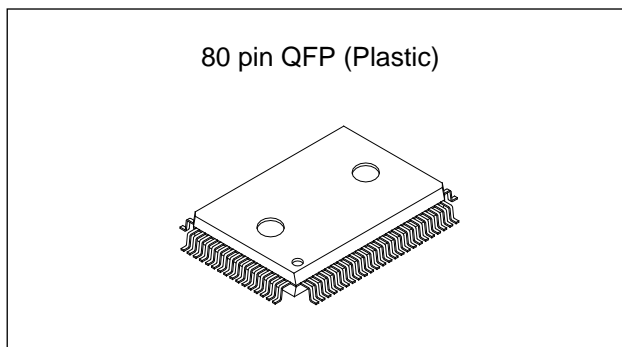


CMOS 8-bit Single Chip Microcomputer**Description**

The CXP84632/84640/84648 is a CMOS 8-bit single chip microcomputer integrating on a single chip an A/D converter, serial interface, timer/counter, time base timer, capture timer/counter, I²C bus interface, remote control reception circuit, PWM output, and 32kHz timer/counter besides the basic configurations of 8-bit CPU, ROM, RAM, and I/O port.

The CXP84632/84640/84648 also provides a sleep/stop function that enables lower power consumption.

**Structure**

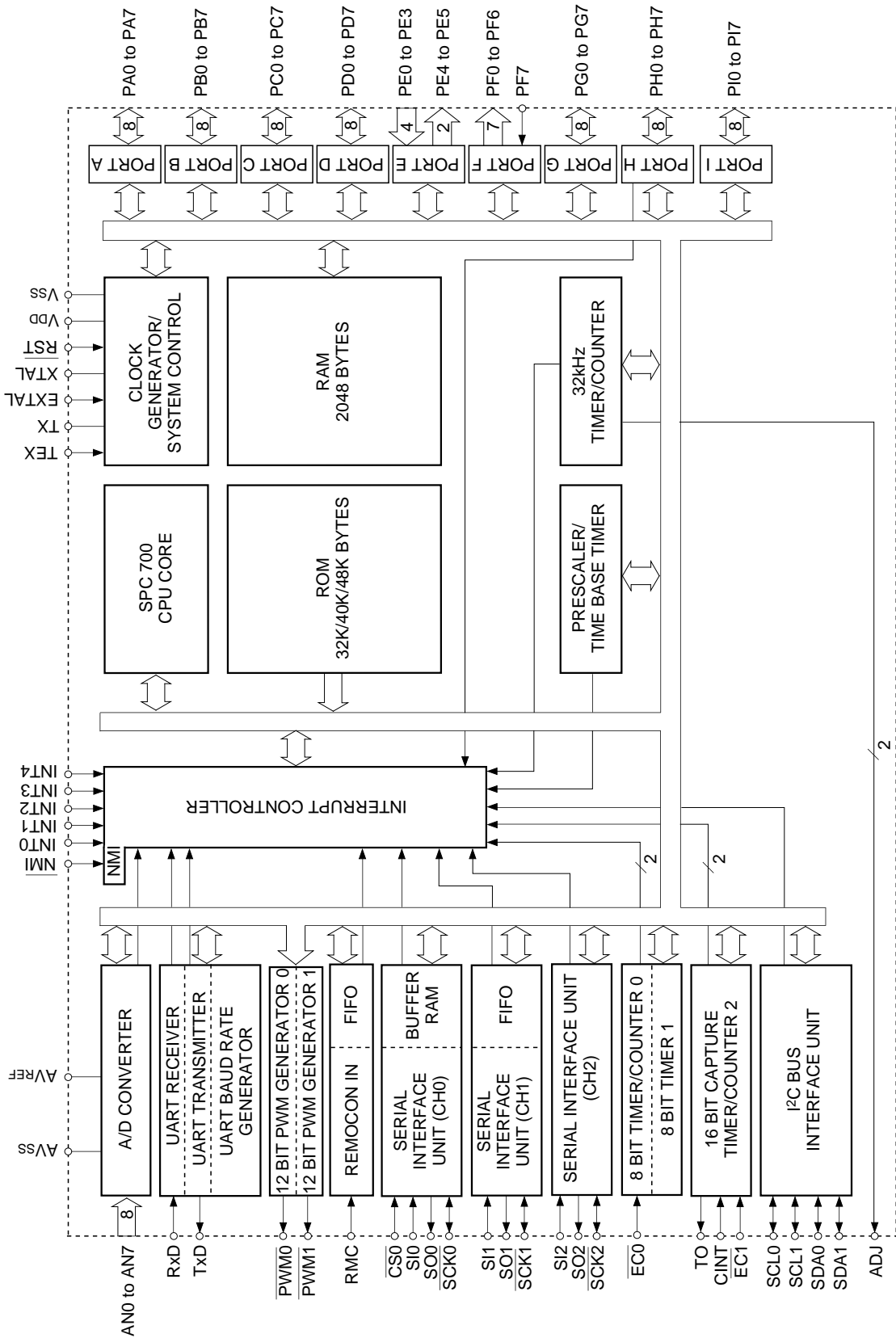
Silicon gate CMOS IC

Features

- Wide range instruction system (213 instructions) to cover various of data.
 - 16-bit arithmetic/multiplication and division/Boolean bit operation instructions
- Minimum instruction cycle
 - 250ns at 16MHz operation (4.5 to 5.5V)
 - 333ns at 12MHz operation (3.0 to 5.5V)
 - 122µs at 32kHz operation (2.7 to 5.5V)
- Incorporated ROM capacity
 - 32K bytes (CXP84632)
 - 40K bytes (CXP84640)
 - 48K bytes (CXP84648)
- Incorporated RAM capacity
 - 2048 bytes
- Peripheral functions
 - A/D converter
 - 8 bits, 8 channels, successive approximation method
(Conversion time 20µs/16MHz)
 - Serial interface
 - Start-stop synchronization (UART), 1 channel
 - Incorporated buffer RAM (Auto transfer for 1 to 32 bytes), 1 channel
 - Incorporated 8-bit, 10-stage FIFO
(Auto transfer for 1 to 10 bytes), 1 channel
 - 8-bit clock synchronization (MSB/LSB first selectable), 1 channel
 - Timer
 - 8-bit timer, 8-bit timer/counter, 19-bit time base timer,
16-bit capture timer/counter, 32kHz timer/counter
 - I²C bus interface
 - 8-bit pulse measurement counter, 6-stage FIFO
 - PWM output circuit
 - 12 bits, 2 channels
- Interruption
 - 21 factors, 15 vectors, multi-interruption possible
- Standby mode
 - SLEEP/STOP
- Package
 - 80-pin plastic QFP
- Piggyback/evaluation chip
 - CXP84600 80-pin ceramic QFP

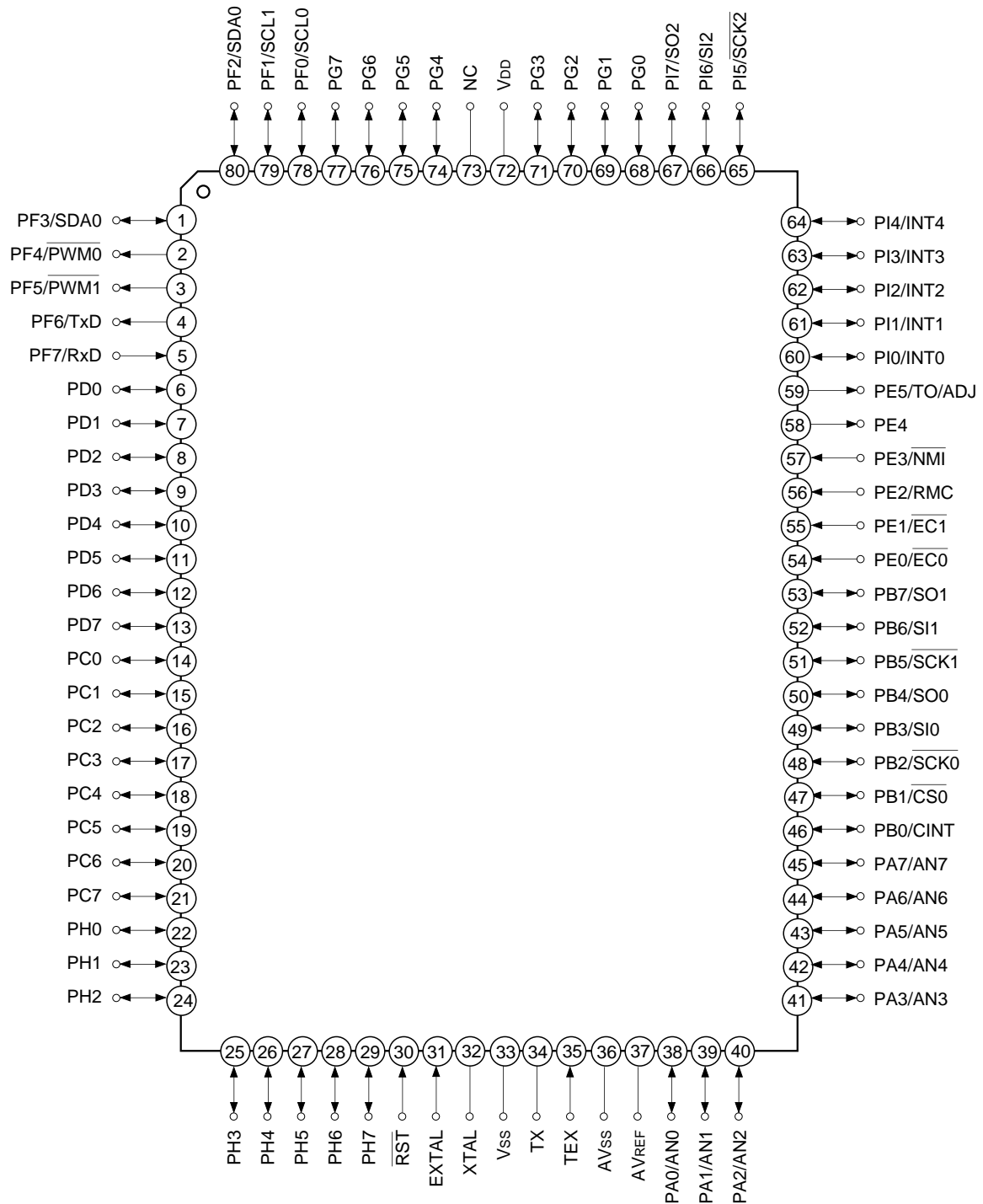
Purchase of Sony's I²C components conveys a licence under the Philips I²C Patent Rights to use these components in an I²C system, provided that the system conforms to the I²C Standard Specifications as defined by Philips.

