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LC87F83P7PA LC87F83P7PAU

CMOS IC

8-bit ETR Microcontroller

FROM 256K byte, RAM 12K byte on-chip

Overview

The LC87F83P7PA/P7PAU is an 8-bit ETR microcomputer that, centered around a CPU running at a minimum bus cycle time of 74.07 ns, integrate on a single chip a number of hardware features such as 256K-byte flash ROM (onboard rewritable), 12K-byte RAM, Onchip debugging, direct control of necessary CD mechanism and CD-DSP for car audio, in the radio reception, the on-chip high-performance PLL circuit provides a high-speed Lock-Up circuit to search for alternative frequency of RDS in a short time, the ability to control the C/N characteristics of a local oscillator, and the high S/N through the direct PLL configuration, two sophisticated 16-bit timers/counters (may be divided into 8-bit timers), four 8-bit timers with a prescaler, a base timer serving as a time-of-day clock, two synchronous SIO ports (with automatic block transmission/reception capabilities), an asynchronous/synchronous SIO port, two UART ports (full duplex), four 12-bit PWM channels, an 8-bit 10-channel AD converter, a high-speed clock counter, a system clock frequency divider, and a 29-source 10-vector interrupt feature.

Features

■Flash ROM

- Single 5V power supply, on-board writeable
- Block erase in 512 byte units
- 262144 × 8 bits (LC87F83P7PA/P7PAU)

■RAM

- 12288 × 9 bit (LC87F83P7PA/P7PAU)

■Minimum Bus Cycle Time

- 74.07ns (13.5MHz)

Note: Bus cycle time indicates the speed to read ROM.

* This product is licensed from Silicon Storage Technology, Inc. (USA).

■ Minimum Instruction Cycle Time (tCYC)

- 222ns (13.5MHz)

■ Ports

- Normal withstand voltage I/O ports

Ports whose I/O direction can be designated in 1 bit units: 57 (P1n, P2n, P30 to P35, P70 to P73, P8n, PBn, PCn, SI2Pm, PWM0, PWM1, XT2, n=0 to 7, m=0 to 3)

Ports whose I/O direction can be designated in 2 bit units: 16 (PEn, PFn n=0 to 7)

Ports whose I/O direction can be designated in 4 bit units: 8 (P0n n=0 to 7)

- Normal withstand voltage input ports: 1 (XT1)
- Main charge pump output ports: 1 (EO)
- Sub charge pump output ports: 1 (SUBPD)
- AM local oscillator input ports: 1 (AMIN)
- FM local oscillator input ports: 1 (FMIN)
- High-speed, universal counter input ports: 1 (HCTR)
- Universal counter input ports: 1 (LCTR)
- Internal low voltage output ports: 1 (VREG)
- Dedicated oscillator ports: 2 (CF1, CF2)
- Reset pin: 1 (RES)
- Digital power pins: 6 (VSSn, VDDn n=1, 2, 4)
- Analogue power pins: 2 (AVSS, AVDD)

■ Timers

- Timer 0: 16-bit programmable timer/counter with capture register
 - Mode 0: 8-bit programmable timer with an 8-bit programmable prescaler (with two 8-bit capture registers) × 2 channels
 - Mode 1: 8-bit programmable timer with an 8-bit programmable prescaler (with two 8-bit capture registers) + 8-bit programmable counter (with two 8-bit capture registers)
 - Mode 2: 16-bit programmable timer with an 8-bit programmable prescaler (with two 16-bit capture registers)
 - Mode 3: 16-bit programmable counter (with 2 16-bit capture registers)
- Timer 1: 16-bit programmable timer/counter that support PWM/ toggle output
 - Mode 0: 8-bit programmable timer with an 8-bit prescaler (with toggle outputs) + 8-bit programmable timer/counter (with toggle outputs)
 - Mode 1: 8-bit PWM with an 8-bit prescaler × 2 channels
 - Mode 2: 16-bit programmable timer/counter with an 8-bit prescaler (with toggle outputs) (toggle outputs also from the lower-order 8 bits)
 - Mode 3: 16-bit programmable timer with an 8-bit prescaler (with toggle outputs) (The lower-order 8 bits can be used as PWM.)
- Timer 4: 8-bit programmable timer with a 6-bit prescaler
- Timer 5: 8-bit programmable timer with a 6-bit prescaler
- Timer 6: 8-bit programmable timer with a 6-bit prescaler (with toggle outputs)
- Timer 7: 8-bit programmable timer with a 6-bit prescaler (with toggle outputs)
- Base timer
 - 1) The clock is selectable from the subclock (32.768kHz crystal oscillator), cycle clock (tCYC), and timer 0 prescaler output.
 - 2) Interrupts programmable in 5 different time schemes.

■ High speed clock counter

- 1) Can count clocks with a maximum clock rate of 20MHz
(When High-speed clock counter is used, timer 0 cannot be used).
- 2) Can generate output real time.

■ SIO: 3 channels

- SIO 0: 8 bit synchronous serial interface
 - 1) LSB first/MSB first mode selectable
 - 2) Built-in 8-bit baudrate generator (4/3 to 512/3 tCYC transfer clock cycle)
 - 3) Automatic continuous data transmission (1 to 256 bits)
- SIO 1: 8 bit asynchronous/synchronous serial interface
 - Mode 0: Synchronous 8-bit serial I/O (2 to or 3 to wire configuration, 2 to 512 tCYC transfer clocks)
 - Mode 1: Asynchronous serial I/O (Half-duplex, 8 data bits, 1 stop bit, 8 to 2048 tCYC baudrates)
 - Mode 2: Bus mode 1 (start bit, 8 data bits, 2 to 512 tCYC transfer clocks)
 - Mode 3: Bus mode 2 (start detect, 8 data bits, stop detect)
- SIO2: 8 bit synchronous serial interface
 - 1) LSB first mode
 - 2) Built-in 3-bit baudrate generator (4/3 to 512/3 tCYC transfer clock cycle)
 - 3) Automatic continuous data transmission (1 to 32 bytes)

■ UART: 2 channels

- 1) Full duplex
- 2) 7/8/9 bit data bits selectable
- 3) 1 stop bit (2 bits in continuous transmission mode)
- 4) Built-in 8-bit baudrate generator (with baudrates of 16/3 to 8192/3 tCYC)

■ AD Converter: 8 bits × 10 channels

■ PWM: Multifrequency 12-bit PWM × 4 channels

■ Remote control receiver noise filtering function (sharing pins with P73, INT3, and T0IN)

- 1) Noise filter time constant selectable from 1 tCYC, 32 tCYC, and 128 tCYC
- 2) The noise filtering function is available for the INT3, T0IN, or T0HCP signal at P73. When P73 is read with an instruction, the signal level at that pin is read regardless of the availability of the noise filtering function.

■ Watchdog timer

- External RC watchdog timer
- Interrupt and reset signals selectable

■ Interrupts

- 29 sources, 10 vector addresses
 - 1) Provides three levels (low (L), high (H), and highest (X)) of multiplex interrupt control. Any interrupt requests of the level equal to or lower than the current interrupt are not accepted.
 - 2) When interrupt requests to two or more vector addresses occur at the same time, the interrupt of the highest level takes precedence over the other interrupts. For interrupts of the same level, the interrupt into the smallest vector address takes precedence.

No.	Vector	Selectable Level	Interrupt signal
1	00003H	X or L	INT0
2	0000BH	X or L	INT1
3	00013H	H or L	INT2/T0L/INT4
4	0001BH	H or L	INT3/INT5/Base timer (BT0, 1)
5	00023H	H or L	T0H/INT6
6	0002BH	H or L	T1L/T1H/INT7
7	00033H	H or L	SIO0/UART1 receive/UART2 receive
8	0003BH	H or L	SIO1/SIO2/UART1 transmit/UART2 transmit
9	00043H	H or L	ADC/T6/T7/PWM4, PWM5
10	0004BH	H or L	Port 0/T4/T5/PWM0, PWM1

- Priority levels $X > H > L$
- Of interrupts of the same level, the one with the smallest vector address takes precedence.
- The Base timers are two interrupt sources of BT0 and BT1, it is one interrupt source by PWM0 and 1, it is one interrupt source by PWM4 and 5.

■ Subroutine stack levels

- 6144 levels maximum (1/2 of capacity of RAM, the stack is allocated in RAM.)

■ High-speed multiplication/division instructions

- 16 bits $\times$ 8 bits (5 tCYC execution time)
- 24 bits $\times$ 16 bits (12 tCYC execution time)
- 16 bits $\div$ 8 bits (8 tCYC execution time)
- 24 bits $\div$ 16 bits (12 tCYC execution time)

■ Oscillation circuits

- RC oscillator circuit (internal): For system clock
- Main XT crystal oscillator circuit: For system clock with internal Rf and Rd
- Sub XT crystal oscillator circuit: For time-of-day clock, for low-speed system clock with internal Rf and external Rd
- Multifrequency RC oscillator circuit (internal): For system clock
- PLL circuit (internal): For AM/FM tuner

■ System clock divider function

- Can run on low current.
- The minimum instruction cycle selectable from 222ns, 444ns, 888ns, 1.78 μ s, 3.55 μ s, 7.10 μ s, 14.2 μ s, 28.4 μ s, and 56.8 μ s.

■ PLL block

- Twelve reference frequencies when main XT is 13.5MHz: 1kHz, 3kHz, 3.125kHz, 5kHz, 6.25kHz, 9kHz, 10kHz, 12.5kHz, 25kHz, 30kHz, 50kHz, and 100kHz
- Range of input frequency
 - 1) AMIN: 0.5 to 40MHz
 - 2) FMIN: 10 to 150MHz
 - 3) HCTR: 0.4 to 12MHz
 - 4) LCTR: 100 to 500kHz
- Supports dead zone control.
- Built-in unlock detection circuit.

■ Universal counter

- This 20-bit counter can be used for frequency measurement.

■ Standby function

- HALT mode: Halts instruction execution while allowing the peripheral circuits to continue operation.
 - 1) Oscillation is not halted automatically.
 - 2) Canceled by system reset, detection VDET0 or occurrence of interrupt.
- HOLD mode: Suspends instruction execution and the operation of the peripheral circuits.
 - 1) The main XT crystal oscillators, RC, and sub XT crystal oscillators automatically stop operation.
 - 2) There are four ways of resetting the HOLD mode.
 - (1) Setting the Reset pin to the lower level.
 - (2) Voltage descent detection (VDET1)
 - (3) Setting at least one of the INT0, INT1, INT2, INT4, and INT5 pins to the specified level.
 - (4) Having an interrupt source established at port 0.
- X'tal HOLD mode: Suspends instruction execution and the operation of the peripheral circuits except the base timer.
 - 1) The main XT crystal oscillators, and RC oscillators automatically stop operation.
 - 2) The state of crystal oscillation established when the HOLD mode is entered is retained.
 - 3) There are five ways of resetting the X'tal HOLD mode.
 - (1) Setting the Reset pin to the low level.
 - (2) Voltage descent detection (VDET0)
 - (3) Setting at least one of the INT0, INT1, INT2, INT4, and INT5 pins to the specified level.
 - (4) Having an interrupt source established at port 0.
 - (5) Having an interrupt source established in the base timer circuit.

