

CMOS 8-bit Single Chip Microcomputer

Description

The CXP86212/86216, CXP86324/86332, CXP86440/86448/86460 are the CMOS 8-bit single chip microcomputer integrating on a single chip an A/D converter, serial interface, timer/counter, time-base timer, on-screen display function, I²C bus interface, PWM output, remote control reception circuit, HSYNC counter, watchdog timer, 32kHz timer/counter besides the basic configurations of 8-bit CPU, ROM, RAM, I/O ports.

The CXP86212/86216, CXP86324/86332, CXP86440/86448/86460 also provide a SLEEP function that enables to lower the power consumption.

Features

- A wide instruction set (213 instructions) which covers various types of data
 - 16-bit operation/multiplication and division/ Boolean bit operation instructions
- Minimum instruction cycle 250ns at 16MHz operation
 122µs at 32kHz operation
- Incorporated ROM 12K bytes (CXP86212)
 24K bytes (CXP86324)
 40K bytes (CXP86440)
 16K bytes (CXP86216)
 32K bytes (CXP86332)
 48K bytes (CXP86448)
 60K bytes (CXP86460)

- Incorporated RAM 352 bytes (CXP86212/86216) 704 bytes (CXP86324/86332) 1536 bytes (CXP86440/86448/86460)
(Excludes VRAM for on-screen display and sprite RAM)

- Peripheral functions
 - A/D converter
 - Serial interface
 - Timer

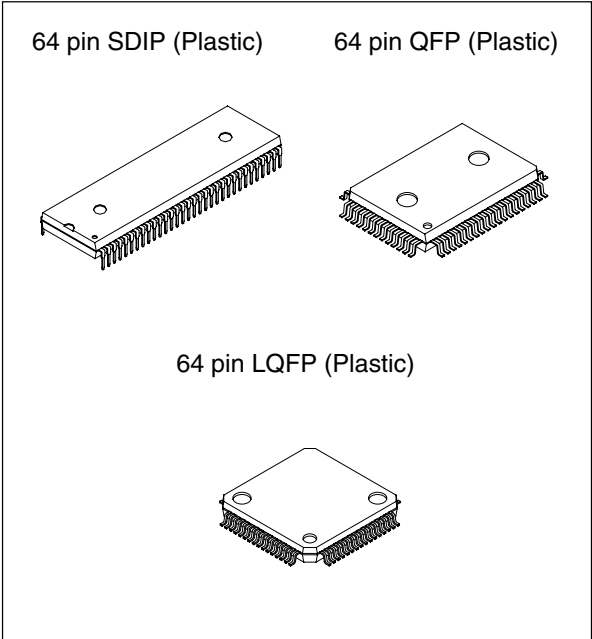
– On-screen display (OSD) function

8-bit 6-channel successive approximation method (Conversion time of 3.25µs at 16MHz)
8-bit clock sync type, 1 channel
8-bit timer
8-bit timer/counter
19-bit time-base timer
32 kHz timer/counter
12 × 16 dots, 128 character types (CXP86212/86216),
256 character types (CXP86324/86332),
384 character types (CXP86440/86448/86460)
15 character colors, 2 lines × 24 characters,
frame background 8 colors/ half blanking,
background on full screen 15 colors/ half blanking
edging/ shadowing/ rounding for every line,
background with shadow for every character (CXP86440/86448/86460),
double scanning,
sprite OSD (CXP86440/86448/86460),
12 × 16 dots, 1 screen, 8 colors for every dot

- I²C bus interface
- PWM output

8 bits, 8 channels
14 bits, 1 channel
8-bit pulse measurement counter, 6-stage FIFO
2 channels

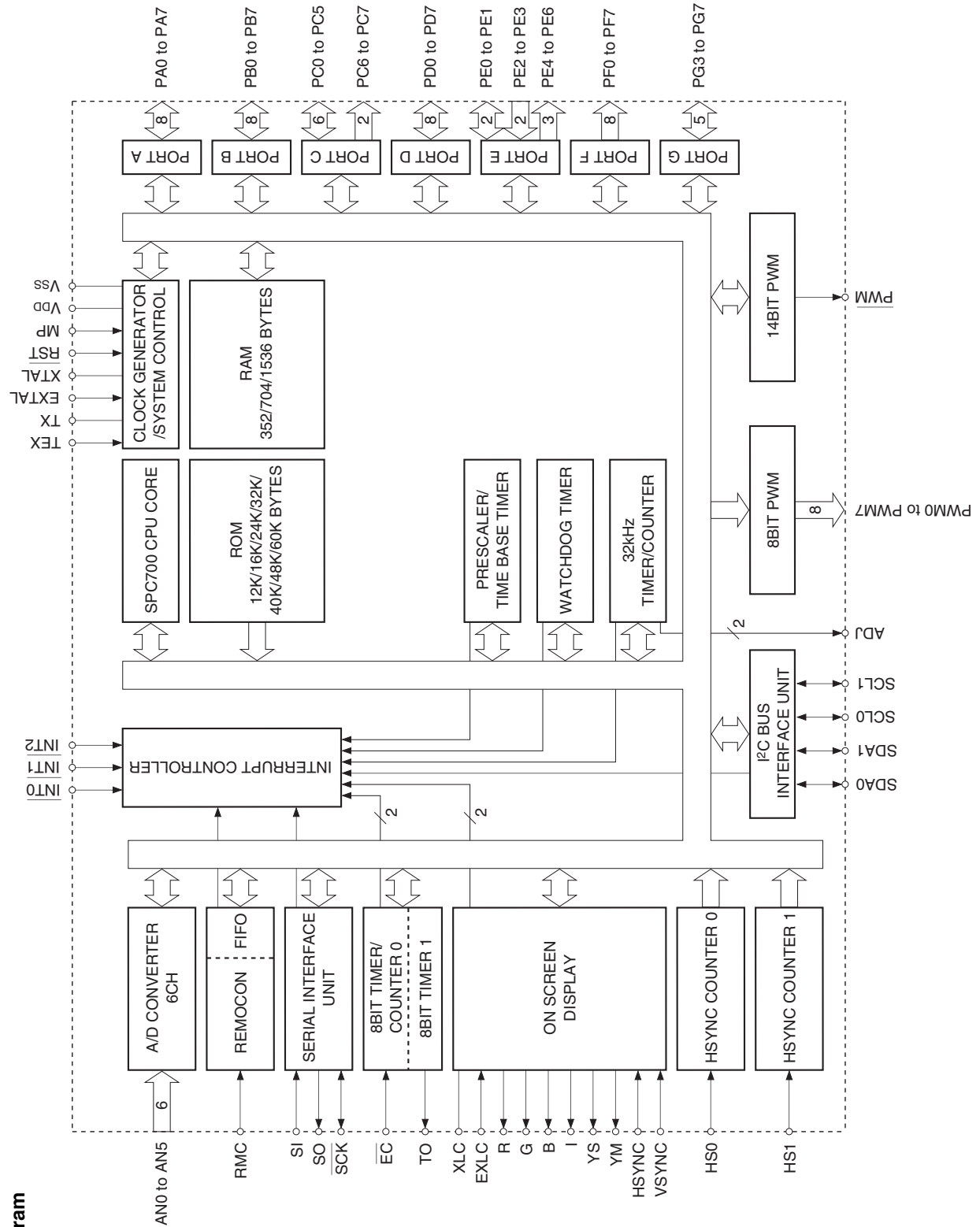
- Remote control reception circuit
- HSYNC counter
- Watchdog timer
- Interruption 13 factors, 13 vectors, multi-interruption possible
- Standby mode Sleep
- Package 64-pin plastic SDIP/QFP/LQFP
- Piggyback/evaluator CXP86400 64-pin ceramic PQFP
 CXP86490 64-pin ceramic PSDIP (Supports custom font)



