[Ideas For Design]

Simple circuit shuts off system when supply voltage is low

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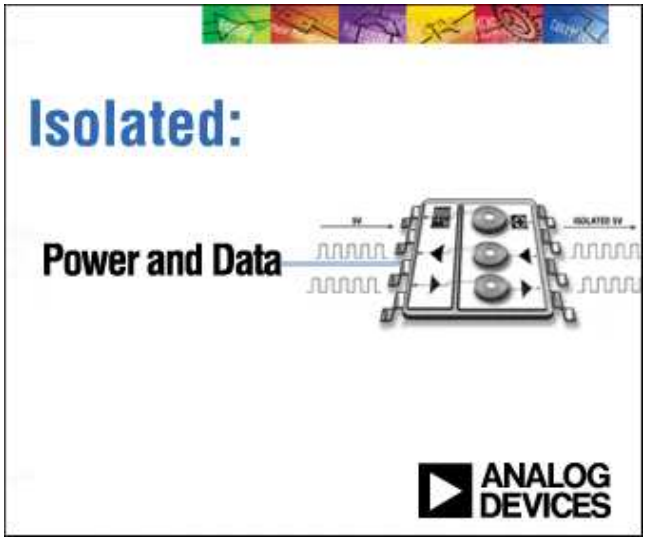


Many low-cost and portable systems, including small consumer electronic products, operate from unregulated power supplies such as batteries or external, plug-in "power bricks." These power sources sometimes produce lower-than-nominal output voltages—either through normal battery discharge, "brownouts," or simply connecting the wrong "brick" to the system. When supply voltage drops below a minimum threshold, it's often good practice to disconnect the supply from the system to prevent poor performance or erratic operation.

The circuit shown accomplishes this with minimal cost, board space, and complexity (see the figure). In addition, the active components are available in tiny, "SOT-23" packages. IC1 is an LM4041 adjustable voltage reference that serves here as a programmable voltage detector. It does this by operating in an unconventional configuration. Typically, the LM4041 develops a voltage between its positive and negative terminals that forces 1.24 V between its "+" and "ADJ" pins. With R3 in the circuit, however, IC1's "-" pin will be near ground when the voltage across R1 is less than 1.24 V, and about a volt below V+ when the voltage across R1 is greater than 1.24 V.

When the supply voltage is in the normal operating range (above about 4.6 V in the circuit shown), the voltage across R1 will be greater than 1.24 V. This pulls the LM4041's "-" pin high, turning on the npn, which then turns on the p-channel MOSFET by pulling its gate low. In this condition, power is supplied to the load through the p-channel device.

When the supply voltage drops below the normal operating range, the LM4041's "-" pin goes low, turning off the npn and the MOSFET pass device, which removes power from the load. R4 provides hysteresis to avoid supply modulation near the switching threshold.

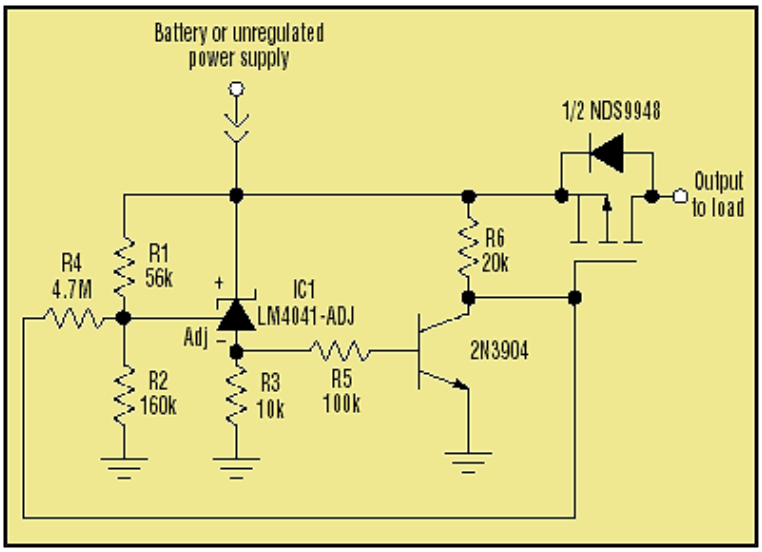
By selecting R1 and R2 properly, you can choose the threshold voltage to fit the needs of your system according to:

$R2/R1 = (V_{low}/1.24\ V) - 1$

where V_{low} is the low-voltage shutoff threshold. By proper choice of R1 and R2, this circuit will work well for shut-off voltages in the range of about 4.5 to 10 V. The lower limit is determined by the pass FET's threshold voltage and the upper limit is determined by IC1's maximum supply-voltage rating. Higher cutoff voltages can be accommodated with

minor circuit changes. The maximum supply voltage for the circuit shown is approximately 30 V.

Figure 1



This low-cost, space-saving circuit will shut down a portable system when the supply voltage drops below a minimum threshold.

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