



EVQ7200-L-00A

42V, 3A Synchronous, Buck Mode LED Driver Evaluation Board

DESCRIPTION

The EVQ7200-L-00A is an evaluation board for the MPQ7200-AEC1, a high-frequency, constant-current LED driver with integrated power MOSFETs. It offers a compact solution to achieve 3A of continuous output current, with excellent load and line regulation over a wide input supply range.

Constant frequency hysteretic control mode provides fast transient response without loop compensation. In buck mode, the MPQ7200-AEC1's switching frequency (up to 2.3MHz) reduces ripple current and electromagnetic interference (EMI).

The MPQ7200-AEC1 is available in a QFN-19 (3mmx4mm) wettable flank package and is AEC-Q100 Grade 1 qualified.

The EVQ7200-L-00A is a fully assembled and tested buck mode LED driver evaluation board. It generates an LED current up to 3A from a 6V to 42V input range.

ELECTRICAL SPECIFICATIONS

Parameter	Symbol	Value	Units
Input voltage	V_{EMI}	6 to 42	V
Output current	I_{OUT}	3	A

FEATURES

- Wide 6V to 42V Operating Input Range
- Configurable 3A Maximum Continuous Output Current in Buck Mode
- 44mΩ/40mΩ Internal Power MOSFETs
- Default 2.3MHz Switching Frequency for Buck Mode with Spread Spectrum
- 100Hz to 2kHz Dimming Frequency for Pulse-Width Modulation (PWM) Dimming
- 500Hz Internal 2-Step Dimming with Programmable Duty Cycle
- Fault Indication for LED Short, LED Open, Output Over-Voltage, and Thermal Shutdown
- Over-Current Protection (OCP) with Latch-Off
- Programmable Thermal Derating via Negative Temperature Coefficient (NTC) Remote Temperature Sensing
- EMI Reduction Technique
- Available in a QFN-19 (3mmx4mm) Wettable Flank Package
- Available in AEC-Q100 Grade 1

APPLICATIONS

- Automotive LED Lighting

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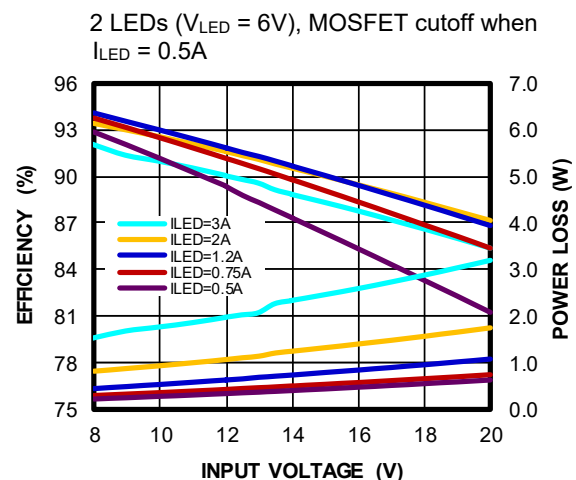
EVQ7200-L-00A EVALUATION BOARD



LxWxH (9cmx9cmx1.3cm)

Board Number	MPS IC Number
EVQ7200-L-00A	MPQ7200GLE-AEC1

Efficiency vs input voltage



QUICK START GUIDE

1. Preset the power supply between 6V and 42V, then turn off the power supply.
2. If longer cables (>0.5m total) are being used between the source and the evaluation board, install a damping capacitor at the input terminals. This is critical when V_{EMI} exceeds 24V.
3. Connect the power supply terminals to:
 - a. Positive (+): VEMI
 - b. Negative (-): GND
4. Connect the load terminals to:
 - a. Positive (+): VLED+
 - b. Negative (-): VLED-
5. After making the connections, turn on the power supply.
6. To use the enable (EN) function, apply a digital input to the EN/DIM pin. Drive EN above 2.5V to turn on the regulator on; drive EN below 1V to turn it off.
7. When 2-step dimming is off ($R_{DUTY} = 4.87k\Omega$), an external 100Hz to 2kHz pulse-width modulation (PWM) waveform can be applied to the EN/DIM pin.
8. Use the EN/DIM pin to start the 2-step dimming function. When EN/DIM is high, the dimming duty cycle is 100%. When EN/DIM is low, the dimming duty cycle percentage varies (see Table 1).

Table 1 shows the proposed resistor (R3) in E96 series for different dimming duty cycles.

Table 1: 2-Step Dimming Duty vs. R3

2-Step Dimming Duty	R3 (Ω)
15%	61900
14%	41200
13%	27400
12%	18200
11%	12100
10%	7870
2-step dimming off	4870
9%	3090
8%	2050
7%	1370
6%	887
5%	576

9. Set the LED current with the external resistor connected to the ISET pin. The value of the external resistor can be calculated with Equation (1):

$$R5 = \frac{16}{I_{LED}(A)}(k\Omega) \quad (1)$$

EVALUATION BOARD SCHEMATIC

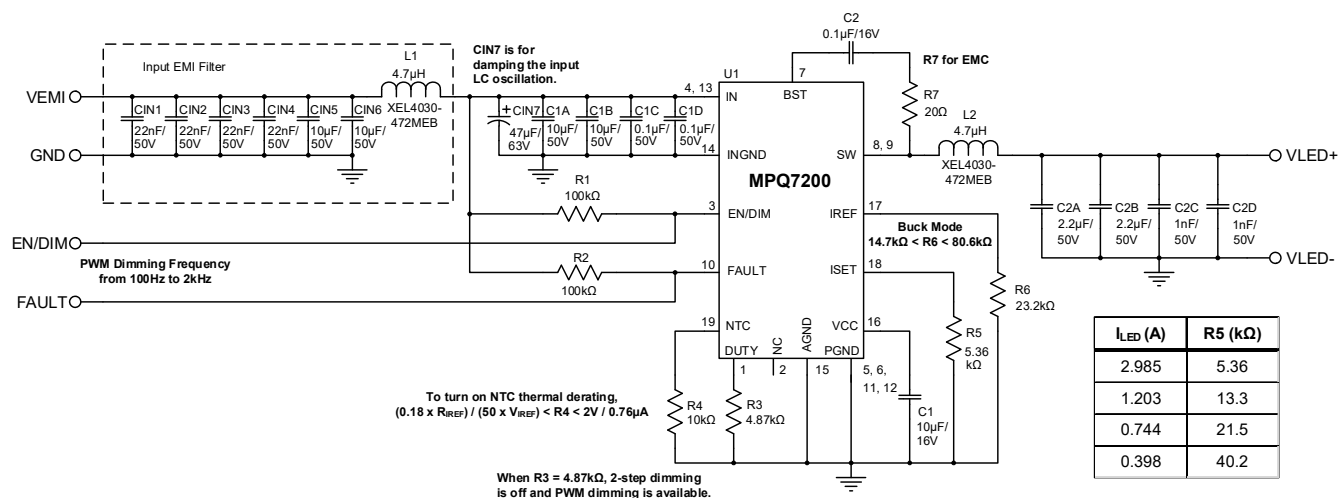
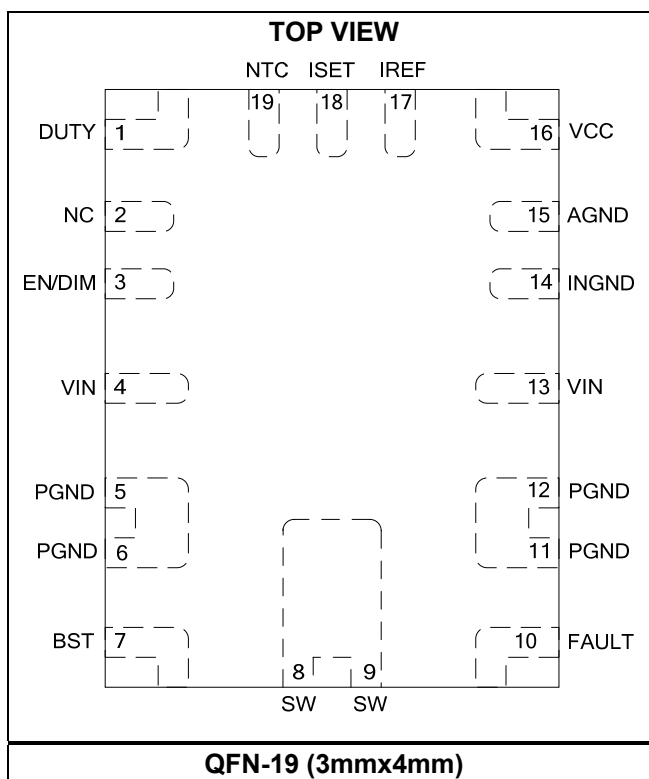


