

SUNSTAR 深圳市商斯达电子有限公司
SHENZHEN SUNSTAR ELECTRONICS CO.,LTD.



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SS0112

ALARM CLOCK WITH THERMOMETER

■ General Description

SS0112 is an integrated circuit provided with digital thermometer function, clock and alarm (with snooze) function. Temperature ranging from -20°C to $+70^{\circ}\text{C}$ (-4°F ~ $+158^{\circ}\text{F}$) is detected by use of a thermistor as a sensor and temperature is displayed on an LCD by 0.1° ~ 0.2°C step.

Alarm has snooze function with 5 min. interval. $3\frac{1}{2}$ digit simultaneous display is made for both time and temperature.

■ Features

- Measurement of temperature (built-in thermistor correction circuit)
- Measurable range: -20°C ~ $+70^{\circ}\text{C}$ (-4°F ~ $+158^{\circ}\text{F}$)
- Resolution: Approx. 0.1°C (0.1°F), Max. 0.2°C (0.4°F)
- Accuracy: $\pm 1^{\circ}\text{C}$
- Sampling cycle: 10 seconds or 1 second
- $3\frac{1}{2}$ digits (clock) + $3\frac{1}{2}$ digits (temp) + 10 indicators, $\frac{1}{2}$ duty LCD
- Alarm with snooze function (5 min interval, 12 times)
- Clock function (display of HOUR and MINUTE)
- Mode selection by a slide switch
- Low power consumption
- Few external components
- No adjustment
- 1.5V battery operation
- Applicable thermistor: Ishizuka 103-AT

