



# LC8766C8A/B2A/96A

## 8-Bit Single Chip Microcontroller

### Preliminary

### Overview

The LC8766C8A/LC8766B2A/LC876696A are 8 bit single chip microcontrollers with the following on-chip functional blocks :

- CPU: operable at a minimum bus cycle time of 100ns
- On-chip ROM Maximum Capacity :
 

LC8766C8A	128K bytes
LC8766B2A	112K bytes
LC876696A	96K bytes
- On-chip RAM: 4096 bytes
- VFD automatic display controller / driver
- 16 bit timer / counter (can be divided into two 8 bit timers)
- 16 bit timer / PWM (can be divided into two 8 bit timers)
- timer for use as date / time clock
- High speed clock counter
- System clock divider function
- synchronous serial I/O port (with automatic block transmit / receive function)
- asynchronous / synchronous serial I/O port
- 12-channel × 8-bit AD converter
- Weak signal detector
- 15-source 10-vectored interrupt system

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

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## Features

- (1) Read-Only Memory (ROM): LC8766C8A      131072 × 8 bits  
    LC8766B2A      114688 × 8 bits  
    LC876696A      98304 × 8 bits
- (2) Random Access Memory (RAM): LC8766C8A/B2A/96A      4096 × 9 bits
- (3) Minimum Bus Cycle Time: 100ns (10MHz)  
       Note: The bus cycle time indicates ROM read time.
- (4) Minimum Instruction Cycle Time: 300ns (10MHz)
- (5) Ports
  - Input/output ports  
       Data direction programmable for each bit individually :      20 (P1n, P70 to P73, P8n)
  - 15V withstand input/output ports  
       Data direction programmable in nibble units :      8 (P0n)  
       (When N-channel open drain output is selected, data can be input in bit units.)  
       Data direction programmable for each bit individually :      8 (P3n)
  - Input ports :      2 (XT1, XT2)
  - VFD output ports  
       Large current outputs for digits :      9 (S0 / T0 to S8 / T8)  
       Large current outputs for digits / segments :      7 (S9 / T9 to S15 / T15)  
       digit / segment outputs :      8 (S16 to S23)  
       segment outputs :      28 (S24 to S51)
  - Other functions  
       Input/output ports :      12 (PFn, PG0 to 3)  
       Input ports :      24 (PCn, PDn, PEn)
  - Oscillator pins :      2 (CF1, CF2)
  - Reset pin :      1 (RES#)
  - Power supply :      6 (VSS1 to 2, VDD1 to 4)
  - VFD power supply :      1 (VP)
- (6) VFD automatic display controller
  - Programmable segment/digit output pattern  
       Output can be switched between digit/segment waveform output (pins 9 to 24 can be used for output of digit waveforms).  
       parallel-drive available for large current VFD.
  - 16-step dimmer function available
- (7) Weak signal detection (MIC signals etc)
  - Counts pulses with width greater than a preset value
  - 2 bit counter
- (8) Timers
  - Timer 0: 16 bit timer / counter with capture register  
       Mode 0: 2 channel 8-bit timer with programmable 8 bit prescaler and 8 bit capture register  
       Mode 1: 8 bit timer with 8 bit programmable prescaler and 8 bit capture register + 8 bit  
               Counter with 8-bit capture register  
       Mode 2: 16 bit timer with 8 bit programmable prescaler and 16 bit capture register  
       Mode 3: 16 bit counter with 16 bit capture register
  - Timer 1: PWM / 16 bit timer toggle output  
       Mode 0: 2 channel 8 bit timer (with toggle output)  
       Mode 1: 2 channel 8 bit PWM  
       Mode 2: 16 bit timer (with toggle output) Toggle output also possible using lower order 8 bits.  
       Mode 3: 16 bit timer (with toggle output) Lower order 8 bits can be used as PWM output.

- Base Timer
  - 1) The clock signal can be selected from any of the following :  
Sub-clock (32.768kHz crystal oscillator), system clock, and prescaler output from timer 0
  - 2) Interrupts can be selected to occur at one of five different times.
- (9) High speed clock counter
  - 1) Capable of counting maximum: 20MHz clock (Using main clock 10MHz)
  - 2) Real time output
- (10) Serial-interface
  - SIO 0: 8 bit synchronous serial Interface
    - 1) LSB first / MSB first function available
    - 2) Internal 8 bit baud-rate generator (maximum transmit clock period 4 / 3 Tcyc)
    - 3) Continuous automatic data communication (1-256 bits)
  - SIO 1: 8 bit asynchronous / synchronous serial interface
    - Mode 0: Synchronous 8 bit serial IO (2-wire or 3-wire, transmit clock 2–512 Tcyc)
    - Mode 1: Asynchronous serial IO (half duplex, 8 data bits, 1 stop bit, baud rate 8–2048Tcyc)
    - Mode 2: Bus mode 1 (start bit, 8 data bits, transmit clock 2–512 Tcyc)
    - Mode 3: Bus mode 2 (start detection, 8 data bits, stop detection)
- (11) AD converter
  - 8 bits × 12 channels
- (12) Remote control receiver circuit (connected to P73 / INT3 / T0IN terminal)
  - Noise rejection function (noise rejection filter time constant can selected from 1 / 32 / 128 Tcyc)
- (13) Watchdog timer
  - The watching timer period is set using an external RC.
  - Watchdog timer can produce interrupt, system reset
- (14) Interrupts: 15-source, 10-vector interrupts
  - 1) Three priority (low, high and highest) multiple interrupts are supported. During interrupt handling, an equal or lower priority interrupt request is refused.
  - 2) If interrupt requests to two or more vector addresses occur at once, the higher priority interrupt takes precedence. In the case of equal priority levels, the vector with the lowest address takes precedence.
- (15) Subroutine stack levels: 2048 levels max. Stack is located in RAM.
- (16) Multiplication and division
  - 16 bit × 8 bit (executed in 5 cycles)
  - 24 bit × 16 bit (12 cycles)
  - 16 bit ÷ 8 bit (8 cycles)
  - 24 bit ÷ 16 bit (12 cycles)
- (17) Oscillation circuits
  - On-chip RC oscillation circuit for system clock use.
  - On-chip CF oscillation circuit for system clock use. (R<sub>f</sub> built in)
  - On-chip Crystal oscillation circuit low speed system clock use. (R<sub>d</sub>, R<sub>f</sub> external)
- (18) System clock divider function
  - Able to reduce current consumption
    - Available minimum instruction cycle time: 300ns, 600ns, 1.2μs, 4.8μs, 9.6μs, 19.2μs, 38.4μs, 76.8μs.
    - (Using 10MHz main clock)

(19) Standby function

- HALT mode

HALT mode is used to reduce power consumption. Program execution is stopped. Peripheral circuits still operate but VFD display and some serial transfer operations stop.