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Block Diagram

Pin Assignment (Top View)



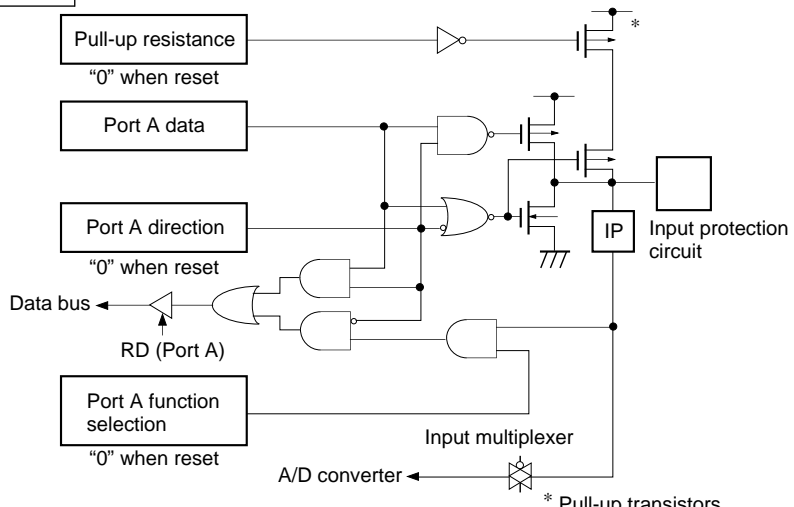
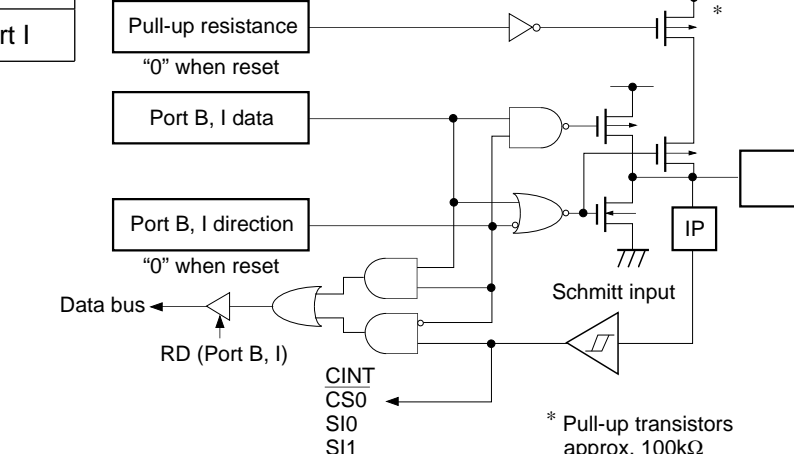
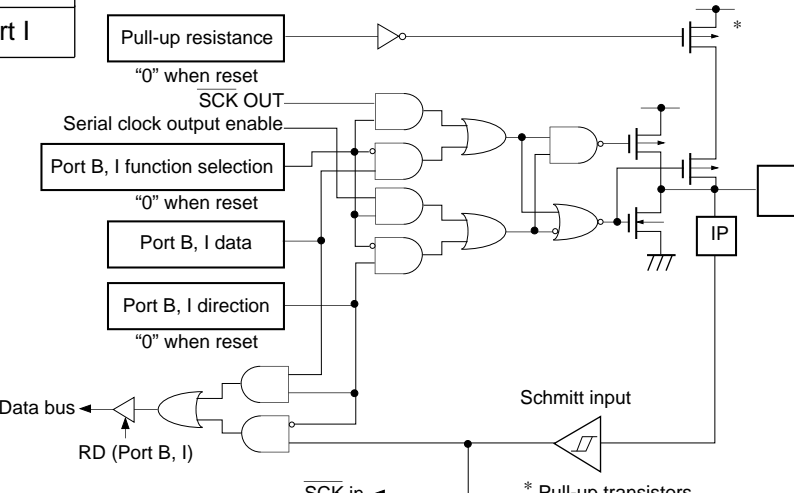
Note) NC (Pin 73) must be connected VDD.

Pin Description

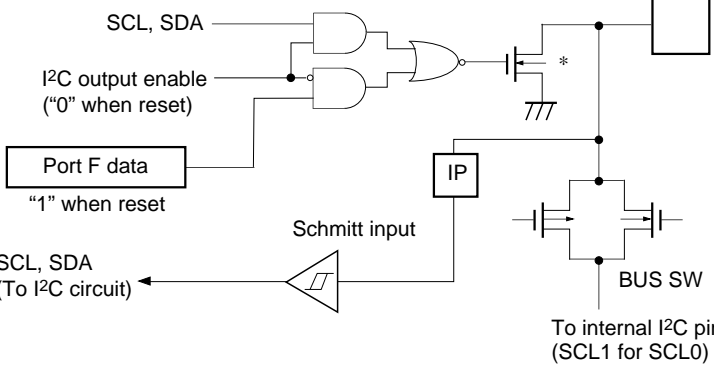
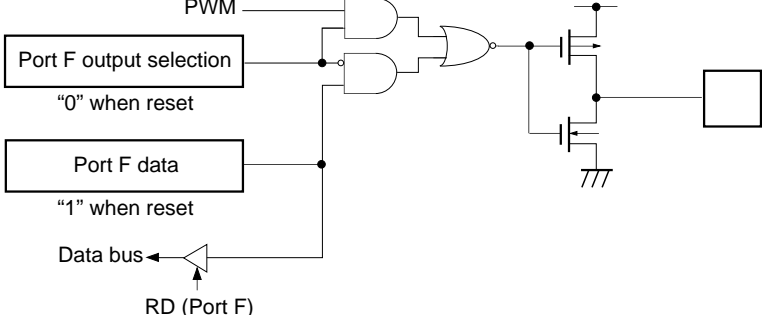
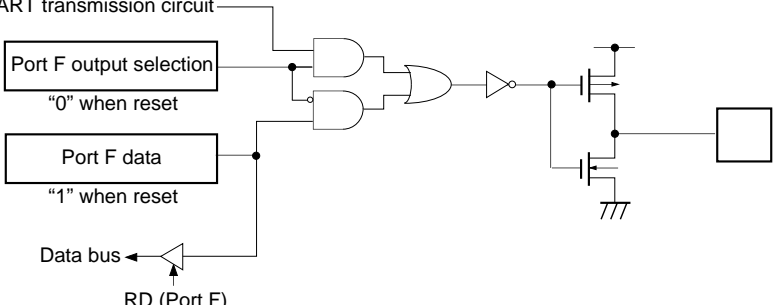
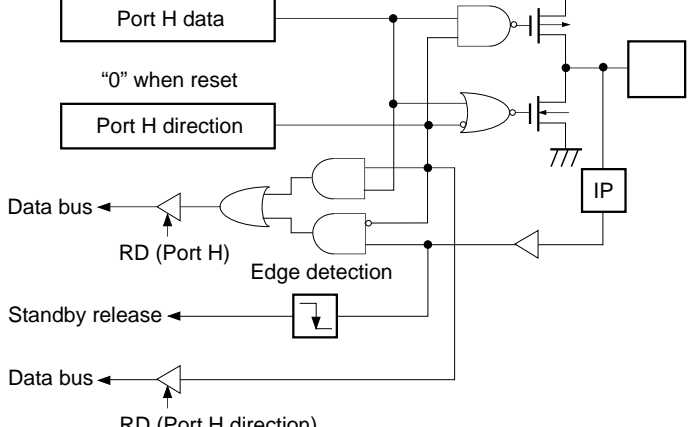
Pin code	I/O	Functions	
PA0/AN0 to PA7/AN7	I/O/Analog input	(Port A) 8-bit I/O port. I/O can be set in a unit of single bits. Incorporation of the pull-up resistance can be set through the software in a unit of 4 bits. (8 pins)	Analog inputs to A/D converter. (8 pins)
PB0/CINT	I/O/Input	(Port B) I/O can be set in a unit of single bits for lower 7 bits. Incorporation of pull-up resistor can be set through the software in a unit of 4 bits. (8 pins)	External capture input to 16-bit timer/counter.
PB1/ $\overline{CS0}$	I/O/Input		Chip select input for serial interface (CH0).
PB2/ $\overline{SCK0}$	I/O/I/O		Serial clock I/O (CH0).
PB3/SI0	I/O/Input		Serial data input (CH0).
PB4/SO0	I/O/Output		Serial data output (CH0).
PB5/ $\overline{SCK1}$	I/O/I/O		Serial clock I/O (CH1).
PB6/SI1	I/O/Input		Serial data input (CH1).
PB7/SO1	I/O/Output		Serial data output (CH1).
PC0 to PC7	I/O	(Port C) 8-bit I/O port. I/O can be set in a unit of single bits. Capable of driving 12mA sync current. Incorporation of pull-up resistor can be set through the software in a unit of 4 bits. (8 pins)	
PD0 to PD7	I/O	(Port D) 8-bit I/O port. I/O can be set in a unit of single bits. Incorporation of pull-up resistor can be set through the software in a unit of 4 bits. (8 pins)	
PE0/ $\overline{EC0}$	Input/Input	(Port E) 6-bit port. Lower 4 bits are for inputs; upper 2 bits are for outputs. (6 pins)	External event inputs for timer/counter. (2 pins)
PE1/ $\overline{EC1}$	Input/Input		Remote control reception circuit input.
PE2/RMC	Input/Input		
PE3/ \overline{NMI}	Input/Input		
PE4	Output		
PE5/TO/ ADJ	Output/Output/ Output		Rectangular wave output for 16-bit timer/counter. Output for 32kHz oscillation frequency division.
PF0/SCL0 PF1/SCL1	Output/I/O	(Port F) Lower 7 bits are for output; of which lower 4 bits are large current (12mA) N-ch open drain output. The uppermost bit (PF7) is for input. (8pins)	Transfer clock I/O for I ² C bus interface. (2pins)
PF2/SDA0 PF3/SDA1	Output/I/O		Transfer data I/O for I ² C bus interface. (2pins)
PF4/ $\overline{PWM0}$	Output/Output		PWM outputs. (2pins)
PF5/ $\overline{PWM1}$	Output/Output		
PF6/TxD	Output/Output		UART transmission data output.
PF7/RxD	Input/Input		UART reception data input.

