SONY

CXP82612/82616

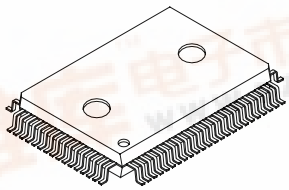
CMOS 8-bit Single Chip Microcomputer

Description

The CXP82612/82616 microcomputer is composed of a CPU, ROM, RAM, and I/O ports. These chips feature many other high-performance circuits in a single-chip CMOS design, including an A/D converter, serial interface, timer/counter, time-base timer, fluorescent display controller/driver, remote control receiver and 32kHz timer/counter.

This device also includes a power-on reset function and sleep/stop functions which can be used to achieve low power consumption.

80 pin QFP (Plastic)



Features

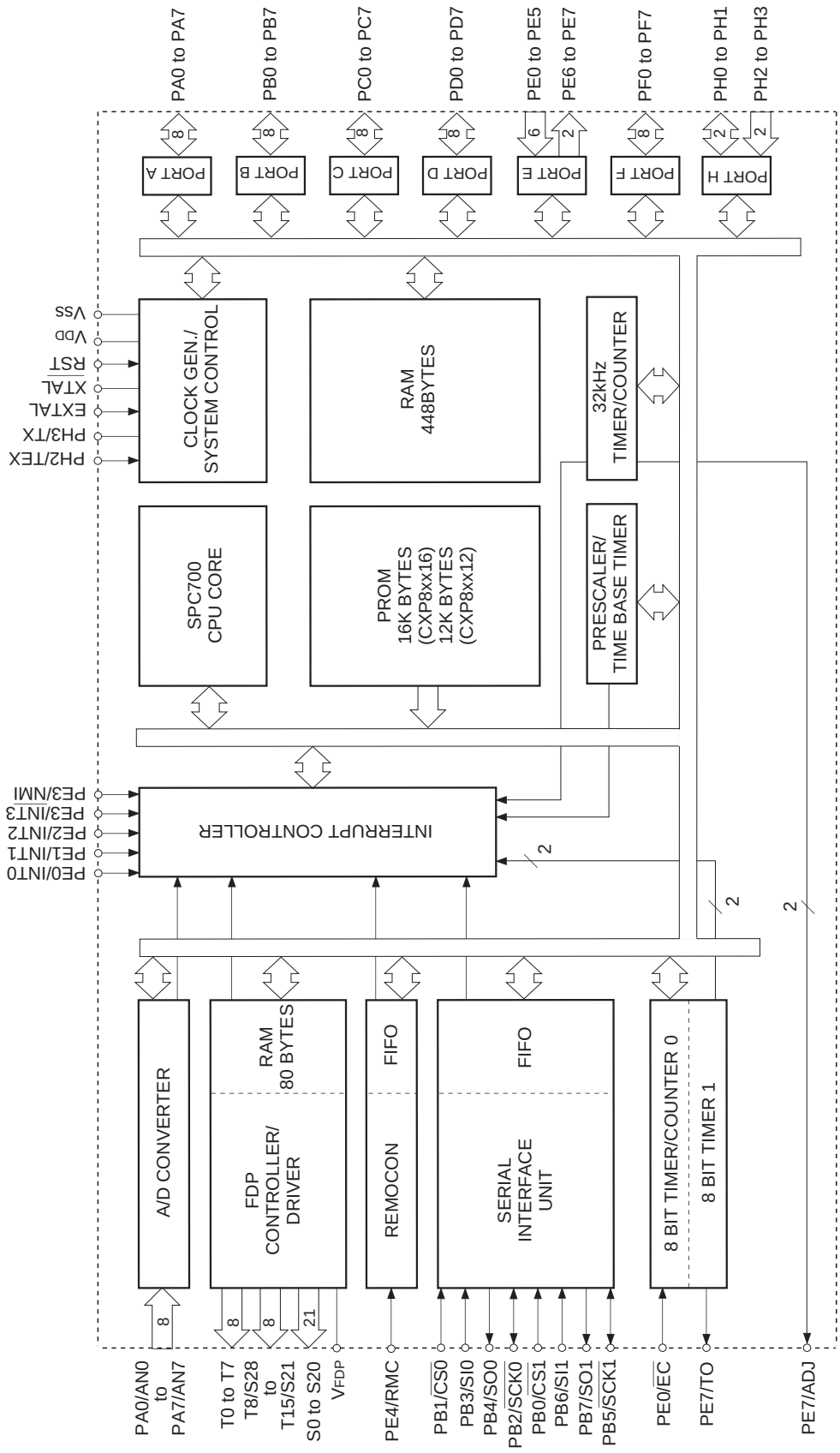
- Instruction set which supports a wide array of data types
  - — 213 types of instructions which include 16-bit calculations, multiplication and division arithmetic, and boolean bit operations.
- Minimum instruction cycle — 400ns for 10MHz, 122µs/for 32kHz operation
- On-chip ROM — 12K bytes (CXP82612)
  16K bytes (CXP82616)
- On-chip RAM — 448 bytes (Including fluorescent display data area)
- Peripheral functions
  - — A/D converter — 8-bit, 8-channel, successive approximation system (conversion rate 32µs/10MHz)
  - — Serial interface — On-chip 8-bit, 8-stage FIFO (1 to 8 bytes auto transfer), 1 circuit 2-channel
  - — Timers — 8-bit timer
    8-bit timer/counter
    19-bit time base timer
    32kHz timer/counter
  - — Fluorescent display controller/driver — Maximum of 336 segments display available
    1 to 16 digits dynamic display
    Dimmer function
    High voltage tolerance output (40V)
    On-chip pull-down resistor (Mask option)
    Hardware key scan function (Maximum of 8 × 16 key matrix available)
  - — Remote control receiver circuit — On-chip 6 stage FIFO 8-bit pulse measurement counter
- Interrupts — 13 factors, 13 vectors multi-interruption possible
- Standby mode — Sleep/stop
- Package — 80-pin plastic QFP
- Piggyback/evaluator — CXP82600 80-pin ceramic QFP

