CAT32 White LED Driver Efficiency and Inductor Value Tradeoffs

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This application brief shows the effect of the inductor value on efficiency when the CAT32 is used as a White LED driver. In addition, it shows the output voltage V_{OUT} and the switch SW pin waveforms and describes how efficiency is defined and measured.

The inductors used are 3.3µH and 6.8µH from Panasonic, ELJEA (type 1210). The set-up uses the Catalyst Semiconductor CAT32EVAL1 evaluation board. The four white LEDs are from Nichia, NSCW100.

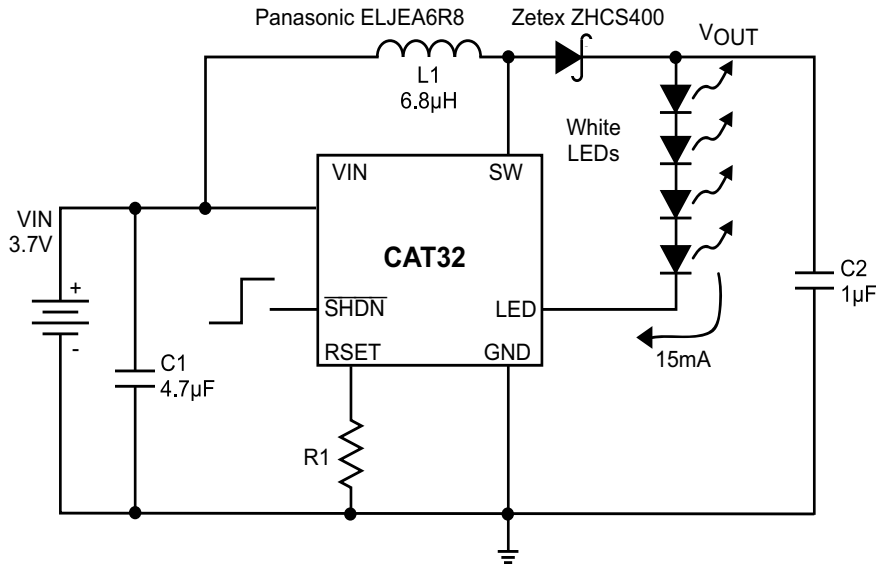


Figure 1. Test set-up with CAT32 driving 4 LEDs

Efficiency

The CAT32 efficiency is defined as the ratio of the power dissipated through the LEDs (not including the loss in the Schottky diode) to the power from the input supply:

$$\text{Efficiency} = P_{LED} / P_{IN} = (V_{OUT} - V_{LED}) \times I_{LED} / (V_{IN} \times I_{IN})$$

The efficiency is measured for an input supply of 3.7V. The efficiency for LED current between 15mA and 20mA is as follows:

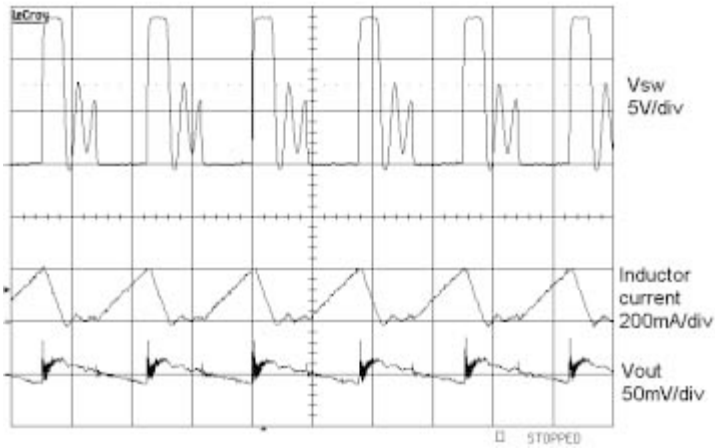
- for L = 6.8µH, the efficiency is 82%
- for L = 3.3µH, the efficiency is 78%

A 4% improvement in efficiency is gained with the larger inductor value. This is true for a given set-up and for this specific type of inductor.

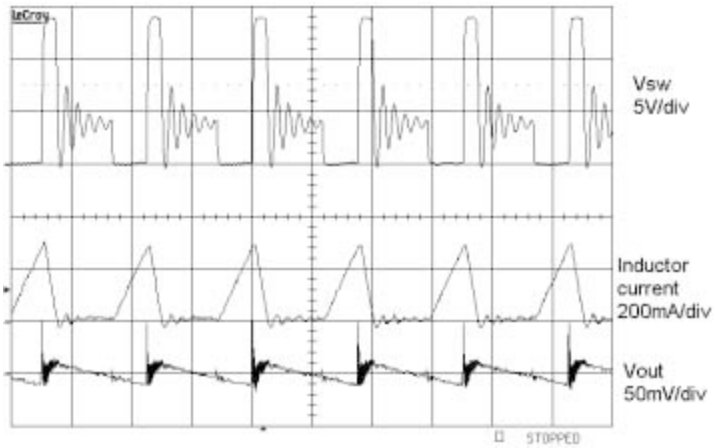
Signal Waveforms

The signal waveforms below show the switch pin voltage (V_{sw}), the inductor current (I_L), and the output voltage (V_{OUT}). The measurement is done for a 3.7V supply and for a 15mA LED current flowing through the 4 LEDs.

Vsw, I_L, & Vout with L= 6.8µH



Vsw, I_L, & Vout with L= 3.3µH



For the smaller inductor value of 3.3µH:

- The switching noise on V_{OUT} is greater
- The charging and discharging time are shorter
- The peak inductor current is greater
- The ringing frequency on SW is higher (when there is no current in the inductor)

In summary, reducing the inductor value has some impact on the overall power efficiency, the inductor peak current, the switching noise and the ringing.

Information on Nichia and their LEDs can be found at: www.nichia.com.

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