OKI Semiconductor

This version: Sep. 1998
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MSM64158A/64158AL

4-Bit Microcontroller with Built-in LCD Driver and Melody Circuit

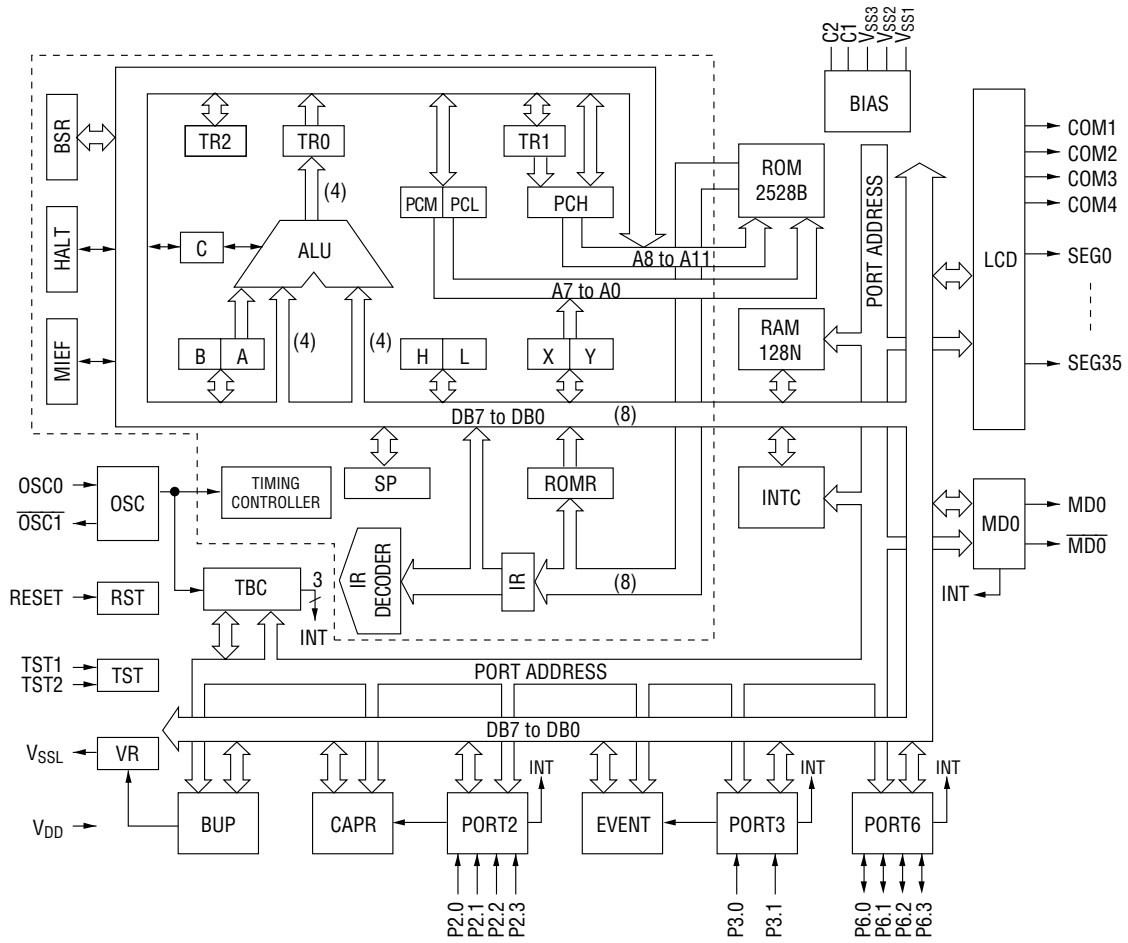
GENERAL DESCRIPTION

The MSM64158A (1.5 V)/64158AL (3.0 V) is a high-performance 4-bit microcontroller that incroporates Oki-original CPU core nX-4/20.
The MSM64158A/64158AL has an LCD driver for up to 144 segments, an event counter, and a melody circuit. It is best suited for applications such as clocks and LCD games.

FEATURES

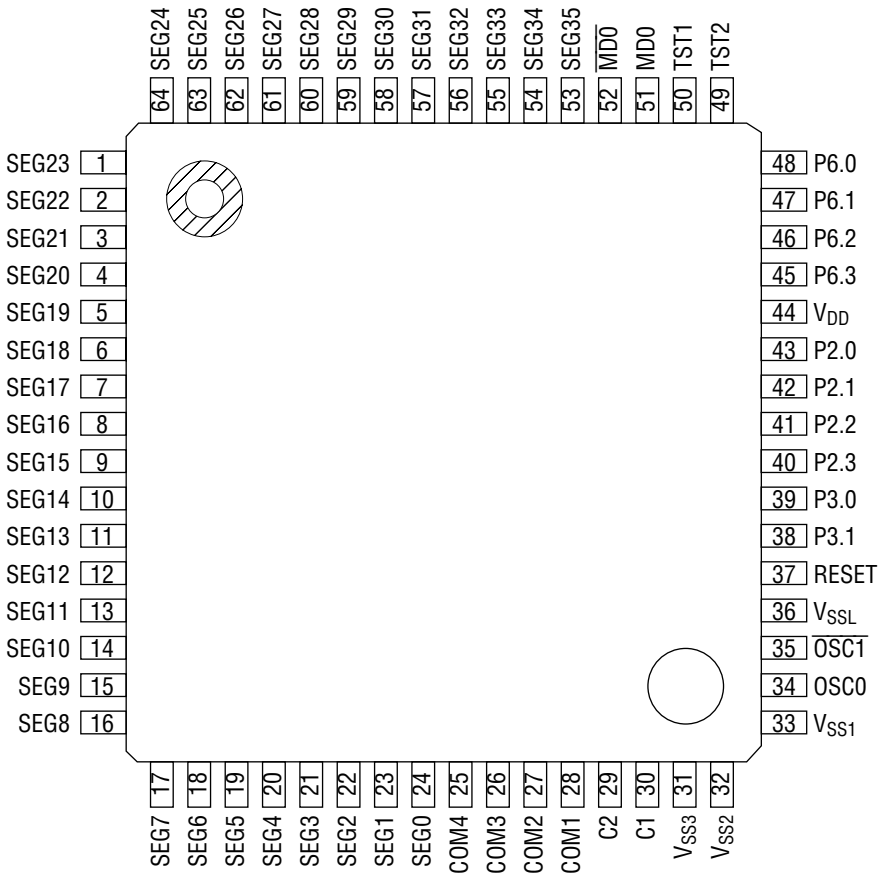
- Operating range
  - Operating voltage : 1.5 V/3.0 V
  - Operating temperature : –40 to +70°C
  - Operating frequency : 32.768 kHz crystal oscillation
    Approx. 32 kHz RC oscillation
  - Supply current (Typ.) : 0.9 µA (3.0 V at HALT mode)
- Minimum instruction execution time : 91 µs
- General memory space : 2528 bytes
- Local memory space : 128 nibbles
- LCD drivers : 40
  Common driver × 4
  Segment driver × 36
  1/4 duty, 1/3 bias; 144 segments (36 × 4)
  1/3 duty, 1/3 bias; 108 segments (36 × 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 × 2 bits (pull-down resistor input /high-impedance input selectable)
    1 port × 4 bits (pull-down resistor input/high-impedance input selectable)
- Event counter : 1
- Melody output : 1
- Interrupts : 7 sources (external 3, time base 3, melody 1)
- Package:
  - 64-pin plastic QFP (QFP64-P-1414-0.80-BK): (Product name : MSM64158A-×××GS-BK, MSM64158AL-×××GS-BK)
  - Chip : MSM64158A-×××, MSM64158AL-×××
    ××× indicates a code number.
- OTP version (for program evaluation) : MSM64P155/64P155L
  (The packages, power polarity, and operating voltage of the MSM64P155/64P155L are different from the MSM64158A/64158AL. For details, refer to the "MSM64P155 User's Manual".)

