Simple reverse-polarity-protection circuit has no voltage drop

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Common methods of reverse-voltage protection employ diodes to prevent damage to a circuit. In one approach, a series diode allows current to flow only if the correct polarity is applied (**Figure 1**). You can also use a diode bridge to rectify the input so that your circuit always receives the correct polarity (**Figure 2**). The drawback of these approaches is that they waste power in the voltage drop across the diodes. With an input current of 1A, the circuit in **Figure 1** wastes 0.7W, and the circuit in **Figure 2** wastes 1.4W.

This Design Idea suggests a simple method that has no voltage drop or wasted power (**Figure 3**).

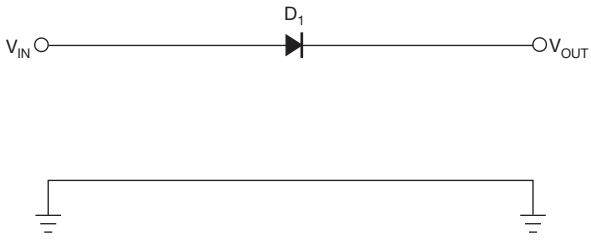

Figure 1 A series diode protects systems from reverse polarity but wastes power in diode losses.

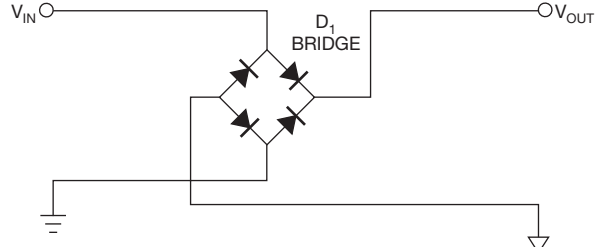

Figure 2 You can use a bridge rectifier so that your system works no matter what the input polarity is. This circuit wastes twice the power, in diode losses, of the circuit in Figure 1.

Select a relay to operate with the reverse-polarity voltage. For example, use a 12V relay for a 12V supply system. When you apply correct polarity to the circuit, D_1 becomes reverse-biased, and the S_1 relay remains off. Then connect the input- and output-power lines to the normally connected pins of the relay, so current flows to the end circuit. Diode D_1 blocks power to the relay, and the protection circuit dissipates no power.

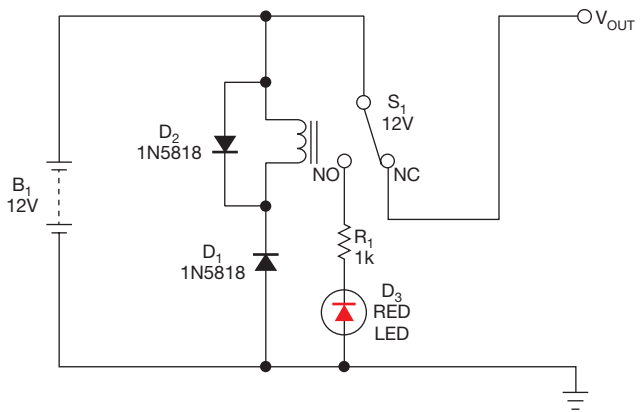

Figure 3 You can wire a relay switch to pass power to your system with no power loss. D_2 clamps inductive kicks from the relay coil.

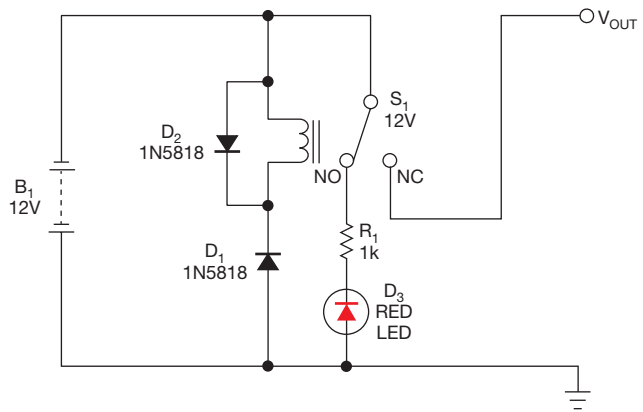

Figure 4 With reversed input voltage, the relay switch engages, interrupting power to the system, and the LED lights.

When you apply incorrect reversed polarity, diode D_1 becomes forward-biased, turning on the relay (**Figure 4**). Turning on the relay cuts the power supply to the end circuit, and red LED D_3 turns on, indicating a reverse voltage. The circuit consumes power only if reverse polarity is applied. Unlike FETs or semiconductor switches, relay contact switches have low on-resistance, meaning that they cause no voltage drop between the input supply and the circuit requiring protection. Thus, the design is suitable for systems with tight voltage margins. EDN