

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 $\pm 0.5\%$ (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 $\pm 0.5\%$ (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

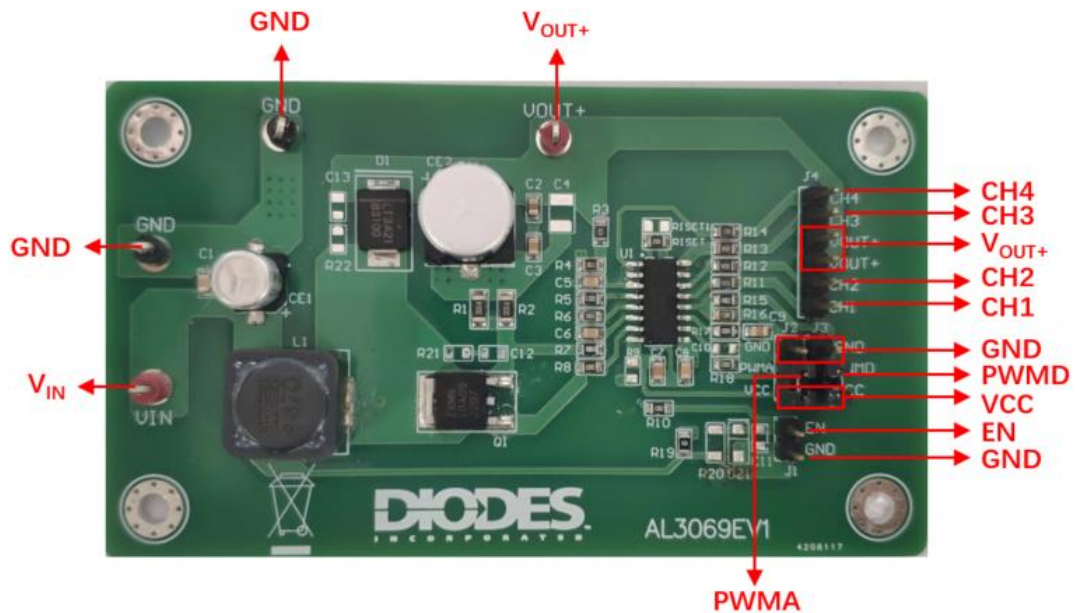


Figure 1: Top View

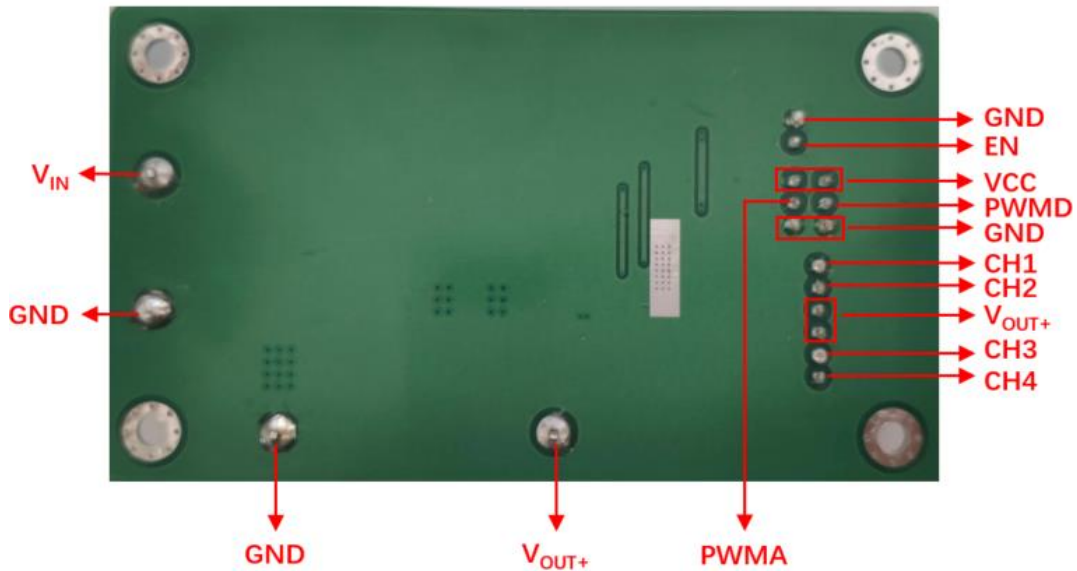


Figure 2: Bottom View

Connection Instructions

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

Evaluation Board Schematic