Structure

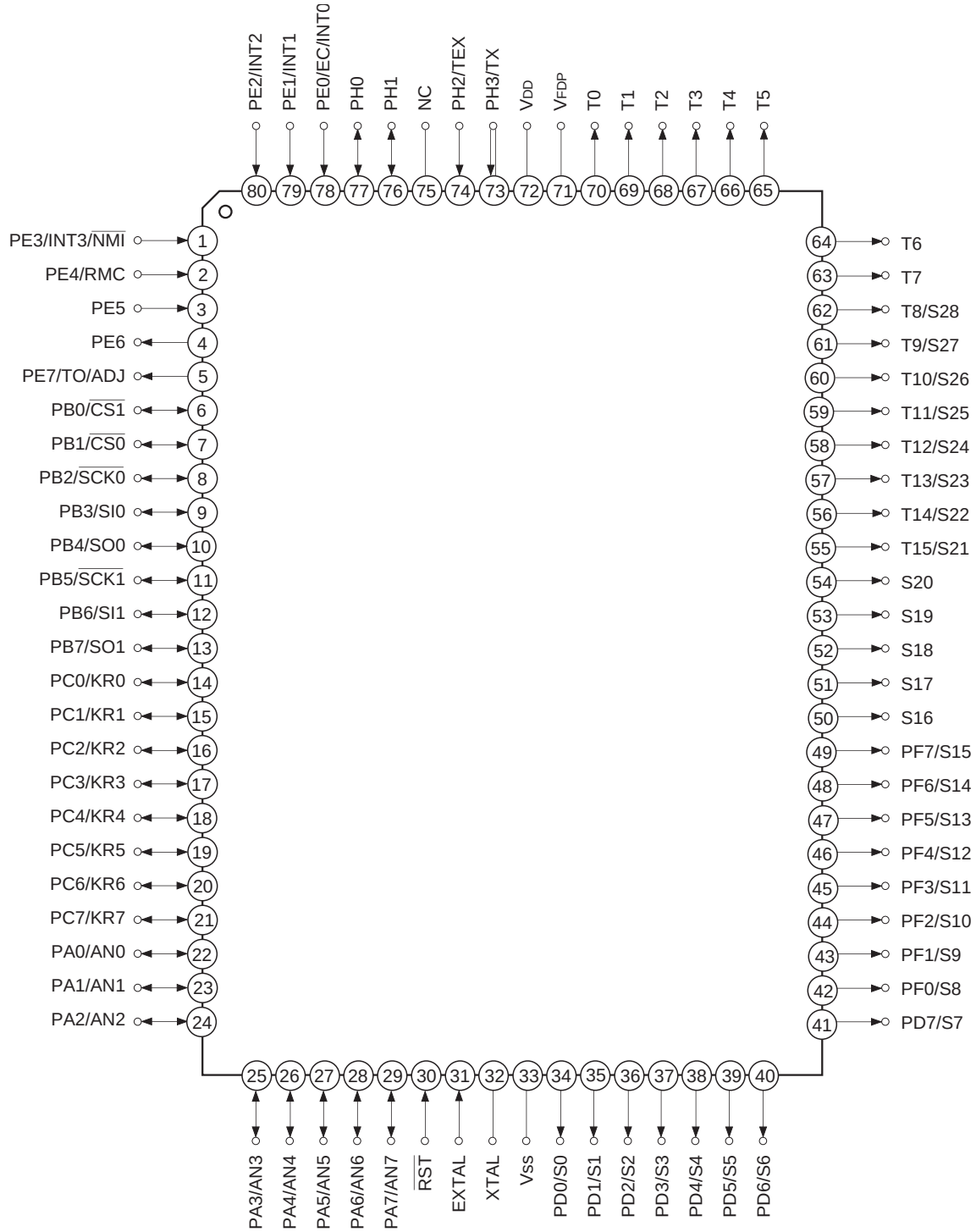
Silicon gate CMOS IC

E93Y22A79-PS

Block Diagram



Pin Assignment (Top View)



Note) 1. NC (Pin 75) is always connected to V_{DD}.

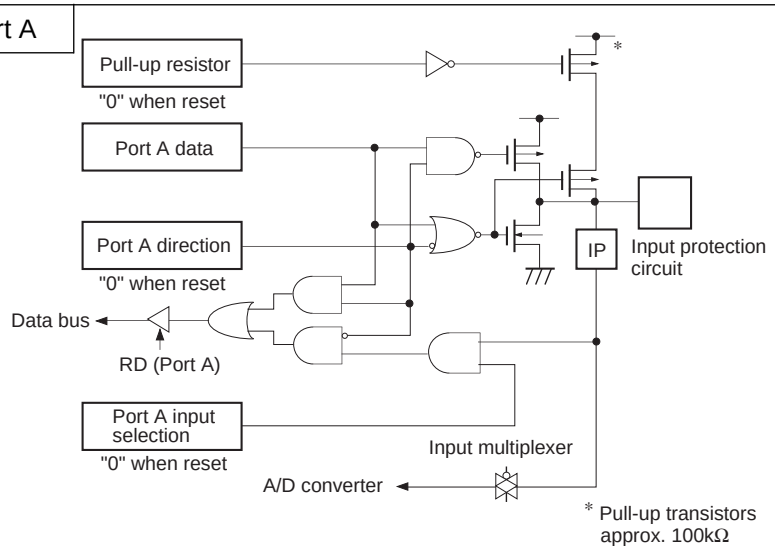
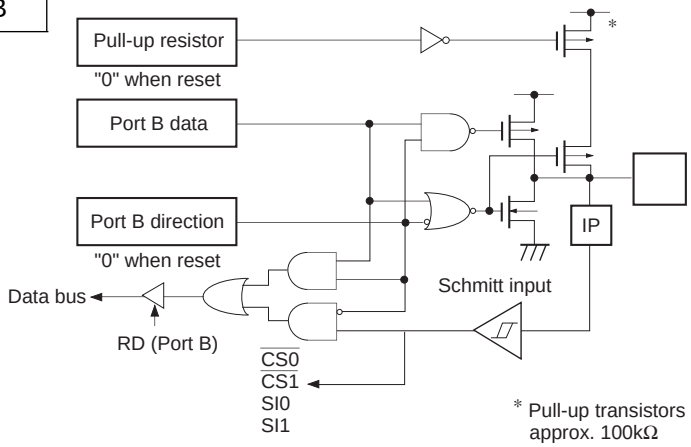
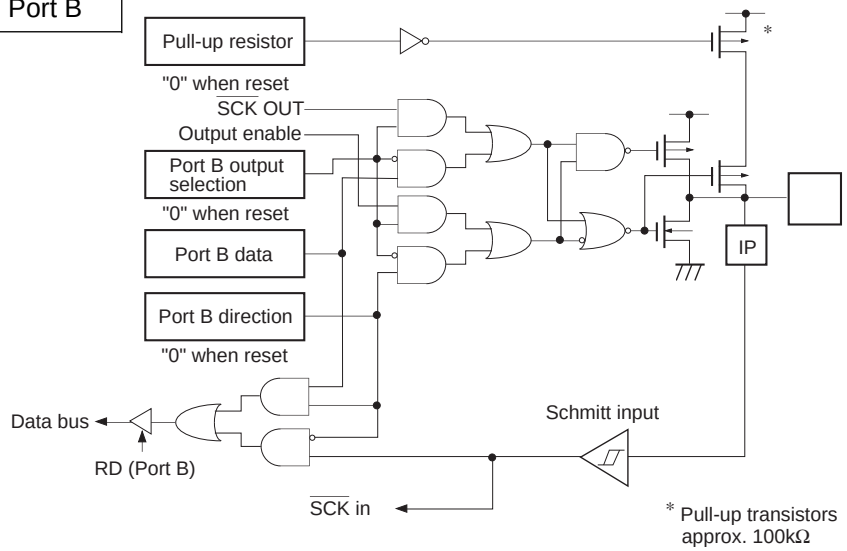
2. PH3/TX (Pin 73) is input port during port selection; oscillation output during oscillation selection