Figure 1: Evaluation Board Schematic

PACKAGE REFERENCE



EVQ7200-L-00A BILL OF MATERIALS

Qty	Ref	Value	Description	Package	Manufacturer	Manufacturer PN
4	C1A, C1B, CIN5, CIN6	10 μ F	Ceramic capacitor, 50V, X7R	1210	Murata	GRM32ER71H106KA8
2	C1C, C1D	0.1 μ F	Ceramic capacitor, 50V, X7R	0603	Murata	GRM188R71H104KA93D
2	C2A, C2B	2.2 μ F	Ceramic capacitor, 50V, X7R	1210	TDK	C3225X7R1H225K
2	C2C, C2D	1nF	Ceramic capacitor, 50V, C0G	0603	Murata	GRM1885C1H02JAC
1	C1	10 μ F	Ceramic capacitor, 16V, X5R	0603	Murata	GRM188R61C106KAA
1	C2	0.1 μ F	Ceramic capacitor, 16V, X7R	0603	Murata	GRM188R71C104KA01D
1	CIN7	47 μ F	Electrolytic capacitor, 63V	SMD	Panasonic	EEHZC1J470P
4	CIN1, CIN2, CIN3, CIN4	22nF	Ceramic capacitor, 50V, X7R	0603	TDK	C1608X7R1H223K
1	L1, L2	4.7 μ H	Inductor, 44.1m Ω DCR, 5.1A	SMD	Coilcraft	XEL4030-472MEB
2	R1, R2	100k Ω	Film resistor, 5%	0603	Yageo	RC0603JR-07100KL
1	R3	4.87k Ω	Film resistor, 1%	0603	Yageo	RC0603FR-074K87L
2	R4	10k Ω	Film resistor, 1%	0603	Yageo	RC0603FR-0710KL
1	R5	5.36k Ω	Film resistor, 1%	0603	Yageo	RC0603FR-075K36L
1	R6	23.2k Ω	Film resistor, 1%	0603	Yageo	RC0603FR-0723K2L
1	R7	20 Ω	Film resistor, 1%	0603	Yageo	RC0603FR-0720RL
1	U1		Step-up/down LED driver	QFN-19 (3mmx4mm)	MPS	MPQ7200GLE-AEC1
5	VEMI, GND, VLED+, VLED-		2 golden pin		Custom ⁽¹⁾	
3	EN/DIM, GND, FAULT		1 golden pin		Custom ⁽¹⁾	

Note:

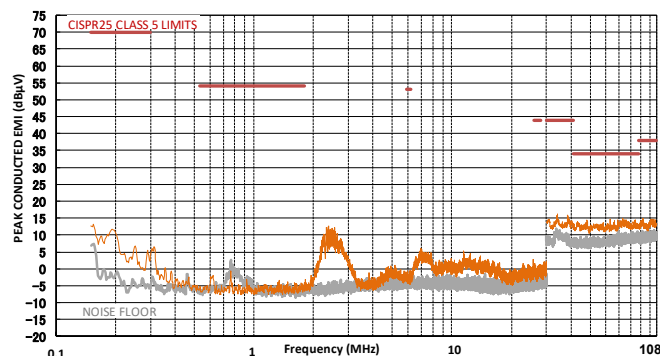
1) MPS custom-produces these pins. Visit the Contact page on our website for more information.

EVB TEST RESULTS

Performance curves and waveforms are tested on the evaluation board. $V_{IN} = 13.5V$, $V_{LED} = 6V$, $L = 4.7\mu H$, $f_{SW} = 2.3MHz$, $T_A = 25^\circ C$, in buck mode, unless otherwise noted.

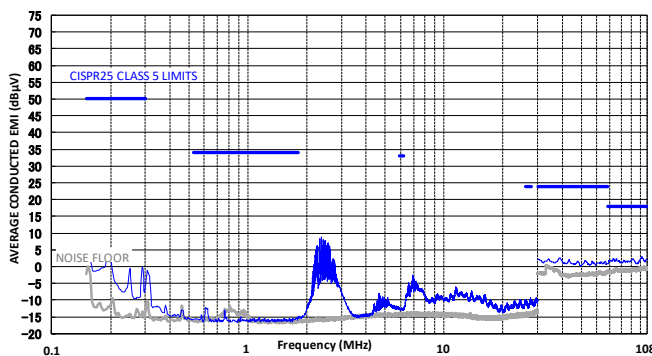
CISPR25 Class 5 Peak Conducted Emissions

150kHz to 108MHz



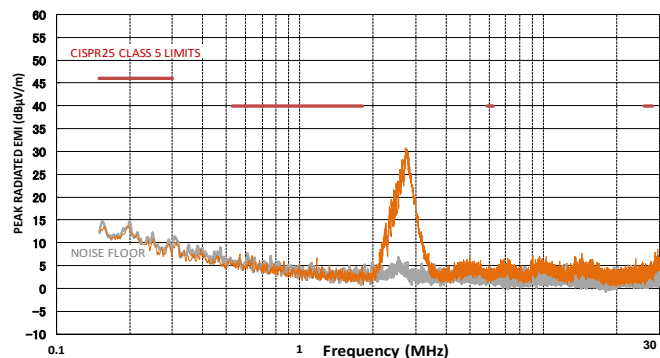
CISPR25 Class 5 Average Conducted Emissions

150kHz to 108MHz



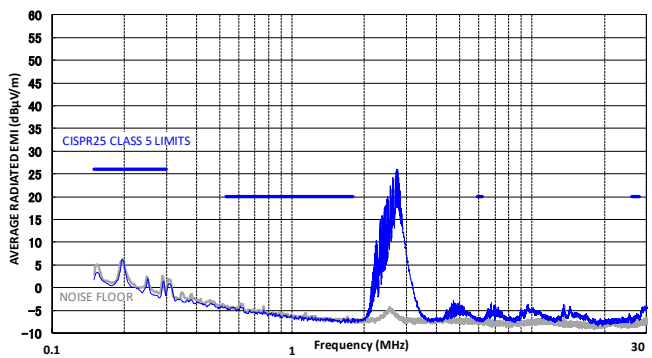
CISPR25 Class 5 Peak Radiated Emissions

150kHz to 30MHz



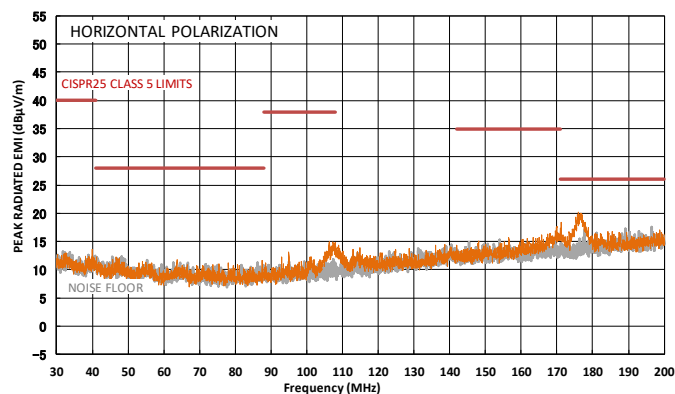
CISPR25 Class 5 Average Radiated Emissions

150kHz to 30MHz



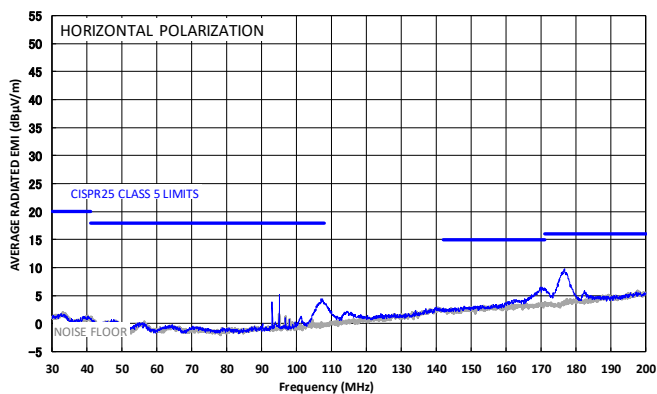
CISPR25 Class 5 Peak Radiated Emissions

Horizontal, 30MHz to 200MHz



CISPR25 Class 5 Average Radiated Emissions

Horizontal, 30MHz to 200MHz

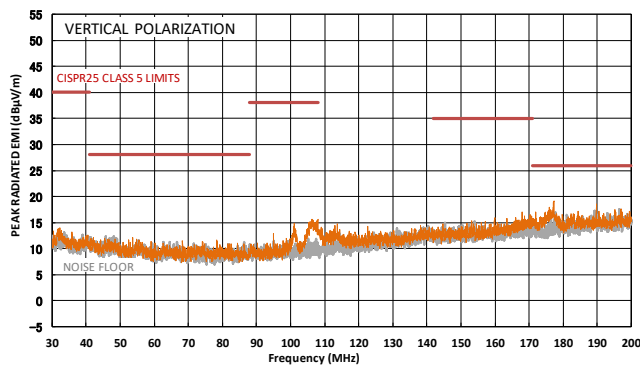


EVB TEST RESULTS (continued)

Performance curves and waveforms are tested on the evaluation board. $V_{IN} = 13.5V$, $V_{LED} = 6V$, $L = 4.7\mu H$, $f_{SW} = 2.3MHz$, $T_A = 25^\circ C$, in buck mode, unless otherwise noted.