- 1) Oscillation circuits are not stopped automatically.
- 2) Release occurs on system reset or by interrupt.

-HOLD mode

HOLD mode is used to reduce power consumption. Both program execution and peripheral circuits are stopped.

- 1) CF, RC and crystal oscillation circuits stop automatically.
- 2) Release occurs on any of the following conditions.
  - (1) input to the reset pin goes low
  - (2) a specified level is input at least one of INT0, INT1, INT2
  - (3) an interrupt condition arises at port 0

-X'tal HOLD mode

X'tal HOLD mode is used to reduce power consumption. Program execution is stopped.

All peripheral circuits except the base timer are stopped.

- 1) CF and RC oscillation circuits stop automatically.
- 2) Crystal oscillator is maintained in its state at HOLD mode inception.
- 3) Release occurs on any of the following conditions
  - (1) input to the reset pin goes low
  - (2) a specified level is input to at least one of INT0, INT1, INT2
  - (3) an interrupt condition arises at port 0
  - (4) an interrupt condition arises at the base-timer

(20) Factory shipment

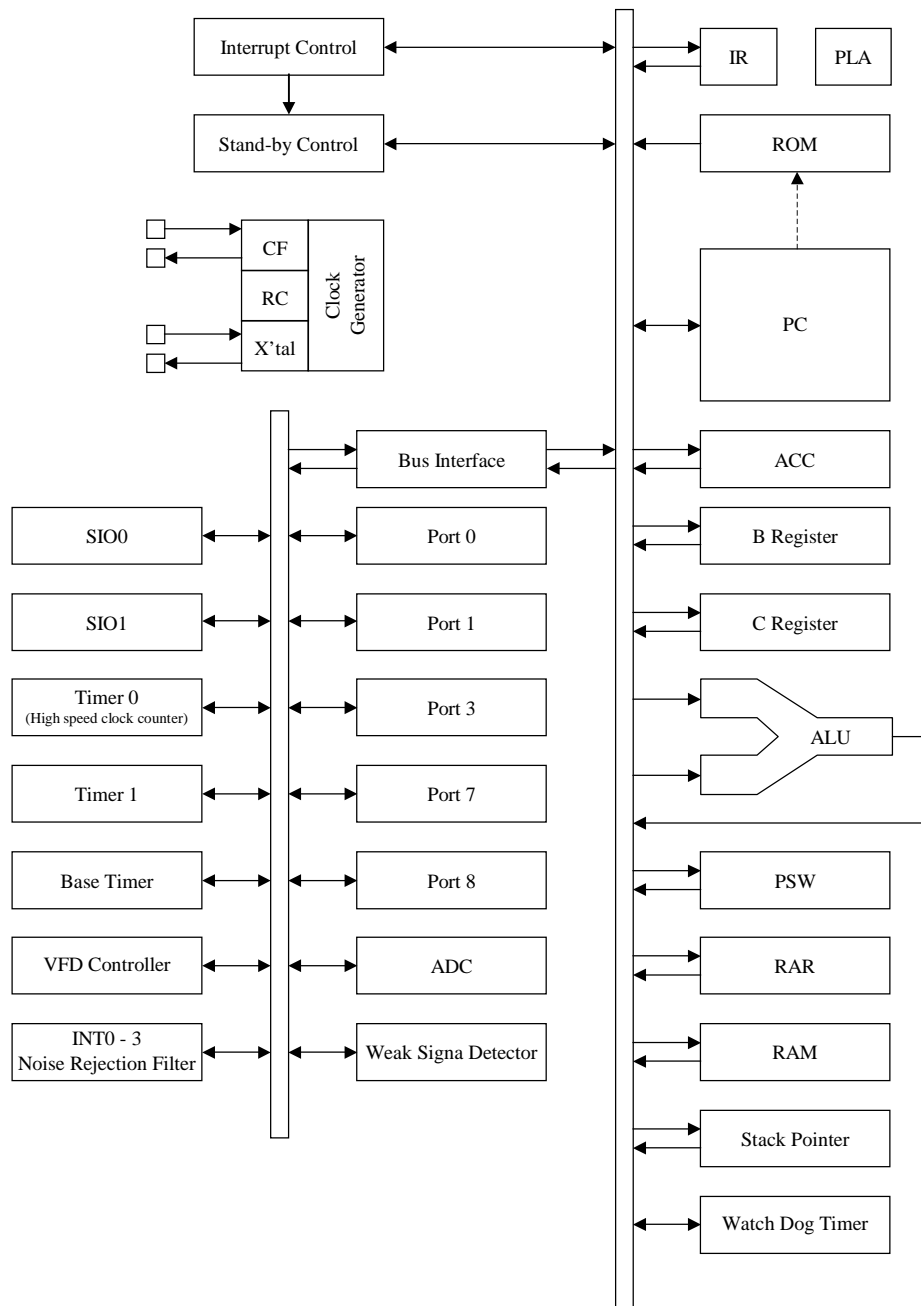
-delivery form QIP100E

(21) Development tools

- Evaluation chip: LC876095
- Emulator: EVA62S + ECB876600 (Evaluation chip board) + SUB876500 + POD100QFP
- Flash ROM version: LC87F66C8A



