

**SONY**

# CXP84540/84548

## CMOS 8-bit Single Chip Microcomputer

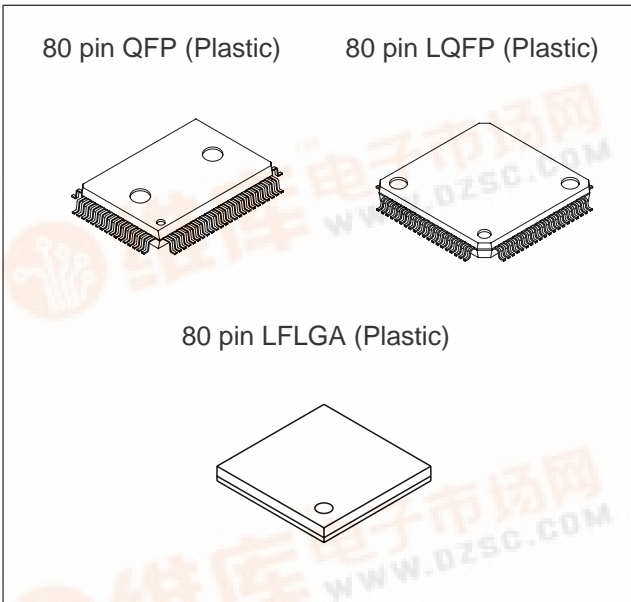
### Description

The CXP84540/84548 is a CMOS 8-bit micro-computer integrating on a single chip an A/D converter, serial interface, timer/counter, time-base timer, capture timer/counter, PWM output and the like besides the basic configurations of 8-bit CPU, ROM, RAM and I/O port.

The CXP84540/84548 also provide a sleep/stop functions that enable to execute the power-on reset function or lower the power consumption.

### Features

- Wide range instruction system (213 instructions) which covers various of data
  - 16-bit arithmetic/multiplication and division/Boolean bit operation instructions
- Minimum instruction cycle      143ns at 28MHz operation (4.5 to 5.5V)  
 200ns at 20kHz operation (3.0 to 5.5V)
- Incorporated ROM capacity      40K bytes (CXP84540)  
 48K bytes (CXP84548)
- Incorporated RAM capacity      1472 bytes
- Peripheral functions
  - A/D converter                      8 bits, 8 channels, successive approximation method (Conversion time of 1.93μs / at 28MHz, 2.7μs / at 20MHz)
  - Serial interface                    Incorporated 8-bit, 8-stage FIFO (Auto transfer for 1 to 8 bytes, latch output function, MSB/LSB first selectable), 1 channel  
 8-bit clock synchronization, 1 channel
  - Timer                                  8-bit timer  
 8-bit timer/counter  
 19-bit time-base timer  
 16-bit capture time/counter
  - PWM output                        8 bits, 2 channels
- Interruption                        14 factors, 14 vectors, multi-interruption possible
- Standby mode                        Sleep/Stop
- Package                                80-pin plastic QFP/LQFP  
 80-pin plastic LFLGA
- Piggyback/evaluator              CXP84500

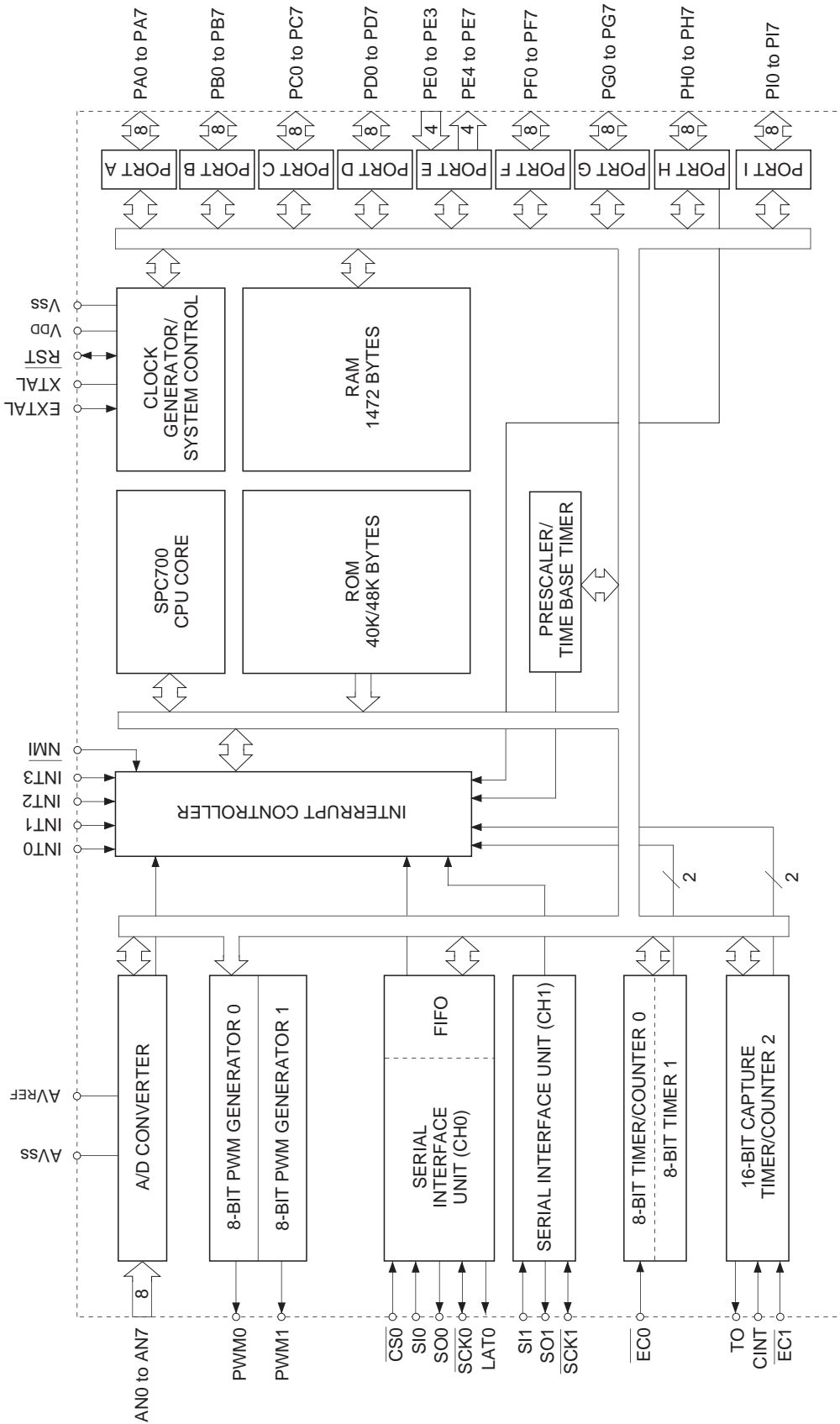


### Structure

Silicon gate CMOS IC

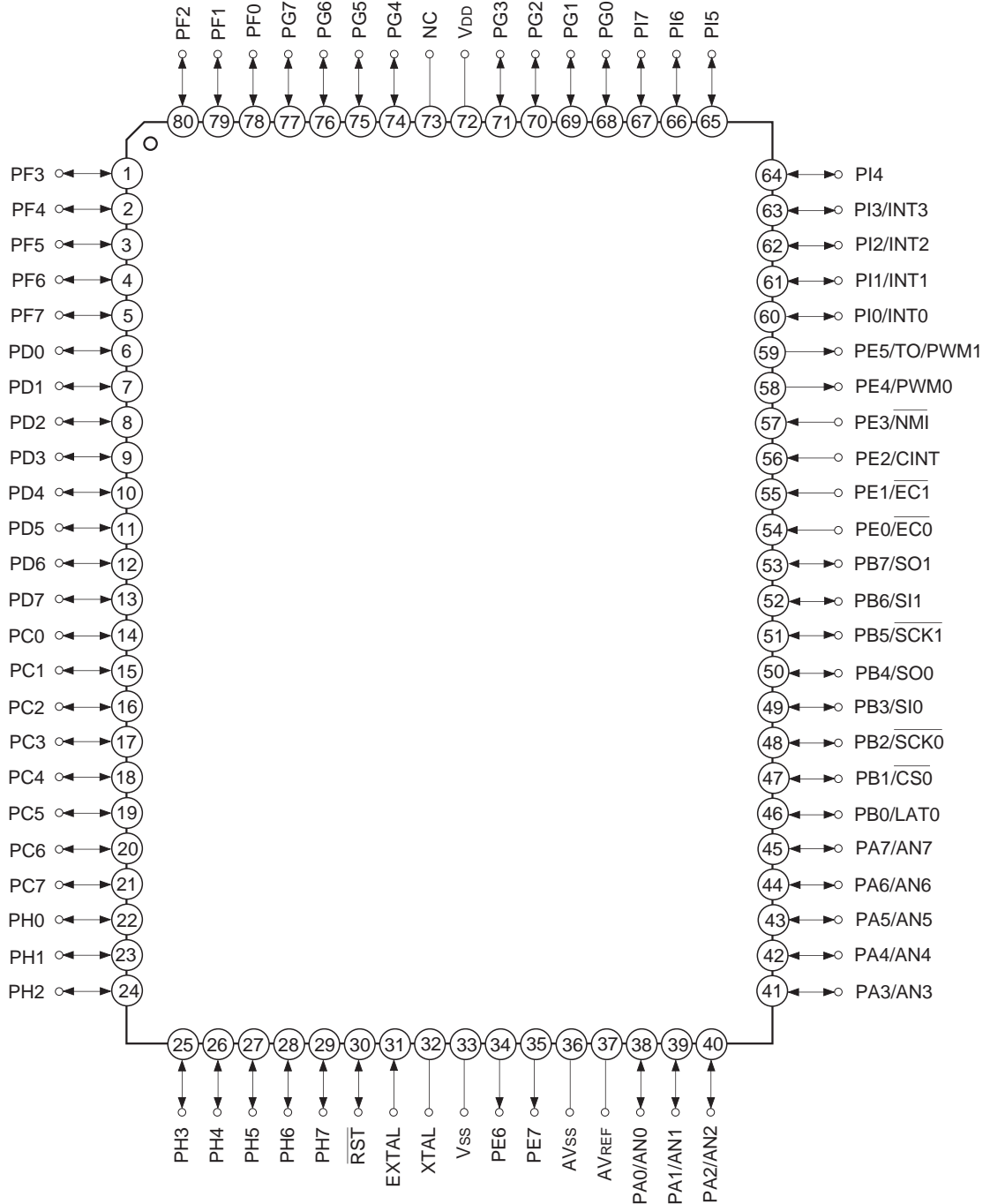
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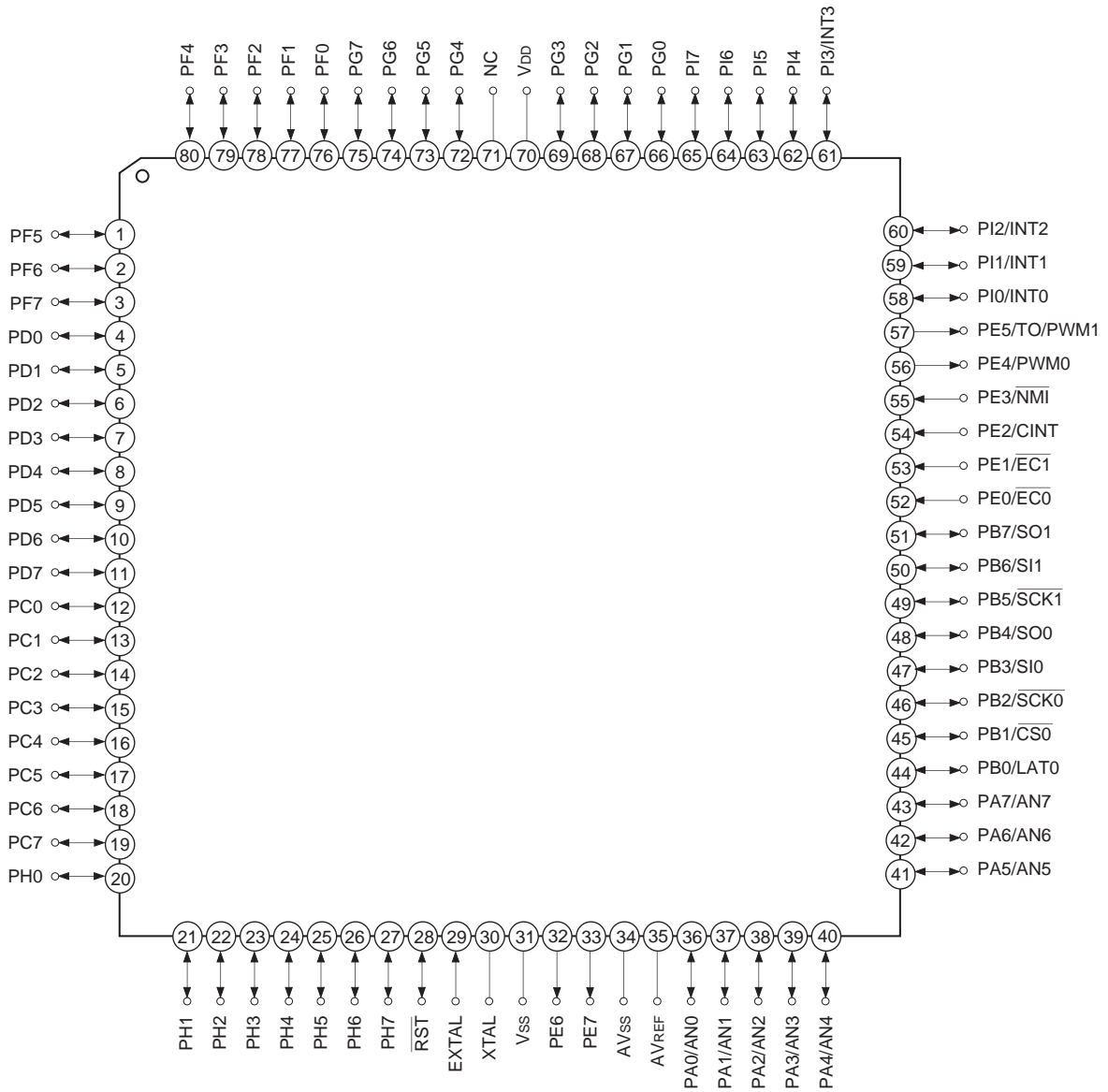
Block Diagram