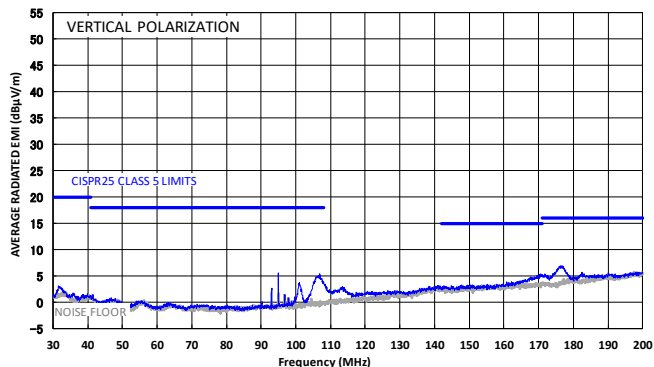
CISPR25 Class 5 Peak Radiated Emissions

Vertical, 30MHz to 200MHz



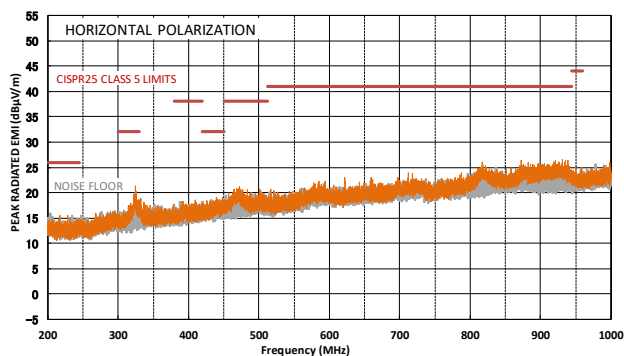
CISPR25 Class 5 Average Radiated Emissions

Vertical, 30MHz to 200MHz



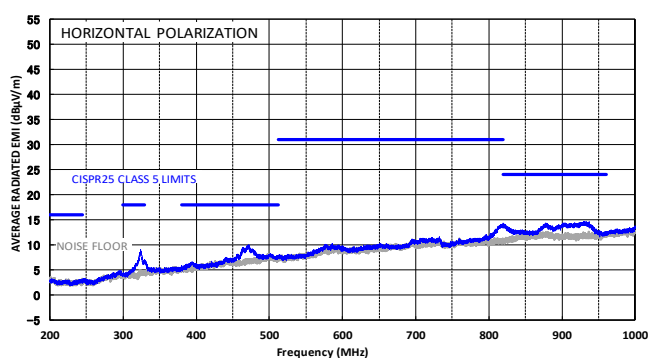
CISPR25 Class 5 Peak Radiated Emissions

Horizontal, 200MHz to 1GHz



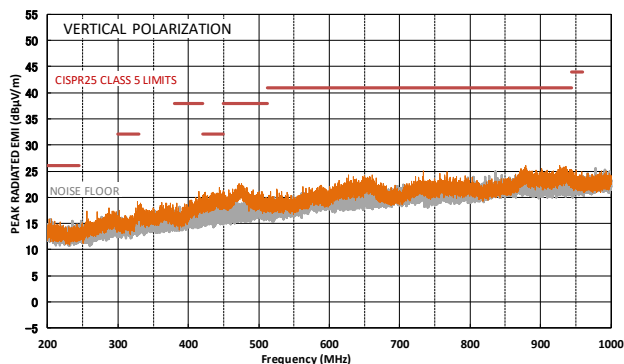
CISPR25 Class 5 Average Radiated Emissions

Horizontal, 200MHz to 1GHz



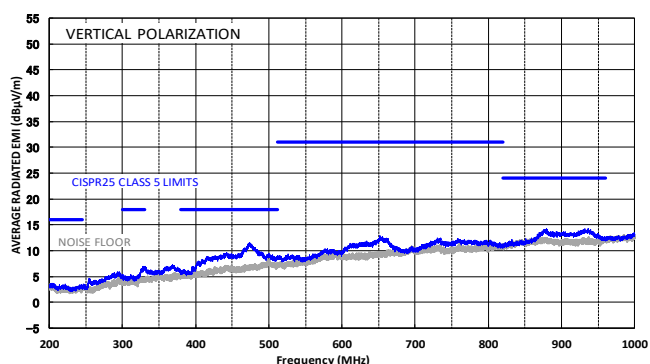
CISPR25 Class 5 Peak Radiated Emissions

Vertical, 200MHz to 1GHz



CISPR25 Class 5 Average Radiated Emissions

Vertical, 200MHz to 1GHz

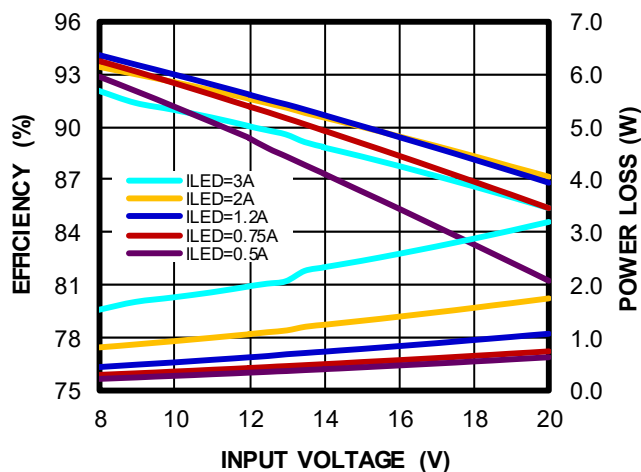


EVB TEST RESULTS (continued)

Performance curves and waveforms are tested on the evaluation board. $V_{IN} = 13.5V$, $V_{LED} = 6V$, $L = 4.7\mu H$, $f_{SW} = 2.3MHz$, $T_A = 25^\circ C$, in buck mode, unless otherwise noted.

