OKI Semiconductor

This version: Sep. 1998
Previous version: Mar. 1996

MSM6351/6351L

Built-in 8 or 5 bit Serial Port and LCD Driver 4-Bit Microcontroller

GENERAL DESCRIPTION

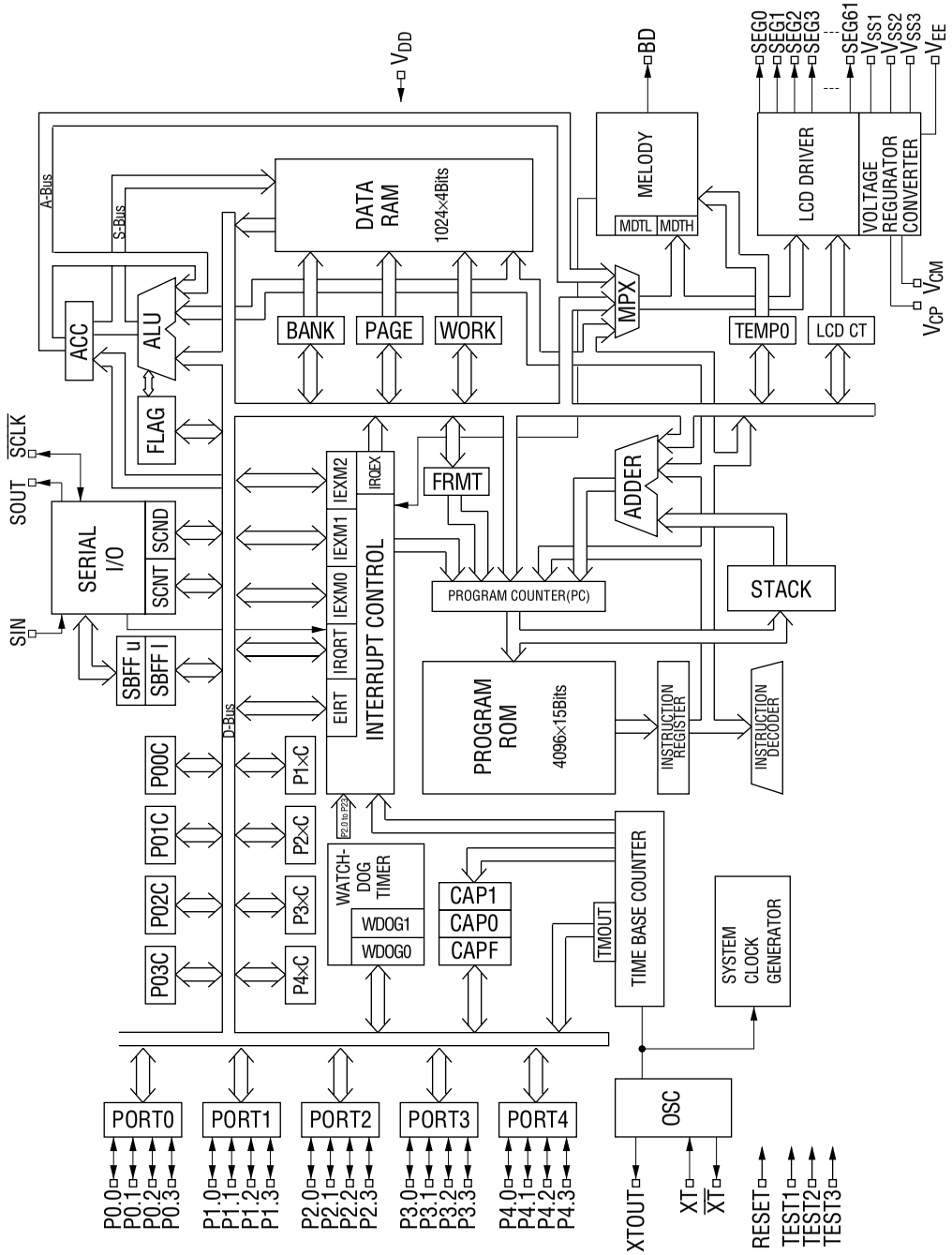
The MSM6351/6351L is a low-power microcontroller manufactured in silicon gate CMOS technology. Integrated into a single chip are ROM, RAM, five I/O ports, serial I/O port, time-base counter, LCD driver, three interrupts, crystal oscillator, and voltage tripler.
The MSM6351/6351L, which can drive LCD display with higher-count segments, is best suited to battery powered applications, such as watches and game machines.
The built-in 8-bit or 5-bit serial port provides a data communication capability with external machines.