BLOCK DIAGRAM



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

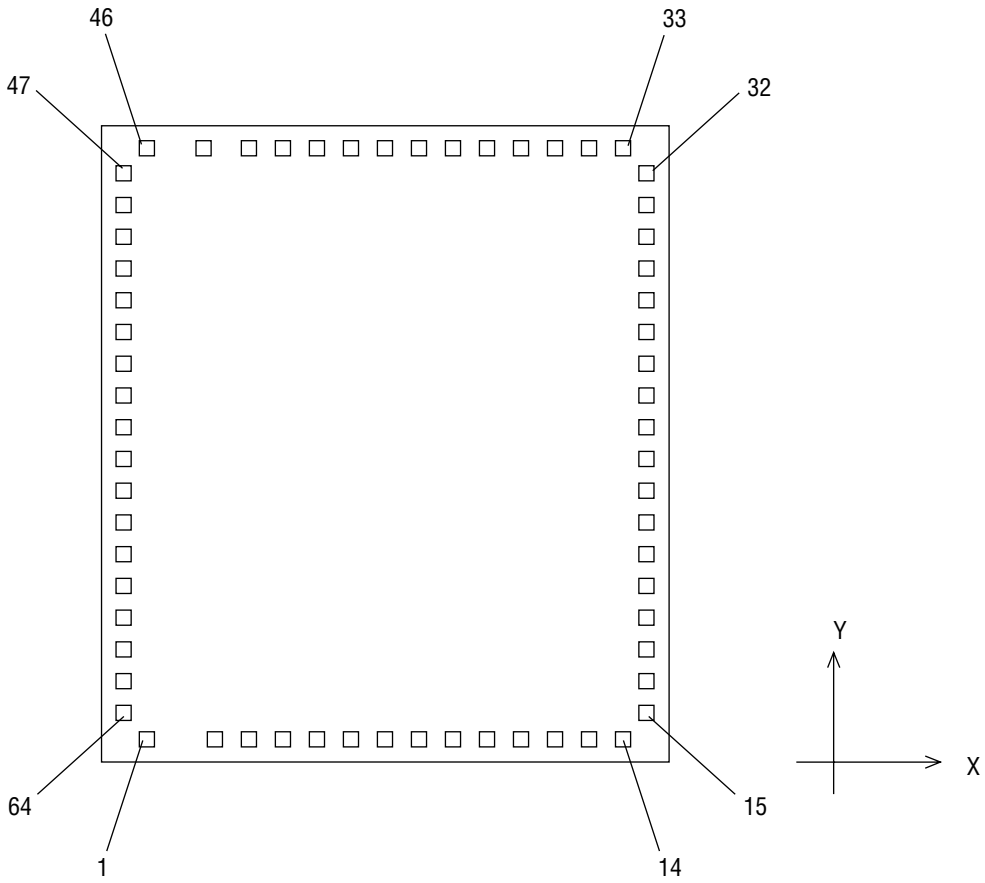
PIN CONFIGURATION (TOP VIEW)



64-Pin Plastic QFP

PAD CONFIGURATION

Pad Layout



Chip Size	: 3.63 mm × 3.99 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	MD0	–1344	–1794	41	COM2	–88	1794
2	$\overline{MD0}$	–1008	–1794	42	COM1	–274	1794
3	SEG35	–824	–1794	43	C2	–461	1794
4	SEG34	–639	–1794	44	C1	–647	1794
5	SEG33	–453	–1794	45	V_{SS3}	–1019	1794
6	SEG32	–267	–1794	46	V_{SS2}	–1496	1794
7	SEG31	–82	–1794	47	V_{SS1}	–1664	1671
8	SEG30	104	–1794	48	OSC0	–1664	1473
9	SEG29	289	–1794	49	$\overline{OSC1}$	–1664	1275
10	SEG28	475	–1794	50	V_{SSL}	–1664	1077
11	SEG27	660	–1794	51	RESET	–1664	879
12	SEG26	846	–1794	52	P3.1	–1664	681
13	SEG25	1031	–1794	53	P3.0	–1664	475
14	SEG24	1216	–1794	54	P2.3	–1664	285
15	SEG23	1664	–1689	55	P2.2	–1664	87
16	SEG22	1664	–1491	56	P2.1	–1664	–111
17	SEG21	1664	–1293	57	P2.0	–1664	–309
18	SEG20	1664	–1095	58	V_{DD}	–1664	–507
19	SEG19	1664	–891	59	P6.3	–1664	–705
20	SEG18	1664	–699	60	P6.2	–1664	–903
21	SEG17	1664	–501	61	P6.1	–1664	–1101
22	SEG16	1664	–303	62	P6.0	–1664	–1299
23	SEG15	1664	–105	63	TST2	–1664	–1497
24	SEG14	1664	93	64	TST1	–1664	–1703
25	SEG13	1664	291				
26	SEG12	1664	489				
27	SEG11	1664	687				
28	SEG10	1664	885				
29	SEG9	1664	1083				
30	SEG8	1664	1281				
31	SEG7	1664	1479				
32	SEG6	1664	1677				
33	SEG5	1395	1794				
34	SEG4	1216	1794				
35	SEG3	1030	1794				
36	SEG2	844	1794				
37	SEG1	657	1794				
38	SEG0	471	1794				
39	COM4	285	1794				
40	COM3	98	1794				

