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19-3491; Rev 1; 3/07

Silicon Oscillator with Reset Output and Enable

General Description

The MAX7382 silicon oscillator replaces ceramic resonators, crystals, and crystal-oscillator modules as the clock source for microcontrollers in 3V, 3.3V, and 5V applications. The MAX7382 features a factory-programmed oscillator, a microprocessor (µP) power-on-reset (POR) supervisor, and a clock enable input.

Unlike typical crystal and ceramic-resonator oscillator circuits, the MAX7382 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 MAX7382 is a good choice for demanding home appliance and automotive environments.

The MAX7382 is available with factory-programmed frequencies ranging from 10MHz to 16MHz. See Table 2 for standard frequencies and contact the factory for custom frequencies and POR thresholds.

The MAX7382 is available in a 5-pin SOT23 package. The MAX7382 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

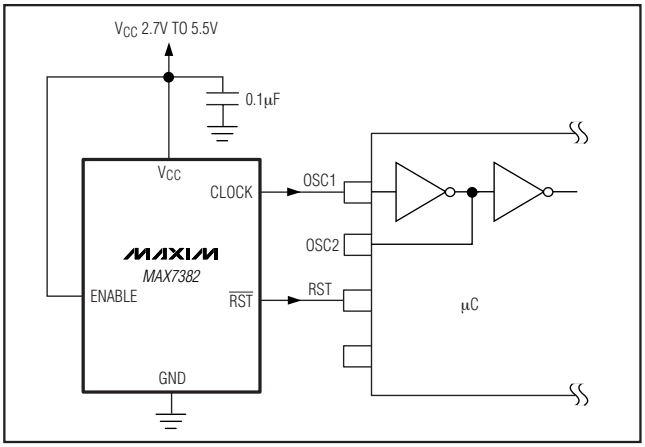
- **2.7V to 5.5V Operation**
- **10MHz to 16MHz Oscillator**
- **Integrated POR (Factory Programmable)**
- **±10mA Clock Output Drive Capability**
- **Clock Enable Input**
- **2.5% Initial Accuracy**
- **±100ppm/°C Frequency Drift**
- **50% Duty Cycle**
- **5ns Output Rise and Fall Time**
- **Typical 4.5mA Operating Current at 16MHz**
- **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	RESET OUTPUT
MAX7382B_ _ _-T	-40°C to +125°C	5 SOT23-5	Active-low push-pull
MAX7382C_ _ _-T	**-40°C to +125°C**	**5 SOT23-5**	**Open drain**

**Standard version is shown in bold. The first letter after the part number designates the reset output option. Insert the letter corresponding to the desired reset threshold level from Table 1 in the next position. Insert the two-letter code from Table 2 in the remaining two positions for the desired frequency range. Table 1 and Table 2 are located at the end of the data sheet.*

Typical Operating Circuit



Silicon Oscillator with Reset Output 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, RST Current .....±50mA
Input Current (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	
Shutdown Supply Current	I_{SHDN}	ENABLE = 0V		0.5	1	µA
LOGIC INPUTS (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_{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 for MAX7382xSxx				
Output Low Voltage	V_{OL}	V_{CC} = 4.5V, I_{SINK} = 20mA			0.4	V
		V_{CC} = 3.0V, I_{SINK} = 10mA				
Clock Frequency Accuracy	f_{CLOCK}	V_{CC} = 5V (for MAX7382xMxx) or V_{CC} = 3.3V (for MAX7382xSxx), T_A = +25°C, deviation from nominal frequency	-2.5		+2.5	%
		V_{CC} = 3.0V to 5.5V, T_A = +25°C, deviation from nominal frequency	-5.0		+3.5	
Clock Temperature Coefficient		(Note 3)		±100	±550	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
Power-On-Reset Threshold Accuracy		V_{CC} rising, deviation from nominal threshold (V_{TH}) (Table 1)	T_A = +25°C	-2		+2	%
				-5		+5	
Power-On-Reset Hysteresis		Difference between rising and falling thresholds			1		%
Power-On-Reset Delay	PORdly	V_{CC} rising from 0 to 5V in 1µs at +25°C			122		µs
RESET OUTPUT ($\overline{RST}$)							
Output High Voltage (Note 4)	V_{OH}	V_{CC} = 4.5V, I_{SOURCE} = 7.0mA (MAX7382xMxx)		V_{CC} - 0.4			V
		V_{CC} = 3.0V, I_{SOURCE} = 2.0mA (MAX7382xSxx)					
Output Low Voltage	V_{OL}	V_{CC} = 4.5V, I_{SINK} = 20mA (MAX7382xMxx)				0.4	V
		V_{CC} = 3.0V, I_{SINK} = 10mA (MAX7382xSxx)					

