Ordering number : ENN*7807

Preliminary

SANYO Semiconductors
DATA SHEET

LC587508A
LC587506A
LC587504A

ROM (8K/6K/4K × 16 bits), RAM (512 × 4 bits), LCD driver
4-bit 1-chip Microcomputers

Overview

The LC587508A/06A/04A are CMOS 4-bit microcontrollers that, centering around a low-voltage-operable CPU, incorporate on a single-chip a number of features including 8K/6K/4K × 16 bits of ROM, 512 × 4 bits of RAM, stack-dedicated RAM (8 levels), 8-bit AD (4CH), 8-bit timer (2 channels) (1 channel can be used as an event counter), 8-bit synchronous serial interface, alarm signal generator circuit, remote control carrier generator circuit, LCD controller and driver, and powerful standby function (power saving feature). They are upward-compatible versions of the LC587408A, extended with reinforced I/O port and segment driver capabilities.

Functions

- Mobile devices with LCD display capabilities (optimum for mobile device applications that require battery-driven low power operation).
- Control and LCD display of and for portable CDs, timers, and health monitoring instruments.
- Remote control for CDs, VCRs, tuners, etc.

Features

■ROM
- LC587508A (8192 × 16 bits)
- LC587506A (6144 × 16 bits)
- LC587504A (4096 × 16 bits)

■RAM
- LC587508A (512 × 4 bits)
- LC587506A (512 × 4 bits)
- LC587504A (512 × 4 bits)

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■Instruction Cycle Time

(all instructions except table lookup instructions execute in one cycle)

- LCD voltage step-up option (1.5V power supply/Ag battery, etc.)

Cycle Time	Supply Voltage	System Clock Oscillation Source	Oscillation Frequency
20μs	1.35 to 1.75V	RC oscillator	200kHz
122μs	1.35 to 1.75V	Xtal (crystal) oscillator	32.768kHz

- LCD voltage step-down option (3.0V power supply/Li battery, etc.)

Cycle Time	Supply Voltage	System Clock Oscillation Source	Oscillation Frequency
1μs	4.5 to 5.5V	CF (ceramic) oscillator	4MHz
4μs	2.5 to 5.5V	CF (ceramic) oscillator	1MHz
10μs	2.5 to 5.5V	CF (ceramic) oscillator	400kHz
122μs	2.0 to 5.5V	Xtal (crystal) oscillator	32.768kHz

* It must be noted when using an LCD, that the lower limit of the system operating voltage becomes higher in accordance with the LCD's bias specifications.

■Ports

Input-only pins

- Port S (4 pins)
- INT pin (1 pin)

Input/output pins

- Port K (4 pins)
  The output type is fixed to "CMOS".
- Port M (4 pins)
  The output type can be programmed to "CMOS" or "Pch" on a port basis.
  (The M4 pin is configured as a signal input pin when timer 2 is set in the event counter mode).
- Port SO (4 pins)
  The output type can be programmed to "CMOS" or "Nch" on a port basis. The three pins SO1, SO2, and SO3 are also used for the serial interface (2-pin serial communication is also possible).
- Port P (4 pins)
  The output type can be programmed to "CMOS" or "Pch" on a port basis.
- Port A (4 pins)
  The output type can be programmed to "CMOS" or "Pch" on a port basis.

Output-only pins

- Port N (4 pins)
  The N3 pin is also used as the remote controller carrier output pin. The N4 pin is also used as the alarm output pin.

LCD driver pins

- Common pin (4 pins)
- Segment pin (35 pins)
  Each segment pin incorporates dedicated memory (segment memory) for holding output data. Its output type can be changed under program control from "LCD driver output" to a general-purpose output type (CMOS, Pch, or Nch).

■Variety of LCD Drive Modes

LCD Drive Mode	No. of Drivable Segments	Required Common Pins
1/3 bias, 1/4 duty	140 segments	COM1 to COM4
1/3 bias, 1/3 duty	105 segments	COM1 to COM3
1/2 bias, 1/4 duty	140 segments	COM1 to COM4
1/2 bias, 1/3 duty	105 segments	COM1 to COM3
DUPLEX	70 segments	COM1 and COM2
STATIC	35 segments	COM1

■Timers

Timer 1

- 6-bit prescaler + 8-bit programmable reload timer
  (The prescaler is shared by timer 1, timer 2, and serial interface).
- Supports programmable generation of the remote controller carrier signal.

Timer 2

- 6-bit prescaler + 8-bit programmable timer
  (The prescaler is shared by timer 1, timer 2, and serial interface).
- Can serve as an event counter.

Base timer (available when the 32.768kHz Xtal oscillation source is selected)

- Allows two signals (125ms/500ms or 250ms/1000ms) to be selected out of four reference signals using a mask option and programming, so that the base timer is flexible with the application.

■Standby Function

HALT mode

- The microcontroller halts execution of instructions in the HALT mode. The oscillation crcuits, timers, the LCD controller and driver, and serial interface continue processing. A program that contains no unnecessary loop and makes effective use of this HALT mode could realize low-power operation.
- The conditions for resetting the HALT mode can be defined under program control. The following sources can reset the HALT mode:
  (1) Change in the level of the signal at the INT pin (1 source)
  (2) Timer 1 (1 source)
  (3) Timer 2 (1 source)
  (4) Base timer (1 source)
  (5) Change in the level of the signal at the serial interface or SO4 pin (either one source)
  (6) Change in the level of the signal at port S or K defined by the SSW instruction (8 sources)
  (7) Reset signal

HOLD mode

- The complete standby mode in which all oscillation circuits are stopped.
- The conditions for resetting the HOLD mode can be defined under program control. The following sources can reset the HOLD mode:
  (1) Change in the level of the signal at the INT pin (1 source)
  (2) Timer 2 event counter mode (1 source)
  (3) Change in the level of the signal at the serial interface or SO4 pin (either one source)
  (4) Change in the level of the signal at port S or K defined by the SSW instruction (8 sources)
  (5) Reset signal

■Interrupt Function (5-source 4-vector addresses)

(1) Change in the level of the signal at the INT pin (1 source)
(2) Timer 1 (1 source)
(3) Timer 2 (1 source)
(4) Change in the level of the signal at the serial interface or SO4 pin (either one source)

■Watchdog Timer

The watchdog timer is of a 16-bit counter type. It can be reset by a combination of two passing points so that it is flexible with the application.

Sample watchdog timer operating times

When Xtal oscillation is selected (32.768kHz, 1- or 2-oscillator mode) : 2000ms (max.)
When CF oscillation is selected (1MHz, 1 oscillation) : 65.536ms (max.)