FEATURES

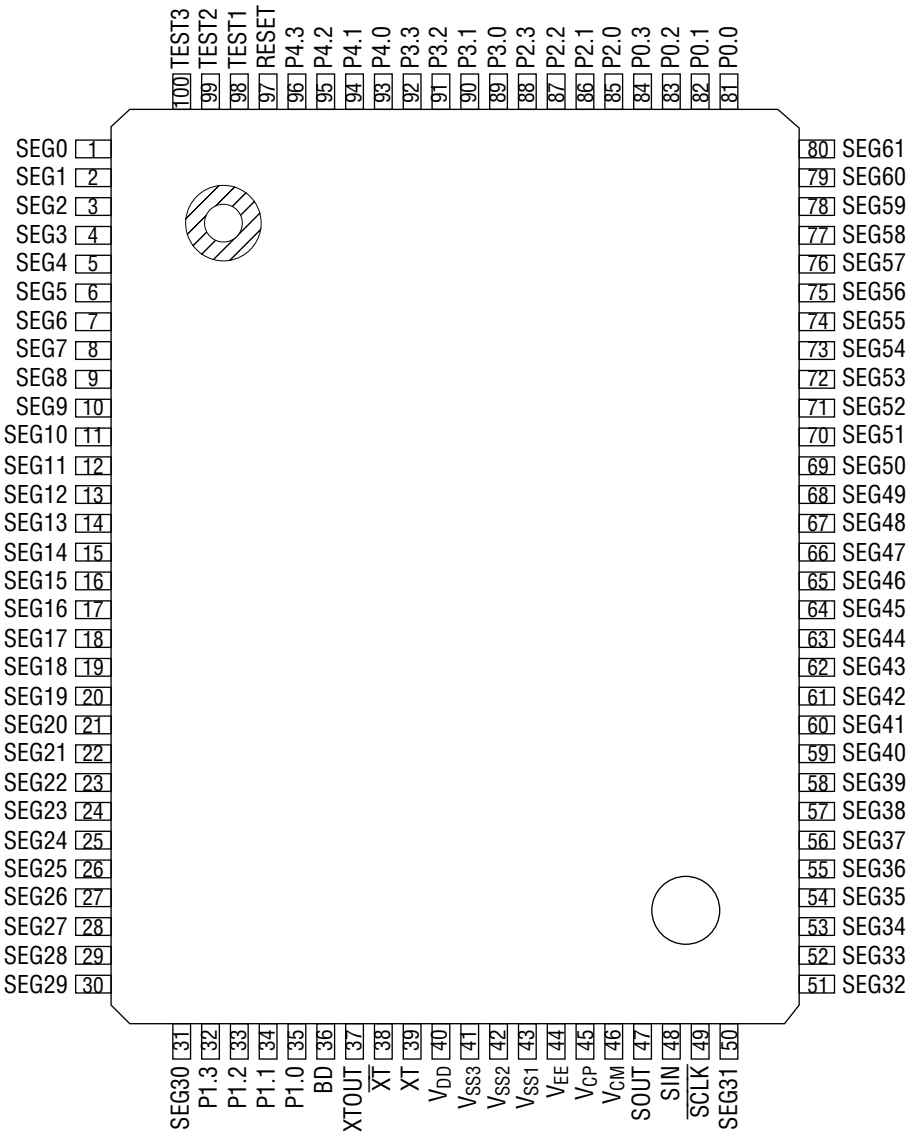
- Low power consumption
- Large capacity memory
- ROM : 4096 words × 15 bits
- RAM : 1024 words × 4 bits
- I/O port
  Input-output port : 5 ports × 4 bits (input or output can be specified for each port)
- 62 LCD drivers (1/3 duty or 1/4 duty is selectable. Up to 232 segments can be displayed)
- Single 1.5 V power supply operation (MSM6351)
  Can be changed to 3.0 V specification by mask option (MSM6351L).
- Melody function
- Built-in watchdog timer
- Built-in 8-bit or 5-bit serial port (asynchronous or synchronous selectable)
- 32.768 kHz crystal oscillator
- Package options:
  100-pin plastic QFP (QFP100-P-1420-0.65-K) (Product name :MSM6351-××GS-K/ MSM6351L-××GS-K)
  100-pin plastic QFP (QFP100-P-1420-0.65-L) (Product name :MSM6351-××GS-L/ MSM6351L-××GS-L)
  100-pin plastic QFP (QFP100-P-1420-0.65-BK) (Product name :MSM6351-××GS-BK/ MSM6351L-××GS-BK)
  Chip

  ×× indicates a code number.

BLOCK DIAGRAM



PIN CONFIGURATION (TOP VIEW)



100-Pin Plastic QFP

PIN DESCRIPTIONS

Symbol	Type	Description				I/O Circuitry
P0.0	I/O	PORT0	• 4-bit I/O port 0 The input (*) /output, the existence (*) / absence of pull-down resistance, and the HALT function release enable/disable (*) condition can be selected for each bit.		Capture trigger signal	A
P0.1						
P0.2						
P0.3						
P1.0 to P1.3		PORT1	• 4-bit I/O port 1	The input (*) /output, the existence (*) / absence of pull-down resistance, and the HALT function release enable/ disable (*) condition can be selected for each port.		
P2.0		PORT2	• 4-bit I/O port 2		External interrupt signal	
P2.1						
P2.2						
P2.3						
P3.0 to P3.3		PORT3	• 4-bit I/O port 3			
P4.0 to P4.3		PORT4	• 4-bit I/O port 4			
XTOUT	O	• Oscillator clock output. The oscillator clock is output when XTF (bit 3 of port P00C) is set to "1".				E
$\overline{XT}$	O	• Oscillator connection pins.				B
XT	I					
RESET	I	• Reset input. This is an input with a pull-down resistor. The system is reset when "1" is input.				C
TEST1	I	• Test input. This is an input with a pull-down resistor.				D
TEST2						
TEST3						
SIN	I	• Serial port data input.				F
SOUT	O	• Serial port data output. When the port is not in an output state, this pin is set at high-impedance level, except when HZOUT (bit 3 of port P2XC) =1 and transmitting data.				G
$\overline{SCLK}$	I/O	• Serial port clock input/output. The input/output (*) is switched by the serial port control register SCNT. In the output mode, the serial clock frequency can be selected from the demultiplied signal (1/1, 1/2 or 1/4 of the system clock).				H
BD	O	• Melody output (buzzer drive output).				I
SEG0 to SEG61	O	• LCD drive output with 1/3 bias and 1/3 duty, or 1/3 bias and 1/4 duty. The duty can be switched by LCD control register LCDCNT. A maximum of 177 segments can be displayed when using 1/3 duty and 232 when using 1/4 duty.				—

