E2E0008-38-94

OKI Semiconductor

MSM5052

Built-in Temperature Circuit and LCD Driver 4-Bit Microcontroller

GENERAL DESCRIPTION

The MSM5052 is a low-power microcontroller manufactured in complementary metal-oxide semiconductor technology. Integrated into a single chip are ROM, RAM, crystal oscillator, voltage doubler, timer, LCD driver, input port, output port, and thermistor-based temperature measuring circuit.
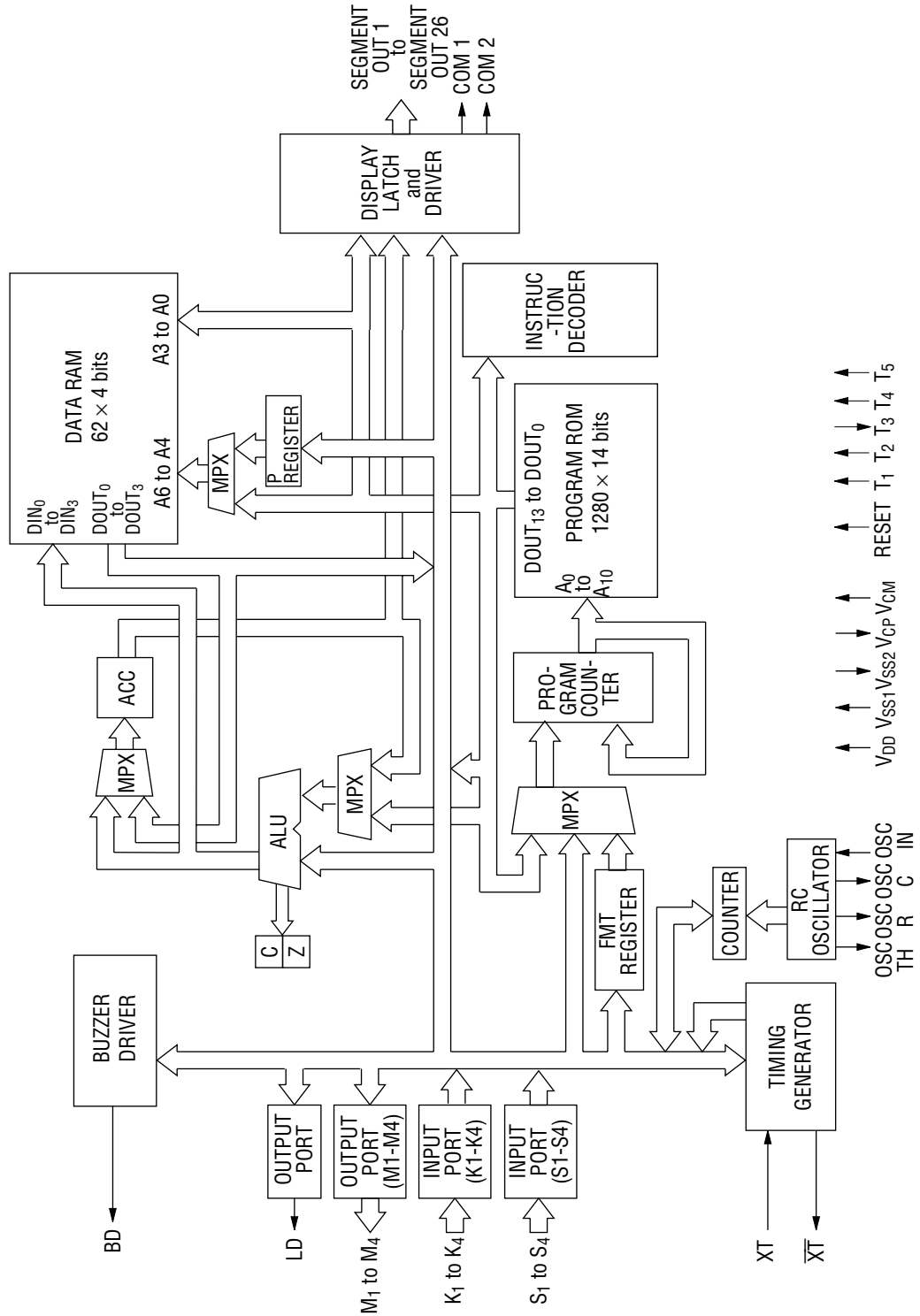Using an on-chip ROM reduces power consumption.
The MSM5052 is widely used in electronic products requiring low-power operation, for example, thermometer and clinical thermometer.
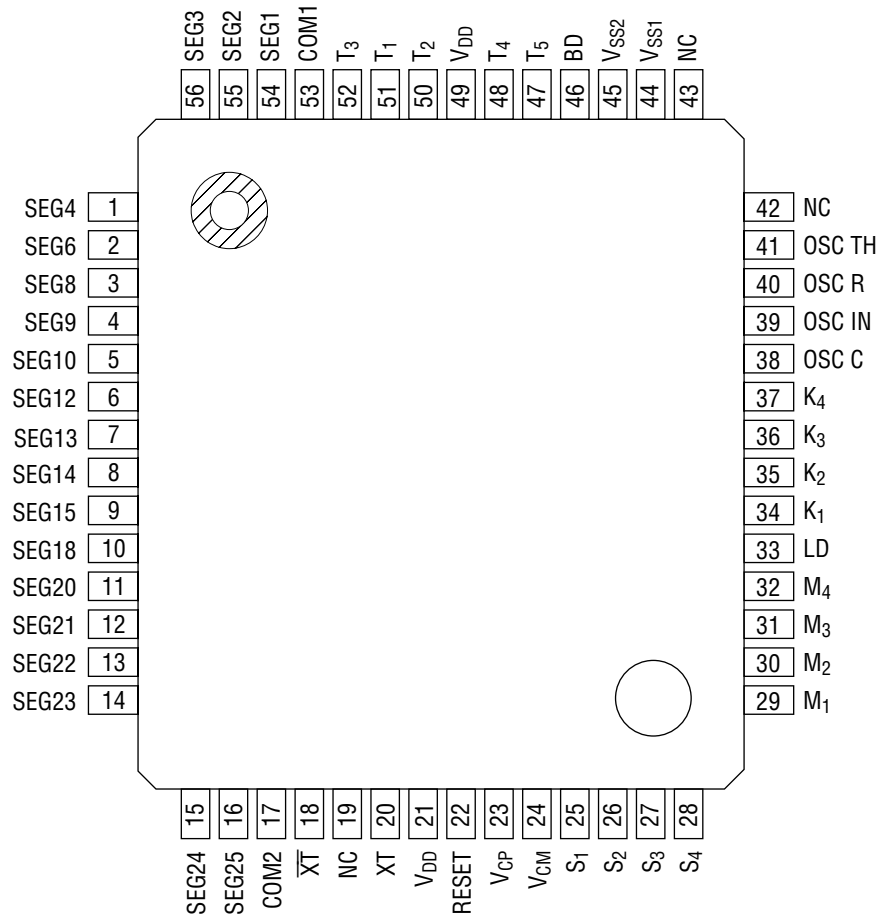
FEATURES

