

OKI Semiconductor

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MSM6051

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

GENERAL DESCRIPTION

The MSM6051 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, melody circuit, LCD driver, input port, and output port.

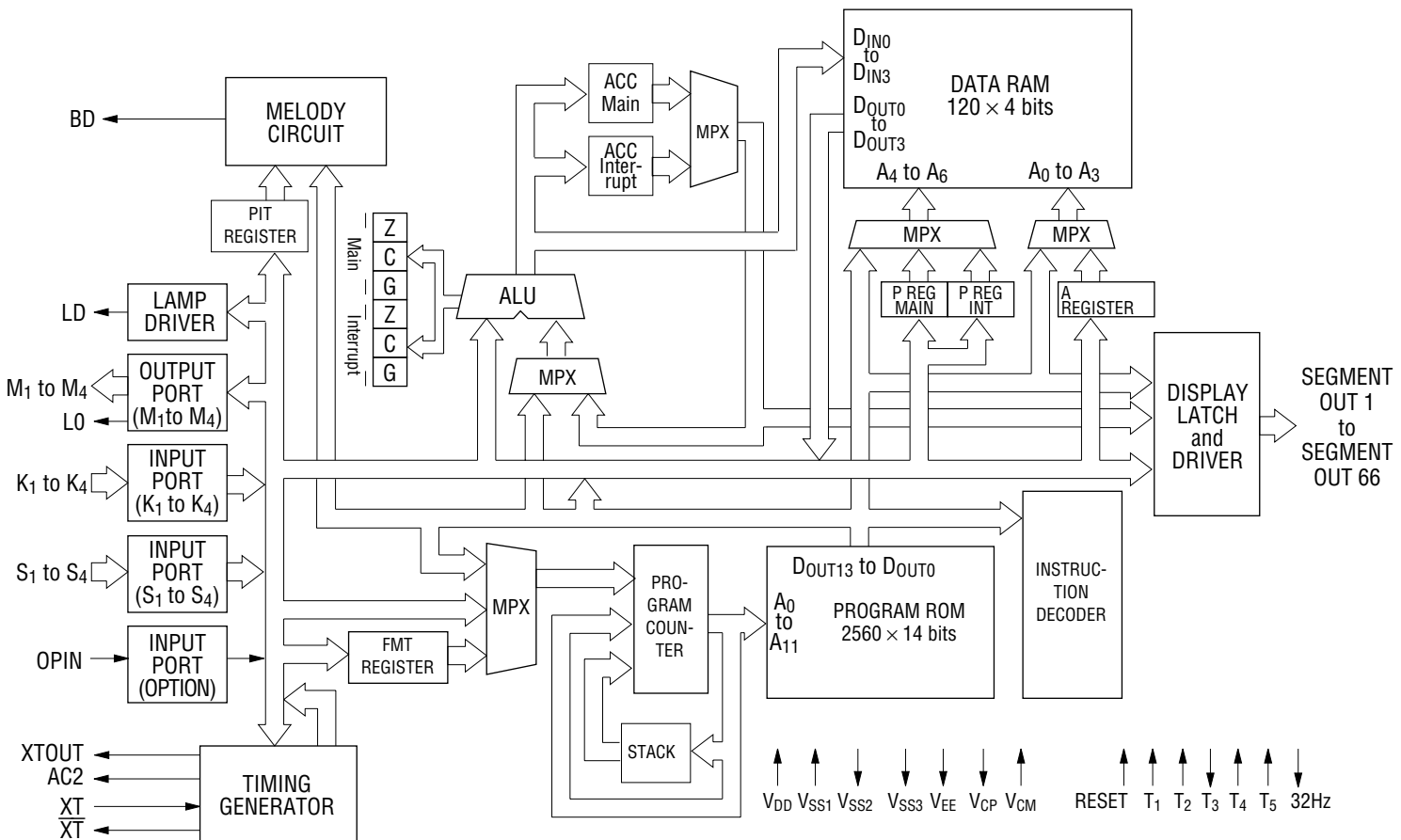
Using the on-chip ROM for application code reduces power consumption.

The MSM6051 is widely used in electronic products requiring low-power operation, such as stopwatches with lap time memory, calculator watches, and handy terminals.