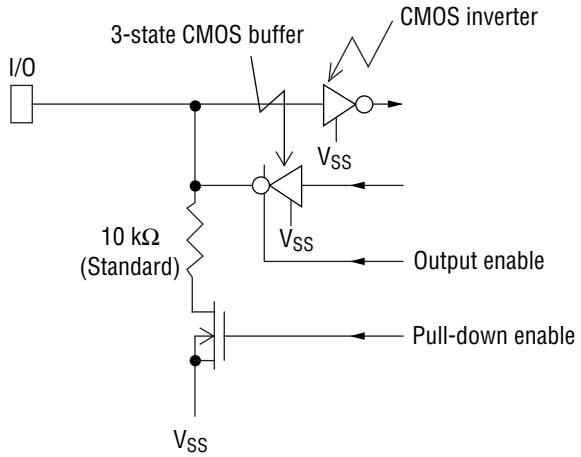
* Means system reset conditions.

PIN DESCRIPTIONS (continued)

Symbol	Description	I/O Circuitry
V_{DD}	• 0 V power supply pin	—
V_{SS1}	• –1.5 V power supply pin (for 1.5 V operation)	—
V_{SS2}	• –3.0 V power supply pin (for 3.0 V operation)	—
V_{SS3}	• –4.5 V power supply pin	—
V_{EE}	• Internal logic power supply pin	—
V_{CM}	• Internal voltage converter capacitor connecting pin	—
V_{CP}		

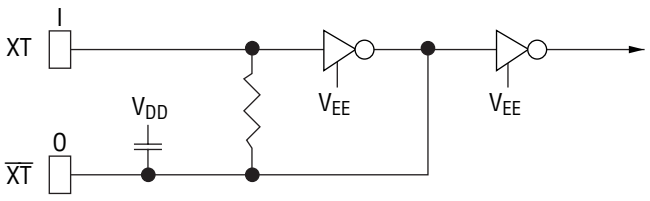
Circuitry on Input/Output Pins

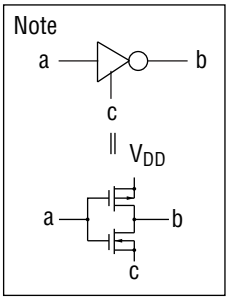
A. Input/output port



Note:
V_{SS}: { 1.5 V operation→V_{SS1}
3.0 V operation→V_{SS2}

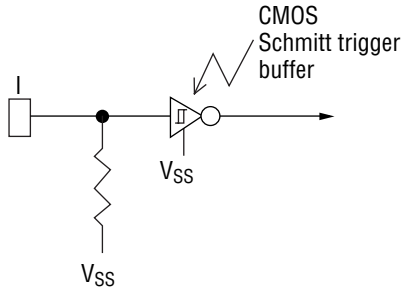
B. Oscillator



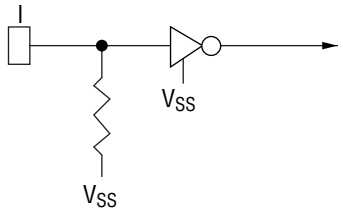


Circuitry on Input/Output Pins (continued)

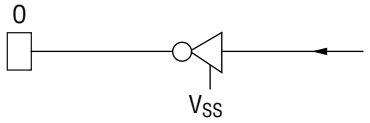
C. RESET input



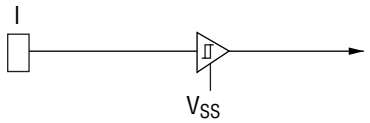
D. TEST input



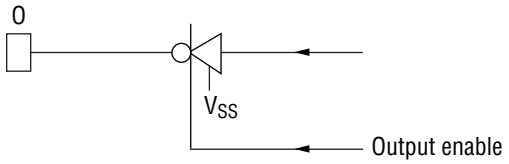
E. XTOUT output



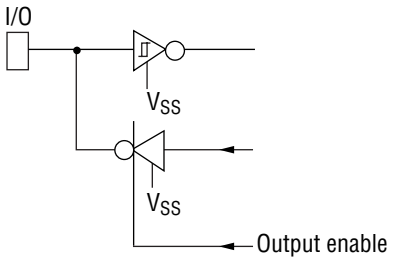
F. SIN input



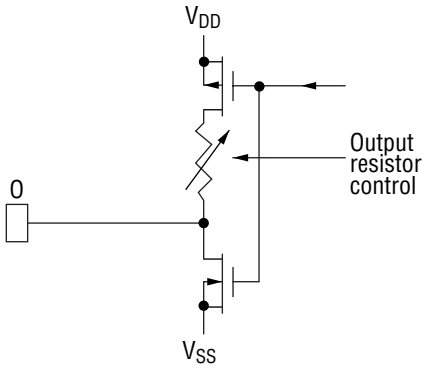
G. SOUT output



H. $\overline{\text{SCLK}}$ input/output



I. BD output



ABSOLUTE MAXIMUM RATINGS (MSM6351 (1.5 V Battery), BUF = "0")

V_{DD} = 0 V (V_{SS1} = Battery Voltage)

Parameter	Symbol	Condition	Rating	Unit
Power Supply Voltage	—	Ta = 25°C	–6.0 to +0.3	V
Input Voltage	V_{IN}		V_{SS1} – 0.3 to V_{SS1} + 0.3	
Output Voltage *1	V_{O1}		V_{SS1} – 0.3 to V_{SS1} + 0.3	
Output Voltage *2	V_{O2}		–6.0 to +0.3	
Storage Temperature	T_{STG}	—	–55 to +125	°C

*1 Normal output
*2 LCD driver output

RECOMMENDED OPERATING CONDITIONS (MSM6351 (1.5 V Battery), BUF = "0")

