AL8806QEV1 User Guide

General Description

This evaluation circuit demonstrates the AL8806Q High Efficiency 30V 1.5A Buck LED Driver.

The evaluation board is preset to drive its maximum current of 1.5A into a single LED or multiple LEDs, the maximum number of which depends on their total forward voltage drop.

The circuit operates in continuous switching mode at a frequency of approximately 170kHz when driving 2 LEDs each having a forward voltage drop of approximately 3.4V at 1.5A.

Key Features

- Automotive Grade with AEC-Q100 Qualification
- 6V to 30V DC input (with 2 LEDs)
- 1.5A LED current
- Drives 1 LED or several LEDs in series
- Brightness control using DC or PWM
- Inherent open circuit LED protection
- Ambient temperature range -40°C to +125°C

Applications

- Automotive LED Lamps
- Multi-Die LED Driver

AL8806QEV1 Specifications

Parameter	Value
Input Voltage	6VDC to 30VDC
LED Current	1.5A (Adjustable)
LED Current Accuracy	±5%
Switching Frequency	~170kHz
Efficiency	~98%
Number of LEDs	2 LEDs in series (Under Tested)
XY Dimension	2.48 ” x 1.57”

EVB (Rev 1.0)

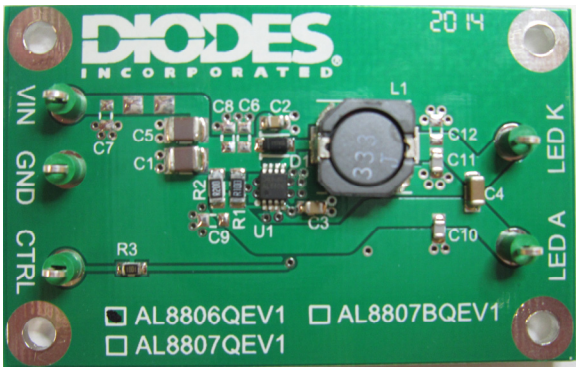


Figure 1: Top View (Single Side Board)

Connection Instructions

Input Voltage: 6VDC to 30VDC (VIN, GND)
LED Outputs: LED A (+), LED K (-)

