

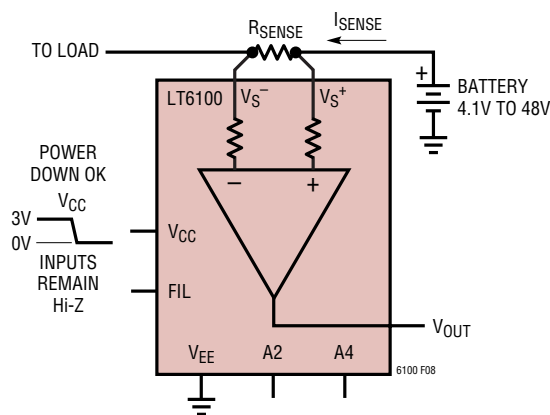
APPLICATION NOTE 105: Current Sense Circuit Collection

Batteries

The science of battery chemistries and the charging and discharging characteristics is a book of its own. This chapter is intended to provide a few examples of monitoring current flow into and out of batteries of any chemistry.

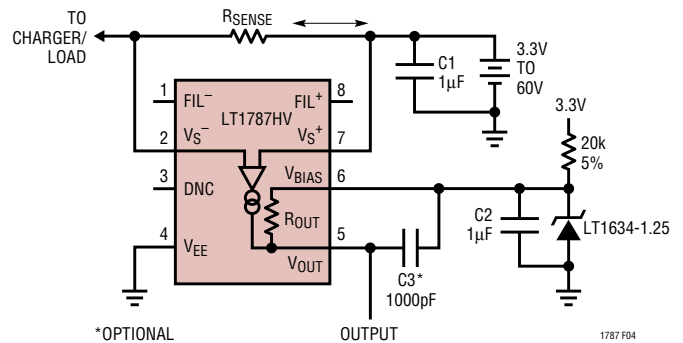
To see other chapters in this Application Note, return to the [Introduction](#).

Input Remains Hi-Z when LT6100 is Powered Down



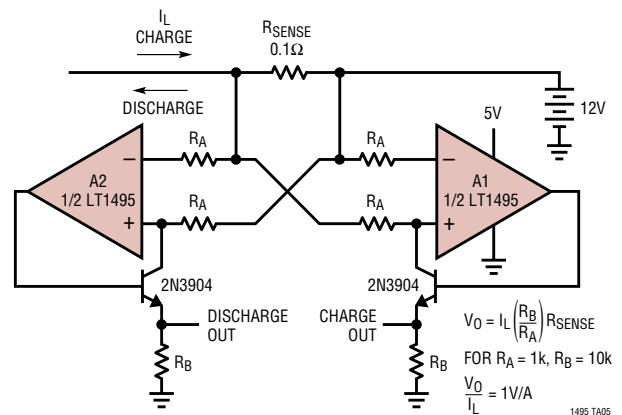
This is the typical configuration for an LT6100, monitoring the load current of a battery. The circuit is powered from a low-voltage supply rail rather than the battery being monitored. A unique benefit of this configuration is that when the LT6100 is powered down, its battery sense inputs remain high impedance, drawing less than 1 μ A of current. This is due to an implementation of Linear Technology's Over-The-Top[®] input technique at its front end.

Charge/Discharge Current Monitor on Single Supply with Shifted V_{BIAS}



Here the LT1787 is used in a single supply mode with the V_{BIAS} pin shifted positive using an external LT1634 voltage reference. The V_{OUT} output signal can swing above and below V_{BIAS} to allow monitoring of positive or negative currents through the sense resistor. The choice of reference voltage is not critical except for the precaution that adequate headroom must be provided for V_{OUT} to swing without saturating the internal circuitry. The component values shown allow operation with V_S supplies as low as 3.1V.