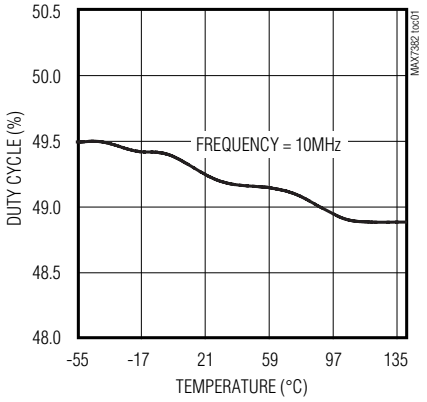
Note 1: All parameters tested at T_A = +25°C. Specifications over temperature are guaranteed by design.
Note 2: Oscillator is enabled when $V_{CC} > V_{TH}$.
Note 3: Guaranteed by design. Not production tested.
Note 4: For push-pull output only.

Silicon Oscillator with Reset Output and Enable

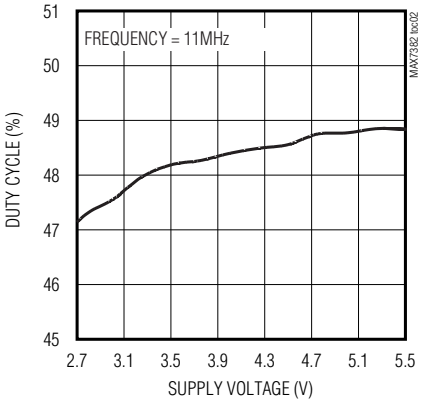
Typical Operating Characteristics

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

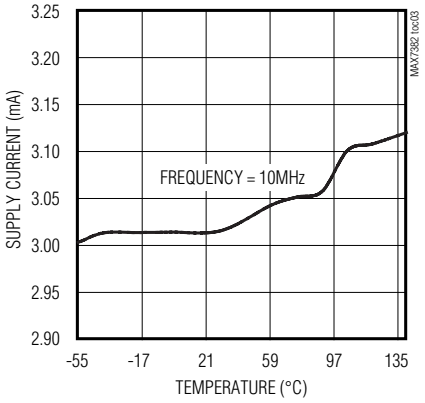
DUTY CYCLE vs. TEMPERATURE



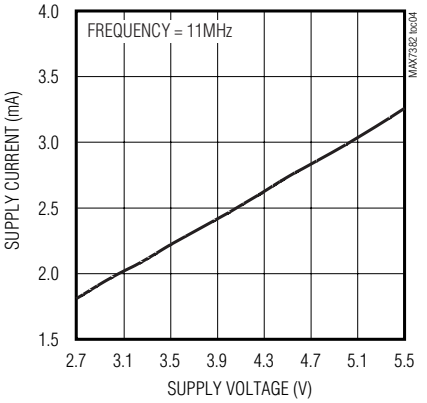
