



LC86P4164

8-bit Single Chip Microcontroller

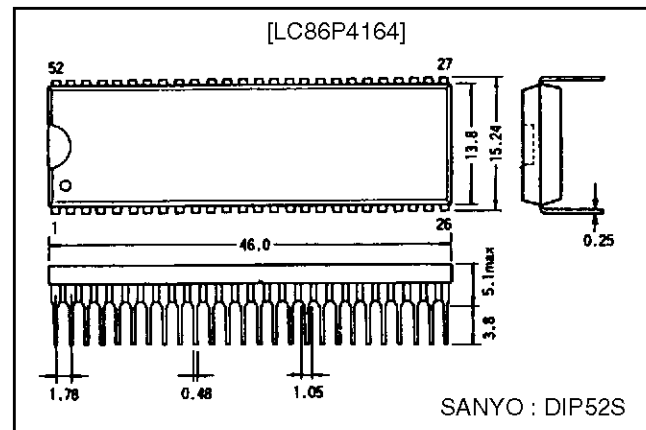
Overview

The LC86P4164 is a CMOS 8-bit single chip microcontroller with one-time PROM for the LC864100 series. This microcontroller has the function and the pin description of the LC864100 series mask ROM version, and the 64K-byte PROM. It is suitable for developing programs.

Package Dimensions

unit : mm

3128-DIP52S



Features

- (1) Option switching by PROM data
The option function of the LC864100 series can be specified by the PROM data. The functions of the trial pieces can be evaluated using the mass production board.
- (2) Internal PROM capacity : 65512 bytes (for program data)
: 8192 × 12 bits (for character data)
- (3) Internal RAM capacity : 384 bytes

Mask ROM version	PROM capacity	RAM capacity
LC864164	65512 bytes	384 bytes
LC864156	57344 bytes	384 bytes
LC864148	49152 bytes	384 bytes
LC864140	40960 bytes	384 bytes
LC864132	32768 bytes	384 bytes
LC864124	24576 bytes	384 bytes
LC864120	20480 bytes	384 bytes
LC864116	16384 bytes	384 bytes
LC864112	12288 bytes	384 bytes

- (4) Operating supply voltage : 4.5 V to 5.5 V
- (5) Instruction cycle time : 1.0 μs to 30 μs
- (6) Operating temperature : -30°C to +70°C
- (7) The pin and the package compatible with the LC864100 series mask ROM devices
- (8) Applicable mask ROM version : LC864164/LC864156/LC864148/LC864140/LC864132
LC864124/LC864120/LC864116/LC864112
- (9) Factory shipment : DIP52S

SANYO Electric Co., Ltd. Semiconductor Business Headquarters

TOKYO OFFICE Tokyo Bldg., 1-10, 1 Chome, Ueno, Taito-ku, TOKYO, 110-8534 JAPAN

LC86P4164

Usage Notes

The LC86P4164 is provided for the first release and small shipping of the LC864100 series.
At using, take notice of the followings.

- (1) Differences between the LC86P4164 and the LC864100 series

Item	LC86P4164	LC864164/56/48/40/32/24/20/16/12
Operation after reset releasing	The option is specified by degrees until 3 ms after going to a 'H' level to the reset terminal. The program is executed from 00H of the program counter.	The program is executed from 00H of the program counter immediately after going to a 'H' level to the reset terminal.
Operating supply voltage range (V _{DD})	4.5 V to 6.0 V	4.5 V to 6.0 V
Operating temperature range (T _{opr})	-30 to +70°C	-30 to +70°C
Power dissipation	Refer to 'electrical characteristics' on the semiconductor news.	

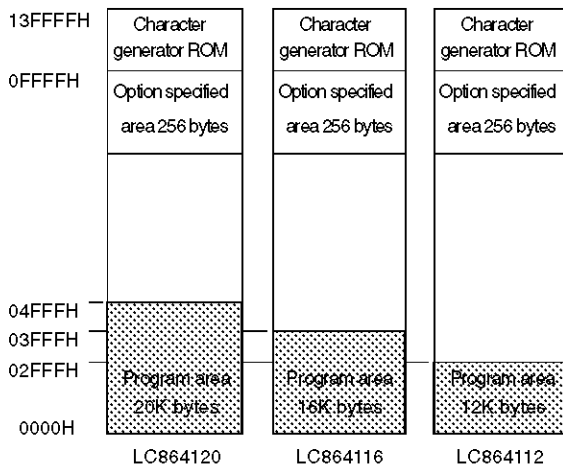
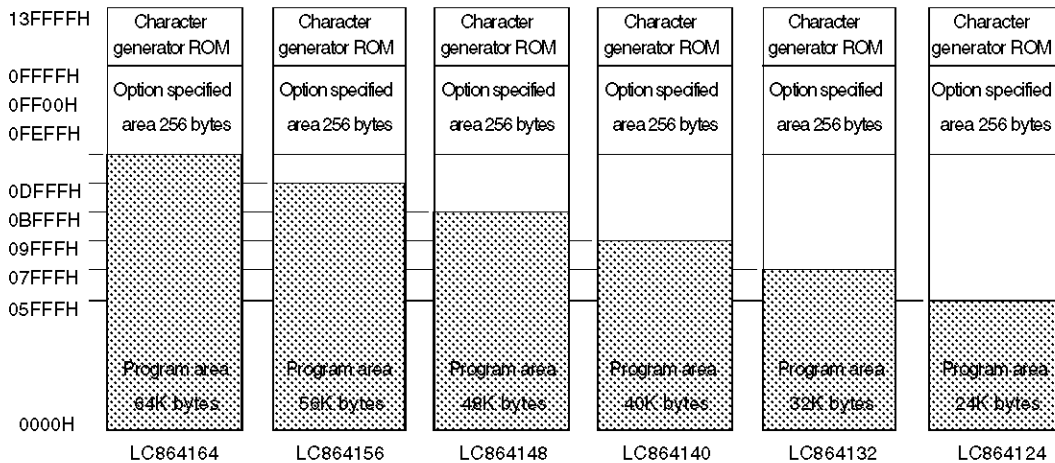
The LC86P4164 uses the program memory area of 256 bytes from FF00H to FFFFH to select the options.

- (2) Option

The option data is created by the option specified program "SU86K.EXE". The created option data is linked to the program area by the linkage loader "L86K.EXE".

- (3) ROM space

The LC86P4164 and LC864100 series use the program memory area of 256 bytes from FF00H to FFFFH to select options. The program memory has 65280 bytes from 0000H to FFFFH.



LC86P4164

How to use

(1) Create a programming data for LC86P4164

Programming data for EPROM of the LC86P4164 is required.

Debugged evaluation file (EVA file) must be converted to an INTEL-HEX formatted file (HEX file) with file converter program, SU86K.EXE. The HEX file is used as the programming data for the LC86P4164.

(2) How to program for the PROM

The LC86P4164 can be programmed by the EPROM programmer with attachment; W86EP4164D.

