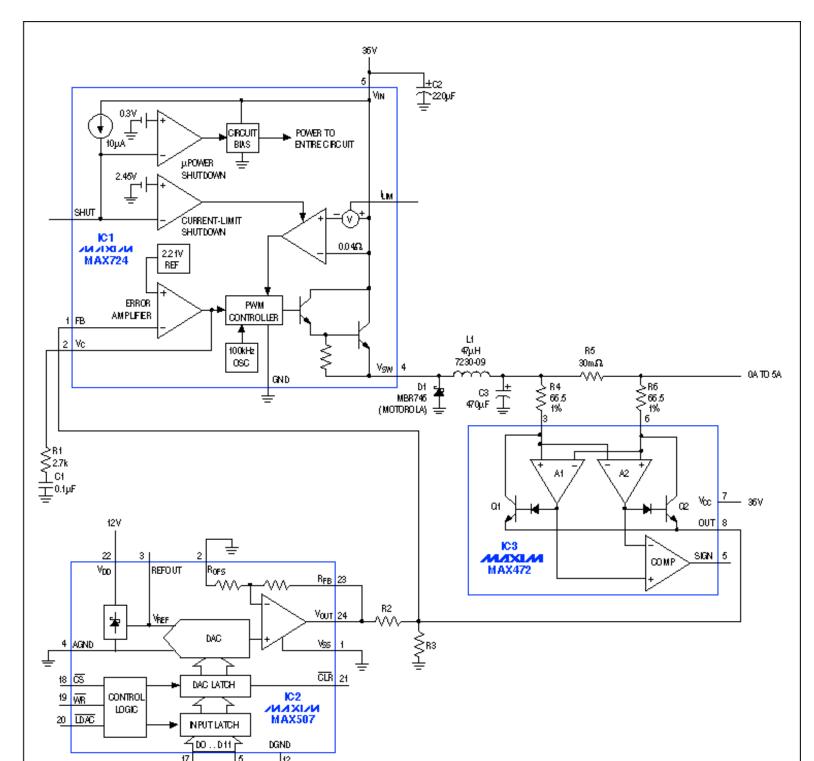
Programmable Current Source Delivers 0A To 5A

This application note describes a circuit for building a digitally programmable current source using a digital-to-analog converter, switch-mode step-down DC-DC converter and a current sense amplifier. The circuit creates a high-efficiency current source that can deliver 0A to 5A with 12-bit resolution.

The variable current source of **Figure 1** generates 0A to 5A with a compliance range of 4V to 30V. It offers two advantages: the 12-bit D/A converter (IC2) makes it digitally programmable, and the switch-mode step-down regulator (IC1) is more efficient than the alternative current source with linear pass transistor. Applications include battery charging and dc motor control.



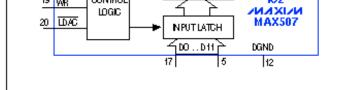


Figure 1. This programmable current source generates 0A to 5A, with 12-bit resolution and a compliance range of 4V to 30V.

IC3 is a high-side, current-sense amplifier normally used in battery-powered systems to detect charge and discharge currents without disturbing the ground path. In this circuit, it senses output current as a voltage drop across R5, and produces a proportional signal current at out (pin 8) Thus, the regulator's feedback voltage (pin 1 of IC1) is set by the DAC and modified by IC3's current feedback, which flows across the parallel combination of R2 and R3. This current feedback opposes any change in load current due to a change in load resistance.

The DAC generates 0V to 10V, producing a source current that varies inversely with code: FFFHEX (10V from IC2) produces 0mA, and 000HEX (0V from IC2) produces 5A. For a given programmed level the actual output varies somewhat with load resistance and the corresponding compliance voltage. When tested at 1.5A, for instance, the output of the circuit deviated about +15mA (from 1.5A) for compliance voltages between 10V and 20V (Figure 2).

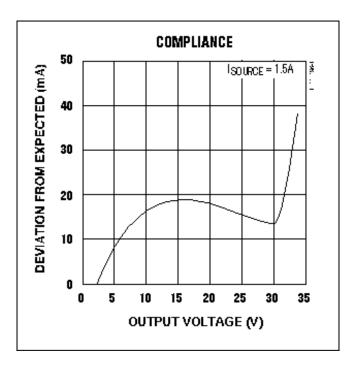


Figure 2. For a programmed level of 1.5A, the output current in Figure 1 deviates with output (compliance) voltage as shown.

You can reconfigure the circuit for other ranges of output current (ISOURCE) by resizing R2 and R3:

$$I_{SOURCE} = \frac{2217[V_{FB}(R2 + R3) - R3V_{DAC}]}{R2R3} ,$$

where VFB = 2.21V and VDAC can range from 0V to 10V.

The desired range for ISOURCE defines values for R2 and R3: VDAC = 10V for the low value of ISOURCE, and VDAC = 0V for the high value of ISOURCE. Substituting these two sets of values in the equation yields two equations, to be solved simultaneously for the values of R2 and R3.

More Information

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