Simple Li-Ion Cell Charger

This circuit uses an LM317T adjustable 3-terminal regulator to provide a simple current-limited charger for Li-ion cells. Three LED indicators are provided for power indication, charging and current limiting. It runs from a 9V DC plugpack.

The 220Ω/560Ω voltage divider at the output of REG1 sets the output voltage to about 4.2V, with VR1 allowing the charge termination/open circuit output voltage to be accurately set to anywhere between 3.6V and 4.25V. Most 3.7V Li-ion and Li-po cells will normally specify a full charge voltage between 4.1V and 4.3V.

Red LED1 provides power-on indication, while green LED2 indicates charging and is extinguished at completion of the charge (ie, when the current drawn from the output is very low). Yellow LED3 indicates when current limiting is in effect.

When current is drawn from the output, it flows through D1, creating a voltage drop of about 0.6-0.8V, depending on how much current is flowing. Above a certain threshold, this is sufficient to forward bias Q1's base-emitter junction, turning the green LED on. As the cell charges and its voltage increases, the charging current falls off, reducing the voltage drop across D1. When the voltage falls sufficiently, Q1 turns off and so does the green LED.

Over-current control is provided by Q2, its 100Ω base resistor and the 3.9Ω 1W current-sense resistor. Return charge current from the cell's negative terminal flows through this 3.9Ω resistor to ground, forming a voltage drop of 3.9V/A or 1V at 256mA. When this is sufficient to forward-bias the base-emitter junction of Q2, it turns on, pulling REG1's adjust terminal towards the negative supply. This lowers its output voltage and hence current and when at the minimum of about 1.25V, the current is limited to around 300mA.

When Q2 is switched on, so is the identically-connected Q3, lighting LED3 (yellow). Diode D2 protects the LM317 in the event that the supply is disconnected while charging.

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