EVQ7200A-L-00A

42V, 3A, 410kHz, Synchronous LED Driver Buck Mode Evaluation Board, AEC-Q100 Qualified

DESCRIPTION

The EVQ7200A-L-00A is an evaluation board designed to demonstrate the capabilities of the MPQ7200A, a constant-current LED driver with integrated power MOSFETs. It offers a compact solution to achieve 3A of continuous output current (I_{OUT}), with excellent load and line regulation across a wide input supply range.

Constant frequency hysteretic control mode provides fast transient response without loop compensation. The switching frequency (f_{SW}) is 410kHz in buck mode for optimized efficiency and electromagnetic interference (EMI) performance.

The MPQ7200A is available in a QFN-19 (3mmx4mm) package with wettable flanks, and is available in AEC-Q100 Grade 1.

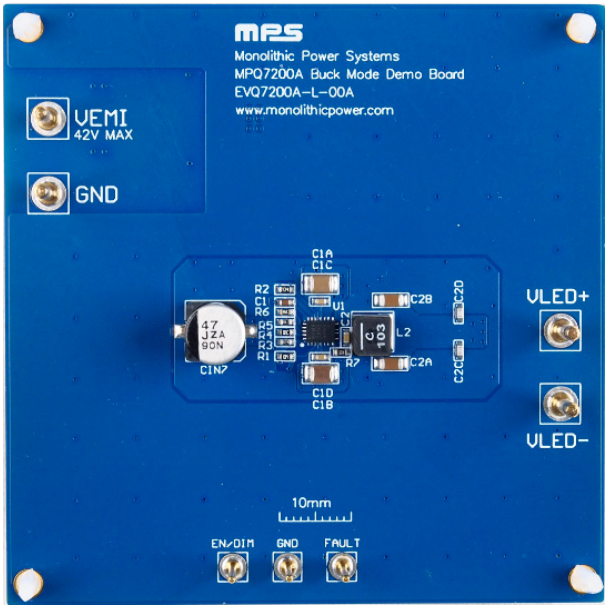
The EVQ7200A-L-00A is a fully assembled and tested buck mode LED driver evaluation board. It generates an LED current up to 3A from a 6V to 42V input range.

PERFORMANCE SUMMARY

Specifications are at T_A = 25°C, unless otherwise noted.

Parameters	Conditions	Value
Input voltage (V_{IN}) range		6V to 42V
Maximum output current (I_{OUT})	V_{IN} = 6V to 42V	3A
Typical efficiency	V_{IN} = 13.5V, 2 LEDs, I_{LED} = 3A	93.32%
Peak efficiency	V_{IN} = 8V, 2 LEDs, I_{LED} = 0.75A	96.22%
Switching frequency (f_{SW})		410kHz

EVALUATION BOARD



LxWxH (8.3cmx8.3cmx1.3cm)

Board Number	MPS IC Number
EVQ7200A-L-00A	MPQ7200AGLE-AEC1

QUICK START GUIDE

1. Preset the power supply between 6V and 42V, then turn off the power supply (see Figure 1).

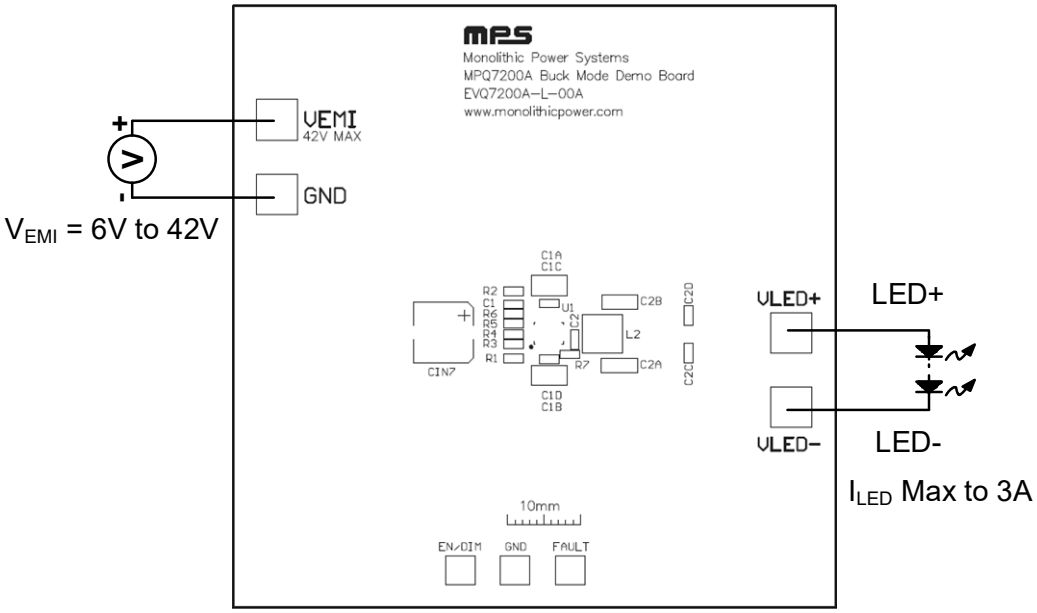


Figure 1: Measurement Equipment Set-Up

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 especially 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 the regulator on; drive EN below 1V to turn it off.
7. When two-step dimming is inactive (R_{DUTY} = 4.87kΩ), an external 100Hz to 2kHz pulse-width modulation (PWM) waveform can be applied to the EN/DIM pin.
8. To initiate the two-step dimming function, use the EN/DIM pin. Table 1 on page 3 shows the proposed resistor (R3) in E96 series for different dimming duty cycles. When EN/DIM is high, the dimming duty cycle is 100%; when EN/DIM is low, the dimming duty cycle percentage varies.

QUICK START GUIDE *(continued)*

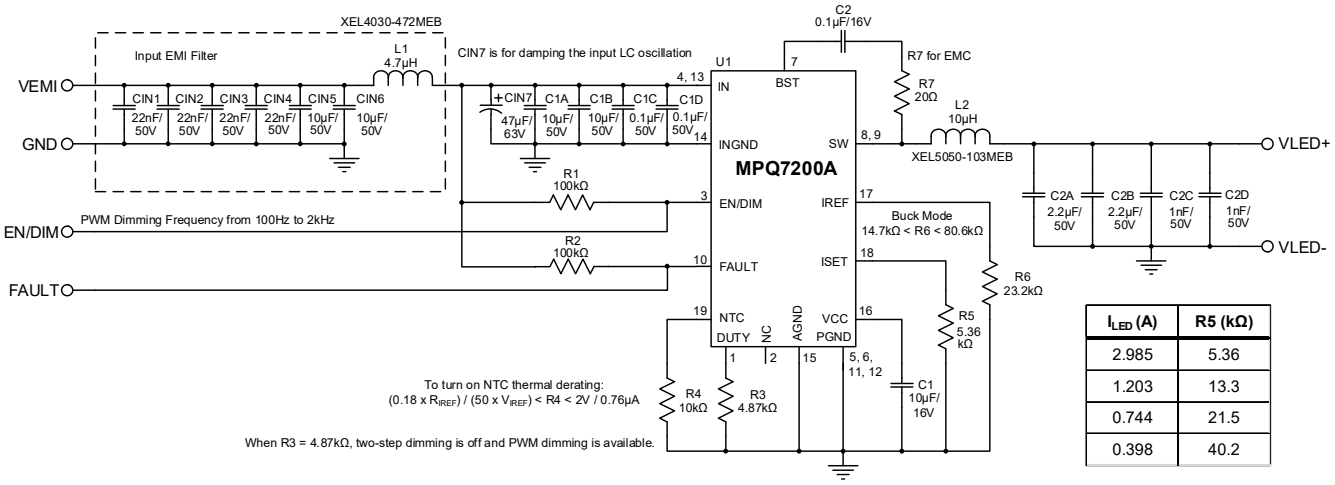
Table 1: Two-Step Dimming Duty vs. R3

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

9. The external resistor (R5) connected to the ISET pin sets the LED current (I_{LED}). R5 can be calculated using Equation (1):

