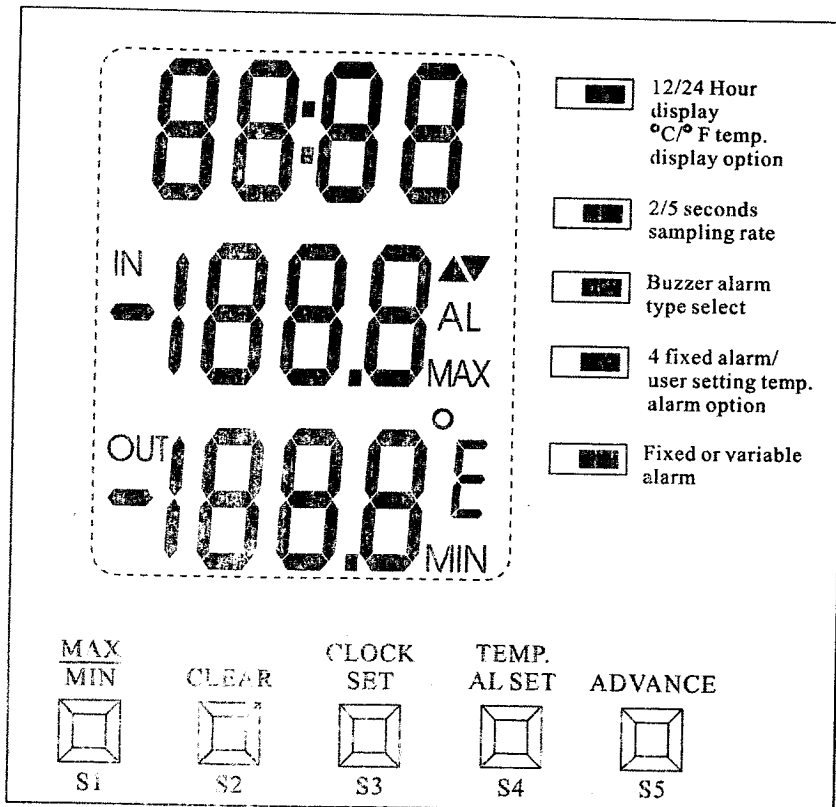


Dual Temperatures with clock IC-50°C (-58°F) ~ +70°C (+158°F)

SS0116



Features:-

- Three lines display of clock, inside temperature and outside temperature
- Maximum and minimum record of temperatures
- Four fixed or variable temperature alarms selectable
- 2 seconds and 5 seconds sensing rate selectable
- two types of alarm sounds selectable
- 12/24 hours selectable
- °C / °F selectable
- Accuracy : 0°C to 50°C ± 1°C otherwise ± 2°C or equivalent in °F
- Resolution: ±0.1°C/°F

1. General Description

SS0116 is low power CMOS IC that displays the clock, indoor and outdoor temperatures simultaneously from -50°C (-58°F) to 70°C (158°F) with versatile temperature alarms selection. It can record the maximum and minimum temperatures.

2. Function of Terminals

2.1 Options:

Terminal	Level	Function
P0.0	VSS1	Continuous Alarm for one minute
	Open	4 beeps per minute
P0.1	VSS1	Fixed Alarms (see fixed alarm selection table)
	Open	Variable Alarms
P0.2	VSS1	24 Hours, Degree C mode
	Open	12 Hours, Degree F mode
P0.3	VSS1	2 seconds sampling rate
	Open	5 seconds sampling rate

2.2 Inputs:

P2.0	VSS1	Max/Min	S1
P2.1	VSS1	Clear	S2
P2.2	VSS1	Set Clock	S3
P2.3	VSS1	Set Temperature Alarm	S4
P3.0	VSS1	Advance	S5
P3.1	VSS1	Backlight	S6

2.3 Output

P1.0	VDD	Turn Backlight On
	VSS1	Turn Backlight Off
P1.3	VDD	Alarm Control On
	VSS1	Alarm Control Off

2.4 Fixed Alarm Table

P3.3	P3.2	High Temperature	Low Temperature Alarm
0	0	5.0	0.0
0	1	22.0	26.0
1	0	24.0	28.0
1	1	38.0	41.0

3. Operation

When power is first applied, all the LCD segments and the alarm sound are turned on for 2 seconds. Then the IC enters normal display mode.

3.1 Normal display Mode (refer to LCD diagram)

Normal display shows Hour in digits 1 and 2, minutes in digits 3 and 4, with colon flashing. The current inside temperature is shown in digits 5,6,7 and 8 with decimal point DP1 and IN flag. The current outside temperature in digits 9, 10, 11 and 12 with decimal point DP2 and OUT flag. The temperature unit and hour system will be determined by the state of port P0.2 as shown in 2.1

In normal display mode, push S1 will render the display to show the maximum and minimum temperatures of the inside temperature. To clear this record, just push S2 and the temperature record will show ---, push S1 again will display the maximum and minimum record of the outside temperature. This record can be cleared similarly by pushing S2. Push S1 again will return to normal display of clock, inside and outside temperatures.

3.2 Set Clock

Clock can be set by pushing **set clock** key once. The hour digits will blink. By pushing the **advance** key once the hour digits will increment by one. Holding down the **advance** key for 2 seconds will cause the hour digits to auto-advance at 4 times per second. Pushing the **set clock** key again will cause the minute digits to blink. The minute digits can be increment in a similar manner. Every time minute is advanced, the internal second counter is zeroed to allow accurate time setting.

