19-3492; Rev 1; 3/07

Silicon Oscillator with Low-Power Frequency Select and Enable

General Description

The MAX7383 dual-speed silicon oscillator replaces ceramic resonators, crystals, and crystal-oscillator modules as the primary and secondary clock source for microcontrollers in 3V, 3.3V, and 5V applications. The MAX7383 features a factory-programmed high-speed oscillator, a 32.768kHz oscillator, a clock enable input, and a clock-selector input. The clock output can be switched at any time between the high-speed clock and the 32.768kHz clock for low-power operation. Switchover is synchronized internally to provide glitch-free clock switching.

Unlike typical crystal and ceramic-resonator oscillator circuits, the MAX7383 is resistant to vibration and EMI. The high-output-drive current and absence of high-impedance nodes makes the oscillator less susceptible to dirty or humid operating conditions. With a wide operating temperature range, the MAX7383 is a good choice for demanding home appliance and automotive environments.

The MAX7383 is available with factory-programmed frequencies ranging from 10MHz to 16MHz. See Table 1 for standard frequencies and contact the factory for custom frequencies and UVLO thresholds.

The MAX7383 is available in a 5-pin SOT23 package. The MAX7383 operating temperature range is -40°C to +125°C.

Applications

White Goods

Automotive

Consumer Products

Appliances and Controls

Handheld Products

Portable Equipment

Microcontroller Systems

Pin Configuration appears at end of data sheet.

Features

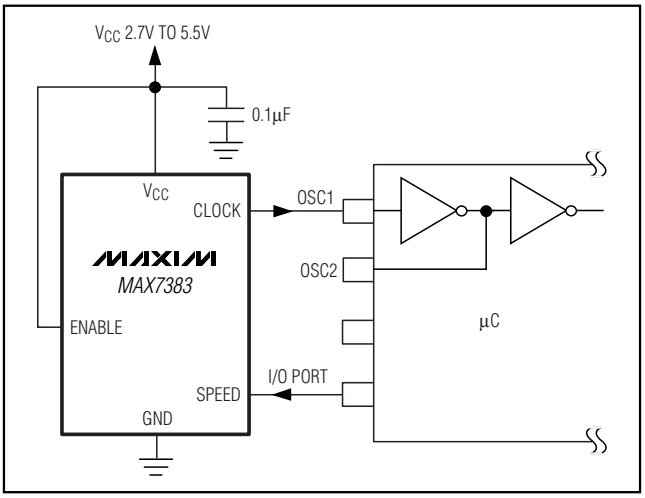
- **2.7V to 5.5V Operation**
- **High-Speed Oscillator from 10MHz to 16MHz**
- **Low-Speed 32.768kHz Oscillator**
- **Glitch-Free Clock-Speed Switching**
- **±10mA Clock-Output Drive Capability**
- **2.5% Initial Accuracy**
- **±50ppm/°C (typ) Frequency Drift**
- **50% Duty Cycle**
- **5ns Output Rise and Fall Time**
- **Clock Enable Input**
- **4mA Operating Current at 16MHz**
- **13µA Operating Current at 32.768kHz**
- **Typical 0.5µA Shutdown Supply Current**
- **-40°C to +125°C Temperature Range**
- **Small 5-Pin SOT23 Package**

Ordering Information

PART*	TEMP RANGE	PIN-PACKAGE	PKG CODE
MAX7383AX _ _-T	-40°C to +125°C	5 SOT23-5	U5-2

**The first two letters are AX. Insert the two-letter suffix from Table 1 in the remaining two positions for the desired frequency range and see Table 2 for all standard part numbers.*

Typical Operating Circuit



Silicon Oscillator with Low-Power Frequency Select and Enable

ABSOLUTE MAXIMUM RATINGS

V_{CC} to GND .....-0.3V to +6.0V
All Other Pins to GND.....-0.3V to (V_{CC} + 0.3V)
CLOCK Current .....±50mA
Input Current (SPEED, ENABLE).....±50mA
Continuous Power Dissipation (T_A = +70°C)
5-Pin SOT23 (derate 7.1mW/°C above +70°C)....571mW (U5-2)

