AL8861EV1 EVALUATION BOARD USER GUIDE

DESCRIPTION

The AL8861EV1, Figure 1, is a double sided evaluation board for the AL8861 step-down, or 'buck', LED driver with internal switch. The evaluation board is preset to drive 680mA into a single LED, or multiple LEDs, the maximum number of which depends on their total forward voltage drop and the supply voltage. (The maximum drive current of the AL8861 is 1000mA)

The operating voltage is nominally 40 volts, but it can be reduced to a minimum of 4.5 volts. The 68uH inductor used in the circuit is based on this nominal supply. The evaluation board should be connected as in Figure 1 below.

Note: The evaluation board does not have reverse supply protection.

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

Terminal VSET provides a connection point for DC or PWM dimming and shutdown.

Warning: At 40V nominal operation with 680mA output, the LED will be hot and very bright

Figure 1: AL8861EV1 evaluation board and connection diagram

AL8861EV1 Connection Point Definition	
Name	**Description**
VIN	Positive supply voltage. 4.5 to 40V
GND	Supply Ground (0V).
VSET	Internal voltage ref. pin (2.5V). This pin can be used to achieve dimming and for switching the output current off. Leave floating for normal operation.
LED A	LED A connects to the external LED anode
LED K	LED K connects to the external LED cathode

AL8861 DEVICE DESCRIPTION

The AL8861 is a continuous mode inductive driver in a TSOT25 package, for driving one or more series-connected LEDs efficiently from a voltage source higher than the LED voltage. The device includes the output switch and a current sense circuit, which requires an external sense resistor to set the nominal current up to 1000mA.

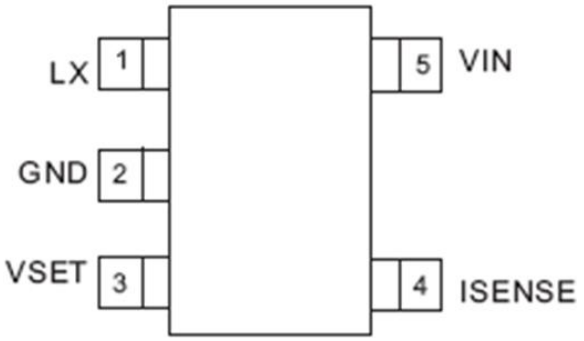
AL8861 DEVICE FEATURES

- Drives one or more series-connected LEDs
- LEDs up to 1000mA.
- Internal 40V switch.
- Wide input voltage: 4.5V to 40V.
- Inherent open circuit LED protection.
- Brightness control using DC or PWM.

DEVICE APPLICATIONS

- LED Retrofit for Low Voltage Halogen
- Low Voltage Industrial Lighting
- LED Backlighting
- Illuminated Signs
- External Driver with Multiple Channels

AL8861 Device Packages, Pin and Definitions



TSOT25 package

AL8861 Device Pin Definition

Name	Pin No	Description
LX	1	Drain of NDMOS switch.
GND	2	Ground (0V).
VSET	3	Internal voltage ref. pin (2.5V) : • Leave floating for normal operation. • Connect to GND to turn off output current. • Drive with DC voltage (0.3V to 2.5V) or with PWM (up to 5V logic level) signal to adjust output current
ISENSE	4	Connect a sense resistor, R1, from the ISENSE pin to VIN to sense the nominal output current. Nominal I_{out} = 0.1/ R1
VIN	5	Input voltage: 4.5V to 40V. Decouple to ground with a 2.2uF or higher ceramic capacitor.

ORDERING INFORMATION

EVALBOARD ORDER NUMBER
AL8861EV1

DEVICE ORDER NUMBER
AL8861WT-7

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

AL8861EV1 EVALUATION BOARD REFERENCE DESIGN

The AL8861EV1 is configured to the reference design in Figure 2.

The operating voltage is a nominal 40V. The nominal current is set at 680mA with a 0R15 sense resistor R1. The circuit operates in continuous mode at approximately 240kHz, with a 68uH inductor and one LED.