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

EVALUATION BOARD SCHEMATIC



I_{LED} (A)	R5 (kΩ)
2.985	5.36
1.203	13.3
0.744	21.5
0.398	40.2

Figure 2: Evaluation Board Schematic

EVQ7200A-L-00A BILL OF MATERIALS

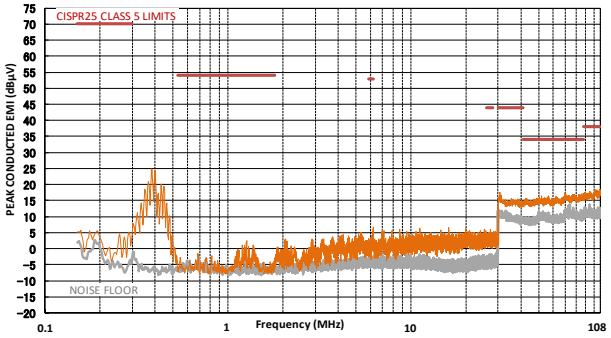
Qty	Ref	Value	Description	Package	Manufacturer	Manufacturer PN
1	L1	4.7µH	Inductor, 44.1mΩ DCR, 4.6A	SMD	Coilcraft	XEL4030-472MEB
1	L2	10µH	Inductor, 40.9mΩ DCR, 4.9A	SMD	Coilcraft	XEL5050-103MEB
4	C1A, C1B, CIN5, CIN6	10µF	Ceramic capacitor, 50V, X7R	1210	Murata	GRM32ER71H106KA8
2	C1C, C1D	0.1µF	Ceramic capacitor, 50V, X7R	0603	Murata	GRM188R71H104KA93D
2	C2A, C2B	2.2µF	Ceramic capacitor, 25V, X7R	1206	Murata	GRM31MR71E225KA93L
2	C2C, C2D	1nF	Ceramic capacitor, 50V, C0G	0603	Murata	GRM1885C1H02JAC
1	C1	10µF	Ceramic capacitor, 16V, X5R	0603	Murata	GRM188R61C106KAA
1	C2	0.1µF	Ceramic capacitor, 16V, X7R	0603	Murata	GRM188R71C104KA01D
1	CIN7	47µF	Electrolytic capacitor, 63V	SMD	Panasonic	EEHZC1J470P
4	CIN1, CIN2, CIN3, CIN4	22nF	Ceramic capacitor, 50V, X7R	0603	TDK	C1608X7R1H223K
10	R1, R2	100kΩ	Film resistor, 5%	0603	Yageo	RC0603JR-07100KL
11	R3	4.87kΩ	Film resistor, 1%	0603	Yageo	RC0603FR-074K87L
12	R4	10kΩ	Film resistor, 1%	0603	Yageo	RC0603FR-0710KL
13	R5	5.36kΩ	Film resistor, 1%	0603	Yageo	RC0603FR-075K36L
14	R6	23.2kΩ	Film resistor, 1%	0603	Yageo	RC0603FR-0723K2L
15	R7	20Ω	Film resistor, 1%	0603	Yageo	RC0603FR-0720RL
5	VEMI, GND, VLED+, VLED-	2mm	Golden pin	DIP	Custom	
4	EN, DIM, GND, FAULT	1mm	Golden pin	DIP	Custom	
1	U1	MPQ7200A	Buck-boost regulator, AEC-Q100	QFN-19 (3mmx4mm)	MPS	MPQ7200AGLE-AEC1

EVB TEST RESULTS

Performance curves and waveforms are tested on the evaluation board, V_{IN} = 13.5V, 2 LEDs in series (V_{LED} = 6V), f_{SW} = 410kHz, L = 10µH, T_A = 25°C, unless otherwise noted.

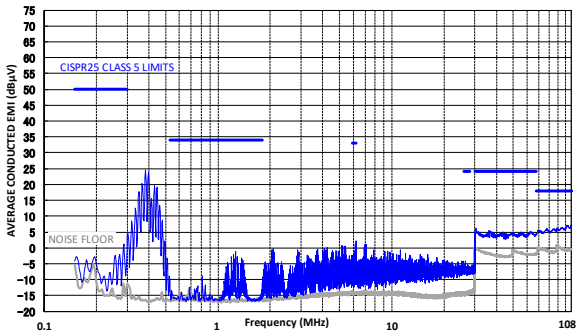
CISPR25 Class 5 Peak Conducted Emissions

150kHz to 108MHz



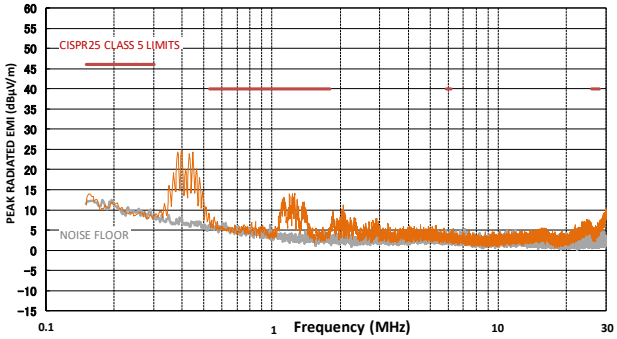
CISPR25 Class 5 Average Conducted Emissions

150kHz to 108MHz



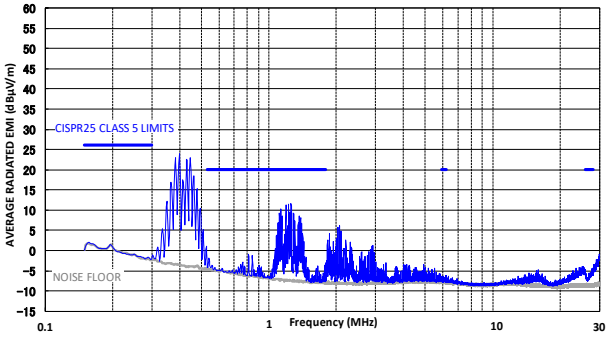
CISPR25 Class 5 Peak Radiated Emissions

150kHz to 30MHz



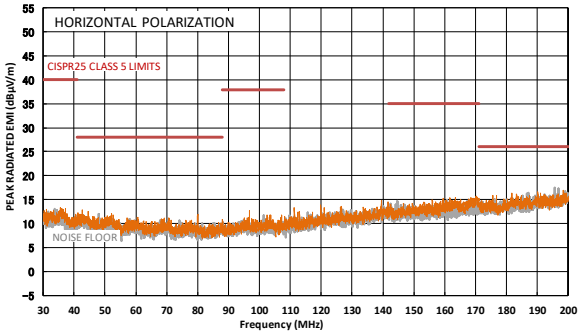
CISPR25 Class 5 Average Radiated Emissions

150kHz to 30MHz



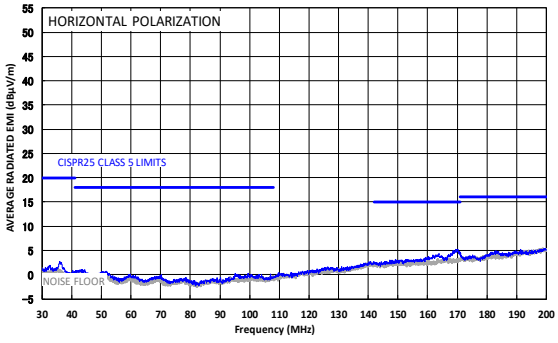
CISPR25 Class 5 Peak Radiated Emissions

Horizontal, 30MHz to 200MHz



CISPR25 Class 5 Average Radiated Emissions

Horizontal, 30MHz to 200MHz

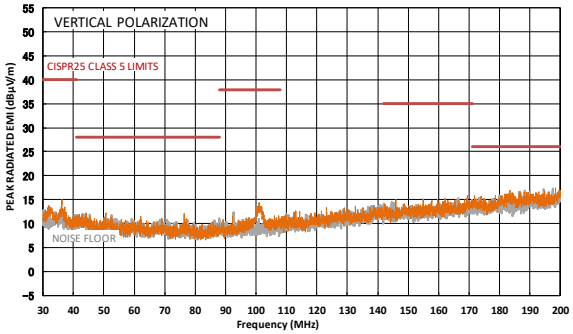


EVB TEST RESULTS *(continued)*

Performance curves and waveforms are tested on the evaluation board, V_{IN} = 13.5V, 2 LEDs in series (V_{LED} = 6V), f_{SW} = 410kHz, L = 10µH, T_A = 25°C, unless otherwise noted.

