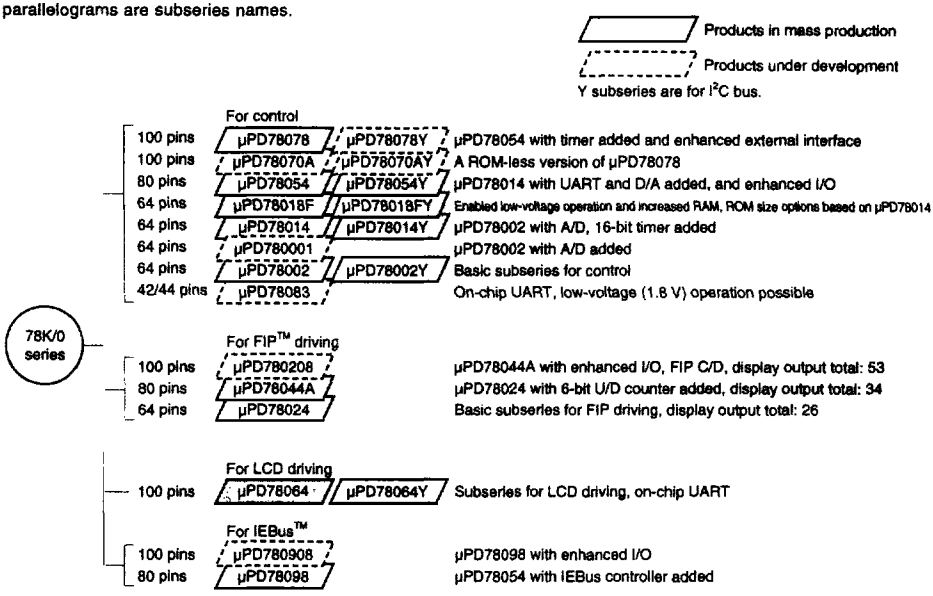
Please refer to "Quality grade on NEC Semiconductor Devices" (Document number IEI-1209) published by NEC Corporation to know the specification of quality grade on the devices and its recommended applications.

Difference between μPD78062(A)/78063(A)/78064(A) and μPD78062/78063/78064

Item \ Part number	μPD78062(A), 78063(A), 78064(A)	μPD78062, 78063, 78064
Quality grade	Special	Standard

78K/0 SERIES LINE-UP

The following shows the products of the 78K/0 Series organized according to their functions. The names in the parallelograms are subseries names.



The following lists the main functional differences among the 78K/0 Series products.

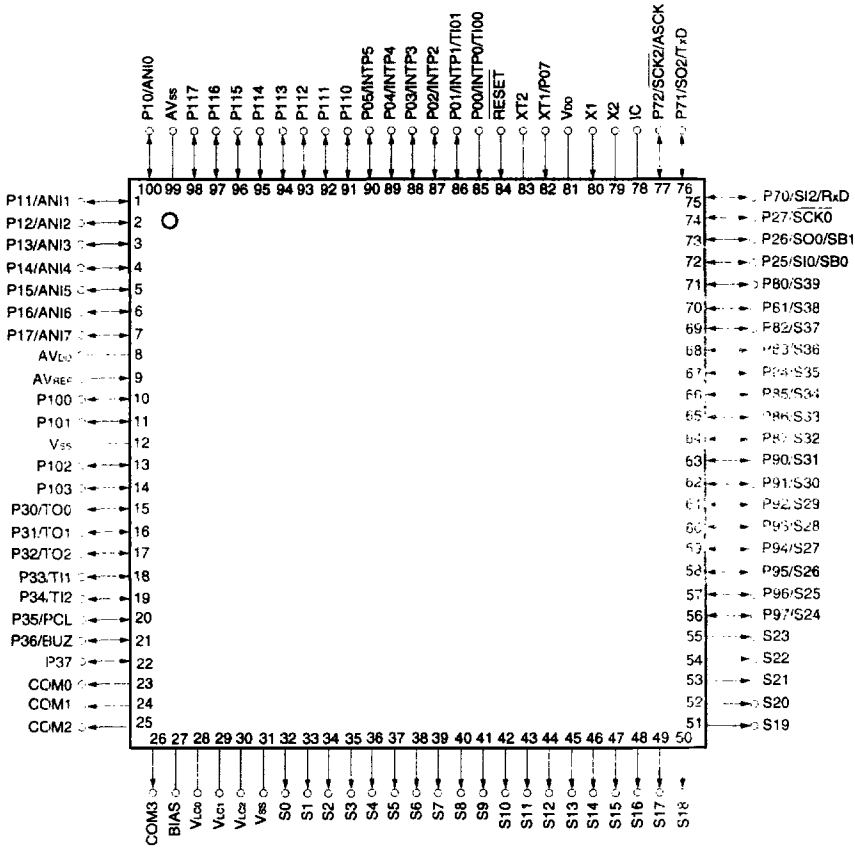
Subseries	Function	ROM Capacity	Timer 8-bit	Timer 16-bit	Timer Watch	Timer WDT	8-bit A/D	8-bit D/A	Serial Interface	I/O	V_{DD} MIN. Value	External Expansion
For control	μPD78078	32 K to 60 K	4ch	1ch	1ch	1ch	8ch	2ch	3ch (UART:1ch)	88	1.8 V	Yes
	μPD78070A	–								61	2.7 V	
	μPD78054	16 K to 60 K	2ch							69	2.0 V	
	μPD78018F	8 K to 48 K						–	2ch	53	1.8 V	
	μPD78014	8 K to 32 K									2.7 V	
	μPD780001	8 K		–	–				1ch	39		No
	μPD78002	8 K to 16 K			1ch		–			53		Yes
	μPD78083				–		8ch		1ch (UART:1ch)	33	1.8 V	No
For FIP driving	μPD780208	32 K to 40 K	2ch	1ch	1ch	1ch	8ch	–	2ch	74	2.7 V	No
	μPD78044A	16 K to 40 K								68		
	μPD78024	24 K to 32 K								54		
For LCD driving	μPD78064	16 K to 32 K	2ch	1ch	1ch	1ch	8ch	–	2ch (UART:1ch)	57	2.0 V	No
For IEBus	μPD780908	60 K	2ch	1ch	1ch	1ch	8ch	2ch	3ch (UART:1ch)	88	2.7 V	Yes
	μPD78098	32 K to 60 K								69		

OVERVIEW OF FUNCTION

Item \ Part Number		μPD78062 (A)	μPD78063 (A)	μPD78064 (A)
Internal memory	ROM	16 Kbytes	24 Kbytes	32 Kbytes
	Internal high-speed RAM	512 bytes	1024 bytes	
	LCD display RAM	40 x 4 bits		
General registers		8 bits x 32 registers (8 bits x 8 registers x 4 banks)		
Instruction cycle		Instruction execution time is variable		
	When main system clock selected	0.4 μs/0.8 μs/1.6 μs/3.2 μs/6.4 μs/12.8 μs (at 5.0MHz operation)		
	When subsystem clock selected	122 μs (at 32.768 kHz operation)		
Instruction set		• 16-bit operation • Multiply/divide (8 bits x 8 bits,16 bits/8 bits) • Bit manipulate (set, reset, test, boolean operation) • BCD adjust, etc.		
I/O ports (including segment signal output pins)		Total : 57 • CMOS input : 2 • CMOS I/O : 55		
A/D converter		• 8-bit resolution x 8 channels		
LCD controller/driver		• Segment signal output : Maximum 40 • Common signal output : Maximum 4 • Bias : 1/2 or 1/3 switchable		
Serial interface		• 3-wire/SBI/2-wire mode selectable : 1 channel • 3-wire/UART mode selectable : 1 channel		
Timer		• 16-bit timer/event counter : 1 channel • 8-bit timer/event counter : 2 channels • Watch timer : 1 channel • Watchdog timer : 1 channel		
Timer output		3 (14-bit PWM output capability : 1)		
Clock output		19.5 kHz, 39.1 kHz, 78.1 kHz, 156 kHz, 313 kHz, 625 kHz, 1.25 MHz, 2.5 MHz, 5.0 MHz (at main system clock 5.0-MHz operation) 32.768 kHz (at subsystem clock 32.768-kHz operation)		
Buzzer output		1.2 kHz, 2.4 kHz, 4.9 kHz, 9.8 kHz (at main system clock 5.0-MHz operation)		
Vectored interrupts	Maskable interrupts	Internal : 12, external : 6		
	Non-maskable interrupts	Internal : 1		
	Software interrupts	Internal : 1		
Test input		Internal : 1, external : 1		
Supply voltage		V_{DD} = 2.0 to 6.0 V		
Package		• 100-pin plastic QFP (Fine pitch) (14 x 14 mm) • 100-pin plastic QFP (14 x 20 mm)		

1. PIN CONFIGURATION (TOP VIEW)

- **100-pin plastic QFP (Fine pitch) (14 x 14 mm)**
  μPD78062GC (A)-xxx-7EA, 78063GC-xxx-7EA
  μPD78064GC (A)-xxx-7EA



Cautions 1. Connect directly the IC (Internally Connected) pin to V_{SS}.

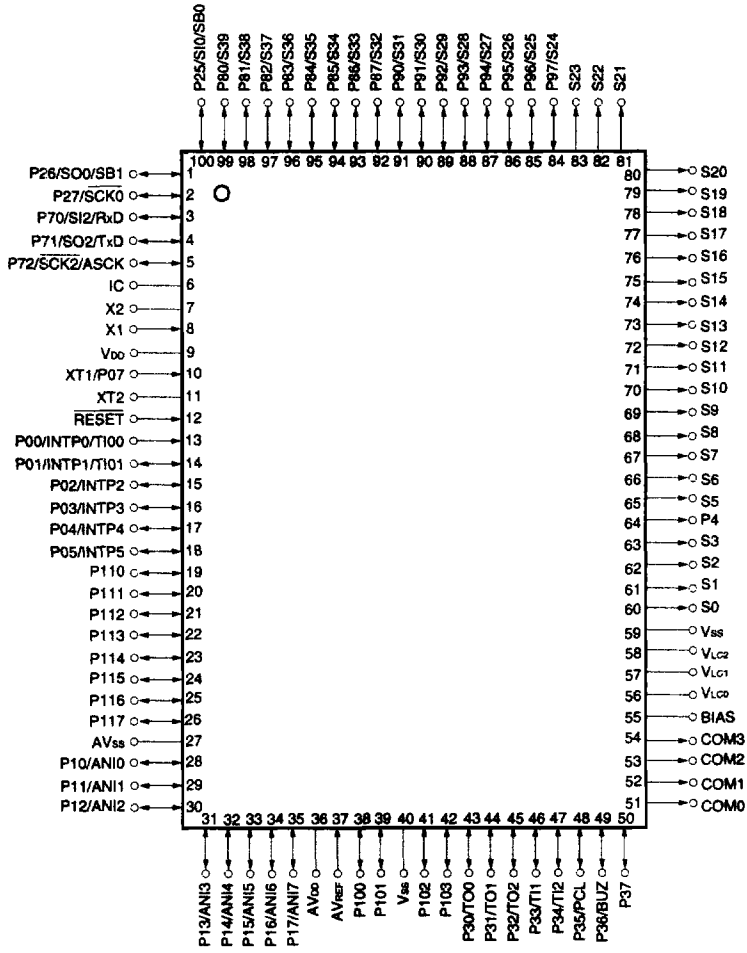
2. Connect the AV_{DD} pin to V_{DD}.

3. Connect the AV_{SS} pin to V_{SS}.

• 100-pin plastic QFP (14 x 20 mm)

μPD78062GF (A)-xxx-3BA, 78063GF (A)-xxx-3BA

μPD78064GF (A)-xxx-3BA



Cautions 1. Connect directly the IC (internally Connected) pin to V_{SS}.

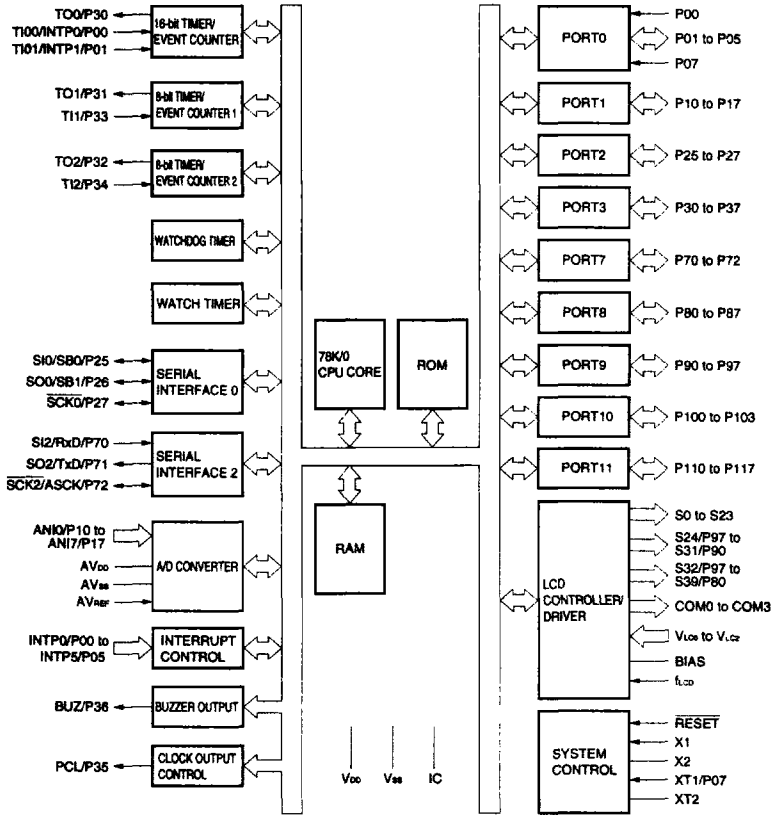
2. Connect the AV_{DD} pin to V_{DD}.

3. Connect the AV_{SS} pin to V_{SS}.

P00 to P05, P07 : Port0
P10 to P17 : Port1
P25 to P27 : Port2
P30 to P37 : Port3
P70 to P72 : Port7
P80 to P87 : Port8
P90 to P97 : Port9
P100 to P103 : Port10
P110 to P117 : Port11
INTP0 to INTP5 : Interrupt from Peripherals
TI00, TI01 : Timer Input
TI1, TI2 : Timer Input
TO0 to TO2 : Timer Output
SB0, SB1 : Serial Bus
SI0, SI2 : Serial Input
SO0, SO2 : Serial Output
$\overline{SCK0}$, $\overline{SCK2}$: Serial Clock
RxD : Receive Data
TxD : Transmit Data
ASCK : Asynchronous Serial Clock
PCL : Programmable Clock
BUZ : Buzzer Clock

S0 to S39 : Segment Output
COM0 to COM3 : Common Output
V_{LC0} to V_{LC2} : LCD Power Supply
BIAS : LCD Power Supply Bias Control
X1, X2 : Crystal (Main System Clock)
XT1, XT2 : Crystal (Subsystem Clock)
$\overline{RESET}$: Reset
ANI0 to ANI7 : Analog Input
AV_{DD} : Analog Power Supply
AV_{SS} : Analog Ground
AV_{REF} : Analog Reference Voltage
V_{DD} : Power Supply
V_{SS} : Ground
IC : Internally Connected

2. BLOCK DIAGRAM



Remark The internal ROM and RAM capacities vary depending on the product.

