



EVQ3359A-LE-00A

1/2/3/4-Channel, Max 150mA/Channel,
Boost WLED Driver with High Dimming Ratio
Evaluation Board, AEC-Q100 Qualified

DESCRIPTION

The EVQ3359A-LE-00A is an evaluation board designed to demonstrate the capabilities of the MPQ3359A and MP3359A, which are four-channel, step-up converters that drive white LED (WLED) arrays as backlighting for small or mid-sized LCD panels. MPQ3359A will be used throughout this datasheet to refer to both unless otherwise specified.

Peak current control is used as the pulse-width modulation (PWM) control architecture for regulating the boost converter. Four channel current sources are applied to the LED cathode to adjust LED brightness. This regulates the current in each LED string to the value set by an external current-setting resistor, with a 2.5% current regulation accuracy between strings.

The MPQ3359A's low on-resistance ($R_{DS(ON)}$) MOSFET and headroom voltage improves efficiency. The switching frequency (f_{SW}) is configurable via a resistor or an external clock.

The MPQ3359A provides analog and PWM dimming via the EN/ADIM and PDIM pins, respectively. The device also has a fixed delay time between LED current (I_{LED}) channels to eliminate noise during PWM dimming.

Protection features include input over-current protection (OCP), inductor current OCP, over-voltage protection (OVP), over-temperature protection (OTP), LED string short protection, LED string open protection, output voltage (V_{OUT}) short-to-GND protection, and LEDx pin short-to-GND protection.

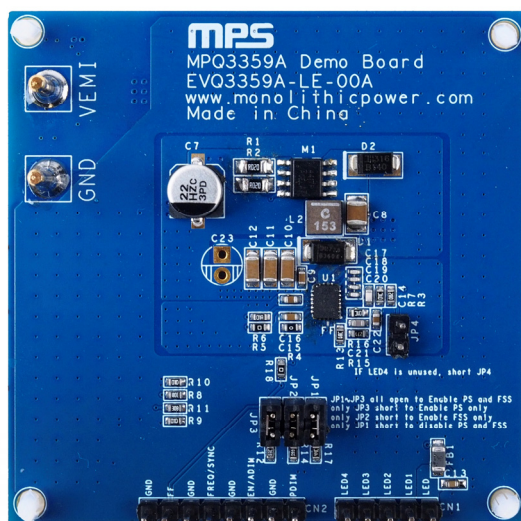
The EVQ3359A-LE-00A is a fully assembled evaluation board. The MP3359A and MPQ3359A are available in a QFN-20 (3mmx4mm) package, and the MPQ3359A is AEC-Q100 Grade 1 qualified.

PERFORMANCE SUMMARY

Specifications are at $T_A = 25^\circ\text{C}$, unless otherwise noted.

Parameters	Conditions	Value
Input voltage (V_{IN})		12V typical
LED strings	The over-voltage protection (OVP) threshold is 40.2V, so it is recommended for the output voltage (V_{OUT}) to be below 36V	4 strings, 12 strings
LED current (I_{LED})	$R_{ISET} = 10\text{k}\Omega$	120mA/string

EVQ3359A-LE-00A EVALUATION BOARD



LxWxH (6.35cmx6.35cmx2cm)

Board Number	MPS IC Number
EVQ3359A-LE-00A	MPQ3359AGLE-AEC1 or MP3359AGLE

Note:

- 1) The default IC on the EVB is the MPQ3359AGLE-AEC1. If the MP3359AGLE is required, contact an MPS FAE to request this version.

QUICK START GUIDE

1. Connect the LED load terminals (4 strings) to:
 - a. Positive (+): LED
 - b. Negative (-): LED1, LED2, LED3, and LED4 (if LED4 is unused, just short JUMP JP4)
2. Connect the DC power supply (typically 12V) terminals to:
 - a. Positive (+): VEMI
 - b. Negative (-): GND
3. For pulse-width modulation (PWM) dimming, pull the EN/ADIM pin high to turn the MPQ3359A on, then apply a PWM signal with a minimum voltage below 0.5V and a maximum voltage above 1.4V via the PDIM pin. It is recommended for the PWM signal frequency to be between 100Hz and 30kHz.
4. For analog dimming, pull the PDIM pin high and apply a PWM signal with a minimum voltage below 0.5V and a maximum voltage above 1.4V via the EN/ADIM pin. It is recommended for the PWM signal frequency to be above 5kHz.

