Function generator

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A **function generator** is a piece of electronic test equipment or software used to generate electrical waveforms. These waveforms can be either repetitive or single-shot, in which case some kind of triggering source is required (internal or external).

Function Generators are used in development, testing and repair of electronic equipment, e.g. as a signal source to test amplifiers, or to introduce an error signal into a control loop.

File:Waveforms.sag
Sine, square, triangle, and sawtooth waveforms.

File:DDS function generator.jog
A DDS function generator.

File:Ken wood FG273 Function Generator.
A typical low-cost function generator.

Contents

Explanation

Analog function generators usually generate a triangle waveform as the basis for all of its other outputs. The triangle is generated by repeatedly charging and discharging a capacitor from a constant current source. This produces a linearly ascending or descending voltage ramp. As the output voltage reaches upper and lower limits, the charging and discharging is reversed using a comparator, producing the linear triangle wave. By varying the current and the size of the capacitor, different frequencies may be obtained. Sawtooth waves can be produced by charging the capacitor slowly, using a current, but using a diode over the current source to discharge quickly - the polarity of the diode changes the polarity of the resulting sawtooth, i.e. slow rise and fast fall, or fast rise and slow fall.

A 50% duty cycle square wave is easily obtained by noting whether the capacitor is being charged or discharged, which is reflected in the current switching comparator output. Other duty cycles (theoretically from 0% to 100%) can be obtained by using a comparator and the sawtooth or triangle signal. Most function generators also contain a non-linear diode shaping circuit that can convert the triangle wave into a reasonably accurate sine wave. It does so by rounding off the hard corners of the triangle wave in a process similar to clipping in audio systems.

A typical function generator can provide frequencies up to 20 MHz. RF generators for higher frequencies are not function generators in the strict sense since they typically produce pure or modulated sine signals only.

Function generators, like most signal generators, may also contain an attenuator, various means of modulating the output waveform, and often the ability to automatically and repetitively "sweep" the frequency of the output waveform (by means of a voltage-controlled oscillator) between two operator-determined limits. This capability makes it very easy to evaluate the frequency response of a given electronic circuit.

Some function generators can also generate white or pink noise.

More advanced function generators use Direct Digital Synthesis (DDS) to generate waveforms. Arbitrary waveform generators use DDS to generate any waveform that can be described by a table of amplitudes.

Other meanings

Another type of function generator is a sub-system that provides an output proportional to some mathematical function of its input; for example, the output may be proportional to the square root of the input. Such devices are used in feedback control systems and in analog computers. A function generator IC named ICL8038 (which is also used as Voltage Controlled Oscillator (VCO)) can be used to generate triangular wave, square wave, saw-tooth wave or even, sine wave simultaneously. For maximum voltage rating of

36, more than 300kHz of frequency can be generated.

See also

- Digital Pattern Generator
- Electronic musical instrument

External links

- Function Generator & Arbitrary Waveform Generator Guidebook (http://www.bkprecision.com/support/downloads/guides/Function_and_Arbitrary_Waveform_Generator_Guidebook/BK-Function-Generator-and-AWG-Guidebook.pdf)
- Waveform Generator Fundamentals (http://www.ztecinstruments.com/waveform-generator-fundamentals)
- Function Generator Tutorial Video in HD (http://www.afrotechmods.com/groovy/function_generator/function_generator.htm)