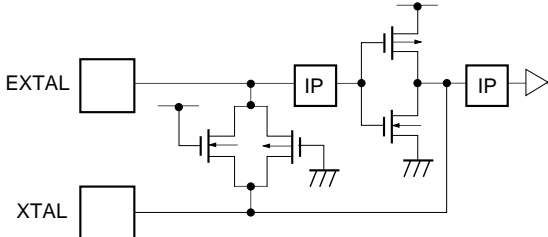
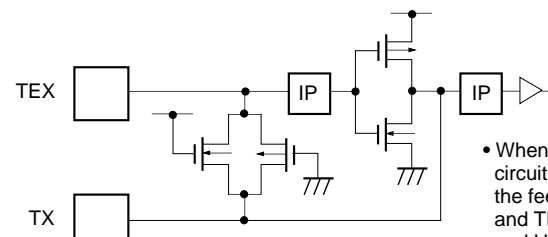
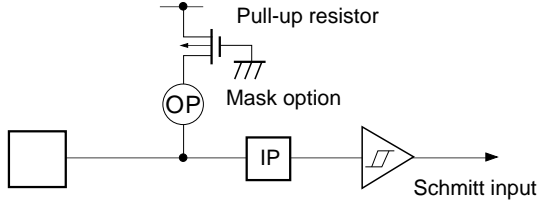
Pin code	I/O	Functions	
PG0 to PG7	I/O	(Port G) 8-bit I/O port. I/O can be set in a unit of single bits. Incorporation of pull-up resistor can be set through the software in a unit of 4 bits. (8 pins)	
PH0 to PH7	I/O	(Port H) 8-bit I/O port. I/O can be set in a unit of single bits. Incorporation of pull-up resistor can be set through the software in a unit of 4 bits. (8 pins)	
PI0/INT0 to PI4/INT4	I/O/Input	(Port I) 8-bit I/O port. I/O can be set in a unit of single bits. Incorporation of pull-up resistor can be set through the software in a unit of 4 bits. (8 pins)	External interruption request inputs. (5 pins)
PI5/ $\overline{\text{SCK2}}$	I/O/I/O		Serial clock I/O. (CH2)
PI6/SI2	I/O/Input		Serial data input. (CH2)
PI7/SO2	I/O/Output		Serial data output. (CH2)
EXTAL	Input	Crystal connectors for system clock oscillation. When the clock is supplied externally, input to EXTAL; opposite phase clock should be input to XTAL.	
XTAL	Output		
TEX	Input	Crystal connectors for 32kHz timer/counter clock oscillation. For usage as event counter, input to TEX, and open TX.	
TX	Output		
$\overline{\text{RST}}$	Input	Low-level active, system reset.	
NC		NC. Under normal operating conditions, connect to V _{DD} .	
AV _{REF}	Input	Reference voltage input for A/D converter.	
AV _{SS}		A/D converter GND.	
V _{DD}		Positive power supply.	
V _{SS}		GND.	

I/O Circuit Format for Pins

Pin	Circuit format	When reset
<p>PA0/AN0 to PA7/AN7</p> <p>8 pins</p>	<p>Port A</p>  <p>Pull-up resistance "0" when reset</p> <p>Port A data</p> <p>Port A direction "0" when reset</p> <p>Data bus</p> <p>RD (Port A)</p> <p>Port A function selection "0" when reset</p> <p>Input multiplexer</p> <p>A/D converter</p> <p>* Pull-up transistors approx. 100kΩ</p>	<p>Hi-Z</p>
<p>PB0/CINT PB1/CS0 PB3/SI0 PB6/SI1 PI6/SI2</p> <p>5 pins</p>	<p>Port B Port I</p>  <p>Pull-up resistance "0" when reset</p> <p>Port B, I data</p> <p>Port B, I direction "0" when reset</p> <p>Data bus</p> <p>RD (Port B, I)</p> <p>Schmitt input</p> <p>CINT CS0 SI0 SI1</p> <p>* Pull-up transistors approx. 100kΩ</p>	<p>Hi-Z</p>
<p>PB2/SCK0 PB5/SCK1 PI5/SCK2</p> <p>3 pins</p>	<p>Port B Port I</p>  <p>Pull-up resistance "0" when reset</p> <p>SCK OUT Serial clock output enable</p> <p>Port B, I function selection "0" when reset</p> <p>Port B, I data</p> <p>Port B, I direction "0" when reset</p> <p>Data bus</p> <p>RD (Port B, I)</p> <p>Schmitt input</p> <p>SCK in</p> <p>* Pull-up transistors approx. 100kΩ</p>	<p>Hi-Z</p>

Pin	Circuit format	When reset
<p>PE5/TO/ADJ</p> <p>1 pin</p>	<p>Port E</p> <p>Internal reset signal</p> <p>Port E data</p> <p>"1" when reset TO</p> <p>ADJ16K*1</p> <p>ADJ2K*1</p> <p>MPX</p> <p>Port E function selection (upper)</p> <p>Port E function selection (lower)</p> <p>"00" when reset</p> <p>TO output enable</p> <p>*1 ADJ signals are frequency dividing output for 32kHz oscillation frequency adjustment. ADJ2K provides usage as buzzer output.</p> <p>*2 Pull-up transistor approx. 150kΩ</p>	<p>High level (with approx. 150kΩ resistor when reset)</p>
<p>PD0 to PD7 PG0 to PG7 PH0 to PH7</p> <p>24 pins</p>	<p>Port D</p> <p>Port G</p> <p>Port H</p> <p>Pull-up resistance</p> <p>"0" when reset</p> <p>Port D, G, H data</p> <p>Port D, G, H direction</p> <p>"0" when reset</p> <p>Data bus</p> <p>RD (Port D, G, H)</p> <p>* Pull-up transistors approx. 100kΩ</p>	<p>Hi-Z</p>
<p>PI0/INT0 to PI4/INT4</p> <p>5 pins</p>	<p>Port I</p> <p>Pull-up resistance</p> <p>"0" when reset</p> <p>Port I data</p> <p>Port I direction</p> <p>"0" when reset</p> <p>Data bus</p> <p>RD (Port I)</p> <p>INT0 INT1 INT2 INT3 INT4</p> <p>* Pull-up transistors approx. 100kΩ</p>	<p>Hi-Z</p>

Pin	Circuit format	When reset
<p>PF0/SCL0 PF1/SCL1 PF2/SDA0 PF3/SDA1</p> <p>4 pins</p>	<p>Port F</p>  <p>* Large current 12mA</p>	<p>Hi-Z</p>
<p>PF4/PWM0 PF5/PWM1</p> <p>2 pins</p>	<p>Port F</p>  <p>RD (Port F)</p>	<p>High level</p>
<p>PF6/TxD</p> <p>1 pin</p>	<p>Port F</p> <p>UART transmission circuit</p>  <p>RD (Port F)</p>	<p>High level</p>
<p>PH0 to PH7</p> <p>8 pins</p>	<p>Port H</p>  <p>RD (Port H)</p> <p>RD (Port H direction)</p>	<p>Hi-Z</p>

Pin	Circuit format	When reset
<p>EXTAL XTAL</p> <p>2 pins</p>	 <ul style="list-style-type: none"> • Diagram shows circuit composition during oscillation. • Feedback resistor is removed during stop, and XTAL becomes High level. 	<p>Oscillation</p>
<p>TEX TX</p> <p>2 pins</p>	 <ul style="list-style-type: none"> • Diagram shows circuit composition during oscillation. • When the operation of the oscillation circuit is stopped by the software, the feedback resistor is removed, and TEX and TX become Low level and High level respectively. 	<p>Oscillation</p>
<p>$\overline{\text{RST}}$</p> <p>1 pin</p>	 <p>Pull-up resistor</p> <p>Mask option</p> <p>Schmitt input</p>	<p>Low level</p>

Absolute Maximum Ratings

(V_{SS} = 0V reference)

Item	Symbol	Rating	Unit	Remarks
Supply voltage	V _{DD}	-0.3 to +7.0	V	
	A _{VSS}	-0.3 to +0.3	V	
Input voltage	V _{IN}	-0.3 to +7.0 ^{*1}	V	
Output voltage	V _{OUT}	-0.3 to +7.0 ^{*1}	V	
High level output current	I _{OH}	-5	mA	Output (value per pin)
High level total output current	∑I _{OH}	-50	mA	Total for all output pins
Low level output current	I _{OL}	15	mA	All pins excluding large current outputs (value per pin)
	I _{OLC}	20	mA	Large current outputs (value per pin) ^{*2}
Low level total output current	∑I _{OL}	100	mA	Total for all output pins
Operating temperature	T _{opr}	-20 to +75	°C	
Storage temperature	T _{stg}	-55 to +150	°C	
Allowable power dissipation	P _D	600	mW	

*1 V_{IN} and V_{OUT} must not exceed V_{DD} + 0.3V.

*2 The large current output is for each pin of Port C (PC), Port F0 (PF0) to Port 3 (PF3).

Note) Usage exceeding absolute maximum ratings may permanently impair the LSI. Normal operation should be conducted under the recommended operating conditions. Exceeding these conditions may adversely affect the reliability of the LSI.