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■ Block Diagram

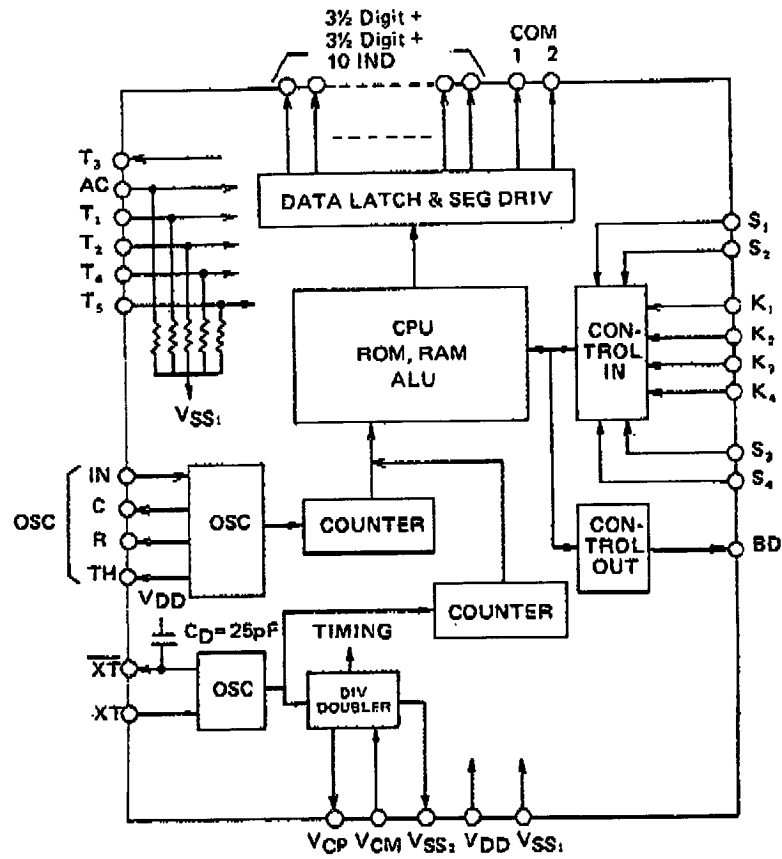
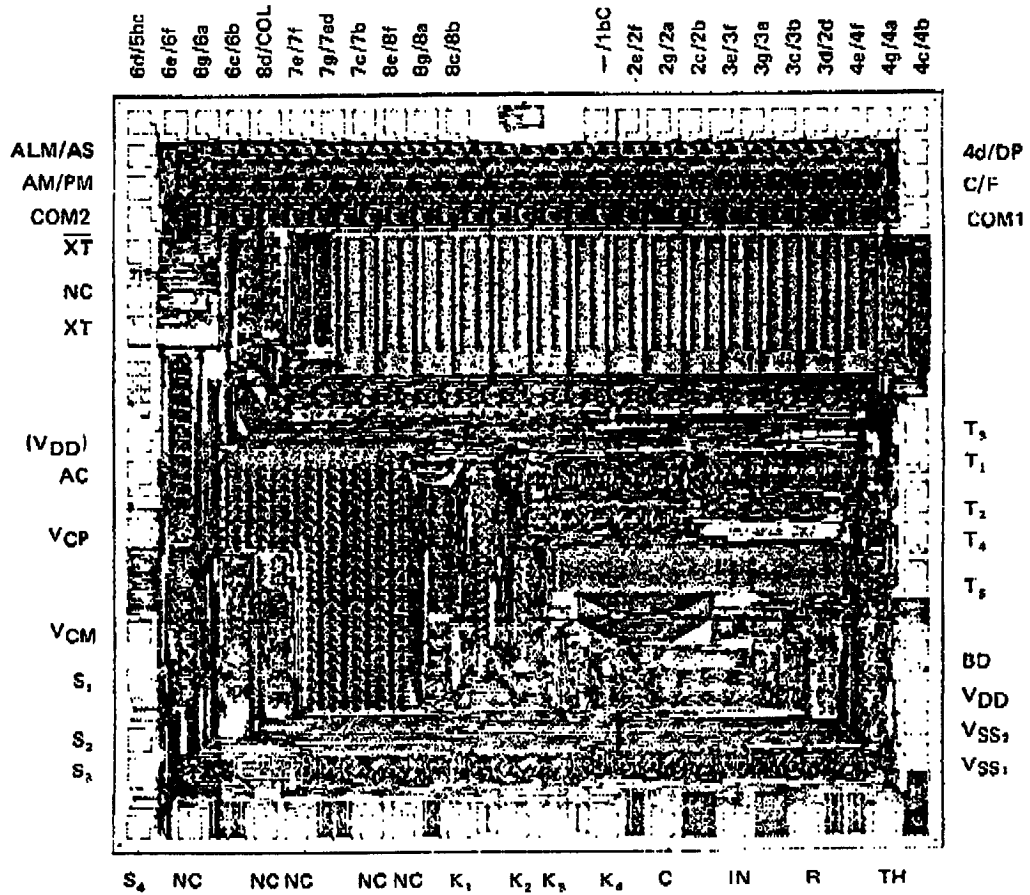


