

## DESCRIPTION

The AL8862QEV1, Figure 1, is a double sided evaluation board for the AL8862Q step-down, or 'buck', LED driver with internal switch in the SO-8EP package. The evaluation board is preset to drive 1000mA 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 AL8862Q is 1000mA).

The suggested operating voltage for the evaluation board ranges from 5V to 55V maximum. The evaluation board should be connected as in Figure 1 below.

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

The nominal current, 1000mA, is set with the 0R1 sense resistor, R1.

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

**Warning: with 1000mA output, the connected LEDs will be hot and very bright**

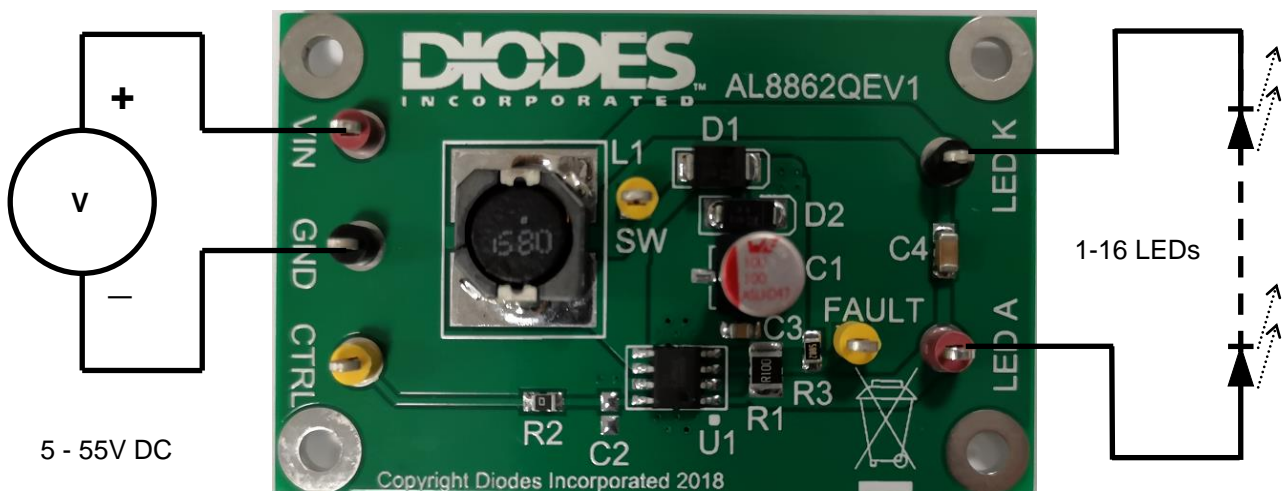


Figure 1. AL8862QEV1 evaluation board and connection diagram

AL8862QEV1 Connection Point Definition	
Name	Description
VIN	Positive supply voltage. 5 to 55V
GND	Supply Ground (0V)
CTRL	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

### AL8862Q DEVICE DESCRIPTION

The AL8862Q is a step-down DC-DC converter designed to drive LEDs with a constant current. The AL8862Q operates with an input supply voltage from 5V to 55V and provides an externally adjustable output current up to 1A. Series connection of the LEDs provides identical LED currents resulting in uniform brightness and eliminating the need for ballast resistors. The AL8862Q switches at frequencies up to 1MHz. This allows the use of smaller size external components, hence minimizing the PCB size.

The maximum output current of AL8862Q is set via an external resistor connected between the VIN and SET input pins. Dimming is achieved by applying either a DC voltage or a PWM signal at the CTRL input pin. The soft-start time can be adjusted using an external capacitor from the CTRL pin to ground. An input voltage of 0.3V or lower at CTRL pin will shut down the power switch.

