

## General Description

The DIODES™ AL8863 is a step-down DC-DC controller designed to drive LEDs with high output current. The device operates at an input supply voltage from 4.5V to 60V. Series connection of the LEDs provides identical LED currents resulting in uniform brightness and eliminating the need for ballast resistors. The switching frequency range of AL8863 is from 50kHz to 1MHz. The wide operating frequency range allows more flexibility on component selection, and also with operating up to 1MHz, it allows the use of smaller size external components, hence minimizing the PCB size and driver board.

The output current of AL8863 is set via an external resistor connected between the VIN and CSN input pins. Dimming is achieved by applying a PWM signal at the DIM input pin. The soft-start time can be adjusted using an external capacitor from the DIM pin to ground.

The AL8863 is available in the thermally enhanced SO-8EP package.

## Applications

- Commercial & Industrial Lighting
- Architecture Lighting
- External LED Drivers and Smart Lighting

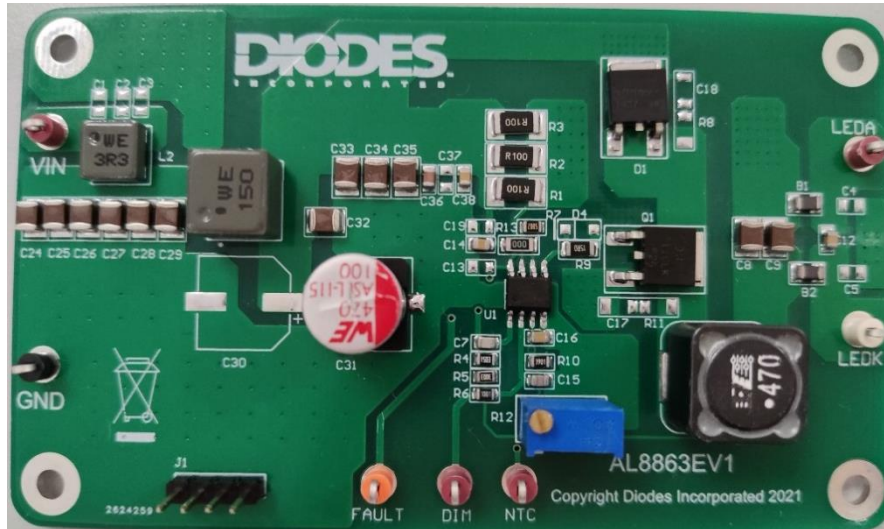
## Key Features

- Wide Input Voltage Range: 4.5V to 60V
- Operating Frequency Range: 50kHz to 1MHz
- 1000:1 PWM Dimming Resolution at 100Hz
- Single Pin for On/Off and Brightness Control by PWM Signal
- Fault Status Indication for Abnormal Operation
- LED Shorted Protection
- Inherent Open-Circuit LED Protection
- Programmable Thermal Fold-Back Operation Through NTC Pin
- Overtemperature Shutdown
- Thermally Enhanced SO-8EP Package
- Totally Lead-Free & Fully RoHS Compliant

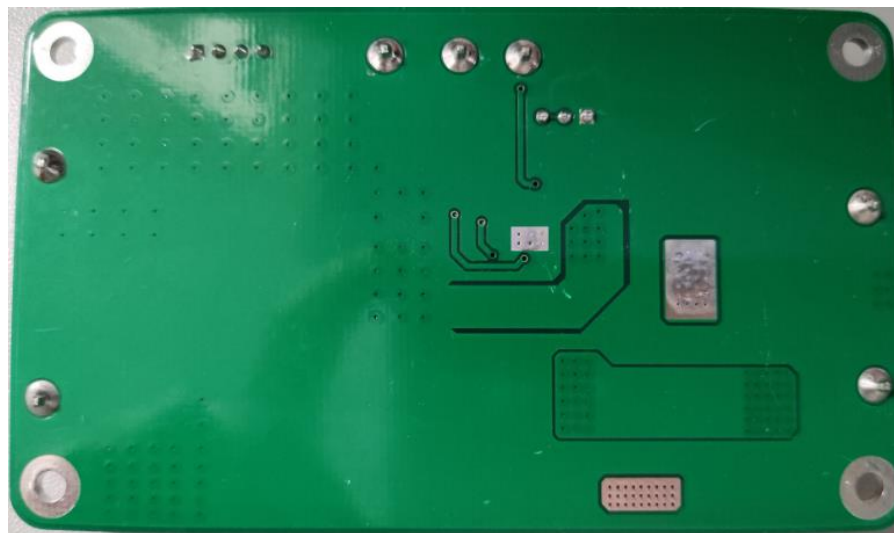
## AL8863EV1 Specifications

Parameter	Value
Input Voltage	5VDC to 60VDC
LED Current	3A
Number of LEDs	1~16 LEDs
Dimension	102mm x 60mm
RoHS Compliance	YES

