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 IC1, 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. IC2A, one-half of a TL082 op amp, operates as a difference amplifier. When R1=R2=R3=R4, 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, IC2B, 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=0.12Ω, 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+R7/R6. If R6=100 kΩ and G=5.15, you can solve for R7 (24.1 kΩ). When you need a precise output current, you can replace the fixed resistor, R6, 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.