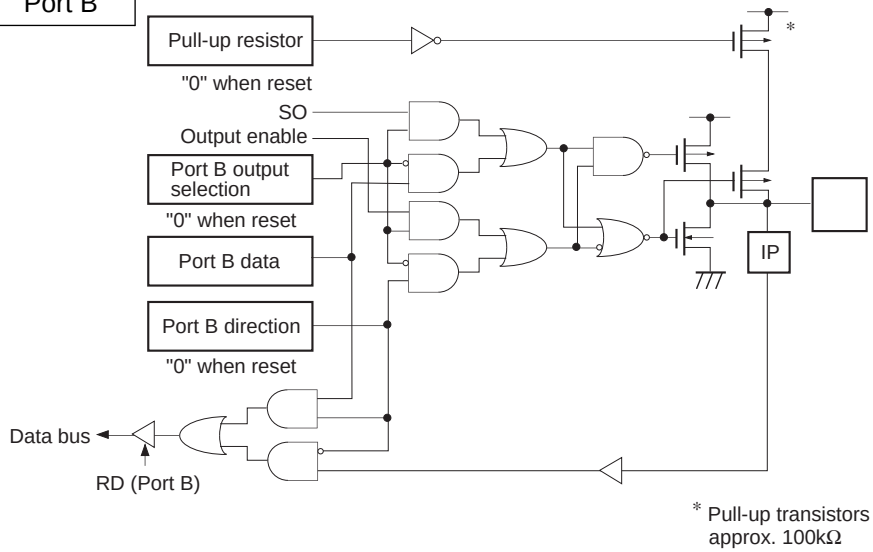
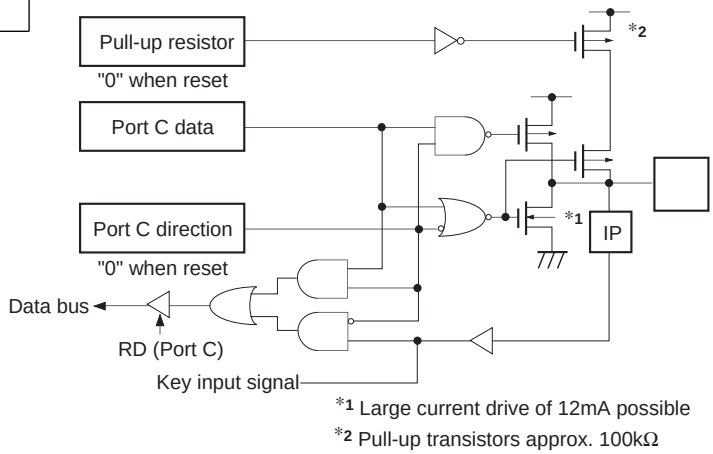
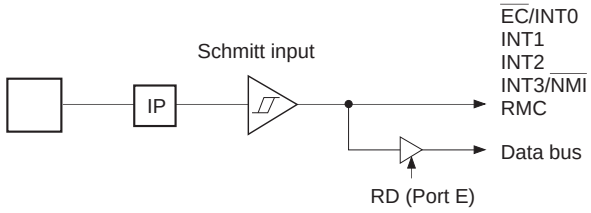
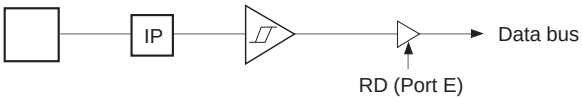
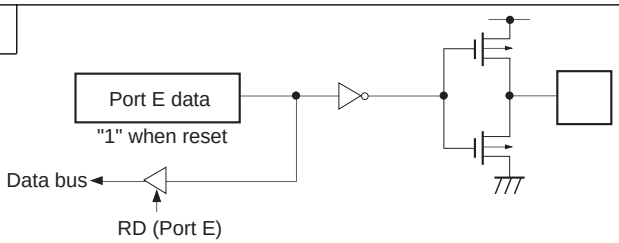
Pin Description

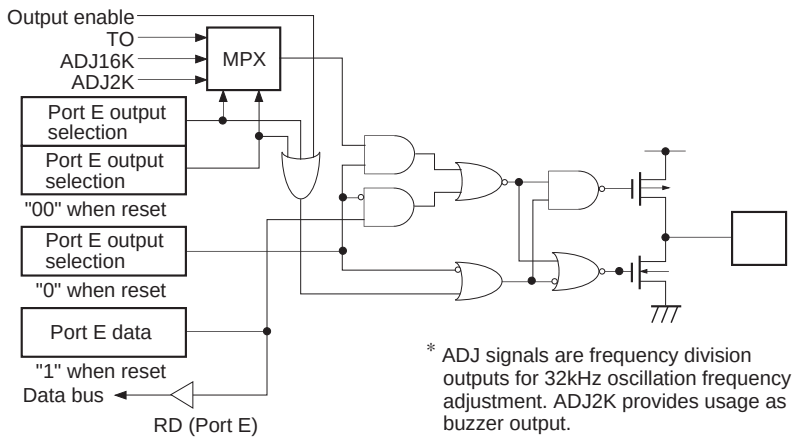
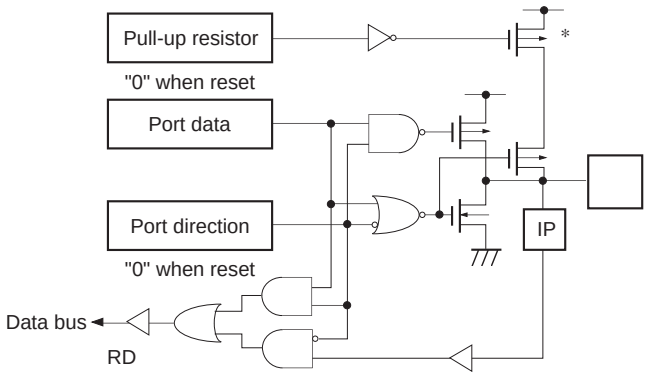
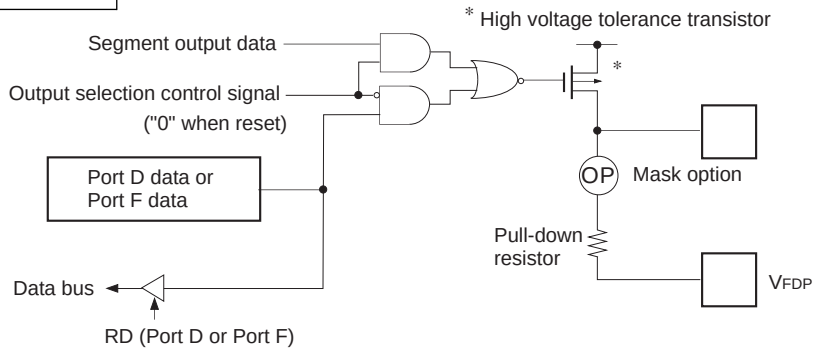
Symbol	I/O	Functions	
PA0/AN0 to PA7/AN7	I/O/Analog Input	(Port A) 8-bit I/O port. I/O can be set in a bit unit. Incorporation of pull-up resistor can be set through the software in a unit of 4 bits. (8 pins)	Analog inputs to A/D converter. (8 pins)
PB0/$\overline{CS1}$	I/O/Input	(Port B) 8-bit I/O port. I/O can be set in a bit unit. Incorporation of pull-up resistor can be set through the software in a unit of 4 bits. (8 pins)	Chip select input for serial interface (CH1).
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/KR0 to PC7/KR7	I/O/Input	(Port C) 8-bit I/O port. I/O can be set in a bit unit. Capable of driving 12mA sink current. Incorporation of pull-up resistor can be set through the software in a unit of 4 bits. (8 pins)	Key return input for FDP segment signal which performs key scanning.
PE0/INT0/ $\overline{EC0}$	Input/Input/ Input	(Port E) 8-bit port. Upper 6 bits are for inputs; lower 2 bits are for outputs. (8 pins)	External interrupt requests. (4 pins) / External event input to timer/counter. (1 pin)
PE1/INT1	Input/Input		External interrupt requests. (4 pins)
PE2/INT2	Input/Input		External interrupt requests. (4 pins)
PE3/INT3/ $\overline{NMI}$	Input/Input/ Input		External interrupt requests. (4 pins) / Non-maskable interruption request input.
PE4/RMC	Input/Input		Input for remote control receiver circuit.
PE5	Input		
PE6	Input		
PE7/TO/ ADJ	Output/Output		Output for timer/counter rectangular waveform and 32kHz oscillation frequency division.

