



LC86E7148

8-Bit Single Chip Microcontroller with the UVEPROM

Preliminary

Overview

The LC86E7148 is a CMOS 8-bit single chip microcontroller with UVEPROM for the LC867100 series. This microcontroller has the function and the pin description of the LC867100 series mask ROM version, and 48K-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 the LC867100 series can be specified by the EPROM data.

LC86E7148 can be checked the functions of the trial pieces using the mass production board.

(2) Internal EPROM capacity : 49152 bytes

(3) Internal RAM capacity : 1152 bytes

Used EPROM or RAM capacity are equal ROM or RAM capacity of mask ROM version which applies LC86E7148.

Mask ROM version	EPROM capacity	RAM capacity
LC867148	49152 bytes	1152 bytes
LC867140	40960 bytes	1152 bytes
LC867132	32768 bytes	768 bytes
LC867128	28672 bytes	768 bytes
LC867124	24576 bytes	768 bytes
LC867120	20480 bytes	640 bytes
LC867116	16384 bytes	640 bytes
LC867112	12288 bytes	512 bytes
LC867108	8192 bytes	512 bytes

(4) Operating supply voltage : 4.5V to 6.0V

(5) Instruction cycle time : 1 μ s to 366 μ s

(6) Operating temperature : +10°C to +40°C

(7) The pin compatible with the LC867100 series mask ROM devices

(8) Applicable mask ROM version : LC867148/LC867140/LC867132/LC867128/LC867124/LC867120
/LC867116/LC867112/LC867108

(9) Factory shipment : QIC80S

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Notice for use

At using, take notice of the followings.

(1) A point of difference LC86E7148 and LC867100 series

Item	LC86E7148	LC867148/40/32/28/24/20/16/12/08
Port form at reset	Please refer 'Port form at reset' on next page.	
Operation after reset releasing	The option is specified until 3ms after going to a 'H' level to the reset terminal by degrees. 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 (VDD)	4.5V to 6.0V	2.5V to 6.0V
Total output current [Σ IOAL(2)] [Σ IOAL(3)]	Refer to 'electrical characteristics' on the semiconductor news.	
Power dissipation		

LC86E7148 uses 256 bytes that is addressed on 0FF00H to FFFFH in the program memory as the option configuration data area. This option configuration can execute all options which LC867100 series have. Next tables show the options that correspond and not correspond to LC86E7148.

• A kind of the option corresponding of the LC86E7148

A kind of option	Pins, Circuits	Contents of the option
Input/output form of input/output ports	Port 0 (specified in a bit)	1. Input : No Pull-up MOS Tr. Output: N-channel open drain *1
	Port 1 (specified in a bit) *1	2. Input : Pull-up MOS Tr. Output: CMOS *2
Pull-up MOS Tr. of input port		1. Input : Programmable pull-up MOS Tr. Output: N-channel open drain
	Port 7 (specified in a bit) *1 Each of P74 and P75 has no option	2. Input : Programmable pull-up MOS Tr. Output : CMOS

*1) Specified in a bit.

*2) Specified in nibble unit. Pull-up MOS Tr. is not provided in N-channel open drain output port.

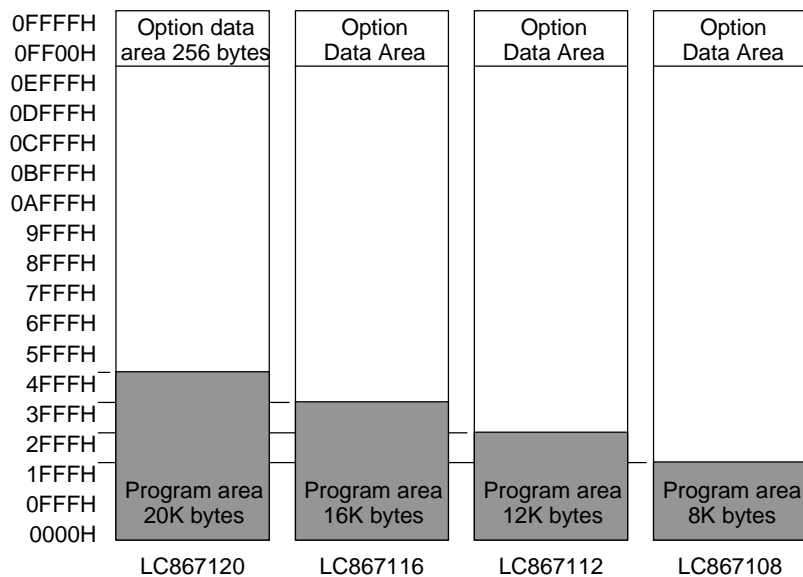
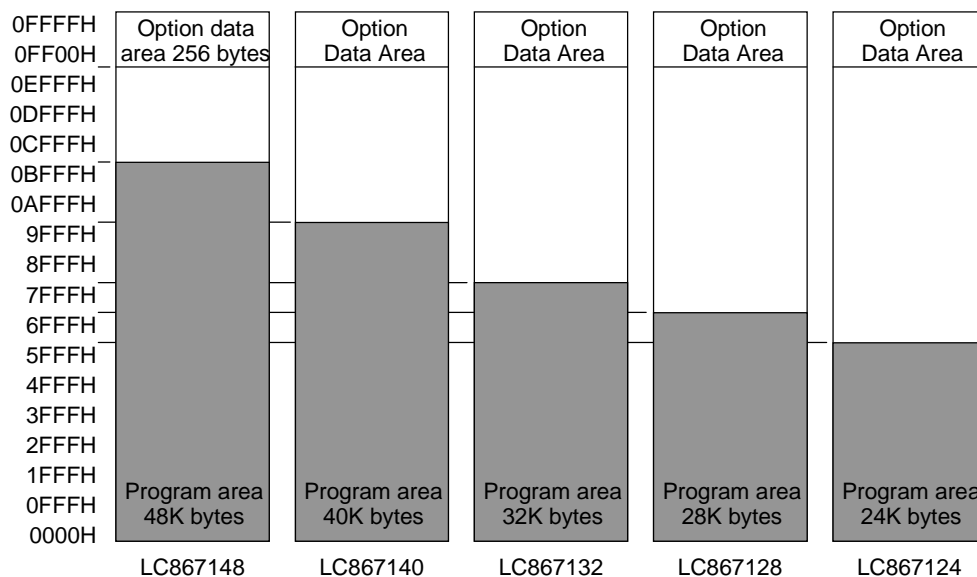
The port operation related the option is different at reset. Refer to the next table.