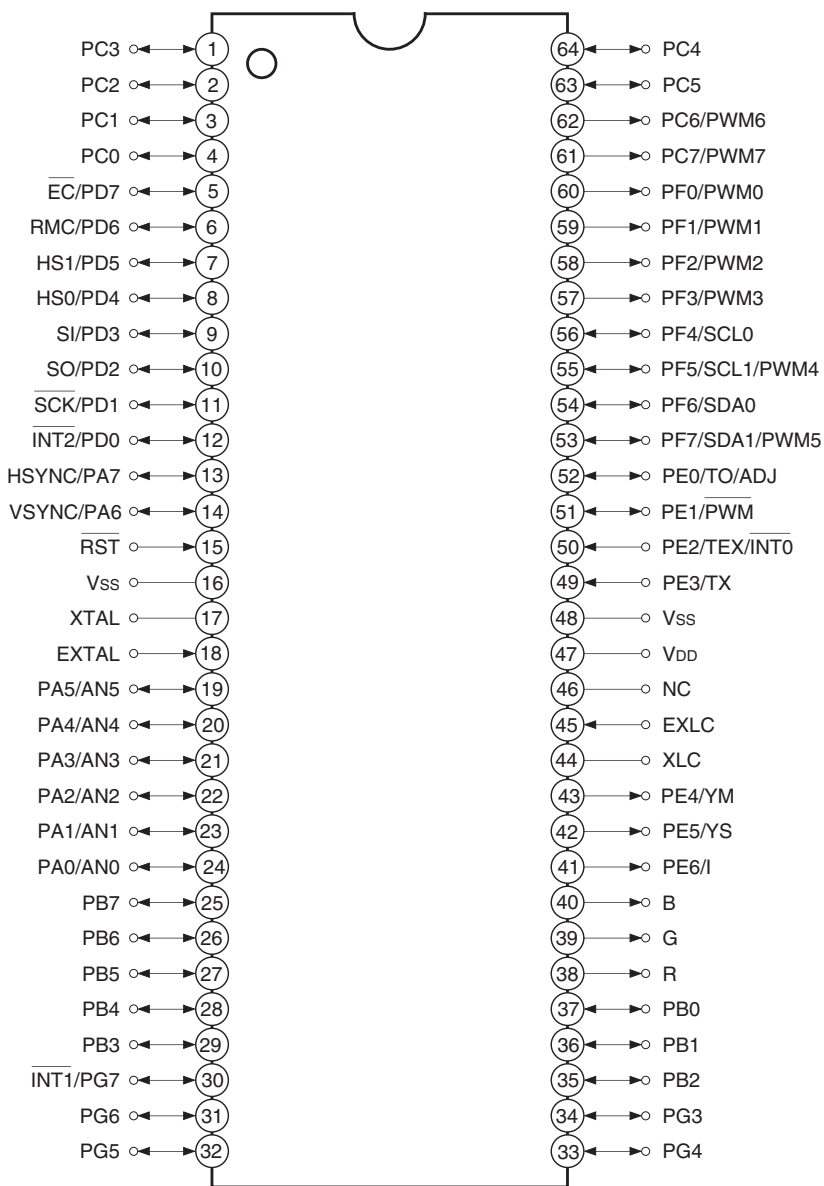
Structure
Silicon gate CMOS IC

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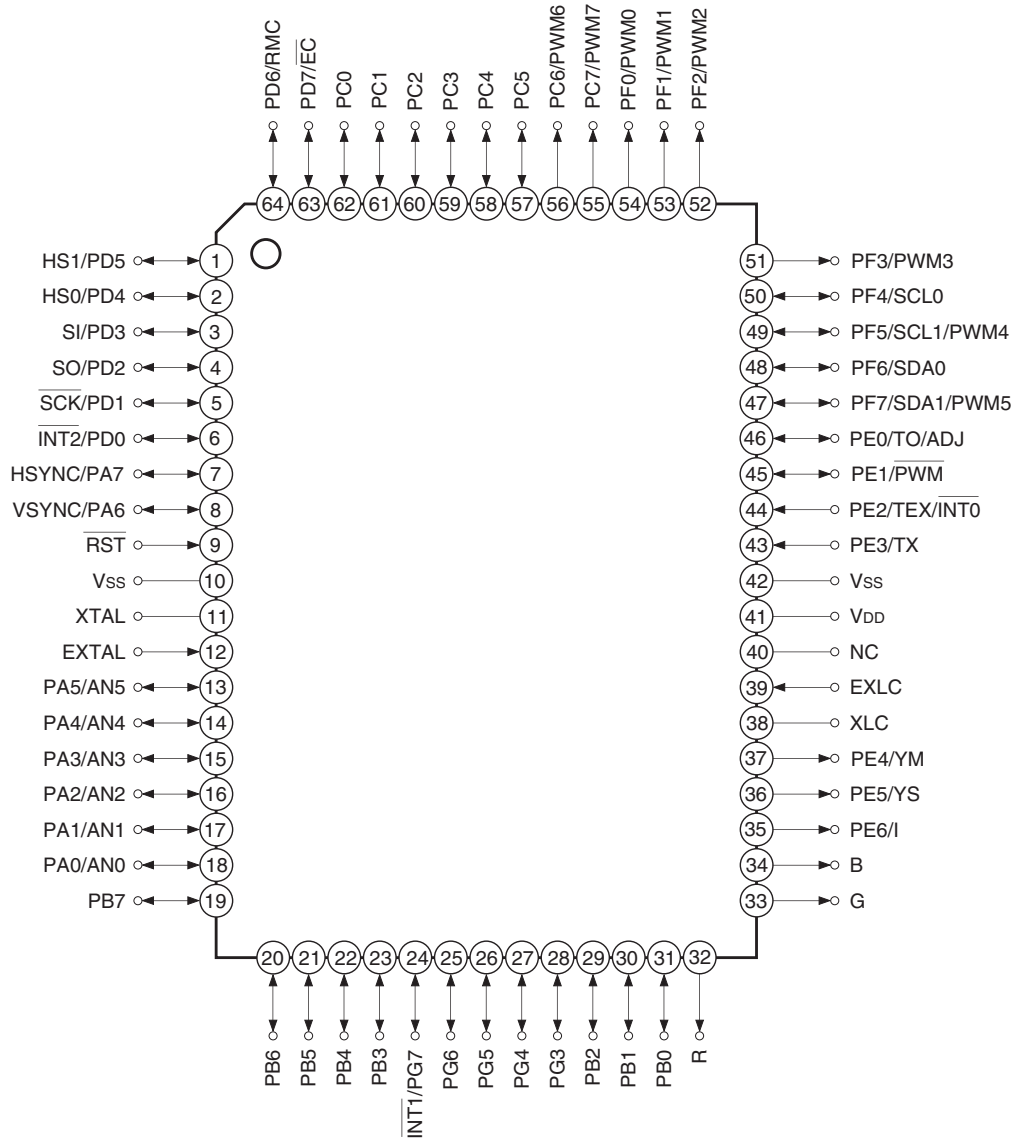
Pin Assignment (Top View) 64-pin SDIP



Note)