PIN DESCRIPTIONS

Basic Functions

Function	Pin	Pad	Symbol	Type	Description
Power Supply	44	58	V_{DD}	—	Digital power supply (0 V)
	33	47	V_{SS1}	—	Digital negative power supply (for 1.5 V spec.) Bias output for LCD drive (for 3.0 V spec.)
	32	46	V_{SS2}	—	Digital negative power supply (for 3.0 V spec.) Bias output for LCD drive (for 1.5 V spec.)
	31	45	V_{SS3}	—	Bias output for LCD drive (–4.5 V)
	30	44	C1	—	Capacitor connection pins for LCD drive bias generation.
	29	43	C2	—	
	36	50	V_{SSL}	—	Negative power supply pin for internal logic (An internally generated constant voltage is present at this pin.)
Oscillation	34	48	OSC0	I	Clock oscillation input and output 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.
	35	49	$\overline{OSC1}$	O	
Test	50	64	TST1	I	Input pins for test.
	49	63	TST2	I	
Reset	37	51	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	43	57	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 function, an external interrupt and capture circuit trigger input are allocated. If P2.0 to P2.3 are all set to a "H" level, the device enters system reset mode.
	42	56	P2.1		
	41	55	P2.2		
	40	54	P2.3		
	39	53	P3.0	I	2-bit input port (port 3): Select between pull-down resistor input and high impedance input with the port 3 control register (P3CON). When configured for secondary function, an external interrupt is allocated to P3.0 and an event counter input is allocated to P3.1.
	38	52	P3.1		
	48	62	P6.0	I/O	4-bit I/O 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 secondary function, an external interrupt is allocated to these pins.
	47	61	P6.1		
	46	60	P6.2		
	45	59	P6.3		
Melody Drivers	51	1	MD0	O	Output pin of melody driver 0.
	52	2	$\overline{\text{MD0}}$	O	Inverted output pin of MD0 output.
LCD Drivers	28	42	COM1	O	LCD common signal output pins.
	27	41	COM2	O	
	26	40	COM3	O	
	25	39	COM4	O	

Basic Functions (continued)

Function	Pin	Pad	Symbol	Type	Description
LCD Drivers	24	38	SEG0	O	LCD segment signal output pins.
	23	37	SEG1	O	
	22	36	SEG2	O	
	21	35	SEG3	O	
	20	34	SEG4	O	
	19	33	SEG5	O	
	18	32	SEG6	O	
	17	31	SEG7	O	
	16	30	SEG8	O	
	15	29	SEG9	O	
	14	28	SEG10	O	
	13	27	SEG11	O	
	12	26	SEG12	O	
	11	25	SEG13	O	
	10	24	SEG14	O	
	9	23	SEG15	O	
	8	22	SEG16	O	
	7	21	SEG17	O	
	6	20	SEG18	O	
	5	19	SEG19	O	
	4	18	SEG20	O	
	3	17	SEG21	O	
	2	16	SEG22	O	
	1	15	SEG23	O	
	64	14	SEG24	O	
	63	13	SEG25	O	
	62	12	SEG26	O	
	61	11	SEG27	O	
	60	10	SEG28	O	
	59	9	SEG29	O	
	58	8	SEG30	O	
	57	7	SEG31	O	
	56	6	SEG32	O	
	55	5	SEG33	O	
	54	4	SEG34	O	
	53	3	SEG35	O	

Secondary Functions

Function	Pin	Pad	Symbol	Type	Description
External Interrupts	43	57	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.
	42	56	P2.1		
	41	55	P2.2		
	40	54	P2.3		
	39	53	P3.0	I	P3.0 secondary function : This is an input pin for external interrupt. This pin can receive an interrupt at a rising edge, a falling edge, or at both rising and falling edges.
	48	62	P6.0	I	P6.0 to P6.3 secondary functions : These are level-triggered external interrupt input pins.
	47	61	P6.1		
	46	60	P6.2		
	45	59	P6.3		
Event Counter Input	38	52	P3.1	I	P3.1 secondary function : Input port for event counter

Handling When Specific Pins Are Not Used

Symbol	Recommended Pin Connection
TST1 to TST2	Open
P2.0 to P2.3	"L" level or open
P3.0, P3.1	"L" level or open
P6.0 to P6.3	In input mode : "L" level or open (Initial setting: input mode) In output mode : Open
MD0, $\overline{MD0}$	Open
COM1 to COM4	Open
SEG0 to SEG35	Open

ABSOLUTE MAXIMUM RATINGS

1.5 V Spec. (MSM64158A)

(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. (MSM64158A)