DUTY CYCLE vs. SUPPLY VOLTAGE



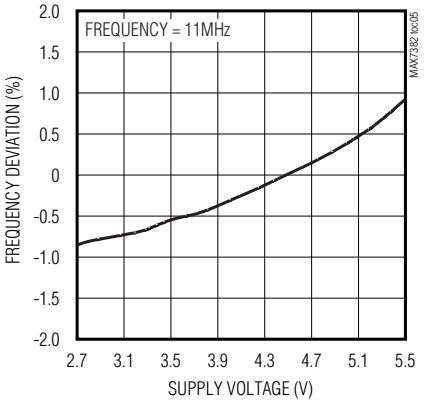
SUPPLY CURRENT vs. TEMPERATURE



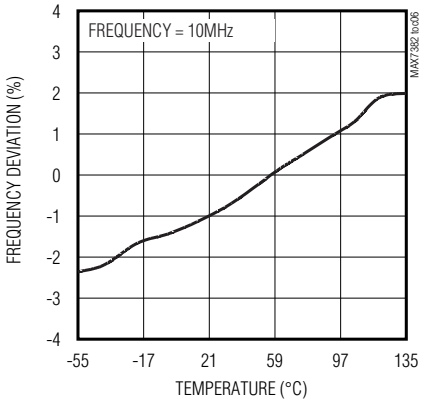
SUPPLY CURRENT vs. SUPPLY VOLTAGE



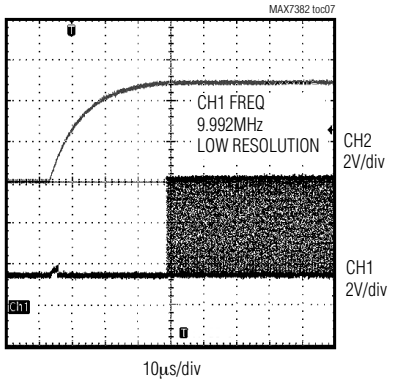
FREQUENCY DEVIATION vs. SUPPLY VOLTAGE



FREQUENCY DEVIATION vs. TEMPERATURE

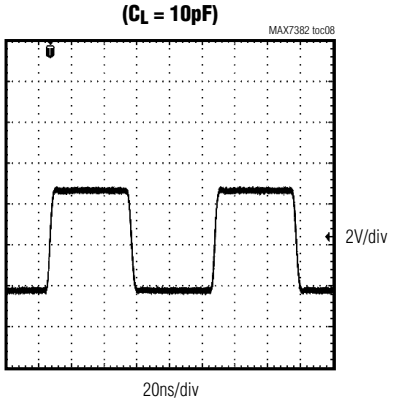


SETTLING TIME FROM START

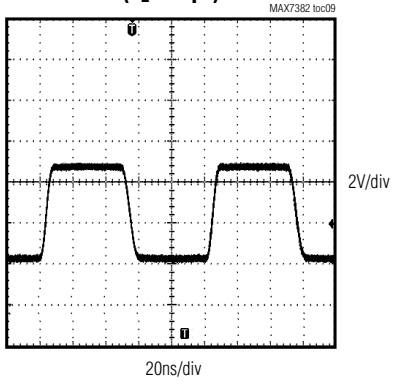


CHANNEL 1 = CLOCK, CHANNEL 2 = V_{CC}

CLOCK OUTPUT WAVEFORM (C_L = 10pF)



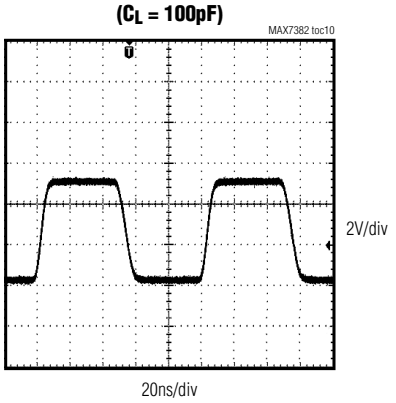
CLOCK OUTPUT WAVEFORM (C_L = 10pF)