1. NC (Pin 46) is left open.
2. Vss (Pins 16 and 48) are both connected to GND.

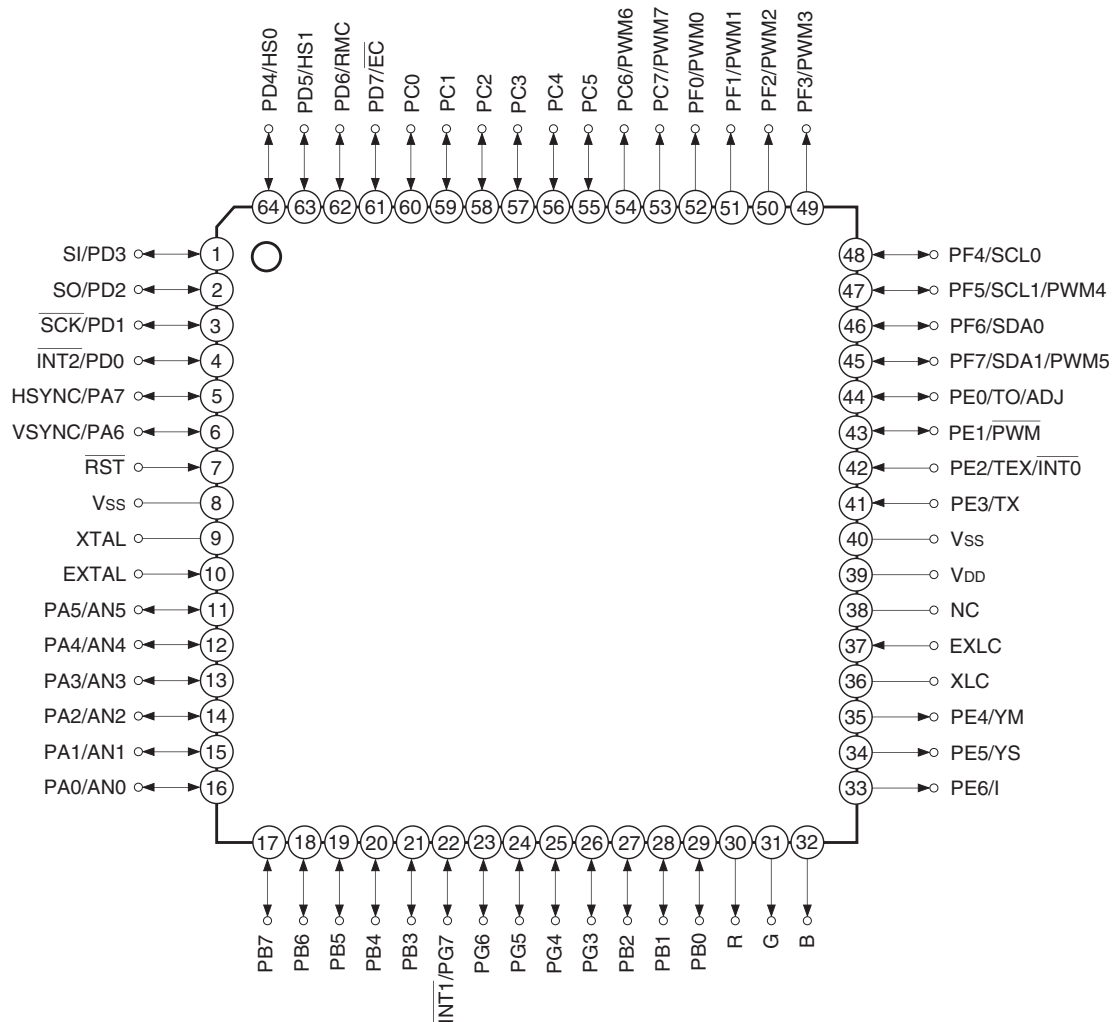
Pin Assignment (Top View) 64-pin QFP



Note)

1. NC (Pin 40) is left open.
2. Vss (Pins 10 and 42) are both connected to GND.

Pin Assignment (Top View) 64-pin LQFP



Note)

1. NC (Pin 38) is left open.
2. Vss (Pins 8 and 40) are both connected to GND.

Pin Description

Symbol	I/O	Description	
PA0/AN0 to PA5/AN5	I/O/ Analog input	(Port A) 8-bit I/O port. I/O can be set in a unit of single bits. (8 pins)	Analog inputs to A/D converter. (6 pins)
PA6/VSYNC	I/O/Input		OSD display vertical sync signal input.
PA7/HSYNC	I/O/Input		OSD display horizontal sync signal input.
PB0 to PB7	I/O	(Port B) 8-bit I/O port. I/O can be set in a unit of single bits. (8 pins)	
PC0 to PC5	I/O	(Port C) Lower 6 bits are I/O ports; I/O can be set in a unit of single bits. Upper 2 bits are output port and large current (12mA) N-channel open drain output. Upper 2 bits are medium drive voltage (12V); lower 6 bits are 5V drive. (8 pins)	
PC6/PWM6 to PC7/PWM7	Output/Output		8-bit PWM output. (2 pins)
PD0/ $\overline{\text{INT2}}$	I/O/Input		External interruption request input. Active at the falling edge.
PD1/ $\overline{\text{SCK}}$	I/O/I/O	(Port D) 8-bit I/O port. I/O can be set in a unit of single bits. Can drive 12mA synk current. (8 pins)	Serial clock I/O.
PD2/SO	I/O/Output		Serial data output.
PD3/SI	I/O/Input		Serial data input.
PD4/HS0	I/O/Input		HSYNC counter (CH0) input.
PD5/HS1	I/O/Input		HSYNC counter (CH1) input.
PD6/RMC	I/O/Input		Remote control reception circuit input.
PD7/ $\overline{\text{EC}}$	I/O/Input		External event input for timer/counter.
PE0/TO/ADJ	I/O/Output/ Output		Rectangular wave output for 8-bit timer/counter. 32kHz oscillation frequency dividing output.
PE1/PWM	I/O/Output	(Port E)	14-bit PWM output.
PE2/TEX/ $\overline{\text{INT0}}$	Input/Input/ Input	Bits 0 and 1 are I/O port; I/O can be set in a unit of single. Bits 2 and 3 are input port. Bits 4, 5 and 6 are output port. (7 pins)	Connects a crystal for 32kHz timer/counter clock oscillation. When used as an event counter, input to TEX pin and leave TX pin open. External interruption request input. Active at the falling edge.
PE3/TX	Input/Output		
PE4/YM	Output/Output		OSD display 6-bit output. (6 pins)
PE5/YS	Output/Output		
PE6/I	Output/Output		
B	Output		
G	Output		
R	Output		

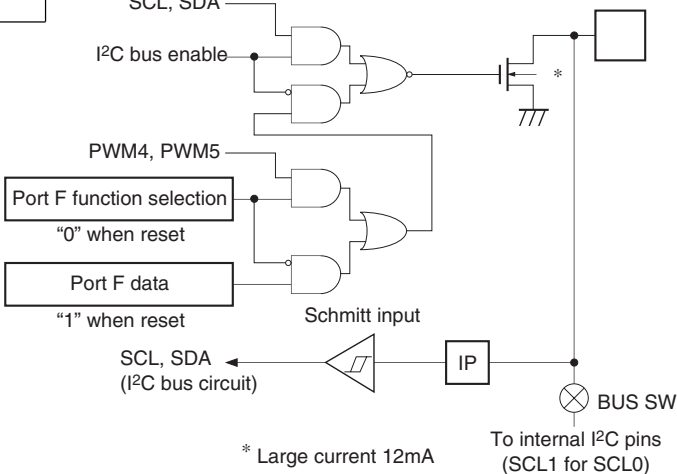
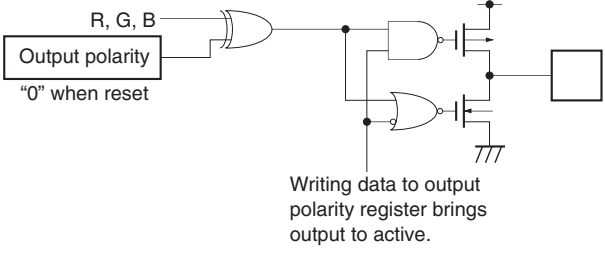
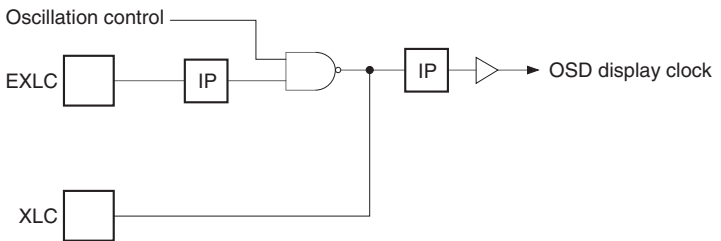
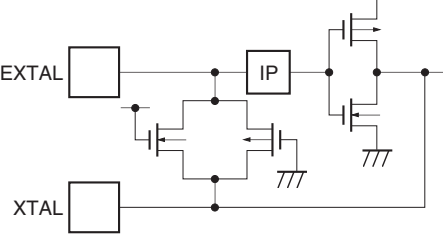
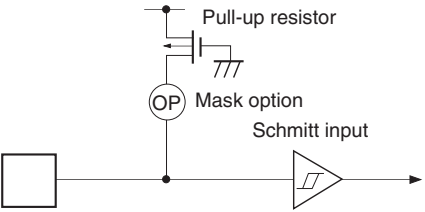
Symbol	I/O	Description	
PF0/PWM0 to PF3/PWM3	Output/Output	(Port F) 8-bit output port and large current (12mA) N-channel open drain output. Lower 4 bits are medium drive voltage (12V); upper 4 bits are 5V drive. (8 pins)	8-bit PWM output. (4 pins)
PF4/SCL0	Output/I/O		I ² C bus interface transfer clock I/O. (2 pins)
PF5/SCL1/PWM4	Output/I/O/Output		8-bit PWM output.
PF6/SDA0	Output/I/O		I ² C bus interface transfer data I/O. (2 pins)
PF7/SDA1/PWM5	Output/I/O/Output		8-bit PWM output.
PG3 to PG6	I/O	(Port G) 5-bit I/O port. I/O can be set in a unit of single bits. (5 pins)	
PG7/ $\overline{\text{INT1}}$	I/O/Input	External interruption request input. Active at the falling edge.	
EXTAL	Input	Connects a crystal for system clock oscillation. When a clock is supplied externally, input to EXTAL pin and input a reversed phase clock to XTAL pin.	
XTAL	Output		
$\overline{\text{RST}}$	Input	System reset; active at Low level.	
EXLC	Input	OSD display clock oscillation I/O. Oscillation frequency is determined by the external L and C.	
XLC	Output		
NC		No connected.	
V _{DD}		Positive power supply.	
V _{SS}		GND. Connect two V _{SS} pins to GND.	

