

# The Mysterious "Negistor"

*A negative-resistance element, disguised as a transistor, with many useful applications.*

IT IS known that some transistors, when connected into a circuit in reverse, have a negative resistance similar to that of the tunnel diode. That is, the current through and the voltage across the transistor both increase until the voltage reaches a certain point. Then the transistor breaks down and any further increase in current results in a decrease in voltage. To simplify our discussion, we will call such devices "negistors." In circuit diagrams, we represent it as a conventional transistor with the letter "N" added.

Chances are you can't buy a negistor as such at your local electronics store. (They probably wouldn't know what you were talking about anyway.) However, if you have a few npn silicon transistors, you probably already have a supply on hand without knowing it. (But don't expect to find a negistor among the germanium or the pnp silicon units.)

There are a number of types of npn transistors among which negistors can be found: Motorola's MPS-5172, the 2N2218, 2N2222, 2N697, for example. Transistors which may be useless for anything else may be excellent negistors. We have used negistors to build both crystal-controlled and tunable sine-wave oscillators, variable-width pulse generators, oscilloscope sweeps, and many other circuits. Other suggested applications include timing circuits for SCR power control, latching circuits for power-supply regulator protection, timers, etc.

**What Makes It Work.** The behavior of the negistor is caused by avalanche multiplication as a result of impact ionization produced by mobile charge carriers. This characteristic is also used to enhance switching speed in some logic circuits.

The negative-resistance characteristic shown in Fig. 1 results when a 2N2218 is connected as shown. In this case the breakdown voltage is about 7.7V. Using this characteristic, the negistor can be used to perform some of the functions of a tunnel diode or a UJT—often with simpler additional circuitry.

When used in tunnel diode applications, the output of a negistor is much greater than that of the diode. As a

UJT, the reverse transistor dissipates power only during breakdown and therefore its use is limited only by the peak current.

**Applications.** A useful circuit employing the negistor is the sawtooth and pulse generator shown in Fig. 2. Output frequency is determined primarily by  $R_1$ ,  $R_2$  and  $C_1$ . The current through the negistor is limited by  $R_2$ , which also sets the maximum fre-

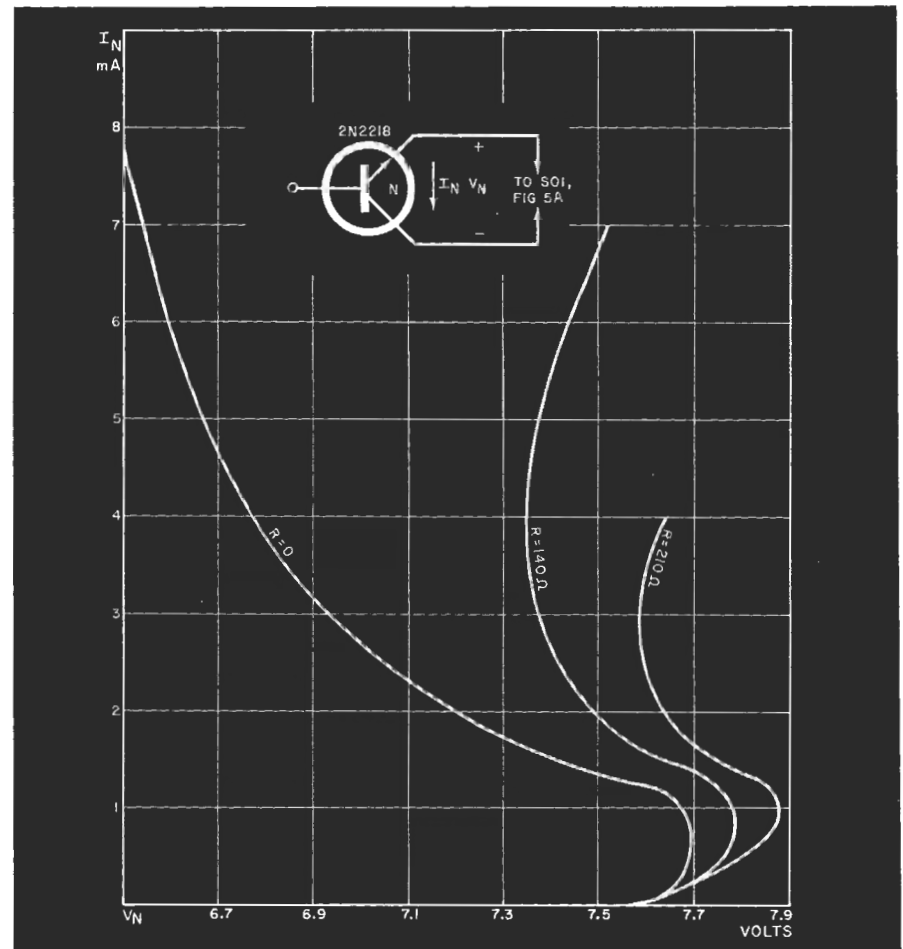


Fig. 1. I-V characteristics of a typical negistor. Many npn transistors exhibit negative-resistance behavior.

