

TC4731 Thermometer specification

Function description:

<1> **TC4731** is the CMOS IC for INDOOR/OUTDOOR temperature display and clock TIMER display .

Temperature measurement range : -50°C (-58°F) $\sim 70^{\circ}\text{C}$ (158°F)

TIMER display range : **1:00** $\sim$ **12:59**

<2> Use **TWO** sensor (**103AT**) : One for INDOOR and another for OUTDOOR

<3> The PAD MODE1, MODE2 are used to select MODE function

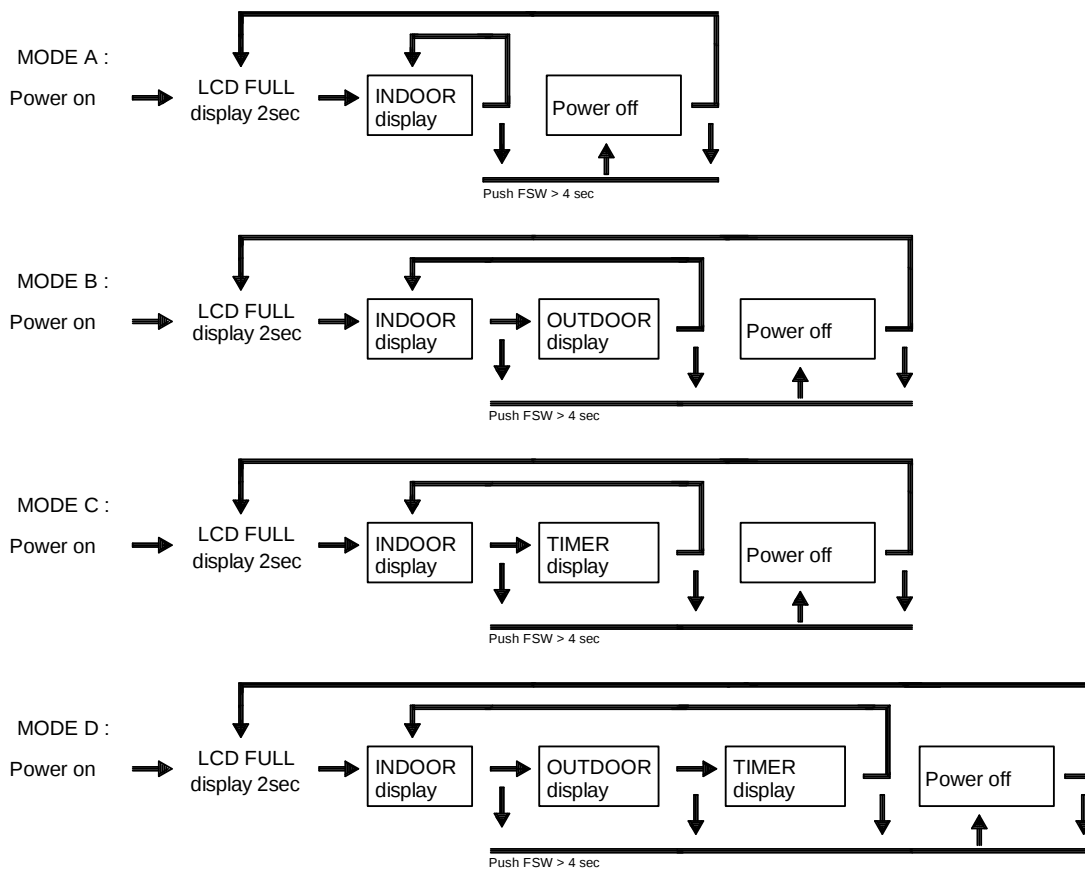
MODE function : (default : **MODE A**)

MODE	MODE1	MODE2	FUNCTION
A	1	1	INDOOR temperature
B	1	0	INDOOR/OUTDOOR temperature
C	0	1	INDOOR temperature & TIMER
D	0	0	INDOOR/OUTDOOR temperature & TIMER

MODE A, MODE B : The oscillator of system clock use **RC** circuit, not use **CRYSTAL**

MODE C, MODE D : The oscillator of system clock use **CRYSTAL**, not use **RC** circuit

<4> Push FSW can select Power on, Power off, INDOOR display, OUTDOOR display, TIMER display.



<5> When Power on LCD **FULL** display 2 sec, then display the current indoor temperature, when LCD FULL display, push FSW can not change MODE

<6> If push FSW key holding time over 4 sec, it will be Power off, then LCD can not display and measure temperature, TIMER counter is continuous

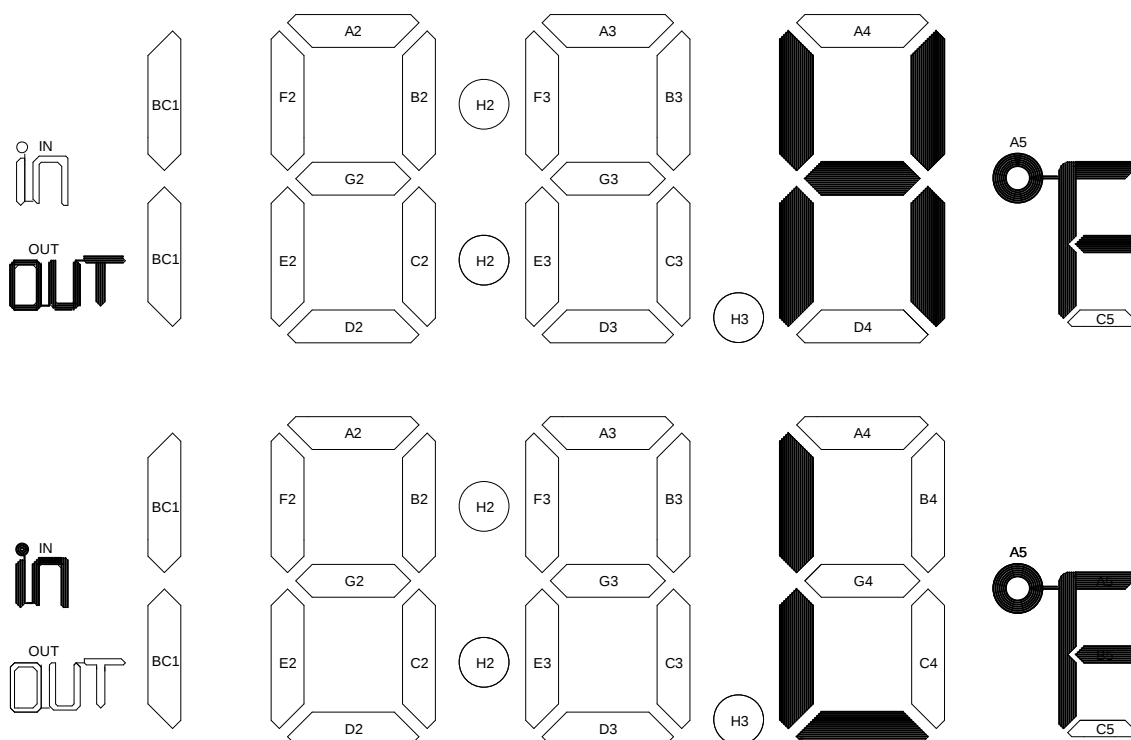
<7> Measure period can select 1 sec, 2 sec, 5 sec, 10 sec by MCY1, MCY2 option pad
function : default is 10 sec

MCY1	MCY2	Measure Period
0	0	10 sec
1	0	5 sec
0	1	2 sec
1	1	1 sec

<8> Temperature display

If temperature $\geq 70^{\circ}\text{C}$ (158°F), then LCD display **H** $^{\circ}\text{C}$ ($^{\circ}\text{F}$) ,

If temperature $< -50^{\circ}\text{C}$ (-58°F), then LCD display **L** $^{\circ}\text{C}$ ($^{\circ}\text{F}$) .



