Crystals

Crystals are used as part of some oscillator and filter circuits to determine resonant frequencies of these circuits.

Piezoelectric Effect

Crystals exhibit the piezoelectric effect, which is what makes them useful in oscillator and filter circuits. Crystals can convert mechanical energy into electrical energy, and vice versa. When squeezed, a crystal will generate a voltage. Also, when a voltage is applied across a crystal, it will vibrate at its resonant frequency.

Advantages

Crystals can serve as a frequency source of high precision and stability, both short-term and long-term. They also exhibit high Q, so they don't exhibit much resistance to AC at the resonant frequency. Like capacitors, crystals don't conduct DC. They exhibit similar qualities in filter circuits.

Crystal Manufacture

Most crystals are made of quartz (a form of silicon). Some are made of rubidium or ceramic.

Since crystals are three-dimensional objects, they can have more than one way they can vibrate. Crystals typically vibrate in these three ways:

1. longitudinally
2. face-shear
3. shear

How a crystal is cut can modify how a crystal vibrates. Crystal manufacturers typically use the AT cut to create crystals for use in electronic circuits; this cut promotes the shear mode, which favors higher frequencies.

Crystal Oscillators

Maybe we don't need to talk about them.

Crystal Filters and Bandwidth

Talk about bandwidth and ripple.

Talk about the number of poles and how that related to bandwidth and ripple.

 Bob McDonald, Brian Hughes, Dan Peck, Terry Tapp

Single crystal, half-lattice

References

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