- Recommended EPROM programmer

Manufacturer	EPROM programmer
Advantest	R4945, R4944
Andou	AF-9704
AVAL	PKW-1100, PKW-3000
Minato electronics	MODEL 1890A

- "27010 (Vpp=12.5V) Intel high speed programming" mode should be adopted. The address must be set to "0 to 13FFFH" and a jumper (DASEC) must be set to 'OFF' at programming.

(3) How to use the data security function

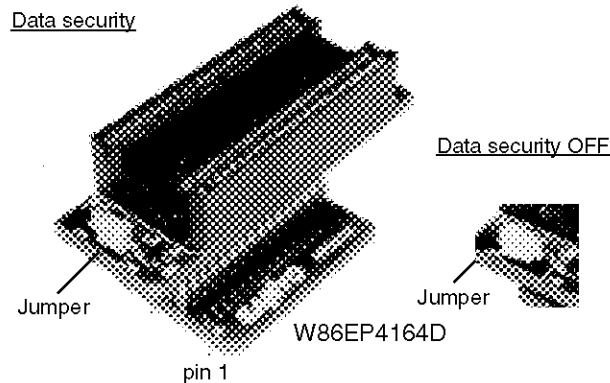
"Data security" is the function to disable the EPROM data from being read out.

The following is the procedure in order to execute the data security function.

- Set 'ON' the jumper of attachment.
- Program again. Then the EPROM programmer displays an error. The error means that the data security functions normally. It is not a trouble of the EPROM programmer or the LSI.

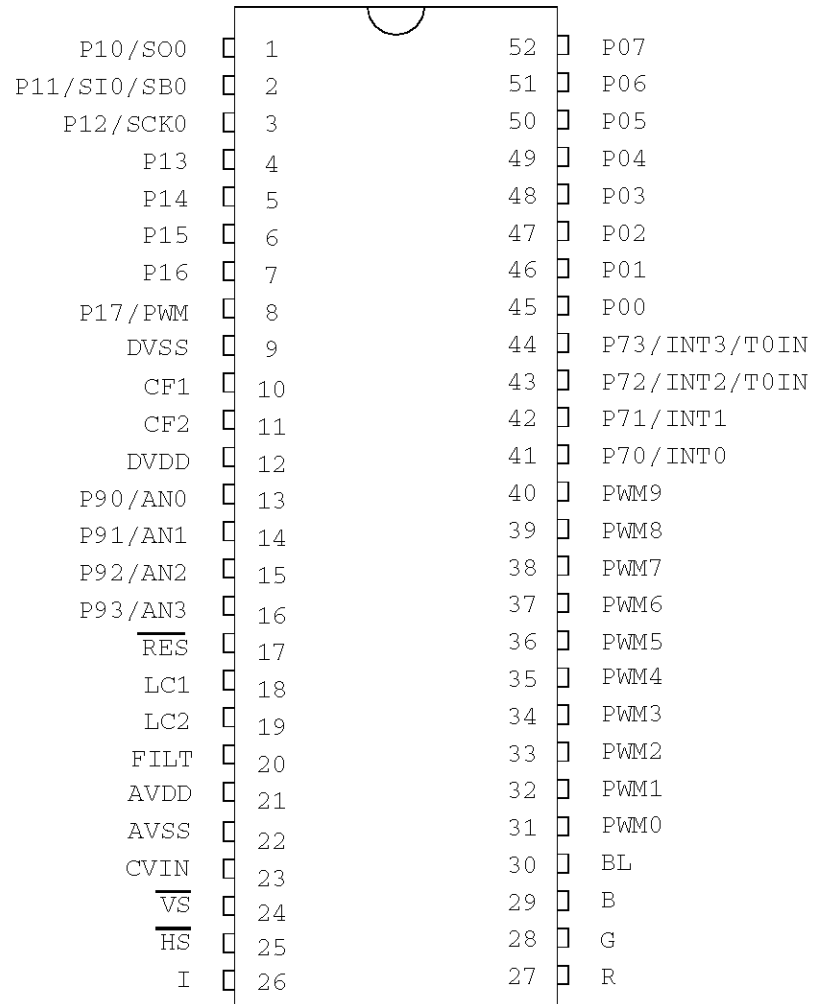
Notes

- Data security is not executed when the data of all address have 'FF' at the procedure 2 above.
- Data security cannot be executed by programming the sequential operation "BLANK=>PROGRAM=>VERIFY" at procedure 2 above.
- Set the jumper to 'OFF' after executing the data security.



