



# CX1SM CRYSTAL

530 kHz to 2.1 MHz

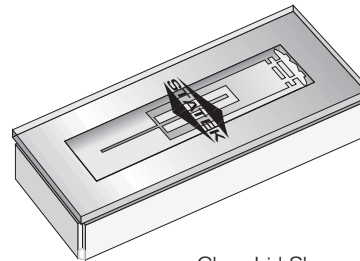
Low Profile, Miniature Surface Mount Quartz Crystal

## DESCRIPTION

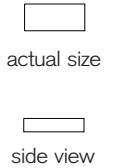
The CX1SM quartz crystals are leadless devices designed for surface mounting on printed circuit boards or hybrid substrates. They are hermetically sealed in a rugged, miniature ceramic package. The CX1SM crystal is manufactured using the STATEK-developed photolithographic process, and was designed utilizing the experience acquired by producing millions of crystals for industrial, commercial, military and medical applications. Maximum process temperature should not exceed 260°C.

## FEATURES

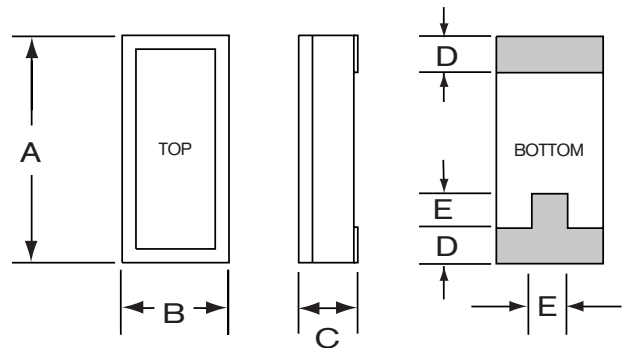
- Extensional mode
- Ideal for use with microprocessors
- Designed for low power applications
- Compatible with hybrid or PC board packaging
- Low aging
- Full military testing available
- Ideal for battery operated applications
- Designed and manufactured in the USA



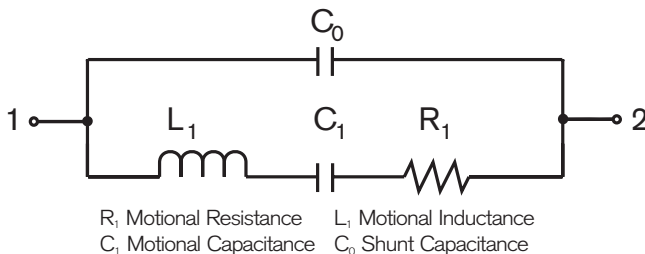
Glass Lid Shown



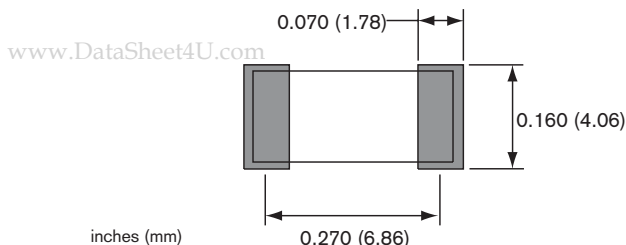
## PACKAGE DIMENSIONS



## EQUIVALENT CIRCUIT



## SUGGESTED LAND PATTERN



DIM	TYP.		MAX.	
	inches	mm	inches	mm
A	0.315	8.00	0.330	8.38
B	0.140	3.56	0.155	3.94
C	-	-	see below	
D	0.045	1.14	0.055	1.40
E	0.060	1.52	0.070	1.78

DIM "C"	GLASS LID		CERAMIC LID	
	inches	mm	inches	mm
MAX				
SM1	0.065	1.65	0.070	1.78
SM2	0.067	1.70	0.072	1.83
SM3	0.070	1.78	0.075	1.90



## SPECIFICATIONS

Specifications are typical at 25°C unless otherwise noted. Specifications are subject to change without notice.