**EVB Physical Picture**



**Figure 1: Top View**



**Figure 2: Bottom View**

## Connection Instructions

**Power Supply Input:** 5~60VDC (VIN, GND);

**DIM:** Multi-function On/Off and brightness control pin, this pin can be used to achieve dimming and for switching the output current off. Leave floating for normal operation;

**PWM Signal Input:** Remove C15 and connect 0Ω for R6, apply PWM signal to DIM (DIM, GND);

**Analog Signal Input:** A low-pass filtered (R6 and C15) be added, apply analog signal to DIM (DIM, GND);

**LED A:** LED A connects to the external LED anode;

**LED K:** LED K connects to the external LED cathode.

## Evaluation Board Schematic

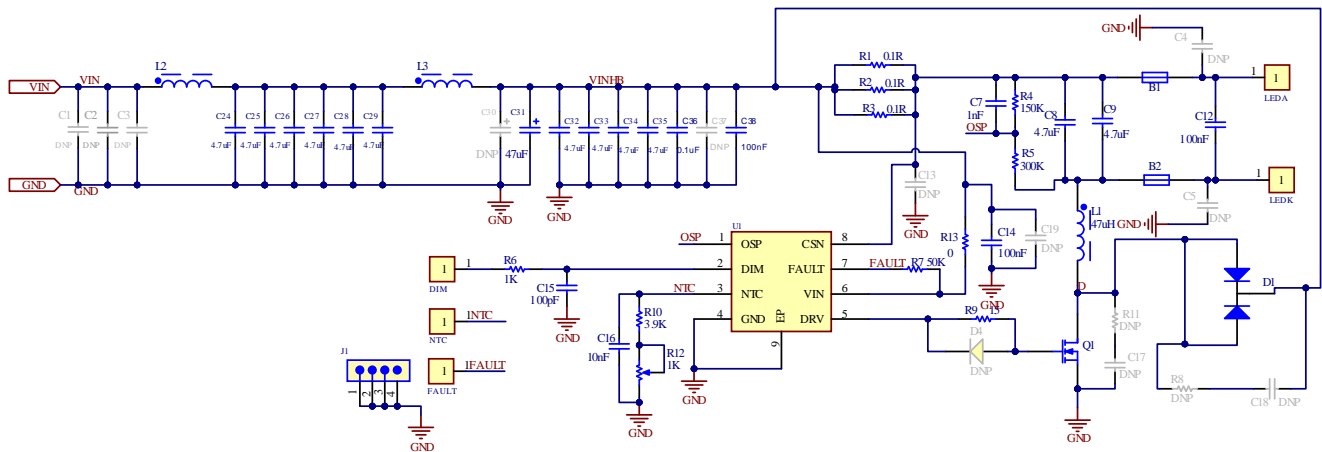
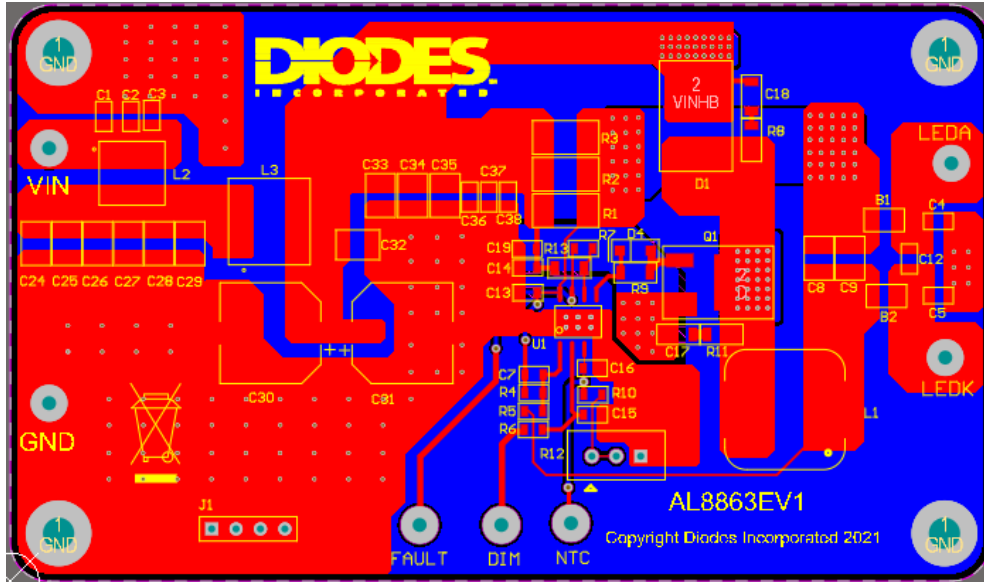
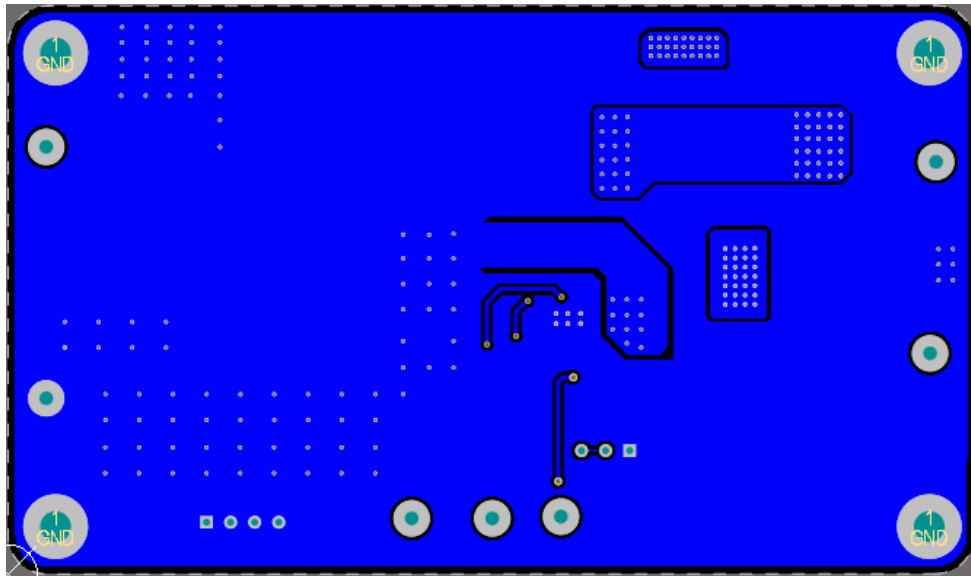


