

**SANYO**

No. #4301

**LC86E6232**

CMOS LSI

**8-Bit Single Chip Microcomputer****Preliminary****Overview**

The LC86E6232 microcomputer is CMOS 8-bit single chip microcomputer with UVEPROM for LC866200A series.

This microcomputer has the function and the pin discription of LC866200A series mask ROM version, and 32K-byte EPROM, the program data is rewritable.

It is suitable to develop the program.

**Features****(1) Option switching by EPROM data**

The option function of LC866200A series can be specified by EPROM data.

LC86E6232 can be checked the functions of trial piece using mass production board.

**(2) Internal 32K-byte UVEPROM**

32K-byte UVEPROM (ultraviolet erasable and programmable ROM) is built in. This corresponds to LC866232A/28A/24A/20A/16A.

**(3) The pin compatible with mask ROM version****(4) Factory shipment**

QFC-100E

**Notice for use**

LC86E6232 is provided for the program development and checking the function of LC866200A series.

At using, take notice of the followings.

**(1) Reset**

It is necessary to be sure to go into 'L' level and hold for 200 $\mu$ s to reset terminal after power supplied voltage has been over inferior limit of supply voltage.

The option is specified until 3ms after going into 'H' level to reset terminal by degrees.

The program is executed from 0H of program counter. The output form of all ports are N-channel open drain while 'L' level to reset terminal.

**(2) Option**

LC86E6232 uses 256 bytes which is addressed on 7F00H~7FFFH in the program memory as option data area. This area does not affect the execution of program but the program memory capacity of LC866232A is 32512 bytes which is addressed on 0000H ~ 7EFFFH.

The option data is created by option specified program "SU866200.EXE". The created option data is linked program area by linkage loader "L866200.EXE".

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.

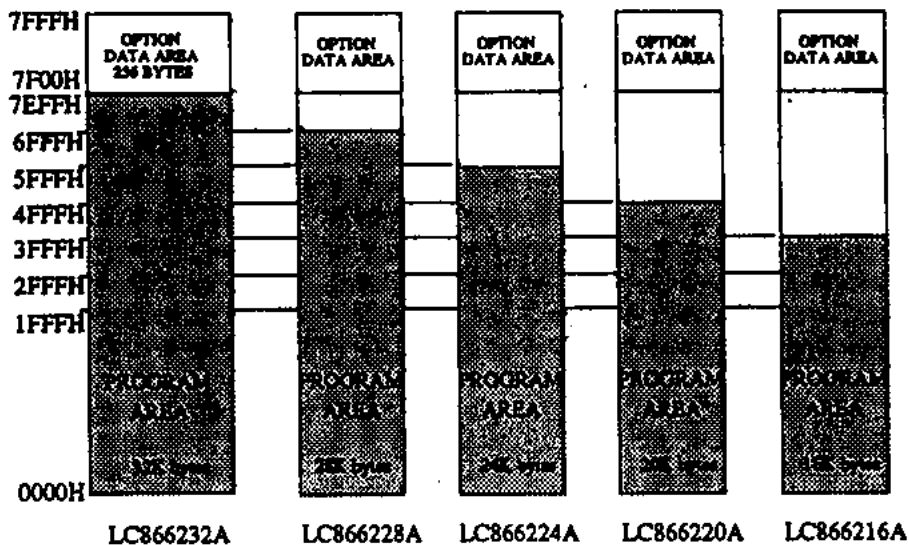
Specifications and information herein are subject to change without notice.

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6292JN No.4301-1/19

# LC86E6232

## (3) ROM space



## (4) Points of difference LC86E6232 and LC866200A series (mask ROM version)

Item	LC86E6232	LC866232A/28A/24A/20A/16A
Operating temperature range (Topg)	+10°C ~ +40°C	-30°C ~ 70°C
Output form of port at reset	Open drain output	Output form specified by option data
Output form of segment · S0/T0 ~ S6/T6 · S7/T7 ~ S15/T15 · S16 ~ S23 · S24 ~ S31	Pulldown resistor  Not provided Provided (fixed) Provided (fixed) Provided (fixed)	Pulldown resistor : Provided / Not provided Specified by option Provided (fixed) Specified by option Specified by option
Operating supply voltage range (VDD)	4.5 ~ 6.0V	2.5 ~ 6.0V

## Option

· A kind of option corresponding LC86E6232

A kind of option	Pins, Circuits	Contents of option
Input/output form of input/output ports	Port 0 (specified in a bit)	1. Input : No Pullup MOS Tr. Output : N-channel opendrain 2. Input : Pullup MOS Tr. Output : COMS
	Port 1, 2 (specified in a bit)	1. Input : Programmable pullup MOS Tr. Output : N-channel opendrain 2. Input : Programmable pullup MOS Tr. Output : COMS
	Port 3, 4, 5 (specified in a bit)	1. Input : No programmable pullup MOS Tr. Output : N-channel opendrain 2. Input : Programmable pullup MOS Tr. Output : COMS
Pullup MOS Tr. of input port	Port 7 (specified in a bit)	1. No pullup MOS Tr. 2. Pullup MOS Tr.

# LC86E6232

· A kind of option not corresponding LC86E6232

A kind of option	Pins, Circuits	Contents of option
Pulldown resistor of high voltage withstand output terminal	· S0/T0~S6/T6 · S16~S31 (specified in a bit)	1. Pulldown resistor 2. No pulldown resistor

## How to use

### (1) Specification of option

LC86E6232 must be programmed after specifying option data. The option is specified by "SU866200.EXE". The specified option file and the file created by our macro assembler "M866200.EXE" are linked by our linkage loader "L86620K.EXE" which creates .HEX file, then the option code is put in the option specified area (7F00H~7FFFH) of its .HEX file.

### (2) How to program for EPROM

LC86E6232 can be programmed by EPROM programmer with attachment ; W86EP6232Q

· Recommended EPROM programmer

Producter	EPROM programmer
Advantest	R4945, R4944, R4943
Andou	AF-9704
AVAL	PKW-1100, PKW-3000
Minato electronics	MODEL1890A

· "27512 (Vpp=12.5V) Intel high speed programming" mode available. The address must be set "0H~7FFFH" and jumper (DASEC) must be set 'OFF' at programming.

