Simple circuit shuts off system when supply voltage is low

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, and about a volt below V+ when the voltage across R1 is greater than 1.24 V.

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:

\[
\frac{R2}{R1} = \left( \frac{V_{\text{low}}}{1.24 \text{ V}} \right) - 1
\]

where \( V_{\text{low}} \) 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
Figure 1

Battery or unregulated power supply

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

Resources

Aloha Hawaii. Time is running out to win it all.

Lantronix Wireless Design Contest
Design engineers – You could win $6,000 or more in our Wireless Design Contest! Using our WiPort™ wireless Device Server™ - wirelessly enable your product and you could be part of the nearly $20,000 in prizes!

Aloha Hawaii. Time is running out to win it all.
The RFIQ Challenge is nearly over. Now is the time to take the final test and find out if you’re the top RFIQ Genius. The winner goes to Hawaii for MTTS '07. Don’t risk missing the deadline! From Tektronix and IEEE Communications Magazine. Test your RFIQ.

High Performance Analog - https://shop.austriamicrosystems.com
Buy your ICs online

Feel like the microcontrollers you’re using are limiting?
Need more performance and flexibility for your next application? Our AVR microcontrollers are here to help! Click here to receive the AVR reference guide.

Sponsored Links

Make your PCBs Online
Design and order PCBs. Low cost. Instant prices. Easy software.
www.pad2pad.com

Try AutoCAD Electrical
Cut electrical controls design costs by 25%. Free Screencast!
www.Autodesk.com

USB Interface Modules
Add USB to your electronic project or robot in minutes.
www.hobbyengineering.com

Electronic Project
Browse a Good collection of Free Electronic Projects