(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 linkage loader “L86K.EXE”.

(3) ROM space

LC86E7148 and LC867100 series use 256 bytes that is addressed on 0FF00H to 0FFFFH in the program memory as the option specified data area. These program memory capacity are 49152 bytes that is addressed on 0000H to 0BFFFH.



How to use

(1) Specification of option

The LC86E7148 must be programmed after specifying option data. The option is specified by "SU86K.EXE". The specified option file and the file created by our macro assembler "M86K.EXE" are linked by our linkage loader "L86K.EXE" which creates .HEX file, then the option code is put in the option specified area (0FF00H to 0FFFFH) of its .HEX file.

(2) How to program for the EPROM

The LC86E7148 can be programmed by EPROM programmer with attachment ; W86EP7148Q

- Recommended EPROM programmer

Productor	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 to "0 to 0FFFFH" and a jumper (DASEC) must be set to 'OFF' at programming.

(3) How to use the data security function

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

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

1. Set 'ON' the jumper of attachment.
2. Program again. Then EPROM programmer displays the error. The error means normally activity of the data security. 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 'FFH' at the sequence 2 above.
- The programming by a sequential operation "BLANK=>PROGRAM=>VERIFY" cannot be executed data security at the sequence 2 above.
- Set to 'OFF' the jumper after executing the data security.