Recommended Operating Conditions

(V_{SS} = 0V reference)

Item	Symbol	Min.	Max.	Unit	Remarks
Supply voltage	V _{DD}	4.5	5.5	V	fc = 16MHz or less
		3.0	5.5	V	fc = 12MHz or less
		2.7	5.5	V	Guaranteed operation range for 1/16 frequency dividing clock or SLEEP mode
		2.7	5.5	V	Guaranteed operation range by TEX clock
		2.5	5.5	V	Guaranteed data hold operation range during STOP
High level input voltage	V _{IH}	0.7V _{DD}	V _{DD}	V	*1, *5
		0.8V _{DD}	V _{DD}	V	*1, *6
	V _{IHS}	0.8V _{DD}	V _{DD}	V	Hysteresis input*2
	V _{IHEX}	V _{DD} - 0.4	V _{DD} + 0.3	V	EXTAL pin*3, *5 TEX pin*4, *5
		V _{DD} - 0.2	V _{DD} + 0.2	V	EXTAL pin*3, *6 TEX pin*4, *6
Low level input voltage	V _{IL}	0	0.3V _{DD}	V	*1, *5
		0	0.2V _{DD}	V	*1, *6
	V _{ILS}	0	0.2V _{DD}	V	Hysteresis input*2
	V _{ILEX}	-0.3	0.4	V	EXTAL pin*3, *5 TEX pin*4, *5
		-0.3	0.2	V	EXTAL pin*3, *6 TEX pin*4, *6
Operating temperature	T _{opr}	-20	+75	°C	

*1 Normal input port (each pin of PA, PB4, PB7, PC, PF0 to PF4, PG, PH and PI7)

*2 Each pin of $\overline{\text{RST}}$, $\overline{\text{CINT}}$, $\overline{\text{CS0}}$, $\overline{\text{SCK0}}$, $\overline{\text{SCK1}}$, $\overline{\text{SCK2}}$, SI0, SI1, SI2, $\overline{\text{EC0}}$, $\overline{\text{EC1}}$, RMC, $\overline{\text{NMI}}$, RxD, INT0, INT1, INT2, INT3 and INT4

*3 It is specified only when the external clock is input.

*4 It is specified only when the external event count clock is input.

*5 This case applies to the range of 4.5 to 5.5V supply voltage (V_{DD}).

*6 This case applies to the range of 3.0 to 5.5V supply voltage (V_{DD}).

Electrical Characteristics

DC Characteristics

Supply voltage (V_{DD}) 4.5 to 5.5V

(Ta = -20 to +75°C, Vss = 0V reference)

Item	Symbol	Pins	Conditions	Min.	Typ.	Max.	Unit
High level output voltage	V_{OH}	PA to PD, PE4, PE5, PF4, PF5, PF6, PG to PI	$V_{DD} = 4.5V, I_{OH} = -0.5mA$	4.0			V
			$V_{DD} = 4.5V, I_{OH} = -1.2mA$	3.5			V
Low level output voltage	V_{OL}	PA to PD, PE4, PE5, PF4, PF5, PF6, PG to PI	$V_{DD} = 4.5V, I_{OL} = 1.8mA$			0.4	V
			$V_{DD} = 4.5V, I_{OL} = 3.6mA$			0.6	V
		PC, PF0 to PF3	$V_{DD} = 4.5V, I_{OL} = 12.0mA$			1.5	V
		PF0 to PF3 (SCL0, SCL1, SDA0, SDA1)	$V_{DD} = 4.5V, I_{OL} = 3.0mA$			0.4	V
			$V_{DD} = 4.5V, I_{OL} = 4.0mA$			0.6	V
Input current	I_{IHE}	EXTAL	$V_{DD} = 5.5V, V_{IH} = 5.5V$	0.5		40	μA
	I_{ILE}		$V_{DD} = 5.5V, V_{IL} = 0.4V$	-0.5		-40	μA
	I_{IHT}	TEX	$V_{DD} = 5.5V, V_{IL} = 5.5V$	0.1		10	μA
	I_{ILT}		$V_{DD} = 5.5V, V_{IL} = 0.4V$	-0.1		-10	μA
	I_{ILR}	\overline{RST}^{*1}	$V_{DD} = 5.5V, V_{IL} = 0.4V$	-1.5		-400	μA
	I_{IL}	PA to PD ^{*2} , PG to PI ^{*2}	$V_{DD} = 4.5V, V_{IL} = 4.0V$	-2.78		-45	μA
I/O leakage current	I_{IZ}	PA to PD ^{*2} , PG to PI ^{*2} , \overline{RST}^{*1}	$V_{DD} = 5.5V$ $V_I = 0, 5.5V$			± 10	μA
Open drain output leakage current (N-ch Tr off state)	I_{LOH}	PF0 to PF3 (SCL0, SCL1, SDA0, SDA1)	$V_{DD} = 5.5V$ $V_{OH} = 5.5V$			10	μA
I ² C bus switch connection impedance (Output Tr off state)	R_{BS}	SCL0: SCL1 SDA0: SDA1	$V_{DD} = 4.5V$ $V_{SCL0} = V_{SCL1} = 2.25V$ $V_{SDA0} = V_{SDA1} = 2.25V$			120	Ω

Item	Symbol	Pins	Conditions	Min.	Typ.	Max.	Unit
Supply current*3	I _{DD1}	V _{DD}	1/2 frequency dividing clock operation		31	50	mA
			V _{DD} = 5.5V, 16MHz crystal oscillation (C ₁ = C ₂ = 15pF)				
	I _{DD2}		V _{DD} = 3V, 32kHz crystal oscillation; and termination of 16MHz oscillation (C ₁ = C ₂ = 47pF)		40	100	μA
	I _{DDS1}		SLEEP mode		2.5	10	mA
			V _{DD} = 5.5V, 16MHz crystal oscillation (C ₁ = C ₂ = 15pF)				
I _{DDS2}	V _{DD} = 3V, 32kHz crystal oscillation; and termination of 16MHz oscillation (C ₁ = C ₂ = 47pF)		8	30	μA		
I _{DDS3}	STOP mode V _{DD} = 5.5V, termination of 16MHz and 32kHz crystal oscillation				10	μA	
Input capacity	C _{IN}	PA to PC, PE0 to PE5, PF to PI, EXTAL, <u>TEX</u> , <u>RST</u>	Clock 1MHz 0V for all pins excluding measured pins		10	20	pF

*1 $\overline{\text{RST}}$ specifies the input current when pull-up resistance has been selected; leakage current when no resistance has been selected.

*2 PA to PD, and PG to PI specify the input current when pull-up resistance has been selected; leakage current when no resistance has been selected.

*3 When all pins are open.

Electrical Characteristics

DC Characteristics

Supply voltage (V_{DD}) 3.0 to 3.6V

(T_a = -20 to +75°C, V_{SS} = 0V reference)

Item	Symbol	Pins	Conditions	Min.	Typ.	Max.	Unit	
High level output voltage	V _{OH}	PA to PD, PE4, PE5, PF4, PF5, PF6	V _{DD} = 3.0V, I _{OH} = -0.15mA	2.7			V	
			V _{DD} = 3.0V, I _{OH} = -0.5mA	2.3			V	
Low level output voltage	V _{OL}		V _{DD} = 3.0V, I _{OL} = 1.2mA			0.3	V	
			V _{DD} = 3.0V, I _{OL} = 1.6mA			0.5	V	
			PC, PF0 to PF3	V _{DD} = 3.0V, I _{OL} = 5.0mA			1	V
			PF0 to PF3 (SCL0, SCL1, SDA0, SDA1)	V _{DD} = 3.0V, I _{OL} = 2.0mA			0.3	V
V _{DD} = 3.0V, I _{OL} = 2.5mA				0.5	V			
Input current	I _{IHE}	EXTAL	V _{DD} = 3.6V, V _{IH} = 3.6V	0.3		20	μA	
	I _{ILE}		V _{DD} = 3.6V, V _{IL} = 0.3V	-0.3		-20	μA	
	I _{IHT}	TEX	V _{DD} = 3.6V, V _{IL} = 3.6V	0.1		10	μA	
			V _{DD} = 3.6V, V _{IL} = 0.4V	-0.1		-10	μA	
	I _{ILR}	$\overline{\text{RST}}^{*1}$	V _{DD} = 3.6V, V _{IL} = 0.3V	-0.9		-200	μA	
	I _{IL}	PA to PD* ² , PG to PI* ²	V _{DD} = 3.6V, V _{IL} = 0.3V			-20	μA	
V _{DD} = 3.0V, V _{IL} = 2.7V			-1.0			μA		
I/O leakage current	I _{Iz}	PA to PD* ² , PG to PI* ² , $\overline{\text{RST}}^{*1}$	V _{DD} = 3.6V V _I = 0, 3.6V			±10	μA	
Open drain output leakage current (N-ch Tr off state)	I _{ILOH}	PF0 to PF3 (SCL0, SCL1, SDA0, SDA1)	V _{DD} = 3.6V V _{OH} = 3.6V			10	μA	
I ² C bus switch connection impedance (Output Tr off state)	R _{Bs}	SCL0: SCL1 SDA0: SDA1	V _{DD} = 3.0V V _{SCL0} = V _{SCL1} = 1.5V V _{SDA0} = V _{SDA1} = 1.5V			300	Ω	

Item	Symbol	Pins	Conditions	Min.	Typ.	Max.	Unit
Supply current*3	I _{DD1}	V _{DD}	1/2 frequency dividing clock operation V _{DD} = 3.6V, 12MHz crystal oscillation (C ₁ = C ₂ = 15pF)		11	25	mA
	I _{DDS1}		SLEEP mode V _{DD} = 3.6V, 12MHz crystal oscillation (C ₁ = C ₂ = 15pF)		0.5	2.5	mA
	I _{DDS3}		STOP mode V _{DD} = 3.6V, termination of 16MHz and 32kHz crystal oscillation			10	μA
Input capacity	C _{IN}	PA to PC, PE0 to PE5, PF to PI, EXTAL, TEX, $\overline{\text{RST}}$	Clock 1MHz 0V for all pins excluding measured pins		10	20	pF

*1 $\overline{\text{RST}}$ specifies the input current when pull-up resistance has been selected; leakage current when no resistance has been selected.

