

SANYO	No. ※4280	LC866032B,866028B,866024B
		8-Bit Single Chip Microcomputer

Preliminary

LC866032B	On-chip 32KBytes ROM and On-chip 512Bytes 8-bit Single Chip Microcomputer
LC866028B	On-chip 28KBytes ROM and On-chip 512Bytes 8-bit Single Chip Microcomputer
LC866024B	On-chip 24KBytes ROM and On-chip 512Bytes 8-bit Single Chip Microcomputer

Overview

The LC866032B/28B/24B microcomputers are 8-bit single chip microcomputers with the following on-chip functional blocks :

- CPU : Operable at a minimum bus cycle time of 0.5 μ s (microsecond)
- On-chip ROM Maximum Capacity : 32K bytes
- On-chip RAM Capacity : 512 bytes
- VFD automatic display controller/driver
- 16-bit timer/counter
- 16-bit timer/PWM
- 4-channel 8-bit AD converter
- Two 8-bit synchronous serial-interface circuits
- 14-source 10-level vectored interrupt system

All of the above functions are fabricated on a single chip.

Features

- | | | |
|--------------------------------------|---|----------------|
| (1) Read-Only Memory (ROM) : | LC866032B | 32512 x 8 bits |
| | LC866028B | 28672 x 8 bits |
| | LC866024B | 24576 x 8 bits |
| (2) Random Access Memory (RAM) : | LC866032B/28B/24B | 512 x 8 bits |
| (3) Minimum bus cycle time : | 0.5 μ s (using 12MHz ceramic resonator oscillation)
Bus cycle time means ROM-read period. | |
| (4) Minimum instruction cycle time : | 1 μ s (using 12MHz CF resonator oscillation)
ROM data is accessed twice in a instruction cycle time.
The operation of the microcomputers herein is about 1.7 times that of LC66000 series, our products in the same specified cycle time. | |

(5) Ports :

- Input/output ports : 2 ports (16 terminals).
 Input/output port programmable in nibble units : 1 port (8 terminals).
 Input/output port programmable in a bit : 1 port (8 terminals).
- Input ports : 2 ports (8 port pins).
- VFD output ports : 30 terminals.
- Large current output for digit : 16 terminals.
- Pull-down resistor option available.

(6) VFD automatic display controller

- Segment/digit output pattern programmable.
 Any segment/digit combination available.
 VFD parallel-drive available.
- 16-step dimmer function available.

(7) AD converter

- 4-channel 8-bit AD converter.

(8) Serial-interface

- 2-channel 8-bit serial-interface.
 LSB first / MSB first function available.
- Internal 8-bit baud-rate generator in common with two serial-interface circuits.

(9) Timer

- Timer 0

- 16-bit timer/counter.
- 2-bit prescaler + 8-bit programmable prescaler .
- Mode 0 : Two 8-bit timers with programmable prescaler.
- Mode 1 : 8-bit timer + 8-bit counter with programmable prescaler.
- Mode 2 : 16-bit timer with programmable prescaler.
- Mode 3 : 16-bit counter.

Resolution of Timer is Tcyc. (Tcyc : cycle time)

- Timer 1

- 16-bit timer/PWM
- Mode 0 : Two 8-bit timers
- Mode 1 : 8-bit timer + 8-bit PWM
- Mode 2 : 16-bit timer
- Mode 3 : Variable-bit PWM (9 - 16 bits)
- In Mode 0 and Mode 1, resolution of Timer and PWM is Tcyc.
- In Mode 2 and Mode 3, resolution of Timer and PWM selectable : Tcyc or 1/2 Tcyc by program.

- Base timer

- Every 500ms overflow system for a clock application (using 32.768kHz crystal oscillation for Base timer clock).
- Every 976 μ s, 3.9ms, 15.6ms, 62.5ms overflow system (using 32.768kHz crystal oscillation for Base timer clock).
- The Base timer clock selectable; 32.768kHz crystal oscillation, System clock, and Programmable prescaler output of Timer 0.

(10) Buzzer output

- The Buzzer sound frequency selectable; 4KHz, 2KHz (using 32.768kHz crystal oscillation for timer clock).

(11) Remote-control receiver (using INT3/P73/T0IN terminals)

- Noise rejection available.
- The interrupt polarity selectable.

(12) Watchdog timer

- The watchdog timer is taken on RC outside.
- Watchdog timer operation selectable : interrupt system , system reset.

(13) Interrupt system

- 14-source 10-level vectored interrupts :
 1. External interrupt INT0 (includes watchdog timer)
 2. External interrupt INT1
 3. External interrupt INT2 , timer TOL
 4. External interrupt INT3 , base timer
 5. Timer/counter T0H
 6. Timer T1L , timer T1H
 7. Serial-interface SIO0
 8. Serial-interface SIO1
 9. AD converter
 10. VFD display controller , port 0

- Interrupt Priority control available

Interrupt Priority control register included.

These microcomputers are available to 3-level interrupt : low-level, high-level and highest-level.

It is available to assign the priority (low-level or high-level) of the eight interruptions : number 3 to 10 above.

And it is available to assign the priority (low-level or highest-level) of the two interruptions : number 1, 2 above.

(14) Real-time service operation

The Real-Time Service (RTS) functions the data-transfer between the Special Function Registers at acknowledging the interrupt request.

The RTS starts within 1 cycle-time and completes within 5 cycle-times after occurring the interrupt request.

(15) Sub-routine stack levels.

- 128 levels maximum : Stack area included in the RAM area.

(16) Multiplication and division

16-bit x 8-bit (7 instruction cycle-times)

16-bit ÷ 8-bit (7 instruction cycle-times)

(17) 3 oscillation circuits

- On-chip RC oscillation circuit using for the system clock.
- On-chip Ceramic resonator oscillation circuit using for the system clock.
- On-chip crystal oscillation circuit using for the system clock and for time-base clock.