■Subroutine Stack

The LC587508A/06A/04A series microcontrollers incorporate 8 levels of stack-dedicated RAM that is shared by the interrupt handler and subroutines. Consequently, no data memory is consumed to save the contents of the program counter.

■Number of Instructions

The LC587508A/06A/04A series microcontrollers are provided with 130 easy-to-use instructions including accumulator manipulation, register-to-memory transfer, arithmetic and logical operations, flag manipulation, I/O port manipulation, and a variety of conditional branch instructions.

■Oscillation Circuits (3 Circuits)

1-oscillation mode -------- One of CF, RC, and Xtal oscillators
2-oscillation mode -------- CF + Xtal oscillators or RC oscillator + Xtal oscillators

CF (ceramic) oscillation circuit
- Fast mode system clock
- 400kHz to 4MHz

RC (resistor & capacitor) oscillation circuit
- Fast mode system clock
- 200kHz to 800kHz (depends on the power requirements)
- 2-pin oscillation

Xtal (crystal) oscillation circuit
- Slow mode system clock
- 32.768kHz, 65.536kHz

■Packaging
- QIP80E (flat package) <Under development>
- Chip

1.5V Supply Voltage Version

Absolute Maximum Ratings at V_{SS} = 0V, Ta = 25°C ± 2°C

Parameter	Symbol	Conditions	Ratings			Unit
			min	typ	max	
Maximum supply voltage	V_{DD}		-0.3		+6.5	V
	$V_{DD}1$		-0.3		+6.5	V
	$V_{DD}2$		-0.3		+6.5	V
Maximum input voltage	V_I-1	Permitted by designated circuit, XTIN and CFIN	Up to the voltage to be generated			
	V_I-1	S1-S4, K1-K4, P1-P4, SO1-SO4, RES, INT, TST (Ports K, P, M, and SO are in input mode.)	-0.3		V_{DD}+0.3	V
Maximum output voltage	V_O-1	Permitted by designated circuit, XTOUT, CFOUT	Up to the voltage to be generated			
	V_O-1	K1-K4, P1-P4, SO1-SO4, N1-N4, CUP1, CUP2, SEG1-SEDG35, COM1-COM4 (Ports K, P, M, and SO are in output mode.)	-0.3		V_{DD}+0.3	V
	V_O-3	Open drain version N1-N4 (Nch)	-0.3		+12	V
Output pin current	I_O-1	Per 1 pin, N1-N4	0		+10	mA
	I_O-2		-10		0	mA
	I_O-3	Per 1 pin, K1-K4, P1-P4, M1-M4, SO1-SO4	0		+1	mA
	I_O-4		-1		0	mA
	ΣI_O-1	Total pin current			20	mA
	ΣI_O-2	(K1-4, P1-4, M1-4, SO1-SO4, N1-N4, SEG1-SEG35)	-20			mA
Power dissipation	P_D max	QIP80E flat package			300	mW
Operating ambient temperature	Topr		-30		+70	°C
Storage ambient temperature	Tstg		-55		+125	°C

Allowable Operating Range at V_{SS} = 0V, Ta = -30°C to + 70°C

Parameter	Symbol	Conditions	Ratings			Unit
			min	typ	max	
Supply voltage	V_{DD}	No LCD version: $V_{DD}2 = V_{DD} \times 2$, $V_{DD}1 = V_{DD}$	1.35		1.75	V
		1/1 bias version: $V_{DD}2 = V_{DD} \times 2$, $V_{DD}1 = V_{DD}$	1.35		1.75	V
		1/2 bias version: $V_{DD}2 = V_{DD} \times 2$, $V_{DD}1 = V_{DD}$	1.35		1.75	V
		1/3 bias version: $V_{DD}2 = V_{DD} \times 3$, $V_{DD}1 = V_{DD} \times 2$	1.35		1.75	V
High-level input voltage	$V_{IH}1$	S1-S4, K1-K4, P1-P4, M1-M4, SO1-SO4, A1-A4, INT	$0.7V_{DD}$		V_{DD}	V
	$V_{IH}2$	RES pin	$0.75V_{DD}$		V_{DD}	V
	$V_{IH}3$	CFIN pin	$0.75V_{DD}$		V_{DD}	V
Low-level input voltage	$V_{IL}1$	S1-S4,K1-K4,P1-P4,M1-M4,SO1-SO4,A1-A4,INT	0		$0.3V_{DD}$	V
	$V_{IL}2$	RES pin	0		$0.25V_{DD}$	V
	$V_{IL}3$	CFIN pin	0		$0.25V_{DD}$	V
Operating frequency	fopr1	V_{DD} = 1.35V to 1.75V 32kHz XTIN/XTOUT crystal oscillator	32		33	kHz
	fopr2	V_{DD} = 1.35V to 1.75V 65kHz XTIN/XTOUT crystal oscillator	60		70	kHz
	fopr3	V_{DD} = 1.35V to 1.75V RC version		200		kHz
	fopr4	V_{DD} = 1.35V to 1.75V SO1/SO3 pins(serial mode) Rising and falling edges of input signal/clock waveform ≤ 10μs	DC		200	kHz

***** Note:

The recommended operating range and electrical characteristics listed above are measured for the test LSI devices that are incorporated in the QIP80E package.

The specifications for the chip version of this LSI are basically identical to those for the QIP80E package version of this LSI except that the some characteristics of the chip version of the LSI differ depending on the board on which the chip is mounted, the bonding pressure, and the molding resin used. Consequently, the recommended operating range and electrical characteristics for the chip version of this LSI are defined at an operating ambient temperature (Ta) of 25°C±2°C.