(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}	—	1 M ±10%	Ω

ELECTRICAL CHARACTERISTICS

1.5 V Spec. (MSM64158A)

DC Characteristics

(V_{DD} = 0 V, V_{SS1} = –1.5 V, Ta = –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 $^{+100\%}_{-20\%}$ Ta = –40 to +60°C BUPF = "0"	–3.2	–3.0	–2.8	V	1, 1'
		C_a, C_b, C_{12} = 0.1 µF $^{+100\%}_{-20\%}$ Ta = –40 to +70°C BUPF = "0"	–3.2	–3.0	–2.7		
		C_a, C_b, C_{12} = 0.1 µF $^{+100\%}_{-20\%}$ Ta = –40 to +60°C BUPF = "1"	–3.2	–3.0	–2.5		
		C_a, C_b, C_{12} = 0.2 µF $^{+100\%}_{-20\%}$ Ta = –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 $^{+100\%}_{-20\%}$ Ta = –40 to +60°C BUPF = "0"	–4.7	–4.5	–4.2	V	
		C_a, C_b, C_{12} = 0.1 µF $^{+100\%}_{-20\%}$ Ta = –40 to +70°C BUPF = "0"	–4.7	–4.5	–4.0		
		C_a, C_b, C_{12} = 0.1 µF $^{+100\%}_{-20\%}$ Ta = –40 to +60°C BUPF = "1"	–4.7	–4.5	–3.9		
		C_a, C_b, C_{12} = 0.2 µF $^{+100\%}_{-20\%}$ Ta = –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	—	—	–1.45	V	1
Crystal Oscillation Hold Voltage	V_{HOLD}	—	—	—	–1.15	V	
External Crystal Oscillator Capacitance	C_G	—	10	—	30	pF	
Internal Crystal OscillatorCapacitance	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 V, V_{SS1} = –1.5 V, Ta = –40 to +70°C unless otherwise specified.)

Parameter	Symbol	Condition		Min.	Typ.	Max.	Unit	Measuring Circuit
Supply Current 1	I_{DD1}	CPU in halt state	Ta = –40 to +40°C	—	2.0	6.0	µA	1
		BUPF = "0"	Ta = +40 to +70°C	—	2.0	40	µA	
Supply Current 1	I_{DD1}	CPU in halt state	Ta = –40 to +40°C	—	3.0	10	µA	
		BUPF = "1"	Ta = +40 to +70°C	—	3.0	50	µA	
Supply Current 2	I_{DD2}	CPU in operation	Ta = –40 to +40°C	—	6.0	15	µA	
		BUPF = "0"	Ta = +40 to +70°C	—	6.0	50	µA	
Supply Current 2	I_{DD2}	CPU in operation	Ta = –40 to +40°C	—	10	25	µA	
		BUPF = "1"	Ta = +40 to +70°C	—	10	60	µA	

• RC oscillation

(V_{DD} = 0 V, V_{SS1} = –1.5 V, R_{OS} = 1 MΩ, Ta = –40 to +70°C unless otherwise specified.)

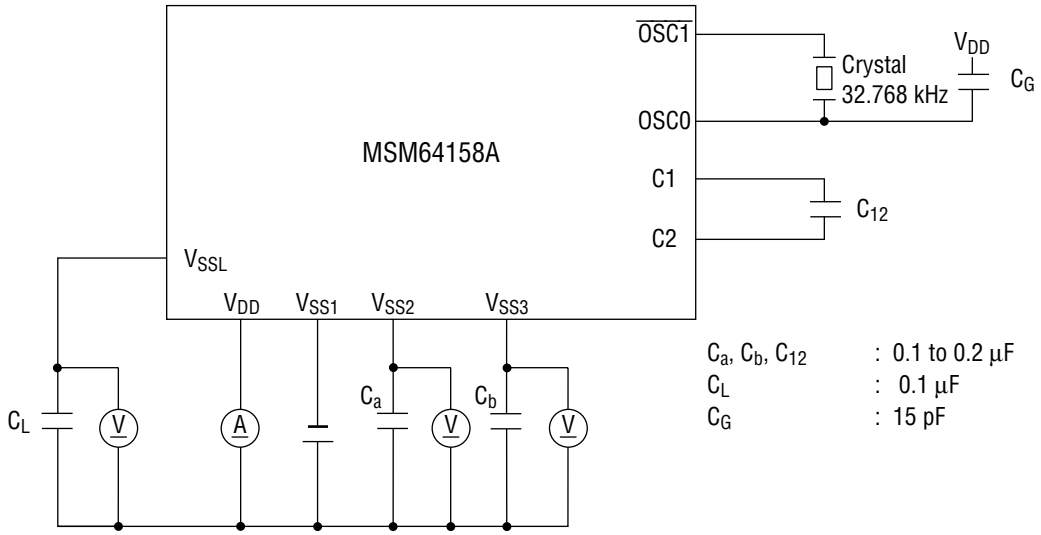
Parameter	Symbol	Condition		Min.	Typ.	Max.	Unit	Measuring Circuit
Supply Current 1	I_{DD1}	CPU in halt state	Ta = –40 to +40°C	—	3.0	10	µA	1'
		BUPF = "0"	Ta = +40 to +70°C	—	3.0	45	µA	
Supply Current 1	I_{DD1}	CPU in halt state	Ta = –40 to +40°C	—	6.0	15	µA	
		BUPF = "1"	Ta = +40 to +70°C	—	6.0	50	µA	
Supply Current 2	I_{DD2}	CPU in operation	Ta = –40 to +40°C	—	7.0	20	µA	
		BUPF = "0"	Ta = +40 to +70°C	—	7.0	50	µA	
Supply Current 2	I_{DD2}	CPU in operation	Ta = –40 to +40°C	—	15	30	µA	
		BUPF = "1"	Ta = +40 to +70°C	—	15	70	µA	

DC Characteristics (continued)