Operating Temperature Range .....-40°C to +125°C
Junction Temperature.....+150°C
Storage Temperature Range.....-65°C to +150°C
Lead Temperature (soldering, 10s).....+300°C

Stresses beyond those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

ELECTRICAL CHARACTERISTICS

(*Typical Operating Circuit*, V_{CC} = 3.0V to 5.5V, T_A = -40°C to +125°C. Typical values are at V_{CC} = 5.0V, T_A = +25°C, unless otherwise noted.) (Notes 1 and 2)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
Operating Supply Voltage	V_{CC}		2.7		5.5	V
Operating Supply Current	I_{CC}	f_{CLOCK} = 16MHz, V_{CC} = 5.5V, no load			8.7	mA
		f_{CLOCK} = 14MHz, V_{CC} = 5.5V, no load			8.0	
		f_{CLOCK} = 12MHz, V_{CC} = 5.5V, no load			6.5	
		f_{CLOCK} = 11MHz, V_{CC} = 5.5V, no load			6.0	
		f_{CLOCK} = 10MHz, V_{CC} = 5.5V, no load			5.4	
		f_{CLOCK} = 32.768kHz, V_{CC} = 5.5V, no load		13	25	µA
Shutdown Supply Current	I_{SHDN}	ENABLE = 0V		0.5	1	µA
LOGIC INPUTS (SPEED, ENABLE)						
Input High Voltage	V_{IH}		0.7 x V_{CC}			V
Input Low Voltage	V_{IL}				0.3 x V_{CC}	V
Input Current	I_{IN}	V_{CC} = V_{SPEED} = V_{ENABLE} = 5.5V			2	µA
CLOCK OUTPUT						
Output High Voltage	V_{OH}	V_{CC} = 4.5V, I_{SOURCE} = 7.0mA	V_{CC} - 0.4			V
		V_{CC} = 3.0V, I_{SOURCE} = 2.0mA				
Output Low Voltage	V_{OL}	V_{CC} = 4.5V, I_{SINK} = 20mA			0.4	V
		V_{CC} = 3.0V, I_{SINK} = 10mA				
Fast Clock Frequency Accuracy	f_{CLOCK}	V_{CC} = 3.3V, T_A = +25°C, deviation from nominal frequency	-2.5		+2.5	%
		T_A = +25°C, deviation from nominal frequency	-5.0		+3.5	
Fast Clock Temperature Coefficient		(Note 3)		±100	±550	ppm/°C
Slow Clock Frequency	f_{CLOCK}	V_{CC} = 3.3V, T_A = +25°C	32.268	32.768	33.268	kHz
		T_A = +25°C	31.768	32.768	33.768	
Slow Clock Temperature Coefficient		(Note 3)		±50	±325	ppm/°C

ELECTRICAL CHARACTERISTICS (continued)

(*Typical Operating Circuit*, V_{CC} = 3.0V to 5.5V, T_A = -40°C to +125°C. Typical values are at V_{CC} = 5.0V, T_A = +25°C, unless otherwise noted.) (Notes 1 and 2)

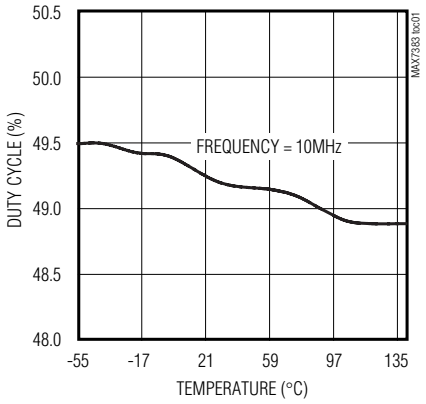
PARAMETER	SYMBOL	CONDITIONS		MIN	TYP	MAX	UNITS
Duty Cycle		(Note 3)		40	50	60	%
Output Period Jitter	J_P	f_{OUT} = 16MHz; ±6σ period jitter			±240		ps
Output Rise Time	t_R	10% to 90%, C_L = 10pF			5		ns
Output Fall Time	t_F	90% to 10%, C_L = 10pF			5		ns
Undervoltage Lockout Threshold Accuracy		V_{CC} rising, deviation from nominal threshold V_{TH} = 2.89V	T_A = +25°C	-2		+2	%
				-5		+5	
UVLO Hysteresis		Difference between rising and falling thresholds			1		%

