# Power supply meets automotive-transient-voltage specs

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**Figure 1** shows a power supply that delivers 5V from a 12V battery. With only a few components, the supply copes with all the automotive transients that ISO (International Organization for Standardization) 7637-1 lists without the need for a bulky transient-voltage suppressor. In normal operation, $R_3$ connects to the common through a microcontroller port. In standby mode, $R_3$ stays open, and the quiescent current of the supply decreases from approximately 2.8 mA to approximately 160 µA, and the output voltage then drops to approximately 3.5V. If your application doesn't require a standby mode, suppress $R_3$ and set $R_5$ to 220Ω. With most common zener diodes, you would then set $R_5$ to 120Ω and $D_1$ to 4.3V. You can use the circuit in 24V systems if $D_2$ is 36V.

If the voltage increases, the current through $D_1$ and the base of $Q_3$ increases, so $Q_3$ increases the current of $Q_2$, which lowers the gate-to-source voltage of $Q_1$. If the input voltage surpasses 19V, $D_2$ starts to conduct and makes $Q_2$ switch off $Q_1$, so permanent overvoltages as high as 200V cannot damage the circuit. The Miller capacitance of $Q_1$ makes it act as a fast integrator, which keeps the system stable. If you remove $D_2$, you must replace $Q_3$ with a high-voltage transistor, such as an MMBTA42.

If you omit $D_2$, the circuit cannot withstand permanent overvoltages without $Q_1$'s overheating. In this case, however, the circuit can cope with all the impulses, including the load-dump pulse, of ISO 7637-1. You should remove $D_2$ only if $C_1$ cannot maintain the voltage during long overvoltages, such as the load-dump pulse, and keeping the voltage is critical.

An added advantage of this circuit over most IC-voltage regulators is that it can sink current through $D_1$ and $Q_3$. This feature allows the use of diodes to fully protect the microprocessor's inputs. Soldering the D-Pack package to a couple of 1-cm² copper pads allows the circuit to source 300 mA at 10 to 16V or 150 mA at 20 to 32V. More dissipation area allows for higher currents. EDN

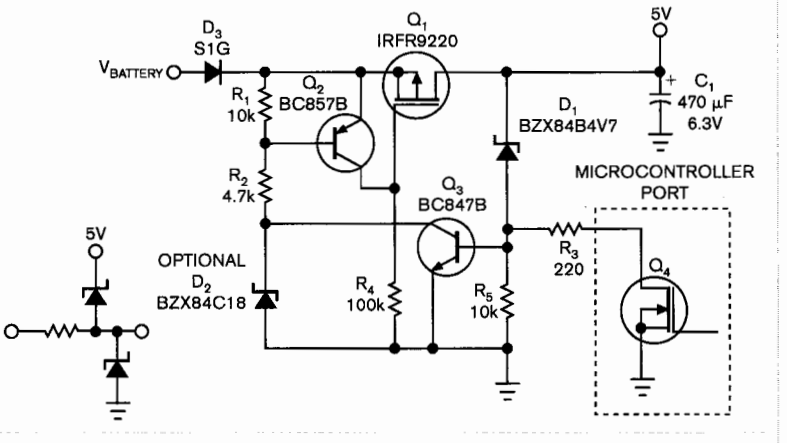


Figure 1 This automotive regulator withstands overvoltages that ISO 7637-1 specifies.