■ Reset

- External reset
- Voltage descent detection (VDET0, VDET1) reset circuit (internal)

■ Onchip debugging function

- Permits software debugging with the test device installed on the target board.

■ Shipping form

- QIP100E (Lead Free Product)

■ Flash ROM version

- LC87F83P7PA
- LC87F83P7PAU (User writing)

LC87F83P7PA/P7PAU

Absolute Maximum Ratings at Ta = 25°C, VSS1 = VSS2 = VSS4 = AVSS = 0V

Parameter		Symbol	Pins/Remarks	Conditions	Specification			
					VDD[V]	min	typ	max
Maximum supply voltage		VDD max	VDD1, VDD2, VDD4, AVDD	VDD1=VDD2=VDD4=AVDD		-0.3		+6.5
Input voltage		VI(1)	CF1, XT1, AMIN, FMIN, HCTR, LCTR			-0.3		VDD+0.3
Input/Output voltage		VI/O(1)	Ports 0, 1, 2 Ports 3, 7, 8 Ports B, C, E, F SI2P0 to SI2P3 PWM0, PWM1, XT2			-0.3		VDD+0.3
Output voltage		VO(1)	EO, SUBPD			-0.3		VDD+0.3
High level output current	Peak output current	IOPH(1)	Ports 0, 1, 2, 3 Ports 71 to 73 Ports B, C, E, F SI2P0 to SI2P3	CMOS output select. per 1 application pin.		-10		
		IOPH(2)	PWM0, PWM1	Per 1 application pin.		-20		
		IOPH(3)	EO, SUBPD	Per 1 application pin.		-5		
	Average output current (Note 1-1)	IOMH(1)	Ports 0, 1, 2, 3 Ports 71 to 73 Ports B, C, E, F SI2P0 to SI2P3	CMOS output select. per 1 application pin.		-7.5		
		IOMH(2)	PWM0, PWM1	Per 1 application pin.		-15		
		IOMH(3)	EO, SUBPD	Per 1 application pin.		-3		
	Total output current	ΣIOAH(1)	P71 to P73	Total of all applicable pins		-25		
		ΣIOAH(2)	PWM0, PWM1 SI2P0 to SI2P3	Total of all applicable pins		-25		
		ΣIOAH(3)	Ports 0	Total of all applicable pins		-25		
		ΣIOAH(4)	Ports 0 PWM0, PWM1 SI2P0 to SI2P3	Total of all applicable pins		-45		
		ΣIOAH(5)	Ports 2, 3, B	Total of all applicable pins		-25		
		ΣIOAH(6)	Ports C	Total of all applicable pins		-25		
		ΣIOAH(7)	Ports 2, 3, B, C	Total of all applicable pins		-45		
		ΣIOAH(8)	Ports F	Total of all applicable pins		-25		
		ΣIOAH(9)	Ports 1, E	Total of all applicable pins		-25		
		ΣIOAH(10)	Ports 1, E, F	Total of all applicable pins		-45		
		ΣIOAH(11)	EO, SUBPD	Total of all applicable pins		-10		

Note 1-1: Average output current is average of current in 100ms interval.

Continued on next page.

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Parameter		Symbol	Pins/Remarks	Conditions	Specification				
					V _{DD} [V]	min	typ	max	unit
Low level output current	Peak output current	IOPL(1)	Ports 0, 1, 2, 3, 8 Ports B, C, E, F SI2P0 to SI2P3 XT2	Per 1 application pin.				10	mA
		IOPL(2)	PWM0, PWM1	Per 1 application pin.				20	
		IOPL(3)	EO, SUBPD	Per 1 application pin.				5	
	Average output current (Note 1-1)	IOML(1)	Ports 0, 1, 2, 3, 7 Ports 8, B, C, E, F SI2P0 to SI2P3 XT2	Per 1 application pin.				7.5	
		IOML(2)	PWM0, PWM1	Per 1 application pin.				20	
		IOML(3)	EO, SUBPD	Per 1 application pin.				5	
	Total output current	ΣIOAL(1)	Ports 7, XT2	Total of all applicable pins				25	
		ΣIOAL(2)	Ports 8	Total of all applicable pins				25	
		ΣIOAL(3)	Ports 7, 8, XT2	Total of all applicable pins				45	
		ΣIOAL(4)	PWM0, PWM1 SI2P0 to SI2P3	Total of all applicable pins				25	
		ΣIOAL(5)	Ports 0	Total of all applicable pins				25	
		ΣIOAL(6)	Ports 0 PWM0, PWM1 SI2P0 to SI2P3	Total of all applicable pins				45	
		ΣIOAL(7)	Ports 2, 3, B	Total of all applicable pins				25	
		ΣIOAL(8)	Ports C	Total of all applicable pins				25	
		ΣIOAL(9)	Ports 2, 3, B, C	Total of all applicable pins				45	
		ΣIOAL(10)	Ports F	Total of all applicable pins				25	
		ΣIOAL(11)	Ports 1, E	Total of all applicable pins				25	
		ΣIOAL(12)	Ports 1, E, F	Total of all applicable pins				45	
		ΣIOAL(13)	EO, SUBPD	Total of all applicable pins				10	
Maximum power consumption		Pd max	QIP100E	Ta = -40 to +85°C				400	mW
Operating temperature range		Topr				-40		+85	°C
Storage temperature range		Tstg				-45		+125	°C

Note 1-1: Average output current is average of current in 100ms interval.

Stresses exceeding Maximum Ratings may damage the device. Maximum Ratings are stress ratings only. Functional operation above the Recommended Operating Conditions is not implied. Extended exposure to stresses above the Recommended Operating Conditions may affect device reliability.

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Recommended operating range at Ta = -40°C to +85°C, V_{SS1} = V_{SS2} = V_{SS4} = AV_{SS} = 0V

Parameter	Symbol	Pins/Remarks	Conditions	V _{DD} [V]	Specification			unit
					min	typ	max	
Operating supply voltage	V _{DD} (1)	V _{DD1} =V _{DD2} =V _{DD4} =AV _{DD}	PLL operation		4.5	5.0	5.5	V
			CPU operation		3.0		5.5	
Memory sustaining supply voltage	V _{HD}	V _{DD1} =V _{DD2} =V _{DD4} =AV _{DD}	RAM and register contents in HOLD mode.		1.0		5.5	
High level input voltage	V _{IH} (1)	Ports 1, 2 SI2P0 to SI2P3 P71 to P73 P70 port input/ interrupt setting		3.0 to 5.5	0.35V _{DD} +0.7		V _{DD}	
	V _{IH} (2)	Ports 0, 3, 8 Ports B, C, E, F PWM0, PWM1		3.0 to 5.5	0.3V _{DD} +0.7		V _{DD}	
	V _{IH} (3)	Port70 Watchdog timer setting		3.0 to 5.5	0.9V _{DD}		V _{DD}	
	V _{IH} (4)	XT1, XT2, $\overline{\text{RES}}$	When XT1 and XT2 general purpose input	3.0 to 5.5	0.75V _{DD}		V _{DD}	
Low level input voltage	V _{IL} (1)	Ports 1, 2 SI2P0 to SI2P3		4.0 to 5.5	V _{SS}		0.1V _{DD} +0.4	
	V _{IL} (2)	P71 to P73 P70 port input/ interrupt setting		3.0 to 4.0	V _{SS}		0.2V _{DD}	
	V _{IL} (3)	Ports 0, 3, 8 Ports B, C, E, F		4.0 to 5.5	V _{SS}		0.15V _{DD} +0.4	
	V _{IL} (4)	PWM0, PWM1		3.0 to 4.0	V _{SS}		0.2V _{DD}	
	V _{IL} (5)	Port70 Watchdog timer setting		3.0 to 5.5	V _{SS}		0.8V _{DD} -1.0	
	V _{IL} (6)	XT1, XT2, $\overline{\text{RES}}$	When XT1 and XT2 general purpose input	3.0 to 5.5	V _{SS}		0.25V _{DD}	
Input amplitude	V _{IN} (1)	FMIN, AMIN, HCTR, LCTR	Excluding CF ability setting="00"	4.5 to 5.5	0.04		1.5	Vrms
	V _{IN} (2)	FMIN, AMIN, HCTR	CF ability setting="00"	4.5 to 5.5	0.07		1.5	
	V _{IN} (3)	FMIN, LCTR	CF ability setting="00"	4.5 to 5.5	0.04		1.5	
Input frequency	FIN(1)	FMIN: V _{IN} (1)		4.5 to 5.5	10		150	MHz
	FIN(2)	FMIN: V _{IN} (2)		4.5 to 5.5	10		50	
	FIN(3)	FMIN: V _{IN} (3)		4.5 to 5.5	50		150	
	FIN(4)	AMIN(H): V _{IN} (1) V _{IN} (2)		4.5 to 5.5	2		40	
	FIN(5)	AMIN(L): V _{IN} (1) V _{IN} (2)		4.5 to 5.5	0.5		10	
	FIN(6)	HCTR: V _{IN} (1) V _{IN} (2)		4.5 to 5.5	0.4		12	
	FIN(7)	LCTR: V _{IN} (1) V _{IN} (3)		4.5 to 5.5	100		500	kHz
Instruction cycle time	tCYC (Note 2-1)			3.0 to 5.5	0.222			μs
Oscillation frequency range	FmCF(1)	CF1, CF2	13.5MHz crystal oscillation	3.0 to 5.5		13.5		MHz
	FmRC		Internal RC oscillation	3.0 to 5.5	0.3	1.0	2.0	
	FmMRC		Frequency variable RC oscillation source oscillation	3.0 to 5.5		16		
	FsX'tal	XT1, XT2	32.768kHz crystal oscillation	3.0 to 5.5		32.768		kHz

Note 2-1: Relationship between tCYC and oscillation frequency is 3/FmCF at a division ratio of 1/1 and 6/FmCF at a division ratio of 1/2.

