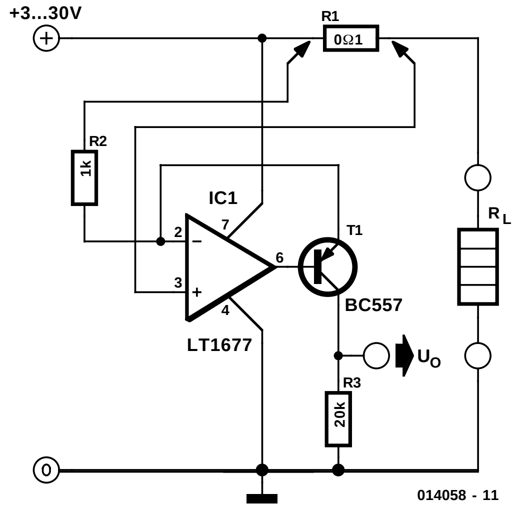
Ammeter

Linear Technology application — www.linear-tech.com

From the feedback from our readers we have learned that the measurement of currents in the positive lead of a power supply is often fraught with practical difficulties. The circuit shown here will in many cases be a welcome aid. The design is not really new, but it is very useful.

The required shunt or current measuring resistor R1 is connected in series with the load. The voltage drop across this resistor is proportional to the current through the load. As usual, the opamp will strive to minimise the potential difference between its inverting- and non-inverting inputs. As a consequence, a compensating current will flow from the emitter of T1 to the inverting input of IC1 with the value U_{R1}/R2. The same current flows through R3 as well, of course, resulting in a voltage of U_{R1}·R3/R2; at the values shown this is 2 V per ampère. This voltage can be displayed with a moving coil instrument or other appropriate indicator.

An important remark: as can be seen, the inverting input of the opamp is effectively connected to the power supply. This requires an opamp with an input common-mode range that includes at least the positive supply rail. Also, the output has to be able to swing (close) to the power supply voltage, otherwise T1 will not turn off sufficiently. This requires a very good 'rail-to-rail' opamp. The LT1677 that is used here is cut out for this purpose and has, among other things, the following characteristics:



– rail-to-rail input and output;
– extremely low noise (3.2 nV/√Hz at 1 kHz);
– gain/bandwidth 7.2 MHz;
– offset 60 µV;
– power supply range 3 to 30 V.

These particular characteristics make the LT1677 eminently suitable for the processing of small signals.

(014058-1)