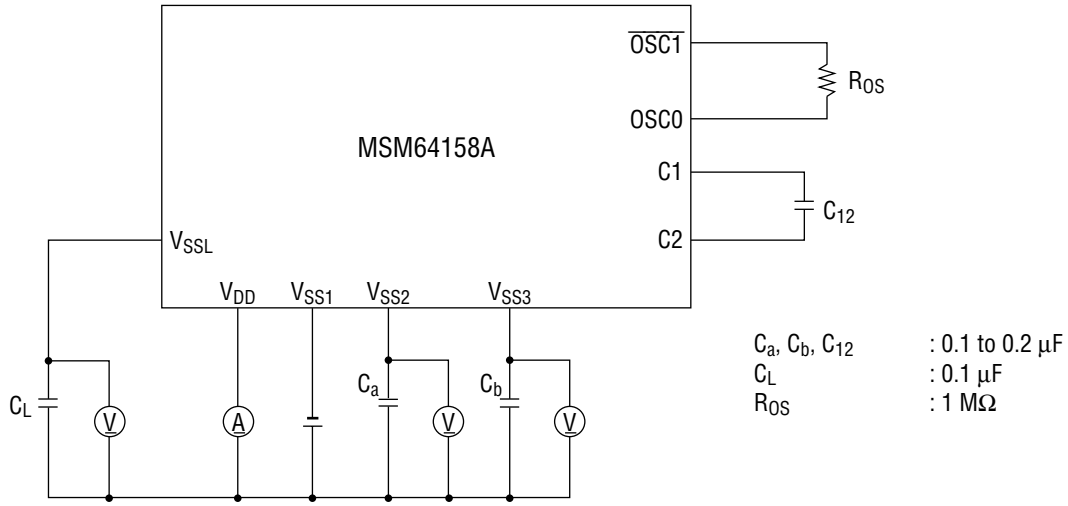
(V_{DD} = 0 V, V_{SS1} = V_{SSL} = –1.5 V, V_{SS2} = –3.0 V, V_{SS3} = –4.5 V, Ta = –40 to +70°C unless otherwise specified.)

Parameter (Pin Name)	Symbol	Condition	Min.	Typ.	Max.	Unit	Measuring Circuit
Output Current 1 (MD0, $\overline{MD0}$)	I_{OH1}	V_{OH1} = –0.5 V	–2.0	–0.6	–0.1	mA	2
	I_{OL1}	V_{OL1} = V_{SS1} + 0.5 V	0.1	0.6	2.0	mA	
Output Current 2 (SEG0 to SEG35) (COM1 to COM4)	I_{OH2}	V_{OH2} = –0.2 V (V_{DD} level)	—	—	–4.0	µA	
	I_{OMH2}	V_{OMH2} = V_{SS1} + 0.2 V (V_{SS1} level)	4.0	—	—	µA	
	I_{OMH2S}	V_{OMH2S} = V_{SS1} – 0.2 V (V_{SS1} level)	—	—	–4.0	µA	
	I_{OML2}	V_{OML2} = V_{SS2} + 0.2 V (V_{SS2} level)	4.0	—	—	µA	
	I_{OML2S}	V_{OML2S} = V_{SS2} – 0.2 V (V_{SS2} level)	—	—	–4.0	µA	
	I_{OL2}	V_{OL2} = V_{SS3} + 0.2 V (V_{SS3} level)	4.0	—	—	µA	
Output Current 3 (P6.0 to P6.3)	I_{OH3}	V_{OH3} = –0.5 V	–5.0	–2.1	–0.3	mA	
	I_{OL3}	V_{OL3} = V_{SS1} + 0.5 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) (P3.0, P3.1) (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)	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}	1.0	10	100	µA	
	I_{IL3}	V_{IL3} = V_{SS1}	–1.0	—	0	µA	
Input Voltage 1 (P2.0 to P2.3) (P3.0, P3.1) (P6.0 to P6.3) (TST1, TST2) (RESET)	V_{IH1}	—	–0.3	—	0	V	4
	V_{IL1}	—	–1.5	—	–1.2	V	

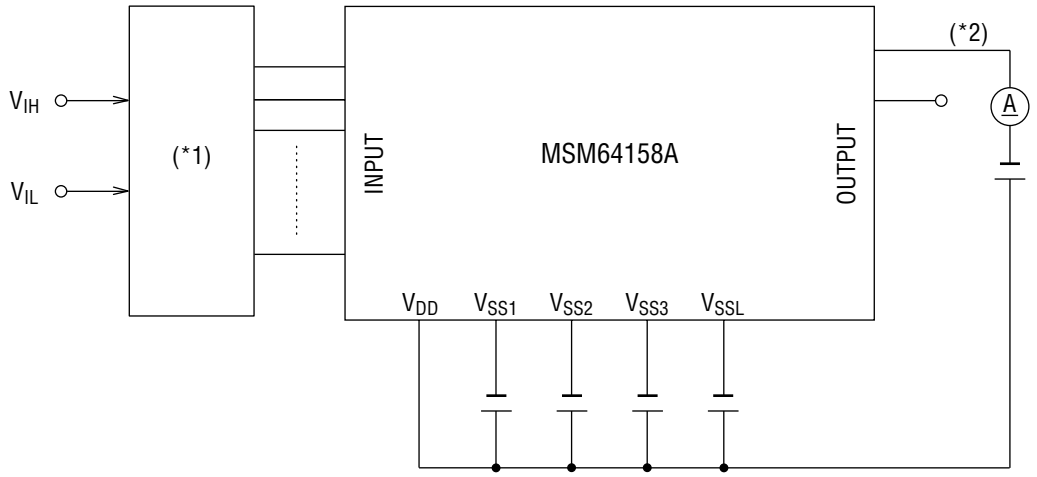
Measuring circuit 1



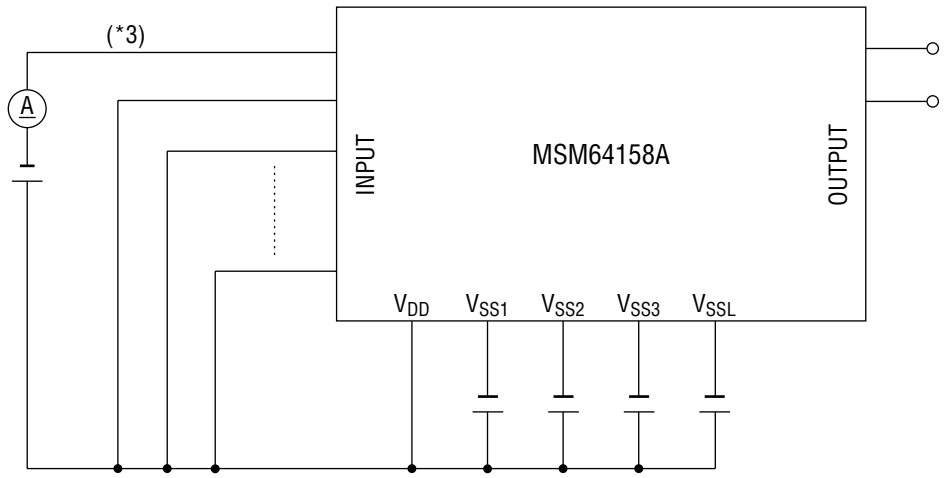
Measuring circuit 1'



