
ELECTRONICS DEVICES AND CIRCUITS

OBJECTIVE

TUNNEL DIODE

TUNNEL DIODES

- was first introduced by ***Leo Esaki*** in 1958.
- is fabricated by doping the semiconductor materials that will form the p-*n* junction at a level one hundred to several thousand times that of a typical semiconductor diode.
- The tunnel diode has a region in its *voltage current characteristic* where the current decreases with increased forward voltage, known as its *negative resistance region*. This characteristic makes the tunnel diode useful in oscillators and as a microwave amplifier.
- widely known as *Esaki diode.*

- are different from any diode in that it has a negative-resistance region.

Negative-resistance region:

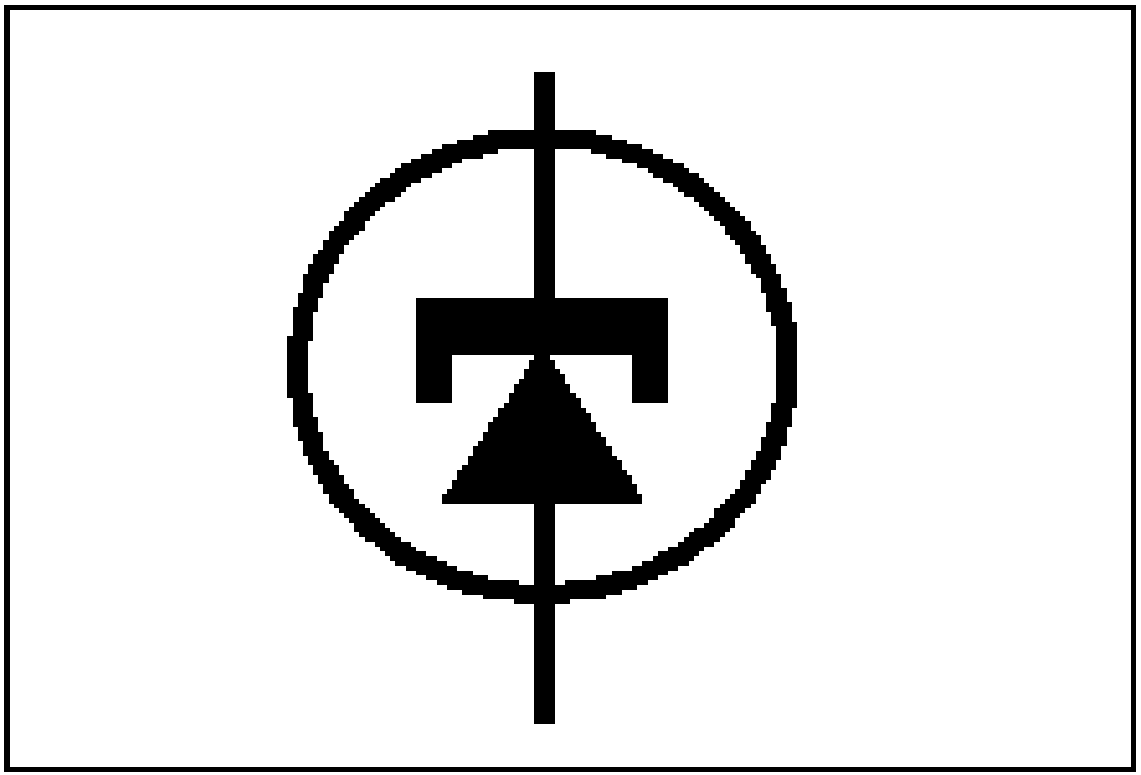
- An increase in terminal voltage results in a reduction in diode current.

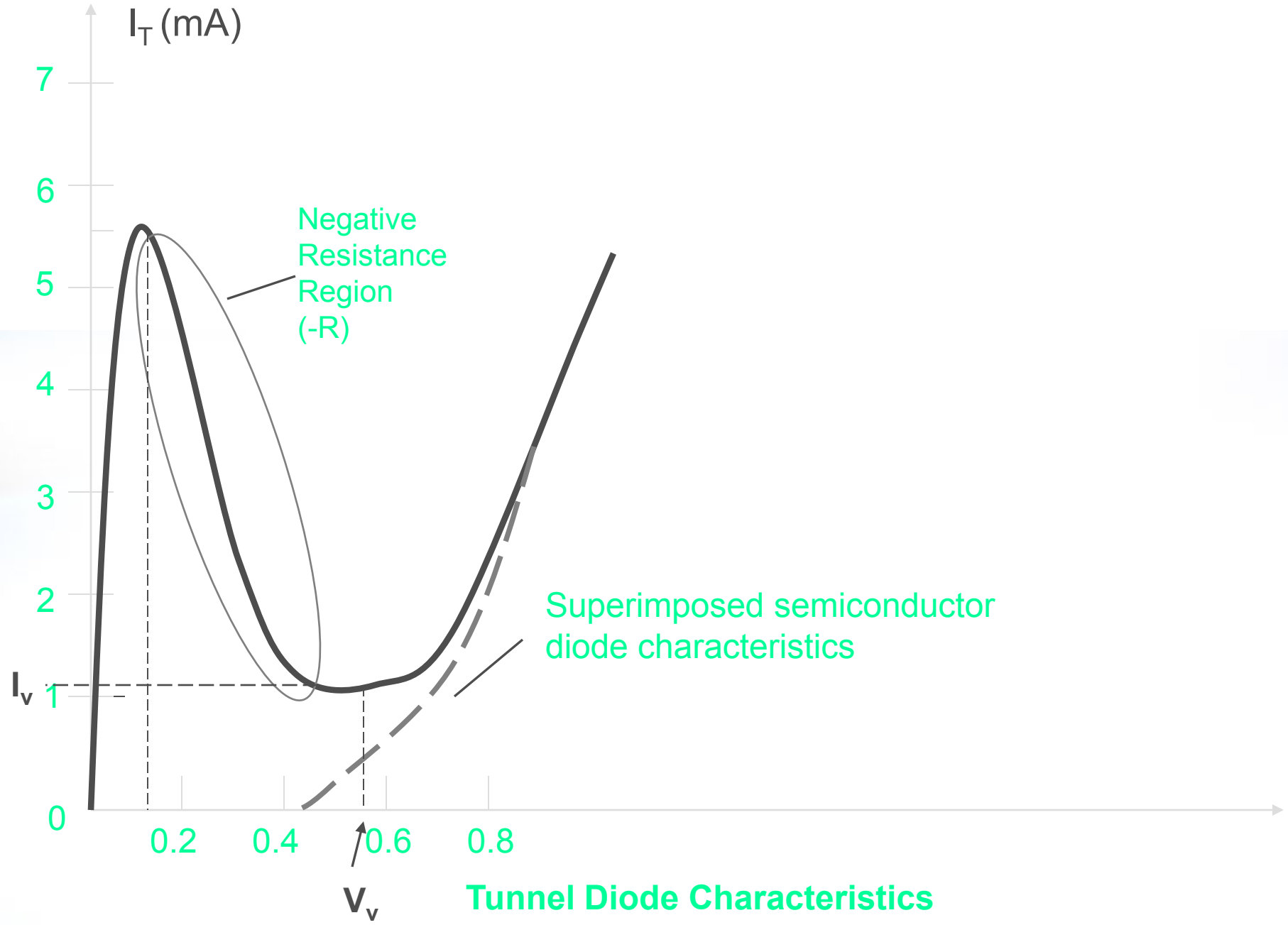
The semiconductor materials most frequently used in the manufacture of tunnel diodes:

