



### Quartz Crystal - Terms and Definitions

**Aging** (see Stability - Aging)

**Calibration** (see Stability - Calibration Tolerance)

**Capacitance** (measured in picofarads)

**Motional (C<sub>1</sub>)** The capacitance of the motional (series) arm of the equivalent circuit, as defined in:  $C_1 = [2 \times (C_0 + C_L) \times \Delta f] / f_s$ .

**Load (C<sub>L</sub>)** The effective external capacitance associated with the crystal unit which determines the load resonance frequency, as defined in:  $C_L = [(C_1 \times C_2) / (C_1 + C_2)] + C_{STRAY}$  (Where C<sub>STRAY</sub> is anywhere from 2pF ~ 6pF).

**Ratio (r)** The ratio of the shunt capacitance to the motional capacitance, as defined in:  $r = C_0 / C_1$ .

**Shunt (C<sub>0</sub>)** The static capacitance between the electrodes, together with stray capacitances of the mounting system.

**Crystal Cut** The orientation angle at which the blanks are cut from the quartz crystal's crystallographic axis. Typical cuts used most for best stability are AT-Cut or BT-Cut in Thickness Shear, or Length-Width-Flexure for Tuning Fork Crystals. (see Mode of Operation, and, Quartz Crystal General Information, Section A-2)

#### Current

**Input / Supply (I<sub>cc</sub>)** The electric current (measured in milliamps) to the Vcc Supply Pin with no output load when output is enabled.

**Drive Level (DL)** The level of power or current (measured in milliwatts or microwatts) in the crystal unit when unit is operating.

**E.S.R. - Equiv. Series Resistance** (see Resistance - Equivalent Series)

**Frequency (fo)** The Nominal Frequency of crystal vibration cycles per second (Hz) during operation (measured in either Mhz, kHz, or Hz).

**Insulation Resistance** (see Resistance - Insulation)

**Mode of Operation** When referred to as "Mode of Vibration", this is the piezoelectric effect of quartz crystal (see Crystal Cut)

**Fundamental** The main operational mode of vibration frequency, sometimes referred to as 1<sup>st</sup> overtone.

**Overtone** The operational mode of vibration frequency in odd number harmonic multiples (approximately) of the fundamental to enable usage over an extended frequency range, typically assigned overtones are 3<sup>rd</sup>, 5<sup>th</sup>, 7<sup>th</sup>, 9<sup>th</sup>, and occasionally 11<sup>th</sup>.

**Operating Temperature** (see Temperature - Operating)

**Output Voltage** (see Voltage - Output)

**Package** The case housing a quartz crystal and its electrodes to external leads or terminals for connecting to a printed circuit board. Abecs Thru-Hole parts are designated by a 3-digit code, and Surface-Mount are 4-digits.

**Power Supply** (see Current - Input)

**Pulling Sensitivity (S)** In a parallel mode crystal, the incremental fractional change in frequency due to an incremental change in the load capacitance, as defined in:  $S \cong C_1 / [2 \times (C_0 + C_L)^2]$ . Also referred to as "Pullability".

**Quality Factor (Q)** The maximum stability that can be attained by a crystal is directly related to the "Q" of the motional arm at resonance, as defined in:  $Q = (2\pi \times f_s \times L_1) / R_1$ . The higher the "Q", the smaller the band width ( $\Delta f$ ) and the steeper the reactance slope ( $f_s - f_a$ ). External circuit reactance value changes have less effect on a high "Q" crystal (less pullability) than lower "Q" devices.



## Quartz Crystal - Terms and Definitions (continued)

### Resistance

**Equivalent Series (R<sub>e</sub>)** The impedance value of the crystal unit in the operating resonant circuit, as defined in:  
 $R_e = (2\pi \times f_s \times L_e) / Q$ .

**Insulation (IR)** The resistance between the leads, or between lead and case (measured in ohms).

**Shock** Normally tested at: 3000G x 0.3ms x 1/2 sine wave x 3 directions, (measured in parts per million) and varies depending on frequency.

### Resonance

**Parallel** The mode at which a crystal operates in a circuit where it appears as inductive. The crystal frequency typically decreases as the load capacitance value increases. The Load Capacitance must be specified to work in Parallel mode (typical values are 12.5pf standard for watch crystals, and 16pF, 18pF (std.), 20pF, and 32pF).

**Series** The mode at which a crystal operates in a circuit where it appears as resistive, and the value of the crystal is approx. equal to the motional resistance.