FEATURES

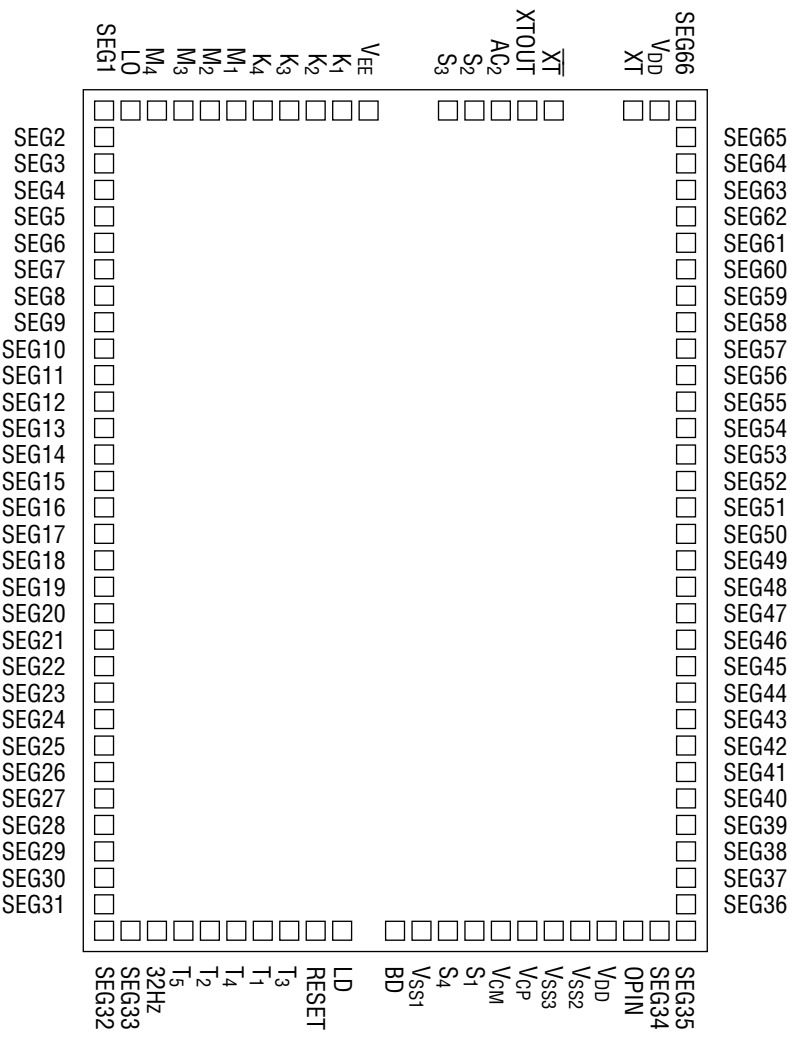
- Low power consumption
- Internal ROM : 2560 × 14 bits
- Internal RAM : 120 × 4 bits
- Input port : 2 ports × 4 bits, 1 port × 1 bit
- Output port : 1 port × 4 bits
- 4 × 4 key matrix input is available by using K₁ to K₄ and M₁ to M₄
- 66 LCD drivers (including 3 commons) (1/3 duty, 1/3 bias, 189 segments)
- 59 instructions
- Minimum instruction execution time : 91.5 μs (Display instruction cycle : 183 μs)
- 1.5 V operating voltage (Can be changed to the lithium battery version by mask option)
- Melody function : Up to 512 notes can be played automatically (with an envelope)
- Lamp drivers
- Crystal oscillator : 32.768 kHz
- Chip (102 pads)

BLOCK DIAGRAM



PAD CONFIGURATION

Pad Layout



Chip size: 5.85×4.10 (mm)

PIN DESCRIPTIONS

Symbol	Description
V_{DD}	Circuit ground potential.
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 $0.1\text{ }\mu\text{F}$ capacitor.
V_{SS3}	Power source for LCD driver (-4.5 V). This pin is connected to the V_{DD} pin through a $0.1\text{ }\mu\text{F}$ capacitor.
V_{EE}	Power source for internal logic (-1.5 to -3.0 V). This pin is connected to the V_{DD} pin through a $0.1\text{ }\mu\text{F}$ capacitor.
V_{CP}, V_{CM}	Booster capacitor connection pins. V_{CP} pin is connected to V_{CM} pin through a $0.1\text{ }\mu\text{F}$ capacitor.
$XT, \overline{XT}$	Input and output pins of oscillator inverter. 32.768 kHz crystal is connected to these pins.
T_1 to T_5	Pins to test internal logic. T_1, T_2, T_4 , and T_5 are pulled down to V_{SS1} . T_3 is an output. The test pins are normally open.
RESET	Pin to clear internal logic pulled down to V_{SS1} . After power is turned on, the MSM6051 can be reset by this pin.
BD	Buzzer output.
LD	Lamp output.
LO	Load data pin of M_1 to M_4 .
AC2	Reset pin for external circuit.
XTOUT	Clock output for external circuit.

ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	Condition	Rating	Unit
Power Supply Voltage	$V_{SS1}-V_{DD}$	$T_a = 25^{\circ}\text{C}$	-2.0 to +0.3	V
Input Voltage	V_{IN}	$T_a = 25^{\circ}\text{C}$	$V_{SS1} - 0.3$ to +0.3	V
Storage Temperature	T_{STG}	—	-55 to +125	$^{\circ}\text{C}$
Operating Temperature	T_{op}	—	-20 to +75	$^{\circ}\text{C}$

