Micropower Circuit Monitors Positive Supply Current

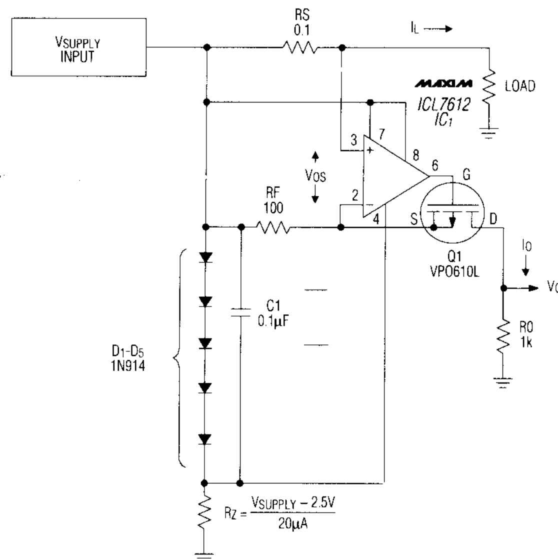
The inexpensive circuit of **Figure 1** converts the load current of a positive power supply to a ground-referenced signal voltage, without recourse to the instrumentation amplifier, extra power supply, and matched sets of resistors typical of such circuits. The output current I_O (proportional to supply current) flows through R_O to produce V_O. Because I_O is generated by a true current source, you can reference V_O to ground or to any reasonable level within the supply range. The measurement is independent of variations in the supply voltage.

Because the op amp's common-mode range includes the supply rails, it can sense small voltages near the positive rail, such as those across R_S. Feedback resistor R_F should equal $100R_S$ or $1000R_S$. The op amp drives P-channel MOSFET Q_1, whose drain-source current produces a voltage across R_F equal to that across R_S, subject to an error of $\pm V_{OS}$. As a result,

$$I_O = (I_L R_S \pm V_{OS})(1/R_F), \text{ and}$$

$$V_O = (I_L R_S \pm V_{OS})(R_O/R_F).$$

The component values shown provide a V_O range of 0 to 1V for the supply-current range 0 to 1A. You can add a trimming potentiometer to null V_{OS}. The remaining gain error depends on the tolerance of R_S, R_F, and R_O, and you can set this error to zero by trimming R_F or R_O. The op amp draws 20µA and operates with a voltage as low as 2.5V. This op amp supply is produced by the five diodes, which are biased by R_Z and the input supply voltage as shown in the table.



VSUPPLY	RZ
+5V	120k
+9V	320k
+12V	470k
+24V	1.1m
+48V	2.2m

$$V_O = (I_L R_S \pm V_{OS}) \times \frac{R_O}{R_F}$$

$$I_O = (I_L R_S \pm V_{OS}) \times \frac{1}{R_F}$$

Figure 1. *This simple load-current monitor produces a proportional signal voltage V_O.*

(Circle 4)