<9> Low battery detection : Low battery status LCD display **1 Hz** blinking, the measure value may be not correct, until POWER OFF firstly and POWER ON again, otherwise it always be blinking.

<10> $^{\circ}\text{C}$ or $^{\circ}\text{F}$ be selected by SFC option pad

SFC pad connects to **VDD** → select $^{\circ}\text{C}$ mode

SFC pad connects to **VSS** → select $^{\circ}\text{F}$ mode

<11> LCD display of TIMER mode : "**HR : MIN**" and " : " **1 Hz** blinking

<12> TIMER display can set hour(use **HR pad**) and minute(use **MIN pad**)

A : Firstly change LCD display to **TIMER** mode

B : Hour set : push **HR key** one time LCD display increase **1** hour, LCD display counter cycle is from **1** to **12**

C : Minute set : push **MIN key** one time LCD display increase **1** minute, LCD display counter cycle is from **00** to **59**

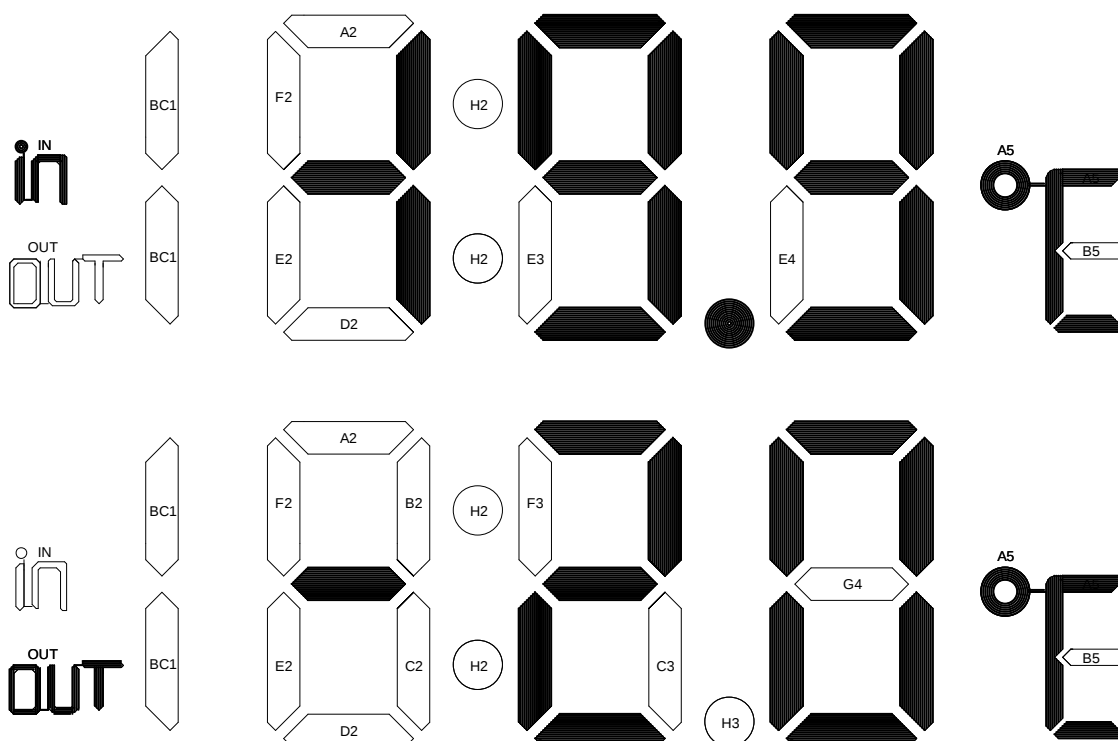
D : Push **HR** or **MIN** key holding time is over **2** sec, LCD DISPLAY value increase **1** by 4 Hz until release SW key

<13> Accuracy of INDOOR/OUTDOOR temperature : $\pm 1^{\circ}\text{C}$ ($\pm 2^{\circ}\text{F}$)

<14> Resolution of INDOOR/OUTDOOR temperature :

A: Temperature $> -20^{\circ}\text{C}$ ($^{\circ}\text{F}$), resolution is **0.1** $^{\circ}\text{C}$ ($^{\circ}\text{F}$), example : **-19.9** $^{\circ}\text{C}$

B: Temperature $\leq -20^{\circ}\text{C}$ ($^{\circ}\text{F}$), resolution is **1** $^{\circ}\text{C}$ ($^{\circ}\text{F}$), example : **-20** $^{\circ}\text{C}$



<15> Electrical formation :

Operating voltage	1.3V~1.65V
Low voltage range	$1.35 \pm 0.05 \text{ V}$

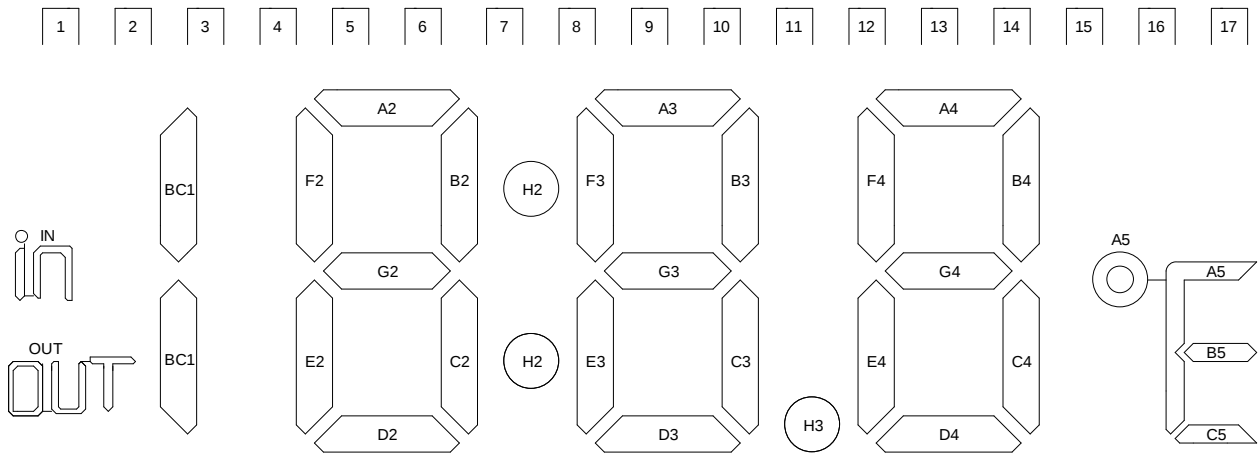
<16> The reference resistor **RF** of application must modulate according to sensor tolerance, the center temperature of modulation is **25.0°C (77.0°F)**. When sensor in **25.0°C (77.0°F)** modulate **RF**, if LCD display **25.0°C (77.0°F)**, then the **RF** value is standard.

