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MATH'S NOTES

WHAT'S NEW AND HOW TO USE IT

An Inexpensive Charger for Lithium-Ion Batteries

As we get ready for the warmer weather and dust off our portable equipment, the subject of batteries always comes to mind. But before rushing out to replace those Ni-Cads, zinc-carbons, and alkaline power sources, consider the latest.

As some of you may be aware, the newest rechargeable battery on the scene is the one using lithium-ion technology. This battery offers performance superior to the common nickel-cadmium type, since it does not have a "memory" and can be trickle charged continuously. You never have to "deep discharge" or recondition these devices, and even disposal is safe for the environment. Furthermore, individual lithium-ion cells provide 3 to 4.1 volts, which is much closer to the voltages needed by modern integrated circuits (such as the emerging 3.6 volt devices) than 1.2 volt Ni-Cads or 1.5 volt zinc-carbons. There is a small problem, however. Lithium-ion batteries are somewhat difficult to charge, since they require a constant current/constant voltage circuit that is quite different from their Ni-Cad counterparts. Fortunately, Linear Technologies has made the job much easier with a new chip, which we describe this month.

c/o CQ magazine

The device we are referring to is the LTC1541. This chip, as shown in fig. 1, contains a precision voltage reference, comparator, and op amp which can be easily and inexpensively interconnected to form a complete lithium-ion charger, as we soon will see. It comes in an 8-pin package and contains no real surprises. The reference, by the way, is accurate to ±0.4% and the chip can be used for other applications needing these components as well.

The complete lithium-ion battery charger/input power supply is shown in fig. 2. In operation, the 2N2907 controls the battery charging current. It is driven by the output of the internal op-amp via the 2N3906. Since this portion of the circuit operates in a linear mode, the 2N2907 will dissipate up to 1 watt and should be adequately heatsunk. The 0.15 ohm resistor senses battery charging current and feeds it to the positive op-amp input via pin 3. The internal reference is divided to 44 millivolts by the 100K and 3.83K resistors and applied to the negative or inverting input. The difference between the two drives the 2N2907 to produce 300 ma of charging current. At the same time, the divided bat-

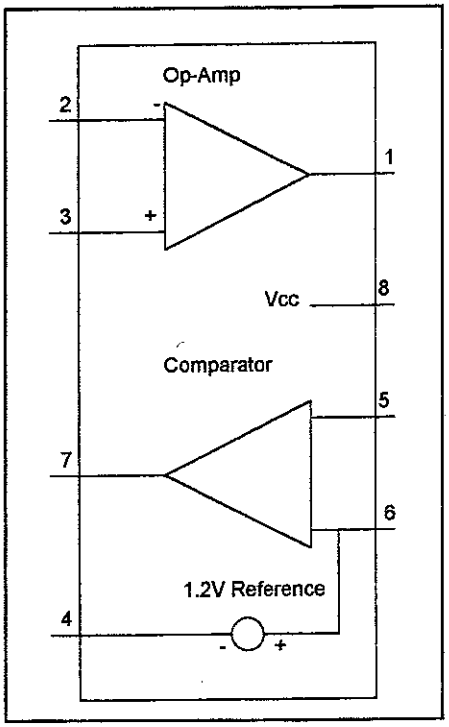

Fig. 1– Internal block diagram of the LTC1541.

