Economical White LED

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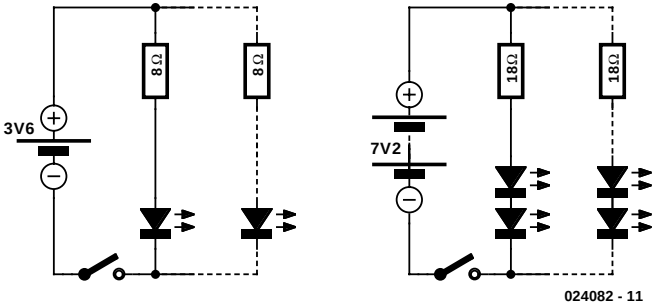

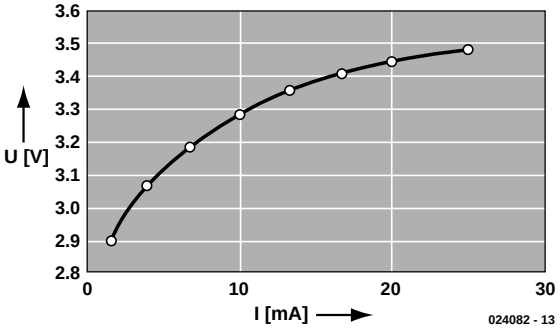

The general assumption is that white LEDs operate at a voltage of 3.6 V and a current of 20 mA, which is about right. Lithium Ion cells coincidentally have a voltage of exactly 3.6 V, which seems to be convenient. However, we can't just connect an

LED to a voltage source (the cell), because the current could become too large and the LED could be damaged. That is why they are usually driven by a current source, but the energy dissipated in the current source is of course lost. Besides, a current source can only function properly when it drops a few volts, which we don't have in this case.

But is it necessary to have a 'real' current source? The amount of light given off by an LED is obviously dependent on the current flowing through it, but our eyes are easily fooled. It is easy to tell the difference in brightness between two different LEDs mounted next to each other, but when you turn on an LED momentarily and then turn it on again a bit later at a different brightness you will barely notice the difference. So as far as the eyes are concerned, there is not much difference whether the LED operates at 10, 20 or 30 mA (!). The conclusion is that we don't really need an accurate current source, but that a 'bad' current source will suffice, limiting the current to safe levels.

With that in mind we get a very simple yet efficient design, where the current source consists of a resistor of a few ohms combined with the internal resistance of the LED, which is about 10 ohm at 20 mA. You can add as many branches in parallel as you like.

It can often be difficult to obtain a single 3.6 V cell, but camcorder battery packs with two cells (7.2 V) are widely available. The circuit remains simple at 7.2 V: two LEDs in series with a current limiting resistor of about double the value. Here too you can have as many branches as you like.

To determine the value of the current limiting resistor you should look at the graph, which shows the relationship between the operating voltage and current of a white LED. As an example we'll show the calculations for the current limiting resistor for an LED current of 20 mA: (3.6-3.44) / 0.02 = 8 Ω. So at 3.6 V the current is 20 mA, at 3.7 V it is about 27 mA and at 3.5 V about 16 mA. In practice the values shown in the circuit of 8 Ω at 3.6 V and 18 Ω at 7.2 V may be increased a little; values of 15 Ω and 33 Ω respectively still work well.

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