(18) Standby function

-HALT mode function

The HALT mode is used to reduce power dissipation. In this operation mode, program execution is stopped. This operation mode can be released by interrupt request signals or the system reset.

-HOLD mode function

The HOLD mode is used to freeze all the oscillations ; RC(internal), CF and Crystal oscillations. This mode can be released by the following operations

- Reset terminal (RES) set to Low level
- P70/INT0, P71/INT1 terminals set to assigned level (programmable)
- Port 0 terminal/terminals set to Low level (programmable)

(19) Factory shipment

DIP 64S delivery form

QFP 64E delivery form

(20) Development support tools

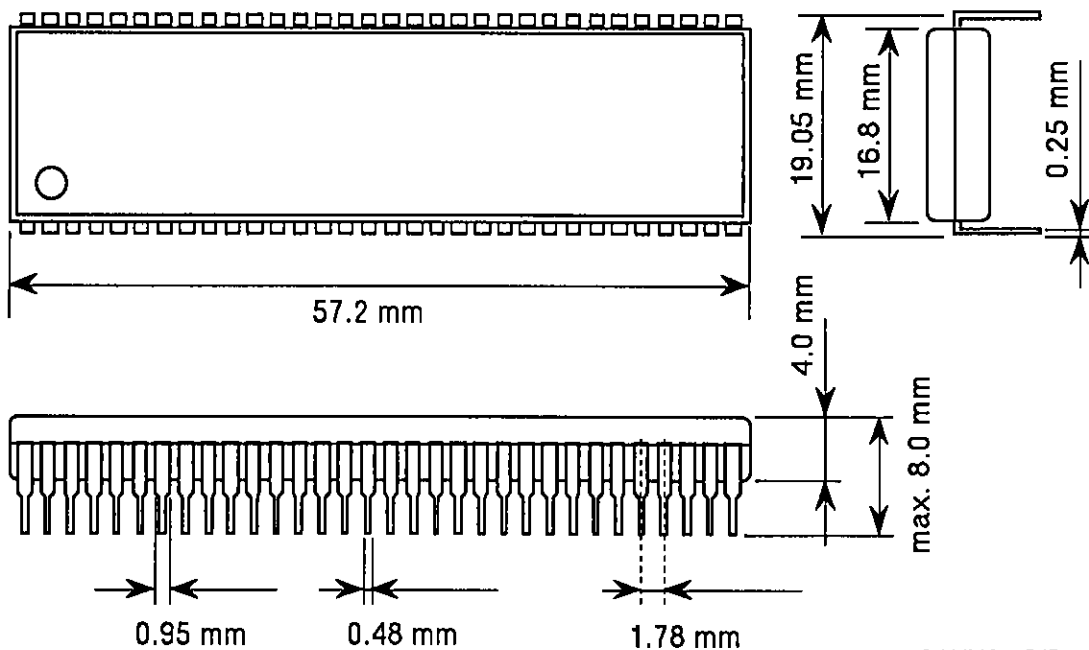
- Evaluation (EVA) chip : LC866099
- EPROM version : LC86E6032
- One time version : LC86P6032
- Emulator : EVA-86000 + ECB866000(Evaluation chip board) + POD866000(POD)

Pin Assignment

•DIP64S

P10/SO0	1	64	P07
P11/SIO/SB0	2	63	P06
P12/SCK0	3	62	P05
P13/SO1	4	61	P04
P14/SI/USB1	5	60	P03
P15/SCK1	6	59	P02
P16/BUZ	7	58	P01
P17/PWM	8	57	P00
TEST1	9	56	S29
RES	10	55	S28
XT1	11	54	S27
XT2	12	53	S26
VSS	13	52	S25
CF1	14	51	S24
CF2	15	50	S23
VDD	16	49	S22
P8G/AN0	17	48	S21
P81/AN1	18	47	S20
P82/AN2	19	46	S19
P83/AN3	20	45	S18
P7G/INT0	21	44	S17
P71/INT1	22	43	S16
P72/INT2/T0IN	23	42	VP
P73/INT3/T0IN	24	41	VDDVPP
S0/T0	25	40	S15/T15
S1/T1	26	39	S14/T14
S2/T2	27	38	S13/T13
S3/T3	28	37	S12/T12
S4/T4	29	36	S11/T11
S5/T5	30	35	S10/T10
S6/T6	31	34	S9/T9
S7/T7	32	33	S8/T8

