

MSM64152A/64152AL**4-Bit Microcontroller with Built-in LCD Driver and Melody Circuit****GENERAL DESCRIPTION**

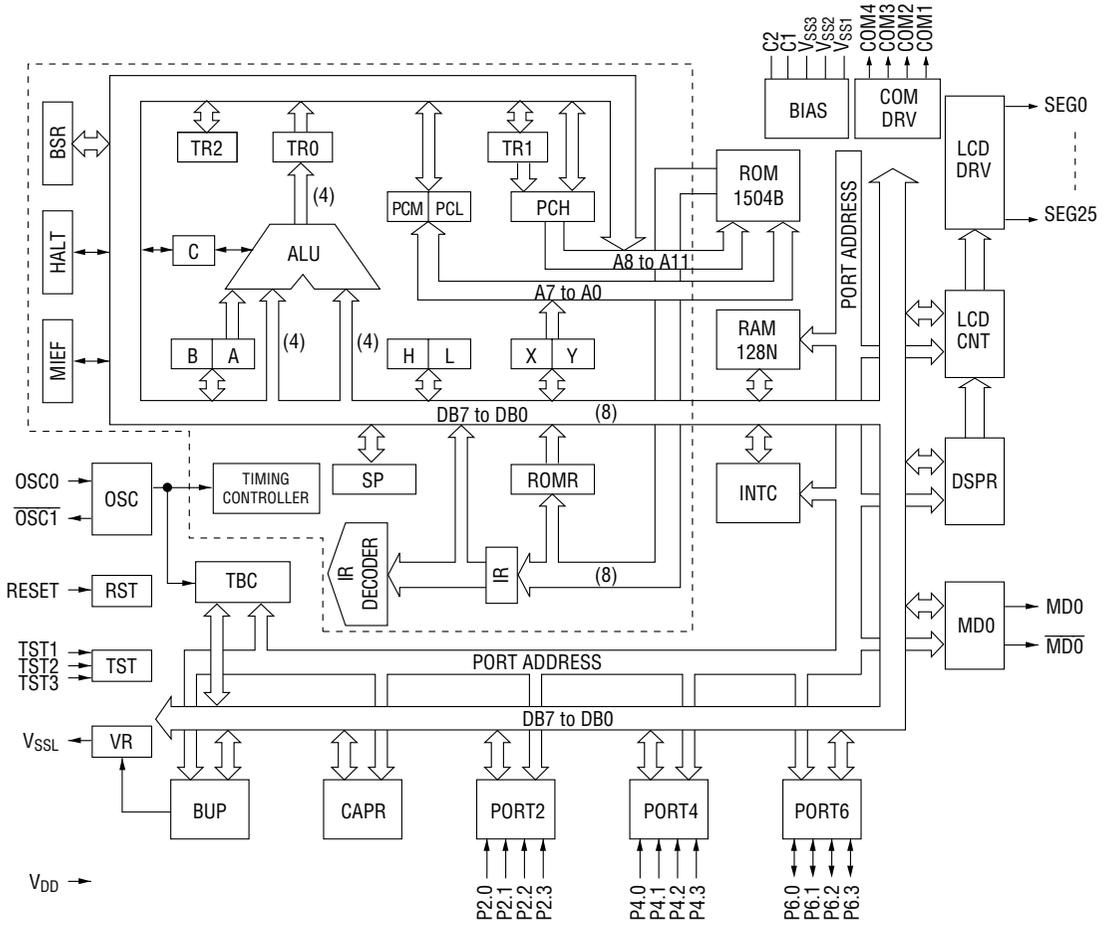
The MSM64152A (1.5 V)/64152AL (3.0 V) is a high-performance 4-bit microcontroller that incorporates Oki-original CPU core nX-4/20.

The MSM64152A/64152AL has an LCD driver for up to 104 segments, an event counter, and a melody circuit. It is best suited for applications such as clocks and LCD games.

FEATURES

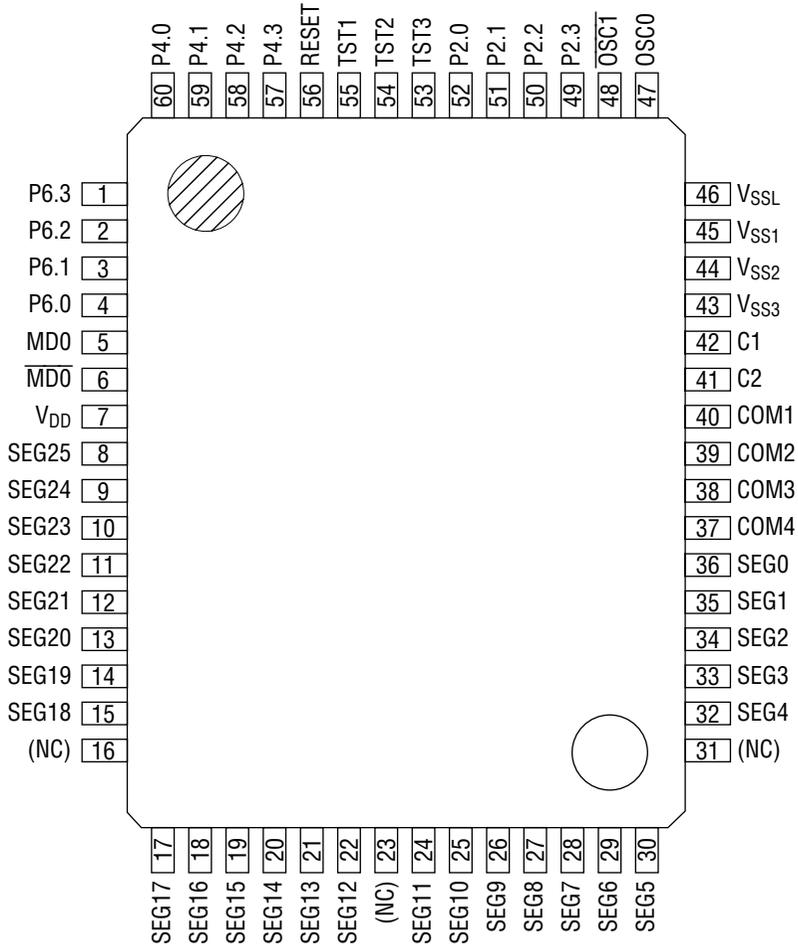
- Operating range
 - Operating voltage : 1.5 V/3.0 V
 - Operating temperature : -40 to +70 °C
 - Operating frequency : 32.768 kHz crystal oscillation
Approx. 32 kHz RC oscillation
 - Supply current (Typ.) : 0.9 μA (3.0 V at HALT mode)
- Minimum instruction execution time : 91 μs
- General memory space : 1504 bytes
- Local memory space : 128 nibbles
- LCD driver : 30
 - Common driver × 4
 - Segment driver × 26
 - 1/4 duty, 1/3 bias; 104 segments (26 × 4)
 - 1/3 duty, 1/3 bias; 78 segments (26 × 3)
- I/O port
 - Input-output port : 1 port × 4 bits (open-drain output/CMOS output selectable; pull-down resistor input/high-impedance input selectable)
 - Input port : 1 port × 4 bits (pull-down resistor input/high-impedance input selectable)
 - Output port : 1 port × 4 bits (CMOS output)
- Event counter : 1 channel
- Melody output : 1
- Interrupts : 7 sources
 - External 2, time base 4, melody 1
- Package:
 - 60-pin plastic QFP (QFP60-P-1519-1.00-K) : (Product name : MSM64152A-xxxGS-K,
MSM64152AL-xxxGS-K)
 - Chip : MSM64152A-xxx, MSM64152AL-xxx
xxx indicates a code number.
- OTP version (for program evaluation) : MSM64P155/64P155L
(The package, power polarity, and operating voltage of the MSM64P155/64P155L are different from the MSM64152A/64152AL. For details, refer to the "MSM64P155 User's Manual".)

