Datasheet

FS9168-017

For wide range thermal measurement application

Fortune SEMICONDUCTOR CORPORATION

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Contents

1 General Description

FS9168-017 is the standard code IC of FS9168 series for wide range thermal measurement. It can provide a low cost and low power consumption thermometer solution easily with 104GT thermistor and a few external components.

2 Features

- Display: 1/3 duty, 1/2 bias 3x13 LCD.
- 1.5V power supply; ≤1μA(sleep mode) and ≤60μA(normal operation).
- Measurement period: 1 time/2 secs or 1 time/5 secs by option.
- Measurement range: -50℃～+300℃；-58℉～+572℉.
- Measurement resolution: 0.1℃(-50℃～+200℃; -4℉～+200℉), and 1℃(>+200℃; +200℉)
- Measurement accuracy: ±(1.5% rdg + 10d) at -50.0℃～-20.0℃, ±(1% rdg + 10d)at -19.9℃～+199.9℃, ±(2% rdg + 2d) at +200℃～+300℃.
- 4 functional buttons: ON/OFF, SELECT (℃/℉), MIN/MAX, HOLD/ALARM.
- 8 minutes auto power-off with beep alarm.
- Over temperature alarm.
- Ambient temperature: 0℃～+50℃
- Package: Dice form (36 pins), 44-pin LQFP.

3 Ordering Information

Product Number	Package Type
FS9168-017V	1. Dice form of 36 pin 2. 44 pin LQFP

Note1: Code number "V" means Version = A~Z.

4 Pad Configuration

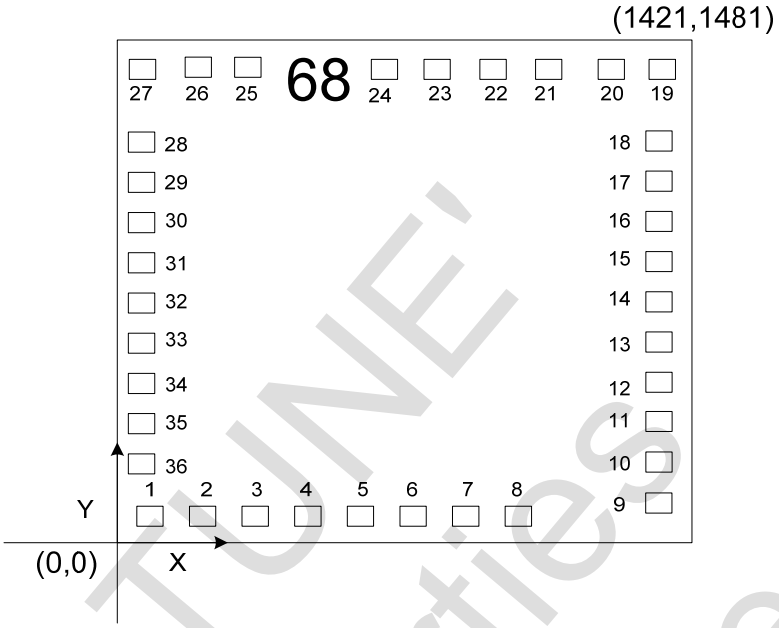


Figure 0-1: FS9168-017 pad configuration

5 Pin Configuration

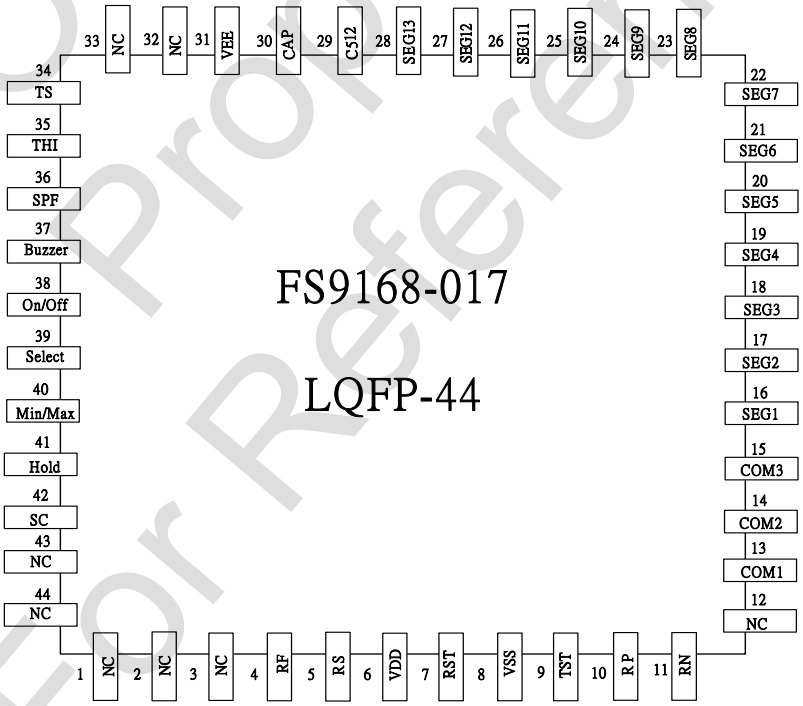


Figure 0-1: FS9168-017 package configuration

6 Pin Description

Name	In/Out	Pad NO.	Description
VDD	I	3	Positive input of power supply (1.5V)
VSS	I	5	Negative input of power supply
TST	I	6	Test pin for IC
RP	I/O	7	System oscillator external resistor connection (450k)
RN	I/O	8	System oscillator external resistor connection (450k)
VEE	I/O	27	Voltage doubler output (+3.0V)
CAP	I/O	26	Voltage doubler capacitor positive terminal
C512	I/O	25	Voltage doubler capacitor negative terminal
COM1~3	O	9~11	LCD common driver
SEG1~12	O	12~23	LCD segment driver
NC		24	-
RF	I	1	Reference resistor connection
RS	I	2	Sensor resistor connection
SC	I	36	Comparator input
BUZZER	O	28	Buzzer output port
SPF	I	29	Auto power-off switch
THI	O	30	Over-temp. alarm
TS	I	31	Measure period select
HOLD	I	32	Data hold switch
MIN/MAX	I	33	Max/min value display switch
SELECT	I	34	Temperature unit select
ON/OFF	I	35	Power switch
RST	I	4	CPU Reset Pin