### (3) How to use the data security function

"Data security" is the function disable to read the data of EPROM.

The following is the process in order to execute data security.

1. Set 'ON' the jumper (DASEC) of attachment.
2. Program again. Then EPROM programmer displays error. The error is the reason of data security, not trouble of EPROM programmer or of LSI.

#### Notes

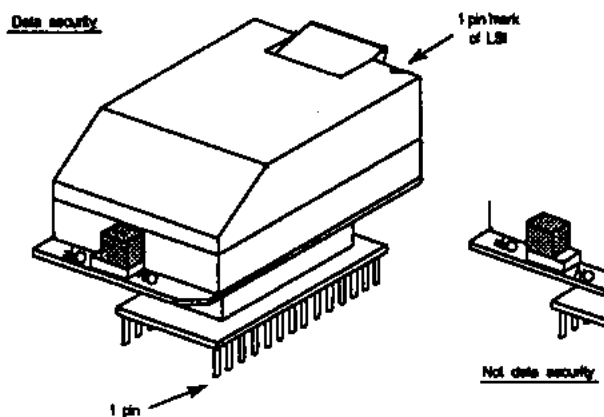
- Data security is not executed when the data of all address have 'FF' at sequence 2 above.
- The programming by sequential operation "BLANK→PROGRAM→VERIFY" cannot be executed data security at sequence 2 above.
- Set 'OFF' the jumper after execution of data security.

### (4) How to eliminate

The programming data can be erased by using the EPROM eraser.

### (5) Shielding

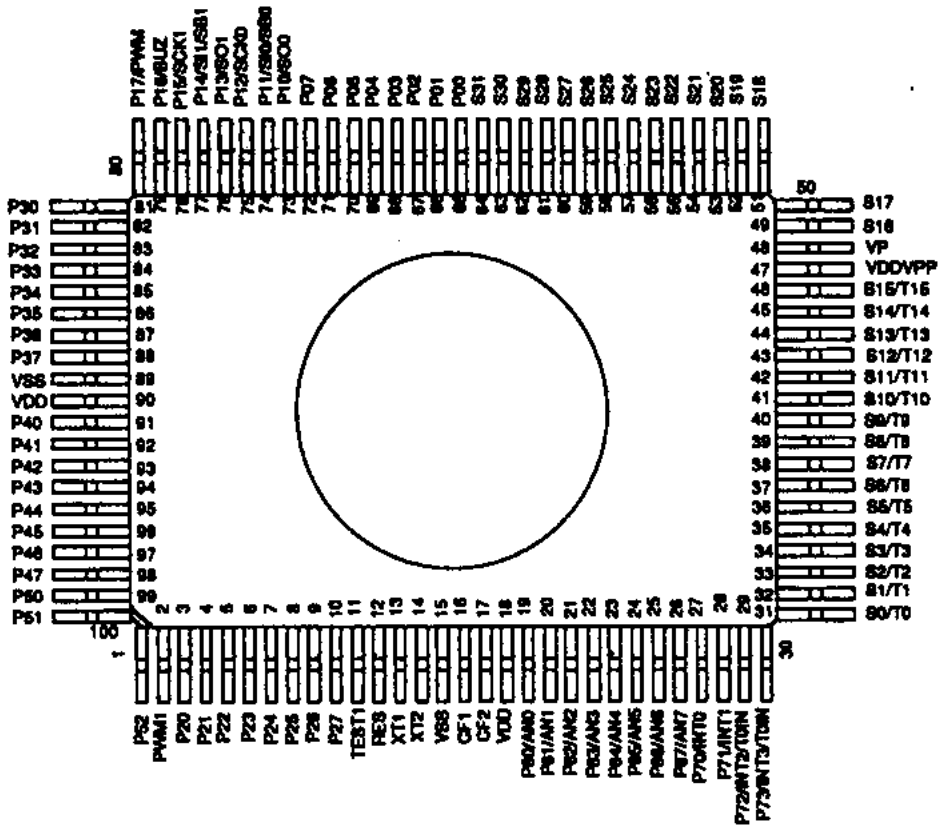
UVEPROM (ultraviolet erasable and programmable ROM) is in it. Put the seal on the window in use.