Pin Assignment (Top View) 80-pin QFP package



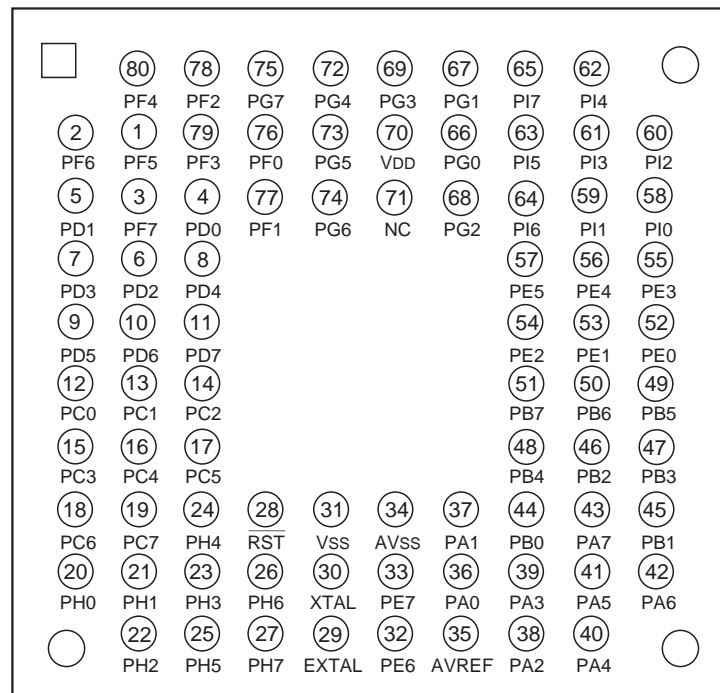
**Note)** NC (Pin 73) is left open. However, this pin is used for the Flash EEPROM incorporated version (CXP845F60).

Pin Assignment (Top View) 80-pin LQFP package



**Note)** NC (Pin 73) is left open.

Pin Assignment (Top View) 80-pin LFLGA package



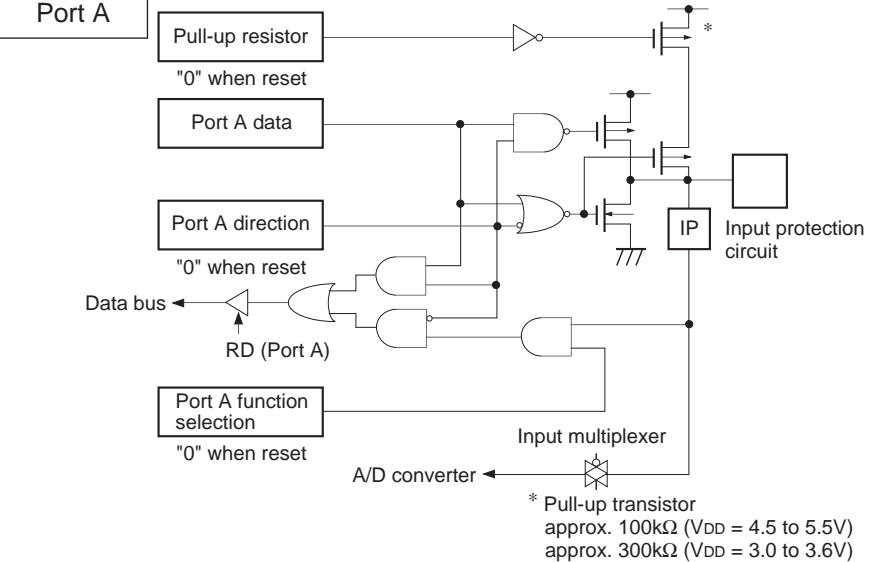
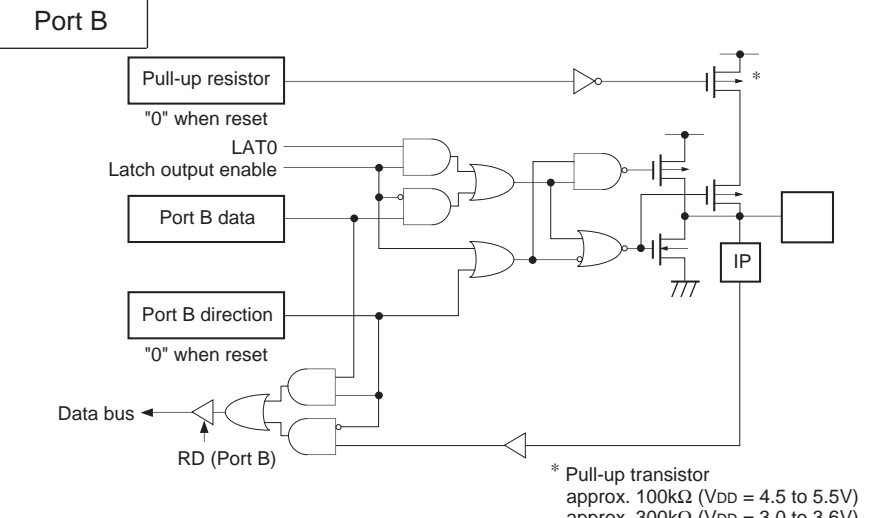
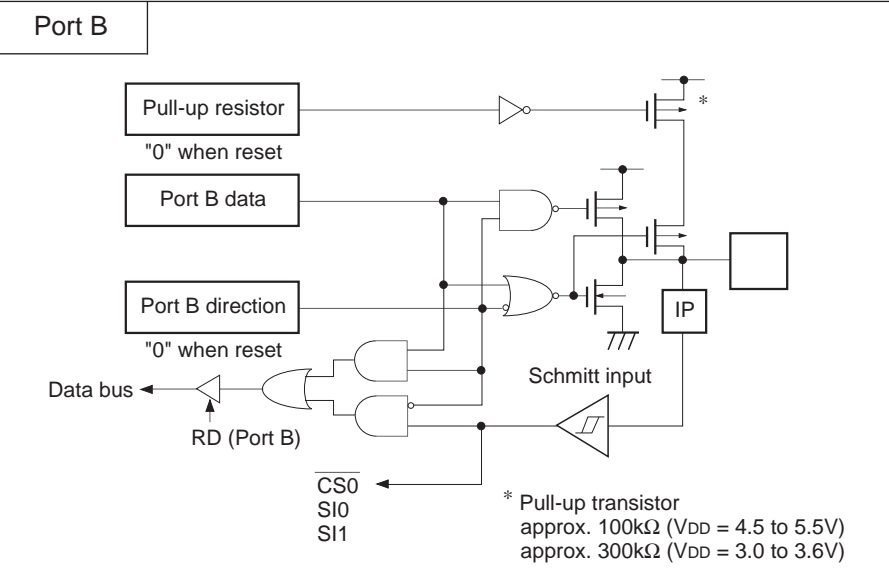
**Note)** NC (Pin 71) is left open.