7 Typical Application Circuit

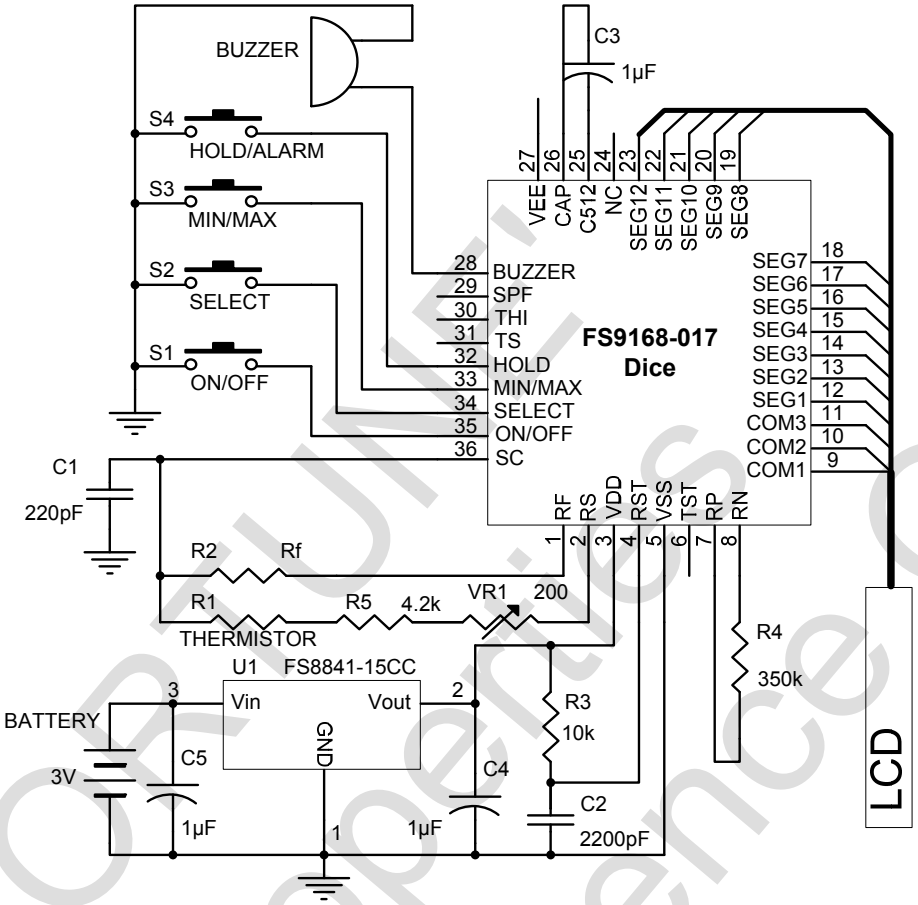


Figure 0-1: FS9168-017 reference circuit

8 Absolute Maximum Ratings

Parameter	Rating	Unit
Supply Voltage to Ground Potential	-0.3 to 1.65	V
Applied Input/Output Voltage	-0.3 to VDD+0.15	V
Ambient Operating Temperature	0 to +70	°C
Storage Temperature	-55 to +150	°C
Soldering Temperature, Time	260°C, 10 Sec	

9 Electrical Characteristics

Symbol	Parameter	Test Condition	Min	Typ	Max	Units
VDD	Recommended Operation Voltage		1.2	1.5	1.65	V
IDD	Supply Current	CPU, R2F ADC On		40	60	μA
IPO	Power off Current	At Sleep mode	0.1	0.2	1.0	μA
FOSC	System Clock	ROSC=350k, VDD=1.5V	25.6	32	38.4	KHz
RNE	Resistance Non-Linearity Error	Rin=22k~38k			0.2	%

10 BOM List

Table 0-1 BOM list

Symbol	Spec.	Note
R1	104GT thermister	Temperature Sensor
R2	*1	Reference resistor
R3	10k ohm	
R4	350k ohm	
R5	4.2k ohm	±1% accuracy
VR1	200 ohm variable resistor	
C1	220pF Cap.	
C2	2200pF Cap.	
C3、C4、C5	1uF Cap.	
BUZZER		
U1	1.5V LDO regulator	FS8841 compatible
S1、S2、S3、S4	Switch button	
IC	FS9168-017	
LCD	3x12 LCD	

*1: The R2 value is about 10k ohm depended on temperature calibration.

11 Calibration method

- Temperature calibration has two kinds -- first low temperature calibration, then high temperature calibration.
- Low temperature calibration is realized by calibration of the referenced resistance. First, adjust VR1 of the Potentiometer to 100Ω, then put a Thermistor Sensor into a water tank with the temperature of 25℃, select the referenced resistance R2, till "25.0℃" is displayed, the low temperature calibration is completed.
- High temperature calibration is realized by compensating Thermistor resistance. First, measure out the resistance when the Thermistor Sensor is in 250℃, then use the resistance value (the difference shall not exceed 1Ω) to be the fixed resistance to replace the Thermistor Sensor, adjust VR1 of the Potentiometer, till the displayed value is "250℃".

12 Operation Function

12.1 Power-on Display

- All of symbols will display in LCD for two seconds after power on, then the current temperature will be displayed.