BLOCK DIAGRAM



--- is the CPU core (nX-4/20).

PIN CONFIGURATION (TOP VIEW)

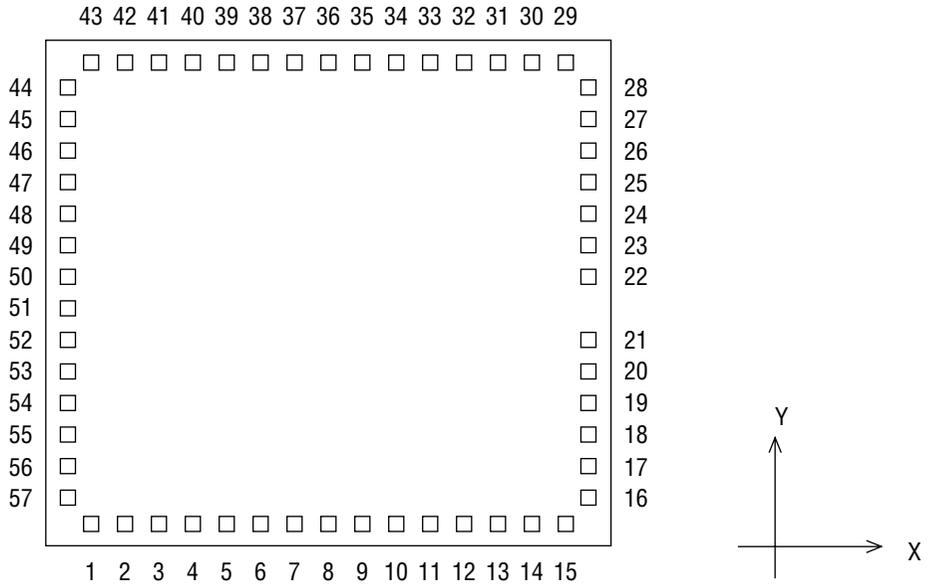


60-Pin Plastic QFP

Note: Pins marked as (NC) are no-connection pins which are left open.

PAD CONFIGURATION

Pad Layout



- Chip Size : 3.90 mm × 3.48 mm
- Chip Thickness : 350 μm (typ.)
- Coordinate Origin : Chip center
- Pad Hole Size : 110 μm × 110 μm
- Pad Size : 120 μm × 120 μm
- Minimum Pad Pitch : 180 μm

Note: The chip substrate voltage is V_{DD} .

Pad Coordinates

| Pad No. | Pad Name | X (μm) | Y (μm) | Pad No. | Pad Name | X (μm) | Y (μm) |
|---------|-------------------------|---------------------|---------------------|---------|--------------------------|---------------------|---------------------|
| 1 | P6.3 | -1529 | -1589 | 41 | V _{SS2} | -1085 | 1589 |
| 2 | P6.2 | -1307 | -1589 | 42 | V _{SS1} | -1307 | 1589 |
| 3 | P6.1 | -1085 | -1589 | 43 | V _{SSL} | -1529 | 1589 |
| 4 | P6.0 | -863 | -1589 | 44 | OSC0 | -1749 | 1340 |
| 5 | MD0 | -640 | -1589 | 45 | $\overline{\text{OSC1}}$ | -1749 | 1132 |
| 6 | $\overline{\text{MD0}}$ | -418 | -1589 | 46 | P2.3 | -1749 | 924 |
| 7 | V _{DD} | -196 | -1589 | 47 | P2.2 | -1749 | 715 |
| 8 | SEG25 | 26 | -1589 | 48 | P2.1 | -1749 | 507 |
| 9 | SEG24 | 242 | -1589 | 49 | P2.0 | -1749 | 299 |
| 10 | SEG23 | 459 | -1589 | 50 | TST3 | -1749 | 91 |
| 11 | SEG22 | 675 | -1589 | 51 | TST2 | -1749 | -117 |
| 12 | SEG21 | 892 | -1589 | 52 | TST1 | -1749 | -326 |
| 13 | SEG20 | 1108 | -1589 | 53 | RESET | -1749 | -534 |
| 14 | SEG19 | 1324 | -1589 | 54 | P4.3 | -1749 | -743 |
| 15 | SEG18 | 1541 | -1589 | 55 | P4.2 | -1749 | -952 |
| 16 | SEG17 | 1749 | -1357 | 56 | P4.1 | -1749 | -1160 |
| 17 | SEG16 | 1749 | -1140 | 57 | P4.0 | -1749 | -1369 |
| 18 | SEG15 | 1749 | -923 | | | | |
| 19 | SEG14 | 1749 | -706 | | | | |
| 20 | SEG13 | 1749 | -490 | | | | |
| 21 | SEG12 | 1749 | -273 | | | | |
| 22 | SEG11 | 1749 | 38 | | | | |
| 23 | SEG10 | 1749 | 254 | | | | |
| 24 | SEG9 | 1749 | 471 | | | | |
| 25 | SEG8 | 1749 | 687 | | | | |
| 26 | SEG7 | 1749 | 904 | | | | |
| 27 | SEG6 | 1749 | 1120 | | | | |
| 28 | SEG5 | 1749 | 1336 | | | | |
| 29 | SEG4 | 1541 | 1589 | | | | |
| 30 | SEG3 | 1324 | 1589 | | | | |
| 31 | SEG2 | 1108 | 1589 | | | | |
| 32 | SEG1 | 892 | 1589 | | | | |
| 33 | SEG0 | 675 | 1589 | | | | |
| 34 | COM4 | 459 | 1589 | | | | |
| 35 | COM3 | 242 | 1589 | | | | |
| 36 | COM2 | 26 | 1589 | | | | |
| 37 | COM1 | -196 | 1589 | | | | |
| 38 | C2 | -418 | 1589 | | | | |
| 39 | C1 | -640 | 1589 | | | | |
| 40 | V _{SS3} | -863 | 1589 | | | | |

PIN DESCRIPTIONS

Basic Functions

| Function | Pin | Pad | Symbol | Type | Description |
|--------------|-----|-----|--------------------------|------|---|
| Power Supply | 7 | 7 | V _{DD} | — | Digital supply voltage(0 V) |
| | 45 | 42 | V _{SS1} | — | Digital negative power supply (1.5 V spec.) Bias output for LCD driver (3.0 V spec.) |
| | 44 | 41 | V _{SS2} | — | Digital negative power supply (3.0 V spec.) Bias output for LCD driver (1.5 V spec.) |
| | 43 | 40 | V _{SS3} | — | Bias output for LCD driver (−4.5 V) |
| | 42 | 39 | C1 | — | For connection to capacitors that generate bias for the LCD driver |
| | 41 | 38 | C2 | — | |
| | 46 | 43 | V _{SSL} | — | Negative power supply voltage pin for internal logic (An internally generated constant voltage is present at this pin.) |
| Oscillation | 47 | 44 | OSCO | I | Clock oscillation pins: Either a crystal (32.768 kHz) and a capacitor (10 to 30 pF) are connected to these pins or a resistor (1 MΩ) is. |
| | 48 | 45 | $\overline{\text{OSCI}}$ | O | |
| Test | 55 | 52 | TST1 | I | Input pins for test |
| | 54 | 51 | TST2 | I | |
| | 53 | 50 | TST3 | I | |
| RESET | 56 | 53 | RESET | I | System reset input pin : Setting this pin to "H" level puts this device into a reset state. Then, setting this pin to "L" level starts executing an instruction from address 000H. This pin is internally connected to V _{SS1} or V _{SS2} through a pull-down resistor. |