**Shock Resistance** (see Resistance - Shock)

**Shunt Capacitance** (see Capacitance - Shunt)

**Stability** (measured in parts per million)

**Aging (fa)** The effect of time in deviation against any specification parameter (e.g. Frequency).

**Calibration Tolerance** The maximum allowable deviation from nominal frequency at room temperature.

**Over Temp. Range** The maximum allowable deviation from nominal frequency over the operating temperature range.

**Storage Temperature** (see Temperature - Storage)

**Temperature** (measured in degrees centigrade)

**Calibration** The room temperature (25°C) reference at which the Frequency Stability is calculated.

**Operating (TOPR)** The temperature range at which the part will perform normally within the specified stability range.

**Storage (TSTG)** The temperature range at which the part can be stored during non-operational status and still perform normally when placed in operational mode.

**Tolerance** (see Stability)

## Crystal Clock Oscillator - Terms and Definitions

**Aging** (see Stability - Aging)

**Calibration** (see Stability - Calibration Tolerance)

**Current** (measured in milliamps)

**Input / Supply (Icc)** The maximum electric current to the Vcc Supply Pin with no output load when output is enabled.

**Output (Io)** The minimum electric current output at either "0" level or "1" level operation.

**Duty Cycle** The measured uniformity (or Symmetry) of the output waveform (measured in percentages). Defined as the ratio of the time periods of the logic "1" level to the logic "0" level (TH:TL), measured at 1.4v for TTL, and 50% of the peak to peak voltage for CMOS and ECL logic.



## Crystal Clock Oscillator - Terms and Definitions (continued)

**Frequency (fo)** The Nominal Frequency of crystal vibration cycles per second (Hz) during operation (measured in either Mhz, kHz, or Hz).

**Logic** The output of an oscillator's driving capability or output (see Output - Load).

**Operating Temperature** (see Temperature - Operating)

### Output

**Current** (see Current - Output)

**Enable Function** (see TriState - Enable)

**Load** The driving capability of an oscillator, usually specified as either CMOS/HCMOS compatible, TTL compatible, or Dual-compatible (both CMOS and TTL) output.

**CMOS/HCMOS (CL)** Output driving capability, measured in picofarads (pF). Also referred to as Load Capacitance for crystals (see Capacitance - Load).

**TTL (N)** Output driving capability, measured by the number of TTL gates that can be driven (typically 1 ~ 10), and sometimes specified as Low-Speed TTL for low power operations (LS TTL).

**Output Voltage** (see Voltage - Output)

**Package** Various case styles, shapes and sizes are manufactured out of different materials to meet various application requirements. Abecs Thru-Hole parts are designated by a 3-digit code, and Surface-Mount are 4-digits.

**Power Supply** (see either Voltage - Input, or, Current - Input)

**Rise (Tr) & Fall (Tf) Time** The Tr is the transition time (measured in nanoseconds) of an oscillator output waveform from the low state (10% of the leading edge) to the high state (90% of the leading edge), and transversely, the Tf is the transition time from the high 90% state to the low 10% state of the output waveform (common Tr and Tf).

**Stability** (measured in parts per million)

**Aging (fa)** The effect of time in deviation against any specification parameter (e.g. Frequency).

**Calibration Tolerance** The maximum allowable deviation from nominal frequency at room temperature over the operating temperature range.

**Start-Up Time** The time (measured in milliseconds) it takes an oscillator to reach its specified RF output. The start-up time

**Storage Temperature** (see Temperature - Storage)

### Supply

**Current** (see Current - Input/Supply)

**Voltage** (see Voltage - Input/Supply)

**Symmetry / Duty** (see Duty Cycle)

**Temperature** (measured in degrees centigrade)

**Calibration** The reference temperature (usually 25°C) at which the frequency is calculated.

**Operating** The temperature range at which the part will perform normally within the calculated stability range.

**Storage** The temperature range at which the part can be stored during non-operational status and still perform normally when placed in operational mode.

## Crystal Clock Oscillator - Terms and Definitions (continued)

**Tolerance** (see Stability)

**TriState** This feature allows the oscillator to be isolated from the circuit upon introduction of a command signal on the input, through an internal pull-up resistor.

**Disable Function** Input is left OPEN or tied to logic "1", allowing normal oscillation.

**Enable Function** Input is grounded or tied to logic "0", output then assumes either a high (typical) or low impedance state (must be specified).

### Voltage

**Input / Supply** The voltage necessary to operate the oscillator.

**High ( $V_{IH}$ )** The minimum input voltage allowable to produce the desired frequency response.

**Low ( $V_{IL}$ )** The maximum input voltage allowable to produce the desired frequency response.

### Output

**High ( $V_{OH}$ )** The minimum output voltage of an oscillator during operation.

**Low ( $V_{OL}$ )** The maximum output voltage of an oscillator during operation.