

€ Normal mode: 35 sources (15 modules), 10 vectors

No.	Vector	Interrupt Module
1	08000H	Watchdog timer (1)
2	08004H	Base timer (2)
3	08008H	Timer 0 (2)
4	08018H	Timer 1 (2)/UART2 (4)
5	0801CH	SMIIC0 (1)
6	08020H	Timer 3 (2)/infrared remote control receiver (4)
7	08024H	Timer 4 (1)
8	08030H	ADC (1)/timer 5 (1)
9	08038H	SIO0 (2)
10	0803CH	Port 0 (3)/RTC2 (1)/SEGINT (8)

€ LC888300 Compatible mode: 35 sources (15 modules), 13 vectors

No.	Vector	Interrupt Module
1	08000H	Watchdog timer (1)
2	08004H	Base timer (2)
3	08008H	Timer 0 (2)
4	08018H	SIO0 (2)
5	0801CH	Timer 1 (2)
6	08020H	UART2 (4)
7	08024H	Timer 3 (2)
8	08028H	Timer 4 (1)
9	0802CH	Timer 5 (1)
10	08030H	ADC (1)
11	08034H	SMIIC0 (1)
12	08038H	Infrared remote control receiver (4)
13	0803CH	Port 0 (3)/RTC2 (1)/SEGINT (8)

€ Priority levels X > H > L

€ When interrupts of the same level occur at the same time, interrupt with a smaller vector address is given priority.

€ The number in parentheses indicates the number of sources in a module.

„Subroutine stack: 8Kbyte RAM area

€ Subroutine calls that automatically save the PSW, interrupt vector call: 6 bytes

€ Subroutine calls that do not automatically save the PSW: 4 bytes

„Multiplication/division instructions

€ 16 bits× 16 bits (18 tCYC execution time)

€ 16 bits÷ 16 bits (18 to 19 tCYC execution time)

€ 32 bits÷ 16 bits (18 to 19 tCYC execution time)

√Oscillator circuits

€ RC oscillator circuit (internal): For system clock

€ CF oscillator circuit: For system clock (OSC1)

€ RC oscillator circuit (external CR1): For system clock (OSC1)

€ Crystal oscillator circuit (Rf built-in): For low-speed system clock (OSC0) (option available)

€ RC oscillator circuit (external CR0): For low-speed system clock (OSC0)

€ SLRC oscillator circuit (internal): For system clock (used during exception processing)

√System clock frequency divider function

€ Can run on low consumption current.

€ Supports frequency-dividing of 1/1 to 1/128 of the system clock

„Standby function

€ HALT mode: Halts instruction execution while allowing the peripheral circuits to continue operation.

1) Oscillation is not halted automatically.

2) HALT mode is released by a system reset or an interrupt .

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- **HOLD mode:** Suspends instruction execution and the operation of the peripheral circuits.
 - 1) OSC1, RC, and OSC0 oscillations automatically stop.
 - 2) There are five ways of releasing the HOLD mode:
 - <1> Setting the reset pin to the low level
 - <2> Having an interrupt source established at port 0
 - <3> Having an interrupt source established at SIO0
 - <4> Having an interrupt source established at UART2
 - <5> Having an interrupt source established at SEGINT
- **HOLDX mode:** Suspends instruction execution and the operation of all the circuits except the peripheral circuits running on OSC0.
 - 1) OSC1 and RC oscillators automatically stop operation.
 - 2) OSC0 retains the state established when the HOLDX mode is entered.
 - 3) There are seven ways of releasing the HOLDX mode:
 - <1> Setting the reset pin to the low level
 - <2> Having an interrupt source established at port 0
 - <3> Having an interrupt source established at SIO0
 - <4> Having an interrupt source established at UART2
 - <5> Having an interrupt source established at SEGINT
 - <6> Having an interrupt source established in the base timer or RTC2 circuit
 - <7> Having an interrupt source established in the infrared remote control receiver circuit

■ **On-chip debugger function**

- Supports software debugging with the microcontroller mounted on the target board.
- Supports source line debugging, tracing, breakpoint manipulation, and realtime display.
- Single-wire communication

■ **Operating temperature**

- -20 to +75°C

■ **Package form**

- TQFP120 (14×14) (lead-free type)

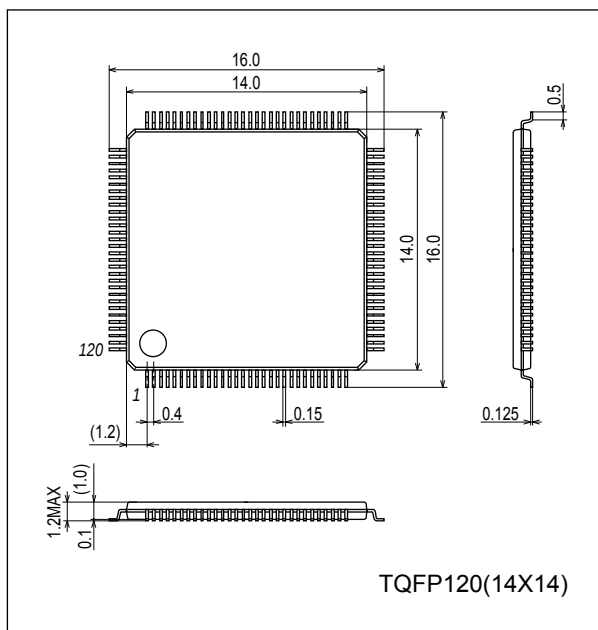
■ **Development tools**

- On-chip debugger: EOCUIF1 + LC88F85D0A

Package Dimensions

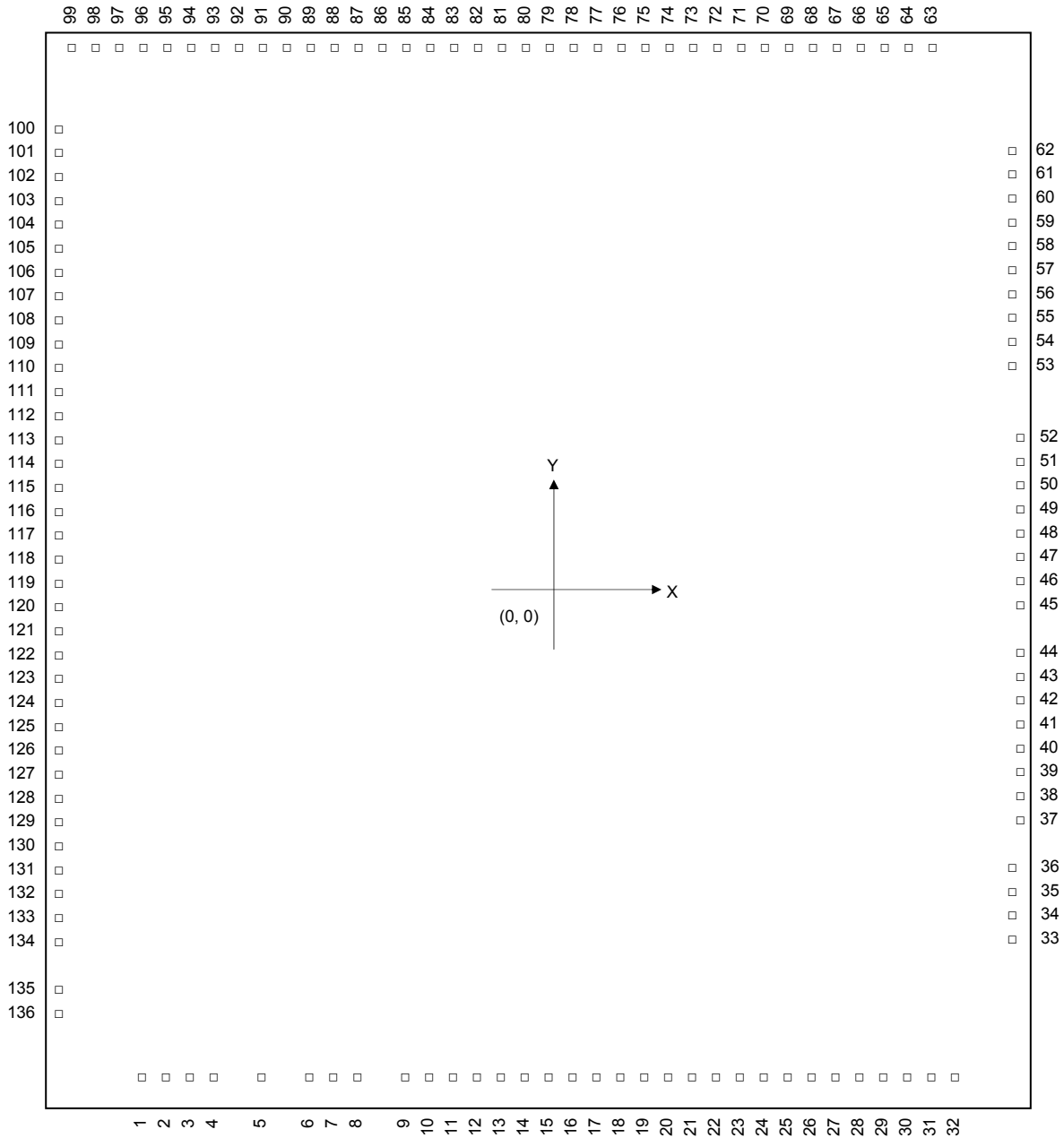
unit : mm (typ)