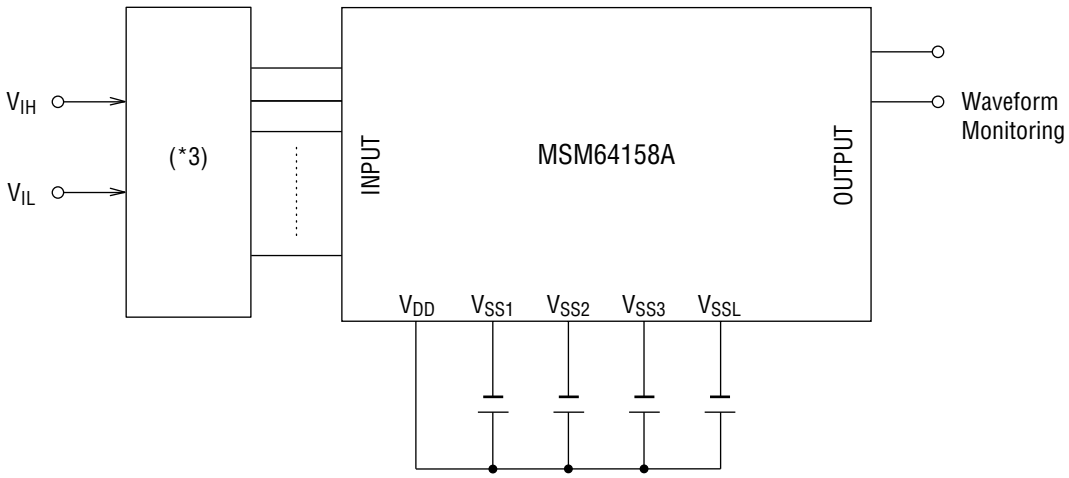
Measuring circuit 2



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. (MSM64158AL)

(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. (MSM64158AL)

(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. (MSM64158AL)

DC Characteristics

(V_{DD} = 0 V, V_{SS2} = –3.0 V, Ta = –40 to +70°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 µF $^{+100\%}_{-20\%}$	–1.7	–1.5	–1.3	V	1 1'
V_{SS3} Voltage	V_{SS3}	C_a, C_b, C_{12} = 0.1 µF $^{+100\%}_{-20\%}$	–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	—	—	–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 MΩ	15	40	75	kHz	1'

DC Characteristics (continued)

• 32.768 kHz crystal oscillation

(V_{DD} = 0 V, V_{SS2} = –3.0 V, Ta = –40 to +70°C unless otherwise specified.)

Parameter	Symbol	Condition		Min.	Typ.	Max.	Unit	Measuring Circuit
Supply Current 1	I_{DD1}	CPU in halt state	Ta = –40 to +40°C	—	0.9	4.5	µA	1
		BUPF = "0"	Ta = +40 to +70°C	—	0.9	30	µA	
Supply Current 1	I_{DD1}	CPU in halt state	Ta = –40 to +40°C	—	1.5	6.0	µA	
		BUPF = "1"	Ta = +40 to +70°C	—	1.5	40	µA	
Supply Current 2	I_{DD2}	CPU in operation	Ta = –40 to +40°C	—	3.0	10	µA	
		BUPF = "0"	Ta = +40 to +70°C	—	3.0	40	µA	
Supply Current 2	I_{DD2}	CPU in operation	Ta = –40 to +40°C	—	5.0	15	µA	
		BUPF = "1"	Ta = +40 to +70°C	—	5.0	50	µA	

• RC oscillation

(V_{DD} = 0 V, V_{SS2} = –3.0 V, R_{OS} = 1 MΩ, Ta = –40 to +70°C unless otherwise specified.)

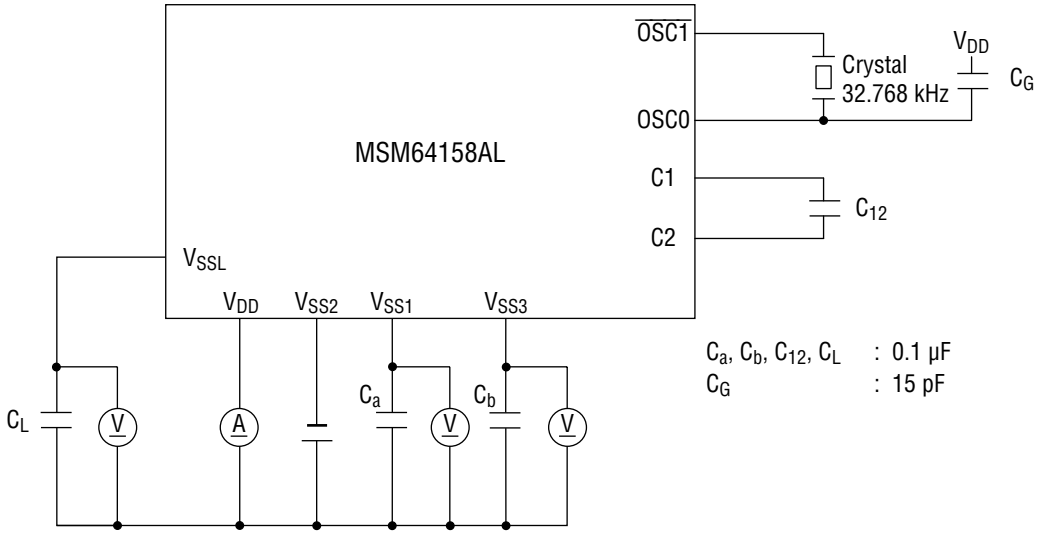
Parameter	Symbol	Condition		Min.	Typ.	Max.	Unit	Measuring Circuit
Supply Current 1	I_{DD1}	CPU in halt state	Ta = –40 to +40°C	—	1.5	6.0	µA	1
		BUPF = "0"	Ta = +40 to +70°C	—	1.5	40	µA	
Supply Current 1	I_{DD1}	CPU in halt state	Ta = –40 to +40°C	—	3.0	10	µA	
		BUPF = "1"	Ta = +40 to +70°C	—	3.0	50	µA	
Supply Current 2	I_{DD2}	CPU in operation	Ta = –40 to +40°C	—	4.0	12	µA	
		BUPF = "0"	Ta = +40 to +70°C	—	4.0	50	µA	
Supply Current 2	I_{DD2}	CPU in operation	Ta = –40 to +40°C	—	8.0	25	µA	
		BUPF = "1"	Ta = +40 to +70°C	—	8.0	60	µA	