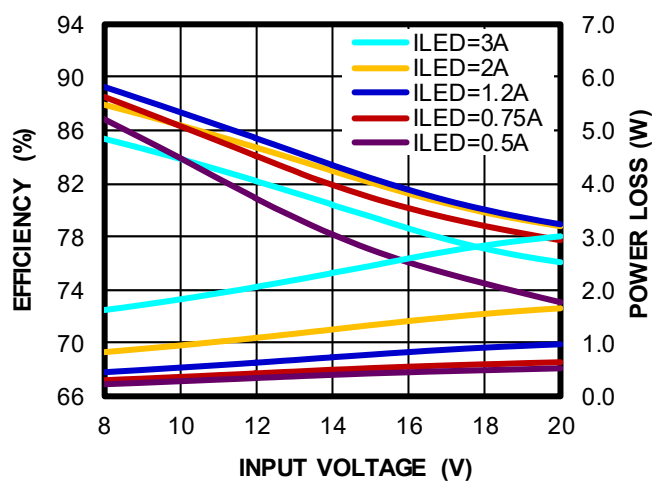
Efficiency vs. Input Voltage

2 LEDs ($V_{LED} = 6V$), MOSFET cutoff when $I_{LED} = 0.5A$



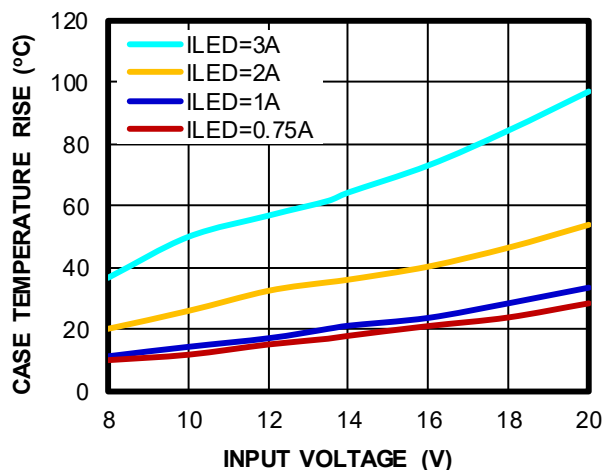
Efficiency vs. Input Voltage

1 LED ($V_{LED} = 3V$), MOSFET cutoff when $I_{LED} = 0.5A$



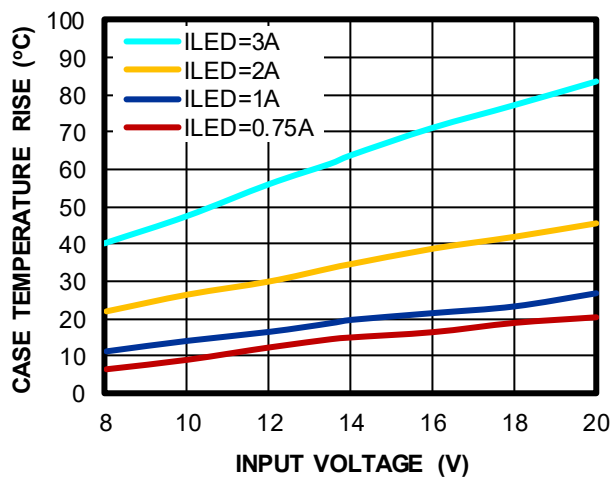
Case Temperature Rise vs. Input Voltage

2 LEDs ($V_{LED} = 6V$)



Case Temperature Rise vs. Input Voltage

1 LED ($V_{LED} = 3V$)



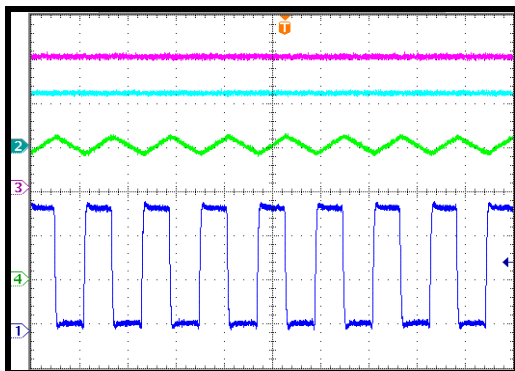
EVB TEST RESULTS (continued)

Performance curves and waveforms are tested on the evaluation board. $V_{IN} = 13.5V$, $V_{LED} = 6V$, $L = 4.7\mu H$, $f_{sw} = 2.3MHz$, $T_A = 25^\circ C$, in buck mode, unless otherwise noted.

Steady State

 $I_{LED} = 3A$

CH2: $V_{LED+} - V_{LED-}$
5V/div.
CH3: I_{LED}
1A/div.
CH4: I_L
1A/div.
CH1: V_{sw}
5V/div.

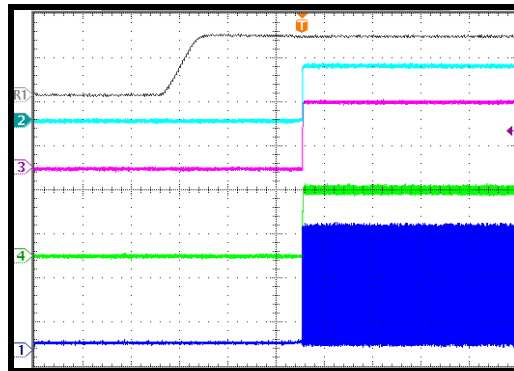


400ns/div.

Start-Up through VIN

 $I_{LED} = 3A$

V_{IN}
10V/div.
CH2: $V_{LED+} - V_{LED-}$
5V/div.
CH3: I_{LED}
2A/div.
CH4: I_L
2A/div.
CH1: V_{sw}
5V/div.

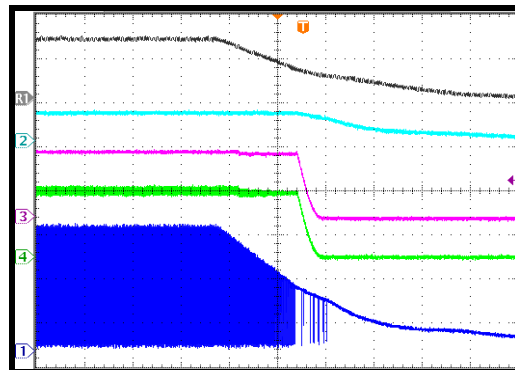


2ms/div.

Shutdown through VIN

 $I_{LED} = 3A$

V_{IN}
10V/div.
CH2: $V_{LED+} - V_{LED-}$
10V/div.
CH3: I_{LED}
2A/div.
CH4: I_L
2A/div.
CH1: V_{sw}
5V/div.

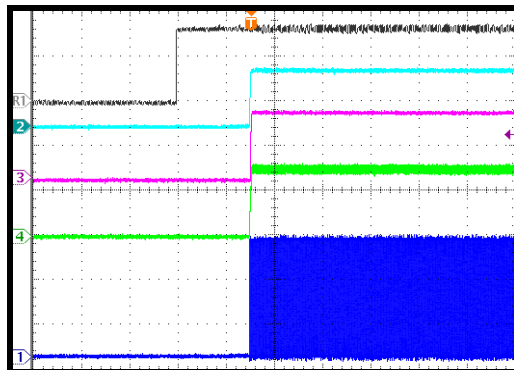


4ms/div.

Start-Up through EN

 $I_{LED} = 3A$

V_{EN}
2V/div.
CH2: $V_{LED+} - V_{LED-}$
5V/div.
CH3: I_{LED}
2A/div.
CH4: I_L
2A/div.
CH1: V_{sw}
5V/div.

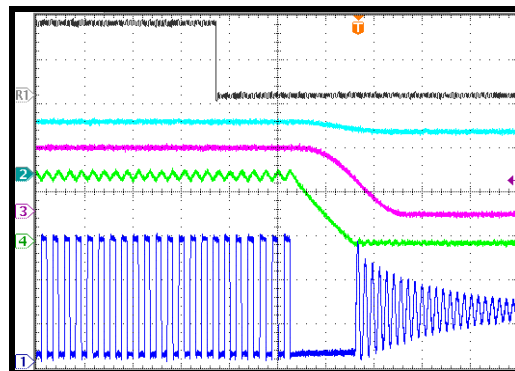


1ms/div.

Shutdown through EN

 $I_{LED} = 3A$

V_{EN}
2V/div.
CH2: $V_{LED+} - V_{LED-}$
5V/div.
CH3: I_{LED}
2A/div.
CH4: I_L
2A/div.
CH1: V_{sw}
5V/div.

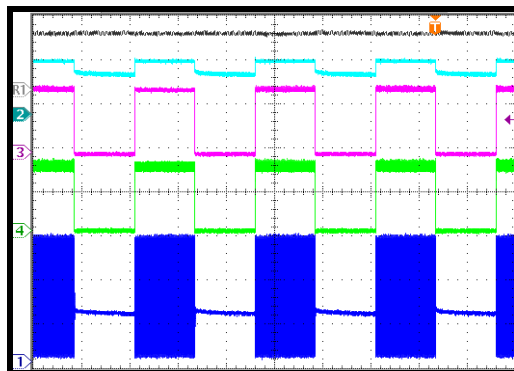


2μs/div.

PWM Dimming Steady State

Dimming frequency = 100Hz

V_{FAULT}
10V/div.
CH2: $V_{LED+} - V_{LED-}$
5V/div.
CH3: I_{LED}
2A/div.
CH4: I_L
2A/div.
CH1: V_{sw}
5V/div.



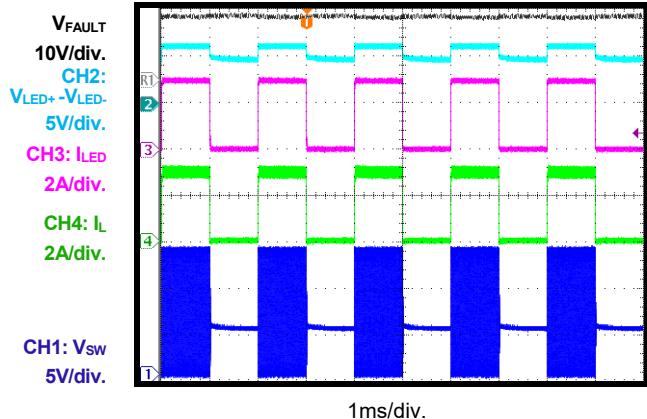
4ms/div.

EVB TEST RESULTS (continued)

Performance curves and waveforms are tested on the evaluation board. $V_{IN} = 13.5V$, $V_{LED} = 6V$, $L = 4.7\mu H$, $f_{SW} = 2.3MHz$, $T_A = 25^\circ C$, in buck mode, unless otherwise noted.