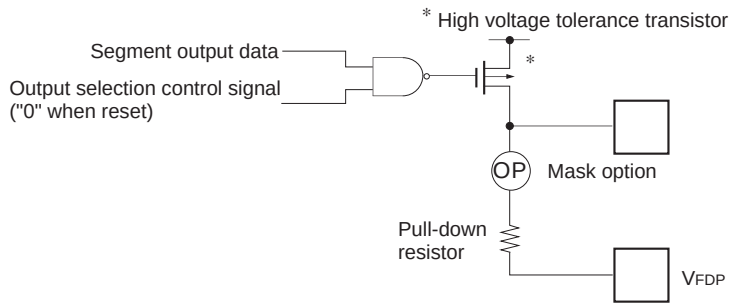
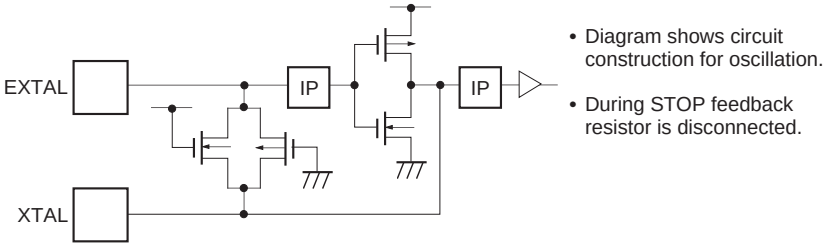
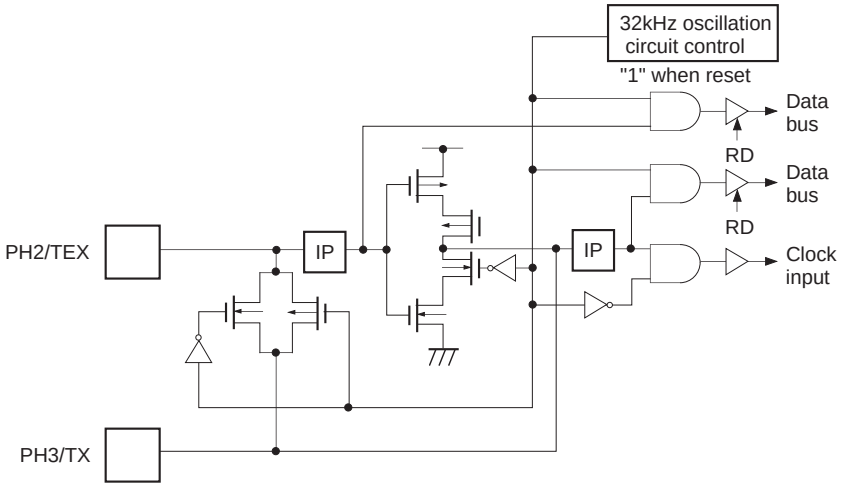
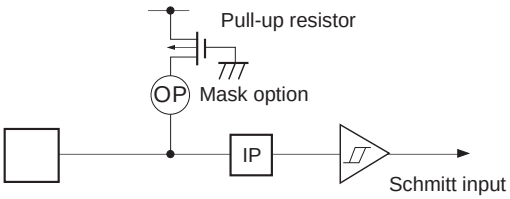
Symbol	I/O	Functions	
PH0 to PH1	I/O	(Port H) 2-bit I/O port. I/O can be set in a bit unit. Incorporation of pull-up resistor can be set through the software in a unit of 2 bits. (2 pins)	
PF0/S8 to PF7/S15	Output/Output	(Port F) 8-bit output port. (8 pins)	Segment signal output for FDP.
S16 to S20	Output	Segment signal output for FDP.	
T8/S28 to T15/S21	Output/Output	Dual purpose output for FDP timing and segment signals.	
T0 to T7	Output	Timing signal output for FDP.	
PD0/S0 to PD7/S7	Output/Output	(Port D) 8-bit output port. (8 pins)	Segment signal output for FDP.
V_{FDP}		Provides voltage for FDP when on-chip resistor is selected under mask option.	
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		
PH2/TEX	Input/Input	(Port H) 2-bit input port. (2 pins)	Crystal connectors for 32kHz timer/counter clock oscillation circuit. Connect a 32kHz crystal oscillator between TEX and TX. For usage as event input, connect clock oscillation source to TEX, and leave TX open.
PH3/TX	Input/Output		
$\overline{RST}$	Input	Low-level active. System reset. $\overline{RST}$ is input pin.	
NC		NC. Under normal operating conditions, connect to V_{DD}.	
V_{DD}		Vcc supply.	
Vss		GND	

I/O Circuit Format for Pins

Pin	Circuit format	When reset
PA0/AN0 to PA7/AN7 8 pins	Port A  	Hi-Z
PB0/$\overline{CS1}$ PB1/$\overline{CS0}$ PB3/SI0 PB6/SI1 4 pins	Port B  SI0 and SI1 are not schmitt input.	Hi-Z
PB2/$\overline{SCK0}$ PB5/$\overline{SCK1}$ 2 pins	Port B  	Hi-Z

Pin	Circuit format	When reset
PB4/SO0 PB7/SO1 2 pins	Port B 	Hi-Z
PC0/KR0 to PC7/KR7 8 pins	Port C 	Hi-Z
PE0/$\overline{EC}$/INT0 PE1/INT1 PE2/INT2 PE3/INT3/$\overline{NMI}$ PE4/RMC 5 pins	Port E 	Hi-Z
PE5 1 pin	Port E 	Hi-Z
PE6 1 pin	Port E 	High level

Pin	Circuit format	When reset
PE7/TO/ADJ 1 pin	Port E  * ADJ signals are frequency division outputs for 32kHz oscillation frequency adjustment. ADJ2K provides usage as buzzer output.	High level (High level with 150kΩ resistor when reset)
PH0 to PH1 2 pins	Port H  * Pull-up transistors approx. 100kΩ	Hi-Z
PD0/S0 to PD7/S7 PF0/S8 to PF7/S15 16 pins	Port D Port F  	Hi-Z or Low level (When PD resistor is connected)

Pin	Circuit format	When reset
S16 to S20 T15/S21 to T8/S28 T0 to T7 21 pins		Hi-Z or Low level (When PD resistor is connected)
EXTAL XTAL 2 pins		Oscillation
PH2/TEX PH3/TX 2 pins		Oscillation halted port input
$\overline{\text{RST}}$ 1 pin		High level