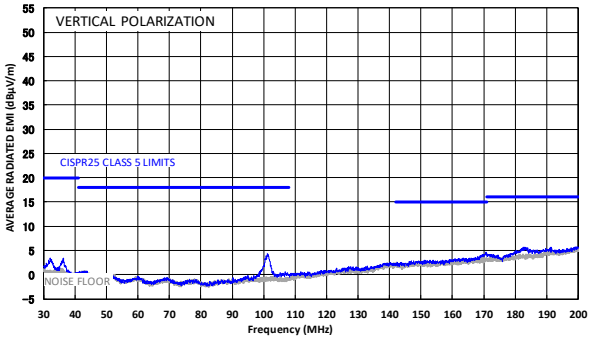
CISPR25 Class 5 Peak Radiated Emissions

Vertical, 30MHz to 200MHz



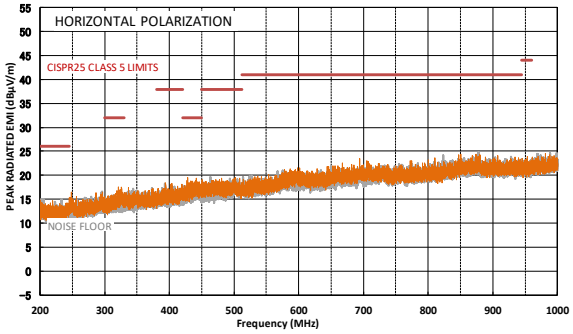
CISPR25 Class 5 Average Radiated Emissions

Vertical, 30MHz to 200MHz



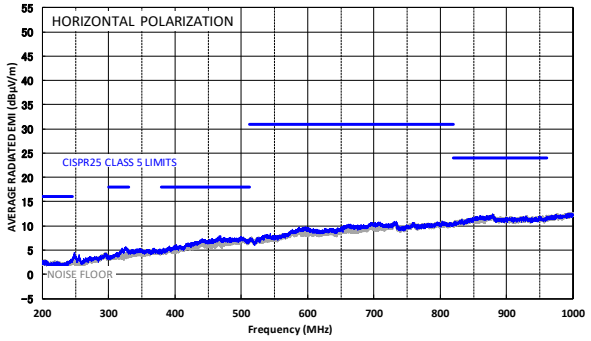
CISPR25 Class 5 Peak Radiated Emissions

Horizontal, 200MHz to 1GHz



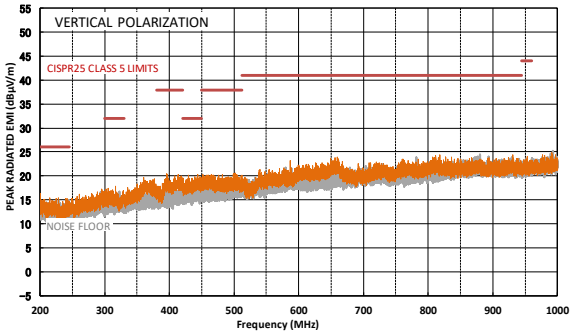
CISPR25 Class 5 Average Radiated Emissions

Horizontal, 200MHz to 1GHz



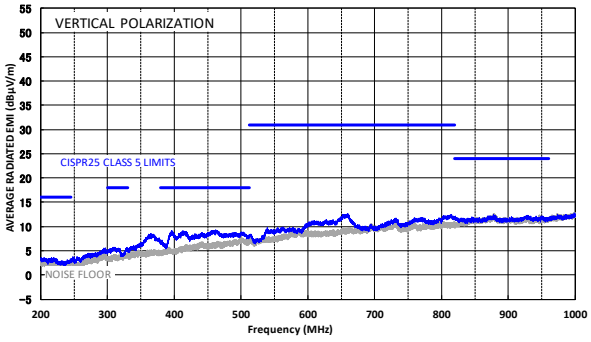
CISPR25 Class 5 Peak Radiated Emissions

Vertical, 200MHz to 1GHz



CISPR25 Class 5 Average Radiated Emissions

Vertical, 200MHz to 1GHz

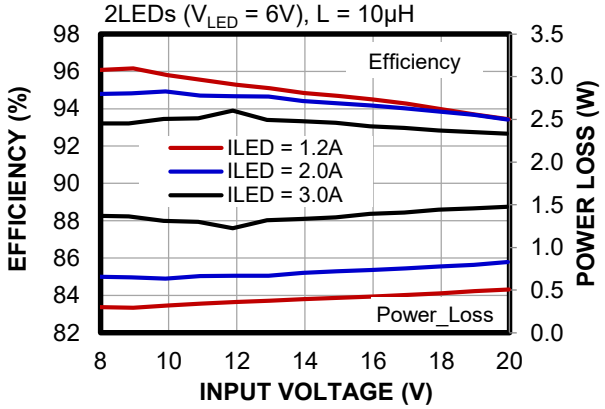


EVB TEST RESULTS *(continued)*

Performance curves and waveforms are tested on the evaluation board, V_{IN} = 13.5V, 2 LEDs in series (V_{LED} = 6V), f_{SW} = 410kHz, L = 10µH, T_A = 25°C, unless otherwise noted. (1)

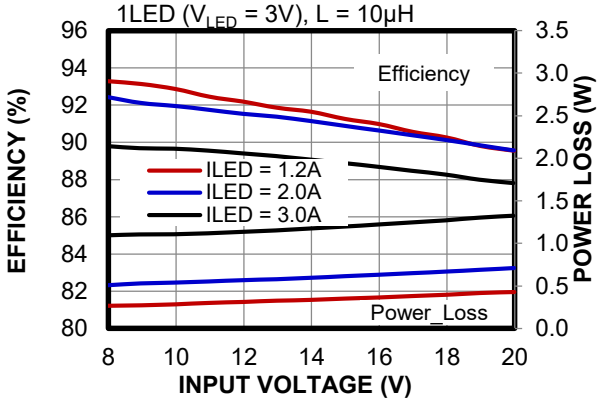
Efficiency vs. Input Voltage vs. Power Loss

2LEDs (V_{LED} = 6V), L = 10µH



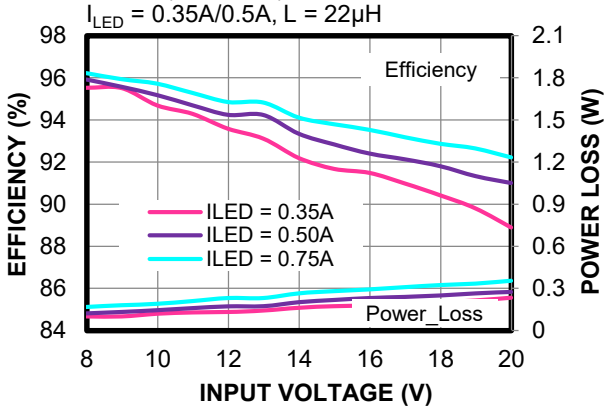
Efficiency vs. Input Voltage vs. Power Loss

1LED (V_{LED} = 3V), L = 10µH



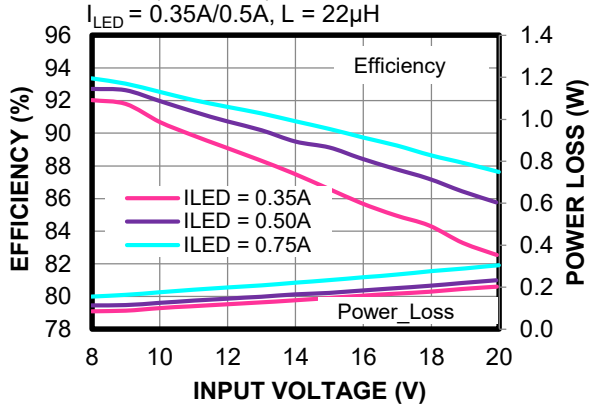
Efficiency vs. Input Voltage vs. Power Loss

2LEDs (V_{LED} = 6V), I_{LED} = 0.75A, L = 15µH, I_{LED} = 0.35A/0.5A, L = 22µH



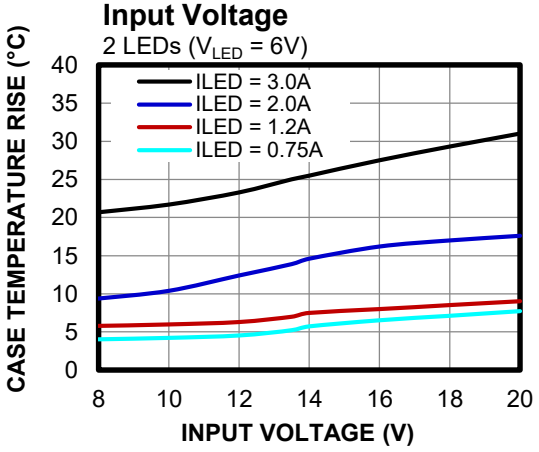
Efficiency vs. Input Voltage vs. Power Loss

1LED (V_{LED} = 3V), I_{LED} = 0.75A, L = 15µH, I_{LED} = 0.35A/0.5A, L = 22µH



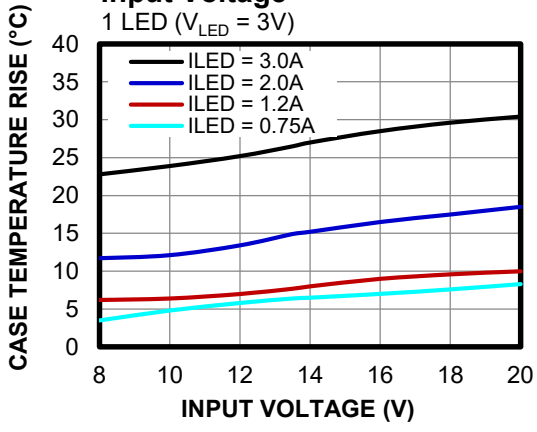
Case Temperature Rise vs. Input Voltage

2 LEDs (V_{LED} = 6V)



Case Temperature Rise vs. Input Voltage

1 LED (V_{LED} = 3V)



Note:

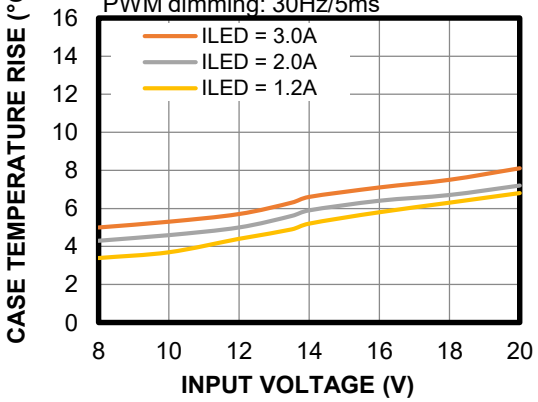
1) The inductor details regarding the efficiency curves follow: L = 15µH (XAL5050-153MEB), L = 22µH (XAL5050-223MEB).