V_{DD} = 0 V (V_{SS1} = Battery Voltage)

Parameter	Symbol	Condition	Range	Unit
Operating Voltage	V_{op}	BUF = "0"	–1.75 to –1.25	V
Operating Temperature	T_{op}	—	–20 to +70	°C
Operating Frequency	f_{OSC}	—	32.768	kHz

ELECTRICAL CHARACTERISTICS (MSM6351 (1.5 V Battery), BUF = "0")

V_{DD} = 0 V, V_{SS1} = –1.5 V (Battery Voltage), V_{SS2} = –3.0 V, V_{SS3} = –4.5 V, f_{OSC} = 32.768 kHz, C_X = 35 pF, Ta = 25°C

Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit	Applied Pin
Power Supply Current	I_{DD}	*1 *2	—	3.0	—	µA	—
Voltage for Oscillation Start	$-V_{OSC}$	Within 2 sec.	—	—	1.4	V	—
Output Current 1 (Common/Segment Output)	$-I_{OH1}$	V_{OH} = –0.2 V	4	—	—	µA	SEG0 to SEG61
	$\lvert I_{OMH1} \rvert$	$V_{OMH} = V_{SS1} \pm 0.2$ V	4	—	—		
	$\lvert I_{OML1} \rvert$	$V_{OML} = V_{SS2} \pm 0.2$ V	4	—	—		
	$-I_{OL1}$	V_{OL} = –4.3 V	4	—	—		
Output Current 2	$-I_{OH2}$	V_O = –0.5 V	150	—	—	µA	PORT0 to PORT4*3, SOUT, SCLK, XTOUT
	I_{OL2}	V_O = –1.0 V	150	—	—		
Output Current 3	$-I_{OH3}$	V_O = –0.5 V	7	—	—	µA	BD
	I_{OL3}	V_O = –1.0 V	20	—	—		
Input Current 1	$-I_{IH1}$	V_I = 0 V I/O input With pull-down resistor	75	150	300	µA	PORT0 to PORT4
Input Leakage Current	$\lvert I_{IL2} \rvert$	V_I = 0 V, –1.5 V I/O input Without pull-down resistor	—	—	1	µA	PORT0 to PORT4, SCLK, SIN, SOUT
Input Current 3	$-I_{IH3}$	V_I = 0 V With pull-down resistor	—	4	—	µA	RESET
Input Voltage	$-V_{IH}$	—	—	—	0.3	V	All input pins
	$-V_{IL}$	—	1.2	—	—		

*1 This value depends on program.
*2 BUF = "0"
*3 PORT0 = P0.0 to P0.3, PORT1 = P1.0 to P1.3, PORT2 = P2.0 to P2.3, PORT3 = P3.0 to P3.3, PORT4 = P4.0 to P4.3

ABSOLUTE MAXIMUM RATINGS (MSM6351L (3.0 V Battery), Halver used (BUF = "0"))

V_{DD} = 0 V (V_{SS2} = Battery Voltage)

Parameter	Symbol	Condition	Rating	Unit
Power Supply Voltage	—	Ta = 25°C	–6.0 to +0.3	V
Input Voltage	V_{IN}		V_{SS2} – 0.3 to V_{SS2} + 0.3	
Output Voltage *1	V_{O1}		V_{SS2} – 0.3 to V_{SS2} + 0.3	
Output Voltage *2	V_{O2}		–6.0 to +0.3	
Storage Temperature	T_{STG}	—	–55 to +125	°C

*1 Normal output
*2 LCD driver output

RECOMMENDED OPERATING CONDITIONS

(MSM6351L (3.0 V Battery), Halver used (BUF = "0"))

V_{DD} = 0 V (V_{SS2} = Battery Voltage)

Parameter	Symbol	Condition	Range	Unit
Operating Voltage	V_{op}	Halver used (BUF = "0")	–3.5 to –2.6	V
Operating Temperature	T_{op}	—	–20 to +70	°C
Operating Frequency	f_{OSC}	—	32.768	kHz

ELECTRICAL CHARACTERISTICS (MSM6351L (3.0 V Battery), Halver used (BUF="0"))

V_{DD} = 0 V, V_{SS1} = –1.5 V, V_{SS2} = –3.0 V (Battery Voltage), V_{SS3} = –4.5 V, f_{OSC} = 32.768 kHz, C_X = 35 pF, Ta = 25°C

Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit	Applied Pin
Power Supply Current	I_{DD}	*1 *2	—	1.5	—	µA	—
Voltage for Oscillation Start	$-V_{OSC}$	Within 2 sec.	—	—	2.4	V	—
Output Current 1 (Common/Segment Output)	$-I_{OH1}$	V_{OH} = –0.2 V	4	—	—	µA	SEG0 to SEG61
	$\lvert I_{OMH1} \rvert$	V_{OMH} = V_{SS1} ±0.2 V	4	—	—		
	$\lvert I_{OML1} \rvert$	V_{OML} = V_{SS2} ±0.2 V	4	—	—		
	$-I_{OL1}$	V_{OL} = –4.3 V	4	—	—		
Output Current 2	$-I_{OH2}$	V_O = –0.5 V	500	—	—	µA	PORT0 to PORT4___*3, SOUT, SCLK, XTOUT
	$-I_{OL2}$	V_O = –2.5 V	500	—	—		
Output Current 3	$-I_{OH3}$	V_O = –0.5 V	7	—	—	µA	BD
	$-I_{OL3}$	V_O = –2.5 V	20	—	—		
Input Current 1	$-I_{IH1}$	V_I = 0 V I/O input With pull-down resistor	150	300	600	µA	PORT0 to PORT4
Input Leakage Current	$\lvert I_{IL2} \rvert$	V_I = 0 V, –3 V I/O input Without pull-down resistor	—	—	1	µA	PORT0 to PORT4, SCLK, SIN, SOUT
Input Current 3	$-I_{IH3}$	V_I = 0 V With pull-down resistor	—	25	—	µA	RESET
Input Voltage	$-V_{IH}$	—	—	—	0.5	V	All input pins
	$-V_{IL}$	—	2.5	—	—		

