



# CX2SM CRYSTAL

760 kHz to 1.35 MHz  
Low Profile Miniature Surface Mount Quartz Crystal

## DESCRIPTION

The CX2SM 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. They are manufactured using the STATEK-developed photolithographic process, and were 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

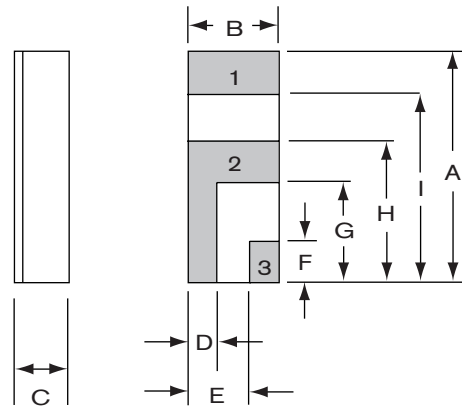
- Extensional mode
- Ideal for use with microprocessors
- Designed for low power applications
- Compatible with hybrid or PC board
- Low aging
- Full military testing available
- Ideal for battery operated applications
- Designed and manufactured in the USA



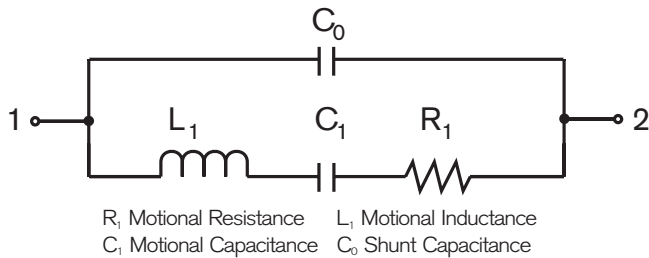
Glass Lid Shown

□ actual size  
□ side view

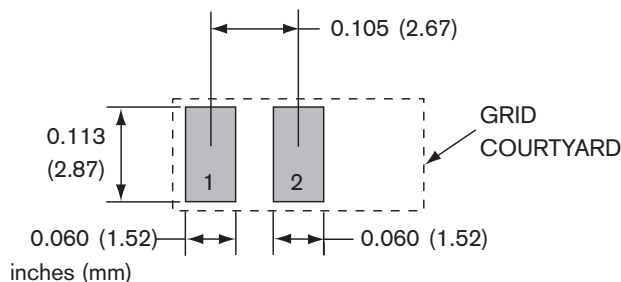
## PACKAGE DIMENSIONS



## EQUIVALENT CIRCUIT



## SUGGESTED LAND PATTERN



DIM	TYP.		MAX.	
	inches	mm	inches	mm
A	0.260	6.60	0.275	6.99
B	0.094	2.39	0.108	2.74
C	-	-	see below	
D	0.035	0.89	0.045	1.14
E	0.059	1.50	0.069	1.75
F	0.050	1.27	0.060	1.52
G	0.105	2.67	0.115	2.92
H	0.155	3.94	0.165	4.19
I	0.210	5.33	0.220	5.59

DIM "C"	GLASS LID		CERAMIC LID	
	inches	mm	inches	mm
MAX				
SM1	0.065	1.65	0.075	1.91
SM2/SM4	0.067	1.70	0.077	1.96
SM3/SM5	0.070	1.78	0.080	2.03

Note: Terminal 1 is electrically connected internally to terminal 3

10135 - Rev C



## SPECIFICATIONS

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

Frequency Range	760 kHz - 1.35 MHz
Functional Mode	Extensional
Calibration Tolerance <sup>1</sup>	± 500 ppm (0.05%) ± 1000 ppm (0.1%) ± 10000 ppm (1.0%)
Load Capacitance	7 pF
Motional Resistance (R <sub>1</sub> )	5 kΩ MAX
Motional Capacitance (C <sub>1</sub> )	1.2fF
Quality Factor (Q)	150 k
Shunt Capacitance (C <sub>0</sub> )	1.0 pF
Drive Level	3 μW MAX
Turning Point (T <sub>0</sub> ) <sup>2</sup>	35°C
Temperature Coefficient (k)	-0.035 ppm/°C <sup>2</sup>
Aging, first year	5 ppm MAX
Shock, survival	1000 g, 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.

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

1. Tighter frequency calibration available.
2. Other turning points available.

## TERMINATIONS

Designation	Termination
SM1	Gold Plated
SM2	Solder Plated
SM3	Solder Dipped
SM4	Solder Plated (Lead Free)
SM5	Solder Dipped (Lead Free)

## PACKAGING OPTIONS

CX2SM - Tray Pack  
-16mm tape, 7" or 13" reels  
(Reference tape and reel data sheet 10109)

## HOW TO ORDER CX2SM CRYSTALS

CX2	S	C	SM1	-	1.0M	,	500	/	I
Blank = Glass Lid C = Ceramic Lid		SM1 = Gold Plated (Lead Free) SM2 = Solder Plated SM3 = Solder Dipped SM4 = Solder Plated (Lead Free) SM5 = Solder Dipped (Lead Free)		Frequency K = kHz M = MHz		Calibration Tolerance @ 25°C (in ppm)		Operating Temp. Range: C = -10°C to +70°C I = -40°C to +85°C M = -55°C to +125°C S = Customer Specified	

## 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<sub>D</sub> and C<sub>G</sub> provides the additional phase shift necessary to sustain oscillation. The oscillation frequency (f<sub>0</sub>) is 15 to 150 ppm above the crystal's series resonant frequency (f<sub>S</sub>).

### Drive Level

R<sub>A</sub> is used to limit the crystal's drive level by forming a voltage divider between R<sub>A</sub> and C<sub>D</sub>. R<sub>A</sub> also stabilizes the oscillator against changes in the amplifiers output resistance (R<sub>0</sub>). R<sub>A</sub> 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<sub>L</sub>). C<sub>L</sub> is approximately equal to:

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

NOTE: C<sub>D</sub> and C<sub>G</sub> include stray layout to ground and C<sub>S</sub> is the stray shunt capacitance between the crystal terminal. In practice, the effective value of C<sub>L</sub> will be less than that calculated from C<sub>D</sub>, C<sub>G</sub> and C<sub>S</sub> values because of the effect of the amplifier output resistance. C<sub>S</sub> should be minimized.

The oscillation frequency (f<sub>0</sub>) 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<sub>1</sub> = Motional Capacitance  
C<sub>0</sub> = Shunt Capacitance

## CONVENTIONAL CMOS PIERCE OSCILLATOR CIRCUIT