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Electrical Characteristics at Ta = -40°C to +85°C, VSS1 = VSS2 = VSS4 = AVSS = 0V

Parameter	Symbol	Pins/Remarks	Conditions	Specification				
				VDD[V]	min	typ	max	unit
High level input current	I _{IH} (1)	Ports 0, 1, 2 Ports 3, 7, 8 Ports B, C, E, F SI2P0 to SI2P3 $\overline{\text{RES}}$ PWM0, PWM1	Output disable Pull-up resistor OFF V _{IN} =V _{DD} (including the off-leak current of the output Tr.)	3.0 to 5.5			1	μA
	I _{IH} (2)	XT1, XT2	Using as an input port V _{IN} =V _{DD}	3.0 to 5.5			1	
	I _{IH} (3)	CF1	V _{IN} =V _{DD}	3.0 to 5.5	1	5	15	
	I _{IH} (4)	FMIN, AMIN, HCTR, LCTR	V _{IN} =V _{DD}	4.5 to 5.5			30	
Low level input current	I _{IL} (1)	Ports 0, 1, 2 Ports 3, 7, 8 Ports B, C, E, F SI2P0 to SI2P3 $\overline{\text{RES}}$ PWM0, PWM1	Output disable Pull-up resistor OFF V _{IN} =V _{DD} (including the off-leak current of the output Tr.)	3.0 to 5.5	-1			μA
	I _{IL} (2)	XT1, XT2	Using as an input port V _{IN} =V _{SS}	3.0 to 5.5	-1			
	I _{IL} (3)	CF1	V _{IN} =V _{SS}	3.0 to 5.5	-15	-5	-1	
	I _{IL} (4)	FMIN, AMIN, HCTR, LCTR	V _{IN} =V _{SS}	4.5 to 5.5	-30			
High level output voltage	V _{OH} (1)	Ports 0, 1, 2, 3 Ports B, C, E, F	I _{OH} =-1.0mA	4.5 to 5.5	V _{DD} -1			V
	V _{OH} (2)	Ports 71, 72, 73 SI2P0 to SI2P3	I _{OH} =-0.4mA	3.0 to 5.5	V _{DD} -0.4			
	V _{OH} (3)	PWM0, PWM1	I _{OH} =-10mA	4.5 to 5.5	V _{DD} -1.5			
	V _{OH} (4)	P30, P31(PWM4, 5 output mode)	I _{OH} =-1.6mA	3.0 to 5.5	V _{DD} -0.4			
	V _{OH} (5)	EO, SUBPD	I _{OH} =-500μA	4.5 to 5.5	V _{DD} -1			
Low level output voltage	V _{OL} (1)	Ports 0, 1, 2, 3 Ports B, C, E, F	I _{OL} =1.0mA	4.5 to 5.5			1.0	V
	V _{OL} (2)	Ports 71, 72, 73 SI2P0 to SI2P3	I _{OL} =0.4mA	3.0 to 5.5			0.4	
	V _{OL} (3)	PWM0, PWM1	I _{OL} =10mA	4.5 to 5.5			1.5	
	V _{OL} (4)		I _{OL} =1.6mA	3.0 to 5.5			0.4	
	V _{OL} (5)	Ports 70, 8, XT2	I _{OL} =1.6mA	3.0 to 5.5			0.4	
	V _{OL} (6)	EO, SUBPD	I _{OL} =500μA	4.5 to 5.5			1.0	
Pull-up resistation	Rpu(1)	Ports 0, 1, 2, 3 Ports 7	V _{OH} =0.9V _{DD}	4.5 to 5.5	15	35	80	kΩ
	Rpu(2)	Ports B, C, E, F		3.0 to 5.5	15	35	150	
Hysteresis voltage	VHYS	$\overline{\text{RES}}$ Ports 1, 2, 7 SI2P0 to SI2P3		3.0 to 5.5		0.1V _{DD}		V
Pin capacitance	CP	All pins	- For pins other than that under test: V_{IN}=V_{SS} - f=1MHz - Ta=25°C	3.0 to 5.5		10		pF
Power down detection voltage	VDET0	V _{DD} 1	Excluding the HOLD mode		3.0	3.3	3.6	V
	VDET1		HOLD mode		1.1	1.6	2.1	

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Serial input/output Characteristics at Ta = -40°C to +85°C, VSS1 = VSS2 = VSS4 = AVSS = 0V

1. SIO0 Serial input/output characteristics (Note 4-1-1)

Parameter			Symbol	Pins/ Remarks	Conditions	V _{DD} [V]	Specification			
							min	typ	max	unit
Serial clock	Input clock	Frequency	tSCK(1)	SCK0(P12)	• See Fig. 2.	3.0 to 5.5	2			tCYC
		Low level pulse width	tSCKL(1)				1			
		High level pulse width	tSCKH(1)				1			
			tSCKHA(1a)		• Continuous data transmission/reception mode • SIO2 is not in use simultaneous. • See Fig. 2. • (Note 4-1-2)		4			
			tSCKHA(1b)				6			
	Output clock	Frequency	tSCK(2)	SCK0(P12)	• CMOS output selected. • See Fig. 2.	3.0 to 5.5	4/3			tSCK
		Low level pulse width	tSCKL(2)				1/2			
		High level pulse width	tSCKH(2)				1/2		tCYC	
			tSCKHA(2a)		tSCKH(2) +2tCYC			tSCKH(2) +(10/3)tCYC		
			tSCKHA(2b)		tSCKH(2) +2tCYC			tSCKH(2) +(16/3)tCYC		
Serial input	Data setup time		tsDI(1)	SIO(P11), SB0(P11)	• Must be specified with respect to rising edge of SIOCLK • See fig. 2.	3.0 to 5.5	0.03			
	Data hold time		thDI(1)				0.03			
Serial output	Input clock	Output delay time	tdD0(1)	SO0(P10), SB0(P11)	• Continuous data transmission/reception mode • (Note 4-1-3)	3.0 to 5.5			(1/3)tCYC +0.05	μs
			tdD0(2)		• Synchronous 8-bit mode. • (Note 4-1-3)				1tCYC +0.05	
	Output clock		tdD0(3)		• (Note 4-1-3)				(1/3)tCYC +0.05	

Note 4-1-1: These specifications are theoretical values. Add margin depending on its use.

Note 4-1-2: To use serial-clock-input in continuous trans/rec mode, a time from SIORUN being set when serial clock is "H" to the first negative edge of the serial clock must be longer than tSCKHA.

Note 4-1-3: Must be specified with respect to falling edge of SIOCLK. Must be specified as the time to the beginning of output state change in open drain output mode. See Fig. 2.

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2. SIO1 Serial input/output characteristics (Note 4-2-1)

Parameter			Symbol	Pins/ Remarks	Conditions	V _{DD} [V]	Specification			
							min	typ	max	unit
Serial clock	Input clock	Frequency	tSCK(3)	SCK1(P15)	• See Fig. 2.	3.0 to 5.5	2			tCYC
		Low level pulse width	tSCKL(3)				1			
		High level pulse width	tSCKH(3)				1			
	Output clock	Frequency	tSCK(4)	SCK1(P15)	• CMOS output selected. • See Fig. 2.	3.0 to 5.5	2			tSCK
		Low level pulse width	tSCKL(4)				1/2			
		High level pulse width	tSCKH(4)				1/2			
Serial input	Data setup time	tsDI(2)	SI1(P14), SB1(P14)	• Must be specified with respect to rising edge of SIOCLK • See fig. 2.	3.0 to 5.5	0.03			μs	
	Data hold time	thDI(2)				0.03				
Serial output	Output delay time	tdD0(4)	SO1(P13), SB1(P14)	• Must be specified with respect to falling edge of SIOCLK • Must be specified as the time to the beginning of output state change in open drain output mode. • See Fig. 2.	3.0 to 5.5			(1/3)tCYC +0.05		

Note 4-2-1: These specifications are theoretical values. Add margin depending on its use.

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3. SIO2 Serial input/output characteristics (Note 4-3-1)

Parameter			Symbol	Pins/ Remarks	Conditions	V _{DD} [V]	Specification			
							min	typ	max	unit
Serial clock	Input clock	Frequency	tSCK(5)	SCK2 (SI2P2)	• See Fig. 2.	3.0 to 5.5	2			tCYC
		Low level pulse width	tSCKL(5)				1			
		High level pulse width	tSCKH(5)				1			
			tSCKHA(5a)		• Continuous data transmission/reception mode of SIO0 is not in use simultaneous. • See Fig. 2. • (Note 4-3-2)		4			
			tSCKHA(5b)				7			
	Output clock	Frequency	tSCK(6)	SCK2 (SI2P2), SCK20 (SI2P3)	• CMOS output selected. • See Fig. 2.	3.0 to 5.5	4/3			tSCK
		Low level pulse width	tSCKL(6)				1/2			
		High level pulse width	tSCKH(6)				1/2			
			tSCKHA(6a)		• Continuous data transmission/reception mode of SIO0 is not in use simultaneous. • CMOS output selected. • See Fig. 2.		tSCKH(6) +(5/3)tCYC		tSCKH(6) +(10/3)tCYC	tCYC
			tSCKHA(6b)				tSCKH(6) +(5/3)tCYC		tSCKH(6) +(19/3)tCYC	
Serial input	Data setup time	tsDI(3)	SI2(SI2P1), SB2(SI2P1)	• Must be specified with respect to rising edge of SIOCLK • See fig. 2.	3.0 to 5.5	0.03			μs	
	Data hold time	thDI(3)				0.03				
Serial output	Output delay time	tdD0(5)	SO2(SI2P0), SB2(SI2P1)	• Must be specified with respect to falling edge of SIOCLK • Must be specified as the time to the beginning of output state change in open drain output mode. • See Fig. 2.	3.0 to 5.5			(1/3)tCYC +0.05	μs	

Note 4-3-1: These specifications are theoretical values. Add margin depending on its use.

Note 4-3-2: To use serial-clock-input, a time from SI2RUN being set when serial clock is "H" to the first negative edge of the serial clock must be longer than tSCKHA.