12.2 ON/OFF Key

- Press the key during power off status will turn on the system (Turn on).
- Press the key during power on status will turn off the system (Turn off).

12.3 SELECT Key

- The temperature unit ℃ is preset after turn on.
- Press the key during measurement can select or switch the temperature unit ℃ and ℉ (℃/℉ switches in a cycle).

12.4 MIN/MAX Key

Table 0-1 LCD display status when press MIN/MAX Key during measurement

Times of Press MIN/MAX Key (in 10 seconds)	LCD display status
1	MIN (minimum temperature value)
2	MAX (maximum temperature value)
3	Current temperature value

Note：

1. LCD display status will show in a cycle according to the a. m. sequence when press the key many times.
2. When the display value is not the current temperature (and not press MIN/MAX Key), it will automatically switch to show the current temperature in 10 sec.

12.5 HOLD/ALARM Key

- Press the key (less than 2 sec.) during measurement, the current temperature value will be locked; then press the key again (less than 2 sec.) will release.
- Press the key during measurement longer than 2 sec. will enter into temperature alarm device; then press the key again longer than 2 sec. will exit from which, and enter into normal measurement status.

12.6 AUTO POWER OFF

- Auto power off time is set 8 min., it will enter Sleep status if there is no action to any key in 8 min. after power on. The set time will be re-calculated if any key is pressed
- Press SELECT Key to power on will cancel the auto power off function.
- If chip SPF pin is connected to VSS will permanently cancel auto power off function.

12.7 Temperature Alarm Device

- Press HOLD/ALARM Key during measurement for 2 sec. will enter into temperature alarm device status, the alarmed temperature displays 300℃. The symbol “AL” will show at the same time.
- After enter into temperature alarm device status, press SELECT Key each time will add 1℃ to the set temperature value. If press SELECT Key firmly, the set temperature value will be added sequentially till the temperature top limit 301℃. Press MIN/MAX Key each time will decrease 1℃ from the set temperature value. If press MIN/MAX Key firmly, the set temperature value will be decreased sequentially till the temperature bottom limit -51℃.
- Press HOLD/ALARM Key longer than 2 sec. will exit from the temperature alarm device status and enter into normal measurement status.
- The symbol of “Hi” will be displayed, if the temperature value is higher or equal to the set alarmed temperature value. The buzzer will sound “Be…” every two second (or every 5 second when “sense temperature every 5 sec.” is selected.); besides, high voltage is output from chip THI pin.
- Unit Conversion: ℃=(5/9)*(℉-32) ; ℉=((9/5)*℃)+32.

12.8 Temperature Sense Time Select

- Temperature sense time is 2 sec/time when chip TS pin is not connected.
- Temperature sense time is 5 sec/time when chip TS pin is connected to VSS.

13 LCD display

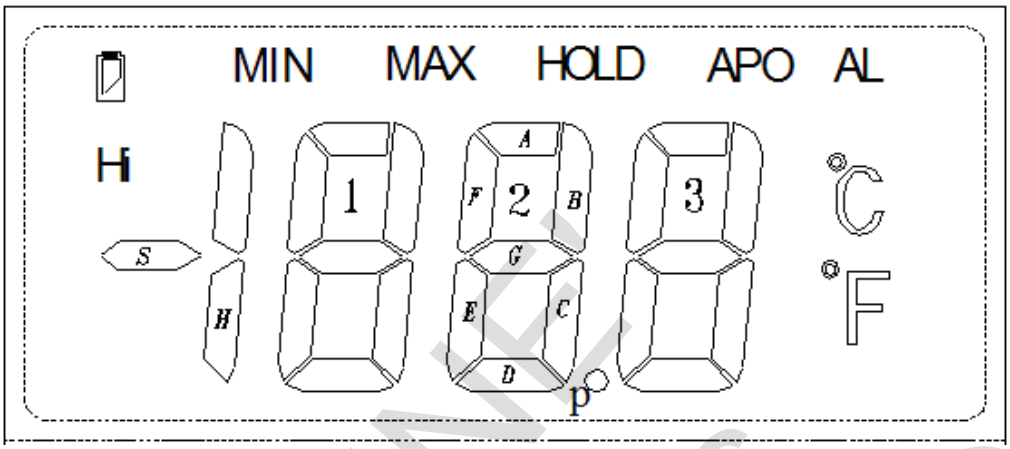
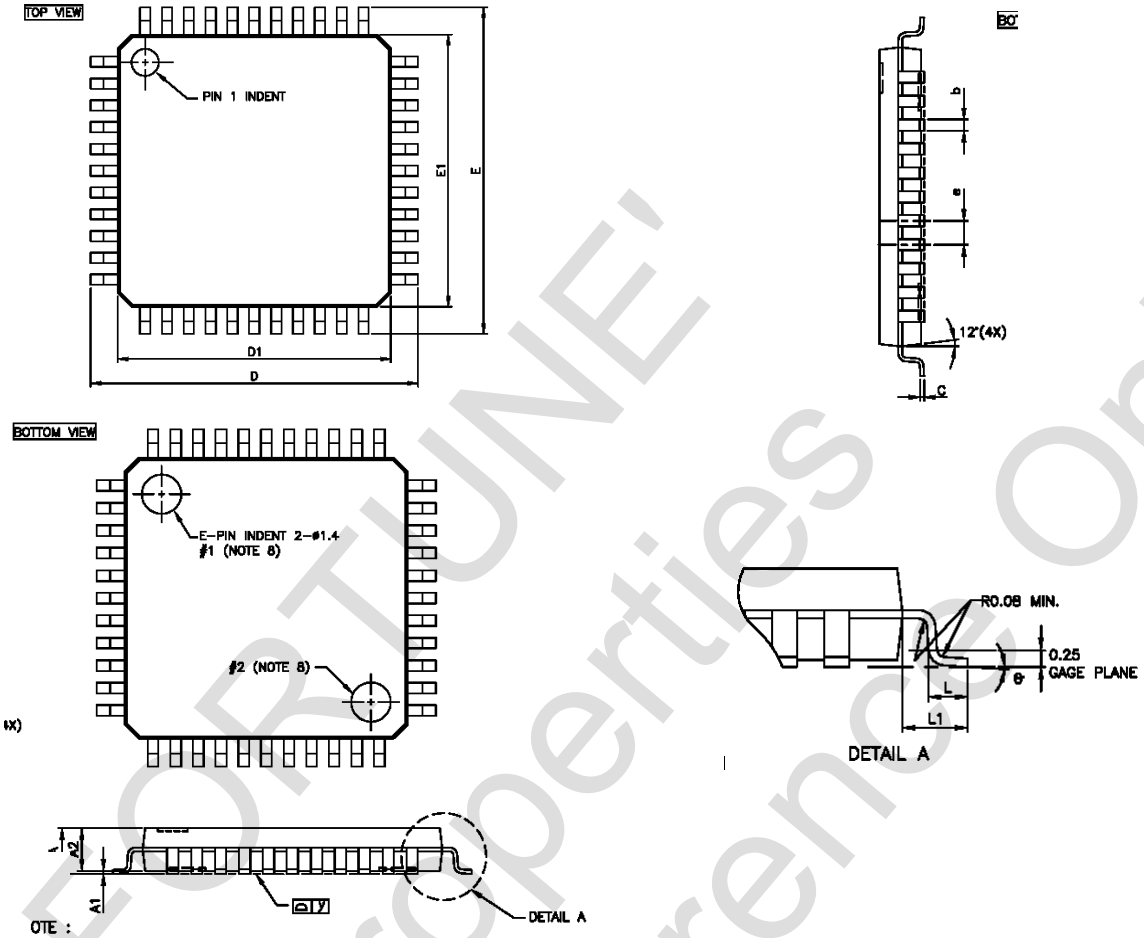