Absolute Maximum Ratings (Vss = 0V)

Item	Symbol	Rating	Unit	Remarks
Supply voltage	V_{DD}	–0.3 to +7.0	V	
Input voltage	V_{IN}	–0.3 to +7.0*1	V	
Output voltage	V_{OUT}	–0.3 to +7.0*1	V	
Display output voltage	V_{OD}	V_{DD} – 40 to V_{DD} + 0.3	V	As P channel transistor is open drain, V_{DD} voltage is determined as standard.
High level output current	I_{OH}	–5	mA	Other than display output pins*2: per pin
	I_{ODH1}	–15	mA	Display output S0 to S20: per pin
	I_{ODH2}	–35	mA	Display output T0 to T7 T8/S28 to T15/S21: per pin
High level total output current	$\sum I_{OH}$	–40	mA	Total of other than display output pins
	$\sum I_{ODH}$	–100	mA	Total of display output pins
Low level output current	I_{OL}	15	mA	Port 1 pin
	I_{OLC}	20	mA	Large current port pin*3
Low level total output current	$\sum I_{OL}$	100	mA	Entire pin toral
Operating temperature	Topr	–20 to +75	°C	
Storage temperature	Tstg	–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 Specifies output current of general-purpose I/O ports.

*3 The large current drive transistor is an N-ch transistor of Port C (PC).

Note) If the absolute maximum ratings are exceed, the LSI could reach permanent breakdown. Also, observing recommended operating conditions is desirable; otherwise, the LSI's reliability could be affected.

Recommended Operating Conditions (Vss = 0V)

Item	Symbol	Min.	Max.	Unit	Remarks
Supply voltage	V_{DD}	4.5	5.5	V	High speed mode (1/2, 1/4 clock) guaranteed operation range
		3.5	5.5	V	Low speed mode (1/16 clock) guaranteed operation range
		2.7	5.5	V	Guaranteed operation range with 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
	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
Low level input voltage	V_{IL}	0	$0.3V_{DD}$	V	*1
	V_{ILS}	0	$0.2V_{DD}$	V	Hysteresis input*2
	V_{ILEX}	–0.3	0.4	V	EXTAL pin*3
Operating temperature	Topr	–20	+75	°C	

*1 All regular input port (PA, PB3, PB4, PB6, PB7, PC, PE5, PH).

*2 For pins $\overline{RST}$, $\overline{CS0}$, $\overline{CS1}$, $\overline{SCK0}$, $\overline{SCK1}$, $\overline{EC}$/INT0, INT1, INT2, INT3/$\overline{NMI}$, RMC.

*3 Specifies only for external clock input.

Electrical Characteristics

DC Characteristics

(Ta = –20 to +75°C, Vss = 0V)

Item	Symbol	Pin	Condition	Min.	Typ.	Max.	Unit
High level output voltage	V_{OH}	PA, PB, PC, PE6, PE7, PH0, PH1	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}		V_{DD} = 4.5V, I_{OL} = 1.8mA			0.4	V
			V_{DD} = 4.5V, I_{OL} = 3.6mA			0.6	V
		PC	V_{DD} = 4.5V, I_{OL} = 12.0mA			1.5	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 PC*2 PH0*2, PH1*2				–50	µA
			V_{DD} = 4.5V, V_{IL} = 4.0V	–3.3			µA
Display output current	I_{OH}	S0 to S20	V_{DD} = 4.5V V_{OH} = V_{DD} – 2.5V	–8			mA
		S21/T15 to S28/T8 T0 to T7		–20			mA
Open drain output leak current (P-CH Tr off state)	I_{LOL}	S0 to S20 S21/T15 to S28/T8 T0 to T7	V_{DD} = 5.5V V_{OL} = V_{DD} – 35V V_{FDP} = V_{DD} – 35V			–20	µA
Pull down resistor*3	R_L	S0 to S20 S21/T15 to S28/T8 T0 to T7	V_{DD} = 5V V_{OD} – V_{FDP} = 30V	60	100	270	kΩ
Input/Output leak current	I_{IZ}	PA to PC*2, PH0*2, PH1*2, $\overline{RST}$*2	V_{DD} = 5.5V V_I = 0, 5.5V			±10	µA

Item	Symbol	Pin	Codition	Min.	Typ.	Max.	Unit
Supply current*4	I_{DD1}	V_{DD}	High-speed mode operation (1/2 frequency divider clock) V_{DD} = 5.5V, 10MHz crystal oscillation (C_1 = C_2 = 15pF)		20	40	mA
	I_{DD2}		V_{DD} = 3V, 32kHz crystal oscillation (C_1 = C_2 = 47pF)		35	100	µA
	I_{DDS1}		Sleep mode V_{DD} = 5.5V, 10MHz crystal oscillation (C_1 = C_2 = 15pF)		1.2	8	mA
	I_{DDS2}		V_{DD} = 3V, 32kHz crystal oscillation (C_1 = C_2 = 47pF)		9	30	µA
	I_{DDS3}		Stop mode V_{DD} = 5.5V, termination of 32kHz and 10MHz crystal oscillation.			30	µA
Input capacitance	C_{IN}	For pins other than S0 to S28, T0 to T7, PE6, PE7, V_{DD}, Vss, V_{FDP}	1MHz clock 0V other than the measured pins		10	20	pF

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

*2 Pins PA to PC, PH0, and PH1 specifies the input current when pull-up resistor has been selected; leakage current when no resistor has been selected.

*3 Applies when the on-chip pull-down resistor is selected under the mask option.

*4 All output pins are left open.

AC Characteristics

(1) Clock timing

(Ta = –20 to +75°C, V_{DD} = 4.5 to 5.5V, Vss = 0V)

Item	Symbol	Pins	Conditions	Min.	Typ.	Max.	Unit
System clock frequency	fc	XTAL EXTAL	Fig. 1, Fig. 2	1		10	MHz
System clock input pulse width	t_{XL}, t_{XH}	EXTAL	Fig. 1, Fig. 2 External clock drive	37.5			ns
System clock input rise and fall time	t_{CR}, t_{CF}	EXTAL	Fig. 1, Fig. 2 External clock drive			200	ns
Event count input clock pulse width	t_{EH}, t_{EL}	$\overline{EC}$	Fig. 3	tsys + 50*			ns
Event count input clock rise and fall time	t_{ER}, t_{EF}	$\overline{EC}$	Fig. 3			20	ms
System clock frequency	fc	TEX TX	V_{DD} = 2.7 to 5.5V Fig. 2 (32kHz clock applied condition)		32.768		kHz
Event count input clock input pulse width	t_{TL}, t_{TH}	TEX	Fig. 3	10			µs
Event count input clock rise and fall time	t_{TR}, t_{TF}	TEX	Fig. 3			20	ms

* tsys indicates the three values below according to the upper two bits (CPU clock selection) of the clock control register (address: 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