3. PIN FUNCTIONS

3.1 PORT PINS (1/2)

Pin Name	I/O	Function		After Reset	Alternate function
P00	Input	Port 0 7-bit I/O port.	Input only	Input	INTP0/TI00
P01	Input/ output		Input/output can be specified bit-wise. When used as an input port, pull-up resistor can be connected by software.	Input	INTP1/TI01
P02					INTP2
P03					INTP3
P04					INTP4
P05					INTP5
P07[Note 1]	Input		Input only	Input	XT1
P10 to P17	Input/ output	Port 1 8-bit input/output port. Input/output can be specified bit-wise. When used as an input port, pull-up resistor can be connected by software.[Note 2]		Input	ANI0 to ANI7
P25	Input/ output	Port 2 3-bit input/output port. Input/output can be specified bit-wise. When used as an input port, pull-up resistor can be connected by software.		Input	SI0/SB0
P26					SO0/SB1
P27					$\overline{SCK0}$
P30	Input/ output	Port 3 8-bit input/output port. Input/output can be specified bit-wise. When used as an input port, pull-up resistor can be connected by software.		Input	TO0
P31					TO1
P32					TO2
P33					TI1
P34					TI2
P35					PCL
P36					BUZ
P37					—
P70	Input/ output	Port 7 3-bit input/output port. Input/output can be specified bit-wise. When used as an input port, pull-up resistor can be connected by software.		Input	SI2/RxD
P71					SO2/TxD
P72					$\overline{SCK2}$/ ASCK

Notes 1. When using the P07/XT1 pins as an input port, set (1) bit 6 (FRC) of the processor clock control register. (the on-chip feedback resistor of the subsystem clock oscillator should not be used.)

2. When using the P10/ANI0 to P17/ANI7 pins as the A/D converter analog input, port 1 is set to the input mode. However, the pull-up resistor is automatically disabled.

3.1 PORT PINS (2/2)

Pin Name	I/O	Function	After Reset	Alternate function
P80 to P87	Input/ output	Port 8 8-bit input/output port Input/output can be specified bit-wise. When used as an input port , pull-up resistor can be connected by software. Input/output port/segment signal output function can be specified in 2-bit unit by the LCD control register.	Input	S39 to S32
P90 to P97	Input/ output	Port 9 8-bit input/output port Input/output can be specified bit-wise. When used as an input port, pull-up resistor can be connected by software. Input/output port/segment signal output function can be specified in 2-bit unit by the LCD control register.	Input	S31 to S24
P100 to P103	Input/ output	Port 10 4-bit input/output port Input/output can be specified bit-wise. When used as an input port, pull-up resistor can be connected by software. LED direct drive capability.	Input	——
P110 to P117	Input/ output	Port 11 8-bit input/output port Input/output can be specified bit-wise. When used as an input port, pull-up resistor can be connected by software. Falling edge detection capability.	Input	——

3.2 NON-PORT PINS (1/2)

Pin Name	I/O	Function	After Reset	Alternate function
INTP0	Input	External interrupt input by which the effective edge (rising edge, falling edge, or both rising edge and falling edge) can be specified.	Input	P00/TI00
INTP1				P01/TI01
INTP2				P02
INTP3				P03
INTP4				P04
INTP5				P05
SI0	Input	Serial interface serial data input.	Input	P25/SB0
SI2				P70/RxD
SO0	Output	Serial interface serial data output.	Input	P26/SB1
SO2				P71/TxD
SB0	Input/ output	Serial interface serial data input/output.	Input	P25/SI0
SB1				P26/SO0
$\overline{SCK0}$	Input/ output	Serial interface serial clock input/output.	Input	P27
$\overline{SCK2}$				P72/ASCK
RxD	Input	Asynchronous serial interface serial data input.	Input	P70/SI2
TxD	Output	Asynchronous serial interface serial data output.	Input	P71/SO2
ASCK	Input	Asynchronous serial interface serial clock input.	Input	P72/$\overline{SCK2}$
TI00	Input	External count clock input to 16-bit timer (TM0).	Input	P00/INTP0
TI01		Capture trigger signal input to capture register (CR00).		P01/INTP1
TI1		External count clock input to 8-bit timer (TM1).		P33
TI2		External count clock input to 8-bit timer (TM2).		P34
TO0	Output	16-bit timer output (shared with 14-bit PWM output).	Input	P30
TO1		8-bit timer output.		P31
TO2				P32
PCL	Output	Clock output (for main system clock, subsystem clock trimming).	Input	P35
BUZ	Output	Buzzer output.	Input	P36
S0 to S23	Output	LCD controller/driver segment signal output.	Output	—
S24 to S31			Input	P97 to P90
S32 to S39				P87 to P80
COM0 to COM3	Output	LCD controller/driver common signal output.	Output	—
V_{LC0} to V_{LC2}	—	LCD drive voltage. Split resistors can be incorporated by mask option.	—	—
BIAS	—	LCD drive power supply.	—	—

3.2 NON-PORT PINS (2/2)

Pin Name	I/O	Function	After Reset	Alternate function
ANI0 to ANI7	Input	A/D converter analog input.	Input	P10 to P17
AV_{REF}	Input	A/D converter reference voltage input.	—	—
AV_{DD}	—	A/D converter analog power supply. Connect to V_{DD}.	—	—
AV_{SS}	—	A/D converter ground potential. Connect to V_{SS}.	—	—
$\overline{RESET}$	Input	System reset input.	—	—
X1	Input	Main system clock oscillation crystal connection.	—	—
X2	—		—	—
XT1	Input	Subsystem clock oscillation crystal connection.	Input	P07
XT2	—		—	—
V_{DD}	—	Positive power supply.	—	—
V_{SS}	—	Ground potential.	—	—
IC	—	Internal connection. Connect directly to V_{SS} pin.	—	—

3.3 PIN I/O CIRCUITS AND RECOMMENDED CONNECTION OF UNUSED PINS

The input/output circuit type of each pin and recommended connection of unused pins are shown in Table 3-1. For the input/output circuit configuration of each type, see Figure 3-1.

Table 3-1. Input/Output Circuit Type of Each Pin (1/2)

Pin Name	Input/output Circuit Type	I/O	Recommended Connection when not Used
P00/INTP0/TI00	2	Input	Connected to V_{SS}.
P01/INTP1/TI01	8-A	Input/output	Independently connected to V_{SS} through resistor.
P02/INTP2			
P03/INTP3			
P04/INTP4			
P05/INTP5			
P07/XT1	16	Input	Connected to V_{DD}.
P10/ANI0 to P17/ANI7	11	Input/output	Independently connected to V_{DD} or V_{SS} through resistor.
P25/SI0/SB0	10-A		
P26/SO0/SB1			
P27/$\overline{SCK0}$			
P30/TO0	5-A		
P31/TO1			
P32/TO2			

Table 3-1. Input/Output Circuit Type of Each Pin (2/2)

Pin Name	Input/output Circuit Type	I/O	Recommended Connection when not Used
P33/TI1	8-A	Input/output	Independently connected to V_{DD} or V_{SS} through resistor
P34/TI2			
P35/PCL	5-A		
P36/BUZ			
P37			
P70/SI2/RxD	8-A		
P71/SO2/TxD	5-A		
P72/$\overline{SCK2}$/ASCK	8-A		
P80/S39 to P87/S32	17-A		
P90/S31 to P97/S24			
P100 to P103	5-A		
P110 to P117	8-A		Independently connected to V_{DD} through resistor
S0 to S23	17	Output	Leave open.
COM0 to COM3	18		
V_{LC0} to V_{LC2}	—	—	
BIAS			
$\overline{RESET}$	2	Input	—
XT2	16	—	Leave open.
AV_{REF}	—		Connected to V_{SS}.
AV_{DD}			Connected to V_{DD}.
AV_{SS}			Connected to V_{SS}.
IC			Connected directly to V_{SS}.

Figure 3-1. Pin Input/Output Circuits (1/2)

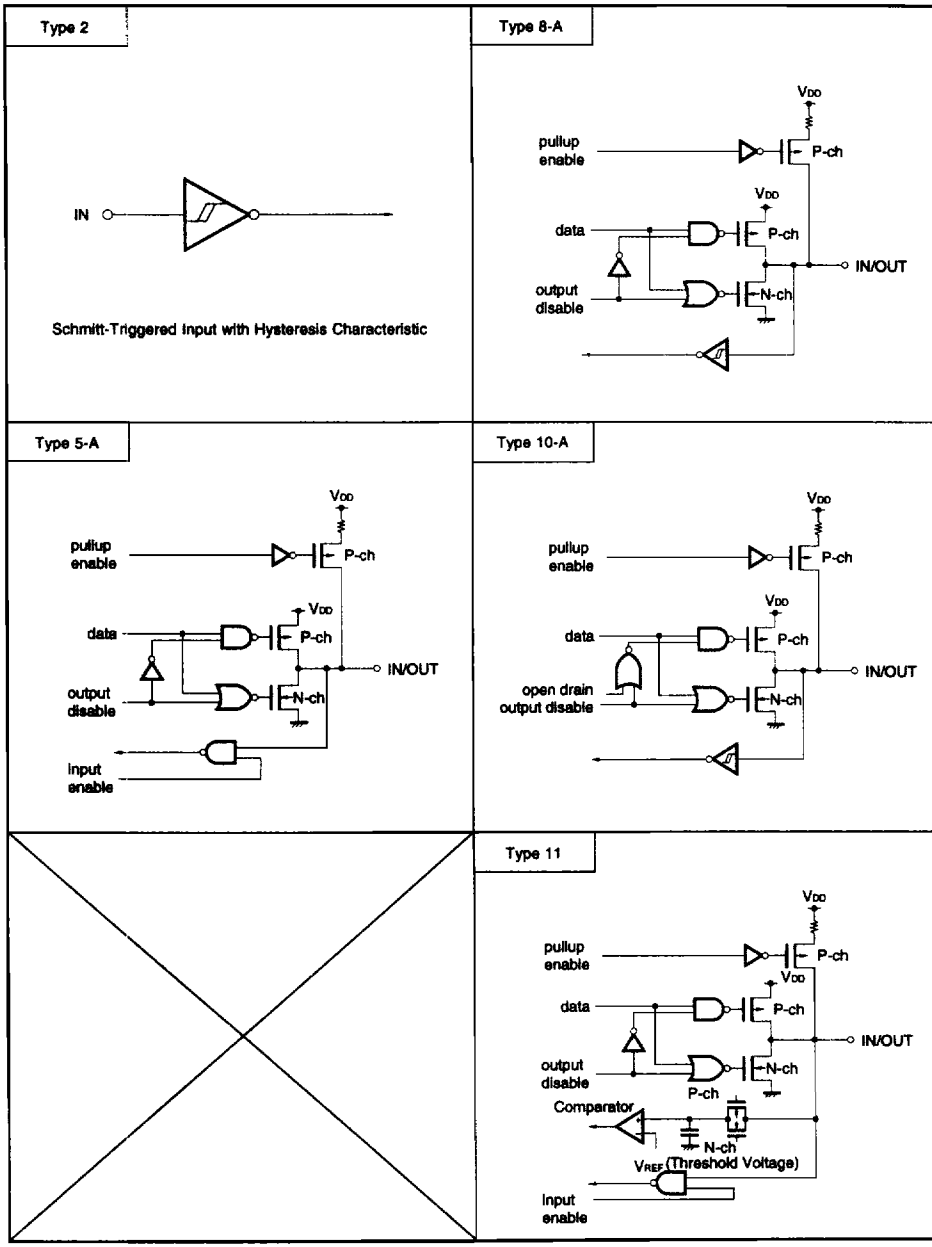
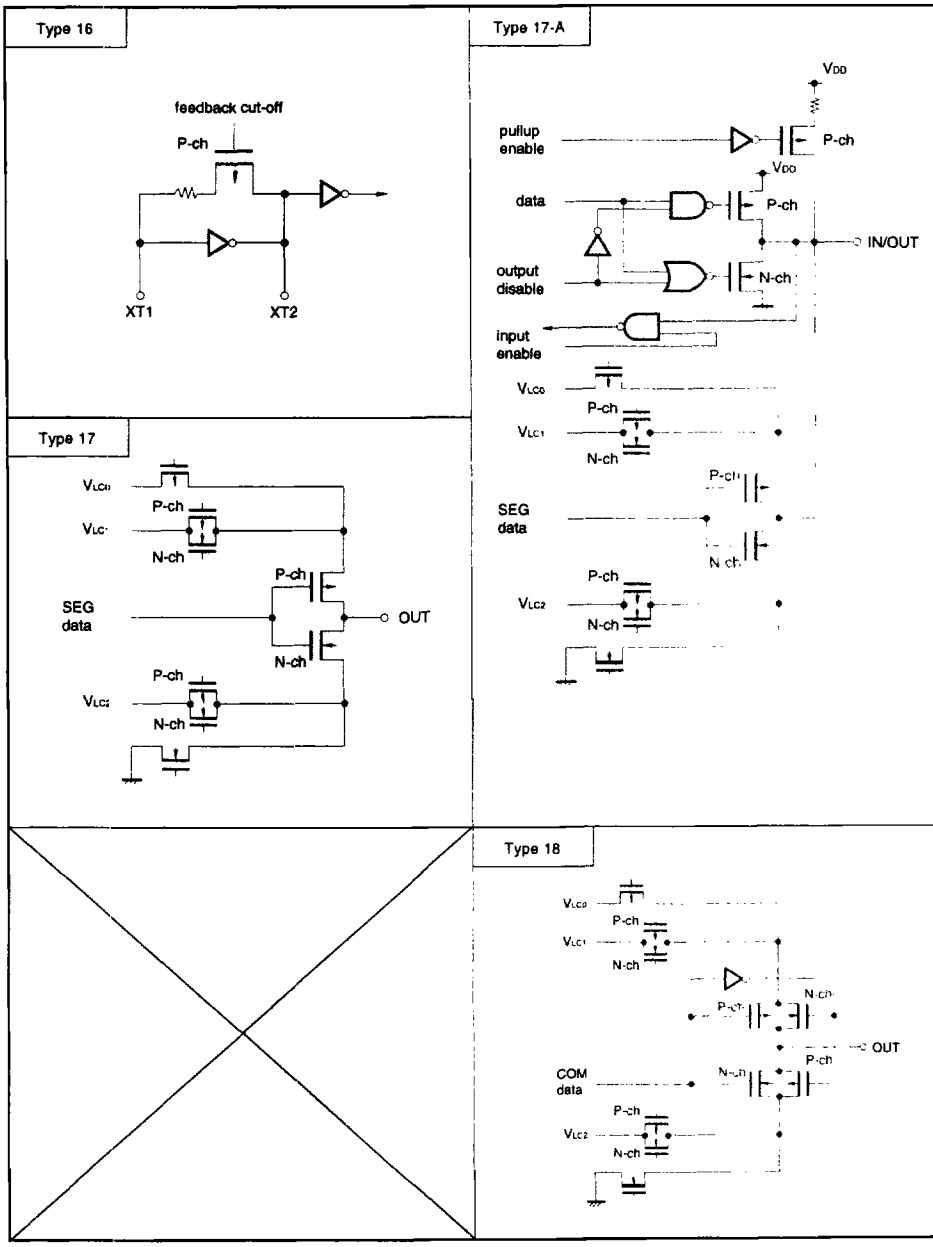