Electrical Characteristics at V_{DD} = 1.55V, V_{SS} = 0V, Ta = -30 to + 70°C

Parameter	Symbol	Conditions	Ratings			Unit
			min	typ	max	
Input resistance	$R_{IN}1A$	$V_{IN} = 0.2V_{DD}$ Low-level hold Tr *1	200	300	400	kΩ
	$R_{IN}1B$	$V_{IN} = V_{DD}$ Pull-down resistance *1	200	300	400	kΩ
	$R_{IN}1C$	$V_{IN} = 0.8V_{DD}$ High-level hold Tr *1	200	300	400	kΩ
	$R_{IN}1D$	$V_{IN} = V_{SS}$ Pull-up resistance *1	200	300	400	kΩ
	$R_{IN}2A$	$V_{IN} = 0.2V_{DD}$ INT low-level hold Tr	200	300	400	kΩ
	$R_{IN}2B$	$V_{IN} = V_{DD}$ INT pull-down resistance	60		220	kΩ
	$R_{IN}2C$	$V_{IN} = 0.8V_{DD}$ INT high-level hold Tr	200	300	400	kΩ
	$R_{IN}2D$	$V_{IN} = V_{SS}$ INT pull-up resistance	60		220	kΩ
	$R_{IN}3$	$V_{IN} = V_{DD}$ RES pull-down resistance	20		300	kΩ
	$R_{IN}4$	$V_{IN} = V_{SS}$ RES pull-up resistance	20		300	kΩ
	$R_{IN}5$	$V_{IN} = V_{DD}$ TST pin pull-down resistance	20		300	kΩ
High-level output voltage Low-level output voltage	V_{OH}-1 V_{OL}-1	V_{DD} = 1.35V/I_{OH} = -500μA V_{DD} = 1.35V/IOL = 500μA * N1-N4	V_{DD}-0.65		0.65	V V
	V_{OH}-2 V_{OL}-2	V_{DD} = 1.35V/I_{OH} = -100μA V_{DD} = 1.35V/I_{OL} = 100μA * K1-K4, P1-P4, M1-M4, SO1-SO4, A1-A4 (Ports K, P, M, SO, and A are in output mode.)	V_{DD}-0.2		0.2	V V
Off output leakage current	|IOFF|	V_{OH} = 10.5V N1-N4 (open version)			1.0	μA
Segment port output impedance • CMOS output port type						
High-level output voltage Low-level output voltage	V_{OH}-3 V_{OL}-3	I_{OH} = -50μA Seg1 to 35 I_{OL} = 50μA	V_{DD}-0.2		0.2	V V
Segment port output impedance • Pch-open drain output type						
Off output leakage current	|IOFF|	$V_{OL} = V_{SS}$			1.0	μA
Segment port output impedance • Nch-open drain output type						
Off output leakage current	|IOFF|	$V_{OH} = V_{DD}$			1.0	μA

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Parameter	Symbol	Conditions	Ratings			Unit
			min	typ	max	
Segment port output impedance • Static type						
High-level output voltage	V_{OH}-4	I_{OH} = -10μA Seg1 to Seg35	V_{DD}2-0.2			V
Low-level output voltage	V_{OL}-4	I_{OL} = 10μA			0.2	V
High-level output voltage	V_{OH}-5	I_{OH} = -100μA COM1	V_{DD}2-0.2			V
Low-level output voltage	V_{OL}-5	I_{OL} = 100μA			0.2	V
Segment port output impedance • 1/2 bias type						
High-level output voltage	V_{OH}-4	I_{OH} = -10μA Seg1 to Seg35	V_{DD}2-0.2			V
Low-level output voltage	V_{OL}-4	I_{OL} = 10μA			0.2	V
High-level output voltage	V_{OH}-5	I_{OH} = -100μA COM1-COM4	V_{DD}2-0.2			V
M-level output voltage	V_{OM}	I_{OH} = -100μA	V_{DD}-0.2			V
Low-level output voltage		I_{OL} = 100μA			V_{DD}+0.2	V
	V_{OL}-5	I_{OL} = 100μA			0.2	V
Segment port output impedance • 1/3 bias type						
High-level output voltage	V_{OH}-4	I_{OH} = -10μA Seg1 to Seg35	V_{DD}2-0.2			V
M-level output voltage	V_{OM}1-1	I_{OH} = -10μA	V_{DD}1-0.2			V
		I_{OL} = 10μA			V_{DD}1+0.2	V
	V_{OM}1-2	I_{OH} = -10μA	V_{DD}-0.2			V
		I_{OL} = 10μA			V_{DD}+0.2	V
Low-level output voltage	V_{OL}-4	I_{OL} = 10μA			0.2	V
High-level output voltage	V_{OH}-6	I_{OH} = -100μA COM1-COM4	V_{DD}2-0.2			V
M-level output voltage	V_{OM}2-1	I_{OH} = -100μA	V_{DD}1-0.2			V
		I_{OL} = 100μA			V_{DD}1+0.2	V
	V_{OM}2-2	I_{OH} = -100μA	V_{DD}-0.2			V
		I_{OL} = 100μA			V_{DD}+0.2	V
Low-level output voltage	V_{OL}-6	I_{OL} = 100μA			0.2	V

Electrical Characteristics at V_{DD} = 1.55V, V_{SS} = 0V, Ta = -30 to + 70°C

Parameter	Symbol	Conditions	Ratings			Unit
			min	typ	max	
Power supply leakage current	ILEK-1	V_{DD} = 3.0V Ta = 25°C	-1.0		1.0	μA
Input leakage current	IOFF	V_{DD} = 3.0V Ta = 25°C VIN = V_{DD}/2 S1-S4, K1-K4, P1-P4, M1-M4, SO1-SO4, A1-A4 (input mode)	-1.0		1.0	μA
Output voltage 1	V_{DD}1-1 V_{DD}2-1	V_{DD} = 1.5V, 1/1 bias, fopr = 32.768kHz V_{DD}1: OPEN/V_{DD}2-V_{SS}: 0.1μF CUP1-CUP2: 0.1μF	1.35 2.85	1.5 3.0	1.65 3.15	V V
Output voltage 2	V_{DD}1-2 V_{DD}2-2	V_{DD} = 1.5V, 1/2 bias, fopr = 32.768kHz V_{DD}1: OPEN/V_{DD}2-V_{SS}: 0.1μF CUP1-CUP2: 0.1μF	1.35 2.85	1.5 3.0	1.65 3.15	V V
Output voltage 3	V_{DD}1-3 V_{DD}2-3	V_{DD} = 1.5V, 1/3 bias, fopr = 32.768kHz V_{DD}1-V_{SS}: 0.1μF/V_{DD}2-V_{SS}: 0.1μF CUP1-CUP2: 0.1μF	2.85 4.35	3.0 4.5	3.15 4.65	V V
Supply current 1	$|I_{DD}|$1-1	V_{DD} = 1.55V Ta = 25°C Xtal 32kHz version (Cd and Rd built in) Cg = 30pF,CI = 31KΩ in HALT mode, LCD = 1/3 bias, 32Hz		1.5	4.0	μA