Basic Functions (continued)

| Function | Pin | Pad | Symbol | Type | Description | |
|----------------|-----|-----|-------------------------|------|---|---|
| Ports | 52 | 49 | P2.0 | I | 4-bit input port (port 2) : Select between pull-down resistor input and high impedance input for each bit with the port 2 control register (P2CON). When configured for secondary functions, an external interrupt and capture circuit trigger input are allocated. If P2.0 to P2.3 are set to "H" level, the IC enters system reset mode. | |
| | 51 | 48 | P2.1 | | | |
| | 50 | 47 | P2.2 | | | |
| | 49 | 46 | P2.3 | | | |
| | 60 | 57 | P4.0 | O | 4-bit output port (port 4) : 4-bit CMOS output port. | |
| | 59 | 56 | P4.1 | | | |
| | 58 | 55 | P4.2 | | | |
| | 57 | 54 | P4.3 | | | |
| | | 4 | 4 | P6.0 | I/O | 4-bit input-output port (port 6) : Select between input and output, between pull-down resistor input and high impedance input, and between open-drain output and CMOS output with the port 6 control register (P6CON). When configured for a secondary function, an external interrupt is allocated. |
| | | 3 | 3 | P6.1 | | |
| 2 | | 2 | P6.2 | | | |
| 1 | | 1 | P6.3 | | | |
| Melody Drivers | 5 | 5 | MD0 | 0 | Output pin of melody driver 0 | |
| | 6 | 6 | $\overline{\text{MD0}}$ | 0 | Inverted output pin of MD0 output | |
| LCD Drivers | 40 | 37 | COM1 | 0 | LCD common signal output pins | |
| | 39 | 36 | COM2 | 0 | | |
| | 38 | 35 | COM3 | 0 | | |
| | 37 | 34 | COM4 | 0 | | |

Basic Functions (continued)

| Function | Pin | Pad | Symbol | Type | Description |
|-------------|-----|-------|--------|------|--------------------------------|
| LCD Drivers | 36 | 33 | SEG0 | 0 | LCD segment signal output pins |
| | 35 | 32 | SEG1 | 0 | |
| | 34 | 31 | SEG2 | 0 | |
| | 33 | 30 | SEG3 | 0 | |
| | 32 | 29 | SEG4 | 0 | |
| | 30 | 28 | SEG5 | 0 | |
| | 29 | 27 | SEG6 | 0 | |
| | 28 | 26 | SEG7 | 0 | |
| | 27 | 25 | SEG8 | 0 | |
| | 26 | 24 | SEG9 | 0 | |
| | 25 | 23 | SEG10 | 0 | |
| | 24 | 22 | SEG11 | 0 | |
| | 22 | 21 | SEG12 | 0 | |
| | 21 | 20 | SEG13 | 0 | |
| | 20 | 19 | SEG14 | 0 | |
| | 19 | 18 | SEG15 | 0 | |
| | 18 | 17 | SEG16 | 0 | |
| | 17 | 16 | SEG17 | 0 | |
| | 15 | 15 | SEG18 | 0 | |
| | 14 | 14 | SEG19 | 0 | |
| | 13 | 13 | SEG20 | 0 | |
| | 12 | 12 | SEG21 | 0 | |
| | 11 | 11 | SEG22 | 0 | |
| | 10 | 10 | SEG23 | 0 | |
| | 9 | 9 | SEG24 | 0 | |
| 8 | 8 | SEG25 | 0 | | |

Secondary Functions

| Function | Pin | Pad | Symbol | Type | Description |
|---------------------|-----|-----|--------|------|--|
| External Interrupts | 52 | 49 | P2.0 | I | P2.0 to P2.3 secondary functions : These are level-triggered external interrupt input pins. Select interrupt enable/disable for each bit with the P2 interrupt enable register (P2IE). If P2.0 to P2.3 pins are set to "H" level for a minimum of 2 seconds, the device enters system reset mode. P2.0, P2.1 secondary functions : trigger input pins for capture circuit. |
| | 51 | 48 | P2.1 | | |
| | 50 | 47 | P2.2 | | |
| | 49 | 46 | P2.3 | | |
| | 4 | 4 | P6.0 | I | P6.0 to P6.3 secondary functions : These are level-triggered external interrupt input pins. |
| | 3 | 3 | P6.1 | | |
| | 2 | 2 | P6.2 | | |
| | 1 | 1 | P6.3 | | |

Handling When Specific Pins Are Not Used

| Symbol | Recommended Pin Connection |
|------------------------------|--|
| TST1 to TST3 | Open |
| P2.0 to P2.3 | "L" level or open |
| P4.0 to P4.3 | Open |
| P6.0 to P6.3 | In input mode : "L" level or open (Initial setting: input mode) In output mode : Open |
| MD0, $\overline{\text{MD0}}$ | Open |
| COM1 to COM4 | Open |
| SEG0 to SEG25 | Open |

ABSOLUTE MAXIMUM RATINGS**1.5 V Spec. (MSM64152A)**(V_{DD} = 0 V)

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

RECOMMENDED OPERATING CONDITIONS**1.5 V Spec. (MSM64152A)**(V_{DD} = 0 V)

| Parameter | Symbol | Condition | Range | Unit |
|-----------------------------------|------------------|------------|---------------|------|
| Operating Temperature | T _{op} | — | -40 to +70 | °C |
| Operating Voltage | V _{SS1} | BUPF = "0" | -1.7 to -1.25 | V |
| | | BUPF = "1" | -1.7 to -1.15 | |
| Crystal Oscillation Frequency | f _{XT} | — | 30 to 35 | kHz |
| External RC Oscillator Resistance | R _{OS} | — | 1M ±10% | Ω |

ELECTRICAL CHARACTERISTICS

1.5 V Spec. (MSM64152A)

DC Characteristics

(V_{DD} = 0 V, V_{SS1} = -1.5 V, T_a = -40 to +70°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 μF ^{+100%} / _{-20%} T _a = -40 to +60°C BUPF = "0" | -3.2 | -3.0 | -2.8 | V | 1 1' |
| | | C _a , C _b , C ₁₂ = 0.1 μF ^{+100%} / _{-20%} T _a = -40 to +70°C BUPF = "0" | -3.2 | -3.0 | -2.7 | | |
| | | C _a , C _b , C ₁₂ = 0.1 μF ^{+100%} / _{-20%} T _a = -40 to +60°C BUPF = "1" | -3.2 | -3.0 | -2.5 | | |
| | | C _a , C _b , C ₁₂ = 0.2 μF ^{+100%} / _{-20%} T _a = -40 to +70°C BUPF = "1" | -3.2 | -3.0 | -2.3 | | |
| V _{SS3} Voltage | V _{SS3} | C _a , C _b , C ₁₂ = 0.1 μF ^{+100%} / _{-20%} T _a = -40 to +60°C BUPF = "0" | -4.7 | -4.5 | -4.2 | V | 1 1' |
| | | C _a , C _b , C ₁₂ = 0.1 μF ^{+100%} / _{-20%} T _a = -40 to +70°C BUPF = "0" | -4.7 | -4.5 | -4.0 | | |
| | | C _a , C _b , C ₁₂ = 0.1 μF ^{+100%} / _{-20%} T _a = -40 to +60°C BUPF = "1" | -4.7 | -4.5 | -3.9 | | |
| | | C _a , C _b , C ₁₂ = 0.2 μF ^{+100%} / _{-20%} T _a = -40 to +70°C BUPF = "1" | -4.7 | -4.5 | -3.7 | | |
| V _{SSL} Voltage | V _{SSL} | BUPF = "0" | -1.5 | -1.3 | -0.6 | V | |
| | | BUPF = "1" | -1.9 | -1.3 | -0.6 | | |
| Crystal Oscillation Start Voltage | V _{STA} | Oscillation start time: within 5 seconds after reset | — | — | -1.45 | V | 1 |
| Crystal Oscillation Hold Voltage | V _{HOLD} | — | — | — | -1.15 | V | |
| External Crystal Oscillator Capacitance | C _G | — | 10 | — | 30 | pF | |
| Internal Crystal Oscillator Capacitance | C _D | — | 10 | 15 | 20 | pF | |
| RC Oscillation Frequency | f _{CR} | R _{OS} = 1 MΩ | 15 | 40 | 75 | kHz | 1' |