3257A



Pad Assignment

- Chip size (X × Y) : 4.10mm × 3.40mm
- PAD opening siz : 59μm
- PAD pitch : 80μm
- Chip thickness : 280μm ± 20μm



- Note: Package pin numbers differ from chip pad numbers. The numbers shown in the above figure are pad numbers.

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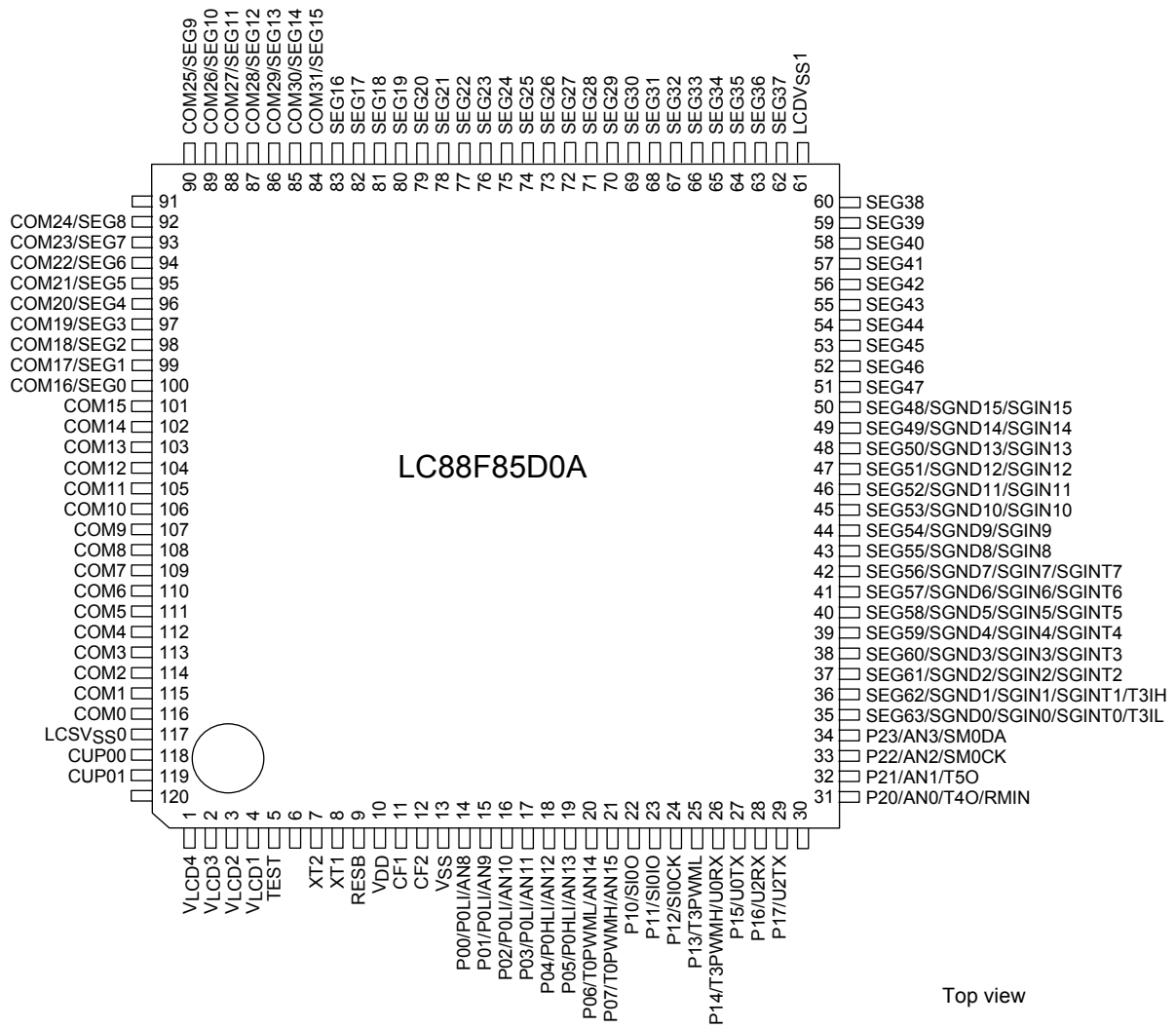
Table of PAD Coordinates

Pad No.	Pin Name	Coordinate		Pad No.	Pin Name	Coordinate	
		X μ m	Y μ m			X μ m	Y μ m
1	V _{LCD4}	-1647.9	-1569.9	48	SEG52	1958.5	208.2
2	V _{LCD3}	-1567.9	-1569.9	49	SEG51	1958.5	298.2
3	V _{LCD2}	-1483.2	-1569.9	50	SEG50	1958.5	388.2
4	V _{LCD1}	-1403.2	-1569.9	51	SEG49	1958.5	478.2
5	TST	-1184.0	-1569.9	52	SEG48	1958.5	568.2
6	XT2	-890.0	-1569.9	53	SEG47	1919.9	710.0
7	XT1	-781.5	-1569.9	54	SEG46	1919.9	790.0
8	RESB	-670.0	-1569.9	55	SEG45	1919.9	870.0
9	V _{DD}	-494.5	-1569.9	56	SEG44	1919.9	950.0
10		-374.5	-1569.9	57	SEG43	1919.9	1030.0
11		-263.5	-1569.9	58	SEG42	1919.9	1110.0
12	CF1	-165.0	-1569.9	59	SEG41	1919.9	1190.0
13	CF2	-85.0	-1569.9	60	SEG40	1919.9	1280.0
14	V _{SS}	10.0	-1569.9	61	SEG39	1919.9	1370.0
15		110.0	-1569.9	62	SEG38	1919.9	1460.0
16		210.0	-1569.9	63	LCDV _{SS1}	1420.0	1569.9
17	P00	300.0	-1569.9	64	SEG37	1300.0	1569.9
18	P01	380.0	-1569.9	65	SEG36	1190.0	1569.9
19	P02	460.0	-1569.9	66	SEG35	1080.0	1569.9
20	P03	540.0	-1569.9	67	SEG34	990.0	1569.9
21	P04	620.0	-1569.9	68	SEG33	910.0	1569.9
22	P05	700.0	-1569.9	69	SEG32	830.0	1569.9
23	P06	780.0	-1569.9	70	SEG31	750.0	1569.9
24	P07	860.0	-1569.9	71	SEG30	670.0	1569.9
25	P10	940.0	-1569.9	72	SEG29	590.0	1569.9
26	P11	1020.0	-1569.9	73	SEG28	510.0	1569.9
27	P12	1100.0	-1569.9	74	SEG27	430.0	1569.9
28	P13	1180.0	-1569.9	75	SEG26	350.0	1569.9
29	P14	1260.0	-1569.9	76	SEG25	270.0	1569.9
30	P15	1340.0	-1569.9	77	SEG24	190.0	1569.9
31	P16	1420.0	-1569.9	78	SEG23	110.0	1569.9
32	P17	1500.0	-1569.9	79	SEG22	30.0	1569.9
33	P20	1919.9	-1415.0	80	SEG21	-50.0	1569.9
34	P21	1919.9	-1325.0	81	SEG20	-130.0	1569.9
35	P22	1919.9	-1192.0	82	SEG19	-210.0	1569.9
36	P23	1919.9	-1057.0	83	SEG18	-290.0	1569.9
37	SEG63	1958.5	-871.8	84	SEG17	-370.0	1569.9
38	SEG62	1958.5	-781.8	85	SEG16	-450.0	1569.9
39	SEG61	1958.5	-691.8	86	-	-	-
40	SEG60	1958.5	-601.8	87	COM31/SEG15	-620.0	1569.9
41	SEG59	1958.5	-511.8	88	-	-	-
42	SEG58	1958.5	-421.8	89	COM30/SEG14	-780.0	1569.9
43	SEG57	1958.5	-331.8	90	-	-	-
44	SEG56	1958.5	-241.8	91	COM29/SEG13	-940.0	1569.9
45	SEG55	1958.5	-61.8	92	-	-	-
46	SEG54	1958.5	28.2	93	COM28/SEG12	-1100.0	1569.9
47	SEG53	1958.5	118.2	94	-	-	-