<17> Low voltage range is **1.35±0.05 V** :

A : if VDD voltage $\geq 1.40\text{V}$ has Low battery status, then must series with **Radj2**

B : if VDD voltage $\leq 1.30\text{V}$ has Low battery status, then must parallel with **Radj1**

<18> LCD FORMAT :

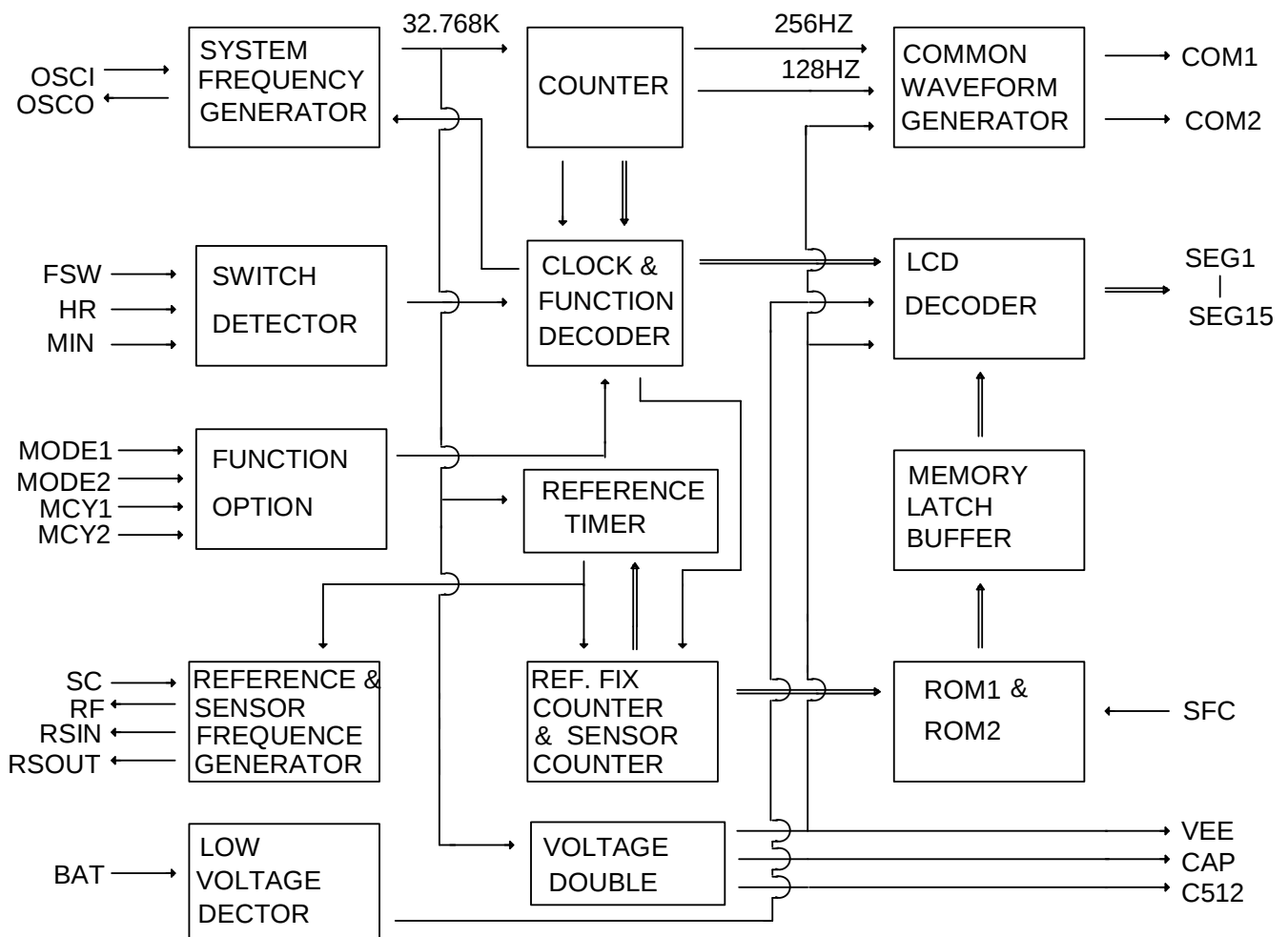


		SEG1	SEG2	SEG3	SEG4	SEG5	SEG6	SEG7	SEG8	SEG9	SEG10	SEG11	SEG12	SEG13	SEG14	SEG15	
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
COM2	COM2	IN	BC1	F2	A2	B2	H2	F3	A3	B3	H3	F4	A4	B4	A5	B5	
COM1		OUT	D2	E2	G2	C2	D4	E3	G3	C3	D3	E4	G4	C4	OFF	C5	COM1

SPEC : A. 1/2 DUTY , 1/2 BIAS . (LCD USES 3 V)