## System Block Diagram



## Pin Assignment

Pin name	I/O	Function	Option																														
VSS1 VSS2	-	• Power supply (-)	No																														
VDD1 VDD2 VDD3 VDD4	-	• Power supply (+)	No																														
VP	-	• Power supply (-)	No																														
PORT0 P00 to P07	I/O	• 8bit input/output port • data direction programmable in nibble units • Use of pull-up resistor can be specified in nibble units • Input for HOLD release • Input for port 0 interrupt • 15V withstand at N-channel open drain output	Yes																														
PORT1 P10 to P17	I/O	• 8bit input/output port • data direction programmable for each bit • Use of pull-up resistor can be specified for each bit • 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: Timer 1 PWML output P17: Timer 1 PWMH output/Buzzer output	Yes																														
PORT3 P30 to P33	I/O	• 8bit Input/output port • Data direction can be specified for each bit • Use of pull-up resistor can be specified for each bit • 15V withstand at N-channel open drain output	Yes																														
PORT7 P70 to P73	I/O	• 4bit Input/output port • Data direction can be specified for each bit • Use of pull-up resistor can be specified for each bit • Other functions P70: INT0 input/HOLD release input/Timer0L capture Input/output for watchdog timer P71: INT1 input/HOLD release input/Timer0H capture input P72: INT2 input/HOLD release input/timer 0 event input/Timer0L capture input/High speed clock counter input P73: INT3 input(noise rejection filter attached input)/timer 0 event input/Timer 0H capture input AD input port: AN8(P70), AN9(P71) The following types of interrupt detection are possible: <table><tr><td></td><td>Rising</td><td>Falling</td><td>Rising/ falling</td><td>H level</td><td>L level</td></tr><tr><td>INT0</td><td>Yes</td><td>Yes</td><td>No</td><td>Yes</td><td>Yes</td></tr><tr><td>INT1</td><td>Yes</td><td>Yes</td><td>No</td><td>Yes</td><td>Yes</td></tr><tr><td>INT2</td><td>Yes</td><td>Yes</td><td>Yes</td><td>No</td><td>No</td></tr><tr><td>INT3</td><td>Yes</td><td>Yes</td><td>Yes</td><td>No</td><td>No</td></tr></table>		Rising	Falling	Rising/ falling	H level	L level	INT0	Yes	Yes	No	Yes	Yes	INT1	Yes	Yes	No	Yes	Yes	INT2	Yes	Yes	Yes	No	No	INT3	Yes	Yes	Yes	No	No	No
	Rising	Falling	Rising/ falling	H level	L level																												
INT0	Yes	Yes	No	Yes	Yes																												
INT1	Yes	Yes	No	Yes	Yes																												
INT2	Yes	Yes	Yes	No	No																												
INT3	Yes	Yes	Yes	No	No																												

Pin name	I/O	Function description	Option
PORT8 P80 to P87	I/O	<ul style="list-style-type: none"> <li>• 8bit Input/output port</li> <li>• Input/output can be specified in a bit unit</li> <li>• Other functions: AD input port: AN0 to AN7 Weak signal detector input port: MICIN(P87)</li> </ul>	No
S0/T0 to S6/T6	O	• Large current output for VFD display controller digit (can be used for segment)	Yes
S7/T7 to S8/T8	O	• Large current output for VFD display controller digit (can be used for segment)	No
S9/T9 to S15/T15	O	• Large current output for VFD display controller segment/digit	No
S16 to S23	I/O	<ul style="list-style-type: none"> <li>• Output for VFD display controller segment/digit</li> <li>• Other functions: High voltage input port: PC0 to PC7</li> </ul>	No
S24 to S31	I/O	<ul style="list-style-type: none"> <li>• Output for VFD display controller segment</li> <li>• Other functions: High voltage input port: PD0 to PD7</li> </ul>	No
S32 to S39	I/O	<ul style="list-style-type: none"> <li>• Output for VFD display controller segment</li> <li>• Other functions: High voltage input port: PE0 to PE7</li> </ul>	Yes
S40 to S47	I/O	<ul style="list-style-type: none"> <li>• Output for VFD display controller segment</li> <li>• Other functions: High voltage input/output port: PF0 to PF7</li> </ul>	Yes
S48 to S51	I/O	<ul style="list-style-type: none"> <li>• Output for VFD display controller segment</li> <li>• Other functions: High voltage input/output port: PG0 to PG3</li> </ul>	No
$\overline{\text{RES}}$	I	Reset terminal	No
XT1	I	<ul style="list-style-type: none"> <li>• Input for 32.768kHz crystal oscillation</li> <li>• Other functions: General purpose input port When not in use, connect to VDD1. AD input port: AN10</li> </ul>	No
XT2	I/O	<ul style="list-style-type: none"> <li>• Output for 32.768kHz crystal oscillation</li> <li>• Other functions: General purpose input port When not in use, set to oscillation mode and leave open circuit. AD input port: AN11</li> </ul>	No
CF1	I	Input terminal for ceramic oscillator	No
CF2	O	Output terminal for ceramic oscillator	No



## Port Output Configuration

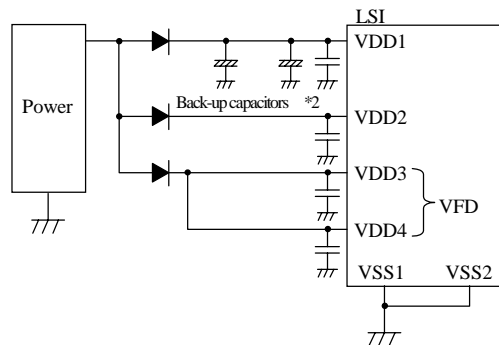
Output configuration and pull-up/pull-down resistor options are shown in the following table.  
Input /output is possible even when port is set to output mode.

Terminal	Option applies to:	Options	Output Format	Pull-up resistor	Pull-down resistor
P00 to P07	1 bit units	1	CMOS	Programmable (Note 1)	-
		2	15 voltage Nch-open drain	None	-
P10 to P17	each bit	1	CMOS	Programmable	-
		2	Nch-open drain	Programmable	-
P30 to P37	each bit	1	CMOS	Programmable	-
		2	15V Nch-open drain	None	-
P70	-	None	Nch-open drain	Programmable	-
P71 to P73	-	None	CMOS	Programmable	-
P80 to P87	-	None	Nch-open drain	None	-
S0/T0 to S6/T6	each bit	1	High voltage Pch-open drain	-	Fixed
		2	High voltage Pch-open drain	-	None
S7/T7 to S15/T15 S16 to S31	-	None	High voltage Pch-open drain	-	fixed
S32 to S47	each bit	1	High voltage Pch-open drain	-	Fixed
		2	High voltage Pch-open drain	-	None
S48 to S51	-	None	High voltage Pch-open drain	-	None
XT1	-	None	Input only	None	-
XT2	-	None	Output for 32.768kHz crystal oscillation	None	-

Note 1 Programmable pull-up resistors of Port 0 can be attached in nibble units (P00-03, P04-07).

