MAXIM

Silicon Oscillator with Low-Power Frequency Switching

MAX7383

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, 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 as standard, 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 32MHz. See Table 1 for standard frequencies and contact the factory for custom frequencies. Refer to the MAX7377 data sheet for frequencies less than 10MHz.

The MAX7383 is available in a 5-pin SOT23 package. The MAX7383 standard operating temperature range is -40°C to +125°C. See the *Applications Information* section for extended operating temperature range.

Applications

White Goods

Automotive

Consumer Products

Appliances and Controls

Handheld Products

Portable Equipment

Microcontroller Systems
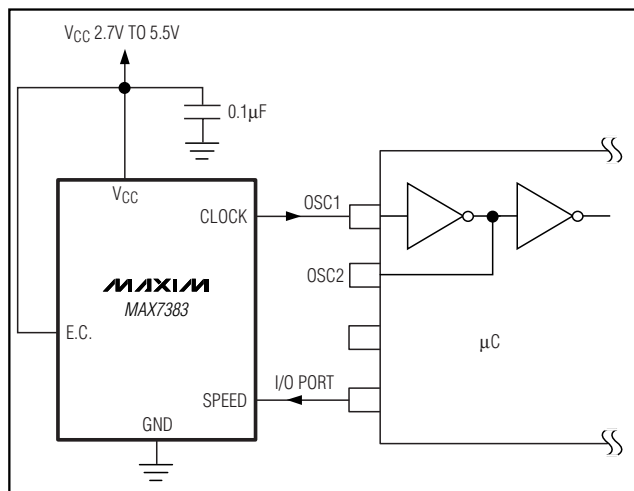
Features

♦ **2.7V to 5.5V Operation**

♦ **High-Speed Oscillator from 10MHz to 32MHz**
   Low-Speed 32kHz 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**

♦ **Low Jitter: 80ps$_{P-P}$ at 16MHz**

♦ **4mA Operating Current at 16MHz**

♦ **13µA, 32kHz Operating Current**

♦ **-40°C to +125°C Temperature Range**

♦ **Small 5-Pin SOT23 Package**

Ordering Information

PART*	TEMP RANGE	PIN-PACKAGE	RESET OUTPUT
MAX7383AX _ _-T	-40°C to +125°C	5 SOT23-5	Active high push-pull

The first two letters are AX. Insert the two-letter code from Table 2 in the remaining two positions for the desired frequency range. Insert the two-letter code from Table 1 in the remaining two positions for the desired frequency range. Table 1 is located at the end of the data sheet.

Typical Operating Circuit

Pin Configuration appears at end of data sheet.

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ABSOLUTE MAXIMUM RATINGS

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

Operating Temperature Range ....-55°C to +135°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} = 2.7V to 5.5V, V_L = V_{CC}, T_A = -40°C to +125°C. Typical values are at V_{CC} = 5.0V, T_A = +25°C, unless otherwise noted.) (Note 1)

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, T_A = -40°C to +125°C, no load			8.7	mA
		f_{CLOCK} = 14.7456MHz, T_A = -40°C to +125°C, no load			8.0	
		f_{CLOCK} = 12MHz, T_A = -40°C to +125°C, no load			6.5	
		f_{CLOCK} = 11.0592MHz, T_A = -40°C to +125°C, no load			6.0	
		f_{CLOCK} = 10MHz, T_A = -40°C to +125°C, no load			5.4	
		f_{CLOCK} = 32.768kHz, T_A = -40°C to +125°C, no load		13	25	µA
LOGIC INPUTS (SPEED)						
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} SPEED = 5.5V			2	µA
CLOCK OUTPUT						
Output High Voltage	V_{OH}	V_L = 4.5V, I_{SOURCE} = 7.0mA	V_L - 0.4			V
		V_L = 2.7V, I_{SOURCE} = 2.0mA				
Output Low Voltage	V_{OL}	V_L = 4.5V, I_{SINK} = 20mA			0.4	V
		V_L = 2.7V, I_{SINK} = 10mA				
Fast Clock Frequency Accuracy	f_{CLOCK}	V_{CC} = 5V, T_A = +25°C, deviation from selected frequency	-2.5		+2.5	%
		V_{CC} = 2.7V to 5.5V, T_A = +25°C, deviation from selected frequency	-5.0		+3.5	
Fast Clock Temperature Coefficient		T_A = -40°C to +125°C		±50	±350	ppm/°C

