

## Ultra-miniature Low Profile SMD

### FEATURES

- Designed for low power applications
- Smallest available package in this frequency range
- Hermetically sealed, ceramic package
- Excellent ageing characteristics
- Full Military testing available

**Fundamental Mode: 600kHz to 1.4MHz**  
**Overtone: 1.8432MHz to 2.5MHz**



### DESCRIPTION

CX4 crystals are leadless devices designed for surface mounting on PCBs or hybrid substrates. The crystal has been designed for low power applications.

### SPECIFICATION

Specifications stated are typical at 25°C unless otherwise indicated. Specifications may change without notice.

Parameters	Fundamental			Overtone	
Frequency (Hz):	600K	1.0M	1.4M	1.8432M	2.4576M
Motional Resistance R1 (kΩ):	300	400	600	500	1000
Motional Resistance R1 Max. (kΩ):	3kΩ				
Motional Capacitance C1 (Ff):	3.5	2.0	1.3	3.5	1.5
Quality Factor Q (k):	250	200	150	80	45
Shunt Capacitance C0 (pF):	1.0	0.8	0.7	1.0	0.8

Standard Calibration Tolerance <sup>1</sup> :	±500ppm (±0.5%) ±1000ppm (±0.1%) ±10000ppm (±1.0%)
Drive Level:	3μW maximum
Load Capacitance CL <sup>2</sup> :	7pF
Turning Point <sup>2</sup> :	35°C
Temperature Coefficient (k):	-0.035ppm/°C <sup>2</sup>

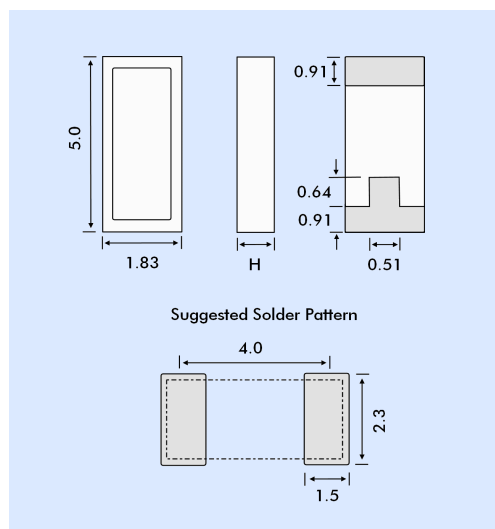
Note: Frequency f at temperature T is related to frequency Fo at turning point temperature To by:

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

Functional mode:	Extensional
Ageing, First year:	±5ppm maximum
Shock, survival:	1500g, 0.3ms, ½ sine
Vibration, survival:	20g rms, 10~2000Hz random
Operating Temperature Range	
Commercial:	-10° to +70°C
Industrial:	-40° to +85°C
Military:	-55 to +125°C
Storage Temperature Range:	-55° to +125°C
Maximum Process Temperature:	+260°C for 20 seconds

1. Tighter tolerance available
2. Other values available

### OUTLINE & DIMENSIONS



Dim. H	Glass Lid	Ceramic Lid
SM1	1.14	1.27
SM2	1.17	1.30
SM3	1.22	1.35
SM4	1.17	1.30
SM5	1.22	1.35

### PACKAGING OPTIONS

CX4 crystals are available either tray packed (<250pcs) or tape and reel (>250 pieces).  
 16mm tape, 178mm or 330mm reels (EIA 418).

### HOW TO ORDER CX4 CRYSTALS

**CX4 - S - C - SM1 - 1.8432M, 500 / I**

'S' if special, custom design. Otherwise leave blank

Blank = glass lid  
C = ceramic lid

Terminations  
 SM1 = Gold plated \*  
 SM2 = Solder plated  
 SM3 = Solder dipped  
 SM4 = Solder plated \*  
 SM5 = Solder dipped \*  
 \* = Lead free

Frequency  
 K = kHz  
 M = MHz

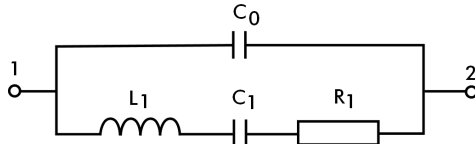
Calibration Tolerance @25°C (in ppm)

Temp. Range  
 C = -10° ~ +70°C  
 I = -40° ~ +85°C  
 M = -55° ~ +125°C  
 S = Customer specified

**Ultra-miniature Low Profile SMD**

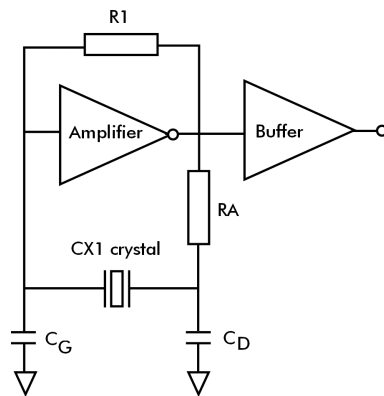
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**CRYSTAL EQUIVALENT CIRCUIT**



R1 Motional Resistance      L1 Motional Inductance  
C1 Motional Capacitance    C0 Shunt Capacitance

**CONVENTIONAL CMOS PIERCE OSCILLATOR CIRCUIT**



**TERMINATIONS - PLATING**

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

**TYPICAL APPLICATION FOR A PIERCE OSCILLATOR**

The low profile CX miniature crystal is ideal for use in 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 Pierce oscillator is shown above. The crystal is effectively inductive and in a Pi network circuit with  $C_D$  and  $C_G$  provides the additional phase shift to sustain oscillation. The oscillation frequency ( $f_o$ ) is 15 to 250ppm above the crystal's 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 amplifier's output resistance ( $R_O$ ).  $R_A$  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:

$$C_L = \frac{C_D \times C_G}{C_D + C_G} + C_S$$

Note:  $C_D$  and  $C_G$  include stray layout-induced capacitance 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 ( $f_o$ ) is approximately equal to:

$$f_o = f_s \left[ 1 + \frac{C_1}{2(C_O + C_L)} \right]$$

Where

- $f_s$  = Series resonant frequency of the crystal
- $C_1$  = Motional Capacitance
- $C_O$  = Shunt Capacitance