Fig. 1

■ Chip Pad Layout

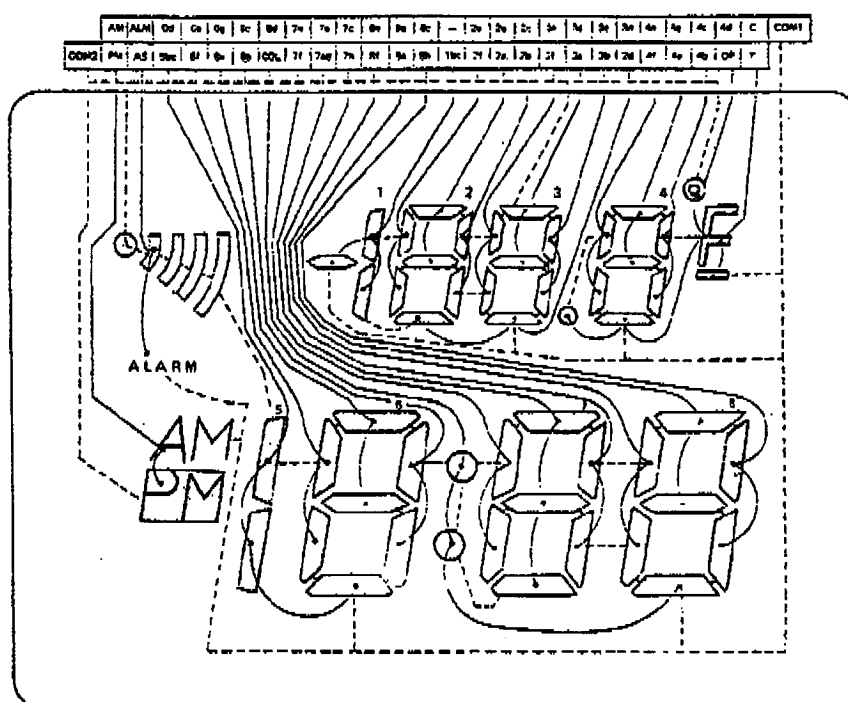


■ PAD Layout

(Unit: μm)			
No.	Signal	X	Y
32	3g/3a	1300	2025
33	3e/3f	1120	2025
34	2c/2b	940	2025
35	2g/2a	760	2025
36	2e/2f	580	2025
37	-/1bc	400	2025
38	8c/8b	-400	2025
39	8g/8a	-580	2025
40	8e/8f	-760	2025
41	7c/7b	-940	2025
42	7g/7ad	-1120	2025
43	7e/7f	-1300	2025
44	8d/COL	-1480	2025
45	6c/6b	-1660	2025
46	6g/6a	-1840	2025
47	6e/6f	-2020	2025
48	6d/5bc	-2230	2025
49	ALM/AS	-2230	1835
50	AM/PM	-2230	1655
51	COM2	-2230	1475
52	XT	-2230	1295
53	NC	-2230	1033
54	XT	-2230	805
55	(V _{DD})	-2230	205
56	AC	-2230	25
57	V _{CP}	-2230	-295
58	V _{CM}	-2230	-885
59	S ₁	-2230	-1169
60	S ₂	-2230	-1507
61	S ₃	-2230	-1687

Segment Out: COM1/COM2
CHIP SIZE: 4.77 x 4.36 [mm]
PAD SIZE: 110 x 110 [μm]
CHIP THICKNESS: 350 ± 30 [μm]

- **LCD Format**



■ Absolute Maximum Ratings

Parameter	Symbol	Condition	Rating	Unit
Supply voltage 1	$V_{SS1} - V_{DD}$	$T_a = 25^\circ\text{C}$	$-2.0 \sim +0.3$	V
Supply voltage 2	$V_{SS2} - V_{DD}$	$T_a = 25^\circ\text{C}$	$-4.0 \sim +0.3$	V
Input voltage	V_{IN}	$T_a = 25^\circ$	$V_{SS1} - 0.3 \sim +0.3$	V
Output voltage 1	V_{OUT1}	$T_a = 25^\circ\text{C}$	$V_{SS1} - 0.3 \sim +0.3$	V
Output voltage 2	V_{OUT2}	$T_a = 25^\circ\text{C}$	$V_{SS2} - 0.3 \sim +0.3$	V
Operating temperature	T_{opr}	—	$-20 \sim +75$	$^\circ\text{C}$
Storage temperature	T_{stg}	—	$-40 \sim +125$	$^\circ\text{C}$

■ Electrical Characteristics

(V_{DD} = 0 V, V_{SS1} = -1.55 V, V_{SS2} = -3.0 V, C_I = 30 kΩ, T_a = 25°C)