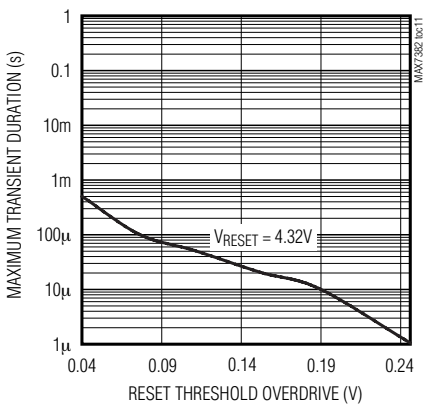
Typical Operating Characteristics (continued)

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

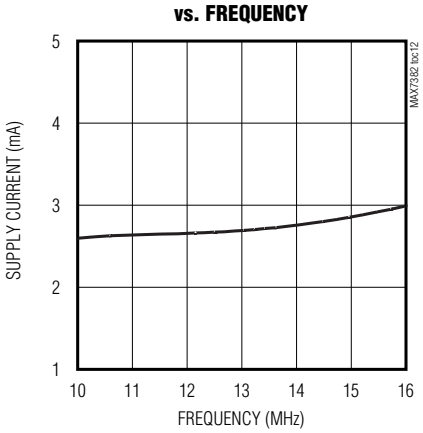
CLOCK OUTPUT WAVEFORM (C_L = 100pF)



MAXIMUM TRANSIENT DURATION vs. RESET THRESHOLD OVERDRIVE



SUPPLY CURRENT vs. FREQUENCY



Pin Description

PIN	NAME	FUNCTION
1	CLOCK	Push-Pull Clock Output
2	GND	Ground
3	$\overline{RST}$	Reset Output. Open-drain or push-pull output. See the *Ordering Information*.
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.

Detailed Description

The MAX7382 is a clock generator with integrated reset for microcontrollers (µCs) and UARTs in 3V, 3.3V, and 5V applications. The MAX7382 is a replacement for crystal-oscillator modules, crystals, or ceramic resonators, and a system reset IC. The clock frequency and reset threshold voltage are factory trimmed to specific values (see Tables 1 and 2). A variety of popular standard frequencies are available. No external components are required for setting or adjusting the frequency.

Oscillator

The push-pull clock output is enabled when V_{CC} > V_{TH} (Table 1) 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 MAX7382 has an active-high enable input that controls the clock and reset outputs. The clock output is driven low and $\overline{RST}$ asserts when the device is disabled. Drive ENABLE low to disable the clock output on next rising edge. Drive ENABLE high to activate the clock output.

Silicon Oscillator with Reset Output and Enable

Applications Information

Interfacing to a Microcontroller Clock Input

The MAX7382 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 MAX7382. Refer to the microcontroller data sheet for clock input compatibility with external clock signals. The MAX7382 requires no biasing components or load capacitance. When using the MAX7382 to retrofit a crystal oscillator, remove all biasing components from the oscillator input.

Reset Output

The MAX7382 is available with two reset output stage options: push-pull active-low and open-drain active-low. $\overline{RST}$ is asserted when the monitored input (V_{CC}) drops below the internal V_{TH} threshold and remains asserted for 120µs after the monitored input exceeds the internal V_{TH} threshold. The open-drain $\overline{RST}$ output requires an external pullup resistor.

Output Jitter

The MAX7382's jitter performance is given in the *Electrical Characteristics* table as a ±6σ period jitter value. 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 MAX7382 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.