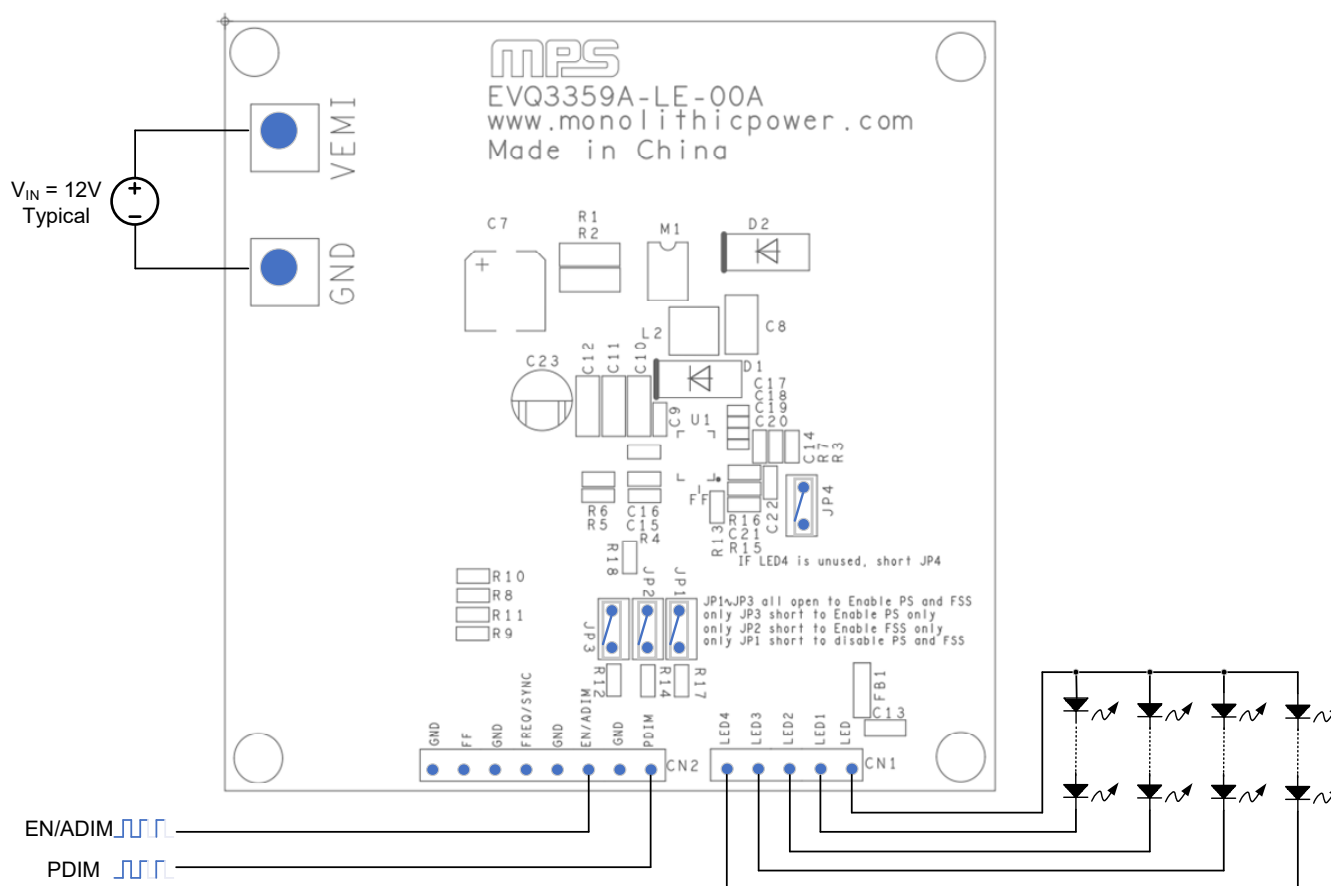


Figure 1: Measurement Equipment Set-Up

EVALUATION BOARD SCHEMATIC

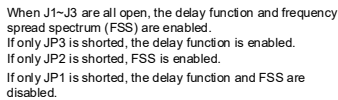


Figure 2: Evaluation Board Schematic

EVQ3359A-LE-00A BILL OF MATERIALS

Qty	Ref	Value	Description	Package	Manufacturer	Manufacturer PN
4	C1, C2, C3, C4	22nF	Ceramic capacitor, 50V, X7R	0603	Wurth	885012206091
2	C5, C6	4.7µF	Ceramic capacitor, 50V, X7S	0805	Murata	GRM21BC71H475KE11L
1	C7	22µF	Electrolytic capacitor, 50V	SMD	Panasonic	EEH2C1H220P
1	C8	4.7µF	Ceramic capacitor, 50V, X7R	1210	Murata	GRM32ER71H475KA88L
2	C9, C15	100nF	Ceramic capacitor, 50V, X7R	0603	Murata	GCM188R71H104KA57D
3	C10, C11, C12	4.7µF	Ceramic capacitor, 50V, X7S	1206	Murata	GCM31CC71H475KA03L
1	C13	10nF	Ceramic capacitor, 50V, X7R	0805	TDK	C2012X7R1H103K
1	C14	100pF	Ceramic capacitor, 50V, C0G	0603	Murata	GRM1885C1H101JA01D
2	C16, C22	470nF	Ceramic capacitor, 16V, X7R	0603	Murata	GRM188R71C474KA88D
4	C17, C18, C19, C20	220pF	Ceramic capacitor, 50V, X7R	0402	Murata	GRM155R71H221KA01D
1	C21	1nF	Ceramic capacitor, 50V, C0G	0603	Murata	GRM1885C1H102JA01D
1	C23	NC				
1	D1	60V	Schottky diode, 2A	SMA	Diodes, Inc.	B260A-13-F
1	D2	40V	Schottky diode, 1A	SMA	Fairchild	B140T
1	FB1	6A	Magnetic bead	1206	Murata	BLM31PG330SN1L
1	L1	4.7µH	Inductor, 44.1mΩ, 5.1A	SMD	Coilcraft	XEL4030-472MEB
1	L2	15µH	Inductor, 120mΩ, 2.8A	SMD	Coilcraft	XAL4040-153MEB
