Battery Charger IC Doubles as Current Sensor

by Craig Varga

It's always fun to find applications for an IC that its designer never intended. The circuit shown in Figure 1 is such a design. In many cases, a circuit is required to provide a ground-referenced output voltage that is proportional to a measured current. Frequently, the current must be measured with a shunt in the positive rail that may be well above ground and, worse yet, may vary considerably with time. The LT1620 was originally intended as a controller for a synchronous buck regulator in battery-charger applications. The normal operating mode for this IC is to mirror a current signal down to a 5V reference supply. By adding a single small-signal MOSFET and a few resistors, it is possible to again mirror this signal to provide a ground referenced output.

Circuit operation is as follows: The LT1620 operates by producing a voltage between the V_{CC} pin and the AVG pin that is 10× the voltage across sense resistor R5. C2 filters this voltage. An internal op amp has its noninverting input at the AVG pin (pin 8), its inverting input at the PROG pin (pin 7) and its output at the I_{OUT} pin (pin 2). With the circuit connected as shown in Figure 1, this amplifier will force enough current through R4 to make the voltage drop on R4 equal to the voltage across C2. This current is mirrored through R3 and is filtered by C3, producing a clean, ground-referenced, DC output voltage. Resistor R2 cancels a small built-in offset in the LT1620's amplifiers. The output voltage obeys the following relationship: $V_O = I_L$ (R5 • R3 • 10)/R4. Changing the value of R3 selects different scale factors.

The circuit yields excellent linearity over a wide range of loads and input voltages. The curve shown in Figure 2 was measured with the sense resistor referenced to a 5V input source. The curve looks the same even at inputs over 25V, so only one curve is presented. Maximum input voltage is 36V. There is a small offset at no load, but in a typical microprocessor-based data acquisition system, only a simple 2-point calibration is needed to obtain absolute accuracy.

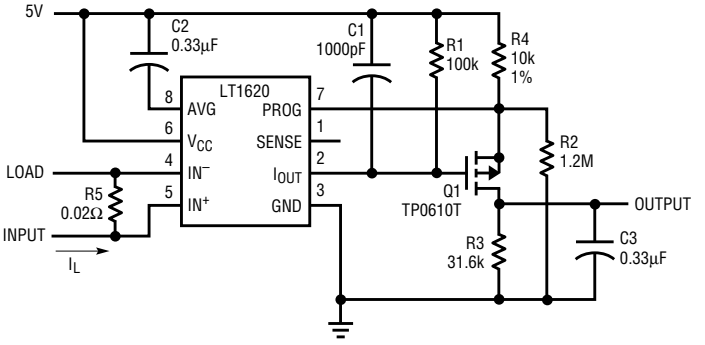

Figure 1. Current sensor schematic

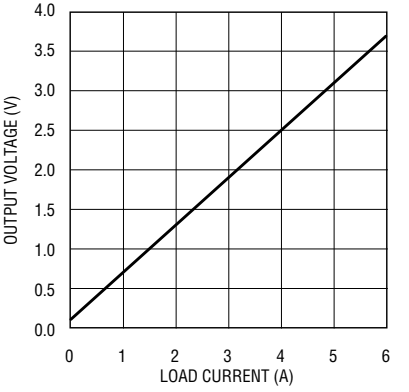

Figure 2. Transfer function