DC Characteristics (continued)

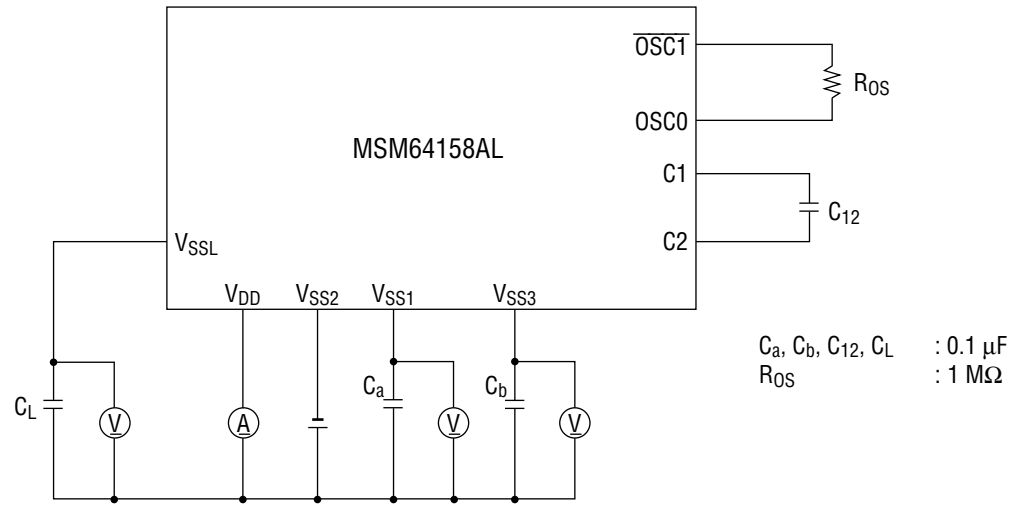
(V_{DD} = 0 V, V_{SS1} = V_{SSL} = –1.5 V, V_{SS2} = –3.0 V, V_{SS3} = –4.5 V, Ta = –40 to +70°C unless otherwise specified.)

Parameter (Pin Name)	Symbol	Condition	Min.	Typ.	Max.	Unit	Measuring Circuit
Output Current 1 (MD0, $\overline{MD0}$)	I_{OH1}	V_{OH1} = –0.5 V	–6.0	–1.8	–0.7	mA	2
	I_{OL1}	V_{OL1} = V_{SS2} + 0.5 V	0.7	1.8	6.0	mA	
Output Current 2 (SEG0 to SEG35) (COM1 to COM4)	I_{OH2}	V_{OH2} = –0.2 V (V_{DD} level)	—	—	–.04	µA	
	I_{OMH2}	V_{OMH2} = V_{SS1} + 0.2 V (V_{SS1} level)	4.0	—	—	µA	
	I_{OMH2S}	V_{OMH2S} = V_{SS1} – 0.2 V (V_{SS1} level)	—	—	–4.0	µA	
	I_{OML2}	V_{OML2} = V_{SS2} + 0.2 V (V_{SS2} level)	4.0	—	—	µA	
	I_{OML2S}	V_{OML2S} = V_{SS2} – 0.2 V (V_{SS2} level)	—	—	–4.0	µA	
	I_{OL2}	V_{OL2} = V_{SS3} + 0.2 V (V_{SS3} level)	4.0	—	—	µA	
Output Current 3 (P6.0 to P6.3)	I_{OH3}	V_{OH3} = –0.5 V	–18	–6.0	–2.0	mA	
	I_{OL3}	V_{OL3} = V_{SS2} + 0.5 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) (P3.0, P3.1) (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)	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}	20	40	200	µA	
	I_{IL3}	V_{IL3} = V_{SS2}	–1.0	—	0	µA	
Input Voltage 3 (P2.0 to P2.3) (P3.0, P3.1) (P6.0 to P6.3) (TST1, TST2) (RESET)	V_{IH1}	—	–0.6	—	0	V	4
	V_{IL1}	—	–3.0	—	–2.4	V	