3.0V Supply Voltage Version

Absolute Maximum Ratings at V_{SS} = 0V, Ta = 25°C ± 2°C

Parameter	Symbol	Conditions	Ratings			Unit
			min	typ	max	
Maximum supply voltage	V_{DD}		-0.3		+6.5	V
	$V_{DD}1$		-0.3		V_{DD}	V
	$V_{DD}2$		-0.3		V_{DD}	V
Maximum input voltage	V_I-1	Permitted by designated circuit, XTIN and CFIN	Up to the voltage to be generated			
	V_I-2	S1-4, K1-4, P1-P4,SO1-SO4, RES, INT, TST (Ports K, P, M, and SO are in input mode.)	-0.3		V_{DD}+0.3	V
Maximum output voltage	V_O-1	Permitted by designated circuit, XTOUT and CFOUT	Up to the voltage to be generated			
	V_O-2	K1-4, P1-P4, SO1-SO4, N1-N4, CUP1, CUP2, SEG1-SEG35, COM1-COM4 (Ports K, P, M, and SO are in output mode.)	-0.3		V_{DD}+0.3	V
	V_O-3	Open-drain version N1-N4 (Nch)	-0.3		+12	V
Output pin current	I_O-1	Per pin, N1-4	0		+10	mA
	I_O-2		-10		0	mA
	I_O-3	Per pin, K1-K4, P1-P4, M1-M4, SO1-SO4	0		+1	mA
	I_O-4		-1		0	mA
	ΣI_O-1	Total pin current			20	mA
	ΣI_O-2	(K1-K4, P1-P4, M1-M4, SO1-SO4, N1-N4,SEG1-SEG35)	-20			mA
Power dissipation	P_D max	QIP80E flat package			300	mW
Operating ambient temp.	Topr		-30		+70	°C
Storage ambient temp.	Tstg		-55		+125	°C

Allowable Operating Range at V_{SS} = 0V, Ta = -30°C to + 70°C

Parameter	Symbol	Conditions	Ratings			Unit
			min	typ	max	
Supply voltage	V_{DD}	No LCD version: $V_{DD}2 = V_{DD}1 = V_{DD}$	2.00		5.50	V
		1/1 bias version: $V_{DD}2 = V_{DD}1 = V_{DD}$	2.00		5.50	V
		1/2 bias version: $V_{DD}2 = V_{DD}1 = V_{DD}/2$	3.00		5.50	V
		1/3 bias version: $V_{DD}2 = V_{DD}/3$, $V_{DD}1 = 2 \times V_{DD}/3$	3.00		5.50	V
High-level input voltage	$V_{IH}1$	S1-S4, K1-K4,P1-P4, M1-M4, SO1-SO4, A1-A4, INT	$0.7V_{DD}$		V_{DD}	V
	$V_{IH}2$	RES pin	$0.75V_{DD}$		V_{DD}	V
	$V_{IH}3$	CFIN pin	$0.75V_{DD}$		V_{DD}	V
Low-level input voltage	$V_{IL}1$	S1-S4, K1-K4, P1-P4, M1-M4, SO1-SO4, A1-A4, INT	0		$0.3V_{DD}$	V
	$V_{IL}2$	RES pin	0		$0.25V_{DD}$	V
	$V_{IL}3$	CFIN pin	0		$0.25V_{DD}$	V
Operating freq.	fopr1	V_{DD} = 2.0V to 5.5V 32kHz XTIN/XTOUT crystal oscillator	32		33	kHz
	fopr2	V_{DD} = 2.2V to 5.5V 65kHz XTIN/XTOUT crystal oscillator	60		70	kHz
	fopr3	V_{DD} = 2.2V to 5.5V CFIN/CFOUT CF version	390		810	kHz
	fopr4	V_{DD} = 2.8V to 5.5V CFIN/CFOUT CF version	390		4200	kHz
	fopr5	V_{DD} = 3.0V to 5.5V SO1/SO3 pin (serial mode) Rising and falling edges of input signal/clock waveform ≤ 10μs	DC		200	kHz

***** Note:

The recommended operating range and electrical characteristics listed above are measured for the test LSI devices that are incorporated in the QIP80E package.

The specifications for the chip version of this LSI are basically identical to those for the QIP80E package version of this LSI except that the some characteristics of the chip version of the LSI differ depending on the board on which the chip is mounted, the bonding pressure, and the molding resin used. Consequently, the recommended operating range and electrical characteristics for the chip version of this LSI are defined at an operating ambient temperature (Ta) of 25°C±2°C.

Electrical Characteristics at V_{DD} = 4.5V, V_{SS} = 0V, Ta = -30 to + 70°C

Parameter	Symbol	Conditions	Ratings			Unit
			min	typ	max	
Input resistance	R_{IN}1A	V_{IN} = 0.2V_{DD} Low-level hold Tr *1	200	400	500	kΩ
	R_{IN}1B	V_{IN} = V_{DD} Pull-down resistance *1	200	300	400	kΩ
	R_{IN}1C	V_{IN} = 0.8V_{DD} High-level hold Tr *1	200	400	500	kΩ
	R_{IN}1D	V_{IN} = V_{SS} Pull-up resistance *1	200	300	400	kΩ
	R_{IN}2A	V_{IN} = 0.2V_{DD} INT low-level hold Tr	200	400	500	kΩ
	R_{IN}2B	V_{IN} = V_{DD} INT pull-down resistance	60		220	kΩ
	R_{IN}2C	V_{IN} = 0.8V_{DD} INT high-level hold Tr	200	400	500	kΩ
	R_{IN}2D	V_{IN} = V_{SS} INT pull-up resistance	60		220	kΩ
	R_{IN}3	V_{IN} = V_{DD} RES pull-down resistance	20		300	kΩ
	R_{IN}4	V_{IN} = V_{SS} RES pull-up resistance	20		300	kΩ
	R_{IN}5	V_{IN} = V_{DD} TST pin pull-down resistance	20		300	kΩ
High-level output voltage Low-level output voltage	V_{OH}-1 V_{OL}-1	V_{DD} = 3.0V/I_{OH} = -5mA V_{DD} = 3.0V/I_{OL} = 5mA * N1-N4	V_{DD}-0.5		 0.5	V V
	V_{OH}-2 V_{OL}-2	V_{DD} = 3.0V/I_{OH} = -1mA V_{DD} = 3.0V/I_{OL} = 1mA * K1-K4, P1-P4, M1-M4, SO1-SO4, A1-A4 (Ports K, P, M, SO, and A are in output mode.)	V_{DD}-0.5		 0.5	V V
Off output leakage current	|IOFF|	V_{OH} = 10.5V N1-N4 (open version)			1.0	μA
Segment port output impedance • CMOS output type						
High-level output voltage Low-level output voltage	V_{OH}-3 V_{OL}-3	I_{OH} = -50μA Seg1 to Seg35 I_{OL} = 50μA	V_{DD}-0.2		 0.2	V V
Segment port output impedance • Pch-open drain output type						
Off output leakage current	|IOFF|	V_{OL} = V_{SS}			1.0	μA
Segment port output impedance • Nch-open drain output type						
Off output leakage current	|IOFF|	V_{OH} = V_{DD}			1.0	μA
Segment port output impedance • Static type						
High-level output voltage Low-level output voltage	V_{OH}-4 V_{OL}-4	I_{OH} = -10μA Seg1 to Seg35 I_{OL} = 10μA	V_{DD}-0.2		 0.2	V V
High-level output voltage Low-level output voltage	V_{OH}-5 V_{OL}-5	I_{OH} = -100μA COM1 I_{OL} = 100μA	V_{DD}-0.2		 0.2	V V
Segment port output impedance • 1/2 bias type						
High-level output voltage Low-level output voltage	V_{OH}-4 V_{OL}-4	I_{OH} = -10μA Seg1 to Seg35 I_{OL} = 10μA	V_{DD}-0.2		 0.2	V V
High-level output voltage M-level output voltage Low-level output voltage	V_{OH}-5 V_{OM} V_{OL}-5	I_{OH} = -100μA COM1-COM4 I_{OH} = -100μA I_{OL} = 100μA I_{OL} = 100μA	V_{DD}-0.2 V_{DD}1-0.2		 V_{DD}1+0.2 0.2	V V V V
Segment port output impedance • 1/3 bias type						
High-level output voltage M-level output voltage Low-level output voltage	V_{OH}-4 V_{OM}1-1 V_{OM}1-2 V_{OL}-4	I_{OH} = -10μA Seg1 to Seg35 I_{OH} = -10μA I_{OL} = 10μA I_{OH} = -10μA I_{OL} = 10μA I_{OL} = 10μA	V_{DD}-0.2 V_{DD}1-0.2 V_{DD}2-0.2 		 V_{DD}1+0.2 V_{DD}2+0.2 0.2	V V V V V V
High-level output voltage M-level output voltage Low-level output voltage	V_{OH}-6 V_{OM}2-1 V_{OM}2-2 V_{OL}-6	I_{OH} = -100μA COM1-COM4 I_{OH} = -100μA I_{OL} = 100μA I_{OH} = -100μA I_{OL} = 100μA I_{OL} = 100μA	V_{DD}-0.2 V_{DD}1-0.2 V_{DD}2-0.2 		 V_{DD}1+0.2 V_{DD}2+0.2 0.2	V V V V V V