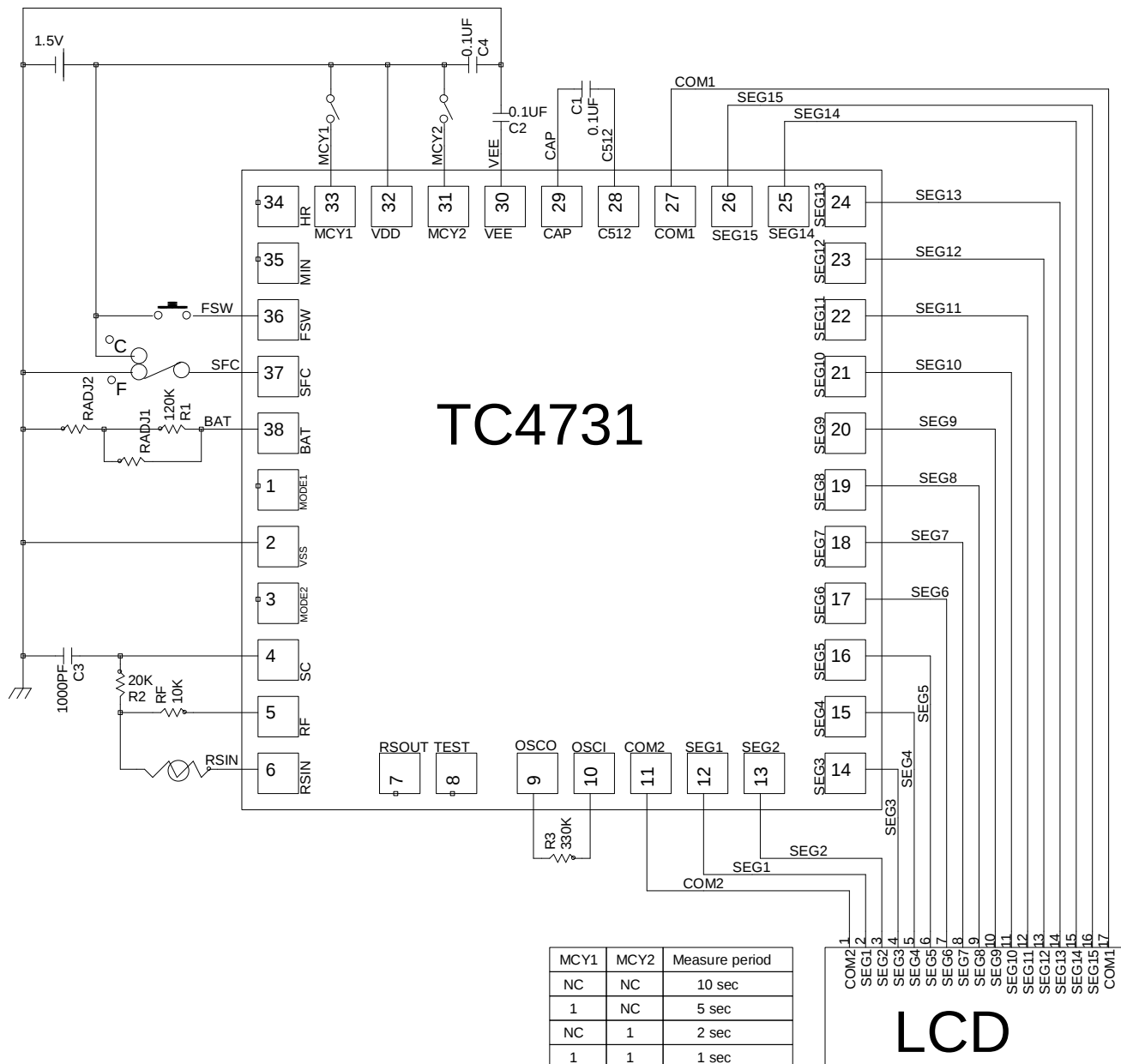
B. $V_{TH} = 1.5 V$

<19> Block diagram



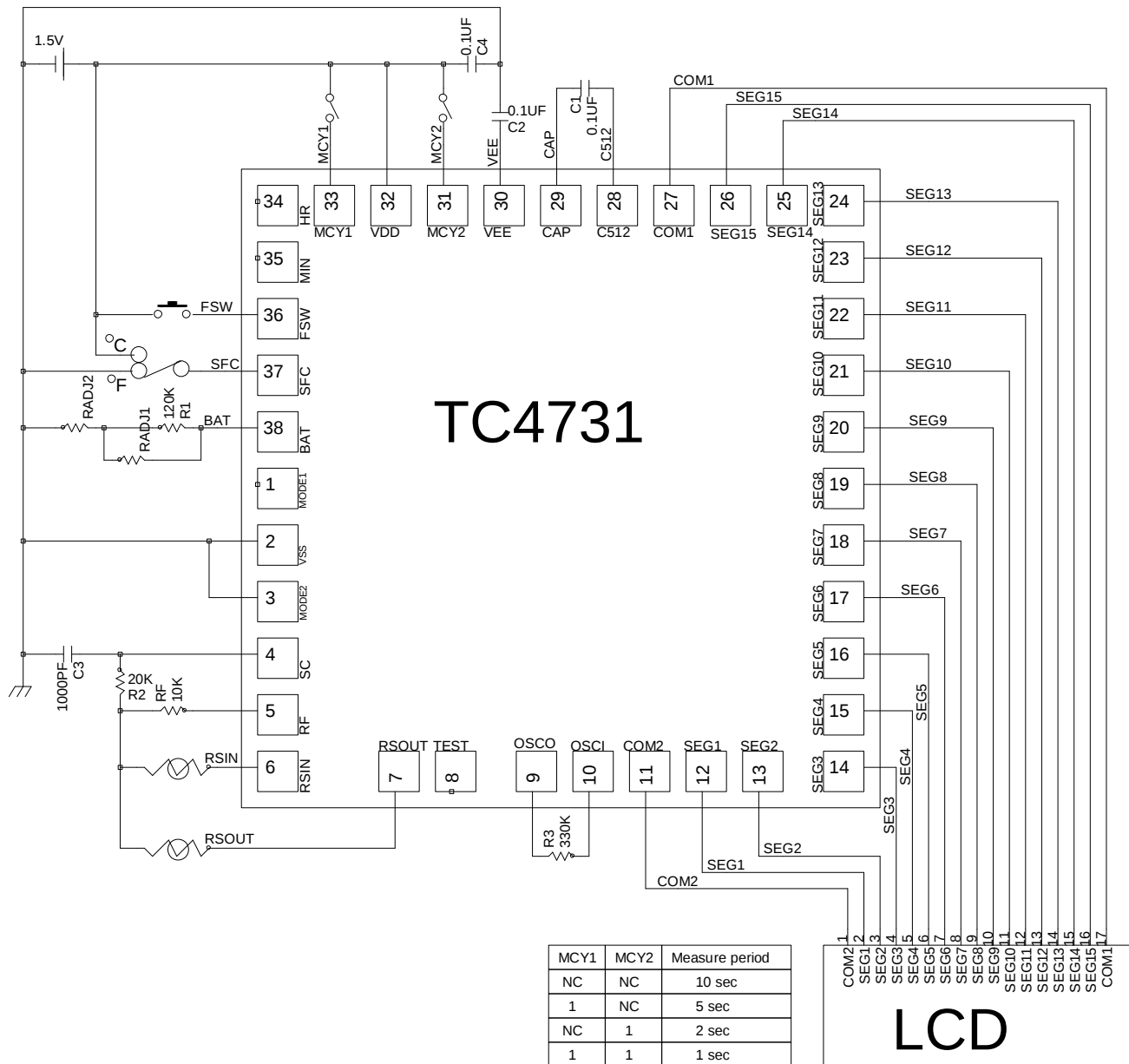
<20-A> TC4731 application (MODE A):

TC4731 application (MODE A)



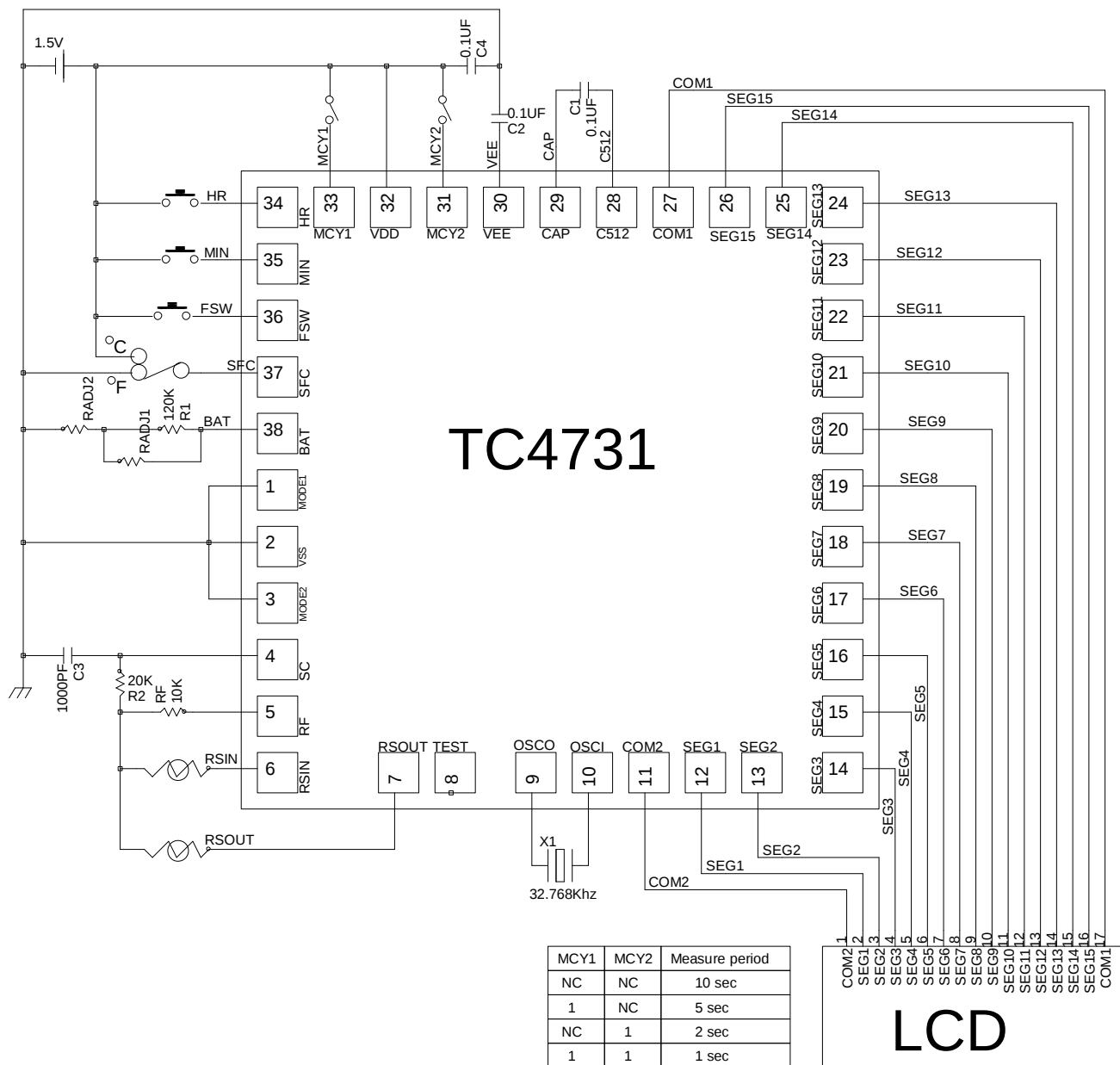
<20-B> TC4731 application (MODE B):