LC86P4164

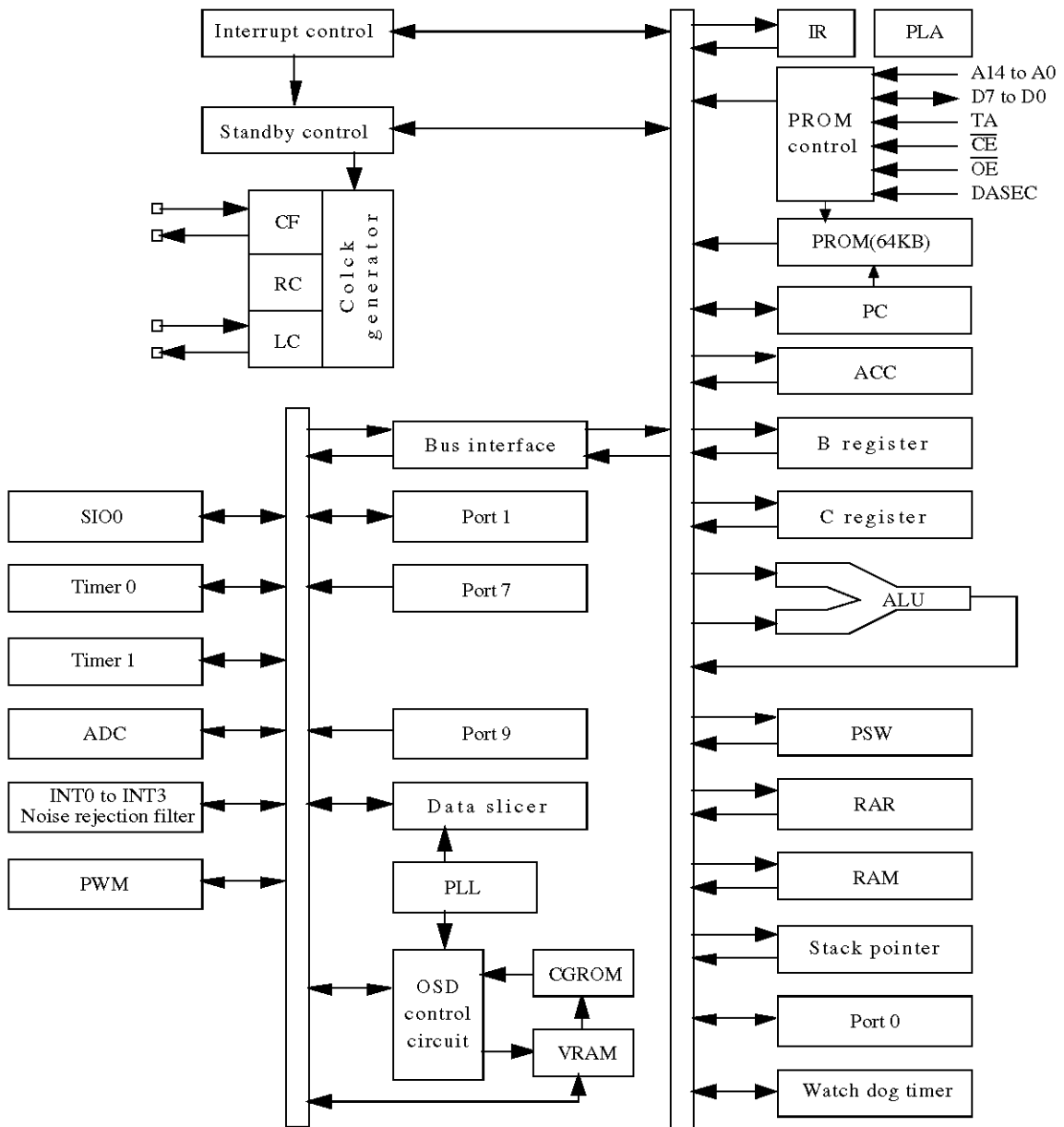
Pin Assignment



Top view

LC86P4164

System Block Diagram



LC86P4164

Pin Description

Pin name	Pin No.	I/O	Function description	Option	PROM mode								
DVSS	9	—	Negative power supply for digital circuit										
CF1	10	I	Input terminal for ceramic resonator										
CF2	11	O	Output terminal for ceramic resonator										
DVDD	12	—	Positive power supply for digital circuit										
$\overline{\text{RES}}$	17	I	Reset terminal										
LC1	18	I	LC oscillation circuit input terminal										
LC2	19	O	LC oscillation circuit output terminal										
FILT	20	O	Filter terminal for PLL										
AVDD	21	—	Positive power supply for analog circuit										
AVSS	22	—	Negative power supply for analog circuit										
CVIN	23	I	Video signal input terminal										
$\overline{\text{VS}}$	24	I	Vertical synchronization signal input terminal										
$\overline{\text{HS}}$	25	I	Horizontal synchronization signal input terminal										
I	26	O	Image intensity control output										
R	27	O	Red (R) output terminal of RGB image output		A4 (*1)								
G	28	O	Green (G) output terminal of RGB image output		A5 (*1)								
B	29	O	Blue (B) output terminal of RGB image output		A6 (*1)								
BL	30	O	Fast blanking control signal Switch TV image signal and caption/ OSD image signal		A7 (*1)								
PWM0 to PWM9	31 to 40	O	PWM0 to PWM9 output terminal 15V withstand		PWM0 to PWM8 : A8 to A16 (*1) PWM9 : "L" fixed								
Port 0	45 to 52	I/O	8-bit Input/output port Input/output can be specified in nibble unit HOLD release input Interrupt input	Pull-up resistor Provided/not provided (in bit units) Output Format CMOS/Nch-OD (in bit units)									
P00 to P07													
Port 1	1 to 8	I/O	8-bit Input/output port Input/output can be specified in bit unit. Other functions	Output Format CMOS/Nch-OD (in bit unit)	D0 to D7 (*2)								
P10 to P17													
			<table style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 30px; border-right: 1px solid black;">P10</td> <td>SIO0 data output</td> </tr> <tr> <td style="border-right: 1px solid black;">P11</td> <td>SIO0 data input /bus input/output</td> </tr> <tr> <td style="border-right: 1px solid black;">P12</td> <td>SIO0 clock input/output</td> </tr> <tr> <td style="border-right: 1px solid black;">P17</td> <td>Timer 1 (PWM) output</td> </tr> </table>	P10	SIO0 data output	P11	SIO0 data input /bus input/output	P12	SIO0 clock input/output	P17	Timer 1 (PWM) output		
P10	SIO0 data output												
P11	SIO0 data input /bus input/output												
P12	SIO0 clock input/output												
P17	Timer 1 (PWM) output												

Continued on next page.

LC86P4164

Continued from preceding page.

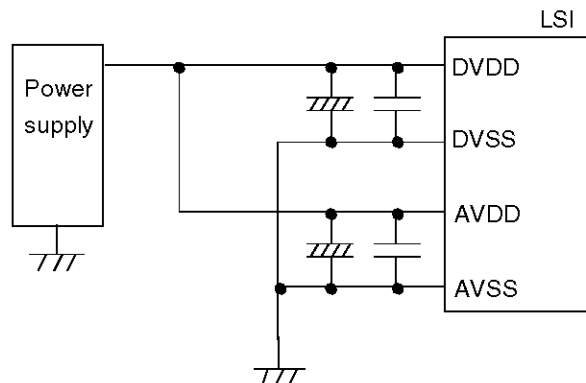
Pin name	Pin No.	I/O	Function Description	Option	PROM mode																																											
Port 7 P70 P71 to P73	41 42 to 44	I/O I	4-bit input port Other functions <table border="1" style="width: 100%; border-collapse: collapse; margin-top: 5px;"> <tr> <td style="width: 10%;">P70</td> <td>INT0 input/HOLD release input/ Nch-transistor output for watchdog timer</td> </tr> <tr> <td>P71</td> <td>INT1 input/HOLD release input</td> </tr> <tr> <td>P72</td> <td>INT2 input/timer 0 event input</td> </tr> <tr> <td>P73</td> <td>INT3 input (noise rejection filter attached input/timer 0 event input</td> </tr> </table> Interrupt receiver format vector address <table border="1" style="width: 100%; border-collapse: collapse; margin-top: 5px;"> <thead> <tr> <th></th> <th>Rising</th> <th>Falling</th> <th>Rising/Falling</th> <th>H level</th> <th>L level</th> <th>Vector</th> </tr> </thead> <tbody> <tr> <td>INT0</td> <td>enable</td> <td>enable</td> <td>disable</td> <td>enable</td> <td>enable</td> <td>03H</td> </tr> <tr> <td>INT1</td> <td>enable</td> <td>enable</td> <td>disable</td> <td>enable</td> <td>enable</td> <td>0BH</td> </tr> <tr> <td>INT2</td> <td>enable</td> <td>enable</td> <td>enable</td> <td>disable</td> <td>disable</td> <td>13H</td> </tr> <tr> <td>INT3</td> <td>enable</td> <td>enable</td> <td>enable</td> <td>disable</td> <td>disable</td> <td>1BH</td> </tr> </tbody> </table>	P70	INT0 input/HOLD release input/ Nch-transistor output for watchdog timer	P71	INT1 input/HOLD release input	P72	INT2 input/timer 0 event input	P73	INT3 input (noise rejection filter attached input/timer 0 event input		Rising	Falling	Rising/Falling	H level	L level	Vector	INT0	enable	enable	disable	enable	enable	03H	INT1	enable	enable	disable	enable	enable	0BH	INT2	enable	enable	enable	disable	disable	13H	INT3	enable	enable	enable	disable	disable	1BH	Pull-up resistor provided/ not provided (in bit units)	P70 : VPP (*3) P71 : DASEC (*4) P72 : \overline{OE} (*5) P73 : CE (*6)
P70	INT0 input/HOLD release input/ Nch-transistor output for watchdog timer																																															
P71	INT1 input/HOLD release input																																															
P72	INT2 input/timer 0 event input																																															
P73	INT3 input (noise rejection filter attached input/timer 0 event input																																															
	Rising	Falling	Rising/Falling	H level	L level	Vector																																										
INT0	enable	enable	disable	enable	enable	03H																																										
INT1	enable	enable	disable	enable	enable	0BH																																										
INT2	enable	enable	enable	disable	disable	13H																																										
INT3	enable	enable	enable	disable	disable	1BH																																										
Port 9 P90 to P93	13 to 16	I	4-bit input port Other function A/D converter input port (4 lines)		A0 to A3 (*3)																																											