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ELECTRICAL CHARACTERISTICS (continued)

(*Typical Operating Circuit*, V_{CC} = 2.7V to 5.5V, V_L = V_{CC}, T_A = -40°C to +125°C. Typical values are at V_{CC} = 5.0V, T_A = +25°C, unless otherwise noted.) (Note 1)

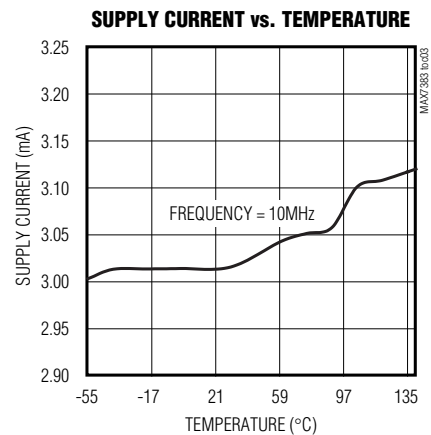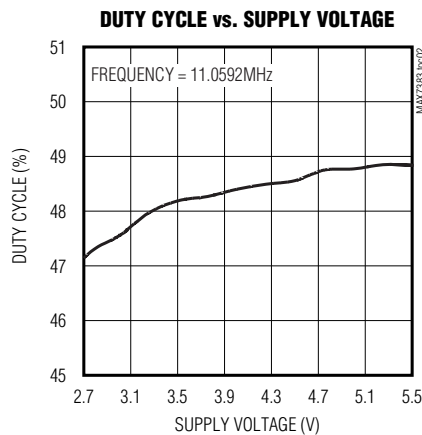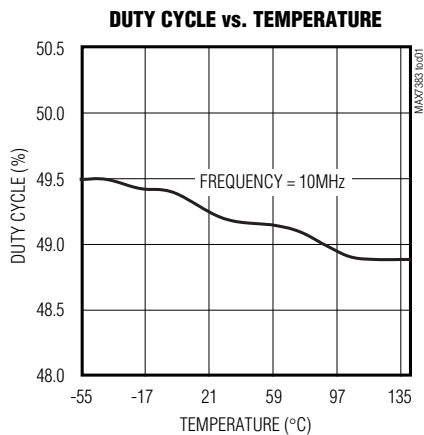| PARAMETER	SYMBOL	CONDITIONS		MIN	TYP	MAX	UNITS
Slow Clock Frequency	f_{CLOCK}	V_{CC} = 5V, T_A = +25°C		32.268	32.768	33.268	kHz
		V_{CC} = 2.7V to 5.5V, T_A = +25°C		31.768	32.768	33.768	
Slow Clock Temperature Coefficient		T_A = -40°C to +125°C			±50	±325	ppm/°C
Duty Cycle		(Note 2)		40	50	60	%
Output Jitter		Observation of 16MHz for 20s using a 500MHz oscilloscope			80		psP-P
Output Rise Time	t_R	10% to 90%				5	ns
Output Fall Time	t_F	90% to 10%				5	ns
Undervoltage Lockout Threshold	V_{TH}	V_{CC} rising, deviation from nominal threshold	T_A = +25°C	2.45		2.55	%
			T_A = -40°C to +125°C	2.37		2.63	
Undervoltage Lockout Hysteresis	HYST	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: Guaranteed by design. Not production tested.