TC4731 application (MODE B)



<20-D> TC4731 application (MODE D):

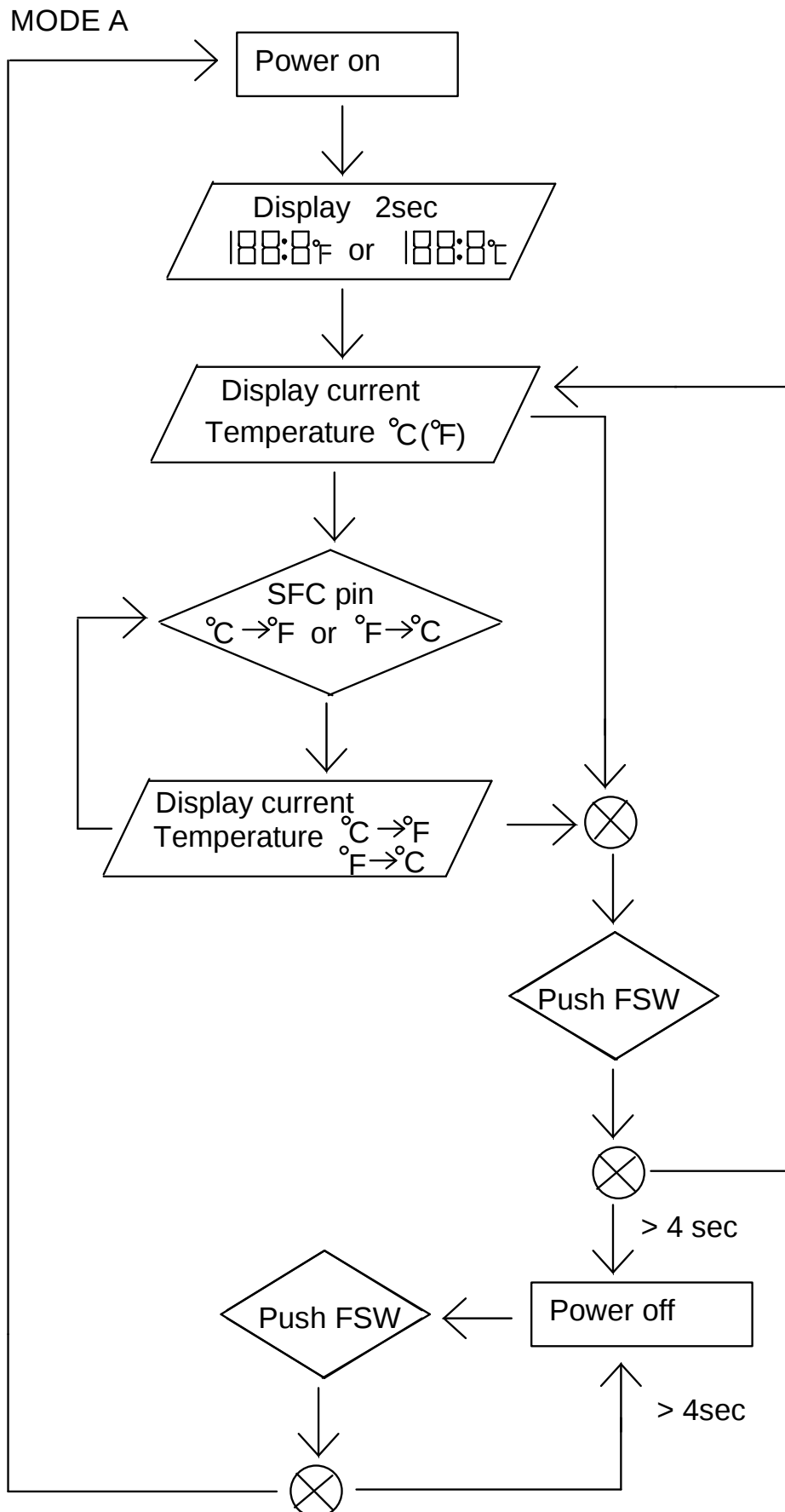
TC4731 application (MODE D)