Package Dimensions 3071

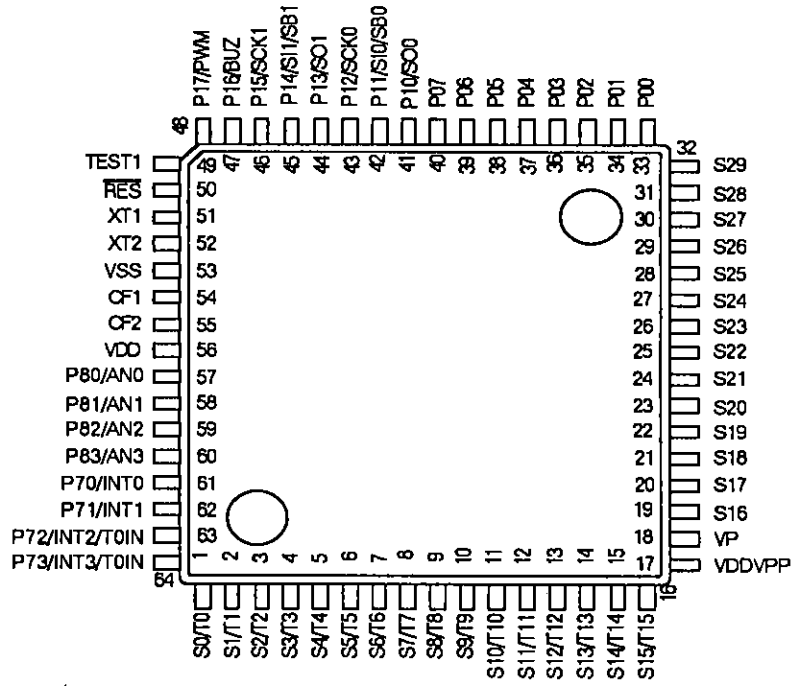


SANYO : DIP64S

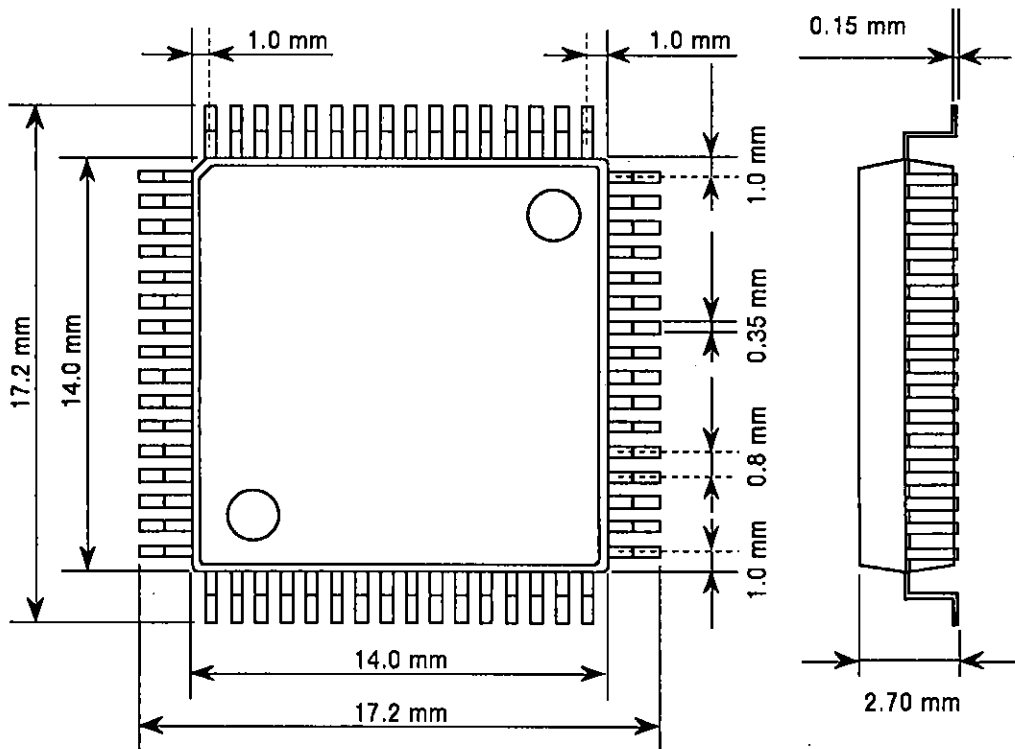
LC866032B,866028B,866024B

Pin Assignment

•QFP64

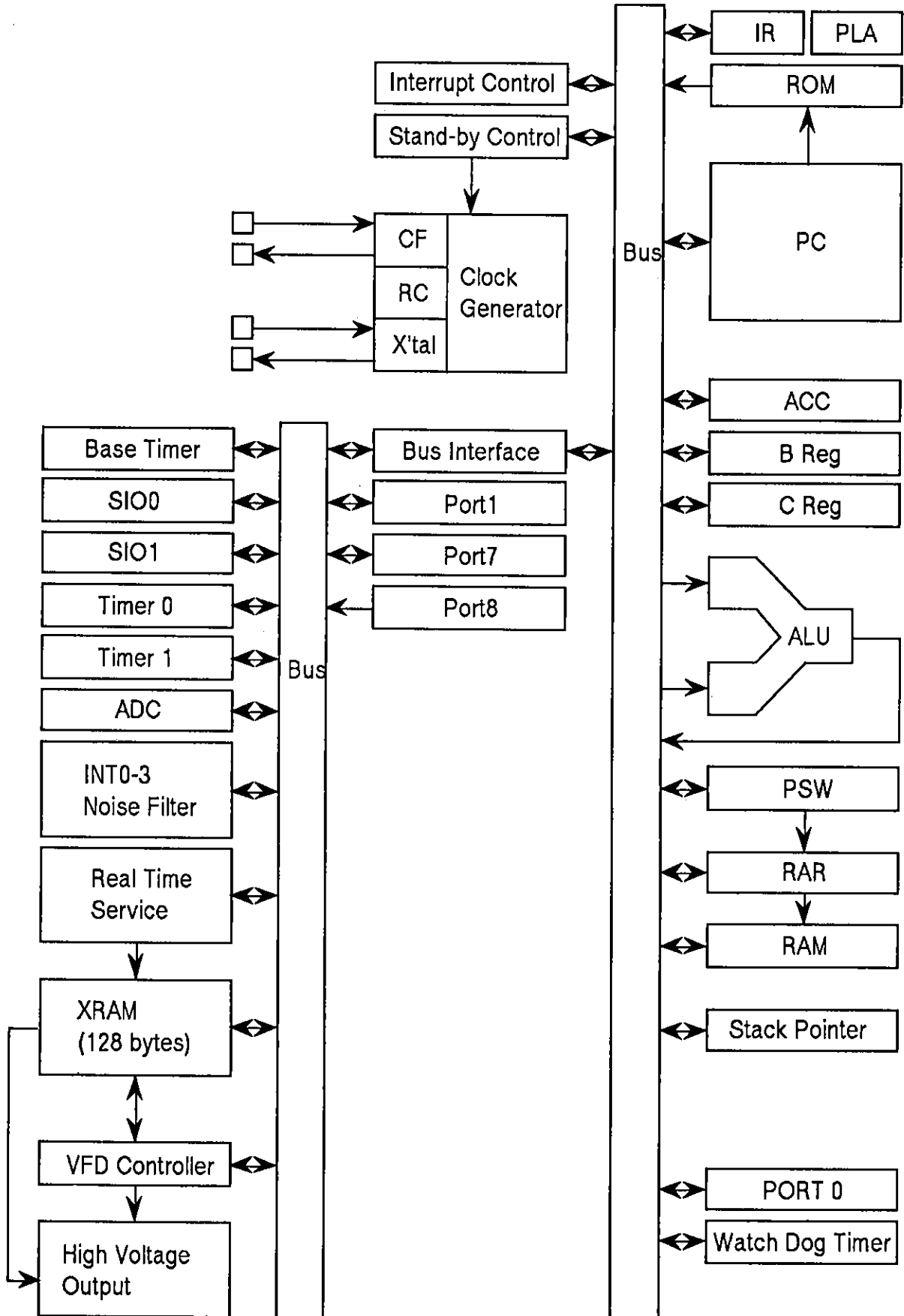


Package Dimensions 3159



SANYO : QIP64E

System Block Diagram



LC866032B,866028B,866024B

LC866032B/28B/24B Pin description

Pin name	I/O	Function description	Option																																			
VSS		Power pin(-).																																				
VDD		Power pin(+).																																				
VP		Power pin(-) for VFD output pulldown resistor.																																				
VDDVPP		Power pin(+).																																				
PORT0 P00-P07	I/O	<ul style="list-style-type: none"> •8-bit input/output port . •Input for port 0 interrupt. •Input/output in nibble units. •Input for HOLD release. 	<ul style="list-style-type: none"> •Pullup resistor : Provided / Not provided. •Output form : CMOS/N-channel open drain. 																																			
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 : Timer 1 output (PWM output) 	Output form : CMOS/N-channel open drain.																																			
PORT7 P70 P71-P73	I/O I	<ul style="list-style-type: none"> •4-bit input port. •Other pin functions. P70 : INT0 input/HOLD release /N-channel Tr. output for watchdog timer. P71 : INT 1 input/HOLD release. P72 : INT 2 input/timer 0 event input. P73 : INT 3 input with noise filter/timer 0 event input. •Interrupt received form , vector address. <table border="1"> <thead> <tr> <th></th> <th>Leading</th> <th>Trailing</th> <th>Leading & Trailing</th> <th>HIGH Level</th> <th>LOW Level</th> <th>VECTOR</th> </tr> </thead> <tbody> <tr> <td>INT0</td> <td>O</td> <td>O</td> <td>O</td> <td>O</td> <td>O</td> <td>03H</td> </tr> <tr> <td>INT1</td> <td>O</td> <td>O</td> <td>X</td> <td>O</td> <td>O</td> <td>0BH</td> </tr> <tr> <td>INT2</td> <td>O</td> <td>O</td> <td>O</td> <td>X</td> <td>X</td> <td>13H</td> </tr> <tr> <td>INT3</td> <td>O</td> <td>O</td> <td>O</td> <td>X</td> <td>X</td> <td>1BH</td> </tr> </tbody> </table>		Leading	Trailing	Leading & Trailing	HIGH Level	LOW Level	VECTOR	INT0	O	O	O	O	O	03H	INT1	O	O	X	O	O	0BH	INT2	O	O	O	X	X	13H	INT3	O	O	O	X	X	1BH	Pullup resistor : Provided / Not provided.
	Leading	Trailing	Leading & Trailing	HIGH Level	LOW Level	VECTOR																																
INT0	O	O	O	O	O	03H																																