Input/Output Circuit Formats for Pins

Pin	Circuit format	When reset
PA0/AN0 to PA5/AN5 6 pins		Hi-Z
PA6/VSYNC PA7/HSYNC 2 pins		Hi-Z
PB0 to PB7 PC0 to PC5 PG3 to PG6 PG7/INT1 19 pins		Hi-Z
PC6/PWM6 PC7/PWM7 PF0/PWM0 to PF3/PWM3 6 pins	<p>* 12V drive voltage Large current 12mA</p>	Hi-Z

Pin	Circuit format	When reset
<p>Port D</p> <p>PD0/$\overline{\text{INT2}}$ PD3/SI PD4/HS0 PD5/HS1 PD6/RMC PD7/$\overline{\text{EC}}$</p> <p>6 pins</p>	<p>Port D data</p> <p>Port D direction "0" when reset</p> <p>Data bus</p> <p>RD (Port D)</p> <p>Schmitt input</p> <p>IP</p> <p>$\overline{\text{INT2}}$, SI, HS0, HS1, RMC, $\overline{\text{EC}}$</p> <p>* Large current 12mA</p>	<p>Hi-Z</p>
<p>Port D</p> <p>PD1/$\overline{\text{SCK}}$ PD2/SO</p> <p>2 pins</p>	<p>SCK, SO</p> <p>SIO output enable</p> <p>Port D data</p> <p>Port D direction "0" when reset</p> <p>Data bus</p> <p>RD (Port D)</p> <p>Schmitt input only for PD1</p> <p>IP</p> <p>$\overline{\text{SCK}}$ only</p> <p>* Large current 12mA</p>	<p>Hi-Z</p>
<p>Port E</p> <p>PE0/TO/ADJ</p> <p>1 pin</p>	<p>Internal reset signal</p> <p>Port E data "1" when reset</p> <p>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) "00" when reset</p> <p>Port E direction "1" when reset</p> <p>Data bus</p> <p>RD (Port E)</p> <p>*1 ADJ signals are frequency dividing outputs for 32kHz oscillation frequency adjustment. ADJ2K provides usage as buzzer output.</p> <p>*2 Pull-up resistors approx. 150kΩ</p>	<p>High level (with approximately 150kΩ resistor when reset)</p>

Pin	Circuit format	When reset
<p>PE1/PWM</p> <p>1 pin</p>	<p>Port E</p> <p>PWM</p> <p>Port E function selection "0" when reset</p> <p>Port E data "1" when reset</p> <p>Port E direction "1" when reset</p> <p>Data bus</p> <p>RD (Port E)</p> <p>IP</p>	<p>High level</p>
<p>PE2/TEX/INT0 PE3/TX</p> <p>2 pins</p>	<p>Port E</p> <p>32kHz oscillation circuit control "1" when reset Schmitt input</p> <p>INT0</p> <p>Data bus</p> <p>RD (Port E)</p> <p>Schmitt input</p> <p>IP</p> <p>IP</p> <p>Schmitt input</p> <p>Clock input</p> <p>PE2/ TEX/ INT0</p> <p>PE3/ TX</p>	<p>Oscillation halted Port input</p>
<p>PE4/YM PE5/YS PE6/I</p> <p>3 pins</p>	<p>Port E</p> <p>YM, YS, I</p> <p>Output polarity "0" when reset</p> <p>Port E function selection "0" when reset</p> <p>Port E data</p> <p>Writing data to output polarity register and port data register brings output to active.</p>	<p>Hi-Z</p>

Pin	Circuit format	When reset
<p>PF4/SCL0 PF5/SCL1/PWM4 PF6/SDA0 PF7/SDA1/PWM5</p> <p>4 pins</p>	<p>Port F</p>  <p>SCL, SDA</p> <p>I²C bus enable</p> <p>PWM4, PWM5</p> <p>Port F function selection "0" when reset</p> <p>Port F data "1" when reset</p> <p>Schmitt input</p> <p>SCL, SDA (I²C bus circuit)</p> <p>* Large current 12mA</p> <p>To internal I²C pins (SCL1 for SCL0)</p> <p>BUS SW</p>	<p>Hi-Z</p>
<p>R G B</p> <p>3 pins</p>	 <p>R, G, B</p> <p>Output polarity "0" when reset</p> <p>Writing data to output polarity register brings output to active.</p>	<p>Hi-Z</p>
<p>EXLC XLC</p> <p>2 pins</p>	 <p>Oscillation control</p> <p>EXLC</p> <p>XLC</p> <p>OSD display clock</p>	<p>Oscillation halted</p>
<p>EXTAL XTAL</p> <p>2 pins</p>	 <p>EXTAL</p> <p>XTAL</p> <ul style="list-style-type: none"> • Diagram shows the circuit composition during oscillation. • Feedback resistor is removed during stop. (This device does not enter the stop mode.) 	<p>Oscillation</p>
<p>$\overline{\text{RST}}$</p> <p>1 pin</p>	 <p>Pull-up resistor</p> <p>Mask option OP</p> <p>Schmitt input</p>	<p>Low level</p>

Absolute Maximum Ratings

(V_{SS} = 0V reference)

Item	Symbol	Ratings	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	
Medium drive output voltage	V _{OUTP}	-0.3 to +15.0	V	
High level output current	I _{OH}	-5	mA	
High level total output current	∑I _{OH}	-50	mA	Total of all output pins
Low level output current	I _{OL}	15	mA	Ports excluding large current output (value per pin)
	I _{OLC}	20	mA	Large current output ports (value per pin* ²)
Low level total output current	∑I _{OL}	130	mA	Total of all output pins
Operating temperature	T _{opr}	-20 to +75	°C	
Storage temperature	T _{stg}	-55 to +150	°C	
Allowable power dissipation	P _D	1000	mW	SDIP-64P-01
		600	mW	QFP-64P-L01
		380	mW	LQFP-64P-L01

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

*² The large current output port is Port C (PC6, PC7), Port D (PD) and Port F (PF).

Note) Usage exceeding absolute maximum ratings may permanently impair the LSI. Normal operation should be conducted under the recommended operating conditions. Exceeding those 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	Guaranteed operation range for 1/2 and 1/4 frequency dividing modes
		3.5	5.5	V	Guaranteed operation range for 1/16 frequency dividing mode or sleep
		2.7	5.5	V	Guaranteed operation range for TEX mode
		—	—	V	Guaranteed data hold range for stop* ¹
High level input voltage	V _{IH}	0.7V _{DD}	V _{DD}	V	* ²
	V _{IHS}	0.8V _{DD}	V _{DD}	V	* ³
	V _{IHEX}	V _{DD} - 0.4	V _{DD} + 0.3	V	EXTAL pin* ⁴ , TEX pin* ⁵
Low level input voltage	V _{IL}	0	0.3V _{DD}	V	* ²
	V _{ILS}	0	0.2V _{DD}	V	* ³
	V _{ILEX}	-0.3	0.4	V	EXTAL pin* ⁴ , TEX pin* ⁵
Operating temperature	T _{opr}	-20	+75	°C	

*¹ This device does not enter the STOP mode.

*² PA1 to 5, PB3 to 7, PC0 to PC5, PD2, PE0, PE1, PE3, PG3 to PG6, SCL0 to 1, SDA0 to 1 pins

*³ VSYNC, HSYNC, INT2, SCK, SI, HS0, HS1, RMC, EC, INT0, INT1, RST pins

*⁴ Specifies only during external clock input.

