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## AL8807EV2 EVALUATION BOARD USER GUIDE

### DESCRIPTION

The AL8807EV2 is an evaluation board showing the application of the Diodes Incorporated AL8807 LED driver device on a board suitable for use in an MR16 lamp.

The board has four main connections: two power inputs P1 and P2, and two LED connections Anode (A) and Cathode (K). The evaluation board is preset to drive 680mA into a single LED.

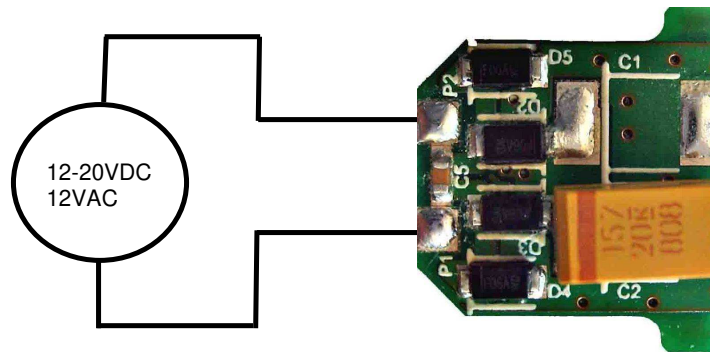
The operating voltage is nominally 12VAC or DC. The 33uH inductor used in the circuit is based on this nominal supply, which should be connected across the P1 and P2 pins.

**Note: The input bridge rectifier provides the board with reverse battery protection.**

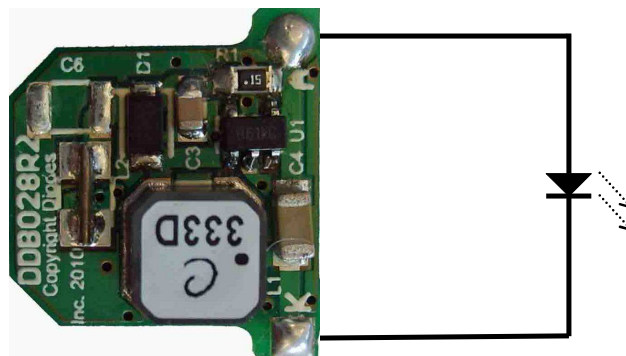
The nominal current, 680mA, is set with the 0R15 sense resistor, R1.

The CTRL pin on the device is not used in this application.

**Warning: The LED will be hot and very bright**



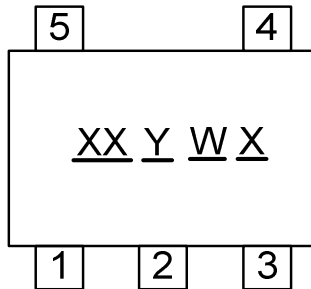
**Figure 1:** AL8807EV2 evaluation board Power input connection P1 and P2



**Figure 2:** AL8807EV2 evaluation board LED connection Anode (A) and Cathode (K)

### AL8807 Device Package, Pin numbering and Definitions

#### (Top View)



XX : Identification code = W5

Y : Year 0~9

W : Week : A~Z = weeks 1~26;  
a~y = weeks 27~51;  
z = both weeks 52 and 53

X : A~Z : Internal code

SOT25 pack

#### AL8807 Device Pin Definition

Name	Pin No	Description
SW	1	Drain of NDMOS switch.
GND	2	Ground (0V).
CTRL	3	Internal voltage ref. pin (2.5V) : <ul style="list-style-type: none"> <li>• Leave floating for normal operation.</li> <li>• Connect to GND to turn off output current.</li> <li>• Drive with DC voltage (0.4V to 2.5V) or with PWM signal to Adjust output current</li> </ul>
SET	4	Connect a sense resistor, $R_s$ , from the SET pin to VIN to sense the nominal output current. Nominal $I_{out} = 0.1 / R1$
VIN	5	Input voltage: 6V to 30V. Decouple to ground with a 4.7uF or higher ceramic capacitor.

#### ORDERING INFORMATION

<b>EVALBOARD ORDER NUMBER</b>
AL8807EV2

<b>DEVICE ORDER NUMBER</b>
AL8807W5-7

Please note: Evaluation boards are subject to availability and qualified sales leads.

## AL8807EV2 EVALUATION BOARD REFERENCE DESIGN

The circuit for the AL8807EV2 is shown in Figure 3.

For other reference designs or further applications information, please refer to the AL8807 datasheet.