Figure 0-1: FS9168-017 LCD configuration

Table 0-1: FS9168-017 LCD true table

LCD pin	IC pin	COM1	COM2	COM3
1	COM1			
2	COM2			
3	COM3			
4	SEG1	F1	E1	H
5	SEG2	A1	G1	D1
6	SEG3	B1	C1	S
7	SEG4	F2	E2	Hi
8	SEG5	A2	G2	D2
9	SEG6	B2	C2	P
10	SEG7	F3	E3	
11	SEG8	A3	G3	D3
12	SEG9	B3	C3	
13	SEG10		HOLD	
14	SEG11	MAX	APO	ALM
15	SEG12	MIN	℃	℉

14 Package Outline



SYMBOL	DIMENSIONS IN MILLIMETERS		
	MIN.	NOM.	MAX.
A	——	——	1.60
A1	0.05	——	0.15
A2	1.35	1.40	1.45
b	0.30	0.37	0.45
C	0.09	——	0.20
E	11.80	12.00	12.20
E1	9.90	10.00	10.10
D	11.80	12.00	12.20
D1	9.90	10.00	10.10
e	——	0.80	——
L	0.45	0.60	0.75
L1	——	1.00	——
θ°	0°	3.5°	7°
y	0.0	——	0.08

Figure 0-1: FS9168-017 package outline

15 Pad Assignment

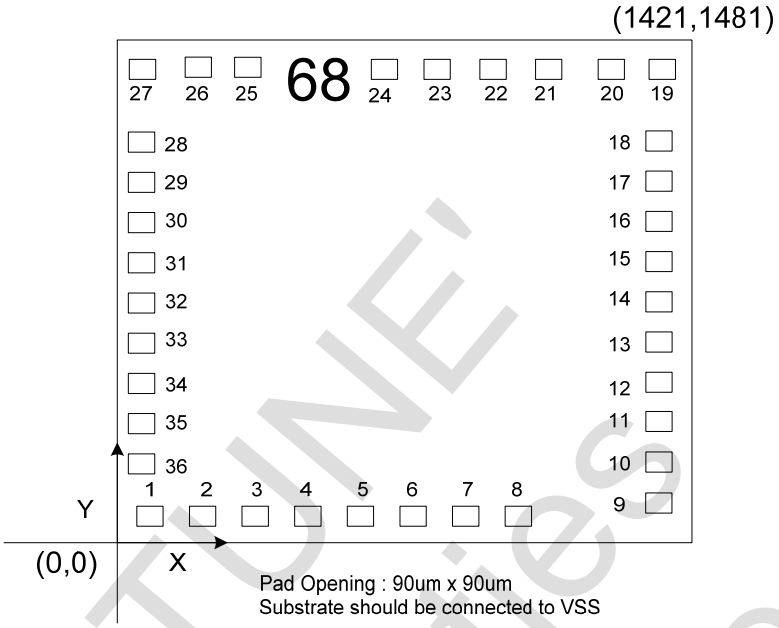


Figure 0-1: FS9168-017 pad assignment

16 Pad Coordinate

PAD NO：36 pads

Table 0-1: FS9168-017 pad coordinate table

Pad No.	Name	X[um]	Y[um]	Pad No.	Name	X[um]	Y[um]
1	RF	85	74	19	SEG<8>	1335	1406
2	RS	205	74	20	SEG<9>	1205	1406
3	VDD	329	74	21	SEG<10>	1095	1406
4	RST	449	74	22	SEG<11>	975	1406
5	VSS	569	74	23	SEG<12>	855	1406
6	TST	689	74	24	NC	738	1406
7	RP	809	74	25	C512	331	1406
8	RN	929	74	26	CAP	200	1406
9	COM<1>	1346	87	27	VEE	74	1406
10	COM<2>	1346	205	28	BUZZER	74	1262
11	COM<3>	1346	324	29	SPF	74	1142
12	SEG<1>	1346	441	30	THI	74	1021
13	SEG<2>	1346	561	31	TS	74	902
14	SEG<3>	1346	681	32	HOLD	74	772
15	SEG<4>	1346	802	33	MIN/MAX	74	650
16	SEG<5>	1346	924	34	SELECT	74	531
17	SEG<6>	1346	1041	35	ON/OFF	74	411
18	SEG<7>	1346	1162	36	SC	74	291