(4) How to eliminate

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

(5) Shielding

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

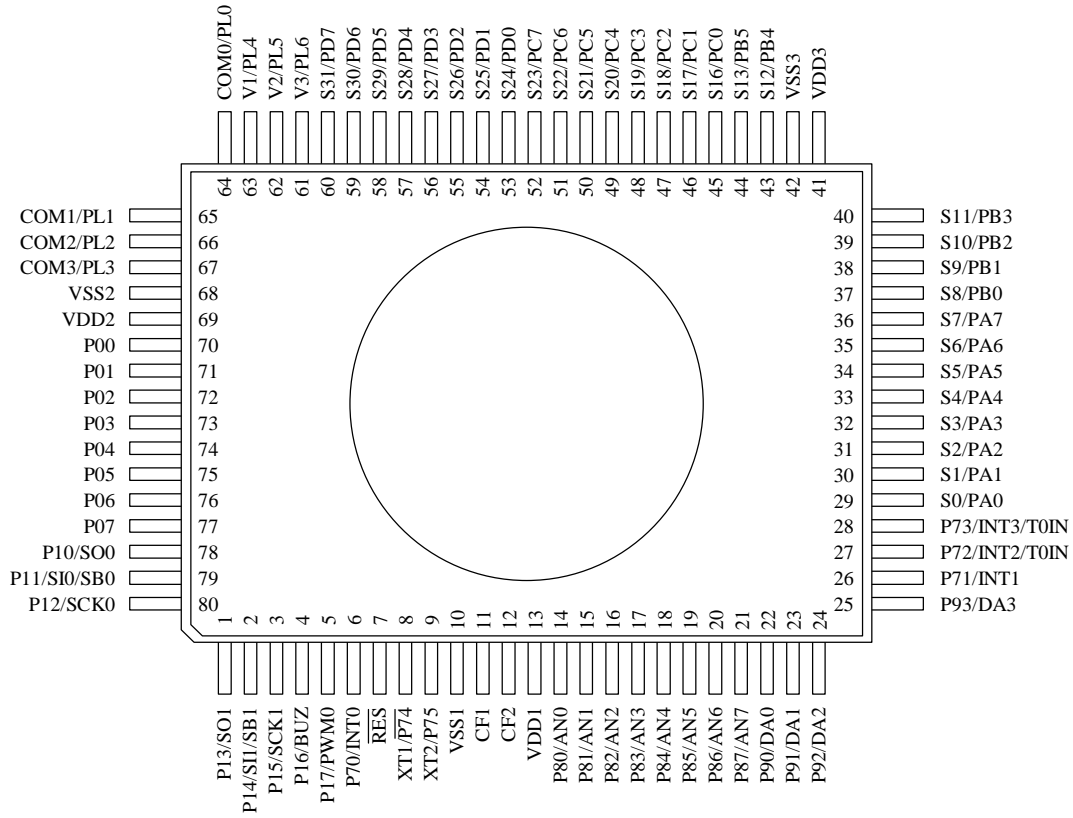
Data security



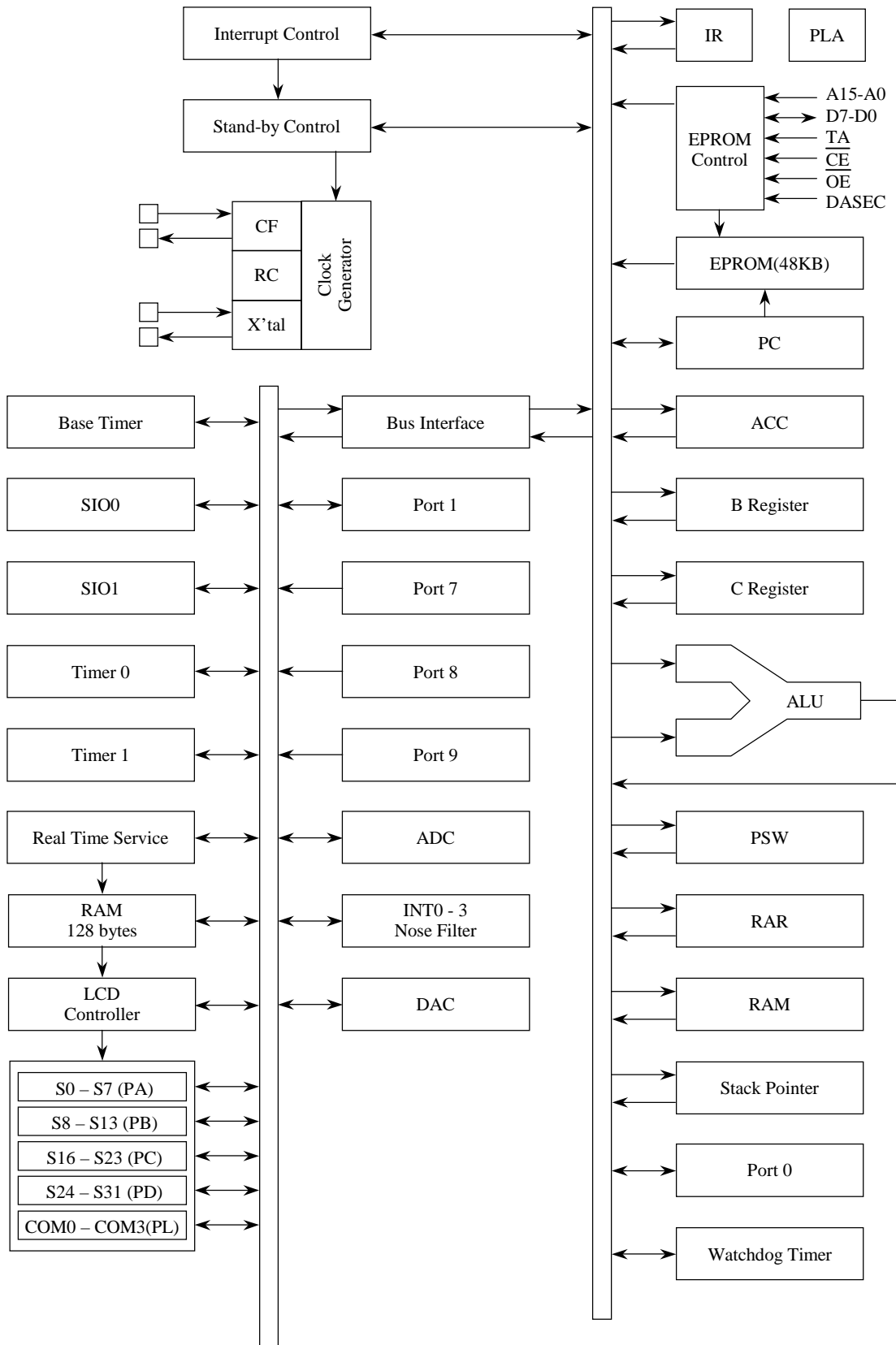
Not data security

W86EP7148Q

Pin Assignment



System Block Diagram



Pin Description

Pin name	I/O	Function description	Option	PROM mode																																			
VSS1 *1	-	Power pin (-)	-																																				
VSS2 *1	-	Power pin (-)	-																																				
VSS3 *1	-	Power pin (-)	-																																				
VDD1 *1	-	Power pin (+)	-																																				
VDD2 *1	-	Power pin (+)	-																																				
VDD3 *1	-	Power pin (+)	-																																				
PORT0 P00 - P07	I/O	<ul style="list-style-type: none"> 8-bit input/output port Input/output in nibble units Input for port 0 interrupt Input for HOLD release 	<ul style="list-style-type: none"> Pull-up resistor : Provided/Not provided (specified in nibble units) Output form (P00 – P07) : CMOS/N-channel open drain (specified in a bit) 																																				
PORT1 P10 - P17	I/O	<ul style="list-style-type: none"> 8-bit input/output port Input/output can be specified in bit unit Other pin functions P10 SIO0 data output P11 SIO0 data input/bus input/output P12 SIO0 clock input/output P13 SIO1 data output P14 SIO1 data input/bus input/output P15 SIO1 clock input/output P16 Buzzer output P17 Timer1 output (PWM output) 	<ul style="list-style-type: none"> Output form : CMOS/N-channel open drain (specified in a bit) 	Data line D0 to D7																																			
PORT7 P70 P71 - P73 P74 - P75	I/O I I	<ul style="list-style-type: none"> 6-bit input port Other pin functions P70 : INT0 input/HOLD release input/ N-channel Tr. output for watchdog timer P71 : INT1 input/HOLD release input P72 : INT2 input/timer 0 event input P73 : INT3 input with noise filter/timer 0 event input Interrupt received form, vector address <table border="1" style="margin-left: 20px;"> <thead> <tr> <th></th> <th>rising</th> <th>falling</th> <th>rising & falling</th> <th>high level</th> <th>low 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> <p>P74 : XT1 terminal for crystal oscillation P75 : XT2 terminal for crystal oscillation</p>		rising	falling	rising & falling	high level	low 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 (specified in a bit) (P70, P71, P72, P73) * P74, P75 don't have the pull-up resistor option.	Power for programming PROM control signals \overline{DASEC} (*2) \overline{OE} (*3) \overline{CE} (*4)
	rising	falling	rising & falling	high level	low 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																																	
Port8 P80 – P87	I	<ul style="list-style-type: none"> 8-bit input port Other function AD input port (8 port pins) 	-																																				
PORT9 P90 - P93	I/O	<ul style="list-style-type: none"> 4-bit input/output port Other function DA output port (4 port pins) AD input port (4 port pins) 	-																																				

