



# CX4 CRYSTAL

Fundamental Mode: 600 kHz to 1.4 MHz

Overtone: 1.8432 MHz - 2.5 MHz

Ultra-Miniature Low Profile  
Surface Mount Quartz Crystal

## DESCRIPTION

STATEK's CX4 quartz crystals are hermetically sealed in an ultra-miniature low profile surface mount ceramic package. This high quality quartz resonator forms the basis of a stable oscillator.

## FEATURES

- Designed for low power applications in this frequency range
- Smallest available package in this frequency range
- Hermetically sealed ceramic package
- Excellent aging characteristics
- Full military testing to MIL-PRF-3098 available
- Designed and manufactured in the USA

## APPLICATIONS

### Medical

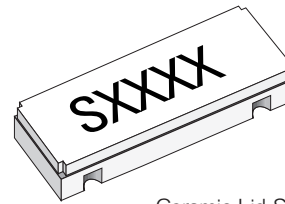
- Pacemaker, defibrillator and hearing aid

### Industrial, Computer & Communications

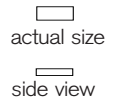
- PCMCIA (FAX, Modem and LAN)
- Smart Card

### Military & Aerospace

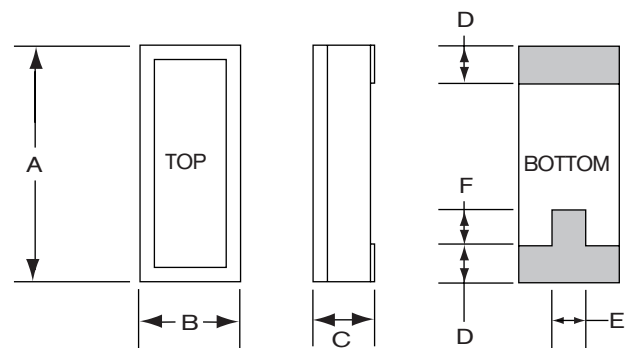
- Airborne hybrid computer
- Low power system clock
- Hybrid multi-chip modules



Ceramic Lid Shown



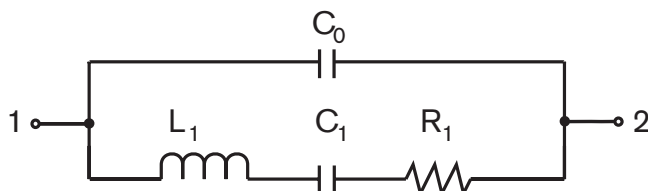
## PACKAGE DIMENSIONS



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	-	-

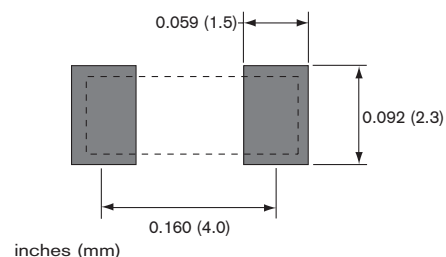
DIM "C"	GLASS LID		CERAMIC LID	
	inches	mm	inches	mm
MAX	0.045	1.14	0.050	1.27
SM1	0.045	1.14	0.050	1.27
SM2/SM4	0.046	1.17	0.051	1.30
SM3/SM5	0.048	1.22	0.053	1.35

## EQUIVALENT CIRCUIT



R<sub>1</sub> Motional Resistance    L<sub>1</sub> Motional Inductance  
C<sub>1</sub> Motional Capacitance    C<sub>0</sub> Shunt Capacitance

## SUGGESTED LAND PATTERN



## SPECIFICATIONS

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

Parameters	Fundamental			Overtone	
	600 K	1.0 M	1.4 M	1.8432 M	2.4576 M
Motional Resistance, $R_1$ ( $\Omega$ )	300	400	600	500	1000
Motional Resistance, $R_1$ MAX	3k $\Omega$				
Motional Capacitance, $C_1$ (fF)	3.5	2.0	1.3	3.5	1.5
Quality Factor, Q (k)	250	200	150	80	45
Shunt Capacitance, $C_0$ (pF)	1.0	0.8	0.7	1.0	0.8

Standard Calibration	$\pm 500$ ppm ( $\pm 0.05\%$ )
Tolerance <sup>1</sup>	$\pm 1000$ ppm ( $\pm 0.1\%$ )
	$\pm 10000$ ppm ( $\pm 1.0\%$ )
Drive Level	3 $\mu$ W MAX
Load Capacitance, $C_L$ <sup>2</sup>	7pF
Turning Point, $T_0$ <sup>2</sup>	35°C
Temperature Coefficient, k	-0.035 ppm/ $^{\circ}$ C <sup>2</sup> TYP

Note: Frequency  $f$  at temperature  $T$  is related to frequency  $f_0$  at turning point temperature  $T_0$  by:

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

Functional Mode	Extensional
Aging, first year	5ppm MAX
Shock, survival	1500 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. Tighter tolerances available

2. Other values available

NOTE: All values subject to change without notice.

## TERMINATIONS

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

## PACKAGING OPTIONS

CX4	- Tray Pack
	- Tape and Reel
	(Reference tape and reel data sheet 10109)

## HOW TO ORDER CX4 CRYSTALS

CX4	S	C	SM1	-	1.8432M	,	500	/	I
	"S" if special or custom design. Blank if standard	C = Ceramic Lid Blank = Glass Lid	SM1 = Gold Plated 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 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 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 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