INT1	O	O	X	O	O	0BH																																
INT2	O	O	O	X	X	13H																																
INT3	O	O	O	X	X	1BH																																
PORT8 P80-P87	I	<ul style="list-style-type: none"> •4-bit input port. •Other functions. AD input port (4 port pins) 																																				
S0/T0- S6/T6	O	Output for VFD display controller segment/timing in common.	Pulldown resistor : Provided / Not provided. (Usable for static output port at pull-down resistor Not provided.)																																			
S7/T7- S15/T15	O	Output for VFD display controller segment/timing with internal pulldown resistor in common.																																				

Pin name	I/O	Function description	Option
S16-S29	O	Output for VFD display controller segment.	Pulldown resistor : Provided / Not provided. (Usable for static output port at pull down register Not provided.)
RES	I	Reset pin with pullup resistor.	
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.	

- 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	Input	Programmable pullup resistor OFF

Pin name	A state of P-channel transistor
S0/T0-S15/T15	P-channel transistor OFF
S16-S29	P-channel transistor OFF

LC866032B,866028B,866024B

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

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	V
		VI(2)	VP			VDD-45		VDD+0.3	
Output voltage		VO	•S0/T0-S15/T15 •S16-S29			VDD-45		VDD+0.3	V
Input/output voltage		VIO	Ports 0,1,70			-0.3		VDD+0.3	V
High Level output current	Peak output current	IOPH(1)	Ports 0,1	•CMOS output. •At each pins.		-4			mA
		IOPH(2)	S0/T0-S15/T15	At each pins.		-30			
		IOPH(3)	S16-S29	At each pins.		-15			
	Total output current	ΣIOAH(1)	Port 0	The total all pins.		-10			
		ΣIOAH(2)	Port 1	The total all pins.		-10			
		ΣIOAH(3)	•S0/T0-S15/T15 •S16-S29	The total all pins.		-130			
Low Level output current	Peak output current	IOPL(1)	Ports 0,1	At each pins.				20	
		IOPL(2)	Port 70	At each pins.				15	
	Total output current	ΣIOAL(1)	Port 0	The total all pins.				40	
		ΣIOAL(2)	Ports 1, 70	The total all pins.				40	
Maximum power dissipation		Pdmax(1)	DIP64S	Ta=-30 to +70°C				760	mW
		Pdmax(2)	QFP64E	Ta=-30 to +70°C				430	
Operating temperature range		Topg				-30		70	°C
Storage temperature range		Tstg				-65		150	°C

- Notes :
- Pre-bake before mounting the QFP package on the substrate.
 - Do not immerse the package in the solder dip tank when mounting the QFP on the substrate.