*1 This value depends on program.
*2 When 3 V battery with halver is used (BUF = "0")
*3 PORT0 = P0.0 to P0.3, PORT1 = P1.0 to P1.3, PORT2 = P2.0 to P2.3, PORT3 = P3.0 to P3.3, PORT4 = P4.0 to P4.3

ABSOLUTE MAXIMUM RATINGS (MSM6351L (3.0 V Battery), Halver not used (BUF = "1"))

V_{DD} = 0 V (V_{SS2} = Battery Voltage)

Parameter	Symbol	Condition	Rating	Unit
Power Supply Voltage	—	Ta = 25°C	–6.0 to +0.3	V
Input Voltage	V_{IN}		V_{SS2} – 0.3 to +0.3	
Output Voltage *1	V_{O1}		V_{SS2} – 0.3 to +0.3	
Output Voltage *2	V_{O2}		–6.0 to +0.3	
Storage Temperature	T_{STG}	—	–55 to +125	°C

*1 Normal output
*2 LCD driver output

RECOMMENDED OPERATING CONDITIONS

(MSM6351L (3.0 V Battery), Halver not used (BUF = "1"))

V_{DD} = 0 V (V_{SS2} = Battery Voltage)

Parameter	Symbol	Condition	Range	Unit
Operating Voltage	V_{op}	Halver not used (BUF = "1")	–3.5 to –2.2	V
Operating Temperature	T_{op}	—	–20 to +70	°C
Operating Frequency	f_{OSC}	—	32.768	kHz

ELECTRICAL CHARACTERISTICS (MSM6351L (3.0 V Battery), Halver not used (BUF="1"))

V_{DD} = 0 V, V_{SS1} = –1.5 V, V_{SS2} = –3.0 V (Battery Voltage), V_{SS3} = –4.5 V, f_{OSC} = 32.768 kHz, C_X = 35 pF, Ta = 25°C

Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit	Applied Pin
Power Supply Current	I_{DD}	*1 *2	—	3.0	—	µA	—
Voltage for Oscillation Start	$-V_{OSC}$	Within 2 sec.	—	—	2.4	V	—
Output Current 1 (Common/Segment Output)	$-I_{OH1}$	V_{OH} = –0.2 V	4	—	—	µA	SEG0 to SEG61
	$\lvert I_{OMH1} \rvert$	$V_{OMH} = V_{SS1} \pm 0.2$ V	4	—	—		
	$\lvert I_{OML1} \rvert$	$V_{OML} = V_{SS2} \pm 0.2$ V	4	—	—		
	$-I_{OL1}$	V_{OL} = –4.3 V	4	—	—		
Output Current 2	$-I_{OH2}$	V_O = –0.5 V	500	—	—	µA	PORT0 to PORT4, $\overline{SOUT}$, SCLK, XTOUT *3
	$-I_{OL2}$	V_O = –2.5 V	500	—	—		
Output Current 3	$-I_{OH3}$	V_O = –0.5 V	7	—	—	µA	BD
	$-I_{OL3}$	V_O = –2.5 V	20	—	—		
Input Current 1	$-I_{IH1}$	V_I = 0 V I/O input With pull-down resistor	150	300	600	µA	PORT0 to PORT4
Input Leakage Current	$\lvert I_{IL2} \rvert$	V_I = 0 V, –3 V I/O input Without pull-down resistor	—	—	1	µA	PORT0 to $\overline{PORT4}$, $\overline{SCLK}$, SIN, SOUT
Input Current 3	$-I_{IH3}$	V_I = 0 V With pull-down resistor	—	25	—	µA	RESET
Input Voltage	$-V_{IH}$	—	—	—	0.5	V	All input pins
	$-V_{IL}$	—	2.5	—	—		

*1 This value depends on program.
*2 When halver is not used (BUF = "1")
*3 PORT0 = P0.0 to P0.3, PORT1 = P1.0 to P1.3, PORT2 = P2.0 to P2.3, PORT3 = P3.0 to P3.3, PORT4 = P4.0 to P4.3

