Sense automobile high-side current with discrete components

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This Design Idea came about as a result of my not having access to those wonderful new ICs that sense current. I needed a discrete circuit that I could build easily but that would still be as accurate as the new ICs. This circuit seems to do the job.

Q_2 is the first current amplifier; it has a gain of 6.2 (**Figure 1**). Q_1 is the temperature-compensation amplifier controlled by IC_{1B}, which keeps the Q_1 collector voltage constant no matter what the temperature does to the circuit. The reference voltage for the circuit is the 5V system supply. The voltages noted on the schematic are as built.

IC_{1A} differentially amplifies the Q_1 and Q_2 collector voltages. The op amp has a gain of 4.9.

R_3 comprises two surface-mount power resistors, stacked one atop the other. The circuit has a range of 25A in for 5V out. This setup works nicely with an analog input to the microprocessor.

The two zener diodes protect the circuit from the automobile electrical system. Such systems have been known to spike to –90V.

If you want to get critical, match R_6 and R_7; more critical again, also match R_1 and R_4. I didn't do this step, and the mismatch did not seem to affect the operation. All resistors except R_3 are 1% 0805 SMT.

Observe sufficient copper weight and width on your PCB traces for maximum current-carrying capacity, and be sure to use Kelvin connections to R_3. This circuit ran slightly warm to the touch at 25A. EDN

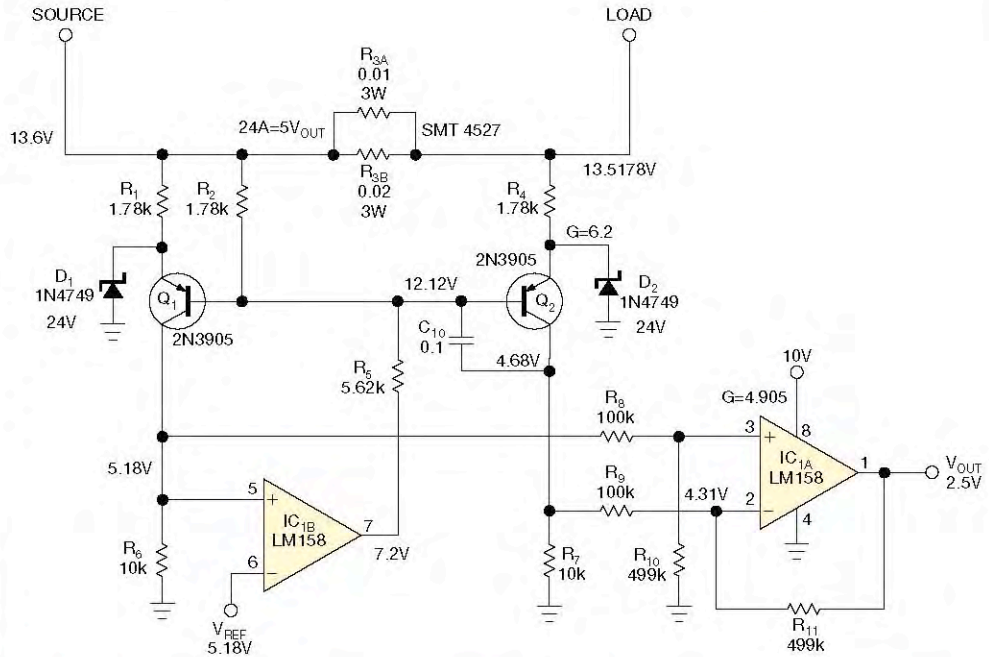

Figure 1 Q_1 and Q_2 convert the high-side voltage drop across current-sense resistor R_3 into a voltage that is within the common-mode range of IC_2.