EV24881-S-00A

60V, 700mA, Synchronous Step-Down LED Driver Evaluation Board

DESCRIPTION

The EV24881-S-00A is an evaluation board designed for the MP24881, a 60V, monolithic, synchronous step-down LED driver with a built-in power N-channel MOSFET and rectifier. It delivers up to 1.1A of continuous output current (I_{OUT}) to high-power LEDs. The wide 10V to 60V input voltage (V_{IN}) range accommodates a variety of step-down lighting applications. Hysteretic current mode control achieves very fast transient response and eliminates the need for loop compensation design.

The MP24881 supports analog dimming and implements down to a 3% dimming depth. It also supports analog dimming with a pulse-width modulation (PWM) signal input, which removes the flicker caused by the PWM frequency. This dimming depth can also be 3%.

The separated PWM and analog signal inputs achieve and simplify hybrid dimming This feature also allows all PWM signals to be controlled by hybrid dimming, with a dimming depth down to 0.1%.

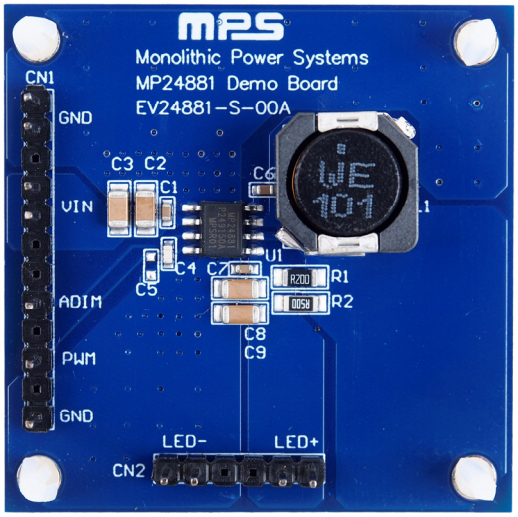
The EV24881-S-00A is used to demonstrate the MP24881's performance, especially its dimming performance and typical waveforms, in applications with a 700mA I_{OUT}.

PERFORMANCE SUMMARY

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

Parameters	Conditions	Value
Input voltage (V_{IN}) range		10V to 60V
Output current (I_{OUT})		I_{OUT} = 700mA
Typical efficiency	V_{IN} = 40V, V_{OUT} = 35V, I_{OUT} = 700mA	98%

EVALUATION BOARD



LxWxH (4.6cmx4.6cmx1cm)

Board Number	MPS IC Number
EV24881-S-00A	MP24881GN

QUICK START GUIDE

To set up the device, refer to Figure 1 and follow the guidelines below.

Non-Dimming Applications

1. Preset the DC power supply output to be between 10V and 60V, then turn off the power supply.
2. Connect the power supply terminals to:
   a. Positive (+): VIN
   b. Negative (-): GND
3. Connect the LED load between LED+ (anode of the LED string) and LED- (cathode of the LED string).
4. Turn on the power supply.

Dimming Applications

1. Preset the DC power supply output to be between 10V and 60V, then turn off the power supply.
2. Connect the power supply terminals to:
   a. Positive (+): VIN
   b. Negative (-): GND
3. Connect the LED load between LED+ (anode of the LED string) and LED- (cathode of the LED string).
4. Connect the dimming input signal to the corresponding pin. For analog dimming, connect the dimming input signal to the ADIM pin. For PWM dimming, connect the dimming input signal to the PWM pin. For hybrid dimming, connect two dimming input signals to the ADIM and PWM pins, respectively.
5. Turn on the dimming input signal.
6. Turn on the power supply.