DC Characteristics (continued)

- 32.768 kHz crystal oscillation

($V_{DD} = 0\text{ V}$, $V_{SS1} = -1.5\text{ V}$, $T_a = -40\text{ to }+70^\circ\text{C}$ unless otherwise specified.)

| Parameter | Symbol | Condition | | Min. | Typ. | Max. | Unit | Measuring Circuit |
|------------------|-----------|---|---|------|------|------|---------------|-------------------|
| Supply Current 1 | I_{DD1} | CPU is in HALT state BUPF = "0" | $T_a = -40\text{ to }+40^\circ\text{C}$ | — | 2.0 | 6.0 | μA | 1 |
| | | | $T_a = +40\text{ to }+70^\circ\text{C}$ | — | 2.0 | 40 | μA | |
| Supply Current 1 | I_{DD1} | CPU is in HALT state BUPF = "1" | $T_a = -40\text{ to }+40^\circ\text{C}$ | — | 3.0 | 10 | μA | |
| | | | $T_a = +40\text{ to }+70^\circ\text{C}$ | — | 3.0 | 50 | μA | |
| Supply Current 2 | I_{DD2} | CPU is in operation state BUPF = "0" | $T_a = -40\text{ to }+40^\circ\text{C}$ | — | 6.0 | 15 | μA | |
| | | | $T_a = +40\text{ to }+70^\circ\text{C}$ | — | 6.0 | 50 | μA | |
| Supply Current 2 | I_{DD2} | CPU is in operation state BUPF = "1" | $T_a = -40\text{ to }+40^\circ\text{C}$ | — | 10 | 25 | μA | |
| | | | $T_a = +40\text{ to }+70^\circ\text{C}$ | — | 10 | 60 | μA | |

- RC oscillation

($V_{DD} = 0\text{ V}$, $V_{SS1} = -1.5\text{ V}$, $R_{OS} = 1\text{ M}\Omega$, $T_a = -40\text{ to }+70^\circ\text{C}$ unless otherwise specified.)

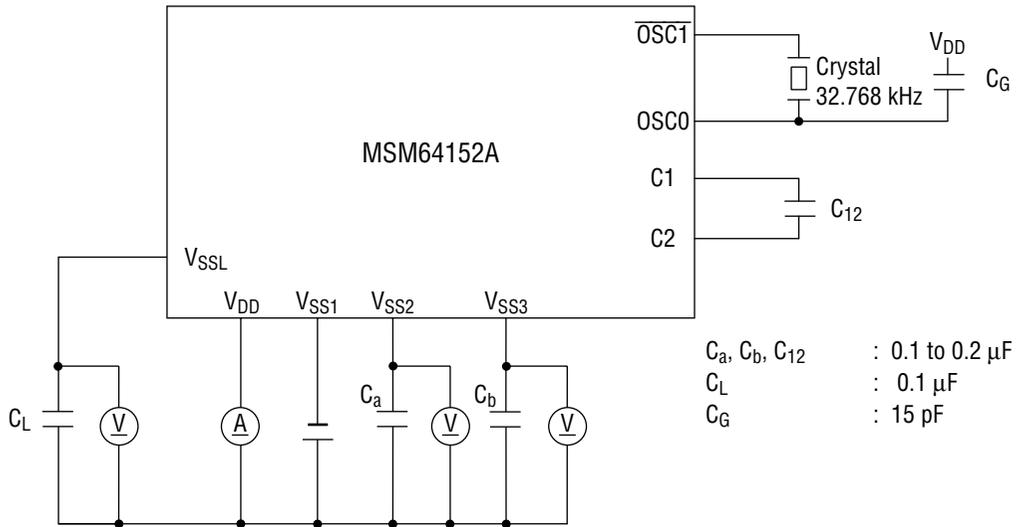
| Parameter | Symbol | Condition | | Min. | Typ. | Max. | Unit | Measuring Circuit |
|------------------|-----------|---|---|------|------|------|---------------|-------------------|
| Supply Current 1 | I_{DD1} | CPU is in HALT state BUPF = "0" | $T_a = -40\text{ to }+40^\circ\text{C}$ | — | 3.0 | 10 | μA | 1' |
| | | | $T_a = +40\text{ to }+70^\circ\text{C}$ | — | 3.0 | 45 | μA | |
| Supply Current 1 | I_{DD1} | CPU is in HALT state BUPF = "1" | $T_a = -40\text{ to }+40^\circ\text{C}$ | — | 6.0 | 15 | μA | |
| | | | $T_a = +40\text{ to }+70^\circ\text{C}$ | — | 6.0 | 50 | μA | |
| Supply Current 2 | I_{DD2} | CPU is in operation state BUPF = "0" | $T_a = -40\text{ to }+40^\circ\text{C}$ | — | 7.0 | 20 | μA | |
| | | | $T_a = +40\text{ to }+70^\circ\text{C}$ | — | 7.0 | 50 | μA | |
| Supply Current 2 | I_{DD2} | CPU is in operation state BUPF = "1" | $T_a = -40\text{ to }+40^\circ\text{C}$ | — | 15 | 30 | μA | |
| | | | $T_a = +40\text{ to }+70^\circ\text{C}$ | — | 15 | 70 | μA | |

DC Characteristics (continued)

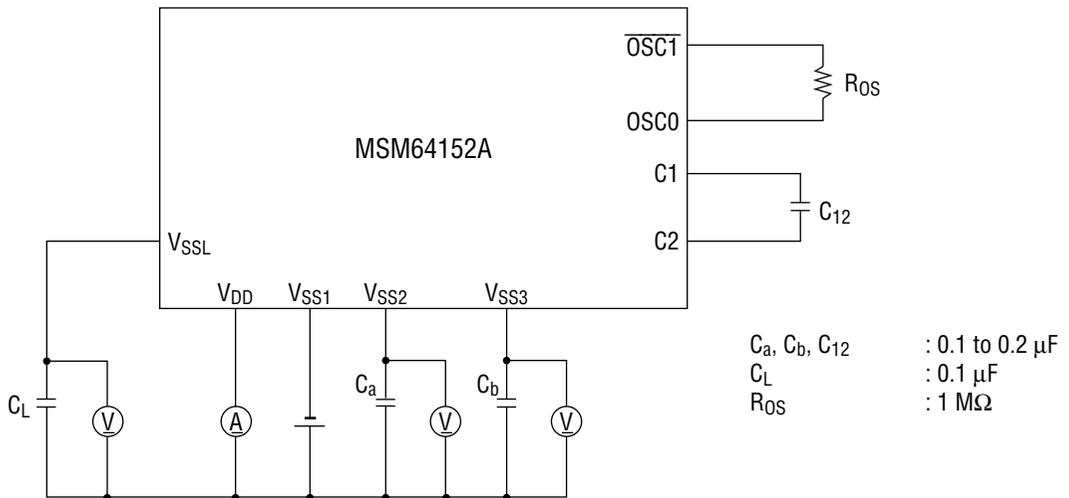
($V_{DD} = 0\text{ V}$, $V_{SS1} = V_{SSL} = -1.5\text{ V}$, $V_{SS2} = -3.0\text{ V}$, $V_{SS3} = -4.5\text{ V}$, $T_a = -40\text{ to }+70^\circ\text{C}$ unless otherwise specified.)