1	M1	-60V	P-channel MOSFET, 23mΩ, 9.3A	SO-8	Analog Power	AM4417P-T1-PF
2	R1, R2	20mΩ	Film resistor, 1%	1206	Yageo	RL1206FR-070R02L
1	R3	191kΩ	Film resistor, 1%	0603	Yageo	RC0603FR-07191KL
3	R4, R5, R18	0Ω	Film resistor, 1%	0603	Yageo	RC0603FR-070RL
1	R6	100Ω	Film resistor, 1%	0603	Yageo	RC0603FR-07100RL
2	R7, R16	10kΩ	Film resistor, 1%	0603	Yageo	RC0603FR-0710KL
2	R8, R11	2kΩ	Film resistor, 1%	0603	Yageo	RC0603FR-072KL
2	R9, R10	100kΩ	Film resistor, 1%	0603	Yageo	RC0603FR-07100KL
1	R12	71.5kΩ	Film resistor, 1%	0603	Yageo	RC0603FR-0771K5L
1	R13	49.9kΩ	Film resistor, 1%	0603	Yageo	RC0603FR-0749K9L
1	R14	47.5kΩ	Film resistor, 1%	0603	Yageo	RC0603FR-0747K5L
1	R15	270Ω	Film resistor, 1%	0603	Yageo	RC0603FR-07270RL
1	R17	28kΩ	Film resistor, 1%	0603	Yageo	RC0603FR-0728KL

**EVQ3359A-LE-00A BILL OF MATERIALS (continued)**

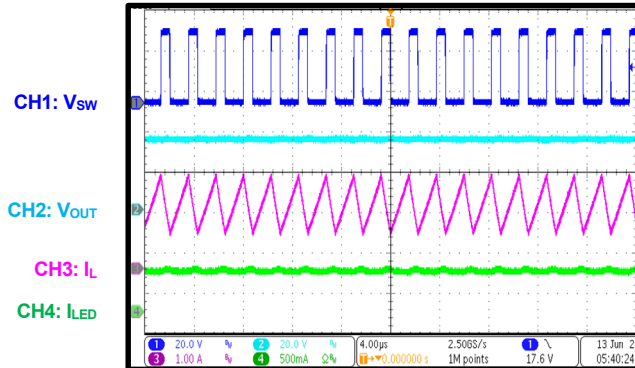
Qty	Ref	Value	Description	Package	Manufacturer	Manufacturer PN
6	CN1, CN2, J1, J2, J3, J4	2.54mm	Connector header, 180°	DIP	Any	
2	VEM11, GND1	2mm	Golden pin	DIP	Any	
1	U1	MPQ3359A or MP3359A	4-channel, step-up boost WLED converter, AEC-Q100 available	QFN-20 (3mmx 4mm)	MPS	MPQ3359AGLE-AEC1 or MP3359AGLE

EVB TEST RESULTS

Performance waveforms are tested on the evaluation board. $V_{IN} = 12V$, 4 strings, 12 LEDs in series, 120mA/string, $L = 15\mu H$, $f_{SW} = 440kHz$, $T_A = 25^\circ C$, unless otherwise noted.