- Germanium – it is typically 10:1
- Gallium Arsenide – it is closer 20:1

The ratio I_p/I_v is very important for computer applications.

A Tunnel Diode





Tunnel Diode Characteristics

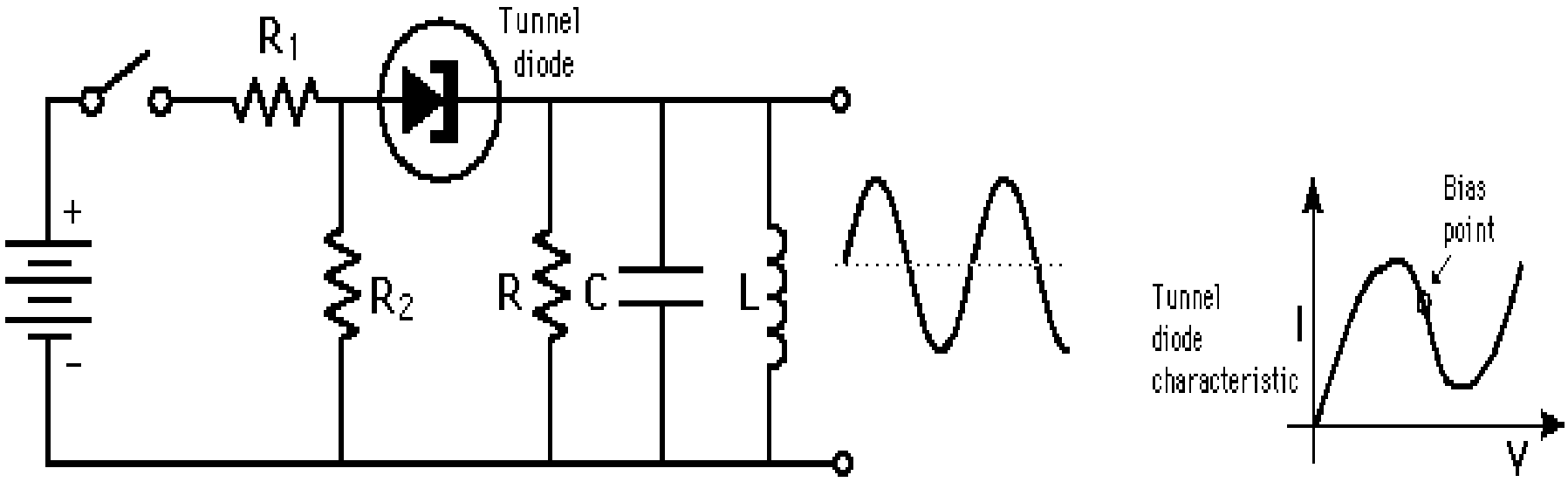
- The peak current, I_p, of a tunnel diode can vary from a few microamperes to several hundred amperes. The peak voltage, however, is limited to about 600 mV. For this reason, a simple VOM with an internal dc battery potential of 1.5V can severely damaged a tunnel diode if applied improperly.

Simplicity, linearity, low power drain, and reliability

- Ensure tunnel diodes' continued life and application.

- The availability of a negative resistance region can be put to good use in the design of oscillators, switching networks, pulse generators, and amplifiers.

Tunnel diode oscillator



The negative resistance region of the tunnel diode makes oscillator action possible. The choice of network elements is designed to establish a load line such as shown in the fig. When the power is turned on, the terminal voltage of the supply will build up from 0V to a final value of E volts.

Sinusoidal Oscillator

- A tunnel diode can also be used to generate a *sinusoidal voltage* using simply a dc supply and a few passive elements. The closing of the switch will result in a sinusoidal voltage that will decrease in amplitude with time.

- Depending on the elements employed, the time period can be from one almost instantaneous to one measurable in minutes using typical parameter values.

- This damping of the oscillator with time is due to the dissipative characteristics of the resistive elements.