INSTRUCTION LIST

	Mnemonic	Instruction code 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0	Description	Machine cycle
Arithmetic operation instruction	ADD ACC, REG1	0 0 0 0 0 0 P 0 1 0 0 r_3 r_2 r_1 r_0	(rP), (ACC), (Z), (C)←(rP) + (ACC)	1
	ADD #i, REG1	0 0 1 1 0 0 P i_3 i_2 i_1 i_0 r_3 r_2 r_1 r_0	(rP), (ACC), (Z), (C)←(rP) +i	1
	ADC REG1	0 0 0 0 0 0 P 0 1 0 1 r_3 r_2 r_1 r_0	(rP), (ACC), (Z), (C)←decimal adj [(rP) + (ACC) + (C)]	1
	ADCN REG1	0 1 1 0 0 0 P N_3 N_2 N_1 N_0 r_3 r_2 r_1 r_0	(rP), (ACC), (Z), (C)←N adjust [(rP) + (C)]	1
	SUB ACC, REG1	0 0 0 0 0 1 P 0 1 0 0 r_3 r_2 r_1 r_0	(rP), (ACC), (Z), (C)←(rP) + (ACC)	1
	SUB #i, REG1	0 0 1 1 0 1 P i_3 i_2 i_1 i_0 r_3 r_2 r_1 r_0	(rP), (ACC), (Z), (C)←(rP) –i	1
	SBC REG1	0 0 0 0 0 1 P 0 1 0 1 r_3 r_2 r_1 r_0	(rP), (ACC), (Z), (C)←decimal adj [(rP) – (ACC) – (C)]	1
	SBCN REG1	0 1 1 0 0 1 P N_3 N_2 N_1 N_0 r_3 r_2 r_1 r_0	(rP), (ACC), (Z), (C)←N adjust [(rP) – (C)]	1
	CMP ACC, REG1	0 0 0 0 0 1 P 1 1 1 0 r_3 r_2 r_1 r_0	(Z), (C)←(rP) – (ACC)	1
	CMP #i, REG1	0 0 1 0 1 1 P i_3 i_2 i_1 i_0 r_3 r_2 r_1 r_0	(Z), (C)←(rP) – i	1
	INC REG1	0 0 0 0 0 0 P 0 0 0 1 r_3 r_2 r_1 r_0	(rP), (ACC), (Z), (C)←(rP) +1	1
	INCD REG2	1 0 0 0 b_1 b_0 0 P_3 P_2 P_1 P_0 r_3 r_2 r_1 r_0	(rPb), (ACC), (Z), (C)←(rPb) +1	1
	DEC REG1	0 0 0 0 0 1 P 0 0 0 1 r_3 r_2 r_1 r_0	(rP), (ACC), (Z), (C)←(rP) –1	1
	DECD REG2	1 0 0 1 b_1 b_0 0 P_3 P_2 P_1 P_0 r_3 r_2 r_1 r_0	(rPb), (ACC), (Z), (C)←(rPb) –1	1
Bit manipulation instruction	BIT ACC, REG1	0 0 0 0 0 0 P 1 1 1 0 r_3 r_2 r_1 r_0	(Z)←($\overline{rP_3}$)∧(ACC3)∨($\overline{rP_2}$)∧(ACC2)∨($\overline{rP_1}$)∧(ACC1) ∨($\overline{rP_0}$)∧(ACC0)	1
	BIT #i, REG1	0 0 1 0 1 0 P i_3 i_2 i_1 i_0 r_3 r_2 r_1 r_0	(Z)←($\overline{rP_3}$)∧i_3∨($\overline{rP_2}$)∧i_2∨($\overline{rP_1}$)∧i_1∨($\overline{rP_0}$)∧i_0	1
	BIS ACC, REG1	0 0 0 0 0 0 P 0 1 1 0 r_3 r_2 r_1 r_0	(rP), (ACC), (Z)←(rP)∨(ACC)	1
	BIS #i, REG1	0 0 1 0 0 0 P i_3 i_2 i_1 i_0 r_3 r_2 r_1 r_0	(rP), (ACC), (Z)←(rP)∨i	1
	BIC ACC, REG1	0 0 0 0 0 1 P 0 1 1 0 r_3 r_2 r_1 r_0	(rP), (ACC), (Z)←(rP)∧($\overline{ACC}$)	1
	BIC #1, REG1	0 0 1 0 0 1 P i_3 i_2 i_1 i_0 r_3 r_2 r_1 r_0	(rP), (ACC), (Z)←(rP)∧ $\overline{i}$	1
	XOR ACC, REG1	0 0 0 0 0 0 P 0 1 1 1 r_3 r_2 r_1 r_0	(rP), (ACC), (Z)←(rP)∀(ACC)	1
	XOR #1, REG1	0 0 1 1 1 1 P i_3 i_2 i_1 i_0 r_3 r_2 r_1 r_0	(rP), (ACC), (Z)←(rP)∀i	1
Rotate instruction	ROR REG1	0 0 0 0 0 0 P 0 0 1 0 r_3 r_2 r_1 r_0	(Z), (ACC)←[$\overline{\rightarrow(C)\rightarrow(rP)\rightarrow}$]	1
	ROL REG1	0 0 0 0 0 1 P 0 0 1 0 r_3 r_2 r_1 r_0	(Z), (ACC)←[$\overline{\leftarrow(C)\leftarrow(rP)\leftarrow}$]	1
	ASR REG1	0 0 0 0 0 0 P 0 0 1 1 r_3 r_2 r_1 r_0	(Z), (ACC)←[O→(rP)→(C)]	1
	ASL REG1	0 0 0 0 0 1 P 0 0 1 1 r_3 r_2 r_1 r_0	(Z), (ACC)←[(C)←(rP)←O]	1
Flag operation instruction	CLG	0 0 0 0 0 0 0 1 0 0 0 0 0 0 0	(G)←O	1
	CLC	0 0 0 0 0 0 0 1 0 0 1 0 0 0 0	(C)←O	1
	CLZ	0 0 0 0 0 0 0 1 0 1 0 0 0 0 0	(Z)←O	1
	CLA	0 0 0 0 0 0 0 1 0 1 1 0 0 0 0	(Z), (C), (G)←O	1
	SEG	0 0 0 0 0 1 0 1 0 0 0 0 0 0 0	(G)←1	1
	SEC	0 0 0 0 0 1 0 1 0 0 1 0 0 0 0	(C)←1	1
	SEZ	0 0 0 0 0 1 0 1 0 1 0 0 0 0 0	(Z)←1	1
	SEA	0 0 0 0 0 1 0 1 0 1 1 0 0 0 0	(Z), (C), (G)←1	1

