General Description

This demonstration board utilizes the AL3069 high-efficiency boost controller with 4-channel current sources for driving WLED backlight. The AL3069 operates over a wide input voltage range from 4.5V to 60V.

The current of 4 channels are simply programmed from 20mA to 400mA with an external resistor. The current matching between each channel is ±0.5% (Typ). Its operating frequency can be adjusted from 0.1MHz to 1MHz, which allows trade-offs between external component size and system efficiency. The AL3069 supports two independent dimming modes: direct PWM dimming and PWM to analog dimming.

The AL3069 features robust protections include cycle by cycle current limit, soft-start, UVLO, programmable OVP, OTP, open/short LED protection, Schottky Diode Short and Open Protection, Inductor Short-Circuit Protection and V_{OUT} Short protection.

Applications

- LCD Monitor
- LCD Display Module
- LCD TV

Key Features

- Input Voltage Range: 4.5V to 60V
- Four High-Precision Current Sources
  - Current Matching ±0.5% (typical)
  - LED String Current up to 250mA per Channel, 400mA Pulse Current
- Low Ripple for Low BOM Cost
- 6KV HBM ESD Class
- High Voltage Pins CS and OVP for Safety Test
- Supports Direct PWM Dimming and PWM to Analog Dimming
- Minimum PWM Dimming Duty Cycle can be 1/5,000 at 100Hz Dimming Frequency
- Built-in Below Comprehensive Protections
  - Overcurrent Protection (OCP)
  - Overvoltage Protection (OVP)
  - Overtemperature Protection (OTP)
  - Undervoltage Lock Out (UVLO)
  - LED Open/Short Protection
  - Schottky Diode/Inductor Short-Circuit Protection
  - V_{OUT} Short/Schottky Diode Open Protection

AL3069EV1 Specifications

Parameter	Value
Input Voltage	10-30VDC
LED Current	120mA * 4Channel
Number of LEDs	13 LEDs in series per channel, 4 channels
XYZ Dimension	96mm x 55 x 15mm