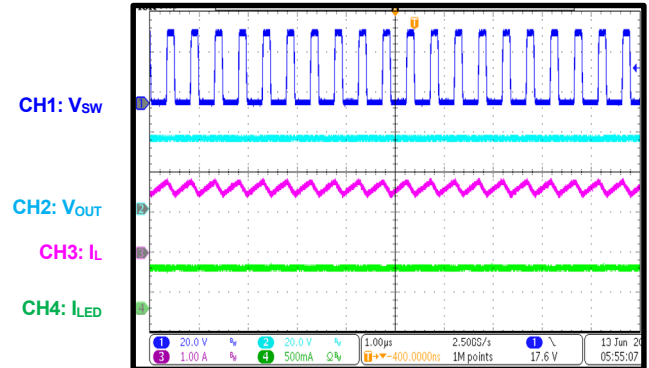
Steady State

$f_{SW} = 440kHz$

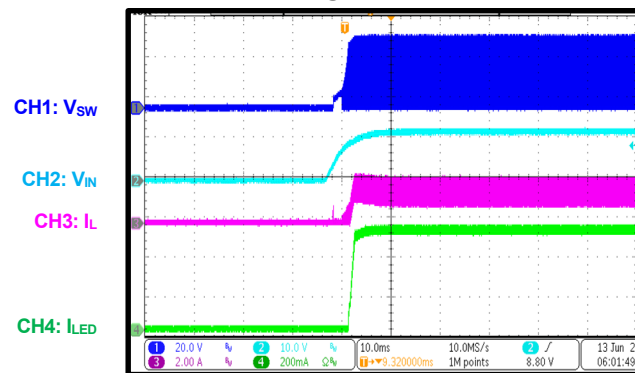


Steady State

$f_{SW} = 2.2MHz$

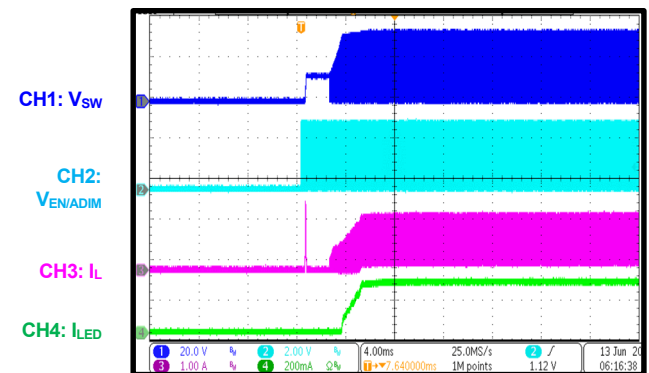


Start-Up through VIN



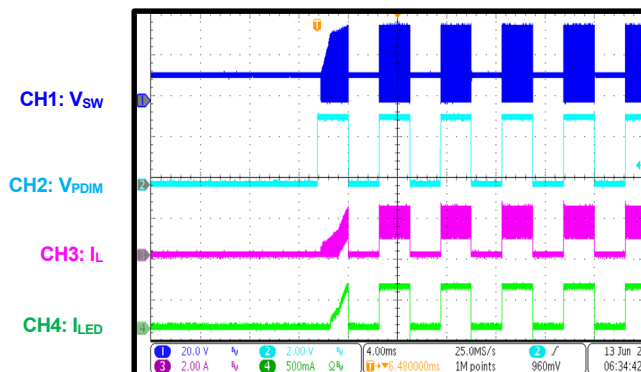
Start-Up through EN/ADIM

$f_{EN/ADIM} = 10kHz$, $D_{EN/ADIM} = 50\%$



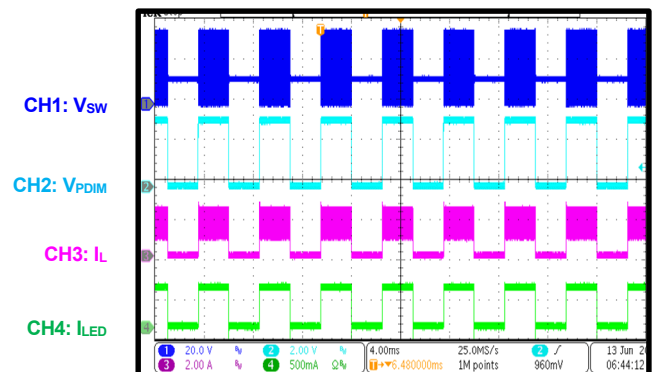
Start-Up through PDIM

$f_{PDIM} = 200Hz$, $D_{PDIM} = 50\%$



PWM Dimming

$f_{PDIM} = 200Hz$, $D_{PDIM} = 50\%$

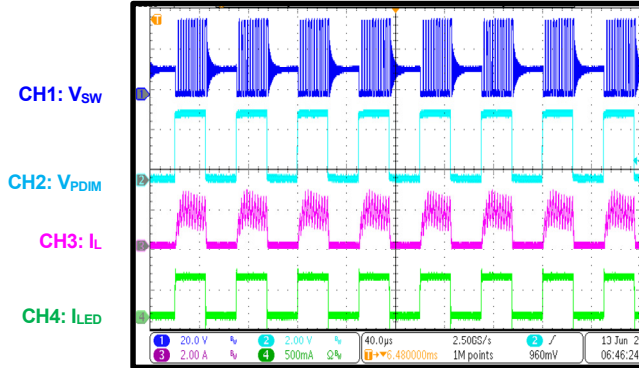


EVB TEST RESULTS *(continued)*

Performance waveforms are tested on the evaluation board. $V_{IN} = 12V$, 4 strings, 12 LEDs in series, 120mA/string, $L = 15\mu H$, $f_{SW} = 440kHz$, $T_A = 25^\circ C$, unless otherwise noted.