Pin Description

Symbol	I/O	Description	
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/LAT0	I/O/Output	(Port B) 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)	Latch output for serial interface (CH0).
PB1/ $\overline{\text{CS0}}$	I/O/Input		Chip select input for serial interface (CH0).
PB2/ $\overline{\text{SCK0}}$	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/ $\overline{\text{SCK1}}$	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. Can drive 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/ $\overline{\text{EC0}}$	Input/Input	(Port E) 8-bit port. Lower 4 bits are for inputs; upper 4 bits are for outputs. (8 pins)	External event inputs for timer/counter. (2 pins)
PE1/ $\overline{\text{EC1}}$	Input/Input		Capture trigger input.
PE2/CINT	Input/Input		Non-maskable interruption request input.
PE3/ $\overline{\text{NMI}}$	Input/Input		8-bit PWM0 output.
PE4/PWM0	Output/Output		Rectangular wave output for 16-bit timer/counter and 8-bit PWM1 output.
PE5/TO/ PWM1	Output/Output/ Output		
PE6	Output		
PE7	Output		
PF0 to PF7	I/O	(Port F) 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)	

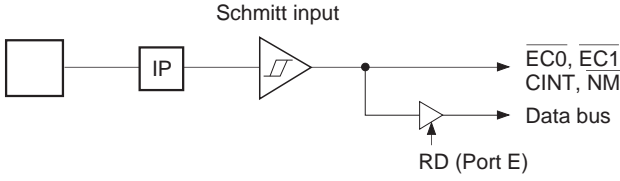
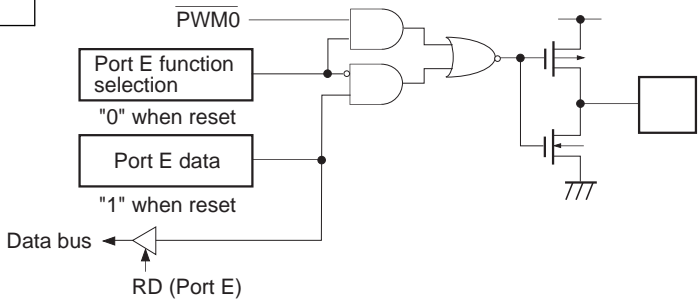
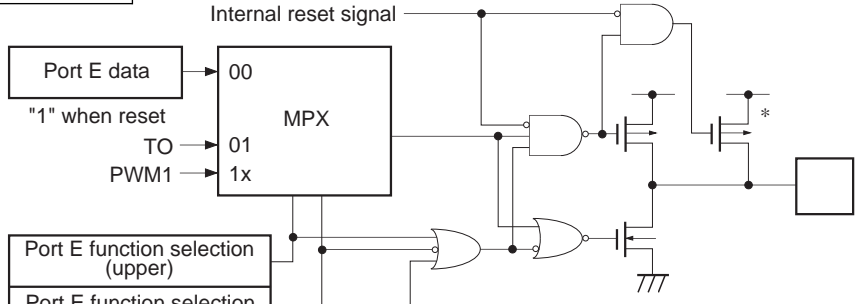
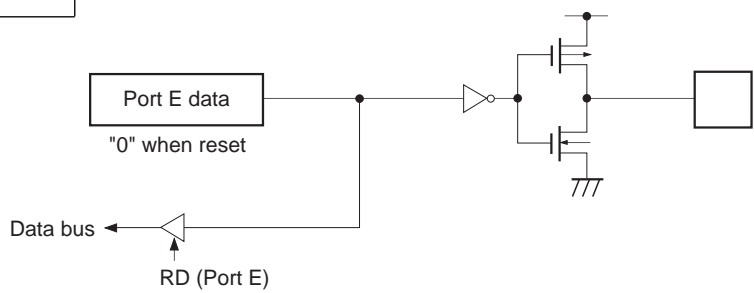
Symbol	I/O	Description	
PG0 to PG7	I/O	(Port G) 8-bit I/O port. I/O can be set in a unit of single bits. Incorporation of pull-up resistor can be set through the software in a unit of 4 bits. (8 pins)	
PH0 to PH7	I/O	(Port H) 8-bit I/O port. I/O and standby release input function can be set in a unit 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 PI3/INT3	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. (4 pins)
PI4 to PI7	I/O		
EXTAL	Input	Crystal connectors for system clock oscillation. When the clock is supplied externally, input it to EXTAL; opposite phase clock should be input to XTAL.	
XTAL	Output		
$\overline{\text{RST}}$	I/O	System reset for active at Low level. This pin is I/O pin, and outputs Low level at the power on with the power-on reset function executed. (Mask option)	
NC		No connected. Leave this pin open. However, this is used for the Flash EEPROM incorporated version (CXP845F60).	
AVREF	Input	Reference voltage input for A/D converter.	
AVss		A/D converter GND.	
VDD		Positive power supply.	
Vss		GND	

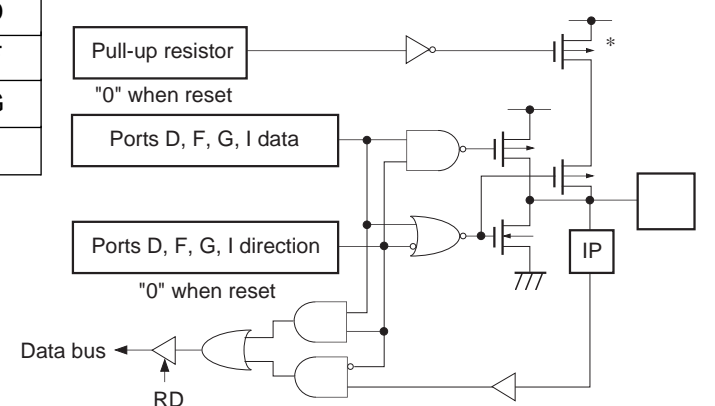
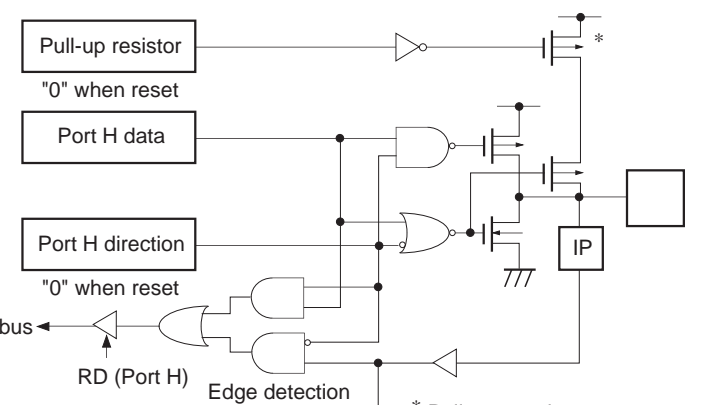
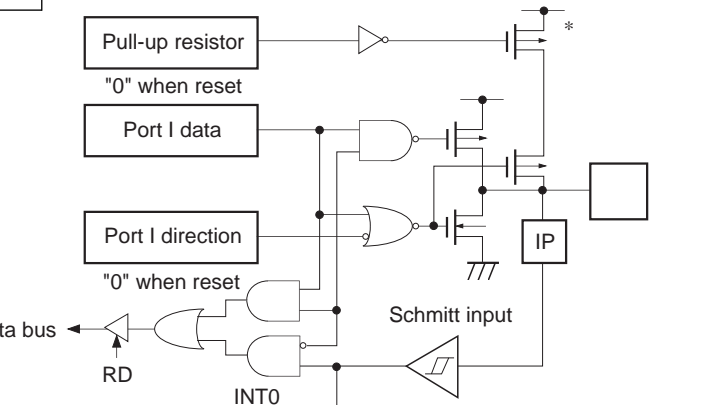
Input/Output Circuit Formats for Pins

Pin	Circuit format	When reset
<p>PA0/AN0 to PA7/AN7</p> <p>8 pins</p>	<p>Port A</p>  <p>* Pull-up transistor approx. 100kΩ (V<sub>DD</sub> = 4.5 to 5.5V) approx. 300kΩ (V<sub>DD</sub> = 3.0 to 3.6V)</p>	<p>Hi-Z</p>
<p>PB0/LAT0</p> <p>1 pin</p>	<p>Port B</p>  <p>* Pull-up transistor approx. 100kΩ (V<sub>DD</sub> = 4.5 to 5.5V) approx. 300kΩ (V<sub>DD</sub> = 3.0 to 3.6V)</p>	<p>Hi-Z</p>
<p>PB1/<math>\overline{\text{CS0}}</math> PB3/SI0 PB6/SI1</p> <p>3 pins</p>	<p>Port B</p>  <p>* Pull-up transistor approx. 100kΩ (V<sub>DD</sub> = 4.5 to 5.5V) approx. 300kΩ (V<sub>DD</sub> = 3.0 to 3.6V)</p>	<p>Hi-Z</p>



Pin	Circuit format	When reset
<p>PB2/<math>\overline{\text{SCK0}}</math> PB5/<math>\overline{\text{SCK1}}</math></p> <p>2 pins</p>	<p>Port B</p> <p>Pull-up resistor "0" when reset</p> <p><math>\overline{\text{SCK0}}</math> OUT</p> <p>Serial clock output enable</p> <p>Port B function selection "0" when reset</p> <p>Port B data</p> <p>Port B direction "0" when reset</p> <p>Data bus</p> <p>RD (Port B)</p> <p><math>\overline{\text{SCK0}}</math>, <math>\overline{\text{SCK1}}</math> in</p> <p>Schmitt input</p> <p>* Pull-up transistor approx. 100k<math>\Omega</math> (<math>V_{DD} = 4.5</math> to 5.5V) approx. 300k<math>\Omega</math> (<math>V_{DD} = 3.0</math> to 3.6V)</p>	<p>Hi-Z</p>
<p>PB4/<math>\overline{\text{SO0}}</math> PB7/<math>\overline{\text{SO1}}</math></p> <p>2 pins</p>	<p>Port B</p> <p>Pull-up resistor "0" when reset</p> <p>SO</p> <p>Serial data output enable</p> <p>Port B function selection "0" when reset</p> <p>Port B data</p> <p>Port B direction "0" when reset</p> <p>Data bus</p> <p>RD (Port B)</p> <p>* Pull-up transistor approx. 100k<math>\Omega</math> (<math>V_{DD} = 4.5</math> to 5.5V) approx. 300k<math>\Omega</math> (<math>V_{DD} = 3.0</math> to 3.6V)</p>	<p>Hi-Z</p>
<p>PC0 to PC7</p> <p>8 pins</p>	<p>Port C</p> <p>Pull-up resistor "0" when reset</p> <p>Port C data</p> <p>Port C direction "0" when reset</p> <p>Data bus</p> <p>RD (Port C)</p> <p>*1 Large current drive (12mA: <math>V_{DD} = 4.5</math> to 5.5V) (5mA: <math>V_{DD} = 3.0</math> to 3.6V)</p> <p>*2 Pull-up transistor approx. 100k<math>\Omega</math> (<math>V_{DD} = 4.5</math> to 5.5V) approx. 300k<math>\Omega</math> (<math>V_{DD} = 3.0</math> to 3.6V)</p>	<p>Hi-Z</p>

