ZXLD1362EV3 USER GUIDE

DESCRIPTION

The ZXLD1362EV3, Figure 1, is a PCB constructed using an aluminium base for evaluating the ZXLD1362 LED driver with internal switch [1]. The evaluation board can be used to drive an external choice of LEDs; the total forward voltage across the LEDs depending on the number and type connected.

The operating voltage is nominally higher than 30V for the external LEDs, and can be raised to 60V maximum, which will reduce the supply current. Please refer to the Zetex ZXLD1360 and ZXLD1350 products for applications requiring input voltages lower than 30V.
The nominal current for the evaluation board is set at 700mA with a 0.15Ω sense resistor, R1.
The 68uH inductor used in the circuit is based on a 30V nominal supply, which should be connected across +VIN and GND pins.
Note: The evaluation board does not have reverse polarity protection. It is fitted with a 2.1mm DC power plug with **positive to the centre pole.**

Test point ADJ provides a connection point for DC or PWM dimming and shutdown.

Warning: with 700mA output, the connected LED will be hot and very bright

Figure 1: ZXLD1362EV3 evaluation board

ZXLD1362 DEVICE DESCRIPTION

The ZXLD1362 is a continuous mode inductive driver in a TSOT23-5 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.

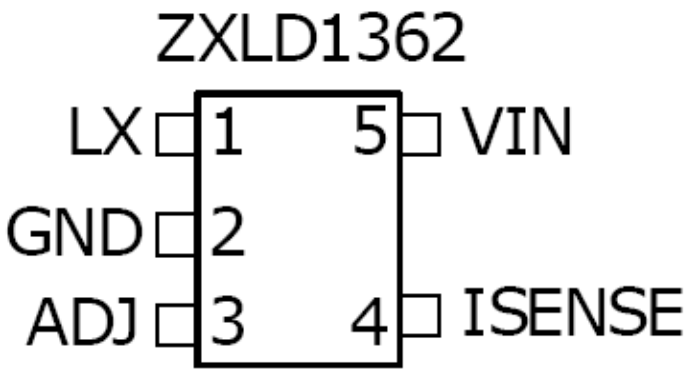
ZXLD1362 DEVICE FEATURES

- Drives one or more series-connected LEDs
- LEDs up to 1000mA.
- Internal 60V switch.
- Wide input voltage: 7V to 60V.
- Inherent open circuit LED protection.
- Brightness control using DC or PWM.
- Internal PWM filter.

DEVICE APPLICATIONS

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

ZXLD1362 Device Packages, Pin and Definitions



TSOT23-5 pack

ZXLD1362 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 a DC voltage (0.3V to 1.25V) or with a PWM signal to adjust output current • Connect a capacitor from this pin to ground to set the 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 60V. Decouple to ground with a 100nF and a 10uF or higher ceramic capacitor depending on the input voltage[1].

ORDERING INFORMATION

EVALBOARD ORDER NUMBER
ZXLD1362EV3

DEVICE ORDER NUMBER
ZXLD1362E5TA

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

ZXLD1362EV3 EVALUATION BOARD
REFERENCE DESIGN

The ZXLD1362EV3 is configured to the reference design in Figure 2. The target application is a driver for one or more series-connected LEDs for luminaires in both commercial and automotive applications.

The maximum operating voltage is 60V, and the nominal current is set at 700mA with a 0.15Ω sense resistor R1. The device operates in continuous mode at approximately 150 kHz, with a 68uH inductor.

An accurate way of determining the current, avoiding the need to insert an ammeter in the current path, 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 and the voltage across the capacitor represents a more stable dc reading of current. Using this method, 100mV represents 0.7 Amp when using a 0.15Ω sense resistor.