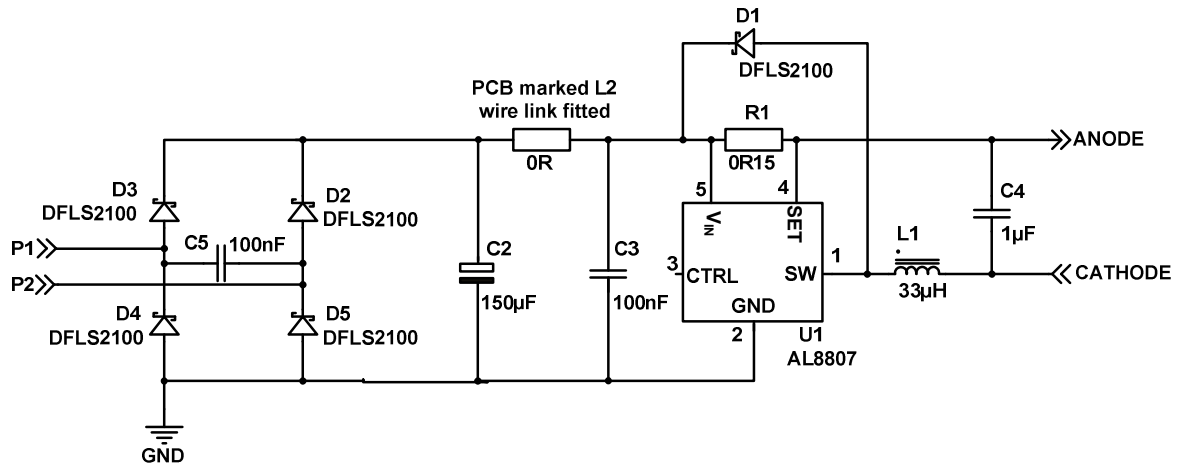


Figure 3: Components fitted Schematic diagram

### AL8807EV2 (Figure 3) Circuit description

The operating voltage is a nominal 12V AC or DC.

The nominal current is set at 680mA with a 0R15 sense resistor, R1.

P1 and P2 are the power input pads, feeding into the bridge rectifier, comprising of D2, D3, D4 and D5. C5 offers EMI filtering at the input pads.

C2 forms the bulk reservoir capacitance, used to sustain operation of the device during the low part of the AC wave.

L2 is not fitted, and the pads are shorted with a link on this evaluation board. It's purpose is to reduce EMI. Please see the full circuit below.

C3 provides local decoupling for the AL8807 device U1. It is important that this is as close as possible to U1, as shown in the layout.

C4 decouples the LED connections, again to minimise EMI, as well as smoothing the current.

L1 smoothes the switching at LX into a DC current for the LED string. D1 operates as the freewheeling diode, preventing large voltage spikes at LX.

The circuit operates in continuous mode at approximately 300kHz (with Dc voltage), with a 33uH inductor and a single LE



## AL8807 Operation

In normal operation, when voltage is applied at +Vin, the AL8807 internal NDMOS switch is turned on. Current starts to flow through sense resistor R1, inductor L1, and the LED. The current ramps up linearly, and the ramp rate is determined by the input voltage +Vin and the inductor L1. This rising current produces a voltage ramp across R1. The internal circuit of the AL8807 senses the voltage across R1 and applies a proportional voltage to the input of the internal comparator. When this voltage reaches an internally set upper threshold, the NDMOS switch is turned off. The inductor current continues to flow through R1, L1, the LED and the schottky diode D1, and back to the supply rail, but it decays, with the rate of decay determined by the forward voltage drop of the LEDs and the schottky diode. This decaying current produces a falling voltage at R1, which is sensed by the AL8807. A voltage proportional to the sense voltage across R1 is applied at the input of the internal comparator. When this voltage falls to the internally set lower threshold, the NDMOS switch is turned on again. This switch-on-and-off cycle continues to provide the average LED current set by the sense resistor R1. Please refer to the datasheets for the threshold limits, AL8807 internal circuits, electrical characteristics and parameters.

## AL8807EV2 Component list

QUANTITY	PCB IDENT	VALUE	DESCRIPTION	SUGGESTED SOURCE
1	U1	AL8807	LED Driver IC	Diodes Inc.
1	D1, D2, D3, D4, D5	DFLS240L	Input bridge & freewheeling diode	Diodes Inc.
1	R1	0R15	Resistor, 0805, +/-1% <+/-300ppm Generic KOA SR732ATTDR150F	Kemet
1	C2	150uF 20v	SMD tantalum Kemet D case, T491X157K020AT	Kemet
1	C1	---	Not Fitted	
1	C3	100nF >=25v	X7R 0805 Generic Kemet C0805C104K5RAC (50v) NIC NMC0805X7R104K50TRPF (50v)	Kemet NIC Components
1	C4	1uF >=25v	X7R 1206 Generic Kemet C1206105K5RAC7800 (50v) NIC NMC1206X7R105K50F (50v)	Kemet NIC Components
1	C5	100nF >=25v	X7R 0603 Generic	
1	C6	---	Not Fitted	
1	L1	33uH	LPS6235 - 333MLB	Coilcraft
1	L2	0R0	Shorting link fitted	

Note: The component part numbers are correct at the time of publication. Diodes Inc reserves the right to substitute other parts where necessary, without further notification.