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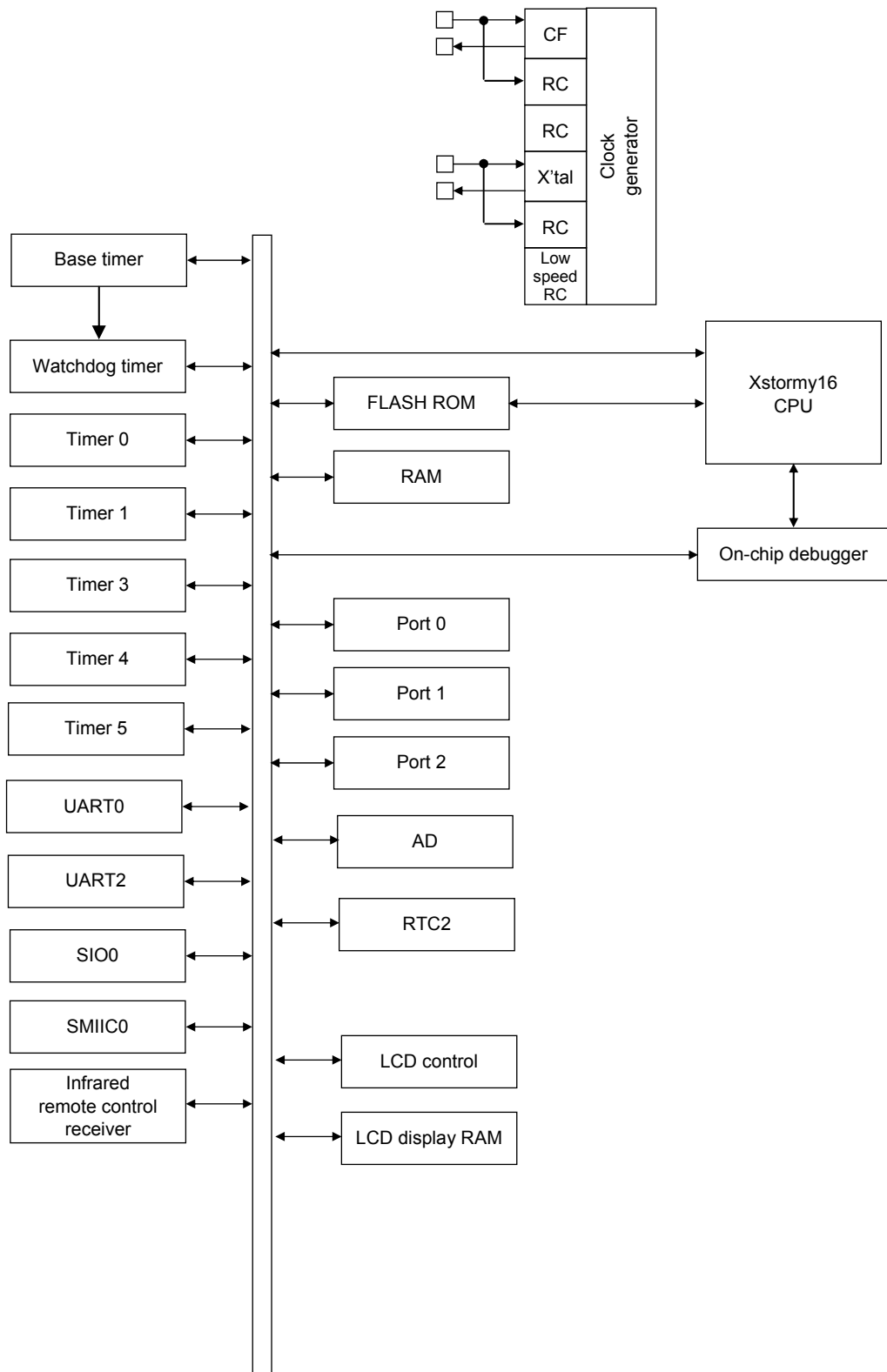
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Pin Assignment



TQFP120 (14×14) “Lead-free Type”

System Block Diagram



Pin Description

Pin Name	I/O	Description
V _{SS}	-	- Power supply pin
V _{DD}	-	+ Power supply pin
V _{LCD1} to 4	-	LCD bias power source (connected to capacitors)
LCDV _{SS0} , LCDV _{SS1}	-	LCD port power source (-)
CUP00, CUP01	-	Switching pins for generating the LCD drive voltage. A capacitor must be connected across both pins.
PORT 0 P00 to P07	I/O	• 8-bit I/O port • I/O specifiable in 1 bit units • Pull-up registers can be turned on and off in 1-bit units. • HOLD releset inputs (P00 to P03, P04, P05) • Port 0 interrupt inputs (P00 to P03, P04, P05) • Pin functions - P00 (AN8) to P07 (AN15): AD converter inputs - P06: Timer 0L output - P07: Timer 0H output/UART0 clock input
PORT 1 P10 to P17	I/O	• 8-bit I/O port • I/O specifiable in 1-bit units • Pull-up registers can be turned on and off in 1-bit units. • Pin functions - P10: SIO0 data output - P11: SIO0 data input/bus input/output - P12: SIO0 clock input/output - P13: Timer 3L output - P14: Timer 3H output/UART0 receive - P15: UART0 transmit - P16: UART2 receive - P17: UART2 transmit
PORT 2 P20 to P23	I/O	• 4-bit I/O port • I/O specifiable in 1-bit units • Pull-up registers can be turned on and off in 1-bit units. • Pin functions - P20 (AN0) to P23 (AN3): AD converter inputs - P20: Timer 4 output/remote controller receive - P21: Timer 5 output - P22: SMIIC0 clock input/output - P23: SMIIC0 bus input/output/data input
COM0 to COM15	O	• LCD common output
COM16/SEG0 to COM31/SEG15	O	• LCD common output/segment output Common output/segment output switched by a register
SEG16 to SEG47	O	• LCD segment output
SEG48 to SEG63	I/O	• LCD segment output • SEG63-SEG48: General-purpose N-channel open drain output/general-purpose input SEG63-SEG48: LCD output in 4-bit units/general-purpose N-channel open drain output/general-purpose input selectable • SEG63-SEG56: Interrupt function (4-bit units) Chatter removal sampling frequency select (4-bit units) Level/edge sense mode select (4-bit units) Hi/low level or rising/falling edge sense mode select (1-bit units) • SEG63-SEG62: Timer 3 external input
TEST	I/O	• TEST pin • On-chip debugger communication pin • An external 100kΩ pull-down resistor must be connected.
RESB	I	Reset pin
CF1	I	Ceramic oscillator input/RC oscillator resistor to be connected
CF2	O	Ceramic oscillator output
XT1	I	32.768kHz crystal oscillator input/RC oscillator resistor to be connected
XT2	O	32.768kHz crystal oscillator output

Port Output Types

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 Name	Options Selected in Units of	Output Type	Pull-up Resistor
P00 to P07	1 bit	CMOS	Programmable
P10 to P17 P20 to P23	1 bit	Multiplexed pin outputs are programmable either as CMOS or N-channel open drain output.	Programmable
SEG48 to SEG63	4 bits	N-channel open drain (LCD segment output)	None