Evaluation Board Schematic

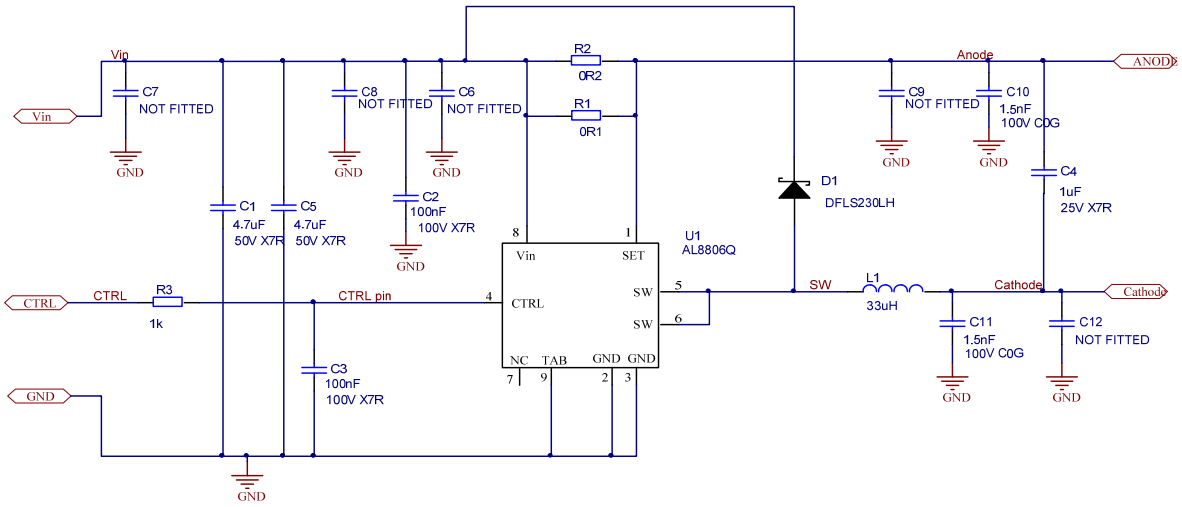


Figure 2: Evaluation Board Schematic

Evaluation Board Layout

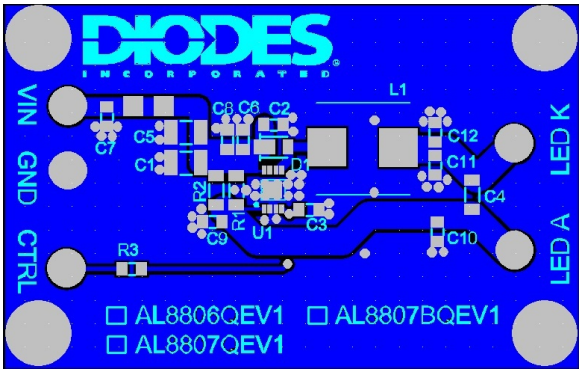


Figure 3: Top View

Figure 4: Bottom View

Bill of Material

#	Name	Quantity	Part number	Manufacturer	Description
1	U1	1	AL8806QMP8-13	Diodes Inc	IC, LED Driver (MSOP-8EP)
2	D1	1	DFLS230LH-7	Diodes Inc	Schottky diode, 30V/2A (PDI123)
3	L1	1	MSS1038-333ML	Coilcraft	Inductor, shielded, 33µH 20%
4	R1	1	-	generic	0.1Ω Resistor 1/8W 1% 1206 SMD
5	R2	1	-	generic	0.2Ω Resistor 1/8W 1% 1206 SMD
6	R3	1	-	generic	1kΩ Resistor 1/8W 1% 0805 SMD
7	C1, C5	2	C1210X475K5RAC	Kemet	4.7µF Cap 50V 10% X7R 1210
8	C2, C3	2	NMC0805X7R104K100PF	NIC	100nF Cap 100V 10% X7R 0805
9	C4	1	NMC1206X7R104K100	NIC	1µF Cap 100V 10% X7R 1206
10	C6, C7, C8, C9, C12	0	-	-	NOT FITTED
11	C10, C11	2	-	generic	1.5nF Cer Cap 100V COG 0805
12	VIN, GND, CTRL, LEDA, LEDK	5	100-108	Hughes	2.15mm Test Loop Terminal

Quick Start Guide

Test Equipment

Count	Description	Manufacturer	Part Number
1	Adjustable Power Supply, up to 30V 2A	Thurlby Thandar	CPX400A
2	Digital Multimeter	Fluke	179
1	Digital Storage Oscilloscope	Tektronix	TDS2024B
2	LED, high brightness, 2A, connected on suitable heat conducting PCB		

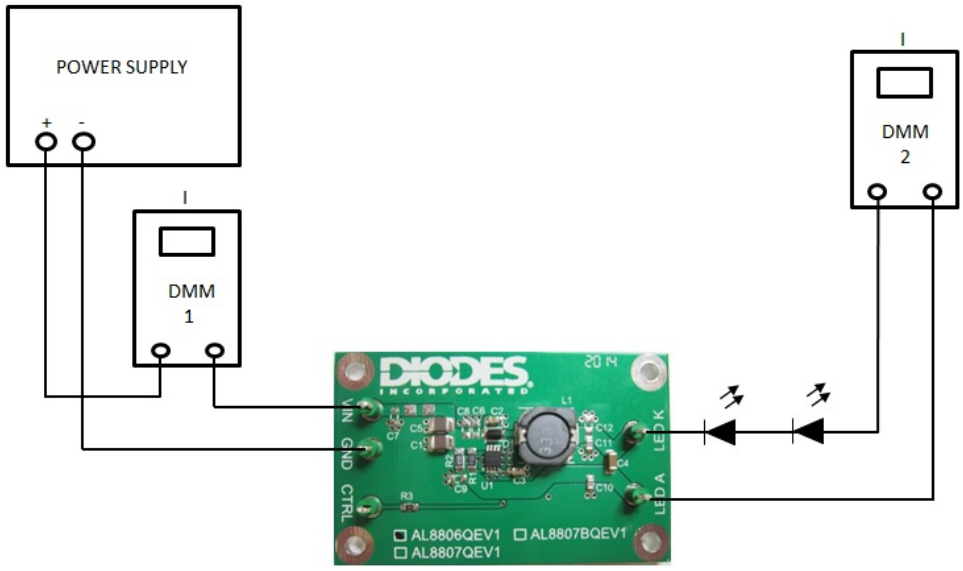
CAUTION: The LEDs are very bright. Ensure they are hidden from direct view, or covered with a dispersing filter.