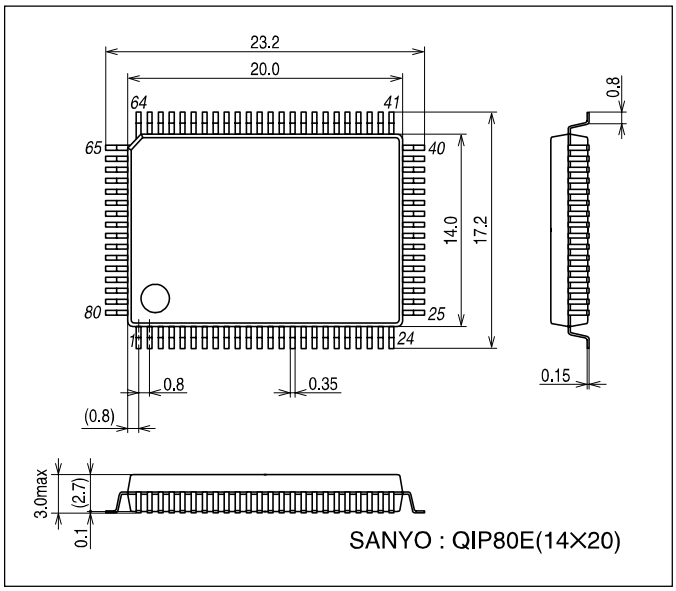
Electrical Characteristics at V_{DD} = 4.5V, V_{SS} = 0V, Ta = -30 to + 70°C

Parameter	Symbol	Conditions	Ratings			Unit
			min	typ	max	
Power leakage current	ILEK-1	V_{DD} = 3.0V Ta = 25°C	-1.0		1.0	μA
Input leakage current	IOFF	V_{DD} = 6.0V Ta = 25°C V_{IN} = V_{DD}/2 S1-S4, K1-K4, P1-P4, M1-M4, SO1-SO4, A1-A4 (input mode)	-1.0		1.0	μA
Output voltage 1	V_{DD}1-1 V_{DD}2-1	V_{DD} = 3.0V, 1/1 bias, fopr = 32.768kHz V_{DD}1: OPEN/V_{DD}2: OPEN CUP1-CUP2: OPEN	2.8 2.8		V_{DD} V_{DD}	V V
Output voltage 2	V_{DD}1-2 V_{DD}2-2	V_{DD} = 3.0V, 1/2 bias, fopr = 32.768kHz V_{DD}1: OPEN/V_{DD}2-V_{SS}: 0.1μF CUP1-CUP2: 0.1μF	1.4 1.4	1.5 1.5	1.6 1.6	V V
Output voltage 3	V_{DD}1-3 V_{DD}2-3	V_{DD} = 3.0V, 1/3 bias, fopr = 32.768kHz V_{DD}1-V_{SS}: 0.1μF/V_{DD}2-V_{SS}: 0.1μF CUP1-CUP2: 0.1μF	1.9 0.9	2.0 1.0	2.1 1.1	V V
Supply current 1	$|I_{DD}|$2-1	V_{DD} = 3.0V Ta = 25°C Xtal 32kHz version (Cd and Rd built in) V_{DD} = 5.0V Ta = 25°C Xtal 32kHz version (Cd and Rd built in) Cg = 30pF,CI = 31kΩ HALT mode, LCD = 1/3 bias, 32Hz		5.0 25.0	10.0 40.0	μA μA
Supply current 2	$|I_{DD}|$2-2	V_{DD} = 3.0V Ta = 25°C CF 400kHz version V_{DD} = 5.0V Ta = 25°C CF 400kHz version Ccg = Ccd = 330pF,HALT mode, LCD = 1/3 bias, 32Hz		150	200 550	μA μA
Supply current 3	$|I_{DD}|$2-3	V_{DD} = 3.0V Ta = 25°C CF 4MHz version V_{DD} = 5.0V Ta = 25°C CF 4MHz version Ccg = Ccd = 33pF, HALT mode, LCD = 1/3 bias, 32Hz		220	300 750	μA μA