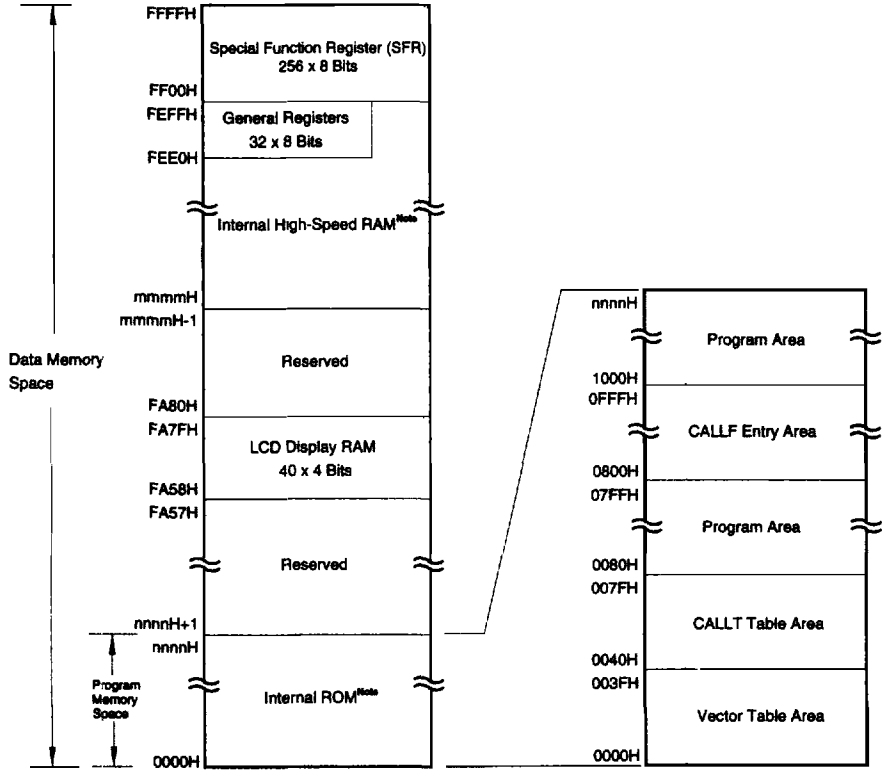
Figure 3-1. Pin Input/Output Circuits (2/2)



4. MEMORY SPACE

The memory map of the μPD78062(A)/78063(A)/78064(A) is shown in Figure 4-1.

Figure 4-1. Memory Map



Note The capacity of the internal ROM and internal high-speed RAM differs according to the product. (refer to the following table.)

Part Number	Last Address of Internal ROM nnnnH	Start Address of Internal High-Speed RAM mmmmH
μPD78062(A)	3FFFH	FD00H
μPD78063(A)	5FFFH	FB00H
μPD78064(A)	7FFFH	

5. PERIPHERAL HARDWARE FUNCTION FEATURE

5.1 PORT

There are two kinds of I/O ports.

• CMOS input (P00, P07)	: 2
• CMOS input/output (P01 to P05, Port 1 to 3, 7 to 11)	: 55
Total	: 57

Table 5-1. Functions of Ports

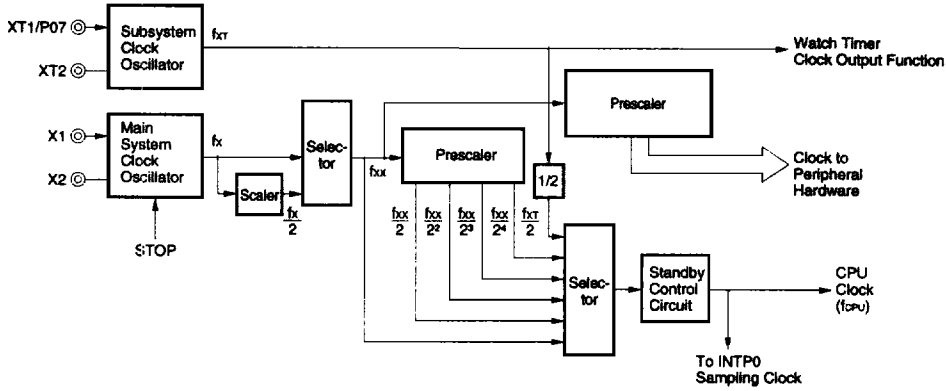
Name	Pin Name	Function
Port 0	P00, P07	Dedicated input port
	P01 to P05	Input/output port. Input/output specifiable bit-wise. When used as input port, on-chip pull-up resistor can be used by software
Port 1	P10 to P17	Input/output port. Input/output specifialbe bit-wise. When used as input port, on-chip pull-up resistor can be used by software.
Port 2	P25 to P27	Input/output port. Input/output specifiable bit-wise. When used as input port, on-chip pull-up resistor can be used by software
Port 3	P30 to P37	Input/output port. Input/output specifiable bit-wise. When used as input port, on-chip pull-up resistor can be used by software
Port 7	P70 to P72	Input/output port. Input/output specifiable bit-wise. When used as input port, on-chip pull-up resistor can be used by software
Port 8	P80 to P87	Input/output port. Input/output specifiable bit-wise. When used as input port, on-chip pull-up resistor can be used by software. Input/output port/segment signal output function specifiable in 2-bit units by LCD control register.
Port 9	P90 to P97	Input/output port. Input/output specifiable bit-wise. When used as input port, on-chip pull-up resistor can be used by software Input/output port/segment signal output function specifiable in 2-bit units by LCD control register.
Port 10	P100 to P103	Input/output port. Input/output specifiable bit-wise. When used as input port, on-chip pull-up resistor can be used by software Direct LED drive capability.
Port 11	P110 to P117	Input/output port. Input/output specifiable bit-wise. When used as input port, on-chip pull-up resistor can be used by software. Test input flag (KRIF) is set to 1 by falling edge detection.

5.2 CLOCK GENERATOR

There are two kinds of clocks, a main system clock and a subsystem clock.
The instruction execution time can also be changed.

- 0.4 μs/0.8 μs/1.6 μs/3.2 μs/6.4 μs/12.8 μs (during 5.0-MHz operation using main system clock)
- 122 μs (during 32.768-kHz operation using subsystem clock)

Figure 5-1. Clock Generator Block Diagram



5.3 TIMER/EVENT COUNTER

Five timer/event counter channels are incorporated.

- 16-bit timer/event counter : 1 channel
- 8-bit timer/event counter : 2 channels
- Watch timer : 1 channel
- Watchdog timer : 1 channel

Table 5-2. Timer/Event Counter Types and Functions

		16-bit Timer/ Event Counter	8-bit Timer/ Event Counter	Watch Timer	Watchdog Timer
Type	Interval timer	1 channel	2 channels	1 channel	1 channel
	External event counter	1 channel	2 channels	–	–
Function	Timer output	1 output	2 outputs	–	–
	PWM output	1 output	–	–	–
	Pulse width measurement	2 inputs	–	–	–
	Square wave output	1 output	2 outputs	–	–
	One-shot pulse output	1 output	–	–	–
	Interrupt request	2	2	2	1

Figure 5-2. 16-Bit Timer/Event Counter Block Diagram

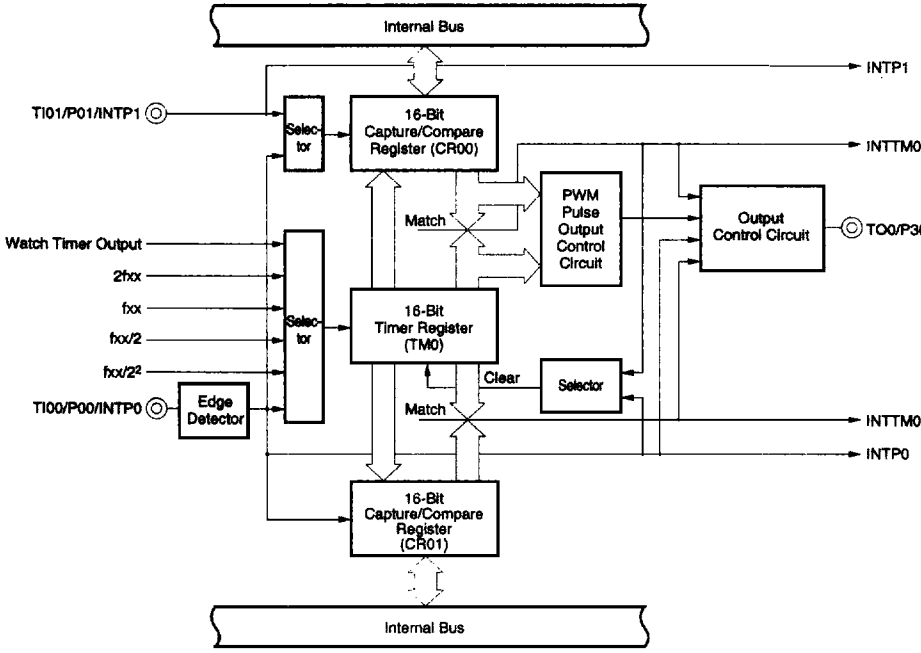


Figure 5-3. 8-Bit Timer/Event Counter Block Diagram

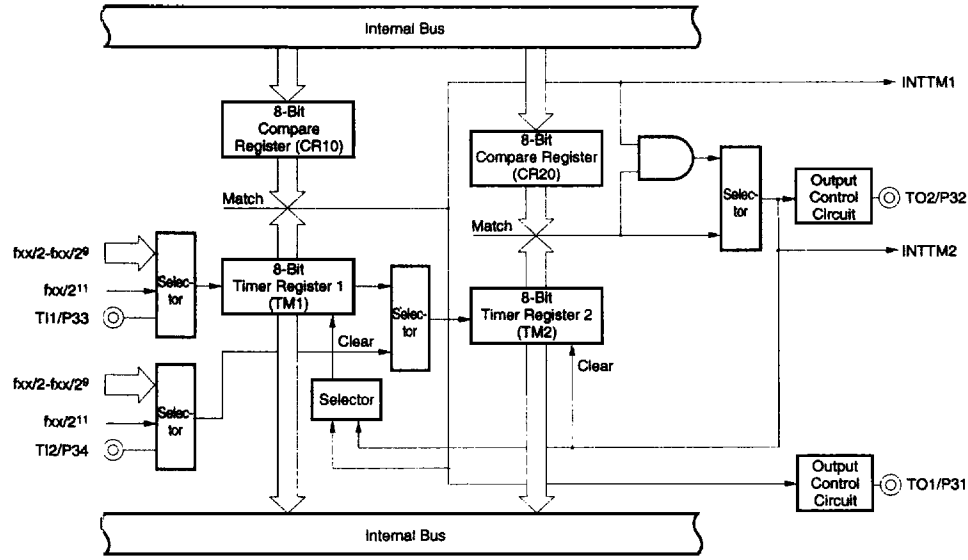


Figure 5-4. Watch Timer Block Diagram

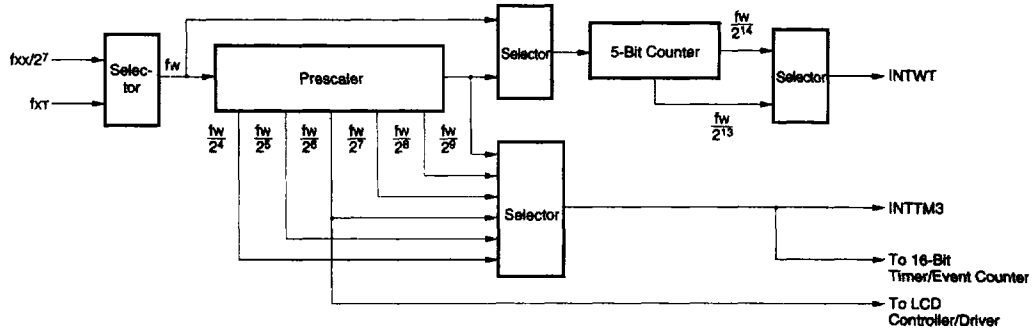
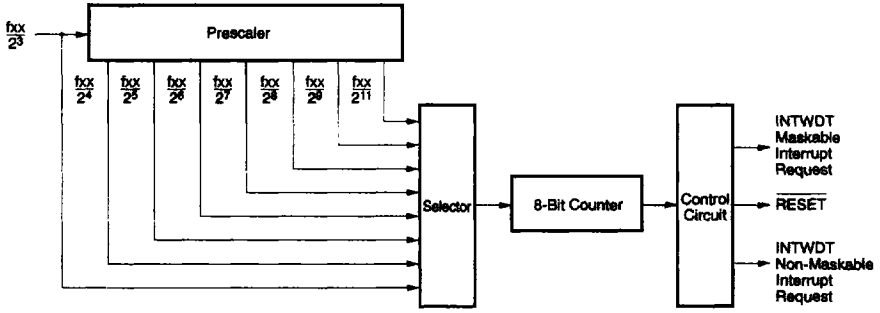


Figure 5-5. Watchdog Timer Block Diagram

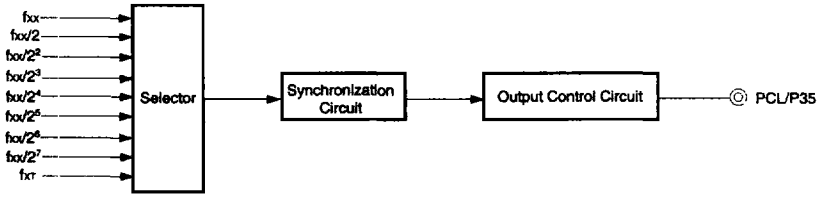


5.4 CLOCK OUTPUT CONTROL CIRCUIT

Clocks of the following frequency can be output as clock outputs:

- 19.5 kHz/39.1 kHz/78.1 kHz/156 kHz/313 kHz/625 kHz/1.25 MHz/2.5 MHz/5.0 MHz (main system clock: in 5.0 kHz operation)
- 32.768 kHz (subsystem clock: in 32.768 kHz operation)

Figure 5-6. Clock Output Circuit Block Diagram

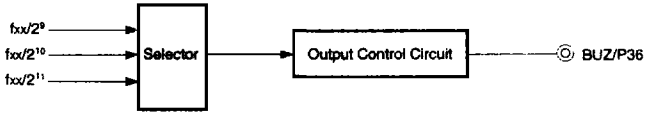


5.5 BUZZER OUTPUT CONTROL CIRCUIT

Clocks of the following frequency can be output as buzzer outputs:

- 1.2 kHz/2.4 kHz/4.9 kHz/9.8 kHz (during 5.0 MHz operation using main system clock)

Figure 5-7. Buzzer Output Control Circuit Block Diagram



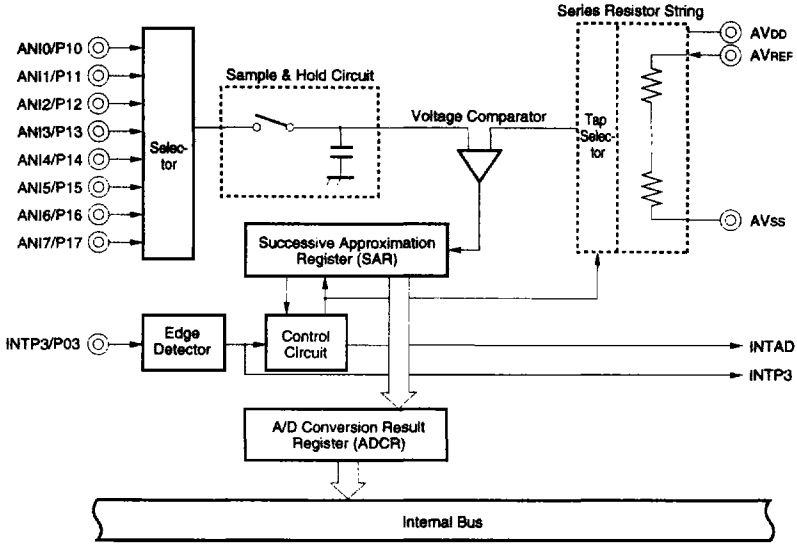
5.6 A/D CONVERTER

Eight 8-bit resolution A/D converter channels are incorporated.