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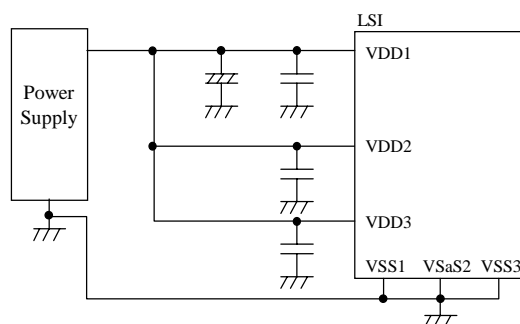
Pin name	I/O	Function description	Option	PROM mode
PORT A (S0/PA0 – S7/PA7)	I/O	<ul style="list-style-type: none"> Segment output terminal for LCD display Can be used as a general input/output port 	-	Address input A0 to A7
PORT B (S8/PB0 – S13/PB5)	I/O	<ul style="list-style-type: none"> Segment output terminal for LCD display Can be used as a general input/output port 	-	Address input A8 to A13
PORT C (S16/PC0 – S23/PC7)	I/O	<ul style="list-style-type: none"> Segment output terminal for LCD display Can be used as a general input/output port 	-	PROM control signal input •TA(*5) Address input •A14,A15
PORT D (S24/PD0 – S31/PD7)	I/O	<ul style="list-style-type: none"> Segment output terminal for LCD display Can be used as a general input/output port 	-	
PORT L (COM0/PL0 – COM3/PL3)	I/O	<ul style="list-style-type: none"> Common output terminal for LCD display Can be used as a general input port 	-	
V1/PL4 – V3/PL6	I	<ul style="list-style-type: none"> Bias power terminal for LCD drive Can be used as a general input port 	-	
$\overline{\text{RES}}$	I	Reset pin	-	
XT1/ $\overline{\text{P74}}$	I	<ul style="list-style-type: none"> Input pin for 32.768kHz crystal oscillation In case of non use, connect to VDD. Other function A general input port $\overline{\text{P74}}$ 	-	
XT2/P75	O (I)	<ul style="list-style-type: none"> Output pin for 32.768kHz crystal oscillation In case of non use, should be left unconnected Other function A general input port P75 	-	
CF1	I	Input pin for ceramic resonator oscillation	-	
CF2	O	Output pin for ceramic resonator oscillation	-	

* All of port options can be specified in bit unit except the pull-up resistor of port 0.

[Notes] • The VDD1, VDD2 and VDD3 terminals must be shorted electrically each other.

• The VSS1, VSS2 and VSS3 terminals must be shorted electrically each other.

*1 Connect like the following figure to reduce noise into a VDD terminals.



*2 Memory select input for data security

*3 Output enable input

*4 Chip enable input

*5 TA → PROM control signal input

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1. Absolute Maximum Ratings at Ta=25°C, VSS=VSS1=VSS2=VSS3=0V

Parameter	Symbol	Pins	Conditions	VDD[V]	Ratings			unit
					min.	typ.	max.	
Supply voltage	VDDMAX	VDD1, VDD2 VDD3	VDD1=VDD2= VDD3		-0.3		+7.0	V
LCD display voltage	VLCD	V1/PL6, V2/PL5 V3/PL4	VDD1=VDD2= VDD3		-0.3		VDD	
Input voltage	VI	•Ports 71, 72, 73 •Ports $\overline{74}$, 75 •Port 8, Port L • \overline{RES}			-0.3		VDD+0.3	
Input/output voltage	VIO	•Ports 0, 1 •Port 9 •Ports A, B, C, D			-0.3		VDD+0.3	
High level output current	Peak output current	IOPH(1)	Ports 0, 1	•CMOS output •At each pins		-4		mA
		IOPH(2)	Ports A, B, C, D			-4		
		IOPH(3)	Port 9			-4		
	Total output current	ΣIOAH(1)	Ports 0, 1	Total all pins		-30		
		ΣIOAH(2)	Ports A, B	Total all pins		-20		
		ΣIOAH(3)	Ports C, D	Total all pins		-20		
		ΣIOAH(4)	Port 9	Total all pins		-20		
	Low level output current	Peak output current	IOPL(1)	Ports 0, 1	At each pins			
IOPL(2)			Ports A, B, C, D	At each pins			20	
IOPL(3)			Port 9	At each pins			20	
IOPL(4)			Port 70	At each pins			15	
Total output current		ΣIOAL(1)	Ports 0, 1	Total all pins			40	
		ΣIOAL(2)	Ports A, B	Total all pins			24	
		ΣIOAL(3)	Ports C, D	Total all pins			24	
		ΣIOAL(4)	Port 9	Total all pins			15	
		ΣIOAL(5)	Port 70	Total all pins			10	
Maximum power dissipation	Pdmax	QIC80S	Ta=+10 to+40°C				515	mW
Operating temperature range	Topr				+10		+40	°C
Storage temperature range	Tstg				-65		+150	

- Notes
- The QFP packages should be heat-soaked for 12 hours at 125°C immediately prior to mounting (This baking is called pre-baking).
 - After pre-baking a controlled environment must be maintained until soldering. The environment must be held at a temperature of 30°C or less and a humidity level of 70% or less. Please solder within 24 hours.