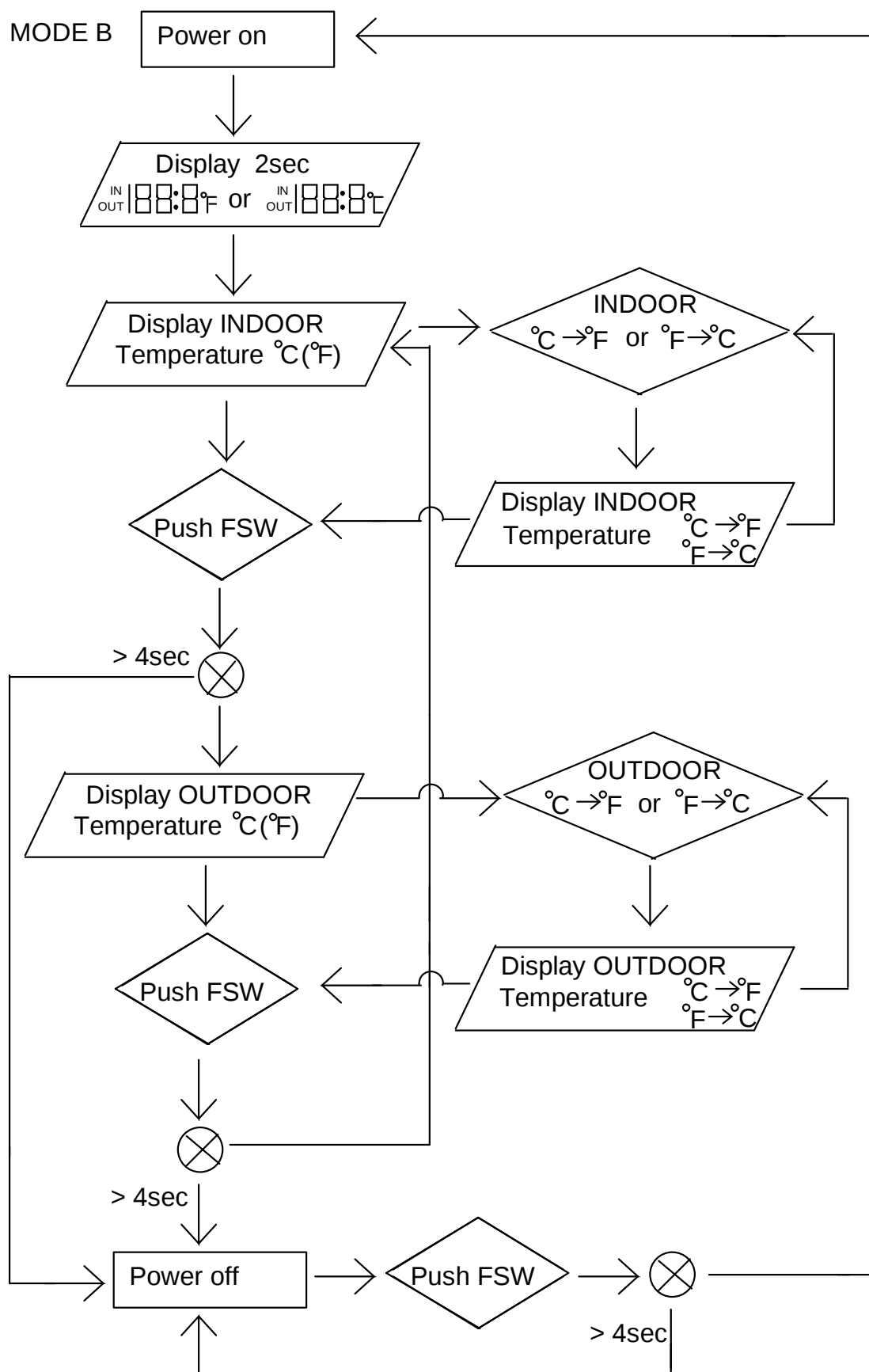
<21> TC4731 Pad description

Pad no.	Pad name	Pad description
1	MODE1	Pad option,select indoor,outdoor,clock function consists of pin 1,3
2	VSS	Negative power (GND)
3	MODE2	Pad option,select indoor,outdoor,clock function consists of pin 1,3
4	SC	Reference and sensor frequency input Pad. the reference and sensor frequency generator consists of Pad 4,5,6,7
5	RF	PMOS open drain, connect to the reference resistor. (RF)
6	RSIN	PMOS open drain, connect to the RSIN sensor resistor (INDOOR)
7	RSOUT	PMOS open drain, connect to the RSOUT sensor resistor (OUTDOOR)
8	TEST	Only for IC test
9	OSCO	The system frequency output pin
10	OSCI	The system frequency input pin
11	COM2	Output pad connect to LCD COM2 pin
12	SEG1	Output pad connect to LCD SEG1 pin
13	SEG2	Output pad connect to LCD SEG2 pin
14	SEG3	Output pad connect to LCD SEG3 pin
15	SEG4	Output pad connect to LCD SEG4 pin
16	SEG5	Output pad connect to LCD SEG5 pin
17	SEG6	Output pad connect to LCD SEG6 pin
18	SEG7	Output pad connect to LCD SEG7 pin
19	SEG8	Output pad connect to LCD SEG8 pin
20	SEG9	Output pad connect to LCD SEG9 pin
21	SEG10	Output pad connect to LCD SEG10 pin
22	SEG11	Output pad connect to LCD SEG11 pin
23	SEG12	Output pad connect to LCD SEG12 pin
24	SEG13	Output pad connect to LCD SEG13 pin
25	SEG14	Output pad connect to LCD SEG14 pin
26	SEG15	Output pad connect to LCD SEG15 pin
27	COM1	Output pad connect to LCD COM1 pin
28	C512	The Pad 28,29 is double voltage 3V capacitor connect.
29	CAP	The Pad 28,29 is double voltage 3V capacitor connect.
30	VEE	voltage 3V
31	MCY2	Pad option, select the thermistor cycle consists of pin 31,33
32	VDD	Position Power(+)
33	MCY1	Pad option, select the thermistor cycle consists of pin 31,33
34	HR	Pull low input pad is used for setting hours
35	MIN	Pull low input pad is used for setting minutes
36	FSW	Pull low input pin, push switch to select the LCD display function
37	SFC	Option : Connect to VDD(°C) , Connect to VSS(°F)
38	BAT	Low battery detected