3.2 Set Temperature Alarm

The variable temperature alarms can be set by pushing the **set alarm** key once. The high Temperature Alarm icon \triangle , the Low Temperature Alarm icon ∇ and the alarm Enable Flag AL are shown. The High Temperature Alarm value is shown by digits 5,6,7 and 8 with DP1 as decimal point. The Low Temperature Alarm value is shown by digits 9,10,11 and 12 with DP2 as decimal point. The icon \triangle will blink and the High Temperature Alarm is set first from -50°C (or equivalent in $^{\circ}\text{F}$ depends on the system selected). Increment of this value is done by pushing the **advance** key. Auto-increment is also possible as in click setting. To set the Low Temperature Alarm, push the **set alarm** key again, the ∇ icon will blink. Set the value in similar manner the high alarm. The alarms can be enabled or disabled by pushing the **set alarm** key, which will toggle the AL flag on, or off to indicate whether the alarms are activated or deactivated.

3.3 Fixed Temperature Alarm

There is no setting required in the fixed alarm mode. Pushing **set alarm** key once will show the alarm values as set by the fixed alarm table. No change can be done except by changing the jumper option as according to the fixed alarm table. However, the alarms can be activated or deactivated by pushing the **set alarm** key.

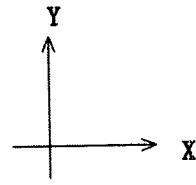
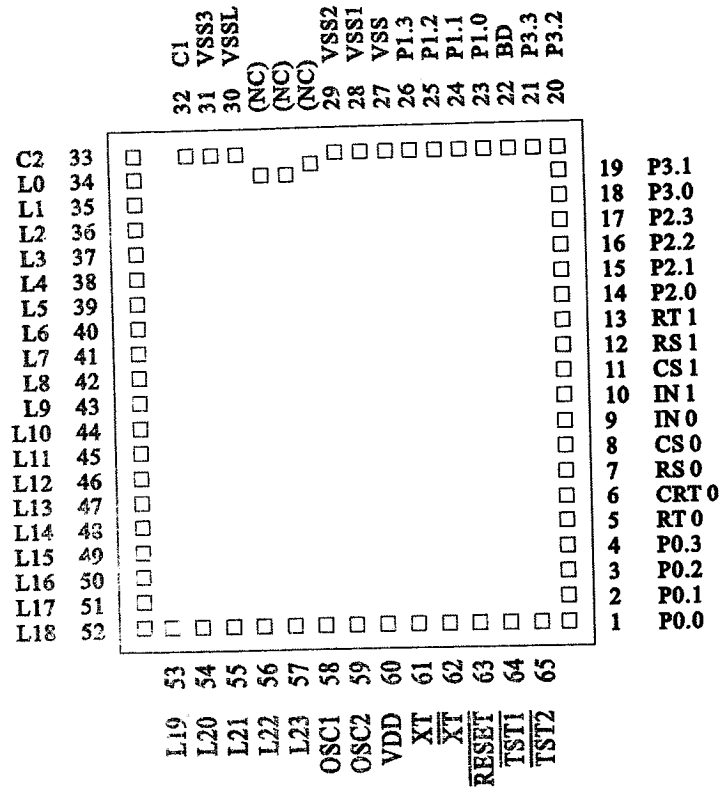
3.4 Alarm Function

The alarm is triggered when the measured temperature is higher than the High Temperature Alarm value or lower than the Low Temperature Alarm value. The alarm buzzer will sound either continuously for one minute or 4 beeps per minute depend on the option chosen. The alarm buzzer can be switched off by pushing any key.

The alarm control output P1.3 will also be on for as long as the measured temperature meets the above criteria.