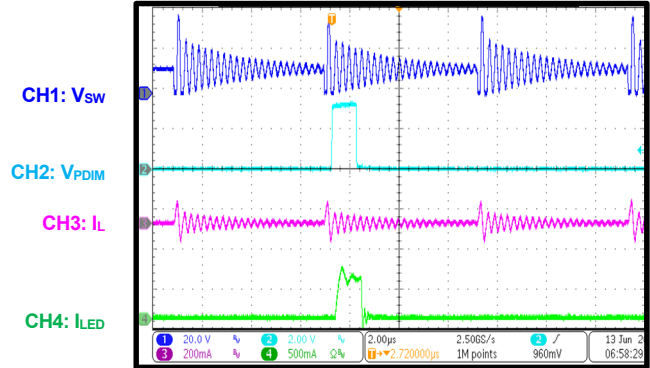
PWM Dimming

$f_{PDIM} = 20kHz$, $D_{PDIM} = 50\%$



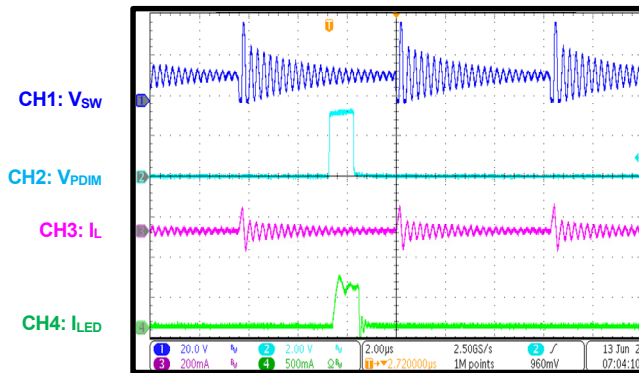
PWM Dimming

$f_{PDIM} = 200Hz$, $D_{PDIM} = 0.02\%$



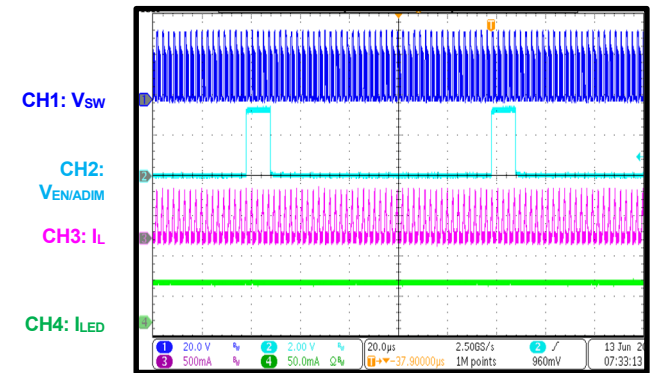
PWM Dimming

$f_{PDIM} = 100Hz$, $D_{PDIM} = 0.01\%$



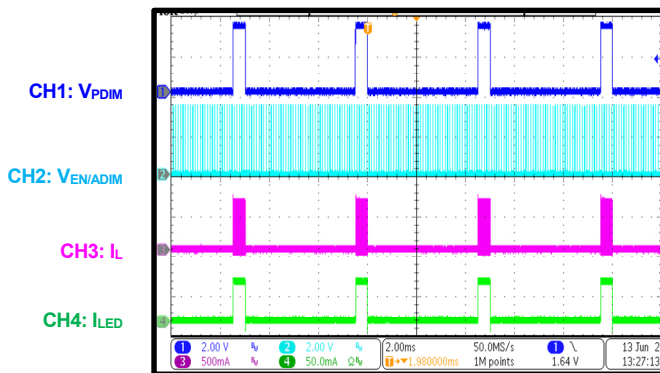
Analog Dimming

$f_{EN/ADIM} = 10kHz$, $D_{EN/ADIM} = 10\%$



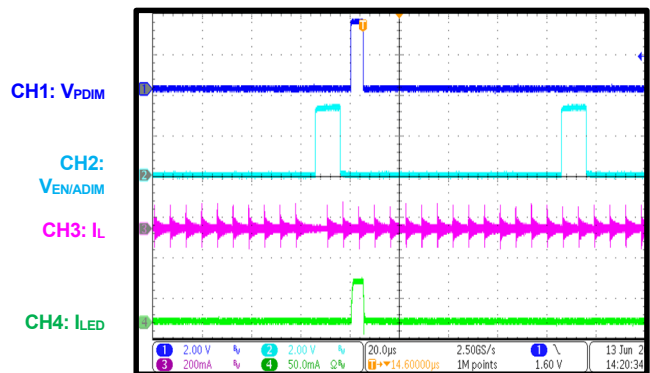