The following two types of start-up method are available.

- Hardware start
- Software start

Figure 5-8. A/D Converter Block Diagram



5.7 SERIAL INTERFACE

Two clocked serial interface channels are incorporated:

- Serial interface channel 0
- Serial interface channel 2

Table 5-3. Serial Interface Channel Block Diagram

Function	Serial Interface Channel 0	Serial Interface Channel 2
3-wire serial I/O mode	● (MSB/LSB-first switchable)	● (MSB/LSB-first switchable)
SBI (serial bus interface) mode	● (MSB-first)	—
2-wire serial I/O mode	● (MSB-first)	—
Asynchronous serial interface (UART) mode	—	● (Dedicated baud rate generator incorporated)

Figure 5-9. Serial Interface Channel 0 Block Diagram

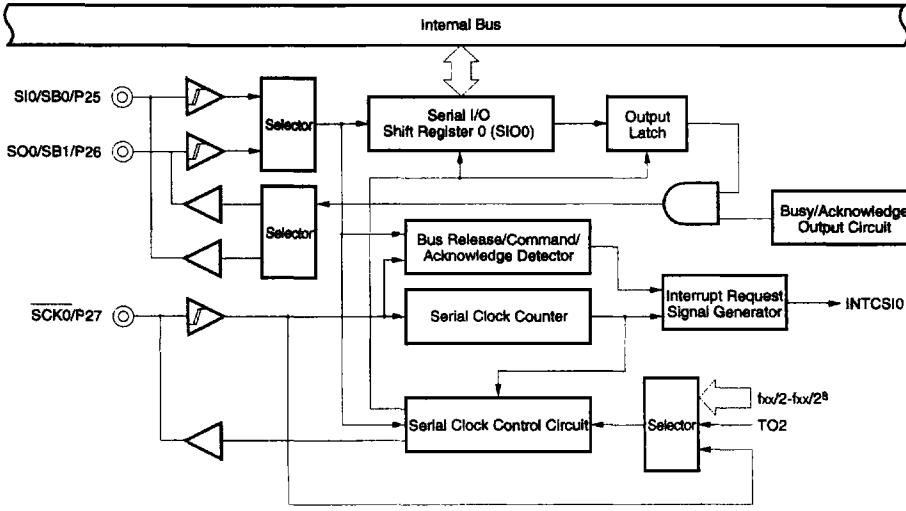
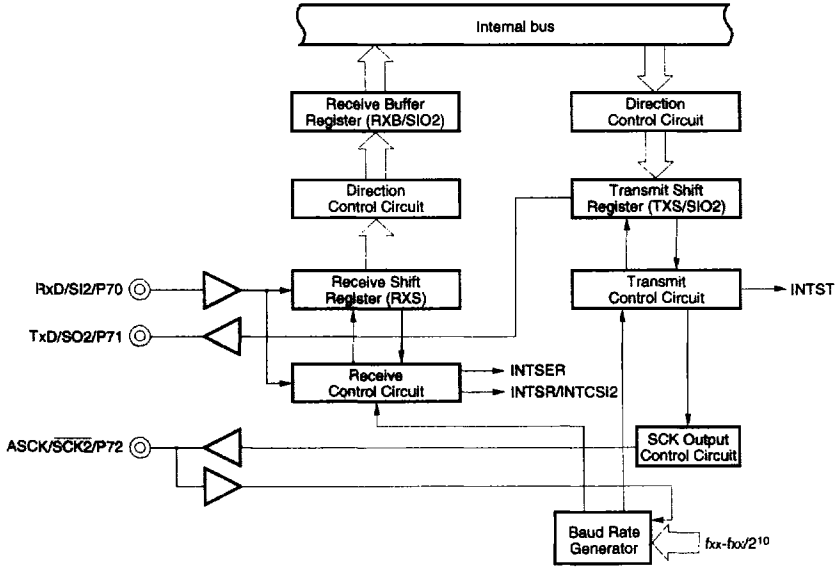


Figure 5-10. Serial Interface Channel 2 Block Diagram



5.8 LCD CONTROLLER/DRIVER

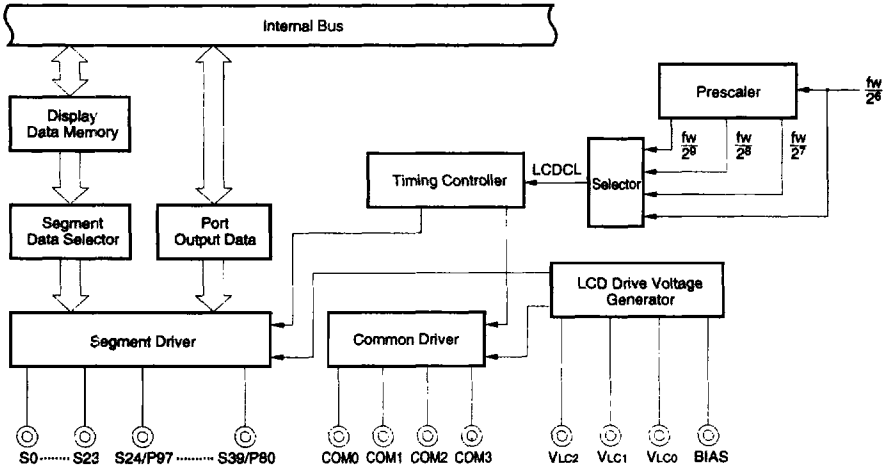
An LCD controller/driver with the following functions is incorporated.

- Selection of 5 types of display mode
- 16 of the segment signal of outputs can be switched to input/output ports in units of 2. (P80/S39 to P87/S32, P90/S31 to P97/S24)

Table 5-4. Display Mode Types and Maximum Number of Display Pixels

Bias Method	Time Multiplexing	Common Signal Used	Maximum Number of Display Pixels
—	Static	COM0 (COM1 to COM3)	40 (40 segments x 1 common)
1/2	2	COM0, COM1	80 (40 segments x 2 commons)
	3	COM0 to COM2	120 (40 segments x 3 commons)
1/3	3	COM0 to COM2	
	4	COM0 to COM3	160 (40 segments x 4 commons)

Figure 5-11. LCD Controller/Driver Block Diagram



6. INTERRUPT FUNCTIONS AND TEST FUNCTIONS

6.1 INTERRUPT FUNCTIONS

There are twenty interrupt functions of three different kinds, as shown below.

- Non-maskable interrupt : 1
- Maskable interrupts : 18
- Software interrupt : 1

Table 6-1. Interrupt Source List

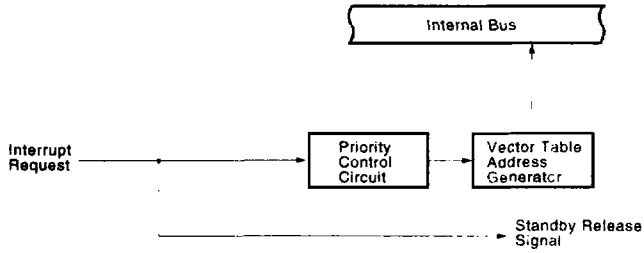
Interrupt Type	Default Priority Note 1	Interrupt Source		Internal/ External	Vector Table Address	Basic Configuration Type Note 2
		Name	Trigger			
Non-maskable	——	INTWDT	Watchdog timer overflow (with watchdog timer mode 1 selected)	Internal	0004H	(A)
Maskable	0	INTWDT	Watchdog timer overflow (with interval timer mode selected)			(B)
	1	INTP0	Pin input edge detection	External	0006H	(C)
	2	INTP1			0008H	(D)
	3	INTP2			000AH	
	4	INTP3			000CH	
	5	INTP4			000EH	
	6	INTP5			0010H	
	7	INTCSI0	Serial interface channel 0 transfer termination	Internal	0014H	(B)
	8	INTSER	Serial interface channel 2 UART reception error generation		0018H	
	9	INTSR	Serial interface channel 2 UART reception termination		001AH	
		INTCSI2	Serial interface channel 2 3-wire transfer termination			
	10	INTST	Serial interface channel 2 UART transmission termination		001CH	
	11	INTTM3	Reference time interval signal from watch timer		001EH	
	12	INTTM00	16-bit timer register and capture/compare register (CR00) match signal generation		0020H	
	13	INTTM01	16-bit timer register and capture/compare register (CR01) match signal generation		0022H	
	14	INTTM1	8-bit timer/event counter 1 match signal generation		0024H	
	15	INTTM2	8-bit timer/event counter 2 match signal generation		0026H	
	16	INTAD	A/D converter conversion termination		0028H	
Software	——	BRK	BRK instruction execution	Internal	003EH	(E)

Notes 1. Default priority is a priority order when more than one maskable interrupt is generated simultaneously. 0 is the highest priority and 16 the lowest priority.

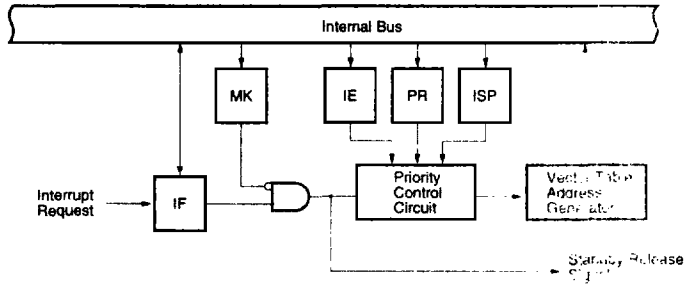
2. Basic configuration types (A) to (E) correspond to those shown on the next page.

Figure 6-1. Basic Configuration of Interrupt Functions (1/2)

(A) Internal non-maskable interrupt



(B) Internal maskable interrupt



(C) External maskable interrupt (INTP0)

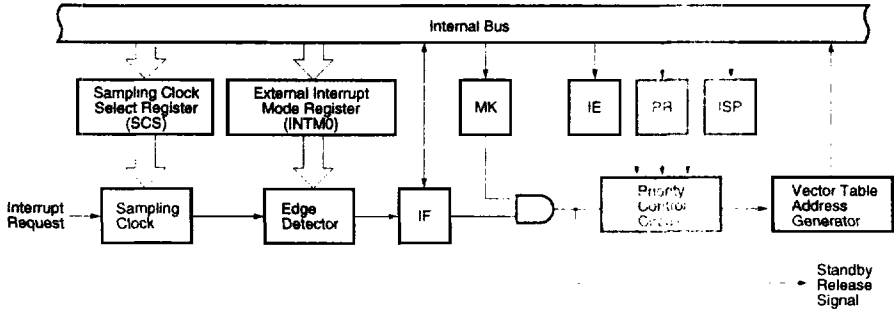
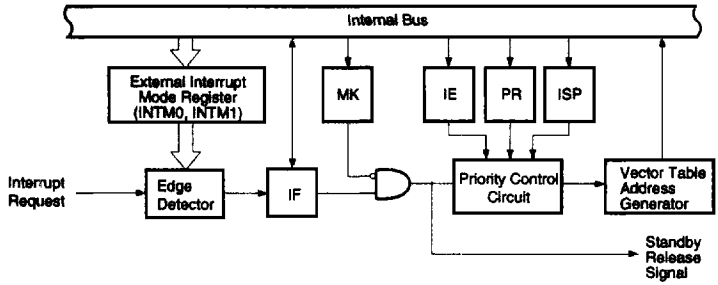
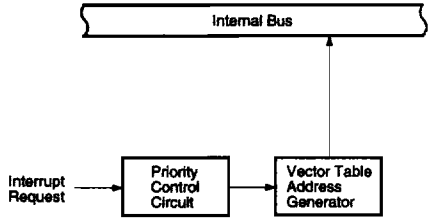


Figure 6-1. Basic Configuration of Interrupt Functions (2/2)

(D) External maskable interrupt (except INTPO)



(E) Software interrupt



IF : Interrupt request flag
IE : Interrupt enable flag
ISP : In-service priority flag
MK : Interrupt mask flag
PR : Priority specification flag

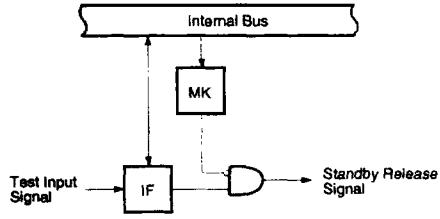
6.2 TEST FUNCTIONS

There are two test functions as shown in Table 6-2.

Table 6-2. Test Input Source List

Test Input Source		Internal/External
Name	Trigger	
INTWT	Watch timer overflow	Internal
INTPT11	Port 11 falling edge detection	External

Figure 6-2. Basic Configuration of Test Function



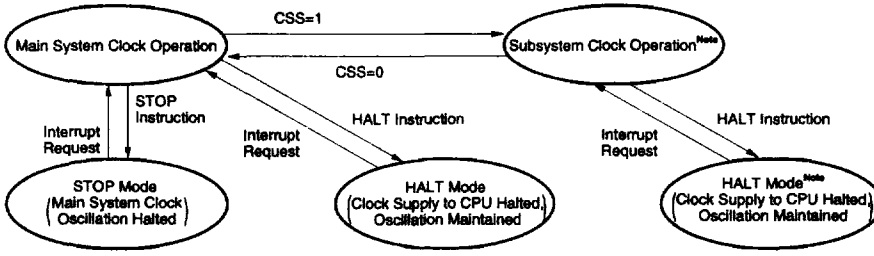
IF : Test input flag
MK : Test mask flag

7. STANDBY FUNCTION

The standby function is a function to reduce current consumption. The following two kinds of standby functions are provided.

- HALT mode : Halts CPU operating clock and can reduce average current consumption by the intermittent operation along with the normal operation.
- STOP mode : Halts main system clock oscillation. Halts all operations with the main system clock and sets ultra-low current consumption state with subsystem clock only.

Figure 7-1. Standby Function



Note Halting the main system clock enables the current consumption to be reduced.
When the CPU is operated by the subsystem clock, the main system clock should be halted by an MCC setting. The STOP instruction is not available.

Caution When the main system clock is stopped and the system is operated by the subsystem clock, the main system clock should be returned to after securing the oscillation stabilization time by a program.

8. RESET FUNCTION

There are the following two kinds of resetting methods.

- External reset by $\overline{\text{RESET}}$ pin.
- Internal reset by watchdog timer runaway time detection.