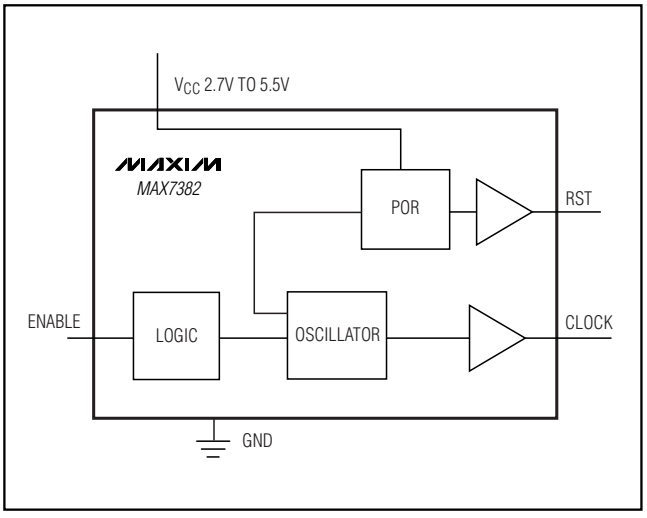


Figure 1. Functional Diagram

Table 1. Standard Reset Threshold Levels

SUFFIX	RESET THRESHOLD (V)
S	2.89 standard value
M	4.38 standard value

Contact factory for nonstandard reset threshold options from 2.5V < V_{TH} < 4.38V.

Table 2. Standard Frequencies

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

For all other frequency options, contact factory.

Table 3. Standard Part Numbers

PART	RESET THRESHOLD (V)	FREQUENCY (MHz)	TOP MARK
MAX7382CSUK	2.89	10	AEVU
MAX7382CSUT	2.89	11	AEYG
MAX7382CSVB	2.89	12	AEVM
MAX7382CSVT	2.89	14	AEYI
MAX7382CSWB	2.89	16	AEVK
MAX7382CMUK	4.38	10	AEXV
MAX7382CMUT	4.38	11	AEXW
MAX7382CMVB	4.38	12	AEVJ
MAX7382CMVT	4.38	14	AEXX
MAX7382CMWB	4.38	16	AEVH

Initial Power-Up and Operation

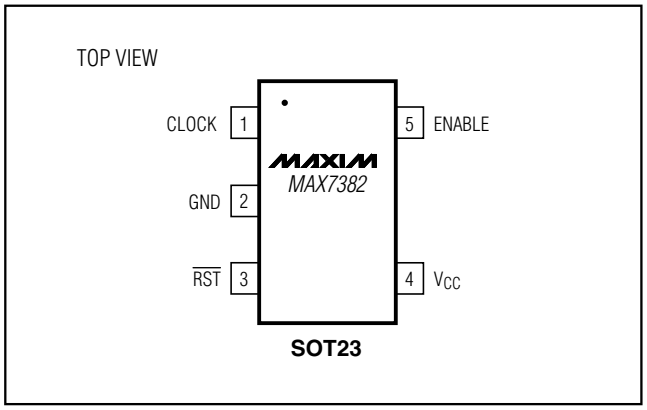
An internal power-up reset holds the clock output low and asserts $\overline{RST}$ until the supply voltage has risen above the power-on- reset threshold (V_{TH}).

$\overline{RST}$ holds the microcontroller in a reset condition until 120µs after the clock has started up. This reset delay ensures that the clock output and the microcontroller's internal clock circuits have stabilized before the system is allowed to start. Typical microcontroller reset delay ranges from 1ms to 250ms to allow a slow crystal oscillator circuit to start up. The MAX7382 has a fast startup, eliminating the need for such a long reset delay.

Power-Supply Considerations

The MAX7382 operates with a 2.7V and 5.5V power-supply voltage. Good power-supply decoupling is needed to maintain the power-supply rejection performance of the MAX7382. Bypass V_{CC} to GND with a 0.1µF surface-mount ceramic capacitor. Mount the bypassing capacitor as close to the device as possible. If possible, mount the MAX7382 close to the microcontroller's decoupling capacitor so that additional decoupling is not required. Use a larger value of bypass capacitor recommended if the MAX7382 is to operate with a large capacitive load. Use a bypass capacitor value of at least 1000 times that of the output load capacitance.