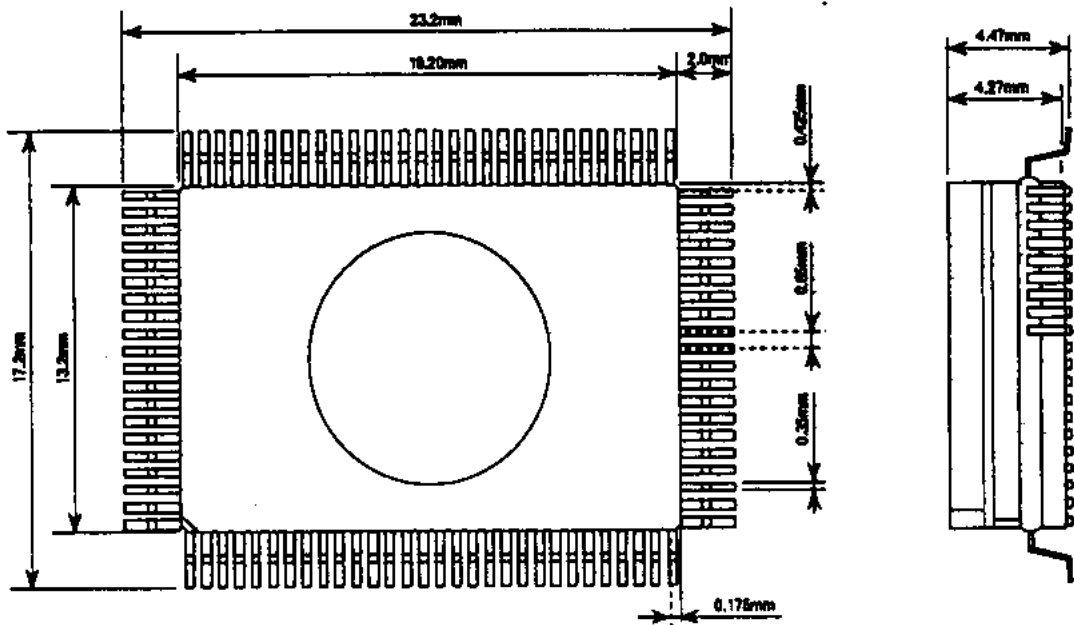
W86EP6232Q

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## Pin Assignment

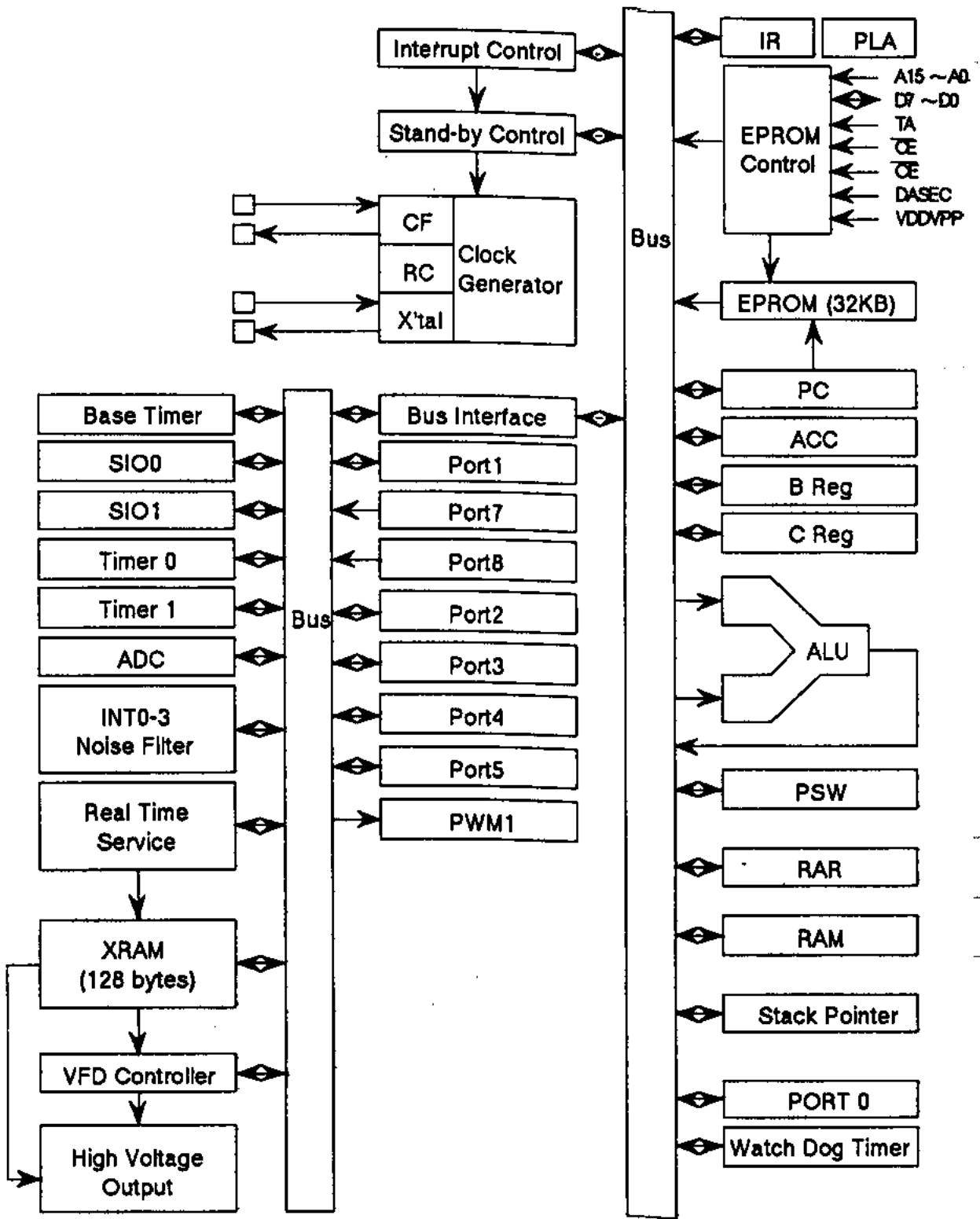


## Case Outline



SANYO : QFC100E

System Block Diagram



LC86E6232

LC86E6232 Pin description

Pin name	I/O	Function description	Option	Function at PROM mode																																			
VSS	—	Power pin(-).																																					
VDD	—	Power pin(+).																																					
VP	—	Power pin(-) for VFD output pulldown resistor.																																					
VDDVPP	—	Power pin(+).		Power for programming																																			
PORT0 P00~P07	I/O	<ul style="list-style-type: none"> <li>·8-bit input/output port .</li> <li>·Input for port 0 interrupt.</li> <li>·Input/output in nibble units.</li> <li>·Input for HOLD release.</li> </ul>	<ul style="list-style-type: none"> <li>·Pullup resistor : Provided / Not provided.</li> <li>·Output form : CMOS/ N-channel open drain.</li> </ul>																																				
PORT1 P10~P17	I/O	<ul style="list-style-type: none"> <li>·8-bit input/output port.</li> <li>·Input/output can be specified in bit unit.</li> <li>·Other pin functions</li> <li>P10 : SIO0 data output</li> <li>P11 : SIO0 data input / bus input/output</li> <li>P12 : SIO0 clock input/output</li> <li>P13 : SIO1 data output</li> <li>P14 : SIO1 data input / bus input/output</li> <li>P15 : SIO1 clock input/output</li> <li>P16 : Buzzer output</li> <li>P17 : Timer 1 output (PWM output)</li> </ul>	Output form : CMOS/ N-channel open drain.	Data input/output · D0~D7																																			
PORT2 P20~P27	I/O	<ul style="list-style-type: none"> <li>·8-bit input/output port.</li> <li>·Input/output can be specified in bit unit.</li> </ul>	Pullup resistor : Provided / Not provided.																																				
PORT3 P30~P37	I/O	<ul style="list-style-type: none"> <li>·8-bit input/output port.</li> <li>·Input/output can be specified in bit unit.</li> <li>·15V withstand at N-channel open drain output.</li> </ul>		Address input A7~A0																																			
PORT4 P40~P47	I/O	<ul style="list-style-type: none"> <li>·8-bit input/output port.</li> <li>·Input/output can be specified in bit unit.</li> <li>·15V withstand at N-channel open drain output.</li> </ul>		Address input ·A14~A8 ·P47 : TA (*4)																																			
PORT5 P50~P52	I/O	<ul style="list-style-type: none"> <li>·3-bit input/output port.</li> <li>·Input/output can be specified in bit unit.</li> <li>·15V withstand at N-channel open drain output.</li> </ul>																																					
PORT7 P70 P71~P73	I/O  I	<ul style="list-style-type: none"> <li>·4-bit input port.</li> <li>·Other pin functions.</li> <li>P70 : INT0 input/HOLD release /N-channel Tr. output for watchdog timer.</li> <li>P71 : INT 1 input/HOLD release.</li> <li>P72 : INT 2 input/timer 0 event input.</li> <li>P73 : INT 3 input with noise filter/timer 0 event input.</li> <li>·Interrupt received form , vector address.</li> </ul>	Pullup resistor : Provided / Not provided.	Input of PROM control signal  <ul style="list-style-type: none"> <li>· DASEC (*1)</li> <li>· <math>\overline{OE}</math> (*2)</li> <li>· <math>\overline{CE}</math> (*3)</li> </ul>																																			
		<table border="1"> <thead> <tr> <th></th> <th>Leading</th> <th>Trailing</th> <th>Leading &amp; Trailing</th> <th>HIGH Level</th> <th>LOW Level</th> <th>VECTOR</th> </tr> </thead> <tbody> <tr> <td>INT0</td> <td>○</td> <td>○</td> <td>×</td> <td>○</td> <td>○</td> <td>03H</td> </tr> <tr> <td>INT1</td> <td>○</td> <td>○</td> <td>×</td> <td>○</td> <td>○</td> <td>0BH</td> </tr> <tr> <td>INT2</td> <td>○</td> <td>○</td> <td>○</td> <td>×</td> <td>×</td> <td>13H</td> </tr> <tr> <td>INT3</td> <td>○</td> <td>○</td> <td>○</td> <td>×</td> <td>×</td> <td>1BH</td> </tr> </tbody> </table>		Leading	Trailing	Leading & Trailing	HIGH Level	LOW Level	VECTOR	INT0	○	○	×	○	○	03H	INT1	○	○	×	○	○	0BH	INT2	○	○	○	×	×	13H	INT3	○	○	○	×	×	1BH		