Pad Configuration

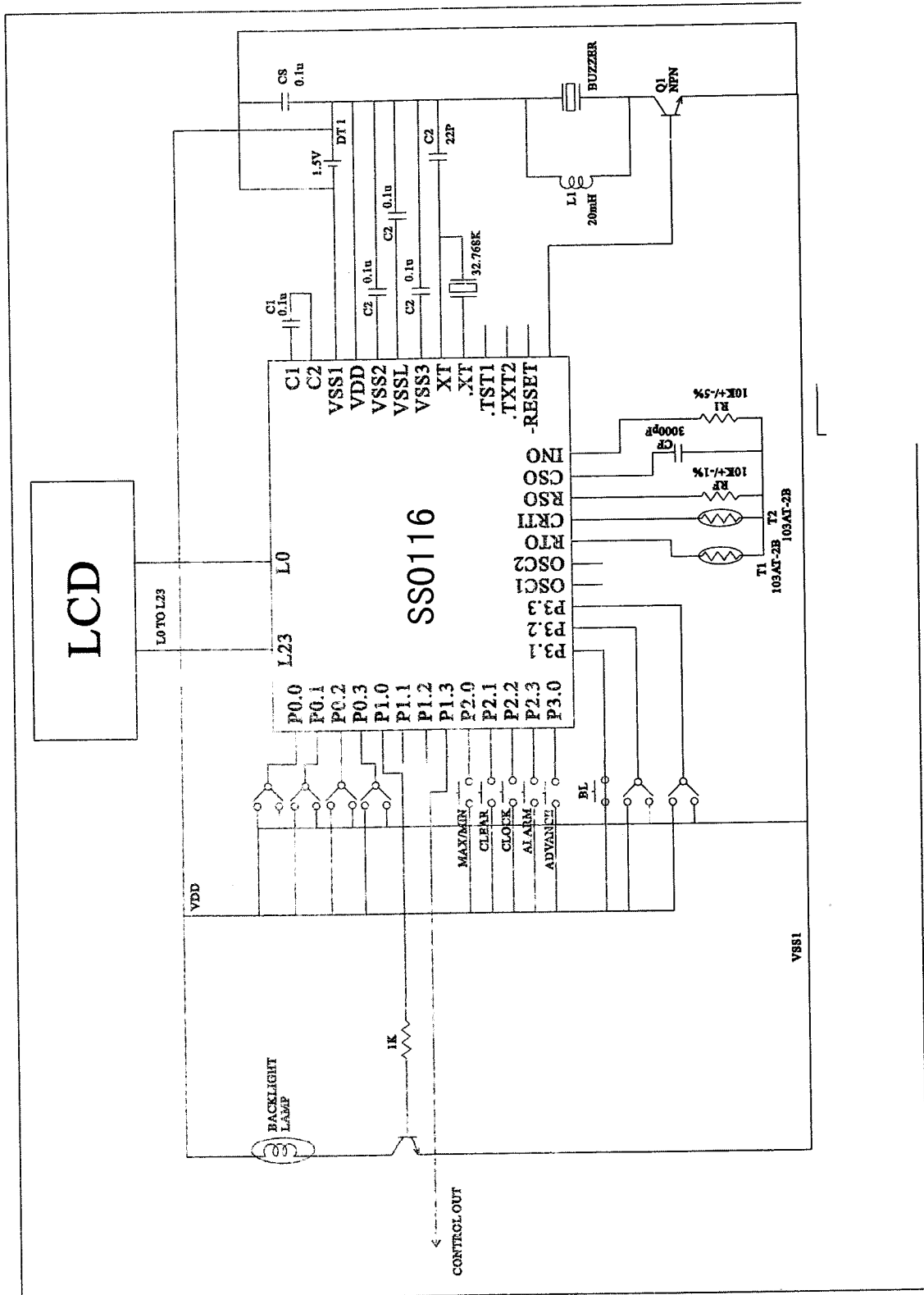
Pad Layout



- Chip Size : 3.96 mm x 4.32 mm
- Chip Thickness : 350 μm (typ.)
- Coordinate Origin : Chip center
- Pad Hole Size : 110 μm x 110 μm
- Pad Size : 120 μm x 120 μm
- Minimum Pad Pitch : 180 μm

Pad Coordinates

Pad No.	Pad Name	X (μm)	Y (μm)	Pad No.	Pad Name	X (μm)	Y (μm)
1	P0.0	1828.80	-1940.40	41	L7	-1829.40	379.50
2	P0.1	1828.80	-1719.30	42	L8	-1829.40	199.50
3	P0.2	1828.80	-1539.30	43	L9	-1829.40	10.20
4	P0.3	1828.80	-1310.10	44	L10	-1829.40	-232.20
5	RT0	1828.80	-1048.50	45	L11	-1829.40	-412.20
6	CRT0	1828.80	-831.30	46	L12	-1829.40	-592.20
7	RS0	1828.80	-651.30	47	L13	-1829.40	-772.20
8	CS0	1828.80	-396.00	48	L14	-1829.40	-1008.00
9	IN0	1828.80	-208.20	49	L15	-1829.40	-1290.00
10	IN1	1828.80	-12.90	50	L16	-1829.40	-1470.00
11	CS1	1828.80	175.50	51	L17	-1829.40	-1710.00
12	RS1	1828.80	390.30	52	L18	-1829.40	-1928.10
13	RT1	1828.80	580.50	53	L19	-1495.20	-1957.50
14	P2.0	1828.80	794.10	54	L20	-1226.70	-1957.50
15	P2.1	1828.80	1001.70	55	L21	-958.80	-1957.50
16	P2.2	1828.80	1194.00	56	L22	-694.80	-1957.50
17	P2.3	1828.80	1374.00	57	L23	-448.80	-1957.50
18	P3.0	1828.80	1555.20	58	OSC1	-243.00	-1957.50
19	P3.1	1828.80	1735.20	59	OSC2	24.90	-1957.50
20	P3.2	1769.70	1957.80	60	VDD	300.60	-1957.50
21	P3.3	1589.70	1957.80	61	XT	480.60	-1957.50
22	BD	1317.60	1957.80	62	XT	660.60	-1957.50
23	P1.0	999.30	1957.80	63	RESET	979.50	-1957.50
24	P1.1	674.70	1957.80	64	TST1	1247.70	-1957.50
25	P1.2	354.90	1957.80	65	TST2	1599.90	-1957.50
26	P1.3	30.30	1957.80				
27	VSS	-231.00	1957.80				
28	VSS1	-411.00	1957.80				
29	VSS2	-647.10	1957.80				
30	VSSL	-1229.40	1957.80				
31	VSS3	-1469.40	1957.80				
32	C1	-1649.40	1957.80				
33	C2	-1829.40	1957.80				
34	L0	-1829.40	1704.00				
35	L1	-1829.40	1524.00				
36	L2	-1829.40	1344.00				
37	L3	-1829.40	1111.20				
38	L4	-1829.40	919.50				
39	L5	-1829.40	739.50				
40	L6	-1829.40	559.50				