## AL8807EV2 EVALUATION BOARD FULL COMPONENT OPTIONS FOR THE PCB LAYOUT

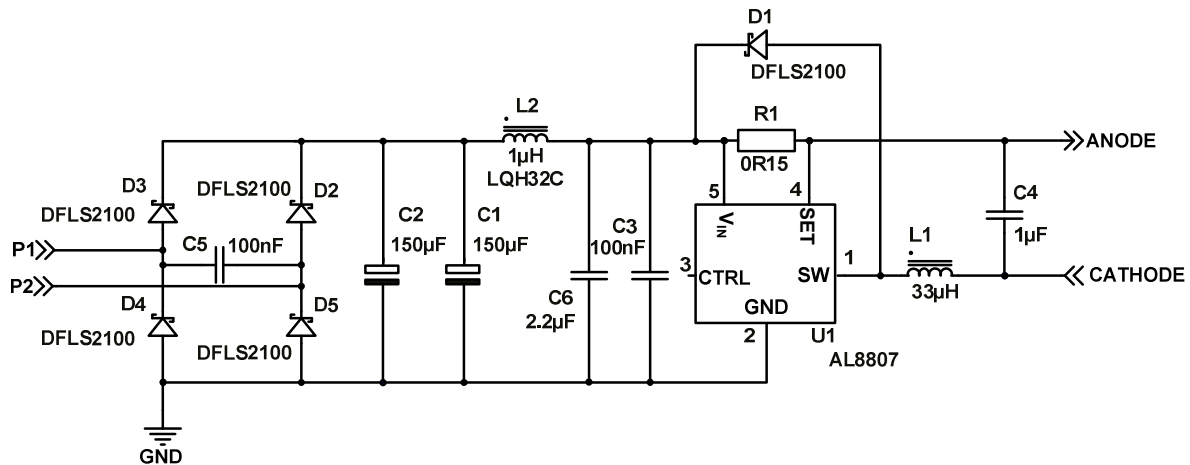


Figure 4: Schematic diagram of full PCB including not fitted Components options on PCB

### AL8807EV2 Full Circuit description

P1 and P2 are the power input pads, feeding into the bridge rectifier, comprising of D2, D3, D4 and D5. C5 offers EMI filtering at the input pads.

C1 and C2 form the bulk reservoir capacitance, used to sustain operation of the device during the low part of the AC wave. In the case of a system driving a single LED, only one capacitor of 150µF is needed.

L2 and C6 form a filter circuit to reduce conducted EMI if necessary. In many cases they may not be required, and where that is so, then L2 pads are shorted out and C6 is not fitted.

C3 provides local decoupling for the AL8807 device U1. It is important that this is as close as possible to U1, as shown in the layout.

R1 sets the LED current. The 0R15 resistor shown gives a LED current of 680mA. C4 decouples the LED connections, again to minimise EMI, as well as smoothing the current. L1 smoothes the switching at LX into a DC current for the LED string. D1 operates as the freewheeling diode, preventing large voltage spikes at LX.

### AL8807EV2 Basic operation at full voltage

1. Connect P1 and P2 to the power supply
2. Set the PSU to 12VAC or 12VDC
3. Turn on the PSU and the LED will illuminate and the current should be approximately 680mA.  
Warning: Do not stare at the LED directly.

### Changing the LED current

1. Remove R1.
2. Calculate and fit a new sense resistor, R1, the value of which is based on the required LED current without dimming. R1 can be calculated using following equation :

$$R1 = 0.1V/I_{OUT}$$

where  $I_{OUT}$  = the LED current.

R1 = the sense resistor value in ohms.

0.1V is the nominal sense voltage with 'CTRL' open circuit or set to 2.5V.