- Low power consumption
- Internal ROM   : 1280×14 bits
- Internal RAM   : 62×4 bits
- I/O port
    Input port   : 2 ports $\times$ 4 bits
    Output port   : 1 port $\times$ 4 bits
                                    1 port $\times$ 1 bit
- 4×4 key matrix input is available by using K_1 to K_4 and M_1 to M_4
- 26 LCD drivers (1/2 duty, 1/2 bias, 52 segments)
- 42 instructions
- Minimum instruction execution time   : 122.1 µs (Display instruction cycle: 244.2 µs)
- 1.5 V operating voltage (Built-in LCD drive voltage doubler)
- Buzzer function
- Built-in thermistor-based temperature measuring circuit
- Crystal oscillator   : 32.768 kHz
- Package options:
    56-pin plastic QFP (QFP56-P-910-0.65-K)   : (Product name : MSM5052-×××GS-K)
    56-pin plastic QFP (QFP56-P-910-0.65-2K) : (Product name : MSM5052-×××GS-2K)
    80-pin plastic QFP (QFP80-P-1420-0.80-BK): (Product name : MSM5052-×××GS-BK)
    Chip (Chip size 4.77 mm $\times$ 4.36 mm)   : (Product name : MSM5052-×××)
                                        ××× indicates a code number.

BLOCK DIAGRAM

PIN CONFIGURATION (TOP VIEW)

Top pins (left to right): 56 SEG3, 55 SEG2, 54 SEG1, 53 COM1, 52 T_3, 51 T_1, 50 T_2, 49 V_{DD}, 48 T_4, 47 T_5, 46 BD, 45 V_{SS2}, 44 V_{SS1}, 43 NC

Left pins (top to bottom):
SEG4 1
SEG6 2
SEG8 3
SEG9 4
SEG10 5
SEG12 6
SEG13 7
SEG14 8
SEG15 9
SEG18 10
SEG20 11
SEG21 12
SEG22 13
SEG23 14

Right pins (top to bottom):
42 NC
41 OSC TH
40 OSC R
39 OSC IN
38 OSC C
37 K_4
36 K_3
35 K_2
34 K_1
33 LD
32 M_4
31 M_3
30 M_2
29 M_1