	Leading	Trailing	Leading & Trailing	HIGH Level	LOW Level	VECTOR																																	
INT0	○	○	×	○	○	03H																																	
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INT2	○	○	○	×	×	13H																																	
INT3	○	○	○	×	×	1BH																																	

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Pin name	I/O	Function description	Option	Function at PROM mode
PORT8 P80~P87	I	·8-bit input port. ·Other functions. AD input port (8 port pins)		
PWM1	O	PWM output port (CMOS)		
S0/T0~ S6/T6	O	Output for VFD display controller segment/timing in common.		
S7/T7~ S15/T15	O	Output for VFD display controller segment/timing in common with internal pulldown resistor.		
S16~S23	O	Output for VFD display controller segment output internal pulldown resistor output		
S24~S31	O	Output for VFD display controller segment output internal pulldown resistor output		
RES	I	Reset pin.		
TEST1	O	Test pin. Should be left unconnected.		
XT1	I	Input pin for 32.768kHz crystal oscillation. In case of non use, connect to VDD.		
XT2	O	Output pin for 32.768kHz crystal oscillation. In case of non use, should be left unconnected.		
CF1	I	Input pin for ceramic resonator oscillation.		
CF2	O	Output pin for ceramic resonator oscillation.		

\*1 Memory select input for data security

\*2 Output enable input

\*3 Chip enable input

\*4 TA → PROM control signal input

\* All of port options can be specified in bit unit.

\* A state of pins at reset.

Pin name	Input/output mode	A state of pullup resistor specified at pullup option
Ports 0,7	Input	Fixed pullup resistor exist
Port 1,2	Input	Programmable pullup resistor OFF
Port 3,4,5	Input	Programmable pullup resistor OFF

Pin name	A state of P-channel transistor
S0/T0~S15/T15	P-channel transistor OFF
S16~S31	P-channel transistor OFF

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1. Absolute maximum ratings / Ta = 25°C, VSS = 0 V

Parameter	Symbol	Pins	Conditions	Limits				unit
				VDD[V]	min.	typ.	max.	
Supply voltage	VDD MAX	VDD, VDDVPP	VDD = VDDVPP		-0.3	~	+7.0	V
Input voltage	VI(1)	· Ports 71, 72, 73 · Port 8 · RES			-0.3	~	VDD+0.3	
	VI(2)	VP			VDD-45	~	VDD+0.3	
Output voltage	VO(1)	· S0/T0 ~ S15/T15 · S16 ~ S31			VDD-45	~	VDD+0.3	
	VO(2)	PWM1			-0.3	~	VDD+0.3	
Input/output voltage	VIO(1)	· Ports 0, 1, 2, 70 · Ports 3, 4, 5 at CMOS output			-0.3	~	VDD+0.3	
	VIO(2)	· Ports 3, 4, 5 at open drain output			-0.3	~	15	
High Level output current	Peak output current	IOPH(1)	· Ports 0, 1, 2, 3, 4, 5 · PWM1	· CMOS output · At each pins.	-4			mA
		IOPH(2)	S0/T0 ~ S15/T15	At each pins.	-30			
		IOPH(3)	S16 ~ S31	At each pins.	-15			
	Total output current	ΣIOAH(1)	Ports 0, 1, 3	The total all pins.	-25			
		ΣIOAH(2)	· Ports 2, 4, 5 · PWM1	The total all pins.	-25			
		ΣIOAH(3)	· S0/T0 ~ S15/T15 · S16 ~ S31	The total all pins.	-140			
Low Level output current	Peak output current	IOPL(1)	· Ports 0, 1, 2, 3, 4, 5 · PWM1	At each pins.			20	
		IOPL(2)	Port 70	At each pins.			15	
	Total output current	ΣIOAL(1)	Ports 0, 1	The total all pins.				40
		ΣIOAL(2)	Port 3	The total all pins.				40
		ΣIOAL(3)	· Ports 2, 5, 70 · PWM1	The total all pins.				40
		ΣIOAL(4)	Port 4	The total all pins.				40
Power dissipation(max.)	Pdmax	QFC100E	Ta = +10 ~ +40°C				500	mW
Operating temperature range	Topg				+10		+40	°C
Storage temperature range	Tstg				-65	~	150	