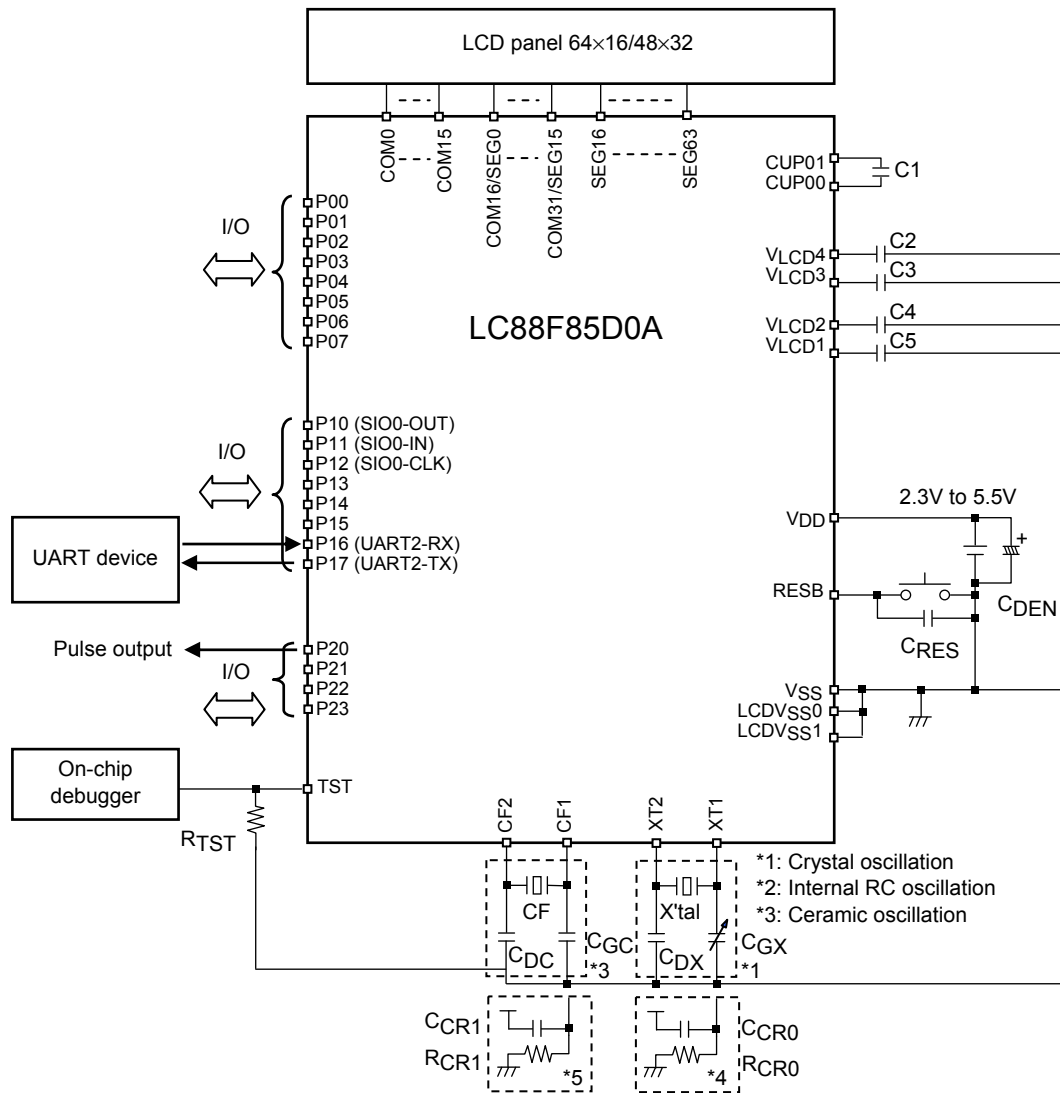
Table of User Options

Option Name	Option	Description
X'tal OSC (*1)	Normal	Normal XT mode
	Low Power	Low power XT mode
Interrupt Vector (*2)	Normal	Interrupt vector switching
	LC888300 Compatible	

*1 The circuit constant values of the external components and oscillation stabilization time differ between the normal XT mode and low power XT mode.

*2 The "LC888300 Compatible" mode is an option that is available to provide compatibility between this model and the LC888300. It is to be unavailable in future models.

Application circuit



X'tal	Crystal resonator
CGX	Trimmer capacitor
CDX	Capacitor for X'tal oscillator
RCR0	Resistor for low-speed oscillator *4: RC oscillation type
CCR0	Capacitor for low-speed oscillation stabilization *4: RC oscillation type (*1)
(*1)	0.1μF capacitor is recommended when using XT1/XT2 as the system clock source.
CF	Ceramic resonator
CGC	Capacitor for CF oscillator
CDC	Capacitor for CF oscillator
RCR1	Resistor for high-speed oscillation *5: RC oscillation type
CCR1	Capacitor for high-speed oscillation stabilization *5: RC oscillation type
C1 to C5	Capacitor
CDEN	Electrolytic capacitor
CRES	Capacitance for RESB
RTST	Resistor used when using the on-chip debugger

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Absolute Maximum Ratings at Ta = 25°C, V_{SS} = LCDV_{SS0} = LCDV_{SS1} = 0V

Parameter	Symbol	Pin/Remarks	Conditions	V _{DD} [V]	Specification			
					min	typ	max	unit
Maximum supply voltage	V _{DD} max	V _{DD}	V _{DD}		-0.3		+6.5	V
LCD supply voltage	V _{LCD} max	V _{LCD2} to V _{LCD4}	V _{DD}		-0.3		+6.5	
Maximum LCD supply voltage	LCD max	SEG0 to SEG63 COM0 to COM31	V _{DD} , V _{LCD4}		-0.3		+6.5	
Input voltage	V _I (1)	CF1, XT1, RESB			-0.3		V _{DD} +0.3	
Input/output voltage	V _{IO} (1)	Ports 0, 1, 2 SEG63 to SEG48			-0.3		V _{DD} +0.3	
High level output current	Peak output current	IOPH(1)	Ports 0, 2	CMOS output select Per 1 applicable pin		-5		mA
		IOPH(2)	Port 1	Per 1 applicable pin		-14		
	Mean output current (Note 1-1)	IOMH(1)	Ports 0, 2	CMOS output select Per 1 applicable pin		-3		
		IOMH(2)	Port 1	CMOS output select Per 1 applicable pin		-9		
	Total output current	ΣIOAH(1)	Ports 0, 2	Total of all applicable pins		-22.5		
		ΣIOAH(2)	Port 1	Total of all applicable pins		-25		
		ΣIOAH(3)	Ports 0, 1, 2	Total of all applicable pins		-47.5		
Low level output current	Peak output current	IOPL(1)	Ports 0, 2	Per 1 applicable pin			13	
		IOPL(2)	Port 1	Per 1 applicable pin			17	
	Mean output current (Note 1-1)	IOML(1)	Ports 0, 2	Per 1 applicable pin			7.5	
		IOML(2)	Port 1	Per 1 applicable pin			10.5	
	Total output current	ΣIOAL(1)	Ports 0, 2	Total of all applicable pins			35	
		ΣIOAL(2)	Port 1	Total of all applicable pins			60	
		ΣIOAL(3)	Ports 0, 1, 2	Total of all applicable pins			80	
Allowable power dissipation	Pd max		Ta=-20 to +75°C				250	mW
Operating ambient temperature	Topr				-20		+75	°C
Storage ambient temperature	Tstg				-65		+125	

Note 1-1: The mean output current is a mean value measured over 100ms.