Parameter	Symbol	Conditions	Limits			Unit	Note
			MIN.	TYP.	MAX.		
Operating voltage 1	V _{SS1}	V _{SS2} = -2.3 ~ -3.3V (Fig. 3)	1.25	1.55	1.65	V	1
Operating voltage 2	V _{SS2}	V _{SS1} = -1.25 ~ -1.65V (Fig. 3)	2.3	3.0	3.3	V	1
Power supply current 1	I _{DD1}	At A/D conversion OFF cycle (Fig. 4)	—	3	5	μA	2
Power supply current 2	I _{DD2}	At A/D conversion operation C _I = 3000pF, R _I = 10kΩ (Fig. 4)	—	40	100	μA	3
Leak current	I _{DD3}	V _{SS1} logic + V _{SS2} logic (Fig. 3)	—	—	1	μA	4
Oscillation start voltage	V _{STA}	Within 10 seconds (Fig. 4)	1.45	—	—	V	
Oscillation hold voltage	V _{HOLD}	(Fig. 4)	1.25	—	—	V	
Output current (1) (COM V _{SS2})	I _{OH1}	(Fig. 3)	V _{OH1} = -0.2V		-4	μA	
	I _{OL1}		V _{OL1} = -2.8V		4		
Output current (2) (COM V _{SS1})	I _{OH2}	(Fig. 3)	V _{OH2} = -1.35V		-4	μA	
	I _{OL2}		V _{OL2} = -1.75V		4		
Output current (3) (Segment)	I _{OH3}	(Fig. 3)	V _{OH3} = -0.2V		-0.4	μA	
	I _{OL3}		V _{OL3} = -2.8V		0.4		
Output current (4) OSC (C, R, TH)	I _{OH4}	(Fig. 3)	V _{OH4} = -0.4V		-400	μA	
	I _{OL4}		V _{OL4} = -1.15V		400		
Output current (5) (BD)	I _{OH5}	(Fig. 3)	V _{OH5} = -0.4V		-200	μA	
	I _{OL5}		V _{OL5} = -1.15V		3		
Switch input current (S ₁ ~ S ₄ , K ₁ ~ K ₄)	I _{IH1}	(Fig. 3)	V _{IH1} = 0.0V		1	μA	
	I _{IL1}		V _{IL1} = -1.55V		-0.2		
Average switch input current (S ₁ ~ S ₄ , K ₁ ~ K ₄)	I _{IH2}	1/512 duty of Switch input current (Fig. 3)	V _{IH2} = 0.0V		0.02	μA	
	I _{IL2}		V _{IL2} = -1.55V		-0.2		
Doubler output voltage	V _{OUT}	V _{SS1} = -1.25V, C _I , C ₂ = 0.1μF, R _L = 3MΩ (Fig. 4)	2.3	—	—	V	
Oscillation built-in capacitance	C _D		—	25	—	pF	
Accuracy in measurement of temperature	T _M	T _a = -20 ~ +70°C R _T = 10kΩ at 25°C, B = 3435 (Fig. 4)	-1.0	—	1.0	°C	5
T _M -V _{SS1} characteristics	ΔeV _{SS1}	V _{SS1} = -1.25 ~ -1.55V (Fig. 4)	-0.5	—	0.5	°C	6
Fundamental oscillation frequency	f _{ST}	(Fig. 4)	—	16	—	kHz	

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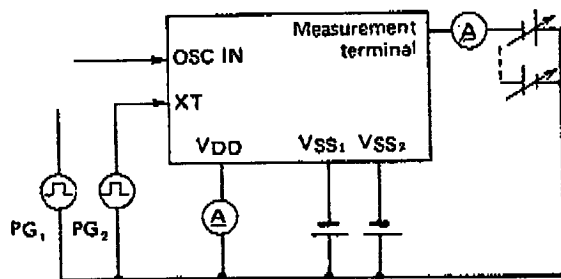


Fig. 3

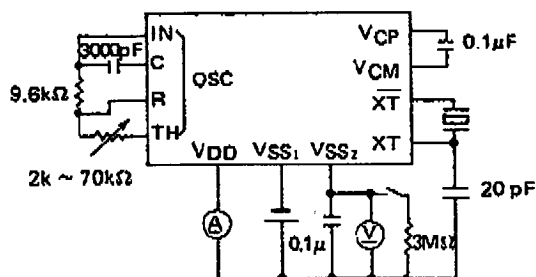


Fig. 4

- Note: 1. Voltage range where oscillation is maintained and functions operate normally.
 2. 9.7/10.0 seconds when A/D conversion circuit is suspending conversion operation, crystal is oscillating and clock is working.
 3. Approx. 0.3 seconds at every 10 seconds at A/D conversion operation.
 4. Leak current at static condition.
 5. Using thermister having $R_T = 10k\Omega \pm 1\%$ at 25°C and $B = 3435$.
 6. ΔeV_{SS1} is expressed by the following formula:

$$\Delta eV_{SS1} = \left| \frac{T_M(V_{SS1} = -1.55\text{ V}) - T_M(V_{SS1} = -1.25\text{ V})}{T_M(V_{SS1} = -1.55\text{ V})} \right|$$