Also the LEDs are very hot. Do not touch!!

LED Operation

1. Set the power supply to 12.0V but do not switch on. Set the current limit to 2.0A.
2. Connect up the AL8806QEV1 board to the equipment as in **Figure 5** below. Set DMM1 and DMM2 to measure current up to 2A.

Figure 5: Test Schematic



3. Cover the LEDs to avoid dazzling.
4. Switch on the power supply. This should illuminate the LEDs. Note that the input current (DMM1) depends on the LED volt drop. The input current is approximately 900mA if the total LED volt drop is about 6.9V. The output current (DMM2) is approximately 1.47A. The input voltage can be varied from approximately 6VDC to 30VDC and the current regulation observed is typically within ±2%.

Observe Switching Waveform

5. The switching waveform can be observed on an oscilloscope.
6. Set the oscilloscope as follows:

Channel 1 sensitivity: 2V/div (at probe tip)
Time base: 2µs/div
Trigger Source: CH1
Trigger Mode: Auto

7. Connect the ground lead of a 10x probe to one of the plated fixing holes of the AL8806QEV1, and touch the probe tip onto the anode of D1 as in **Figure 6** below. On the oscilloscope, press RUN/STOP to capture the waveform. The cursor readout

indicates a switching frequency of 170kHz approximately –see **Figure 7**. (This frequency is dependent on the LED volt drop.)

Figure 6: Waveform Capture

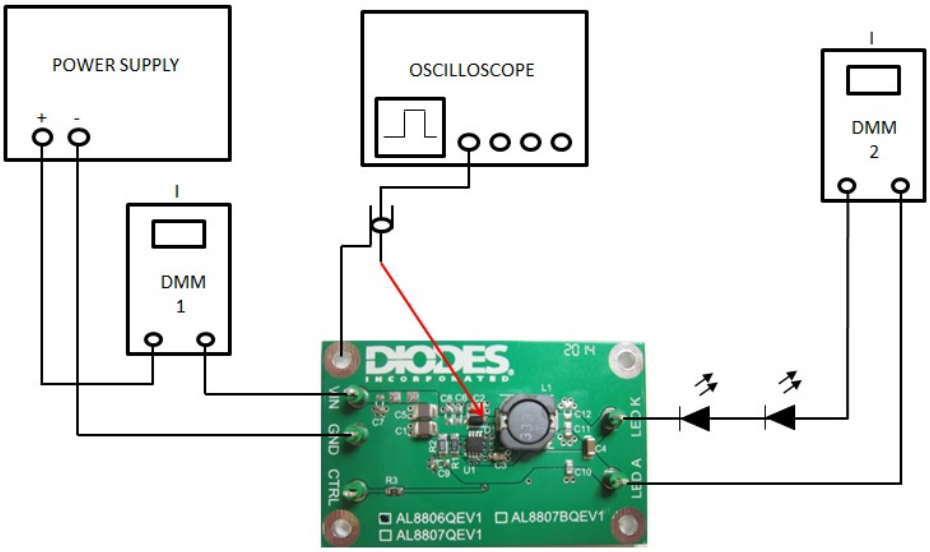
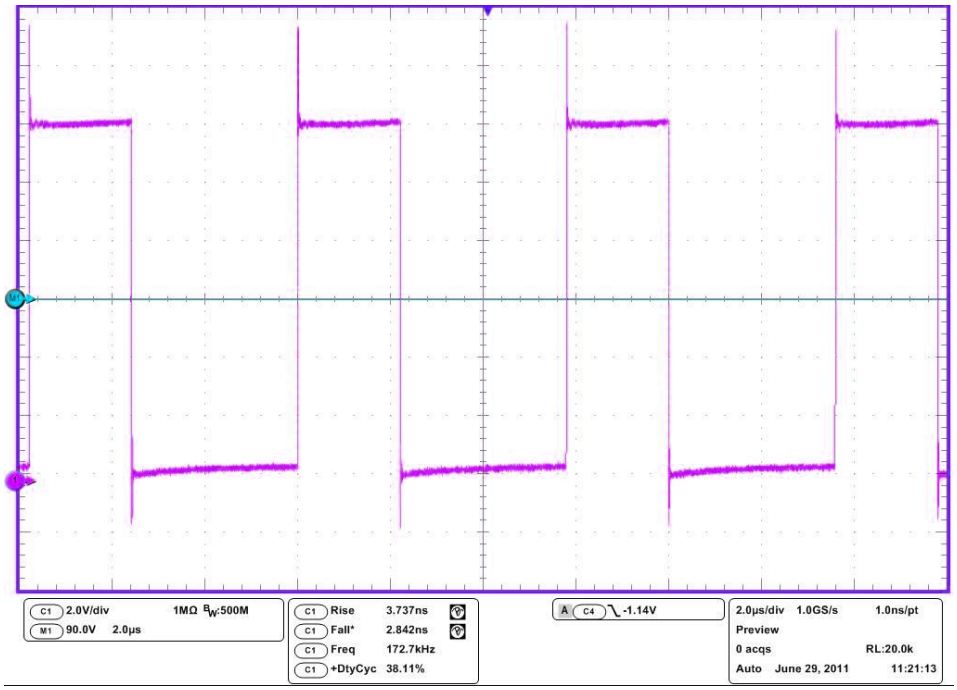


