

Quartz Crystal - Terms and Definitions

Aging	The effect of time in deviation against any specification parameter (e.g. Frequency)
Calibration	The maximum allowable deviation from nominal frequency at room temperature
Capacitance	(measured in picofarads)
Motional (C_1)	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_L)	The effective external capacitance associated with the crystal unit which determines the load resonance frequency, as defined in: $C_L = [(C_1 \times C_2) / (C_1 + C_2)] + C$ (where C 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_0)	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 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
Current	
Input/Supply (I_{cc})	The electric current (measured in milliamps) to the V 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
ESR (Equivalent Resistance) (R_1)	The impedance value of the crystal unit in the operating resonant circuit, as defined in: $R_1 = (2\pi \times f_s \times L_1) / Q$
Frequency (F_0)	The Nominal Frequency of crystal vibration cycles per second (Hz) during operation (measured in either Mhz, kHz, or Hz).
Insulation Resistance (I_R)	The resistance between the leads, or between lead and case (measured in ohms).
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 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 , 5 , 7 , 9 , and occasionally 11 .
Operating (T_{opr}) Temperature	The temperature range at which the part will perform normally within the specified stability range
Output Voltage	
High (V_{OH})	The minimum input voltage allowable to produce the desired frequency response
Low (V_{OL})	The maximum input voltage allowable to produce the desired frequency response
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 either Voltage - Input, or 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: $S \cong C_1 / [2 \times (C_0 + C_L)]$. 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: $Q = (2 \times f_s \times L_1) / R$. The higher the "Q", the smaller the band width (Δf) 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.

Resistance

Equivalent Series (R_1) The impedance value of the crystal unit in the operating resonant circuit, as defined in: $R_1 = (2\pi \times f_s \times L_1) / Q$

Insulation (I_R) 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 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

Shunt Capacitance The static capacitance between the electrodes, together with stray capacitances of the mounting system

Stability (measured in parts per million)

Aging (F_A) 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 (T_{STC}) The temperature range at which the part can be stored during non-operational status and still perform normally when placed in operational mode

Temperature

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

Operating Temp (T_{OPR}) The temperature range at which the part will perform normally within the specified stability range

Storage (T_{STC}) The temperature range at which the part can be stored during non-operational status and still perform normally when placed in operational mode

Tolerance

Aging (F_A) 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

Crystal Clock Oscillator - Terms and Definitions

Aging (FA)	The effect of time in deviation against any specification parameter (e.g. Frequency).
Calibration	The maximum allowable deviation from nominal frequency at room temperature over the operating temperature range
Current	
Input / Supply (I_{CC})	The maximum electric current to the V Supply Pin with no output load when output is enabled
Output (I_O)	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 (T :T), measured at 1.4v for TTL, and 50% of the peak to peak voltage for CMOS and ECL logic
Frequency (f_o)	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 Frequency	The temperature range at which the part will perform normally within the calculated stability range
Output	
Current	The minimum electric current output at either "0" level or "1" level operation
Enable Function	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
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	
High (V_{OH})	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)
Low (V_{OL})	The maximum input voltage allowable to produce the desired frequency response
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 (T_R) & Fall (T_F) Time	The T_R 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 T_F is the transition time from the high90%state to the low10%state of the output waveform (common T_R and T_F).

Stability

Aging (f_a)	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 startup time

Storage Temperature

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

Supply

Current	The maximum electric current to the V Supply Pin with no output load when output is enabled
Voltage	The voltage necessary to operate the oscillator

Symmetry / Duty

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 (T :T), measured at 1.4v for TTL, and 50% of the peak to peak voltage for CMOS and ECL logic

Temperature

Operating	The reference temperature (usually 25 C) at which the frequency is calculated
Calibration	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

Tolerance

Aging (f_a)	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.

Tristate

Enable	Input is grounded or tied to logic "0", output then assumes either a high (typical) or low impedance state (must be specified)
Disable	Input is left OPEN or tied to logic "1", allowing normal oscillation

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