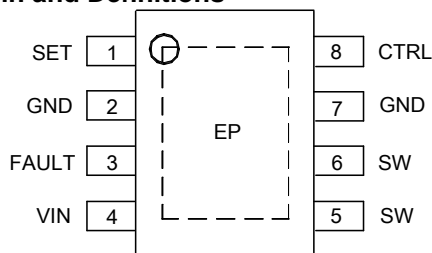
### AL8862Q DEVICE FEATURES

- Wide Input Voltage Range: 5V to 55V
- Output Current up to 1A
- Brightness control using DC or PWM.
- High Efficiency (Up to 97%)
- Fault Status Indication for Abnormal Operation
- LED Short-Circuit Protection
- Inherent Open-Circuit LED Protection
- Current-Sense Resistor Short-Circuit Protection
- Overtemperature Shutdown
- Up to 1MHz Switching Frequency

### DEVICE APPLICATIONS

- Automotive Interior LED Lamps
- Automotive Exterior LED Lamps

### AL8862Q Device Packages, Pin and Definitions



SO-8EP package

### AL8862Q Device Pin Definition

Name	Pin No	Description
SW	5,6	Drain of NDMOS switch
GND	2,7	Ground (0V)
CTRL	8	Internal voltage ref. pin (2.5V): <ul style="list-style-type: none"> <li>• Leave floating for normal operation</li> <li>• Drive to voltage below 0.3V to turn off output current</li> <li>• Drive with DC voltage (0.4V to 2.5V) or with PWM (up to 5V logic level) signal to adjust output current</li> </ul>
FAULT	3	FAULT Indication for abnormal operation
SET	1	Connect a sense resistor, R1, from the SET pin to VIN to sense the nominal output current. Nominal $I_{out} = 0.1 / R1$
VIN	4	Input voltage: 5V to 55V. Must be locally bypassed with a capacitor

## ORDERING INFORMATION

EVALBOARD ORDER NUMBER
AL8862QE1

DEVICE ORDER NUMBER
AL8862QSP-13

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

### AL8862QE1 EVALUATION BOARD REFERENCE DESIGN

The AL8862QE1 is configured to the reference design in Figure 2.

The maximum operating voltage for the evaluation board is 60V. The nominal current is set at 1000mA with a 0R1 sense resistor R1.

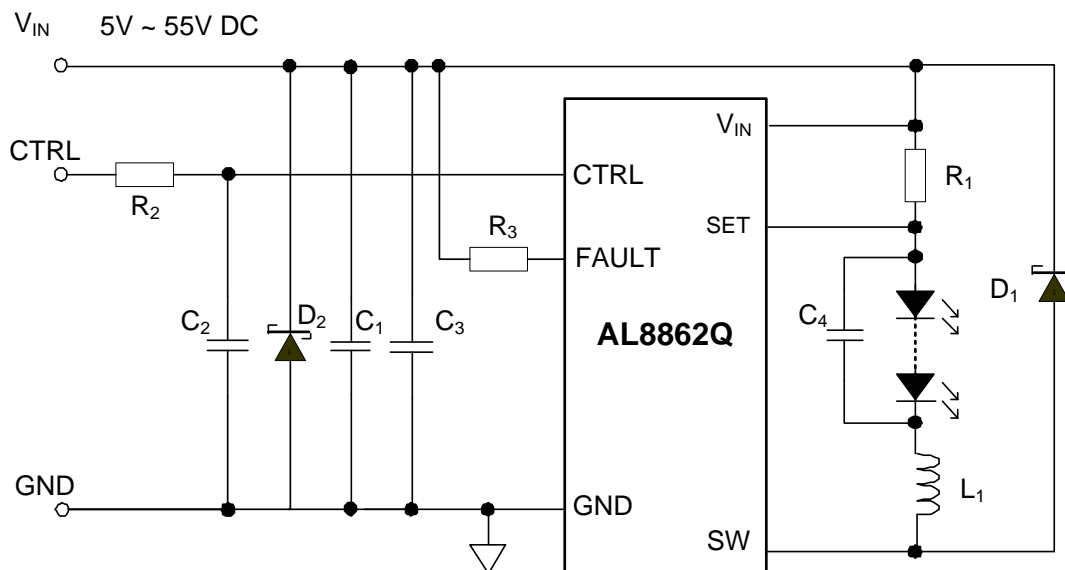
Both DC and PWM dimming can be achieved by driving the CTRL pin.

For DC dimming, the CTRL pin may be driven between 0.4V and 2.5V adjusting the output current from 10% to 100% of  $I_{LED}$ . Driving the CTRL pin below 0.3V will shut down the output current.

