High-voltage regulator is immune to burnout

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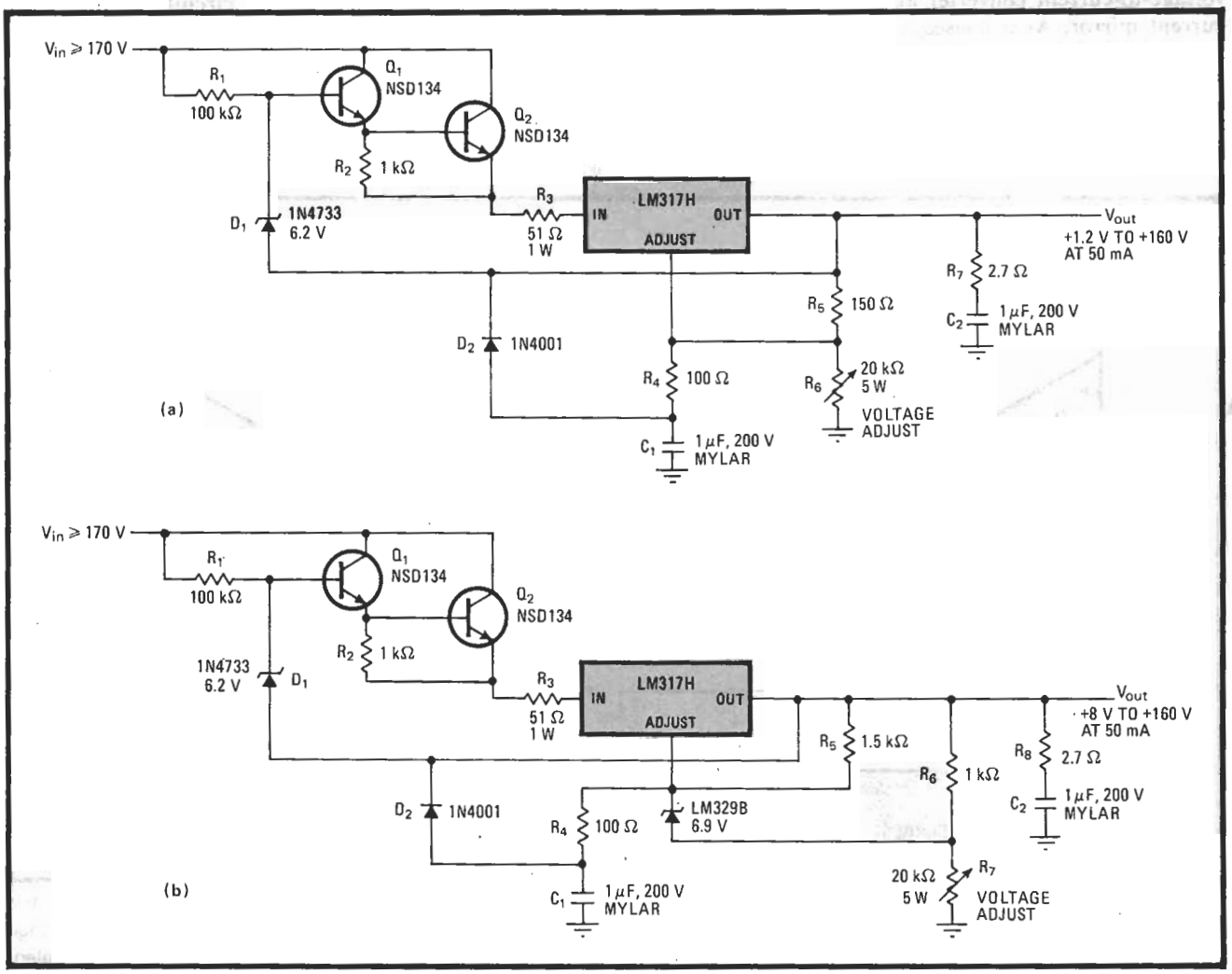
The floating-mode operation of adjustable three-terminal regulators in the LM117 family make them ideal for high-voltage service. Because the regulator sees only the input-output differential—40 volts for the LM117—its voltage rating will not be exceeded for outputs in the hundreds of volts. But the device may break down if the output is shorted unless a circuit can be developed for withstanding the high voltage typically encountered and the output current is limited to a safe value in the event of a dead short.

The circuit surrounding the regulator will serve to solve the problem. Zener diode D_1 maintains a 5-V input output differential over the entire range of output voltages from 1.2 to 160 V. Because high-voltage transistors inherently have a relatively low β, a Darlington arrangement is used to stand off the high input potentials.

The zener diode's impedance will be low, so that no bypass capacitor is required directly at the regulator's input. In fact, no capacitor should be used if the circuit is to survive a short at the output. Resistor R_3 limits the short-circuit current to 100 milliamperes. The RC network at the output improves the circuit's transient response, as does bypassing the adjustment pin. R_4 and D_2 protect the adjustment input from breakdown, if there should be a short circuit at the output.

The approach shown in (b) will serve well in precision regulator applications. Here a LM329B 6.9-V zener reference has been stacked in series with the LM317's internal reference to improve temperature stability and regulation.

These techniques can be employed for higher output voltages and/or currents by either using better high-voltage transistors or cascoded or paralleled transistors. In any event, the output short-circuit current determined by R_2 must be within Q_2's safe area of operations so that secondary breakdown cannot occur. □



Skirting shorts. Three-terminal regulator (a), configured for high-voltage duties as a consequence of operating in the floating mode, is protected by appropriate circuitry against burnout due to shorts. LM329B zener (b) and minor changes improve stability and regulation.