ZXLD1360EV13 EVALUATION BOARD USER GUIDE

DESCRIPTION

ZXLD1360EV13 is an evaluation board showing the application of the Diodes Incorporated ZXLD1360 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 ADJ pin is not used in this application.

Warning: At 12V nominal operation with 680mA output, the LED will be hot and very bright

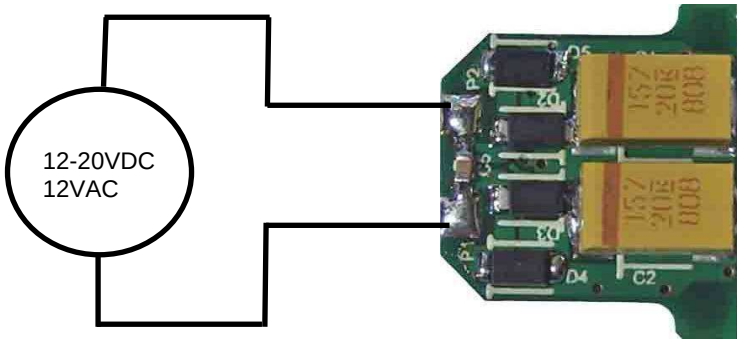


Figure 1: ZXLD1360EV13 evaluation board Power input connection P1 and P2

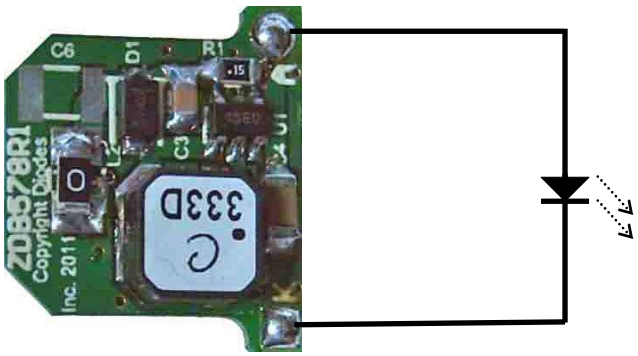


Figure 2: ZXLD1360EV13 evaluation board LED connection Anode (A) and Cathode (K)

ZXLD1360 DEVICE DESCRIPTION

The ZXLD1360 is a continuous mode inductive driver in a SOT25 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.

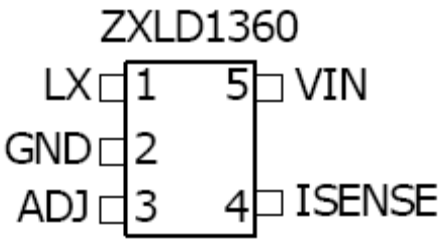
ZXLD1360 DEVICE FEATURES

- Drives one or more series-connected LEDs
- LEDs up to 1000mA.
- Internal 30V switch.
- Wide input voltage: 7V to 30V.
- Inherent open circuit LED protection.
- Brightness control using DC or PWM.

DEVICE APPLICATIONS

- LED flashlights.
- High Power LED driving.
- Low-voltage halogen replacement LEDs.
- Automotive lighting.
- Illuminated signs

ZXLD1360 Device Packages, Pin and Definitions



TSOT23-5 pack

ZXLD1360 Device Pin Definition

Name	Pin No	Description
LX	1	Drain of NDMOS switch.
GND	2	Ground (0V).
ADJ	3	Internal voltage ref. pin (1.25V) : • Leave floating for normal operation. • Connect to GND to turn off output current. • Drive with DC voltage (0.3V to 1.25V) or with PWM signal to adjust output current or.... • Connect a capacitor from this pin to ground to set soft-start time.
ISENSE	4	Connect a sense resistor, Rs, from the ADJ pin to VIN to sense the nominal output current. Nominal I_{out} = 0.1/ R1
VIN	5	Input voltage: 7V to 30V. Decouple to ground with a 2u2F or higher capacitor.

ORDERING INFORMATION

EVALBOARD ORDER NUMBER
ZXLD1360EV13

DEVICE ORDER NUMBER
ZXLD1360ET5TA

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

ZXLD1360EV13 EVALUATION BOARD REFERENCE DESIGN

The ZXLD1360EV13 is configured to the reference design in Figure 3.