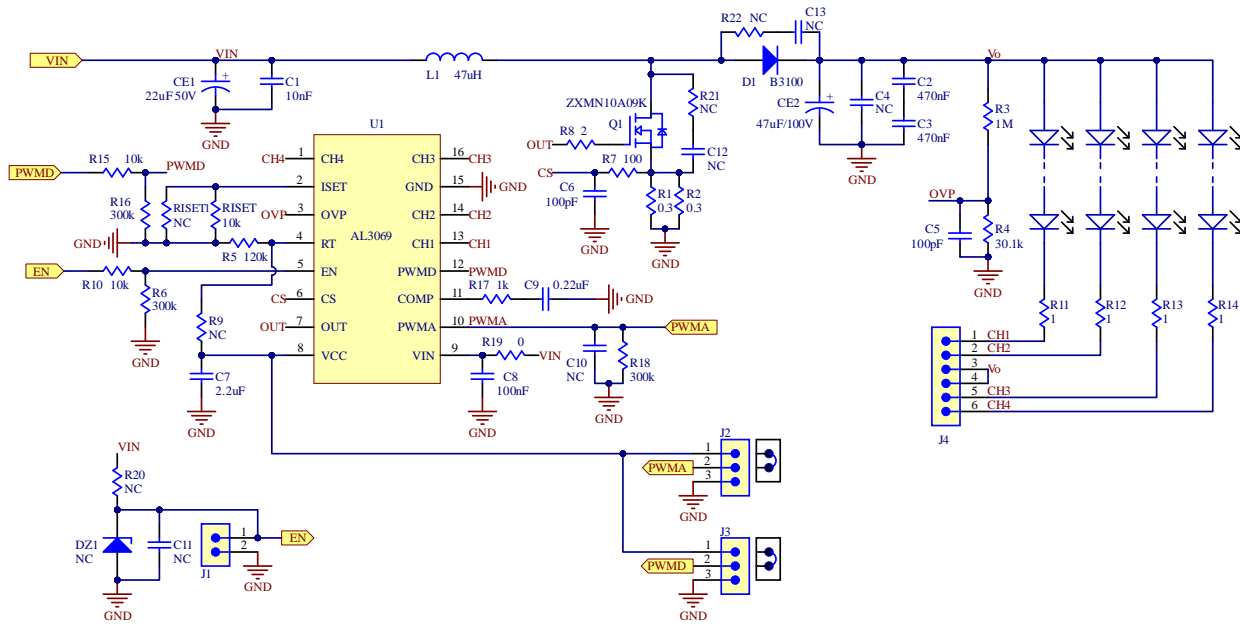


Figure 3: Evaluation Board Schematic

Evaluation Board Layout

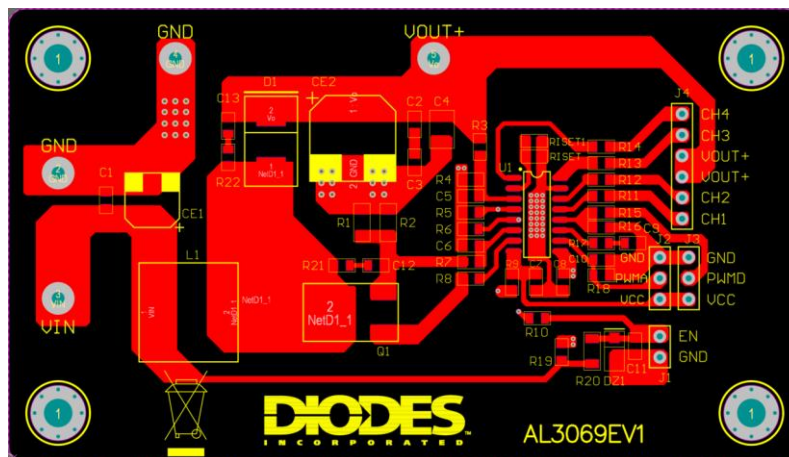


Figure 4: PCB Board Layout Top View

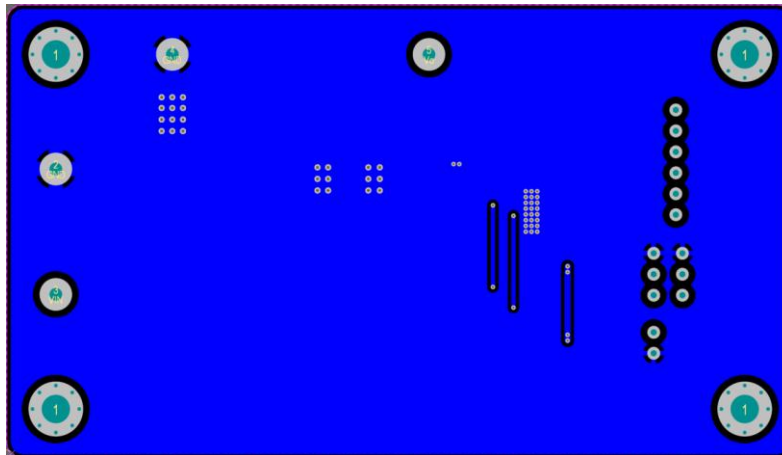


Figure 5: PCB Board Layout Bottom View

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 ($V_{pp}=5V$) 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 ($V_{pp}=5V$) to J2 PWMA pin to dim the LEDs.

