Keywords: current source, current sense amplifier, CSA, amp, compliance, adjustable current source, constant current source, battery charger, LDO, low dropout linear regulator, linear regulator, DAC, digital-to-analog converter, D/A converter

Apr 26, 2011

APPLICATION NOTE 921

Adjustable Linear Current Source Operates on 5V

Abstract: The circuit described uses a current-sense amplifier (CSA) and low-dropout linear regulator (LDO) to make an adjustable current source with a compliance of 0V to 4.7V. The control voltage can come from a separate voltage input or can be generated under digital control using a 10- or 12-bit, serial or parallel, digital-to-analog converter (DAC).

A similar design idea appeared in the 12/95 issue of Electronic Engineering (UK).

The current regulator of Figure 1 features a low-dropout voltage regulator (MAX603) whose voltage feedback is derived from the input current of a current-sense amplifier (MAX4072). This connection allows the regulator IC to oppose any change in output current. When powered from 5V, the current source has a compliance range of 0V to 4.7V.

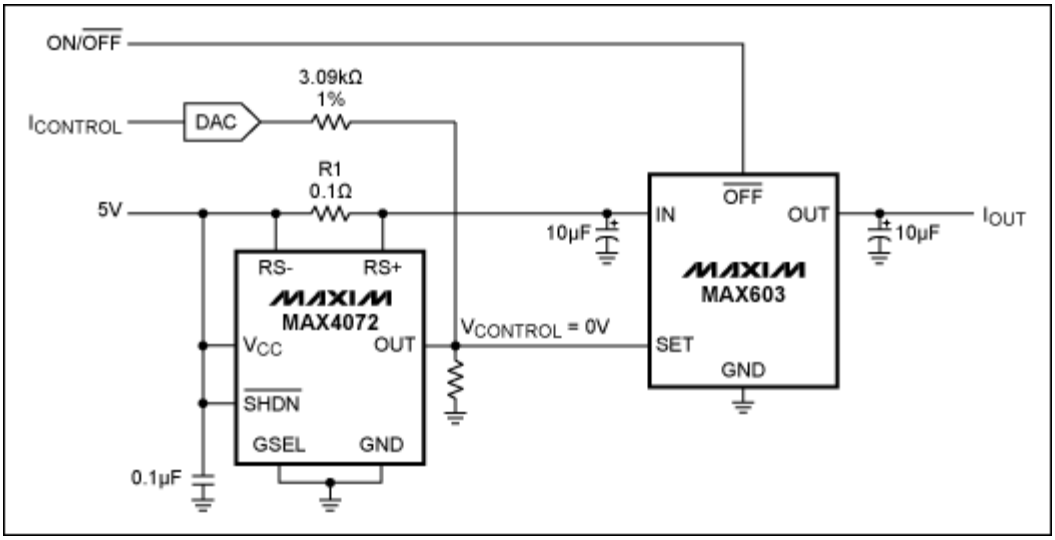

Figure 1. The MAX4072 current-sense amplifier converts R1 current to a proportional output voltage, enabling the MAX603 voltage regulator to produce a regulated output current.

To set a specific, regulated I_{OUT} level between 0mA and 250mA, apply 0V to 5V at $I_{CONTROL}$: 0V sets I_{OUT} = 250mA, and 5V sets I_{OUT} = 0mA. Alternatively, a digital-to-analog converter (DAC) can provide digital control of I_{OUT}. For 12-bit resolution (60µA per LSB), use a parallel-input MAX530 or a serial-input MAX531. For 10-bit resolution (250µA per LSB), use a parallel-input MAX503 or a serial-input MAX504.

You should take care not to exceed the package power-dissipation rating for the LDO. At room temperature, the rating is 1.8W, so a reasonable limit (with safety factor) is 1.5W. The internal dissipation is simply the programmed current multiplied by the voltage difference between the input and output. Under worst-case conditions (I_{OUT} = 250mA, output grounded, and a dissipation limit of 1.5W), the input voltage can be as high as 6V (i.e., 6V × 250mA = 1.5W).

Related Parts

MAX4072	Bidirectional, High-Side, Current-Sense Amplifiers with Reference	-- Free samples
MAX503	5V, Low-Power, Parallel-Input, Voltage-Output, 10-Bit DAC	-- Free samples
MAX504	5V, Low-Power, Voltage-Output, Serial, 10-Bit DACs	-- Free samples
MAX530	+5V, Low-Power, Parallel-Input, Voltage-Output, 12-Bit DAC	-- Free samples

MAX531	+5V, Low-Power, Voltage-Output, Serial 12-Bit DACs	-- Free samples
MAX603	5V/3.3V or Adjustable, Low-Dropout, Low-I_Q, 500mA Linear Regulators	-- Free samples

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