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## 2. Recommended operating range / $T_a = +10^\circ\text{C}$ to $+40^\circ\text{C}$ , $V_{SS} = 0\text{ V}$

Parameter	Symbol	Pins	Conditions	Limits				unit
				VDD[v]	min.	typ.	max.	
Operating supply voltage range	VDD	VDD	$0.98\ \mu\text{s} \leq T_{\text{cyc}}$ $T_{\text{cyc}} \leq 400\ \mu\text{s}$		4.5		6.0	V
HOLD voltage	VHD	VDD	RAMs and Registers hold voltage at HOLD mode.		2.0		6.0	
Pulldown voltage	VP	VP		4.5~6.0	-35		VDD	
Input high voltage	VIH(1)	Port 0 (Schmitt)	Output disable	4.5~6.0	0.4VDD +0.9		VDD	
	VIH(2)	· Ports 1,2 · Ports 72,73 · Ports 3,4,5 at CMOS output. (Schmitt)	Output disable	4.5~6.0	0.75VDD		VDD	
	VIH(3)	· Ports 3,4,5 at open drain output. (Schmitt)	Output disable	4.5~6.0	0.75VDD		13.5	
	VIH(4)	· Port 70 Port input/ interrupt. · Port 71 · RES (Schmitt)	Output N-channel Tr. OFF	4.5~6.0	0.75VDD		VDD	
	VIH(5)	Port 70 Watchdog timer.	Output N-channel Tr. OFF	4.5~6.0	0.9VDD		VDD	
	VIH(6)	Port 8			4.5~6.0	0.75VDD		VDD
Input low voltage	VIL(1)	Port 0 (Schmitt)	Output disable	4.5~6.0	VSS		0.2VDD	
	VIL(2)	· Ports 1,2,3,4,5 · Ports 72,73 (Schmitt)	Output disable	4.5~6.0	VSS		0.25VDD	
	VIL(3)	· Port 70 Port input/ interrupt. · Port 71 · RES (Schmitt)	N-channel Tr. OFF	4.5~6.0	VSS		0.25VDD	
	VIL(4)	Port 70 Watchdog timer.	N-channel Tr. OFF	4.5~6.0	VSS		0.8VDD -1.0	
	VIL(5)	Port 8			4.5~6.0	VSS		0.25VDD
Operation cycle time	Tcyc			4.5~6.0	0.98		400	$\mu\text{s}$

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Parameter	Symbol	Pins	Conditions	Limits				
				VDD[V]	min.	typ.	max.	unit.
Oscillation frequency range (Note 1)	FmCF(1)	CF1,CF2	·12MHz(ceramic resonator oscillation). ·Refer to figure 1	4.5~6.0	11.76	12	12.24	MHz
	FmCF(2)	CF1,CF2	·3MHz(ceramic resonator oscillation). ·Refer to figure 1	4.5~6.0	2.94	3	3.06	
	FmRC		RC oscillation	4.5~6.0	0.4	0.8	2.0	
	FsXtal	XT1,XT2	·32.768kHz(crystal oscillation). ·Refer to figure 2	4.5~6.0		32.768		kHz
Oscillation stable time period (Note 1)	TmsCF(1)	CF1,CF2	·12MHz(ceramic resonator oscillation). ·Refer to figure 3	4.5~6.0		0.02	0.3	ms
	TmsCF(2)	CF1,CF2	·3MHz(ceramic resonator oscillation). ·Refer to figure 3	4.5~6.0		0.1	1	
	TasXtal	XT1,XT2	·32.768kHz(crystal oscillation). ·Refer to figure 3	4.5~6.0		1	1.5	s

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

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3. Electrical characteristics /  $T_a = +10^\circ\text{C}$  to  $+40^\circ\text{C}$ ,  $V_{SS} = 0\text{ V}$

Parameter	Symbol	Pins	Conditions	Limits				
				VDD[V]	min.	typ.	max.	unit.
Input high current	IIH(1)	· Ports 3,4,5 at open drain output	· Output disable · VIN=13.5V (including off-leak current of output Tr.)	4.5~6.0			1	$\mu\text{A}$
	IIH(2)	· Port 7 without pullup MOS Tr. · Ports 1,2,3,4,5	· Output disable · VIN=VDD (including off-leak current of output Tr.)	4.5~6.0			1	
	IIH(3)	· Port 7 without pullup MOS Tr. · Port 8	VIN=VDD	4.5~6.0			1	
	IIH(4)	· RES	VIN=VDD	4.5~6.0			1	
Input low current	IIL(1)	· Ports 1,2,3,4,5 · Port 0 without pullup MOS Tr.	· Output disable · Pullup MOS Tr. OFF. VIN=VSS (including off-leak current of output Tr.)	4.5~6.0	-1			
	IIL(2)	· Port 7 without pullup MOS Tr. · Port 8	VIN=VSS	4.5~6.0	-1			
	IIL(3)	· RES	VIN=VSS	4.5~6.0	-1			
Output high voltage	VOH(1)	· Ports 0,1,2,3,4,5 at CMOS output	IOH=-1.0mA	4.5~6.0	VDD-1			V
	VOH(2)	· PWM1	IOH=-0.1mA	4.5~6.0	VDD-0.5			
	VOH(3)	S0/T0~S15/T15	IOH=-20mA	4.5~6.0	VDD-1.8			
	VOH(4)		· IOH=-1.0mA · The current of any unmeasurement pin is not over 1 mA.	4.5~6.0	VDD-1			
	VOH(5)	S16~S31	IOH=-5mA	4.5~6.0	VDD-1.8			
	VOH(6)		· IOH=-1.0mA · The current of any unmeasurement pin is not over 1 mA.	4.5~6.0	VDD-1			
Output low voltage	VOL(1)	Ports 0,1,2,3,4,5	IOL=10mA	4.5~6.0			1.5	
	VOL(2)		IOL=1.6mA	4.5~6.0			0.4	
	VOL(3)	Port 70	IOL=1mA	4.5~6.0			0.4	
Pullup MOS Tr. resistor	Rpu	· Ports 0,1,2,3,4,5 · Port 7	VOH=0.9 VDD	4.5~6.0	15	40	70	k $\Omega$

