

FEATURES

- **Extensional Mode**
- **Ideal for use with microprocessors**
- **Designed for low power applications**
- **Full military testing available**
- **Low ageing**

DESCRIPTION

CX1SM crystals are leadless devices designed for surface mounting. The crystals are hermetically sealed in a rugged, ceramic package. CX1SM is intended for use in Pierce (single inverter) oscillator circuits.

SPECIFICATION

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

Parameters	Fundamental			Overtone		
Frequency Range (Hz):	555k	614k	1.0M	1.4M	1.8432	2.1M
Motional Resistance R (Ω):	600	275	500	775	300	475
Motional Resistance R1 (max.):	3kΩ					
Motional Capacitance C1 (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 C0 (pF):	1.2	1.3	1.1	1.0	1.3	1.3

Calibration Tolerance*:	±500ppm (0.05%) ±1000ppm (0.1%) ±10000ppm (1.0%)
Drive Level:	3.0μW max.
Load Capacitance**:	7pF
Turning Point (T0)**:	35°C
Temperature Coefficient (k):	-0.035ppm/°C²

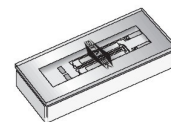
Note: Frequency f at temperature T is related to frequency F0 at turning point temperature T0 by:

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

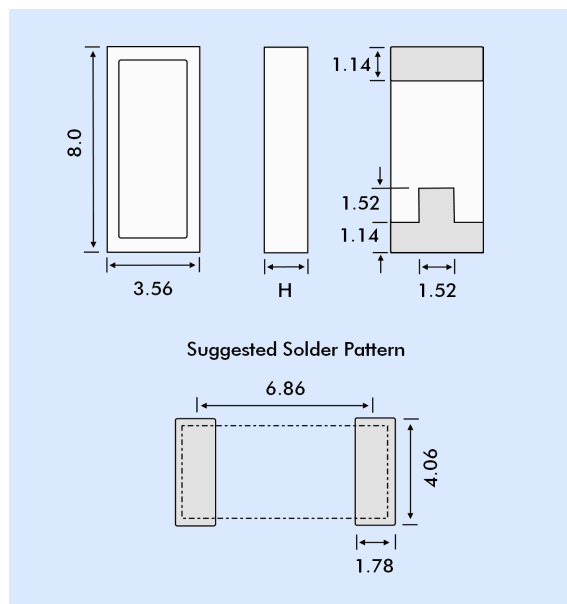
Function Mode:	Extensional
Ageing, first year:	5ppm max.
Shock, survival:	750g, 0.3ms, ½ sine
Vibration, survival:	10g rms, 20~2000Hz random
Operating Temperature Range	
Commercial:	-10° to +70°C
Industrial:	-40° to +85°C
Military:	-55° to +125°C
Storage Temperature Range:	-55° to +125°C
Maximum Process Temperature:	+260°C for 20 seconds

* Tighter tolerances are available.

** Other values are available



OUTLINE & DIMENSIONS



DIMENSION 'H'

Terminations	Glass Lid	Ceramic Lid
SM1	1.65	1.78
SM2/SM4	1.70	1.83
SM3/SM5	1.78	1.90

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)

HOW TO ORDER CX1SM CRYSTALS

CX1 - S - C - SM1 - 1.0M 500 / I

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

Blank = glass lid
C = ceramic lid

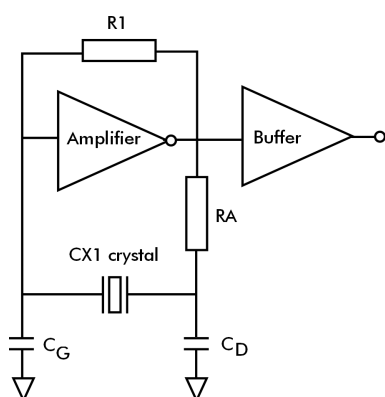
Terminations
SM1 = Gold plated *
SM2 = Solder plated
SM3 = Solder dipped
SM4 = Solder plated *
SM5 = Solder dipped *
* = Lead free

Frequency
K = kHz
M = MHz

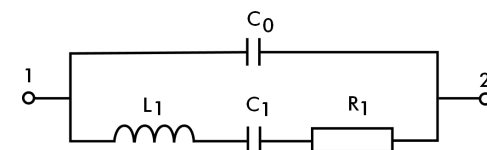
Calibration Tolerance @25°C (in ppm)

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

CONVENTIONAL CMOS PIERCE OSCILLATOR CIRCUIT



CRYSTAL EQUIVALENT CIRCUIT



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

PACKAGING OPTIONS

CX1SM crystals are available either tray packed (<250pcs) or tape and reel (>250 pieces).
16mm tape, 178mm or 330mm reels (EIA 418).

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 CD and CG provides the additional phase shift to sustain oscillation. The oscillation frequency (fo) is 15 to 250ppm above the crystal's resonant frequency (fs).

Drive Level

RA is used to limit the crystal's drive level by forming a voltage divider between RA and CD. RA also stabilizes the oscillator against changes in the amplifier's output resistance (RO). RA 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 (CL). CL is approximately equal to:

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

Note: CD and CG include stray layout-induced capacitance to ground and CS is the stray shunt capacitance between the crystal terminal. In practice, the effective value of CL will be less than that calculated from CD, CG and CS values because of the effect of the amplifier output resistance. CS should be minimized.

The oscillation frequency (fo) is approximately equal to:

$$f_o = f_s \left[1 + \frac{C_1}{2(C_0 + C_L)} \right]$$

Where

- Fs = Series resonant frequency of the crystal
- C1 = Motional Capacitance
- C0 = Shunt Capacitance