

Step-Up Booster Powers Eight White LEDs

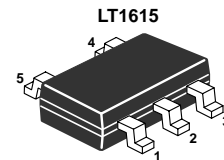
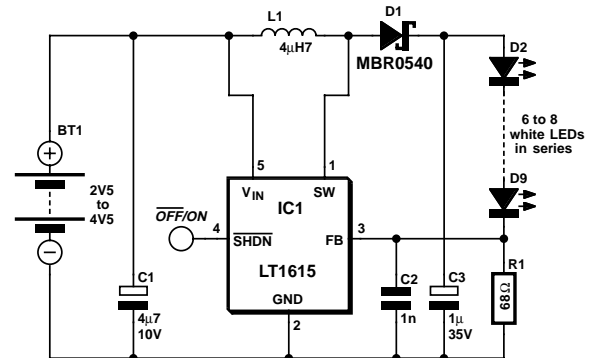
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Tiny white LEDs are capable of delivering ample white light without the fragility problems and costs associated with fluorescent backlights. They do pose a problem however in that their forward voltage can be as high as 4 V, precluding them being powered directly from a single Li-Ion cell.

Applications requiring more white LEDs or higher efficiency can use an LT1615 boost converter to drive a series connected array of LEDs. The high efficiency circuit (about 80%) shown here can provide a constant-current drive for up to eight LEDs. Driving eight white LEDs in series requires at least 29 V at the output and this is possible thanks to the internal 36-V, 350-mA switch in the LT1615. The constant-current design of the circuit guarantees a steady current through all LEDs, regardless of the forward voltage differences between them. Although this circuit was designed to operate from a single Li-Ion battery (2.5V to 4.5V), the LT1615 is also capable of operating from inputs as low as 1 V with relevant output power reductions.

The Motorola MBR0520 surface mount Schottky diode (0.5 A 20 V) is a good choice for D1 if the output voltage does not exceed 20 V. In this application however, it is better to use a diode that can withstand higher voltages like the MBR0540 (0.5 A, 40 V). Schottky diodes, with their low forward voltage drop and fast switching speed, are the best match. Many different manufacturers make equivalent parts, but make sure that the component is rated to handle at least 0.35 A. Inductor L1, a 4.7- μ H choke, is available from Murata, Sumida, Coilcraft, etc.

In order to maintain the constant off-time (0.4 ms) control scheme of the LT1615, the on-chip power switch is turned off only after the 350-mA (or 100-mA for the LT1615-1) current limit is reached. There is a 100-ns delay between the time when the current limit is reached and when the switch actually turns off. During this delay, the inductor current exceeds the current limit by a small amount. This current overshoot can be beneficial as it helps increase the amount of available output current for smaller inductor values. This will be the peak current passed by the inductor (and the diode) during normal operation. Although it is internally current-limited to 350 mA,



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the power switch of the LT1615 can handle larger currents without problems, but the overall efficiency will suffer. Best results will be obtained when I_{PEAK} is kept well below 700 mA for the LT1615.

The LT1615 uses a constant off-time control scheme to provide high efficiencies over a wide range of output current. The LT1615 also contains circuitry to provide protection during start-up and under short-circuit conditions. When the FB pin voltage is at less than approximately 600 mV, the switch off-time is increased to 1.5 ms and the current limit is reduced to around 250 mA (i.e., 70% of its normal value). This reduces the average inductor current and helps minimize the power dissipation in the LT1615 power switch and in the external inductor L1 and diode D1.

The output current is determined by $V_{ref}/R1$, in this case, $1.23V/68 = 18 \text{ mA}$.

Further information on the LT1615 may be found in the device datasheets which may be downloaded from www.linear-tech.com/pdf/16151fa.pdf