9. INSTRUCTION SET

(1) 8-bit instruction

MOV, XCH, ADD, ADDC, SUB, SUBS, AND, OR, XOR, CMP, MULU, DIVUW, INC, DEC, ROR, ROL, RORC, ROLC, ROR4, ROL4, PUSH, POP, DBNZ

2nd operand / 1st operand	#byte	A	r[Note]	sfr	saddr	!addr16	PSW	[DE]	[HL]	[HL+byte] [HL+B] [HL+C]	$addr16	1	None
A	ADD ADDC SUB SUBC AND OR XOR CMP		MOV XCH ADD ADDC SUB SUBC AND OR XOR CMP	MOV XCH	MOV XCH ADD ADDC SUB SUBC AND OR XOR CMP	MOV XCH ADD ADDC SUB SUBC AND OR XOR CMP	MOV	MOV XCH	MOV XCH ADD ADDC SUB SUBC AND OR XOR CMP	MOV XCH ADD ADDC SUB SUBC AND OR XOR CMP		ROR ROL RORC ROLC	
r	MOV	MOV ADD ADDC SUB SUBC AND OR XOR CMP											INC DEC
r1											DBNZ		
sfr	MOV	MOV											
saddr	MOV ADD ADDC SUB SUBC AND OR XOR CMP	MOV									DBNZ		INC DEC
!addr16		MOV											
PSW	MOV	MOV											PUSH POP
[DE]		MOV											
[HL]		MOV											ROR4 ROL4
[HL+byte] [HL+B] [HL+C]		MOV											
X													MULL
C													DIVUW

Note Except r = A

(2) 16-bit instruction

MOVW, XCHW, ADDW, SUBW, CMPW, PUSH, POP, INCW, DECW

2nd operand / 1st operand	#word	AX	rp[Note]	sfrp	saddrp	!addr16	SP	None
A	ADDW SUBW CMPW		MOVW XCHW	MOVW	MOVW	MOVW	MOVW	
rp	MOVW	MOVW[Note]						INCW, DECW PUSH, POP
sfrp	MOVW	MOVW						
saddrp	MOVW	MOVW						
!addr16		MOVW						
SP	MOVW	MOVW						

Note Only when rp = BC, DE, HL

(3) Bit manipulation instruction

MOV1, AND1, OR1, XOR1, SET1, CLR1, NOT1, BT, BF, BTCLR

2nd operand / 1st operand	A.bit	sfr.bit	saddr.bit	PSW.bits	[HL].bit	CY	$addr16	None
A.bit						MOV1	BT BF BTCLR	SET1 CLR1
sfr.bit						MOV1	BT BF BTCLR	SET1 CLR1
saddr.bit						MOV1	BT BF BTCLR	SET1 CLR1
PSW.bit						MOV1	BT BF BTCLR	SET1 CLR1
[HL].bit						MOV1	BT BF BTCLR	SET1 CLR1
CY	MOV1 AND1 OR1 XOR1	MOV1 AND1 OR1 XOR1	MOV1 AND1 OR1 XOR1	MOV1 AND1 OR1 XOR1	MOV1 AND1 OR1 XOR1			SET1 CLR1 NOT1

(4) Call instruction/branch instruction

CALL, CALLF, CALLT, BR, BC, BNC, BZ, BNZ, BT, BF, BTCLR, DNZB

2nd Operand / 1st Operand	AX	!addr16	!addr11	[addr5]	$addr16
Basic instruction	BR	CALL BR	CALLF	CALLT	BR, BC, BNC, BZ, BNZ
Compound Instruction					BT, BF, BTCLR DBNZ

(5) Other instructions

ADJBA, ADJBS, BRK, RET, RETI, RETB, SEL, NOP, EI, DI, HALT, STOP

10. ELECTRICAL SPECIFICATIONS

ABSOLUTE MAXIMUM RATINGS (T_A = 25 °C)

Parameter	Symbol	Test Conditions			Rating	Unit
Supply voltage	V_{DD}				−0.3 to +7.0	V
	AV_{DD}				−0.3 to V_{DD} + 0.3	V
	AV_{REF}				−0.3 to V_{DD} + 0.3	V
	AV_{SS}				−0.3 to +0.3	V
Input voltage	V_I				−0.3 to V_{DD} + 0.3	V
Output voltage	V_O				−0.3 to V_{DD} + 0.3	V
Analog input voltage	V_{AN}	P10 to P17	Analog input pin		AV_{SS} − 0.3 to AV_{REF} + 0.3	V
Output current, high	I_{OH}	Per pin			−10	mA
		Total for P00 to P05, P07, P10 to P17, P100, P101 & P110 to P117			−15	mA
		Total for P25 to P27, P30 to P37, P70 to P72, P80 to P87, P90 to P97, P102 & P103			−15	mA
Output current, low	I_{OL} Note	Per pin		Peak value	30	mA
				R.m.s. value	15	mA
		Total for P00 to P05, P10 to P17, P100, P101 & P110 to P117		Peak value	100	mA
				R.m.s. value	70	mA
		Total for P30 to P37, P102 & P103		Peak value	100	mA
				R.m.s. value	70	mA
		Total for P25 to P27, P70 to P77, P80 to P87 & P90 to P97		Peak value	50	mA
				R.m.s. value	20	mA
Operating ambient temperature	T_A				−40 to +85	°C
Storage temperature	T_{stg}				−65 to +150	°C

Note The r.m.s. value should be calculated as follows: [R.m.s. value] = [Peak value] x $\sqrt{\text{Duty}}$

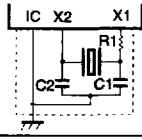
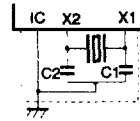
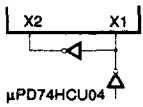
Caution The product quality may be damaged even if a value of only one of the above parameters exceeds the absolute maximum rating or any value exceeds the absolute maximum rating for an instant. That is, the absolute maximum rating is a rating value which may cause a product to be damaged physically. The absolute maximum rating values must therefore be observed when using the product.

CAPACITANCE (T_A = 25 °C, V_{DD} = V_{SS} = 0 V)

Parameter	Symbol	Test Conditions	MIN.	TYP.	MAX.	Unit
Input capacitance	C_{IN}	f = 1 MHz unmeasured pins returned to 0 V.			15	pF
Output capacitance	C_{OUT}				15	pF
I/O capacitance	C_{IO}				15	pF

Remark Unless specified otherwise, the characteristics of dual-function pins are the same as those of port pins.

MAIN SYSTEM CLOCK OSCILLATOR CHARACTERISTICS (T_A = −40 to +85 °C, V_{DD} = 2.0 to 6.0 V)

Resonator	Recommended circuit	Parameter	Test conditions	MIN.	TYP.	MAX.	Unit
Ceramic resonator		Oscillator frequency (fx) Note 1	V_{DD} = Oscillator voltage range	1		5	MHz
		Oscillation stabilization time Note 2	After V_{DD} reaches oscillator voltage range MIN.			4	ms
Crystal resonator		Oscillator frequency (fx) Note 1		1		5	MHz
		Oscillation stabilization time Note 2	V_{DD} = 4.5 to 6.0 V			10	ms
						30	
External clock		X1 input frequency (fx) Note 1		1.0		5.0	MHz
		X1 input high/low level width (t_{XH}, t_{XL})		85		500	ns

Notes 1. Indicates only oscillator characteristics. Refer to "AC Characteristics" for instruction execution time.

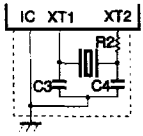
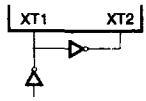
2. Time required to stabilize oscillation after reset or STOP mode release.

Cautions 1. When using the main system clock oscillator, wiring in the area enclosed with the dotted line should be carried out as follows to avoid an adverse effect from wiring capacitance.

- **Wiring should be as short as possible.**
- **Wiring should not cross other signal lines.**
- **Wiring should not be placed close to a varying high current.**
- **The potential of the oscillator capacitor ground should be the same as Vss.**
- **Do not ground it to the ground pattern in which a high current flows.**
- **Do not fetch a signal from the oscillator.**

2. If the main system clock oscillator is operated by the subsystem clock when the main system clock is stopped, reswitching to the main system clock should be performed after the stable oscillation time has been obtained by the program.

SUBSYSTEM CLOCK OSCILLATOR CHARACTERISTICS (T_A = −40 to +85°C, V_{DD} = 2.0 to 6.0 V)

Resonator	Recommended Circuit	Parameter	Test Conditions	MIN.	TYP.	MAX.	Unit
Crystal resonator		Oscillator frequency (f_{XT}) Note 1		32	32.768	35	kHz
		Oscillation stabilization time Note 2	V_{DD} = 4.5 to 6.0 V		1.2	2	s
						10	
External clock		XT1 input frequency (f_{XT}) Note 1		32		100	kHz
		XT1 input high-/low-level width (t_{XH}/t_{XL})		5		15	μs

Notes 1. Indicates only oscillator characteristics. Refer to "AC Characteristics" for instruction execution time.

2. Time required to stabilize oscillation after V_{DD} has reached the minimum oscillation voltage range.

Cautions 1. When using the subsystem clock oscillator, wiring in the area enclosed with the dotted line should be carried out as follows to avoid an adverse effect from wiring capacitance.

- **Wiring should be as short as possible.**
- **Wiring should not cross other signal lines.**
- **Wiring should not be placed close to a varying high current.**
- **The potential of the oscillator capacitor ground should be the same as V_{SS}.**
- **Do not ground it to the ground pattern in which a high current flows.**
- **Do not fetch a signal from the oscillator.**

2. The subsystem clock oscillator is designed as a low amplification circuit to provide low consumption current, causing misoperation by noise more frequently than the main system clock oscillation circuit. Special care should therefore be taken about the wiring method when the subsystem clock is used.

RECOMMENDED OSCILLATOR CONSTANT

MAIN SYSTEM CLOCK: CERAMIC OSCILLATOR (T_A = –40 to +85 °C)

Manufacturer	Part Number	Frequency (MHz)	Recommended Circuit Constant		Oscillator Voltage Range		Remarks
			C1 (pF)	C2 (pF)	MIN. (V)	MAX. (V)	
Murata Mfg. Co., Ltd.	CSA5.00MG	5.00	30	30	2.2	6.0	
	CST5.00MGW	5.00	Built-in	Built-in	2.7	6.0	
Matsushita Electronics Components Co., Ltd.	EF0GC5004A4	5.00	Built-in	Built-in	2.7	6.0	Lead type
	EF0EC5004A4	5.00	Built-in	Built-in	2.0	6.0	Round lead type
	EF0EN5004A4	5.00	33	33	2.7	6.0	Lead type
	EF0S5004B5	5.00	Built-in	Built-in	2.7	6.0	Chip type
Kyocera Corporation	KBR-5.0MSA	5.00	33	33	2.7	6.0	Lead type
	PBRC5.00A	5.00	33	33	2.7	6.0	Chip type
	KBR-5.0MKS	5.00	Built-in	Built-in	2.7	6.0	Lead type
	KBR-5.0MWS	5.00	Built-in	Built-in	2.7	6.0	Chip type

SUBSYSTEM CLOCK: CRYSTAL RESONATOR (T_A = –40 to +60 °C)

Manufacturer	Part Number	Frequency (kHz)	Recommended Circuit Constant			Oscillator Voltage Range	
			C1 (pF)	C2 (pF)	R2 (kΩ)	MIN. (V)	MAX. (V)
Kyocera Corporation	KF-38G-12P0200 (Load capacitance 12 pF)	32.768	15	22	220	2.0	6.0

Caution The operation of the oscillator constants is guaranteed, but not their reliability. If you require higher reliability, contact the oscillator manufacturer directly.

DC CHARACTERISTICS (T_A = −40 to +85 °C, V_{DD} = 2.0 to 6.0 V)

Parameter	Symbol	Test Conditions		MIN.	TYP.	MAX.	Unit
Input voltage, high	V_{IH1}	P10 to P17, P30 to P32, P35 to P37, P80 to P87, P90 to P97, P100 to P103	V_{DD} = 2.7 to 6.0 V	0.7V_{DD}		V_{DD}	V
				0.8V_{DD}		V_{DD}	V
	V_{IH2}	P00 to P05, P25 to P27, P33, P34, P70 to P72, P110 to P117, $\overline{RESET}$	V_{DD} = 2.7 to 6.0 V	0.8V_{DD}		V_{DD}	V
				0.85V_{DD}		V_{DD}	V
	V_{IH3}	X1, X2	V_{DD} = 2.7 to 6.0 V	V_{DD} − 0.5		V_{DD}	V
				V_{DD} − 0.2		V_{DD}	V
	V_{IH4}	XT1/P07, XT2	4.5 V ≤ V_{DD} ≤ 6.0 V	0.8V_{DD}		V_{DD}	V
			2.7 V ≤ V_{DD} < 4.5 V	0.9V_{DD}		V_{DD}	V
			2.0 V ≤ V_{DD} < 2.7 V[Note]	0.9V_{DD}		V_{DD}	V
Input voltage, low	V_{IL1}	P10 to P17, P30 to P32, P35 to P37, P80 to P87, P90 to P97, P100 to P103	V_{DD} = 2.7 to 6.0 V	0		0.3V_{DD}	V
				0		0.2V_{DD}	V
	V_{IL2}	P00 to P05, P25 to P27, P33, P34, P70 to P72, P110 to P117, $\overline{RESET}$	V_{DD} = 2.7 to 6.0 V	0		0.2V_{DD}	V
				0		0.15V_{DD}	V
	V_{IL3}	X1, X2	V_{DD} = 2.7 to 6.0 V	0		0.4	V
				0		0.2	V
	V_{IL4}	XT1/P07, XT2	4.5 V ≤ V_{DD} ≤ 6.0 V	0		0.2V_{DD}	V
			2.7 V ≤ V_{DD} < 4.5 V	0		0.1V_{DD}	V
			2.0 V ≤ V_{DD} < 2.7 V[Note]	0		0.1V_{DD}	V
Output voltage, high	V_{OH}	V_{DD} = 4.5 to 6.0 V, I_{OH} = −1 mA		V_{DD} − 1.0		V_{DD}	V
		I_{OH} = −100 μA		V_{DD} − 0.5		V_{DD}	V
Output voltage, low	V_{OL1}	P100 to P103	V_{DD} = 4.5 to 6.0 V, I_{OL} = 15 mA		0.4	2.0	V
		P00 to P05, P10 to P17, P25 to P27, P30 to P37, P70 to P72, P80 to P87, P90 to P97, P110 to P117	V_{DD} = 4.5 to 6.0 V, I_{OL} = 1.6 mA			0.4	V
	V_{OL2}	SB0, SB1, $\overline{SCK0}$	V_{DD} = 4.5 to 6.0 V, open-drain, pull-up (R = 1 kΩ)			0.2V_{DD}	V
	V_{OL3}	I_{OL} = 400 μA				0.5	V

Note When P07/XT1 is used as P07, the inverse phase of P07 should be input to XT2.

Remark Unless specified otherwise, the characteristics of dual-function pins are the same as those of port pins.