Note 1: All parameters tested at T_A = +25°C. Specifications over temperature are guaranteed by design.
Note 2: Oscillator is enabled when $V_{CC} > V_{TH}$.
Note 3: Guaranteed by design. Not production tested.

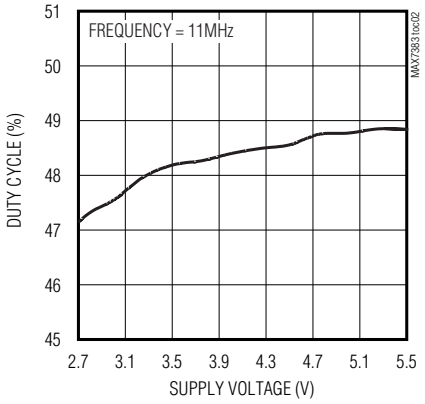
Typical Operating Characteristics

($V_{CC} = V_{ENABLE} = V_{SPEED}$ = 5V, T_A = +25°C, frequency = 10MHz, unless otherwise noted.)

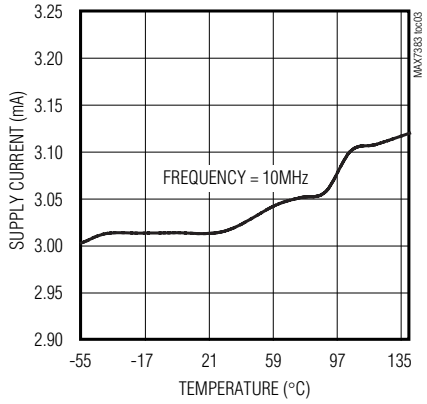
DUTY CYCLE vs. TEMPERATURE



DUTY CYCLE vs. SUPPLY VOLTAGE



SUPPLY CURRENT vs. TEMPERATURE

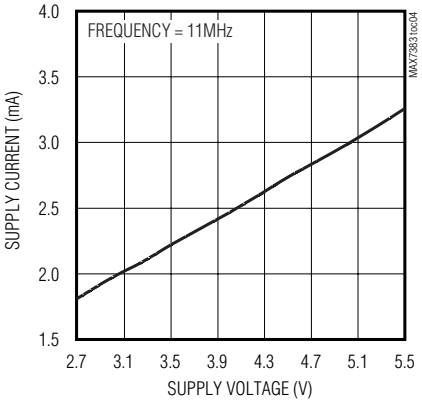


Silicon Oscillator with Low-Power Frequency Select and Enable

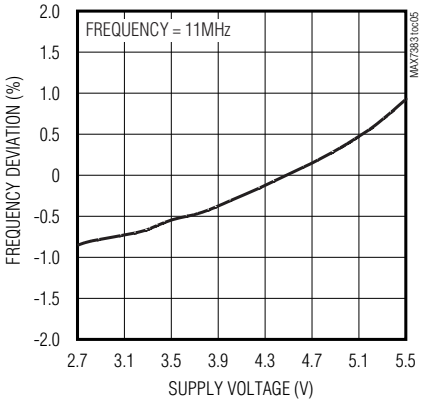
Typical Operating Characteristics (continued)

(V_{CC} = V_{ENABLE} = V_{SPEED} = 5V, T_A = +25°C, frequency = 10MHz, unless otherwise noted.)