| Parameter (Pin Name) | Symbol | Condition | Min. | Typ. | Max. | Unit | Measuring Circuit |
|---|-------------|---|------|------|------|---------------|----------------------|
| Output Current 1 (P4.0 to P4.3) (MD0, MD0) | I_{OH1} | $V_{OH1} = -0.5\text{ V}$ | -2.0 | -0.6 | -0.1 | mA | 2 |
| | I_{OL1} | $V_{OL1} = V_{SS1} + 0.5\text{ V}$ | 0.1 | 0.6 | 2.0 | mA | |
| Output Current 2 (SEG0 to SEG25) (COM1 to COM4) | I_{OH2} | $V_{OH2} = -0.2\text{ V}$ (V_{DD} level) | — | — | -4.0 | μA | |
| | I_{OMH2} | $V_{OMH2} = V_{SS1} + 0.2\text{ V}$ (V_{SS1} level) | 4.0 | — | — | μA | |
| | I_{OMH2S} | $V_{OMH2S} = V_{SS1} - 0.2\text{ V}$ (V_{SS1} level) | — | — | -4.0 | μA | |
| | I_{OML2} | $V_{OML2} = V_{SS2} + 0.2\text{ V}$ (V_{SS2} level) | 4.0 | — | — | μA | |
| | I_{OML2S} | $V_{OML2S} = V_{SS2} - 0.2\text{ V}$ (V_{SS2} level) | — | — | -4.0 | μA | |
| | I_{OL2} | $V_{OL2} = V_{SS3} + 0.2\text{ V}$ (V_{SS3} level) | 4.0 | — | — | μA | |
| Output Current 3 (P6.0 to P6.3) | I_{OH3} | $V_{OH3} = -0.5\text{ V}$ | -5.0 | -2.1 | -0.3 | mA | |
| | I_{OL3} | $V_{OL3} = V_{SS1} + 0.5\text{ V}$ | 0.1 | 0.7 | 2.0 | mA | |
| Output Leakage Current (P6.0 to P6.3) | I_{OOH} | $V_{OH} = V_{DD}$ | — | — | 0.3 | μA | |
| | I_{OOL} | $V_{OL} = V_{SS1}$ | -0.3 | — | — | μA | |
| Input Current 1 (P2.0 to P2.3) (P6.0 to P6.3) | I_{IH1} | $V_{IH1} = V_{DD}$ (When pulled down) | 1.0 | 20 | 100 | μA | 3 |
| | I_{IH1Z} | $V_{IH1} = V_{DD}$ (In a high-impedance state) | 0 | — | 1.0 | μA | |
| | I_{IL1} | $V_{IL1} = V_{SS1}$ | -1.0 | — | 0 | μA | |
| Input Current 2 (TST1, TST2, TST3) | I_{IH2} | $V_{IH2} = V_{DD}$ | 0.3 | 0.75 | 1.5 | mA | |
| | I_{IL2} | $V_{IL2} = V_{SS1}$ | -1.0 | — | 0 | μA | |
| Input Current 3 (RESET) | I_{IH3} | $V_{IH3} = V_{DD}$ | 15 | 40 | 100 | μA | |
| | I_{IL3} | $V_{IL3} = V_{SS1}$ | -1.0 | — | 0 | μA | |
| Input Voltage 1 (P2.0 to P2.3) (P6.0 to P6.3) (TST1, TST2, TST3) (RESET) | V_{IH1} | — | -0.3 | — | 0 | V | 4 |
| | V_{IL1} | — | -1.5 | — | -1.2 | V | |

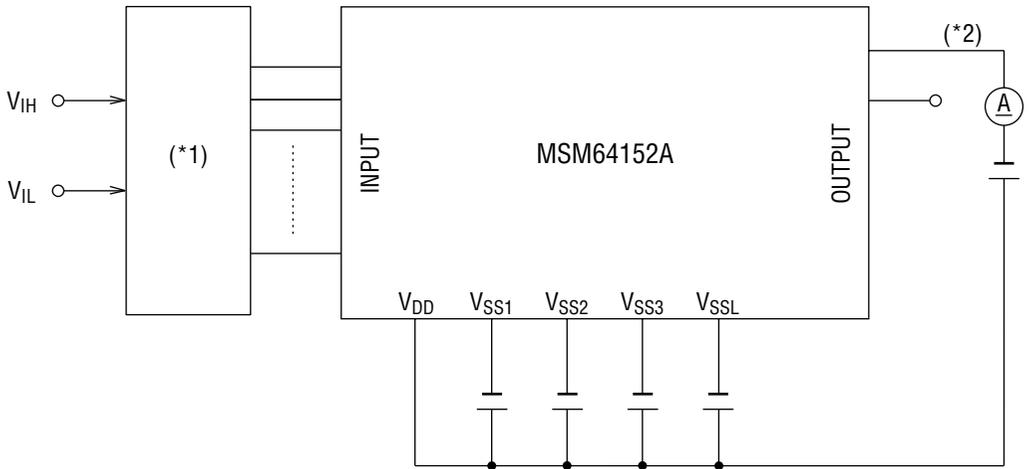
Measuring circuit 1



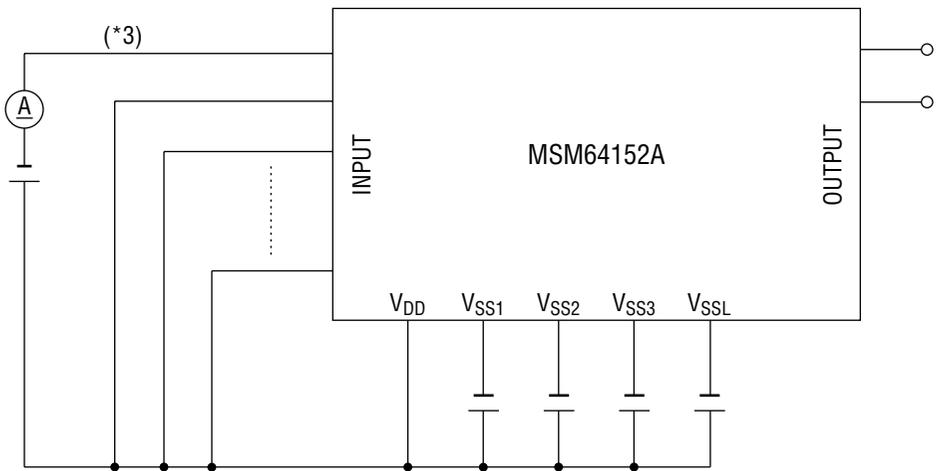
Measuring circuit 1'