*2 PA to PD, and PG to PI specify the input current when pull-up resistance has been selected; leakage current when no resistance has been selected.

*3 When all pins are open.

AC Characteristics

(1) Clock timing

(Ta = -20 to +75°C, VDD = 4.5 to 5.5V, Vss = 0V reference)

Item	Symbol	Pin	Conditions	Min.	Typ.	Max.	Unit
System clock frequency	fc	XTAL EXTAL	Fig. 1, Fig. 2	VDD = 4.5 to 5.5V	1	16	MHz
					1	12	
System clock input pulse width	tXL tXH	EXTAL	Fig. 1, Fig. 2 External clock drive	VDD = 4.5 to 5.5V	28		ns
					37.5		
System clock input rise time, fall time	tCR tCF	EXTAL	Fig. 1, Fig. 2 External clock drive			200	ns
Event count input clock pulse width	tEH tEL	EC0 EC1	Fig. 3		4tsys*1		ns
Event count input clock rise time, fall time	tER tEF	EC0 EC1	Fig. 3			20	ms
System clock frequency	fc	TEX TX	VDD = 2.7 to 5.5V Fig. 2 (32kHz clock applied condition)		32.768		kHz
Event count input clock input pulse width	tTL tTH	TEX	Fig. 3	10			µs
Event count input clock rise time, fall time	tTR tTF	TEX	Fig. 3			20	ms

*1 tsys indicates the three values below according to the upper two bits (CPU clock selection) of the control clock register (CLC: 00FEH).

tsys [ns] = 2000/fc (upper two bits = "00"), 4000/fc (upper two bits = "01"), 16000/fc (Upper two bits = "11")

Fig. 1. Clock timing

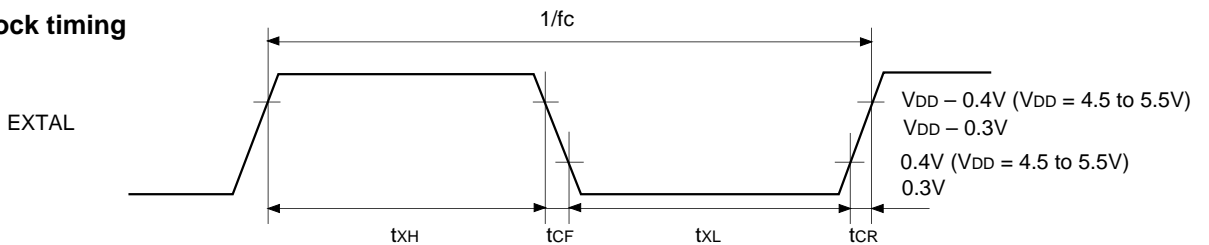


Fig. 2. Clock applied conditions

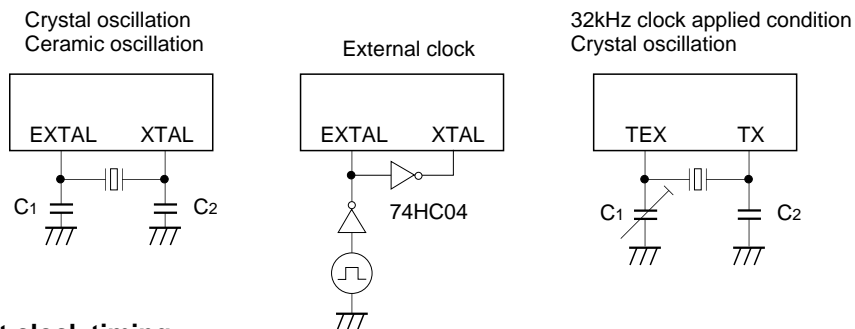
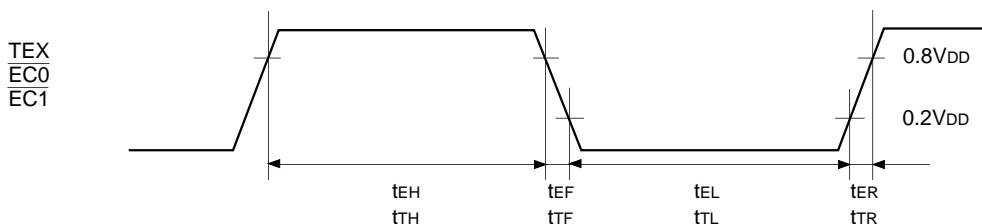


Fig. 3. Event count clock timing



(2) Serial transfer (CH0)

(Ta = -20 to +75°C, VDD = 4.5 to 5.5V, Vss = 0V reference)

Item	Symbol	Pin	Condition	Min.	Max.	Unit
$\overline{CS}\downarrow \rightarrow \overline{SCK}$ delay time	t _{D_{CSK}}	$\overline{SCK0}$	Chip select transfer mode (SCK = output mode)		t _{sys} + 200	ns
$\overline{CS}\uparrow \rightarrow \overline{SCK}$ floating delay time	t _{D_{CSKF}}	$\overline{SCK0}$	Chip select transfer mode (SCK = output mode)		t _{sys} + 200	ns
$\overline{CS}\downarrow \rightarrow \overline{SO}$ delay time	t _{D_{CSO}}	SO0	Chip select transfer mode		t _{sys} + 200	ns
$\overline{CS}\downarrow \rightarrow \overline{SO}$ floating delay time	t _{D_{CSOF}}	SO0	Chip select transfer mode		t _{sys} + 200	ns
\overline{CS} High level width	t _{WH_{CS}}	$\overline{CS0}$	Chip select transfer mode	t _{sys} + 200		ns
\overline{SCK} cycle time	t _{K_{CY}}	$\overline{SCK0}$	Input mode	2t _{sys} + 200		ns
			Output mode	16000/fc		ns
\overline{SCK} High and Low level widths	t _{K_H} t _{K_L}	$\overline{SCK0}$	Input mode	t _{sys} + 100		ns
			Output mode	8000/fc - 100		ns
SI input setup time (against $\overline{SCK}\uparrow$)	t _{SIK}	SI0	\overline{SCK} input mode	-t _{sys} + 100		ns
			\overline{SCK} output mode	200		ns
SI input hold time (against $\overline{SCK}\uparrow$)	t _{K_{SI}}	SI0	\overline{SCK} input mode	2t _{sys} + 100		ns
			\overline{SCK} output mode	100		ns
$\overline{SCK}\downarrow \rightarrow \overline{SO}$ delay time	t _{K_{SO}}	SO0	\overline{SCK} input mode		2t _{sys} + 200	ns
			\overline{SCK} output mode		100	ns

Note 1) t_{sys} indicates three values according to the contents of the clock control register (CLC; 00FEH) upper 2 bits (CPU clock selection).

t_{sys} [ns] = 2000/fc (upper 2 bits = "00"), 4000/fc (upper 2 bits = "01"), 16000/fc (upper 2 bits = "11")

Note 2) \overline{CS} , \overline{SCK} , SI and SO represent $\overline{CS0}$, $\overline{SCK0}$, SI0 and SO0, respectively.

Note 3) The load of \overline{SCK} output mode and SO output delay time is 50pF + 1TTL.

Serial transfer (CH0)

(Ta = -20 to +75°C, VDD = 3.0 to 3.6V, Vss = 0V reference)

Item	Symbol	Pin	Condition	Min.	Max.	Unit
$\overline{CS}\downarrow \rightarrow \overline{SCK}$ delay time	t _{DCSK}	$\overline{SCK0}$	Chip select transfer mode (SCK = output mode)		t _{sys} + 250	ns
$\overline{CS}\uparrow \rightarrow \overline{SCK}$ floating delay time	t _{DCSKF}	$\overline{SCK0}$	Chip select transfer mode (SCK = output mode)		t _{sys} + 200	ns
$\overline{CS}\downarrow \rightarrow \overline{SO}$ delay time	t _{DCSO}	SO0	Chip select transfer mode		t _{sys} + 250	ns
$\overline{CS}\downarrow \rightarrow \overline{SO}$ floating delay time	t _{DCSOF}	SO0	Chip select transfer mode		t _{sys} + 200	ns
\overline{CS} High level width	t _{WHCS}	$\overline{CS0}$	Chip select transfer mode	t _{sys} + 200		ns
\overline{SCK} cycle time	t _{KCY}	$\overline{SCK0}$	Input mode	2t _{sys} + 200		ns
			Output mode	16000/fc		ns
\overline{SCK} High and Low level widths	t _{KH} t _{KL}	$\overline{SCK0}$	Input mode	t _{sys} + 100		ns
			Output mode	8000/fc - 150		ns
SI input setup time (against $\overline{SCK}\uparrow$)	t _{SIK}	SI0	\overline{SCK} input mode	-t _{sys} + 100		ns
			\overline{SCK} output mode	200		ns
SI input hold time (against $\overline{SCK}\uparrow$)	t _{KSI}	SI0	\overline{SCK} input mode	2t _{sys} + 100		ns
			\overline{SCK} output mode	100		ns
$\overline{SCK}\downarrow \rightarrow \overline{SO}$ delay time	t _{KSO}	SO0	\overline{SCK} input mode		2t _{sys} + 250	ns
			\overline{SCK} output mode		125	ns