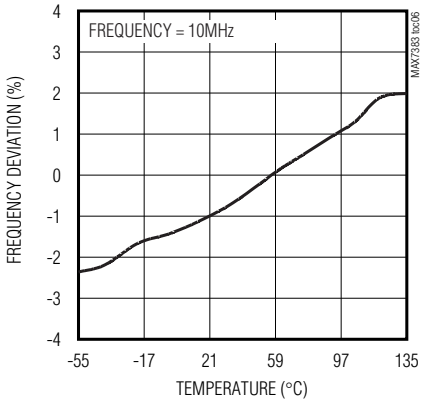
SUPPLY CURRENT vs. SUPPLY VOLTAGE



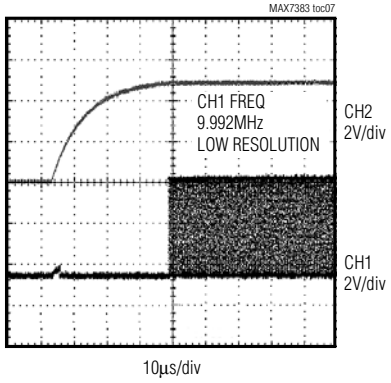
FREQUENCY DEVIATION vs. SUPPLY VOLTAGE



FREQUENCY DEVIATION vs. TEMPERATURE

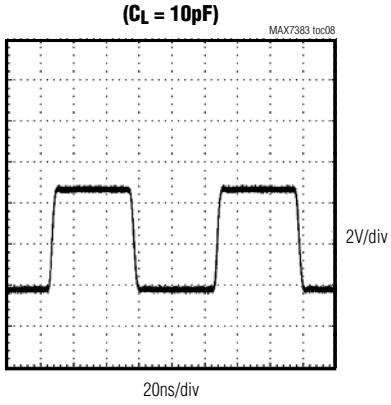


SETTLING TIME FROM START

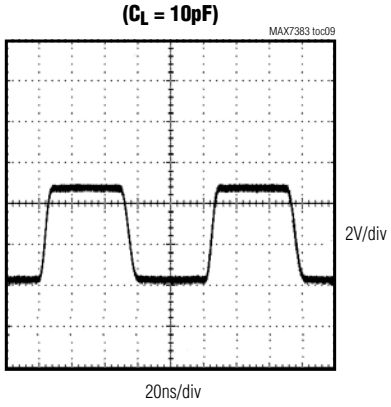


CHANNEL 1 = CLOCK, CHANNEL 2 = V_{CC}

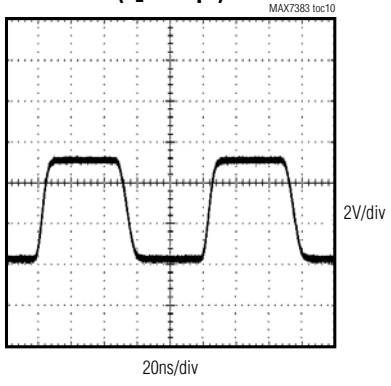
CLOCK OUTPUT WAVEFORM (C_L = 10pF)



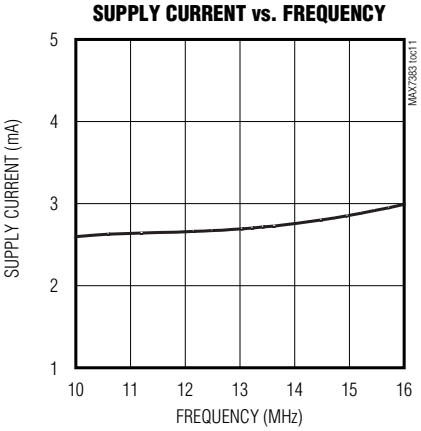
CLOCK OUTPUT WAVEFORM (C_L = 10pF)