Figure 3: Evaluation Board Schematic

**Evaluation Board Layout**



**Figure 4: PCB Board Layout Top View**



**Figure 5: PCB Board Layout Bottom View**

## Quick Start Guide

1. By default, the evaluation board is preset at 3A LED current by R1, R2 and R3.
2. Non-dimming operation: Leave DIM pin floating for normal operation.
3. Power Supply: Connect the 5~60VDC to VIN & GND pin to supply the system.
4. PWM Dimming: Remove C15, apply a PWM signal (Low level <0.3V, High level >2.6V, transition time less than 1 $\mu$ s) to PWM pin to dim the LEDs. The recommended PWM signal frequency is from 100Hz to 20 kHz.
5. Analog Dimming: Add a low-pass filtered (R6 and C15) DC signal converted from DC source, the DIM pin can be driven between 0.3V and 2.6V adjusting over a wide full range.
6. Soft-start: Connect a capacitor (C15) to increase soft-start time.

## Bill of Material

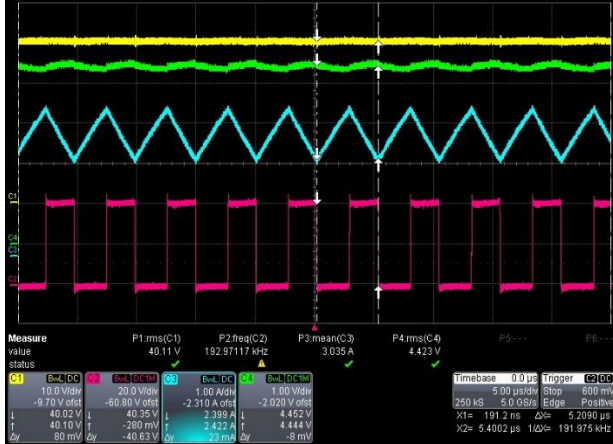
DESIGNATOR	Value	Package	DESCRIPTION	Manufacturer	QUANTITY
U1	AL8863SP-13	SO-8EP	60V BUCK LED CONTROLLER WITH FAULT FLAG	Diodes	1
Q1	DMT10H010LK3	TO252	N-Channel 100 V 68.8A (Tc) 3W (Ta) Surface Mount TO-252-3,DMT10H010LK3	Diodes	1
D1	SBR15U100CTL	TO252	DIODE ARRAY SBR 100V 7.5A TO252,SBR15U100 CTL	Diodes	1
L1	7447709470	1212	Fixed Inductors WE-PD 47uH	Würth Elektronik	1
L2	74439344033	6030	Fixed Inductors WE-XHMI SMD 6030 3.3uH	Würth Elektronik	1
L3	74439358150	8080	Fixed Inductors WE-XHMI SMD 8080 15uH	Würth Elektronik	1