The ADJ pin connects to a low pass filter within the ZXLD1362 chip to provide some decoupling, but the external capacitor C2 (100nF) is used to provide additional decoupling to reduce any high frequency noise as well as enabling the soft start function.
Both DC and PWM dimming can be achieved by driving the ADJ pin. For DC dimming, the ADJ pin may be driven between 0.3V and 1.25V. Driving the ADJ pin below 0.2V will shut down the output current. For PWM dimming, an external open-collector NPN transistor or open-drain N-channel MOSFET can be used to drive the ADJ pin. The PWM frequency can be low, around 100Hz to 1 kHz, or high between 10 kHz to 50 kHz.
For low frequency, PWM capacitor C2 should be removed on the evaluation board, to give a more accurate duty cycle.
Shorting R2 will connect the test pin ADJ to device pin ADJ if needed.
The external capacitor C2 on the ADJ pin sets the soft start time. The amount of soft start time achievable is approximately 0.2ms/nF.
For other reference designs or further applications information, please refer to the ZXLD1362 datasheet.

Schematic Diagram

Figure 2 shows the schematic for the ZXLD1362EV3 evaluation board.

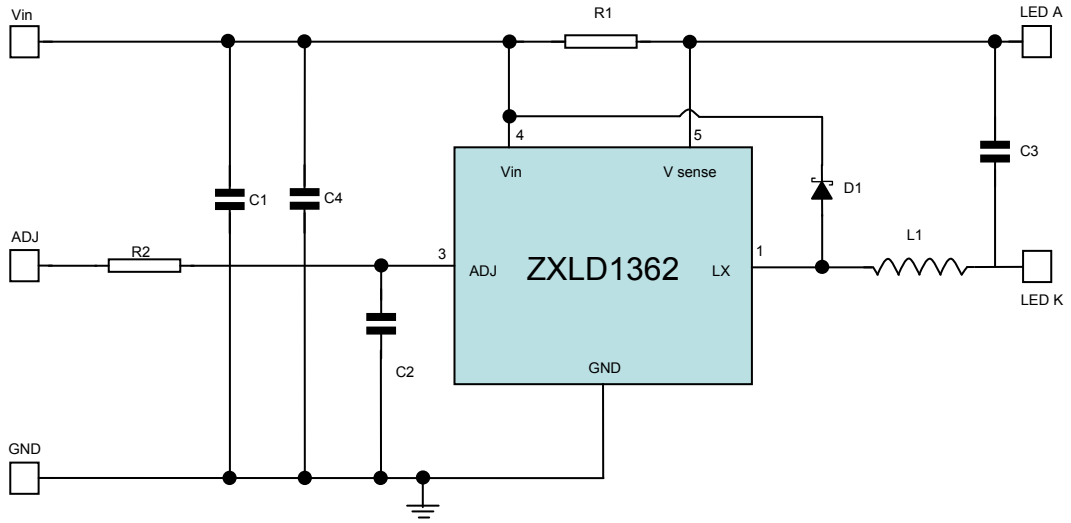


Figure 2: Schematic for the evaluation board ZXLD1362EV3

ZXLD1362 Operation

In normal operation, when voltage is applied at +VIN, the ZXLD1362 internal NDMOS switch is turned on. Current starts to flow through sense resistor R1, inductor L1, and the LEDs. 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 ZXLD1362 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 LEDs, 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 ZXLD1362. 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 an average current (set by the sense resistor R1) to the LEDs, . Please refer to the datasheet [1] for the threshold limits, ZXLD1362 internal circuits, electrical characteristics and parameters.

ZXLD1362EV1 Evaluation Board - BOM

Ref	Value	Package	Part Number	Manufacturer	Notes
R1	0.15R	0805	CRL1220 R15TD	Tyco	5%, 200ppm
R2	1kΩ	0805	Generic	-	-
C1	10uF 100V	SMD	NACEW100M1006.3x8TR13F	NIC	Electrolytic - 20%
C2,C4	100nF, 100V	0805	NMC0805X7R104K100TRPLPF	NIC	20%
C3	100nF	1206	NMC1206X7R104K100TRPLP3KF	NIC	
L1	68uH	-	NPIS24H680MTRF	NIC	68uH/1.5A rms
D1	100V, 3A	SMC	30BQ100PBF	IR	Schottky diode
U1	**ZXLD1362**	**TSOT23-5**	**ZXLD1362E5TA**	**Zetex**	**DC-DC converter**

The aluminium PCB guarantees a good thermal dissipation for the ZXLD1362 device, which can produce up to 1 watt of heat under maximum load conditions. Other sources of heat are the Schottky diode, the inductor and the sense resistor. Care must be taken in their placement.