EVB TEST RESULTS *(continued)*

Performance curves and waveforms are tested on the evaluation board, V_{IN} = 13.5V, 2 LEDs in series (V_{LED} = 6V), f_{SW} = 410kHz, L = 10µH, T_A = 25°C, unless otherwise noted.

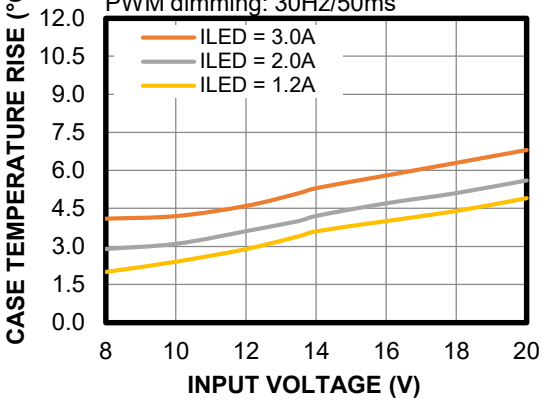
Case Temperature Rise vs. Input Voltage

2 LEDs (V_{LED} = 6V),
PWM dimming: 30Hz/5ms



Case Temperature Rise vs. Input Voltage

1 LED (V_{LED} = 3V),
PWM dimming: 30Hz/50ms



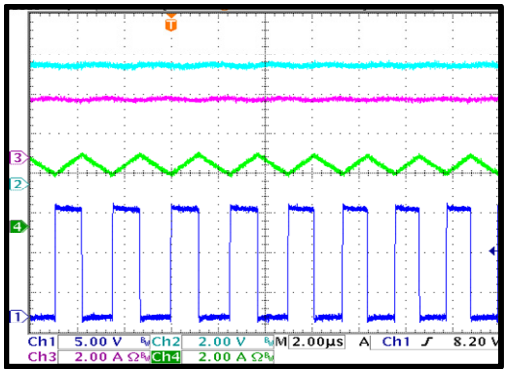
EVB TEST RESULTS *(continued)*

Performance curves and waveforms are tested on the evaluation board, V_{IN} = 13.5V, I_{LED} = 3A, 2 LEDs in series (V_{LED} = 6V), f_{SW} = 410kHz, L = 10µH, T_A = 25°C, unless otherwise noted.

Steady State

I_{LED} = 3A

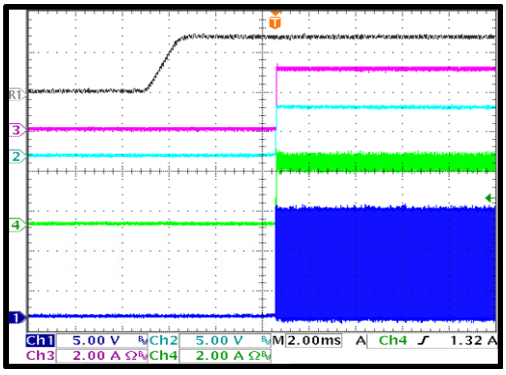
CH3: I_{LED}
CH2: V_{LED+} - V_{LED-}
CH4: I_L
CH1: V_{SW}



Start-Up through VIN

I_{LED} = 3A

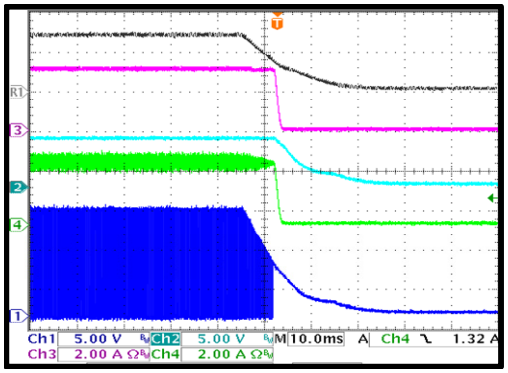
R1: V_{IN}: 10V/div.
CH3: I_{LED}
CH2: V_{LED+} -V_{LED-}
CH4: I_L
CH1: V_{SW}



Shutdown through VIN

I_{LED} = 3A

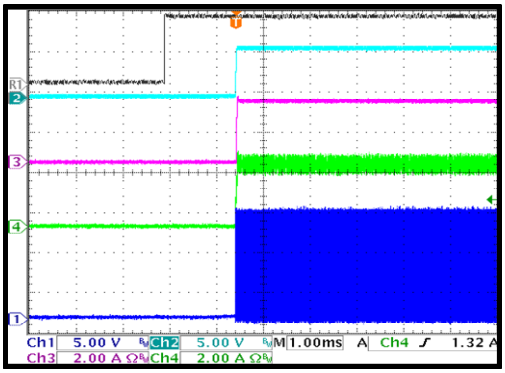
R1: V_{IN}: 10V/div.
CH3: I_{LED}
CH2: V_{LED+} -V_{LED-}
CH4: I_L
CH1: V_{SW}



Start-Up through EN

I_{LED} = 3A

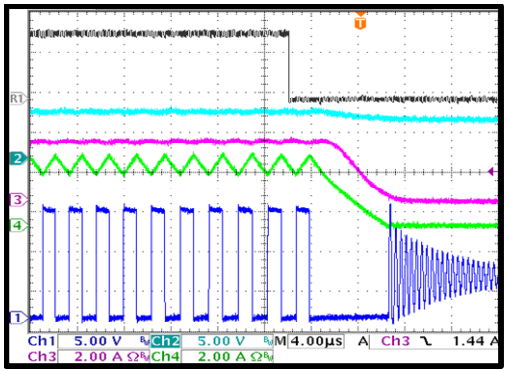
$V_{EN/DIM}$: 2V/div.
CH2: V_{LED+} -V_{LED-}
CH3: I_{LED}
CH4: I_L
CH1: V_{SW}



Shutdown through EN

I_{LED} = 3A

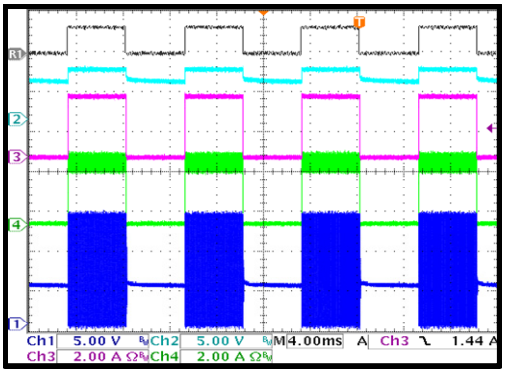
R1: $V_{EN/DIM}$: 2V/div.
CH2: V_{LED+} -V_{LED-}
CH3: I_{LED}
CH4: I_L
CH1: V_{SW}



PWM Dimming Steady State

Dimming frequency = 100Hz

R1: $V_{EN/DIM}$: 5V/div.
CH2: V_{LED+} -V_{LED-}
CH3: I_{LED}
CH4: I_L
CH1: V_{SW}



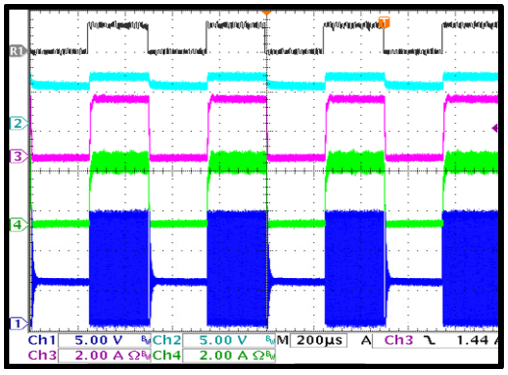
EVB TEST RESULTS *(continued)*

Performance curves and waveforms are tested on the evaluation board, V_{IN} = 13.5V, 2 LEDs in series (V_{LED} = 6V), f_{SW} = 410kHz, L = 10µH, T_A = 25°C, unless otherwise noted.