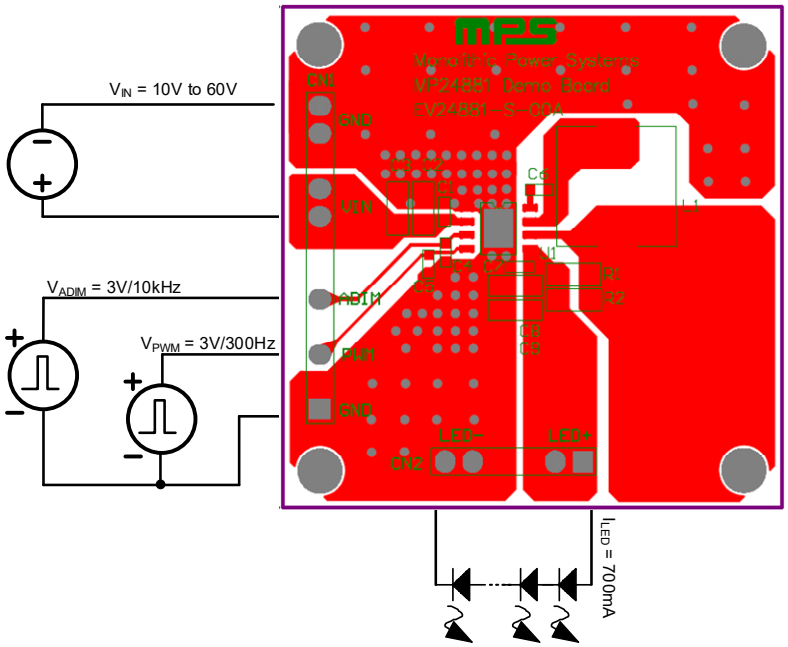


Figure 1: Measurement Equipment Set-Up

EVALUATION BOARD SCHEMATIC

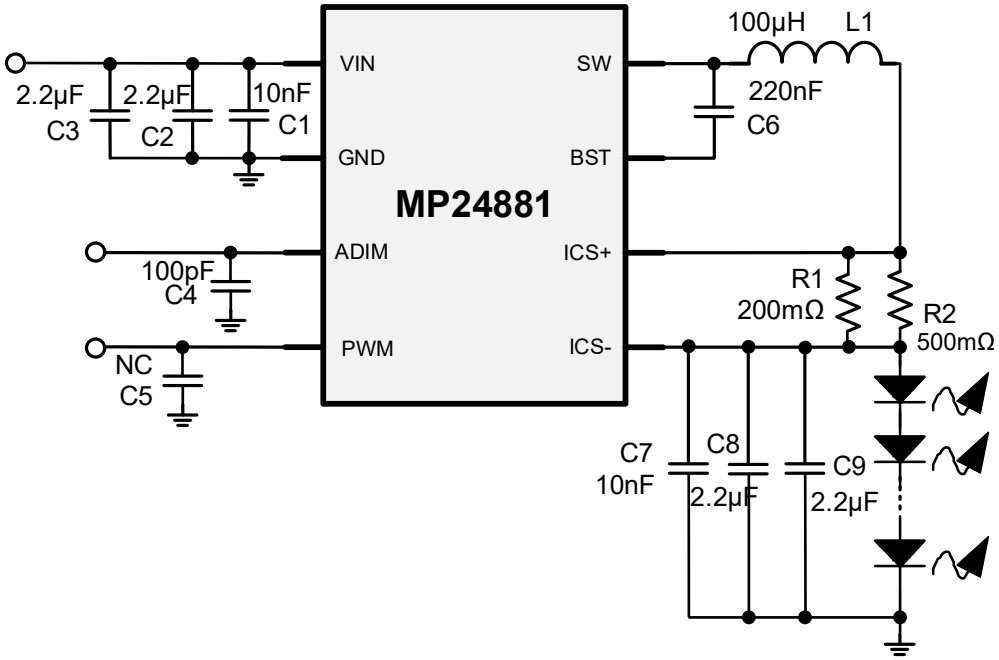


Figure 2: Evaluation Board Schematic

EV24881-S-00A BILL OF MATERIALS

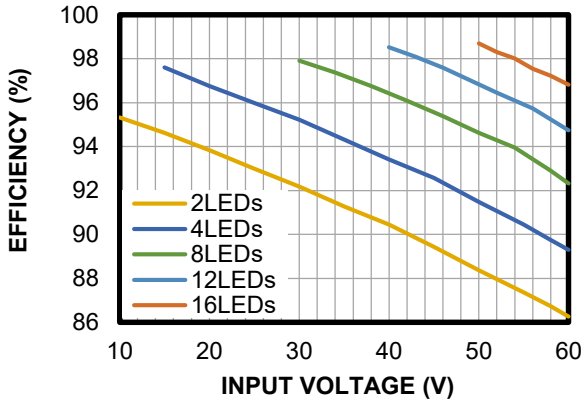
Qty	Ref	Value	Description	Package	Manufacturer	Manufacturer PN
2	C1, C7	10nF	Ceramic capacitor, 100V, X7R	0603	Murata	GRM188R72A103KA01D
4	C2, C3, C8, C9	2.2µF	Ceramic capacitor, 100V, X7R	1206	Murata	GRM31CR72A225KA73L
1	C6	220nF	Ceramic capacitor, 16V, X7R	0603	Murata	GRM188R71C224KA01D
1	C4	100pF	Ceramic capacitor, 50V, NP0	0603	Wurth	885012006057
1	C5	NC				
1	L1	100µH	Inductor, 2.1A, 105mΩ	SMD	Wurth	7447707101
1	R1	200mΩ	Thick film chip resistor, 1%	1206	Yageo	RL1206FR-070R2L
1	R2	500mΩ	Thick film chip resistor, 1%	1206	Yageo	RL1206FR-070R5L
1	U1	MP24881	Step-down LED lighting driver	SOIC-8EP	MPS	MP24881GN