C31	865060857005	Ø10	WCAP-ASLL EL-Capacitors,47uF/100V	Würth Elektronik	1
B1,B2	7427922	1206	Ferrite Beads,60ohm	Würth Elektronik	2
C8,C9,C24,C25,C26,C27,C28,C29,C32,C33,C34,C35	4.7uF/100V	12010	Ceramic Cap,4.7uF/100V, X7R	Generic	12
R1,R2,R3	0.1Ω	2010	SMD Resistor, 0.1R,1%	Generic	3
R4	150K	0805	SMD Resistor,150K, 5%	Generic	1
R5	300K	0805	SMD Resistor, 300K, 5%	Generic	1
R6	1K	0805	SMD Resistor, 1K, 5%	Generic	1
R7	50K	0805	SMD Resistor, 50K, 5%	Generic	1
R9	15Ω	1206	SMD Resistor, 15R, 1%	Generic	1
R10	3.9K	0805	SMD Resistor, 3.9K, 1%	Generic	1
R12	potentiometers	N/A	10K potentiometers, 3296W-1-103	BOCHEN	1
R13	0Ω	1206	SMD Resistor, 0R,1%	Generic	1
C7	1nF/100V	0805	Ceramic Cap,1nF/100V, X7R	Generic	1
C12,C14,C38	100nF/100V	0805	Ceramic Cap,100nF/100V,±10%,X7R	Generic	3
C36	1uF/100V	0805	Ceramic Cap,1uF/100V, X7R	Generic	1
C15	100pF/100V	0805	Ceramic Cap,100pF/100V, X7R	Generic	1
C16	10nF/100V	0805	Ceramic Cap,10nF/100V, X7R	Generic	1
VIN,LED A,DIM,NTC	Connector, red	DIP	---	---	4
GND	Connector, black	DIP	---	---	1
LED K	Connector, white	DIP	---	---	1

FAULT	Connector, orange	DIP	---	---	1
J1	Pin Header	DIP	---	---	1

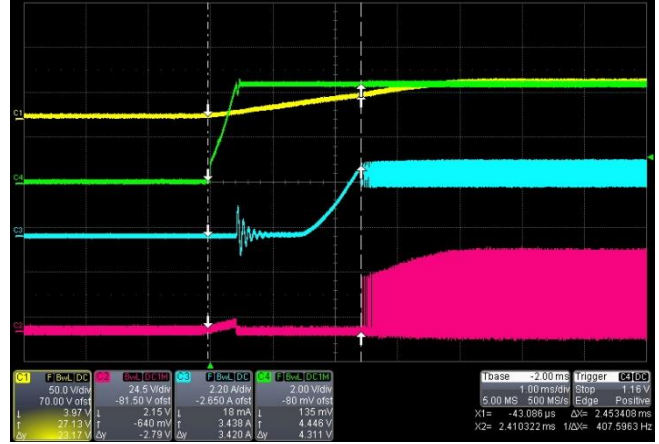
Note: The component part numbers are correct at the time of publication. Diodes Inc. reserves the right to substitute other parts where necessary, without further notification.

## Functional Waveforms

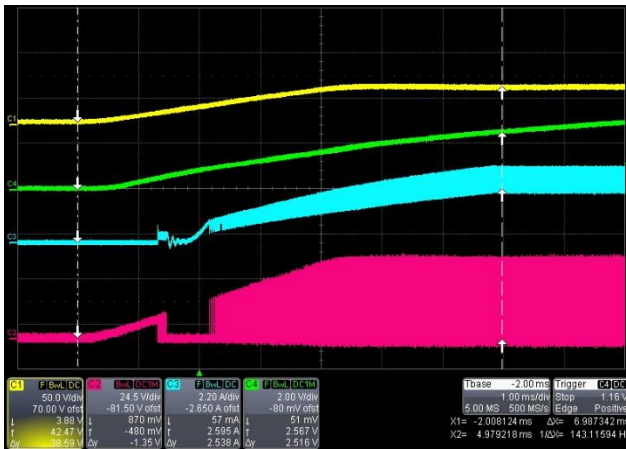
**Switching waveform(Vin=40V, 6LEDs)**  
(Y-Vin, R-SW, G-DIM, B-I<sub>L</sub>)