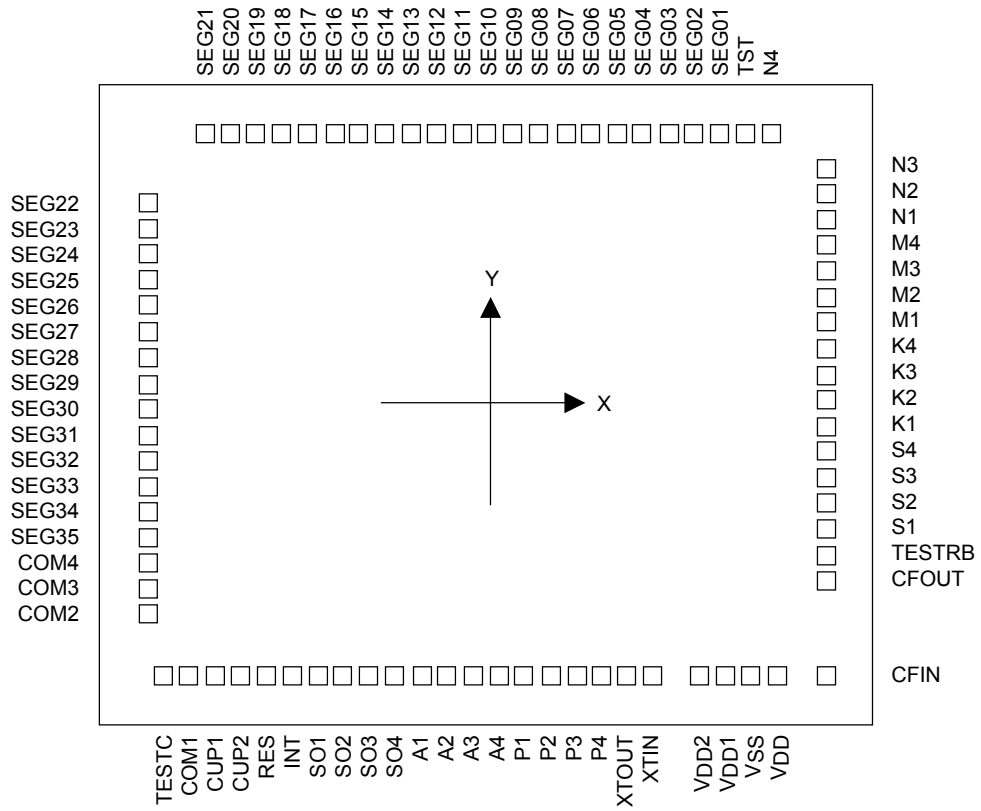
Package Dimensions

unit : mm

3174A



PAD Reference Diagram



PAD Coordinate Values

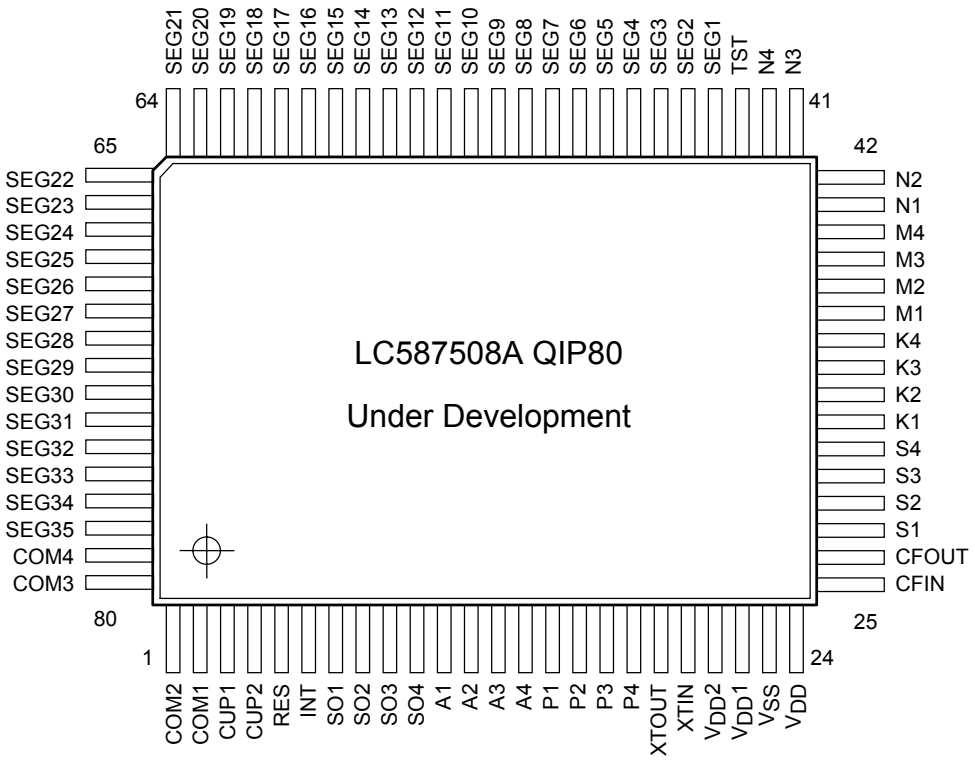
NO	Pin Name	X Cord.	Y Cord.
1	V_{DD}	1405	-1318
2	CFIN	1643	-1315
3	CFOUT	1643	-850
4	TESTRB	1643	-725
5	S1	1643	-600
6	S2	1643	-475
7	S3	1643	-350
8	S4	1643	-225
9	K1	1643	-100
10	K2	1643	25
11	K3	1643	150
12	K4	1643	275
13	M1	1643	400
14	M2	1643	525
15	M3	1643	650
16	M4	1643	775
17	N1	1643	900
18	N2	1643	1025
19	N3	1643	1150
20	N4	1380	1318
21	TST	1255	1318
22	SEG1	1130	1318
23	SEG2	1005	1318
24	SEG3	880	1318
25	SEG4	755	1318
26	SEG5	630	1318
27	SEG6	505	1318
28	SEG7	380	1318
29	SEG8	255	1318
30	SEG9	130	1318

NO	Pin Name	X Cord.	Y Cord.
31	SEG10	5	1318
32	SEG11	-120	1318
33	SEG12	-245	1318
34	SEG13	-370	1318
35	SEG14	-495	1318
36	SEG15	-620	1318
37	SEG16	-745	1318
38	SEG17	-870	1318
39	SEG18	-995	1318
40	SEG19	-1120	1318
41	SEG20	-1245	1318
42	SEG21	-1370	1318
43	SEG22	-1643	980
44	SEG23	-1643	855
45	SEG24	-1643	730
46	SEG25	-1643	605
47	SEG26	-1643	480
48	SEG27	-1643	355
49	SEG28	-1643	230
50	SEG29	-1643	105
51	SEG30	-1643	-20
52	SEG31	-1643	-145
53	SEG32	-1643	-270
54	SEG33	-1643	-395
55	SEG34	-1643	-520
56	SEG35	-1643	-645
57	COM4	-1643	-770
58	COM3	-1643	-895
59	COM2	-1643	-1020
60	TESTC	-1570	-1318