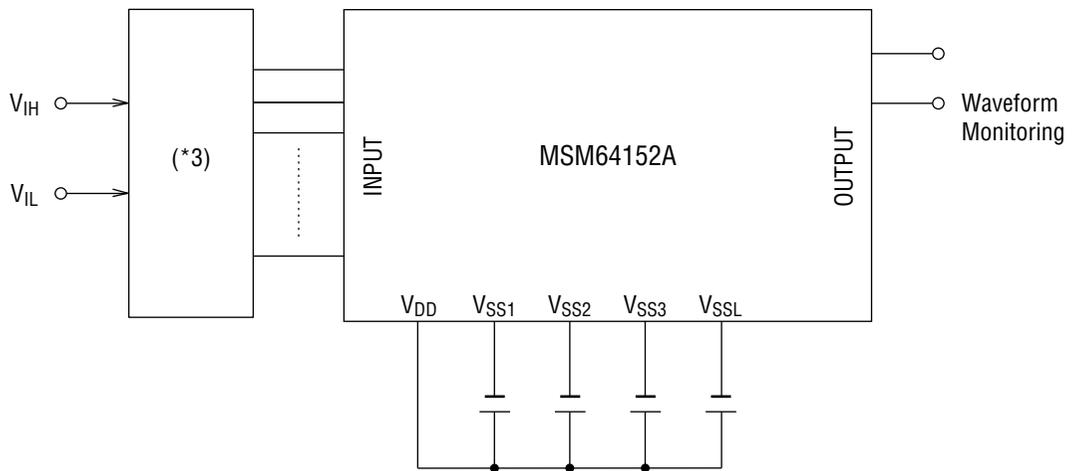
Measuring circuit 2



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.

ABSOLUTE MAXIMUM RATINGS**3.0 V Spec. (MSM64152AL)**(V_{DD} = 0 V)

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

RECOMMENDED OPERATING CONDITIONS**3.0 V Spec. (MSM64152AL)**(V_{DD} = 0 V)

| Parameter | Symbol | Condition | Range | Unit |
|-----------------------------------|------------------|------------|--------------|------|
| Operating Temperature | T _{op} | — | -40 to +70 | °C |
| Operating Voltage | V _{SS2} | BUPF = "0" | -3.5 to -2.5 | V |
| | | BUPF = "1" | -3.5 to -2.0 | |
| Crystal Oscillation Frequency | f _{XT} | — | 30 to 66 | kHz |
| External RC Oscillator Resistance | R _{OS} | — | 1 M ±10% | Ω |

ELECTRICAL CHARACTERISTICS

3.0 V Spec. (MSM64152AL)

DC Characteristics

($V_{DD} = 0\text{ V}$, $V_{SS2} = -3.0\text{ V}$, $T_a = -40\text{ to }+70^\circ\text{C}$ unless otherwise specified.)

| Parameter | Symbol | Condition | Min. | Typ. | Max. | Unit | Measuring Circuit |
|---|------------|---|------|------|------|------|-------------------|
| V_{SS1} Voltage | V_{SS1} | $C_a, C_b, C_{12} = 0.1\ \mu\text{F}$ $\begin{matrix} +100\% \\ -20\% \end{matrix}$ | -1.7 | -1.5 | -1.3 | V | 1 1' |
| V_{SS3} Voltage | V_{SS3} | $C_a, C_b, C_{12} = 0.1\ \mu\text{F}$ $\begin{matrix} +100\% \\ -20\% \end{matrix}$ | -4.7 | -4.5 | -4.2 | V | |
| V_{SSL} Voltage | V_{SSL} | BUPF = "0" | -1.5 | -1.3 | -0.6 | V | |
| | | BUPF = "1" | -1.9 | -1.3 | -0.6 | | |
| Crystal Oscillation Start Voltage | V_{STA} | Oscillation start time: within 5 seconds after reset | — | — | -2.5 | V | 1 |
| Crystal Oscillation Hold Voltage | V_{HOLD} | — | — | — | -2.0 | V | |
| External Crystal Oscillator Capacitance | C_G | — | 10 | — | 30 | pF | |
| Internal Crystal Oscillator Capacitance | C_D | — | 10 | 15 | 20 | pF | |
| RC Oscillation Frequency | f_{CR} | $R_{OS} = 1\ \text{M}\Omega$ | 15 | 40 | 75 | kHz | 1' |

DC Characteristics (continued)

- 32.768 kHz crystal oscillation

($V_{DD} = 0\text{ V}$, $V_{SS2} = -3.0\text{ V}$, $T_a = -40\text{ to }+70^\circ\text{C}$ unless otherwise specified.)

| Parameter | Symbol | Condition | Min. | Typ. | Max. | Unit | Measuring Circuit | |
|------------------|-----------|---|---|------|------|------|-------------------|---|
| Supply Current 1 | I_{DD1} | CPU is in HALT state BUPF = "0" | $T_a = -40\text{ to }+40^\circ\text{C}$ | — | 0.9 | 4.5 | μA | 1 |
| | | | $T_a = +40\text{ to }+70^\circ\text{C}$ | — | 0.9 | 30 | μA | |
| Supply Current 1 | I_{DD1} | CPU is in HALT state BUPF = "1" | $T_a = -40\text{ to }+40^\circ\text{C}$ | — | 1.5 | 6.0 | μA | |
| | | | $T_a = +40\text{ to }+70^\circ\text{C}$ | — | 1.5 | 40 | μA | |
| Supply Current 2 | I_{DD2} | CPU is in operation state BUPF = "0" | $T_a = -40\text{ to }+40^\circ\text{C}$ | — | 3.0 | 10 | μA | |
| | | | $T_a = +40\text{ to }+70^\circ\text{C}$ | — | 3.0 | 40 | μA | |
| Supply Current 2 | I_{DD2} | CPU is in operation state BUPF = "1" | $T_a = -40\text{ to }+40^\circ\text{C}$ | — | 5.0 | 15 | μA | |
| | | | $T_a = +40\text{ to }+70^\circ\text{C}$ | — | 5.0 | 50 | μA | |

- RC oscillation

($V_{DD} = 0\text{ V}$, $V_{SS2} = -3.0\text{ V}$, $R_{OS} = 1\text{ M}\Omega$, $T_a = -40\text{ to }+70^\circ\text{C}$ unless otherwise specified.)