Pin	Circuit format	When reset
<p>PE0/<math>\overline{EC0}</math> PE1/<math>\overline{EC1}</math> PE2/CINT PE3/<math>\overline{NMI}</math></p> <p>4 pins</p>	<p>Port E</p> 	<p>Hi-Z</p>
<p>PE4/PWM0</p> <p>1 pin</p>	<p>Port E</p> 	<p>High level</p>
<p>PE5/TO/ PWM1</p> <p>1 pin</p>	<p>Port E</p>  <p>* Pull-up transistor approx. 150k<math>\Omega</math> (<math>V_{DD} = 4.5</math> to <math>5.5V</math>) approx. 400k<math>\Omega</math> (<math>V_{DD} = 3.0</math> to <math>3.6V</math>)</p>	<p>High level (with resistor of pull-up transistor ON for reset)</p>
<p>PE6, PE7</p> <p>2 pins</p>	<p>Port E</p> 	<p>Low level</p>

Pin	Circuit format	When reset
<p>PD0 to PD7 PF0 to PF7 PG0 to PG7 PI4 to PI7</p> <p>28 pins</p>	<p>Port D Port F Port G Port I</p>  <p>Pull-up resistor "0" when reset</p> <p>Ports D, F, G, I data</p> <p>Ports D, F, G, I direction "0" when reset</p> <p>Data bus</p> <p>RD</p> <p>* Pull-up transistor approx. 100kΩ (V<sub>DD</sub> = 4.5 to 5.5V) approx. 300kΩ (V<sub>DD</sub> = 3.0 to 3.6V)</p>	<p>Hi-Z</p>
<p>PH0 to PH7</p> <p>8 pins</p>	<p>Port H</p>  <p>Pull-up resistor "0" when reset</p> <p>Port H data</p> <p>Port H direction "0" when reset</p> <p>Data bus</p> <p>RD (Port H)</p> <p>Edge detection</p> <p>Standby release</p> <p>* Pull-up transistor approx. 100kΩ (V<sub>DD</sub> = 4.5 to 5.5V) approx. 300kΩ (V<sub>DD</sub> = 3.0 to 3.6V)</p>	<p>Hi-Z</p>
<p>PI0/INT0 to PI3/INT3</p> <p>4 pins</p>	<p>Port I</p>  <p>Pull-up resistor "0" when reset</p> <p>Port I data</p> <p>Port I direction "0" when reset</p> <p>Data bus</p> <p>RD</p> <p>Schmitt input</p> <p>INT0 INT1 INT2 INT3</p> <p>* Pull-up transistor approx. 100kΩ (V<sub>DD</sub> = 4.5 to 5.5V) approx. 300kΩ (V<sub>DD</sub> = 3.0 to 3.6V)</p>	<p>Hi-Z</p>

Pin	Circuit format	When reset
<p>EXTAL XTAL</p> <p>2 pins</p>	<ul style="list-style-type: none"> <li>• Diagram shows the circuit composition during oscillation.</li> <li>• Feedback resistor is removed during stop mode and XTAL becomes High level.</li> </ul>	<p>Oscillation</p>
<p><math>\overline{\text{RST}}</math></p> <p>1 pin</p>	<p>Pull-up resistor</p> <p>Mask option</p> <p>Schmitt input</p> <p>From power-on reset circuit (Mask option)</p>	<p>Low level</p>

## Absolute Maximum Ratings

(V<sub>SS</sub> = 0V reference)

Item	Symbol	Ratings	Unit	Remarks
Supply voltage	V <sub>DD</sub>	-0.3 to +7.0	V	
	AV <sub>SS</sub>	-0.3 to +0.3	V	
Input voltage	V <sub>IN</sub>	-0.3 to +7.0*1	V	
Output voltage	V <sub>OUT</sub>	-0.3 to +7.0*1	V	
High level output current	I <sub>OH</sub>	-5	mA	Output (value per pin)
High level total output current	∑I <sub>OH</sub>	-50	mA	Total of all output pins
Low level output current	I <sub>OL</sub>	15	mA	Pins excluding large current outputs (value per pin)
	I <sub>OLC</sub>	20	mA	Large current outputs (value per pin*2)
Low level total output current	∑I <sub>OL</sub>	100	mA	Total of all output pins
Operating temperature	T <sub>opr</sub>	-20 to +75	°C	
Storage temperature	T <sub>stg</sub>	-55 to +150	°C	
Allowable power dissipation	P <sub>D</sub>	600	mW	QFP-80P-L01
		380	mW	LQFP-80P-L01
		500	mW	LFLGA-80P-02

\*1 V<sub>IN</sub> and V<sub>OUT</sub> must not exceed V<sub>DD</sub> + 0.3V.

\*2 The large current drive transistor is the N-ch transistor of Port C (PC)

**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<sub>SS</sub> = 0V reference)

Item	Symbol	Min.	Max.	Unit	Remarks
Supply voltage*1	V <sub>DD</sub>	4.5 (3.0)	5.5	V	Guaranteed operation range for 1/2 and 1/4 frequency dividing clocks
		3.5 (2.7)	5.5		Guaranteed operation range for 1/16 frequency dividing clock and sleep mode
		2.0	5.5		Guaranteed data hold range during stop mode
High level input voltage	V <sub>IH</sub>	0.7V <sub>DD</sub>	V <sub>DD</sub>	V	*2
	V <sub>IHS</sub>	0.8V <sub>DD</sub>	V <sub>DD</sub>	V	Hysteresis input*3
	V <sub>IHEX</sub>	0.9V <sub>DD</sub>	V <sub>DD</sub> + 0.3	V	EXTAL*4
Low level input voltage	V <sub>IL</sub>	0	0.3V <sub>DD</sub>	V	*2
	V <sub>ILS</sub>	0	0.2V <sub>DD</sub>	V	Hysteresis input*3
	V <sub>ILEX</sub>	-0.3	0.1V <sub>DD</sub>	V	EXTAL*4
Operating temperature	T <sub>opr</sub>	-20	+75	°C	

\*1 Specifies values in parenthesis for 1 to 20MHz system clock operation.

\*2 Normal input ports (PA, PB0, PB4, PB7, PC, PE0 to PE3, PD, PF to PH, PI4 to PI7)

\*3 RST, CINT, CS0, SCK0, SCK1, EC0, EC1, SI0, SI1, NMI, INT0, INT1, INT2, INT3

\*4 Specifies only during external clock input.

**Electrical Characteristics**

**DC Characteristics** ( $V_{DD}$  4.5 to 5.5V)

( $T_a = -20$  to  $+75^\circ\text{C}$ ,  $V_{SS} = 0\text{V}$  reference)

Item	Symbol	Pins	Conditions	Min.	Typ.	Max.	Unit
High level output voltage	$V_{OH}$	PA to PD, PE4 to PE7, PF to PI, $\overline{RST}$ (only $V_{OL}$ )*1	$V_{DD} = 4.5\text{V}$ , $I_{OH} = -0.5\text{mA}$	4.0			V
			$V_{DD} = 4.5\text{V}$ , $I_{OH} = -1.2\text{mA}$	3.5			V
Low level output voltage	$V_{OL}$	PA to PD, PE4 to PE7, PF to PI, $\overline{RST}$ (only $V_{OL}$ )*1	$V_{DD} = 4.5\text{V}$ , $I_{OL} = 1.8\text{mA}$			0.4	V
			$V_{DD} = 4.5\text{V}$ , $I_{OL} = 3.6\text{mA}$			0.6	V
		PC	$V_{DD} = 4.5\text{V}$ , $I_{OL} = 12.0\text{mA}$			1.5	V
Input current	$I_{IHE}$	EXTAL	$V_{DD} = 5.5\text{V}$ , $V_{IH} = 5.5\text{V}$	0.1		25	$\mu\text{A}$
	$I_{ILE}$		$V_{DD} = 5.5\text{V}$ , $V_{IL} = 0.4\text{V}$	-0.1		-25	$\mu\text{A}$
	$I_{ILR}$	$\overline{RST}$ *2	$V_{DD} = 5.5\text{V}$ , $V_{IL} = 4.0\text{V}$	-1.5		-400	$\mu\text{A}$
	$I_{IL}$	PA to PD*3 PF to PI*3	$V_{DD} = 4.5\text{V}$ , $V_{IL} = 4.0\text{V}$	-2.78		-50	$\mu\text{A}$
I/O leakage current	$I_{IZ}$	PA to PD*3 PF to PI*3 PE0 to PE3, $\overline{RST}$ *2	$V_{DD} = 5.5\text{V}$ , $V_I = 0, 5.5\text{V}$			$\pm 10$	$\mu\text{A}$
Supply current *4	$I_{DD1}$	$V_{DD}$	1/2 frequency dividing clock operation $V_{DD} = 5.5\text{V}$ , 28MHz crystal oscillation ( $C_1 = C_2 = 5\text{pF}$ )		28	58	mA
	$I_{DD2}$						
	$I_{DDS1}$		Sleep mode		4.0	10	mA
	$I_{DDS2}$		$V_{DD} = 5.5\text{V}$ , 28MHz crystal oscillation ( $C_1 = C_2 = 5\text{pF}$ )				
	$I_{DDS3}$		Stop mode $V_{DD} = 5.5\text{V}$ , termination of 28MHz crystal oscillation			10	$\mu\text{A}$
Input capacity	$C_{IN}$	PA to PD, PE0 to PE3, PF to PI, EXTAL, $\overline{RST}$	Clock 1MHz 0V for no-measured pins		10	20	pF

\*1 Specifies  $\overline{RST}$  pin when the power-on reset circuit is selected with mask option.

\*2 For  $\overline{RST}$  pin, specifies the input current when pull-up resistance is selected; leakage current when no resistance is selected.

\*3 For PA to PD and PF to PI pins, specifies the input current when pull-up resistance is selected; leakage current when no resistance is selected.

\*4 When all pins are open.