- *1 An → Address input
- *2 Data I/O
- *3 Power for programming
- *4 Memory select input/output for data security
- *5 Output Enable input
- *6 Chip Enable input

- All of port options except the 4-bit unit pull-up resistor option of Port 0 can be specified in a bit unit.
- Port status during reset

Terminal	I/O	Pull-up resistor status at selecting pull-up option
Port 0	Input	Pull-up resistor OFF, ON after reset release
Port 1	Input	Programmable pull-up resistor OFF
Port 7	Input	Fixed pull-up resistor provided

* AVDD and AVSS are the power supply terminals for built-in analog circuit while DVDD and DVSS are the power supply terminals for built-in digital circuit. Connect them like the following figure to reduce the mutual noise influence.



LC86P4164

Specifications

1. Absolute Maximum Ratings at Ta = 25°C, VSS = 0 V

Parameter	Symbol	Pins	Conditions	Ratings			Unit		
				V _{DD} [V]	min	typ		max	
Supply voltage	V _{DDmax}	DVDD, AVDD	DVDD = AVDD		-0.3		+7.0	V	
Input voltage	V _I (1)	<ul style="list-style-type: none"> • P71, 72, 73 • Port 9 • RES, HS, VS, CVIN 			-0.3		V _{DD} +0.3		
Output voltage	V _O (1)	R, G, B, BL, I, FILT			-0.3		V _{DD} +0.3		
	V _O (2)	PWM0 to PWM9			-0.3		+15		
Input/output voltage	V _{IO} (1)	Ports 0, 1, P70			-0.3		V _{DD} +0.3		
High-level output current	Peak output current	I _{OPH} (1)	Ports 0, 1	<ul style="list-style-type: none"> • Pull-up MOS transistor output • At each pin 		-2			mA
		I _{OPH} (2)	Ports 0, 1	<ul style="list-style-type: none"> • CMOS output • At each pin 		-4			
		I _{OPH} (3)	R, G, B, BL, I	<ul style="list-style-type: none"> • CMOS output • At each pin 		-5			
	Total output current	ΣI _{OA} H(1)	Port 1	The total of all pins		-10			
		ΣI _{OA} H(2)	Port 0	The total of all pins		-10			
		ΣI _{OA} H(3)	R, G, B, BL, I	The total of all pins		-15			
Low-level output current	Peak output current	I _{OPL} (1)	Ports 0, 1	At each pin				20	
		I _{OPL} (2)	P70	At each pin				30	
		I _{OPL} (3)	<ul style="list-style-type: none"> • R, G, B, BL, I • PWM0 to PWM9 	At each pin				5	
	Total output current	ΣI _{OAL} (1)	Port 0	The total of all pins					40
		ΣI _{OAL} (2)	Port 1, P70	The total of all pins					40
		ΣI _{OAL} (3)	R, G, B, BL, I	The total of all pins					15
		ΣI _{OAL} (4)	PWM0 to PWM9	The total of all pins					30
Maximum power dissipation	P _{d max}	DIP52S	Ta = -30 to +70°C				430	mW	
Operating temperature range	T _{opr}				-30		+70	°C	
Storage temperature range	T _{stg}				-55		+125		

* DVSS and AVSS must be supplied the same voltage, V_{SS}. V_{SS} = DVSS = AVSS
 DVDD and AVDD must be supplied the same voltage, V_{DD}. V_{DD} = DVDD = AVDD

LC86P4164

2. Recommended Operating Range at Ta = -30°C to +70°C, V_{SS} = 0 V

Parameter	Symbol	Pins	Conditions	Ratings			Unit	
				V _{DD} [V]	min	typ		max
Operating supply voltage range	V _{DD}	DVDD, AVDD	0.98 μs ≤ tCYC tCYC ≤ 1.02 μs		4.5		5.5	V
Hold voltage	V _{HD}	DVDD, AVDD	RAMs and the registers hold data at HOLD mode.		2.0		5.5	
Input high-level voltage	V _{IH} (1)	Port 0 (Schmitt)	Output disable	4.5 to 5.5	0.6V _{DD}		V _{DD}	
	V _{IH} (2)	• Port 1 (Schmitt) • P72,73 • HS,VS	Output disable	4.5 to 5.5	0.75V _{DD}		V _{DD}	
	V _{IH} (3)	• P70 port input / interrupt • P71 • $\overline{\text{RES}}$ (Schmitt)	Output N-channel transistor OFF	4.5 to 5.5	0.75V _{DD}		V _{DD}	
	V _{IH} (4)	P70 Watchdog timer input	Output N-channel transistor OFF	4.5 to 5.5	V _{DD} -0.5		V _{DD}	
	V _{IH} (5)	Port 9 port input		4.5 to 5.5	0.7V _{DD}		V _{DD}	
Input low-level voltage	V _{IL} (1)	Port 0 (Schmitt)	Output disable	4.5 to 5.5	V _{SS}		0.2V _{DD}	
	V _{IL} (2)	• Port 1 (Schmitt) • P72,73 • $\overline{\text{HS}}, \overline{\text{VS}}$ • Port 9	Output disable	4.5 to 5.5	V _{SS}		0.25V _{DD}	
	V _{IL} (3)	• P70 port input / interrupt • P71 • $\overline{\text{RES}}$ (Schmitt)	N-channel transistor OFF	4.5 to 5.5	V _{SS}		0.25V _{DD}	
	V _{IL} (4)	P70 Watchdog timer input	N-channel transistor OFF	4.5 to 5.5	V _{SS}		0.6V _{DD}	
	V _{IL} (5)	Port 9 port input		4.5 to 5.5	V _{SS}		0.3V _{DD}	
CVIN input amplitude	V _{CVIN}	CVIN		5.0	0.7		2.3	Vp-p *
Operation cycle time	tCYC(1)		OSD function	4.5 to 5.5	0.98	1	1.02	μs
	tCYC(2)		Except OSD function	4.5 to 5.5	0.98		30	

* Vp-p : Peak-to-peak voltage

LC86P4164

Parameter	Symbol	Pins	Conditions	Ratings			Unit	
				V _{DD} [V]	min	typ		max
Oscillation frequency range (Note 1)	FmCF	CF1, CF2	12MHz (ceramic resonator oscillation) Refer to Figure 1.	4.5 to 5.5	11.76	12	12.24	MHz
	FmLC	LC1, LC2	14.11MHz (LC oscillation) Refer to Figure 2.	4.5 to 5.5		14.11		
	FmRC		RC oscillation	4.5 to 5.5	0.4	0.8	2.0	
Oscillation stable time period (Note 2)	tmsCF	CF1, CF2	12 MHz (ceramic resonator oscillation) Refer to Figure 3.	4.5 to 5.5		0.02	0.2	ms

(Note 1) The oscillation constant is shown on Table 1 and Table 2.