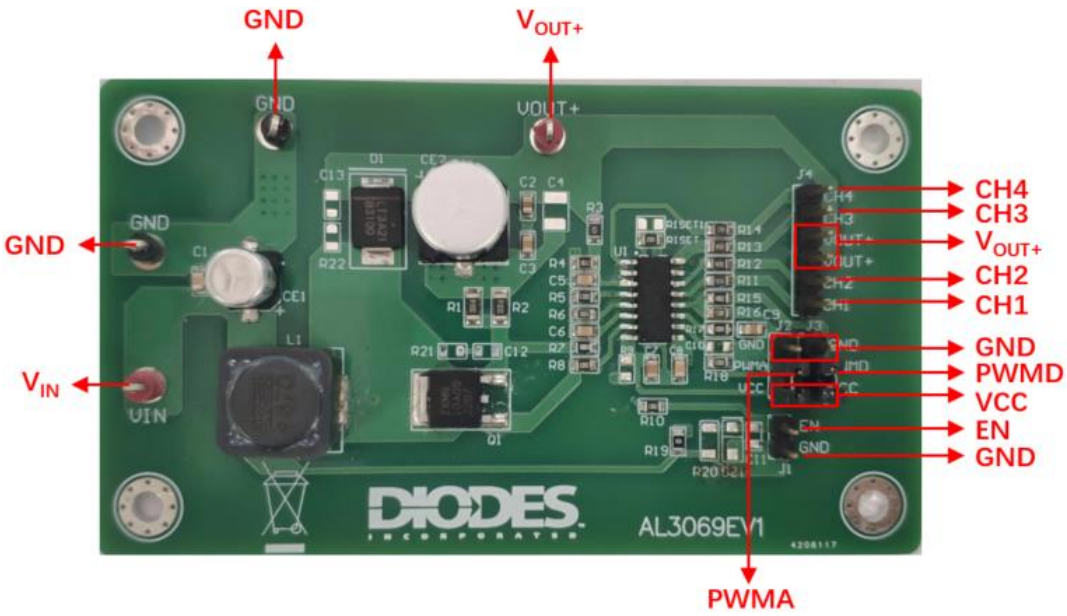


Figure 1: Top View

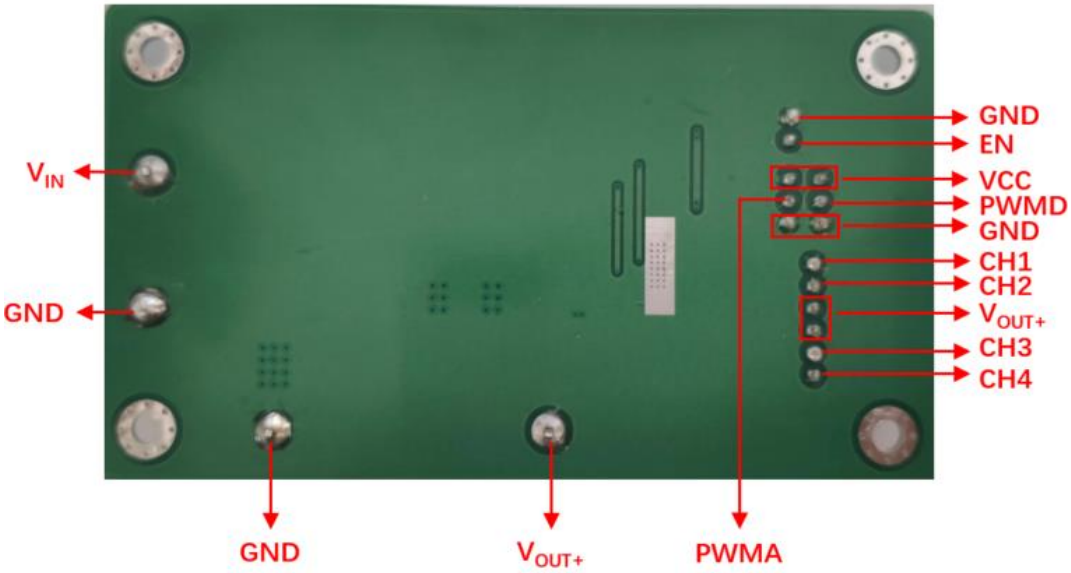


Figure 2: Bottom View

Connection Instructions

Power Supply Input: 20VDC (VIN, GND)
Enable Signal Input: 3.3VDC or 5VDC (EN, GND)
PWMD Signal Input: (PWMD, GND)
PWMA Signal Input: (PWMA, GND)
LED Outputs: LED+ (Vout+), LED- (CH1~CH4)