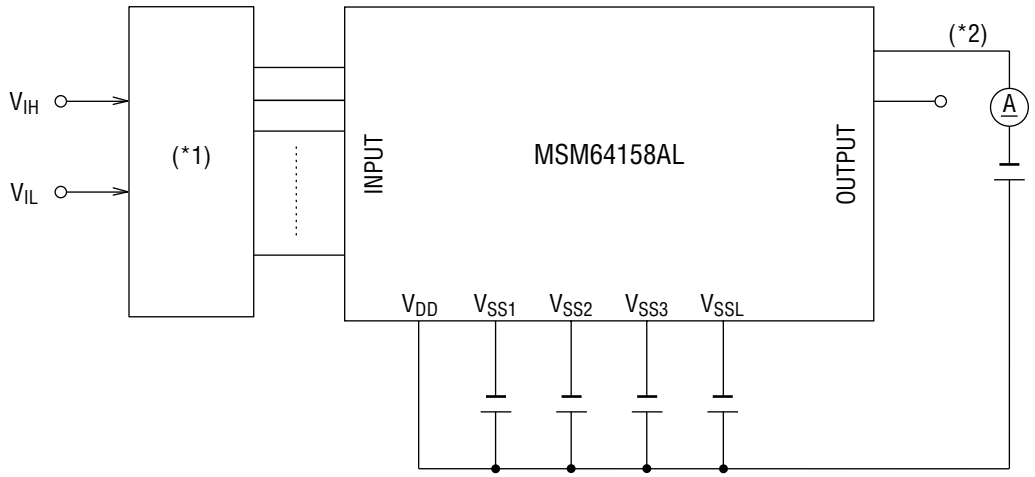
Measuring circuit 1



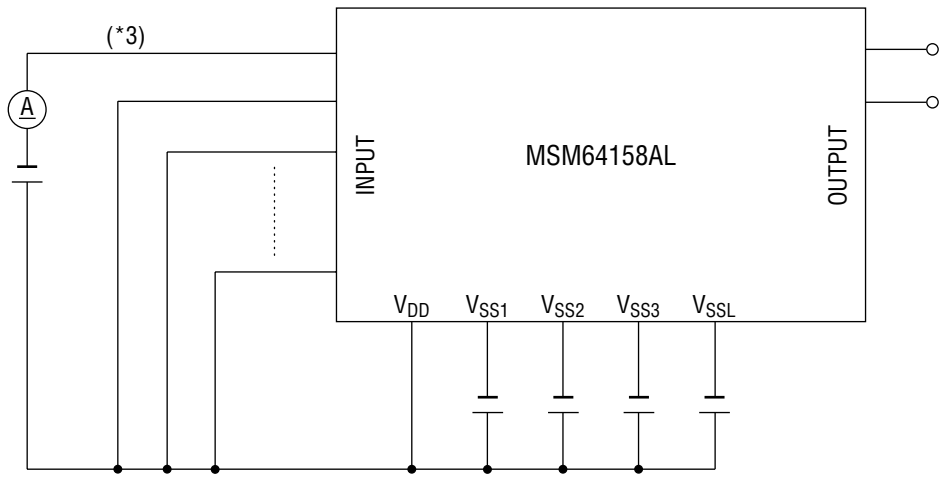
Measuring circuit 1'



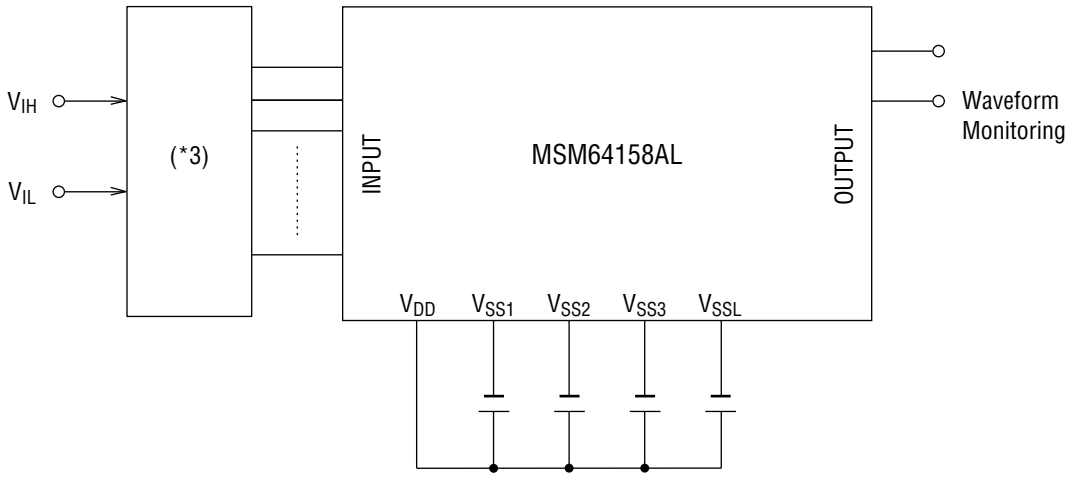
Measuring circuit 2



Measuring circuit 3



Measuring circuit 4

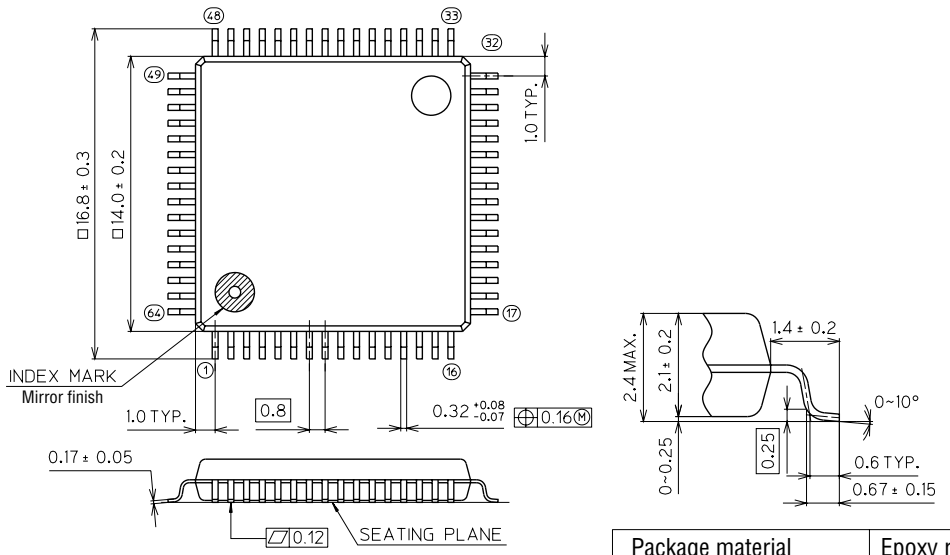


*1 Input logic circuit to determine the specified measuring conditions.
*2 Measured at the specified output pins.
*3 Measured at the specified input pins.

PACKAGE DIMENSIONS

(Unit : mm)

QFP64-P-1414-0.80-BK



Package material	Epoxy resin
Lead frame material	42 alloy
Pin treatment	Solder plating
Solder plate thickness	5 μm or more
Package weight (g)	0.87 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).