*⁵ Specifies only during external event count input. - 12 -

Electrical Characteristics

DC characteristics

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

Item	Symbol	Pins	Conditions	Min.	Typ.	Max.	Unit
High level output voltage	V _{OH}	PA, PB, PC0 to PC5, PD, PE0 to PE1, PE4 to PE6, PG, R, G, B	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, PE0 to PE1, PE4 to PE6, PF0 to PF3, PG, R, G, B	V _{DD} = 4.5V, I _{OL} = 1.8mA			0.4	V
			V _{DD} = 4.5V, I _{OL} = 3.6mA			0.6	V
		PC6, PC7, PD, PF	V _{DD} = 4.5V, I _{OL} = 12.0mA			1.5	V
		PF4 to PF7 (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 _{IH} = 5.5V	0.1		10	μA
	I _{ILT}		V _{DD} = 5.5V, V _{IL} = 0.4V	-0.1		-10	μA
	I _{ILR}			RST*1	-1.5		-400
I/O leakage current	I _{Iz}	PA to PE, PG, R, G, B, RST*1	V _{DD} = 5.5V, V _I = 0, 5.5V			±10	μA
Open drain I/O leakage current (in N-ch Tr off state)	I _{LOH}	PC6, PC7, PF0 to PF3	V _{DD} = 5.5V, V _{OH} = 12.0V			50	μA
		PF4 to PF7	V _{DD} = 5.5V, V _{OH} = 5.5V			10	μA
I ² C bus switch connection impedance (in 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
Supply current*2	I _{DD1}	V _{DD}	1/2 frequency dividing mode		18	28	mA
			V _{DD} = 5.5V, 16MHz crystal oscillation (C ₁ = C ₂ = 15pF)				
	I _{DD2}		V _{DD} = 3.3V, 32MHz crystal oscillation (C ₁ = C ₂ = 47pF)	30	80	μA	
			Sleep mode				
	I _{DDS1}		V _{DD} = 5.5V, 16MHz crystal oscillation (C ₁ = C ₂ = 15pF)	1.2	2.1	mA	
			V _{DD} = 3.3V, 32MHz crystal oscillation (C ₁ = C ₂ = 47pF)				12
I _{DDS2}							
I _{DDS3}	Stop mode*3 V _{DD} = 5.5V, termination of 16MHz and 32MHz oscillation	—	—	—	μA		

Item	Symbol	Pins	Conditions	Min.	Typ.	Max.	Unit
Input capacitance	C _{IN}	PA to PD, PE0 to PE3, R, G, B, PF4 to PF7, PG3 to PG7, <u>EXTAL</u> , TEX, EXLC, <u>RST</u>	Clock 1 MHz 0V other than the measured pins		10	20	pF

*1 For RST pin, specifies the input current when pull-up resistance is selected, and specifies the leakage current when non-resistor is selected.

*2 When all output pins are left open. Specifies only when the OSD oscillation is halted.

*3 This device does not enter the stop mode.

AC Characteristics

(1) Clock timing

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

Item	Symbol	Pins	Conditions	Min.	Typ.	Max	Unit
System clock frequency	fc	XTAL EXTAL	Fig. 1, Fig.2	8		16	MHz
System clock input pulse width	t _{XL} , t _{XH}	EXTAL	Fig. 1, Fig.2 External clock drive	28			ns
System clock input rise and fall times	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	4t _{sys} *1			ns
Event count input clock rise and fall times	t _{ER} , t _{EF}	\overline{EC}	Fig. 3			20	ms
System clock frequency	fc	TEX TX	VDD = 2.7 to 5.5 V Fig. 2 (32kHz clock applied conditions)		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 times	t _{TR} , t _{TF}	TEX	Fig. 3			20	ms

*1 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")

Fig. 1. Clock timing

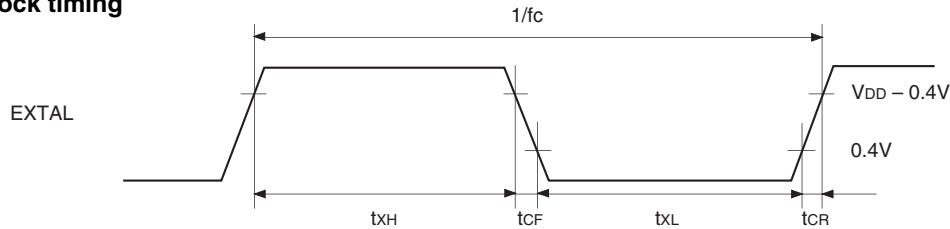


Fig.2. Clock applied conditions

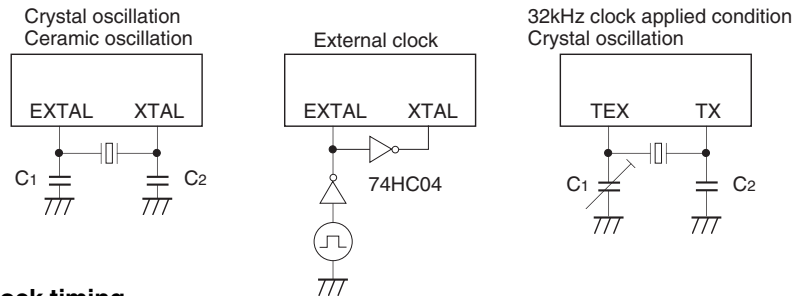
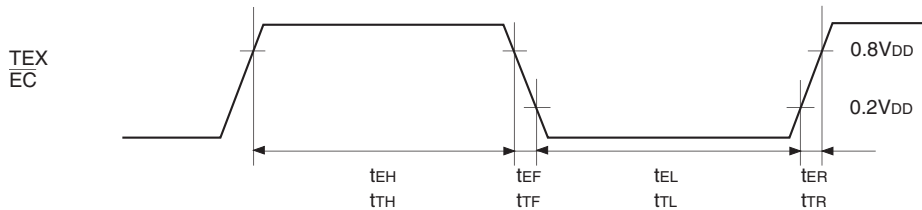


Fig. 3. Event count clock timing



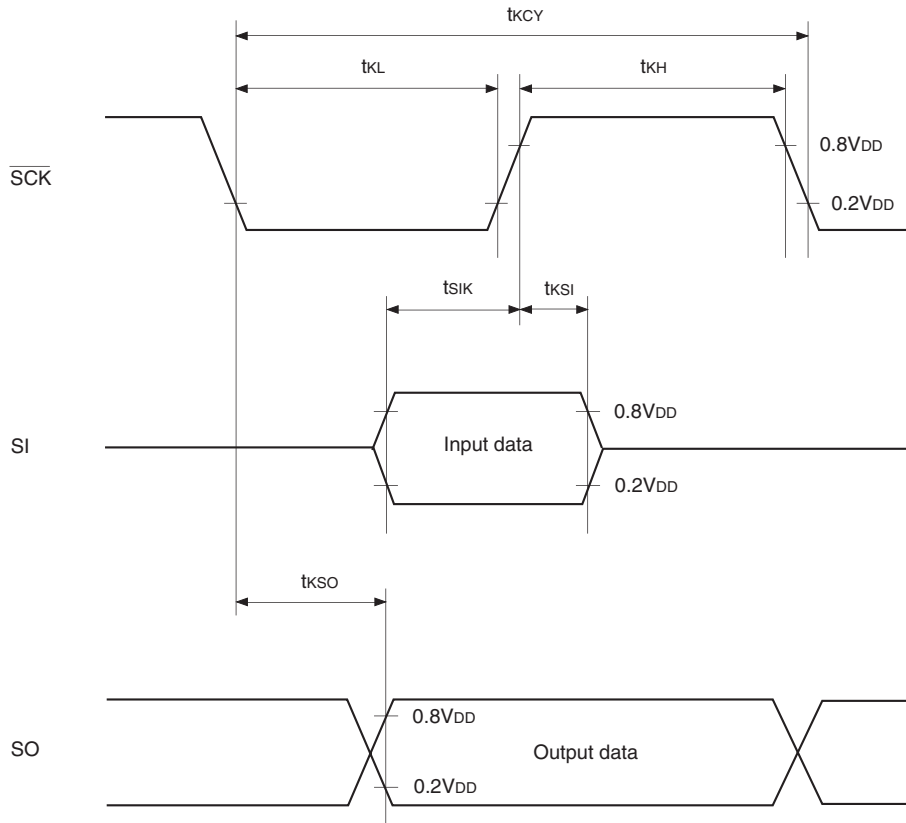
(2) Serial transfer

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

Item	Symbol	Pins	Conditions	Min.	Max.	Unit
$\overline{\text{SCK}}$ cycle time	t_{KCY}	$\overline{\text{SCK}}$	Input mode	1000		ns
			Output mode	$8000/f_c$		ns
$\overline{\text{SCK}}$ High and Low level width	t_{KH}	$\overline{\text{SCK}}$	$\overline{\text{SCK}}$ input mode	400		ns
	t_{KL}		$\overline{\text{SCK}}$ output mode	$4000/f_c - 50$		ns
SI input setup time (for $\overline{\text{SCK}} \uparrow$)	t_{SIK}	SI	$\overline{\text{SCK}}$ input mode	100		ns
			$\overline{\text{SCK}}$ output mode	200		ns
SI hold time (for $\overline{\text{SCK}} \uparrow$)	t_{KSI}	SI	$\overline{\text{SCK}}$ input mode	200		ns
			$\overline{\text{SCK}}$ output mode	100		ns
$\overline{\text{SCK}} \downarrow \rightarrow \text{SO}$ delay time	t_{KSO}	SO	$\overline{\text{SCK}}$ input mode		200	ns
			$\overline{\text{SCK}}$ output mode		100	ns