(Note 2) The oscillation stable time period means the time to oscillate stably after the following conditions.

1. Supplying voltage.
 2. Release the HOLD mode.
 3. Release stopping the main-clock oscillation.
- Refer to Figure 3 for details.

LC86P4164

3. Electrical Characteristics at Ta = -30°C to +70°C, V_{SS} = 0 V

Parameter	Symbol	Pins	Conditions	Ratings			Unit	
				V _{DD} [V]	min	typ		max
Input high-level current	I _{IH} (1)	<ul style="list-style-type: none"> Port 1 Port 0 without pull-up MOS transistor 	<ul style="list-style-type: none"> Output disable Pull-up MOS transistor OFF V_{IN} = V_{DD} (including the off-leak current of the output transistor) 	4.5 to 5.5			1	μA
	I _{IH} (2)	<ul style="list-style-type: none"> Port 7 without pull-up MOS transistor Port 9 <u>RES</u> HS, VS 	V _{IN} = V _{DD}	4.5 to 5.5			1	
Input low-level current	I _{IL} (1)	<ul style="list-style-type: none"> Port 1 Port 0 without pull-up MOS transistor 	<ul style="list-style-type: none"> Output disable Pull-up MOS transistor OFF V_{IN} = V_{SS} (including the off-leak current of the output transistor) 	4.5 to 5.5	-1			
	I _{IL} (2)	<ul style="list-style-type: none"> Port 7 without pull-up MOS transistor Port 9 	V _{IN} = V _{SS}	4.5 to 5.5	-1			
	I _{IL} (3)	<ul style="list-style-type: none"> <u>RES</u> HS, VS 	V _{IN} = V _{SS}	4.5 to 5.5	-1			
Output high-level voltage	V _{OH} (1)	CMOS output of Ports 0, 1	I _{OH} = -1.0 mA	4.5 to 5.5	V _{DD} -1			V
	V _{OH} (2)	R, G, B, BL, I	I _{OH} = -0.1 mA	4.5 to 5.5	V _{DD} -0.5			
Output low-level voltage	V _{OL} (1)	Ports 0, 1	I _{OL} = 10 mA	4.5 to 5.5			1.5	
	V _{OL} (2)	Ports 0, 1	<ul style="list-style-type: none"> I_{OL} = 1.6 mA The total current of the ports 0,1 is not over 40 mA 	4.5 to 5.5			0.4	
	V _{OL} (3)	<ul style="list-style-type: none"> R, G, B, BL, I PWM0 to PWM9 	<ul style="list-style-type: none"> I_{OL} = 30 mA The current of any unmeasurement pin is not over 3 mA. 	4.5 to 5.5			0.4	
	V _{OL} (4)	P70	I _{OL} = 1 mA	4.5 to 5.5			0.4	
Pull-up MOS transistor resistance	R _{pu}	<ul style="list-style-type: none"> Ports 0,1 Port 7 	V _{OH} = 0.9 V _{DD}	4.5 to 5.5	13	38	80	kΩ
Output off-leakage current	I _{OFF}	PWM0 to PWM9	V _{OUT} = 13.5 V	4.5 to 5.5			5	μA
Hysteresis voltage	V _{HIS}	<ul style="list-style-type: none"> Ports 0,1 Port 7 <u>RES</u> HS, VS 	Output disable	4.5 to 5.5		0.1 V _{DD}		V

LC86P4164

Parameter	Symbol	Pins	Conditions	Ratings			Unit	
				V _{DD} [V]	min	typ		max
Input clamp voltage	V _{CLMP}	CVIN		5.0	2.3	2.5	2.7	V
Pin capacitance	CP	All pins	<ul style="list-style-type: none"> • f = 1 MHz • Unmeasured input pins are set to V_{SS} level. • Ta = 25°C 	4.5 to 5.5		10		pF

4. Serial Input/Output Characteristics at Ta = -30°C to +70°C, V_{SS} = 0 V

Parameter	Symbol	Pins	Conditions	Ratings			Unit		
				V _{DD} [V]	min	typ		max	
Serial clock	Input clock	Cycle	tCKCY (1)	<ul style="list-style-type: none"> • SCK0 • SCLK0 	Refer to Figure 5.	4.5 to 5.5	2		tCYC
		Low-level pulse width	tCKCY (1)			4.5 to 5.5	1		
		High-level pulse width	tCKCY (1)			4.5 to 5.5	1		
	Output clock	Cycle	tCKCY (2)	<ul style="list-style-type: none"> • SCK0 • SCLK0 	<ul style="list-style-type: none"> • Use a pull-up resistor (1 kΩ) during open drain output • Refer to Figure 5. 	4.5 to 5.5	2		
		Low-level pulse width	tCKCY (2)			4.5 to 5.5		1/2tCKCY	
		High-level pulse width	tCKCY (2)			4.5 to 5.5		1/2tCKCY	
Serial input	Data set-up time	tICK	SI0	<ul style="list-style-type: none"> • Data set-up to SCK0 rising • Data hold from SCK0 rising • Refer to Figure 5. 	4.5 to 5.5	0.1		μs	
	Data hold time	tCKI			4.5 to 5.5	0.1			
Serial output	Output delay time (External serial clock)	tCKO(1)	SO0	<ul style="list-style-type: none"> • Use a pull-up resistor (1 kΩ) during open drain output. • Data set-up to SCK0 falling • Data hold from SCK0 falling • Refer to Figure 5. 	4.5 to 5.5			7/12tCYC +0.2	μs
	Output delay time (Internal serial clock)	tCKO(2)			4.5 to 5.5			1/3tCYC +0.2	