Both DC and PWM dimming can be achieved by driving the VSET pin. For DC dimming, the VSET pin may be driven between 0.3V and 2.5V adjusting the output current from 0% to 100% of I_{LED}. Recommended dimming range is from 5% to 100%.
Driving the VSET pin below 0.2V will shut down the output current.
A PWM signal (low level ≤ 0.2V and high level > 2.5) allows the output current to be adjusted above or below the level set by the resistor connected to ISENSE input pin. The PWM frequency can be around 100Hz to 1kHz, providing a resolution of 10 bits.
For low frequency PWM, C2 should be removed from the evaluation board, to give a more accurate duty cycle.
Shorting R2 will connect the test pin VSET to device pin VSET, if required.

For other reference designs or further applications information, please refer to the AL8861 datasheet.

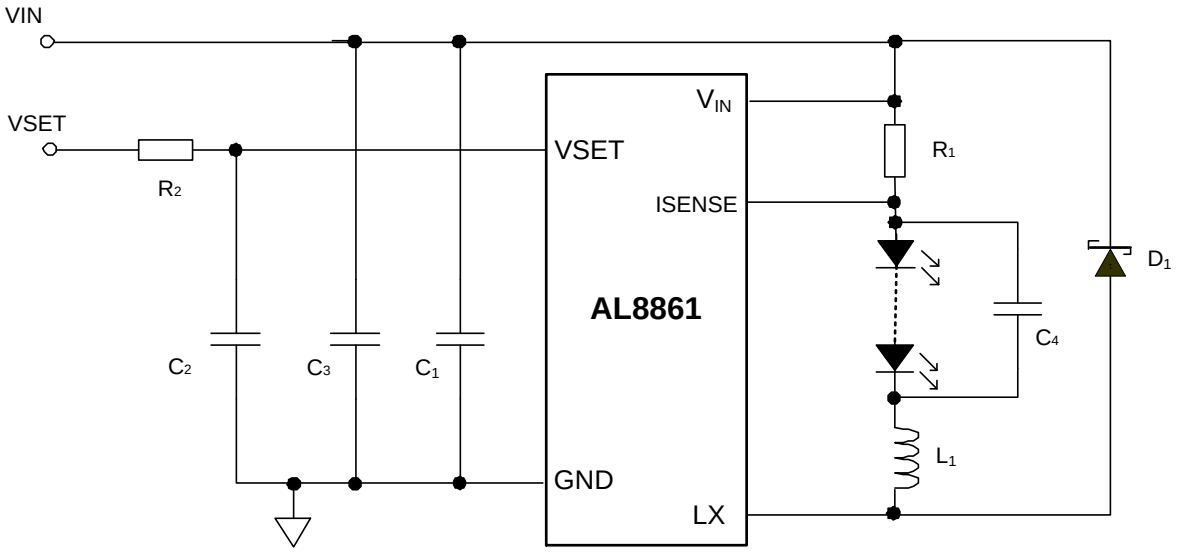


Figure 2: Schematic diagram

AL8861 Operation

In normal operation, when a voltage is applied at +Vin, the AL8861 internal NDMOS switch is turned on. Current starts to flow through sense resistor R1, inductor L1, and the LED. The current ramps up linearly, the ramp rate being determined by the input voltage +Vin and the inductor L1. This rising current produces a voltage ramp across R1. The internal circuit of the AL8861 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 AL8861. 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, AL8861 internal circuits, electrical characteristics and parameters.

AL8861EV1 Component list

Ref	Value	Package	Part Number	Manufacturer	Notes
U1	AL8861	TSOT25	AL8861WT-7	Diodes	DC-DC converter
D1	40V, 3A		B240A	Diodes	Schottky diode
R1	0R15	1206		Generic	1%
R2,	0	0805		Generic	5%
C1	4.7uF 50V	1210	C1210X475K5RAC	Generic KEMET	X7R
C2	Not Fitted				Optional soft start capacitor
C3	100nF, 100V	0805	NMC0805X7R104K100 PF GRM21BR71H104KA01L	Generic NIC Comps MURATA	X7R
C4	100nF 100V	1206	NMC1206X7R104K100	Generic NIC Comps	X7R
L1	68uH		MSS1038-683ML NPIS24H680MTRF	Coilcraft NIC Comps	

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.

AL8861EV1 Basic operation at full voltage

1. Connect Vin and GND
   Warning: The board does not feature reverse battery/supply protection.
2. Set the PSU to 40V
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.

Switching the output current off

Shorting the VSET pin to GND will cause the LED current to go to zero.