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Parameter	Symbol	Pins	Conditions	Limits				
				VDD[V]	min.	typ.	max.	unit.
Output off-leakage current	I <sub>OFF</sub> (1)	·S0/T0~S6/T6 ·S24~S31 (Without pull down resistor.)	·Output P-channel Tr. OFF. ·V <sub>OUT</sub> =V <sub>SS</sub>	4.5~6.0	-1			μA
	I <sub>OFF</sub> (2)		·Output P-channel Tr. OFF. ·V <sub>OUT</sub> =V <sub>DD</sub> -40V	4.5~6.0	-30			
Pulldown transistor resistor	R <sub>pd</sub>	·S7/T7~S15/T15 ·S16~S23 (With pulldown resistor.)	·Output P-channel Tr. OFF. ·V <sub>OUT</sub> =3V ·V <sub>p</sub> =-30V	5.0	60	100	200	kΩ
Hysteresis voltage	V <sub>HIS</sub>	·Ports 0,1 ·Port 7 ·RES	·Output disable	4.5~6.0		0.1V <sub>DE</sub>		V
Pin capacitance	CP	All pins.	·f=1MHz ·Unmeasurement terminals for input are set to V <sub>SS</sub> level. ·T <sub>a</sub> =25°C	4.5~6.0		10		pF

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4. Serial input/output characteristics /  $T_a = +10^\circ\text{C}$  to  $+40^\circ\text{C}$ ,  $V_{SS} = 0\text{ V}$

Parameter		Symbol	Pins	Conditions	Limits					
					VDD[V]	min.	typ.	max.	unit.	
Serial clock	Input clock	Cycle	TCKCY(1)	SCK0,SCK1	Refer to figure 5	4.5~6.0	2			Tcyc
		Low level pulse width	TCKL(1)			4.5~6.0	1			
		High level pulse width	TCKH(1)			4.5~6.0	1			
	Output clock	Cycle	TCKCY(2)	SCK0,SCK1	Use pullup resistor (1kΩ) when open drain output. Refer to figure 5	4.5~6.0	2			
		Low level pulse width	TCKL(2)			4.5~6.0		1/2Tckcy		
		High level pulse width	TCKH(2)			4.5~6.0		1/2Tckcy		
Serial input	Data set up time	TICK	·SIO,SII ·SB0,SB1	·Data set-up to SCK0,1 ·Data hold from SCK0,1 ·Refer to figure 5	4.5~6.0	0.1			μs	
	Data hold time	TCKI			4.5~6.0	0.1				
Serial output	Output delay time (Serial clock is external clock)	TCKO(1)	·SO0,SO1 ·SB0,SB1	·Use pullup resistor (1kΩ) when open drain output. ·Data hold from SCK0,1 ·Refer to figure 5	4.5~6.0			7/12Tcyc +0.2		
	Output delay time (Serial clock is internal clock)	TCKO(2)			4.5~6.0			1/3Tcyc +0.2		

5. Pulse input conditions / Ta=+10°C to +40°C, VSS = 0 V

Parameter	Symbol	Pins	Conditions	Limits				
				VDD[V]	min.	typ.	max.	unit.
High/low level pulse width	TPIH(1) TPIL(1)	·INT0,INT1 ·INT2/TOIN	·Interrupt acceptable ·Timer0-countable	4.5~6.0	1			Tcyc
	TPIH(2) TPIL(2)	INT3/TOIN (The noise rejection clock select to 1/1.)	·Interrupt acceptable ·Timer0-countable	4.5~6.0	2			
	TPIH(3) TPIL(3)	INT3/TOIN (The noise rejection clock select to 1/64.)	·Interrupt acceptable ·Timer0-countable	4.5~6.0	128			
	TPIL(4)	RES	Reset acceptable	4.5~6.0	200			μs

6. A/D converter characteristics / Ta=+10°C to +40°C, VSS = 0 V

Parameter	Symbol	Pins	Conditions	Limits				
				VDD[V]	min.	typ.	max.	unit.
Resolution	N			4.5~6.0		8		bit
Absolute precision (Note 2)	ET			4.5~6.0			±1.5	LSB
Conversion time	TCAD		AD conversion time=16×Tcyc (ADCR2=0) (Note 3)	4.5~6.0	15.68		65.28	μs
					(Tcyc=0.98 μs)	(Tcyc=4.08 μs)		
			AD conversion time=32×Tcyc (ADCR2=1) (Note 3)		31.36		130.56	
					(Tcyc=0.98 μs)		(Tcyc=4.08 μs)	
Analog input voltage range	VAIN	AN0~AN7		4.5~6.0	VSS		VDD	V
Analog port input current	IAINH		VAIN=VDD	4.5~6.0			1	μA
	IAINL		VAIN=VSS	4.5~6.0	-1			

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

(Note 3) The conversion time means the time to set complete digital conversion value to register from execution of instruction to start conversion.