DC Characteristics ( $V_{DD} = 3.0$  to  $3.6V$ )( $T_a = -20$  to  $+75^\circ C$ ,  $V_{SS} = 0V$  reference)

Item	Symbol	Pins	Conditions	Min.	Typ.	Max.	Unit
High level output voltage	$V_{OH}$	PA to PD, PE4 to PE7, PF to PI, $\overline{RST}$ (only $V_{OL}$ )*1	$V_{DD} = 3.0V$ , $I_{OH} = -0.15mA$	2.7			V
			$V_{DD} = 3.0V$ , $I_{OH} = -0.5mA$	2.3			V
Low level output voltage	$V_{OL}$	PA to PD, PE4 to PE7, PF to PI, $\overline{RST}$ (only $V_{OL}$ )*1	$V_{DD} = 3.0V$ , $I_{OL} = 1.2mA$			0.3	V
			$V_{DD} = 3.0V$ , $I_{OL} = 1.6mA$			0.5	V
		PC	$V_{DD} = 3.0V$ , $I_{OL} = 5mA$			1.0	V
Input current	$I_{IHE}$	EXTAL	$V_{DD} = 3.6V$ , $V_{IH} = 3.6V$	0.05		15	$\mu A$
	$I_{ILE}$		$V_{DD} = 3.6V$ , $V_{IL} = 0.3V$	-0.05		-15	$\mu A$
	$I_{ILR}$	$\overline{RST}$ *2	$V_{DD} = 3.6V$ , $V_{IL} = 2.7V$	-0.7		-200	$\mu A$
	$I_{IL}$	PA to PD*3 PF to PI*3	$V_{DD} = 3.6V$ , $V_{IL} = 2.7V$			-30	$\mu A$
			$V_{DD} = 3.0V$ , $V_{IL} = 2.7V$	-1.0			$\mu A$
I/O leakage current	$I_{IZ}$	PA to PD*3 PF to PI*3 PE0 to PE3, $\overline{RST}$ *2	$V_{DD} = 3.6V$ , $V_I = 0, 3.6V$			$\pm 5$	$\mu A$
Supply current*4	$I_{DD1}$	$V_{DD}$	1/2 frequency dividing clock operation		13.5	30	mA
	$I_{DD2}$		$V_{DD} = 3.6V$ , 20MHz crystal oscillation ( $C_1 = C_2 = 10pF$ )				
	$I_{DDS1}$		Sleep mode		1.2	4.0	mA
	$I_{DDS2}$		$V_{DD} = 3.6V$ , 20MHz crystal oscillation ( $C_1 = C_2 = 10pF$ )				
	$I_{DDS3}$		Stop mode				
			$V_{DD} = 3.6V$ , termination of 20MHz crystal oscillation				

\*1 Specifies  $\overline{RST}$  pin when the power-on reset circuit is selected with mask option.

\*2 For  $\overline{RST}$  pin, specifies the input current when pull-up resistance is selected; leakage current when no resistance is selected.

\*3 For PA to PD and PF to PI pins, specifies the input current when pull-up resistance is selected; leakage current when no resistance is selected.

\*4 When all pins are open.

AC Characteristics

(1) Clock timing

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

Item	Symbol	Pin	Conditions	Min.	Typ.	Max.	Unit
System clock frequency	$f_c$	XTAL EXTAL	Fig. 1, Fig. 2	$V_{DD} = 4.5$ to $5.5\text{V}$	1	28	MHz
					1	20	
System clock input pulse width	$t_{XL}$ , $t_{XH}$	EXTAL	Fig. 1, Fig. 2 External clock drive	$V_{DD} = 4.5$ to $5.5\text{V}$	15.6		ns
					23		
System clock input rise time, fall time	$t_{CR}$ , $t_{CF}$	EXTAL	Fig. 1, Fig. 2 External clock drive			100	ns
Event count input clock pulse width	$t_{EH}$ , $t_{EL}$	$\overline{\text{EC0}}$ $\overline{\text{EC1}}$	Fig. 3			$t_{\text{sys}} + 50^{*1}$	ns
Event count input clock rise time, fall time	$t_{ER}$ , $t_{EF}$	$\overline{\text{EC0}}$ $\overline{\text{EC1}}$	Fig. 3			20	ns

\*1  $t_{\text{sys}}$  indicates three values according to the contents of the clock control register (CLC: 00FEh) upper 2 bits (CPU clock selection).

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

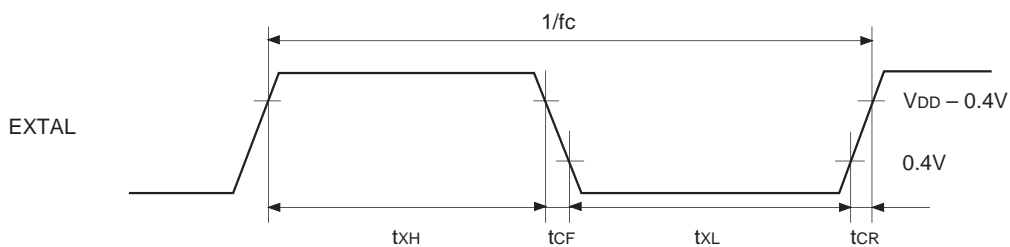


Fig. 1. Clock timing

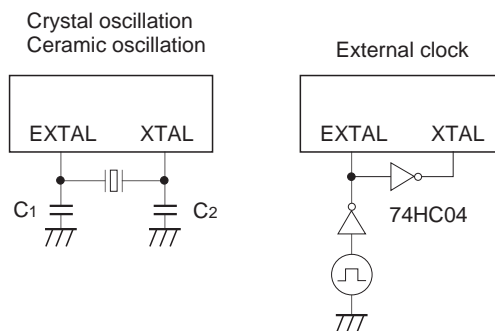


Fig. 2. Clock applied conditions

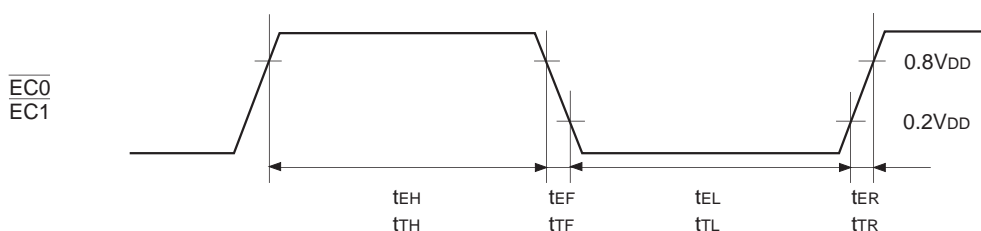


Fig. 3. Event count clock timing



## (2) Serial transfer (CH0)

(Ta = -20 to +75°C, V<sub>DD</sub> = 4.5 to 5.5V, V<sub>SS</sub> = 0V reference)

Item	Symbol	Pin	Condition	Min.	Max.	Unit
$\overline{CS0} \downarrow \rightarrow \overline{SCK0}$ delay time	t <sub>DCSK</sub>	$\overline{SCK0}$	Chip select transfer mode ( $\overline{SCK0}$ = output mode)		1.5t <sub>sys</sub> + 100	ns
$\overline{CS0} \uparrow \rightarrow \overline{SCK0}$ float delay time	t <sub>DCSKF</sub>	$\overline{SCK0}$	Chip select transfer mode ( $\overline{SCK0}$ = output mode)		1.5t <sub>sys</sub> + 100	ns
$\overline{CS0} \downarrow \rightarrow SO0$ delay time	t <sub>DCSO</sub>	SO0	Chip select transfer mode		1.5t <sub>sys</sub> + 100	ns
$\overline{CS0} \uparrow \rightarrow SO0$ float delay time	t <sub>DCSOF</sub>	SO0	Chip select transfer mode		1.5t <sub>sys</sub> + 100	ns
$\overline{CS0}$ High level width	t <sub>WHCS</sub>	$\overline{CS0}$	Chip select transfer mode	t <sub>sys</sub> + 150		ns
$\overline{SCK0}$ cycle time	t <sub>KCY</sub>	$\overline{SCK0}$	Input mode	2t <sub>sys</sub> + 200		ns
			Output mode	8000/fc		ns
$\overline{SCK0}$ High, Low level widths	t <sub>KH</sub> t <sub>KL</sub>	$\overline{SCK0}$	Input mode	t <sub>sys</sub> + 90		ns
			Output mode	4000/fc - 25		ns
SIO input setup time (for $\overline{SCK0} \uparrow$ )	t <sub>SIK</sub>	SIO	$\overline{SCK0}$ input mode	50		ns
			$\overline{SCK0}$ output mode	100		ns
SIO input hold time (for $\overline{SCK0} \uparrow$ )	t <sub>SKI</sub>	SIO	$\overline{SCK0}$ input mode	t <sub>sys</sub> + 100		ns
			$\overline{SCK0}$ output mode	50		ns
$\overline{SCK0} \downarrow \rightarrow SO0$ delay time	t <sub>KSO</sub>	SO0	$\overline{SCK0}$ input mode		t <sub>sys</sub> + 100	ns
			$\overline{SCK0}$ output mode		50	ns
$\overline{SCK0} \downarrow \rightarrow LAT0$ output delay time	t <sub>LADLY</sub>	LAT0	Latch output mode ( $\overline{SCK0}$ = output mode)	t <sub>KCY</sub>	t <sub>KCY</sub> + 50	ns
LAT0 data pulse width	t <sub>LAPLS</sub>	LAT0	Latch output mode ( $\overline{SCK0}$ = output mode)	t <sub>KCY</sub> - 10	t <sub>KCY</sub> + 50	ns

**Note 1)** t<sub>sys</sub> indicates three values according to the contents of the clock control register (CLC: 00FEh) upper 2 bits (CPU clock selection).

t<sub>sys</sub> [ns] = 2000/fc (Upper 2 bits = "00"), 4000/fc (Upper 2 bits = "01"), 16000/fc (Upper 2 bits = "11")