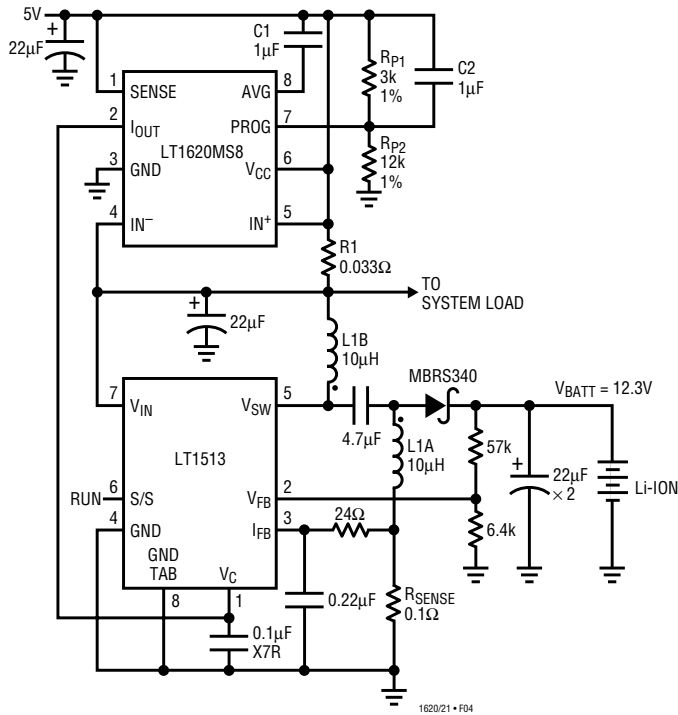
Battery Current Monitor



One LT1495 dual op-amp package can be used to establish separate charge and discharge current monitoring outputs. The LT1495 features Over-the-Top operation allowing the battery potential to be as high as 36V with only a 5V amplifier supply voltage.

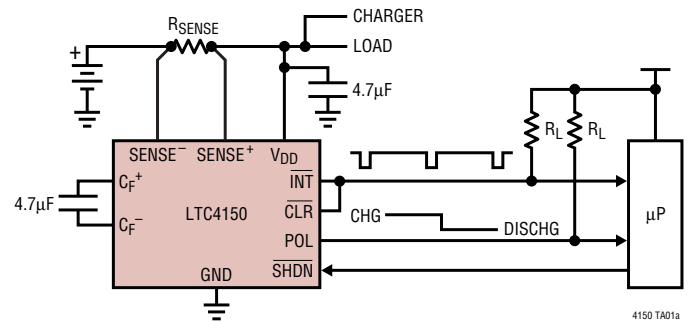
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Input Current Sensing Application



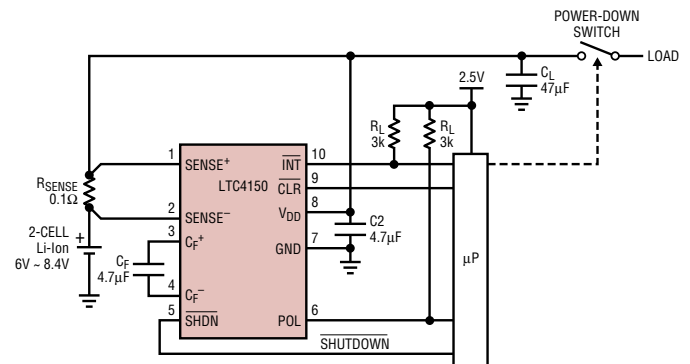
The LT1620 is coupled with an LT1513 SEPIC battery charger IC to create an input over current protected charger circuit. The programming voltage ($V_{CC} - V_{PROG}$) is set to 1.0V through a resistor divider (R_{P1} and R_{P2}) from the 5V input supply to ground. In this configuration, if the input current drawn by the battery charger combined with the system load requirements exceeds a current limit threshold of 3A, the battery charger current will be reduced by the LT1620 such that the total input supply current is limited to 3A.