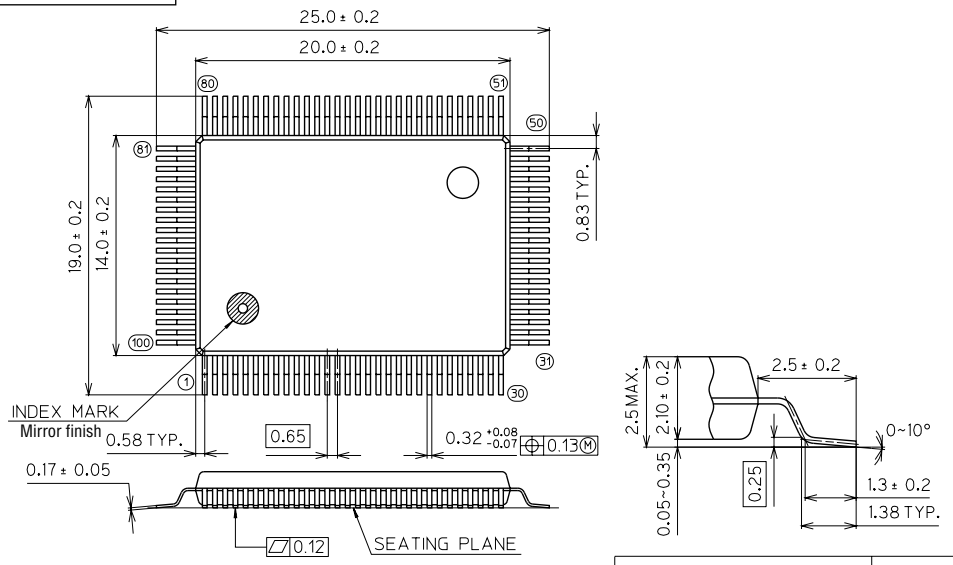
INSTRUCTION LIST (continued)

	Mnemonic	Instruction code																Description	Machine cycle
		14	13	12	11	10	9	8	7	6	5	4	3	2	1	0			
Data transfer instruction	MOV ACC, REG1	0	0	0	0	0	0	P	1	1	1	1	r_3	r_2	r_1	r_0		(rP)←(ACC)	1
	MOVD ACC, REG2	1	0	1	0	b_1	b_0	0	P_3	P_2	P_1	P_0	r_3	r_2	r_1	r_0		(rPb)←(ACC)	1
	MOV #i, REG1	0	0	1	1	1	0	P	i_3	i_2	i_1	i_0	r_3	r_2	r_1	r_0	When P=0 in bit 8, N=n+1; when P=1, N=−n.	(rP), (ACC), (Z)←i	1
	MOV REG1, ACC	0	0	0	0	0	1	P	1	1	1	1	r_3	r_2	r_1	r_0		(ACC), (Z)←(rP)	1
	MOVD REG2, ACC	1	0	1	1	b_1	b_0	0	P_3	P_2	P_1	P_0	r_3	r_2	r_1	r_0		(ACC), (Z)←(rPb)	1
	EXG REG1	0	0	0	0	0	1	P	0	0	0	0	r_3	r_2	r_1	r_0		(rP)↔(ACC)	1
	EXGD REG2	0	1	1	1	b_1	b_0	0	P_3	P_2	P_1	P_0	r_3	r_2	r_1	r_0		(rPb)↔(ACC)	1
Subroutine instruciton	CALL adrs	1	1	1	a_{11}	a_{10}	a_9	a_8	a_7	a_6	a_5	a_4	a_3	a_2	a_1	a_0		(STACK)←(PC), (PC)←a_{11} to a_0, (SP)←(SP)+1	1
	RET	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0		(PC)←(STACK)+1, (SP)←(SP)−1	1
	RTI	0	0	0	0	0	1	0	1	1	0	0	0	0	0	0		(PC)←(STACK)+1, (SP)←(SP)−1 (at INT routine)	1
Jump instruction	JMP adrs	1	1	0	a_{11}	a_{10}	a_9	a_8	a_7	a_6	a_5	a_4	a_3	a_2	a_1	a_0		(PC)←a_{11} to a_0	1
	AMP @ REG1	0	0	0	0	0	0	0	1	1	0	1	r_3	r_2	r_1	r_0		(PC)←(PC)+(rP)+1	1
	JMPO @ REG1	0	0	0	0	0	1	0	1	1	0	1	r_3	r_2	r_1	r_0		(PC)←(PC)+7∧(rP)+1	1
	BGT n	0	0	0	0	1	1	P	0	0	1	n_4	n_3	n_2	n_1	n_0		if (G)=1 then (PC)←(PC)+N else (PC)←(PC)+1	1
	BLE n	0	0	0	0	1	1	P	1	0	1	n_4	n_3	n_2	n_1	n_0		if (G)=0 then (PC)←(PC)+N else (PC)←(PC)+1	1
	BCS n	0	0	0	0	1	1	P	0	0	0	n_4	n_3	n_2	n_1	n_0		if (C)=1 then (PC)←(PC)+N else (PC)←(PC)+1	1
	BCC n	0	0	0	0	1	1	P	1	0	0	n_4	n_3	n_2	n_1	n_0		if (C)=0 then (PC)←(PC)+N else (PC)←(PC)+1	1
	BEQ n (BZE n)	0	0	0	0	1	1	P	0	1	0	n_4	n_3	n_2	n_1	n_0		if (Z)=1 then (PC)←(PC)+N else (PC)←(PC)+1	1
	BNE n (BNZ n)	0	0	0	0	1	1	P	1	1	0	n_4	n_3	n_2	n_1	n_0		if (Z)=0 then (PC)←(PC)+N else (PC)←(PC)+1	1
	BGE n	0	0	0	0	1	1	P	0	1	1	n_4	n_3	n_2	n_1	n_0		if {(G)=1 or (Z)=1} then (PC)←(PC)+N else (PC)←(PC)+1	1
	BLT n	0	0	0	0	1	1	P	1	1	1	n_4	n_3	n_2	n_1	n_0		if {(G)=0 and (Z)=0} then (PC)←(PC)+N else (PC)←(PC)+1	1
Melody start	MSA adrs *	0	0	0	0	1	0	a_8	a_7	a_6	a_5	a_4	a_3	a_2	a_1	a_0		Specifies the first address of note data. ($E00_H$~FFF_H)	2
Display instruction	DSP dig, REG1 *	0	0	0	1	0	0	P	dig_3	dig_2	dig_1	dig_0	r_3	r_2	r_1	r_0		digit (Low Part)←(rP), (ACC)	1
	DSPH dig, REG1 *	0	0	0	1	0	1	P	dig_3	dig_2	dig_1	dig_0	r_3	r_2	r_1	r_0		digit (High Part)←(rP), (ACC)	1
	DSPF dig, REG1 *	0	0	0	1	1	0	P	dig_3	dig_2	dig_1	dig_0	r_3	r_2	r_1	r_0		digit (Low Part)←(rP) via Table	2
	DSPF dig, REG1 *	0	0	0	1	1	1	P	dig_3	dig_2	dig_1	dig_0	r_3	r_2	r_1	r_0		digit (Low Part)←(rP) via Table	2
Input/output instruction	OUT REG1, PORT	0	1	0	1	0	y_4	P	y_3	y_2	y_1	y_0	r_3	r_2	r_1	r_0		(PORTy)←(rP)	1
	OUT #i, PORT	0	1	0	1	1	y_4	P	y_3	y_2	y_1	y_0	i_3	i_2	i_1	i_0		(PORTy)←i	1
	INP PORT, REG1	0	1	0	0	0	y_4	P	y_3	y_2	y_1	y_0	r_3	r_2	r_1	r_0		(rP), (ACC)←(PORTy)	1
CPU control	NOP	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		NO Operation	1
	HALT	0	0	0	0	0	1	0	0	1	1	1	0	0	0	0		HAIT CPU	1