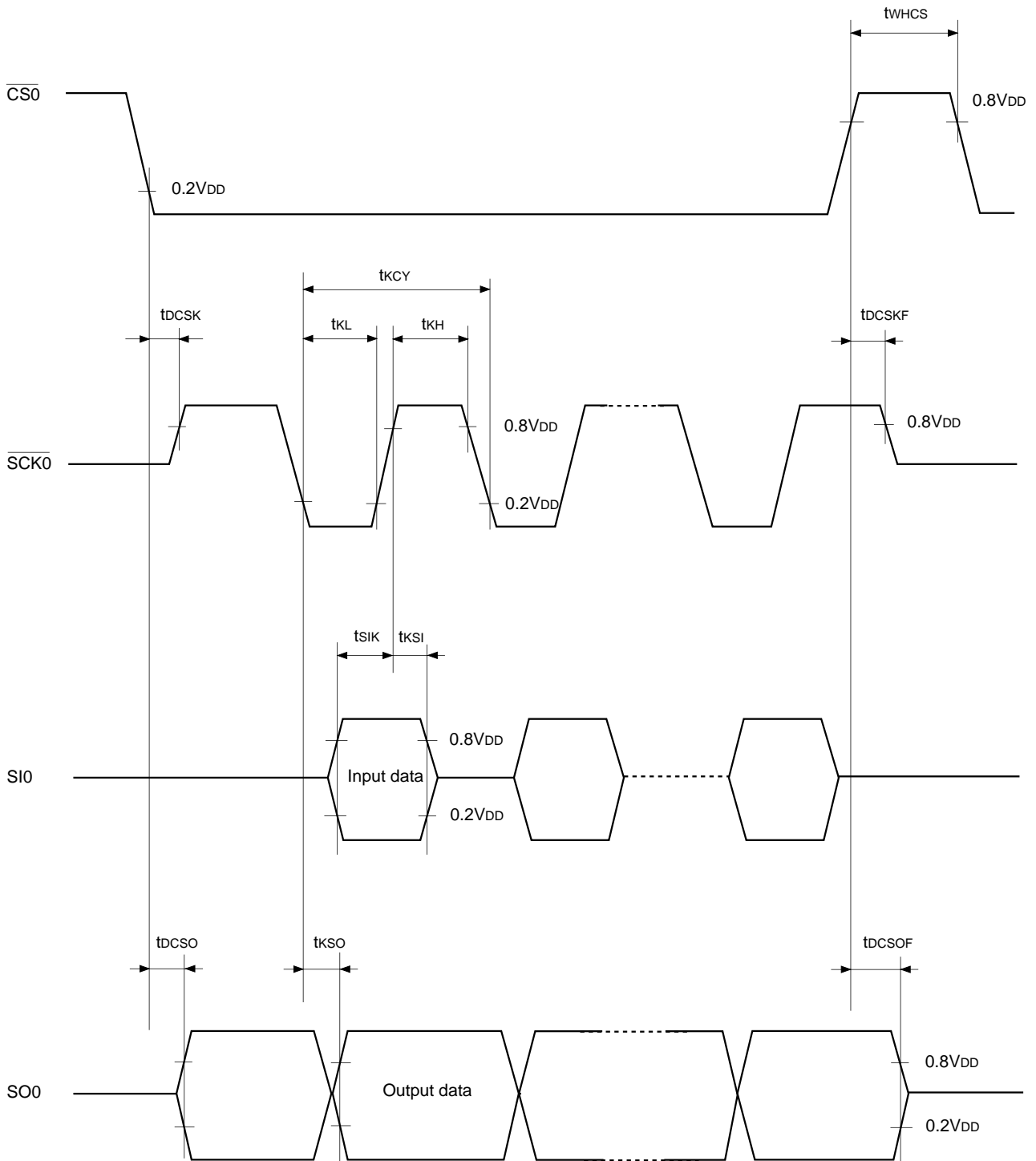
Note 1) t_{sys} indicates three values according to the contents of the clock control register (CLC; 00FEH) upper 2 bits (CPU clock selection).

t_{sys} [ns] = 2000/fc (upper 2 bits = "00"), 4000/fc (upper 2 bits = "01"), 16000/fc (upper 2 bits = "11")

Note 2) \overline{CS} , \overline{SCK} , SI and SO represent $\overline{CS0}$, $\overline{SCK0}$, SI0 and SO0, respectively.

Note 3) The load of \overline{SCK} output mode and SO output delay time is 50pF.

Fig. 4. Serial transfer CH0 timing



Serial transfer (CH1, CH2)

(Ta = -20 to +75°C, VDD = 4.5 to 5.5V, VSS = 0V reference)

Item	Symbol	Pin	Condition	Min.	Max.	Unit
$\overline{\text{SCK}}$ cycle time	t_{KCY}	$\overline{\text{SCK1}}$ $\overline{\text{SCK2}}$	Input mode	$2t_{\text{sys}} + 200$		ns
			Output mode	$16000/f_c$		ns
$\overline{\text{SCK}}$ High and Low level widths	t_{KH} t_{KL}	$\overline{\text{SCK1}}$ $\overline{\text{SCK2}}$	Input mode	$t_{\text{sys}} + 100$		ns
			Output mode	$8000/f_c - 50$		ns
SI input setup time (against $\overline{\text{SCK}}\uparrow$)	t_{SIK}	SI1 SI2	$\overline{\text{SCK}}$ input mode	100		ns
			$\overline{\text{SCK}}$ output mode	200		ns
SI input hold time (against $\overline{\text{SCK}}\uparrow$)	t_{KSI}	SI1 SI2	$\overline{\text{SCK}}$ input mode	$t_{\text{sys}} + 200$		ns
			$\overline{\text{SCK}}$ output mode	100		ns
$\text{SCK}\downarrow \rightarrow \text{SO}$ delay time	t_{KSO}	SO1 SO2	$\overline{\text{SCK}}$ input mode		$t_{\text{sys}} + 200$	ns
			$\overline{\text{SCK}}$ output mode		100	ns

Note 1) t_{sys} indicates three values according to the contents of the clock control register (CLC; 00FEH) upper 2 bits (CPU clock selection).

$$t_{\text{sys}} [\text{ns}] = 2000/f_c \text{ (Upper 2 bits = "00")}, 4000/f_c \text{ (Upper 2 bits = "01")}, 16000/f_c \text{ (Upper 2 bits = "11")}$$

Note 2) $\overline{\text{SCK}}$, SI and SO represent $\overline{\text{SCK1}}$, SI1, and SO1, respectively for CH1; they represent $\overline{\text{SCK2}}$, SI2 and SO2, respectively for CH2.

Note 3) The load of $\overline{\text{SCK1}}$ and $\overline{\text{SCK2}}$ output modes and SO1 and SO2 output delay times is 50pF+1TTL.

Serial transfer (CH1, CH2)

(Ta = -20 to +75°C, VDD = 3.0 to 3.6V, VSS = 0V reference)

Item	Symbol	Pin	Condition	Min.	Max.	Unit
$\overline{\text{SCK}}$ cycle time	t_{KCY}	$\overline{\text{SCK1}}$ $\overline{\text{SCK2}}$	Input mode	$2t_{\text{sys}} + 200$		ns
			Output mode	$16000/f_c$		ns
$\overline{\text{SCK}}$ High and Low level widths	t_{KH} t_{KL}	$\overline{\text{SCK1}}$ $\overline{\text{SCK2}}$	Input mode	$t_{\text{sys}} + 100$		ns
			Output mode	$8000/f_c - 150$		ns
SI input setup time (against $\overline{\text{SCK}}\uparrow$)	t_{SIK}	SI1 SI2	$\overline{\text{SCK}}$ input mode	100		ns
			$\overline{\text{SCK}}$ output mode	200		ns
SI input hold time (against $\overline{\text{SCK}}\uparrow$)	t_{KSI}	SI1 SI2	$\overline{\text{SCK}}$ input mode	$t_{\text{sys}} + 200$		ns
			$\overline{\text{SCK}}$ output mode	100		ns
$\text{SCK}\downarrow \rightarrow \text{SO}$ delay time	t_{KSO}	SO1 SO2	$\overline{\text{SCK}}$ input mode		$t_{\text{sys}} + 250$	ns
			$\overline{\text{SCK}}$ output mode		125	ns

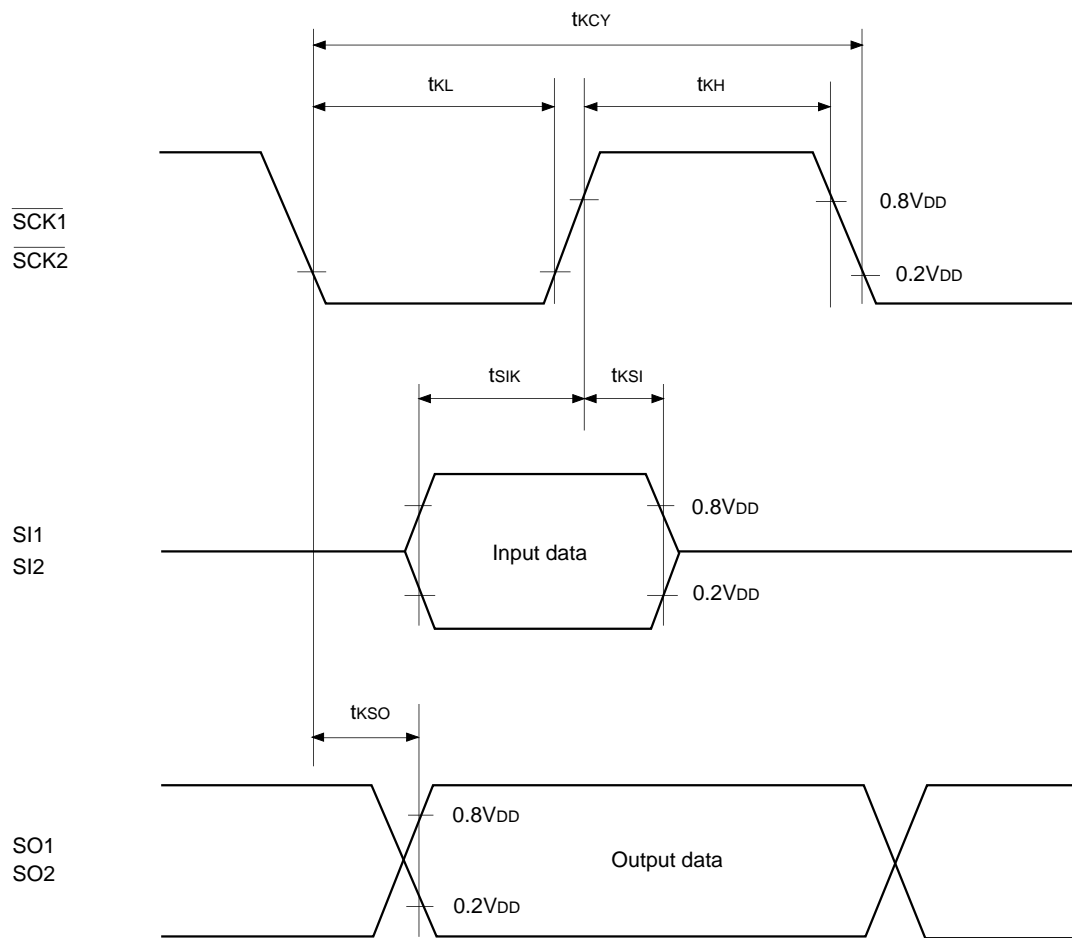
Note 1) t_{sys} indicates three values according to the contents of the clock control register (CLC; 00FEH) upper 2 bits (CPU clock selection).

$$t_{\text{sys}} [\text{ns}] = 2000/f_c \text{ (Upper 2 bits = "00")}, 4000/f_c \text{ (Upper 2 bits = "01")}, 16000/f_c \text{ (Upper 2 bits = "11")}$$

Note 2) $\overline{\text{SCK}}$, SI and SO represent $\overline{\text{SCK1}}$, SI1, and SO1, respectively for CH1; they represent $\overline{\text{SCK2}}$, SI2 and SO2, respectively for CH2.