Bottom pins (left to right): 15 SEG24, 16 SEG25, 17 COM2, 18 $\overline{XT}$, 19 NC, 20 XT, 21 V_{DD}, 22 RESET, 23 V_{CP}, 24 V_{CM}, 25 S_1, 26 S_2, 27 S_3, 28 S_4
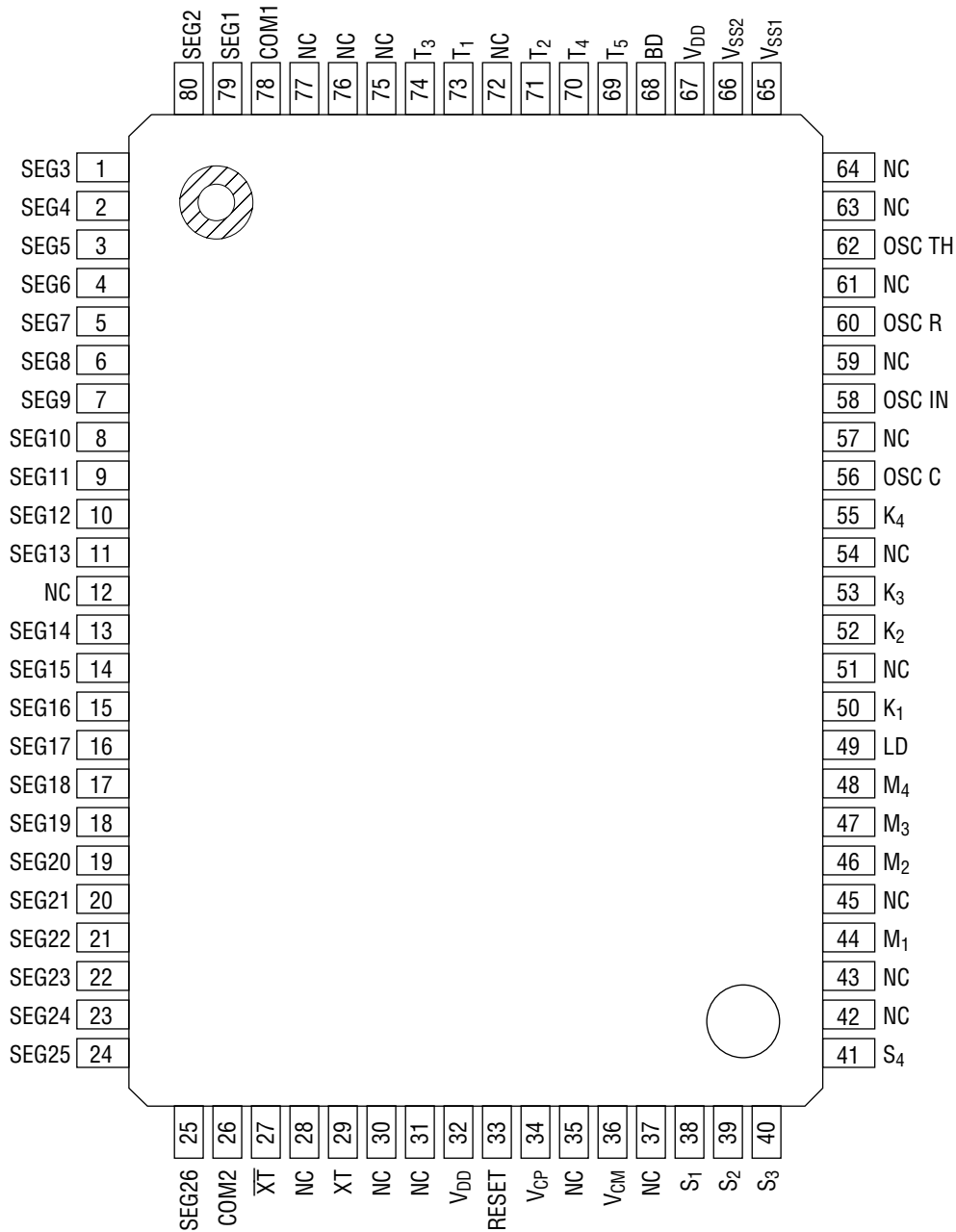
NC: No-connection pin