LC86P4164

5. Pulse Input Conditions at Ta = -30°C to +70°C, VSS = 0 V

Parameter	Symbol	Pins	Conditions	Ratings			Unit	
				V _{DD} [V]	min	typ		max
High/low level pulse width	tPIH(1) tPIL(1)	• INT0,INT1 • INT2/T0IN	• Interrupt acceptable • Timer0-countable	4.5 to 5.5	1		tCYC	
	tPIH(2) tPIL(2)	INT3/T0IN (The noise rejection clock is selected to 1/1)	• Interrupt acceptable • Timer0-countable	4.5 to 5.5	2			
	tPIH(3) tPIL(3)	INT3/T0IN (The noise rejection clock is selected to 1/16)	• Interrupt acceptable • Timer0-countable	4.5 to 5.5	32			
	tPIL(4)	$\overline{\text{RES}}$	Reset acceptable	4.5 to 5.5	200		μs	
	tPIH(5) tPIL(5)	$\overline{\text{HS}}, \overline{\text{VS}}$	Display position controllable Each active edge of $\overline{\text{HS}}, \overline{\text{VS}}$ must be more than 1tCYC. Refer to Figure 7.	4.5 to 5.5	10		tCYC	
Rising/falling time	tTHL tTLH	$\overline{\text{HS}}$	Refer to Figure 7.	4.5 to 5.5		500	ns	
Horizontal pull-in range	FH	$\overline{\text{HS}}$	The monitor point in Figure 10 is 1/2 V _{DD} .	4.5 to 5.5	15.23	15.73	16.23	kHz

6. A/D Converter Characteristics at Ta = -30°C to +70°C, VSS = 0 V

Parameter	Symbol	Pins	Conditions	Ratings			Unit	
				V _{DD} [V]	min	typ		max
Resolution	N			4.5 to 5.5	4		bit	
Absolute precision	ET		(Note 3)	4.5 to 5.5		± 1/4	± 1/2	LSB
Conversion time	tCAD	From selecting Vref to resulting	1 bit conversion time = 2tCYC	4.5 to 5.5			1.96	μs
Reference current	I _{REF}		(Regulate the ladder resistor)	4.5 to 5.5		1.0	2.0	mA
Analog input voltage range	V _{AIN}	AN0 to AN3		4.5 to 5.5	V _{SS}		V _{DD}	V
Analog port input current	I _{AINH}		V _{AIN} = V _{DD}	4.5 to 5.5			1	μA
	I _{AINL}		V _{AIN} = V _{SS}	4.5 to 5.5	-1			

(Note 3) Absolute precision excepts quantizing error (±1/2 LSB).

LC86P4164

7. Current Dissipation Characteristics at Ta = -30°C to +70°C , V_{SS} = 0 V

Parameter	Symbol	Pins	Conditions	Ratings			Unit	
				V _{DD} [V]	min	typ		max
Current dissipation during basic operation (Note 4)	I _{DDOP} (1)	DVDD, AVDD	<ul style="list-style-type: none"> • FmCF = 12 MHz Ceramic resonator oscillation • FmLC = 14.11 MHz LC oscillation • System clock : CF oscillation • Internal RC oscillation stops 	4.5 to 5.5		21	32	mA
Current dissipation in HALT mode (Note 4)	I _{DDHALT} (1)	DVDD, AVDD	<ul style="list-style-type: none"> • HALT mode • FmCF = 12 MHz Ceramic resonator oscillation • FmLC = 0 Hz (oscillation stops) • System clock : CF oscillation • Internal RC oscillation stops. 	4.5 to 5.5		5	10	mA
	I _{DDHALT} (2)	DVDD, AVDD	<ul style="list-style-type: none"> • HALT mode • FmCF = 0 MHz (oscillation stops) • FmLC = 0 Hz (oscillation stops) • System clock : Internal RC 	4.5 to 5.5		400	800	μA
Current dissipation in HOLD mode (Note 4)	I _{DDHOLD}	DVDD, AVDD	<ul style="list-style-type: none"> • HOLD mode • All oscillation stops. 	4.5 to 5.5		0.05	20	μA

(Note 4) The currents of the output transistors and the pull-up MOS transistors are ignored.

LC86P4164

Oscillation type	Manufacturer	Oscillator	C1	C2
12 MHz ceramic resonator oscillation	Murata	CSA12.0MTZ	33 pF	33 pF
		CST12.0MTW	on chip	
	Kyocera	KBR-12.0M	47 pF	47 pF

* Both C1 and C2 must use an K rank ($\pm 10\%$) and an SL characteristics.

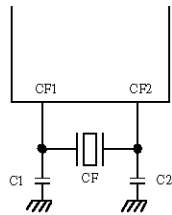
Table 1. Ceramic Resonator Oscillation Guaranteed Constant (main-clock)

Oscillation type	L	C3	C4
14.11 MHz LC oscillation	5.6 μH	27 pF	30 pF (Trimmer)
	4.7 $\mu\text{H} \pm 10\%$ (Variable)	27 pF	27 pF

* See Figure 11,12.

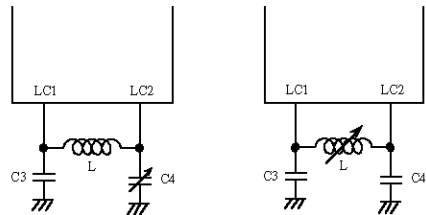
Table 2. LC Oscillation Guaranteed Constant (OSD clock)

- (Notes)
- Since the circuit pattern affects the oscillation frequency, place the oscillation-related parts as close to the oscillation pins as possible with the shortest possible pattern length.
 - If you use other oscillators than those shown above, we provide no guarantee for the characteristics.
 - Adjust the voltage of monitor point in Figure 10 to $1/2V_{DD} \pm 10\%$ by the LC oscillation constant 'L' or 'C' to lock the PLL circuit.