EVB TEST RESULTS

Performance curves and waveforms are tested on the evaluation board. V_{IN} = 56V, I_{OUT} = 700mA, T_A = 25°C, unless otherwise noted.

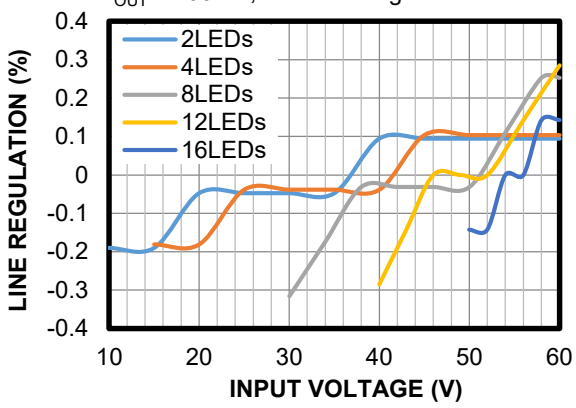
Efficiency vs. V_{IN}

I_{OUT} = 700mA, non-dimming



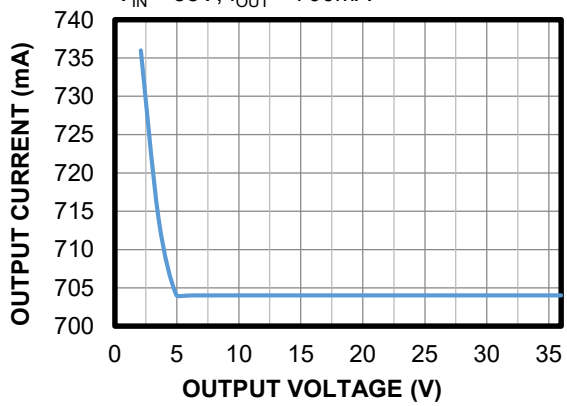
Line Regulation

I_{OUT} = 700mA, non-dimming



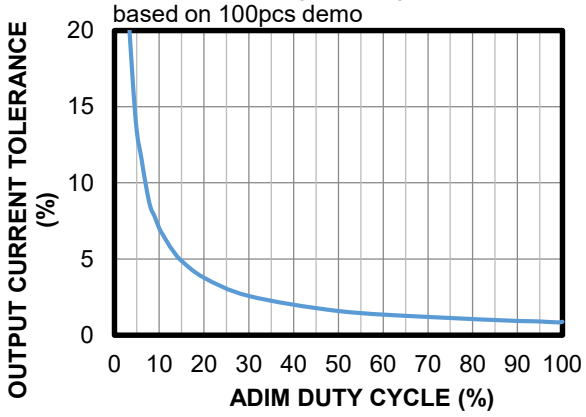
Load Regulation

V_{IN} = 58V, I_{OUT} = 700mA



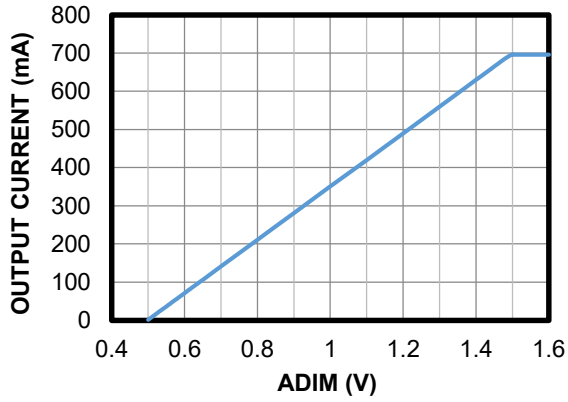
Output Current Tolerance vs. ADIM Duty Cycle