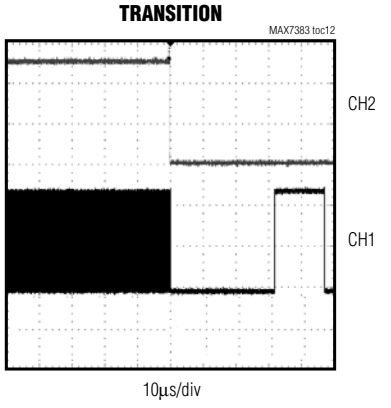
CLOCK OUTPUT WAVEFORM (C_L = 100pF)



SUPPLY CURRENT vs. FREQUENCY



HIGH-SPEED TO LOW-SPEED TRANSITION

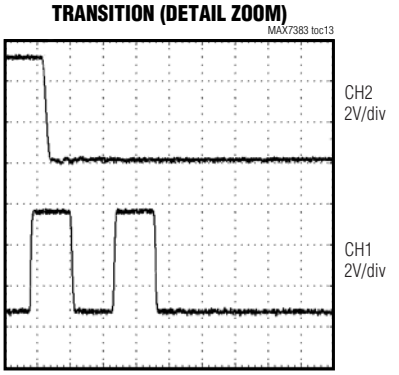


CHANNEL 1 = CLOCK, CHANNEL 2 = SPEED

Typical Operating Characteristics (continued)

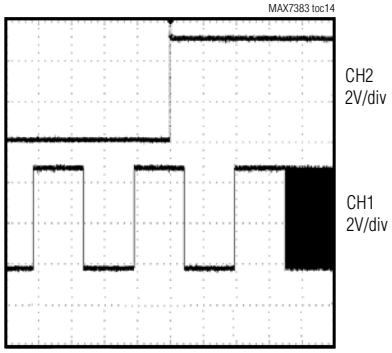
(V_{CC} = V_{ENABLE} = V_{SPEED} = 5V, T_A = +25°C, frequency = 10MHz, unless otherwise noted.)

HIGH-SPEED TO LOW-SPEED TRANSITION (DETAIL ZOOM)



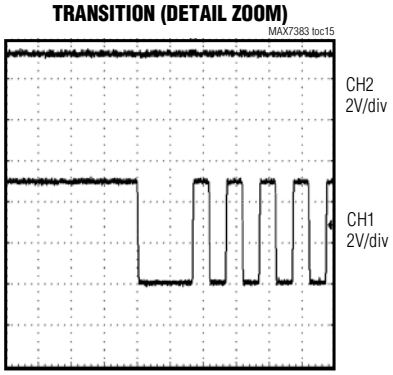
CHANNEL 1 = CLOCK, CHANNEL 2 = SPEED

LOW-SPEED TO HIGH-SPEED TRANSITION



CHANNEL 1 = CLOCK, CHANNEL 2 = SPEED

LOW-SPEED TO HIGH-SPEED TRANSITION (DETAIL ZOOM)



CHANNEL 1 = CLOCK, CHANNEL 2 = SPEED

Pin Description

PIN	NAME	FUNCTION
1	CLOCK	Push-Pull Clock Output
2	GND	Ground
3	SPEED	Clock Speed Select Input. Drive SPEED low to select the 32.768kHz fixed frequency. Drive SPEED high to select the factory-trimmed frequency.
4	V_{CC}	Positive Supply Voltage. Bypass V_{CC} to GND with a 0.1µF capacitor.
5	ENABLE	Active-High Clock Enable Input. See the *ENABLE Input* section for more details.

Silicon Oscillator with Low-Power Frequency Select and Enable

Detailed Description

The MAX7383 is a dual-speed clock generator for microcontrollers (µCs) and UARTs in 3V, 3.3V, and 5V applications. The MAX7383 is a replacement for two crystal-oscillator modules, crystals, or ceramic resonators. The high-speed clock frequency is factory programmed to specific values (see Tables 1 and 2). A variety of popular standard frequencies are available. The low-speed clock frequency is fixed at 32.768kHz. No external components are required for setting or adjusting the frequency.

Oscillator

The push-pull clock output is enabled when V_{CC} > 2.89V and drives a load to within 400mV of either supply rail. The clock output remains stable over the full operating voltage range and does not generate short output cycles during either power-on or changing of the frequency. A typical oscillating startup is shown in the *Typical Operating Characteristics*.