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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Allowable Operating Conditions at Ta = -20°C to +75°C, V_{SS} = LCDV_{SS0} = LCDV_{SS1} = 0V

Parameter	Symbol	Pin/Remarks	Conditions	Ratings				
				V _{DD} [V]	min	typ	max	unit
Operating supply voltage (Note2-1)	V _{DD} (1)	V _{DD}	0.098μs≤tCYC≤66μs		4.5		5.5	V
			0.123μs≤tCYC≤66μs		3.0		5.5	
			0.490μs≤tCYC≤66μs		2.0		5.5	
LCD drive voltage	V _{LCD} (1)	V _{LCD2} to V _{LCD4}					5.5	
Memory sustaining supply voltage	V _{HD}	V _{DD}	RAM and register contents sustained in HOLD mode.		2.0		5.5	
High level input voltage	V _{IH} (1)	Ports 0, 1, 2	Output disabled		0.30V _{DD} +0.70		V _{DD}	
	V _{IH} (2)	CF1, RESB			0.75V _{DD}		V _{DD}	
Low level input voltage	V _{IL} (1)	Ports 0, 1, 2	Output disabled		V _{SS}		0.10V _{DD} +0.40	
	V _{IL} (2)	CF1, RESB			V _{SS}		0.25V _{DD}	
Instruction cycle time (Note 2-2)	tCYC			4.5 to 5.5	0.098		66	μs
				3.0 to 5.5	0.123		66	
				2.0 to 5.5	0.490		66	
External system clock frequency	FEXCF(1)	CF1	- CF2 pin open - System clock frequency division ratio=1/1 - External system clock duty=50±5%	4.5 to 5.5	0.1		10	MHz
				3.0 to 5.5	0.1		8	
				2.0 to 5.5	0.1		2	
Oscillation frequency range (Note 2-3)	FmCF(1)	CF1,CF2	10MHz ceramic oscillation See Fig. 1.	4.5 to 5.5		10		MHz
	FmCF(2)	CF1,CF2	8MHz ceramic oscillation See Fig. 1.	3.0 to 5.5		8		
	FmCF(3)	CF1,CF2	4MHz ceramic oscillation See Fig. 1.	2.4 to 5.5		4		
	FmRC		Internal RC oscillation	2.0 to 5.5	0.5	1.0	2.0	
	FmSLRC		Internal SLRC oscillation	2.0 to 5.5	18	30	45	kHz
	FsX'tal	XT1, XT2	32.768kHz crystal oscillation See Fig. 2.	2.2 to 5.5		32.768		
	FmRC1(1)	CF1	High-speed RC oscillation (Note 2-4)	2.4 to 5.5	400		4200	
	FmRC1(2)	CF1	High-speed RC oscillation (Note 2-4)	2.0 to 5.5	400		2000	
	FsRC0	XT1	Low-speed RC oscillation (Note 2-4)	2.2 to 5.5	30		80	

Note2-1: V_{DD} must be held greater than or equal to 3.0V when onboard writing to flash ROM.

Note2-2: Relationship between tCYC and oscillation frequency is 1/FmCF at a frequency division ratio of 1/1 and 2/FmCF at a division ratio of 1/2.

Note2-3: See Tables 1 and 2 for the oscillation constants.

Note2-4: Ta=0°C to 60°C

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LCD Drive Voltage at Ta = -20°C to +75°C, V_{SS} = LCDV_{SS0} = LCDV_{SS1} = 0V

Special notes: 0.1μF capacitors are connected to V_{LCD1}, V_{LCD2}, V_{LCD3}, and V_{LCD4}. (with no panel load)

Parameter	Symbol	Pin/Remarks	Conditions	V _{DD} [V]	Specification			
					min	typ	max	unit
LCD drive voltage	V _{LCD1}	V _{DD} V _{LCD1}	Contrast "00"	2.0 to 5.5	Typ ×0.88	1.030	Typ ×1.10	V
			Contrast "01"			1.045		
			Contrast "02"			1.060		
			Contrast "03"			1.075		
			Contrast "04"			1.090		
			Contrast "05"			1.105		
			Contrast "06"			1.120		
			Contrast "07"			1.135		
			Contrast "08"			1.150		
			Contrast "09"			1.165		
			Contrast "10"			1.180		
			Contrast "11"			1.195		
			Contrast "12"			1.210		
			Contrast "13"			1.225		
			Contrast "14"			1.240		
			Contrast "15"			1.255		
	V _{LCD2}					2×V _{LCD1}		
	V _{LCD3}					3×V _{LCD1}		
	V _{LCD4}					4×V _{LCD1}		

SMIIC0 I²C Mode I/O Characteristics

Parameter			Symbol	Pin/Remarks	Conditions	V _{DD} [V]	Specification			
							min	typ	max	unit
Clock	Input clock	Period	tSCL	SM0CK (P22)	• See Fig. 8.	2.0 to 5.5	5			Tfilt
		Low level pulse width	tSCLL				2.5			
		High level pulse width	tSCLH				2			
	Output clock	Period	tSCLx	SM0CK (P22)	• Specified as the time up to the beginning of output change.	2.0 to 5.5	10			tSCL
		Low level pulse width	tSCLLx				1/2			
		High level pulse width	tSCLHx				1/2			
SM0CK, SM0DA pin input spike suppression time		tsp	SM0CK(P22) SM0DA(P23)	• See Fig. 8.	2.0 to 5.5			1	Tfilt	
Start-to-stop period bus release time		Input	tBUF	SM0CK(P22) SM0DA(P23)	• See Fig. 8.	2.0 to 5.5	2.5			Tfilt
			Output	tBUFx	SM0CK(P22) SM0DA(P23)		• Standard clock mode • Specified as the time up to the beginning of output change.	5.5		
		• High-speed clock mode • Specified as the time up to the beginning of output change.					1.6			
Start/restart condition hold time		Input	tHD;STA	SM0CK(P22) SM0DA(P23)	• When SMIIC register control bit I ² CSHDS=0 • See Fig. 8.	2.0 to 5.5	2.0			Tfilt
					• When SMIIC register control bit I ² CSHDS=1 • See Fig. 8.		2.5			
		Output	tHD;STAx	SM0CK(P22) SM0DA(P23)	• Standard clock mode • Specified as the time up to the beginning of output change.		4.1			μs
					• High-speed clock mode • Specified as the time up to the beginning of output change.		1.0			
Restart condition setup time		Input	tSU;STA	SM0CK(P22) SM0DA(P23)	• See Fig. 8.	2.0 to 5.5	1.0			Tfilt
					Output		tSU;STAx	SM0CK(P22) SM0DA(P23)	• Standard clock mode • Specified as the time up to the beginning of output change.	5.5
		• High-speed clock mode • Specified as the time up to the beginning of output change.	1.6							

Continued on next page.

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UART0 Operating Conditions at Ta = -20 to +75°C, V_{SS} = LCDV_{SS0} = LCDV_{SS1} = 0V

Parameter	Symbol	Pin/Remarks	Conditions	Specification				
				V _{DD} [V]	min	typ	max	unit
Transfer rate	UBR0	U0RX(P14), U0TX(P15), U0BRG(P07)		2.0 to 5.5	4		8	tBGCYC

Note 4-5: tBGCYC denotes 1 period of the baudrate clock source.

UART2 Operating Conditions at Ta = -20 to +75°C, V_{SS} = LCDV_{SS0} = LCDV_{SS1} = 0V

Parameter	Symbol	Pin/Remarks	Conditions	Specification				
				V _{DD} [V]	min	typ	max	unit
Transfer rate	UBR2	U2RX(P16), U2TX(P17)		2.0 to 5.5	8		4096	tBGCYC

Note 4-6: tBGCYC denotes 1 period of the baudrate clock source.

Pulse Input Conditions at Ta = -20 to +75°C, V_{SS} = LCDV_{SS0} = LCDV_{SS1} = 0V

Parameter	Symbol	Pin/Remarks	Conditions	Specification				
				V _{DD} [V]	min	typ	max	unit
	tPIL(2)	RESB	Resettable.	2.0 to 5.5	10			μs

AD Converter Characteristics at Ta = -20 to +75°C, V_{SS} = LCDV_{SS0} = LCDV_{SS1} = 0V

12-bits AD Conversion Mode

Parameter	Symbol	Pin/Remarks	Conditions	Specification				
				V _{DD} [V]	min	typ	max	unit
Resolution	NAD	AN0(P20), AN1(P21), AN2(P22), AN3(P23), AN8(P00) to AN15(P07)		2.9 to 5.5		12		bit
Absolute accuracy	ETAD		(Note 6-1)	2.9 to 5.5			±16	LSB
Conversion time	TCAD12		Conversion time is calculated.	4.5 to 5.5	27		209	μs
				2.9 to 5.5	67		209	
Analog input voltage range	VAIN			2.9 to 5.5	V _{SS}		V _{DD}	V
Analog port input current	IAINH		VAIN=V _{DD}	2.9 to 5.5			1	μA
	IAINL		VAIN=V _{SS}	2.9 to 5.5	-1			

- Conversion time calculation method: TCAD12= ((52/(AD division ratio))+2) × tCYC

8-bits AD Conversion Mode

Parameter	Symbol	Pin/Remarks	Conditions	Specification				
				V _{DD} [V]	min	typ	max	unit
Resolution	NAD	AN0(P20), AN1(P21), AN2(P22), AN3(P23), AN8(P00) to AN15(P07)		2.9 to 5.5		8		bit
Absolute accuracy	ETAD		(Note 6-1)	2.9 to 5.5			±1.5	LSB
Conversion time	TCAD8		Conversion time is calculated.	4.5 to 5.5	17		129	μs
				2.9 to 5.5	42		129	
Analog input voltage range	VAIN			2.9 to 5.5	V _{SS}		V _{DD}	V
Analog port input current	IAINH		VAIN=V _{DD}	2.9 to 5.5			1	μA
	IAINL		VAIN=V _{SS}	2.9 to 5.5	-1			

- Conversion time calculation method: TCAD8= ((32/(AD division ratio))+2) × tCYC

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

Note 6-2: The conversion time refers to the interval from the time a conversion starting instruction is issued till the time the complete digital value against the analog input value is loaded in the result register.