PWM input analog dimming, based on 100pcs demo



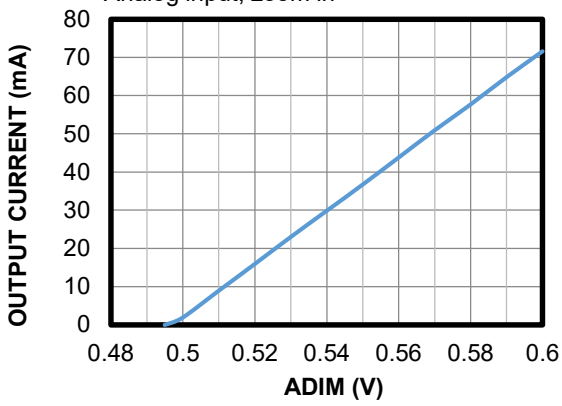
Analog Dimming Curve

Analog input



Analog Dimming Curve

Analog input, zoom in

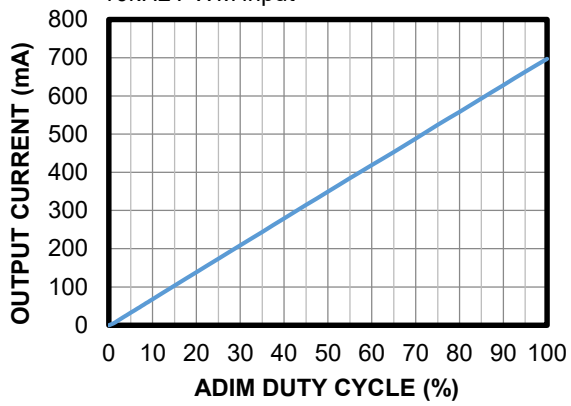


EVB TEST RESULTS *(continued)*

Performance curves and waveforms are tested on the evaluation board. V_{IN} = 56V, I_{OUT} = 700mA, T_A = 25°C, unless otherwise noted.