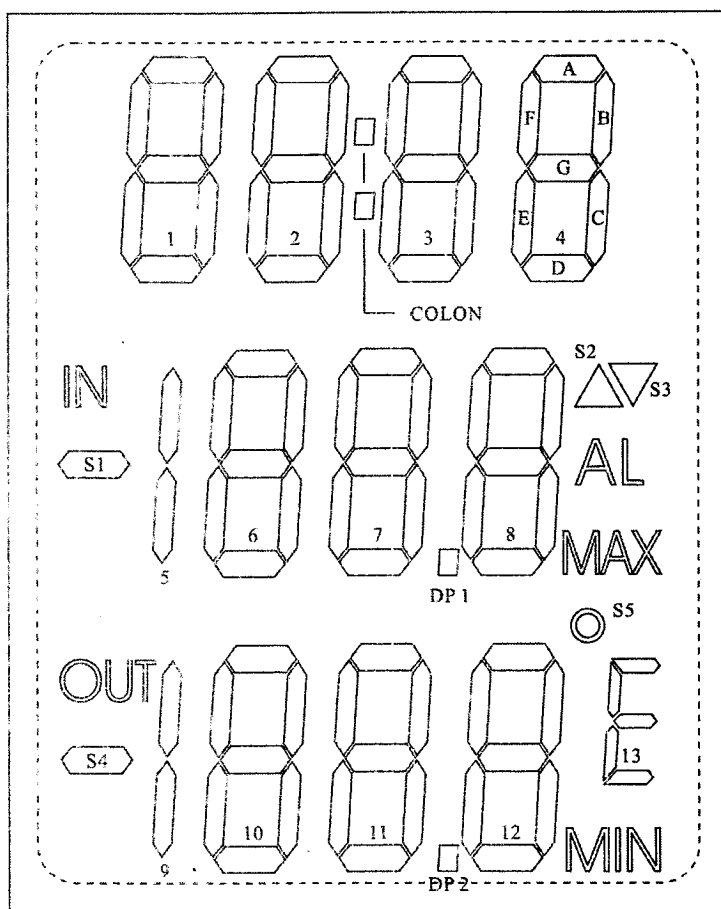


LCD Segment Layout

PIN	COM1 Group	COM2 Group	COM3 Group	COM4 Group
L0	MAX, MIN	13G	13D	S5,13AEF, DP1, DP2
L1	AL	S2	S3	COLON
L3	8D	8C	8B	8A
L3	7D	8E	8G	8F
L4	IN	7C	7B	7A
L5	S1	7E	7G	7F
L6	6D	6C	6B	6A
L7	5BC	6E	6G	6F
L8	---	---	---	COM4
L9	---	---	COM3	---
L10	---	COM2	---	---
L11	COM1	---	---	---
L12	4A	4B	4C	4D
L13	4F	4G	4E	3D
L14	3A	3B	3C	1ADEG
L15	3F	3G	3E	1C
L16	2A	2B	2C	2D
L17	2F	2G	2E	1B
L18	12A	12B	12C	12D
L19	12F	12G	12E	11D
L20	11A	11B	11C	OUT
L21	11F	11G	11E	S4
L22	10A	10B	10C	10D
L23	10F	10G	10E	9BC

LCD Information

DISPLAY TYPE	IN POSITIVE	
CONNECTOR TYPE	ELASTOMER	
VIEWING DIRECTION	12 O'CLOCK	
DRIVING IC		
DRIVING SCHEME	1/4 DUTY, 1/3 BIAS	
DRIVING VOLTAGE	4.5V @ 20 °C	
OPERATION TEMPERATURE	-10°C - 60 °C	
STORAGE TEMPERATRE	-20°C - 65 °C	
POLARIZERS	--- FRONT	STD. TRANSMISSIVE
	--- BACK	STD. REFLECTIVE



ELECTRICAL CHARACTERISTICS (1.5V Spec.)**ABSOLUTE MAXIMUM RATINGS (1.5V Spec.)**(V_{DD} = 0 V)

Parameter	Symbol	Condition	Rating	Unit
Power Supply Voltage 1	V _{SS}	T _a = 25°C	-2.0 to +0.3	V
Power Supply Voltage 2	V _{SS1}	T _a = 25°C	-2.0 to +0.3	V
Power Supply Voltage 3	V _{SS2}	T _a = 25°C	-4.0 to +0.3	V
Power Supply Voltage 4	V _{SS3}	T _a = 25°C	-5.5 to +0.3	V
Power Supply Voltage 5	V _{SSL}	T _a = 25°C	-2.0 to +0.3	V
Input Voltage 1	V _{IN1}	V _{SS} Input, T _a = 25°C	V _{SS} -0.3 to +0.3	V
Input Voltage 2	V _{IN2}	V _{SS1} Input, T _a = 25°C	V _{SS1} -0.3 to +0.3	V
Input Voltage 3	V _{IN3}	V _{SSL} Input, T _a = 25°C	V _{SSL} -0.3 to +0.3	V
Output Voltage 1	V _{OUT1}	V _{SS} Output, T _a = 25°C	V _{SS} -0.3 to +0.3	V
Output Voltage 2	V _{OUT2}	V _{SS1} Output, T _a = 25°C	V _{SS1} -0.3 to +0.3	V
Output Voltage 3	V _{OUT3}	V _{SS2} Output, T _a = 25°C	V _{SS2} -0.3 to +0.3	V
Output Voltage 4	V _{OUT4}	V _{SS3} Output, T _a = 25°C	V _{SS3} -0.3 to +0.3	V
Output Voltage 5	V _{OUT5}	V _{SSL} Output, T _a = 25°C	V _{SSL} -0.3 to +0.3	V
Storage Temperature	T _{STG}	--	-55 to +150	°C

RECOMMENDED OPERATING CONDITIONS (1.5V Spec.)(V_{DD} = 0 V)

Parameter	Symbol	Condition	Range	Unit
Operating Temperature	T _{OP}	--	-40 to +85	°C
Operating Voltage	V _{SS} , V _{SS1}	V _{SS1} is grounded	-1.7 to -1.25	V
External 400kHz RC Oscillator Resistance	R _{OS}	--	250 to 500	kΩ
Crystal Oscillation Frequency	f _{XT}	--	30 to 35	kHz

DC Characteristics (1.5V Spec.) $(V_{DD} = 0V, V_{SS} = V_{SS1} = -1.5V, T_a = -40 \text{ to } +85^\circ\text{C}$ unless otherwise specified)

Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit	Measuring Circuit	
V_{SS2} Voltage	V_{SS2}	$C_a, C_b, C_{12} = 0.1\mu\text{F}$	+100% -50%	-3.2	-3.0	-2.8	V	1
V_{SS3} Voltage	V_{SS3}	$C_a, C_b, C_{12} = 0.1\mu\text{F}$	+100% -50%	-4.7	-4.5	-4.3	V	
V_{SSL} Voltage	V_{SSL}	--		-1.5	-1.3	-0.6	V	
Crystal Oscillation Start Voltage	V_{STA}	Oscillation start time: within 5 seconds	--	--	-1.45	V		
Crystal Oscillation Hold Voltage	V_{HOLD}	--	--	--	-1.25	V		
Crystal Oscillation Stop Detection Time	V_{STOP}	--	0.1	--	1000	ms		
Internal Crystal Oscillator Capacitance	C_G	--	10	15	20	pF		
External Crystal Oscillator Capacitance	C_{GEX}	When external C_G used	10	--	30	pF		
Internal Crystal Oscillator Capacitance	C_D	--	10	15	20	pF		
Internal 400k RC Oscillator Capacitance	C_{OS}	--	8.0	12	16	pF		
400k RC Oscillation Frequency	f_{OSC}	External resistor $R_{OS} = 300k\Omega$ $V_{SS} = -1.25 \text{ to } -1.7V$	80	220	350	kHz		
POR Generation Voltage	V_{POR1}	When V_{SS} is between V_{POR1} and $-1.5V$	-0.4	--	0	V		
POR Non-generation Voltage	V_{POR2}	No POR when V_{SS} is between V_{POR2} and $-1.5V$	-1.5	--	-1.2	V		
Battery Check Reference Voltage	V_{RB}	$T_a = 25^\circ\text{C}$	-0.73	-0.63	-0.53	V		
V_{RB} Temperature Variation	ΔV_{RB}	--	--	-2.0	--	mV/ $^\circ\text{C}$	2	

- Notes :
1. "POR" denotes Power On Rest
 2. " T_{STOP} " indicates that if the crystal oscillator stops over the value of T_{STOP} , the system reset occurs.

DC Characteristics (1.5V Spec.) (continued)

(V_{DD} = 0V, V_{SS} = V_{SS1} = -1.5V, Ta = -40 to +85°C unless otherwise specified)

Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit	Measuring Circuit	
Supply Current 1	I _{DD1}	CPU in halt state (400k RC oscillation halt)	Ta = -40 to +40°C	--	2.0	5.0	μA	1
			Ta = +40 to +85°C	--	2.0	30	μA	
Supply Current 2	I _{DD2}	CPU in operating state (400k RC oscillation halt)	Ta = -40 to +40°C	--	5.0	15	μA	
			Ta = +40 to +85°C	--	5.0	40	μA	
Supply Current 3	I _{DD3}	CPU in operating state (400k RC oscillation in operation) R _{OS} = 300kΩ	--	40	80	μA		
Supply Current 4	I _{DD4}	CPU in halt state (400k RC oscillation halt), RC oscillator for A/D converter is in operating state	RTO = 10 kΩ	--	150	230	μA	
			RTO = 2 kΩ	--	600	900	μA	
Supply Current 5	I _{DD5}	Battery Check circuit in operating state, CPU in operating state (400k RC oscillation halt)	--	25	125	μA		

DC Characteristics (1.5V Spec.) (continued)

($V_{DD} = 0V$, $V_{SS} = V_{SS1} = V_{SS2} = -1.5V$, $V_{SS2} = -3.0V$, $V_{SS3} = -4.5V$,
 $T_a = -40$ to $+85^\circ C$ unless otherwise specified)

Parameter (Pin Name)	Symbol	Condition	Min.	Typ.	Max.	Unit	Measuring Circuit
Output Current 1 (P1.0)	I_{OH1}	$V_{OH1} = -0.5 V$	-2.1	-0.5	-0.1	mA	2
	I_{OL1}	$V_{OL1} = V_{SS} + 0.5 V$	1.0	3.0	9.0	mA	
Output Current 2 (P1.1 to P1.3) (P2.0 to P2.3) (P3.0 to P3.3)	I_{OH2}	$V_{OH2} = -0.5 V$	-2.1	-0.5	-0.1	mA	
	I_{OL2}	$V_{OL2} = V_{SS} + 0.5 V$	0.1	0.5	2.1	mA	
Output Current 3 (BD)	I_{OH3}	$V_{OH3} = -0.7 V$	-1.8	-0.4	-0.1	mA	
	I_{OL3}	$V_{OL3} = V_{SS} + 0.7 V$	0.1	0.4	1.8	mA	
Output Current 4 (RTO, RT1, RSO, RS1, CRTO, CSO, CS1)	I_{OH4}	$V_{OH4} = -0.1 V$	-1.1	-0.4	-0.2	mA	
	I_{OL4}	$V_{OL4} = V_{SS} + 0.1 V$	0.2	0.4	1.1	mA	
Output Current 5 (When L16 to L23 are configured as output ports)	I_{OH5}	$V_{OH5} = -0.5 V$	-1.5	-0.4	-0.08	mA	
	I_{OL5}	$V_{OL5} = V_{SS} + 0.5 V$	0.08	0.4	1.5	mA	
Output Current 6 (OSC2)	I_{OH6}	$V_{OH6} = -0.5 V$	-2.1	-0.5	-0.1	mA	
	I_{OL6}	$V_{OL6} = V_{SS} + 0.5 V$	0.1	0.5	2.1	mA	
Output Current 7 (L0 to L23)	I_{OH7}	$V_{OH7} = -0.2 V$ (V_{DD} level)	--	--	4.0	μA	
	I_{OMH7}	$V_{OMH7} = V_{SS1} + 0.2 V$ (V_{SS1} level)	4.0	--	--	μA	
	I_{OMH7S}	$V_{OMH7S} = V_{SS1} - 0.2 V$ (V_{SS1} level)	--	--	-4.0	μA	
	I_{OML7}	$V_{OML7} = V_{SS2} + 0.2 V$ (V_{SS2} level)	4.0	--	--	μA	
	I_{OML7S}	$V_{OML7S} = V_{SS2} - 0.2 V$ (V_{SS2} level)	--	--	-4.0	μA	
	I_{OL7}	$V_{OL7} = V_{SS3} + 0.2 V$ (V_{SS3} level)	4.0	--	--	μA	
Output Leakage Current (P1.0 to P1.3) (P2.0 to P2.3) (P3.0 to P3.3) (RTO, RT1, RS0, RS1, CRT0, CS0, CS1)	I_{OOH}	$V_{OH} = V_{DD}$	--	--	0.3	μA	
	I_{OOL}	$V_{OL} = V_{SS}$	-0.3	--	--	μA	