Note 3) The load of $\overline{\text{SCK1}}$ and $\overline{\text{SCK2}}$ output modes and SO1 and SO2 output delay times is 50pF.

Fig. 5. Serial transfer CH1 and CH2 timing

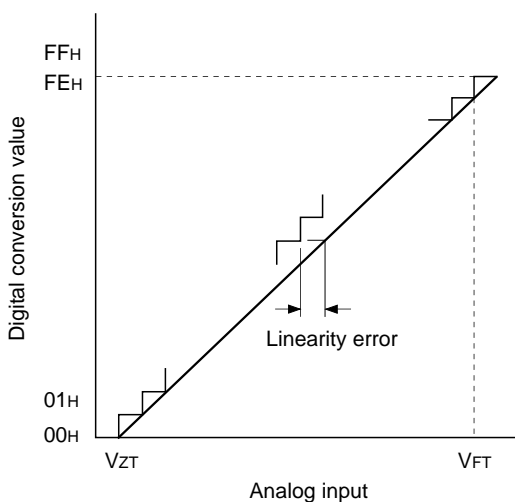


(3) A/D converter characteristics

(Ta = -20 to +75°C, VDD = 3.0 to 5.5V, AVREF = 2.7 to VDD, VSS = AVSS = 0V reference)

Item	Symbol	Pin	Condition	Min.	Typ.	Max.	Unit	
Resolution						8	Bits	
Linearity error			Ta = 25°C VDD = AVREF = 5.0V VSS = AVSS = 0V			±3	LSB	
Zero transition voltage	VZT*1			-50	10	70	mV	
Full-scale transition voltage	VFT*2			4910	4970	5030	mV	
Linearity error			Ta = 25°C VDD = AVREF = 3.3V VSS = AVSS = 0V			±5	LSB	
Zero transition voltage	VZT*1			-10	6.5	70	mV	
Full-scale transition voltage	VFT*2			3215	3280	3345	mV	
Conversion time	tCONV			160/fADC*3			µs	
Sampling time	tsAMP			12/fADC*3			µs	
Reference input voltage	VREF	AVREF	VDD = 4.5 to 5.5V	VDD - 0.5		VDD	V	
			VDD = 3.0 to 3.6V	VDD - 0.3		VDD	V	
Analog input voltage	VIAN	AN0 to AN7		0		AVREF	V	
AVREF current	IREF	AVREF	Operation mode	VDD = 5.5V		0.6	1.0	mA
				VDD = 3.6V		0.4	0.7	mA
	IREFS		SLEEP mode STOP mode 32kHz operation mode				10	µA

Fig.6. Definition of A/D converter terms



*1 VZT: Value at which the digital conversion value changes from 00H to 01H and vice versa.

*2 VFT: Value at which the digital conversion value changes from FEH to FFH and vice versa.

*3 fADC indicates the below values due to the contents of bit 6 (CKS) of the A/D control register (ADC: 00F9H) and bits 7 (PCK1) and 6 (PCK0) of the clock control register (CLC: 00FEH).

CKS PCK1, PCK0	0(φ/2 selection)	1(φ selection)
	00 (φ = fEX/2)	fADC = fc/2
01 (φ = fEX/4)	fADC = fc/4	fADC = fc/2
11 (φ = fEX/16)	fADC = fc/16	fADC = fc/8

(4) Interruption, reset input ($T_a = -20$ to $+75^\circ\text{C}$, $V_{DD} = 3.0$ to 5.5V , $V_{SS} = 0\text{V}$ reference)

Item	Symbol	Pin	Condition	Min.	Max.	Unit
External interruption High, Low level width	t_{IH} t_{IL}	INT0 INT1 INT2 INT3 INT4 $\overline{\text{NMI}}$		1		μs
Reset input Low level width	t_{RSL}	$\overline{\text{RST}}$		$32/f_c$		μs

Fig. 7. Interruption input timing

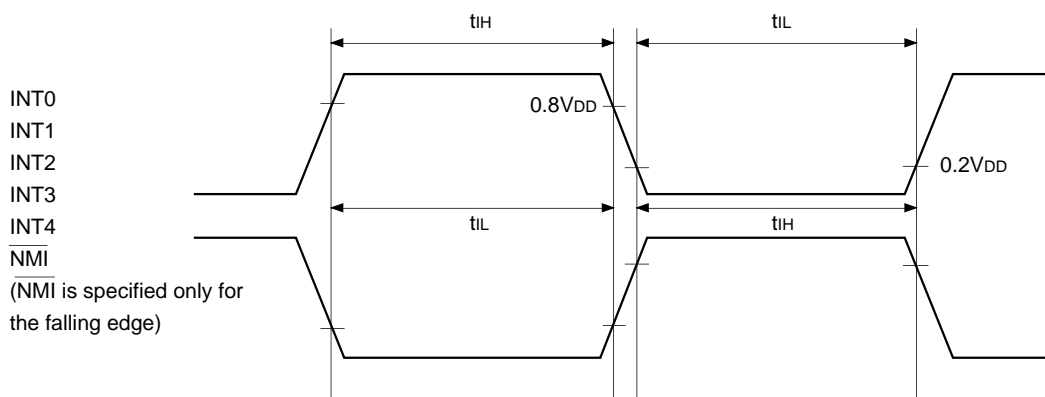
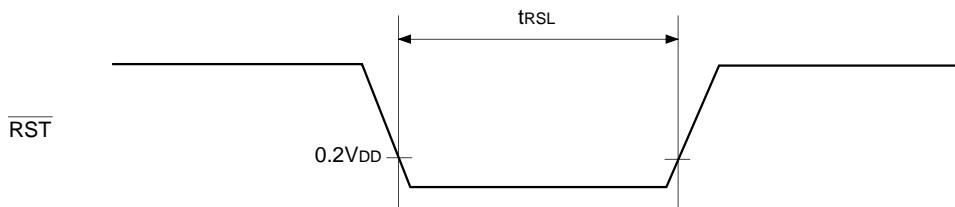


Fig. 8. $\overline{\text{RST}}$ input timing



(5) I²C bus timing

(Ta = -20 to +75°C, V_{DD} = 4.5 to 5.5V, V_{SS} = 0V reference)

Item	Symbol	Pin	Condition	Min.	Max.	Unit
SCL clock frequency	f _{SCL}	SCL		0	100	kHz
Bus-free time before starting transfer	t _{BUF}	SDA, SCL		4.7		μs
Hold time for starting transfer	t _{HD; STA}	SDA, SCL		4.0		μs
Clock Low level width	t _{LOW}	SCL		4.7		μs
Clock High level width	t _{HIGH}	SCL		4.0		μs
Setup time for repetitive transfers	t _{SU; STA}	SDA, SCL		4.7		μs
Data hold time	t _{HD; DAT}	SDA, SCL		0*1		μs
Data setup time	t _{SU; DAT}	SDA, SCL		250		ns
SDA, SCL rise time	t _R	SDA, SCL			1	μs
SDA, SCL fall time	t _F	SDA, SCL			300	ns
Setup time for transfer completion	t _{SU; STO}	SDA, SCL		4.7		μs

*1 The data hold time must exceed 300ns because the SCL rise time (300ns max.) is not taken into consideration.

Fig. 9. I²C bus transfer timing

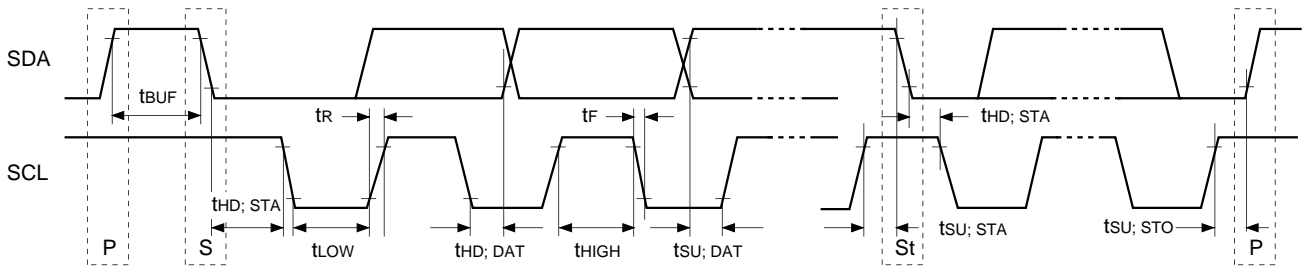
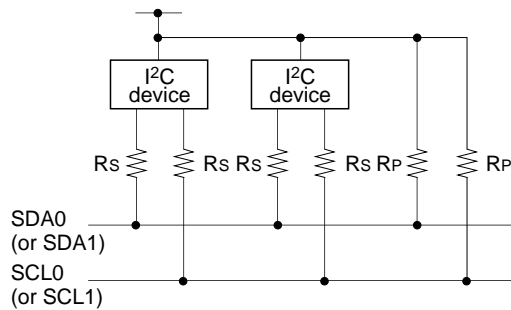


Fig. 10. Recommended circuit example for I²C device



- Pull-up resistors (R_P) must be connected to SDA0 (or SDA1) and SCL0 (or SCL1).
- Serial resistance (R_s = 300Ω or less) of SDA0 (or SDA1) and SCL0 (or SCL1) reduces spike noise caused by CRT flash-over.