56-Pin Plastic QFP

Note: SEG5, SEG7, SEG11, SEG16, SEG17, SEG19, and SEG26 are not connected to package pins.
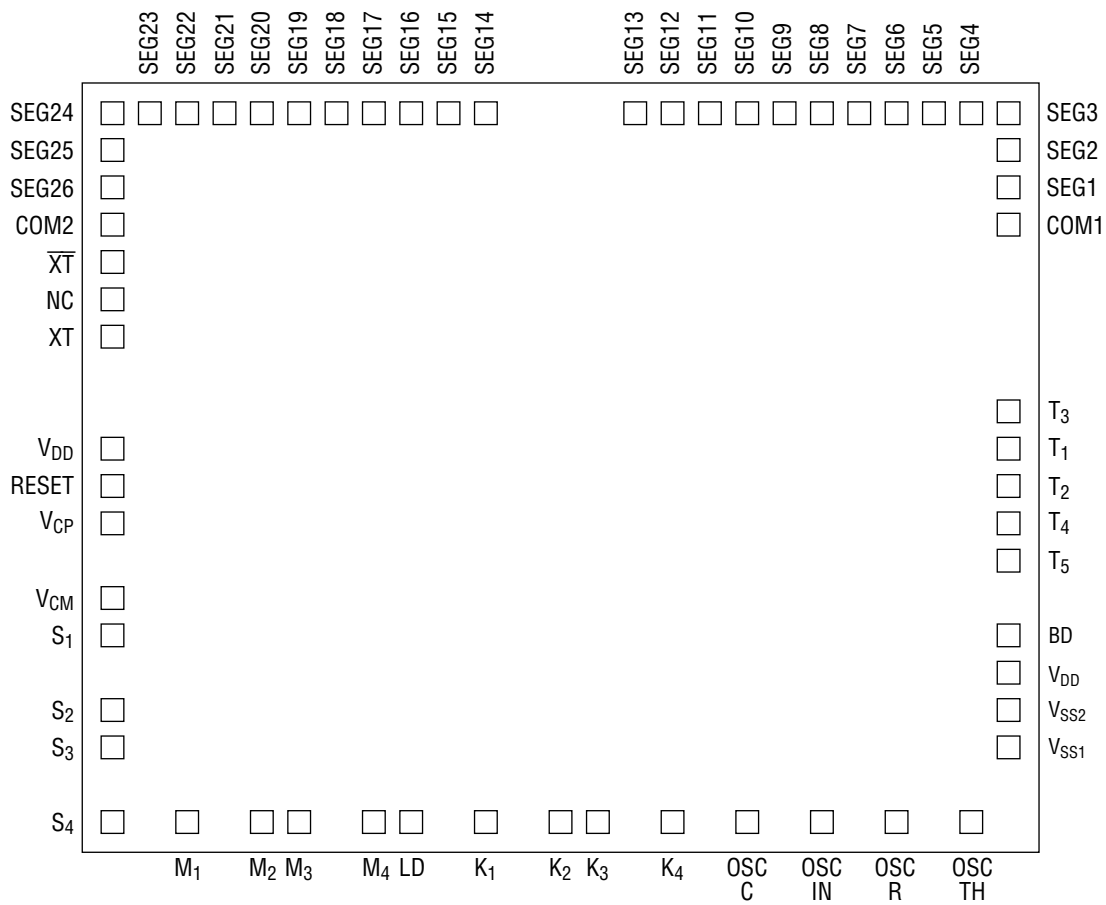
PIN CONFIGURATION (TOP VIEW) (continued)

Top pins (left to right): 80 SEG2, 79 SEG1, 78 COM1, 77 NC, 76 NC, 75 NC, 74 T_3, 73 T_1, 72 NC, 71 T_2, 70 T_4, 69 T_5, 68 BD, 67 V_{DD}, 66 V_{SS2}, 65 V_{SS1}

Left pins (top to bottom):

Pin	Signal
1	SEG3
2	SEG4
3	SEG5
4	SEG6
5	SEG7
6	SEG8
7	SEG9
8	SEG10
9	SEG11
10	SEG12
11	SEG13
12	NC
13	SEG14
14	SEG15
15	SEG16
16	SEG17
17	SEG18
18	SEG19
19	SEG20
20	SEG21
21	SEG22
22	SEG23
23	SEG24
24	SEG25

Right pins (top to bottom):

Pin	Signal
64	NC
63	NC
62	OSC TH
61	NC
60	OSC R
59	NC
58	OSC IN
57	NC
56	OSC C
55	K_4
54	NC
53	K_3
52	K_2
51	NC
50	K_1
49	LD
48	M_4
47	M_3
46	M_2
45	NC
44	M_1
43	NC
42	NC
41	S_4

Bottom pins (left to right): 25 SEG26, 26 COM2, 27 $\overline{XT}$, 28 NC, 29 XT, 30 NC, 31 NC, 32 V_{DD}, 33 RESET, 34 V_{CP}, 35 NC, 36 V_{CM}, 37 NC, 38 S_1, 39 S_2, 40 S_3

NC: No-connection pin

80-Pin Plastic QFP

PAD CONFIGURATION

Pad Layout

Chip size 4.77 × 4.36 (mm)

PIN DESCRIPTIONS

Symbol	Description
V_{DD}	Ground.
V_{SS1}	Power source (–1.5 V).
V_{SS2}	Power source for LCD driver (–3.0 V). This pin is connected to the V_{DD} pin through a 0.1 μF capacitor.
V_{CP}, V_{CM}	Booster capacitor connection pins. V_{CP} pin is connected to the V_{CM} pin through a 0.1 μF capacitor.
XT, $\overline{XT}$	Input and output pins of oscillator inverter. A 32.768 kHz crystal is connected to these pins.
T1 to T5	Pins to test internal logic. T1, T2, T4, and T5 are pulled down to V_{SS1}. T3 is the output. Test pins are normally open.
RESET	Pin to clear internal logic, pulled down to V_{SS1}. After power is turned on, the MSM5052 can be reset by this pin.
BD	Buzzer output.
OSC TH, OSC R, OSC C, OSC IN	Pins to RC oscillation circuit for temperature detection. These are the fundamental resistor, thermistor, and capacitor connection pins.

ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	Condition	Rating	Unit
Power Supply Voltage	V_{SS1}-V_{DD}	Ta = 25°C	−2.0 to +0.3	V
Input Voltage	V_{IN}	Ta = 25°C	V_{SS1} − 0.3 to +0.3	V
Storage Temperature	T_{STG}	—	−55 to +125	°C
Operating Temperature	T_{op}	—	−20 to +75	°C

ELECTRICAL CHARACTERISTICS

DC Characteristics

$(V_{DD} = 0$ V, $V_{SS1} = -1.55$ V, $V_{SS2} = -3.0$ V, $C_1 = 30$ pF, Ta = 25°C$)$

Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit
V_{SS1} Operating Voltage	V_{SS1}	V_{SS1} pin	−1.65	−1.55	−1.25	V
Power Supply Current 1	I_{DD1}	Temperature sampling off (Refer to measuring circuit)	—	3.0 *1	—	μA
Power Supply Current 2	I_{DD2}	Temperature sampling on (Refer to measuring circuit)	—	100 *2	—	μA
Oscillation Start Voltage	V_{OSC}	Within 10 seconds, V_{SS1} pin (Refer to measuring circuit)	—	—	−1.45	V
Output Current 1 COM	I_{OH1}	$V_{OH1} = -0.2$ V	—	—	−4	μA
	I_{OM1}	$V_{OM1} = V_{SS1} \pm 0.2$ V	−4	—	+4	
	I_{OL1}	$V_{OL1} = -2.8$ V	4	—	—	
Output Current 2 SEGMENT	I_{OH2}	$V_{OH2} = -0.2$ V	—	—	−0.4	μA
	I_{OL2}	$V_{OL2} = -2.8$ V	0.4	—	—	
Output Current 3 C, R, TH	I_{OH3}	$V_{OH3} = -0.4$ V	—	—	−400	μA
	I_{OL3}	$V_{OL3} = -1.15$ V	400	—	—	
Output Current 4 M_1-M_4, LD	I_{OH4}	$V_{OH4} = -0.4$ V	—	—	−100	μA
	I_{OL4}	$V_{OL4} = -1.15$ V	10	—	—	
Output Current 5 BD	I_{OH5}	$V_{OH5} = -0.4$ V	−200	—	−50	μA
	I_{OL5}	$V_{OL5} = -1.15$ V	3	—	—	
Input Current S_1-S_4, K_1-K_4	I_{IH}	$V_{IN} = 0$ V	3	—	30	μA
	I_{IL}	$V_{IN} = -1.55$ V	−0.2	—	—	
Built-in CD Capacitance	CD	—	—	25	—	pF

*1 The typ. value varies depending on the application program.
*2 The typ. value varies depending on the application program and RC thermistor to be used.
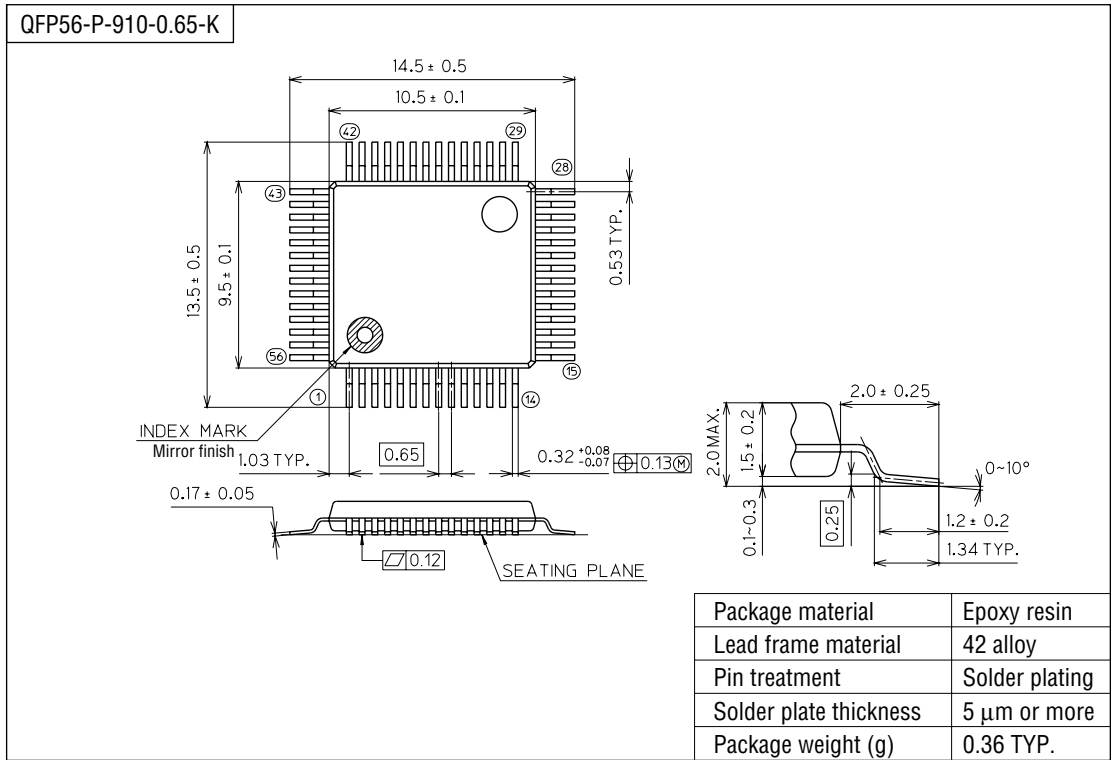
Measuring circuit