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

Fig. 4. Serial transfer timing

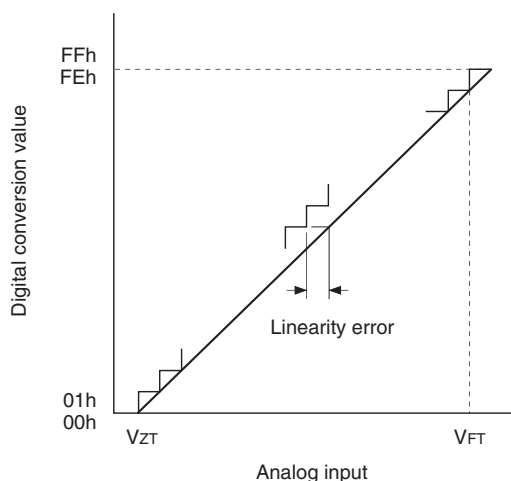


(3) A/D converter

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

Item	Symbol	Pins	Conditions	Min.	Typ.	Max.	Unit
Resolution						8	Bits
Linearity error			$T_a = 25^\circ\text{C}$ $V_{DD} = 5.0\text{V}$ $V_{SS} = 0\text{V}$			± 3	LSB
Zero transition voltage	V_{ZT}^{*1}			-10	10	70	mV
Full-scale transition voltage	V_{FT}^{*2}			4910	4970	5030	mV
Conversion time	t_{CONV}			$26/f_{ADC}^{*3}$			μs
Sampling time	t_{SAMP}			$6/f_{ADC}^{*3}$			μs
Analog input voltage	V_{IAN}	AN0 to AN5		0		V_{DD}	V

Fig. 5. Definitions for A/D converter terms



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

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

*3 f_{ADC} indicates the below values due to the contents of bit 6 (CKS) of the A/D control register (ADC: 00F6h):

$$f_{ADC} = f_c \text{ (CKS = "0")}, f_c/2 \text{ (CKS = "1")}$$

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

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

Fig. 6. Interruption input timing

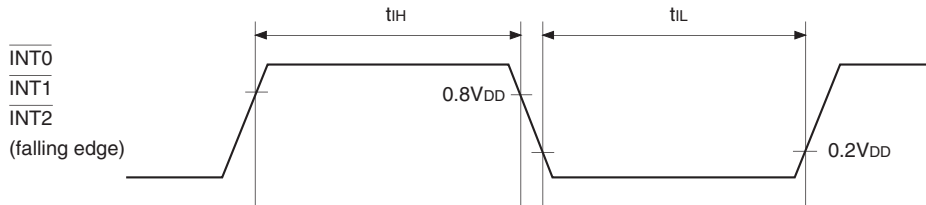
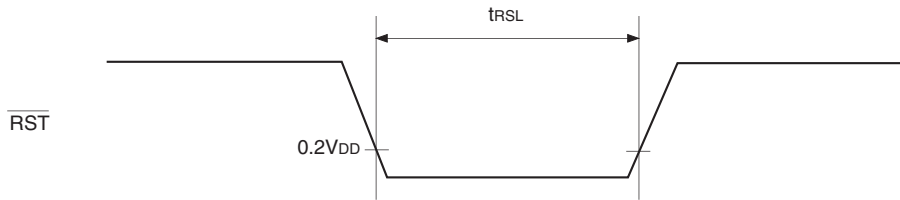


Fig. 7. $\overline{\text{RST}}$ input timing



(5) I²C bus timing

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

Item	Symbol	Pins	Conditions	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 repeated 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 should be 300ns or more because the SCL rise time (300ns Max.) is not included in it.

Fig. 8. I²C bus transfer timing

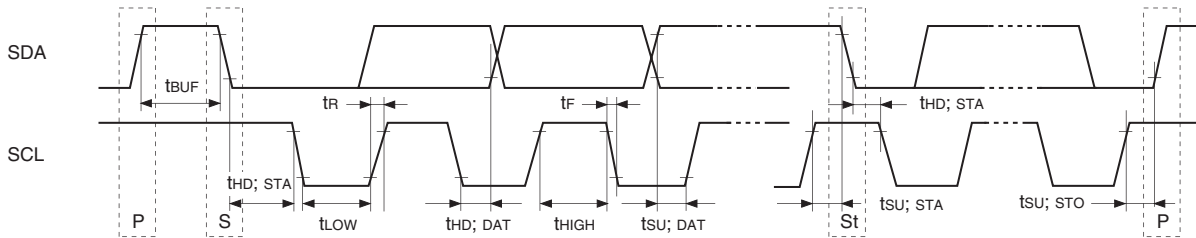
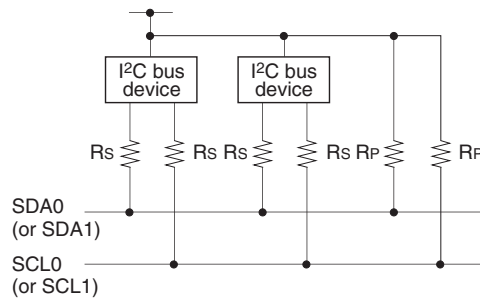


Fig. 9. I²C bus device recommended circuit



- A pull-up resistor (Rp) must be connected to SDA0 (or SDA1) and SCL0 (or SCL1).
- The SDA0 (or SDA1) and SCL0 (or SCL1) series resistance (Rs = 300Ω or less) can be used to reduce the spike noise caused by CRT flashover.

(6) OSD timing

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

Item	Symbol	Pins	Conditions	Min.	Max	Unit
OSD clock frequency	fosc	EXLC XLC	Fig. 11	4	30.4	MHz
HSYNC pulse width	tHWD	HSYNC	Fig. 10	2		µs
VSYNC pulse width	tVWD	VSYNC	Fig. 10	1		H*2
HSYNC afterwrite rise and fall times	tHCG	HSYNC	Fig. 10		200	ns
VSYNC beforewrite rise and fall times	tVCG	VSYNC	Fig. 10		1.0	µs

*1 The maximum value of fosc is specified with the following equation.

$$f_{osc} [max] \leq f_c \times 1.9$$

*2 H indicates 1HSYNC period.