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■ Functional Description

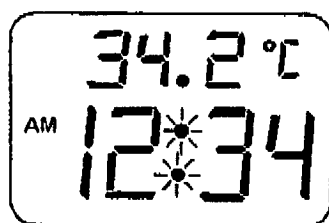
Thermometer

Temperature is always on display regardless of mode selection (ON/OFF of K1, K2, K3 and K4). A thermistor is used for detecting temperature and A/D conversion is performed by frequency conversion method. High accuracy is accomplished in the wide range of $-20^{\circ}\text{C} \sim +70^{\circ}\text{C}$ ($-4^{\circ}\text{F} \sim +158^{\circ}\text{F}$) by providing the IC with non-linear correction circuit for thermistor.

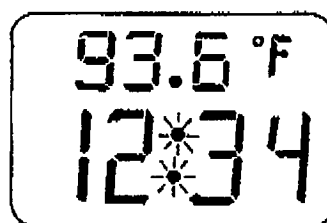
- Measurable temperature range; $^{\circ}\text{C}$ (S3 = OPEN) : $-20.0^{\circ}\text{C} \sim +70.0^{\circ}\text{C}$
 $^{\circ}\text{F}$ (S3 = V_{DD}) : $-4.0^{\circ}\text{F} \sim +158.0^{\circ}\text{F}$
- Suitable thermistor; $R_T = 10\text{k}\Omega \pm 1\%$ at 25°C
 $B = 3435 \pm 1\%$
- Resolution; by 0.1°C step (Max. 0.2°C step)

Resolution	$^{\circ}\text{C}$
0.2 ~ 0.1	$-20 \sim 3$
0.1	$3 \sim 29$
0.1 ~ 0.2	$29 \sim 62$
0.2	$62 \sim 70$

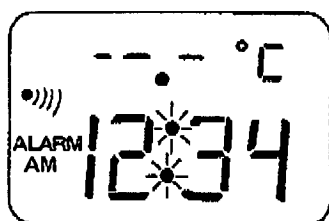
- Sampling cycle; S4 ON (V_{DD}) : 1 second
S4 OFF (OPEN) : 10 seconds
- $^{\circ}\text{C}/^{\circ}\text{F}$ selection; S3 ON (V_{DD}) : $^{\circ}\text{F}$ display
S3 OFF (OPEN) : $^{\circ}\text{C}$ display

TEMP ($^{\circ}\text{C}$)

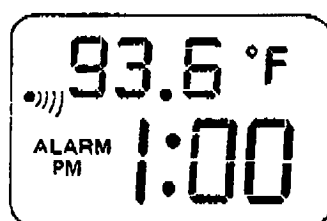
TIME

TEMP ($^{\circ}\text{F}$)

TIME

TEMP ($^{\circ}\text{C}$)
OUT OF
RANGE

ALARM TIME

TEMP ($^{\circ}\text{F}$)

ALARM TIME



1 Hz Flashing

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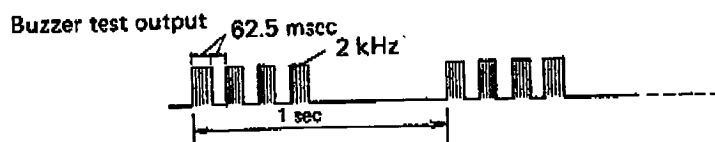
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(3) Disarming alarm operation

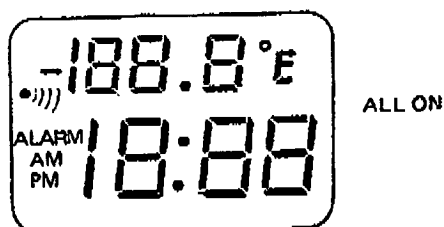
Alarm stand-by indicator (●)))) turns off and alarm operation is disarmed when all of K1, K2, K3 and K4 are OFF (OPEN).

Buzzer test, segments all-on

Buzzer sound is output and segments are in the ALL-ON status, when S1 and S2 are ON (VDD) simultaneously in either snooze stand-by mode or alarm stand-by mode.