An on-line Calculator is available to speed up the design process at:

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

### PCB Layout

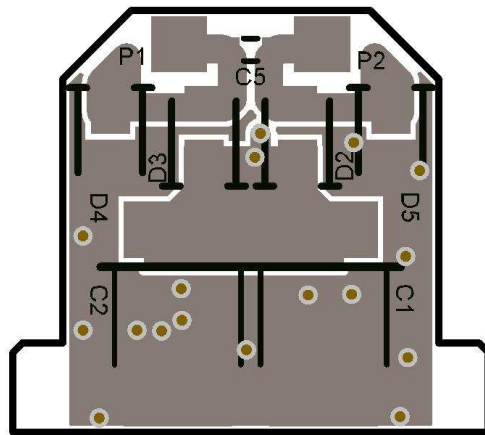


Figure 6 PCB top copper and component overlay

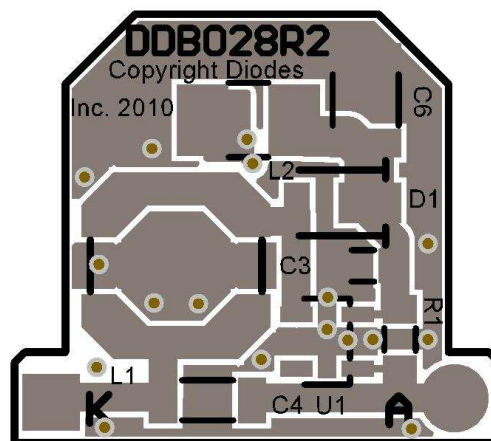


Figure 7 PCB bottom copper and component overlay

## PERFORMANCE

### System Efficiency

The system efficiency depends on the sense resistor, supply voltage, switching inductor and the number of LEDs.

With a 12VDC supply,  $L_1=33\mu\text{H}$  and two series LEDs at  $I_{\text{LED}} = 680\text{mA}$ , the switching frequency is typically 310kHz, and the efficiency level is ~ 86% .

Using the same components but with three series LEDs, the switching frequency is typically 180kHz and the efficiency rises to ~ 89%.

### Radiated EMI performance of the AL8807EV2.

#### Conditions

$V_{\text{in}} = 12\text{V DC}$

Circuit components as per Figure 3  $L_1 = 33\mu\text{H}$   $R_{\text{sense}} = 0.15\Omega$

$I_{\text{LED}} = 680\text{mA}$

2 white LEDs  $V_F = 3.1\text{V}$

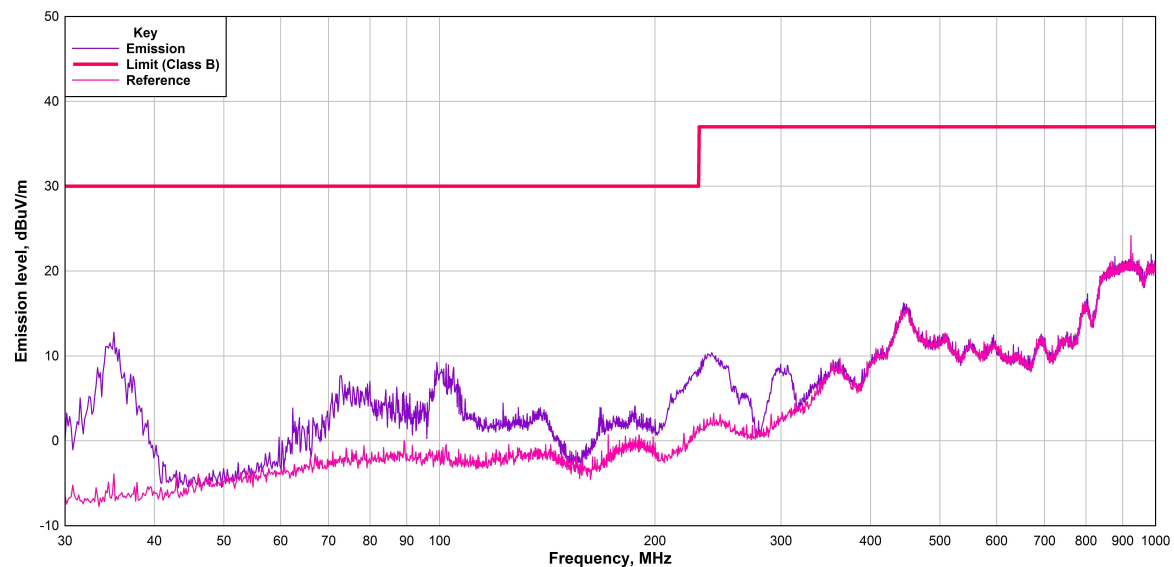


Figure 5 Radiated EMI performance of AL8807EV2

The EMI performance was measured at  $12V_{\text{DC}}$  driving two white LEDs ( $V_F = 3.1\text{V}$  at  $680\text{mA}$ ) on the AL8807EV2. The red bold line is for EN55022 class B used for domestic equipment including lighting. The bottom magenta line is the noise floor of the test chamber. The middle purple line is the EMI emitted radiation of the AL8807 over 30MHz to 1000MHz. This shows that the AL8807 passes the standard with at least 16dB margin.

**For further advice, please contact our local FAE or contact our local sales offices as listed below.**



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