Pin Configuration



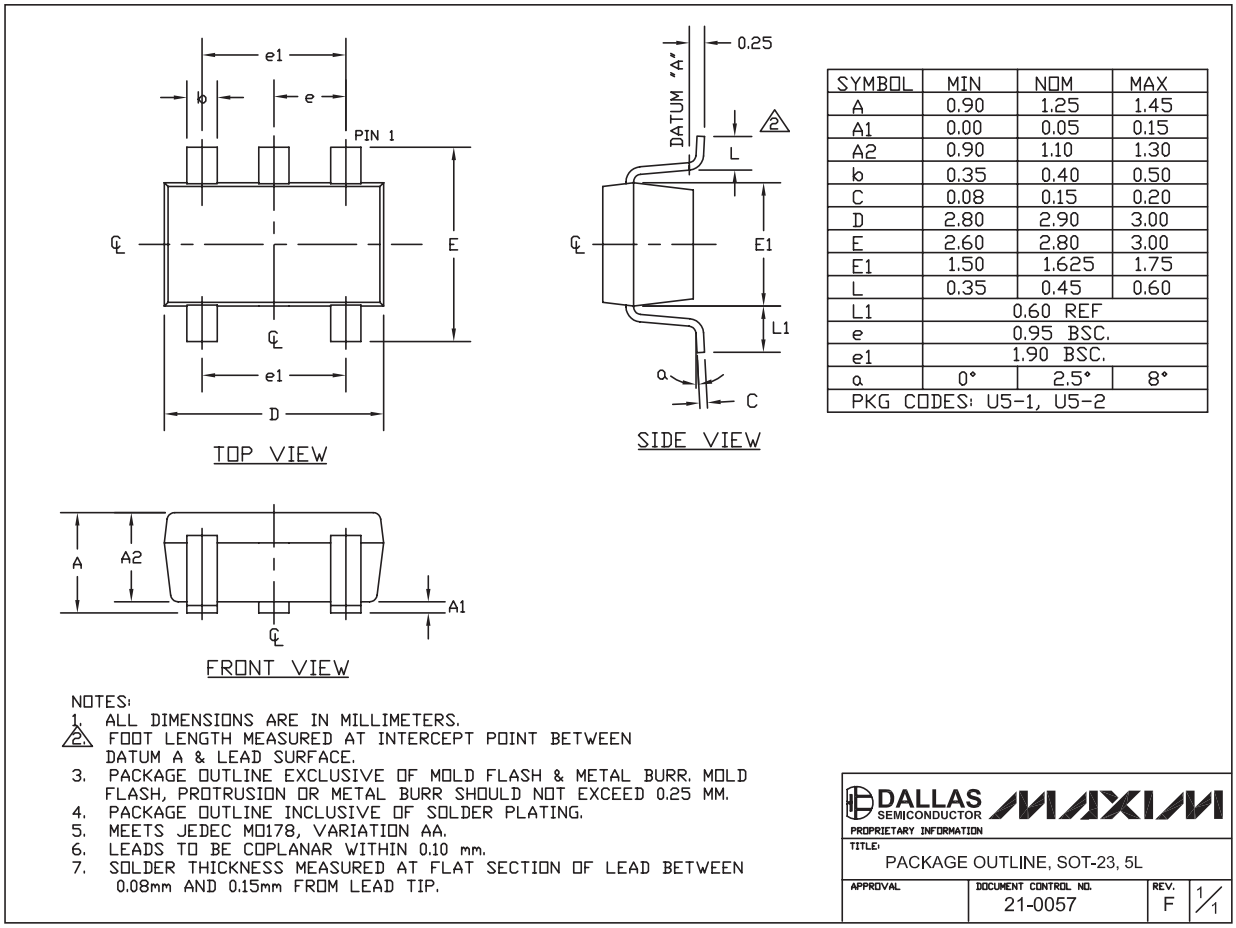
Chip Information

PROCESS: BiCMOS

Silicon Oscillator with Reset Output 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**.)



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.		
α	0°	2.5°	8°
PKG CODES: U5-1, U5-2			

Revision History

Pages changed at Rev 1: 1–8