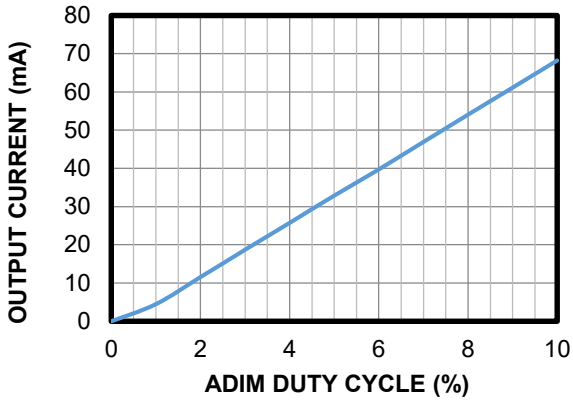
Analog Dimming Curve

10kHz PWM input



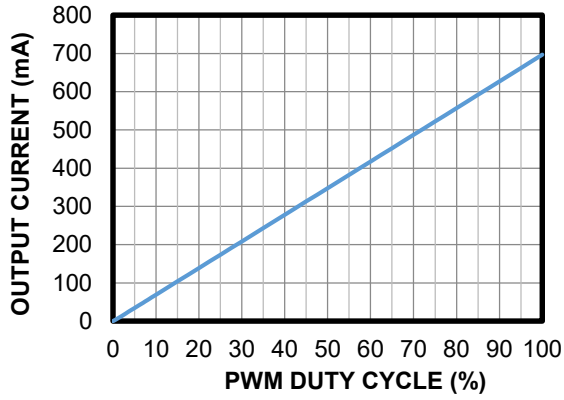
Analog Dimming Curve

10kHz PWM input, zoom in



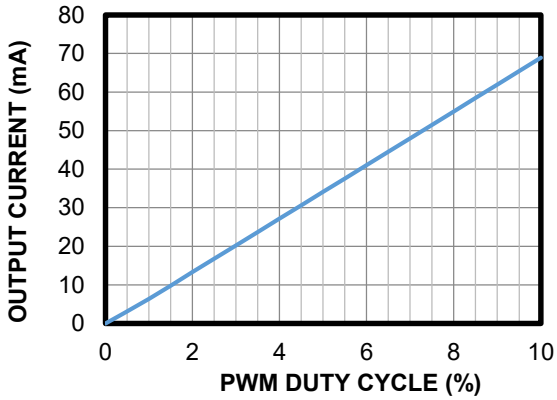
PWM Dimming Curve

300Hz PWM input



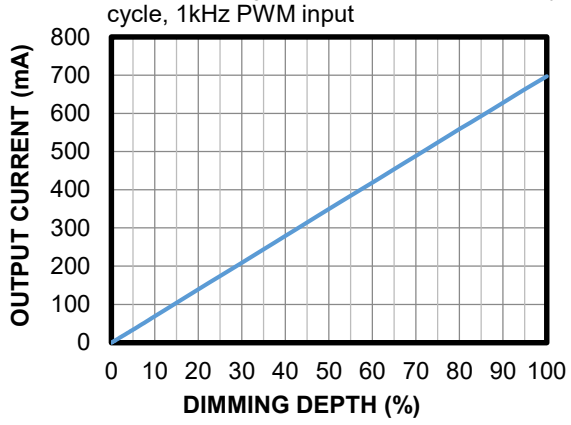
PWM Dimming Curve

300Hz PWM input, zoom in



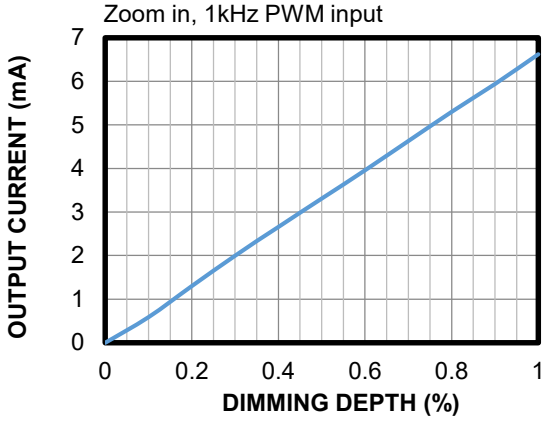
Hybrid Dimming Curve

PWM dimming is added at 10% ADIM duty cycle, 1kHz PWM input



Hybrid Dimming

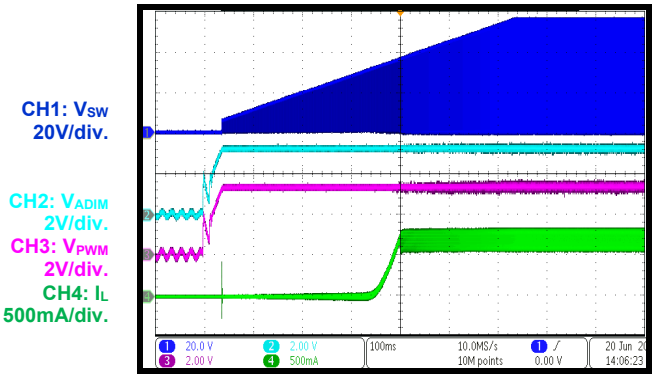
Zoom in, 1kHz PWM input



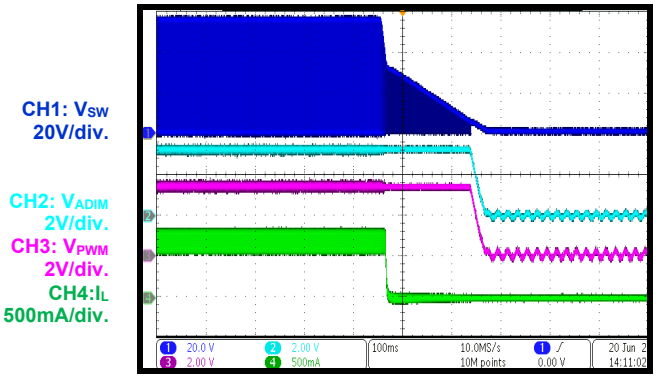
EVB TEST RESULTS *(continued)*

Performance curves and waveforms are tested on the evaluation board. V_{IN} = 56V, I_{OUT} = 700mA, T_A = 25°C, unless otherwise noted.