PWM Dimming and Analog Dimming

$f_{PDIM} = 200Hz$, $D_{PDIM} = 10\%$, $f_{EN/ADIM} = 10kHz$, $D_{EN/ADIM} = 10\%$



PWM Dimming and Analog Dimming

$f_{PDIM} = 200Hz$, $D_{PDIM} = 0.1\%$, $f_{EN/ADIM} = 10kHz$, $D_{EN/ADIM} = 10\%$

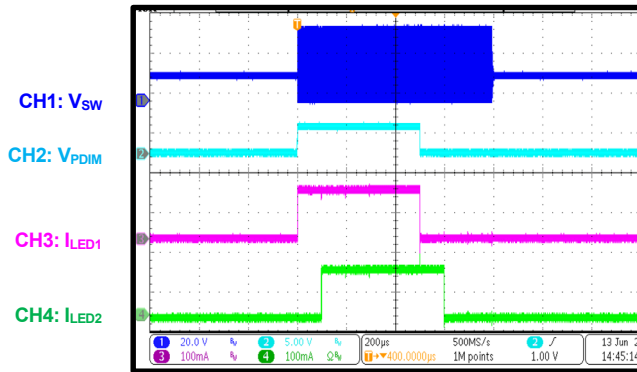


EVB TEST RESULTS *(continued)*

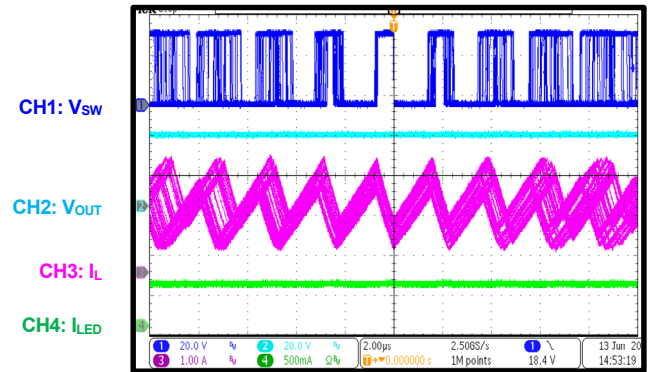
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PWM Dimming with 100 μs Delay Function