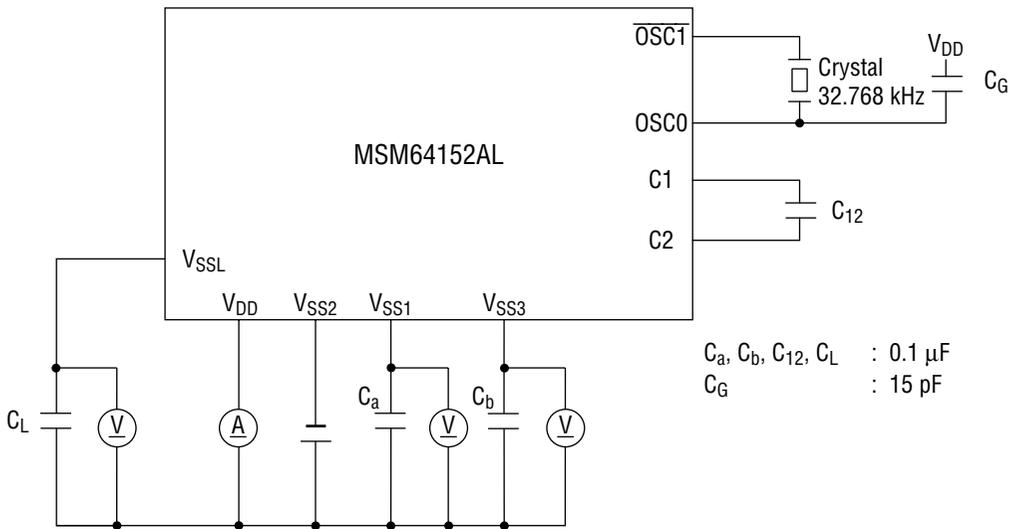
| Parameter | Symbol | Condition | Min. | Typ. | Max. | Unit | Measuring Circuit | |
|------------------|-----------|---|---|------|------|------|-------------------|----|
| Supply Current 1 | I_{DD1} | CPU is in HALT state BUPF = "0" | $T_a = -40\text{ to }+40^\circ\text{C}$ | — | 1.5 | 6.0 | μA | 1' |
| | | | $T_a = +40\text{ to }+70^\circ\text{C}$ | — | 1.5 | 40 | μA | |
| Supply Current 1 | I_{DD1} | CPU is in HALT state BUPF = "1" | $T_a = -40\text{ to }+40^\circ\text{C}$ | — | 3.0 | 10 | μA | |
| | | | $T_a = +40\text{ to }+70^\circ\text{C}$ | — | 3.0 | 50 | μA | |
| Supply Current 2 | I_{DD2} | CPU is in operation state BUPF = "0" | $T_a = -40\text{ to }+40^\circ\text{C}$ | — | 4.0 | 12 | μA | |
| | | | $T_a = +40\text{ to }+70^\circ\text{C}$ | — | 4.0 | 50 | μA | |
| Supply Current 2 | I_{DD2} | CPU is in operation state BUPF = "1" | $T_a = -40\text{ to }+40^\circ\text{C}$ | — | 8.0 | 25 | μA | |
| | | | $T_a = +40\text{ to }+70^\circ\text{C}$ | — | 8.0 | 60 | μA | |

DC Characteristics (continued)

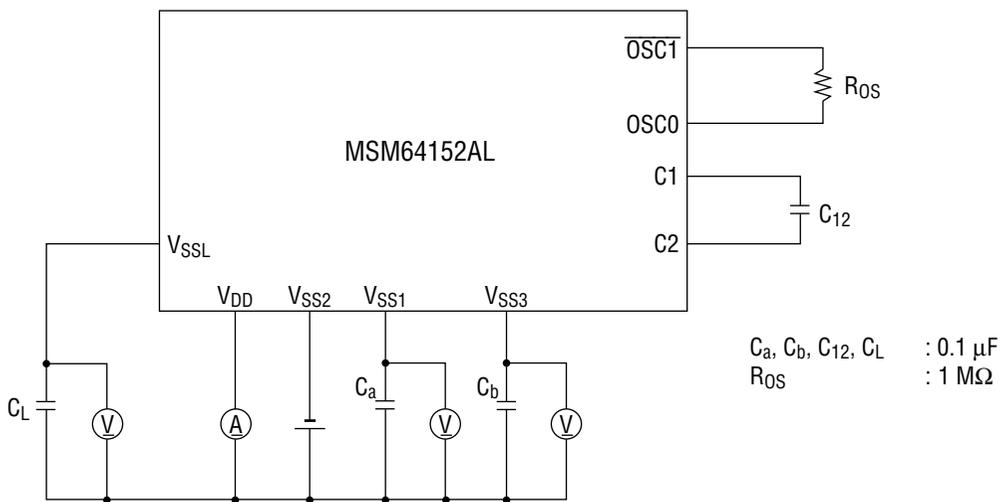
($V_{DD} = 0\text{ V}$, $V_{SS1} = V_{SSL} = -1.5\text{ V}$, $V_{SS2} = -3.0\text{ V}$, $V_{SS3} = -4.5\text{ V}$, $T_a = -40\text{ to }+70^\circ\text{C}$ unless otherwise specified.)

| Parameter (Pin Name) | Symbol | Condition | Min. | Typ. | Max. | Unit | Measuring Circuit |
|---|-------------|---|------|------|------|---------------|----------------------|
| Output Current 1 (P4.0 to P4.3) (MD0, MD0) | I_{OH1} | $V_{OH1} = -0.5\text{ V}$ | -6.0 | -1.8 | -0.7 | mA | 2 |
| | I_{OL1} | $V_{OL1} = V_{SS2} + 0.5\text{ V}$ | 0.7 | 1.8 | 6.0 | mA | |
| Output Current 2 (SEG0 to SEG25) (COM1 to COM4) | I_{OH2} | $V_{OH2} = -0.2\text{ V}$ (V_{DD} level) | — | — | -4.0 | μA | |
| | I_{OMH2} | $V_{OMH2} = V_{SS1} + 0.2\text{ V}$ (V_{SS1} level) | 4.0 | — | — | μA | |
| | I_{OMH2S} | $V_{OMH2S} = V_{SS1} - 0.2\text{ V}$ (V_{SS1} level) | — | — | -4.0 | μA | |
| | I_{OML2} | $V_{OML2} = V_{SS2} + 0.2\text{ V}$ (V_{SS2} level) | 4.0 | — | — | μA | |
| | I_{OML2S} | $V_{OML2S} = V_{SS2} - 0.2\text{ V}$ (V_{SS2} level) | — | — | -4.0 | μA | |
| | I_{OL2} | $V_{OL2} = V_{SS3} + 0.2\text{ V}$ (V_{SS3} level) | 4.0 | — | — | μA | |
| Output Current 3 (P6.0 to P6.3) | I_{OH3} | $V_{OH3} = -0.5\text{ V}$ | -18 | -6.0 | -2.0 | mA | |
| | I_{OL3} | $V_{OL3} = V_{SS2} + 0.5\text{ V}$ | 0.7 | 1.6 | 6.0 | mA | |
| Output Leakage Current (P6.0 to P6.3) | I_{OOH} | $V_{OH} = V_{DD}$ | — | — | 0.3 | μA | |
| | I_{OOL} | $V_{OL} = V_{SS2}$ | -0.3 | — | — | μA | |
| Input Current 1 (P2.0 to P2.3) (P6.0 to P6.3) | I_{IH1} | $V_{IH1} = V_{DD}$ (When pulled down) | 50 | 100 | 300 | μA | 3 |
| | I_{IH1Z} | $V_{IH1} = V_{DD}$ (In a high-impedance state) | 0 | — | 1.0 | μA | |
| | I_{IL1} | $V_{IL1} = V_{SS2}$ | -1.0 | — | 0 | μA | |
| Input Current 2 (TST1, TST2, TST3) | I_{IH2} | $V_{IH2} = V_{DD}$ | 0.75 | 1.5 | 3.0 | mA | |
| | I_{IL2} | $V_{IL2} = V_{SS2}$ | -1.0 | — | 0 | μA | |
| Input Current 3 (RESET) | I_{IH3} | $V_{IH3} = V_{DD}$ | 40 | 80 | 200 | μA | |
| | I_{IL3} | $V_{IL3} = V_{SS2}$ | -1.0 | — | 0 | μA | |
| Input Voltage 3 (P2.0 to P2.3) (P6.0 to P6.3) (TST1, TST2, TST3) (RESET) | V_{IH1} | — | -0.6 | — | 0 | V | 4 |
| | V_{IL1} | — | -3.0 | — | -2.4 | V | |