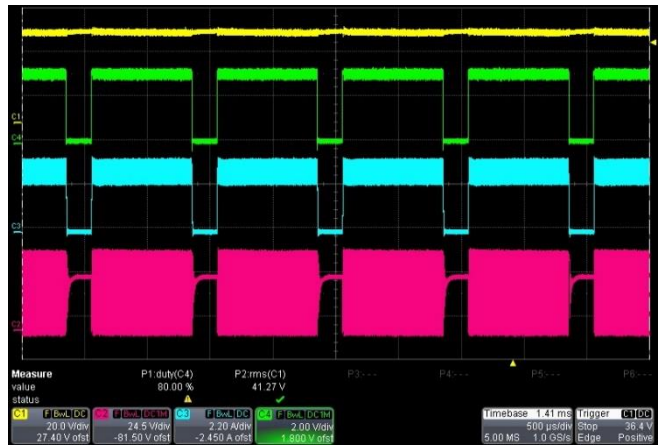
**Start-up waveform(Vin=40V, 6LEDs)**  
(Y-Vin, R-SW, G-DIM, B-I<sub>L</sub>)



**Soft Start waveform**  
(Vin=40V, 6LEDs, C15=100nF)  
(Y-Vin, R-SW, G-DIM, B-I<sub>L</sub>)

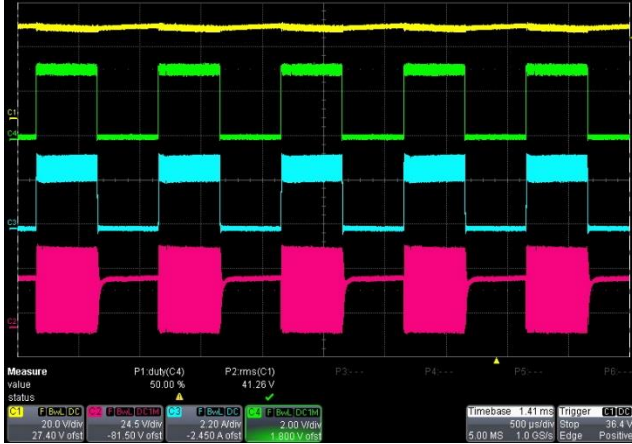


**PWM Dimming waveform(Vin=40V, 6LEDs)**  
(PWM frequency=1KHz, Duty=80%)  
(Y-Vin, R-SW, G-DIM, B-I<sub>L</sub>)

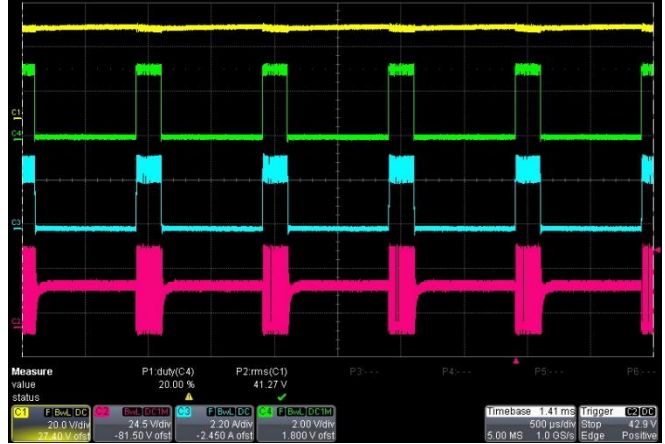


**Functional Waveforms**

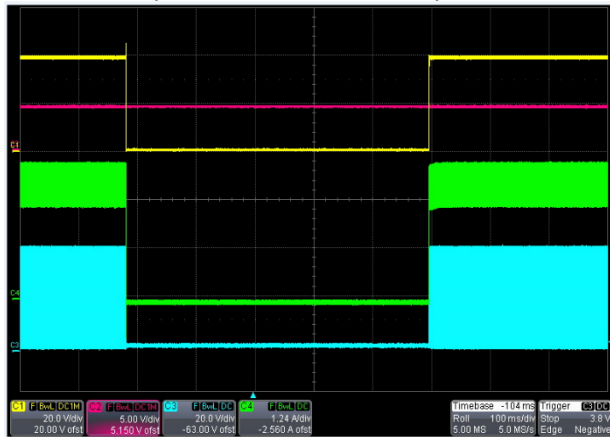
**PWM Dimming waveform(Vin=40V, 6LEDs)  
(PWM frequency=1KHz, Duty=50%)  
(Y-Vin, R-SW, G-DIM, B-I<sub>L</sub>)**



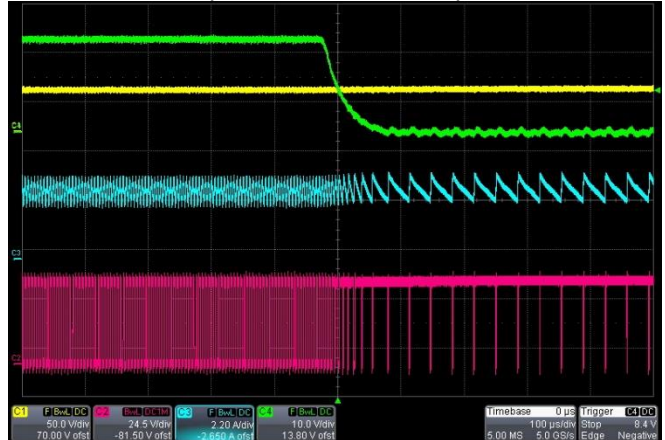
**PWM Dimming waveform(Vin=40V, 6LEDs)  
(PWM frequency=1KHz, Duty=20%)  
(Y-Vin, R-SW, G-DIM, B-I<sub>L</sub>)**