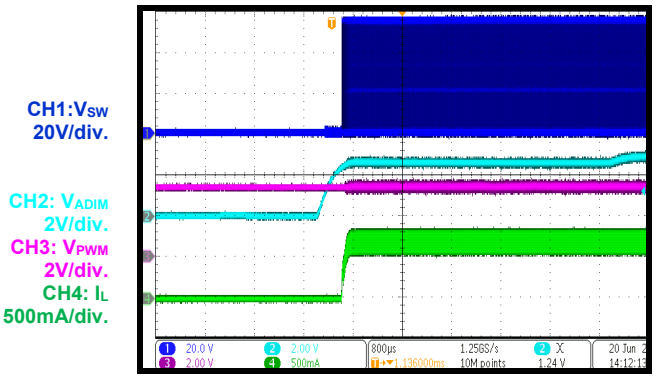
Start-Up through VIN
ADIM and PWM floating



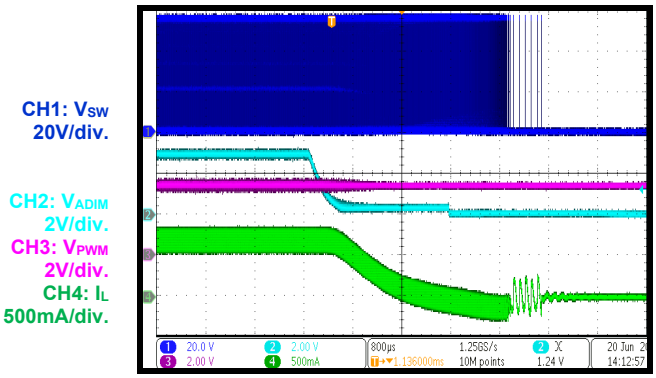
Shutdown through VIN
ADIM and PWM floating



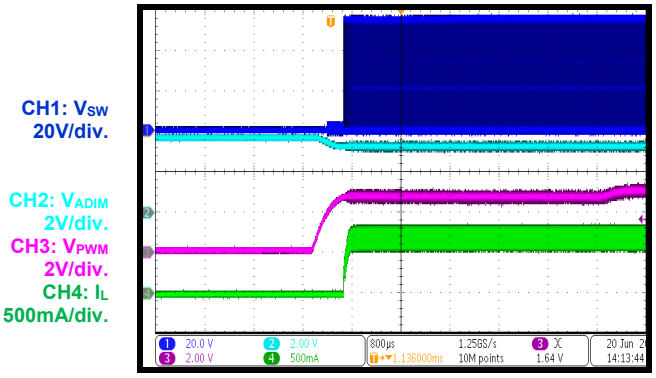
Start-Up through ADIM
PWM floating



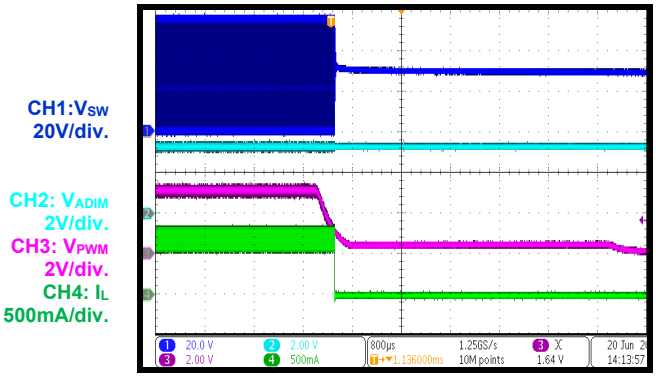
Shutdown through ADIM
PWM floating



Start-Up through PWM
ADIM floating



Shutdown through PWM
ADIM floating

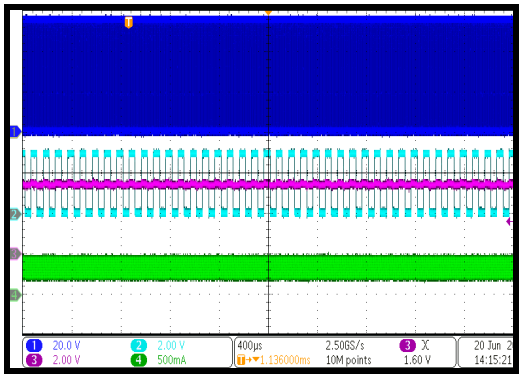


EVB TEST RESULTS *(continued)*

Performance curves and waveforms are tested on the evaluation board. V_{IN} = 56V, I_{OUT} = 700mA, T_A = 25°C, unless otherwise noted.

