UJT Sine-Wave Generators

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Unijunction transistors can produce more than just pulses and saw-tooth waveforms; with a little ingenuity they can make acceptable sine waves.

USUALLY unijunction transistors are not used in sine-wave generators. In fact, they are most often used to produce pulses or saw-tooth waveforms. Yet a sine-wave output can be obtained from a UJT in circuits properly designed for the purpose.

For example, a sine-wave output is produced by the crystal oscillator circuit of Fig. 1. This circuit is useful in applications where efficiency and waveform purity (freedom from harmonic distortion) are relatively unimportant. Actually, efficiency and waveform purity is dependent upon the base-2 impedance and supply-voltage level. In Fig. 1 this is accomplished by adjusting potentiometer $R2$.

A more efficient and much less critical circuit can be designed when the operating frequency is to be determined by LC components, that is, an inductor and capacitor, as shown in the circuit of Fig. 2. The field-effect transistor, $Q2$, in this case, is not part of the oscillator proper but is simply a source-follower whose sole purpose is to reduce loading. UJT $Q1$ is the oscillator. Operating frequency is determined by $L1$ and $C1$. In this application, $C1$ is made adjustable over a limited range to permit setting the output frequency at exactly 50 kilohertz.

However, UJT $Q1$ does not produce the sine waveform directly. In fact, it pulses. The pulse is applied in series with $L1$ and $C1$, and occupies only a short interval of the entire cycle. The sine-wave output signal is the result of a change in voltage across capacitor $C1$.

Actually, the waveform at the emitter of $Q1$ is not ideal for the task, but it comes so close that a critical inspection of the trace on an oscilloscope screen would be needed to note the departure from true sine waveform.

The advantage of this circuit is that, with the value of resistors $R1$ and $R2$ as given in Fig. 2, the output waveform is not significantly affected by variations in the power-supply voltage level. The prototype operates as efficiently at 12 and 3 volts d.c. as it does at 9 volts d.c. Only the amplitude changes as the supply-voltage level is changed.

This UJT sine-wave oscillator can be used at frequencies as high as 100 kHz and as low as 100 Hz by choosing appropriate values for $L1$ and $C1$. A 400-Hz circuit is shown in the schematic diagram of Fig. 3. In this case, the inductor is an iron-core audio-frequency choke having an inductance of about 3 henrys. The Mylar capacitor, $C1$, is a 0.047-μF unit.

In both Figs. 2 and 3, it will be noted that the LC ratio is quite high. It is necessary to use a high LC ratio to produce the sine waveform. If the ratio decreases, distortion occurs in the positive-going excursions of the waveform. Furthermore, as distortion increases, the operating frequency increases beyond that indicated by the LC product.

If the LC ratio is made much too low, the oscillator produces an output signal having a saw-tooth waveform. ▲

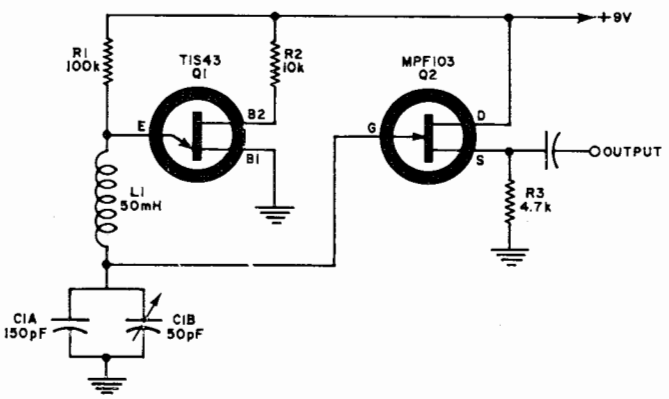

Fig. 2. In this circuit L1 and C1 determine the frequency.

Fig. 1. Crystal-controlled UJT oscillator produces sine waves.

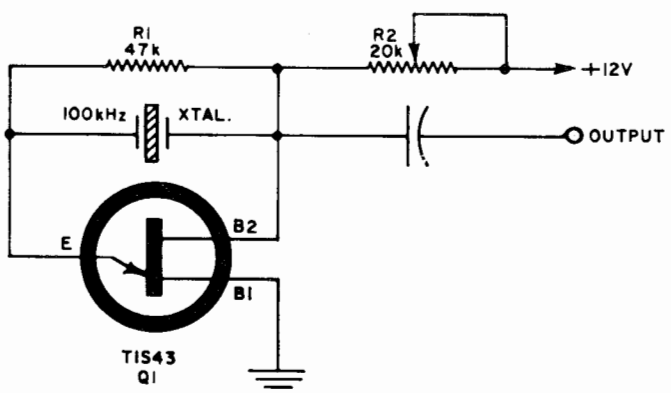

Fig. 3. The resonant frequency of this circuit is 400 Hz.