PACKAGE DIMENSIONS

(Unit : mm)

QFP100-P-1420-0.65-K



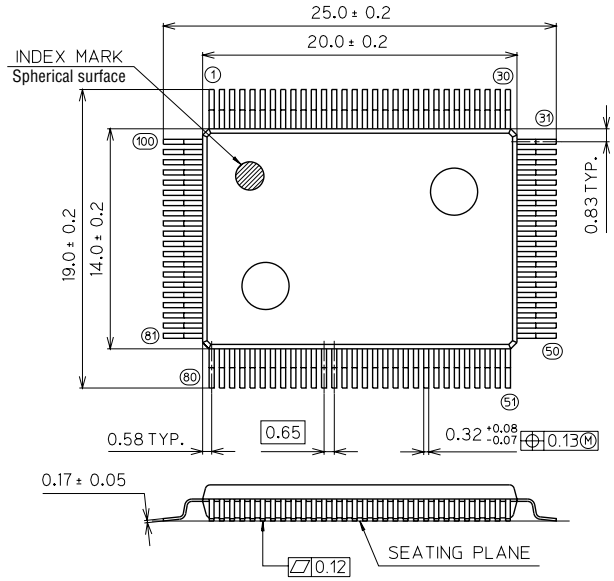
Package material	Epoxy resin
Lead frame material	42 alloy
Pin treatment	Solder plating
Solder plate thickness	5 μm or more
Package weight (g)	1.29 TYP.

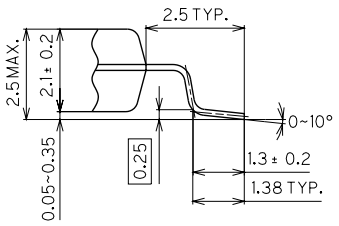
Notes for Mounting the Surface Mount Type Package

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)

QFP100-P-1420-0.65-L





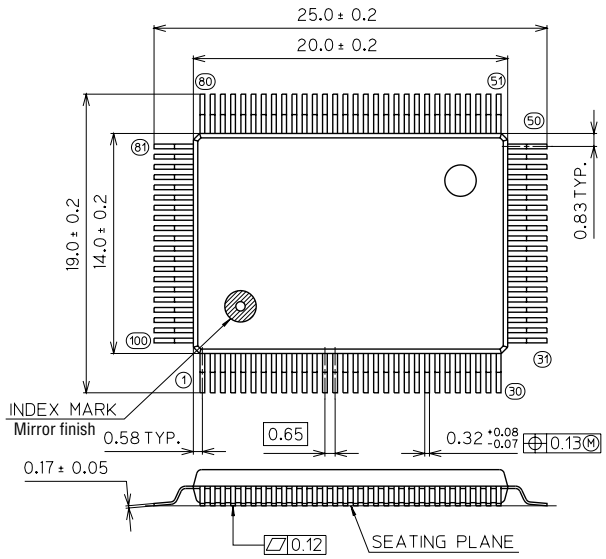
Package material	Epoxy resin
Lead frame material	42 alloy
Pin treatment	Solder plating
Solder plate thickness	5 μm or more
Package weight (g)	1.29 TYP.

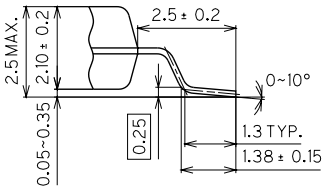
Notes for Mounting the Surface Mount Type Package

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)

QFP100-P-1420-0.65-BK





Package material	Epoxy resin
Lead frame material	42 alloy
Pin treatment	Solder plating
Solder plate thickness	5 μm or more
Package weight (g)	1.29 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).