17 104GT thermistor parameter table

Type：104GT, Resistor error：±3 %, R25 value：100.0kΩ/25℃, and B parameter error：±2 %.

Temp (℃)	Max. R (kΩ)	Typ. R (kΩ)	Min. R (kΩ)	Temp. Error (℃)		Temp (℃)	Max. R (kΩ)	Typ. R (kΩ)	Min. R (kΩ)	Temp. Error (℃)	
-50	9848	8743	7755		1.6	-13	791.4	738.3	688	-1.2	1.3
-49	9115	8105	7200		1.6	-12	745.5	696.2	649.6	-1.2	1.2
-48	8442	7518	6689	-1.6	1.6	-11	702.6	656.9	613.6	-1.2	1.2
-47	7825	6978	6218	-1.6	1.6	-10	662.4	620	579.9	-1.2	1.2
-46	7257	6482	5784	-1.6	1.6	-9	624.3	585.1	547.8	-1.2	1.2
-45	6735	6024	5384	-1.6	1.6	-8	588.7	552.3	517.8	-1.2	1.2
-44	6225	5603	5014	-1.6	1.6	-7	555.3	521.6	489.5	-1.1	1.2
-43	5813	5214	4673	-1.6	1.6	-6	524.1	492.9	463.1	-1.1	1.2
-42	5405	4856	4358	-1.6	1.6	-5	494.8	465.9	438.2	-1.1	1.1
-41	5029	4524	4066	-1.5	1.6	-4	467.4	448.5	414.8	-1.1	1.1
-40	4682	4218	3797	-1.5	1.5	-3	441.7	416.8	392.9	-1.1	1.1
-39	4356	3930	3542	-1.5	1.5	-2	417.6	394.4	372.2	-1.1	1.1
-38	4055	3663	3306	-1.5	1.5	-1	394.9	373.4	352.8	-1.1	1.1
-37	3777	3417	3088	-1.5	1.5	0	373.7	353.7	334.5	-1.1	1.1
-36	3520	3188	2886	-1.5	1.5	1	353.4	334.9	317.1	-1	1.1
-35	3282	2977	2699	-1.5	1.5	2	334.5	317.3	300.8	-1	1
-34	3062	2782	2525	-1.5	1.5	3	316.6	300.7	285.3	-1	1
-33	2859	2601	2364	-1.5	1.5	4	299.8	285.1	270.8	-1	1
-32	2671	2433	2214	-1.4	1.5	5	284.1	270.4	257.1	-1	1
-31	2496	2277	2075	-1.4	1.5	6	269.2	256.4	244.2	-1	1
-30	2334	2132	1945	-1.4	1.4	7	255.3	243.5	232	-1	1
-29	2182	1996	1823	-1.4	1.4	8	242.1	231.2	220.5	-0.9	1
-28	2041	1869	1710	-1.4	1.4	9	299.8	219.6	209.7	-0.9	1
-27	1910	1751	1604	-1.4	1.4	10	218.1	208.6	199.4	-0.9	0.9
-26	1789	1642	1506	-1.4	1.4	11	207	198.2	189.6	-0.9	0.9
-25	1676	1540	1415	-1.4	1.4	12	196.5	188.3	180.6	-0.9	0.9
-24	1571	1446	1329	-1.4	1.4	13	186.6	179	171.7	-0.9	0.9
-23	1473	1357	1250	-1.3	1.4	14	177.2	170.3	163.4	-0.9	0.9
-22	1382	1275	1176	-1.3	1.4	15	168.4	162	155.6	-0.8	0.9
-21	1298	1199	1106	-1.3	1.4	16	160.1	154.1	148.2	-0.8	0.8
-20	1219	1127	1042	-1.3	1.3	17	152.3	146.7	141.2	-0.8	0.8
-19	1144	1060	980.5	-1.3	1.3	18	144.9	139.7	134.6	-0.8	0.8
-18	1075	996.5	923.2	-1.3	1.3	19	137.9	133.1	128.4	-0.8	0.8
-17	1010	937.6	869.7	-1.3	1.3	20	131.3	126.8	122.4	-0.8	0.8
-16	949.6	882.6	819.6	-1.3	1.3	21	125	120.9	116.8	-0.7	0.8
-15	893.2	831.2	772.8	-1.2	1.3	22	119	115.2	111.4	-0.7	0.7
-14	840.6	783.2	729.1	-1.2	1.3	23	113.4	109.9	106.4	-0.7	0.7