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Pulse input conditions at Ta = -40°C to +85°C, VSS1 = VSS2 = VSS4 = AVSS = 0V

Parameter	Symbol	Pins/Remarks	Conditions	VDD[V]	Specification			
					min	typ	max	unit
High/low level pulse width	tPIH(1) tPIL(1)	INT0(P70), INT1(P71), INT2(P72), INT4(P20 to P23), INT5(P24 to P27), INT6(P20), INT7(P24)	• Interrupt source flag can be set. • Event inputs for timer 0 or 1 are enabled.	3.0 to 5.5	1			tCYC
	tPIH(2) tPIL(2)	INT3(P73) when noise filter time constant is 1/1.	• Interrupt source flag can be set. • Event inputs for timer 0 are enabled.	3.0 to 5.5	2			
	tPIH(3) tPIL(3)	INT3(P73) when noise filter time constant is 1/32.	• Interrupt source flag can be set. • Event inputs for timer 0 are enabled.	3.0 to 5.5	64			
	tPIH(4) tPIL(4)	INT3(P73) when noise filter time constant is 1/28.	• Interrupt source flag can be set. • Event inputs for timer 0 are enabled.	3.0 to 5.5	256			
	tPIL(5)	RES	Reset acceptable	3.0 to 5.5	200			μs

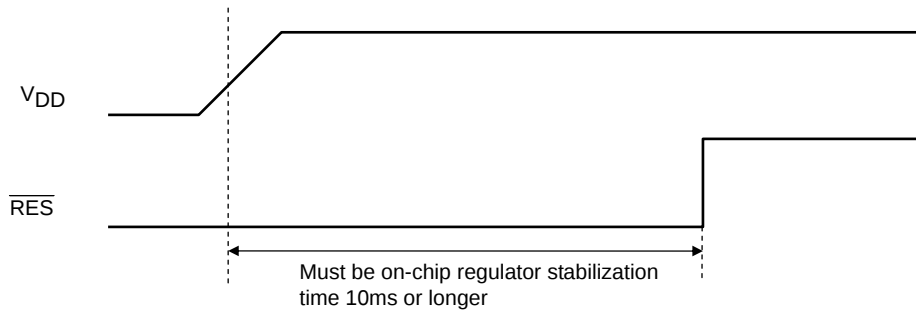


Fig. Timing of Power-on Reset Operation

AD converter characteristics at Ta = -40°C to +85°C, VSS1 = VSS2 = VSS4 = AVSS = 0V

Parameter	Symbol	Pins/Remarks	Conditions	VDD[V]	Specification			
					min	typ	max	unit
Resolution	N	AN0(P80)		3.0 to 5.5		8		bit
Absolute precision	ET	to AN7(P87)	(Note 6-1)	3.0 to 5.5			±1.5	LSB
Conversion time	TCAD	AN8(P70)	AD conversion time=32×tCYC (when ADCR2=0) (Note 6-2)	3.0 to 5.5	7.104(tCYC=0.222μs)			μs
		AN9(P71)	AD conversion time=64×tCYC (when ADCR2=1) (Note 6-2)	3.0 to 5.5	14.21(tCYC=0.222μs)			
Analog input voltage range	VAIN			3.0 to 5.5	VSS		VDD	V
Analog port input current	IAINH		VAIN=VDD	3.0 to 5.5			1	μA
	IAINL		VAIN=VSS	3.0 to 5.5	-1			

Note 6-1: The quantization error (±1/2 LSB) is excluded from the absolute accuracy value.

Note 6-2: The conversion time refers to the interval from the time the instruction for starting the converter is issued till the complete digital value corresponding to the analog input value is loaded in the required register.

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Consumption Current Characteristics at Ta = -40°C to +85°C, VSS1 = VSS2 = VSS4 = AVSS = 0V

Parameter	Symbol	Pins/ Remarks	Conditions	Specification				
				VDD[V]	min	typ	max	unit
Normal mode consumption current (Note 7-1)	IDDOP(1)	VDD1 =VDD2 =VDD4 =AVDD	- FmCF=13.5MHz crystal oscillation mode - FmX'tal=32.768kHz by crystal oscillation mode - System clock set to 13.5MHz - Internal RC oscillation stopped - Frequency variable RC oscillation stopped 1/1 frequency division ratio.	4.5 to 5.5		8.0	10.0	mA
	IDDOP(2)		- System clock set to 13.5MHz - Internal RC oscillation stopped - Frequency variable RC oscillation stopped 1/1 frequency division ratio.	3.0 to 4.5		6.0	8.0	
	IDDOP(3)		- FmCF=0Hz (oscillation stopped) - FmX'tal=32.768kHz by crystal oscillation mode - System clock set to internal RC oscillation - Frequency variable RC oscillation stopped 1/2 frequency division ratio.	4.5 to 5.5		0.8	1.2	
	IDDOP(4)		- System clock set to internal RC oscillation - Frequency variable RC oscillation stopped 1/2 frequency division ratio.	3.0 to 4.5		0.6	1.0	
	IDDOP(5)		- FmCF=0Hz (oscillation stopped) - FmX'al=32.768kHz by crystal oscillation mode. - Internal RC oscillation stopped - System clock set to 1MHz with frequency variable RC oscillation 1/2 frequency division ratio.	4.5 to 5.5		0.8	2.0	
	IDDOP(6)		- System clock set to 1MHz with frequency variable RC oscillation 1/2 frequency division ratio.	3.0 to 4.5		0.5	1.5	
	IDDOP(7)		- FmCF=0Hz (oscillation stopped) - FmX'al=32.768kHz by crystal oscillation mode. - System clock set to 32.768kHz - Internal RC oscillation stopped - Frequency variable RC oscillation stopped 1/2 frequency division ratio.	4.5 to 5.5		300	500	μA
	IDDOP(8)		- System clock set to 32.768kHz - Internal RC oscillation stopped - Frequency variable RC oscillation stopped 1/2 frequency division ratio.	3.0 to 4.5		250	450	
	IDDOP(9)		- FmCF=13.5MHz crystal oscillation mode - FmX'tal=32.768kHz by crystal oscillation mode - System clock set to 13.5MHz - Internal RC oscillation operation - Frequency variable RC oscillation stopped 1/1 frequency division ratio. - FM Amp ON 130MHz Reception - HCTR Amp ON IF count 10.7MHz	4.5 to 5.5		15.0	20.0	mA

Note 7-1: The consumption current value includes none of the currents that flow into the output Tr and internal pull-up resistors.

General-purpose I/O port "L" output when the above-mentioned data is measured

However, the P0 port is an input setting because of the mode setting

Continued on next page.

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Continued from preceding page.

Parameter	Symbol	Pins/ Remarks	Conditions	Specification				
				V _{DD} [V]	min	typ	max	unit
HALT mode consumption current (Note 7-1)	IDDHALT(1)	V _{DD1} =V _{DD2} =V _{DD4} =AV _{DD}	- HALT mode - FmCF=13.5MHz crystal oscillation mode - FmX'tal=32.768kHz by crystal oscillation mode - System clock set to 13.5MHz - Internal RC oscillation stopped - Frequency variable RC oscillation stopped 1/1 frequency division ratio.	4.5 to 5.5		2.0	3.0	mA
	IDDHALT(2)		- System clock set to 13.5MHz - Internal RC oscillation stopped - Frequency variable RC oscillation stopped 1/1 frequency division ratio.	3.0 to 4.5		1.8	2.5	
	IDDHALT(3)		- HALT mode - FmCF=0Hz (oscillation stopped) - FmX'tal=32.768kHz by crystal oscillation mode	4.5 to 5.5		0.5	1.0	
	IDDHALT(4)		- System clock set to internal RC oscillation - Frequency variable RC oscillation stopped 1/2 frequency division ratio.	3.0 to 4.5		0.3	0.8	
	IDDHALT(5)		- HALT mode - FmCF=0Hz (oscillation stopped) - FmX'al=32.768kHz by crystal oscillation mode.	4.5 to 5.5		1.0	2.0	
	IDDHALT(6)		- Internal RC oscillation stopped - System clock set to 1MHz with frequency variable RC oscillation 1/2 frequency division ratio.	3.0 to 4.5		0.8	1.5	
	IDDHALT(7)		- HALT mode - FmCF=0Hz (oscillation stopped) - FmX'al=32.768kHz by crystal oscillation mode.	4.5 to 5.5		250	500	
	IDDHALT(8)		- System clock set to 32.768kHz - Internal RC oscillation stopped - Frequency variable RC oscillation stopped 1/2 frequency division ratio.	3.0 to 4.5		200	400	
HOLD mode consumption current	IDDHOLD(1)	V _{DD1}	HOLD mode	4.5 to 5.5		1.5	20.0	μA
	IDDHOLD(2)			3.0 to 4.5		1.0	18.0	
Time-base clock HOLD mode consumption current	IDDHOLD(3)	V _{DD1}	- Timer HOLD mode - FmX'tal=32.768kHz by crystal oscillation mode	4.5 to 5.5		150	300	
	IDDHOLD(4)			3.0 to 4.5		100	200	
Intermittent for time-base clock mode consumption current	IDDCLOCK(1)	V _{DD1} =V _{DD2} =V _{DD4} =AV _{DD}	- Intermittent for clock mode - Each 500ms is shifted to a normal mode, and 20 steps are executed. - FmCF=0Hz (oscillation stopped) - FmX'al=32.768kHz by crystal oscillation mode.	4.5 to 5.5		250	500	
	IDDCLOCK(2)		- System clock set to 32.768kHz - Internal RC oscillation stopped - Frequency variable RC oscillation stopped 1/1 frequency division ratio.	3.0 to 4.5		200	400	

Note 7-1: The consumption current value includes none of the currents that flow into the output Tr and internal pull-up resistors.

General-purpose I/O port "L" output when the above-mentioned data is measured

However, the P0 port is an input setting because of the mode setting

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F-ROM Write Characteristics at $T_a = +10^{\circ}\text{C}$ to $+55^{\circ}\text{C}$, $V_{SS1} = V_{SS2} = V_{SS4} = AV_{SS} = 0\text{V}$

Parameter	Symbol	Pins/ Remarks	Conditions	Specification				
				$V_{DD}[\text{V}]$	min	typ	max	unit
Onboard programming current	IDDFW(1)	V_{DD1}	128-byte programming - Erasing current including	3.0 to 5.5		25	40	mA
Programming time	tFW(1)		128-byte programming - Erasing current including - Time for setting up 128 byte data is excluded.	3.0 to 5.5		22.5	35	ms

UART(Full Duplex) Operating Conditions at $T_a = -40^{\circ}\text{C}$ to $+85^{\circ}\text{C}$, $V_{SS1} = V_{SS2} = V_{SS4} = AV_{SS} = 0\text{V}$

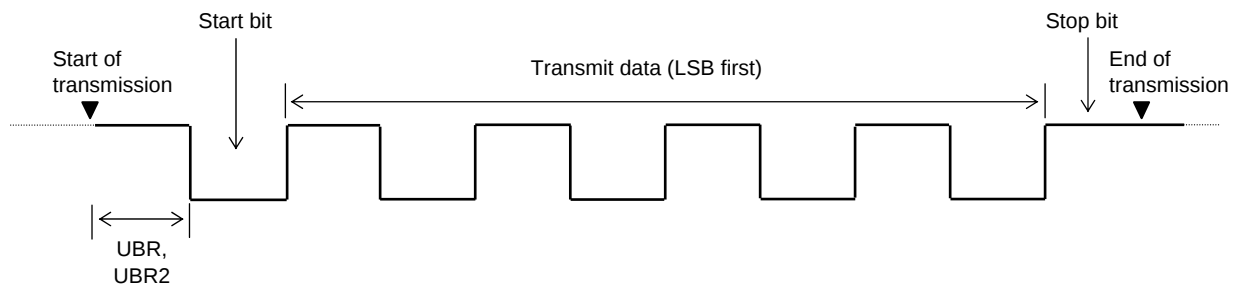
Parameter	Symbol	Pins/ Remarks	Conditions	Specification				
				$V_{DD}[\text{V}]$	min	typ	max	unit
Transfer clock rate	UBR, UBR2	UTX1(P32), RTX1(P33), UTX2(P34), RTX2(P35)		3.0 to 5.5	16/3		8192/3	tCYC