DC CHARACTERISTICS (T_A = −40 to +85 °C, V_{DD} = 2.0 to 6.0 V)

Parameter	Symbol	Test Conditions		MIN.	TYP.	MAX.	Unit
Input leakage current, high	I_{LIH1}	$V_I = V_{DD}$	P00 to P05, P10 to P17, P25 to P27, P30 to P37, P70 to P72, P80 to P87, P90 to P97, P100 to P103, P110 to P117			3	μA
	I_{LIH2}		X1, X2, XT1/P07, XT2			20	μA
Input leakage current, low	I_{LIL1}	V_I = 0 V	P00 to P05, P10 to P17, P25 to P27, P30 to P37, P70 to P72, P80 to P87, P90 to P97, P100 to P103, P110 to P117			−3	μA
	I_{LIH2}		X1, X2, XT1/P07, XT2			−20	μA
Output leakage current, high	I_{LOH}	$V_O = V_{DD}$				3	μA
Output leakage current, low	I_{LOL}	V_O = 0 V				−3	μA
Software pull-up resistor	R	V_I = 0 V, P01 to P05, P10 to P17, P25 to P27, P30 to P37, P70 to P72, P80 to P87, P90 to P97, P100 to P103, P110 to P117	4.5 V ≤ V_{DD} ≤ 6.0 V	15	40	90	kΩ
			2.7 V ≤ V_{DD} < 4.5 V	20		500	kΩ
Supply current[Note 1]	I_{DD1}	5.00 MHz, Crystal oscillation (f_{XX} = 2.5 MHz)[Note 2] operating mode	V_{DD} = 5.0 V ± 10 %[Note 4]		4	12	mA
			V_{DD} = 3.0 V ± 10 %[Note 5]		0.6	1.8	mA
			V_{DD} = 2.2 V ± 10 %[Note 5]		0.35	1.05	mA
		5.00 MHz, Crystal oscillation (f_{XX} = 5.0 MHz)[Note 3] operating mode	V_{DD} = 5.0 V ± 10 %[Note 4]		6.5	19.5	mA
			V_{DD} = 3.0 V ± 10 %[Note 5]		0.8	2.4	mA
	I_{DD2}	5.00 MHz, Crystal oscillation (f_{XX} = 2.5 MHz)[Note 2] HALT mode	V_{DD} = 5.0 V ± 10 %		1.4	4.2	mA
			V_{DD} = 3.0 V ± 10 %		500	1500	μA
			V_{DD} = 2.2 V ± 10 %		280	840	μA
		5.00 MHz, Crystal oscillation (f_{XX} = 5.0 MHz)[Note 3] HALT mode	V_{DD} = 5.0 V ± 10 %		1.6	4.8	mA
			V_{DD} = 3.0 V ± 10 %		650	1950	μA

Notes 1. Not including currents flowing in on-chip pull-up resistors or LCD split resistors.
2. Main system clock f_{XX} = f_X/2 operation (when oscillation mode selection register is set to 00H)
3. Main system clock f_{XX} = f_X operation (when oscillation mode selection register is set to 01H)
4. High-speed mode operation (when processor clock control register is set to 00H)
5. Low-speed mode operation (when processor clock control register is set to 04H)

Remark Unless specified otherwise, the characteristics of dual-function pins are the same as those of port pins.

DC CHARACTERISTICS (T_A = −40 to +85 °C, V_{DD} = 2.0 to 6.0 V)

Parameter	Symbol	Test Conditions		MIN.	TYP.	MAX.	Unit
Supply current[Note 1]	I_{DD3}	32.768 kHz, Crystal oscillation operating mode[Note 2]	V_{DD} = 5.0 V ± 10 %		60	120	μA
			V_{DD} = 3.0 V ± 10 %		32	64	μA
			V_{DD} = 2.2 V ± 10 %		24	48	μA
	I_{DD4}	32.768 kHz, Crystal oscillation HALT mode[Note 2]	V_{DD} = 5.0 V ± 10 %		25	55	μA
			V_{DD} = 3.0 V ± 10 %		5	15	μA
			V_{DD} = 2.2 V ± 10 %		2.5	12.5	μA
	I_{DD5}	XT1 = 0 V STOP mode When feedback resistor is connected	V_{DD} = 5.0 V ± 10 %			30	μA
			V_{DD} = 3.0 V ± 10 %		0.5	10	μA
			V_{DD} = 2.2 V ± 10 %		0.3	10	μA
	I_{DD6}	XT1 = 0 V STOP mode When feedback resistor is disconnected	V_{DD} = 5.0 V ± 10 %		0.1	30	μA
			V_{DD} = 3.0 V ± 10 %		0.05	10	μA
			V_{DD} = 2.2 V ± 10 %		0.05	10	μA

Notes 1. Not including currents flowing in on-chip pull-up resistors or LCD split resistors

2. When the main system clock is stopped.

DC CHARACTERISTICS (T_A = −10 to +85 °C)

(1) Static Display Mode (V_{DD} = 2.0 to 6.0 V)

Parameter	Symbol	Test Conditions		MIN.	TYP.	MAX.	Unit
LCD drive voltage	V_{LCD}			2.0		V_{DD}	V
LCD split resistor	R_{LCD}			60	100	150	kΩ
LCD output voltage deviation[Note] (common)	V_{ODC}	I_O = ±5 μA	2.0 V ≤ V_{LCD} ≤ V_{DD} V_{LCD0} = V_{LCD}	0		±0.2	V
LCD output voltage deviation[Note] (segment)	V_{ODS}	I_O = ±1 μA		0		±0.2	V

Note The voltage deviation is the difference from the output voltage corresponding to the ideal value of the segment and common outputs (V_{LCDn}; n = 0, 1, 2).

(2) 1/3 Bias Method (V_{DD} = 2.5 to 6.0 V)

Parameter	Symbol	Test Conditions		MIN.	TYP.	MAX.	Unit
LCD drive voltage	V_{LCD}			2.5		V_{DD}	V
LCD split resistor	R_{LCD}			60	100	150	kΩ
LCD output voltage deviation[Note] (common)	V_{ODC}	I_O = ±5 μA	2.5 V ≤ V_{LCD} ≤ V_{DD} V_{LCD0} = V_{LCD}	0		±0.2	V
LCD output voltage deviation[Note] (segment)	V_{ODS}	I_O = ±1 μA	V_{LCD1} = V_{LCD} x 2/3 V_{LCD2} = V_{LCD} x 1/3	0		±0.2	V

Note The voltage deviation is the difference from the output voltage corresponding to the ideal value of the segment and common outputs (V_{LCDn}; n = 0, 1, 2).

(3) 1/2 Bias Method (V_{DD} = 2.7 to 6.0 V)

Parameter	Symbol	Test Conditions		MIN.	TYP.	MAX.	Unit
LCD drive voltage	V_{LCD}			2.7		V_{DD}	V
LCD split resistor	R_{LCD}			60	100	150	kΩ
LCD output voltage deviation[Note] (common)	V_{ODC}	I_O = ±5 μA	2.7 V ≤ V_{LCD} ≤ V_{DD} V_{LCD0} = V_{LCD}	0		±0.2	V
LCD output voltage deviation[Note] (segment)	V_{ODS}	I_O = ±1 μA	V_{LCD1} = V_{LCD} x 1/2 V_{LCD2} = V_{LCD1}	0		±0.2	V

Note The voltage deviation is the difference from the output voltage corresponding to the ideal value of the segment and common outputs (V_{LCDn}; n = 0, 1, 2).

AC CHARACTERISTICS (T_A = −40 to +85 °C, V_{DD} = 2.0 to 6.0 V)

(1) Basic Operation

Parameter	Symbol	Test Conditions		MIN.	TYP.	MAX.	Unit
Cycle time (Minimum instruction execution time)	T_{CY}	Operating on main system clock (f_{XX} = 2.5 MHz) Note 1	V_{DD} = 2.7 to 6.0 V	0.8		64	μs
				2.2		64	μs
		Operating on main system clock (f_{XX} = 5.0 MHz) Note 2	4.5 ≤ V_{DD} ≤ 6.0 V	0.4		32	μs
			2.7 ≤ V_{DD} < 4.5 V	0.8		32	μs
		Operating on subsystem clock		40 Note 3	122	125	μs
TI1, 2 input frequency	f_{TI}	V_{DD} = 4.5 to 6.0 V		0		4	MHz
				0		275	kHz
TI1, 2 input high/low-level width	t_{TIH}, t_{TIL}	V_{DD} = 4.5 to 6.0 V		100			ns
				1.8			μs
Interrupt input high/low-level width	t_{INTH}, t_{INTL}	INTP0		8/f_{sam} Note 4			μs
		INTP1 to INTP5, P110 to P117	V_{DD} = 2.7 to 6.0 V	10			μs
				20			μs
$\overline{RESET}$ low-level width	t_{RSL}	V_{DD} = 2.7 to 6.0 V		10			μs
				20			μs

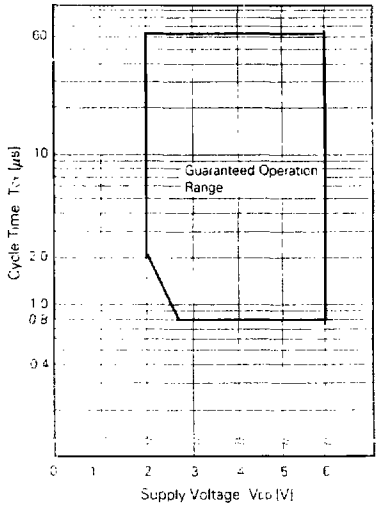
Notes 1. Main system clock f_{XX} = f_X/2 operation (when oscillation mode selection register is set to 00H)

2. Main system clock f_{XX} = f_X operation (when oscillation mode selection register is set to 01H)

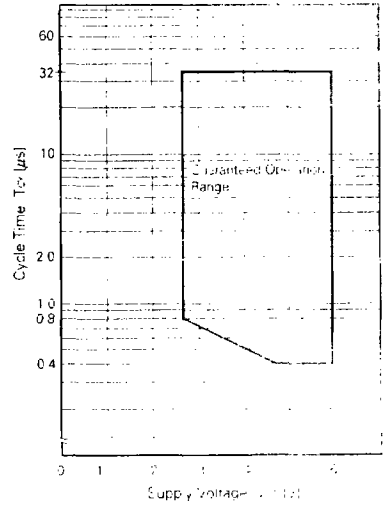
3. This is the value when the external clock is used. The value is 114 μs (min.) when the crystal resonator is used.

4. In combination with bits 0 (SCS0) and 1 (SCS1) of sampling clock select register, selection of f_{sam} is possible between $f_{XX}/2^N$, $f_{XX}/32$, $f_{XX}/64$ and $f_{XX}/128$ (when N = 0 to 4).

T_{CY} vs V_{DD} (At main system clock f_{XX} = f_X/2 operation)



T_{CY} vs V_{DD} (At main system clock f_{XX} = f_X operation)



(2) Serial Interface (T_A = −40 to +85 °C, V_{DD} = 2.0 to 6.0 V)

(a) Serial interface channel 0

(i) 3-wire serial I/O mode ($\overline{SCK0}$... Internal clock output)

Parameter	Symbol	Test Conditions	MIN.	TYP.	MAX.	Unit
$\overline{SCK0}$ cycle time	t_{KCY1}	4.5 V ≤ V_{DD} ≤ 6.0 V	800			ns
		2.7 V ≤ V_{DD} < 4.5 V	1600			ns
			3200			ns
$\overline{SCK0}$ high/low-level width	t_{KH1}, t_{KL1}	V_{DD} = 4.5 to 6.0 V	$t_{KCY1}/2 - 50$			ns
			$t_{KCY1}/2 - 100$			ns
SI0 setup time (to $\overline{SCK0}$↑)	t_{SIK1}	4.5 V ≤ V_{DD} ≤ 6.0 V	100			ns
		2.7 V ≤ V_{DD} < 4.5 V	150			ns
			300			ns
SI0 hold time (from $\overline{SCK0}$↑)	t_{KSI1}		400			ns
SO0 output delay time from $\overline{SCK0}$↓	t_{KSO1}	C = 100 pF[Note]			300	ns

Note C is the load capacitance of $\overline{SCK0}$, SO0 output line.

(ii) 3-wire serial I/O mode ($\overline{SCK0}$...External clock input)

Parameter	Symbol	Test Conditions	MIN.	TYP.	MAX.	Unit
$\overline{SCK0}$ cycle time	t_{KCY2}	4.5 V ≤ V_{DD} ≤ 6.0 V	800			ns
		2.7 V ≤ V_{DD} < 4.5 V	1600			ns
			3200			ns
$\overline{SCK0}$ high/low-level width	t_{KH2}, t_{KL2}	4.5 V ≤ V_{DD} ≤ 6.0 V	400			ns
		2.7 V ≤ V_{DD} < 4.5 V	800			ns
			1600			ns
SI0 setup time (to $\overline{SCK0}$↑)	t_{SIK2}		100			ns
SI0 hold time (from $\overline{SCK0}$↑)	t_{KSI2}		400			ns
SO0 output delay time from $\overline{SCK0}$↓	t_{KSO2}	C = 100 pF[Note]			300	ns
$\overline{SCK0}$ rise, fall time	t_{R2}, t_{F2}				1000	ns

Note C is the load capacitance of SO0 output line.

(iii) SBI mode ($\overline{SCK0}$...Internal clock output)

Parameter	Symbol	Test Conditions		MIN.	TYP.	MAX.	Unit
$\overline{SCK0}$ cycle time	t_{KCY3}	V_{DD} = 4.5 to 6.0 V		800			ns
				3200			ns
$\overline{SCK0}$ high/low-level width	t_{KH3}, t_{KL3}	V_{DD} = 4.5 to 6.0 V		$t_{KCY3}/2 - 50$			ns
				$t_{KCY3}/2 - 150$			ns
SB0, SB1 setup time (to $\overline{SCK0}$↑)	t_{SIK3}	V_{DD} = 4.5 to 6.0 V		100			ns
				300			ns
SB0, SB1 hold time (from $\overline{SCK0}$↑)	t_{KSI3}			$t_{KCY3}/2$			ns
SB0, SB1 output delay time from $\overline{SCK0}$↓	t_{KSO3}	R = 1 kΩ, C = 100 pF[Note]	V_{DD} = 4.5 to 6.0 V	0		250	ns
				0		1000	ns
SB0, SB1↓ from $\overline{SCK0}$↑	t_{KSB}			t_{KCY3}			ns
$\overline{SCK0}$↓ from SB0, SB1↓	t_{SBK}			t_{KCY3}			ns
SB0, SB1 high-level width	t_{SBH}			t_{KCY3}			ns
SB0, SB1 low-level width	t_{SBL}			t_{KCY3}			ns

Note R and C are the load resistance and load capacitance of the $\overline{SCK0}$, SB0 and SB1 output line.