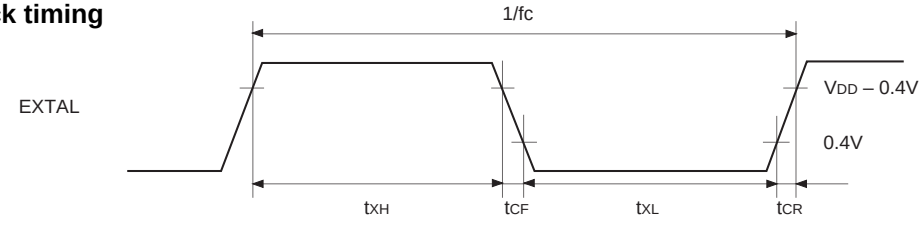


Fig. 2. Clock applied conditions

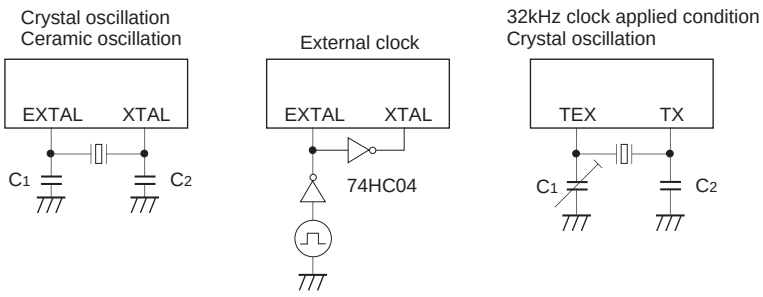
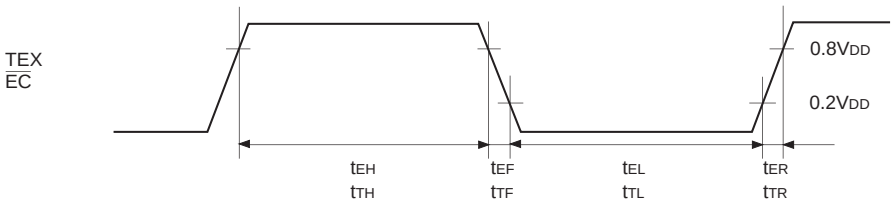


Fig. 3. Event count clock timing



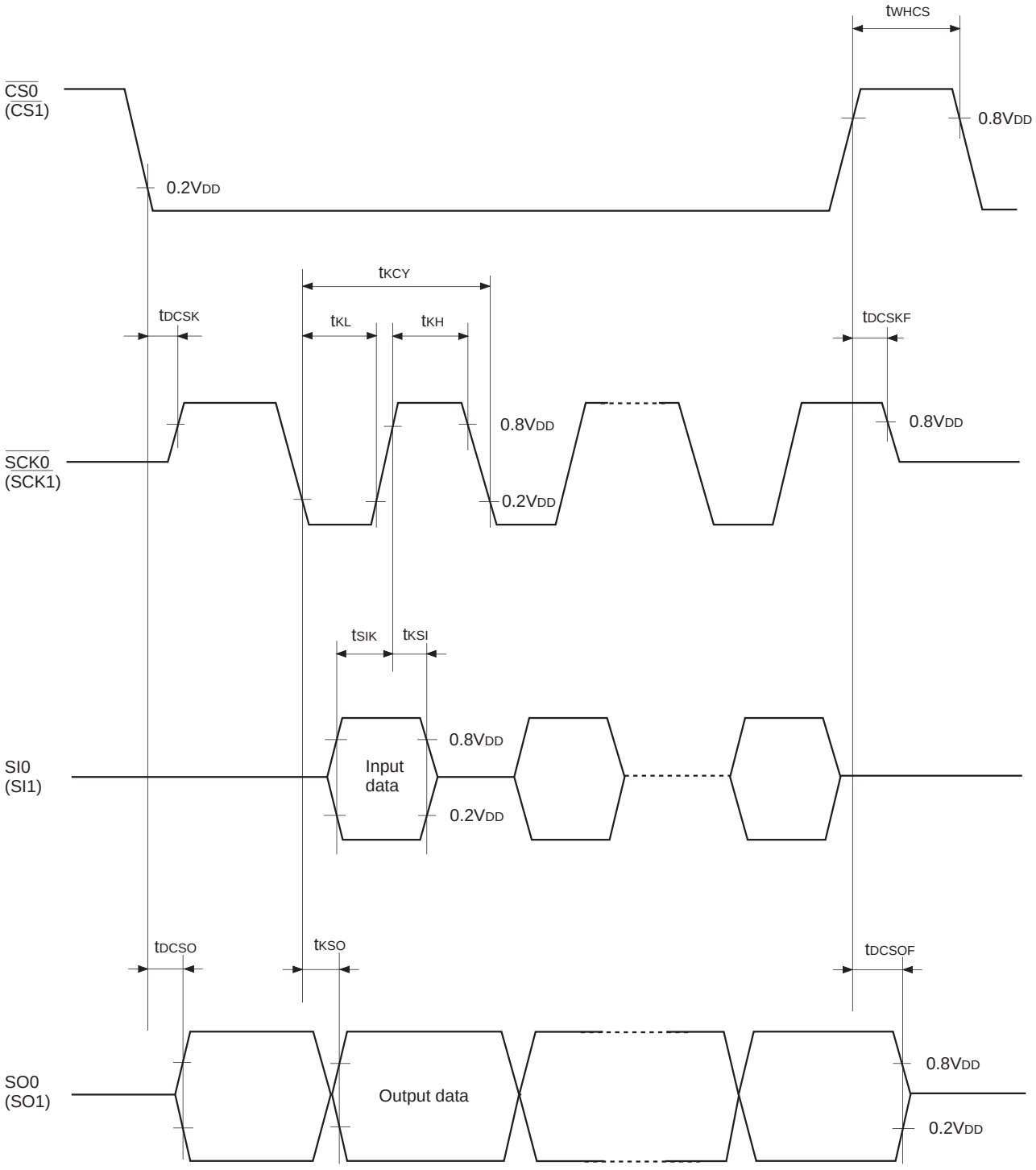
(2) Serial transfer (Ta = –20 to +75°C, V_{DD} = 4.5 to 5.5V, Vss = 0V)