Data length: 7, 8, and 9 bits (LSB first)

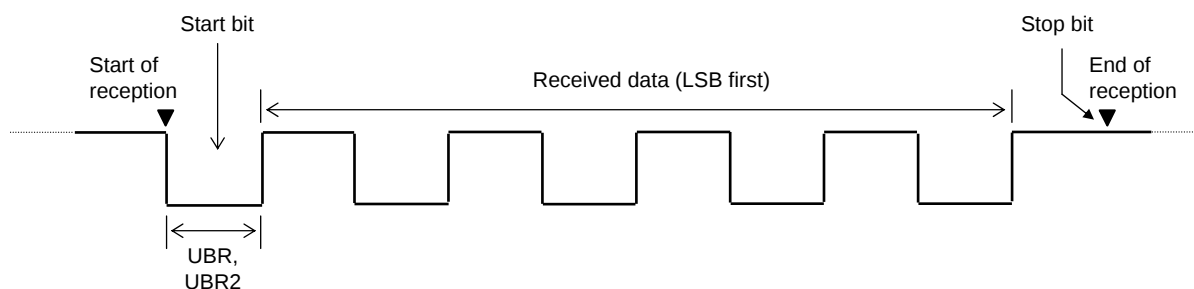
Stop bits: 1 bit (2-bit in continuous data transmission)

Parity bits: No

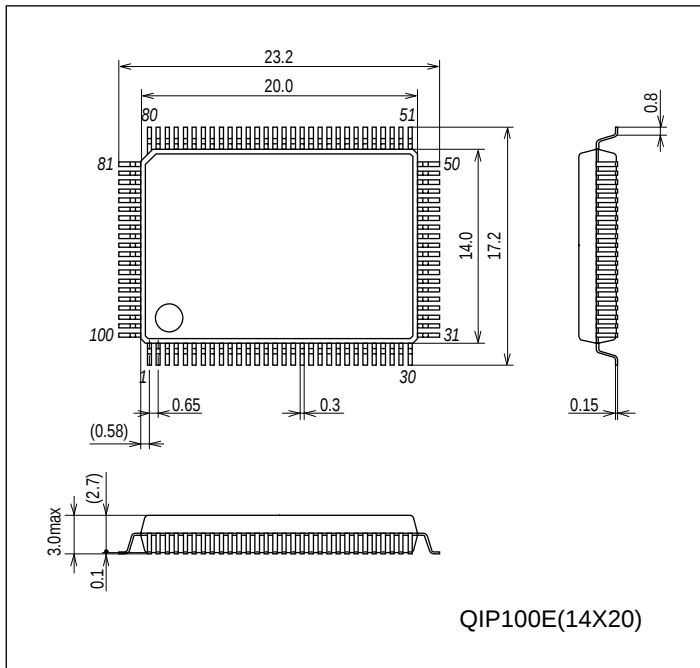
Example of Continuous 8-bit Data Transmission Mode Processing (First Transmit Data=55H)



Example of Continuous 8-bit Data Reception Mode Processing (First Receive Data=55H)

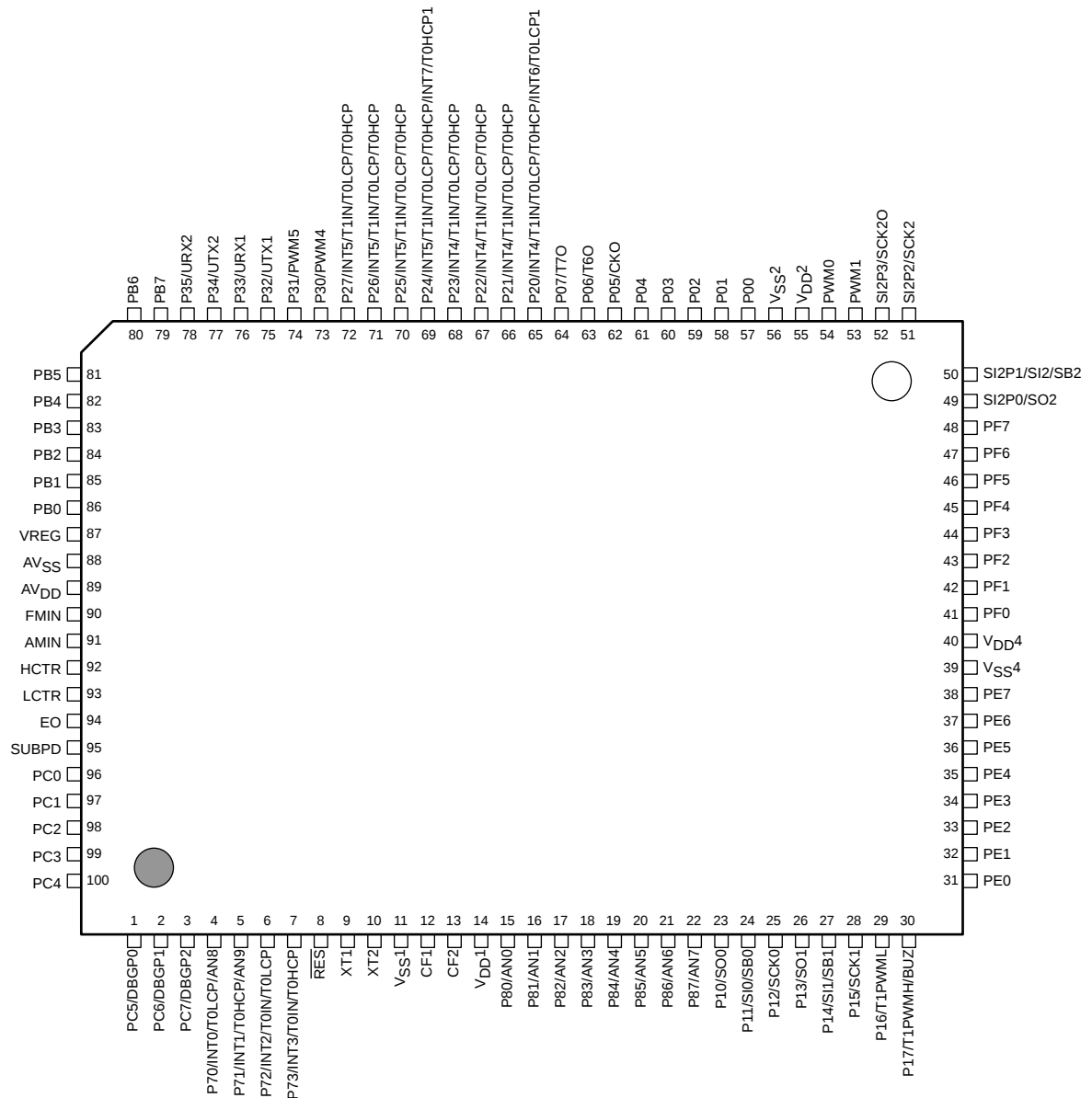


3151A



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Pin Assignment



Top view

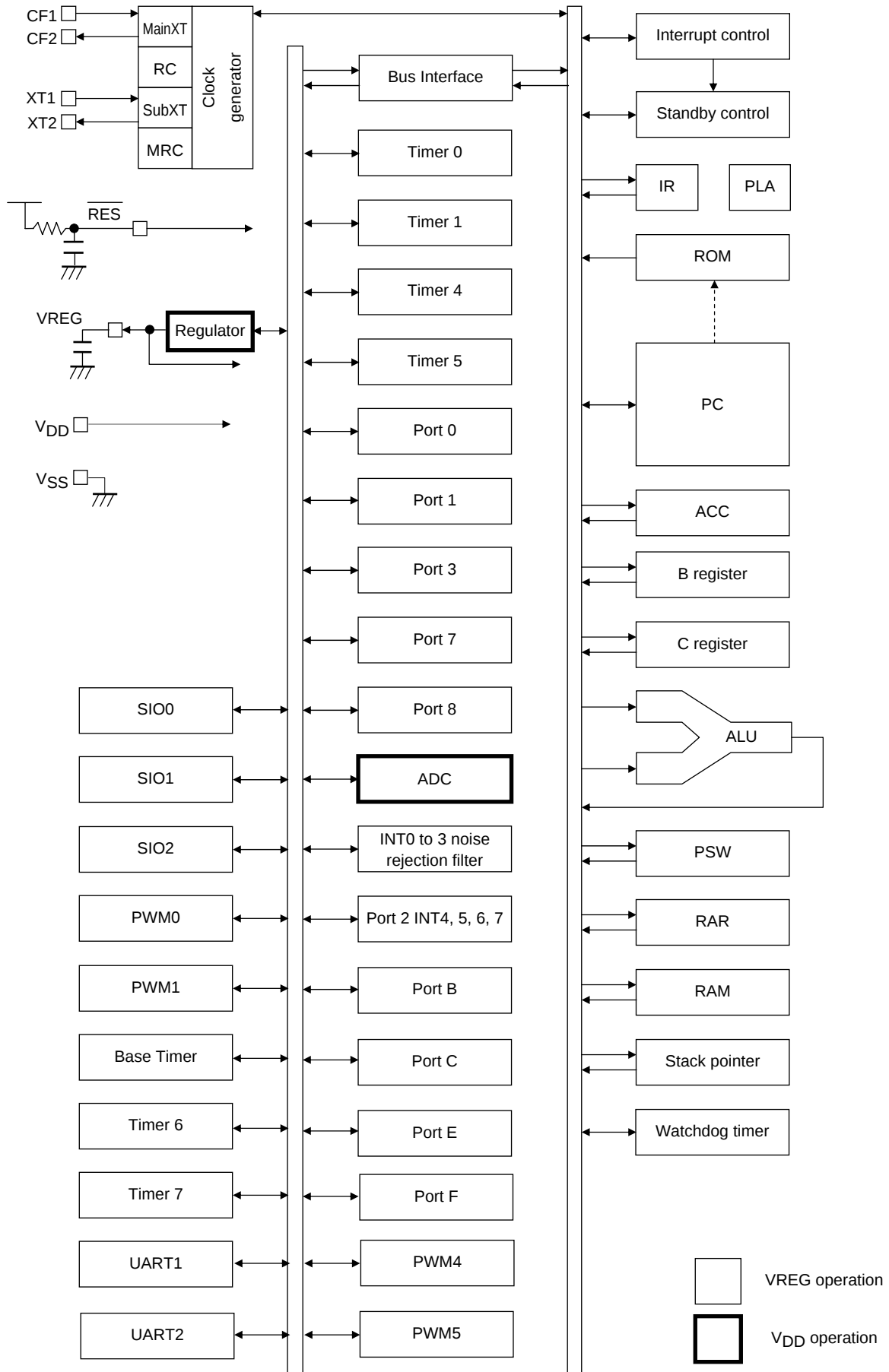
QIP100E (Lead Free Product)