C_1 : 20 pF
C_2, C_3 : 0.1 µF
C_4 : 3000 pF
R_1, R_2 : 10 kΩ

APPLICATION CIRCUIT

*1 Inner switch or pad on PCB
*2 Bonding option

R₁ : 33 kΩ
R₂ : 20 kΩ

TH : 40BT-5
40 kΩ ±10% at 25°C
B = 3550 ±2%

C₁ : 680 pF
C₂ : 5 to 35 pF
C₃ : 0.1 μF
C₄ : 0.1 μF

1	Thermometer one-second sampling
2	Thermometer 10-second sampling
3	The highest temperature alarm
4	The lowest temperature alarm
5	Clock
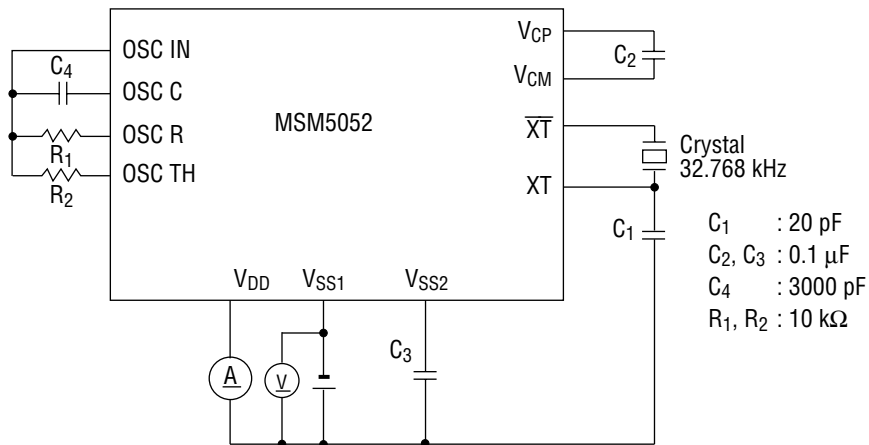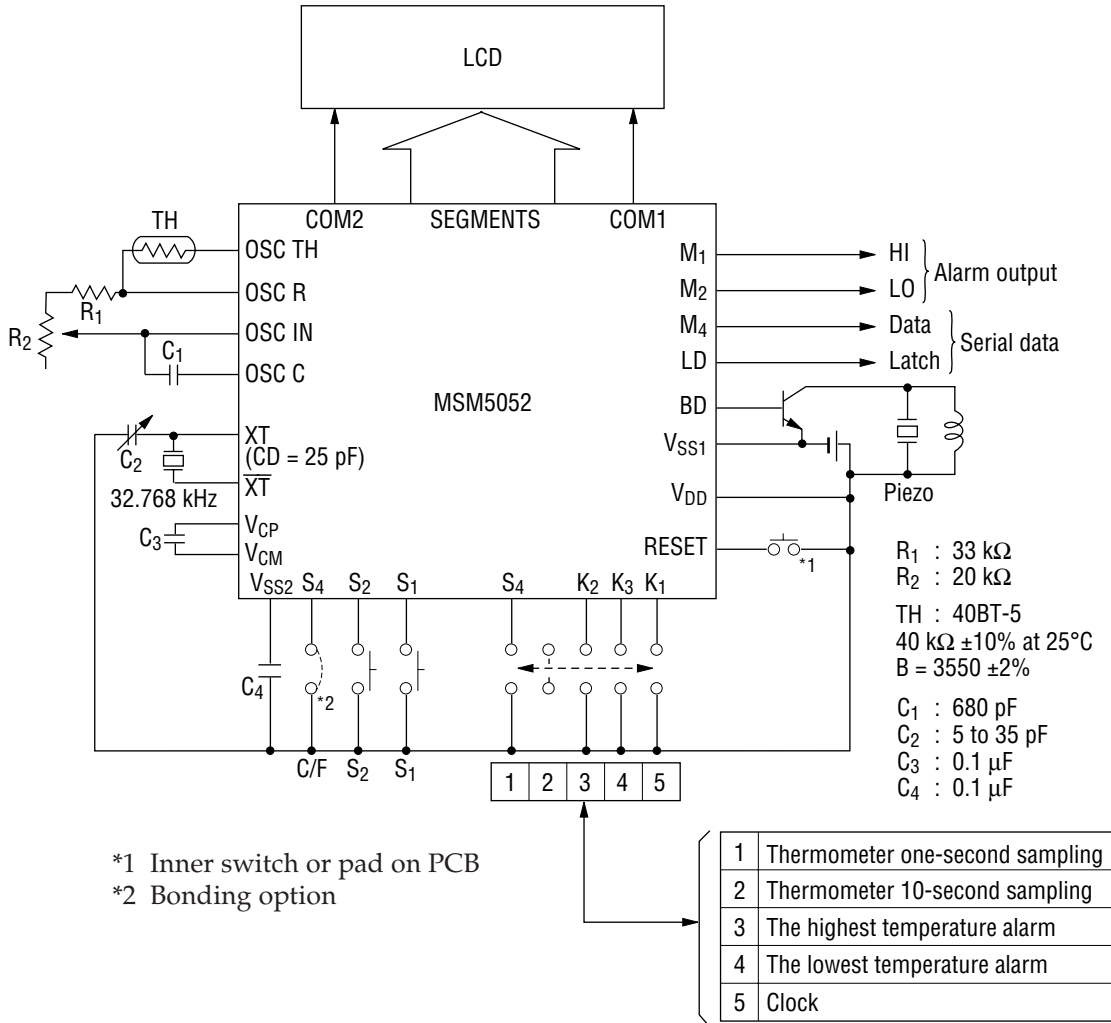
PACKAGE DIMENSIONS