**LED open protection(Vin=40V, 6LEDs)  
(Y-V<sub>FAULT</sub>, R-DIM, G- I<sub>L</sub>, B-SW)**



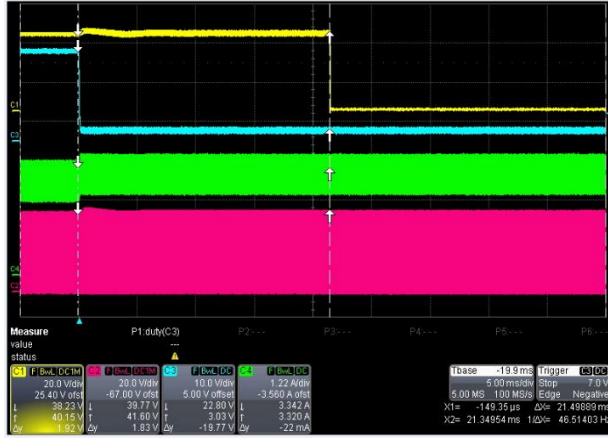
**LED short protection(Vin=40V, 6LEDs)  
(Y-Vin, R-SW, G-V<sub>out</sub>, B-I<sub>L</sub>)**



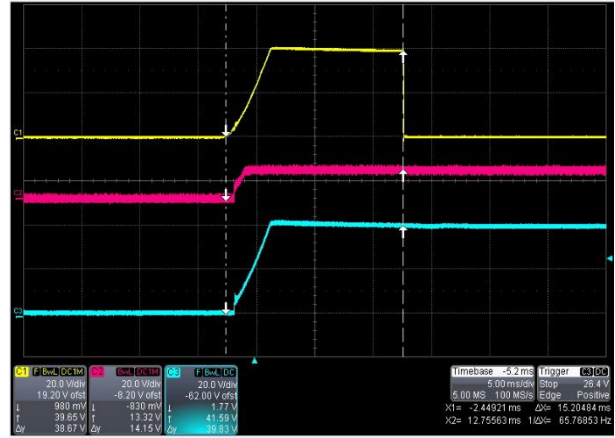


**Functional Waveforms**

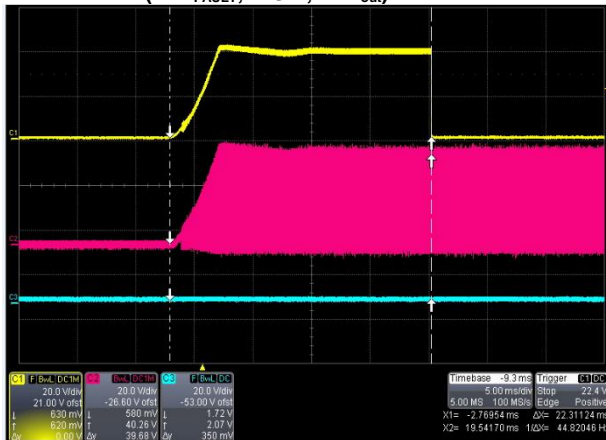
**LED short protection\_1 (Vin=40V, 6LEDs)**  
(Y-VFAULT, R-SW, G- I<sub>L</sub>, B-V<sub>out</sub>)