Item	Symbol	Pin	Condition	Min.	Max.	Unit
$\overline{CS0}\downarrow\rightarrow\overline{SCK0}$ ($\overline{CS1}\downarrow\rightarrow\overline{SCK1}$) delay time	t_{DCSK}	$\overline{SCK0}$ ($\overline{SCK1}$)	Chip select transfer mode ($\overline{SCK0}$ ($\overline{SCK1}$) = output mode)		tsys + 200	ns
$\overline{CS0}\uparrow\rightarrow\overline{SCK0}$ ($\overline{CS1}\uparrow\rightarrow\overline{SCK1}$) float delay time	t_{DCSKF}	$\overline{SCK0}$ ($\overline{SCK1}$)	Chip select transfer mode ($\overline{SCK0}$ ($\overline{SCK1}$) = output mode)		tsys + 200	ns
$\overline{CS0}\downarrow\rightarrow$ SO0 ($\overline{CS1}\downarrow\rightarrow$ SO1) delay time	t_{DCSO}	SO0 (SO1)	Chip select transfer mode		tsys + 200	ns
$\overline{CS0}\uparrow\rightarrow$ SO0 ($\overline{CS1}\uparrow\rightarrow$ SO1) float delay time	t_{DCSOF}	SO0 (SO1)	Chip select transfer mode		tsys + 200	ns
$\overline{CS0}$ ($\overline{CS1}$) high level width	t_{WHCS}	$\overline{CS0}$ ($\overline{CS1}$)	Chip select transfer mode	tsys + 200		ns
$\overline{SCK0}$ ($\overline{SCK1}$) cycle time	t_{KCY}	$\overline{SCK0}$ ($\overline{SCK1}$)	Input mode	2tsys + 200		ns
			Output mode	16000/fc		ns
$\overline{SCK0}$ ($\overline{SCK1}$) high and low level widths	t_{KH} t_{KL}	$\overline{SCK0}$ ($\overline{SCK1}$)	Input mode	tsys + 100		ns
			Output mode	8000/fc – 50		ns
SI0 (SI1) input setup time (for SCK0 ↑ ($\overline{SCK1}$ ↑))	t_{SIK}	SI0 (SI1)	$\overline{SCK0}$ ($\overline{SCK1}$) input mode	100		ns
			$\overline{SCK0}$ ($\overline{SCK1}$) output mode	200		ns
SI0 (SI1) input hold time (for SCK0 ↑ ($\overline{SCK1}$ ↑))	t_{KSI}	SI0 (SI1)	$\overline{SCK0}$ ($\overline{SCK1}$) input mode	tsys + 200		ns
			$\overline{SCK0}$ ($\overline{SCK1}$) output mode	100		ns
$\overline{SCK0}\downarrow\rightarrow$ SO0 ($\overline{SCK1}\downarrow\rightarrow$ SO1) delay time	t_{KSO}	SO0 (SO1)	$\overline{SCK0}$ ($\overline{SCK1}$) input mode		tsys + 200	ns
			$\overline{SCK0}$ ($\overline{SCK1}$) output mode		100	ns

Note 1) tsys indicates the three values below according to the upper two bits (CPU clock selection) of the control register clock (address: 00FE$_H$).
tsys [ns] = 2000/fc (upper two bits = "00"), 4000/fc (upper two bits = "01"), 16000/fc (upper two bits = "11")

Note 2) The load condition for the $\overline{SCK0}$ ($\overline{SCK1}$) output mode, SO0 (SO1) output delay time is 50pF + 1TTL.

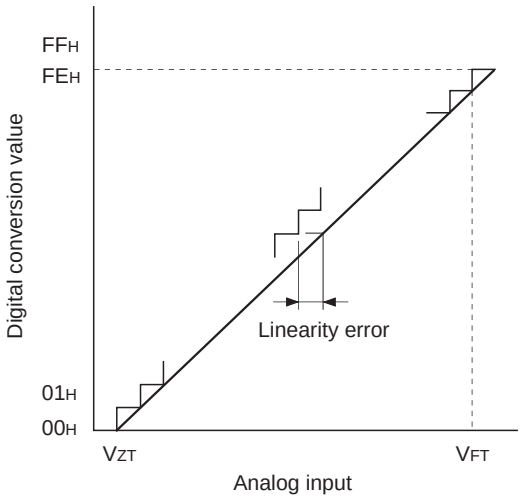
Fig. 4. Serial transfer CH0 timing



(3) A/D converter characteristics (Ta = –20 to +75°C, V_{DD} = 4.5 to 5.5V, AV_{REF} = 4.0 to AV_{DD}, Vss = 0V)

Item	Symbol	Pin	Condition	Min.	Typ.	Max.	Unit
Resolution						8	Bits
Linearity error			Ta = 25°C V_{DD} = 5.0V V_{SS} = 0V			±3	LSB
Zero transition voltage	V_{ZT}*1			–10	–70	150	mV
Full-scale transition voltage	V_{FT}*2			4930	5050	5120	mV
Conversion time	t_{CONV}			160/f_{ADC}*3			µs
Sampling time	t_{SAMP}			12/f_{ADC}*3			µs
Analog input voltage	V_{IAN}	AN0 to AN7		0		AV_{REF}	V

Fig. 5. Definition of A/D converter terms



*1 V_{ZT} : Value at which the digital conversion value changes from 00_H to 01_H and vice versa.

*2 V_{FT} : Value at which the digital conversion value changes from FE_H to FF_H and vice versa.

*3 f_{ADC} indicates the below values due to the bit6 (CKS) of A/D control registor (address: $00F9_H$) and the Bit7 (PCK1) and Bit6 (PCK0) of clock control registor (address: $00FE_H$)

CKS / PCK1, 0	0 (ϕ/2 selection)	1 (ϕ selection)
00 (ϕ = f_{EX}/2)	f_{ADC} = f_C/2	f_{ADC} = f_C
01 (ϕ = f_{EX}/4)	f_{ADC} = f_C/4	f_{ADC} = f_C/2
11 (ϕ = f_{EX}/16)	f_{ADC} = f_C/16	f_{ADC} = f_C/8

(4) Interruption, reset input (Ta = –20 to +75°C, V_{DD} = 4.5 to 5.5V, Vss = 0V)

Item	Symbol	Pin	Condition	Min.	Max.	Unit
External interruption high and low level widths	t_{IH} t_{IL}	INT0 INT1 INT2 INT3 $\overline{NMI}$		1		µs
Reset input low level width	t_{RSL}	$\overline{RST}$		32/fc		µs

Fig 6. Interruption input timing

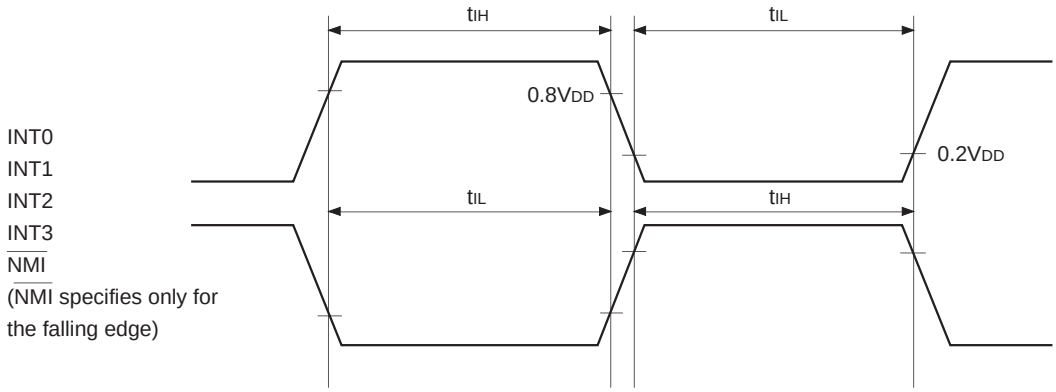
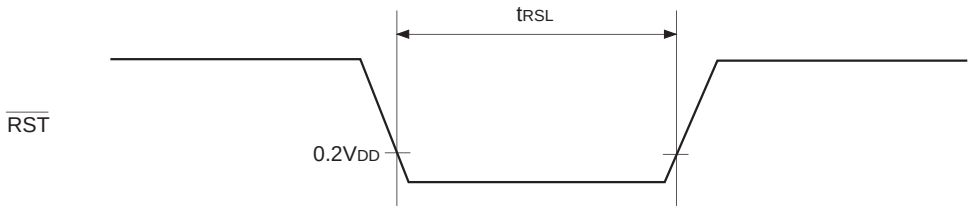
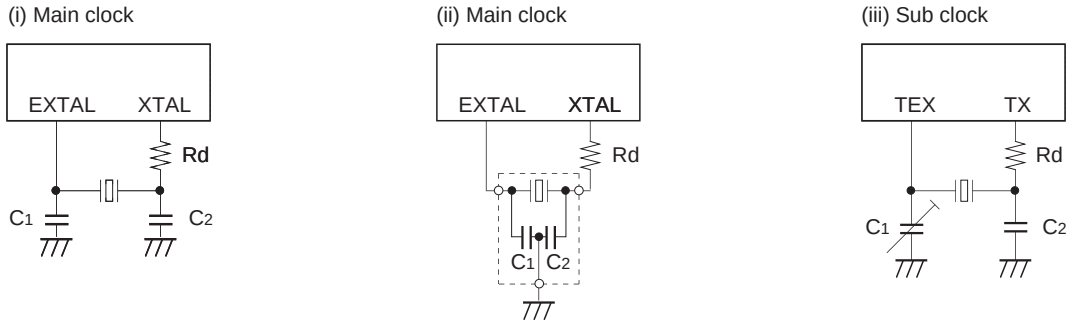