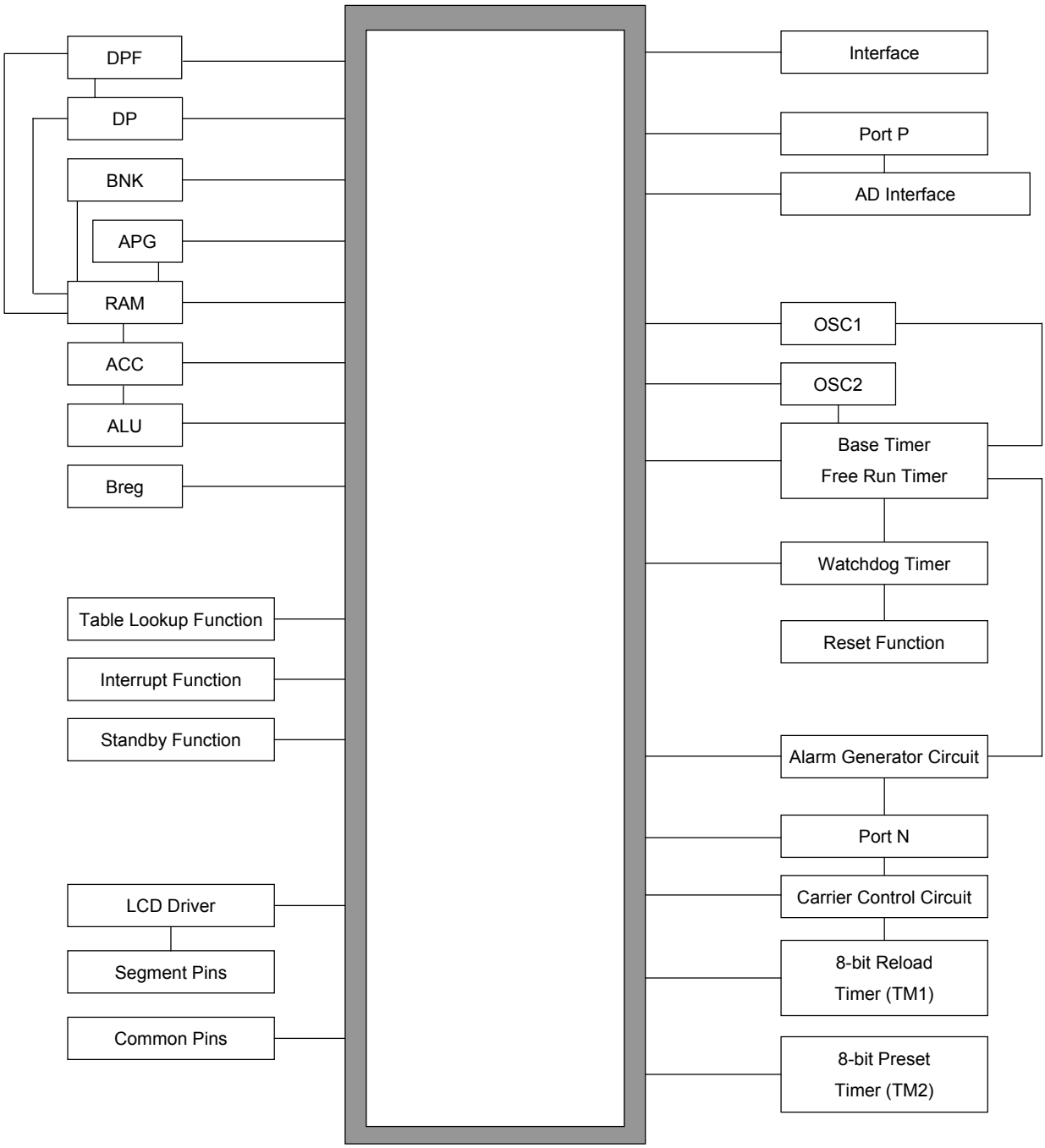
NO	Pin Name	X Cord.	Y Cord.
61	COM1	-1445	-1318
62	CUP1	-1320	-1318
63	CUP2	-1195	-1318
64	RES	-1070	-1318
65	INT	-945	-1318
66	SO1	-820	-1318
67	SO2	-695	-1318
68	SO3	-570	-1318
69	SO4	-445	-1318
70	A1	-320	-1318
71	A2	-195	-1318
72	A3	-70	-1318
73	A4	55	-1318
74	P1	180	-1318
75	P2	305	-1318
76	P3	430	-1318
77	P4	555	-1318
78	XTOUT	680	-1318
79	XTIN	805	-1318
80	$V_{DD}2$	1030	-1318
81	$V_{DD}1$	1155	-1318
82	V_{SS}	1280	-1318

* TST, TESTRB, and TESTC PAD must be held open.

Pin Layout



System Block Diagram



Mask Option Overview

The mask options make the microcontroller's hardware features conform with the application's specifications. The user can select mask options arbitrarily.

Oscillator circuit related options

- OSC1 SELECT---------- Selects the OSC1 oscillation specifications to be applied to the application product.
  1: EXT 2: RC 3: CF 4: NONUSED

- OSC1 PRE-DIV---------- Selects the OSC1 system clock specifications.
  1: OSC1/1 2: OSC1/2

- OSC1 WAIT TIME SELECT -------- Selects the OSC1 release time.
  1: 1/4K 2: 1/8K 3: 1/16K 4: 1/32K 5: 1/64K

- OSC2(Xtal) SELECT---------- Selects the OSC2 oscillation specifications to be applied to the application product.
  1: 2kHz 2: 5kHz 3: NONUSED

- OSC2(Xtal) CdRd SELECT---------- Selects the OSC2 oscillation specifications.
  1: USE 2: NONUSE

Other options

- RESISTOR SOURCE LEVEL------- Selects the pull-up or pull-down specifications.
  1: PULL DOWN 2: PULL UP

- POWER SOURCE LEVEL ---------- Specifies the LCD voltage step-up or step-down circuit according to the power supply system selected.
  1: V_{DD} = 1.5V 2: V_{DD} = 3.0V

- RES PORT RESISTOR SELECT --- Selects the specifications for the RESET pin.
  1: OPEN 2: PULL DOWN 3: PULL UP

- RES PORT LEVEL---------- Selects the level of the reset signal.
  1: L-LEVEL 2: H-LEVEL

- N PORT INITIAL LEVEL ---------- Selects the initial state of port N.
  1: L-LEVEL 2: H-LEVEL