**LED open protection\_FAULT**  
(Vin=40V, 6LEDs)\_start up  
(Y-VFAULT, R-Vdrive, B-V<sub>out</sub>)

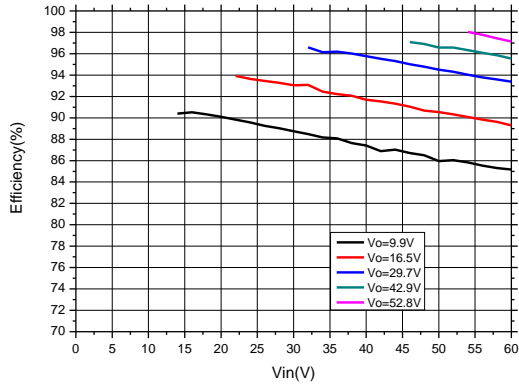


**LED short protection\_FAULT**  
(Vin=40V, 6LEDs)\_start up  
(Y- VFAULT, R-SW, B- V<sub>out</sub>)

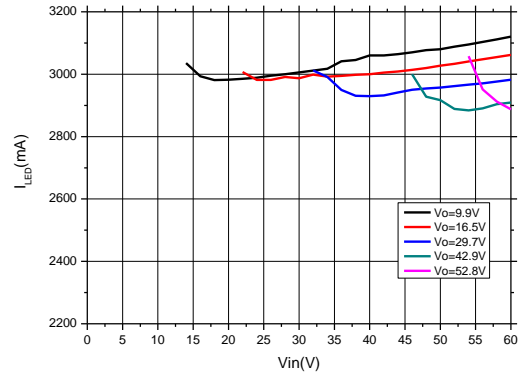


**Functional Data Curves**

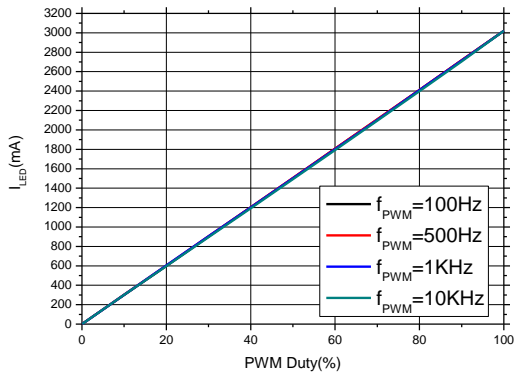
**Efficiency vs. Input Voltage**



**LED Current vs. Input Voltage**



**PWM Dimming (Vin=40V, 6LEDs)**



**CISPR15 EMI Performance**

Figure 6 presents the EMI performance of the AL8863EV1 EVb at 20V input with 6LEDs load. Conducted emissions are measured over a frequency range of 150 kHz to 30 MHz according to the CISPR 15 low-frequency specification. CISPR15 peak and average limit lines are denoted in red. The blue and black spectra are measured using peak and average detection, respectively.

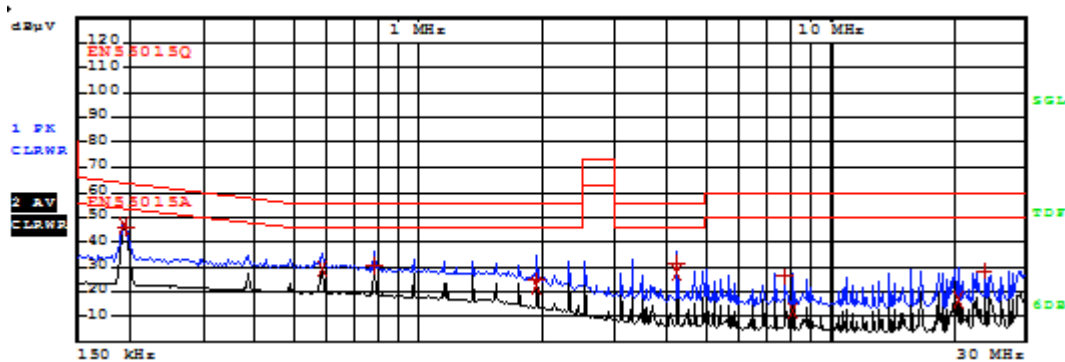


Figure 6: CISPR 15 Conducted Emissions Plot, 150 kHz to 30 MHz,  
VIN = 40 V, IOU<sub>T</sub> = 3A, 6LEDs

**Thermal Test**

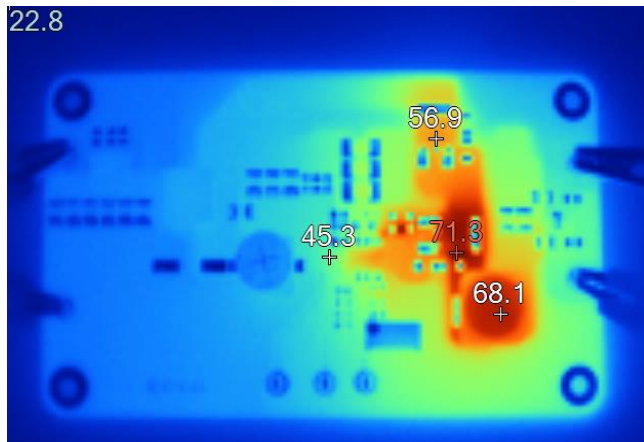


Figure 7: Top  
(Vin=40V, 6LEDs, Burn-in time=60min)