Evaluation Board Schematic

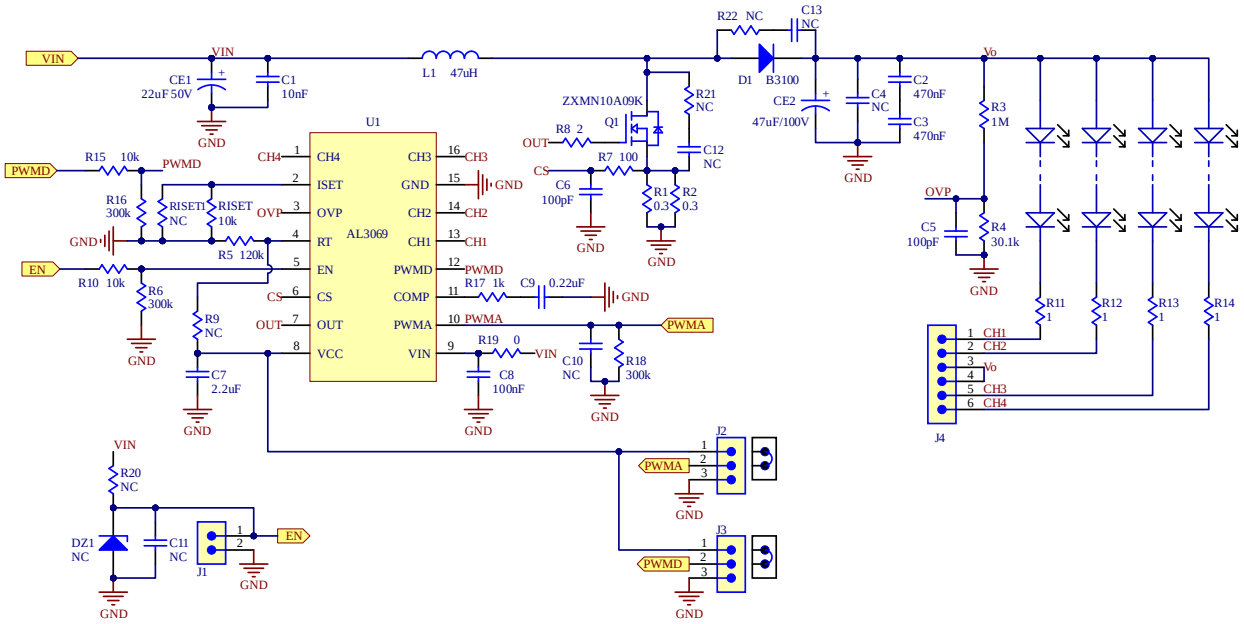


Figure 3: Evaluation Board Schematic

Evaluation Board Layout

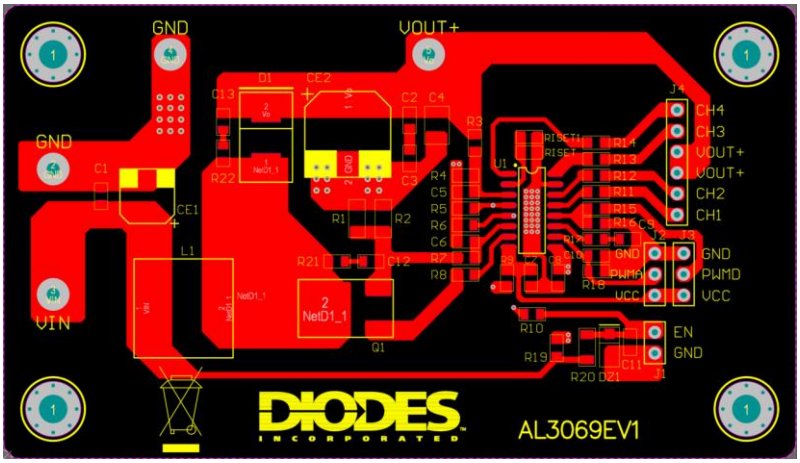


Figure 4: PCB Board Layout Top View

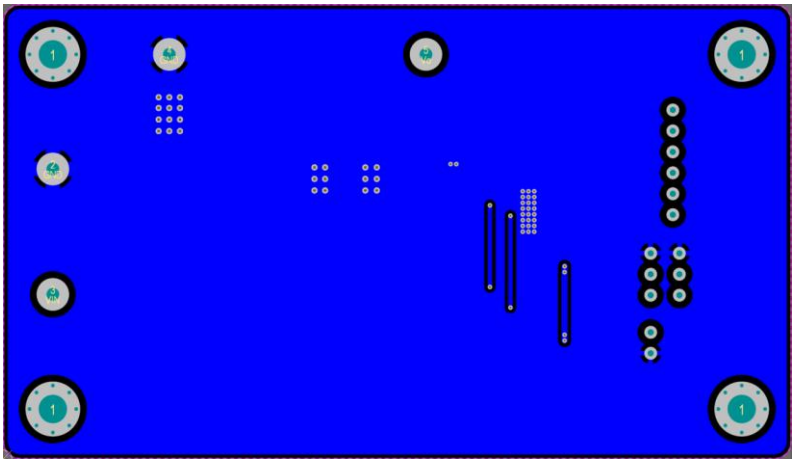


Figure 5: PCB Board Layout Bottom View

Quick Start Guide

1. By default, the evaluation board is preset at 120mA LED Current per channel by R_{ISET}.
2. Connect the anode wire of external LED string to Vout+ pin.
3. Connect the cathode wire of external LED string to CH1~CH4 pins.
4. Power Supply: Apply 20VDC to Vin & GND pin to supply AL3069
5. Enable the IC: Apply 3.3VDC or 5VDC to EN & GND pin to enable the circuit.
6. Follow the above steps, LED string should light up in non-dimming mode.
7. If you want to enter dimming mode, follow the steps below:
   1) Direct PWM dimming:
      a. Remove the Jumper on J3 (PWMD-VCC)
      b. Connect PWMA pin to VCC pin by the Jumper on J2 (preset on the board)
      c. Apply a synchronal PWM signal (Vpp=5V) to J3 PWMD pin to dim the LEDs.
   2) PWM to Analog dimming:
      a. Remove the Jumper on J2 (PWMA-VCC)