DC Characteristics (1.5V Spec.) (continued)

($V_{DD} = 0V$, $V_{SS} = V_{SS1} = V_{SSL} = -1.5V$, $V_{SS2} = -3.0V$, $V_{SS3} = -4.5V$,
 $T_a = -40$ to $+85^{\circ}C$ unless otherwise specified)

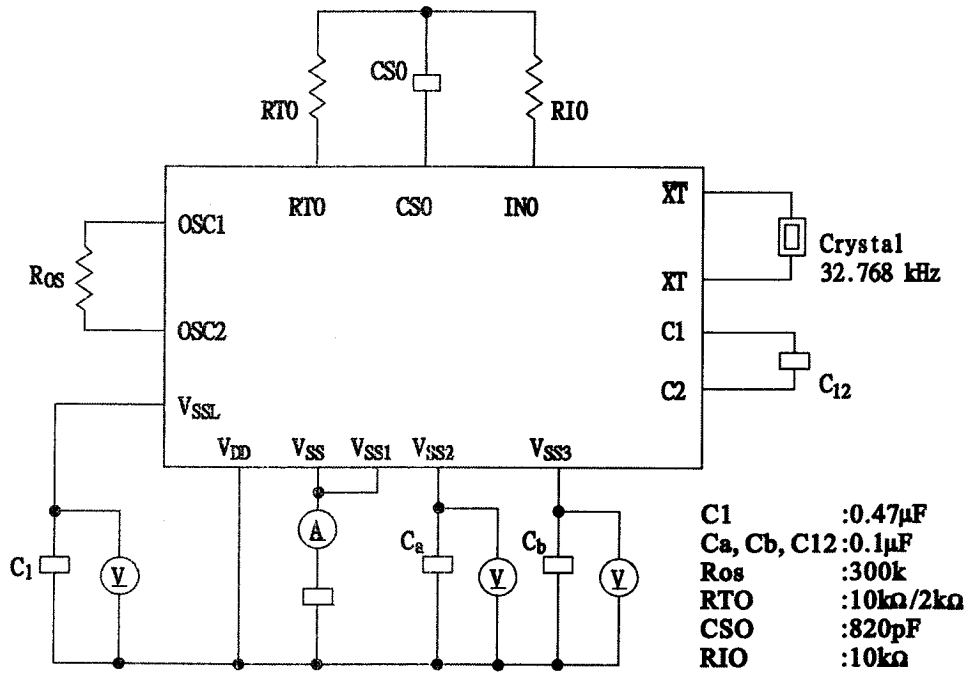
Parameter (Pin Name)	Symbol	Condition	Min.	Typ.	Max.	Unit	Measuring Circuit
Input Current 1 (P0.0 to P0.3) (P2.0 to P2.3) (P3.0 to P3.3) (P4.0 to P4.3)	I_{IH1}	$V_{IH1} = V_{DD}$ (when pulled down)	2.0	10	60	μA	3
	I_{IL1}	$V_{IH1} = V_{SS}$ (when pulled up)	-60	-10	-2.0	μA	
	I_{IH1Z}	$V_{IH1} = V_{DD}$ (in a high impedance state)	0	--	1.0	μA	
	I_{IL1Z}	$V_{IL1} = V_{SS}$ (in a high impedance state)	-1.0	--	0	μA	
Input Current 2 (IN0, IN1)	I_{IH2}	$V_{IH2} = V_{DD}$ (when pulled down)	2.0	10	60	μA	
	I_{IH2Z}	$V_{IH2} = V_{DD}$ (in a high impedance state)	0	--	1.0	μA	
	I_{IL2Z}	$V_{IL2} = V_{SS}$ (in a high impedance state)	-1.0	--	0	μA	
Input Current 3 (OSC1)	I_{IL3}	$V_{IL3} = V_{SS}$ (when pulled up)	-60	-18	-4.0	μA	
	I_{IH3Z}	$V_{IH3} = V_{DD}$ (in a high impedance state)	0	--	1.0	μA	
	I_{IL3Z}	$V_{IL3} = V_{SS}$ (in a high impedance state)	-1.0	--	0	μA	
Input Current 4 (\overline{RESET} , $\overline{TST1}$, $\overline{TST2}$)	I_{IH4}	$V_{IH4} = V_{DD}$	0	--	1.0	μA	
	I_{IL4}	$V_{IL4} = V_{SS}$	-1.5	-0.75	-0.3	mA	
Input Voltage 1 (P0.0 to P0.3) (P2.0 to P2.3) (P3.0 to P3.3)	V_{IH1}	--	-0.3	--	0	V	4
	V_{IL1}	--	-1.5	--	-1.2	V	
Input Voltage 2 (IN0, IN1, OSC1)	V_{IH2}	--	-0.3	--	0	V	
	V_{IL2}	--	-1.5	--	-1.2	V	
Input Voltage 3 (\overline{RESET} , $\overline{TST1}$, $\overline{TST2}$)	V_{IH3}	--	-0.3	--	0	V	
	V_{IL3}	--	-1.5	--	-1.2	V	