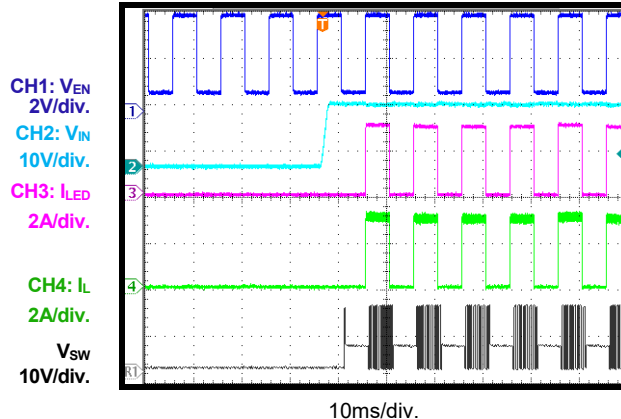
PWM Dimming Steady State

Dimming frequency = 500Hz



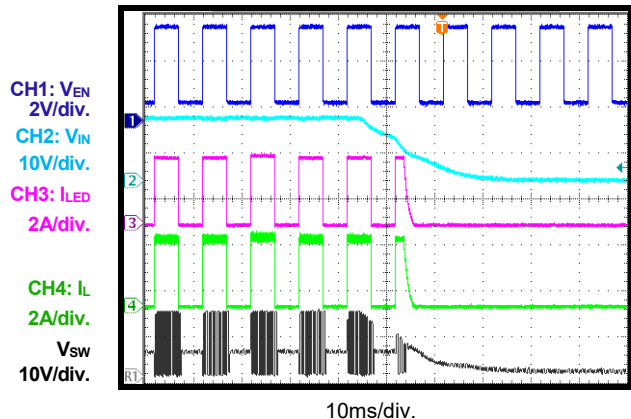
PWM Dimming

Start-up through VIN



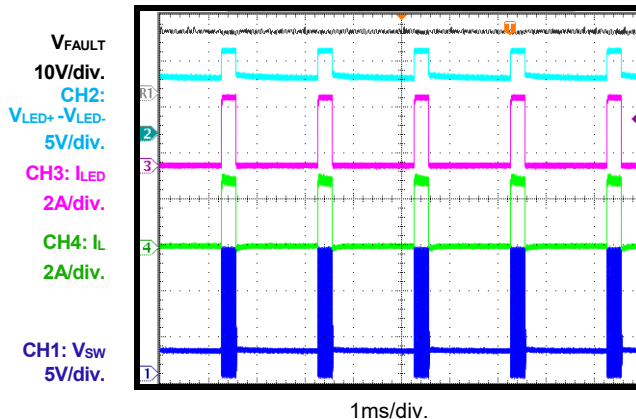
PWM Dimming

Shutdown through VIN



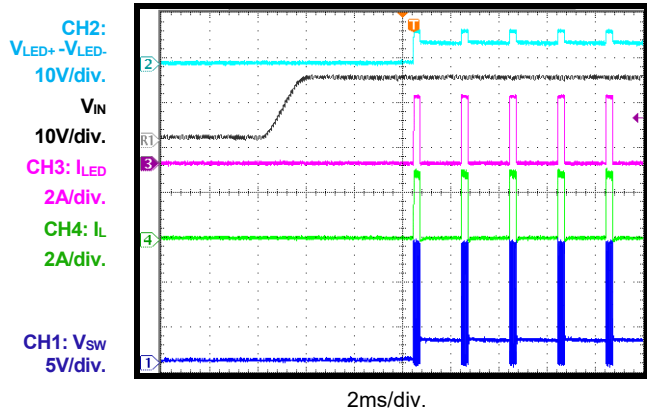
2-Step Dimming

Steady state



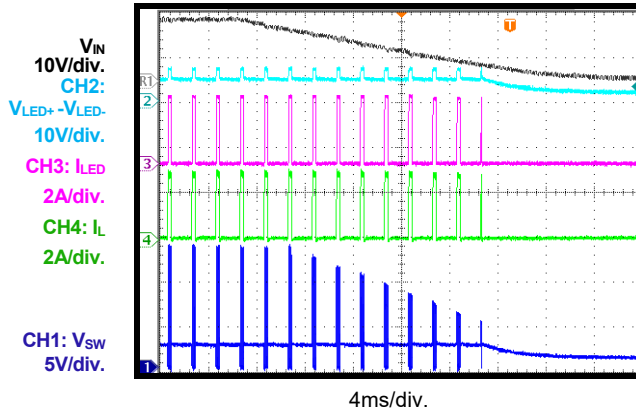
2-Step Dimming

Start-up through VIN



2-Step Dimming

Shutdown through VIN

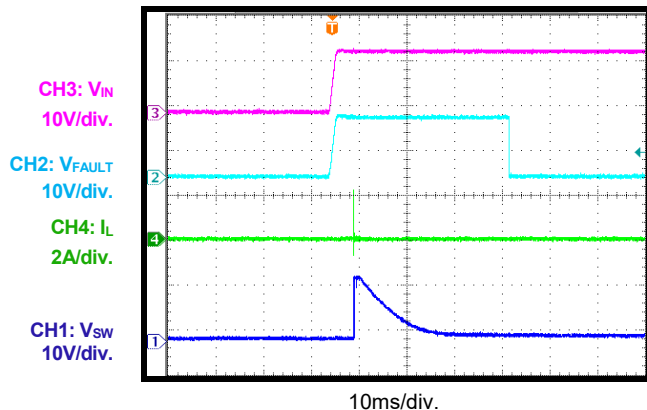


EVB TEST RESULTS (continued)

Performance curves and waveforms are tested on the evaluation board. $V_{IN} = 13.5V$, $V_{LED} = 6V$, $L = 4.7\mu H$, $f_{SW} = 2.3MHz$, $T_A = 25^\circ C$, in buck mode, unless otherwise noted.