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2. Recommended Operating Range at Ta=+10°C to +40°C, VSS=0V

Parameter	Symbol	Pins	Conditions	Ratings			unit	
				VDD[V]	min.	typ.		max.
Operating supply voltage range	VDD(1)	VDD1,VDD2,VDD3	0.98μs ≤ tCYC ≤ 400μs		4.5		6.0	V
	VDD(2)		3.9μs ≤ tCYC ≤ 400μs		2.5		6.0	
Hold voltage	VHD	VDD1,VDD2,VDD3	RAMs and the registers hold voltage at HOLD mode.		2.0		6.0	
Input high voltage	VIH(1)	Port 0	Output disable	4.5-6.0	0.4VDD +0.9		VDD	
	VIH(2)	•Ports 1, 9 •Ports A, B, C, D •Ports 72, 73 (Schmitt)	Output disable	4.5-6.0	0.75VDD		VDD	
	VIH(3)	•Port 70 Port input/interrupt •Port 71 •RES (Schmitt)	Output N-channel Tr. OFF	4.5-6.0	0.75VDD		VDD	
	VIH(4)	Port 70 Watchdog timer	Output N-channel Tr. OFF	4.5-6.0	0.9VDD		VDD	
	VIH(5)	•Port 8	Output N-channel Tr. OFF	4.5-6.0	0.75VDD		VDD	
Input low voltage	VIL(1)	Port 0	Output disable	4.5-6.0	VSS		0.2VDD	
	VIL(2)	•Ports 1, 9 •Ports A, B, C, D •Ports 72, 73 (Schmitt)	Output disable	4.5-6.0	VSS		0.25VDD	
	VIL(3)	•Port 70 Port input/interrupt •Port 71 •RES (Schmitt)	Output N-channel Tr. OFF	4.5-6.0	VSS		0.25VDD	
	VIL(4)	Port 70 Watchdog timer	Output N-channel Tr. OFF	4.5-6.0	VSS		0.8VDD -1.0	
	VIL(5)	•Port 8	Output N-channel Tr. OFF	4.5-6.0	VSS		0.25VDD	
Operation cycle time	tCYC			4.5-6.0	0.98		400	μs
				4.5-6.0	3.9		400	

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Parameter	Symbol	Pins	Conditions	Ratings			unit	
				VDD[V]	min.	typ.		max.
Oscillation frequency range (Note 1)	FmCF(1)	CF1, CF2	•6MHz (ceramic resonator oscillation) •Refer to figure 1	4.5-6.0	5.88	6	6.12	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	3.0	
	FsXtal	XT1, XT2	•32.768kHz (crystal oscillation) •Refer to figure 2	4.5-6.0		32.768		kHz
Oscillation stabilizing time period (Note 1)	tmsCF(1)	CF1, CF2	•6MHz (ceramic resonator oscillation) •Refer to figure 3	4.5-6.0				ms
	tmsCF(2)	CF1, CF2	•3MHz (ceramic resonator oscillation) •Refer to figure 3	4.5-6.0				
	tssXtal	XT1, XT2	•32.768kHz (crystal oscillation) •Refer to figure 3	4.5-6.0				s

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

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3. Electrical Characteristics at Ta=+10°C to +40°C, VSS=VSS1=VSS2=VSS3=0V

Parameter	Symbol	Pins	Conditions	VDD[V]	Ratings			unit
					min.	typ.	max.	
Input high current	IIH(1)	•Port 1 •Port 0 without pull-up MOS Tr.	•Output disable •Pull-up MOS Tr. OFF. VIN=VDD (including the off-leak current of the output Tr.)	4.5-6.0			1	μA
	IIH(2)	•Port 7 without pull-up MOS Tr. •Port 8	VIN=VDD	4.5-6.0			1	
	IIH(3)	Port 9	VIN=VDD	4.5-6.0			1	
	IIH(4)	Ports A, B, C, D, L	VIN=VDD	4.5-6.0			1	
	IIH(5)	$\overline{\text{RES}}$	VIN=VDD	4.5-6.0			1	
	IIH(6)	Ports $\overline{74}, 75$	Using as port VIN=VDD	4.5-6.0			1	
Input low current	IIl(1)	•Port 1 •Port 0 without pull-up MOS Tr.	•Output disable •Pull-up MOS Tr. OFF. VIN=VSS (including the off-leak current of the output Tr.)	4.5-6.0	-1			
	IIl(2)	•Port 7 without pull-up MOS Tr. •Port 8	VIN=VSS	4.5-6.0	-1			
	IIl(3)	Port 9	VIN=VSS	4.5-6.0	-1			
	IIl(4)	Ports A, B, C, D, L	VIN=VSS	4.5-6.0	-1			
	IIl(5)	$\overline{\text{RES}}$	VIN=VSS	4.5-6.0	-1			
	IIl(6)	Ports $\overline{74}, 75$	Using as port VIN=VSS	4.5-6.0	-1			
Output high voltage	VOH(1)	Ports 0,1 of CMOS output	IOH=-1.0mA	4.5-6.0	VDD-1			V
	VOH(2)	•Port 9 of CMOS output •Ports A, B, C, D of CMOS output	IOH=-1.0mA	4.5-6.0	VDD-1			
Output low voltage	VOL(1)	Ports 0, 1	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	
	VOL(4)	Port 9	IOL=6mA	4.5-6.0			1.5	
	VOL(5)		IOL=1.2mA	4.5-6.0			0.4	
	VOL(6)	Ports A, B, C, D	IOL=8mA	4.5-6.0			1.5	
	VOL(7)	of CMOS output	IOL=1.6mA	4.5-6.0			0.4	

Continue.