PWM Dimming Steady State

Dimming frequency = 2kHz

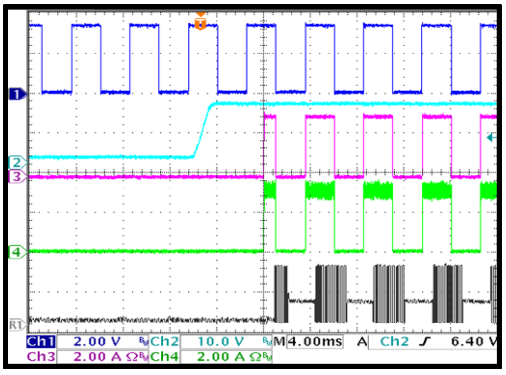
R1: $V_{EN/DIM}$: 5V/div.
CH2: V_{LED+} - V_{LED-}
CH3: I_{LED}
CH4: I_L
CH1: V_{SW}



PWM Dimming

Start-up through VIN

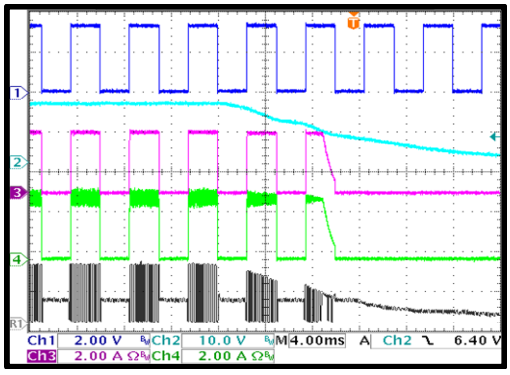
CH1: $V_{EN/DIM}$
CH2: V_{IN}
CH3: I_{LED}
CH4: I_L
R1: V_{SW}: 10V/div.



PWM Dimming

Shutdown through VIN

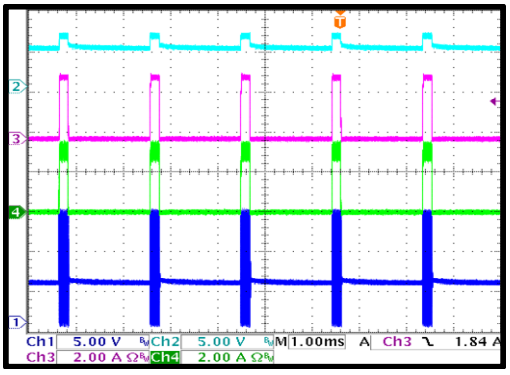
CH1: $V_{EN/DIM}$
CH2: V_{IN}
CH3: I_{LED}
CH4: I_L
R1: V_{SW}: 10V/div.



Two-Step Dimming

Steady state

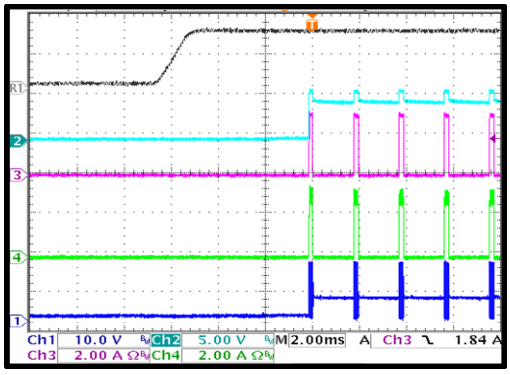
CH2: V_{LED+} - V_{LED-}
CH3: I_{LED}
CH4: I_L
CH1: V_{SW}



Two-Step Dimming

Start-up through VIN

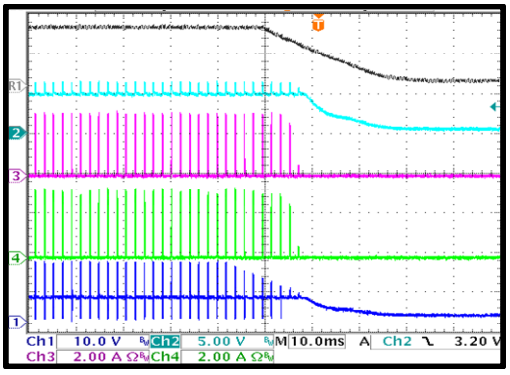
R1: V_{IN}: 10V/div.
CH2: V_{LED+} - V_{LED-}
CH3: I_{LED}
CH4: I_L
CH1: V_{SW}



Two-Step Dimming

Shutdown through VIN

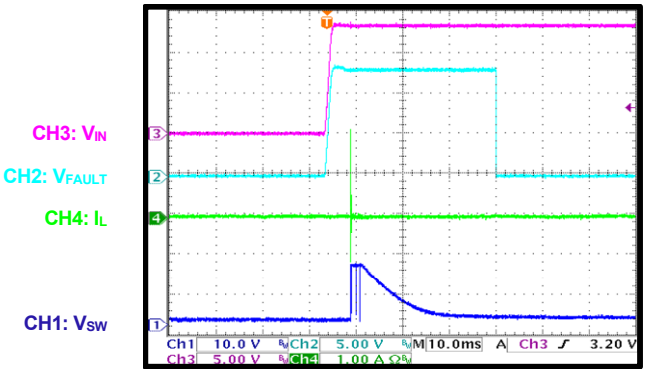
R1: V_{IN}: 10V/div.
CH2: V_{LED+} - V_{LED-}
CH3: I_{LED}
CH4: I_L
CH1: V_{SW}



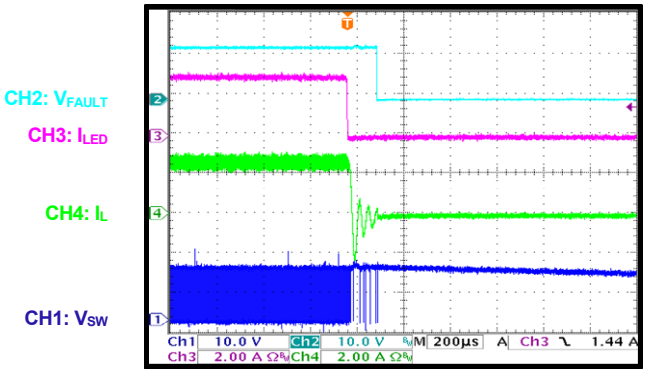
EVB TEST RESULTS *(continued)*

Performance curves and waveforms are tested on the evaluation board, V_{IN} = 13.5V, 2 LEDs in series (V_{LED} = 6V), f_{SW} = 410kHz, L = 10µH, T_A = 25°C, unless otherwise noted.