      b. Connect PWMD pin to VCC pin by the Jumper on J3 (preset on the board)
      c. Apply a synchronal PWM signal (Vpp=5V) to J2 PWMA pin to dim the LEDs.

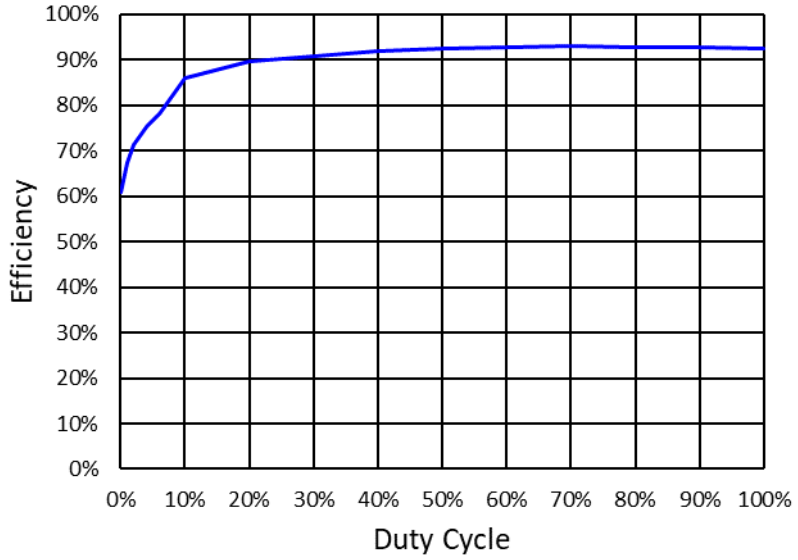
Bill of Material

#	Name	Description	Package	Quantity
1	U1	AL3069, Boost controller with 4-channel current source, Diodes Incorporated (Diodes)	SO-16	1
2	L1	744770147 WE-PD, 47uH/3A, 12*12*8mm	SMD	1
3	Q1	N-MOS, ZXMN10A09K, 100V/7.7A, Diodes	TO-252 (DPAK)	1
4	D1	Schottky Rectifier, B3100, 100V/3A, Diodes	SMC	1
5	R1,R2	1206, 0.3Ω, 1%, 1/3W	1206	2
6	R3	0805, 1MΩ, 1%	0805	1
7	R4	0805, 30kΩ , 1%	0805	1
8	R5	0805, 120kΩ, 1%	0805	1
9	R6,R16,R18	0805, 300kΩ, 5%	0805	3
10	R7	0805, 100Ω, 1%	0805	1
11	R8	0805, 2Ω, 1%	0805	1
12	R10,R15, RISET	0805, 10kΩ, 1%	0805	3
13	R11,R12, R13,R14	0805, 1Ω, 1%	0805	4
14	R17	0805, 1kΩ, 1%	0805	1
15	R19	0805, 0Ω, 1%	0805	1
16	CE1	SMD, Φ6.3*8mm, 22uF, 50V, 105℃	Φ6.3	1
17	CE2	SMD, Φ10*10.5mm, 47uF, 100V, 105℃	Φ10	1
18	C1	0805, X7R, 10nF, 50V	0805	1
19	C2,C3	0805, X7R, 470nF, 50V	0805	2
20	C5,C6	0805, NP0, 100pF, 50V	0805	2
21	C7	0805, X7R, 2.2uF, 16V	0805	1
22	C8	0805, X7R, 100nF, 50V	0805	1
23	C9	0805, X7R, 220nF, 16V	0805	1

