

Quartz is a mono-crystal made of Si and O₂ and exhibits a phenomenon called “the [piezoelectric effect](#)” which is the generation of electric polarization when given mechanical stimulus that causes deformation in the crystal lattice.

The crystals and oscillators carried by Suntsu are manufactured using quartz crystal and incorporated into common electronic equipment present in our daily lives such as cell phones, GPS devices, and computers to name a few. Suntsu’s crystals and oscillators play a critical role in transmitting information within these devices. Many engineers liken the crystal device oscillating at a specified signal, such as a TCXO in a cell phone, to a heart pumping blood into a body.

Since the mid 1950’s crystals have been grown in gigantic pressure vessels called [autoclaves](#). These vessels are filled with an alkaline solution, their upper halves are loaded with [seed quartz](#) (a plate of pure crystal with few flaws in the crystal arrangement) and the lower halves are filled with a raw natural crystal material called [lasca](#). The mixture is then exposed to high temperatures (300C to 400C) and high pressure conditions (1000 to 1500 atmospheric pressure) which generates re-crystallization and produces synthetic quartz crystal. This process can take up to a couple of months depending on the crystal. It is critical that the quartz be free from impurities as it is the biggest determinant in deciding a superior or poor quality frequency control device. Suntsu requires its suppliers to employ stringent control systems so that only the highest quality synthetic quartz crystal is produced.

Quartz crystal has directional properties and it is therefore necessary to identify the crystal axis to make it functional as an electronic component. This process is called “[lumbering](#).” Depending on the purpose, cutting is carried out at required angles measured against this crystal axis. Crystals are designed to oscillate in a stable manner and at high frequencies, the oscillating frequency is in inverse proportion to thickness of crystal, meaning the higher frequency is, the thinner the crystal is, and vice versa. By applying this characteristic, crystal is cut and ground until a targeted frequency (thickness) and size (physical dimension) are achieved. This process requires very fine precise control up to parts per million and is significant because it is where the property of the crystal is almost determined and is the stage where the actual crystal blank is produced.

After being cut and ground the crystal blank has small cracks and stains on the surface, which together are called the [affected layer](#). Chemicals are used to smooth and clean the [affected layer](#) in order to remove the distortions. At this point, fine-tuning of the frequency is conducted as well and upon completion some of the crystal blanks end up smaller than a cross section of rice and thinner than paper.

After the targeted frequency and size have been achieved a metal film of gold, silver or other metals are glued onto the crystal blank using a method called “[base plating](#).” This process is where it becomes possible to generate oscillation of an electric signal because the electric connection is made. Current supplied to this metal film oscillates the crystal blank and frequency becomes available. This is the application of an “[inverse piezoelectric effect](#).”

It is here where the crystal blank will either be processed into a standard crystal or coupled with an IC or internal circuitry to create an oscillator. The electrode plated crystal blank is then loaded into a [package](#) by using a [conductive adhesive agent](#). At this stage the finished product is starting to take shape. After ensuring that it is firmly adhered and can withstand falls and vibrations, the frequency stability is checked and the package is sealed with a [cap](#) in a nitrogen atmosphere. This protects the crystal blanks from air and dust, thus making it more stable over a long period of time. In the end a strict final check is conducted as to whether the targeted specifications are fulfilled or not and only then are the components quality approved, marked and packed up for shipping.