



# CX4VSM CRYSTAL

30 kHz to 250 kHz

Ultra-Miniature Low Profile  
Surface Mount Quartz Crystal

## DESCRIPTION

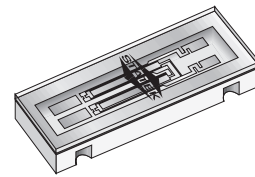
STATEK's ultra-miniature CX4VSM quartz crystals are hermetically sealed in surface mount ceramic packages and custom laser-tuned to frequencies ranging from 30 kHz to 250 kHz. This high quality tuning fork resonator is intended for use in Pierce (single inverter) oscillators with a maximum process temperature not to exceed 260°C.

## FEATURES

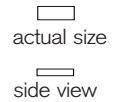
- Ultra-miniature, surface mount design
- Available with glass or ceramic lid
- Hermetically sealed ceramic package
- Quartz crystal tuning fork design
- High shock and vibration survival
- Excellent aging characteristics
- Designed for low power applications
- Full military testing available
- Designed and manufactured in the USA

## APPLICATIONS

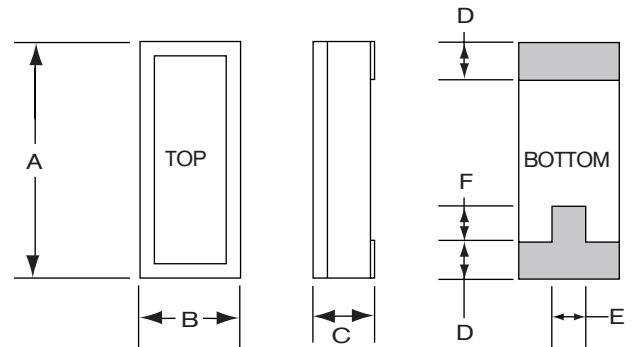
- Medical Implantable and Non-Implantable Devices
- Military Devices
- Smart Card
- Transponder / Animal Migration
- Space Limited Devices
- Handheld Battery Operated Devices
- Down Hole / Industrial Instrumentation
- Computer / Computer Peripherals



Glass Lid Shown



## PACKAGE DIMENSIONS

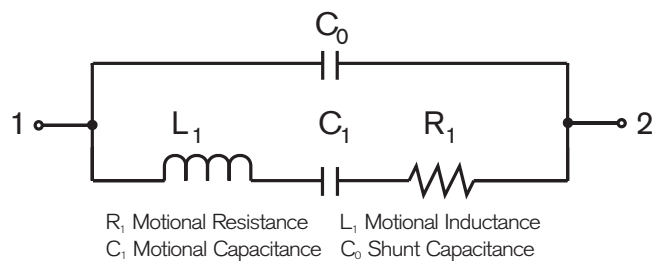


DIM	TYP.		MAX.	
	inches	mm	inches	mm
A	0.197	5.00	0.210	5.33
B	0.072	1.83	0.085	2.16
C	-	-	see below	
D	0.036	0.91	0.046	1.16
E	0.020	0.51	-	-
F	0.025	0.64	-	-

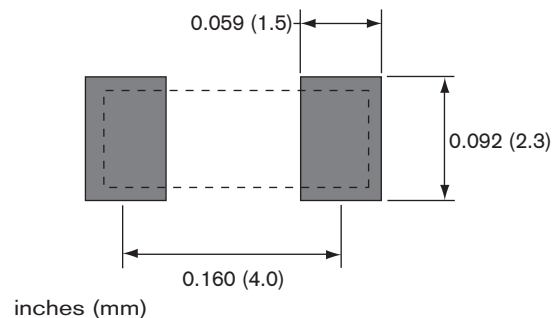
## THICKNESS (DIM C)

Lid	Termination	Maximum	
		inches	mm
Ceramic	SM1	0.050	1.27
	SM2/SM4	0.051	1.30
	SM3/SM5	0.053	1.35
Glass	SM1	0.045	1.14
	SM2/SM4	0.046	1.17
	SM3/SM5	0.048	1.22

## EQUIVALENT CIRCUIT



## SUGGESTED LAND PATTERN



10103 - Rev D



## SPECIFICATIONS

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

Parameters	Fundamental		Overtone
Frequency, (kHz)	32.768	100	200
Motional Resistance $R_1$ (k $\Omega$ )	50	18	2.4
Motional Capacitance $C_1$ (fF)	2.3	1.07	2.2
Quality Factor Q (k)	40	85	140
Shunt Capacitance $C_0$ (pF)	1.1	0.7	1.2
Load Capacitance (pF) <sup>1</sup>	9	8	5
Turning Point (°C) <sup>1</sup>	25	10	29

Standard Calibration Tolerance for 32.768 kHz<sup>2</sup>

Glass Lid:	± 30 ppm (0.003%)	± 100 ppm (0.01%)	± 1000 ppm (0.1%)
Ceramic Lid:	± 100 ppm (0.01%)	± 1000 ppm (0.1%)	± 10000 ppm (1.0%)

Drive Level 0.5  $\mu$ W MAX

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:  $\frac{f-f_0}{f_0} = k(T-T_0)^2$

Aging, first year 5 ppm

Shock, survival 5,000 g, 0.3 ms, 1/2 sine

Vibration, survival 20 g RMS, 10-2,000 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.

1. Other values available

2. Tighter tolerances available

## TERMINATIONS

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

## PACKAGING OPTIONS

CX4VSM - Tray Pack  
- 16mm tape, 7" or 13" reels  
(Reference tape and reel data sheet 10109)

## HOW TO ORDER CX4VSM CRYSTALS

CX4V	S	C	SM1	32.768K	100	/	I
"S" if special or custom design. Blank if standard		C = Ceramic Lid Blank = Glass Lid	SM1 = Gold Plated (Pb Free) SM2 = Solder Plated SM3 = Solder Dipped SM4 = Solder Plated (Pb Free) SM5 = Solder Dipped (Pb Free)	Frequency K = kHz	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 CX4 family of surface mount crystals are ideal for small, high density, battery operated portable products. The CX4 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 50 to 150 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 ( $R_O$ ).  $R_A$  should be increased for higher voltage operation.

### Load Capacitance

The CX4 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