(iv) SBI mode ($\overline{SCK0}$...External clock input)

Parameter	Symbol	Test Conditions		MIN.	TYP.	MAX.	Unit
$\overline{SCK0}$ cycle time	t_{KCY4}	V_{DD} = 4.5 to 6.0 V		800			ns
				3200			ns
$\overline{SCK0}$ high/low-level width	t_{KH4}, t_{KL4}	V_{DD} = 4.5 to 6.0 V		400			ns
				1600			ns
SB0, SB1 setup time (to $\overline{SCK0}$↑)	t_{SIK4}	V_{DD} = 4.5 to 6.0 V		100			ns
				300			ns
SB0, SB1 hold time (from $\overline{SCK0}$↑)	t_{KSI4}			$t_{KCY4}/2$			ns
SB0, SB1 output delay time from $\overline{SCK0}$↓	t_{KSO4}	R = 1 kΩ, C = 100 pF[Note]	V_{DD} = 4.5 to 6.0 V	0		300	ns
				0		1000	ns
SB0, SB1↓ from $\overline{SCK0}$↑	t_{KSB}			t_{KCY4}			ns
$\overline{SCK0}$↓ from SB0, SB1↓	t_{SBK}			t_{KCY4}			ns
SB0, SB1 high-level width	t_{SBH}			t_{KCY4}			ns
SB0, SB1 low-level width	t_{SBL}			t_{KCY4}			ns
$\overline{SCK0}$ rise, fall time	t_{R4}, t_{F4}					1000	ns

Note *R and C are the load resistance and load capacitance of the SB0 and SB1 output line.*

(v) 2-wire serial I/O mode ($\overline{SCK0}$... Internal clock output)

Parameter	Symbol	Test Conditions		MIN.	TYP.	MAX.	Unit
$\overline{SCK0}$ cycle time	t_{KCY5}	R = 1 kW, C = 100 pF[Note]	V_{DD} = 2.7 to 6.0 V	1600			ns
				3200			ns
$\overline{SCK0}$ high-level width	t_{KH5}		V_{DD} = 2.7 to 6.0 V	$t_{KCY5}/2 - 160$			ns
				$t_{KCY5}/2 - 190$			ns
$\overline{SCK0}$ low-level width	t_{KL5}		V_{DD} = 4.5 to 6.0 V	$t_{KCY5}/2 - 50$			ns
				$t_{KCY5}/2 - 100$			ns
SB0, SB1 setup time (to $\overline{SCK0}$↑)	t_{SIK5}		4.5 V ≤ V_{DD} ≤ 6.0 V	300			ns
			2.7 V ≤ V_{DD} < 4.5 V	350			ns
				400			ns
SB0, SB1 hold time (from $\overline{SCK0}$↑)	t_{KSI5}			600			ns
SB0, SB1 output delay time from $\overline{SCK0}$↓	t_{KSO5}					300	ns

Note R and C are the load resistance and load capacitance of the $\overline{SCK0}$, SB0 and SB1 output lines.

(vi) 2-wire serial I/O mode ($\overline{SCK0}$... External clock input)

Parameter	Symbol	Test Conditions		MIN.	TYP.	MAX.	Unit
$\overline{SCK0}$ cycle time	t_{KCY6}	V_{DD} = 2.7 to 6.0 V		1600			ns
				3200			ns
$\overline{SCK0}$ high-level width	t_{KH6}	V_{DD} = 2.7 to 6.0 V		650			ns
				1300			ns
$\overline{SCK0}$ low-level width	t_{KL6}	V_{DD} = 2.7 to 6.0 V		800			ns
				1600			ns
SB0, SB1 setup time (to $\overline{SCK0}$↑)	t_{SIK6}			100			ns
SB0, SB1 hold time (from $\overline{SCK0}$↑)	t_{KSI6}			$t_{KCY6}/2$			ns
SB0, SB1 output delay time from $\overline{SCK0}$↓	t_{KSO6}	R = 1 kΩ, C = 100 pF[Note]	V_{DD} = 4.5 to 6.0 V	0		300	ns
				0		500	ns
$\overline{SCK0}$ rise, fall time	t_{R6}, t_{F6}					1000	ns

Note R and C are the load resistance and load capacitance of the SB0 and SB1 output lines.

(b) Serial interface channel 2

(i) 3-wire serial I/O mode ($\overline{SCK2}$... Internal clock output)

Parameter	Symbol	Test Conditions	MIN.	TYP.	MAX	Unit
$\overline{SCK2}$ cycle time	t_{KCY7}	4.5 V ≤ V_{DD} ≤ 6.0 V	800			ns
		2.7 V ≤ V_{DD} < 4.5 V	1600			ns
			3200			ns
$\overline{SCK2}$ high/low-level width	t_{KH7}, t_{KL7}	V_{DD} = 4.5 to 6.0 V	t_{KCY1}/2−50			ns
			t_{KCY1}/2−100			ns
SI2 setup time (to $\overline{SCK2}$↑)	t_{SIK7}	4.5 V ≤ V_{DD} ≤ 6.0 V	100			ns
		2.7 V ≤ V_{DD} < 4.5 V	150			ns
			300			ns
SI2 hold time (from $\overline{SCK2}$↑)	t_{KSI7}		400			ns
SO2 output delay time from $\overline{SCK2}$↓	t_{KSO7}	C = 100 pF[Note]			300	ns

Note C is the load capacitance of the $\overline{SCK2}$ and SO2 output lines.

(ii) 3-wire serial I/O mode ($\overline{SCK2}$...External clock input)

Parameter	Symbol	Test Conditions	MIN.	TYP	MAX.	Unit
$\overline{SCK2}$ cycle time	t_{KCY8}	4.5 V ≤ V_{DD} ≤ 6.0 V	800			ns
		2.7 V ≤ V_{DD} < 4.5 V	1600			ns
			3200			ns
$\overline{SCK2}$ high/low-level width	t_{KH8}, t_{KL8}	4.5 V ≤ V_{DD} ≤ 6.0 V	400			ns
		2.7 V ≤ V_{DD} < 4.5 V	800			ns
			1600			ns
SI2 setup time (to $\overline{SCK2}$↑)	t_{SIK8}		100			ns
SI2 hold time (from $\overline{SCK2}$↑)	t_{KSI8}		400			ns
SO2 output delay time from $\overline{SCK2}$↓	t_{KSO8}	C = 100 pF[Note]			300	ns
$\overline{SCK2}$ rise, fall time	t_{R8}, t_{F8}				1000	ns

Note C is the load capacitance of the SO2 output line.

(iii) UART mode (Dedicated baud rate generator output)

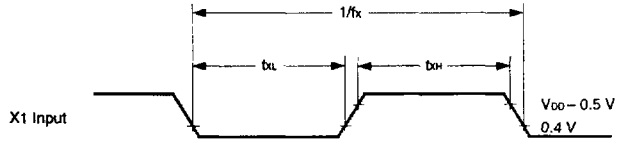
Parameter	Symbol	Test Conditions	MIN.	TYP.	MAX.	Unit
Transfer rate		4.5 V ≤ V_{DD} ≤ 6.0 V			78125	bps
		2.7 V ≤ V_{DD} < 4.5 V			39063	bps
					19531	bps

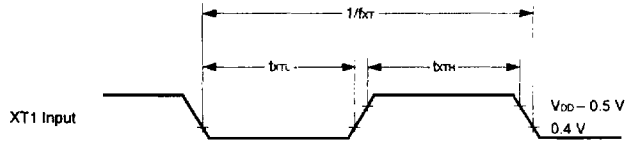
(iv) UART mode (External clock input)

Parameter	Symbol	Test Conditions	MIN.	TYP.	MAX.	Unit
ASCK cycle time	t_{KCY9}	4.5 V ≤ V_{DD} ≤ 6.0 V	800			ns
		2.7 V ≤ V_{DD} < 4.5 V	1600			ns
			3200			ns
ASCK high/low-level width	t_{KH9}, t_{KL9}	4.5 V ≤ V_{DD} ≤ 6.0 V	400			ns
		2.7 V ≤ V_{DD} < 4.5 V	800			ns
			1600			ns
Transfer rate		4.5 V ≤ V_{DD} ≤ 6.0 V			39063	bps
		2.7 V ≤ V_{DD} < 4.5 V			19531	bps
					9766	bps
ASCK rise, fall time	t_{R9}, t_{F9}				1000	ns

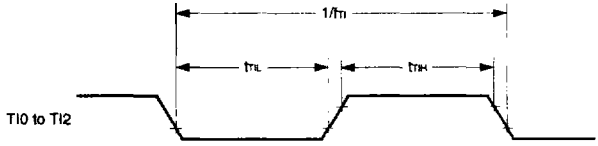
AC Timing Test Point (Excluding X1, XT1 Input)

Clock Timing



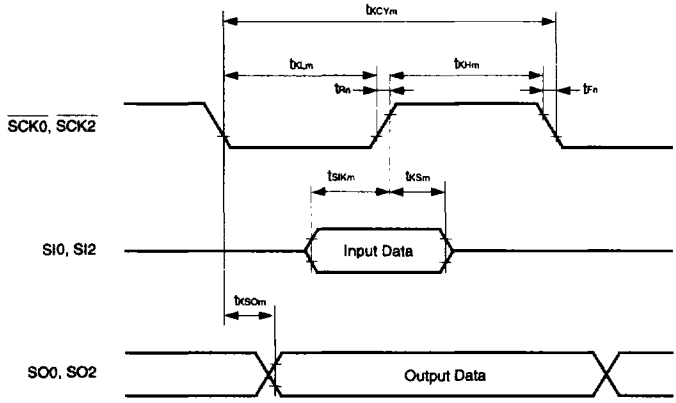


TI Timing



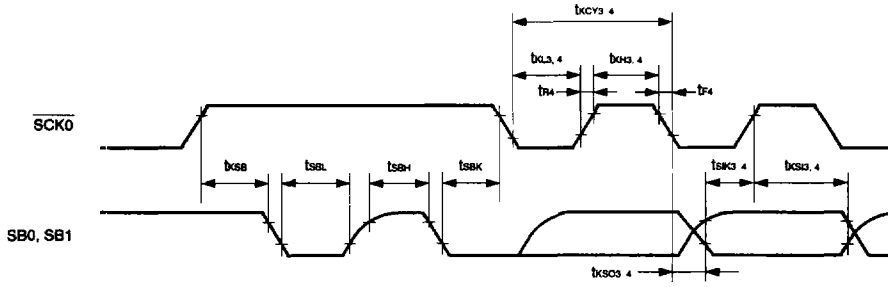
Serial Transfer Timing

3-wire serial I/O mode:

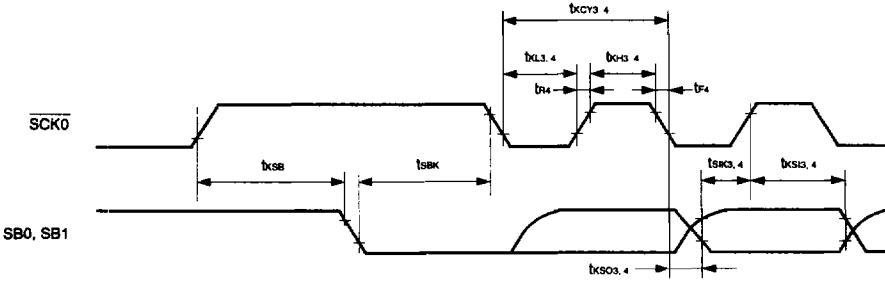


m = 1, 2, 7, 8
n = 2, 8

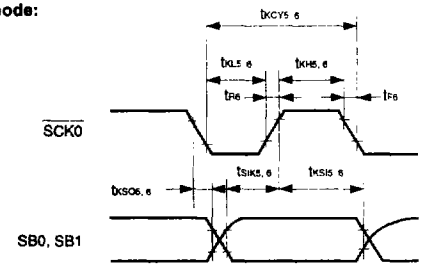
SBI mode (bus release signal transfer):



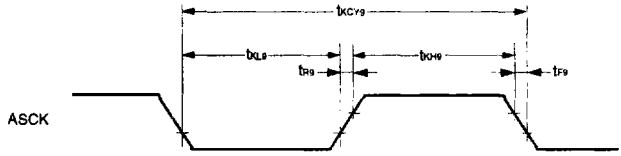
SBI mode (command signal transfer):



2-wire serial I/O mode:



UART mode:



***A/D Converter* (T_A = –40 to +85 °C, AV_{DD} = V_{DD} = 2.0 to 6.0 V, AV_{SS} = V_{SS} = 0 V)**

Parameter	Symbol	Test Conditions	MIN.	TYP.	MAX	Unit
Resolution			8	8	8	bit
Overall error [Note]		2.7 V ≤ AV_{REF} ≤ 6.0 V			±0.6	%
					±1.4	%
Conversion time	t_{CONV}		19.1		200	μs
Sampling time	t_{SAMP}		12/f_{XX}			μs
Analog input voltage	V_{IAN}		AV_{SS}		AV_{REF}	V
Reference voltage	AV_{REF}		2.0		AV_{DD}	V
AV_{REF}-AV_{SS} resistance	R_{AIREF}		4	14		kΩ

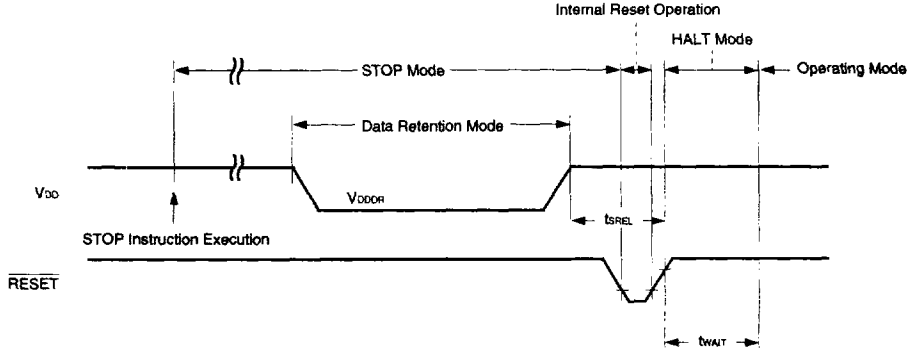
Note Quantization error (±1/2 LSB) is not included. This is expressed in proportion to the full-scale value.

DATA MEMORY STOP MODE LOW SUPPLY VOLTAGE DATA RETENTION CHARACTERISTICS (T_A = −40 to +85 °C)

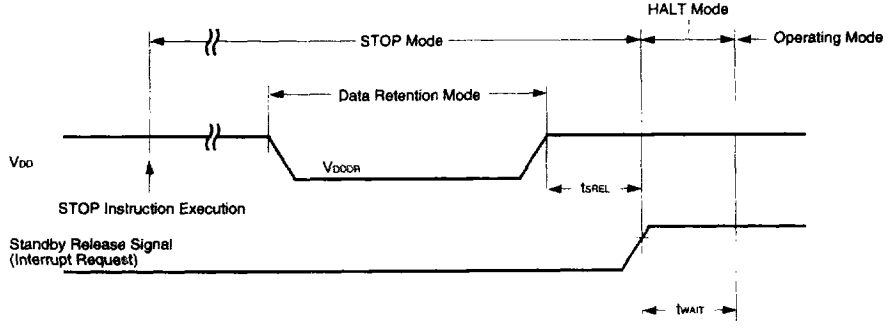
Parameter	Symbol	Test Conditions	MIN.	TYP.	MAX.	Unit
Data retention supply voltage	V_{DDDR}		1.8		6.0	V
Data retention supply current	I_{DDDR}	V_{DDDR} = 1.8 V Subsystem clock stopped and feed-back resistor disconnected		0.1	10	μA
Release signal set time	t_{SREL}		0			μs
Oscillation stabilization wait time	t_{WAIT}	Release by $\overline{RESET}$		$2^{17}/f_x$		ms
		Release by interrupt		**Note**		ms

Note In combination with bits 0 to 2 (OSTS0 to OSTS2) of oscillation stabilization time select register, selection of $2^{12}/f_{XX}$ and $2^{14}/f_{XX}$ to $2^{17}/f_{XX}$ is possible.