ENABLE Input

The MAX7383 has an active-high enable input that controls the clock and reset outputs. The clock output is driven low when the device is disabled. Drive ENABLE low to disable the clock output on the next rising edge. Drive ENABLE high to activate the clock output.

Clock-Speed Selection

Drive SPEED low to select slow clock speed (nominally 32.768kHz) or high to select full clock speed. SPEED can be connected to V_{CC} or to GND to select fast or slow clock speed, or connected to a logic output (such as a µP GPIO port) used to change clock speed on the fly. If SPEED is connected to a µP GPIO port, connect a pullup or pulldown resistor to set the clock to the preferred speed on power-up. SPEED input bias current is 2µA max, so a resistor value as high as 100kΩ can be used.

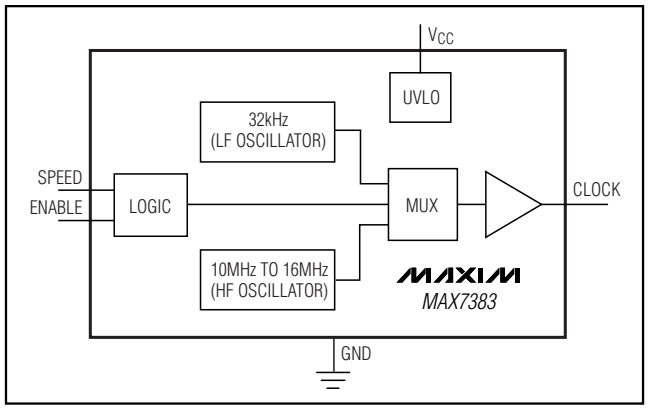


Figure 1. Functional Diagram

Table 1. Standard Frequencies

SUFFIX	STANDARD FREQUENCY (MHz)
UK	10
UT	11
VB	12
VT	14
WB	16

For all other frequency options, contact factory.

Table 2. Standard Part Numbers

PART	FREQUENCY (MHz)	TOP MARK
MAX7383AXUK	10	AEVN
MAX7383AXUT	11	AEVO
MAX7383AXVB	12	AEVP
MAX7383AXVT	14	AEVQ
MAX7383AXWB	16	AEVT

Applications Information

Interfacing to a Microcontroller Clock Input

The MAX7383 clock output is a push-pull, CMOS, logic output that directly drives a µP or µC clock input. There are no impedance-matching issues when using the MAX7383. Refer to the microcontroller data sheet for clock input compatibility with external clock signals. The MAX7383 requires no biasing components or load capacitance. When using the MAX7383 to retrofit a crystal oscillator, remove all biasing components from the oscillator input.

Output Jitter

The MAX7383's jitter performance is given in the *Electrical Characteristics* table as a ±6σ period jitter. Jitter measurements are approximately proportional to the period of the output of the device. The jitter performance of all clock sources degrades in the presence of mechanical and electrical interference. The MAX7383 is relatively immune to vibration, shock, and EMI influences and thus provides a considerably more robust clock source than crystal or ceramic resonator-based oscillator circuits.

Initial Power-Up and Operation

An internal-undervoltage lockout function holds the clock output low until the supply voltage has risen above 2.89V. The clock output then starts at the frequency selected by SPEED.