_____**Typical Operating Characteristics**

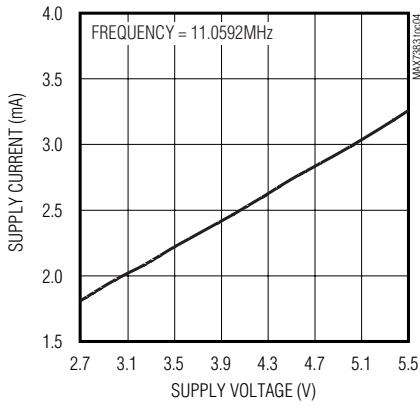(V_{CC} = V_L = 5V, T_A = +25°C, frequency = 10MHz, unless otherwise noted.)

DUTY CYCLE vs. TEMPERATURE

DUTY CYCLE vs. SUPPLY VOLTAGE

SUPPLY CURRENT vs. TEMPERATURE

Silicon Oscillator with Low-Power Frequency Switching

(V_{CC} = V_L = 5V, T_A = +25°C, frequency = 10MHz, unless otherwise noted.)
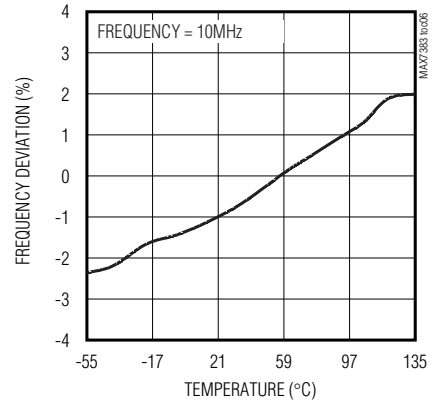
SUPPLY CURRENT vs. SUPPLY VOLTAGE
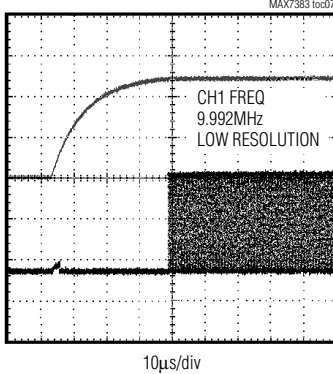
FREQUENCY DEVIATION vs. SUPPLY VOLTAGE
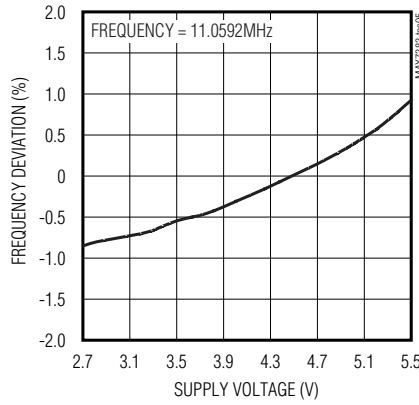
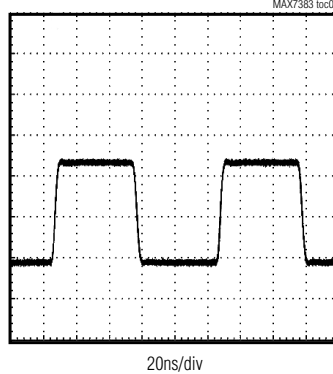**FREQUENCY DEVIATION vs. TEMPERATURE**
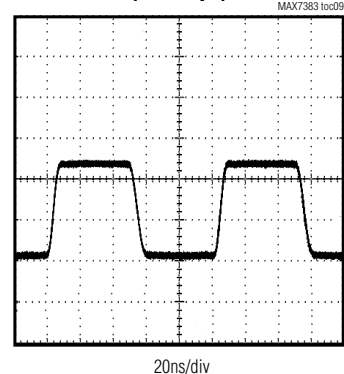
SETTLING TIME FROM START