Coulomb Counter



The LTC4150 is a micropower high-side sense circuit that includes a V/F function. Voltage across the sense resistor is cyclically integrated and reset to provide digital transitions that represent charge flow to or from the battery. A polarity bit indicates the direction of the current. Supply potential for the LTC4150 is 2.7V to 8.5V. In the free-running mode (as shown, with CLR & INT connected together) the pulses are approximately 1 μ s wide and around 1Hz full-scale.

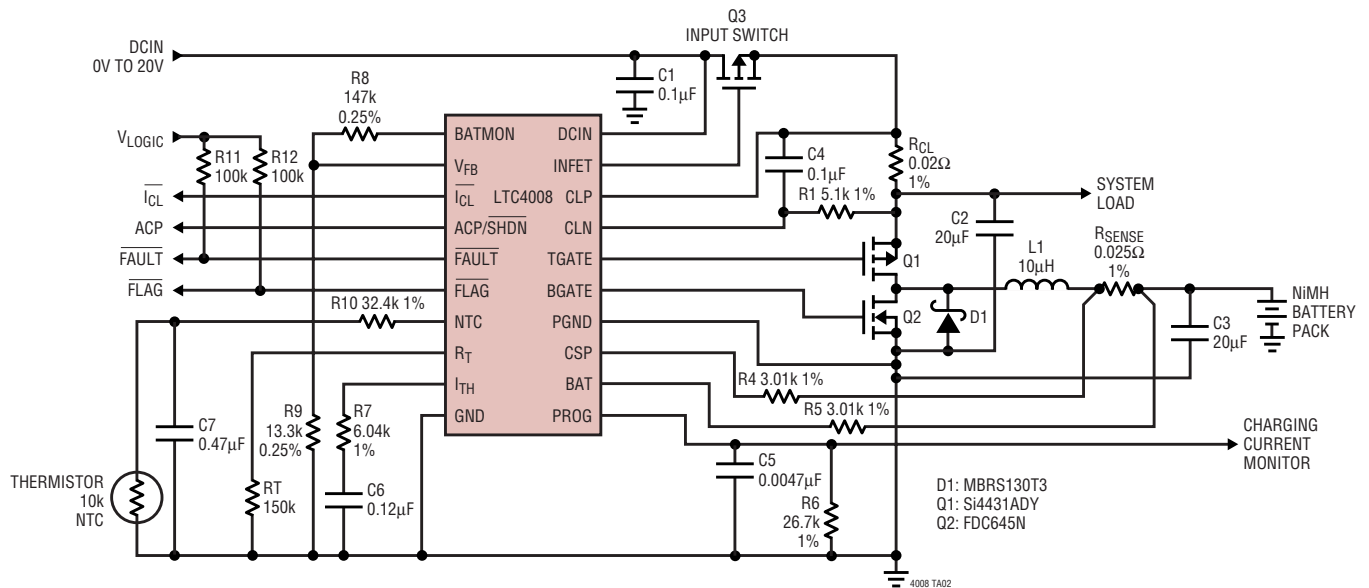
Li-Ion Gas Gauge



This is the same as the Coulomb Counter circuit, except that the microprocessor clears the integration cycle complete condition with software, so that a relatively slow polling routine may be used.

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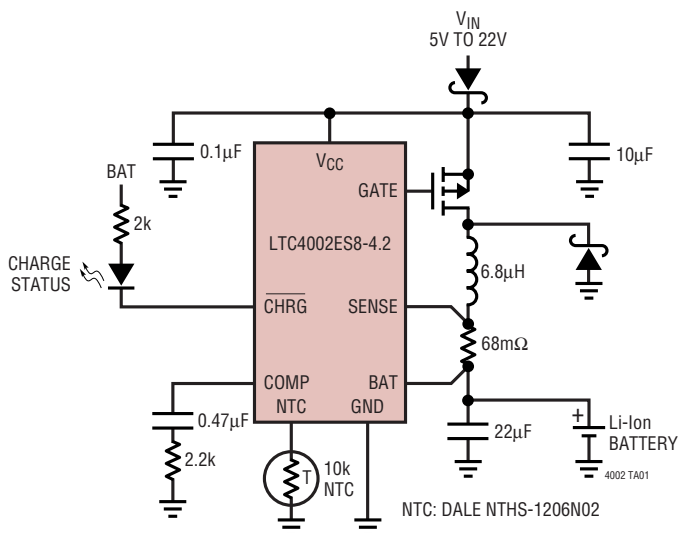
NiMH Charger