Parameters	Fundamental				Overtone	
	555 k	614 k	1.0 M	1.4 M	1.8432 M	2.1M
Motional Resistance, $R_1$ ( $\Omega$ )	600	275	500	775	300	475
Motional Resistance, $R_1$ MAX	3 k $\Omega$					
Motional Capacitance, $C_1$ (fF)	2.5	3.6	2.0	1.5	2.8	2.6
Quality Factor, Q (k)	170	260	190	100	110	70
Shunt Capacitance, $C_0$ (pF)	1.2	1.3	1.1	1.0	1.3	1.3

Calibration Tolerance\*  $\pm 500$  ppm (0.05%)  
 $\pm 1000$  ppm (0.1%)  
 $\pm 10000$  ppm (1.0%)

Drive Level 3  $\mu$ W MAX

Load Capacitance\*\* 7 pF

Turning Point ( $T_0$ )\*\* 35°C

Temperature Coefficient (k) -0.035 ppm/°C<sup>2</sup>

Note: Frequency  $f$  at temperature  $T$  is related to frequency  $f_0$  at turning point temperature  $T_0$  by:  $\frac{f-f_0}{f_0} = k(T-T_0)^2$

Function Mode Extensional  
 Aging, first year 5 ppm MAX  
 Shock, survival 750 g peak, 0.3 ms, 1/2 sine  
 Vibration, survival 10 g RMS, 20-1,000 Hz random  
 Operating Temp. Range -10°C to +70°C (Commercial)  
 -40°C to +85°C (Industrial)  
 -55°C to +125°C (Military)

Storage Temp. Range -55°C to +125°C

Max Process Temperature 260°C for 20 sec.

\*Tighter tolerances available.

\*\* Other values available.

## TERMINATIONS

Designation	Termination
SM1	Gold Plated
SM2	Solder Plated
SM3	Solder Dipped

## PACKAGING OPTIONS

CX1SM - Tray Pack  
 - Tape and Reel  
 (Reference tape and reel data sheet 10109)

## HOW TO ORDER CX1SM CRYSTALS

CX1	S	C	SM1	-	1.0M,	500	/	M
Blank = Glass Lid C = Ceramic Lid		Frequency K = kHz M = MHz		Operating Temp. Range: C = -10°C to +70°C I = -40°C to +85°C M = -55°C to +125°C S = Customer Specified		Calibration Tolerance @ 25°C (in ppm)		
*S* if special or custom design. Blank if Std.		SM1 = Gold Plated SM2 = Solder Plated SM3 = Solder Dipped						

## TYPICAL APPLICATION FOR A PIERCE OSCILLATOR

The low profile CX miniature surface mount crystal is ideal for small, high density, battery operated portable products. The CX crystal designed in a Pierce oscillator (single inverter) circuit provides very low current consumption and high stability. A conventional CMOS Pierce oscillator circuit is shown below. The crystal is effectively inductive and in a PI-network circuit with  $C_D$  and  $C_G$  provides the additional phase shift necessary to sustain oscillation. The oscillation frequency ( $f_0$ ) is 15 to 250 ppm above the crystal's series resonant frequency ( $f_S$ ).

### Drive Level

$R_A$  is used to limit the crystal's drive level by forming a voltage divider between  $R_A$  and  $C_D$ .  $R_A$  also stabilizes the oscillator against changes in the amplifiers output resistance ( $R_0$ ).  $R_A$  should be increased for higher voltage operation.

### Load Capacitance

The CX crystal calibration tolerance is influenced by the effective circuit capacitances, specified as the load capacitance ( $C_L$ ).  $C_L$  is approximately equal to:

$$C_L = \frac{C_D \times C_G}{C_D + C_G} + C_S \quad (1)$$

NOTE:  $C_D$  and  $C_G$  include stray layout to ground and  $C_S$  is the stray shunt capacitance between the crystal terminal. In practice, the effective value of  $C_L$  will be less than that calculated from  $C_D$ ,  $C_G$  and  $C_S$  values because of the effect of the amplifier output resistance.  $C_S$  should be minimized.

The oscillation frequency ( $f_0$ ) is approximately equal to:

$$f_0 = f_S \left[ 1 + \frac{C_1}{2(C_0 + C_L)} \right] \quad (2)$$

Where  $f_S$  = Series resonant frequency of the crystal  
 $C_1$  = Motional Capacitance  
 $C_0$  = Shunt Capacitance

## CONVENTIONAL CMOS PIERCE OSCILLATOR CIRCUIT