Main clock

Figure 1 Ceramic Resonator Oscillation



OSD clock

Figure 2 LC Resonator Oscillation

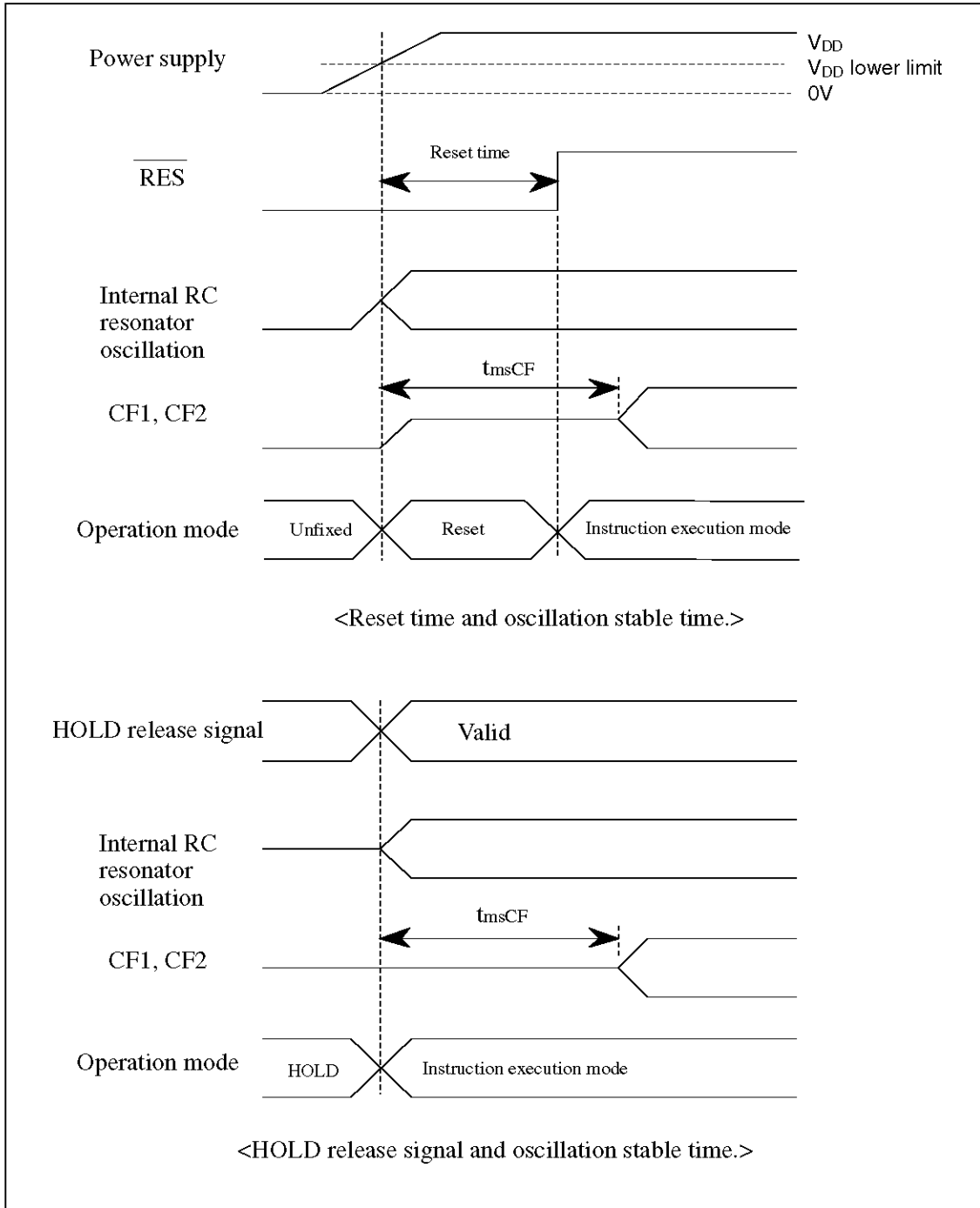


Figure 3 Oscillation Stable Time

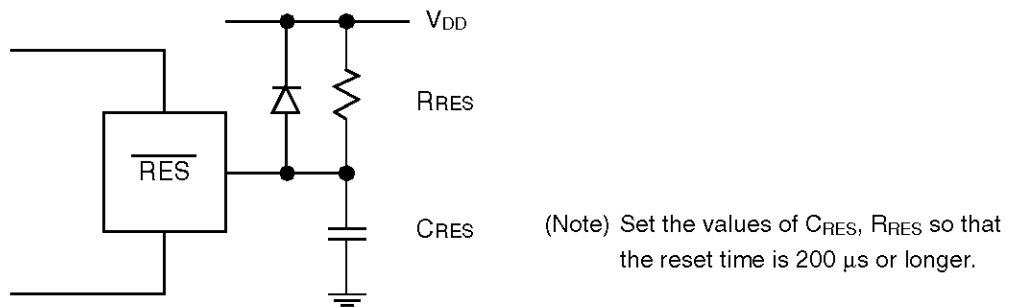
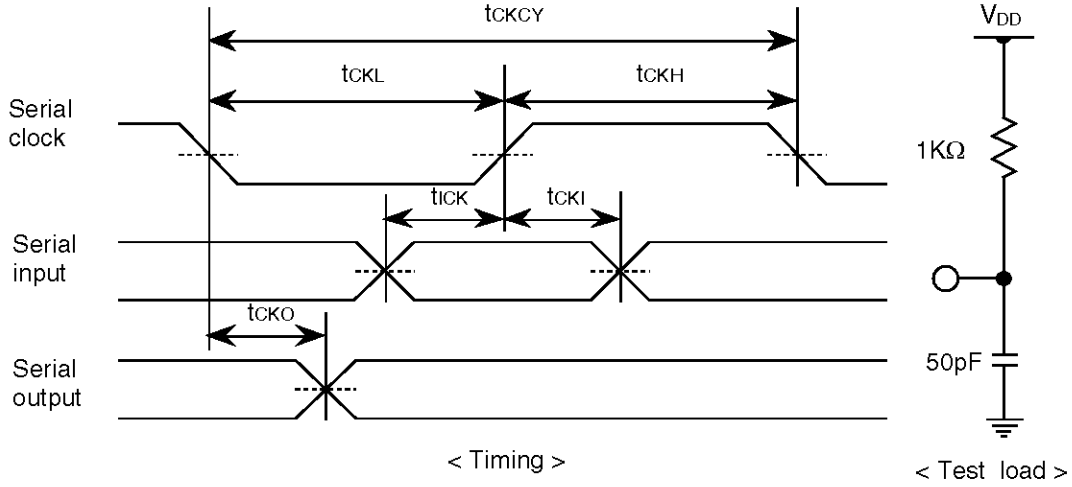


Figure 4 Reset Circuit

LC86P4164



< AC timing point >



< Timing >

< Test load >

Figure 5 Serial Input/output Test Condition

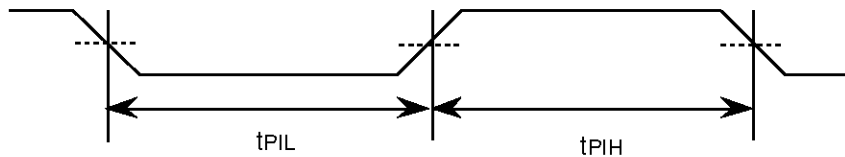
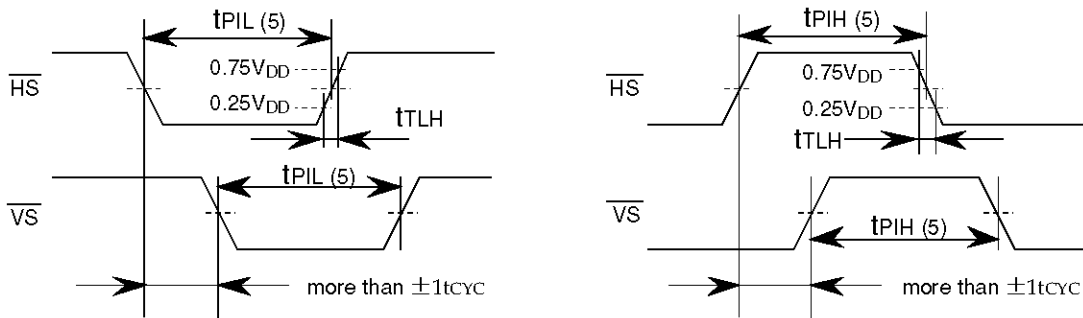