(Unit : mm)

QFP56-P-910-0.65-K

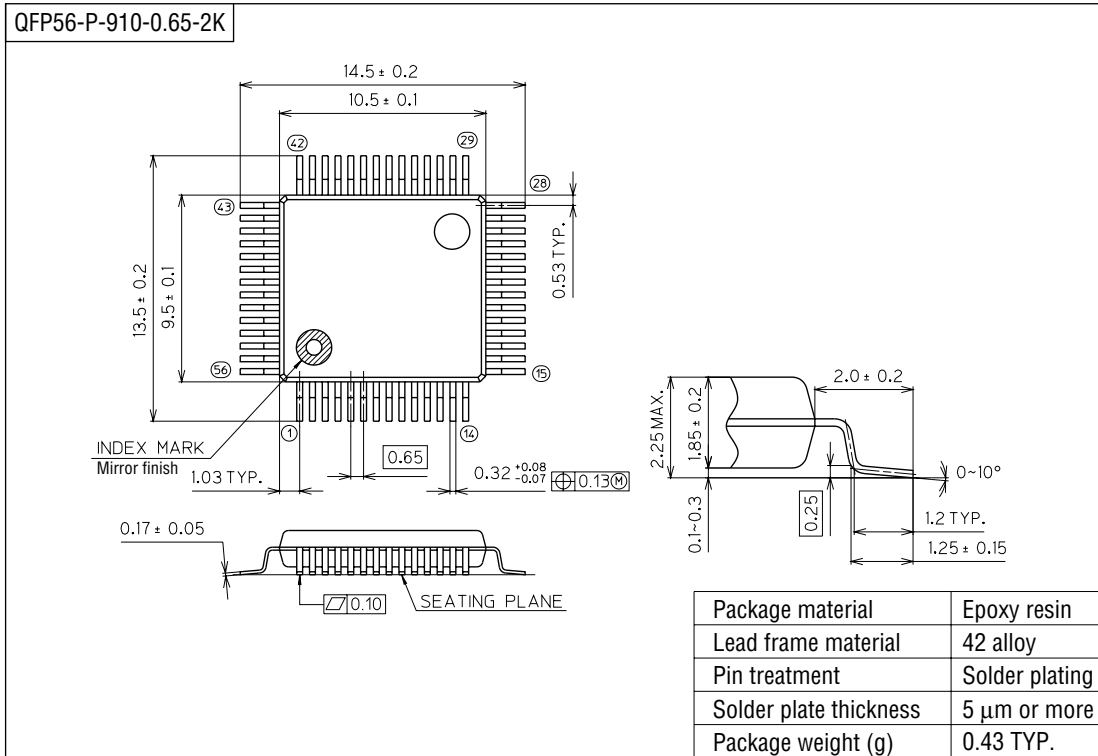| Package material	Epoxy resin
Lead frame material	42 alloy
Pin treatment	Solder plating
Solder plate thickness	5 μm or more
Package weight (g)	0.36 TYP.