DC Characteristics (1.5V Spec.) (continued)

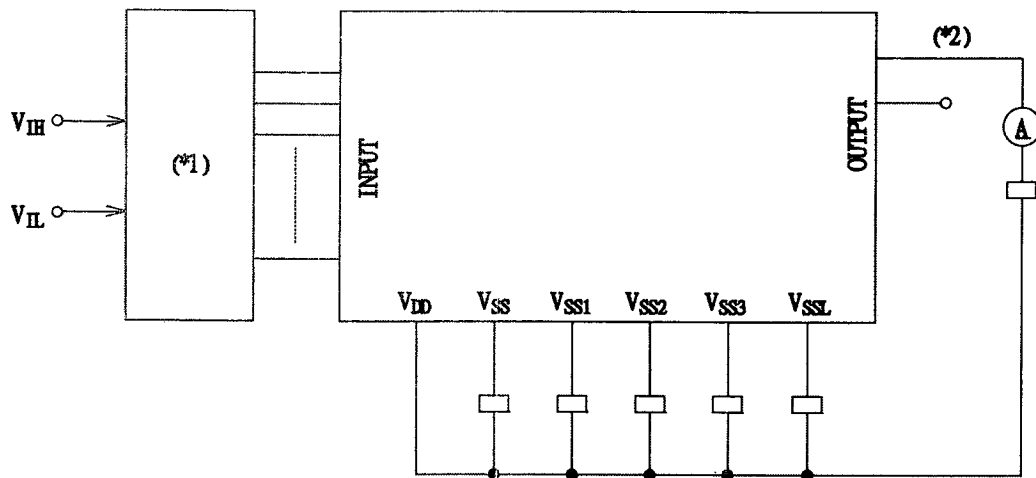
($V_{DD} = 0V$, $V_{SS} = V_{SS1} = V_{SSL} = -1.5V$, $V_{SS2} = -3.0V$, $V_{SS3} = -4.5V$,
 $T_a = -40$ to $+85^{\circ}C$ unless otherwise specified)

Parameter (Pin Name)	Symbol	Condition	Min.	Typ.	Max.	Unit	Measuring Circuit
Hysteresis Width (P0.0 to P0.3) (P2.0 to P2.3) (P3.0 to P3.3)	ΔV_{T1}	--	0.05	0.1	0.3	V	4
Hysteresis Width (RESET, TST1, TST2)	ΔV_{T2}	--	0.05	0.1	0.3	V	
Input Pin Capacitance (P0.0 to P0.3) (P2.0 to P2.3) (P3.0 to P3.3)	C_{IN}	--	--	--	5.0	pF	1