CH1 FREQ
9.992MHz
LOW RESOLUTION

10µs/div

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

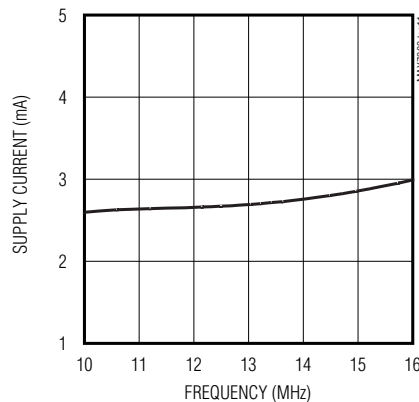**CLOCK OUTPUT WAVEFORM (C_L = 10pF)**

20ns/div

CLOCK OUTPUT WAVEFORM (C_L = 10pF)
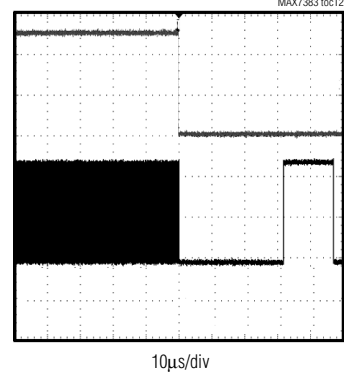
20ns/div

CLOCK OUTPUT WAVEFORM (C_L = 100pF)

20ns/div
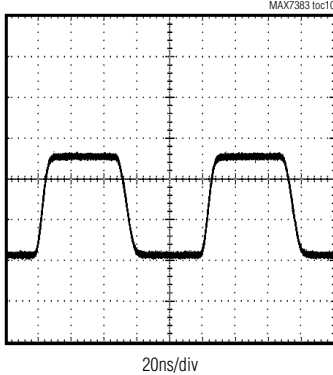
SUPPLY CURRENT vs. FREQUENCY

HIGH-SPEED TO LOW-SPEED TRANSITION

10µs/div

CHANNEL 1 = CLOCK, CHANNEL 2 = SPEED

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_____Typical Operating Characteristics (continued)

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

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

MAX7383 toc13

40ns/div

CHANNEL 1 = CLOCK, CHANNEL 2 = SPEED
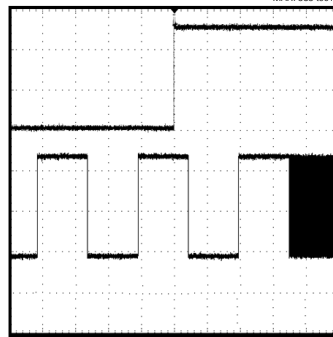
LOW-SPEED TO HIGH-SPEED TRANSITION

MAX7383 toc14

10µs/div

CHANNEL 1 = CLOCK, CHANNEL 2 = SPEED

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

MAX7383 toc15
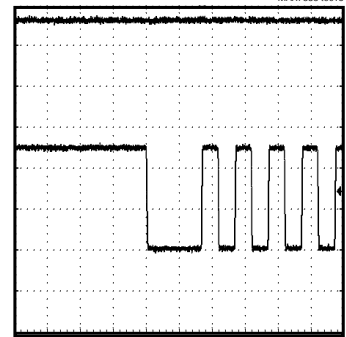
100ns/div

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 32kHz 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	E.C.	Externally Connected. Connect to Vcc.

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_____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 trimmed to specific values. A variety of popular standard frequencies are available. The low-speed clock frequency is fixed at 32.768kHz. See Table 1. No external components are required for setting or adjusting the frequency.

Oscillator
The push-pull clock output 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 start-up is shown in the _Typical Operating Characteristics_.

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 500kΩ can be used.