Fig. 10. OSD timing

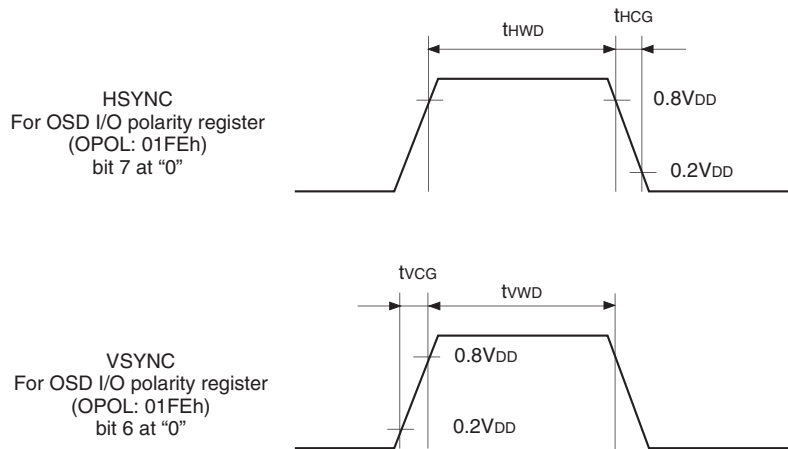
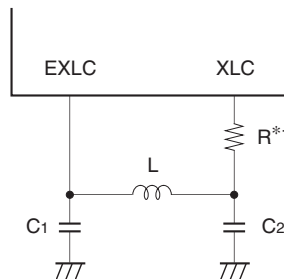


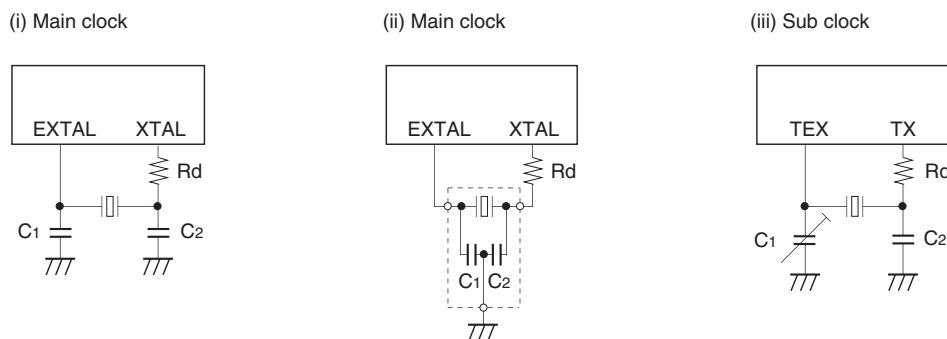
Fig. 11. LC oscillation circuit connection



*1 The series resistor for XLC (R = 1kΩ or less) can reduce the frequency of occurrence of the undesired radiation.

Appendix

Fig. 12. Recommended oscillation circuit



Manufacture	Model	fc (MHz)	C1 (pF)	C2 (pF)	Rd (Ω)	Circuit example
MURATA MFG CO., LTD.	CSA10.0MTZ	10.0	30	30	0*1	(i)
	CSA12.0MTZ	12.0				
	CSA16.00MXZ040	16.0	5	5		
	CST10.0MTW*	10.0	30	30		(ii)
	CST12.0MTW*	12.0				
	CST16.00MXW0C1*	16.0	5	5		
RIVER ELETEC CO., LTD.	HC-49/U03	8.0	18	18	330*1	(i)
		12.0	12	12		
		16.0	10	10		
KINSEKI LTD.	HC-49/U (-S)	8.0	10	10	0*1	
		12.0	5	5		
		16.0	OPEN	OPEN		
	P3	32.768kHz	30	33	120k	(iii)

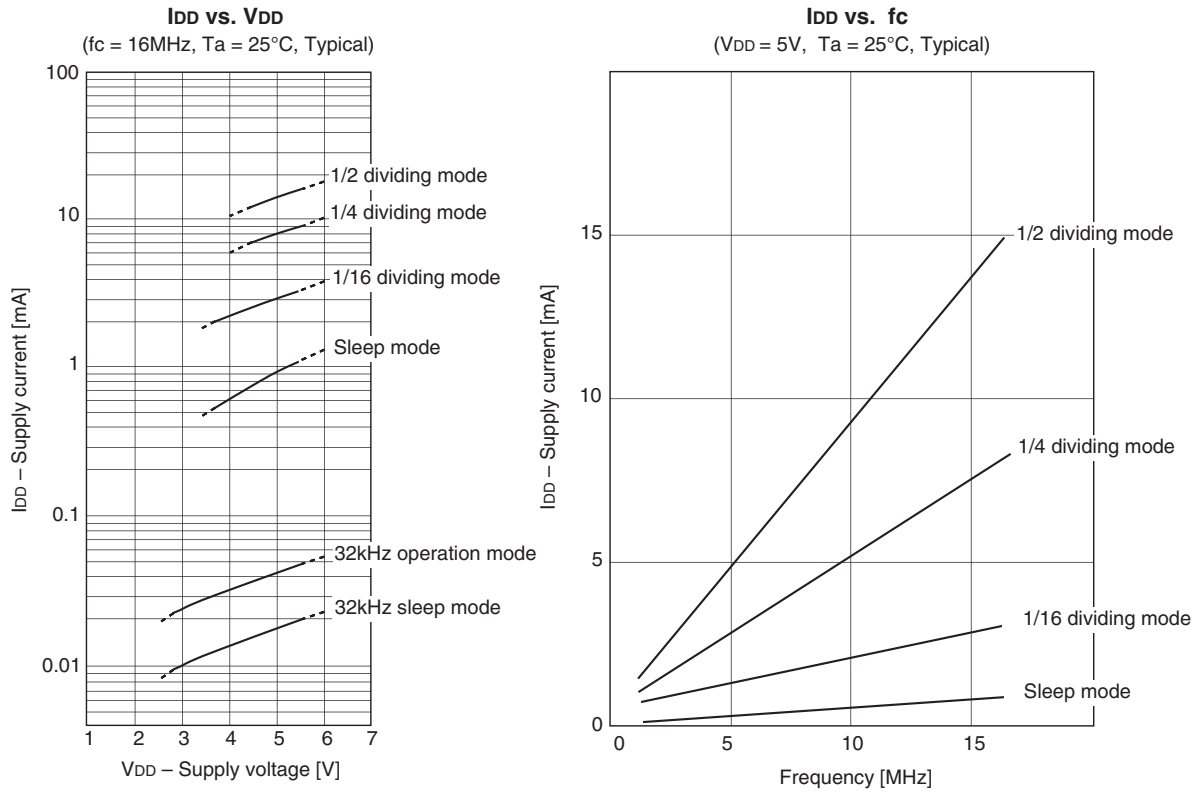
* Models with an asterisk (*) have the built-in ground capacitance (C1, C2).

*1 The series resistor for XTAL (Rd = 500Ω or less) can reduce the effect of the noise caused by the electrostatic discharge.

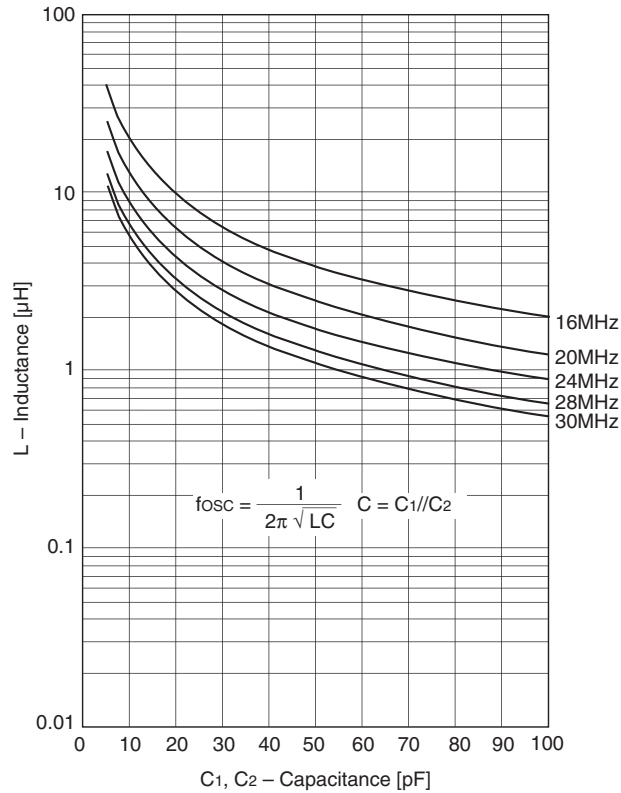
Mask Option Table

Item	Content	
Reset pin pull-up resistor	Non-existent	Existent

Fig. 13. Characteristic curves



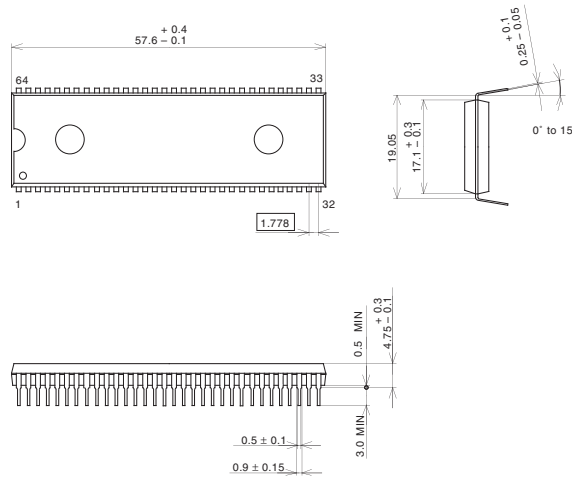
Parameter curve for OSD oscillator L vs. C
(Analytically calculated value)