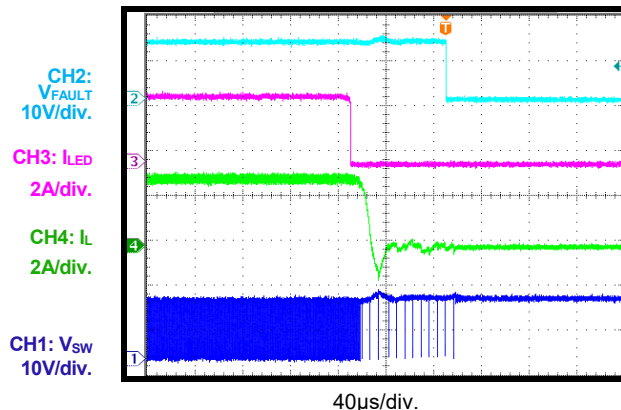
No Dimming

LED open power on



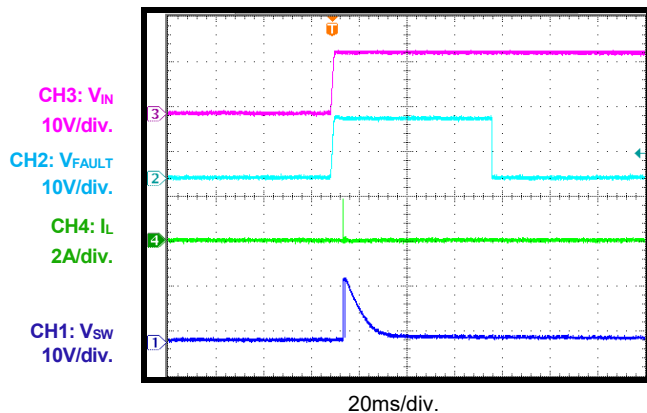
No Dimming

LED open entry



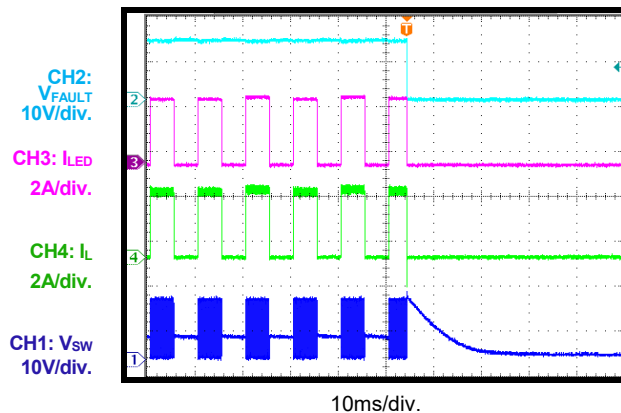
PWM Dimming

LED open power on



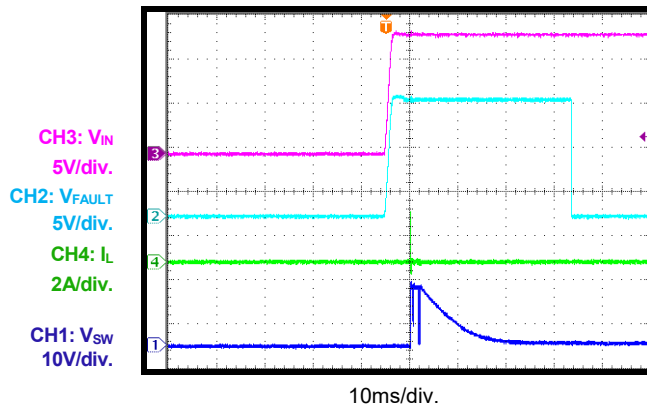
PWM Dimming

LED open entry



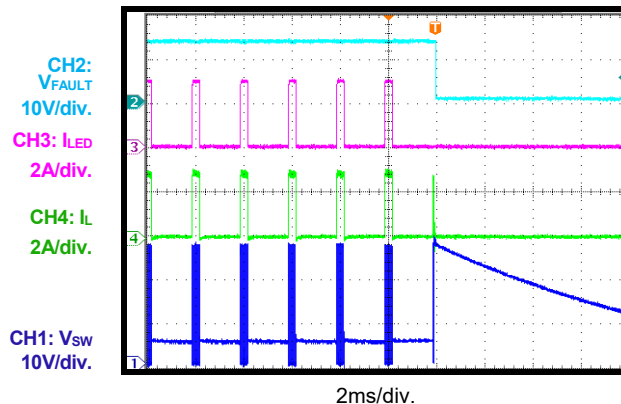
2-Step Dimming

LED open power on



2-Step Dimming

LED open entry

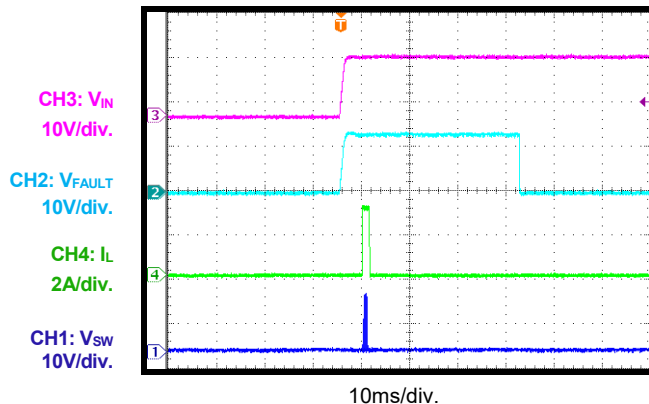


EVB TEST RESULTS (continued)

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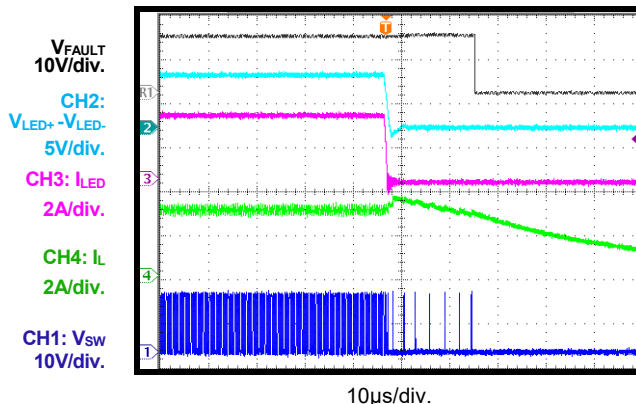
No Dimming

LED+ short to LED- power on



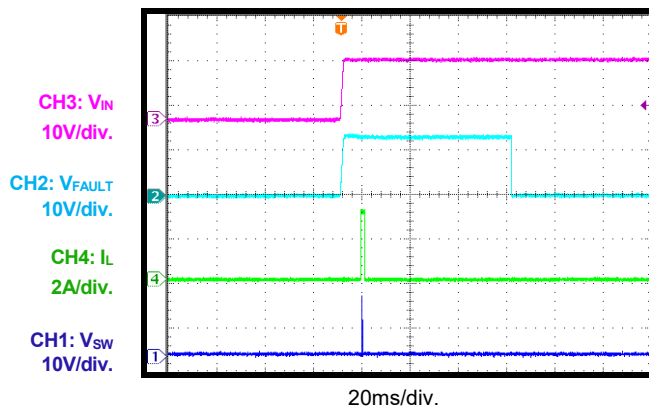
No Dimming

LED+ short to LED- entry



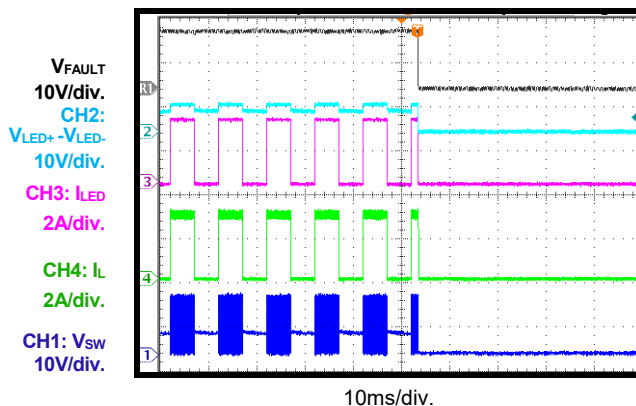
PWM Dimming

LED+ short to LED- power on



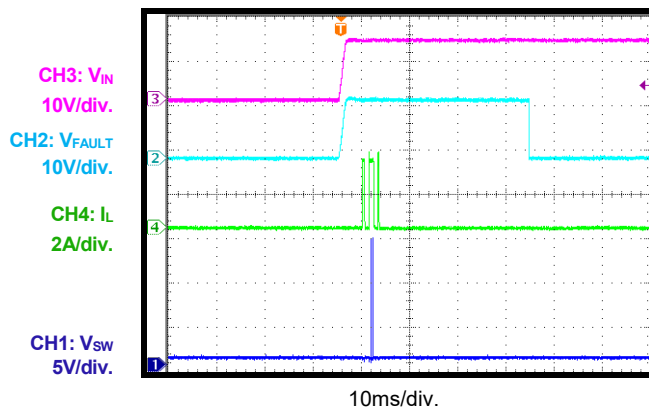
PWM Dimming

LED+ short to LED- entry



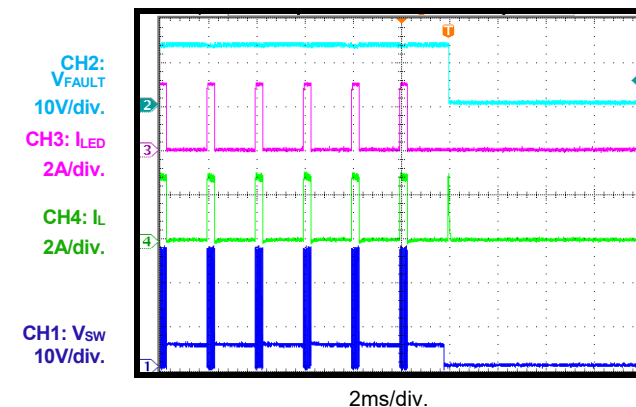
2-Step Dimming

LED+ short to LED- power on



2-Step Dimming

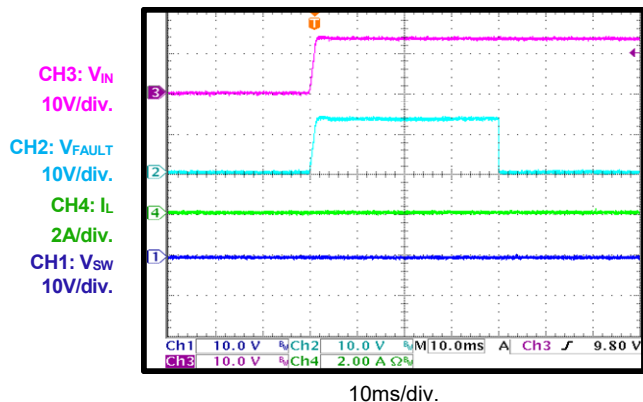
LED+ short to LED- entry



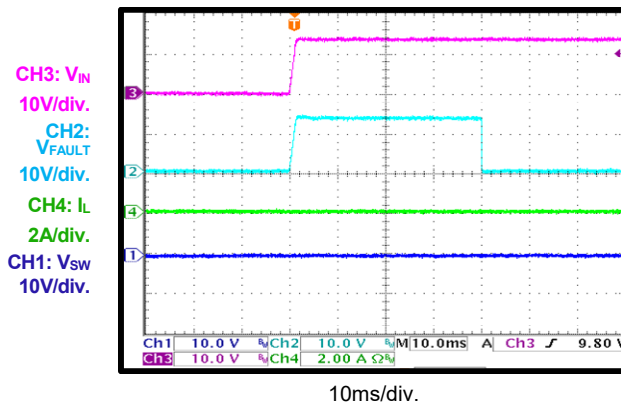
EVB TEST RESULTS (continued)