ELECTRICAL CHARACTERISTICS

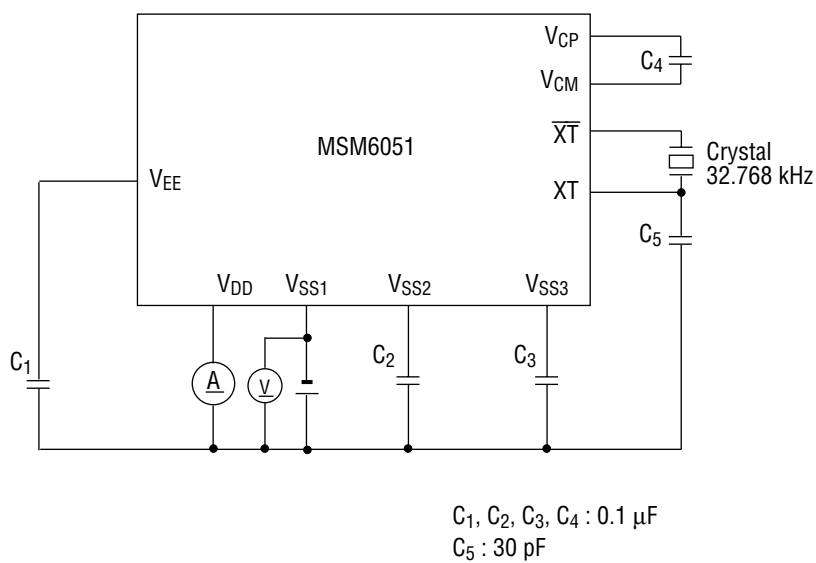
DC Characteristics

($V_{DD} = 0\text{ V}$, $V_{SS1} = V_{EE} = -1.55\text{ V}$, $V_{SS2} = -3.0\text{ V}$, $V_{SS3} = -4.5\text{ V}$, $C_I = 30\text{ k}\Omega$, $T_a = 25^{\circ}\text{C}$)

Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit
V_{SS1} Operating Voltage	$-V_{SS1}$	V_{SS1} pin	1.25	1.55	1.65	V
Power Supply Current	I_{DD}	V_{SS1} pin (Refer to Measuring Circuit)	—	3.0 *	—	μA
Oscillation Start Voltage	$-V_{OSC}$	Within 5 seconds, V_{SS1} pin (Refer to Measuring Circuit)	1.45	—	—	V
Output Current 1 COM 1 to 3	I_{OH1}	$V_{OH1} = -0.2\text{ V}$	—	—	-4	μA
	I_{OMH1}	$V_{OMH1} = V_{SS1} \pm 0.2\text{ V}$	-4	—	4	
	I_{OML1}	$V_{OML1} = V_{SS2} \pm 0.2\text{ V}$	-4	—	4	
	I_{OL1}	$V_{OL1} = -4.3\text{ V}$	4	—	—	
Output Current 2 SEGMENT	I_{OH2}	$V_{OH2} = -0.2\text{ V}$	—	—	-4	μA
	I_{OMH2}	$V_{OMH2} = V_{SS1} \pm 0.2\text{ V}$	-4	—	4	
	I_{OML2}	$V_{OML2} = V_{SS2} \pm 0.2\text{ V}$	-4	—	4	
	I_{OL2}	$V_{OL2} = -4.3\text{ V}$	4	—	—	
Output Current 3 LO	I_{OH3}	$V_{OH3} = -0.5\text{ V}$	—	—	-10	μA
	I_{OL3}	$V_{OL3} = -1.15\text{ V}$	10	—	—	
Output Current 4 M_1 to M_4	I_{OH4}	$V_{OH4} = -0.5\text{ V}$	—	—	-500	μA
	I_{OL4}	$V_{OL4} = -1.0\text{ V}$	2	—	10	
Output Current 5 LD	I_{OH5}	$V_{OH5} = -0.55\text{ V}$ $V_{SS1} = -1.25\text{ V}$ $V_{EE} = -2.0\text{ V}$	-82.5	-25	-12.5	μA
	I_{OL5}	$V_{OL5} = -0.85\text{ V}$ $V_{SS2} = -2.0\text{ V}$	1	—	—	
Output Current 6 BD	I_{OH6}	$V_{OH6} = -0.55\text{ V}$ $V_{SS1} = -1.25\text{ V}$ $V_{EE} = -2.0\text{ V}$	-51.5	-30	-17.2	μA
	I_{OL6}	$V_{OL6} = -0.85\text{ V}$ $V_{SS2} = -2.0\text{ V}$	—	5	—	
Input Current 1 S_1 to S_4	I_{IH1}	$V_{IH1} = 0\text{ V}$	2	20	100	μA
	I_{IL1}	$V_{IL1} = -1.55\text{ V}$	-0.2	—	—	
Input Current 2 K_1 to K_4	I_{IH2}	$V_{IH2} = 0\text{ V}$	5	13	26	μA
	I_{IL2}	$V_{IL2} = -1.55\text{ V}$	-0.2	—	—	
Input Current 3 OPIN	I_{IH3}	$V_{IH3} = 0\text{ V}$	—	30	45	μA
	I_{IL3}	$V_{IL3} = -1.55\text{ V}$	-0.2	—	—	
Built-in CD Capacitance	CD	—	—	20	—	pF

* The typ. value varies depending on the application program.

Measuring circuit



APPLICATION CIRCUIT