Temp (℃)	Max. R (kΩ)	Typ. R (kΩ)	Min. R (kΩ)	Temp. Error (℃)	
24	108	104.8	101.6	-0.7	0.7
25	103	100	97	-0.7	0.7
26	98.38	95.42	92.47	-0.7	0.7
27	93.99	91.08	88.18	-0.7	0.7
28	89.83	86.97	84.12	-0.8	0.8
29	85.87	83.06	80.27	-0.8	0.8
30	82.12	79.36	76.62	-0.8	0.8
31	78.53	75.82	73.14	-0.8	0.8
32	75.12	72.46	69.83	-0.8	0.9
33	71.87	69.27	66.7	-0.9	0.9
34	68.79	66.24	63.73	-0.9	0.9
35	65.86	63.36	60.9	-0.9	0.9
36	63.07	60.63	58.22	-0.9	1
37	60.42	58.02	55.67	-1	1
38	57.89	55.55	53.25	-1	1
39	55.49	53.2	50.95	-1	1.1
40	53.2	50.96	48.76	-1.1	1.1
41	50.99	48.8	46.66	-1.1	1.1
42	48.89	46.75	44.67	-1.1	1.1
43	46.89	44.8	42.77	-1.1	1.1
44	44.99	42.94	40.96	-1.1	1.2
45	43.17	41.17	39.24	-1.2	1.2
46	41.43	39.49	37.6	-1.2	1.2
47	39.78	37.88	36.04	-1.2	1.3
48	38.2	36.35	34.55	-1.3	1.3
49	36.7	34.89	33.13	-1.3	1.3
50	35.26	33.49	31.78	-1.3	1.3
51	33.88	32.15	30.49	-1.3	1.4
52	32.55	30.87	29.25	-1.4	1.4
53	31.29	29.65	28.07	-1.4	1.4
54	30.09	28.49	26.96	-1.4	1.4
55	28.94	27.37	25.87	-1.4	1.5
56	27.83	26.31	24.85	-1.5	1.5
57	26.78	25.3	23.87	-1.5	1.5
58	25.77	24.33	22.94	-1.5	1.6
59	24.81	23.4	22.05	-1.6	1.6
60	23.89	22.51	21.19	-1.6	1.6
61	23	21.66	20.37	-1.6	1.6
62	22.15	20.84	19.59	-1.6	1.7

Temp (℃)	Max. R (kΩ)	Typ. R (kΩ)	Min. R (kΩ)	Temp. Error (℃)	
63	21.33	20.06	18.84	-1.7	1.7
64	20.55	19.31	18.12	-1.7	1.7
65	19.81	18.59	17.44	-1.7	1.8
66	19.09	17.91	16.78	-1.7	1.8
67	18.4	17.25	16.16	-1.8	1.8
68	17.75	16.62	15.56	-1.8	1.9
69	17.12	16.02	14.98	-1.8	1.9
70	16.51	15.44	14.43	-1.9	1.9
71	15.93	14.89	13.9	-1.9	1.9
72	15.37	14.35	13.39	-1.9	2
73	14.83	13.84	12.91	-1.9	2
74	14.32	13.35	12.44	-2	2
75	13.82	12.88	11.99	-2	2.1
76	13.35	12.43	11.56	-2	2.1
77	12.89	12	11.15	-2.1	2.1
78	12.45	11.58	10.76	-2.1	2.2
79	12.03	11.18	10.38	-2.1	2.2
80	11.63	10.8	10.02	-2.2	2.2
81	11.24	10.43	9.668	-2.2	2.2
82	10.86	10.07	9.332	-2.2	2.3
83	10.5	9.732	9.01	-2.3	2.3
84	10.16	9.404	8.701	-2.3	2.3
85	9.822	9.089	8.404	-2.3	2.4
86	9.501	8.786	8.118	-2.3	2.4
87	9.192	8.495	7.843	-2.4	2.4
88	8.895	8.215	7.58	-2.4	2.5
89	8.609	7.945	7.326	-2.4	2.5
90	8.333	7.686	7.082	-2.5	2.5
91	8.066	7.434	6.846	-2.5	2.6
92	7.809	7.193	6.619	-2.5	2.6
93	7.561	6.96	6.401	-2.6	2.6
94	7.323	6.736	6.191	-2.6	2.7
95	7.093	6.52	5.989	-2.6	2.7
96	6.871	6.313	5.794	-2.7	2.7
97	6.658	6.113	5.607	-2.7	2.8
98	6.453	5.92	5.427	-2.7	2.8
99	6.254	5.735	5.254	-2.8	2.8
100	6.063	5.556	5.087	-2.8	2.9
101	5.879	5.383	4.925	-2.8	2.9

Temp (℃)	Max. R (kΩ)	Typ. R (kΩ)	Min. R (kΩ)	Temp. Error (℃)	
102	5.7	5.217	4.77	-2.9	2.9
103	5.529	5.057	4.621	-2.9	3
104	5.363	4.902	4.476	-2.9	3
105	5.203	4.753	4.338	-3	3
106	5.048	4.609	4.204	-3	3.1
107	4.899	4.47	4.075	-3	3.1
108	4.755	4.336	3.95	-3.1	3.1
109	4.617	4.207	3.83	-3.1	3.2
110	4.482	4.082	3.714	-3.1	3.2
111	4.352	3.961	3.602	-3.2	3.2
112	4.227	3.845	3.494	-3.2	3.3
113	4.105	3.732	3.389	-3.2	3.3
114	3.988	3.623	3.289	-3.3	3.4
115	3.874	3.518	3.191	-3.3	3.4
116	3.765	3.416	3.097	-3.3	3.4
117	3.659	3.318	3.007	-3.4	3.5
118	3.556	3.223	2.919	-3.4	3.5
119	3.457	3.132	2.834	-3.5	3.5
120	3.361	3.043	2.753	-3.5	3.6
121	3.268	2.957	2.673	-3.5	3.6
122	3.178	2.874	2.596	-3.6	3.6
123	3.09	2.793	2.522	-3.6	3.7
124	3.006	2.715	2.451	-3.6	3.7
125	2.924	2.64	2.381	-3.7	3.8
126	2.845	2.567	2.341	-3.7	3.8
127	2.768	2.497	2.249	-3.7	3.8
128	2.694	2.428	2.187	-3.8	3.9
129	2.622	2.362	2.126	-3.8	3.9
130	2.553	2.298	2.067	-3.8	3.9
131	2.485	2.236	2.01	-3.9	4
132	2.42	2.176	1.955	-3.9	4
133	2.356	2.118	1.902	-4	4.1
134	2.295	2.061	1.85	-4	4.1
135	2.235	2.007	1.8	-4	4.1
136	2.177	1.954	1.752	-4.1	4.2
137	2.121	1.902	1.705	-4.1	4.2
138	2.067	1.853	1.659	-4.1	4.3
139	2.014	1.805	1.615	-4.2	4.3
140	1.963	1.758	1.573	-4.2	4.3