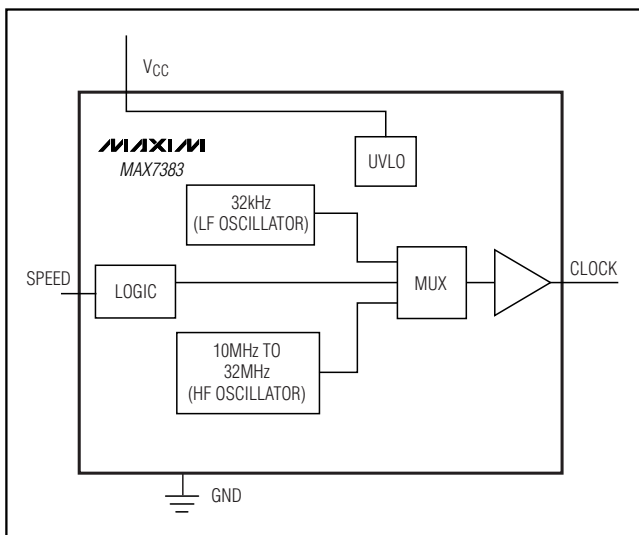## Table 1. Standard Frequencies

SUFFIX	STANDARD FREQUENCY (MHz)
UK	10
UT	11.0592
VB	12
VT	14.7456
WB	16
YN	32

For all other frequency options, contact factory.

Table 2. Standard Part Numbers

PART	FREQUENCY (MHz)	TOP MARK
MAX7383AXUK	10	AEVN
MAX7383AXUT	11.0592	AEVO
MAX7383AXVB	12	AEVP
MAX7383AXVT	14.7456	AEVQ
MAX7383AXWB	16	AEVT
MAX7383AXYN*	32	AEVS

*Contact factory for availability.

_____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 peak-to-peak value obtained by observing the output of the MAX7383 for 20s with a 12GHz oscilloscope. Jitter measurements are approximately proportional to the period of the output of the device. Thus, a 10MHz device has approximately twice the jitter value of a 20MHz 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

Figure 1. Functional Diagram

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MAX7383

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 2.5V. The clock output then starts at the frequency selected by SPEED.

Extended Temperature Operation
The MAX7383 was tested to +135°C during product characterization and shown to function normally at this temperature (see the *Typical Operating Characteristics*). However, production test and qualification is only performed from -40°C to +125°C at this time. Contact the factory if operation outside this range is required.
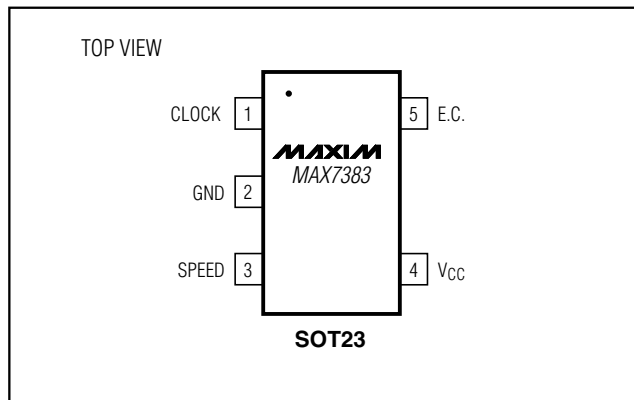
Power-Supply Considerations
The MAX7383 operates with power-supply voltages from 2.7V and 5.5V. Good power-supply decoupling is needed to maintain the power-supply rejection performance of the MAX7383. Bypass V_{CC} to GND with a 0.1µF surface-mount ceramic capacitor. Mount the bypassing capacitor as 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
TRANSISTOR COUNT: 2937
PROCESS: BiCMOS