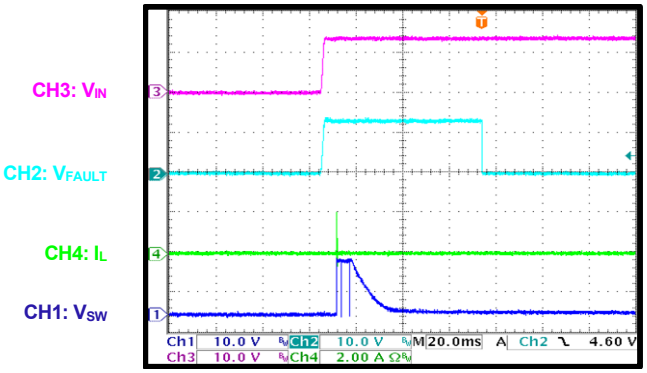
No Dimming
LED open start-up



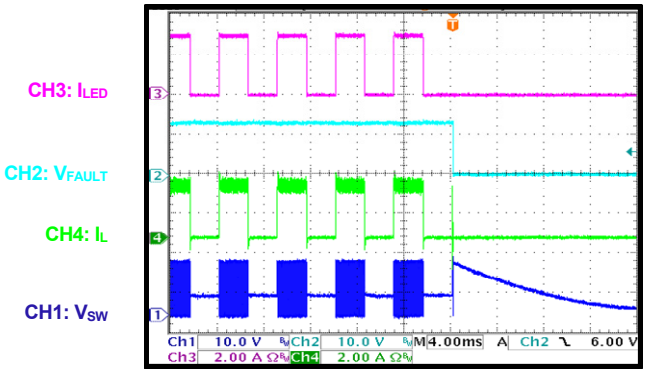
No Dimming
LED open entry



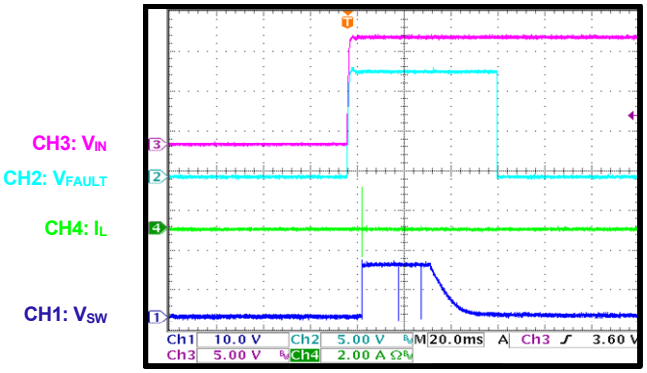
PWM Dimming
LED open start-up



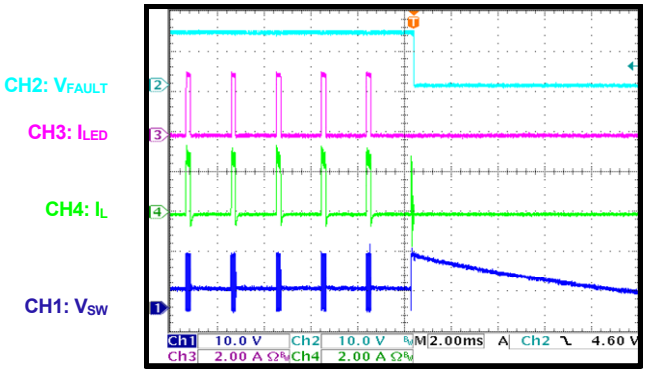
PWM Dimming
LED open entry



Two-Step Dimming
LED open start-up



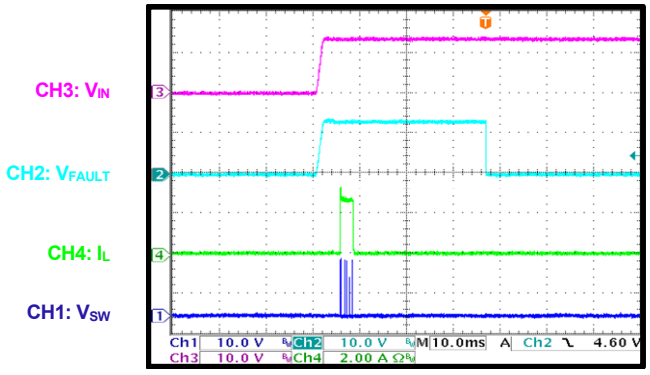
Two-Step Dimming
LED open start-up



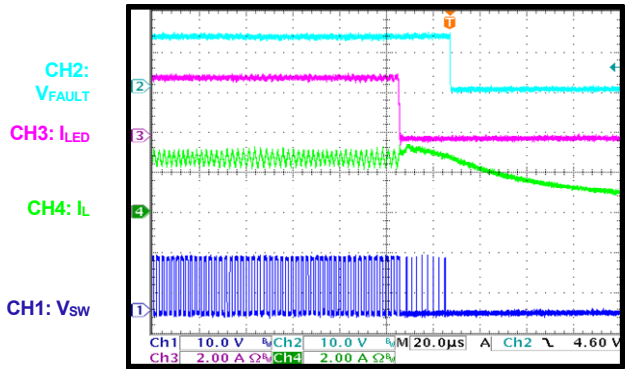
EVB TEST RESULTS *(continued)*

Performance curves and waveforms are tested on the evaluation board, V_{IN} = 13.5V, 2 LEDs in series (V_{LED} = 6V), f_{SW} = 410kHz, L = 10µH, T_A = 25°C, unless otherwise noted.

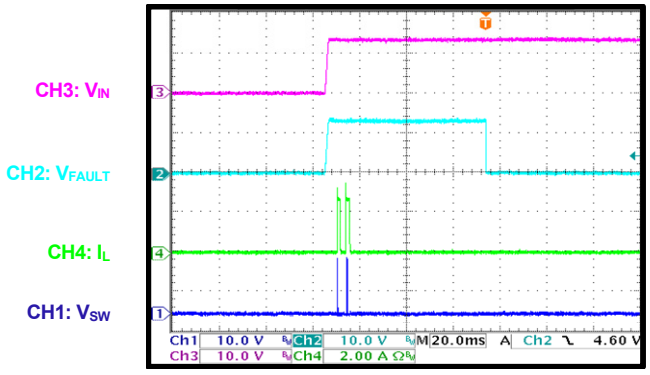
No Dimming
LED+ short to LED- start-up



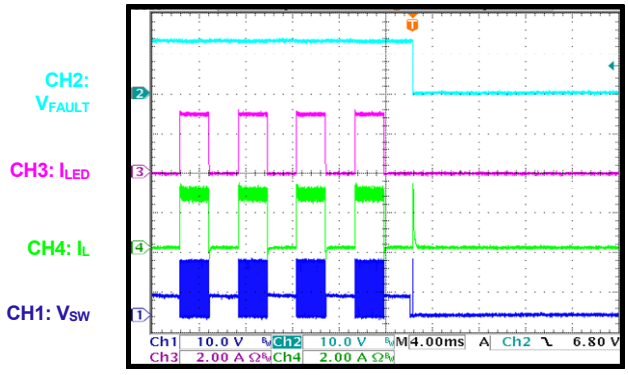
No Dimming
LED+ short to LED- entry



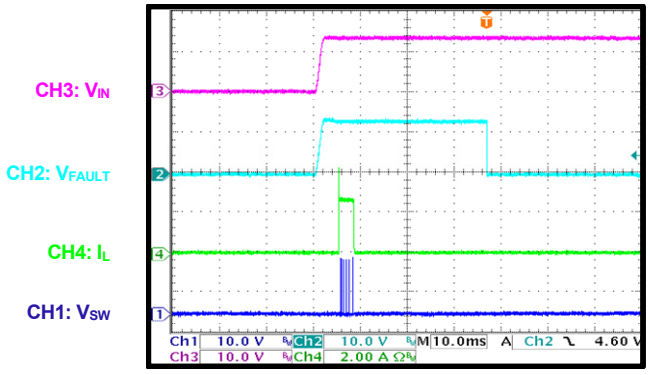
PWM Dimming
LED+ short to LED- start-up



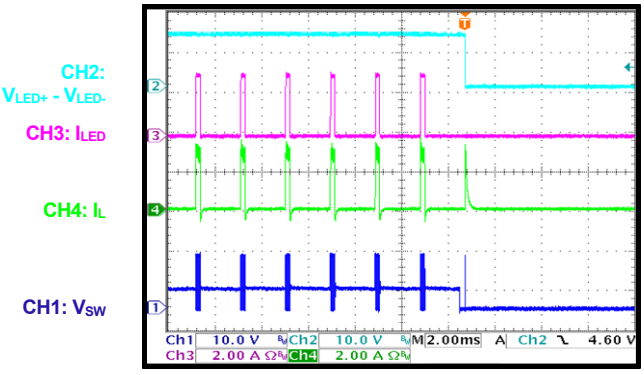
PWM Dimming
LED+ short to LED- entry



Two-Step Dimming
LED+ short to LED- start-up



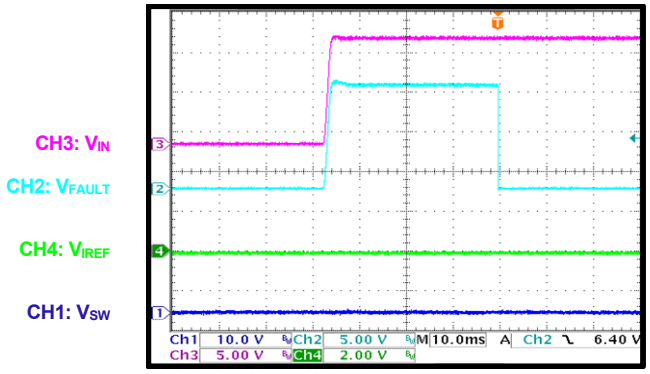
Two-Step Dimming
LED+ short to LED- entry



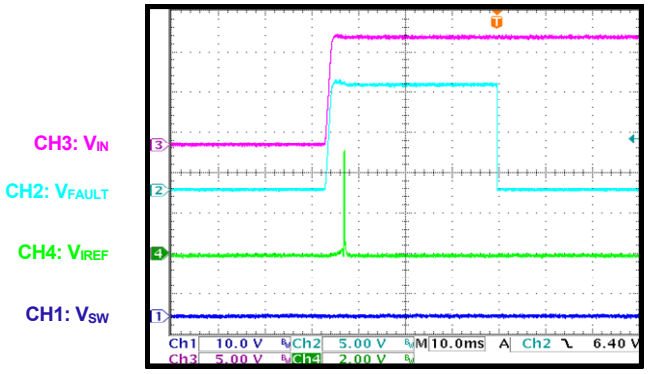
EVB TEST RESULTS *(continued)*

Performance curves and waveforms are tested on the evaluation board, V_{IN} = 13.5V, 2 LEDs in series (V_{LED} = 6V), f_{SW} = 410kHz, L = 10µH, T_A = 25°C, unless otherwise noted.