\* Note 1: Connect as follows to reduce noise on VDD and increase the back-up time.  
VSS1, and VSS2 must be connected together and grounded.

\*Note 2 : The power supply for the internal memory is VDD1 but it uses the VDD2 as the power supply for ports. When the VDD2 is not backed up, the port level does not become “H” even if the port latch is in the “H” level. Therefore, when the VDD2 is not backed up and the port latch is “H” level, the port level is unstable in the HOLD mode, and the back up time becomes shorter because the through current runs from VDD to GND in the input buffer.  
If VDD2 is not backed up, output “L” by the program or pull the port to “L” by the external circuit in the HOLD mode so that the port level becomes “L” level and unnecessary current consumption is prevented.



## 1. Absolute Maximum Ratings at Ta=25°C and VSS1=VSS2=0V

Parameter		Symbol	Pins	Conditions	VDD[V]	Ratings			unit
						min.	typ.	max.	
Supply voltage		VDDMAX	VDD1,VDD2, VDD3,VDD4	VDD1=VDD2= VDD3=VDD4		-0.3		+7.0	V
Input voltage		VI(1)	XT1,XT2,CF1, $\overline{\text{RES}}$			-0.3		VDD+0.3	
		VI(2)	VP			VDD-45		VDD+0.3	
Output voltage		VO(1)	S0/T0 to S15/T15			VDD-45		VDD+0.3	
Input/Output voltage		VIO(1)	•Port 0: CMOS output option •Port 1 •Port 3: CMOS output option •Port 7 •Port 8			-0.3		VDD+0.3	
		VIO(2)	•Port 0 open drain •Port 3 open drain			-0.3		15	
		VIO(3)	S16 to S51			VDD-45		VDD+0.3	
High level output current	Peak output current	IOPH(1)	Port 0, 1, 3	•CMOS output selected •Current at each pin		-10			mA
		IOPH(2)	Port71,72,73	Current at each pin		-3			
		IOPH(3)	S0/T0 to S15/T15	Current at each pin		-30			
		IOPH(4)	S16 to S51	Current at each pin		-15			
	Total output current	$\Sigma$ IOAH(1)	Port 0	Total of all pins		-30			
		$\Sigma$ IOAH(2)	Port 1,3	Total of all pins		-30			
		$\Sigma$ IOAH(3)	Port 7	Total of all pins		-5			
		$\Sigma$ IOAH(4)	S0/T0 to S15/T15	Total of all pins		-65			
		$\Sigma$ IOAH(5)	S16 to S27	Total of all pins		-60			
		$\Sigma$ IOAH(6)	S28 to S39	Total of all pins		-60			
		$\Sigma$ IOAH(7)	S40 to S51	Total of all pins		-60			
Low level output current	Peak output current	IOPL(1)	Port 02,03	For each pin				30	
		IOPL(2)	•Port 00,01,04 to 07 •Port 1,3	For each pin				20	
		IOPL(3)	Port 7,8	For each pin				5	
	Total output current	$\Sigma$ IOAL(1)	Port 00,01,02,03	For each pin				60	
		$\Sigma$ IOAL(2)	•Port 04,05,06,07 •Port 1,3	For each pin				50	
		$\Sigma$ IOAL(3)	Ports 7,8	For each pin				20	
Maximum power dissipation		Pdmax	QIP100E	Ta = -30 to+70°C				450	mW
Operating temperature range		Topr				-30		70	°C
Storage temperature range		Tstg				-55		125	

## 2. Recommended Operating Range at Ta=-30°C to +70°C, VSS1=VSS2=0V

Parameter	Symbol	Pins	Conditions	VDD[V]	Ratings			unit
					min.	typ.	max.	
Operating supply voltage range	VDD(1)	VDD1=VDD2=VDD3=VDD4	0.294μs ≤ Tcyc ≤ 200μs		4.5		6.0	V
Hold voltage	VHD	VDD1	RAM and the register data are kept in HOLD mode.		2.0		6.0	
Pull-down voltage	VP	VP		4.5–6.0	-35		VDD	
Input high voltage	VIH(1)	•Port 0,3: CMOS output option •Port 8	Output disable	4.5–6.0	0.3VDD+0.7		VDD	
	VIH(2)	Port 0,3: N-ch open drain output	Output disable	4.5–6.0	0.3VDD+0.7		13.5	
	VIH(3)	•Port 1 •Port71,72,73 •P70 port input/interrupt	Output disable	4.5–6.0	0.3VDD+0.7		VDD	
	VIH(4)	S16 to S51	Output P-channel Tr. OFF	4.5–6.0	0.3VDD+1.0		VDD	
	VIH(5)	P70 Weak signal input	Output disable	4.5–6.0	0.75VDD		VDD	
	VIH(6)	Port 70 Watchdog timer	Output disable	4.5–6.0	0.9VDD		VDD	
	VIH(7)	XT1, XT2, CF1, $\overline{RES}$		4.5–6.0	0.75VDD		VDD	
Input low voltage	VIL(1)	•Port 0,3: CMOS output option •Port 8	Output disable	4.5–6.0	VSS		0.15VDD+0.4	
	VIL(2)	Port 0,3: N-ch open drain output	Output disable	4.5–6.0	VSS		0.15VDD+0.4	
	VIL(3)	•Port 1 •Port 71,72,73 •P70 port input/interrupt	Output disable	4.5–6.0	VSS		0.1VDD+0.4	
	VIL(4)	S16 to S51	Output P-channel Tr. OFF	4.5–6.0	-35		0.2VDD	
	VIL(5)	Port 87 weak signal input	Output disabled	4.5–6.0	VSS		0.25VDD	
	VIL(6)	Port 70 Watchdog timer	Output disabled	4.5–6.0	VSS		0.8VDD-1.0	
	VIL(7)	XT1,XT2,CF1, $\overline{RES}$		4.5–6.0	VSS		0.25VDD	
Operation cycle time	tCYC			4.5–6.0	0.294		200	μs
External system clock frequency	fEXCF(1)	CF1	•CF2 open circuit •system clock divider set to 1/1 •external clock DUTY = 50±50%	4.5–6.0	0.1		10	MHz
			•CF2 open circuit •system clock divider set to 1/2	4.5–6.0	0.2		20	