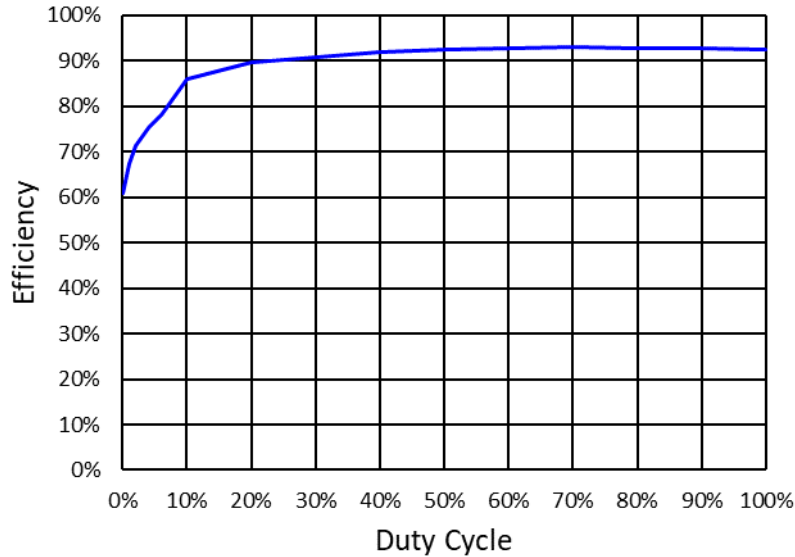
Bill of Material

#	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, R1SET	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°C	Φ6.3	1
17	CE2	SMD, Φ10*10.5mm, 47uF, 100V, 105°C	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

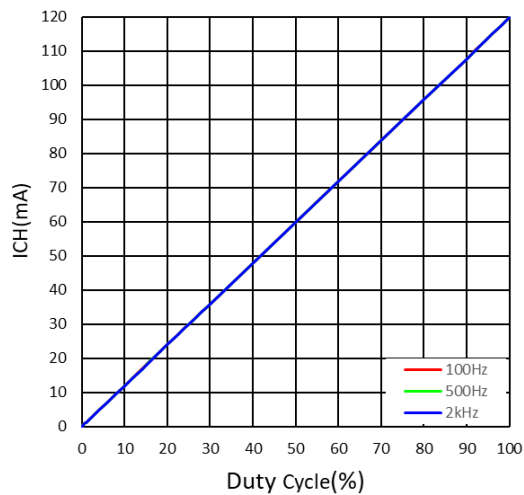
Test condition: $V_{IN}=20V$, $V_{EN}=3.3V$, $V_O=40V$ (13LEDs/CH), $I_{CHX}=120mA$