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PIN No.	NAME
1	PC5/DBGP0
2	PC6/DBGP1
3	PC7/DBGP2
4	P70/INT0/T0LCP/AN8
5	P71/INT1/T0HCP/AN9
6	P72/INT2/T0IN/T0LCP
7	P73/INT3/T0IN/T0HCP
8	RES
9	XT1
10	XT2
11	V _{SS} 1
12	CF1
13	CF2
14	V _{DD} 1
15	P80/AN0
16	P81/AN1
17	P82/AN2
18	P83/AN3
19	P84/AN4
20	P85/AN5
21	P86/AN6
22	P87/AN7
23	P10/SO0
24	P11/SI0/SB0
25	P12/SCK0
26	P13/SO1
27	P14/SI1/SB1
28	P15/SCK1
29	P16/T1PWML
30	P17/T1PWMH/BUZ
31	PE0
32	PE1
33	PE2
34	PE3
35	PE4
36	PE5
37	PE6
38	PE7
39	V _{SS} 4
40	V _{DD} 4
41	PF0
42	PF1
43	PF2
44	PF3
45	PF4
46	PF5
47	PF6
48	PF7
49	SI2P0/SO2
50	SI2P1/SI2/SB2

PIN No.	NAME
51	SI2P2/SCK2
52	SI2P3/SCK2O
53	PWM1
54	PWM0
55	V _{DD} 2
56	V _{SS} 2
57	P00
58	P01
59	P02
60	P03
61	P04
62	P05/CKO
63	P06/T6O
64	P07/T7O
65	P20/INT4/T1IN/T0LCP/T0HCP/INT6/T0LCP1
66	P21/INT4/T1IN/T0LCP/T0HCP
67	P22/INT4/T1IN/T0LCP/T0HCP
68	P23/INT4/T1IN/T0LCP/T0HCP
69	P24/INT5/T1IN/T0LCP/T0HCP/INT7/T0HCP1
70	P25/INT5/T1IN/T0LCP/T0HCP
71	P26/INT5/T1IN/T0LCP/T0HCP
72	P27/INT5/T1IN/T0LCP/T0HCP
73	P30/PWM4
74	P31/PWM5
75	P32/UTX1
76	P33/URX1
77	P34/UTX2
78	P35/URX2
79	PB7
80	PB6
81	PB5
82	PB4
83	PB3
84	PB2
85	PB1
86	PB0
87	VREG
88	AV _{SS}
89	AV _{DD}
90	FMIN
91	AMIN
92	HCTR
93	LCTR
94	EO
95	SUBPD
96	PC0
97	PC1
98	PC2
99	PC3
100	PC4

System Block Diagram



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Pin Description

Name	Pin No.	I/O	Function Description	Option																														
V _{SS} 1	11	-	• Power supply pin	No																														
V _{SS} 2	56		• Connect it with GND																															
V _{SS} 4	39																																	
AV _{SS}	88																																	
V _{DD} 1	14	-	• Power supply pin	No																														
V _{DD} 2	55		• Connect it with V _{DD}																															
V _{DD} 4	40																																	
AV _{DD}	89																																	
Port 0		I/O	• 8-bit I/O port	Yes																														
P00	57		• I/O specifiable in 4-bit units																															
P01	58		• Pull-up resistor can be turned on and off in 4-bit units																															
P02	59		• HOLD release input																															
P03	60		• Port 0 interrupt input																															
P04	61		• Other functions																															
P05	62		P05: System clock output																															
P06	63		P06: Timer 6 toggle output																															
P07	64		P07: Timer 7 toggle output																															
Port 1		I/O	• 8-bit I/O port	Yes																														
P10	23		• I/O specifiable in 1-bit units																															
P11	24		• Pull-up resistor can be turned on and off in 1-bit units																															
P12	25		• Other functions																															
P13	26		P10: SIO0 data output																															
P14	27		P11: SIO0 data input, bus I/O																															
P15	28		P12: SIO0 clock I/O																															
P16	29		P13: SIO1 data output																															
P17	30		P14: SIO1 data input, bus I/O P15: SIO1 clock I/O P16: Timer 1 PWML output P17: Timer 1 PWMH output, beeper output																															
Port 2		I/O	• 8-bit I/O port	Yes																														
P20	65		• I/O specifiable in 1-bit units																															
P21	66		• Pull-up resistor can be turned on and off in 1-bit units																															
P22	67		• Other functions																															
P23	68		P20: INT4 input/HOLD release input/timer 1 event input/timer 0L capture input/ timer 0H capture input/INT6 input/timer 0L capture 1 input																															
P24	69		P21 to P23: INT4 input/HOLD release input/timer 1 event input/timer 0L capture input/ timer 0H capture input																															
P25	70		P24: INT5 input/HOLD release input/timer 1 event input/timer 0L capture input/ timer 0H capture input/INT7 input/timer 0H capture 1 input																															
P26	71		P25 to P27: INT5 input/HOLD release input/timer 1 event input/timer0L capture input/ timer 0H capture input																															
P27	72		• Interrupt acknowledge type																															
			<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>INT4</td><td>Y</td><td>Y</td><td>Y</td><td>N</td><td>N</td></tr><tr><td>INT5</td><td>Y</td><td>Y</td><td>Y</td><td>N</td><td>N</td></tr><tr><td>INT6</td><td>Y</td><td>Y</td><td>Y</td><td>N</td><td>N</td></tr><tr><td>INT7</td><td>Y</td><td>Y</td><td>Y</td><td>N</td><td>N</td></tr></table>			Rising	Falling	Rising/ Falling	H level	L level	INT4	Y	Y	Y	N	N	INT5	Y	Y	Y	N	N	INT6	Y	Y	Y	N	N	INT7	Y	Y	Y	N	N
	Rising		Falling		Rising/ Falling	H level	L level																											
INT4	Y		Y		Y	N	N																											
INT5	Y		Y		Y	N	N																											
INT6	Y		Y		Y	N	N																											
INT7	Y	Y	Y	N	N																													
Port 3		I/O	• 6-bit I/O port	Yes																														
P30	73		• I/O specifiable in 1-bit units																															
P31	74		• Pull-up resistor can be turned on and off in 1-bit units																															
P32	75		• Other functions																															
P33	76		P30: PWM4 output																															
P34	77		P31: PWM5 output																															
P35	78		P32: UART1 transmit P33: UART1 receive P34: UART2 transmit P35: UART2 receive																															

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Name	Pin No.	I/O	Function Description	Option																														
Port 7		I/O	• 4-bit I/O port • I/O specifiable in 1-bit units • Pull-up resistor can be turned on and off in 1-bit units • Other functions P70: INT0 input/HOLD release input/Timer 0L capture input/Output for watchdog timer/ AD converter input port P71: INT1 input/HOLD release input/Timer 0H capture input/ AD converter input port P72: INT2 input/HOLD release input/Timer 0 event input/timer0L capture input P73: INT3 input with noise filter/Timer 0 event input/timer 0H capture input • Interrupt acknowledge type <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>Y</td><td>Y</td><td>N</td><td>Y</td><td>Y</td></tr><tr><td>INT1</td><td>Y</td><td>Y</td><td>N</td><td>Y</td><td>Y</td></tr><tr><td>INT2</td><td>Y</td><td>Y</td><td>Y</td><td>N</td><td>N</td></tr><tr><td>INT3</td><td>Y</td><td>Y</td><td>Y</td><td>N</td><td>N</td></tr></table>		Rising	Falling	Rising/ falling	H level	L level	INT0	Y	Y	N	Y	Y	INT1	Y	Y	N	Y	Y	INT2	Y	Y	Y	N	N	INT3	Y	Y	Y	N	N	No
	Rising	Falling	Rising/ falling	H level	L level																													
INT0	Y	Y	N	Y	Y																													
INT1	Y	Y	N	Y	Y																													
INT2	Y	Y	Y	N	N																													
INT3	Y	Y	Y	N	N																													
Port 8		I/O	• 8-bit I/O port (Output: N-channel open drain) • I/O specifiable in 1-bit units • Other functions P80 to P87: AD converter input port	No																														
P80	15																																	
P81	16																																	
P82	17																																	
P83	18																																	
P84	19																																	
P85	20																																	
P86	21																																	
P87	22																																	
Port B		I/O	• 8-bit I/O port • I/O specifiable in 1-bit units • Pull-up resistor can be turned on and off in 1-bit units	Yes																														
PB0	86																																	
PB1	85																																	
PB2	84																																	
PB3	83																																	
PB4	82																																	
PB5	81																																	
PB6	80																																	
PB7	79																																	
Port C		I/O	• 8-bit I/O port • I/O specifiable in 1-bit units • Pull-up resistor can be turned on and off in 1-bit units Other functions PC5 to PC7 (DBGP0 to DBG P2): On-chip Debugger port	Yes																														
PC0	96																																	
PC1	97																																	
PC2	98																																	
PC3	99																																	
PC4	100																																	
PC5	1																																	
PC6	2																																	
PC7	3																																	
Port E		I/O	• 8-bit I/O port • I/O specifiable in 2-bit units • Pull-up resistor can be turned on and off in 1-bit units	No																														
PE0	31																																	
PE1	32																																	
PE2	33																																	
PE3	34																																	
PE4	35																																	
PE5	36																																	
PE6	37																																	
PE7	38																																	
Port F		I/O	• 8-bit I/O port • I/O specifiable in 2-bit units • Pull-up resistor can be turned on and off in 1-bit units	No																														
PF0	41																																	
PF1	42																																	
PF2	43																																	
PF3	44																																	
PF4	45																																	
PF5	46																																	
PF6	47																																	
PF7	48																																	

Continued on next page.

LC87F83P7PA/P7PAU

Continued from preceding page.

