Micropower Circuit Monitors Positive Supply Current

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Abstract: The following application note shows a circuit that converts the load current of a positive power supply into a ground referenced signal voltage using the ICL7612 operational amplifier.

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 100$R_S$ or 1000$R_S$. 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,

$I_O = (I_L R_S)(1/R_F)$ and,

$V_O = (I_L R_S)(R_O/R_F)$.

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 $R_S$, $R_F$ or $R_O$. The op amp draws 20$\mu$A 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.
Figure 1. This simple load-current monitor produces a proportional signal voltage $V_0$.

**Related Parts**

ICL7612 Single/Dual/Triple/Quad Operational Amplifiers  
Free Samples

**More Information**

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