Temp (℃)	Max. R (kΩ)	Typ. R (kΩ)	Min. R (kΩ)	Temp. Error (℃)	
141	1.913	1.712	1.531	-4.3	4.4
142	1.865	1.668	1.491	-4.3	4.4
143	1.818	1.626	1.452	-4.3	4.5
144	1.773	1.584	1.414	-4.4	4.5
145	1.729	1.544	1.378	-4.4	4.5
146	1.686	1.505	1.342	-4.5	4.6
147	1.644	1.467	1.308	-4.5	4.6
148	1.604	1.431	1.275	-4.5	4.7
149	1.565	1.395	1.242	-4.6	4.7
150	1.527	1.36	1.211	-4.6	4.7
151	1.49	1.327	1.18	-4.7	4.8
152	1.454	1.294	1.151	-4.7	4.8
153	1.419	1.262	1.122	-4.7	4.9
154	1.385	1.231	1.094	-4.8	4.9
155	1.352	1.202	1.067	-4.8	4.9
156	1.32	1.172	1.041	-4.8	5
157	1.289	1.144	1.015	-4.9	5
158	1.258	1.117	0.9902	-4.9	5.1
159	1.229	1.09	0.9661	-5	5.1
160	1.2	1.064	0.9427	-5	5.2
161	1.173	1.039	0.9199	-5.1	5.2
162	1.145	1.015	0.8977	-5.1	5.2
163	1.119	0.9907	0.8762	-5.1	5.3
164	1.093	0.9675	0.8554	-5.2	5.3
165	1.068	0.945	0.8351	-5.2	5.4
166	1.044	0.9231	0.8153	-5.3	5.4
167	1.021	0.9018	0.7961	-5.3	5.5
168	0.9976	0.8811	0.7775	-5.3	5.5
169	0.9753	0.861	0.7594	-5.4	5.5
170	0.9535	0.8414	0.7418	-5.4	5.6
171	0.9322	0.8222	0.7245	-5.5	5.6
172	0.9115	0.8036	0.7078	-5.5	5.7
173	0.8914	0.7854	0.6915	-5.5	5.7
174	0.8717	0.7678	0.6757	-5.6	5.8
175	0.8526	0.7506	0.6602	-5.6	5.8
176	0.834	0.7339	0.6453	-5.7	5.9
177	0.8159	0.7176	0.6307	-5.7	5.9
178	0.7982	0.7018	0.6165	-5.8	5.9
179	0.781	0.6864	0.6027	-5.8	6

Temp (℃)	Max. R (kΩ)	Typ. R (kΩ)	Min. R (kΩ)	Temp. Error (℃)	
180	0.7643	0.6714	0.5892	-5.8	6
181	0.7479	0.6567	0.5761	-5.9	6.1
182	0.732	0.6425	0.5633	-5.9	6.1
183	0.7165	0.6286	0.5509	-6	6.2
184	0.7014	0.615	0.5388	-6	6.2
185	0.6866	0.6018	0.527	-6.1	6.3
186	0.6723	0.589	0.5156	-6.1	6.3
187	0.6583	0.5765	0.5044	-6.2	6.4
188	0.6446	0.5643	0.4935	-6.2	6.4
189	0.6313	0.5524	0.4829	-6.2	6.4
190	0.6183	0.5408	0.4726	-6.3	6.5
191	0.6056	0.5294	0.4625	-6.3	6.5
192	0.5932	0.5184	0.4526	-6.4	6.6
193	0.5811	0.5076	0.443	-6.4	6.6
194	0.5693	0.4971	0.4337	-6.5	6.7
195	0.5578	0.4868	0.4245	-6.5	6.7
196	0.5466	0.4768	0.4156	-6.6	6.8
197	0.5356	0.4671	0.407	-6.6	6.8
198	0.5249	0.4576	0.3985	-6.6	6.9
199	0.5145	0.4483	0.3903	-6.7	6.9
200	0.5043	0.4393	0.3822	-6.7	7
201	0.4944	0.4304	0.3744	-6.8	7
202	0.4846	0.4218	0.3667	-6.8	7.1
203	0.4751	0.4133	0.3593	-6.9	7.1
204	0.4659	0.4051	0.352	-6.9	7.2
205	0.4568	0.3971	0.3449	-7	7.2
206	0.448	0.3893	0.3379	-7	7.3
207	0.4394	0.3816	0.3311	-7.1	7.3
208	0.4309	0.3741	0.3245	-7.1	7.4
209	0.4227	0.3668	0.3181	-7.2	7.4
210	0.4147	0.3597	0.3118	-7.2	7.5
211	0.4068	0.3528	0.3056	-7.3	7.5
212	0.3991	0.346	0.2996	-7.3	7.6
213	0.3916	0.3393	0.2937	-7.3	7.6
214	0.3842	0.3328	0.288	-7.4	7.7
215	0.3771	0.3265	0.2824	-7.4	7.7
216	0.37	0.3203	0.277	-7.5	7.8
217	0.3632	0.3142	0.2716	-7.5	7.8
218	0.3565	0.3083	0.2664	-7.6	7.9