**Note 2)** The load condition for the  $\overline{SCK0}$  output mode, SO0 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
$\overline{\text{CS0}} \downarrow \rightarrow \overline{\text{SCK0}}$ delay time	t <sub>DCSK</sub>	$\overline{\text{SCK0}}$	Chip select transfer mode ( $\overline{\text{SCK0}}$ = output mode)		1.5t <sub>sys</sub> + 200	ns
$\overline{\text{CS0}} \uparrow \rightarrow \overline{\text{SCK0}}$ float delay time	t <sub>DCSKF</sub>	$\overline{\text{SCK0}}$	Chip select transfer mode ( $\overline{\text{SCK0}}$ = output mode)		1.5t <sub>sys</sub> + 200	ns
$\overline{\text{CS0}} \downarrow \rightarrow \text{SO0}$ delay time	t <sub>DCSO</sub>	SO0	Chip select transfer mode		1.5t <sub>sys</sub> + 200	ns
$\overline{\text{CS0}} \uparrow \rightarrow \text{SO0}$ float delay time	t <sub>DCSOF</sub>	SO0	Chip select transfer mode		1.5t <sub>sys</sub> + 200	ns
$\overline{\text{CS0}}$ High level width	t <sub>WHCS</sub>	$\overline{\text{CS0}}$	Chip select transfer mode	t <sub>sys</sub> + 200		ns
$\overline{\text{SCK0}}$ cycle time	t <sub>KCY</sub>	$\overline{\text{SCK0}}$	Input mode	2t <sub>sys</sub> + 200		ns
			Output mode	8000/fc		ns
$\overline{\text{SCK0}}$ High, Low level widths	t <sub>KH</sub> t <sub>KL</sub>	$\overline{\text{SCK0}}$	Input mode	t <sub>sys</sub> + 80		ns
			Output mode	4000/fc - 50		ns
SIO input setup time (for $\overline{\text{SCK0}} \uparrow$ )	t <sub>SIK</sub>	SIO	$\overline{\text{SCK0}}$ input mode	80		ns
			$\overline{\text{SCK0}}$ output mode	150		ns
SIO input hold time (for $\overline{\text{SCK0}} \uparrow$ )	t <sub>KSI</sub>	SIO	$\overline{\text{SCK0}}$ input mode	t <sub>sys</sub> + 120		ns
			$\overline{\text{SCK0}}$ output mode	70		ns
$\overline{\text{SCK0}} \downarrow \rightarrow \text{SO0}$ delay time	t <sub>KSO</sub>	SO0	$\overline{\text{SCK0}}$ input mode		t <sub>sys</sub> + 200	ns
			$\overline{\text{SCK0}}$ output mode		80	ns
$\overline{\text{SCK0}} \downarrow \rightarrow \text{LAT0}$ output delay time	t <sub>LADLY</sub>	LAT0	Latch output mode ( $\overline{\text{SCK0}}$ = output mode)	t <sub>KCY</sub>	t <sub>KCY</sub> + 100	ns
LAT0 data pulse width	t <sub>LAPLS</sub>	LAT0	Latch output mode ( $\overline{\text{SCK0}}$ = output mode)	t <sub>KCY</sub> - 10	t <sub>KCY</sub> + 100	ns

**Note 1)** t<sub>sys</sub> indicates three values according to the contents of the clock control register (CLC: 00FEh) upper 2 bits (CPU clock selection).

t<sub>sys</sub> [ns] = 2000/fc (Upper 2 bits = "00"), 4000/fc (Upper 2 bits = "01"), 16000/fc (Upper 2 bits = "11")

**Note 2)** The load condition for the  $\overline{\text{SCK0}}$  output mode, SO0 output delay time is 50pF + 1TTL.

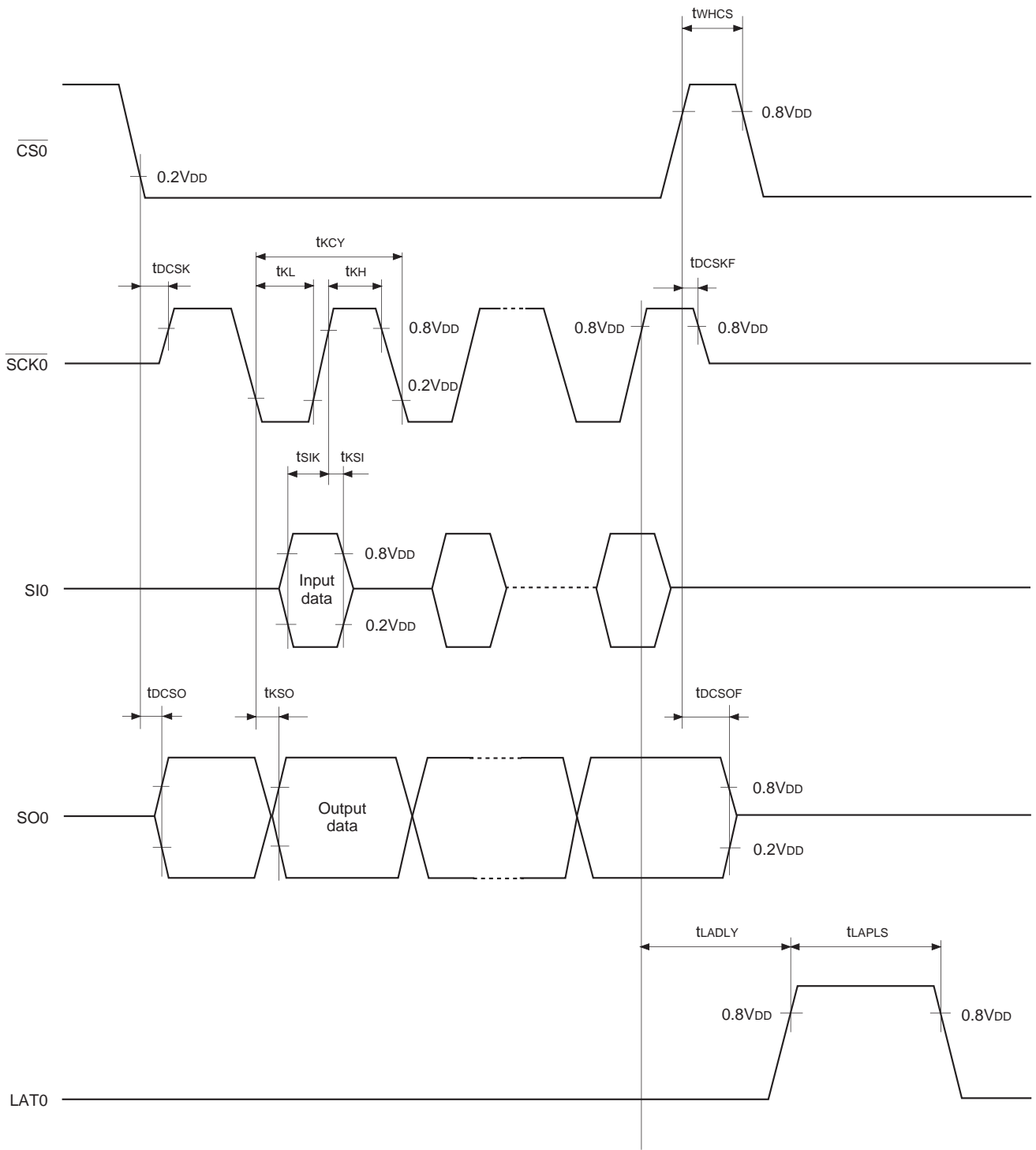


Fig. 4. Serial transfer CH0 timing

**(3) Serial transfer (CH1)**

( $T_a = -20$  to  $+75^\circ\text{C}$ ,  $V_{DD} = 4.5$  to  $5.5\text{V}$ ,  $V_{SS} = 0\text{V}$  reference)

Item	Symbol	Pin	Condition	Min.	Max.	Unit
$\overline{\text{SCK1}}$ cycle time	$t_{\text{KCY}}$	$\overline{\text{SCK1}}$	Input mode	500		ns
			Output mode	$8000/f_c$		ns
$\overline{\text{SCK1}}$ High, Low level widths	$t_{\text{KH}}$ $t_{\text{KL}}$	$\overline{\text{SCK1}}$	Input mode	200		ns
			Output mode	$4000/f_c - 25$		ns
SI1 input set-up time (for $\overline{\text{SCK1}}$ $\uparrow$ )	$t_{\text{SIK}}$	SI1	$\overline{\text{SCK1}}$ input mode	50		ns
			$\overline{\text{SCK1}}$ output mode	100		ns
SI1 input hold time (for $\overline{\text{SCK1}}$ $\uparrow$ )	$t_{\text{KSI}}$	SI1	$\overline{\text{SCK1}}$ input mode	100		ns
			$\overline{\text{SCK1}}$ output mode	50		ns
$\overline{\text{SCK1}}$ $\downarrow \rightarrow$ SO1 delay time	$t_{\text{KSO}}$	SO1	$\overline{\text{SCK1}}$ input mode		100	ns
			$\overline{\text{SCK1}}$ output mode		50	ns

**Note)** The load condition for the  $\overline{\text{SCK1}}$  output mode, SO1 output delay time is  $50\text{pF} + 1\text{TTL}$ .

( $T_a = -20$  to  $+75^\circ\text{C}$ ,  $V_{DD} = 3.0$  to  $3.6\text{V}$ ,  $V_{SS} = 0\text{V}$  reference)

Item	Symbol	Pin	Condition	Min.	Max.	Unit
$\overline{\text{SCK1}}$ cycle time	$t_{\text{KCY}}$	$\overline{\text{SCK1}}$	Input mode	700		ns
			Output mode	$8000/f_c$		ns
$\overline{\text{SCK1}}$ High, Low level widths	$t_{\text{KH}}$ $t_{\text{KL}}$	$\overline{\text{SCK1}}$	Input mode	300		ns
			Output mode	$4000/f_c - 50$		ns
SI1 input set-up time (for $\overline{\text{SCK1}}$ $\uparrow$ )	$t_{\text{SIK}}$	SI1	$\overline{\text{SCK1}}$ input mode	70		ns
			$\overline{\text{SCK1}}$ output mode	150		ns
SI1 input hold time (for $\overline{\text{SCK1}}$ $\uparrow$ )	$t_{\text{KSI}}$	SI1	$\overline{\text{SCK1}}$ input mode	150		ns
			$\overline{\text{SCK1}}$ output mode	70		ns
$\overline{\text{SCK1}}$ $\downarrow \rightarrow$ SO1 delay time	$t_{\text{KSO}}$	SO1	$\overline{\text{SCK1}}$ input mode		150	ns
			$\overline{\text{SCK1}}$ output mode		80	ns