Soft start

Adding a C2 capacitor will create a soft-start power-up sequence (1.5ms/nF). This delay will reduce the PWM dimming performance.

Changing the LED current

1. Remove R1.
2. Calculate and replace 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 'VSET' open circuit or set to 2.5V.

The device calculator at the address below can be used to speed up the redesign phase:

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

PERFORMANCE

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

With a 30V supply and two LEDs, the switching frequency is typically 330kHz, and the efficiency level is 88%.

For further advice, please contact your local Diodes Field Applications Engineer, or one of our sales offices listed on the back page of this document.

INTENTIONALLY BLANK

INTENTIONALLY BLANK

IMPORTANT NOTICE

DIODES INCORPORATED MAKES NO WARRANTY OF ANY KIND, EXPRESS OR IMPLIED, WITH REGARD TO THIS DOCUMENT, INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE (AND THEIR EQUIVALENTS UNDER THE LAWS OF ANY JURISDICTION).

Diodes Incorporated and its subsidiaries reserve the right to make modifications, enhancements, improvements, corrections or other changes without further notice to this document and any product described herein. Diodes Incorporated does not assume any liability arising out of the application or use of this document or any product described herein; neither does Diodes Incorporated convey any license under its patent or trademark rights, nor the rights of others. Any Customer or user of this document or products described herein in such applications shall assume all risks of such use and will agree to hold Diodes Incorporated and all the companies whose products are represented on Diodes Incorporated website, harmless against all damages.

Diodes Incorporated does not warrant or accept any liability whatsoever in respect of any products purchased through unauthorized sales channels. Should Customers purchase or use Diodes Incorporated products for any unintended or unauthorized application, Customers shall indemnify and hold Diodes Incorporated and its representatives harmless against all claims, damages, expenses, and attorney fees arising out of, directly or indirectly, any claim of personal injury or death associated with such unintended or unauthorized application.

Products described herein may be covered by one or more United States, international or foreign patents pending. Product names and markings noted herein may also be covered by one or more United States, international or foreign trademarks.

LIFE SUPPORT

Diodes Incorporated products are specifically not authorized for use as critical components in life support devices or systems without the express written approval of the Chief Executive Officer of Diodes Incorporated. As used herein:

A. Life support devices or systems are devices or systems which:

1. are intended to implant into the body, or

2. support or sustain life and whose failure to perform when properly used in accordance with instructions for use provided in the labeling can be reasonably expected to result in significant injury to the user.

B. A critical component is any component in a life support device or system whose failure to perform can be reasonably be expected to cause the failure of the life support device or to affect its safety or effectiveness.

Customers represent that they have all necessary expertise in the safety and regulatory ramifications of their life support devices or systems, and acknowledge and agree that they are solely responsible for all legal, regulatory and safety-related requirements concerning their products and any use of Diodes Incorporated products in such safety-critical, life support devices or systems, notwithstanding any devices- or systems-related information or support that may be provided by Diodes Incorporated. Further, Customers must fully indemnify Diodes Incorporated and its representatives against any damages arising out of the use of Diodes Incorporated products in such safety-critical, life support devices or systems.

www.diodes.com

Sales offices

The Americas
3050 E. Hillcrest Drive
Westlake Village,
CA 91362-3154
Tel: (+1) 805 446 4800
Fax: (+1) 805 446 4850

Europe
Kustermannpark
Balanstraße 59,
D-81541 München
Germany
Tel: (+49) 894 549 490
Fax: (+49) 894 549 4949

Taiwan
7F, No. 50,
Min Chuan Road
Hsin-Tien
Taipei, Taiwan
Tel: (+886) 289 146 000
Fax: (+886) 289 146 639

Shanghai
Rm. 606, No.1158
Changning Road
Shanghai, China
Tel: (+86) 215 241 4882
Fax (+86) 215 241 4891

Shenzhen
Room A1103-04,
ANLIAN Plaza, #4018
Jintian Road
Futian CBD,
Shenzhen, China
Tel: (+86) 755 882 849 88
Fax: (+86) 755 882 849 99

Korea
6 Floor, Changhwa B/D,
1005-5 Yeongtong-dong,
Yeongtong-gu, Suwon-si,
Gyeonggi-do, Korea 443-813
Tel: (+82) 312 731 884
Fax: (+82) 312 731 885