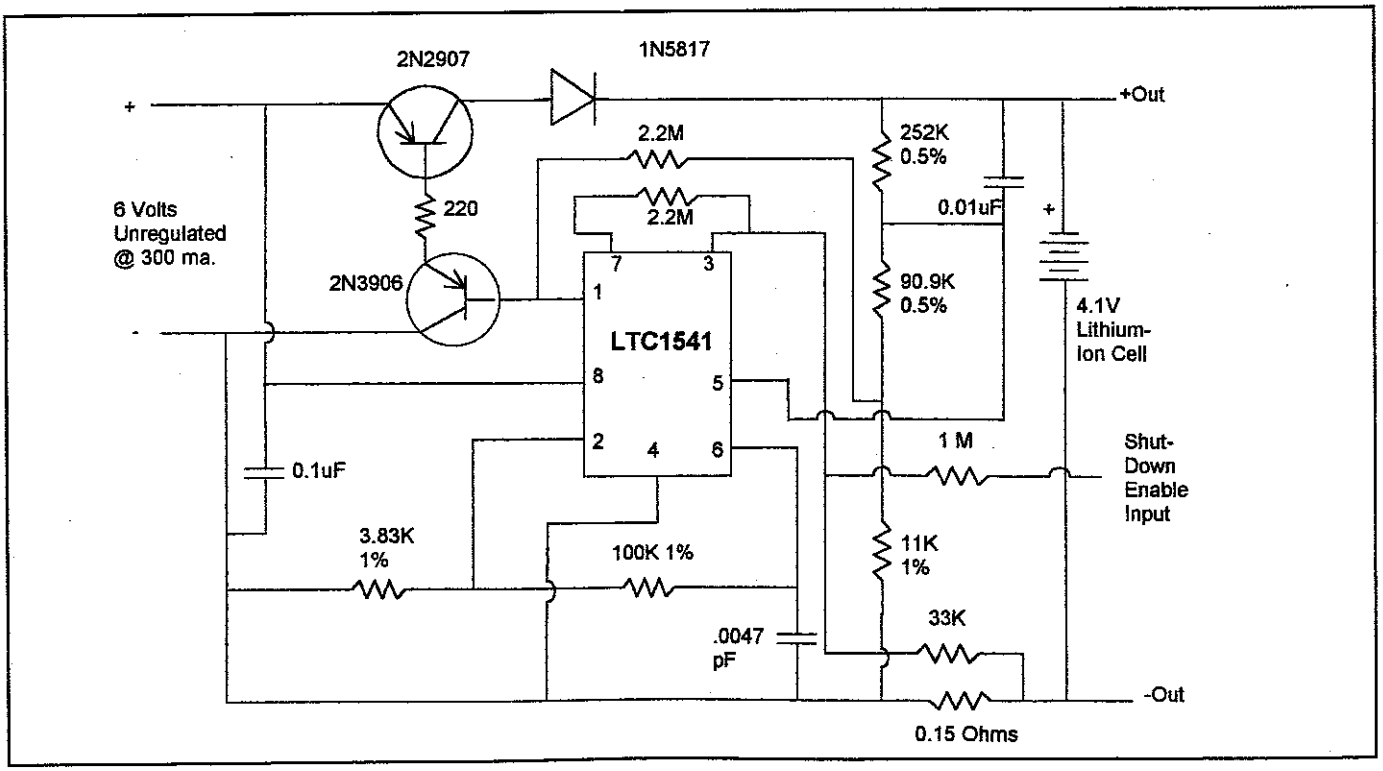

Fig. 2– Complete lithium-ion battery charger circuit.

tery voltage present at the junction of the 252K and 90.0K resistor is applied to the positive comparator input at pin 5. This is compared to the reference (internally connected to pin 6), and when 4.1 volts is reached, shuts down the linear regulator by controlling the op-amp via pin 3. A shutdown input is also provided to turn off the LTC1541 when the charging function is not required. This can be used to reduce current drawn by the chip when the battery is being used to power the external circuit.

Since both charging current and voltage are regulated by this circuit, the unregulated 6 volt input source is not critical and can come from a wall-type adapter. If the battery is also connected to the external circuitry it will power, the circuit will share the current. This means that with no external load, all current will be used to charge the battery. With some external load, the battery charging current will reduce in proportion to the current drawn by the load. In this way the circuit can be used to both charge the battery and power external circuitry at the same time. Now you can have an AC line powered device (via the wall adapter) which continues to operate in the event of a power failure. Pretty neat stuff!

If you require more information on this device, contact Linear Technologies at 1630 McCarthy Blvd., Milpitas, CA 95035-7417 (1-800-4-LINEAR, or on the web at <www.linear-tech.com>).

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