Notes for Mounting the Surface Mount Type Package

The SOP, QFP, TSOP, SOJ, QFJ (PLCC), SHP and BGA are surface mount type packages, which are very susceptible to heat in reflow mounting and humidity absorbed in storage.
Therefore, before you perform reflow mounting, contact Oki's responsible sales person for the product name, package name, pin number, package code and desired mounting conditions (reflow method, temperature and times).
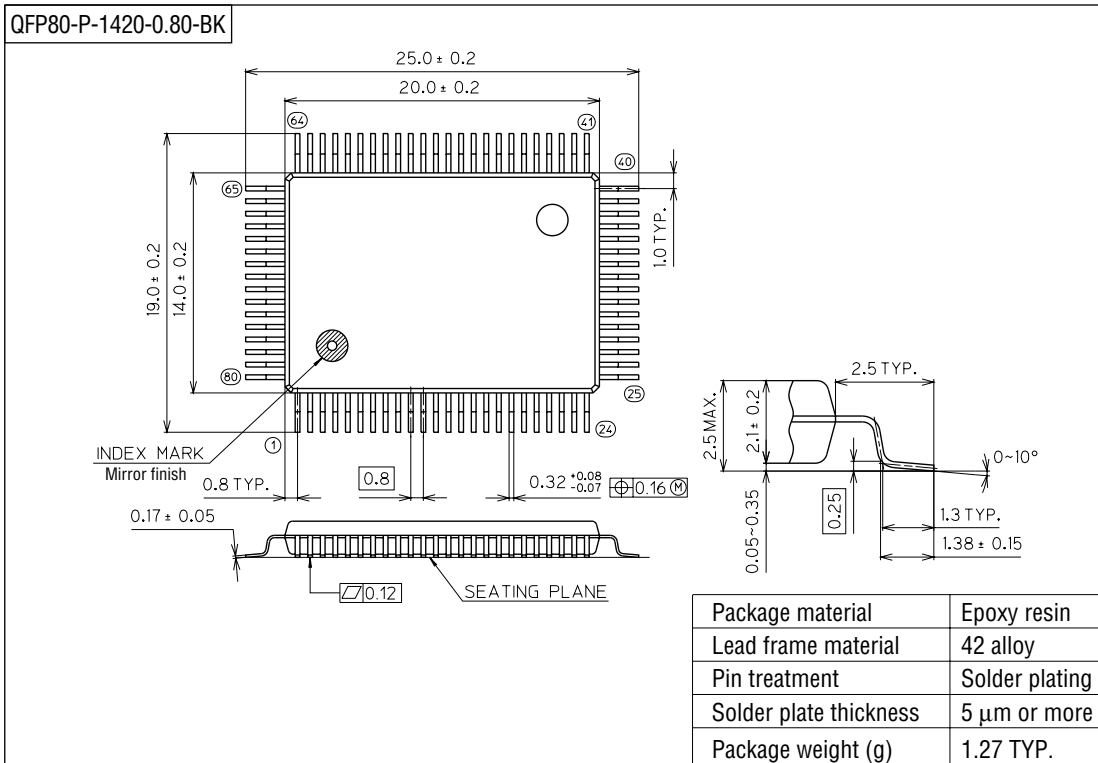
(Unit : mm)

QFP56-P-910-0.65-2K

Package material	Epoxy resin
Lead frame material	42 alloy
Pin treatment	Solder plating
Solder plate thickness	5 µm or more
Package weight (g)	0.43 TYP.

Notes for Mounting the Surface Mount Type Package

The SOP, QFP, TSOP, SOJ, QFJ (PLCC), SHP and BGA are surface mount type packages, which are very susceptible to heat in reflow mounting and humidity absorbed in storage.
Therefore, before you perform reflow mounting, contact Oki's responsible sales person for the product name, package name, pin number, package code and desired mounting conditions (reflow method, temperature and times).

(Unit : mm)

QFP80-P-1420-0.80-BK

Package material	Epoxy resin
Lead frame material	42 alloy
Pin treatment	Solder plating
Solder plate thickness	5 μm or more
Package weight (g)	1.27 TYP.

Notes for Mounting the Surface Mount Type Package

The SOP, QFP, TSOP, SOJ, QFJ (PLCC), SHP and BGA are surface mount type packages, which are very susceptible to heat in reflow mounting and humidity absorbed in storage.
Therefore, before you perform reflow mounting, contact Oki's responsible sales person for the product name, package name, pin number, package code and desired mounting conditions (reflow method, temperature and times).