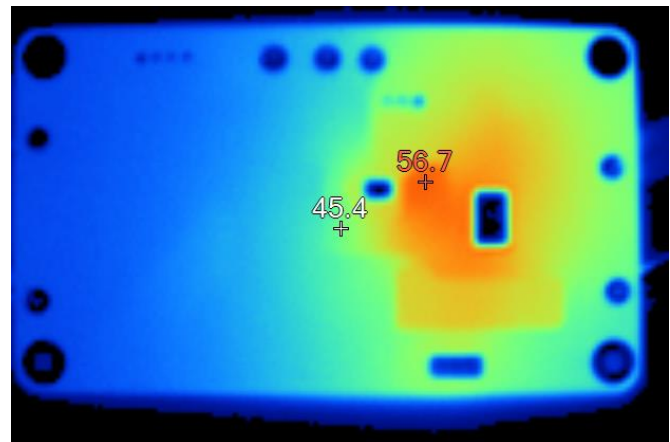


Figure 8: Bottom  
(Vin=40V, 6LEDs, Burn-in time=60min)

### IMPORTANT NOTICE

1. DIODES INCORPORATED (Diodes) AND ITS SUBSIDIARIES MAKE NO WARRANTY OF ANY KIND, EXPRESS OR IMPLIED, WITH REGARDS TO ANY INFORMATION CONTAINED IN THIS DOCUMENT, INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE OR NON-INFRINGEMENT OF THIRD PARTY INTELLECTUAL PROPERTY RIGHTS (AND THEIR EQUIVALENTS UNDER THE LAWS OF ANY JURISDICTION).
2. The Information contained herein is for informational purpose only and is provided only to illustrate the operation of Diodes' products described herein and application examples. Diodes does not assume any liability arising out of the application or use of this document or any product described herein. This document is intended for skilled and technically trained engineering customers and users who design with Diodes' products. Diodes' products may be used to facilitate safety-related applications; however, in all instances customers and users are responsible for (a) selecting the appropriate Diodes products for their applications, (b) evaluating the suitability of Diodes' products for their intended applications, (c) ensuring their applications, which incorporate Diodes' products, comply the applicable legal and regulatory requirements as well as safety and functional-safety related standards, and (d) ensuring they design with appropriate safeguards (including testing, validation, quality control techniques, redundancy, malfunction prevention, and appropriate treatment for aging degradation) to minimize the risks associated with their applications.
3. Diodes assumes no liability for any application-related information, support, assistance or feedback that may be provided by Diodes from time to time. Any customer or user of this document or products described herein will assume all risks and liabilities associated with such use, and will hold Diodes and all companies whose products are represented herein or on Diodes' websites, harmless against all damages and liabilities.
4. Products described herein may be covered by one or more United States, international or foreign patents and pending patent applications. Product names and markings noted herein may also be covered by one or more United States, international or foreign trademarks and trademark applications. Diodes does not convey any license under any of its intellectual property rights or the rights of any third parties (including third parties whose products and services may be described in this document or on Diodes' website) under this document.
5. Diodes' products are provided subject to Diodes' Standard Terms and Conditions of Sale (<https://www.diodes.com/about/company/terms-and-conditions/terms-and-conditions-of-sales/>) or other applicable terms. This document does not alter or expand the applicable warranties provided by Diodes. Diodes does not warrant or accept any liability whatsoever in respect of any products purchased through unauthorized sales channel.
6. Diodes' products and technology may not be used for or incorporated into any products or systems whose manufacture, use or sale is prohibited under any applicable laws and regulations. Should customers or users use Diodes' products in contravention of any applicable laws or regulations, or for any unintended or unauthorized application, customers and users will (a) be solely responsible for any damages, losses or penalties arising in connection therewith or as a result thereof, and (b) indemnify and hold Diodes and its representatives and agents harmless against any and all claims, damages, expenses, and attorney fees arising out of, directly or indirectly, any claim relating to any noncompliance with the applicable laws and regulations, as well as any unintended or unauthorized application.
7. While efforts have been made to ensure the information contained in this document is accurate, complete and current, it may contain technical inaccuracies, omissions and typographical errors. Diodes does not warrant that information contained in this document is error-free and Diodes is under no obligation to update or otherwise correct this information. Notwithstanding the foregoing, Diodes reserves the right to make modifications, enhancements, improvements, corrections or other changes without further notice to this document and any product described herein. This document is written in English but may be translated into multiple languages for reference. Only the English version of this document is the final and determinative format released by Diodes.
8. Any unauthorized copying, modification, distribution, transmission, display or other use of this document (or any portion hereof) is prohibited. Diodes assumes no responsibility for any losses incurred by the customers or users or any third parties arising from any such unauthorized use.
9. This Notice may be periodically updated with the most recent version available at <https://www.diodes.com/about/company/terms-and-conditions/important-notice>

DIODES is a trademark of Diodes Incorporated in the United States and other countries.  
The Diodes logo is a registered trademark of Diodes Incorporated in the United States and other countries.  
© 2022 Diodes Incorporated. All Rights Reserved.

[www.diodes.com](http://www.diodes.com)