$f_{PDIM} = 200Hz$, $D_{PDIM} = 10\%$

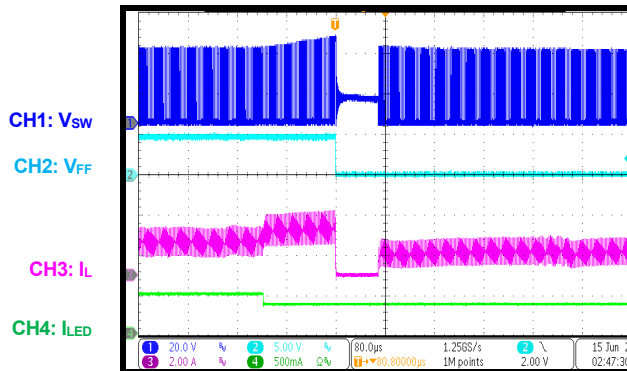


Frequency Spread Spectrum



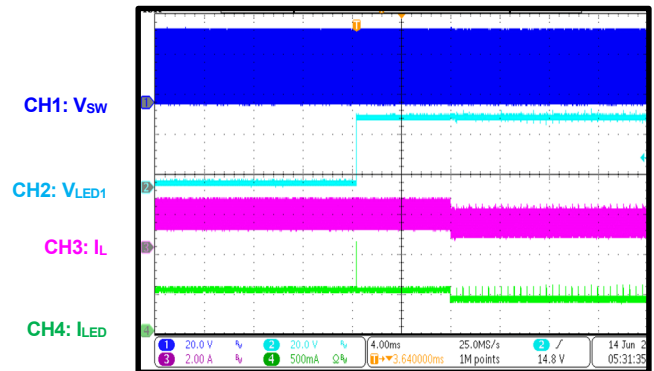
LED Open Protection

Open LED1 during normal operation



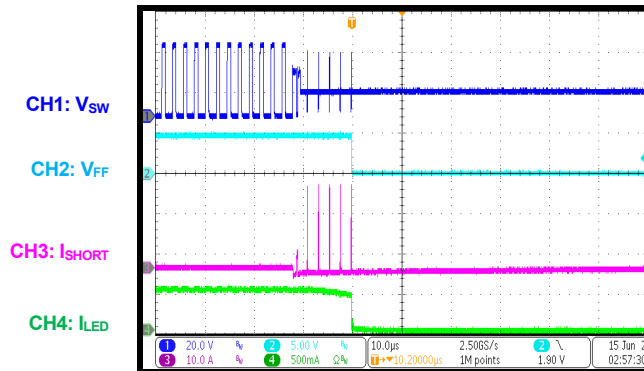
LED Short Protection

Short LED1 during normal operation



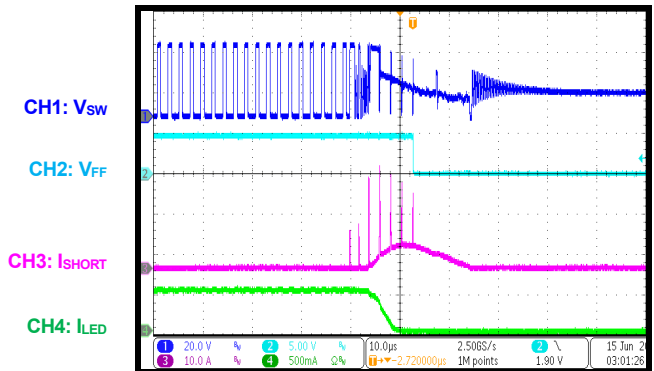
Short Inductor Protection

Short inductor during normal operation



Short Diode Protection

Short diode during normal operation

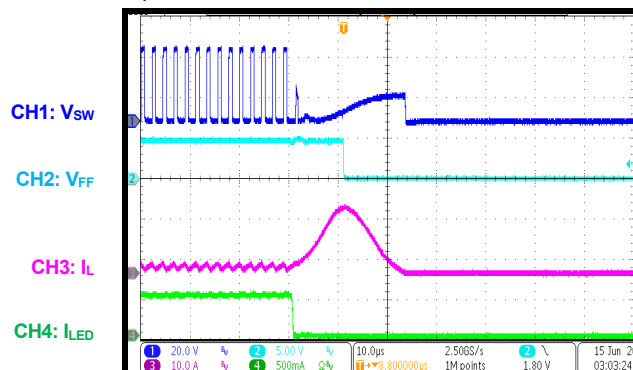


EVB TEST RESULTS *(continued)*

Performance waveforms are tested on the evaluation board. $V_{IN} = 12V$, 4 strings, 12 LEDs in series, 120mA/string, $L = 15\mu H$, $f_{SW} = 440kHz$, $T_A = 25^\circ C$, unless otherwise noted.