Efficiency:

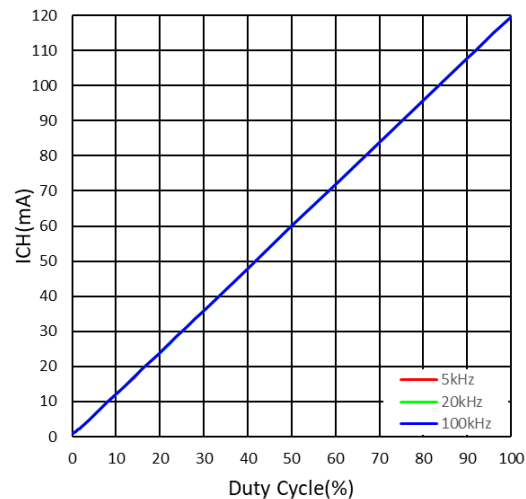


PWM to Analog Dimming @ $f_{PWA}=20\text{ kHz}$
Efficiency vs. Duty Cycle

Dimming Curve:

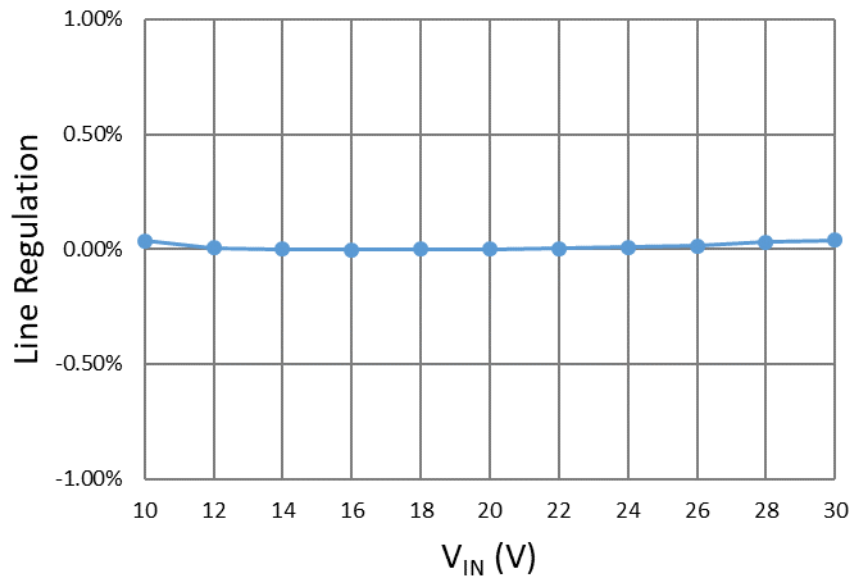


Direct PWM Dimming
Channel Current vs. Duty Cycle



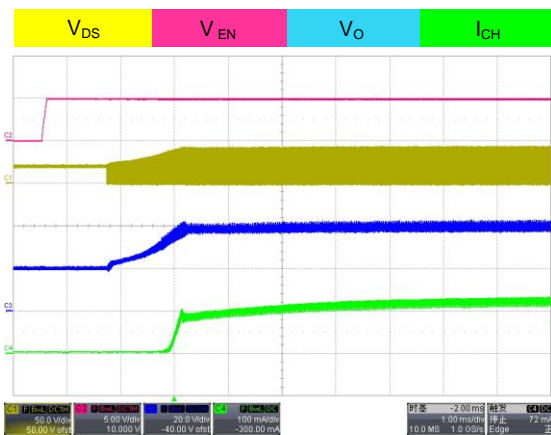
PWM to Analog Dimming
Channel Current vs. Duty Cycle