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Parameter	Symbol	Pins	Conditions	Ratings			unit	
				VDD[V]	min.	typ.		max.
LCD output regulation	VODLS	S0 to S13, S16 to S31	•Deference voltage to ideal value •VLCD, 2/3VLCD, 1/3VLCD	4.5-6.0	0		±0.2	V
	VODLC	COM0 to COM3	•Deference voltage to ideal value •VLCD, 2/3VLCD, 1/2VLCD, 1/3VLCD	4.5-6.0	0		±0.2	
LCD ladder resistor	RLCD(1)		Resistance at a ladder resistor	4.5-6.0		60		kΩ
	RLCD(2)		•Resistance at a ladder resistor •1/2R mode	4.5-6.0		30		
Pull-up MOS Tr. resistor	Rpu	•Ports 0, 1 •Ports A, B, C, D •Ports 70, 71, 72, 73	VOH=0.9VDD	4.5-6.0	15	40	70	
Hysteresis voltage	VHIS	•Ports 0, 1 •Ports 70, 71, 72, 73 •RES	Output disable	4.5-6.0		0.1VDD		V
Pin capacitance	CP	All pins	•f=1MHz •Unmeasurement terminals for the input are set to VSS level. •Ta=25°C	4.5-6.0		10		pF

4. Serial Input / Output Characteristics at Ta=+10°C to +40°C, VSS=VSS1=VSS2=VSS3=0V

Parameter		Symbol	Pins	Conditions	Ratings			unit	
					VDD[V]	min.	typ.		max.
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 pull-up 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		1/2 tCKCY	
		High Level pulse width	tCKH(2)			4.5-6.0		1/2 tCKCY	
Serial input	Data set up time	tICK	•SI0,SI1 •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 pull-up 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 at Ta=+10°C to +40°C, VSS=VSS1=VSS2=VSS3=0V

Parameter	Symbol	Pins	Conditions	VDD[V]	Ratings			unit
					min.	typ.	max.	
High/low level pulse width	tPIH(1) tPIL(1)	•INT0, INT1 •INT2/T0IN	•Interrupt acceptable •Timer0-countable	4.5-6.0	1			tCYC
	tPIH(2) tPIL(2)	INT3/T0IN (The noise rejection clock is selected to 1/1.)	•Interrupt acceptable •Timer0-countable	4.5-6.0	2			
	tPIH(3) tPIL(3)	INT3/T0IN (The noise rejection clock is selected to 1/16.)	•Interrupt acceptable •Timer0-countable	4.5-6.0	32			
	tPIH(4) tPIL(4)	INT3/T0IN (The noise rejection clock is selected to 1/64.)	•Interrupt acceptable •Timer0-countable	4.5-6.0	128			
	tPIL(5)	\overline{RES}	Reset acceptable	4.5-6.0	200			μs

6. AD Converter Characteristics at Ta=+10°C to +40°C, VSS=VSS1=VSS2=VSS3=0V

Parameter	Symbol	Pins	Conditions	VDD[V]	Ratings			unit
					min.	typ.	max.	
Resolution	NAD			4.5-6.0		8		bit
Absolute precision (Note 2)	ETAD			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 (tCYC= 0.98μs)		65.28 (tCYC= 4.08μs)	μs
			AD conversion time = 32 × tCYC (ADCR2=1) (Note 3)		31.36 (tCYC= 0.98μs)		130.56 (tCYC= 4.08μs)	
Analog input voltage range	VAIN	AN0 - AN11		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 from executing the AD conversion instruction to setting the complete digital conversion value to the register.

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7. DA Converter Characteristics at Ta=+10°C to +40°C, VSS=VSS1=VSS2=VSS3=0V

Parameter	Symbol	Pins	Conditions	VDD[V]	Ratings			unit
					min.	typ.	max.	
Resolution	NDA			4.5-6.0		8		bit
Total error			8 bit mode	4.5-6.0			1.0	%
			9 bit mode				0.8	
			9.5 bit mode				0.7	
Settling time	tSAD		(Note 4)	4.5-6.0			0.5	μs
Analog output voltage range	VAOUT	DA0 to DA3	8 bit mode	4.5-6.0		VSS	VDD	V
			9 bit mode (1)			VSS	1/2VDD	
			9 bit mode (2)			1/2VDD	VDD	
			9.5 bit mode			1/3VDD	2/3VDD	
Output resistor	RODA		(Note 5)	4.5-6.0		4		kΩ

(Note 4) Settling time means the time from executing the DA conversion instruction to generating the analog voltage output corresponding to the digital data on the specific port.

