

DN96

MR11 LED Lighting application with AL8805

Introduction

MR11 lamps are one variety of Multifaceted Reflector (MR) lamps that usually employ a halogen filament capsule as the light source. They are used in many retail and consumer lighting applications where their size, configurability, spot-lighting capability and aesthetics provide utility and creativity. Low efficiency, heat generation and halogen capsule handling issues are among the disadvantages of the technology. They typically operate from 12V DC or 12V AC, using conventional electromagnetic transformers.

LEDs offer a more energy efficient and no radiated heat, no Ultra Violet light solution to replace some halogen lamp applications.

This reference design is intended to fit into the base connector space of an MR11 style LED lamp. The design has been optimized for part count and thermal performance. The design can be used with single 3W LED in the Lens section.



Figure 1: Picture of MR11 LED spot light

Data sheet

It is recommended that this design note is used with the data sheet for the AL8805 see

<http://www.diodes.com/products/catalog/list.php?parent-id=91>

Description

The system diagram of the MR11 lamp solution with AL8805 and SBR2A40P1 as bridge rectifier is shown in Figure 2, and Table 1 provides the bill of materials.

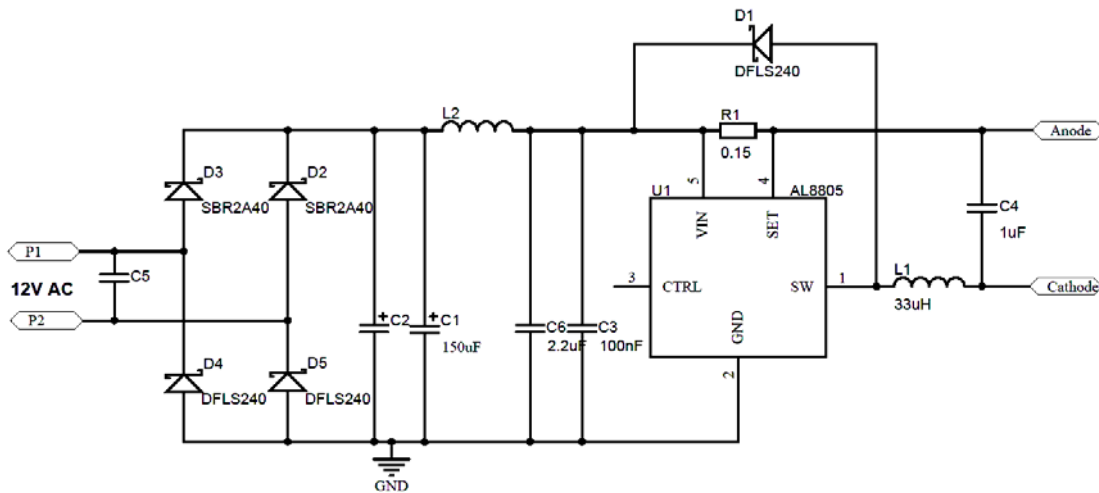


Figure 2: Circuit schematic

The **AL8805** is designed for LED current drive applications of up to 1A. The monolithic NMOSFET is sized appropriately to provide a cost-effective die size and is rated to 1A, which with the hysteretic mode of operation (the inductor current waveform will ramp +/-20% about the nominal current set point) provides sufficient margin for accurate LED current sensing.

The use of super barrier rectifiers **SBR2A40P1**, reduce the power loss significantly in the rectifier section. This is due to the ultra low forward voltage characteristic of super barrier rectifier.

As the AL8805 has a hysteretic switching topology, the switching frequency is dependent on several factors - input voltage, target current and number of LEDs. Excel based calculators are available for system initial evaluation and component choice.

See AL8805 Excel calculator

<http://www.diodes.com/destools/calculators.html>

Design Consideration

The input impedance of the CTRL pin is high and is susceptible to leakage currents from other sources. Anything that sinks current from this pin will reduce the output current. In order to avoid any kind of electromagnetic coupling a guard track around this pin is used.

The PCB had provision to incorporate a pi filter in order to meet the conductive EMI test requirements. The pi-filter formed by C5, C1, C6 and L2 form a pi-filter which is used to attenuate the high frequency conductive noise generated due to the switching of AL8805.

Results

The performances of the systems are outlined in table 1 and in figure 3 and 4. They display a level of efficiency generally higher than 80% with DC voltage input.

Table 1: DC Test data

DC Input (include input bridge)

Input Voltage (V)	Input Current (mA)	Total LED Voltage (V)	LED Current (mA)	Efficiency (%)
8	358.1	3.42	669.5	79.9
10	283.2	3.42	669.4	80.8
12	234.7	3.42	669.5	81.3
14	200.4	3.42	668.7	81.5
16	175.3	3.42	668.3	81.5
18	156.2	3.42	669	81.4

