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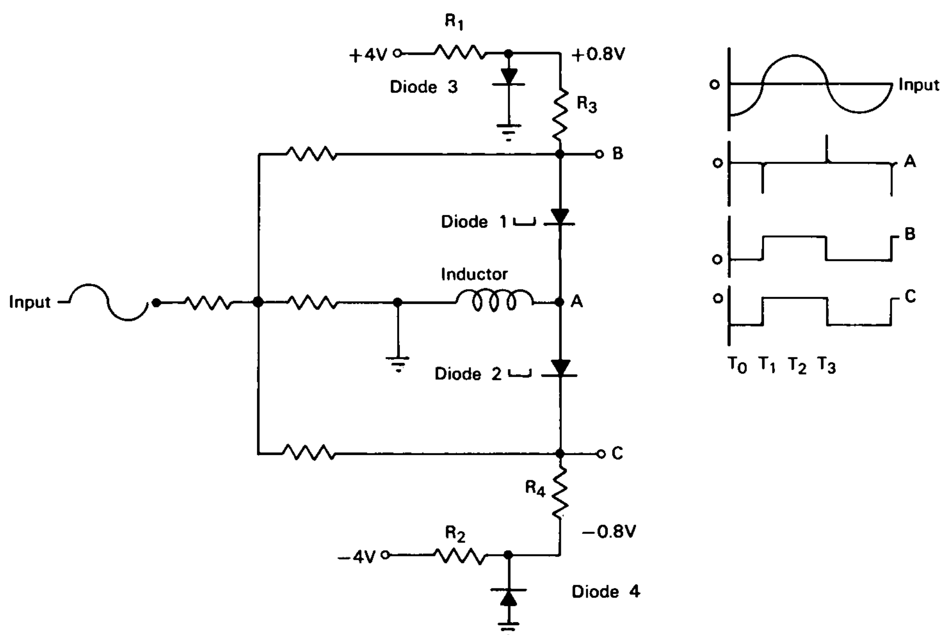
NASA TECH BRIEF

Tunnel-Diode Circuit Features Zero-Level Clipping



The problem: Clipper circuits are used in a wide variety of applications. Often, clipping action must start as the input voltage crosses the waveform zero axis (positive-to-negative or negative-to-positive transition point). Conventional transistor and diode circuits have been designed for this function but generally fail to maintain the start of clipping at the zero point.

The solution: A tunnel-diode circuit that provides clipping action as the voltage crosses the zero axis. Separate outputs are provided for positive and negative clipping.

How it's done: At time T_0 the input voltage is negative, diode 1 is in the low-voltage/high-current state and diode 2 is in the high-voltage/low-current state. Both diodes are biased at their peak-point voltages. As the negative-input voltage moves towards positive, the current through diode 1 increases until at T_1 the peak-current value is reached and diode 1 switches to the high-voltage state. The rapid decrease in current through diode 1 causes a back emf to appear across the inductor. The negative pulse appearing at point A, due to the voltage developed across the inductor, causes diode 2 to switch to its low-voltage/high-current state and the output voltage at point C falls to the zero level. As the positive voltage (peak at T_2) decreases, the current through diode 2 will increase until, at T_3 which is at exactly input voltage zero, the peak current value of diode 2 is reached and it switches to the high-voltage/low-current state. At

(continued overleaf)

this time, T_3, the inductive voltage at A is positive and diode 1 switches to the low-voltage/high-current state. In this manner, diode 1 and diode 2 will switch to the opposite voltage/current state at every zero crossing (times T_1 and T_3) of the input voltage. Switching time is in the order of nanoseconds. The positive square waves which appear at B and the negative square waves which appear at C will rise and fall exactly coincident with the respective zero crossing of the input voltage regardless of the frequency, amplitude, or shape of the input signal, within the limits of circuit operation. Resistors R_1 and R_2 and diodes 3 and 4 provide the biasing and compensating circuits for the tunnel diodes. Resistors R_3 and R_4 are the load resistors for outputs B and C respectively.

Notes:

1. This circuit would be effective as a limiter in any FM receiver.
2. The circuit has been operated successfully over a wide frequency range and at temperatures from −50° to +70°C.
3. Inquiries concerning this invention may be directed to:

   Technology Utilization Officer
   Goddard Space Flight Center
   Greenbelt, Maryland, 20771
   Reference: B65-10002

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

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