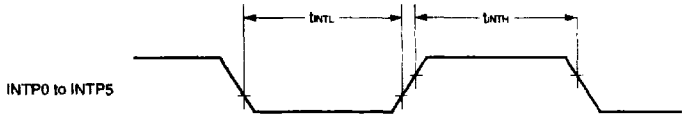
Data Retention Timing (STOP Mode Release by $\overline{RESET}$)



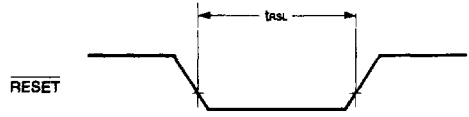
Data Retention Timing (STOP Mode Release by Standby Release Signal: Interrupt Signal)



Interrupt Input Timing

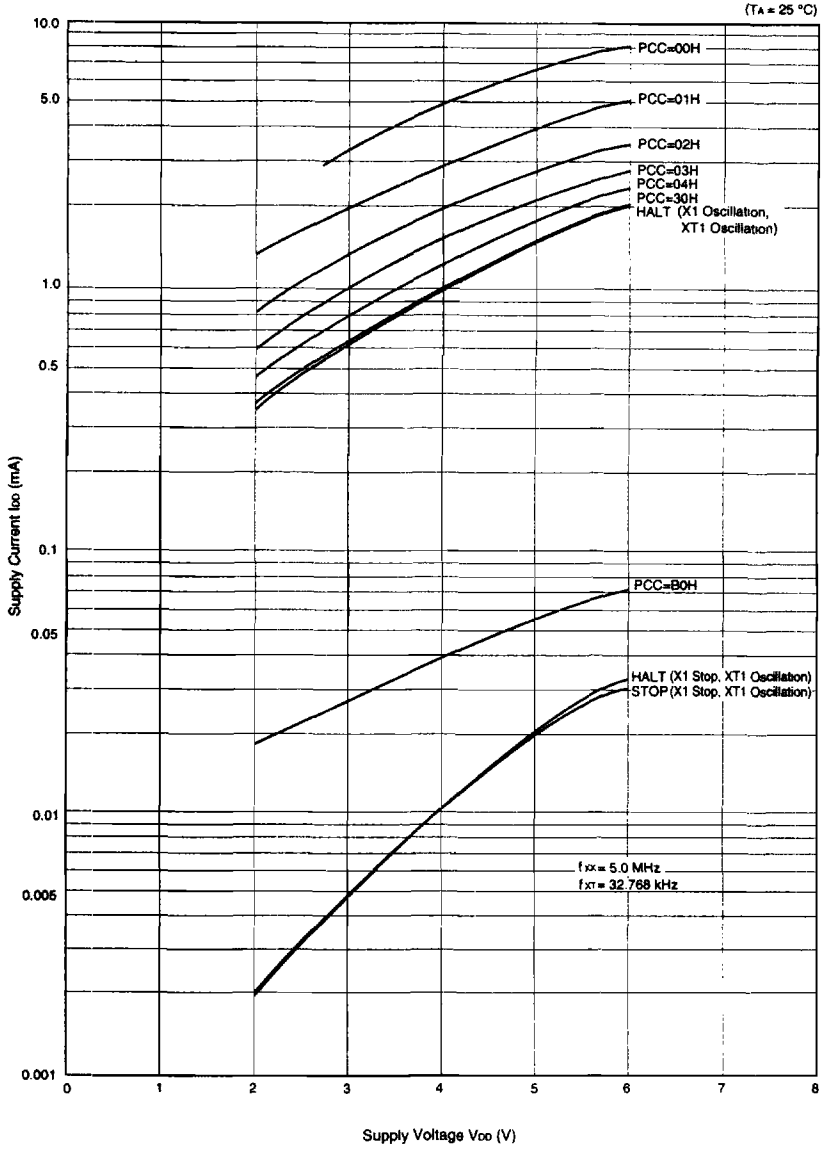


$\overline{\text{RESET}}$ Input Timing

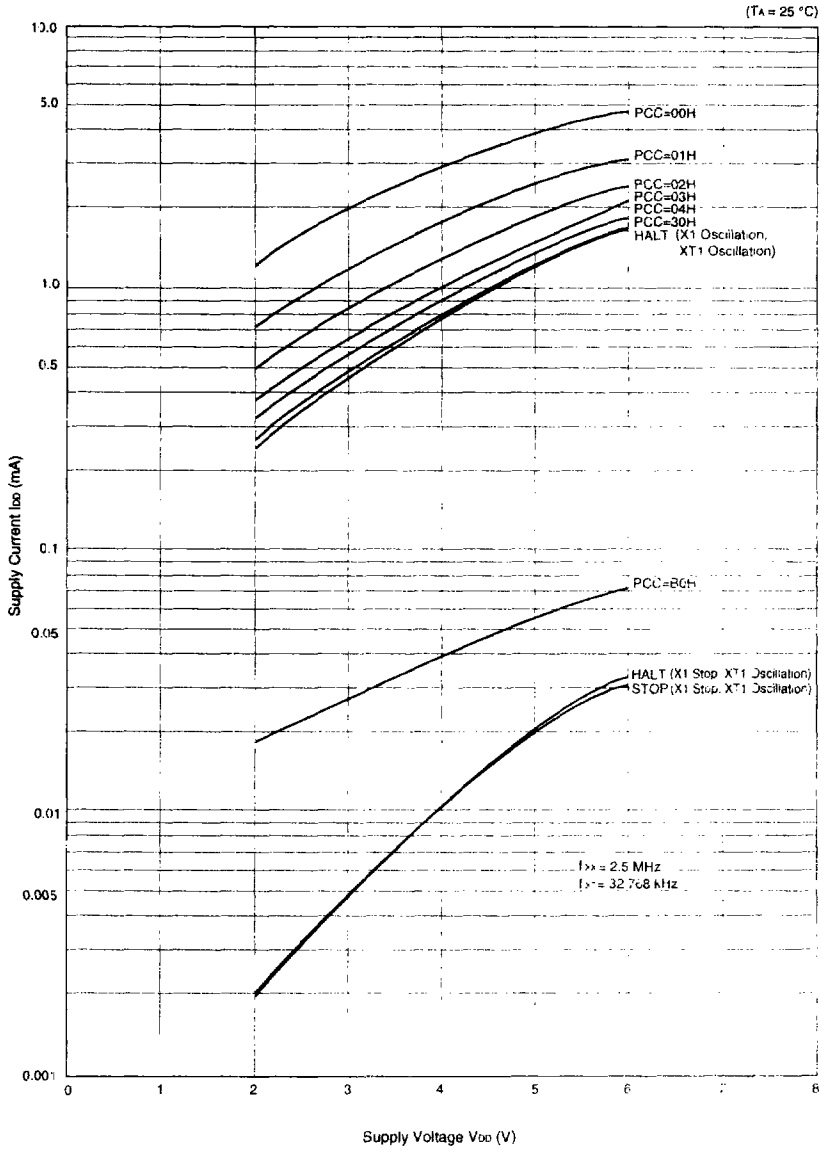


11. CHARACTERISTIC CURVES (REFERENCE VALUES)

I_{DD} vs V_{DD} (Main System Clock: 5.0 MHz)

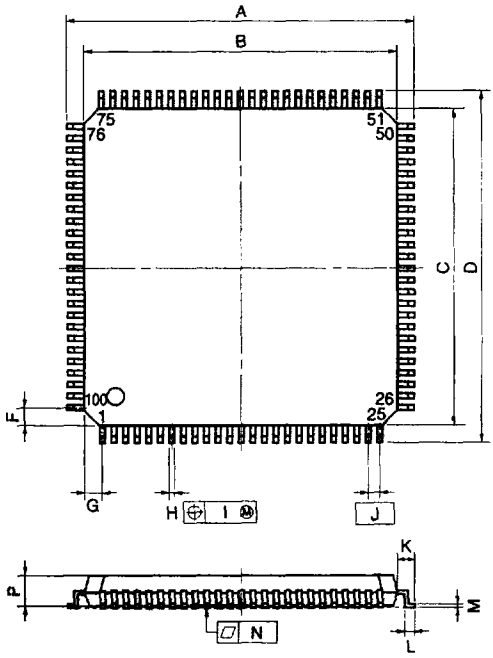


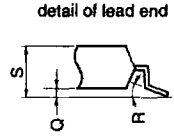
I_{DD} vs V_{DD} (Main System Clock: 2.5 MHz)



12. PACKAGE DRAWINGS

100 PIN PLASTIC QFP (FINE PITCH) (□14)





NOTE

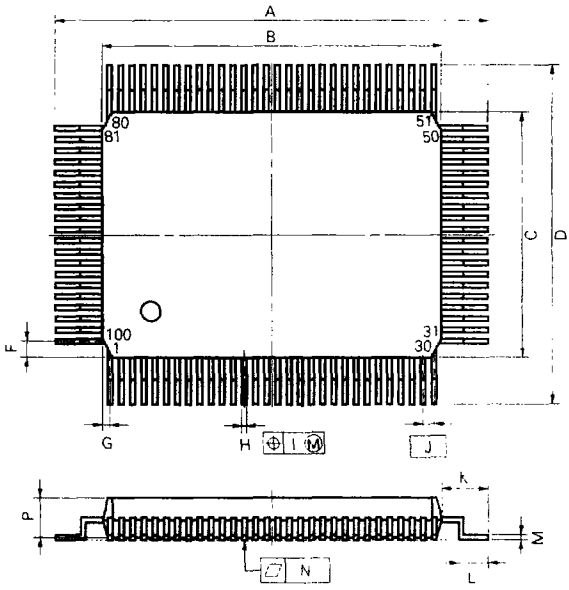
Each lead centerline is located within 0.10 mm (0.004 inch) of its true position (T.P.) at maximum material condition.

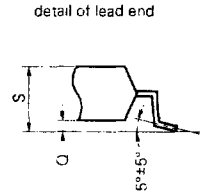
ITEM	MILLIMETERS	INCHES
A	16.0±0.2	0.630±0.008
B	14.0±0.2	$0.551^{+0.009}_{-0.008}$
C	14.0±0.2	$0.551^{+0.009}_{-0.008}$
D	16.0±0.2	0.630±0.008
F	1.0	0.039
G	1.0	0.039
H	$0.22^{+0.05}_{-0.04}$	0.009±0.002
I	0.10	0.004
J	0.5 (T.P.)	0.020 (T.P.)
K	1.0±0.2	$0.039^{+0.009}_{-0.008}$
L	0.5±0.2	$0.020^{+0.008}_{-0.009}$
M	$0.17^{+0.03}_{-0.07}$	$0.007^{+0.001}_{-0.003}$
N	0.10	0.004
P	1.45	0.057
Q	0.125±0.075	0.005±0.003
R	5°±5°	5°±5°
S	1.7 MAX.	0.067 MAX.

P100GC-50-7EA-2

Remark Dimensions and materials of ES products are the same as those of mass-produced products.

100 PIN PLASTIC QFP (14×20)





P100GF-65-3BA1-2

NOTE
Each lead centerline is located within 0.15 mm (0.006 inch) of its true position (T.P.) at maximum material condition.

ITEM	MILLIMETERS	INCHES
A	23.6±0.4	0.929±0.016
B	20.0±0.2	0.795$^{+0.009}_{-0.008}$
C	14.0±0.2	0.551$^{+0.009}_{-0.008}$
D	17.6±0.4	0.693±0.016
F	0.8	0.031
G	0.6	0.024
H	0.30±0.10	0.012$^{+0.004}_{-0.005}$
I	0.15	0.006
J	0.65 (T.P.)	0.026 (T.P.)
K	1.8±0.2	0.071$^{+0.008}_{-0.009}$
L	0.8±0.2	0.031$^{+0.009}_{-0.008}$
M	0.15$^{+0.10}_{-0.05}$	0.006$^{+0.004}_{-0.003}$
N	0.10	0.004
P	2.7	0.106
Q	0.1±0.1	0.004±0.004
S	3.0 MAX	0.119 MAX.

Remark Dimensions and materials of ES products are the same as those of mass-produced products.

13. RECOMMENDED SOLDERING CONDITIONS

The μPD78062(A)/78063(A)/78064(A) should be soldered and mounted under the conditions recommended in the table below.

For details of recommended soldering conditions, refer to the information document **"Semiconductor Device Mounting Technology Manual" (IE-1207).**

For soldering methods and conditions other than those recommended below, contact an NEC sales representative.

Table 13-1. Surface Mounting Type Soldering Conditions (1/2)

(1) μPD78062GC(A)-xxx-7EA : 100-pin plastic QFP (Fine pitch) (14 x 14 mm)
μPD78063GC(A)-xxx-7EA : 100-pin plastic QFP (Fine pitch) (14 x 14 mm)
μPD78064GC(A)-xxx-7EA : 100-pin plastic QFP (Fine pitch) (14 x 14 mm)

Soldering Method	Soldering Conditions	Recommended Condition Symbol
Infrared reflow	Package peak temperature: 235 °C, Duration: 30 sec. max. (at 210 °C or above), Number of times: Twice max., Time limit: 7 days[Note] (thereafter 10 hours prebaking required at 125 °C) < precautions> (1) The second reflow should be started after the first reflow device temperature has returned to the ordinary level. (2) Flux washing with water must not be performed after the first reflow.	IR35-107-2
VPS	Package peak temperature: 215 °C, Duration: 40 sec. (at 200 °C or above), Number of times: Twice max., Time limit: 7 days[Note] (thereafter 10 hours prebaking required at 125 °C) <precautions> (1) The second reflow should be started after the first reflow device temperature has returned to the ordinary level. (2) Flux washing with water must not be performed after the first reflow.	VP15-107-2
Partial heating	Pin temperature: 300 °C max. Duration: 3 sec. max. (per pin row)	—

Note For the storage period after dry-pack decapsulation, storage conditions are max. 25 °C, 65 % RH.

Table 13-1. Surface Mounting Type Soldering Conditions (2/2)

(2) μPD78062GF(A)-xxx-3BA : 100-pin plastic QFP (14 x 20 mm)
μPD78063GF(A)-xxx-3BA : 100-pin plastic QFP (14 x 20 mm)
μPD78064GF(A)-xxx-3BA : 100-pin plastic QFP (14 x 20 mm)

Soldering Method	Soldering Conditions	Recommended Condition Symbol
Infrared reflow	Package peak temperature: 235 °C, Duration: 30 sec. max. (at 210 °C or above), Number of times: Twice max. < precautions> (1) The second reflow should be started after the first reflow device temperature has returned to the ordinary level. (2) Flux washing with water must not be performed after the first reflow.	IR35-00-2
VPS	Package peak temperature: 215 °C, Duration: 40 sec. (at 200 °C or above), Number of times: Twice max. <precautions> (1) The second reflow should be started after the first reflow device temperature has returned to the ordinary level. (2) Flux washing with water must not be performed after the first reflow.	VP15-00-2
Wave soldering	Solder bath temperature: 260 °C max., Duration: 10 sec. max., Number of times: Once, Preliminary heat temperature: 120°C max. (Package surface temperature)	WS60-00-1
Partial heating	Pin temperature: 300 °C max. Duration: 3 sec. max. (per pin row)	—

Caution Use of more than one soldering method should be avoided (except in the case of partial heating).