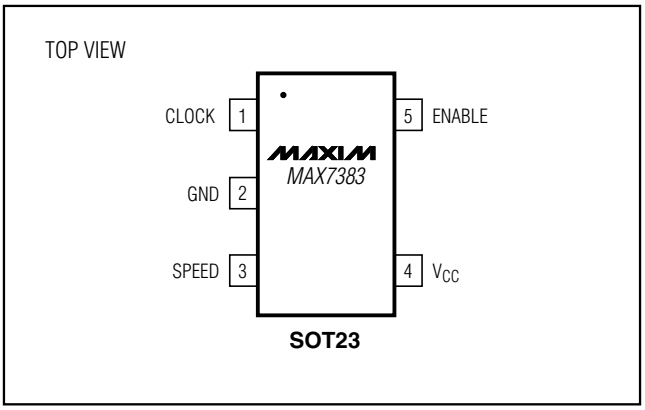
Power-Supply Considerations

The MAX7383 operates with power-supply voltages from 2.7V and 5.5V. Good power-supply decoupling is needed to maintain the power-supply rejection performance of the MAX7383. Bypass V_{CC} to GND with a 0.1µF surface-mount ceramic capacitor. Mount the bypassing capacitor as close to the device as possible. Use a larger value of bypass capacitor recommended if the MAX7383 is to operate with a large capacitive load. Use a bypass capacitor value of at least 1000 times that of the output load capacitance.

Chip Information

PROCESS: BiCMOS

Pin Configuration

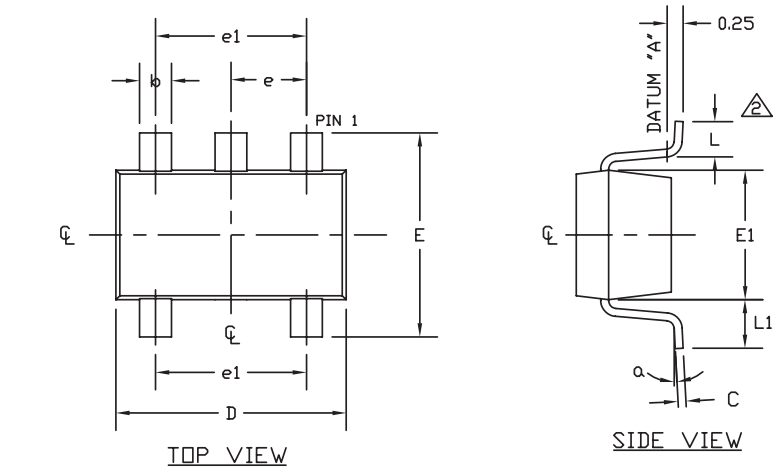


Silicon Oscillator with Low-Power Frequency Select and Enable

Package Information

(The package drawing(s) in this data sheet may not reflect the most current specifications. For the latest package outline information, go to **www.maxim-ic.com/packages**.)

SOT-23 5L .EPS



SYMBOL	MIN	NOM	MAX
A	0.90	1.25	1.45
A1	0.00	0.05	0.15
A2	0.90	1.10	1.30
b	0.35	0.40	0.50
C	0.08	0.15	0.20
D	2.80	2.90	3.00
E	2.60	2.80	3.00
E1	1.50	1.625	1.75
L	0.35	0.45	0.60
L1	0.60 REF		
e	0.95 BSC.		
e1	1.90 BSC.		
a	0°	2.5°	8°
PKG CODES: U5-1, U5-2			

NOTES:
1. ALL DIMENSIONS ARE IN MILLIMETERS.
2. FOOT LENGTH MEASURED AT INTERCEPT POINT BETWEEN DATUM A & LEAD SURFACE.
3. PACKAGE OUTLINE EXCLUSIVE OF MOLD FLASH & METAL BURR. MOLD FLASH, PROTRUSION OR METAL BURR SHOULD NOT EXCEED 0.25 MM.
4. PACKAGE OUTLINE INCLUSIVE OF SOLDER PLATING.
5. MEETS JEDEC MO178, VARIATION AA.
6. LEADS TO BE COPLANAR WITHIN 0.10 mm.
7. SOLDER THICKNESS MEASURED AT FLAT SECTION OF LEAD BETWEEN 0.08mm AND 0.15mm FROM LEAD TIP.

DALLAS SEMICONDUCTOR MAXIM
PROPRIETARY INFORMATION

TITLE: PACKAGE OUTLINE, SOT-23, 5L

APPROVAL	DOCUMENT CONTROL NO.	REV.	
	21-0057	F	1/1

Revision History

Pages changed at Rev 1: 1–8