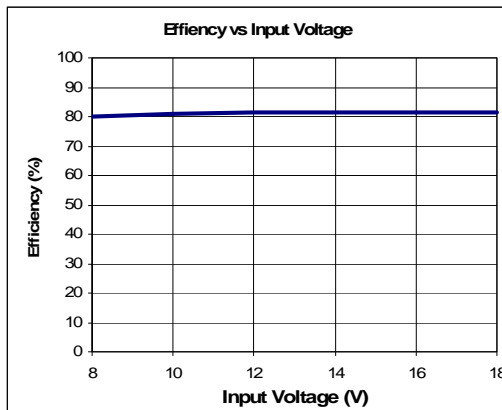


Figure 3: LED driver system efficiency

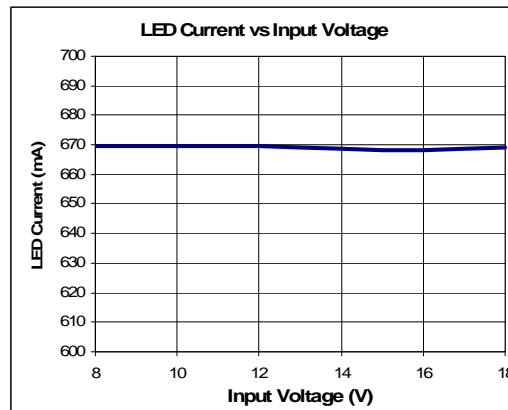


Figure 4: LED driver current regulation

Figure 5 shows the typical waveform for driver operated under 12V 50Hz AC input.

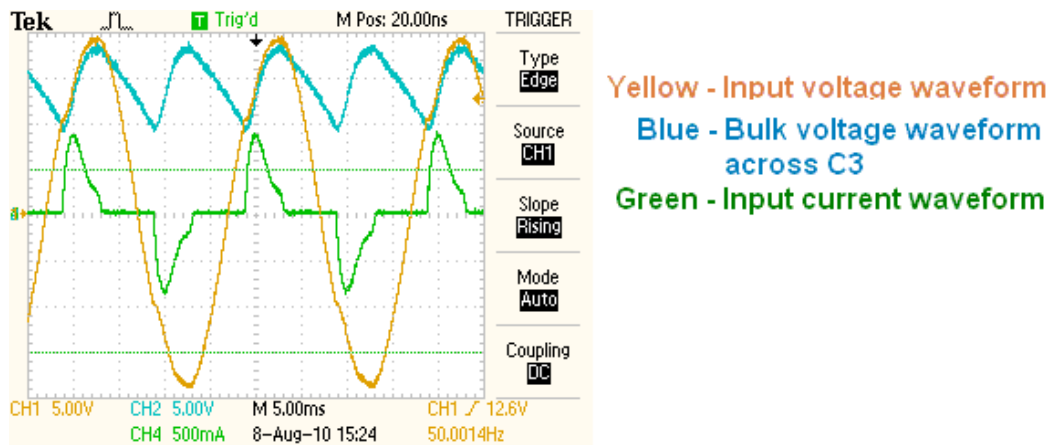


Figure 5 Waveform with 12V 50HZ AC input

The BOM in table 2 and the PCB layout in figures 6 and 7, complete the tools needed to design a MR11 LED Spotlight driver using the AL8805.

Table 2: Bill of Material

Item	Designator	Value	Description	Manufacturer
1	U1	AL8805	1A 30V LED driver IC	Diodes Inc.
2	D1	DLFS240	40V 2A Schottky Rectifier	Diodes Inc.
3	D2 D3 D4 D5	SBR2A40P1	40V 2A Super Barrier Rectifier	Diodes Inc.
4	R1	0R15	Resistor, 1%, 0805	generic
5	C1	150uF/20V	SMD tantalum Kemet D case, T491X157K020AT	Kemet
6	C2	--	Not Fitted	
7	C3	100nF/25V	SMD 0805 X7R	generic
8	C4	1uF/25V	SMD 1206 X7R	generic
9	C5	--	Not Fitted	
10	C6	2.2uF/25V	SMD 1206 X7R	generic
11	L1	33uH	LPS6235-333ML	Coilcraft
12	L2	--	Fitted with 0R Jumper	

PCB layout

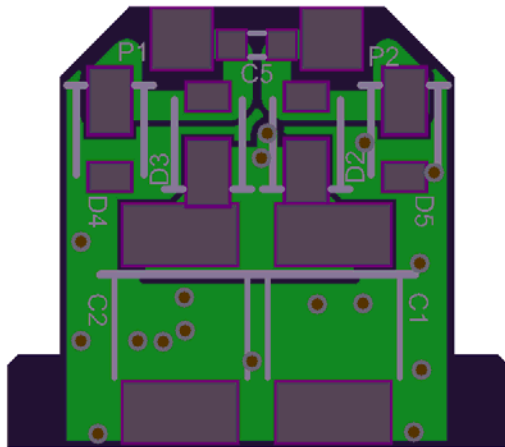


Figure 6: Top Layer

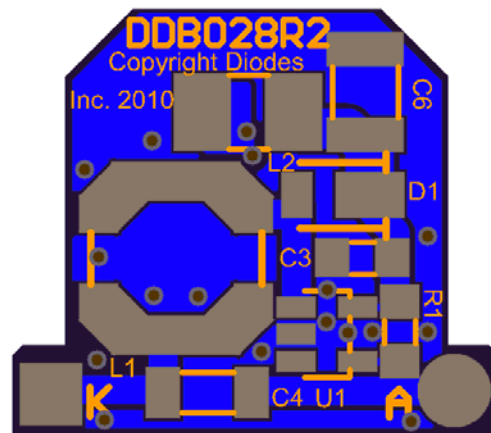


Figure 7: Bottom Layer

Conclusion

This design note provides a simple tool to design a MR11 LED spotlight driver using the AL8805 LED driver. It provides high level of efficiency as well as LED current control over 12V AC input voltages. The PCB designs include provision for a pi-filter to comply with the conductive EMI requirement.

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