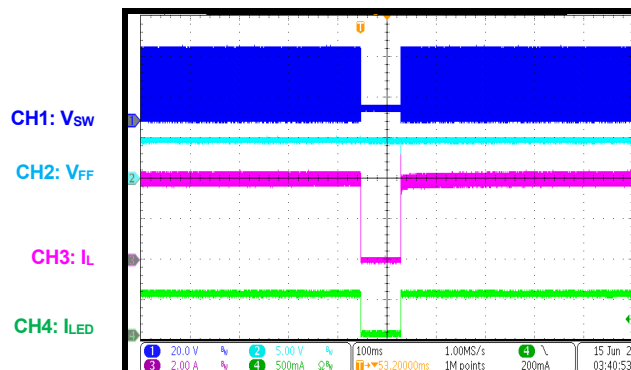
V_{OUT} Short-to-GND Protection

Input OCP threshold = 10A



Over-Temperature Protection

$V_{IN} = 6V$



PCB LAYOUT

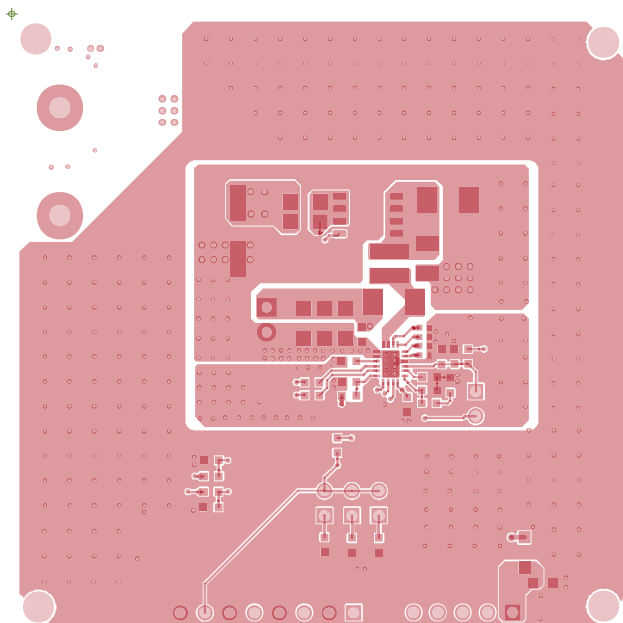


Figure 3: Top Layer

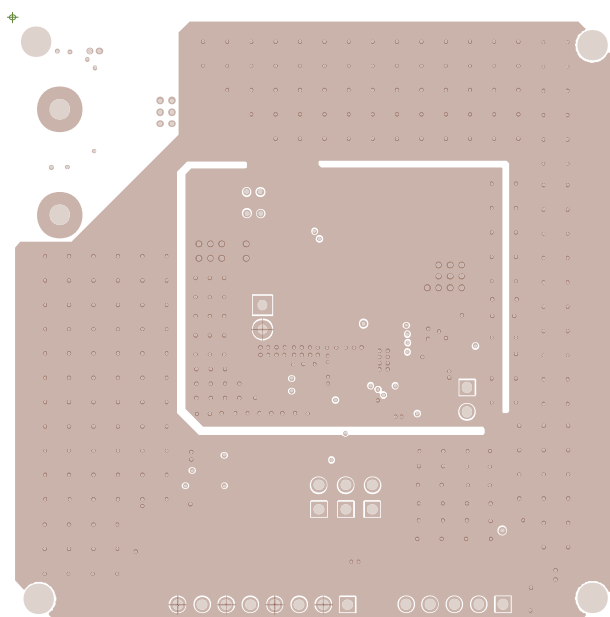


Figure 4: Mid-Layer 1

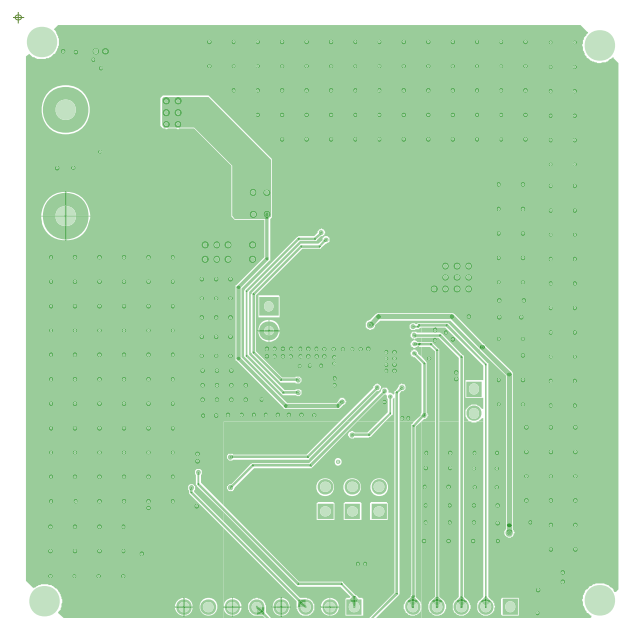


Figure 5: Mid-Layer 2

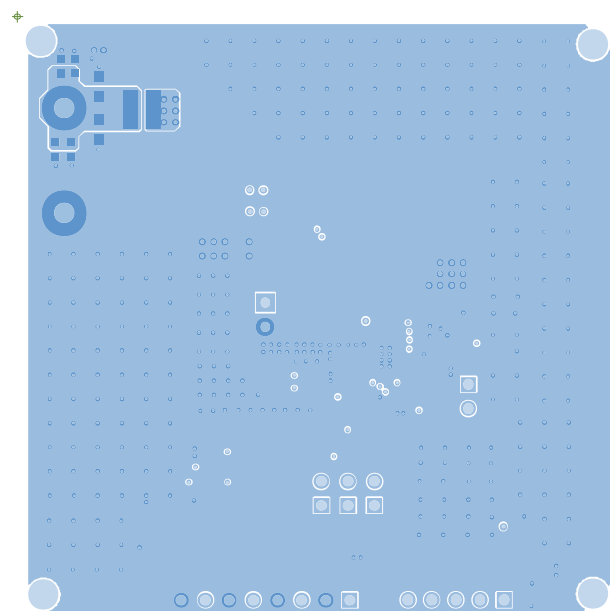


Figure 6: Bottom Layer

REVISION HISTORY

Revision #	Revision Date	Description	Pages Updated
1.0	11/14/2024	Initial Release	-

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