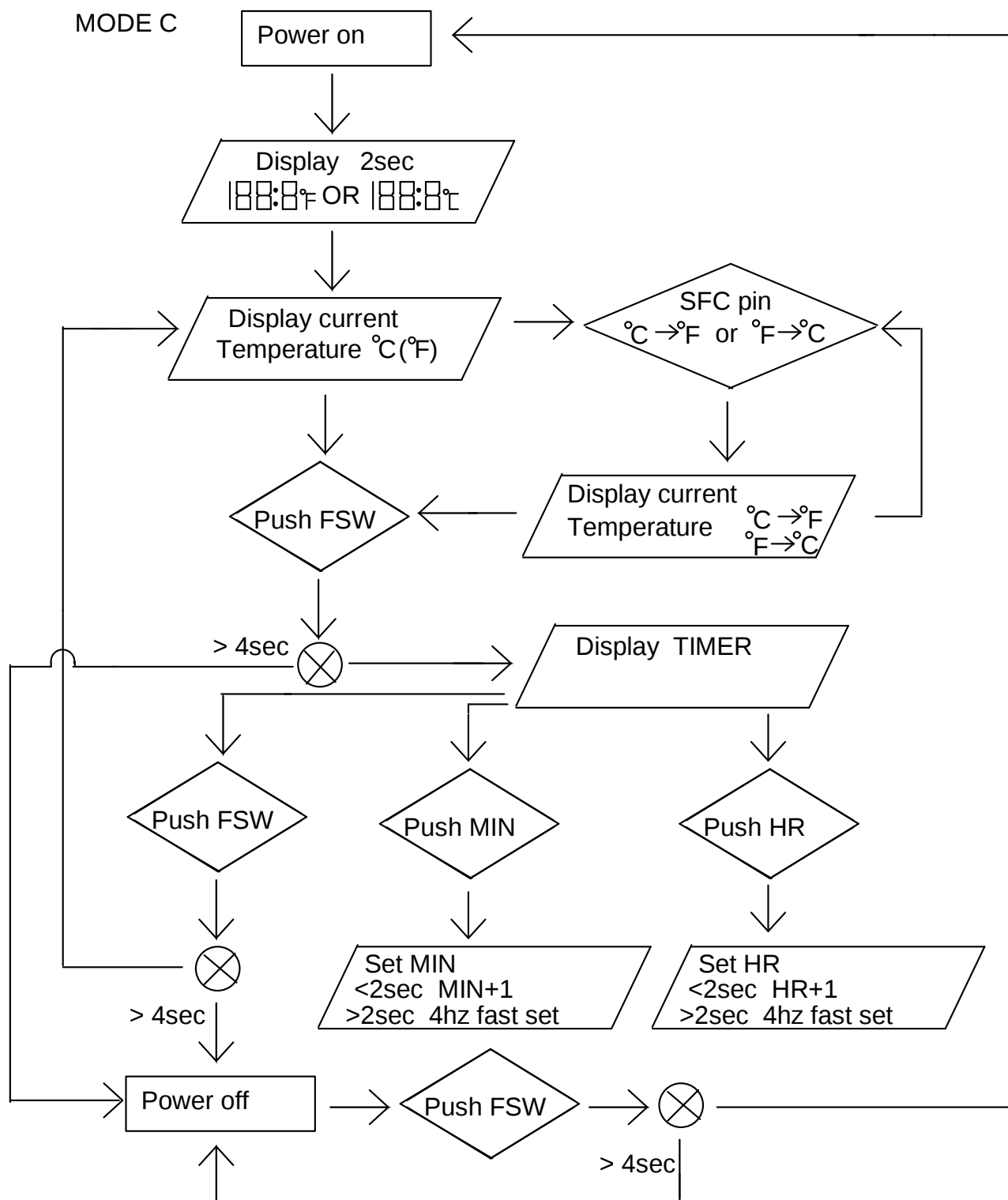
<22-A> TC4731 flow chart for MODE A



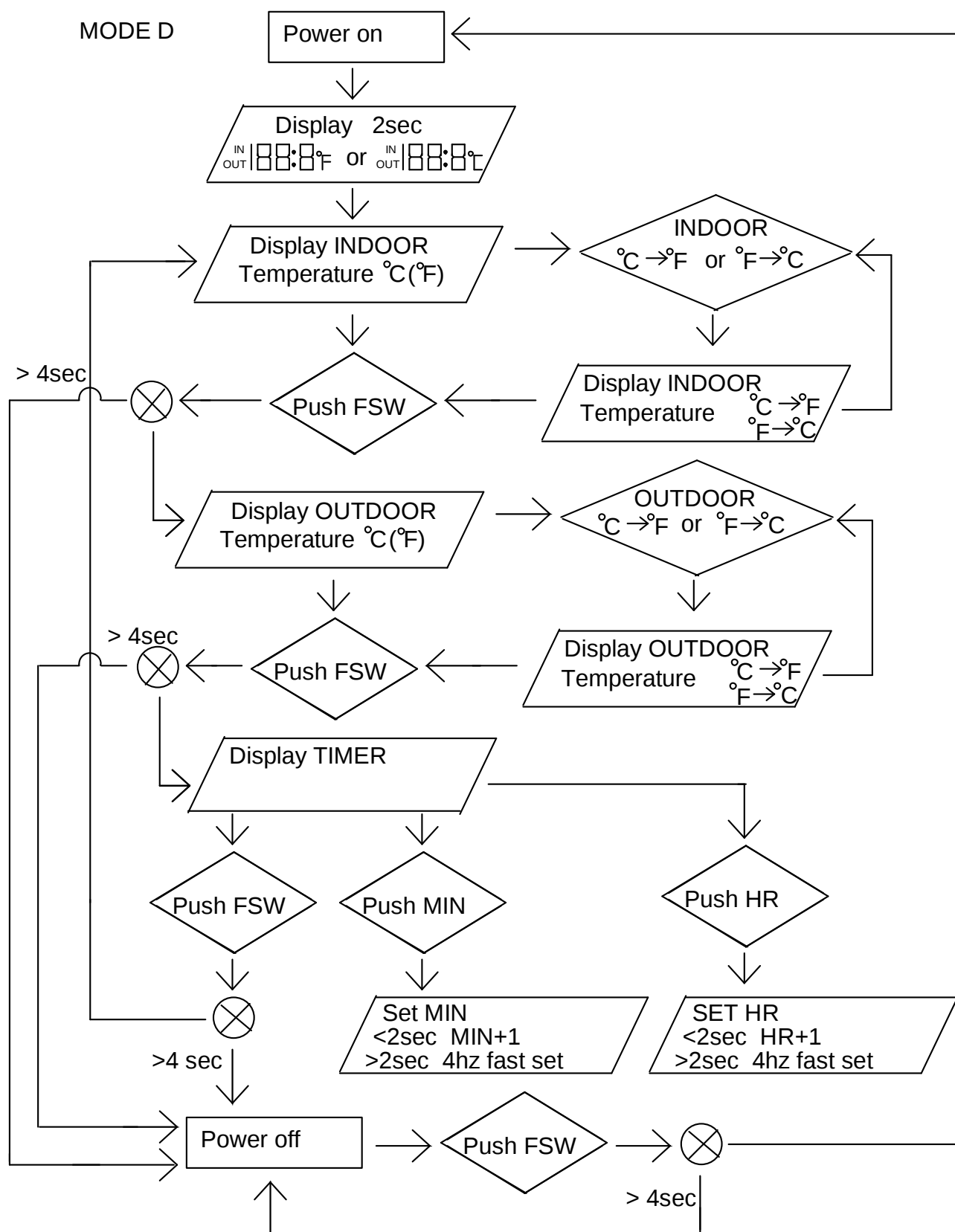
<22-B> TC4731 flow chart for MODE B



<22-C> TC4731 flow chart for MODE C



<22-D> TC4731 flow chart for MODE D



TC4731 electrical characteristics

1. Electric characteristics (Test condition : Vdd=1.5V at room temperature = 25 °C)

Item	Symbol	Condition	Standard value			Unit	Fig	Note
			MIN	TYP	MAX			
VDD Operating Voltage	VDD		1.3	1.50	1.65	V	1,2	
Full Consumption current(1)	Idd	Operating Current For Crystal	—	—	70	uA	4	
Full Consumption current(2)	Ist	Stand-by Current For Crystal	—	—	1.5	uA	4	
Full Consumption current(3)	Idd	Operating Current For RC Oscillation	—	—	80	uA	3	
Full Consumption current(4)	Ist	Stand-by Current For RC Oscillation	—	—	0.5	uA	3	
Double Output Voltage	VEE		—	3.0	—	V	3,4	
Oscillation Frequency(1)	fxtal	X1=32.768K CRYSTALL	—	32.768	—	Khz	4	
Oscillation Frequency(2)	fosco	R3=330K	—	32.768	—	Khz	3	
Oscillation Frequency(3)	fsc	R2=20K RF=10K(103AT) C3=1000P	—	59	—	Khz	3,4	
Input Current(2) (FSW,MIN,HR)	IIH2	VIH=1.5V	2	—	25	uA	5	
Input Current(3) (SFC)	IIH3 IIL3	VIH=1.5V VIL=0V	—	—	0.5 0.5	uA	5	
Input Current(4) (MODE1,MODE2)	IIL4	VIL=0V	—	—	35	uA	5	
Input Current(5) (MCY1,MCY2)	IIH5	VIH=1.5V	—	—	120	uA	5	
Output Current(1) (COM)	IOL1 IOH1	VOL1=0.3V VOH1=2.7V	60 30	—	—	uA	5	
Output Current(2) (SEG)	IOL2 IOH2	VOL2=0.3V VOH2=2.7V	60 30	—	—	uA	5	

2. Absolute maximum rating

No	Item	Symbol	Rating	Unit
1	Supply voltage	VDD	+1.3~+1.65	V
2	Operating temperature	Topr	-50~+75	°C
3	Storage temperature	Tstg	-50~+125	°C