Line Regulation

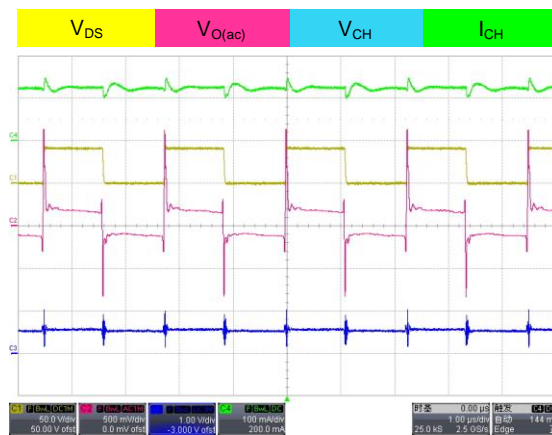


Functional Waveforms

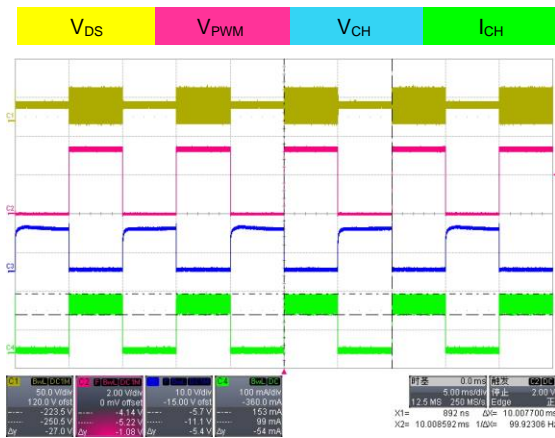
Test condition: $V_{IN}=20V$, $V_O=40V$ (13LEDs/CH)



System Startup (100% Duty)



Steady State (100% Duty)



Direct PWM Dimming ($f_{PWM} = 100\text{Hz}$, 50% Duty)

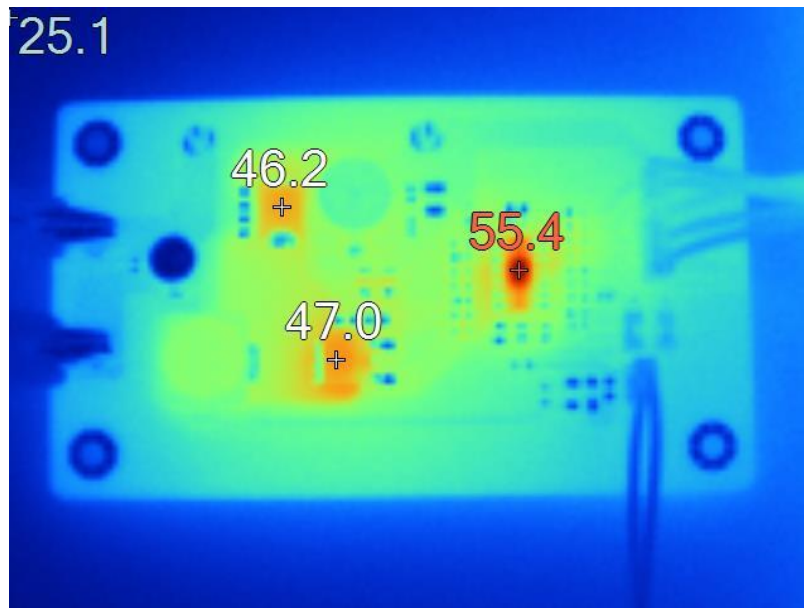


PWM to Analog Dimming ($f_{PWA} = 10\text{kHz}$, 50% Duty)

Thermal Test

Test condition: $V_{IN} = 20\text{V}$, $V_{EN} = 3.3\text{V}$, $V_{PWA} = V_{PMD} = 5\text{V}$, $V_O = 40\text{V}$ (13LEDs/CH), $I_{CH} = 120\text{mA}$, $T_a = 25^\circ\text{C}$

Vin(V)	Iin(A)	Vout(V)	Iout(A)	Efficiency (%)	Power Mos Temp (°C)	Diode Temp (°C)	IC Temp (°C)
20	0.944	38.12	0.471	95.1	47	46.2	55.4



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