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7.Current dissipation characteristics / Ta=+10°C to +40°C , VSS = 0 V

Parameter	Symbol	Pins	Conditions	Limits				
				VDD[v]	min.	typ.	max.	unit.
Current dissipation during basic operation (Note 4)	IDDOP(1)	VDD	<ul style="list-style-type: none"> <li>·FmCF=12MHz</li> <li>Ceramic resonator oscillation.</li> <li>·FsXtal=32.768 kHz crystal oscillation.</li> <li>·System clock : CF oscillation.</li> <li>·Internal RC oscillation stops.</li> </ul>	4.5~6.0		13	26	mA
	IDDOP(2)		<ul style="list-style-type: none"> <li>·FmCF=3MHz</li> <li>Ceramic resonator oscillation.</li> <li>·FsXtal=32.768 kHz crystal oscillation.</li> <li>·System clock : CF oscillation.</li> <li>·Internal RC oscillation stops.</li> </ul>	4.5~6.0		6.5	14	
	IDDOP(3)		<ul style="list-style-type: none"> <li>·FmCF=0Hz (when oscillation stops).</li> <li>·FsXtal=32.768 kHz crystal oscillation.</li> <li>·System clock : RC oscillation.</li> </ul>	4.5~6.0		4	10	
	IDDOP(4)		<ul style="list-style-type: none"> <li>·FmCF=0Hz (when oscillation stops).</li> <li>·FsXtal=32.768 kHz crystal oscillation.</li> <li>·System clock : Xtal oscillation.</li> <li>·Internal RC oscillation stops.</li> </ul>	4.5~6.0		3.5	9	

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Parameter	Symbol	Pins	Conditions	Limits				
				VDD[V]	min.	typ.	max.	unit.
Current dissipation HALT mode (Note 4)	IDDHALT(1)	VDD	·HALT mode ·FmCF=12MHz Ceramic resonator oscillation. ·FsXtal=32.768 kHz crystal oscillation. ·System clock : CF oscillation . ·Internal RC oscillation stops.	4.5~6.0		5	10	mA
	IDDHALT(2)		·HALT mode FmCF=3MHz Ceramic resonator oscillation. ·FsXtal=32.768 kHz crystal oscillation. ·System clock : CF oscillation . ·Internal RC oscillation stops.	4.5~6.0		1.9	4.8	
	IDDHALT(3)		·HALT mode FmCF=0Hz (when oscillation stops). ·FsXtal=32.768 kHz crystal oscillation. ·System clock : RC oscillation.	4.5~6.0		400	800	μA
	IDDHALT(4)		·HALT mode FmCF=0Hz (when oscillation stops). ·FsXtal=32.768 kHz crystal oscillation. ·System clock : Xtal oscillation. ·Internal RC oscillation stops.	4.5~6.0		20	70	
Current dissipation HOLD mode (Note 4)	IDDHOLD(1)	VDD	HOLD mode	4.5~6.0		0.05	30	
	IDDHOLD(2)			2.5~4.5		0.02	20	

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



Table 1. Ceramic resonator oscillation guaranteed constant (main-clock)

A kind of oscillation	Producer	Oscillator	C1	C2
12MHz ceramic resonator oscillation	Murata	CSA12.0MTZ	33pF	33pF
		CSA12.0MT	33pF	33pF
		CST12.0MTW	on chip	
3MHz ceramic resonator oscillation	Murata	KBR-12.0M	33pF	33pF
		CSA3.00MG	33pF	33pF
	Kyocera	CST3.00MGW	on chip	
	Kyocera	KBR-3.0MS	47pF	47pF

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

Table 2. Crystal oscillation guaranteed constant (sub-clock)

A kind of oscillation	Producer	Oscillator	C3	C4
32.768kHz crystal oscillation	Dai Sinky	DT-38(1TA252E00)	18pF	18pF
	Kyocera	KF-38G-13P0200	18pF	18pF

\* Both C3 and C4 must be used J rank ( $\pm 5\%$ ) and CH characteristics.

(Not in need of high precision, use K rank ( $\pm 10\%$ ) and SL characteristics.)

- 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 herein, we provide no guarantee for the characteristics.

