design ideas

Switching regulator forms constant-current source

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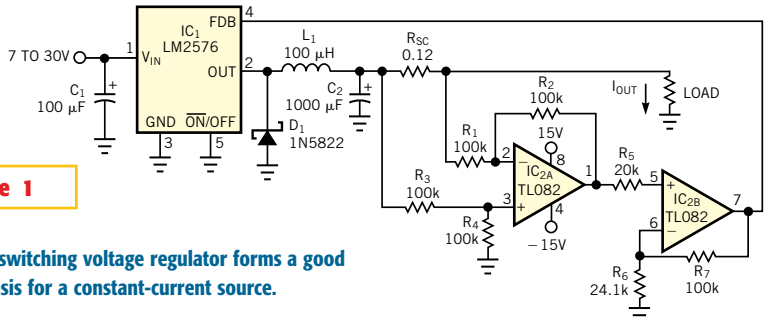
Many applications require current sources rather than voltage sources. When you need a high-current source, using a linear regulator is inadvisable, because of the high power dissipation in the series resistor. To solve the wasted-power problem, you can use a switch-mode regulator. The circuit of **Figure 1** uses IC_1, an LM2576 adjustable regulator. It needs only a few external elements and has an adjustable sensing input, which you use for controlling the output current. Resistor R_{SC} is a current sensor. IC_{2A}, one-half of a TL082 op amp, operates as a difference amplifier. When $R_1=R_2=R_3=R_4$, the output voltage is proportional to the current flowing in R_{SC}. Good common-mode rejection and a wide common-mode voltage range are important, because the amplifier works with large, changing common-mode signals.

The second half of the TL082 op amp, IC_{2B}, operates as a noninverting amplifier. The required gain depends on the output current you need: $G=V_{REF}/V_{SC}$, where G is gain, V_{REF} is the voltage on the sensing input of the LM2576, and V_{SC} is the voltage across R_{SC}. Note that $V_{SC}=I_{OUT}R_{SC}$, where I_{OUT} is the output current. For example, if $I_{OUT}=2A$ and $R_{SC}=0.12\Omega$, then $V_{SC}=0.24V$. Typically, for the LM2576, $V_{REF}=1.237V$. So, you can obtain the gain of the noninverting amplifier from the gain equation: $G=5.15V/V$. The overall gain of the noninverting amplifier is $G=1+R_7/R_6$. If $R_7=100\ k\Omega$ and $G=5.15$, you can solve for R_6 (24.1 kΩ). When you need a precise output current, you can replace the fixed resistor, R_6, with a series connection of a fixed resistor and a potentiometer. Tests showed that the output current is practically constant with varying loads. For example, the 2A output current changed less than 1% for an output-voltage range of 0.3 to 15V.

Figure 1



A switching voltage regulator forms a good basis for a constant-current source.

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