(Note 5) DA data = 80H

8. Current Dissipation Characteristics at Ta=+10°C to +40°C, VSS=VSS1=VSS2=VSS3=0V

Parameter	Symbol	Pins	Conditions	VDD[V]	Ratings			unit
					min.	typ.	max.	
Current dissipation during basic operation (Note 6)	IDDOP(1)	VDD1=VDD2=VDD3	<ul style="list-style-type: none"> •FmCF=6MHz Ceramic resonator oscillation •FsXtal=32.768kHz crystal oscillation •System clock : CF oscillation •Internal RC oscillation stops •1/1 divided 	4.5-6.0		15	30	mA
	IDDOP(2)		<ul style="list-style-type: none"> •FmCF=3MHz Ceramic resonator oscillation •FsXtal=32.768kHz crystal oscillation •System clock : CF oscillation •Internal RC oscillation stops •1/2 divided 	4.5-6.0		6	15	
	IDDOP(3)		<ul style="list-style-type: none"> •FmCF=0Hz (when oscillation stops) •FsXtal=32.768kHz crystal oscillation •System clock : RC oscillation •1/2 divided 	4.5-6.0		4	13	
	IDDOP(4)		<ul style="list-style-type: none"> •FmCF=0Hz (when oscillation stops) •FsXtal=32.768kHz crystal oscillation •System clock : crystal oscillation •Internal RC oscillation stops •1/2 divided 	4.5-6.0		4	9	

Continue.

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Parameter	Symbol	Pins	Conditions	Ratings			unit	
				VDD[V]	min.	typ.		max.
Current dissipation in HALT mode (Note 6)	IDDHALT(1)	VDD1= VDD2= VDD3	<ul style="list-style-type: none"> •HALT mode •FmCF=6MHz Ceramic resonator oscillation •FsXtal=32.768kHz crystal oscillation •System clock : CF oscillation •Internal RC oscillation stops •1/1 divided 	4.5-6.0		6	11	mA
	IDDHALT(2)		<ul style="list-style-type: none"> •HALT mode •FmCF=3MHz Ceramic resonator oscillation •FsXtal=32.768kHz crystal oscillation •System clock : CF oscillation •Internal RC oscillation stops •1/2 divided 	4.5-6.0		2.2	9	
	IDDHALT(3)		<ul style="list-style-type: none"> •HALT mode FmCF=0Hz (when oscillation stops) •FsXtal=32.768kHz crystal oscillation •System clock : RC oscillation •1/2 divided 	4.5-6.0		500	1700	μA
	IDDHALT(4)		<ul style="list-style-type: none"> •HALT mode FmCF=0Hz (when oscillation stops) •FsXtal=32.768kHz crystal oscillation •System clock : crystal oscillation •Internal RC oscillation stops •1/2 divided 	4.5-6.0		25	100	
	IDDHALT(5)							
Current dissipation in HOLD mode (Note 6)	IDDHOLD(1)	VDD1= VDD2= VDD3	HOLD mode	4.5-6.0		0.05	30	

(Note 6) The currents of the output transistors and the pull-up MOS transistors are ignored.

Table 1. Ceramic resonator oscillation recommended constant (main clock)

Oscillation type	Maker	Oscillator	C1	C2
6MHz ceramic resonator oscillation	Murata	CSA6.00MG	33pF	33pF
		CST6.00MGW	on chip	
	Kyocera	KBR-6.0MSA	33pF	33pF
		PBRC6.00A(chip type)	33pF	33pF
		KBR-6.0MKS PBRC6.00B(chip type)	on chip	
3MHz ceramic resonator oscillation	Murata	CSA3.00MG	33pF	33pF
		CST3.00MGW	on chip	
	Kyocera	KBR-3.0MS	47pF	47pF

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

Table 2. Crystal oscillation guaranteed constant (sub clock)

Oscillation type	Maker	Oscillator	C3	C4
32.768kHz crystal oscillation				

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

(It is about the application which is 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.