Pin Configuration

TOP VIEW

```
          ┌───────────┐
          │    •      │
  CLOCK  1│           │5  E.C.
          │  MAXIM    │
          │  MAX7383  │
   GND   2│           │
          │           │
  SPEED  3│           │4  V_CC
          └───────────┘
             SOT23
```
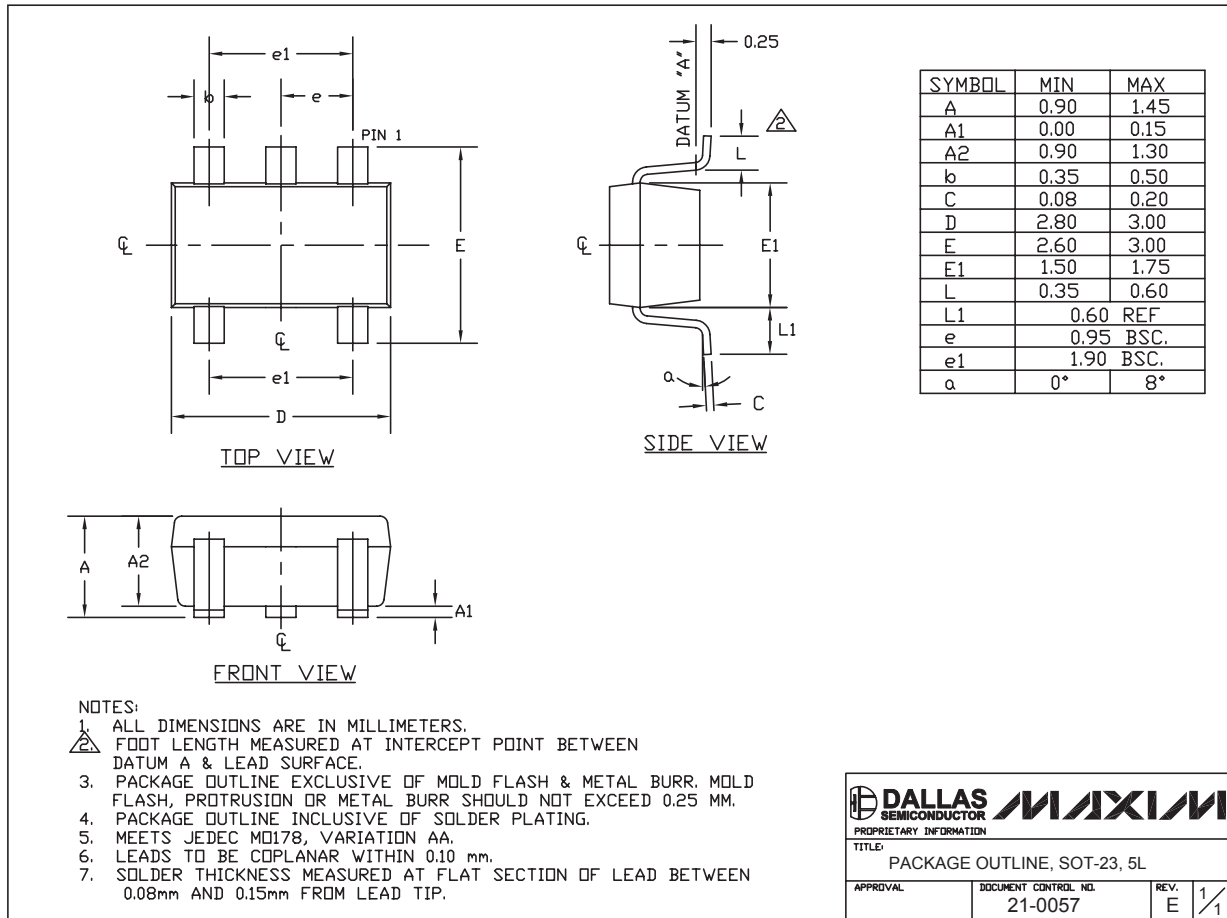
Silicon Oscillator with Low-Power Frequency Switching

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**.)

SYMBOL	MIN	MAX
A	0.90	1.45
A1	0.00	0.15
A2	0.90	1.30
b	0.35	0.50
C	0.08	0.20
D	2.80	3.00
E	2.60	3.00
E1	1.50	1.75
L	0.35	0.60
L1	0.60 REF	
e	0.95 BSC.	
e1	1.90 BSC.	
α	0°	8°

TOP VIEW

SIDE VIEW

FRONT VIEW

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	E	1/1

SOT-23 5L.EPS