Name	Pin No.	I/O	Function Description	Option
SIO2	49 50 51 52	I/O	• 4-bit I/O port • I/O specifiable in 1-bit units • Other functions: SIO2P0: SIO2 data output SIO2P1: SIO2 data input, bus input/output SIO2P2: SIO2 clock input/output SIO2P3: SIO2 clock output	No
SI2P0				
SI2P1				
SI2P2				
PWM0	54	I/O	• PWM0 output port • General-purpose I/O available	No
PWM1	53	I/O	• PWM1 output port • General-purpose I/O available	No
RES	8	I	• Reset pin - Must connect it with V_{DD1} through RC (Refer to Page27 Figure 1)	No
XT1	9	I	• Input terminal for 32.768kHz X'tal oscillation • Other functions: General-purpose input port - Must be set for input with software and connected to V_{SS1} if not to be used.	No
XT2	10	I/O	• Output terminal for 32.768kHz X'tal oscillation • Other functions: General-purpose I/O port - Must be set for general-purpose output and kept open if not to be used. - Please connect suitable dumping resistance for the crystal used between the terminal when you use it as Output terminal for 32.768kHz X'tal oscillation.	No
CF1	12	I	• Input terminal for 13.5MHz X'tal oscillation	No
CF2	13	O	• Output terminal for 13.5MHz X'tal oscillation	No
EO	94	O	• Output terminal for main charge pump	No
SUBPD	95	O	• Output terminal for sub charge pump	No
FMIN	90	I	• Input terminal for FM VCO (local oscillator) • The signal input to this pin must be capacitor coupled (Note.1) • Input frequency: 10 to 150MHz - Please open the terminal when you do not use this terminal. Moreover, please make the pull-down of this terminal effective with software.	No
AMIN	91	I	• Input terminal for AM VCO (local oscillator) • The signal input to this pin must be capacitor coupled (Note.1) • Input frequency: 0.5 to 40MHz - Please open the terminal when you do not use this terminal. Moreover, please make the pull-down of this terminal effective with software.	No
HCTR	92	I	• Input terminal for Universal counter • The signal input to this pin must be capacitor coupled (Note.1) • Input frequency: 0.4 to 12MHz - Please open the terminal when you do not use this terminal. Moreover, please make the pull-down of this terminal effective with software.	No
LCTR	93	I	• Input terminal for Universal counter • The signal input to this pin must be capacitor coupled (Note.1) • Input frequency: 100 to 500kHz - Please open the terminal when you do not use this terminal. Moreover, please make the pull-down of this terminal effective with software.	No
VREG	87	O	• Internal low voltage output • Connect a bypass capacitor to this pin. (Refer to Page27)	No

Note.1: Put the coupling capacitor near the terminal. About 100pF of capacity is preferable.

Especially, adjust the capacity of HCTR and LCTR to 1000pF or less.

Port Output Configuration

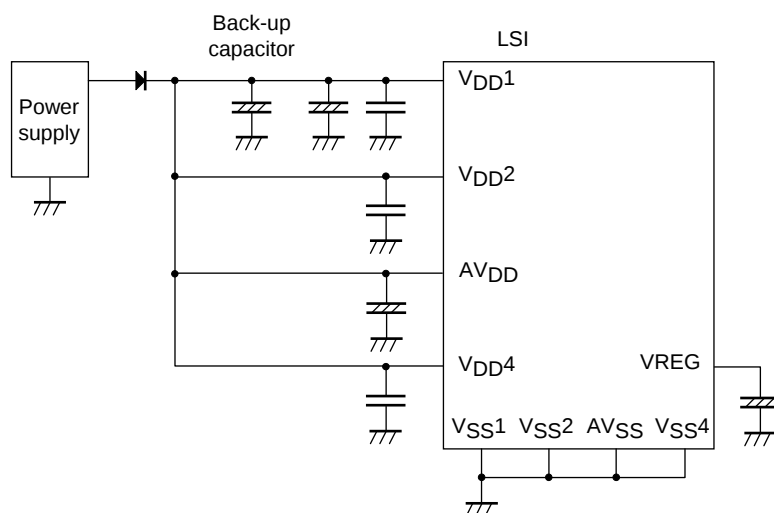
The table below lists the types of port outputs and the presence/absence of a pull-up resistor.
Data can be read into any input port even if it is in the output mode.

Port	Options selected in units of	Option type	Output type	Pull-up resistor
P00 to P07	1 bit	1	CMOS	Programmable (Note 1)
		2	N-channel open drain	No
P10 to P17 P20 to P27 P30 to P35	1 bit	1	CMOS	Programmable
		2	N-channel open drain	Programmable
PB0 to PB7 PC0 to PC7	1 bit	1	CMOS	Programmable
		2	N-channel open drain	Programmable
PE0 to PE7 PF0 to PF7	-	No	CMOS	Programmable
P70	-	No	N-channel open drain	Programmable
P71 to P73	-	No	CMOS	Programmable
P80 to P87	-	No	N-channel open drain	No
SI2P0, SI2P2, SI2P3 PWM0, PWM1	-	No	CMOS	No
SI2P1	-	No	CMOS (when selected as ordinary port) N-channel open drain (When SIO2 data is selected)	No
FMIN, AMIN, HCTR, LCTR	-	No	Input only	No
EO, SUBPD	-	No	Output only	No
XT1	-	No	Input only	No
XT2	-	No	Output for 32.768kHz quartz oscillator N-channel open drain (when in general-purpose output mode)	No

Note 1: Programmable pull-up resistors for port 0 are controlled in 4 bit units (P00 to 03, P04 to 07).

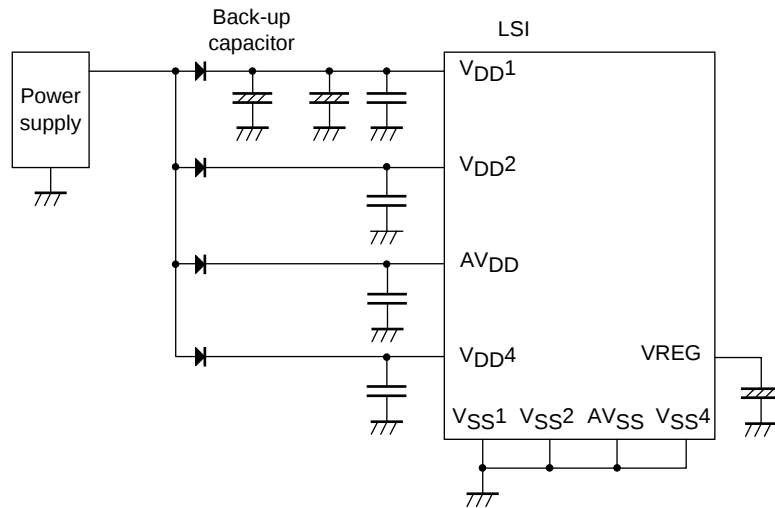
*1: Make the following connection to minimize the noise input to the V_{DD1} pin and prolong the backup time.
Be sure to electrically short the V_{SS1}, V_{SS2}, AV_{SS} and V_{SS4} pins.

(Example 1) When backup is active in the HOLD mode, the high level of the port outputs is supplied by the backup capacitors.



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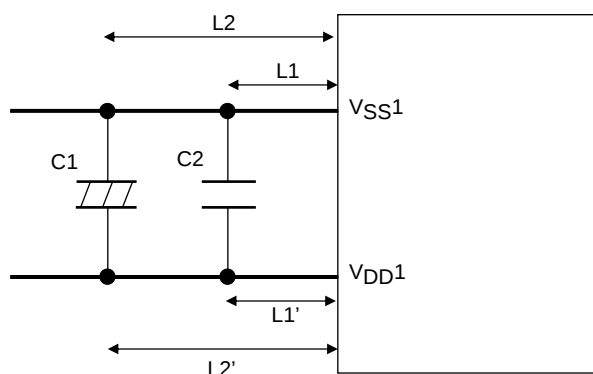
(Example 2) The high-level output at the ports is unstable when the HOLD mode backup is in effect.



V_{DD1}, V_{SS1} Terminal condition

It is necessary to place capacitors between V_{DD1} and V_{SS1} as describe below.

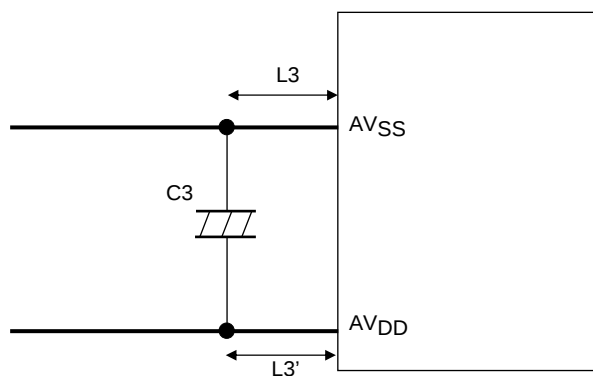
- Place capacitors as close to V_{DD1} and V_{SS1} as possible.
- Place capacitors so that the length of each terminal to the each leg of the capacitor be equal ($L1 = L1'$, $L2 = L2'$).
- Place high capacitance capacitor C1 and low capacitance capacitor C2 in parallel.
- Capacitance of C2 must be more than 0.1μF.
- Please mount a suitable capacitor about C1.
- Use thicker pattern for V_{DD1} and V_{SS1}.



AV_{DD}, AV_{SS} Terminal condition

It is necessary to place capacitors between AV_{DD} and AV_{SS} as describe below.

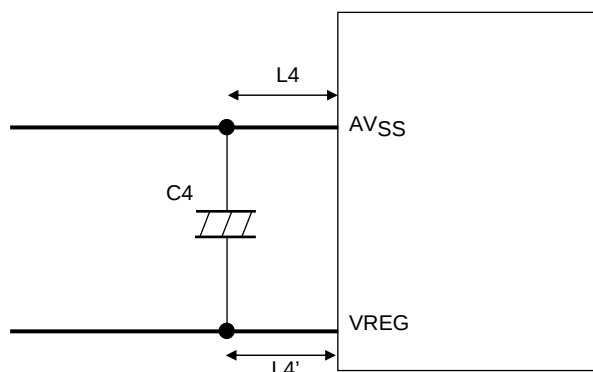
- Place capacitors as close to AV_{DD} and AV_{SS} as possible.
- Place capacitors so that the length of each terminal to the each leg of the capacitor be equal ($L3 = L3'$).
- Capacitance of C3 must be more than 1μF.
- Use thicker pattern for AV_{DD} and AV_{SS}.



VREG, AVSS Terminal condition

It is necessary to place capacitors between VREG and AVSS as describe below.