Continued

Parameter	Symbol	Pins	Conditions	Ratings				unit
				VDD[V]	min.	typ.	max.	
Oscillation stabilizing time period (Note 1)	FmCF(1)	CF1, CF2	10MHz ceramic resonator oscillation Refer to figure 1	4.5–6.0		10		
	FmCF(2)	CF1, CF2	4MHz ceramic resonator oscillation Refer to figure 1	4.5–6.0		4		
	FmRC		RC oscillation	4.5–6.0	0.3	1.0	2.0	
	FsX'tal	XT1, XT2	32.768kHz crystal resonator oscillation Refer to figure 2	4.5–6.0		32.768		

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

## 3. Electrical Characteristics at Ta=-30°C to +70°C, VSS1=VSS2=0V

Parameter	Symbol	Pins	Conditions	Ratings				unit
				VDD[V]	min.	typ.	max.	
Input high current	IIH(1)	Ports 0,3: N-ch open drain output	•Output disabled •VIN=13.5V (including OFF state leak current of the output Tr.)	4.5–6.0			5	μA
	IIH(2)	Port 0,1,3,7,8	•Output disabled •Pull-up resistor OFF. •VIN=VDD (including OFF state leak current of the output Tr.)	4.5–6.0			1	
	IIH(3)	S16 to S51 without pull-down resistor (Port C,D,E,F,G)	When configured as an input port VIN=VDD	4.5–6.0			60	
	IIH(4)	$\overline{\text{RES}}$	VIN=VDD	4.5–6.0			1	
	IIH(5)	XT1,XT2	When configured as an input port VIN=VDD	4.5–6.0			1	
	IIH(6)	CF1	VIN=VDD	4.5–6.0			15	
	IIH(7)	P87/AN7/MICIN weak signal input	VIN=VBIS+0.5V (VBIS : Bias voltage)	4.5–6.0	4.2	8.5	15	
Input low current	IIL(1)	Port 0,1,3,7,8	•Output disabled •VIN=VSS (including OFF state leak current of the output Tr.)	4.5–6.0	-1			
	IIL(2)	$\overline{\text{RES}}$	VIN=VSS	4.5–6.0	-1			
	IIL(3)	XT1,XT2	When configured as an input port VIN=VSS	4.5–6.0	-1			
	IIL(4)	CF1	VIN=VSS	4.5–6.0	-15			
	IIL(5)	P87/AN7/MICIN weak signal input	VIN=VBIS-0.5V (VBIS : Bias voltage)	4.5–6.0	-15	-8.5	-4.2	
Output high voltage	VOH(1)	Port 0,1,3: CMOS output option	IOH=-1.0mA	4.5–6.0	VDD-1			V
	VOH(2)		IOH=-0.1mA	4.5–6.0	VDD-0.5			
	VOH(3)	Port 7	IOH=-0.4mA	4.5–6.0	VDD-1			
	VOH(4)	S0/T0–S15/T15	IOH=-20.0mA	4.5–6.0	VDD-1.8			
	VOH(5)		IOH=-1.0mA IOH at any single pin is not over 1mA.	4.5–6.0	VDD-1			
	VOH(6)	S2+ to S51	IOH=-5.0mA	4.5–6.0	VDD-1.8			
	VOH(7)		IOH=-1.0mA IOH at any single pin is not over 1mA.	4.5–6.0	VDD-1			
Output low voltage	VOL(1)	Port 02, 03	IOL=30mA	4.5–6.0			1.5	
	VOL(2)	Port 0,1,3	IOL=10mA	4.5–6.0			1.5	
	VOL(3)		IOL=1.6mA	4.5–6.0			0.4	
Pull-up resistor	Rpu	Port 0,1,3,7	VOH=0.9VDD	4.5–6.0	15	40	70	kΩ

Continued

Parameter	Symbol	Pins	Conditions	Ratings				unit
				VDD[V]	min.	typ.	max.	
Output off-leak current	IOFF(1)	S0/T0 to S15/T15, S16 to S51 without pull-down resistor	•Output P-ch Tr. OFF •VOUT=VSS	4.5–6.0	-1			$\mu\text{A}$
	IOFF(2)		•Output P-ch Tr. OFF •VOUT=VDD-40V	4.5–6.0	-30			
Resistance of the low level hold Tr.	Rinpd	S16 to S51	•Output P-ch Tr. OFF	4.5–6.0		200		$\text{k}\Omega$
High voltage pull-down resistor	Rpd	S0/T0 to S15/T15, S16 to S51 with pull-down resistor	•Output P-ch Tr. OFF •VOUT=3V •Vp=-30V	5.0	60	100	200	
Hysteresis voltage	VHIS(1)	•Port 1,7 • $\overline{\text{RES}}$		4.5–6.0		0.1VDD		V
	VHIS(2)	Port 87 weak signal input		4.5–6.0		0.1VDD		
Pin capacitance	CP	All pins	•All other terminals connected to VSS. •f=1MHz •T <sub>a</sub> =25°C	4.5–6.0		10		pF
Input sensitivity	Vsen	Port 87 weak signal input		4.5–6.0	0.12VDD			Vpp

## 4. Serial Input/Output Characteristics at Ta=-30°C to +70°C, VSS1=VSS2=0V

Parameter		Symbol	Pins	Conditions	VDD[V]	Ratings			unit
						min.	typ.	max.	
Serial clock	Input clock	Cycle Time	tSCK(1)	SCK0(P12)	Refer to figure 6	4.5–6.0	4/3		tCYC
		Low Level pulse width	tSCKL(1)			2/3			
			tSCKLA(1)			2/3			
		High Level pulse width	tSCKH(1)			2/3			
			tSCKHA(1)			3			
		Cycle Time	tSCK(2)	SCK1(P15)	Refer to figure 6	4.5–6.0	2		
	Output clock	Low Level pulse width	tSCKL(2)			1			tSCK
			tSCKLA(2)			3/4			
		High Level pulse width	tSCKH(3)			1/2			
			tSCKHA(2)			2			
		Cycle Time	tSCK(3)	SCK0(P12)	•CMOS output option •Refer to figure 6	4.5–6.0	4/3		
		Low Level pulse width	tSCKL(3)				1/2		
Serial input	Data set-up time	tsDI	SI0(P11), SI1(P14), SB0(P11), SB1(P14)	•Measured with respect to SI0CLK leading edge. •Refer to figure 6	4.5–6.0	0.03			μs
		Data hold time	thDI			0.03			
	Output delay time	tdDO	SO0(P10), SO1(P13), SB0(011), SB1(P14)	•Measured with respect to SI0CLK trailing edge. •When port is open drain: Time delay from SI0CLK trailing edge to the SO data change. •Refer to figure 6	4.5–6.0			1/3 tCYC +0.05	

