Application note MLX10801

Power LED driver for automotive applications
Power saving low side coil driver
Electronic fuse

1. Scope

The following document gives some general guidelines for an EMC adequate board design.

2. Application Schematic

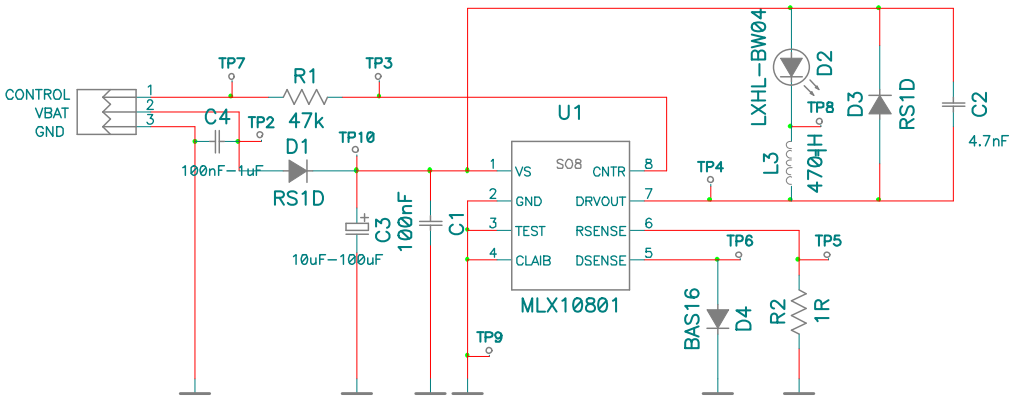

Figure 1: Typical single LED light source application

3. Electromagnetic Emission

3.1. Minimising emission levels

There are generally two important factors which can help minimising emission levels of the circuit. Firstly, the external circuitry can be optimised and secondly, an adequate board design can reduce parasitic effects created by the board itself. On a not EME optimised evaluation board a first emission test was performed to give a practical example and to show the influence of the discrete components.

3.2. Optimising the external circuitry

The capacitors C2, C3 and C4 affect emission behaviour in a wide range. By varying these capacitances, a significant improvement can be achieved.
While performing the test it went out, that C4 heavily influences the emission behaviour of the circuitry. An optimum could be found with a standard ceramic cap of 1µF. If cost is the main limiting factor, a ceramic cap of 100nF also shows a major improvement.
An increase of the capacitance of the buffer cap C3 also helps to minimise emission levels especially in the lower spectral range < 1MHz. This capacitance should be as large as board space and cost allow. A test with 100µF has shown best results while improvements could also be achieved with 33µF.
The ceramic cap C2 minimises transients during switching from active (FET drives LED current) in passive (free wheel diode drives LED current) mode. Generally, the larger the cap the better this peaks are filtered. However, a larger cap also slows down rise times and makes therefore efficiency worse. A compromise was found with 4,7nF.

The C2 capacitor can be left completely away, in case the coil is driven in an optimal way. This can be done by choosing the right coil inductance and the right parameter set to be trimmed (refer to the MLX10801 IC specification for details).

3.3. Optimising the board design

The optimal capacitances found for the tested board are **no absolute values**. They depend very much on the PCB as resonances can arise from the board itself due to parasitics. This is especially true for boards not optimised for good emission behaviour. An EME optimised PCB could minimise such effects and can also help, to reduce the capacitances in their values and costs.

In general the following rules should be applied:

- Traces should be as short as possible
- L3, C2, D3 and the LED should be placed as close together as possible
- Especially the connection from the IC pin DRVOUT to the coil must be kept short.
- Ground areas should be as large as possible. If a 2 layer PCB is used, one layer should be assigned as ground layer and a good connectivity between both layers should be observed
- C4 should be placed very close to the input connector
- C3 and C1 should be placed close to pin 1 (VS) of the chip; C1 directly to pin 1
- Chose the right coil inductance in conjunction with the right parameter set to be trimmed. This could avoid the use of C2 completely.

3.4. Results

Even without optimising the board layout, great improvements could be achieved by a variation of the capacitances of C2, C3 and C4 as described above. In order to get a better feeling for the results, an *Emission Level Scheme* (according to IEC 61967-4) was implemented into the figures. It shows the maximal allowed emission level for integrated circuits specified by several OEM manufacturers.

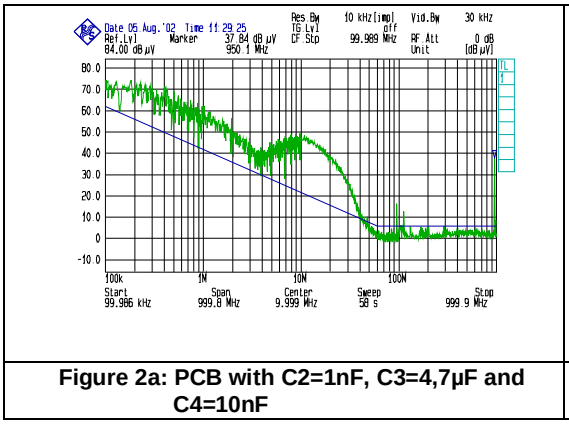

Figure 2a: PCB with C2=1nF, C3=4,7µF and C4=10nF

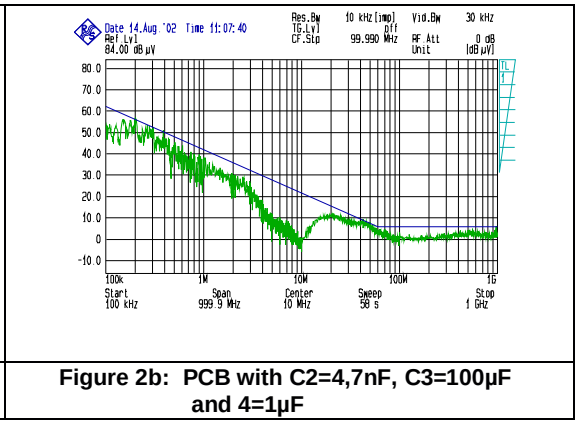

Figure 2b: PCB with C2=4,7nF, C3=100µF and 4=1µF

4. Immunity to electromagnetic fields

Tests on component level are currently in progress. Results will be published as soon as they are available. The method used for the test is *Direct Power Injection* (DPI), a method for conducted coupling of RF power into power and communication lines of the circuit. This method delivers a maximum reproducibility of the measurement results.

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