The conversion time is twice the normal value when one of the following conditions occurs:

- The first AD conversion is executed in the 12-bit AD conversion mode after a system reset.
- The first AD conversion is executed after the AD conversion mode is switched from 8-bit to 12-bit AD conversion mode.

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Consumption Current Characteristics at Ta = -20 to +75°C, V_{SS} = LCDV_{SS0} = LCDV_{SS1} = 0V

Parameter	Symbol	Pin/ Remarks	Conditions		Specification				
					V _{DD} [V]	min	typ	max	unit
Normal mode consumption current (Note 7-1)	IDDOP(1)	V _{DD}	- FOSC0=32.768kHz - System clock set to FOSC0 side - Internal RC oscillation stopped - FOSC1=0Hz (oscillation stopped) - Frequency division ratio set to 1/1 - Normal XT mode [No panel load]	LCD display ON	2.0 to 5.5		87	170	μA
	IDDOP(2)				2.0 to 3.6		44	110	
	IDDOP(3)			LCD display OFF	2.0 to 5.5		75	155	
	IDDOP(4)				2.0 to 3.6		35	95	
	IDDOP(5)		- FOSC0=32.768kHz - System clock set to FOSC0 side - Internal RC oscillation stopped - FOSC1=0Hz (oscillation stopped) - Frequency division ratio set to 1/1 - Low power XT mode [No panel load]	LCD display ON	2.0 to 5.5		53	100	
	IDDOP(6)				2.0 to 3.6		35	65	
	IDDOP(7)			LCD display OFF	2.0 to 5.5		48	92	
	IDDOP(8)				2.0 to 3.6		31	55	
	IDDOP(9)		- FmCF=10MHz ceramic oscillator - FOSC0=0Hz (oscillation stopped) - System clock set to 10MHz side - Internal RC oscillation stopped - Frequency division ratio set to 1/1		4.5 to 5.5		8.4	15.2	mA
	IDDOP(10)		- FmCF=8MHz ceramic oscillator - FOSC0=0Hz (oscillation stopped) - System clock set to 8MHz side - Internal RC oscillation stopped - Frequency division ratio set to 1/1		4.5 to 5.5		7.6	14.7	
	IDDOP(11)		- FmCF=4MHz ceramic oscillator - FOSC0=0Hz (oscillation stopped) - System clock set to 4MHz - Internal RC oscillation stopped - Frequency division ratio set to 1/2		3.0 to 4.5		5.8	11	
	IDDOP(12)		- FmCF=4MHz ceramic oscillator - FOSC0=0Hz (oscillation stopped) - System clock set to 4MHz - Internal RC oscillation stopped - Frequency division ratio set to 1/2		4.5 to 5.5		3.6	5.5	
	IDDOP(13)		- System clock set to internal RC side - Internal RC oscillation oscillated - FOSC0=0Hz (oscillation stopped) - FOSC1=0Hz (oscillation stopped) - Frequency division ratio set to 1/1		2.2 to 4.5		2.2	4.7	
	IDDOP(14)		- System clock set to internal RC side - Internal RC oscillation oscillated - FOSC0=0Hz (oscillation stopped) - FOSC1=0Hz (oscillation stopped) - Frequency division ratio set to 1/1		2.0 to 5.5		2.2	5.6	
	IDDOP(15)		- System clock set to internal RC side - Internal RC oscillation oscillated - FOSC0=0Hz (oscillation stopped) - FOSC1=0Hz (oscillation stopped) - Frequency division ratio set to 1/1		2.0 to 3.6		1.2	3.6	
	IDDOP(16)		- FOSC1=1MHz R_{CR1}=470kΩ - System clock set to FOSC1 side - Internal RC oscillation stopped - FOSC0=0Hz (oscillation stopped) - Frequency division ratio set to 1/1 *Ta=0 to 60°C		2.0 to 5.5		1.5	2.6	
	IDDOP(17)		- FOSC1=1MHz R_{CR1}=470kΩ - System clock set to FOSC1 side - Internal RC oscillation stopped - FOSC0=0Hz (oscillation stopped) - Frequency division ratio set to 1/1 *Ta=0 to 60°C		2.0 to 3.6		1.0	2.5	
	IDDOP(18)		- FOSC0=64kHz R_{CR0}=910kΩ - System clock set to FOSC0 side - Internal RC oscillation stopped - FOSC1=0Hz (oscillation stopped) - Frequency division ratio set to 1/1 *Ta=0 to 60°C		2.0 to 5.5		100	187	μA
	IDDOP(19)		- FOSC0=64kHz R_{CR0}=910kΩ - System clock set to FOSC0 side - Internal RC oscillation stopped - FOSC1=0Hz (oscillation stopped) - Frequency division ratio set to 1/1 *Ta=0 to 60°C		2.0 to 3.6		62	120	

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

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Parameter	Symbol	Pin/ Remarks	Conditions		V _{DD} [V]	Specification					
						min	typ	max	unit		
HALT mode consumption current (Note 7-2)	IDDHALT(1)	V _{DD}	HALT mode • FOSC0=32.768kHz • System clock set to FOSC0 side • Internal RC oscillation stopped • FOSC1=0Hz (oscillation stopped) • Frequency division ratio set to 1/1 • Normal XT mode [No panel load]	LCD display ON	2.0 to 5.5		45	110	μA		
	IDDHALT(2)				2.0 to 3.6		16	50			
	IDDHALT(3)			LCD display OFF	2.0 to 5.5		36	90			
	IDDHALT(4)				2.0 to 3.6		7.8	51			
	IDDHALT(5)		HALT mode • FOSC0=32.768kHz • System clock set to FOSC0 side • Internal RC oscillation stopped • FOSC1=0Hz (oscillation stopped) • Frequency division ratio set to 1/1 • Low power XT mode [No panel load]	LCD display ON	2.0 to 5.5		15.5	53			
	IDDHALT(6)				2.0 to 3.6		12	30			
	IDDHALT(7)			LCD display OFF	2.0 to 5.5		6.5	40			
	IDDHALT(8)				2.0 to 3.6		4	30			
	IDDHALT(9)		HALT mode • FmCF=10MHz ceramic oscillator • FOSC0=0Hz (oscillation stopped) • System clock set to 10MHz side • Internal RC oscillation stopped • Frequency division ratio set to 1/1		4.5 to 5.5		2.0	3.4	mA		
	IDDHALT(10)		HALT mode • FmCF=8MHz ceramic oscillator • Internal RC oscillation stopped • FOSC0=0Hz (oscillation stopped) • System clock set to 8MHz side • Internal RC oscillation stopped • Frequency division ratio set to 1/1		4.5 to 5.5		1.7	2.9			
	IDDHALT(11)				3.0 to 4.5		1.2	2.1			
	IDDHALT(12)		HALT mode • FmCF=4MHz ceramic oscillator • FOSC0=0Hz (oscillation stopped) • System clock set to 4MHz side • Internal RC oscillation stopped • Frequency division ratio set to 1/2		4.5 to 5.5		0.7	1.2			
	IDDHALT(13)				2.2 to 4.5		0.3	0.85			
	IDDHALT(14)		HALT mode • System clock set to internal RC side • Internal RC oscillation oscillated • FOSC0=0Hz (oscillation stopped) • FOSC1=0Hz (oscillation stopped) • Frequency division ratio set to 1/1		2.0 to 5.5		0.7	1.3			
	IDDHALT(15)				2.0 to 3.6		0.3	0.6			
	IDDHALT(16)		HALT mode • FOSC1=1MHz R _{CR1} =470kΩ • System clock set to FOSC1 side • Internal RC oscillation stopped • FOSC0=0Hz (oscillation stopped) • Frequency division ratio set to 1/1 *Ta=0 to 60°C		2.0 to 5.5		0.2	0.5			
	IDDHALT(17)				2.0 to 3.6		0.1	0.3			
	IDDHALT(18)			HALT mode • FOSC0=64kHz R _{CR0} =910kΩ • System clock set to FOSC0 side • Internal RC oscillation stopped • FOSC1=0Hz (oscillation stopped) • Frequency division ratio set to 1/1 *Ta=0 to 60°C		2.0 to 5.5		20		60	μA
	IDDHALT(19)					2.0 to 3.6		10		40	

Note 7-2: The consumption current value includes none of the currents that flow into the output Tr and internal pull-up resistors.