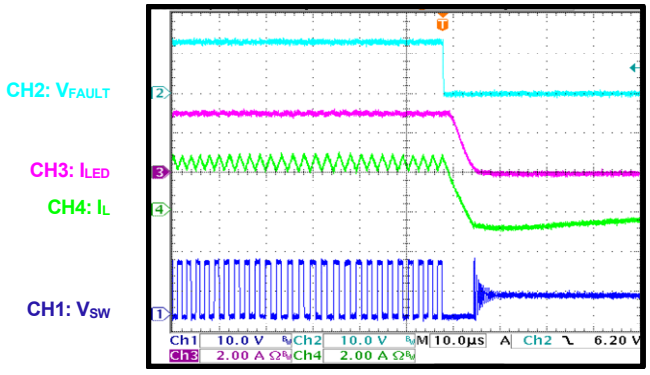
I_{REF} Short before Start-Up



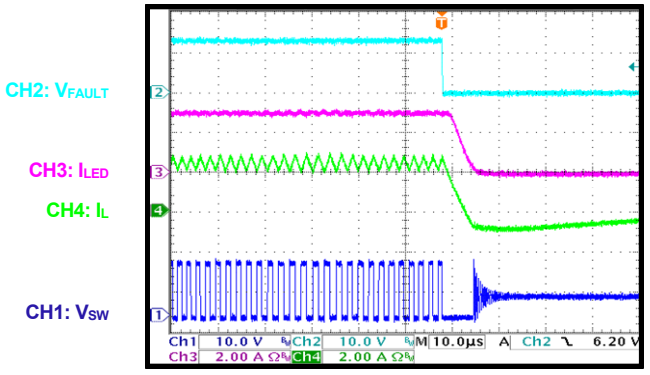
I_{REF} Open before Start-Up



I_{REF} Short after Start-Up

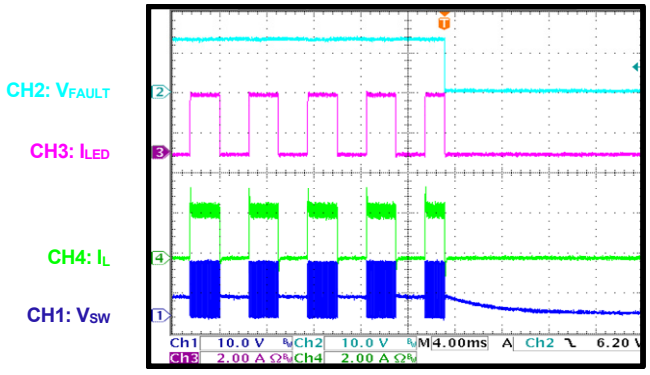


I_{REF} Open after Start-Up



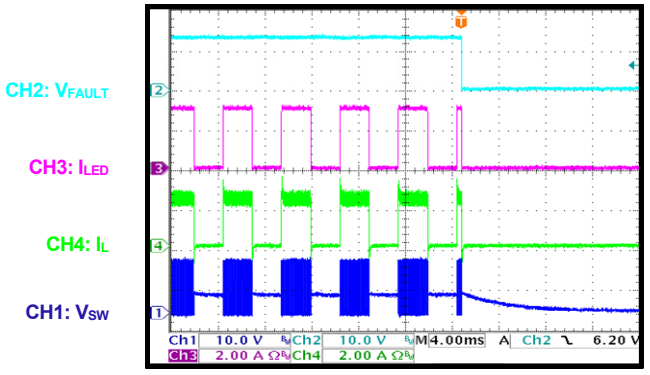
I_{REF} Short after Start-Up

PWM dimming



I_{REF} Open after Start-Up

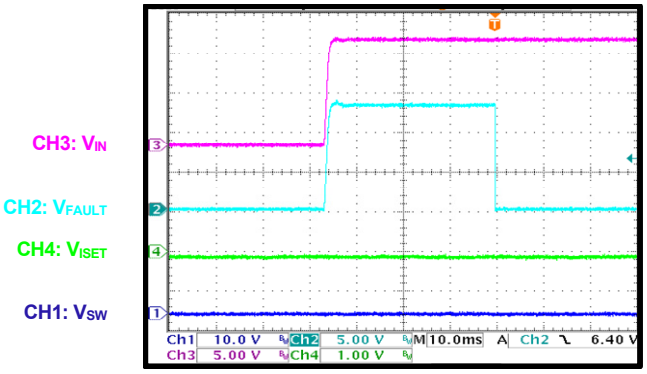
PWM dimming



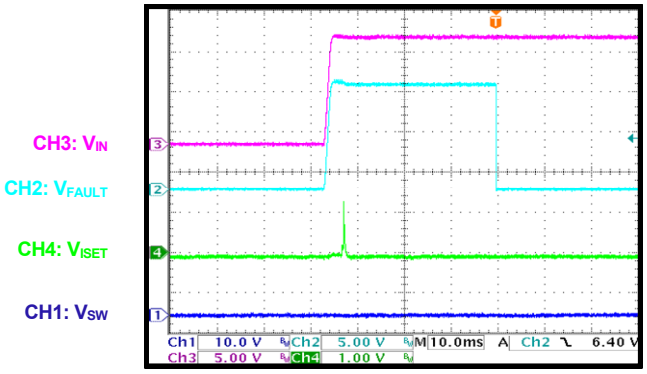
EVB TEST RESULTS *(continued)*

Performance curves and waveforms are tested on the evaluation board, V_{IN} = 13.5V, 2 LEDs in series (V_{LED} = 6V), f_{SW} = 410kHz, L = 10µH, T_A = 25°C, unless otherwise noted.