3. OPERATING PARAMETER: (VDD=1.5V)

- (A). Operating voltage : 1.3V ~ 1.65V
- (B). Operating average current : $\leq 30\mu\text{A}$ (cycle 1 sec)
 $\leq 20\mu\text{A}$ (cycle 2 sec)
 $\leq 14\mu\text{A}$ (cycle 5 sec)
 $\leq 12\mu\text{A}$ (cycle 10 sec)
- (C). Input voltage : $V_{IL} \leq V_{SS} + 0.3\text{V}$
 $V_{IH} \geq V_{DD} - 0.3\text{V}$
- (D). Output voltage : $V_{OL} \leq V_{SS} + 0.1\text{V}$
 $V_{OH} \geq V_{DD} - 0.1\text{V}$

FIG. 1

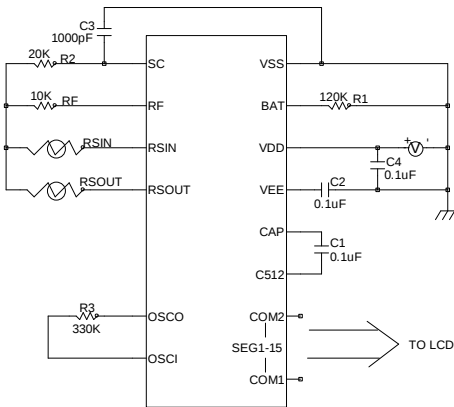


FIG. 2

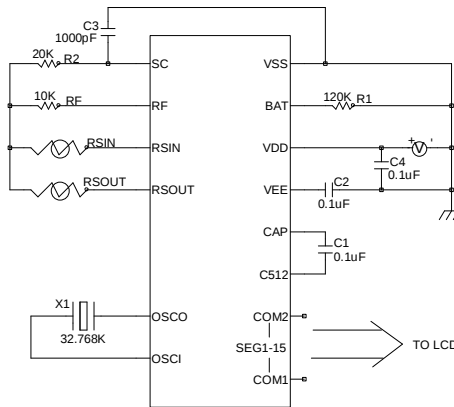


FIG. 5

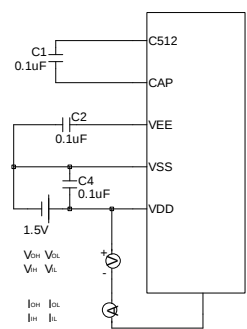


FIG. 3

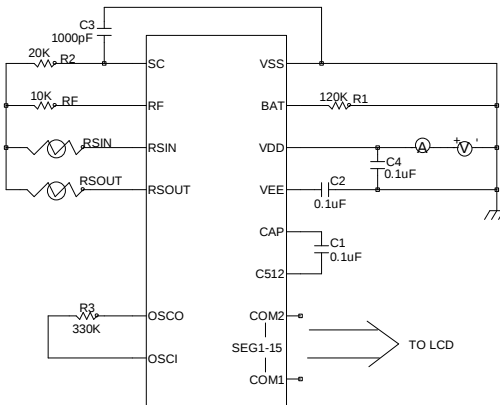
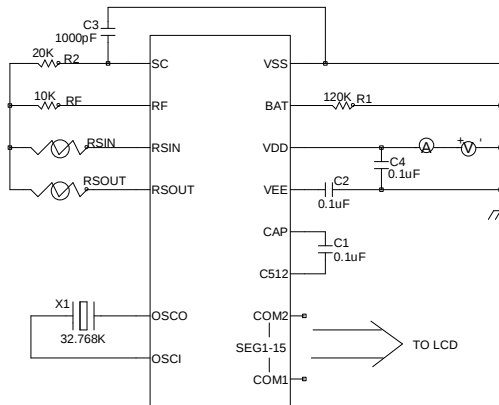
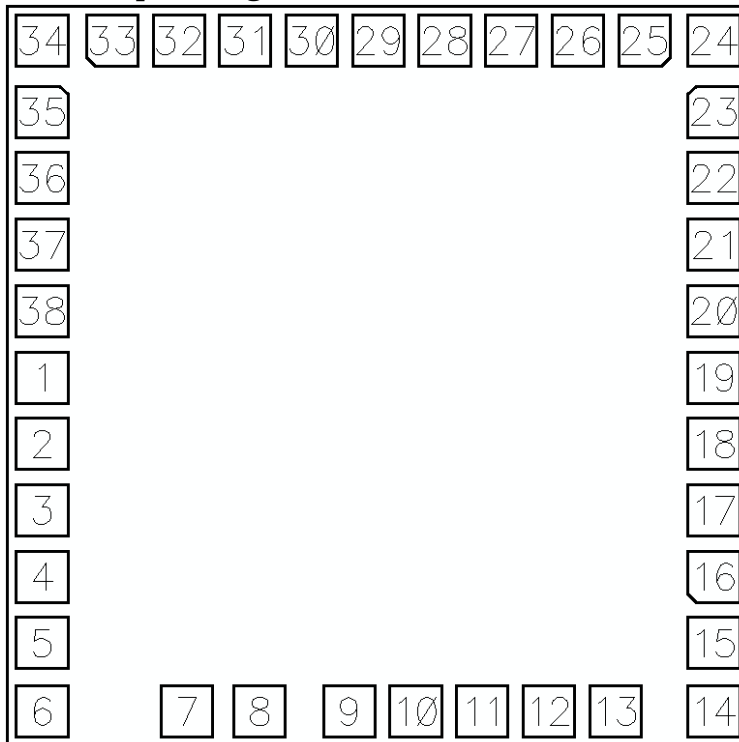


FIG. 4



TC4731 pad diagram



CHIP SIZE: X= 1310 um Y=1310 um

Pad Name	Pad No.	Coordinate (X,Y)	Pad Name	Pad No.	Coordinate (X,Y)
MODE1	1	(-555.500, -2.500)	SEG9	20	(555.500, 107.500)
VSS	2	(-555.500, -112.500)	SEG10	21	(555.500, 217.500)
MODE2	3	(-555.500, -222.500)	SEG11	22	(555.500, 327.500)
SC	4	(-555.500, -332.500)	SEG12	23	(555.500, 437.500)
RF	5	(-555.500, -442.500)	SEG13	24	(555.500, 555.500)
RSIN	6	(-555.500, -555.500)	SEG14	25	(440.500, 555.500)
RSOUT	7	(-315.500, -555.500)	SEG15	26	(330.500, 555.500)
TEST	8	(-195.500, -555.500)	COM1	27	(220.500, 555.500)
OSCO	9	(-47.500, -555.500)	C512	28	(110.500, 555.500)
OSCI	10	(62.500, -555.500)	CAP	29	(0.500, 555.500)
COM2	11	(172.500, -555.500)	VEE	30	(-109.500, 555.500)
SEG1	12	(282.500, -555.500)	MCY2	31	(-219.500, 555.500)
SEG2	13	(392.500, -555.500)	VDD	32	(-329.500, 555.500)
SEG3	14	(555.500, -555.500)	MCY1	33	(-439.500, 555.500)
SEG4	15	(555.500, -442.500)	HR	34	(-555.500, 555.500)
SEG5	16	(555.500, -332.500)	MIN	35	(-555.500, 437.500)
SEG6	17	(555.500, -222.500)	FSW	36	(-555.500, 327.500)
SEG7	18	(555.500, -112.500)	SFC	37	(-555.500, 217.500)
SEG8	19	(555.500, -2.500)	BAT	38	(-555.500, 107.500)

NOTICE: On PCB, IC Substrate should not connect directly with VDD or VSS.