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NASA TECH BRIEF

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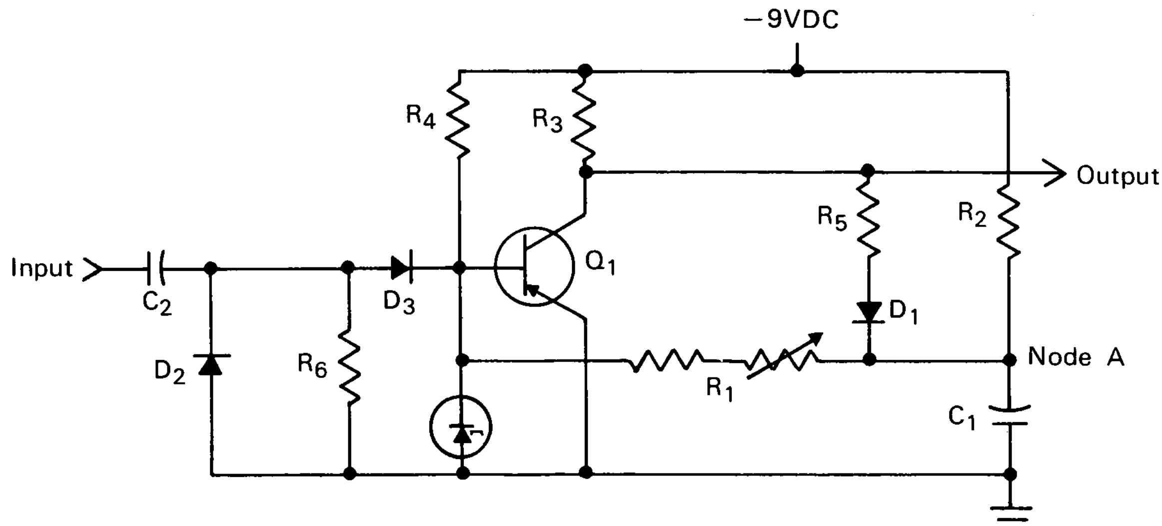
Monostable Circuit with Tunnel Diode Has Fast Recovery



The problem: Design an improved monostable multivibrator (MSMV). Present devices fail to meet ideal operating characteristics in that output voltage rise time is greater than desired; the time period from quasi-stable to stable state is not constant; and available duty cycle time is typically only 65% of operating time.

The solution: A monostable multivibrator incorporating a tunnel diode in the circuit. Improved characteristics of this MSMV include improved rise time, more constant quasi-stable time, and up to 95% duty cycle time.

How it's done: The MSMV circuit shown in the illustration is typical of binary circuits in that it maintains a steady state until a triggering signal is applied to the input, causing a shift to a quasi-stable state for a fixed period of time.

When the circuit is in its stable state, the tunnel diode conducts and the transistor Q_1 is saturated. If a positive trigger pulse is fed into the input, it will cause the tunnel diode to switch to a low-voltage state and to switch off. This initiates a quasi-stable state, the duration of which is controlled by the variable resistor and the choice of capacitor.

With D_1 back-biased and exhibiting a high impedance to node A, C_1 will begin to seek the steady state voltage where the low voltage resistance of the tunnel diode is approximately 50 ohms. Node A can be considered a changing voltage source for the supply of current to the tunnel diode. Current through R_4 is insufficient to supply the necessary switching current to the tunnel diode. When the sum of the two currents from node A and R_4 peaks, diode tunnelling process is initiated and the tunnel diode switches to

(continued overleaf)

the on state. Voltage across the tunnel diode is impressed across the base-to-emitter of Q_1 causing it to switch to its saturated state, thus terminating the quasi-stable state of the multivibrator. Capacitor C_1 will then discharge through the low impedance of the now forward-biased diode D_1 and saturated Q_1, completing the transition back to the steady-state condition necessary before a new quasi-stable period can be initiated.

Use of a tunnel diode in this circuit makes it possible for the MSMV to exceed the performance of present multivibrators in two respects: the rise time of the output voltage is faster—less than 0.2 microsecond—and is more dependable, and duty cycle is raised from about 65% to approximately 95%.

Notes:

1. This circuit may be incorporated in any digital electronics system to improve fast response time and reliability. Specific devices could include computers, switching equipment, telemetry, and counters.
2. For further information about this innovation inquiries should be directed to:
   Technology Utilization Officer
   Goddard Space Flight Center
   Greenbelt, Maryland 20771
   Reference: B63-10603

Patent status: NASA encourages the immediate commercial use of this invention. Inquiries about obtaining rights for its commercial use may be made to NASA Headquarters, Washington, D.C. 20546.

Source: Paul Heffner
(GSFC-132)