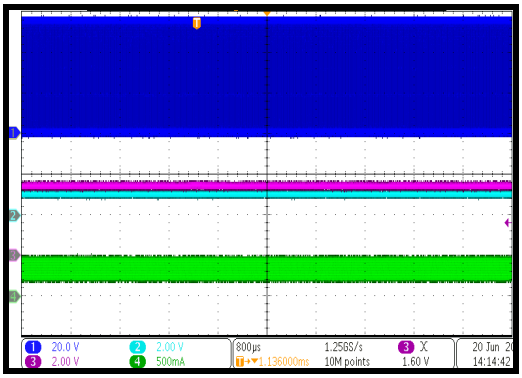
Analog Dimming
ADIM = 50%at 10kHz

CH1: V_{SW} 20V/div.
CH2: V_{ADIM} 2V/div.
CH3: V_{PWM} 2V/div.
CH4: I_L 500mA/div.



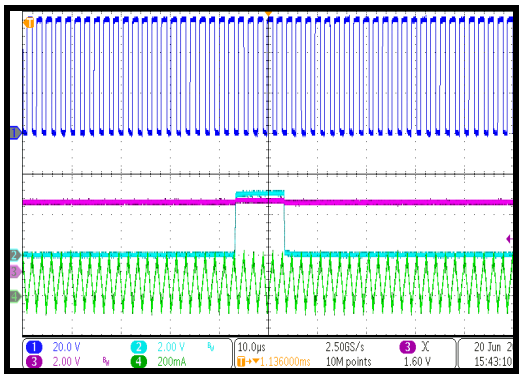
Analog Dimming
ADIM = 1V

CH1: V_{SW} 20V/div.
CH2: V_{ADIM} 2V/div.
CH3: V_{PWM} 2V/div.
CH4: I_L 500mA/div.



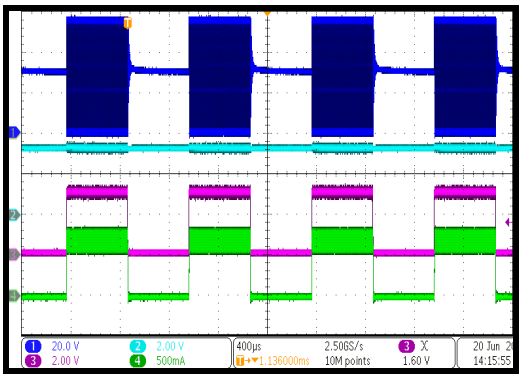
Analog Dimming
ADIM = 10% duty cycle at 10kHz

CH1: V_{SW} 20V/div.
CH2: V_{ADIM} 2V/div.
CH3: V_{PWM} 2V/div.
CH4: I_L 200mA/div.



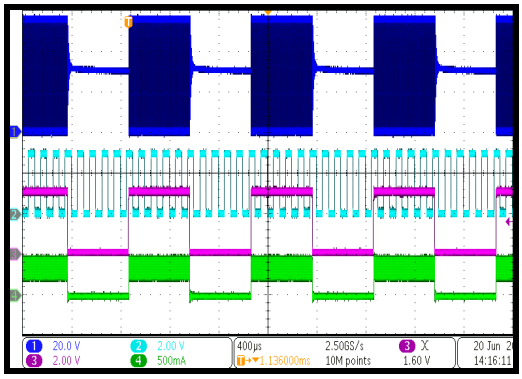
PWM Dimming
PWM = 50% duty cycle at 1kHz

CH1: V_{SW} 20V/div.
CH2: V_{ADIM} 2V/div.
CH3: V_{PWM} 2V/div.
CH4: I_L 500mA/div.



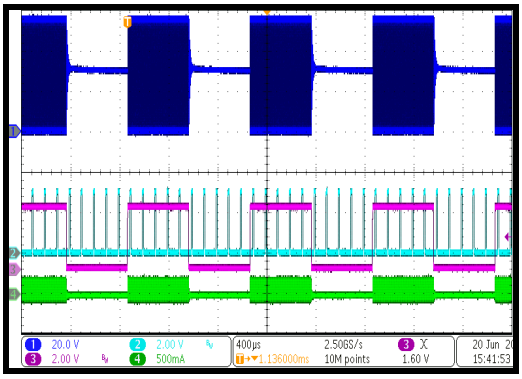
Hybrid Dimming
ADIM = 50% duty cycle at 10kHz, PWM = 50% at 1kHz

CH1: V_{SW} 20V/div.
CH2: V_{ADIM} 2V/div.
CH3: V_{PWM} 2V/div.
CH4: I_L 500mA/div.