Package Outline

Unit: mm

64PIN SDIP (PLASTIC)

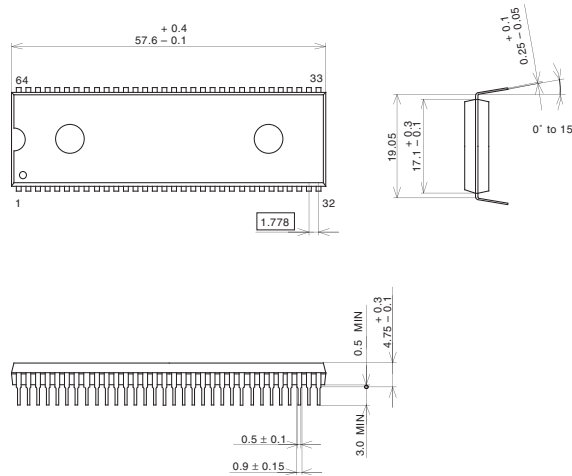


PACKAGE STRUCTURE

SONY CODE	SDIP-64P-01
EIAJ CODE	P-SDIP64-17.1x57.6-1.778
JEDEC CODE	

PACKAGE MATERIAL	EPOXY RESIN
LEAD TREATMENT	SOLDER PLATING
LEAD MATERIAL	42/COPPER ALLOY
PACKAGE MASS	8.6g

64PIN SDIP (PLASTIC)



PACKAGE STRUCTURE

SONY CODE	SDIP-64P-01
EIAJ CODE	P-SDIP64-17.1x57.6-1.778
JEDEC CODE	

PACKAGE MATERIAL	EPOXY RESIN
LEAD TREATMENT	SOLDER PLATING
LEAD MATERIAL	42/COPPER ALLOY
PACKAGE MASS	8.6g

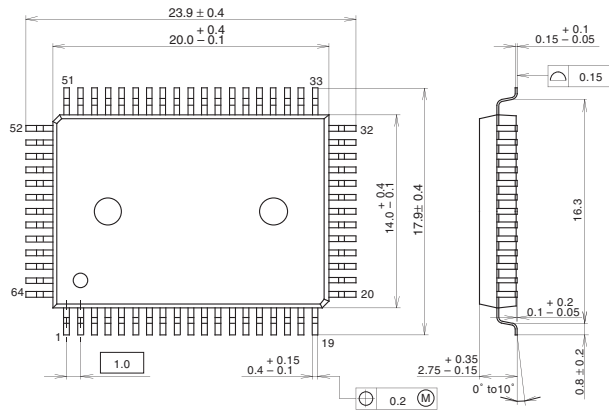
LEAD SPECIFICATIONS

ITEM	SPEC.
LEAD MATERIAL	ALLOY 42
LEAD TREATMENT	Sn-Bi 2.5%
LEAD TREATMENT THICKNESS	5-18 μ m

Package Outline

Unit: mm

64PIN QFP (PLASTIC)

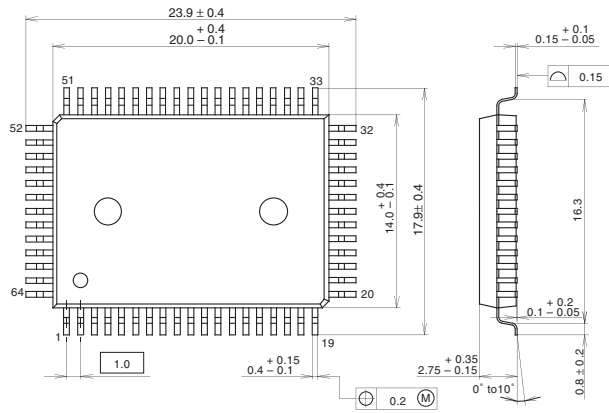


PACKAGE STRUCTURE

SONY CODE	QFP-64P-L01
EIAJ CODE	P-QFP64-14x20-1.0
JEDEC CODE	—

PACKAGE MATERIAL	EPOXY RESIN
LEAD TREATMENT	SOLDER PLATING
LEAD MATERIAL	42/COPPER ALLOY
PACKAGE MASS	1.5g

64PIN QFP (PLASTIC)



PACKAGE STRUCTURE

SONY CODE	QFP-64P-L01
EIAJ CODE	P-QFP64-14x20-1.0
JEDEC CODE	—

PACKAGE MATERIAL	EPOXY RESIN
LEAD TREATMENT	SOLDER PLATING
LEAD MATERIAL	42/COPPER ALLOY
PACKAGE MASS	1.5g

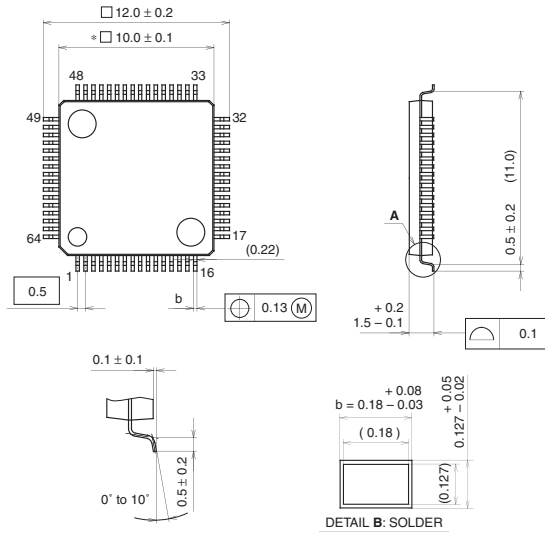
LEAD SPECIFICATIONS

ITEM	SPEC.
LEAD MATERIAL	ALLOY 42
LEAD TREATMENT	Sn-Bi 2.5%
LEAD TREATMENT THICKNESS	5-18µm

Package Outline

Unit: mm

64PIN LQFP (PLASTIC)



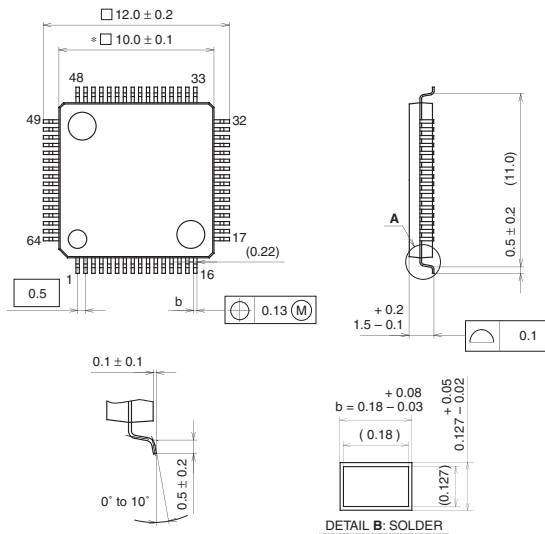
NOTE: Dimension "*" does not include mold protrusion.

PACKAGE STRUCTURE

SONY CODE	LQFP-64P-L01
EIAJ CODE	P-LQFP64-10x10-0.5
JEDEC CODE	

PACKAGE MATERIAL	EPOXY RESIN
LEAD TREATMENT	SOLDER PLATING
LEAD MATERIAL	42/COPPER ALLOY
PACKAGE MASS	0.3g

64PIN LQFP (PLASTIC)



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

PACKAGE STRUCTURE

SONY CODE	LQFP-64P-L01
EIAJ CODE	P-LQFP64-10x10-0.5
JEDEC CODE	

PACKAGE MATERIAL	EPOXY RESIN
LEAD TREATMENT	SOLDER PLATING
LEAD MATERIAL	42/COPPER ALLOY
PACKAGE MASS	0.3g

LEAD PLATING SPECIFICATIONS

ITEM	SPEC.
LEAD MATERIAL	42 ALLOY
SOLDER COMPOSITION	Sn-Bi Bi:1-4wt%
PLATING THICKNESS	5-18μm