## 5. Pulse Input Conditions at Ta=-30°C to +70°C, VSS1=VSS2=0V

Parameter	Symbol	Pins	Conditions	VDD[V]	Ratings			unit
					min.	typ.	max.	
High/low level pulse width	tPIH(1) tPIL(1)	INT0(P70), INT1(P71), INT2(P72)	•Interrupt acceptable •Events to timer 0 can be input.	4.5–6.0	1			tCYC
	tPIH(2) tPIL(2)	INT3(P73) (Noise rejection ratio set to 1/1.)	•Interrupt acceptable •Events to timer 0 can be input.	4.5–6.0	2			
	tPIH(3) tPIL(3)	INT3(P73) (Noise rejection ratio set to 1/32.)	•Interrupt acceptable •Events to timer 0 can be input.	4.5–6.0	64			
	tPIH(4) tPIL(4)	INT3(P73) (Noise rejection ratio set to 1/128.)	•Interrupt acceptable •Events to timer 0 can be input.	4.5–6.0	256			
	tPIH(5) tPIL(5)	MICIN(P87)	•Weak signal detection counter enabled	4.5–6.0	1			
	tPIH(6) tPIL(6)	NKIN(P72)	•High speed clock counter countable	4.5–6.0	1/12			
	tPIL(7)	$\overline{\text{RES}}$	•Reset possible	4.5–6.0	200			μs

## 6. AD Converter Characteristics at Ta=-30°C to +70°C, VSS1=VSS2=0V

Parameter	Symbol	Pins	Conditions	VDD[V]	Ratings			unit
					min.	typ.	max.	
Resolution	N	AN0(P80) to AN7(P87) AN8(P70), AN9(P71) AN10(XT1), AN11(XT2)		4.5–6.0		8		bit
Absolute precision	ET		(Note2)	4.5–6.0			±1.5	LSB
Conversion time	TCAD		AD conversion time = 32 × tCYC (ADCR2=0) (Note 3)	4.5–6.0	15.62 (tCYC= 0.488μs)		97.92 (tCYC= 3.06μs)	μs
			AD conversion time = 64 × tCYC (ADCR2=1) (Note 3)		18.82 (tCYC= 0.294μs)		97.92 (tCYC= 1.53μs)	
Analog input voltage range	VAIN			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 not including quantizing error (±1/2 LSB).

(Note 3) Conversion time means time from executing AD conversion instruction to loading complete digital value to register.



## 7. Current Dissipation Characteristics at Ta=-30°C to +70°C, VSS1=VSS2=0V

Parameter	Symbol	Pins	Conditions	VDD[V]	Ratings			unit
					min.	typ.	max	
Current dissipation during basic operation (Note 4)	IDDOP(1)	VDD1= VDD2= VDD3= VDD4	•FmCF=10MHz for Ceramic resonator oscillation •FsX'tal=32.768kHz for crystal oscillation •System clock: CF oscillation •Internal RC oscillation stopped. •Divider set to 1/1	4.5–6.0		10	30	mA
	IDDOP(2)		•CF1=20MHz for external clock •FsX'tal=32.768kHz for crystal oscillation vSystem clock: CF oscillation •Internal RC oscillation stopped. •Divider set to 1/2	4.5–6.0		11	31	
	IDDOP(3)		•FmCF=4MHz Ceramic resonator oscillation •FsX'tal=32.768kHz for crystal oscillation •System clock: CF oscillation •Internal RC oscillation stopped. •Divider set to 1/1	4.5–6.0		4.6	17	
	IDDOP(4)		•FmCF=0Hz (No oscillation) •FsX'tal=32.768kHz for crystal oscillation •System clock: RC oscillation •Divider set to 1/2	4.5–6.0		1	10	
	IDDOP(5)		•FmCF=0Hz (No oscillation) •FsX'tal=32.768kHz for crystal oscillation •System clock: 32.768kHz •Internal RC oscillation stopped. •Divider set to 1/2	4.5–6.0		40	140	

Continued

Parameter	Symbol	Pins	Conditions	Ratings				unit
				VDD[V]	min.	typ.	max.	
Current dissipation HALT mode (Note 4)	IDDHALT(1)	VDD1= VDD2= VDD3= VDD4	HALT mode •FmCF=10MHz for Ceramic resonator oscillation •FsX'tal=32.768kHz for crystal oscillation •System clock : CF oscillation •Internal RC oscillation stopped. •Divider: 1/1	4.5 to 6.0		4	12	mA
	IDDHALT(2)		HALT mode •CF1=20MHz for external clock •FsX'tal=32.768kHz for crystal oscillation •System clock : CF oscillation •Internal RC oscillation stopped. •Divider 1/2	4.5 to 6.0		4.8	13	
	IDDHALT(3)		HALT mode •FmCF=4MHz for Ceramic resonator oscillation •FsX'tal=32.768kHz for crystal oscillation •System clock : CF oscillation •Internal RC oscillation stopped. •Divider: 1/2	4.5 to 6.0		1.8	6	
	IDDHALT(4)		HALT mode •FmCF=0Hz (When oscillation stops.) •FsX'tal=32.768kHz for crystal oscillation •System clock : RC oscillation •Divider: 1/2	4.5 to 6.0		500	1600	μA
	IDDHALT(5)		HALT mode •FmCF=0Hz (When oscillation stops.) •FsX'tal=32.768kHz for crystal oscillation •System clock : 32.768kHz •Internal RC oscillation stopped. •Divider: 1/2	4.5 to 6.0		25	100	