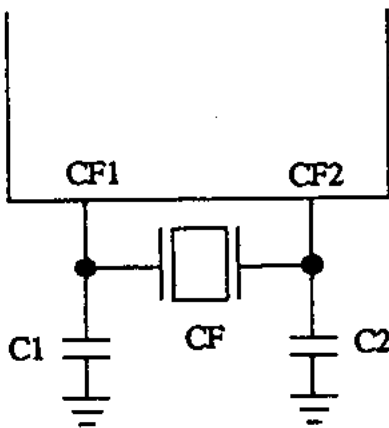


Figure 1 Main-clock circuit  
Ceramic resonator oscillation

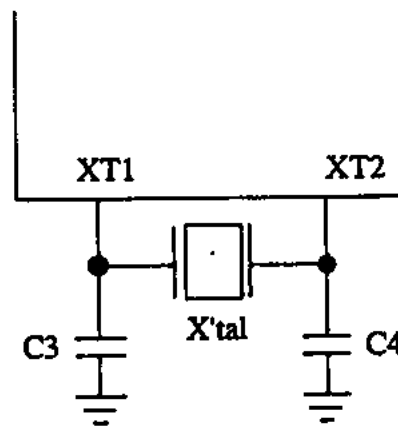


Figure 2 Sub-clock circuit  
Crystal oscillation

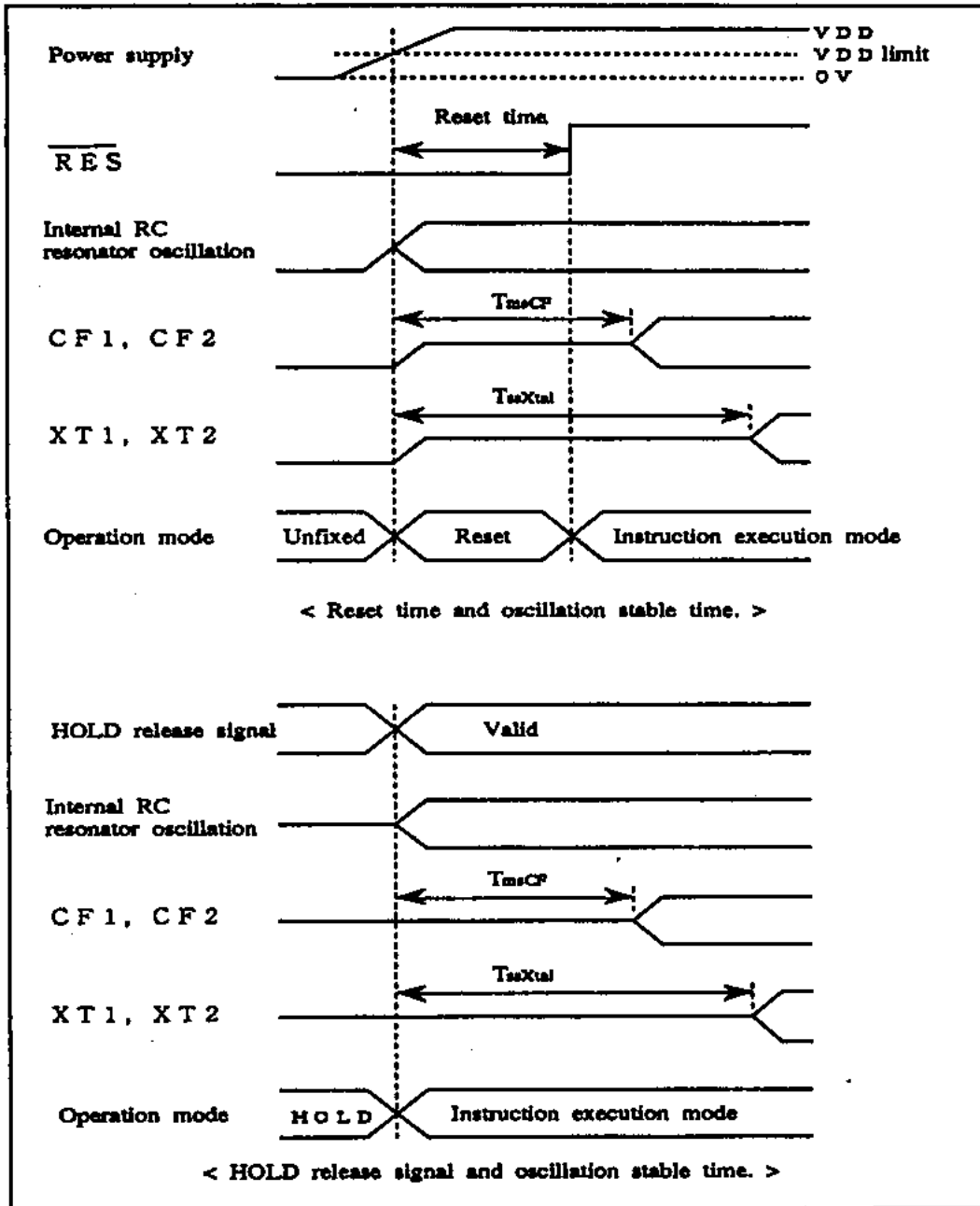
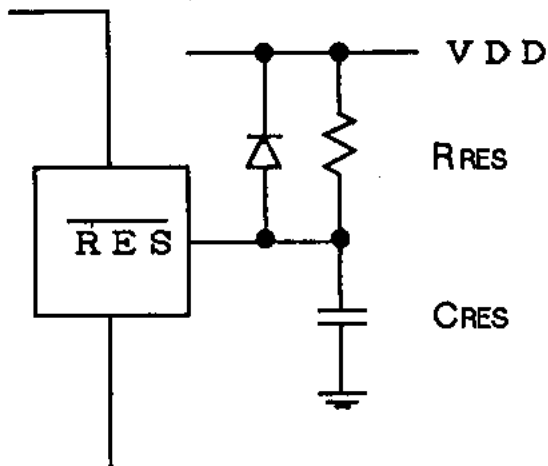
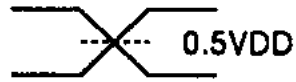


Figure. 3 Oscillation stable time



(Note) Fix the value of CRES, RRES that is sure to reset until  $200\mu s$ , after Power supply has been over inferior limit of supply voltage.

Figure. 4 Reset circuit



< AC timing point >

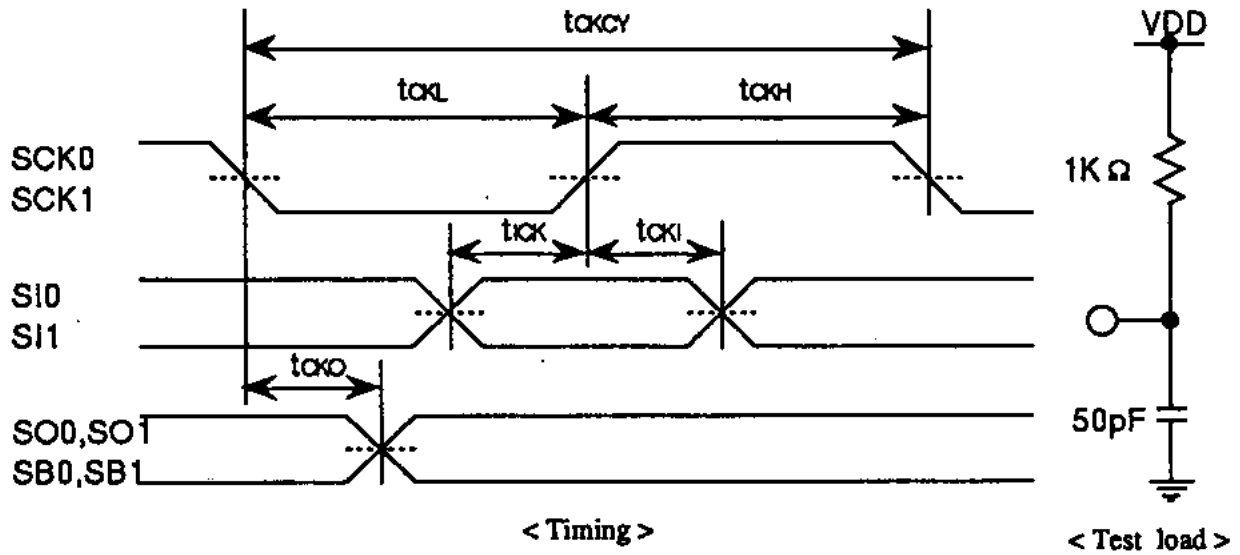


Figure. 5 Serial input/output test condition

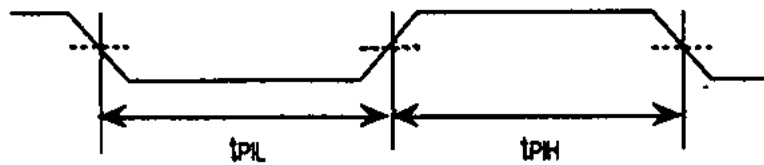


Figure. 6 Pulse input timing condition