LC866032B,866028B,866024B

2. Recommended operating range / Ta = -30 to +70°C, VSS = 0 V

Parameter	Symbol	Pins	Conditions	Limits				unit
				VDD [v]	min.	typ.	max.	
Operating supply voltage range	VDD(1)	VDD	0.98μs ≤ Tcyc Tcyc ≤ 400μs		4.5		6.0	V
	VDD(2)		3.9μs ≤ Tcyc Tcyc ≤ 400μs		2.5		6.0	
HOLD voltage	VHD	VDD	RAMs and Registers hold voltage at HOLD mode.		2.0		6.0	
Pulldown voltage	VP	VP		2.5 to 6.0	-35		VDD	
Input high voltage	VIH(1)	Port 0 (Schmitt)	Output disable	2.5 to 6.0	0.4VDD +0.9		VDD	
	VIH(2)	•Port 1 •Ports 72,73 (Schmitt)	Output disable	2.5 to 6.0	0.75VDD		VDD	
	VIH(3)	•Port 70 port input/ interrupt. •Port 71 •RES (Schmitt)	Output N-channel Tr. OFF	2.5 to 6.0	0.75VDD		VDD	
	VIH(4)	Port 70 Watchdog timer	Output N-channel Tr. OFF	2.5 to 6.0	0.9VDD		VDD	
	VIH(5)	Port 8			2.5 to 6.0	0.75VDD		VDD
Input low voltage	VIL(1)	Port 0 (Schmitt)	Output disable	2.5 to 6.0	VSS		0.2VDD	
	VIL(2)	•Port 1 •Ports 72,73 (Schmitt)	Output disable	2.5 to 6.0	VSS		0.25VDD	
	VIL(3)	•Port 70 Port input/ interrupt. •Port 71 •RES (Schmitt)	N-channel Tr. OFF	2.5 to 6.0	VSS		0.25VDD	
	VIL(4)	Port 70 Watchdog timer	N-channel Tr. OFF	2.5 to 6.0	VSS		0.8VDD -1.0	
	VIL(5)	Port 8			2.5 to 6.0	VSS		0.25VDD
Operation cycle time	Tcyc			4.5 to 6.0	0.98		400	μs
				2.5 to 6.0	3.9		400	

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 to 6.0	11.76	12	12.24	MHz
	FmCF(2)	CF1,CF2	•3MHz(ceramic resonator oscillation). •Refer to figure 1	2.5 to 6.0	2.94	3	3.06	
	FmRC		RC oscillation	2.5 to 6.0	0.4	0.8	3.0	
	FsXtal	XT1,XT2	•32.768kHz(crystal oscillation). •Refer to figure 2	2.5 to 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 to 6.0		0.02	0.2	ms
	TmsCF(2)	CF1,CF2	•3MHz(ceramic resonator oscillation). •Refer to figure 3	4.5 to 6.0		0.1	1	
				2.5 to 6.0		0.1	3	
	TssXtal	XT1,XT2	•32.768kHz(crystal oscillation). •Refer to figure 3	4.5 to 6.0		1	1.5	s
2.5 to 6.0					1	3		

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

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3. Electrical characteristics / Ta=-30 to +70°C, VSS = 0 V

Parameter	Symbol	Pins	Conditions	Limits				unit
				VDD [v]	min.	typ.	max.	
Input high current	IIH(1)	•Port 1 •Port 0 without pullup MOS Tr.	•Output disable •Pullup MOS Tr. OFF. VIN=VDD (including off-leak current of output Tr.)	2.5 to 6.0			1	μA
	IIH(2)	•Port 7 without pullup MOS Tr. •Port 8	VIN=VDD	2.5 to 6.0			1	
	IIH(3)	•RES	VIN=VDD	2.5 to 6.0			1	
Input low current	IIL(1)	•Port 1 •Port 0 without pullup MOS Tr.	•Output disable •Pullup MOS Tr. OFF. VIN=VSS (including off-leak current of output Tr.)	2.5 to 6.0	-1			
	IIL(2)	•Port 7 without pullup MOS Tr. •Port 8	VIN=VSS	2.5 to 6.0	-1			
	IIL(3)	•RES	VIN=VSS	2.5 to 6.0	-1			
Output high voltage	VOH(1)	CMOS output of ports 0,1	IOH=-1.0mA	4.5 to 6.0	VDD-1			V
	VOH(2)		IOH=-0.1mA	2.5 to 6.0	VDD-0.5			
	VOH(3)	S0/T0 - S15/T15	IOH=-20mA	4.5 to 6.0	VDD-1.8			
	VOH(4)		•IOH=-1.0mA •The current of any unmeasurement pin is not over 1 mA.	2.5 to 6.0	VDD-1			
	VOH(5)	S16 - S29	IOH=-5mA	4.5 to 6.0	VDD-1.8			
	VOH(6)		•IOH=-1.0mA •The current of any unmeasurement pin is not over 1 mA.	2.5 to 6.0	VDD-1			