Continued

Parameter	Symbol	Pins	Conditions	Ratings				unit
				VDD[V]	min.	typ.	max.	
Current dissipation HOLD mode	IDDHOLD(1)	VDD1	HOLD mode •CF1=VDD or open circuit (when using external clock)	4.5 to 6.0		0.05	25	μA
Current dissipation Date/time clock HOLD mode	IDDHOLD(2)	VDD1	Date/time clock HOLD mode •CF1=VDD or open circuit (when using external clock) •FmX'tal=32.768kHz for crystal oscillation	4.5 to 6.0		20	90	

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

Main system clock oscillation circuit characteristics

The characteristics in the table below is based on the following conditions:

1. Use the standard evaluation board SANYO has provided.
2. Use the peripheral parts with indicated value externally.
3. The peripheral parts value is a recommended value of oscillator manufacturer

Table 1. Main system clock oscillation circuit characteristics using ceramic resonator

Frequency	Manufacturer	Oscillator	Circuit parameters			Operating supply voltage range	Oscillation stabilizing time		Notes
			C1	C2	Rd1		typ	max	
10MHz	Murata	CST10.0MTW	(30pF)	(30pF)	0Ω	4.5 to 6.0V	0.06ms	0.2ms	Built in C1, C2
4MHz	Murata	CSTS0400MG03	(15pF)	(15pF)	680Ω	4.5 to 6.0V	0.03ms	0.15ms	Built in C1, C2

The oscillation stabilizing time is a period until the oscillation becomes stable after VDD becomes higher than minimum operating voltage. (Refer to Figure4)

Subsystem clock oscillation circuit characteristics

The characteristics in the table below is based on the following conditions:

1. Use the standard evaluation board SANYO has provided.
2. Use the peripheral parts with indicated value externally.
3. The peripheral parts value is a recommended value of oscillator manufacturer

Table 2. Subsystem clock oscillation circuit characteristics using crystal oscillator

Frequency	Manufacturer	Oscillator	Circuit parameters				Operating supply voltage range	Oscillation stabilizing time		Notes
			C3	C4	Rf	Rd2		typ	max	
32.768kHz	Seiko EPSON	MC-306	18pF	18pF	10MΩ	750kΩ	4.5 to 6.0V	1.3S	3.0S	
		C-002RX								

The oscillation stabilizing time is a period until the oscillation becomes stable after executing the instruction which starts the sub-clock oscillation or after releasing the HOLD mode. (Refer to Figure4)

(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.

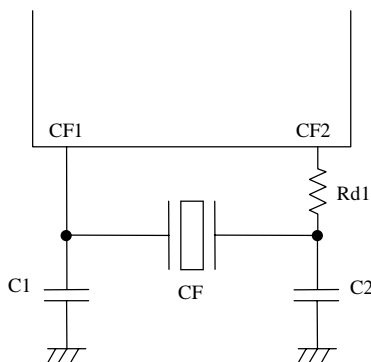


Figure 1 Ceramic oscillation circuit

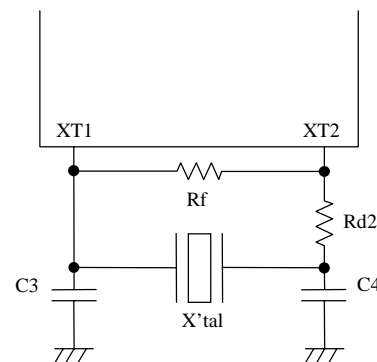


Figure 2 Crystal oscillation circuit

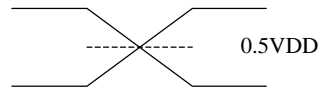


Figure 3 AC timing measurement point

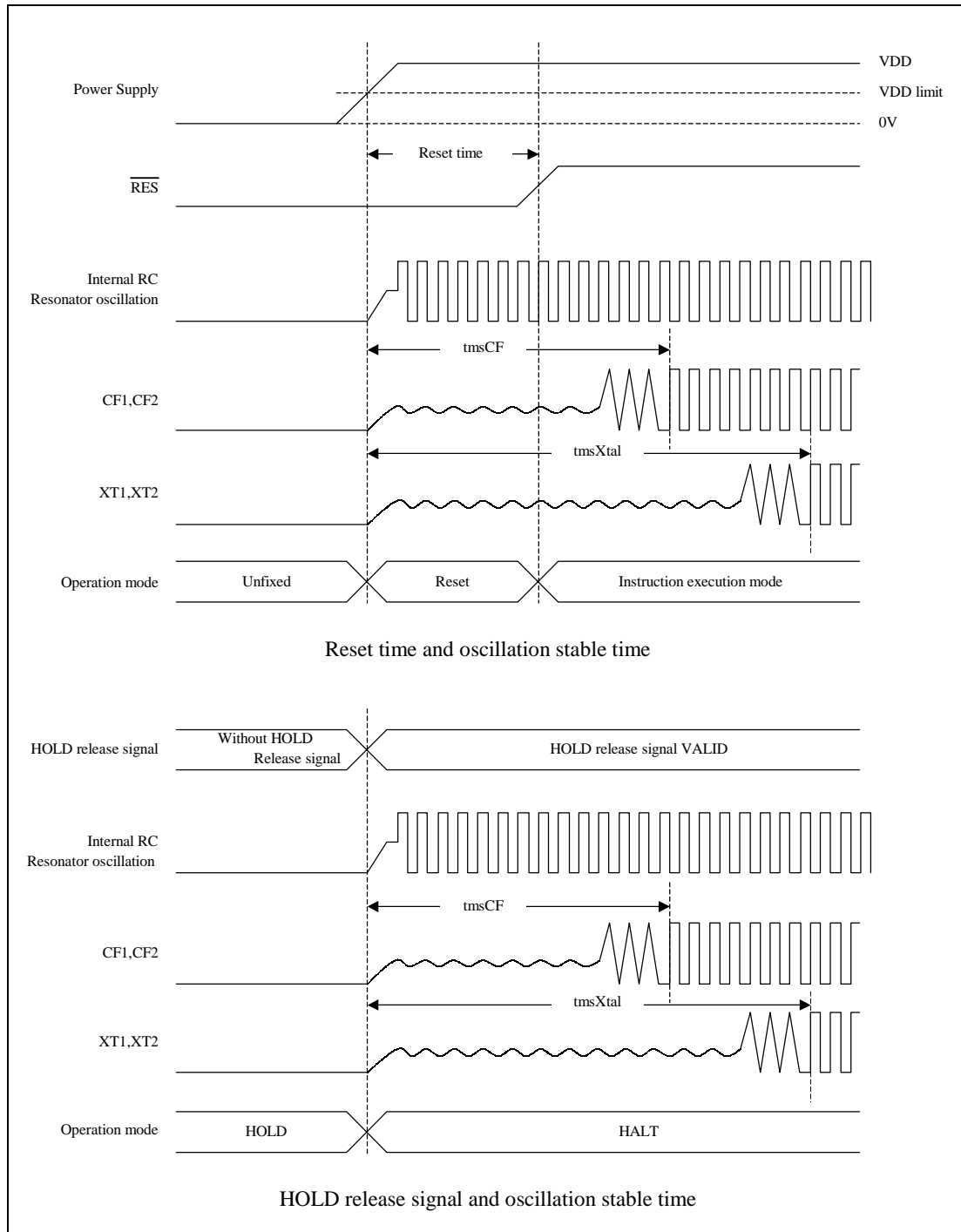
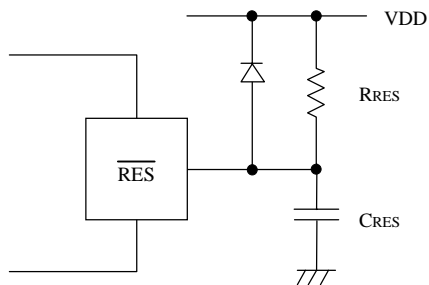