Segment output

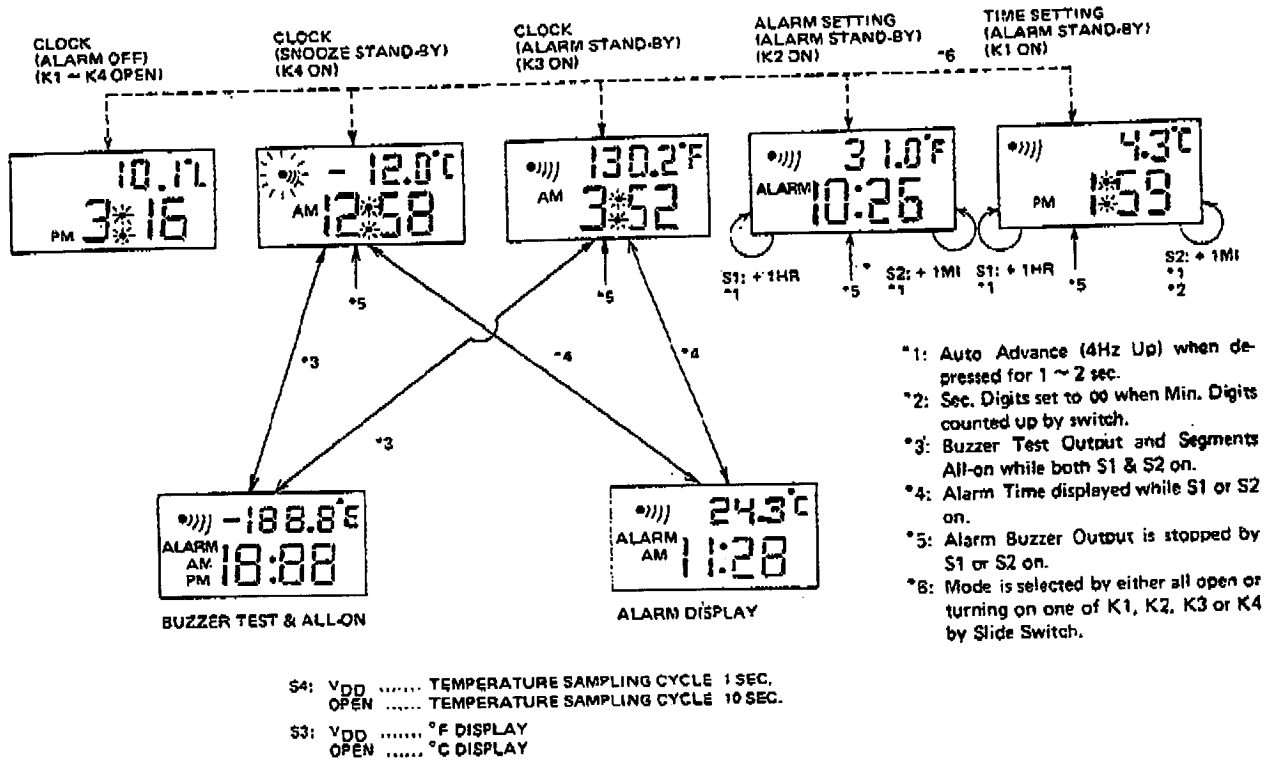


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■ Mode Selection



■ Adjustment and initialization

(1) Temperature adjustment

This IC does not need temperature adjustment.

- 103-AT (ISHIZUKA) is to be used as thermistor.
- The resistor used for temperature measurement should have good temperature characteristics and be as less affected by time as possible.

(2) Initialization

Initialization is done by pushing AC switch.

AC terminal should be connected to VDD after power-on, since CPU architecture is adopted in this IC.