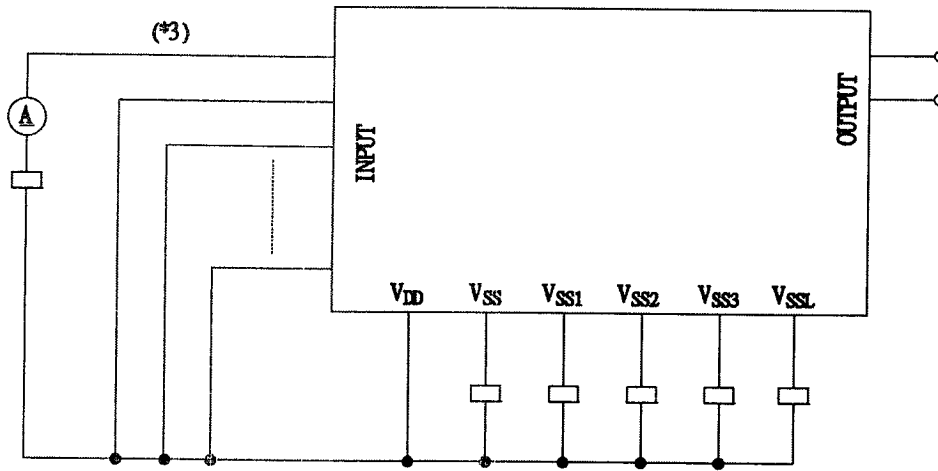
Measuring circuit 1



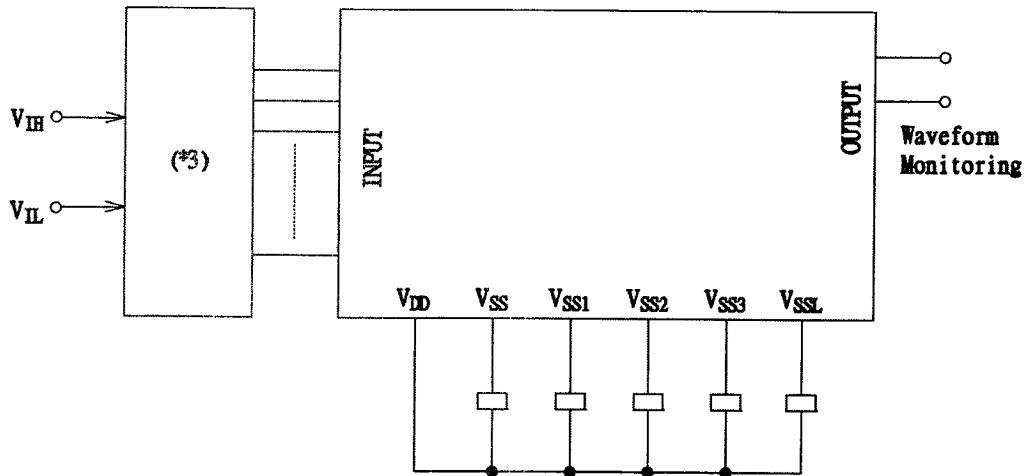
Measuring circuit 2



Measuring circuit 3



Measuring circuit 4



- *1 Input logic circuit to determine the specified measuring conditions.
- *2 Measured at the specified output pins.
- *3 Measured at the specified input pins.

A/D Converter Characteristics(V_{DD} = 0V, V_{SS} = V_{SS1} = -1.5V, Ta = -40 to +85°C unless otherwise specified)

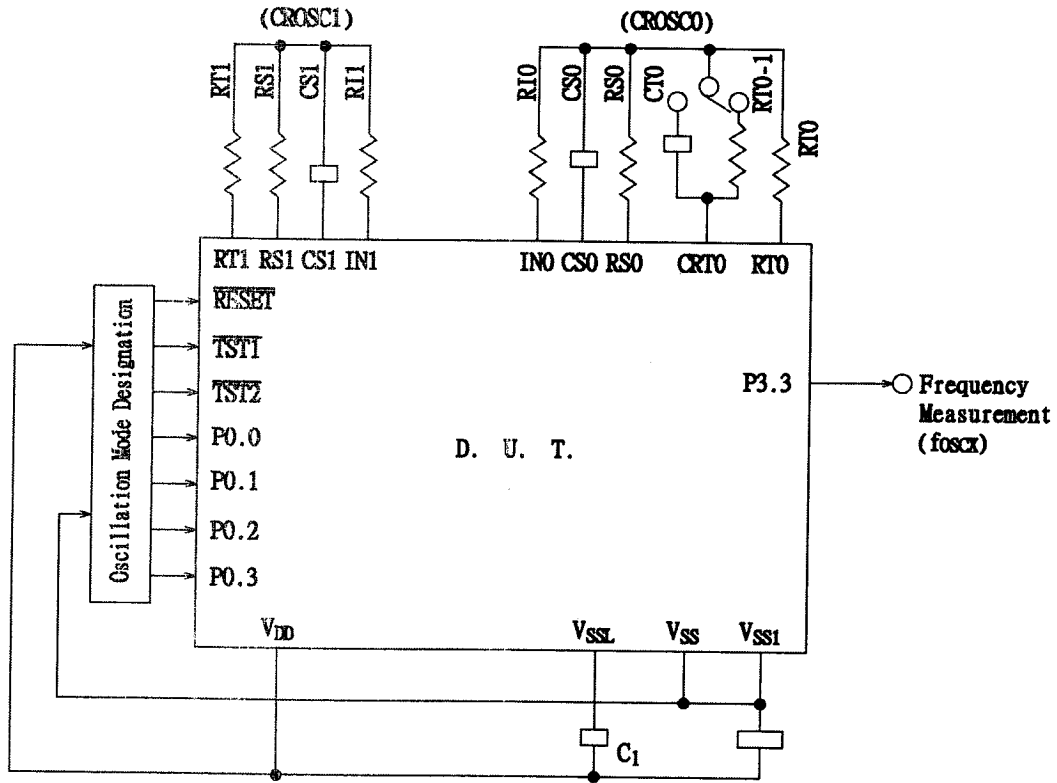
Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit	Measuring Circuit
Resistor for Oscillation	RS0, RS1, RT0, RT0-1, RT1	CS0, CT0, CS1 ≥ 740pF	2.0	--	--	kΩ	5
Input Current Limiting Resistor	RI0, RI1	--	1.0	10	--	kΩ	
Oscillation Frequency	f _{OSC1}	Resistor for oscillation = 2 kΩ	165	221	256	kHz	
	f _{OSC2}	Resistor for oscillation = 10 kΩ	41.8	52.2	60.6	kHz	
	f _{OSC3}	Resistor for oscillation = 200 kΩ	2.55	3.04	3.53	kHz	
RS-RT Oscillation Frequency Ratio (*)	Kf1	RTO, RTO-1, RT1 = 2 kΩ	3.89	4.18	4.35	--	
	Kf2	RTO, RTO-1, RT1 = 10 kΩ	0.990	1.0	1.010	--	
	Kf3	RTO, RTO-1, RT1 = 200 kΩ	0.0561	0.0584	0.0637	--	

* Kfx is the ratio of the oscillation frequency by a sensor resistor to the oscillation frequency by a reference resistor in the same condition.

$$Kfx = \frac{f_{OSCx}(RT0 - CS0 \text{ Oscillation})}{f_{OSCx}(RS0 - CS0 \text{ Oscillation})}, \frac{f_{OSCx}(RT0-1 - CS0 \text{ Oscillation})}{f_{OSCx}(RS0 - CS0 \text{ Oscillation})}, \frac{f_{OSCx}(RT1 - CS1 \text{ Oscillation})}{f_{OSCx}(RS1 - CS1 \text{ Oscillation})}$$

(x = 1,2,3)

Measuring circuit 5



RTO, RTO-1 = 2kΩ/10kΩ/200kΩ
RSO, RS1 = 10kΩ
RIO, RI1 = 10kΩ
CSO, CTO, Cs1 = 820pF
C1 = 0.1μF

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