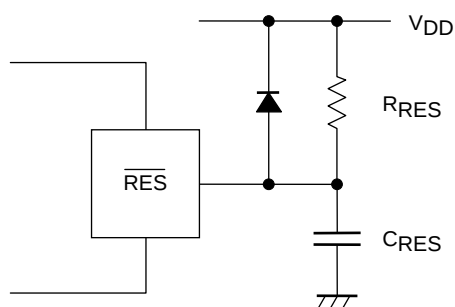
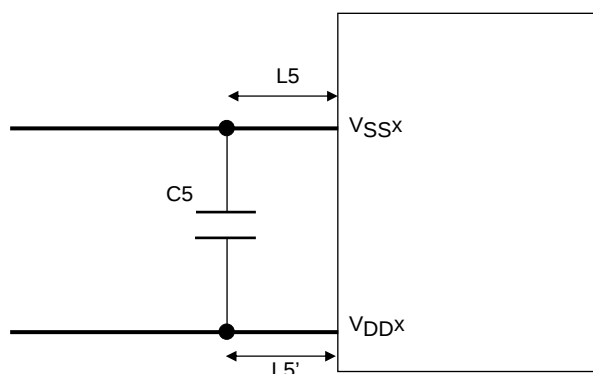
- Place capacitors as close to VREG and AVSS as possible.
- Place capacitors so that the length of each terminal to the each leg of the capacitor be equal ($L4 = L4'$).
- Capacitance of C4 must be more than $1\mu\text{F}$ to $10\mu\text{F}$.
- Use thicker pattern for VREG and AVSS.



VDDx, VSSx Terminal condition x=2, 4

It is necessary to place capacitors between VDDx and VSSx as describe below.

- Place capacitors as close to VDDx and VSSx as possible.
- Place capacitors so that the length of each terminal to the each leg of the capacitor be equal ($L5 = L5'$).
- Capacitance of C5 must be more than $0.1\mu\text{F}$.
- Use thicker pattern for VDDx and VSSx.



(Note) Select C_{RES} and R_{RES} value to assure that reset is generated after the V_{DD} becomes higher than the minimum operating voltage.

Recommended value
 C_{RES} : $0.47\mu\text{F}$
 R_{RES} : $270\text{k}\Omega$

Figure 1 Reset circuit

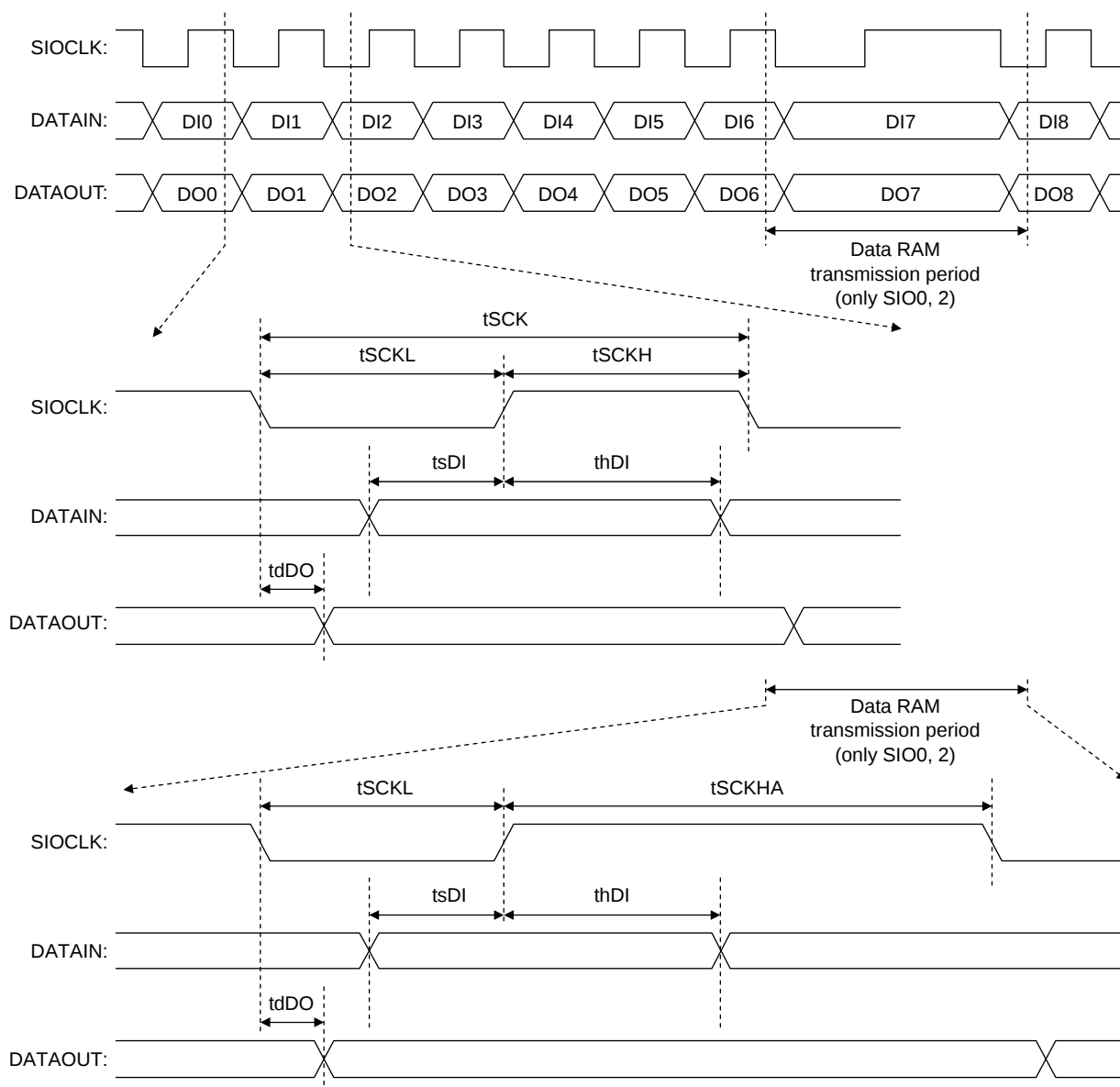


Figure 2 Serial input/output test condition

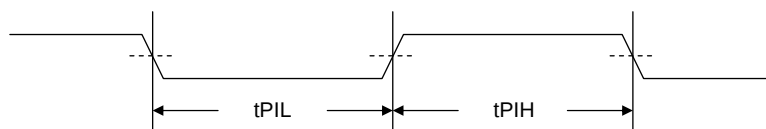


Figure 3 Pulse input timing condition

Concerning differences of the Mask Version and the Flash Version

- 1) Although the electrical specifications are the same for the mask and flash versions, differences may arise in the actual values for threshold level of the input ports, output current of the output ports, input sensitivity, etc. Variations may also be found from lot to lot. It must therefore be kept in mind that if finished products are designed using the actual values of the samples, these variations may prevent the finished products from operating.
- 2) The undesirable radiation level is not listed among the specifications. Since differences may arise between the mask and flash versions, this must be kept in mind when designing the finished products.

Concerning differences of ROM writing in our company and user

	ROM writing in our company	ROM writing in user
Name of articles	LC87F83P7PA-FXXXX-E	LC87F83P7PAU-QIP-E
Tape Out	Necessary	Unnecessary
Data confirmation after writing	Our company	User
Terminal destruction confirmation after writing	Our company	User
Terminal curved confirmation after writing	Our company	User

The W87F83256Q circuit board must be requested as the data writing board.

The AF-9708 made by Ando is recommended as the ROM writer. Confirm ROM writer's version to the office.

Method of ordering ROM when ROM writing by our company is done

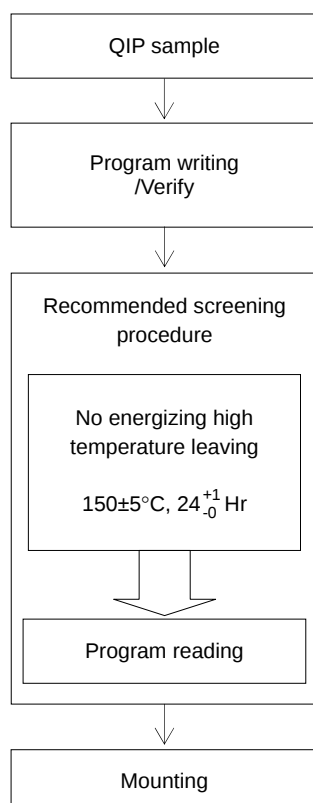
Please submit Program of flash ROM and Flash ROM order material to the person in charge of each business.

Condition before it mounts

1. Writing by user

PROM unwriting shipment goods

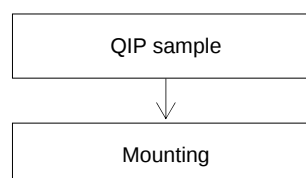
It is recommended to mount according to the following procedures.



2. Writing by our company

PROM writing shipment goods

Please mount according to the following procedures.



Example of Writing Data onto the on-chip Flash ROM of the LC87F83P7PAU (using the AF-9708)

I. Writing the data using the AF-9708 (made by ANDO) PROM programmer

1. ROMTYPE settings

→ Select [MAKER] →
 → Select [SANYO] →
 → Select [LC87F83P7PA] →

It corresponds now PROM PROGRAMMER AF-9708 (made of ANDO). Please inquire of the person in charge of each business.

2. Start/Stop address settings

→ : Address setting mode

Type No.	ROM capacity	Stop address
LC878396PB	96KB	3FFFF
LC8783C8PB	128KB	
LC8783G1PB/G0PB	160KB	
LC8783J2PB/J3PB	192KB	
LC8783M4PB	224KB	
LC8783P6PB/P7PB	256KB	

3. Executing data erasure

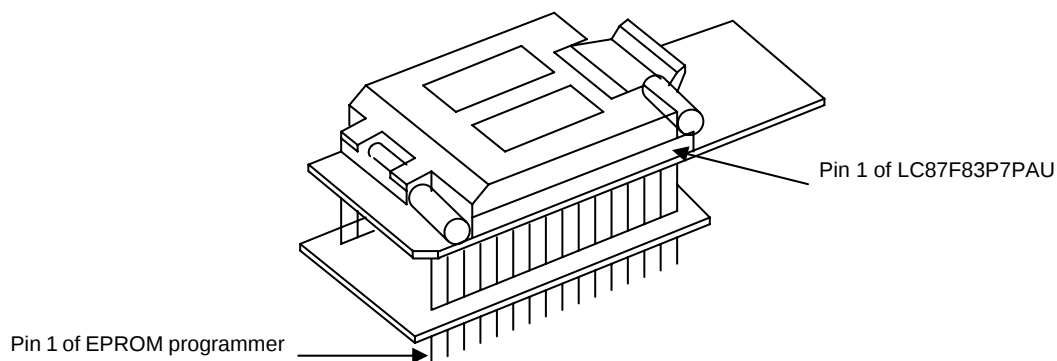
→ → : For data erasure execution.

4. Executing data writing

→ → : For program and verify execution.

II. Writing board

The writing board is shown in the figure below. The position of pin 1 must be checked before connecting to the EPROM programmer.



To be used for the general-purpose EPROM programmer: Model W87F83256Q

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