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Parameter	Symbol	Pin/ Remarks	Conditions	Specification				
				V _{DD} [V]	min	typ	max	unit
HOLD mode consumption current	IDDHOLD(1)	V _{DD}	HOLD mode • CF1=V _{DD} or open (external clock mode)	2.0 to 5.5		0.08	35	μA
	IDDHOLD(2)			2.0 to 3.6		0.02	25	
HOLDX mode consumption current	IDDHOLD(3)		HOLDX mode • CF1=V _{DD} or open (external clock mode)	2.0 to 5.5		30	65	
	IDDHOLD(4)		• FOSC0=32.768kHz • Normal XT mode	2.0 to 3.6		5	55	
	IDDHOLD(5)		HOLDX mode • CF1=V _{DD} or open (external clock mode)	2.0 to 5.5		0.6	35	
	IDDHOLD(6)		• FOSC0=32.768kHz • Low power XT mode	2.0 to 3.6		0.4	25	

Note 7-3: The consumption current value includes none of the currents that flow into the output Tr and internal pull-up resistors.

F-ROM Writing Characteristics at Ta = +10°C to +55°C, V_{SS} = LCDV_{SS0} = LCDV_{SS1} = 0V

Parameter	Symbol	Pin/ Remarks	Conditions	Specification				
				V _{DD} [V]	min	typ	max	unit
Onboard writing current	IDDFW(1)	V _{DD}	• Excluding power dissipation in the microcontroller block	3.0 to 5.5			15	mA
Writing time	tFW(1)		• 512-/1K-byte erase operation	3.0 to 5.5			30	ms
	tFW(2)		• 2-byte writing operation	3.0 to 5.5			60	μs

Characteristics of a Sample OSC1 System Clock Oscillation Circuit

Sample main system clock oscillation circuit characteristics

Given below are the characteristics of a sample main system clock oscillation circuit that are measured using a Our designated oscillation characteristics evaluation board and external components with circuit constant values with which the oscillator vendor confirmed normal and stable oscillation.

Table 1 Characteristics of the Main System Clock Oscillation Circuit that Uses a Ceramic Oscillator

Nominal Frequency	Vendor Name	Oscillator Name	Circuit Constant				Operating Voltage Range [V]	Oscillation Stabilization Time		Remarks
			C3 [pF]	C4 [pF]	Rf [Ω]	Rd2 [Ω]		typ [ms]	max [ms]	
10MHz	MURATA Manufacturing Co., Ltd.	CSTCE10M0G52-R0	(10)	(10)	OPEN	150	2.4 to 5.5	0.02	0.5	C1 and C2 integrated type
8MHz		CSTCE8M00G52-R0	(10)	(10)	OPEN	470	2.4 to 5.5	0.02	0.5	C1 and C2 integrated type
4MHz		CSTCR4M00G53-R0	(15)	(15)	OPEN	1.5K	2.2 to 5.5	0.02	0.5	C1 and C2 integrated type
		CSTCR4M00G53095-R0	(15)	(15)	OPEN	1.5K	2.0 to 5.5	0.02	0.5	C1 and C2 integrated type

The oscillation stabilization time refers to the time interval that is required for the oscillation to get stabilized after V_{DD} exceeds its lower limit operating voltage (see Figure 4).

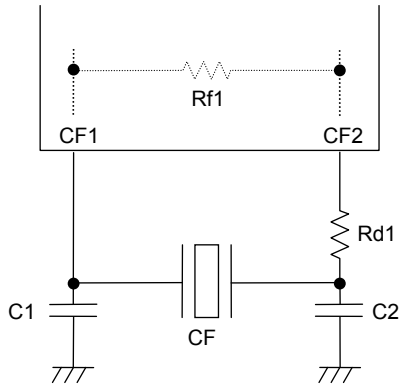


Figure 1 CF Oscillator Circuit

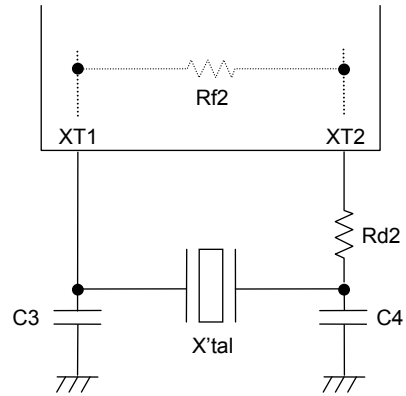


Figure 2 XT Oscillator Circuit

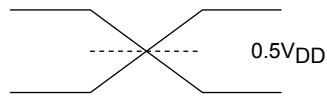
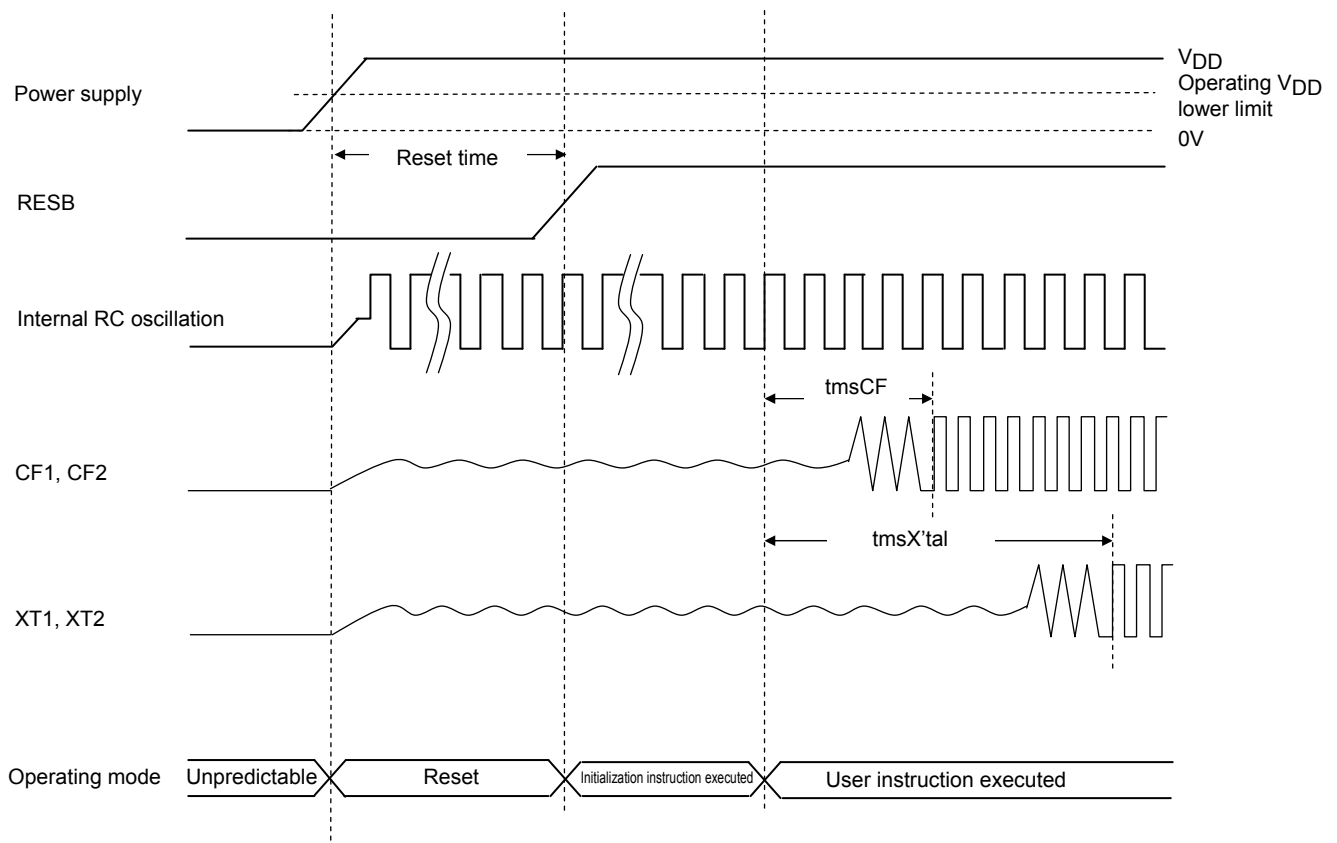
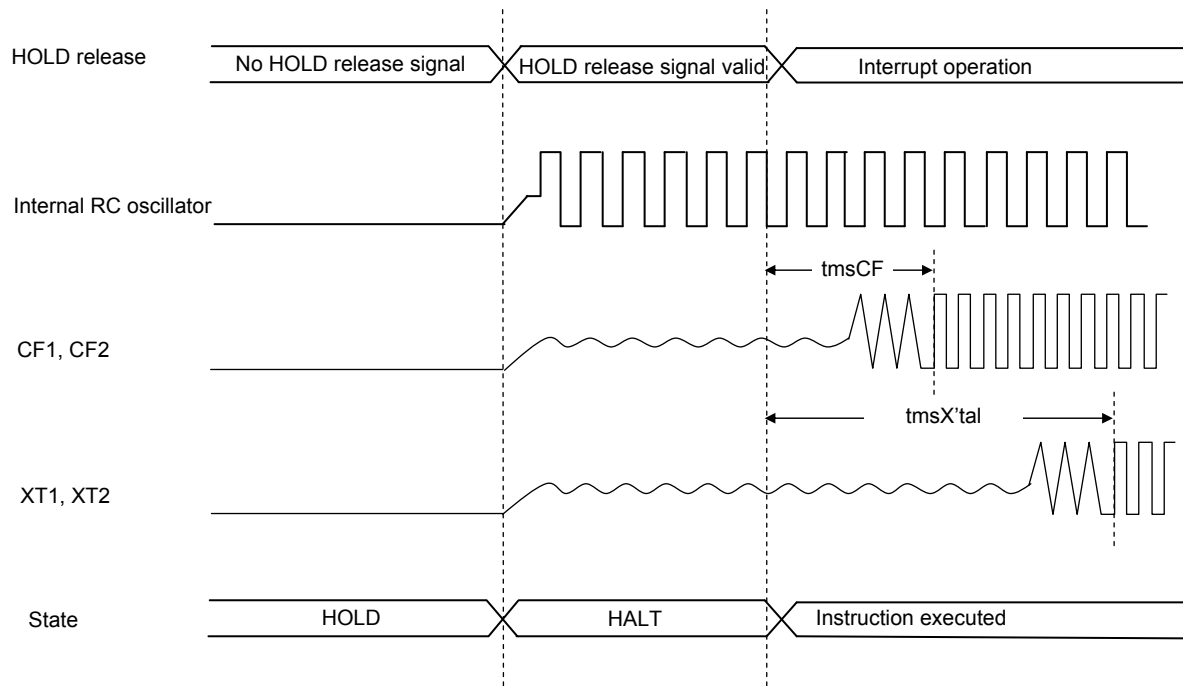