Figure 6 Pulse Input Timing Condition - 1



(a) In case of active low

(b) In case of active high

Figure 7 Pulse Input Timing Condition - 2

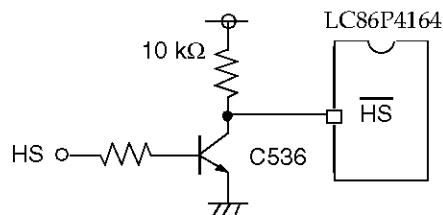


Figure 8 Recommended Interface Circuit

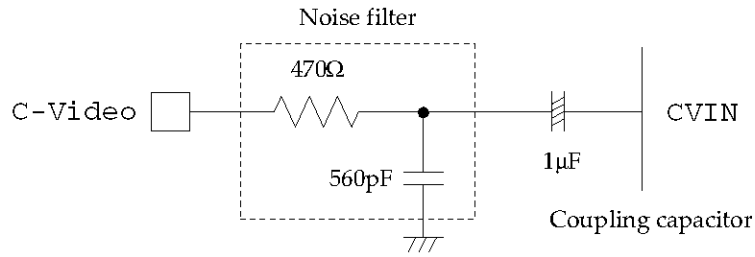


Figure 9 CVIN Recommended Circuit

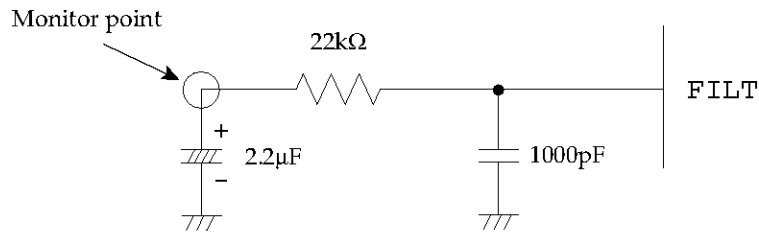


Figure 10 FILT Recommended Circuit

(Note) • Place the parts connected to the FILT terminal at the shortest pattern length possible on the board.

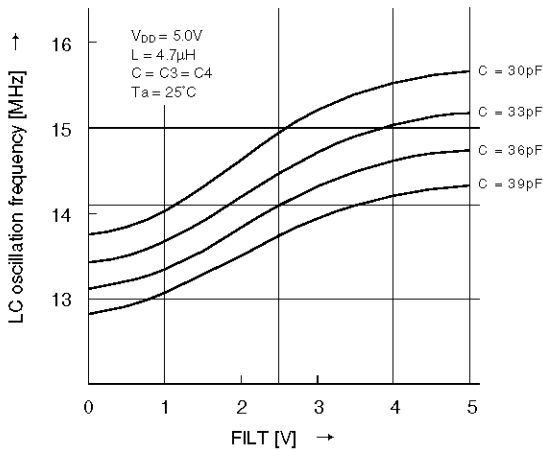


Figure 11 FILT-LC Oscillation Frequency (1)

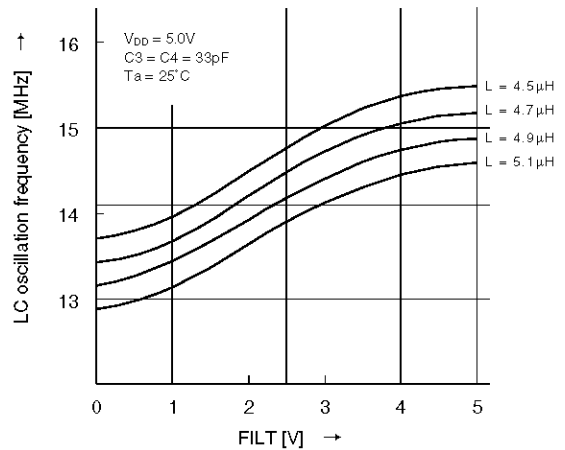


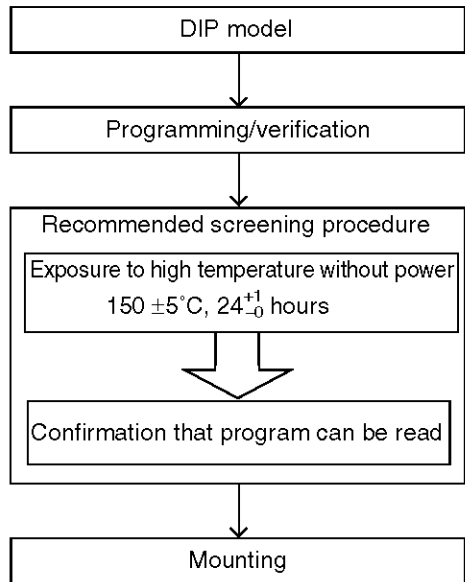
Figure 12 FILT-LC Oscillation Frequency (2)

Requirements Prior to Mounting

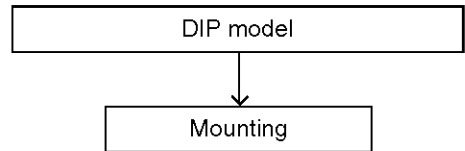
Notes on Handling

- The construction of one-time microcontrollers in which the PROM is not programmed precludes Sanyo from fully testing them before they are shipped. The screening procedure described below is recommended in order to attain higher reliability after programming the PROM.
- The nature of one-time microcontrollers in which the PROM is not programmed precludes us from fully testing them by writing all of the bits. Therefore, it is not possible for us to guarantee a write yield of 100%.
- Storage in moisture-proof packaging (unopened)
While they are still in the moisture-proof packaging, these devices should be stored at a temperature of 30°C and a humidity of no more than 70%.
- After opening the moisture-proof packaging
These devices should be mounted and soldered as soon as possible after the moisture-proof packaging is opened. Once the moisture-proof packaging is opened, the devices should be stored at a temperature of 30°C and a humidity of no more than 70% for no more than 96 hours.

- a. In the case of models that are programmed by the user (models that are shipped with the PROM not programmed)



- b. Requirements prior to mounting for models that are programmed by Sanyo (models that are shipped with the PROM already programmed)



■ No products described or contained herein are intended for use in surgical implants, life-support systems, aerospace equipment, nuclear power control systems, vehicles, disaster/crime-prevention equipment and the like, the failure of which may directly or indirectly cause injury, death or property loss.

■ Anyone purchasing any products described or contained herein for an above-mentioned use shall:

- ① Accept full responsibility and indemnify and defend SANYO ELECTRIC CO., LTD., its affiliates, subsidiaries and distributors and all their officers and employees, jointly and severally, against any and all claims and litigation and all damages, cost and expenses associated with such use
- ② Not impose any responsibility for any fault or negligence which may be cited in any such claim or litigation on SANYO ELECTRIC CO., LTD., its affiliates, subsidiaries and distributors or any of their officers and employees jointly or severally.

■ Information (including circuit diagrams and circuit parameters) herein is for example only; it is not guaranteed for volume production. SANYO believes information herein is accurate and reliable, but no guarantees are made or implied regarding its use or any infringements of intellectual property rights or other rights of third parties.

This catalog provides information as of March, 1998. Specifications and information herein are subject to change without notice.