**Note)** The load condition for the  $\overline{\text{SCK1}}$  output mode, SO1 output delay time is  $50\text{pF}$ .

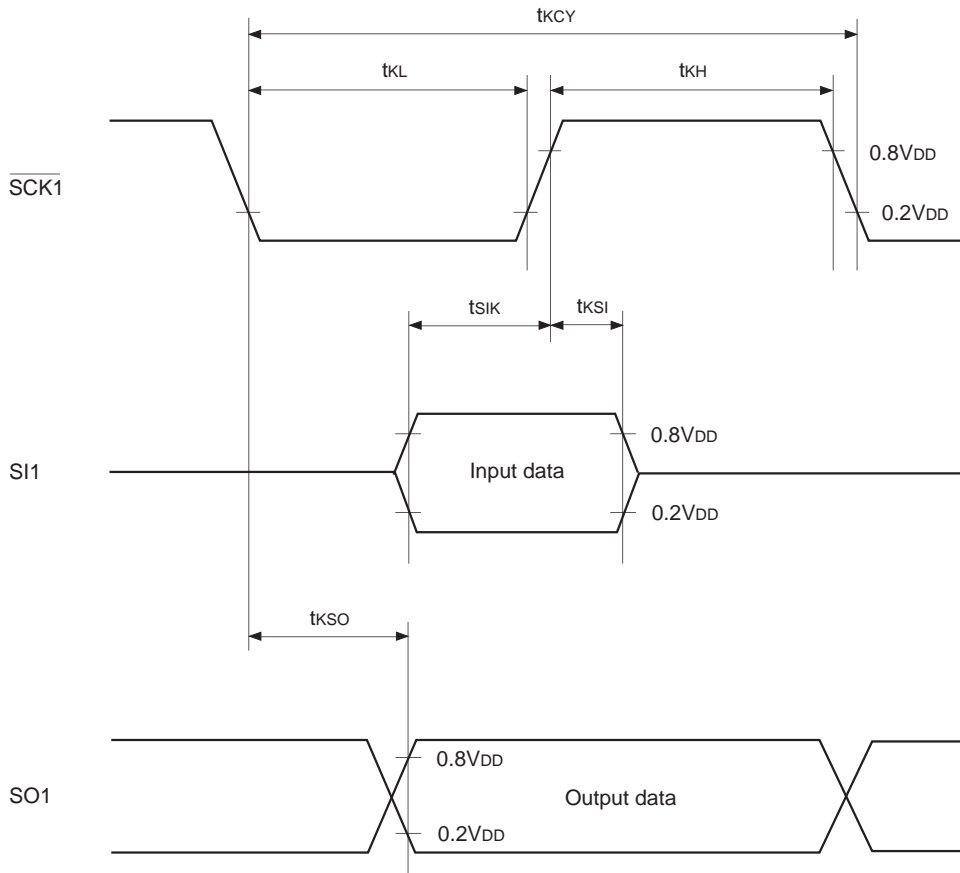


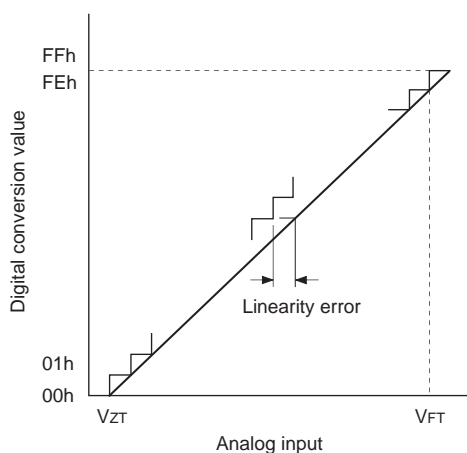
Fig. 5. Serial transfer CH1 timing

**(4) A/D converter characteristics** (Ta = -20 to +75°C, VDD = 4.5 to 5.5V, AVREF = 4.0 to VDD, VSS = AVSS = 0V reference)

Item	Symbol	Pin	Condition	Min.	Typ.	Max.	Unit
Resolution						8	Bits
Linearity error						±4	LSB
Zero transition voltage	VZT*1		Ta = 25°C VDD = AVREF = 5.0V VSS = AVSS = 0V	-10	10	70	mV
Full-scale transition voltage	VFT*2			4910	4970	5030	mV
Conversion time	tCONV			27/fADC*3			µs
Sampling time	tSAMP			6/fADC*3			µs
Reference input voltage	VREF	AVREF		VDD - 0.5		VDD	V
Analog input voltage	VIAN	AN0 to AN7		0		AVREF	V
AVREF current	IREF	AVREF	Operation mode		0.6	1.0	mA
	IREFS		Sleep mode Stop mode			10	µA

(Ta = -20 to +75°C, VDD = 3.0 to 3.6V, AVREF = 2.7 to VDD, VSS = AVSS = 0V reference)

Item	Symbol	Pin	Condition	Min.	Typ.	Max.	Unit
Resolution						8	Bits
Linearity error						±5	LSB
Zero transition voltage	VZT*1		Ta = 25°C VDD = AVREF = 3.3V VSS = AVSS = 0V	-10	6.5	70	mV
Full-scale transition voltage	VFT*2			3216	3280.5	3345	mV
Conversion time	tCONV			27/fADC*3			µs
Sampling time	tSAMP			6/fADC*3			µs
Reference input voltage	VREF	AVREF		VDD - 0.3		VDD	V
Analog input voltage	VIAN	AN0 to AN7		0		AVREF	V
AVREF current	IREF	AVREF	Operation mode		0.4	0.7	mA
	IREFS		Sleep mode Stop mode			5	µA

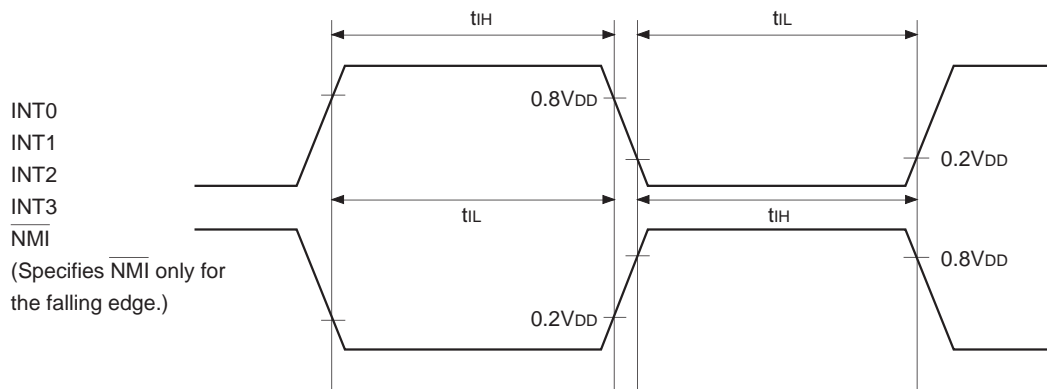


- \*1 VZT: Value at which the digital conversion value changes from 00h to 01h and vice versa.
- \*2 VFT: Value at which the digital conversion value changes from FEh to FFh and vice versa.
- \*3 fADC indicates the values below due to the contents of bit 6 (CKS) of the A/D control register (ADC: 00F9h).  
 $f_{ADC} = f_c$  (CKS = "0"),  $f_c/2$  (CKS = "1")  
 However, the selection for  $f_{ADC} = f_c$  (CKS = "0") is limited in the clock range of  $f_c = 1$  to 14MHz (VDD 4.5 to 5.5V) and  $f_c = 1$  to 10MHz (VDD = 3.0 to 4.5V).

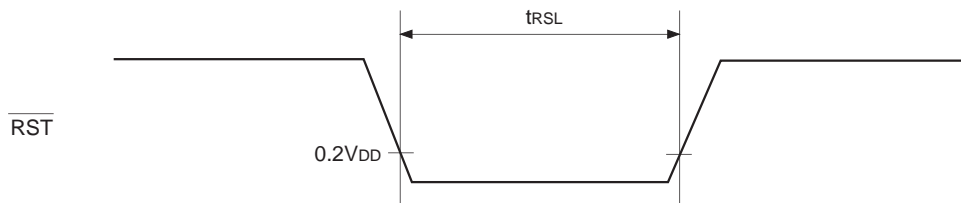
**Fig. 6. Definition of A/D converter terms**

**(4) Interruption, reset input** (Ta = -20 to +75°C, VDD = 3.0 to 5.5V, VSS = 0V reference)

Item	Symbol	Pin	Condition	Min.	Max.	Unit
External interruption High, Low level widths	t <sub>IH</sub> t <sub>IL</sub>	INT0 INT1 INT2 INT3 NMI		1		μs
Reset input Low level width	t <sub>RSL</sub>	RST		32/fc		μs



**Fig 7. Interruption input timing**



**Fig. 8. RST input timing**

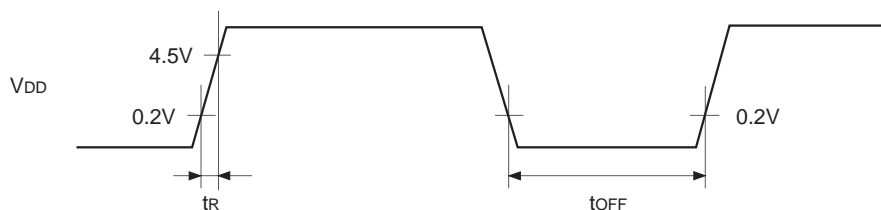
**(5) Power-on reset\*1**

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

Item	Symbol	Pin	Condition	Min.	Max.	Unit
Power supply rise time	t <sub>R</sub>	VDD	Power-on reset	0.05	50	ms
Power supply cut-off time	t <sub>OFF</sub>		Repetitive power-on reset	1		ms

\*1 Specifies only when the power-on reset function is selected.

Power-on reset function can be selected only for the supply voltage range of 4.5 to 5.5V.



Take care when turning the power on.

**Fig. 9. Power-on reset**

Appendix

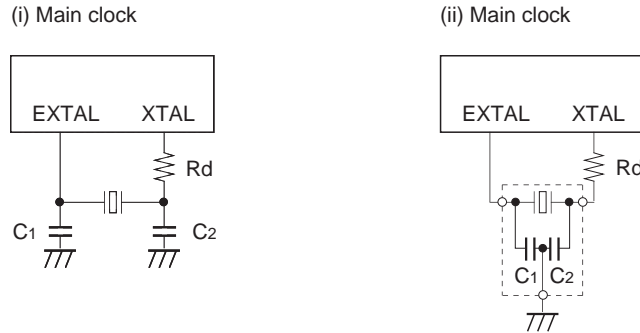


Fig. 10. SPC700 Series recommended oscillation circuit

Manufacturer	Model	fc (MHz)	C1 (pF)	C2 (pF)	Rd ( $\Omega$ )	Circuit example
MURATA MFG CO., LTD.	CSA8.00MTZ	8.00	30	30	0	(i)
	CSA10.0MTZ	10.00				
	CSA12.00MTZ	12.00				
	CST8.00MTW*	8.00				(ii)
	CST10.0MT*	10.00				
	CST12.0MTW*	12.00				
	CSA16.00MXZ040	16.00	5	5	0	(i)
	CST16.00MXZ0C1*	16.00	5	5	0	(ii)
	CSA20.00MXZ040	20.00	OPEN	OPEN	0	(i)
	CSA24.00MXZ040	24.00	3	3	0	
CSA28.00MXZ040	28.00	3	3	0		
TDK CORPORATION.	CCR20.0MC6*	20.00	16	16	0	(ii)
	CCR24.0MC6*	24.00	16	16	0	
KINSEKI LTD.	HC49/U-S	28.00	1	1	220	(i)
	CX-11F	28.00	1	1	220	

Models with an asterisk (\*) have the built-in ground capacitance (C1, C2).