Initial status is; CLOCK AM 12:00
 ALARM AM 12:00

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■ Function of Terminals

Name of terminal	Level	Function
OSC IN, C, R, TH	$V_{DD} = H$ $V_{SS1} = L$	Capacitor, resistor, thermistor connection terminal for temperature detection circuit.
K1, K2, K3, K4	$V_{DD} = H$ $(V_{SS1}) = L$	Each mode is selected by either all open or turning on one of K1, K2, K3, K4. • $K1 = K2 = K3 = K4 = (V_{SS1})$ Clock mode (Alarm disarmed) • $K1 = V_{DD}, K2 = K3 = K4 = (V_{SS1})$ Clock setting mode (Alarm stand-by) • $K2 = V_{DD}, K1 = K3 = K4 = (V_{SS1})$ Alarm setting mode (Alarm stand-by) • $K3 = V_{DD}, K1 = K2 = K4 = (V_{SS1})$ Clock mode (Alarm stand-by) • $K4 = V_{DD}, K1 = K2 = K3 = (V_{SS1})$ Clock mode (Snooze stand-by)
S1, S2	$V_{DD} = \text{Operation}$ $(V_{SS1}) = \text{Suspension}$	Time and alarm time setting input terminals.
S3	$V_{DD} = ^\circ F$ $(V_{SS1}) = ^\circ C$	$^\circ C / ^\circ F$ switching terminal
S4	$V_{DD} = 1 \text{ sec. sampling}$ $(V_{SS1}) = 10 \text{ sec. sampling}$	Sampling cycle switching terminal.
AC	$V_{DD} = H$ $(V_{SS1}) = L$	Inner logic clear terminal (Initial clear is necessary since CPU architecture is adopted)
V_{CP}, V_{CM}		Booster capacitor connection terminals
T1 ~ T5	$V_{DD} = H$ $(V_{SS1}) = L$	Terminals for inner logic test, T1 ~ T3, T5 are pulled down to V_{SS1} . T4 is output terminal.

(V_{SS1}): open or V_{SS1}

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Typical Application

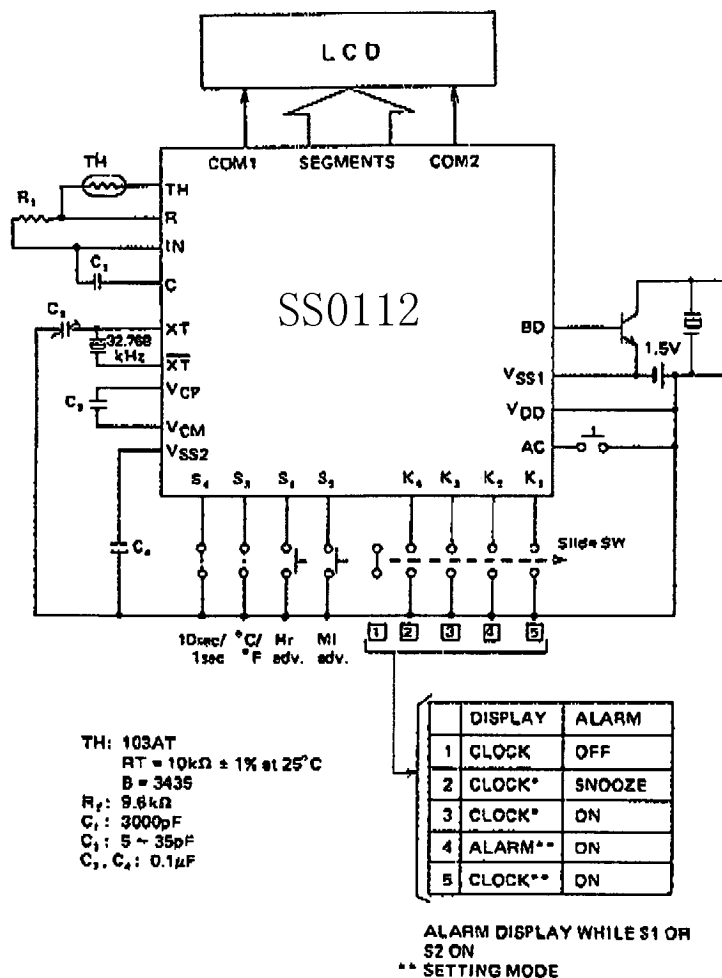


Table of thermistor characteristics applicable to SS0112

°C	Resistance Value*
-20	6774
-15	5339
-10	4245
-5	3389
0	2728
5	2205
10	1796
15	1468
20	1209
25	1000
30	831.3
35	694.1
40	582.8
45	491.2
50	416.1
55	353.7
60	302.1
65	258.9
70	222.9

*Relative values assuming the value at 25°C to be 1000.
 Centre resistance value at 25°C is $10k\Omega$.

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