Appendix

Fig. 11. SPC700 Series recommended oscillation circuit

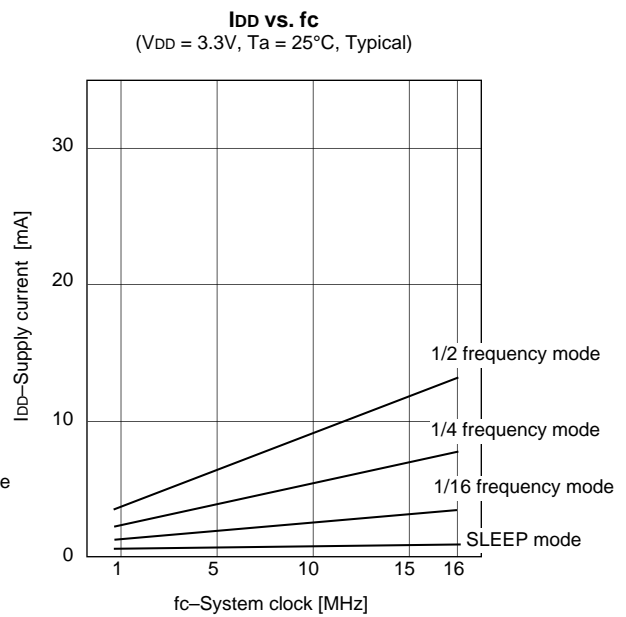
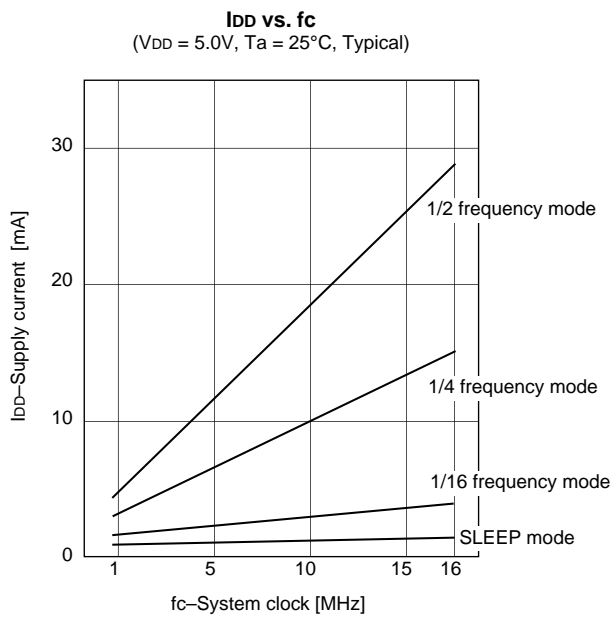
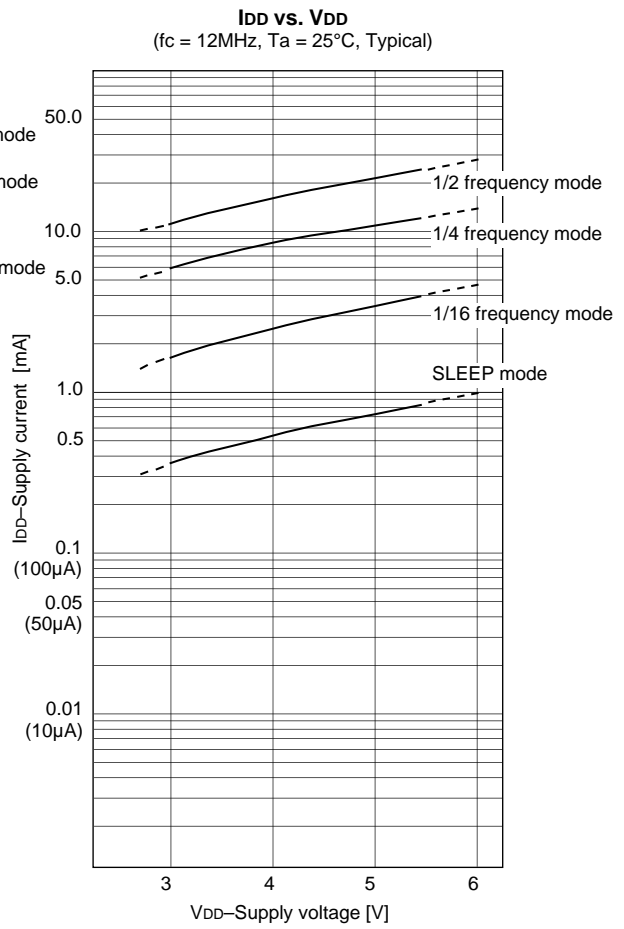
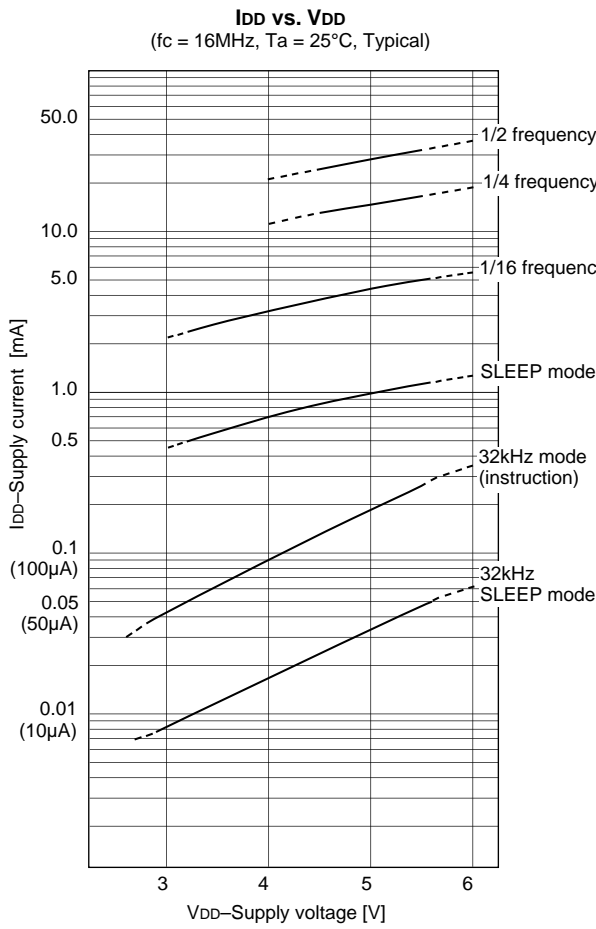


Manufacturer	Model	fc (MHz)	C1 (pF)	C2 (pF)	Rd (Ω)	Circuit example
RIVER ELETEC CO., LTD.	HC-49/U03	8.00	10	10	0	(i)
		10.00	5	5		
		12.00				
		16.00				
KINSEKI LTD.	HC-49/U (-S)	8.00	16 (12)	16 (12)	0	(i)
		10.00	16 (12)	16 (12)	0	
		12.00	12	12	0	
		16.00	12	12	0	
	P3	32.768kHz	30	18	470k	(ii)

Mask option table

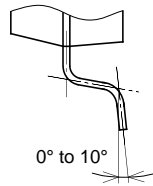
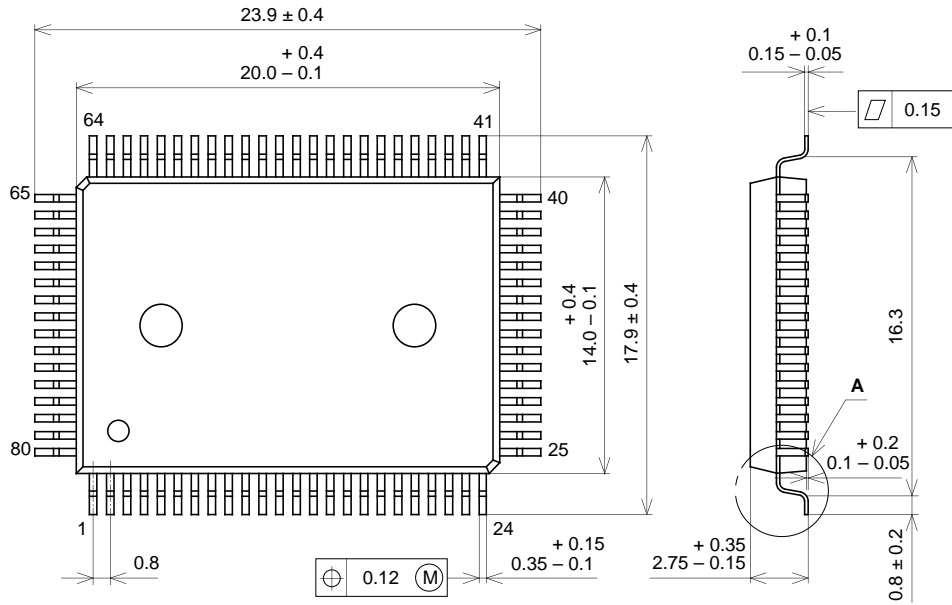
Item	Content	
	Reset pin pull-up resistor	Non-existent

Characteristics Curve



Package Outline Unit: mm

80PIN QFP (PLASTIC)



DETAIL A

SONY CODE	QFP-80P-L01
EIAJ CODE	*QFP080-P-1420-A
JEDEC CODE	_____

PACKAGE STRUCTURE

PACKAGE MATERIAL	EPOXY RESIN
LEAD TREATMENT	SOLDER PLATING
LEAD MATERIAL	COPPER / 42 ALLOY
PACKAGE WEIGHT	1.6g