Warning: At 60V operation with 700mA output, the board temperature rises by around 50C from ambient after 30 minutes of operation.

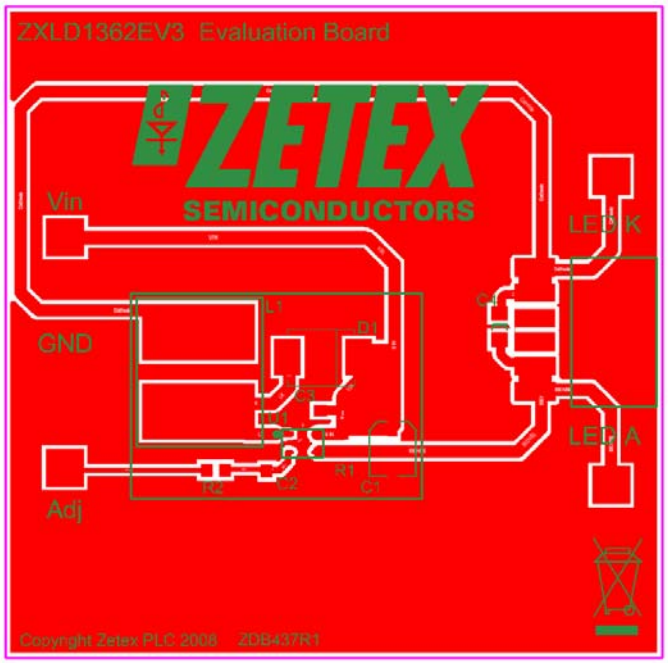


Figure 3: Component layout and circuit board view

ZXLD1362EV3 Connection Point Definition	
Name	**Description**
+VIN	Positive supply voltage.
GND	Supply Ground (0V).
ADJ	Internal voltage ref. pin (1.25V). This pin can be used to achieve dimming and soft-start, and for switching the output current off. • Leave floating for normal operation. • See 'Circuit Features' section to achieve dimming, soft-start and for switching the output current off.
LED A	LED A connects to the external LED anode
LED K	LED K connects to the external LED cathode

ZXDL1362EV3 Basic operation at full voltage

1. Connect external LEDs across test pins 'LED A' (anode) and 'LED K' (cathode). The number of external LEDs that can be connected depends on their operating power and forward voltage drop, but typically 16 x 3.4V LEDs can be connected using a 60V rail. For an external load other than LEDs, the positive terminal of the load should be connected the anode and the negative to the cathode.

2. Connect VIN and GND.

   Warning: The board does not feature reverse battery/supply protection.

3. Set the PSU to the desired input voltage (usually between 30V and 60V)

4. Turn on the PSU. The external LEDs will illuminate and the current should be approximately 700mA.

   Warning: Do not stare at the LEDs directly.

Circuit features

N.B. Remove power whilst changing components!

Soft-start

1. The evaluation board is fitted with capacitor C2, which performs the soft start function by slowing the rise time of the adjust pin at start-up. The pin output impedance is 50K so CxR is the time constant to reach 66% of output current.

PWM

1. Remove the soft start capacitor C2

2. Refer to the datasheet for how to perform PWM

Switching off the output current

3. Shorting the ADJ pin to GND will cause the LED current to go to zero. Releasing this pin will switch on the system (creating a soft-start power up sequence if the C2 capacitor is used).

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 :

   $R1 = 0.1(V / I_{OUT})$ where I_{OUT} = the LED current.
   R1 = the sense resistor value in ohms.
   0.1V is the nominal sense voltage with ADJ open circuit or set to 1.25V.

PERFORMANCE

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

With a 60V supply and 15 LEDs, the switching frequency is typically 200 kHz and efficiency levels >90% are achievable.

Visit our website www.zetex.com to find useful tools for circuit design and simulation.

REFERENCE

[1] ZXLD1362 Datasheet – www.zetex.com

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