The LTC4008 is a complete NiMH battery pack controller. It provides automatic switchover to battery power when the external DC power source is removed. When power is

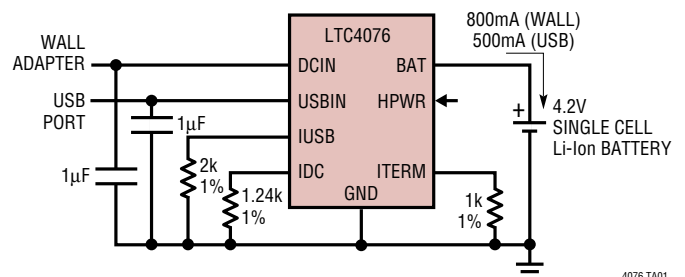
connected the battery pack is always kept charged and ready for duty.

Single Cell Li-Ion Charger



Controlling the current flow in Lithium-Ion battery chargers is essential for safety and extending useful battery life. Intelligent battery charger ICs can be used in fairly simple circuits to monitor and control current, voltage and even battery pack temperature for fast and safe charging.

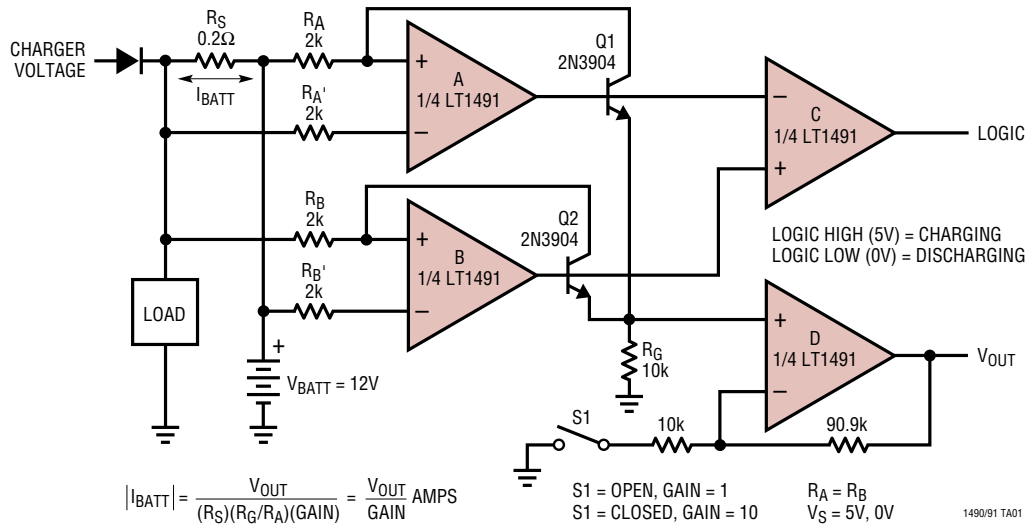
Li-Ion Charger



Just a few external components are required for this single Li-Ion cell charger. Power for the charger can come from a wall adapter or a computer's USB port.

APPLICATION NOTE 105: Current Sense Circuit Collection

Battery Monitor



Op-amp sections A & B form classical high-side sense circuits in conjunction with Q1 & Q2 respectively. Each section handles a different polarity of battery current flow and delivers metered current to load resistor R_G . Section C operates as a comparator to provide a logic signal indi-

cating whether the current is a charge or discharge flow. S1 sets the section D buffer op-amp gain to +1 or +10. Rail-to-Rail op-amps are required in this circuit, such as the LT1491 quad in the example.