Parameter	Symbol	Pins	Conditions	Limits				unit
				VDD [v]	min.	typ.	max.	
Output low voltage	VOL(1)	Ports 0,1	IOL=10mA	4.5 to 6.0			1.5	V
	VOL(2)		•IOL=1.6mA •The total current of port 0,1 is not over 40 mA.	4.5 to 6.0			0.4	
	VOL(3)		•IOL=1.0mA •The current of any unmeasurement pin is not over 1 mA.	2.5 to 6.0			0.4	
	VOL(4)	Port 70	IOL=1mA	4.5 to 6.0			0.4	
	VOL(5)		IOL=0.5mA	2.5 to 6.0			0.4	
Pullup MOS Tr. resistor	Rpu	•Ports 0,1 •Port 7	VOH=0.9 VDD	4.5 to 6.0	15	40	70	kΩ
			VOH=0.9 VDD	2.5 to 4.5	25	60	120	
Output off-leakage current	IOFF(1)	•S0/T0 - S6/T6 •S16 - S29 (Without pull-down resistor)	•Output P-channel Tr. OFF. •VOUT=VSS	2.5 to 6.0	-1			μA
	IOFF(2)		•Output P-channel Tr. OFF. •VOUT=VDD-40V	2.5 to 6.0	-30			
Pulldown transistor resistor	Rpd	•S0/T0 - S15/T15 •S16 - S29 (With pull down resistor)	•Output P-channel Tr. OFF. •VOUT=3 V •Vp=-30 V	5.0	60	100	200	kΩ
Hysteresis voltage	VHIS	•Ports 0,1 •Port 7 •RES	•Output disable	2.5 to 6.0		0.1VDD		V
Pin capacitance	CP	All pins.	•f=1MHz •Unmeasurement terminals for input are set to VSS level. •Ta=25°C	2.5 to 6.0		10		pF

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4. Serial input/output characteristics / Ta=-30 to +70°C, VSS = 0 V

Parameter		Symbol	Pins	Conditions	Limits				unit
					VDD [v]	min.	typ.	max.	
Serial clock	Input clock	Cycle	TCKCY(1)	SCK0,SCK1	Refer to figure 5	2.5 to 6.0	2		Tcyc
		Low level pulse width	TCKL(1)			2.5 to 6.0	1		
		High level pulse width	TCKH(1)			2.5 to 6.0	1		
	Output clock	Cycle	TCKCY(2)	SCK0,SCK1	<ul style="list-style-type: none"> •Use pullup resistor (1kΩ) when open drain output. •Refer to figure 5 	2.5 to 6.0	2		
		Low level pulse width	TCKL(2)			2.5 to 6.0		1/2Tckcy	
		High level pulse width	TCKH(2)			2.5 to 6.0		1/2Tckcy	
Serial input	Data set up time	TICK	<ul style="list-style-type: none"> •SI0,SI1 •SB0,SB1 	<ul style="list-style-type: none"> •Data set-up to SCK0,1 •Data hold from SCK0,1 •Refer to figure 5 	4.5 to 6.0	0.1		μs	
	Data hold time	TCKI			2.5 to 6.0	0.4			
Serial output	Output delay time (Serial clock is extrnal clock)	TCKO(1)	<ul style="list-style-type: none"> •SO0,SO1 •SB0,SB1 	<ul style="list-style-type: none"> •Use pullup resistor (1kΩ) when open drain output. 	4.5 to 6.0			7/12Tcyc +0.2	
					2.5 to 6.0			7/12Tcyc +1	
	Output delay time (Serial clock is internal clock)	TCKO(2)		<ul style="list-style-type: none"> •Data hold from SCK0,1 •Refer to figure 5 	4.5 to 6.0			1/3Tcyc +0.2	
					2.5 to 6.0			1/3Tcyc +1	

5. Pulse input conditions / Ta=-30 to +70°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/T0IN	•Interrupt acceptable •Timer0-countable	2.5 to 6.0	1			Tcyc
	TPIH(2) TPIL(2)	•INT3/T0IN (The noise rejection clock select to 1/1.)	•Interrupt acceptable •Timer0-countable	2.5 to 6.0	2			
	TPIH(3) TPIL(3)	•INT3/T0IN (The noise rejection clock select to 1/64.)	•Interrupt acceptable •Timer0-countable	2.5 to 6.0	128			
	TPIL(4)	•RES	Reset acceptable	2.5 to 6.0	200			μs

6. AD converter characteristics / Ta=-30 to +70°C, VSS = 0 V

Parameter	Symbol	Pins	Conditions	Limits				
				VDD [v]	min.	typ.	max.	unit
Resolution	N			4.5 to 6.0		8		bit
Absolute precision	ET		Note 2	4.5 to 6.0			± 1.5	LSB
Conversion time	TCAD		AD conversion time=16xTcyc (ADCR2=0) Note 3	4.5 to 6.0	15.68 (Tcyc=0.98μs)		65.28 (Tcyc=4.08μs)	μs
			AD conversion time=32xTcyc (ADCR2=1) Note 3					
Analog input voltage range	VAIN	AN0 - AN3		4.5 to 6.0	VSS		VDD	V
Analog port input current	IAINH		VAIN=VDD	4.5 to 6.0			1	μA
	IAINL		VAIN=VSS	4.5 to 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 instructions to start conversion.