Figure 7: Oscilloscope Waveform



Dimming

Both DC and PWM dimming can be achieved by driving the CTRL input pin. For DC dimming, the CTRL pin may be driven between 0.5V and 2.5V adjusting the output current from 25% to 100% of the maximum value of 1.5A nominal. Driving the CTRL pin below 0.4V will shut down the output current.

A PWM signal (low level ≤ 0.4V and high level > 2.5V) allows the output current to be adjusted up to 1.5A. The PWM frequency can be around 100Hz to 1kHz, providing a resolution of 10 bits. In this case, C3 should be removed or reduced from the evaluation board (Refer to AL8806QEV1 schematic) to give a more accurate control.

Current Setting

The LED current is set by the sense resistor value, R_{SENSE}. On this PCB, there are two resistors in parallel.

$$R_{SENSE} = R_1 * R_2 / (R_1 + R_2)$$

For the schematic values this gives a resistance of 0.1 * 0.2 (0.1 + 0.2) = 0.0667 ohms.

The LED current flows through R_{SENSE}. The sense voltage is 100mV, so the LED current is simply

$$I_{LED} = 0.1/ R_{SENSE}$$

For the schematic values this gives an LED current of 0.1/0.0667 = 1.500 A nominally. In practice there is a slight reduction in current partly due to the resistance of the PCB copper, depending on the PCB layout. At 1.5A this reduction is typically 1 to 2% using AL8806QEV1.

The following table gives commercially available resistor values for typical current requirements, allowing a current error of 3% maximum not including the effect of PCB copper. A power limit of 250mW is assumed for the 0805 size resistors with 50% de-rating.

LED Current	R1, ohms	R2, ohms
150mA	0.68	DO NOT FIT
300mA	0.33	DO NOT FIT
380mA	0.51	DO NOT FIT
500mA	0.2	DO NOT FIT
660mA	0.15	DO NOT FIT
1A	0.1	DO NOT FIT
1.1A	0.15	0.22
1.5A	0.1	0.2

Performance

The performance of the AL8806QEV1 demonstrated shows the capability to regulate LED current. The LED current of 1.5A is approximately 2% lower than the calculated value. This is partly due to copper resistance. With a load of 2 LEDs, the current changes by less than ±2% over the input voltage range from 6VDC to 30VDC. With 2 LEDs and a supply of 12VDC, the circuit operates in continuous mode with a switching frequency of approximately 170kHz.

Power efficiency is approximately 95%.

For further advice, please contact your local Diodes Field Applications Engineer.

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