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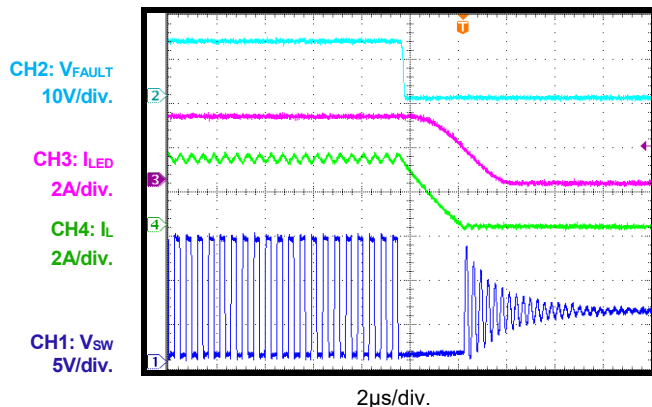
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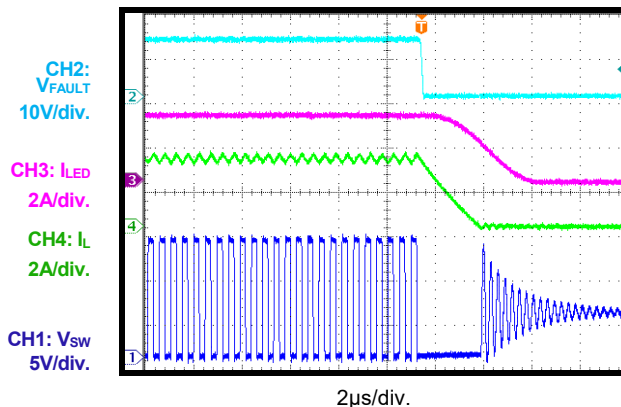
IREF Open before Start-Up



IREF Short after Start-Up

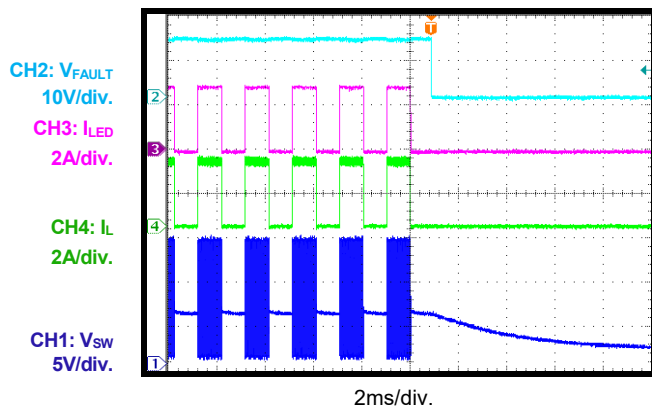


IREF Open after Start-Up



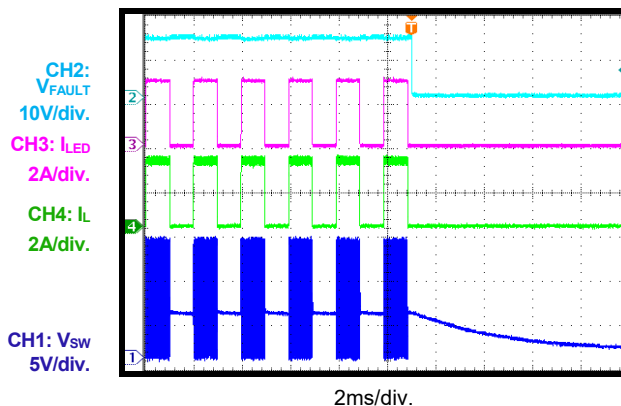
IREF Short after Start-Up

PWM dimming



IREF Open after Start-Up

PWM dimming



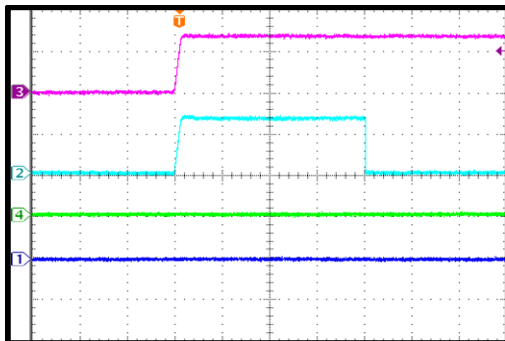
EVB TEST RESULTS (continued)

Performance curves and waveforms are tested on the evaluation board. $V_{IN} = 13.5V$, $V_{LED} = 6V$, $L = 4.7\mu H$, $f_{SW} = 2.3MHz$, $T_A = 25^{\circ}C$, in buck mode, unless otherwise noted.

ISET Short before Start-Up

PWM dimming

CH3: V_{IN}
10V/div.
CH2: V_{FAULT}
10V/div.
CH4: I_L
2A/div.
CH1: V_{SW}
10V/div.

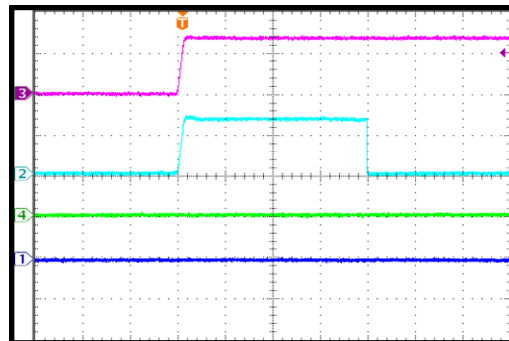


10ms/div.

ISET Open before Start-Up

PWM dimming

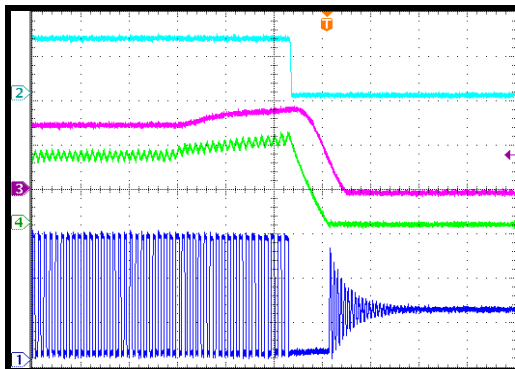
CH3: V_{IN}
10V/div.
CH2: V_{FAULT}
10V/div.
CH4: I_L
2A/div.
CH1: V_{SW}
10V/div.



10ms/div.

ISET Short after Start-Up

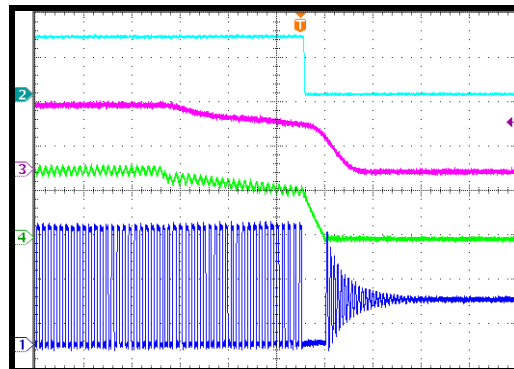
CH2: V_{FAULT}
10V/div.
CH3: I_{LED}
2A/div.
CH4: I_L
2A/div.
CH1: V_{SW}
5V/div.



4μs/div.

ISET Open after Start-Up

CH2: V_{FAULT}
10V/div.
CH3: I_{LED}
2A/div.
CH4: I_L
2A/div.
CH1: V_{SW}
5V/div.

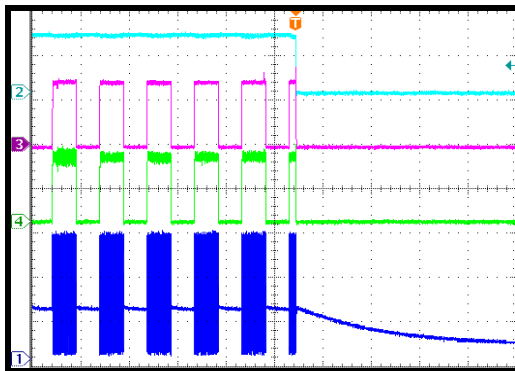


4μs/div.

ISET Short after Start-Up

PWM dimming

CH2: V_{FAULT}
10V/div.
CH3: I_{LED}
2A/div.
CH4: I_L
2A/div.
CH1: V_{SW}
5V/div.