7. Current dissipation characteristics / Ta=-30 to +70°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"> •FmCF=12MHz Ceramic resonator oscillation. •FsXtal=32.768 kHz crystal oscillation. •System clock : CF oscillation. •Internal RC oscillation stops. 	4.5 to 6.0		10	20	mA	
	IDDOP(2)		<ul style="list-style-type: none"> •FmCF=3MHz Ceramic resonator oscillation. •FsXtal=32.768 kHz crystal oscillation. •System clock : CF oscillation . •Internal RC oscillation stops. 	4.5 to 6.0		3	9		
	IDDOP(3)		RC oscillation stops.	2.5 to 4.5		1.5	5		
	IDDOP(4)		<ul style="list-style-type: none"> •FmCF=0Hz (when oscillation stops). •FsXtal=32.768 kHz crystal oscillation. •System clock : RC oscillation. 	4.5 to 6.0		0.7	2.3		
	IDDOP(5)		RC oscillation.	2.5 to 4.5		0.4	1.6		
	IDDOP(6)		<ul style="list-style-type: none"> •FmCF=0Hz (when oscillation stops). •FsXtal=32.768 kHz crystal oscillation. •System clock : Xtal oscillation. •Internal RC oscillation stops. 	4.5 to 6.0		35	130		μA
	IDDOP(7)		oscillation stops.	2.5 to 4.5		15	70		

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 to 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 to 6.0		2.2	7.4	
	IDDHALT(3)		oscillation stops.	2.5 to 4.5		0.8	3.6	
	IDDHALT(4)		•HALT mode FmCF=0Hz (when oscillation stops). •FsXtal=32.768 kHz crystal oscillation. •System clock : RC oscillation.	4.5 to 6.0		400	1100	μA
	IDDHALT(5)		RC oscillation.	2.5 to 4.5		200	700	
	IDDHALT(6)		•HALT mode FmCF=0Hz (when oscillation stops). •FsXtal=32.768 kHz crystal oscillation. •System clock : Xtal oscillation. •Internal RC oscillation stops.	4.5 to 6.0		25	100	
	IDDHALT(7)		oscillation stops.	2.5 to 4.5		8	55	
Current dissipation HOLD Note 4	IDDHOLD(1)	VDD	HOLD mode	4.5 to 6.0		0.05	30	
	IDDHOLD(2)			2.5 to 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
		CST3.00MGW	on chip	
	Kyocera	KBR-3.0MS	47pF	47pF

•Both C1 and C2 must be K rank ($\pm 10\%$) capacitors with 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 J rank ($\pm 5\%$) capacitors with CH characteristics.

(In the application which is not required of high-precision, use K rank ($\pm 10\%$) and SL characteristics.)

- Note
- Place the oscillation-related parts as close to the oscillation pins as possible with the shortest pattern length since the circuit pattern affects the oscillation frequency.
 - If you use the oscillators except above, we provide no guarantee for specifications herein.