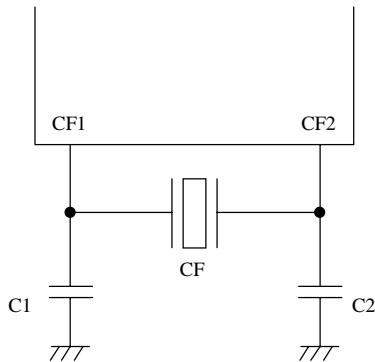


Figure 1 Ceramic oscillation circuit

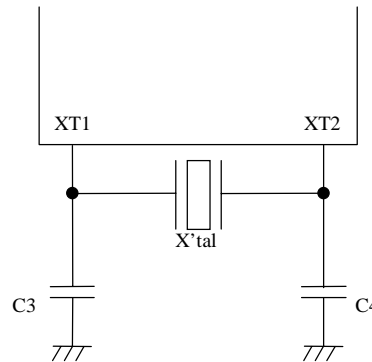


Figure 2 Crystal oscillation circuit

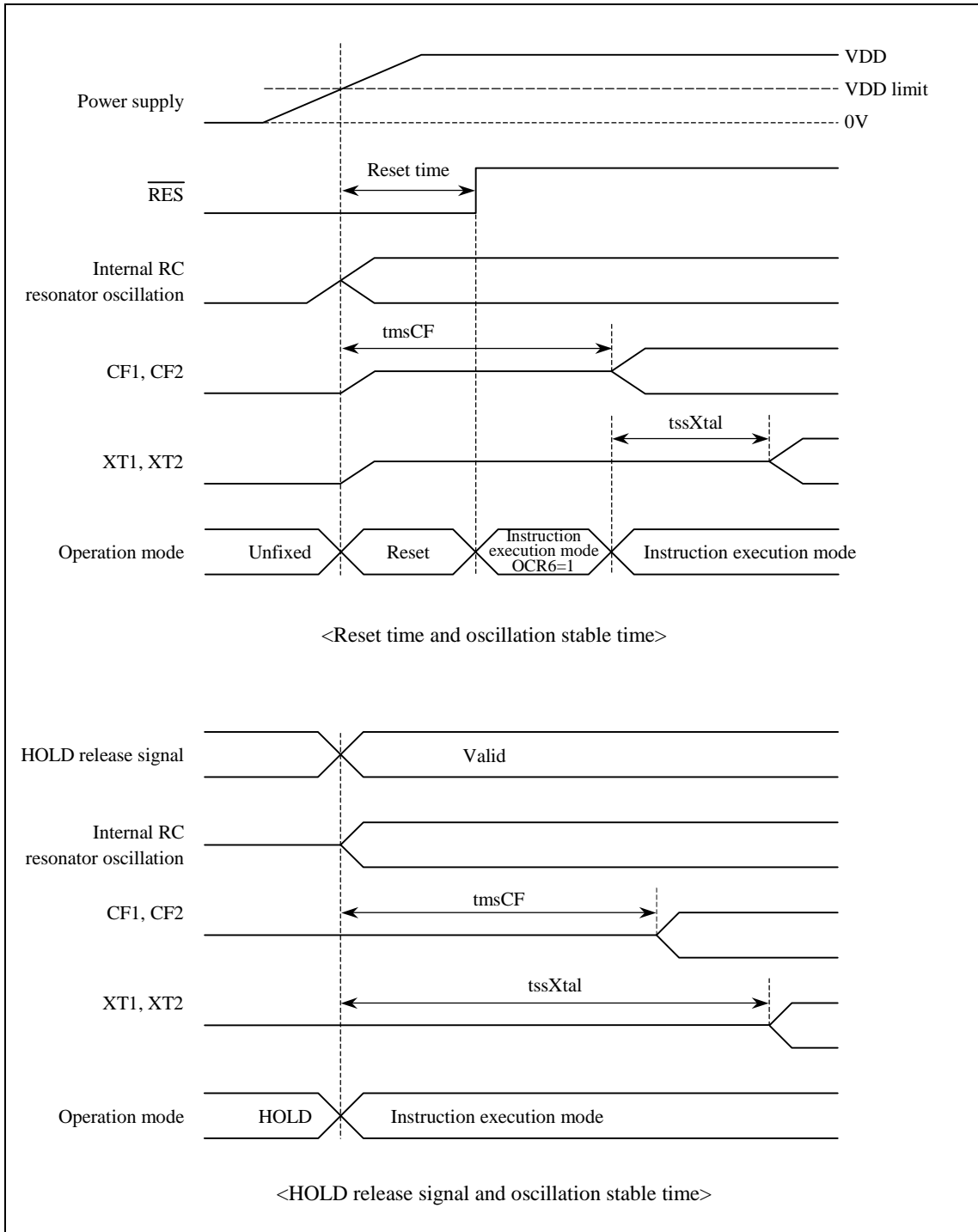
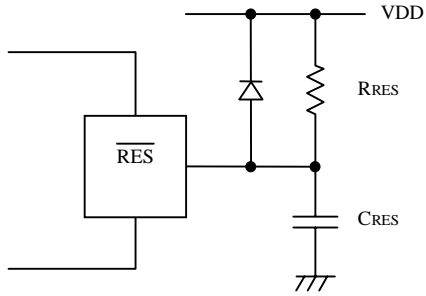


Figure 3 Oscillation stable time



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

Figure 4 Reset circuit

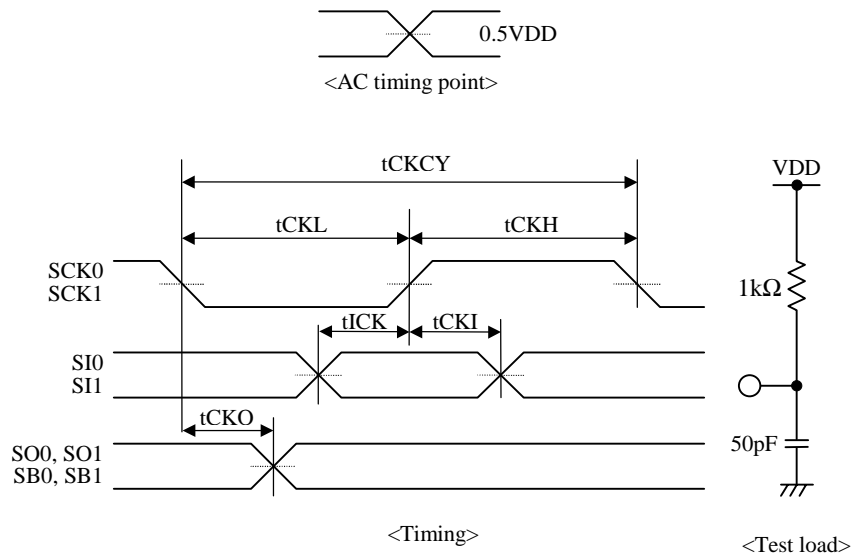


Figure 5 Serial input / output test condition

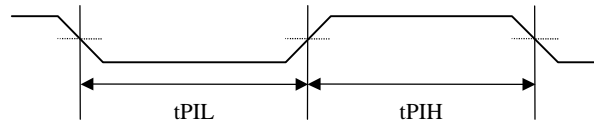


Figure 6 Pulse input timing condition

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