

The unijunction transistor

The unijunction transistor was one of the most attractive, simple and versatile semiconductor devices made available to electronic designers until discrete components were replaced by integrated circuits.

The device was introduced in 1955 by General Electric. Here the article from [Electronics, March 1955](#). In the article the device was referred to as a double base diode but soon later the name was changed to unijunction transistor or UJT

UJT was a simple device, a silicon N-type bar with two ohmic contacts at both ends and a P-N junction about at two third of its length. The intermediate electrode is called emitter, while the two end contacts are referred to as B1 and B2 bases, B1 being the one farthest from the emitter. The construction of UJT and the related symbol are given in the figure below:

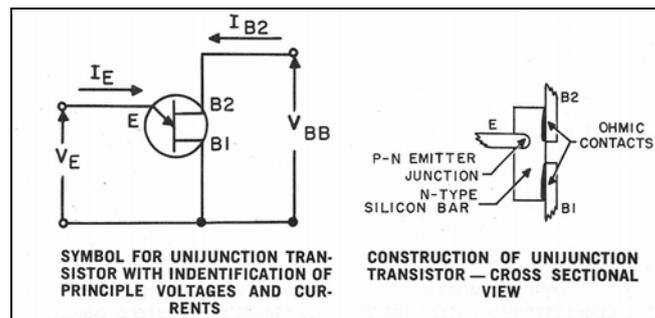


Fig. 1 - Symbols used for UJT and internal construction of the device.

The interbase resistance is somewhere from 5 and 10 kohms. B2 is normally biased at a positive voltage, V_{bb} , and B1 is grounded, the silicon bar acting as a voltage divider. No current can pass through the emitter until the P-N junction is reverse-biased. The conduction can take place only at an emitter voltage equal to the voltage existing on the voltage divider plus the direct drop on the junction, 0.67 volt at 25°C. This value is defined by the intrinsic stand-off ratio, η , which is equivalent to the internal partition ratio.

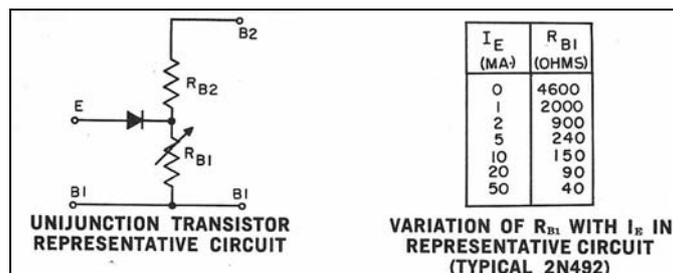


Fig. 2 - Equivalent circuit of UJT and influence of emitter current on R_{b1} resistance.

Above the equivalent circuit of UJT. Looking at the table on the right, we see that the resistance value R_{b1} sharply decreases when emitter current increases. The well

defined emitter negative resistance characteristics and the simple use made the device advantageous in countless circuits. The basic use of UJT devices was in relaxation oscillators, but we can find many other applications, such as in lamp dimmers, motor controllers, battery chargers, tachometers, counters, frequency dividers or crystal oscillators. In some applications, as metronome, audio oscillator, timer or comparator, UJT was capable of driving power loads, as loudspeakers or relays. In this case efficiency was very high, since energy stored in the capacitor was transferred almost entirely to the load.

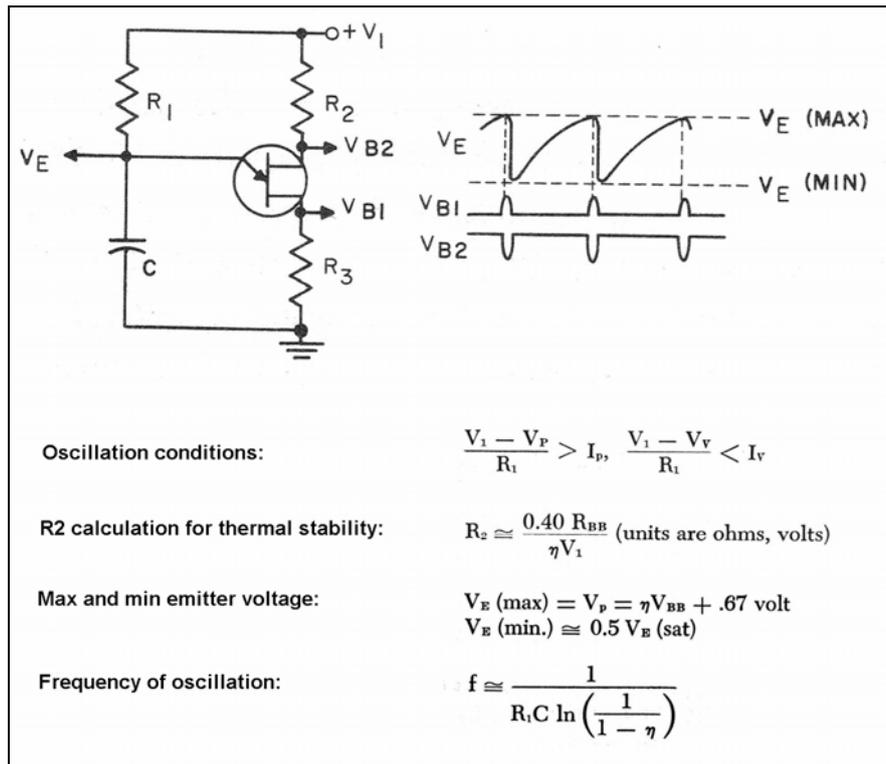


Fig. 3 - UJT relaxation oscillator, waveforms and formulae to calculate values of components.

In the above figure we see the basic relaxation oscillator and the formulae required to calculate the value of components. Values for Rbb, η, Vp and Vv can be find on the datasheet of the unijunction device, such as for [2N4870](#).

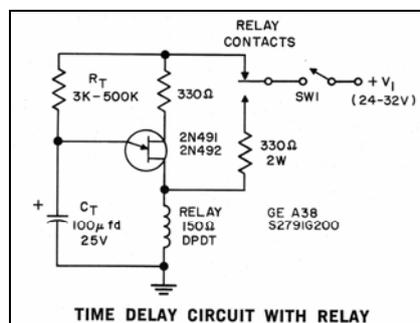


Fig. 4 - UJT delay circuit driving the coil of a latching relay.

Here some [UJT applications](#) from Markus and GE Transistor Manual.