Clock Generator For Digital System

A clock generator is an electronic oscillator that produces a clock signal for use in synchronizing a circuit's operation. The signal can range from a simple symmetrical square wave to more complex arrangements. The basic parts that all clock generators share are a resonant circuit and an amplifier.

The resonant circuit is usually a quartz piezo-electric oscillator, although simpler tank circuits and even RC circuits may be used.

The amplifier circuit usually inverts the signal from the oscillator and feeds a portion back into the oscillator to maintain oscillation.

How Clock Generators Work:

Clock generators are generally made of a quartz or ceramic piezo-electric circuit board that includes an oscillator and an amplifier. As the piezo-electric material responds to changes in pressure, the oscillator produces a constant wave that repeats itself, such as a square wave, in order to synchronize external events. The amplifier receives and inverses this signal, passes it along to the output, and returns a portion of the signal back to the oscillator.

Applications

Clock generators can be used in a wide variety of applications, the most notable being computer systems. Clock generators are used in computers to manage memory cards, peripheral devices, CPUs, ports, etc. In fact, computer experts often reset clock generators in order to control these devices’ speed and performance. Clock generators are also used in telecommunication systems, digital switching systems, and many mechanical devices.

Advantages

Clock generators are advantageous because they allow mechanical devices to stay synchronized with their digital counterparts. Many clock generators, known as “programmable clock generators,” can be modified to change the signal they produce, allowing users to change the speed at which mechanical and digital devices perform tasks. Clock generators are usually small, lightweight, and inexpensive to produce, allowing them to be placed in ever smaller electronic devices such as laptops, notebooks, and smartphones.

Quartz Crystal Oscillator

A crystal oscillator is an electronic oscillator circuit that uses the mechanical resonance of a vibrating crystal of piezoelectric material to create an electrical signal with a constant frequency.This frequency is often used to keep track of time, as in quartz wristwatches, to provide a stable clock signal for digital integrated circuits, and to stabilize frequencies for radio transmitters and receivers. The most common type of piezoelectric resonator used is a quartz crystal, so oscillator circuits incorporating them became known as crystal oscillators. However, other piezoelectric materials including polycrystalline ceramics are used in similar circuits.

The frequency stability of the output signal can be greatly improved by the proper selection of the components used for the resonant feedback circuit, including the amplifier. But there is a limit to the stability that can be obtained from normal LC and RC tank circuits.

To obtain a very high level of oscillator stability a Quartz Crystal is generally used as the frequency determining device to produce another types of oscillator circuit known generally as a Quartz Crystal Oscillator, (XO).

When a voltage source is applied to a small thin piece of quartz crystal, it begins to change shape producing a characteristic known as the Piezo-electric effect. This Piezo-electric Effect is the property of a crystal by which an electrical charge produces a mechanical force by changing the shape of the crystal and vice versa, a mechanical force applied to the crystal produces an electrical charge.

Then, piezo-electric devices can be classed as Transducers as they convert energy of one kind into energy of another (electrical to mechanical or mechanical to electrical). This piezo-electric effect produces mechanical vibrations or oscillations which can be used to replace the standard LC tank circuit in the previous oscillators.

There are many different types of crystal substances that can be used as oscillators with the most important of these for electronic circuits being the quartz minerals, due in part to their greater mechanical strength.

The quartz crystal used in a Quartz Crystal Oscillator is a very small, thin piece or wafer of cut quartz with the two parallel surfaces metallised to make the required electrical connections. The physical size and thickness of a piece of quartz crystal is tightly controlled since it affects the final or fundamental frequency of oscillations.

The equivalent electrical circuit for the quartz crystal shows a series RLC circuit, which represents the mechanical vibrations of the crystal, in parallel with a capacitance, Cp which represents the electrical connections to the crystal. Quartz crystal oscillators tend to operate towards their “series resonance”.