Fig. 7. $\overline{RST}$ input timing



Appendix

Fig. 8. Recommended oscillation circuit



Manufacturer	Model	fc (MHz)	C_1 (pF)	C_2 (pF)	Rd (Ω)	Circuit example
MURATA MFG CO., LTD.	CSA4.19MG	4.19	30	30	0	(i)
	CSA8.00MTZ	8.00				
	CSA10.0MTZ	10.00				
	CST4.19MGW*	4.19				(ii)
	CST8.00MTW*	8.00				
	CST10.0MTW*	10.00				
RIVER ELETEC CORPORATION	HC-49/U03	4.19	12	12	0	(i)
		8.00				
		10.00				
KINSEKI LTD.	HC-49/U (-S)	4.19	27	27	0	
		8.00				
		10.00	20	20		
	P3	32.768kHz	50	22	1M	(iii)

Those marked with an asterisk (∗) signify types with built-in ground capacitance (C_1, C_2).

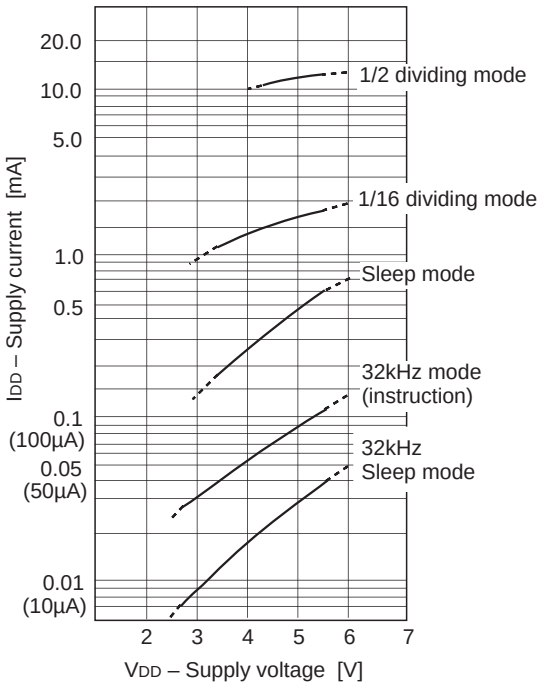
Mask Option Table

Item	Content	
Reset pin pull-up resistor	Non-existent	Existent
High voltage tolerance pull-down resistor	Non-existent	Existent (selected every pin)

Charactreistics Curves

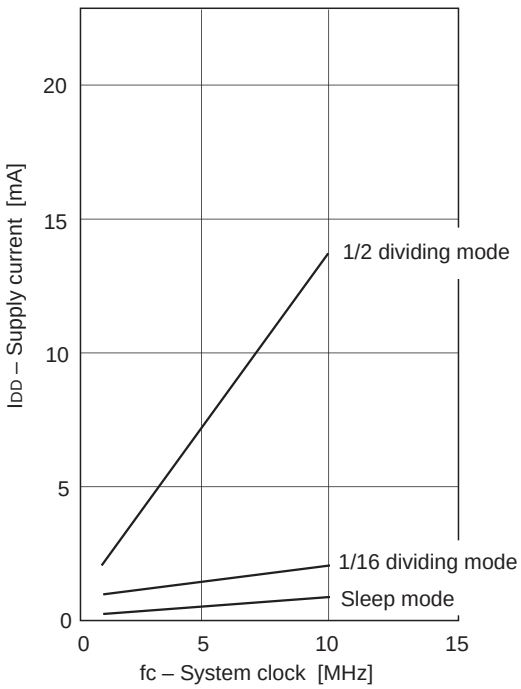
IDD vs. VDD

(fc = 10MHz, Ta = 25°C, Typical)



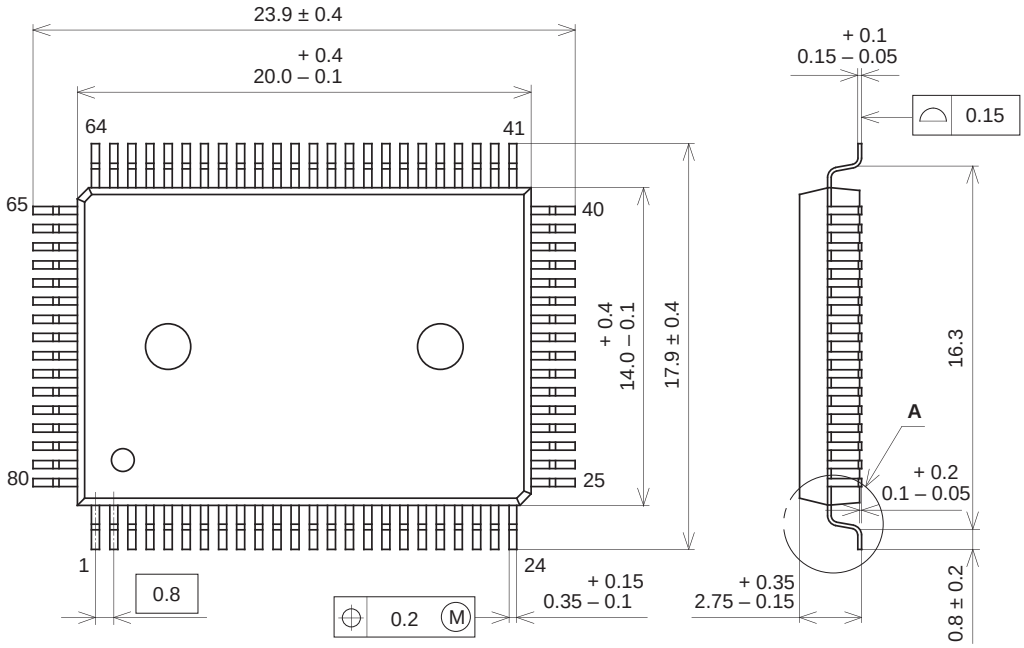
IDD vs. fc

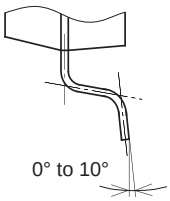
(VDD = 5V, Ta = 25°C, Typical)



Package Outline Unit : mm

80PIN QFP (PLASTIC)





DETAIL **A**

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

PACKAGE STRUCTURE

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