For PWM dimming, a PWM signal (low level  $\leq 0.3V$  and high level  $> 2.5$ ) allows the output current to be adjusted above or below the level set by the resistor connected to SET input pin. The PWM frequency can be around 100Hz to 1kHz, providing a resolution of 10 bits. For better resolution, C2 should be removed from the evaluation board, to give a more accurate duty cycle.

Shorting R2 will connect the test pin CTRL to device pin CTRL, if required. The external capacitor C2 on the CTRL pin sets the soft start time. The amount of soft start time achievable is approximately 1.5ms/nF.

For other reference designs or further applications information, please refer to the AL8862Q datasheet.



**Figure 2. Schematic of the Evaluation Board**

## AL8862Q OPERATION

In normal operation, when voltage is applied at  $V_{IN}$ , the AL8862Q's internal NDMOS switch is turned on. Current starts to flow through sense resistor R1, inductor L1, and the LED(s). The current ramps up linearly, the ramp rate being determined by the input voltage  $V_{IN}$  and inductor L1. This rising current produces a voltage ramp across R1. The internal circuit of the AL8862Q senses this voltage 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(s), Schottky diode D1, and back to the supply rail. The current 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 AL8862Q. 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 for the threshold limits, AL8862Q internal circuits, electrical characteristics and parameters.

## AL8862QE1 EVALUATION BOARD - BILL OF MATERIALS

Ref	Value	Package	Part Number	Manufacturer	Notes
U1	AL8862Q	SO-8EP	AL8862QSP-13	Diodes Incorporated (Diodes)	DC-DC Converter
D1	100V, 2A	SMB	B2100Q-13-F	(Diodes)	Schottky diode
D2	60V	SMA	SMAJ60A	(Diodes)	TVS
R1	0R1	1210	Generic		+/-1%
R2	0R0	0805	Generic		+/-5%
R3	50k	0805	Generic		+/-5%
C1	10 $\mu$ F,100V		865080845005	Würth Elektronik	6.3mm x 8mm SMD electrolytic 85C
C2	Not Fitted				Optional soft start capacitor
C3	100nF,100V	0805	Generic NMC0805X7R1 04K100	NIC Components	X7R +/-20%
C4	1 $\mu$ F,100V	1206	Generic NMC1206X7R1 05K100	NIC Components	X7R +/-20%
L1	68 $\mu$ H		7447714680	Würth Elektronik	68 $\mu$ H, ~0.1R, ~1.9A

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

The FR4 PCB design, with adequate copper top and bottom and plated through vias for thermal coupling, guarantees a good thermal dissipation for the AL8862Q device. Other sources of heat are the Schottky diode, the inductor, and the sense resistor, therefore care must be taken in their placement.

**Warning: At 60V operation with 1A output, the board will become hot!**

## AL8862QEV1 BASIC OPERATION AT FULL VOLTAGE

1. Connect external LEDs across the 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.
2. Connect VIN and GND.  
Warning: The board does not have reverse battery/supply protection.
3. Set the PSU to the desired input voltage (60V max.)
4. Turn on the PSU. The LEDs will illuminate and the current should be approximately 1A  
Warning: Do not stare at the LED directly.
5. The switching waveform on the SW pin can be acquired using the test point SW
6. The FAULT status can be acquired using the test point FAULT

### Soft-start

The AL8862Q has a in-built soft start function. A capacitor, C2 may be fitted to the evaluation board to increase the soft start time by slowing the rise time of the adjust pin at start-up at the rate of 1.5ms/nF. The board is supplied with a zero-ohm resistor in position R2. Please see the data sheet for further details.

### PWM Dimming

1. Remove the soft start capacitor C2 (if it has been added by the user)
2. Refer to the datasheet for instructions on how to perform PWM

### Switching off the output current

Shorting the CTRL 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. Refer to the datasheet for the derating curve and the power dissipation capability of the package.
2. Remove R1.
3. 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:

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

Where,  $I_{LED}$  = the LED current.

R1 = the sense resistors value in ohms.

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

### Fault Indicator

The AL8862Q includes an active low, open-drain fault indicator (FAULT). The FAULT pin goes low when one of the following conditions occurs:

1. Open circuit across LED string
2. Short circuit across current sense resistor
3. Overtemperature condition

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