System Performance

Test condition: V_{IN}= 20V, V_{EN}=3.3V, V_O=40V (13LEDs/CH), I_{CHX}=120mA

Efficiency:



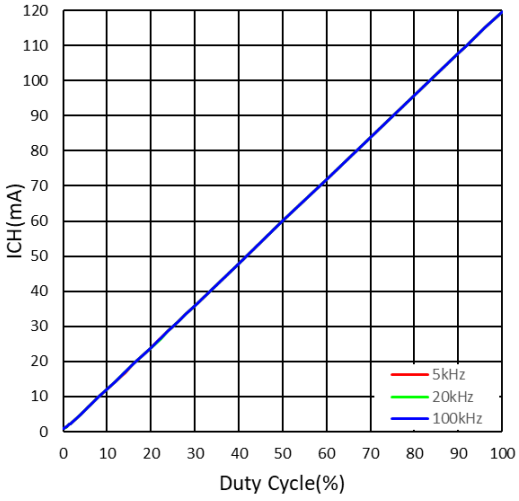
PWM to Analog Dimming @f_{PWM}=20 kHz

Efficiency vs. Duty Cycle

Dimming Curve:

Direct PWM Dimming

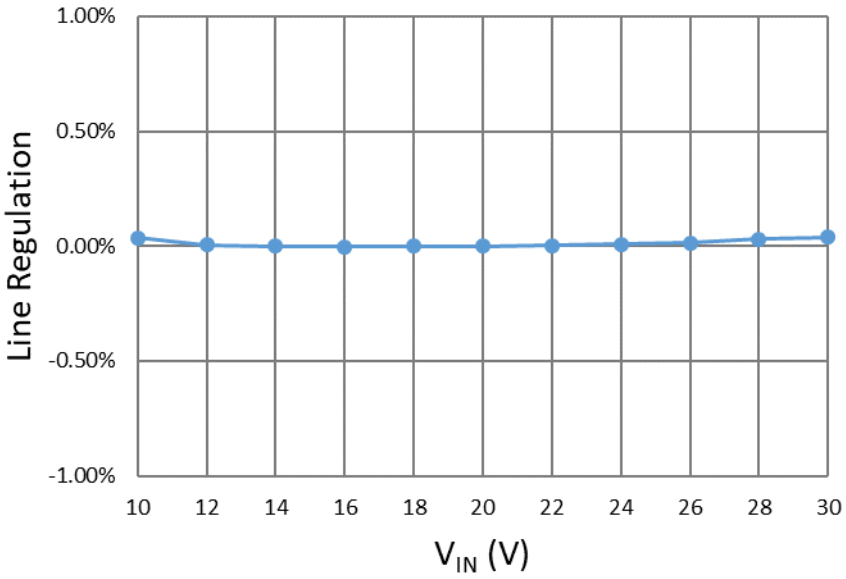
Channel Current vs. Duty Cycle



PWM to Analog Dimming

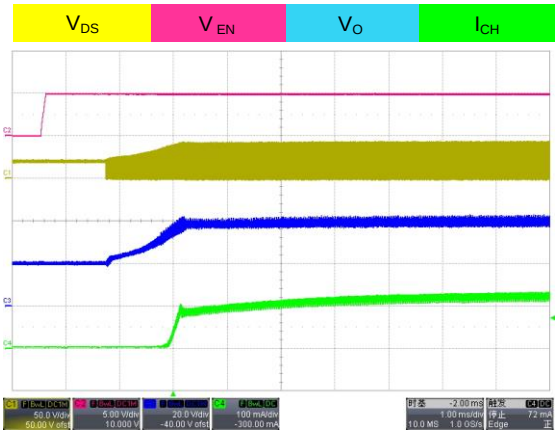
Channel Current vs. Duty Cycle

Line Regulation



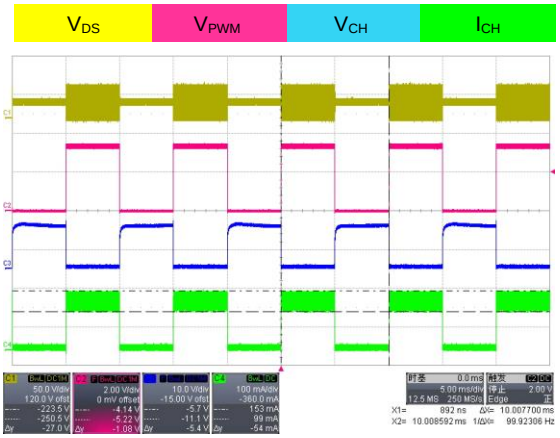
Functional Waveforms

Test condition: V_{IN}= 20V, V_O=40V (13LEDs/CH)