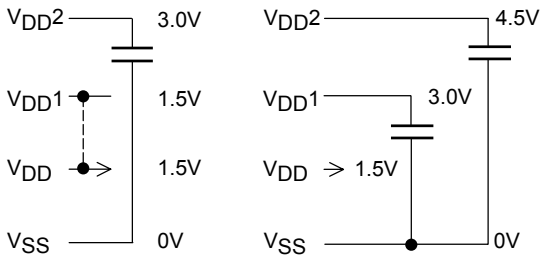
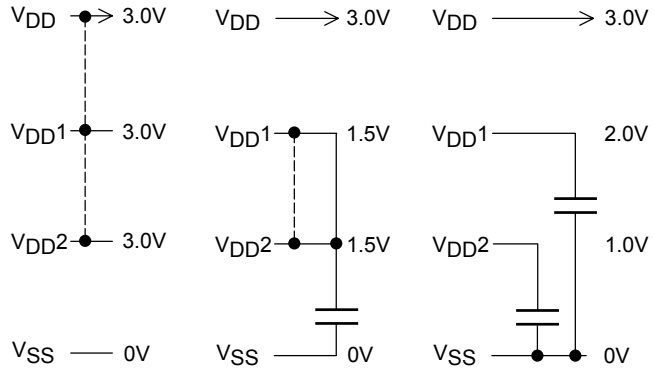
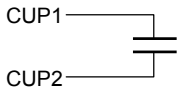
- N1 PORT---------- Selects the output type of port N1.
  1: N-CH 2: C-MOS

- N2 PORT---------- Selects the output type of port N2.
  1: N-CH 2: C-MOS

- N3 PORT---------- Selects the output type of port N3.
  1: N-CH 2: C-MOS

- N4 PORT---------- Selects the output type of port N4.
  1: N-CH 2: C-MOS

Pin Function Chart

Pin Name	I/O	Function	Reset-time State
V_{SS}		Power supply (-) pin	
V_{DD}		Power supply (+) pin	
$V_{DD}1$ $V_{DD}2$		LCD drive power pin The external circuit control varies with the power requirements and LCD drive bias system. [1.5V power supply specifications]  (1/1, 1/2 bias specifications) (1/3 bias specifications) [3.0V power supply specifications]  (1/1 bias specifications) (1/2 bias specifications) (1/3 biasspecifications)	
CUP1 CUP2		LCD drive pin The external circuit control varies with the LCD drive bias system.  [1.5V power supply specification] Connect capacitor for 1/1, 1/2, and 1/3 bias systems. [3.0V power supply specifications] Connect capacitor for 1/2, 1/3 bias systems.	
CFIN CFOUT	Input Output	OSC1 (fast mode) oscillator pin	
XTIN XTOUT	Input Output	OSC2 (slow mode) oscillator pin Xtal: 32kHz, 65kHz	
INT	Input	1-bit input pin External interrupt pin The input type and interrupt level are determined by the program. (pull-up, pull-down, open) (rising edge, falling edge) Also available is the level hold function that prevents the pin from being floated.	Interrupt acceptance: Disabled
S1 S2 S3 S4	Input Input Input Input	4-bit input port Incorporate pull-up or pull-down resistors that can be controlled through the program on a port basis. Incorporate input change detector and chatter elimination circuits that can be controlled through the program in 1 bit units. The chatter elimination time varies with the oscillator specifications. 32.768kHz Xtal oscillator: 7.8ms or 1.95ms Also available is the level hold function that prevents the pin from being floated.	Pull-up or -down resistor: ON (After reset: OFF)

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Pin Name	I/O	Function	Reset-time State
K1 K2 K3 K4	Input/output Input/output Input/output Input/output	4-bit input/output port Incorporate pull-up or pull-down resistors that can be controlled through the program on a port basis. Incorporate input change detector and chatter elimination circuits that can be controlled through the program on a port basis. The chatter elimination time varies with the oscillation specifications. 32.768kHz Xtal oscillator: 7.8ms or 1.95ms Output type: CMOS Also available is the "level hold function" that prevents the pin from being floated.	Input mode Pull-up or -down resistor: ON (After reset: OFF) Output latch data: High
SO1 SO2 SO3 SO4	Input/output Input/output Input/output Input/output	4-bit input/output port (also used by the serial interface) SO1: Serial input pin SO2: Serial output pin SO3: Serial clock pin 2-wire serial transmission is also possible. The SO4 pin can also be used as a halt reset or interrupt source pin when the serial function is not to be used. Incorporate pull-up or pull-down resistors that can be controlled through the program on a port basis. The output type can be controlled through the program on a port basis (CMOS/Nch). Also available is the "level hold function" that prevents the pin from being floated.	Input mode Pull-up or -down resistor: ON (After reset state is exited: OFF) 4-bit parallel mode Output latch data: High
M1 M2 M3 M4	Input/output Input/output Input/output Input/output	4-bit I/O port Incorporate pull-up or pull-down resistors that can be controlled through the program on a port basis. The output type can be controlled through the program on a port basis (CMOS/Pch). The M4 pin serves as a clock input pin when timer 2 is run in the event counter mode. Also available is the "level hold function" that prevents the pin from being floated.	Input mode Pull-up or -down resistor: ON (After reset state is exited: OFF) Output latch data: High
P1 P2 P3 P4	Input/output Input/output Input/output Input/output	4-bit I/O port Incorporate pull-up or pull-down resistors that can be controlled through the program on a port basis. The output type can be controlled through the program on a port basis (CMOS/Pch). Also available is the level hold function that prevents the pin from being floated.	Input mode Pull-up or -down resistor: ON (After reset state is exited: OFF) Output latch data: High
A1 A2 A3 A4	Input/output Input/output Input/output Input/output	4-bit I/O port Incorporate pull-up or pull-down resistors that can be controlled through the program on a port basis. The output type can be controlled through the program on a port basis (CMOS/Pch). Also available is the "level hold function" that prevents the pin from being floated.	Input mode Pull-up or -down resistor: ON (After reset state is exited: OFF) Output latch data: High
N1 N2 N3 N4	Output Output Output Output	4-bit output port The output type can be controlled through the program on a port basis (CMOS/Nch). These pins serve as a middle voltage withstand pin when output type is set to open-drain. The N3 pin is an output pin for generating the remote controller carrier signal. The N4 pin is an output pin for the alarm pulse signal.	The output level is determined by an option.
SEG01 to SEG35	Output Output	LCD panel segment drive pins Support 6 drive modes. Pins SEG01 to SEG16 can also be configured as general-purpose output pins (CMOS, Pch, Nch) through the program. The LCD drive and general-purpose output pins can be used in any combination.	
COM1 COM2 COM3 COM4	Output Output Output Output	LCD panel common electrode drive pins COM1 to COM4 are used according to the LCD drive duty mode. The LCD drive frequency (frame frequency) is determined under program control.	

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Pin Name	I/O	Function	Reset-time State
RES	Input	Input pin used to reset the microcontroller. 200μs or longer reset signal must be applied to this pin. The input type and reset level of this pin are determined with mask options.	
TST	Input	Test pin Must be connected to the V_{SS} pin (power supply-side).	