Figure 4 Oscillation stablization time



(Note) Set CRES, RRES values such that reset time exceeds 200 $\mu$ s.

Figure 5 Reset circuit

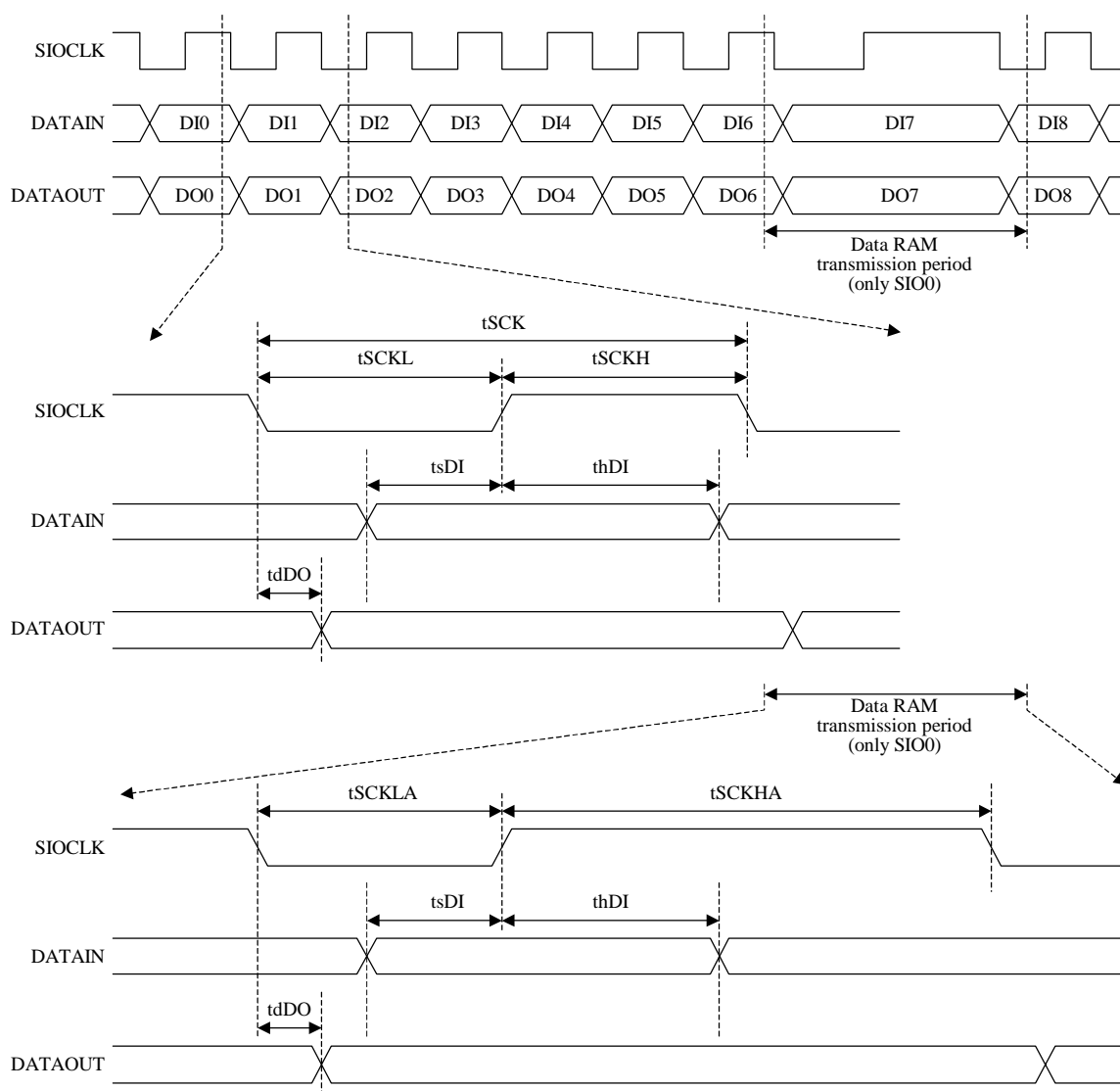


Figure 6 Serial input / output test condition

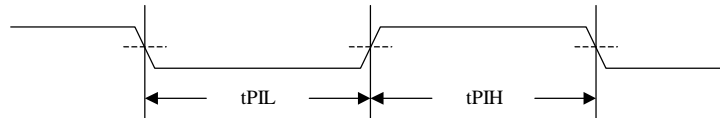


Figure 7 Pulse input timing condition

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