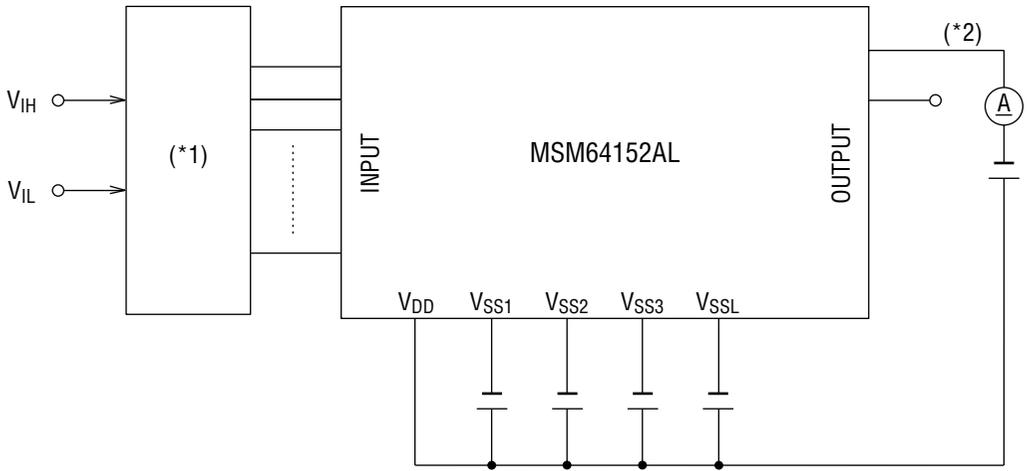
Measuring circuit 1



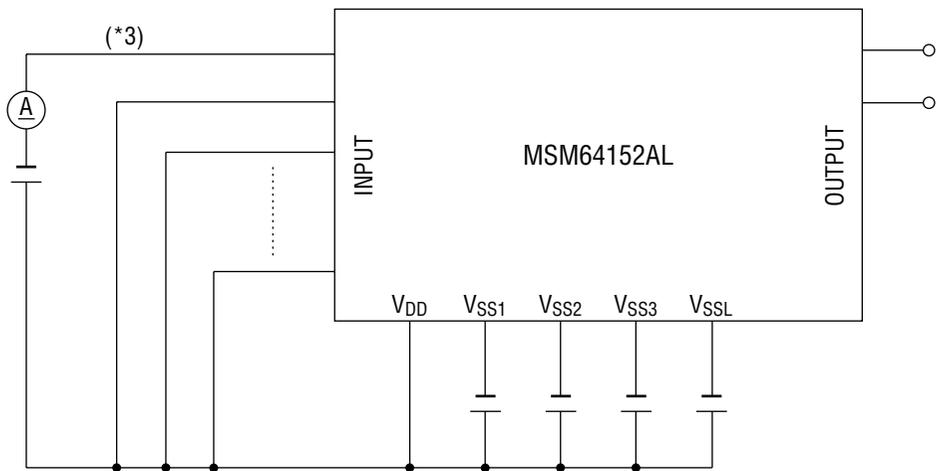
Measuring circuit 1'



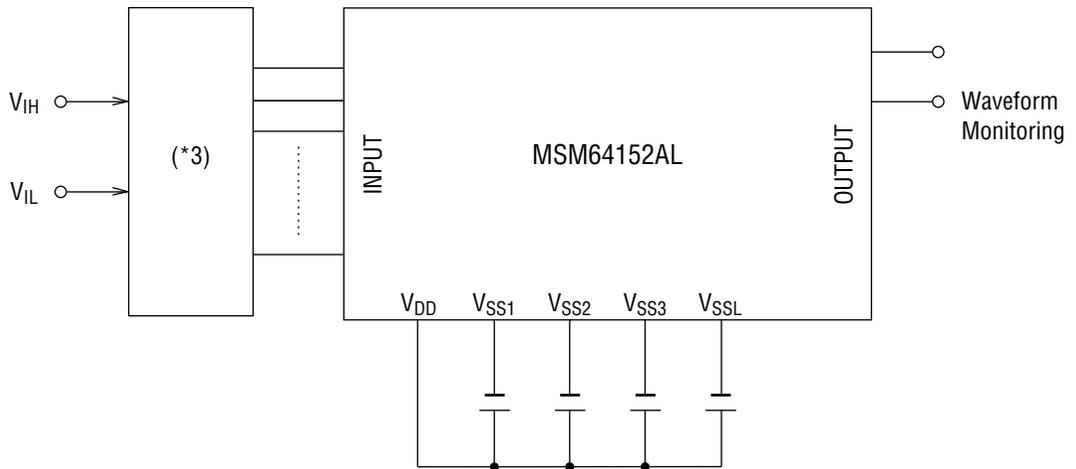
Measuring circuit 2



Measuring circuit 3



Measuring circuit 4



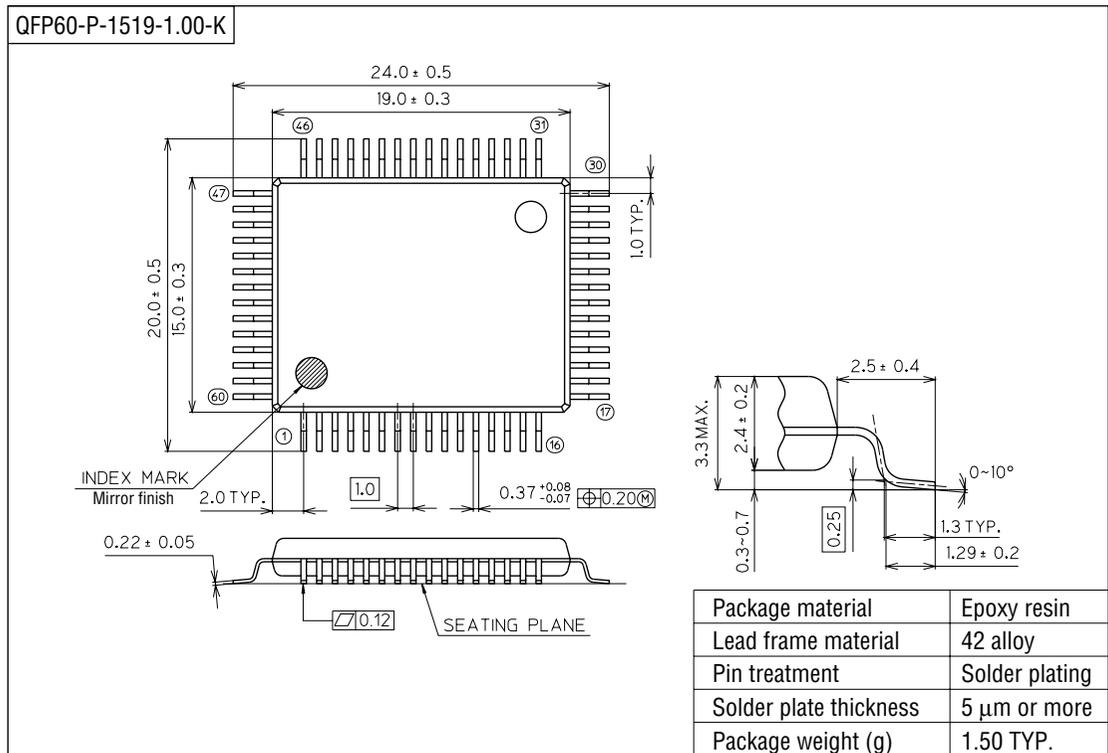
*1 Input logic circuit to determine the specified measuring conditions.

*2 Measured at the specified output pins.

*3 Measured at the specified input pins.

PACKAGE DIMENSIONS

(Unit : mm)



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).