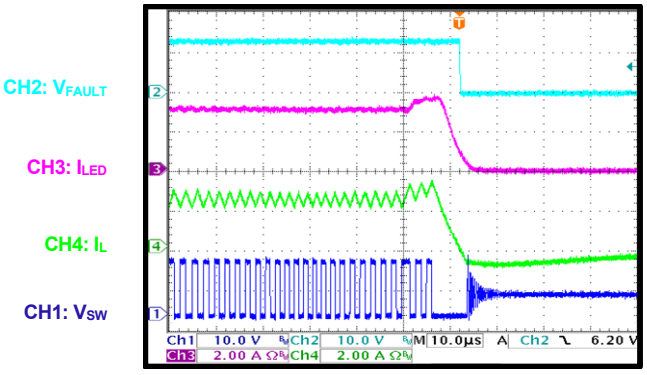
I_{SET} Short before Start-Up



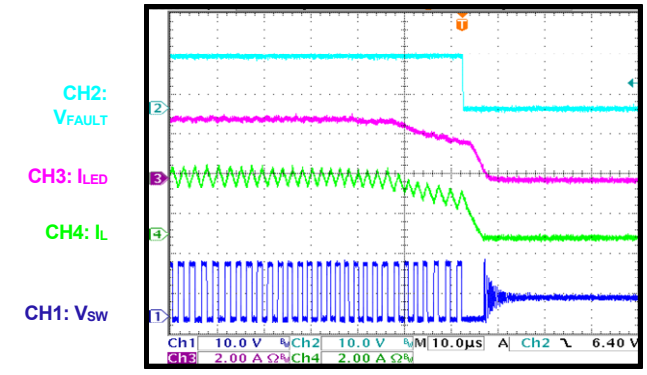
I_{SET} Open before Start-Up



I_{SET} Short after Start-Up

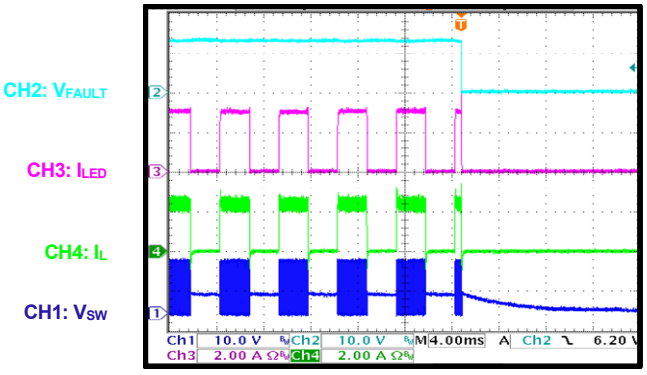


I_{SET} Open after Start-Up



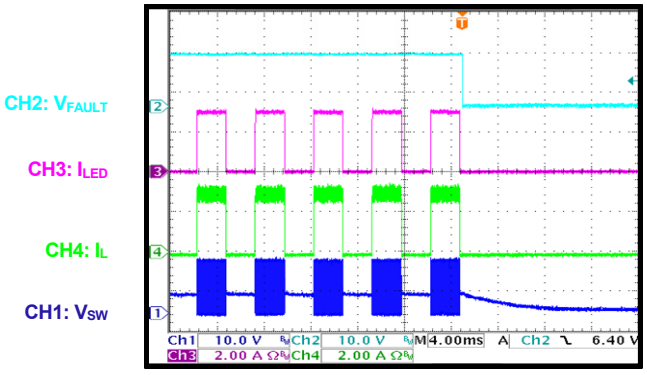
I_{SET} Short after Start-Up

PWM dimming



I_{SET} Open after Start-Up

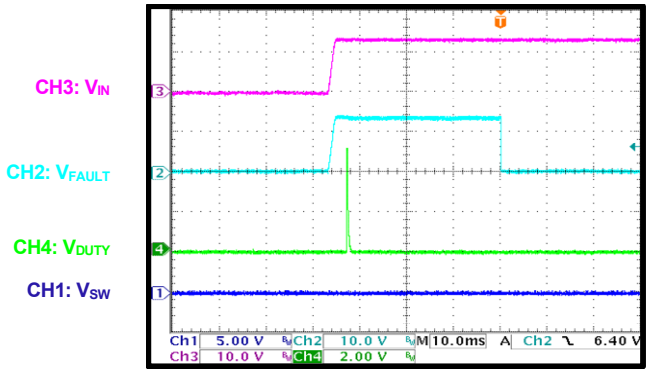
PWM dimming



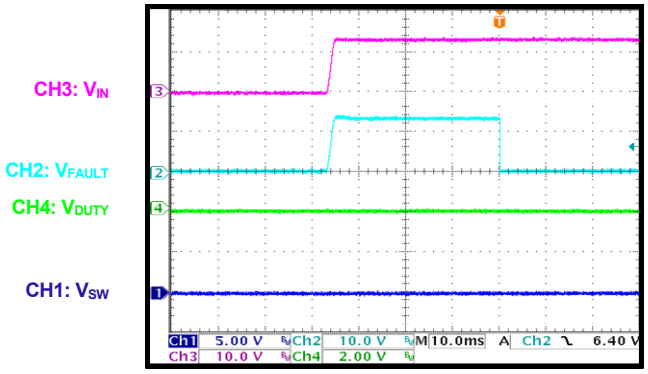
EVB TEST RESULTS *(continued)*

Performance curves and waveforms are tested on the evaluation board, V_{IN} = 13.5V, 2 LEDs in series (V_{LED} = 6V), f_{SW} = 410kHz, L = 10µH, T_A = 25°C, unless otherwise noted.

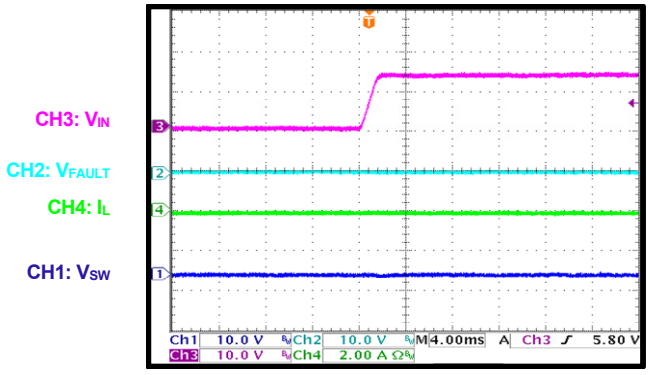
I_{DUTY} Short before Start-Up



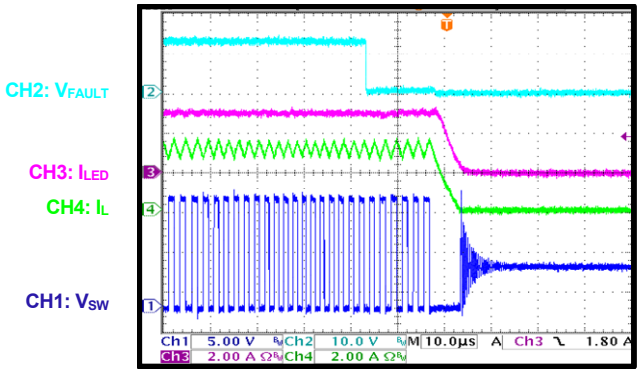
I_{DUTY} Open before Start-Up



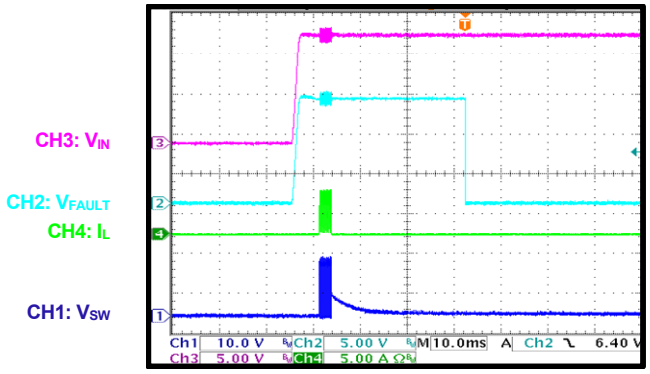
FAULT Short during VIN Start Up



FAULT Short after VIN Start-Up



False Mode Detection during VIN Start-Up



PCB LAYOUT

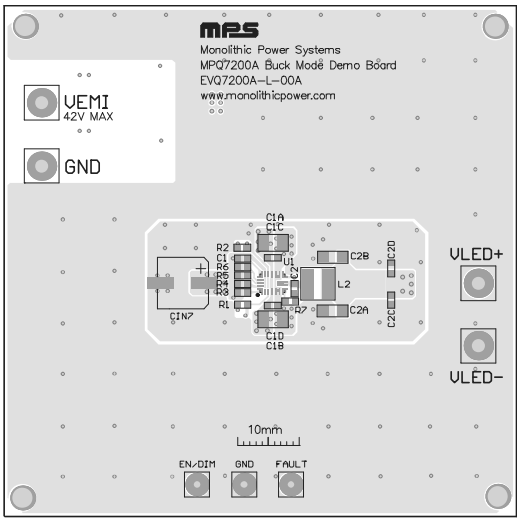


Figure 3: Top Silk and Top Layer

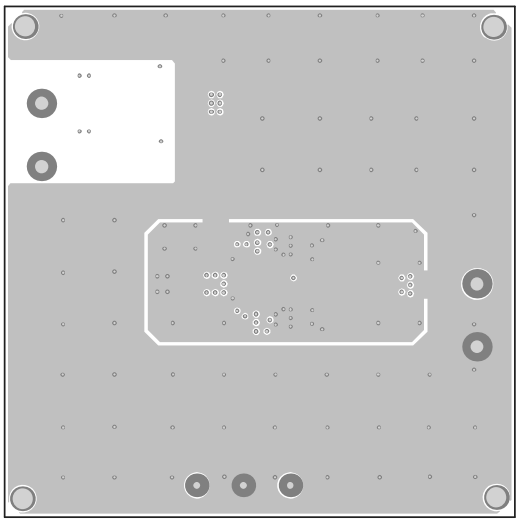


Figure 4: Mid-Layer 1

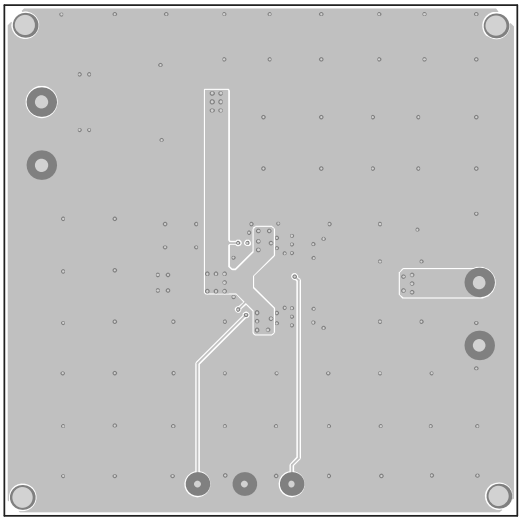


Figure 5: Mid-Layer 2

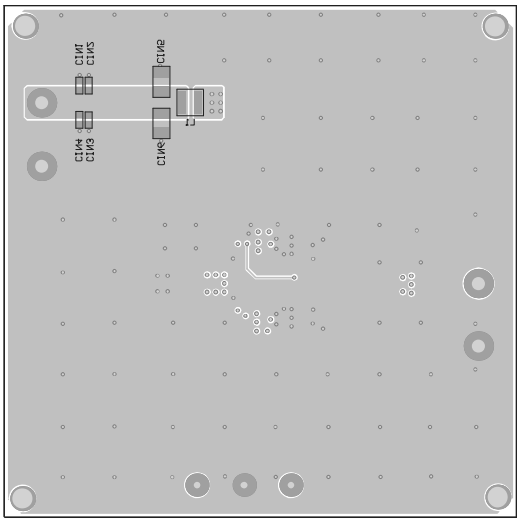


Figure 6: Bottom Layer and Bottom Silk

REVISION HISTORY

Revision #	Revision Date	Description	Pages Updated
1.0	2/7/2022	Initial Release	-