Temp (℃)	Max. R (kΩ)	Typ. R (kΩ)	Min. R (kΩ)	Temp. Error (℃)	
219	0.3499	0.3025	0.2613	-7.6	7.9
220	0.3435	0.2969	0.2563	-7.7	8
221	0.3372	0.2913	0.2514	-7.7	8
222	0.3311	0.2859	0.2467	-7.8	8.1
223	0.3251	0.2806	0.242	-7.8	8.1
224	0.3192	0.2755	0.2375	-7.9	8.2
225	0.3135	0.2704	0.233	-7.9	8.2
226	0.3079	0.2655	0.2287	-8	8.3
227	0.3024	0.2606	0.2245	-8	8.3
228	0.297	0.2559	0.2203	-8.1	8.4
229	0.2917	0.2513	0.2162	-8.1	8.4
230	0.2866	0.2468	0.2123	-8.2	8.5
231	0.2816	0.2423	0.2084	-8.2	8.5
232	0.2766	0.238	0.2046	-8.3	8.6
233	0.2718	0.2338	0.2009	-8.3	8.6
234	0.2671	0.2296	0.1972	-8.4	8.7
235	0.2624	0.2256	0.1937	-8.4	8.8
236	0.2579	0.2216	0.1902	-8.5	8.8
237	0.2535	0.2177	0.1868	-8.5	8.9
238	0.2491	0.2139	0.1835	-8.6	8.9
239	0.2449	0.2102	0.1802	-8.6	9
240	0.2407	0.2065	0.177	-8.7	9
241	0.2367	0.203	0.1739	-8.7	9.1
242	0.2327	0.1995	0.1709	-8.8	9.1
243	0.2287	0.196	0.1679	-8.8	9.2
244	0.2249	0.1927	0.1649	-8.9	9.2
245	0.2212	0.1894	0.1621	-8.9	9.3
246	0.2175	0.1862	0.1593	-9	9.4
247	0.2139	0.1831	0.1565	-9	9.4
248	0.2104	0.18	0.1539	-9.1	9.5
249	0.2069	0.177	0.1512	-9.2	9.5
250	0.2035	0.174	0.1486	-9.2	9.6
251	0.2002	0.1711	0.1461	-9.3	9.6
252	0.1969	0.1683	0.1437	-9.3	9.7
253	0.1937	0.1655	0.1412	-9.4	9.8
254	0.1906	0.1628	0.1389	-9.4	9.8
255	0.1876	0.1601	0.1365	-9.5	9.9
256	0.1846	0.1575	0.1343	-9.5	9.9
257	0.1816	0.1549	0.132	-9.6	10

Temp (℃)	Max. R (kΩ)	Typ. R (kΩ)	Min. R (kΩ)	Temp. Error (℃)	
258	0.1787	0.1524	0.1298	-9.6	10
259	0.1759	0.1499	0.1277	-9.7	10.1
260	0.1731	0.1475	0.1256	-9.7	10.2
261	0.1704	0.1452	0.1236	-9.8	10.2
262	0.1677	0.1428	0.1215	-9.9	10.3
263	0.1651	0.1406	0.1196	-9.9	10.3
264	0.1625	0.1383	0.1176	-10	10.4
265	0.16	0.1361	0.1157	-10	10.4
266	0.1575	0.134	0.1138	-10.1	10.5
267	0.1551	0.1319	0.112	-10.1	10.6
268	0.1527	0.1298	0.1103	-10.2	10.6
269	0.1504	0.1278	0.1085	-10.2	10.7
270	0.1481	0.1258	0.1068	-10.3	10.7
271	0.1459	0.1239	0.1051	-10.3	10.8
272	0.1437	0.122	0.1034	-10.4	10.9
273	0.1415	0.1201	0.1018	-10.5	10.9
274	0.1394	0.1182	0.1002	-10.5	11
275	0.1373	0.1164	0.09867	-10.6	11
276	0.1352	0.1147	0.09714	-10.6	11.1
277	0.1332	0.1129	0.09564	-10.7	11.2
278	0.1313	0.1112	0.09417	-10.7	11.2
279	0.1293	0.1095	0.09272	-10.8	11.3

Temp (℃)	Max. R (kΩ)	Typ. R (kΩ)	Min. R (kΩ)	Temp. Error (℃)	
280	0.1274	0.1079	0.0913	-10.9	11.4
281	0.1255	0.1063	0.08991	-10.9	11.4
282	0.1237	0.1047	0.08854	-11	11.5
283	0.1219	0.1032	0.0872	-11	11.5
284	0.1202	0.1016	0.08589	-11.1	11.6
285	0.1184	0.1001	0.0846	-11.1	11.7
286	0.1167	0.09866	0.08339	-11.2	11.7
287	0.115	0.09722	0.08208	-11.3	11.8
288	0.1134	0.0958	0.08087	-11.3	11.9
289	0.1118	0.09441	0.07967	-11.4	
290	0.1102	0.09305	0.07849	-11.4	
291	0.1086	0.0917	0.07734	-11.5	
292	0.1071	0.09039	0.07621	-11.6	
293	0.1056	0.08909	0.07509	-11.6	
294	0.1041	0.08782	0.074	-11.7	
296	0.1012	0.08534	0.07187	-11.8	
297	0.09985	0.08414	0.07084	-11.9	
298	0.09847	0.08295	0.06982	-11.9	
299	0.09711	0.08179	0.06882	-12	
300	0.09578	0.08065	0.06784	-12	

18 Revision history

Version	Date	Page	Description
1.1	2005/02	-	The first detail release version.
1.2	2012/04	5	Add dice coordinate on Figure 4-1
		7	Add “Dice” notation on the application circuit for Figure 7-1