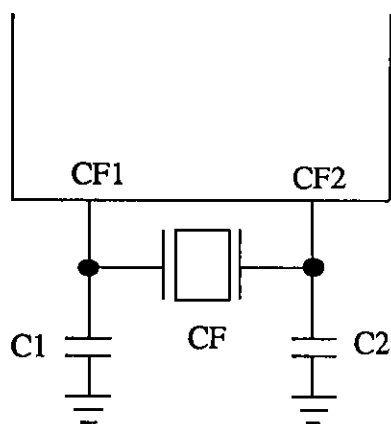


Figure 1 Main-clock circuit
Ceramic resonator oscillation

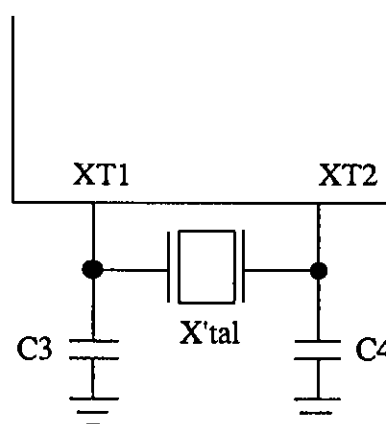


Figure 2 Sub-clock circuit
Crystal oscillation

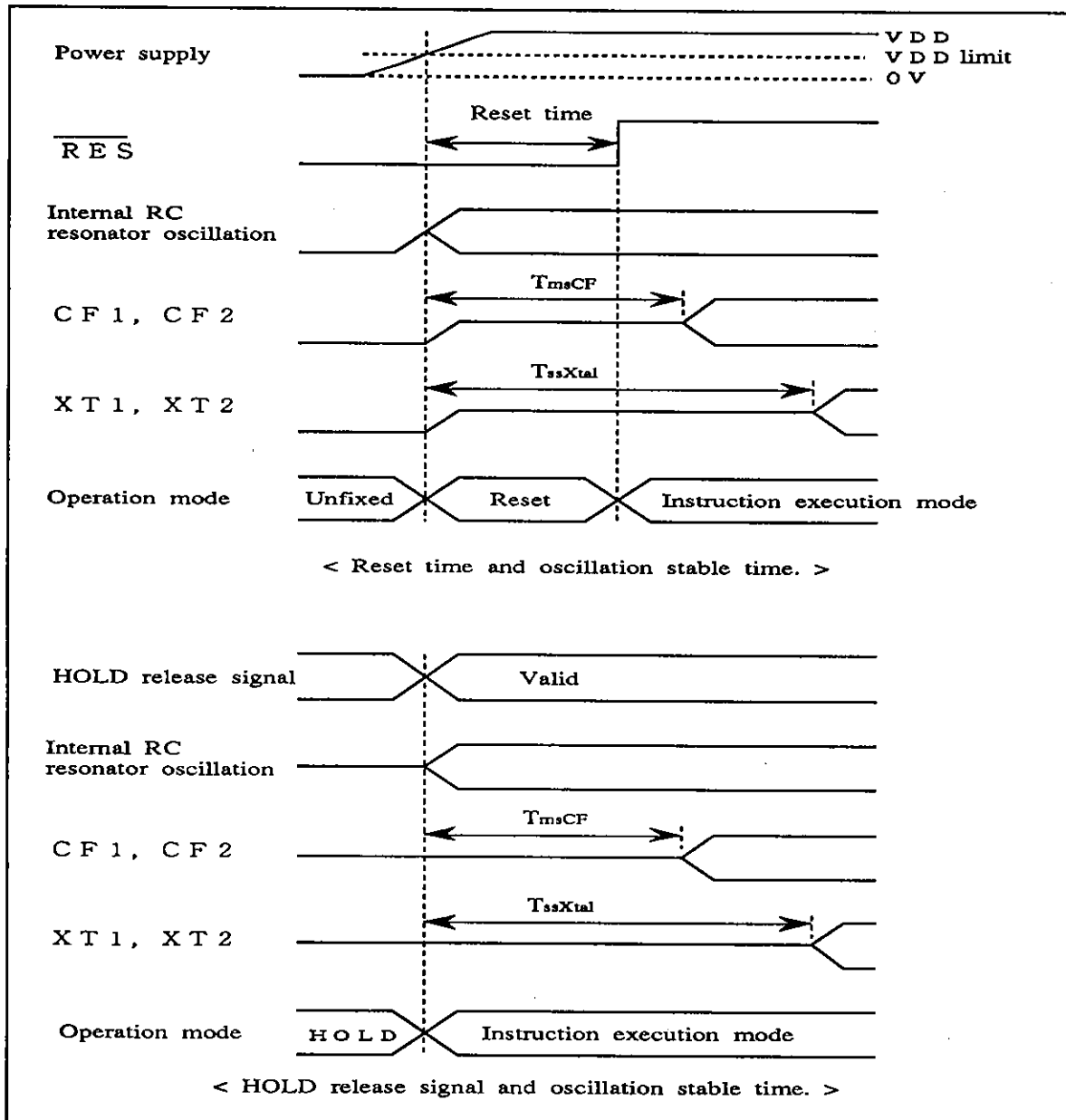
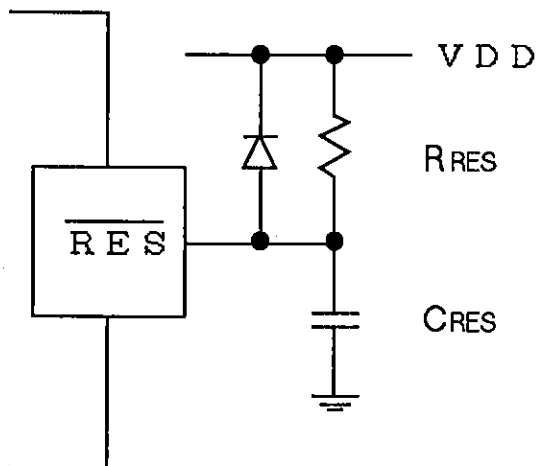
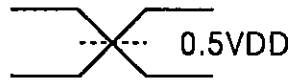


Figure 3 Oscillation stable time

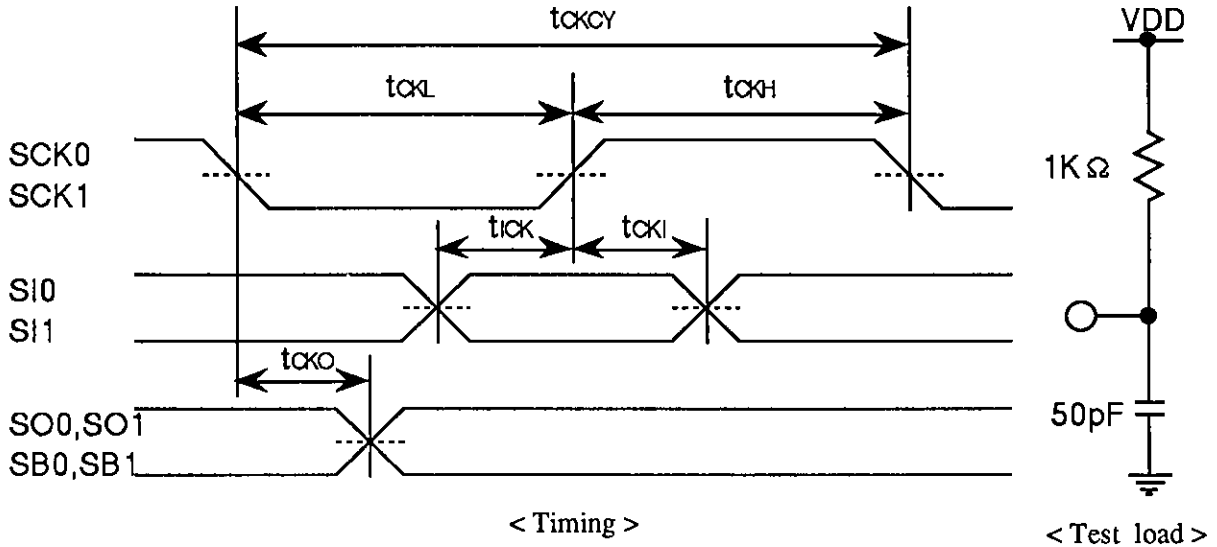


(Note) Fix the value of CRES,RRES that is sure to reset until $200\mu s$, after Power supply has been over inferior limit of supply voltage.

Figure 4 Reset circuit



< AC timing point >



< Timing >

< Test load >

Figure 5 Serial input/output test condition

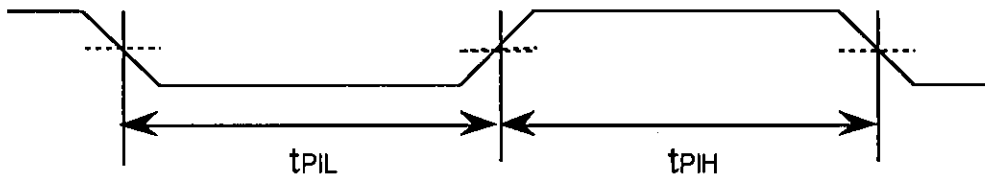


Figure 6 Pulse input timing condition

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