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MHZ Crystal Quartz Crystal Oscillata Miniatura 16 Enclosed in an HC-49 hermetically sealed / s package, used as a resonator in a crystal oscillator.typeelectromeChanicalWorking PrinciplesEzelectricity, ResonanceVentedalExander M. Nicholson, Walter Guyton CadyFirst Production1918Electronic symbol A crystal oscillator is a swinging circuit Electronic using the mechanical resonance of a vibration crystal of piezoelectric material to generate an electrical signal with a constant frequency. [1][2][3] This frequency is often used to keep track of time, as in quartz watches, to provide a stable clock signal for digital integrated circuits, and stabilize frequencies for transmitters and radio receivers. The most common type of piezoelectric resonator used is a quartz crystal, so biscuits incorporating circuits became known as crystal oscillators. [1] However, other piezoelectric materials whose polycrystalline ceramics are used in similar circuits. A crystal oscillator invokes the slight change of a quartz crystal under an electric field, a proprietary known as electrostriction or reverse piezoelectricity. A voltage applied to electrodes on the crystal induces to change shape; When the voltage is removed, the crystal generates a small voltage as you can elastically return to its original shape. Oscillates quartz with a stable resonance frequency, behave like a RLC circuit, but with a higher Q factor (less energy loss at each oscillation cycle). Once a quartz crystal is adjusted to a particular frequency (which is influenced by the mass of electrodes connected to the crystal, the orientation of the crystal, temperature and other factors), it maintains that frequency at high stabilment. [4] Quartz crystals are manufactured for frequencies from a few dozens of kilohertz to hundreds of megahertz. Starting from 2003, about two billion crystals are produced every year. [5] Most are used for consumer devices such as wristwatches, watches, radio, computers and mobile phones. However, in applications that require small size and weight of the crystals can be replaced by bulk thin acoustic resonator films, in particular if it is necessary high frequency (more than about 1.5 GHz) resonance. Quartz crystals also find proof inside and measuring devices, such as counters, signal generators, and oscilloscopes. Crystal resonator Terminology quartz (left) and the quartz crystal oscillator (right) A crystal oscillator is an electronic oscillator circuit that uses a piezoelectric resonator, a crystal, as a frequency determination element. Crystal is the term commonly used in electronics for the frequency determination component, a quartz or ceramic wafer with electrodes connected to it. A more precise term because it is piezoelectric resonator. The crystals are also used in other types of electronic circuits, such as quartz filters. Piezoelectric resonators are sold as separate components for use in crystal oscillating circuits. An example is shown in the figure. They are also often incorporated into a single package with the crystal oscillator circuit, shown on the right side. History 100 KHZ crystal oscillators at the US National Bureau of Standards which is served as the frequency standard for the United States in 1929 very early Bell Labs Crystals of Vectron International Collection Piezoelectricity was discovered by Jacques and Pierre Curie in 1880 . Paul Langevin quartz resonators first investigated for use in Sonar during World War I. The first controlled crystal oscillator, using a rock crystal of Rochelle, was built in 1917 and [6] In 1918 by Alexander M. Nicholson to Bell Telephone Laboratories, although his priority was challenged by Walter Guyton Cady. [7] Cady built the first quartz crystal oscillator in 1921. [8] Other first innovators in quartz crystal oscillators include G. W. Pierce and Louis Essen. quartz crystal oscillators have been developed for high-stabilized reference frequencies during 1920 and e First of crystals, radio stations control frequency with granted circuits, which could easily derive out frequency with 3a 4Å, khz. [9] Since the issuing stations that frequencies have been assigned only to 10 kHz separates, the interference between adjacent stations due to the frequency drift was a common problem. [9] In 1925, Westinghouse installed a crystal oscillator in the Punta Kdka station, [9] and in 1926, quartz crystals were used to control the frequency of numerous issuers and were popular with amateurs. [10] In 1928, Warren Marrison of Bell Telephone Laboratories developed the first quartz-crystal watch. With precision up to 1 second in 30 years (30 bis ms / y, or 0.95a ns / s) [8], quartz precision pendulum watches replaced as more precise time clocks in the world until atomic watches have been developed In 1950. Using the first works at the Bell, AT & T laboratories at the end of their frequency of the product division for the control, then scored and Known today as Vectron International. [11] A number of studies has begun to produce quartz crystals for electrical use during this period. Using those that today are considered primitive methods, about 100,000 crystal units have been produced in the United States during 1939. Through the crystals of the Second World War were made by the crystal of natural quartz, practically all from Brazil. The shortage of crystals during the war caused by the request for control of the accurate frequency of military and naval radares have stimulated the post-war period in culture of synthetic quartz, and in 1950 a hydrothermal process for the growth of quartz crystals on a commercial scale It was developed at the Bell Laboratories. From 1970 practically all the crystals used in electronics were synthetic. In 1968, Juergen Staudte invented a photolithographic process to manufacture quartz crystal oscillators during work at North American Aviation (now Rockwell) that allowed them to be made quite small for portable products like watches. [12] Although crystal oscillators even more commonly used quartz crystals, devices that use other materials are becoming more common, such as ceramic resonators. Ways of oscillation Crystal Operation A crystal is a solid in which the constituent atoms, molecules or ions are packaged in a regularly ordered, repeating model extends into all three spatial dimensions. Almost any object in elastic material could be used as a crystal, with suitable transducers, since all objects have natural resonant vibration frequencies. For example, steel is very elastic and has a high sound speed. It has often been used in mechanical filters before quartz. The resonance frequency depends on the size, shape, elasticity, and the speed of the sound in the material. High frequency crystals are usually cut into the shape of a simple rectangle or circular disk. Low frequency crystals, such as those used in digital watches, are usually cut into the form of a diapason. For applications that do not require very precise times, a low-cost ceramic resonator is often used instead of a quartz crystal. When a quartz crystal is properly cut and mounted, it can be done to distort in an electric field by applying a voltage to a near or crystal electrode. This property is known as electrostriction or reverse piezoelectricity. When the field is removed, the quartz generates an electric field as you return to its previous shape, and this can generate a tension. The result is that a quartz crystal behaves like a RLC circuit, composed of a Condenser and resistance, with a precise resonance frequency. Quartz has the further advantage that its elastic constants and the format change in such a way that a temperature frequency dependence can be very low. The specific characteristics depend on the vibration mode and the angle to which quartz is cut (compared to its crystallographic axes). [13] Therefore, the resonance frequency of the slab, which depends on its size, does not change much. This means that a quartz watch, filter or oscillator oscillator accurate. For critical applications the quartz oscillator is mounted in a temperature control container, called a crystalline oven and can also be mounted on the shock absorbers to prevent disturbance from external mechanical vibrations. Modeling the electric model A quartz crystal can be modeled as a power network with low impedance resonance points (series) and high impedance (parallel) spaced up close. Mathematically (using the transformation of the laplace), the impedance of this network can be written as: schematic symbol and equivalent circuit for a quartz crystal in a z (s) oscillator = (1 s Å ε

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