Zener test circuit serves as dc source

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THIS DESIGN IDEA describes a versatile test circuit for zener diodes after yet another misread zener diode had infiltrated the ranks of 1N4148 diodes assembled on a pc board. As a bonus, the circuit can serve as a moderate-voltage, power-limited adjustable dc source. Although conventional multimeters' resistance ranges typically apply enough voltage to forward-bias most diodes, few can drive a zener diode into reverse conduction. **Figure 1a** shows a simple variable-frequency dc/dc step-up converter whose output voltage depends on the device under test's breakdown voltage.

Upon power application, Pin 3 of IC_1 (one section of a 74HC132 quad dual-input Schmitt-trigger NAND gate) goes to logic one and switches on Q_1, an N-channel logic-level power MOSFET. Current flows through Q_1 and R_6 and stores energy in inductor L_1's magnetic field. Zener diode D_1 limits the voltage at IC_1's Pin 1 to 4.7V. Simultaneously, diode

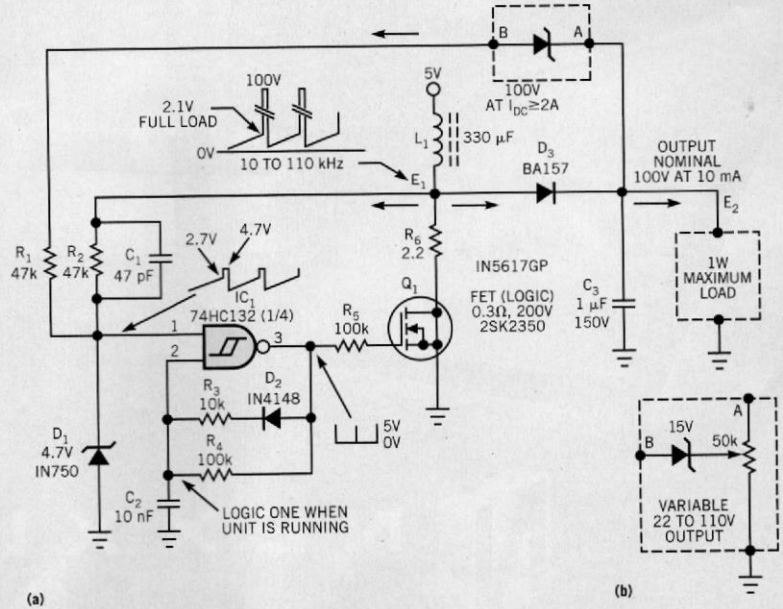

Figure 1 The output voltage of a simple variable-frequency dc/dc step-up converter depends on the device under test's breakdown voltage (a). To use the circuit as a variable medium-voltage power supply, replace the device under test with a network (b).

D_2 and resistor R_3 charge C_2 and establish a logic one at IC_1's Pin 2. When the voltage at point E_1 reaches approximately 2.7V, IC_1's input-voltage threshold, IC_1's output goes to logic zero, switching off Q_1.

Energy stored in L_1's magnetic field discharges through fast-recovery diode D_3 and charges C_3. Capacitor C_1 helps remove diode D_1's stored charge and helps restart the charging cycle.

After several cycles, the voltage at E_2 reaches the device under test's reverse-breakdown voltage and feeds current via R_1 to IC_1's Pin 1. As a result, the voltage at E_2 stabilizes at the sum of the device under test's reverse-breakdown voltage and a constant offset voltage of 5.4V comprising the voltage across D_1—4.7V—plus the forward voltage across D_3—0.7V. Thus, for a 100V zener as the device under test, the voltage at E_2 measures approximately 105.4V.

At start-up and under fault conditions, resistor R_4, diode D_2, and resistor R_3 produce an asymmetrical oscillation at approximately 2 kHz, which reduces the average current through L_1 and Q_1 to a safe level.

To use the circuit as a variable medium-voltage power supply, replace the device under test with the network in **Figure 1b**. Adjusting the potentiometer varies the voltage at point E_2 from 22 to 120V. Maximum current available from the circuit depends on the dc resistance, L_1's magnetic-saturation characteristics, and Q_1's on-resistance. For a nominal 5V power supply and 430 mA of input current, the circuit delivers 10 mA at 100V for a 100V output, yielding an efficiency of approximately 50%. Feeding L_1 from a separate 12V power supply improves efficiency.

If you design your own inductor for L_1, aim for a nominal inductance of 330 µH at 2A and a dc winding resistance of less than 0.5Ω. For optimum operation, use a fast-recovery diode for D_3 and a logic-level N-channel MOSFET with a breakdown voltage of 200V or greater and an on-resistance of less than 0.3Ω for Q_1. Note that zener-diode manufacturers specify breakdown voltages at specific test currents. Also, when you subject them to high reverse voltages, signal diodes exhibit zener behavior.□