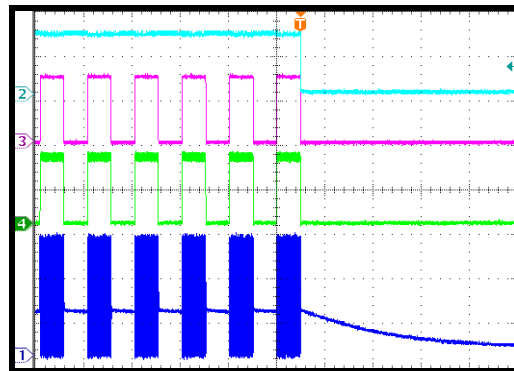


2ms/div.

ISET Open after Start-Up

PWM dimming

CH2: V_{FAULT}
10V/div.
CH3: I_{LED}
2A/div.
CH4: I_L
2A/div.
CH1: V_{SW}
5V/div.

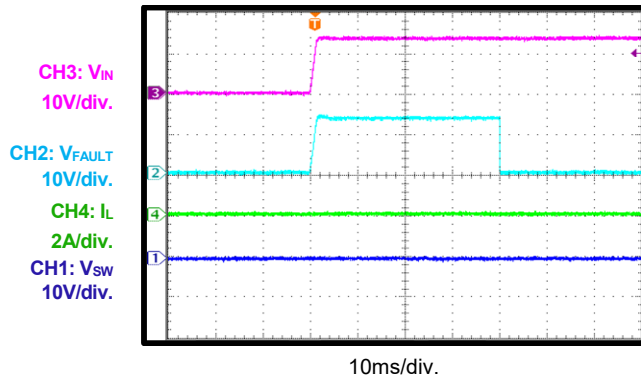


2ms/div.

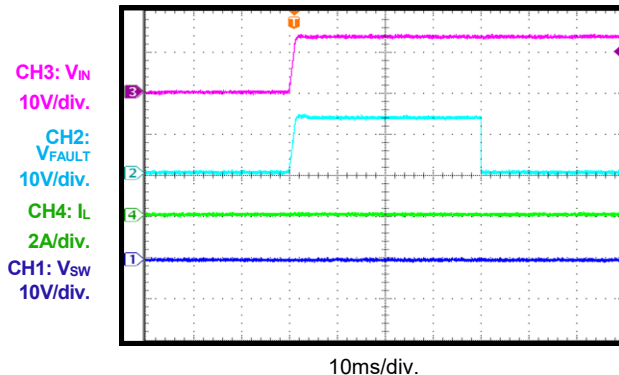
EVB TEST RESULTS *(continued)*

Performance curves and waveforms are tested on the evaluation board. $V_{IN} = 13.5V$, $V_{LED} = 6V$, $L = 4.7\mu H$, $f_{SW} = 2.3MHz$, $T_A = 25^\circ C$, in buck mode, unless otherwise noted.

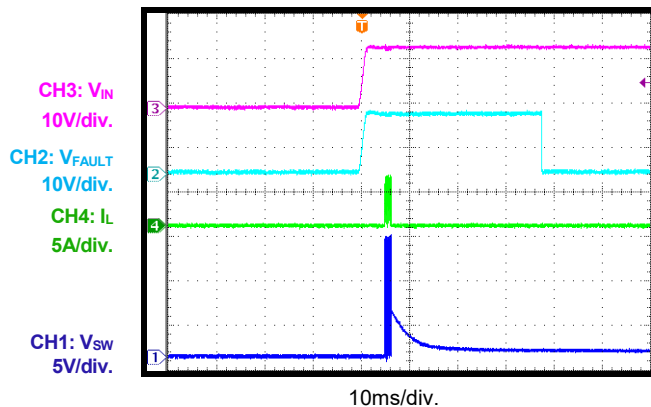
DUTY Short before Start-Up



DUTY Open before Start-Up



Mode Detect with Incorrect Configuration at VIN Start-Up



PCB LAYOUT

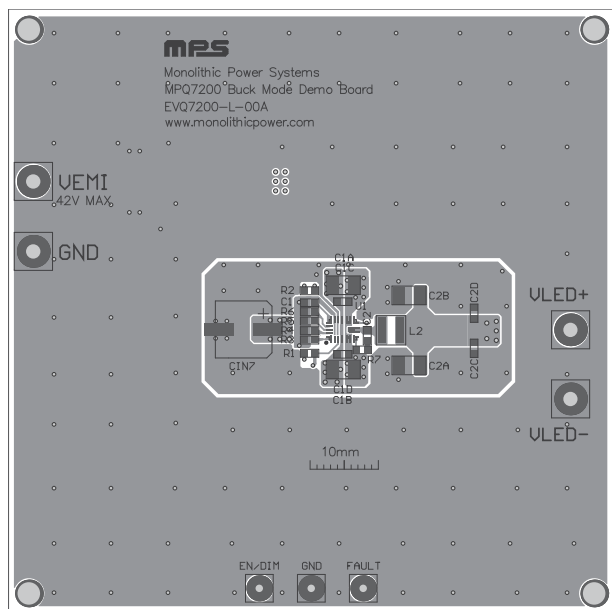


Figure 2: Top Silk and Top Layer

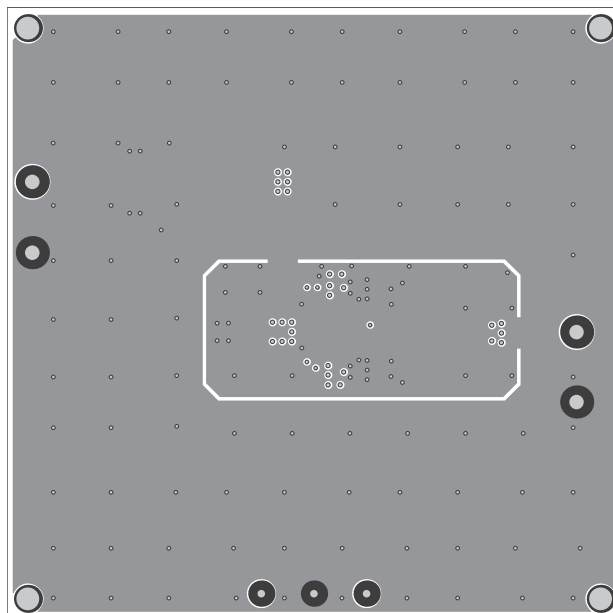


Figure 3: Mid-Layer 1

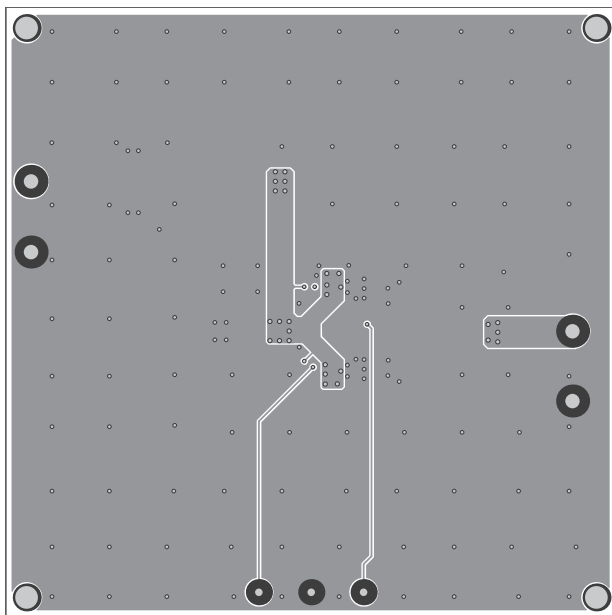


Figure 4: Mid-Layer 2

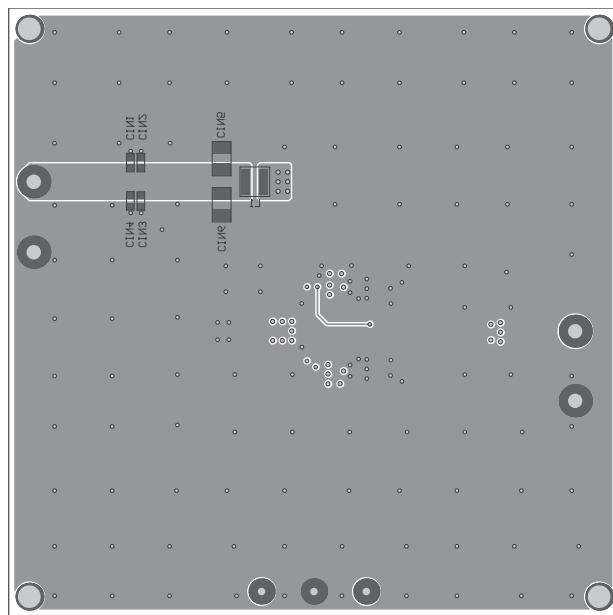


Figure 5: Bottom Layer and Bottom Silk

REVISION HISTORY

Revision #	Revision Date	Description	Pages Updated
1.0	1/4/2021	Initial Release	-

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