System Startup (100% Duty)

Steady State (100% Duty)



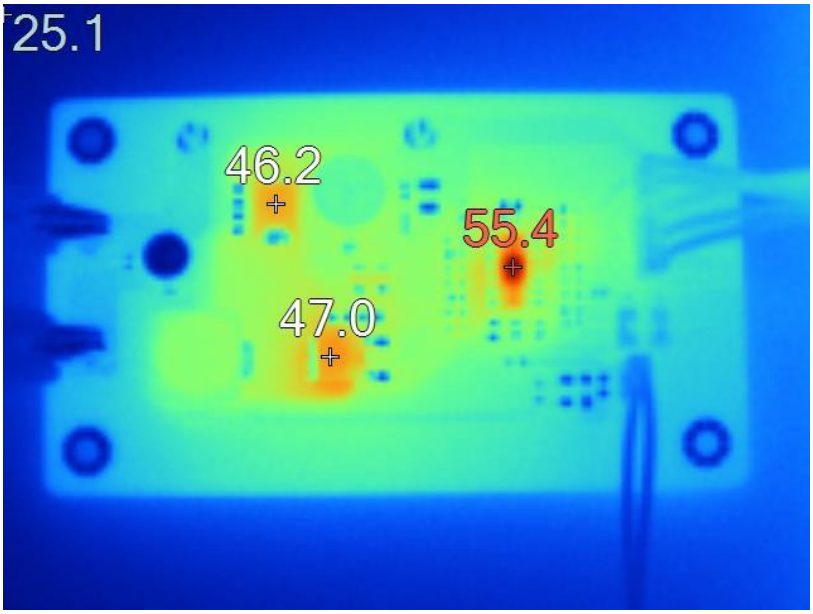
Direct PWM Dimming (f_{PWMD}=100Hz, 50% Duty)

PWM to Analog Dimming (f_{PWMA}=10 kHz, 50% Duty)

Thermal Test

Test condition: V_{IN}= 20V, V_{EN}=3.3V, V_{PWMA}= V_{PWMD} =5V, V_O=40V (13LEDs/CH), I_{CHX}=120mA, Ta=25℃

Vin(V)	I_{in}(A)	Vout(V)	Iout(A)	Efficiency (%)	Power Mos Temp (℃)	Diode Temp (℃)	IC Temp (℃)
20	0.944	38.12	0.471	95.1	47	46.2	55.4



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

www.diodes.com