The operating voltage is a nominal 12V AC or DC. The nominal current is set at 680mA with a 0R15 sense resistor, R1 and the circuit operates in continuous mode at approximately 300kHz (with Dc voltage), with a 33uH inductor and a single LED.

An accurate way of determining the current is to measure the voltage on the sense resistor. A 10K resistor and a 1uF capacitor can be used to form a low pass filter, the voltage across the capacitor representing a more stable DC reading of current. 100mV represents 1 Amp when using a 0R1 sense resistor.

For other reference designs or further applications information, please refer to the ZXLD1360 datasheet.

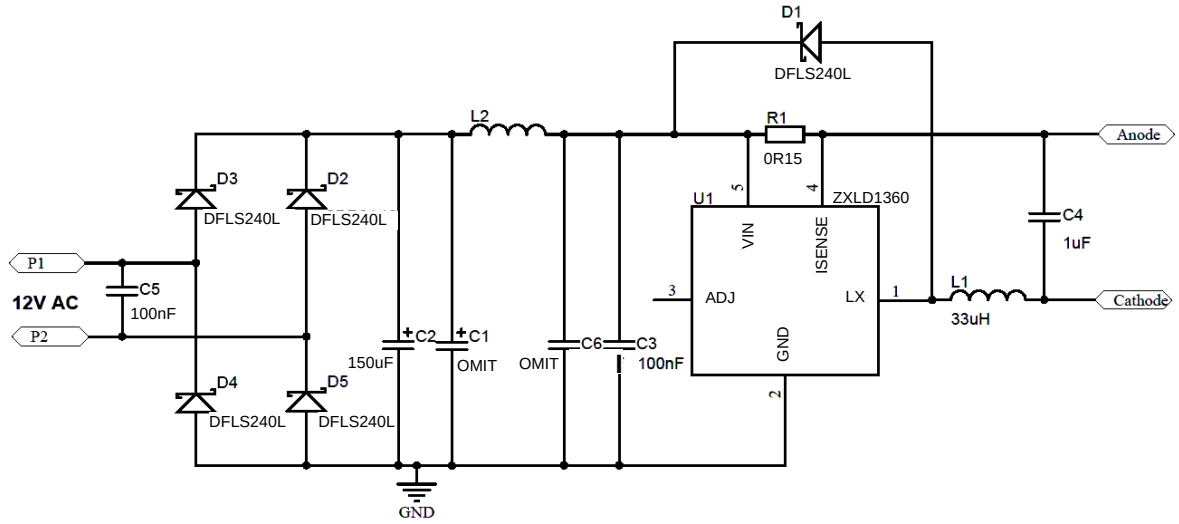


Figure 3: Schematic diagram

ZXLD1360EV13 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 150uF is needed.

C4 decouples the LED connections to minimise EMI, as well as smoothing the current.
Components positions L2 and C6 are provided to form a filter to further reduce conducted EMI if necessary.
In many cases they may not be required, in which case, L2 pads are shorted out and C6 is not fitted.
The board is supplied in this configuration.
C3 provides local decoupling for the ZXLD1360 device U1. It is important that this is as close as possible to U1, as reflected in the layout.

R1 sets the LED current, in this case to 680mA.
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.

ZXLD1360 Operation

In normal operation, when voltage is applied at +Vin, the ZXLD1360 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 ZXLD1360 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 ZXLD1360. 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, ZXLD1360 internal circuits, electrical characteristics and parameters.

ZXLD1360EV13 Component list

QUANTITY	PCB IDENT	VALUE	DESCRIPTION	SUGGESTED SOURCE
1	U1	ZXLD1360	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	C1	---	Not Fitted	
1	C2	150uF 20V	SMD tantalum Kemet D case, T491X157K020AT	Kemet
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	Wire link or 1206 or 1210 generic resistor 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.

ZXLD1360EV13 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/destools/calculators.html

PERFORMANCE

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

With a 12VDC supply, the switching frequency is typically 300kHz, and the efficiency level is >80% .

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

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