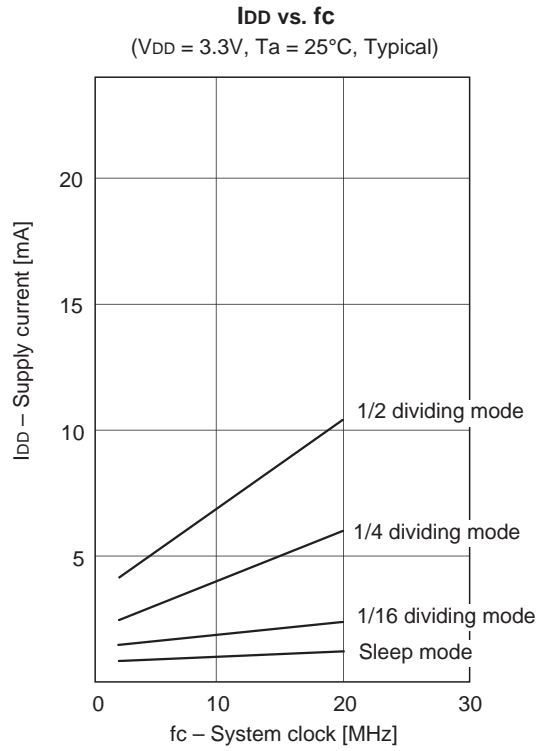
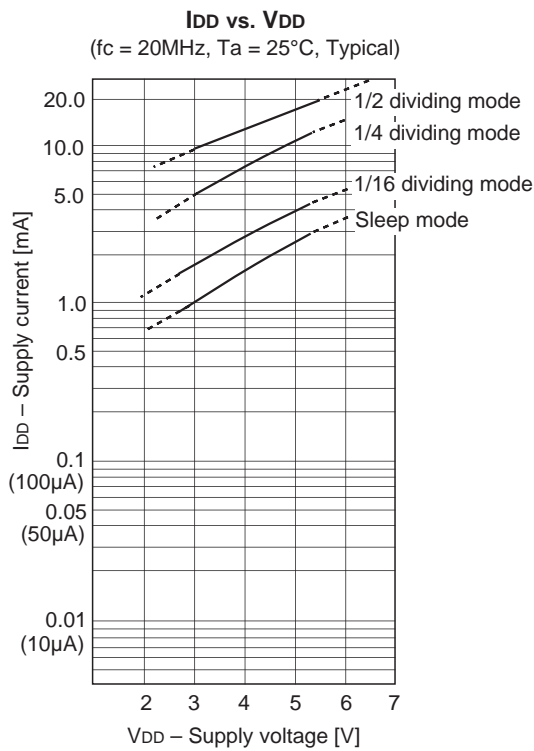
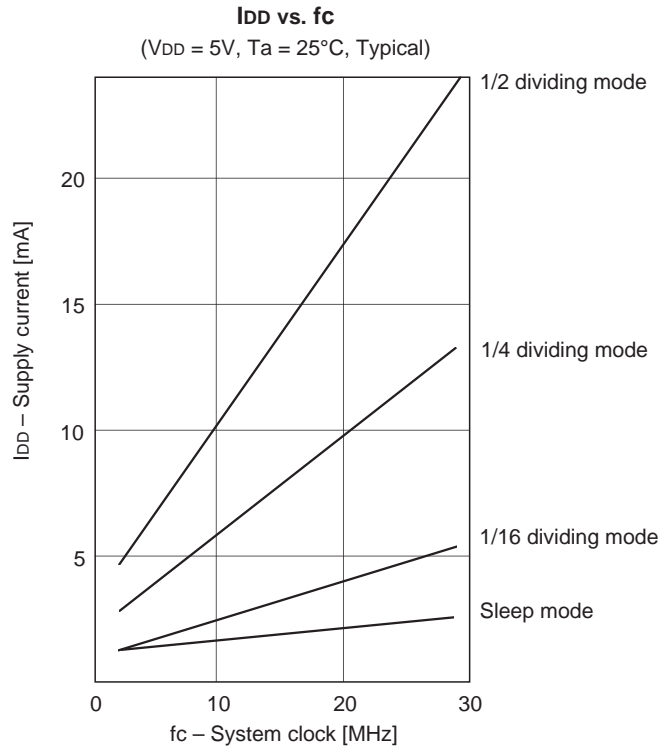
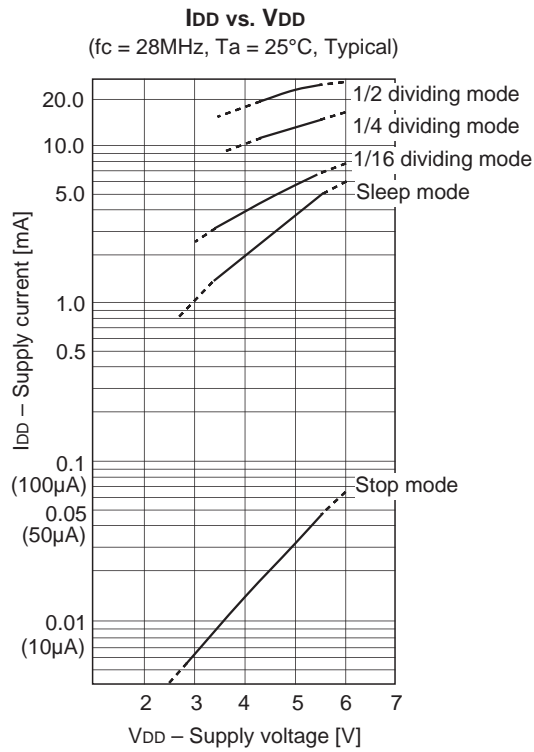
Mask option table

Item	Contents	
Reset pin pull-up resistor	Non-existent	Existent
Power-on reset circuit *1	Non-existent	Existent

\*1 "Existent" for power-on reset circuit cannot be selected when the supply voltage V<sub>DD</sub> of 3.0 to 4.5V.



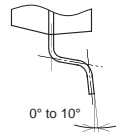
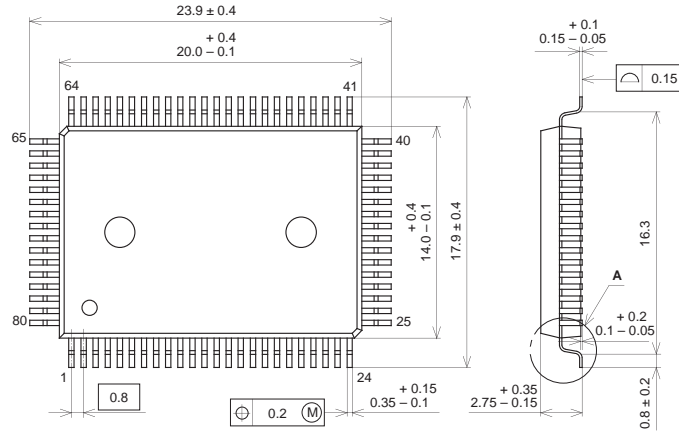
Characteristics Curves



Package Outline

Unit: mm

80PIN QFP (PLASTIC)



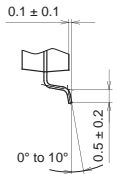
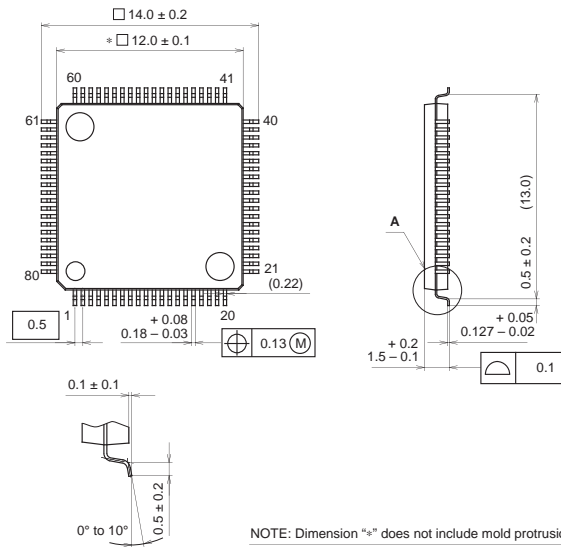
DETAIL A

PACKAGE STRUCTURE

SONY CODE	QFP-80P-L01
EIAJ CODE	QFP080-P-1420
JEDEC CODE	

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

80PIN LQFP (PLASTIC)



DETAIL A

NOTE: Dimension "e\*" does not include mold protrusion.

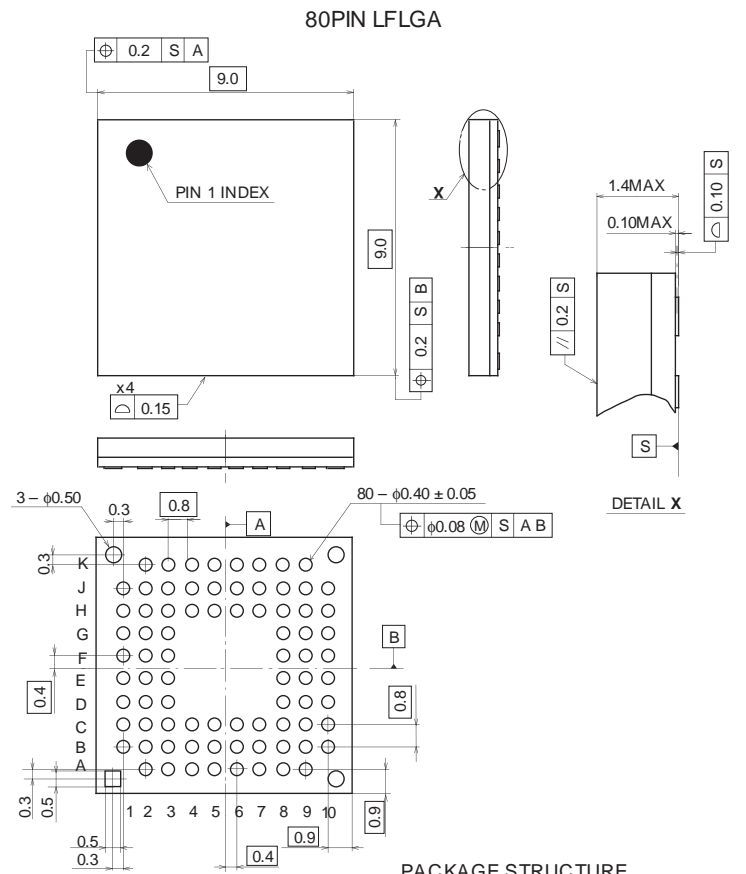
PACKAGE STRUCTURE

SONY CODE	LQFP-80P-L01
EIAJ CODE	LQFP080-P-1212
JEDEC CODE	

PACKAGE MATERIAL	EPOXY RESIN
LEAD TREATMENT	SOLDER PLATING
LEAD MATERIAL	42 ALLOY
PACKAGE MASS	0.5g

Package Outline

Unit: mm



PACKAGE STRUCTURE

SONY CODE	LFLGA-80P-02
EIAJ CODE	P-LFLGA80-9x9-0.8
JEDEC CODE	—

PACKAGE MATERIAL	ORGANIC SUBSTRATE
TERMINAL TREATMENT	GOLD PLATING
TERMINAL MATERIAL	NICKEL PLATING
PACKAGE MASS	0.3g