Figure 3 AC Timing Measurement Point

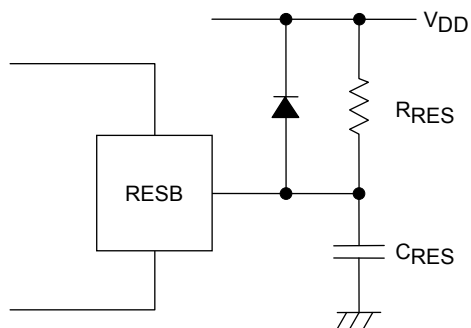


Reset Time and Oscillation Stabilization Time



HOLD Reset and Oscillation Stabilization Time

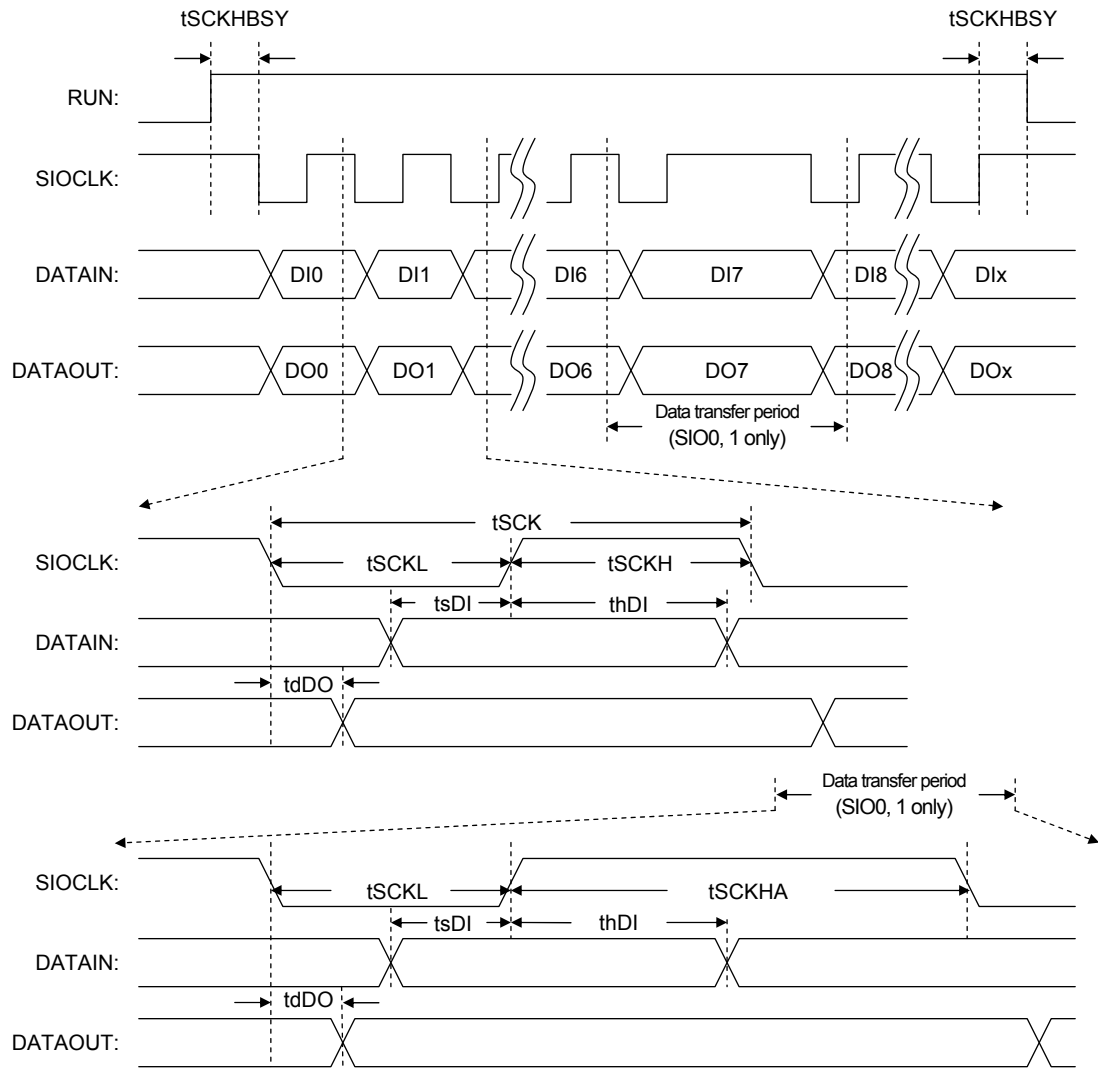
Figure 4 Oscillation Stabilization Time



Note:

Make sure that reset is in effect when power is turned on. Determine the values of C_{RES} and R_{RES} so that the reset is in effect for a period of 10μs after the power gets stabilized.

Figure 5 Reset Circuit



*: Remarks: DIx and DOx are the final communication bits. X = 0 to 32768

Figure 6 Serial I/O Waveforms Examples

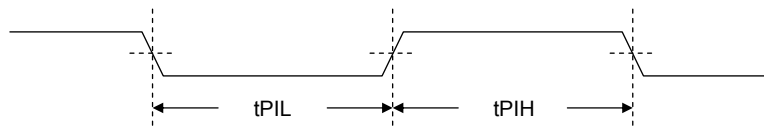


Figure 7 Pulse Input Timing Signal Waveform