Hybrid Dimming
ADIM = 10% duty cycle at 10kHz, PWM = 50% at 1kHz

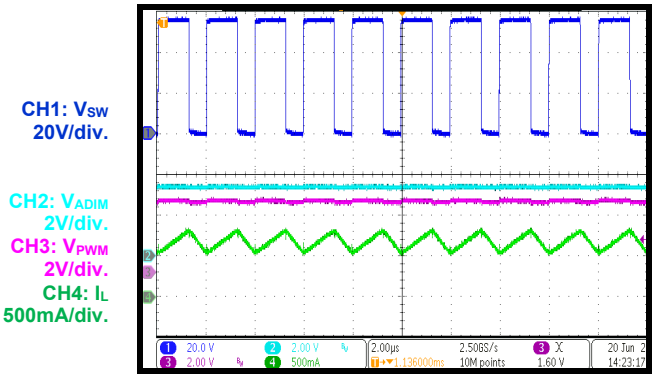
CH1: V_{SW} 20V/div.
CH2: V_{ADIM} 2V/div.
CH3: V_{PWM} 2V/div.
CH4: I_L 500mA/div.



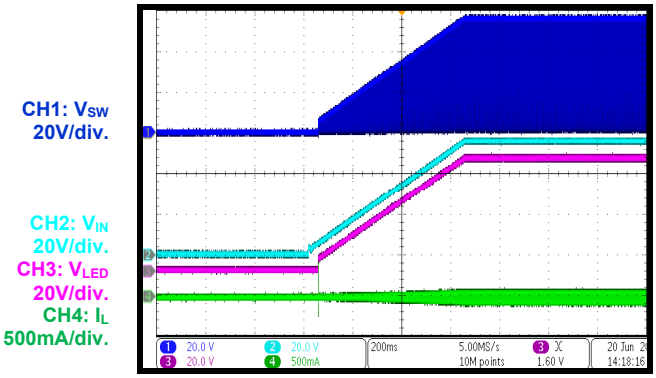
EVB TEST RESULTS *(continued)*

Performance curves and waveforms are tested on the evaluation board. V_{IN} = 56V, I_{OUT} = 700mA, T_A = 25°C, unless otherwise noted.

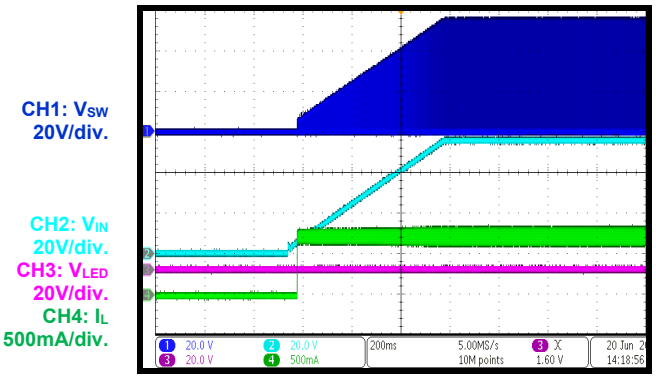
Steady State
ADIM and PWM floating



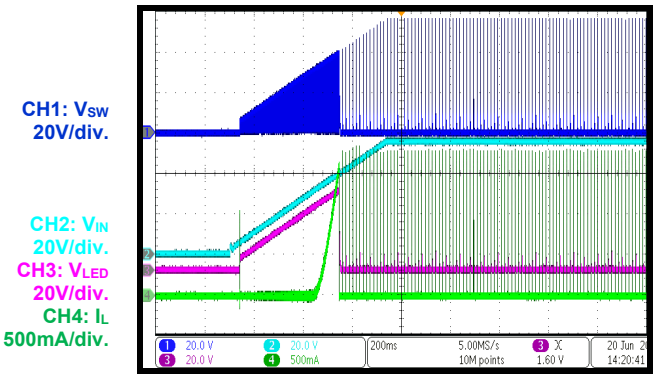
Open LED before VIN Start-Up
ADIM and PWM floating



Short LED before VIN Start-Up
ADIM and PWM floating



Short R_{CS} before VIN Start-Up
ADIM and PWM floating



PCB LAYOUT

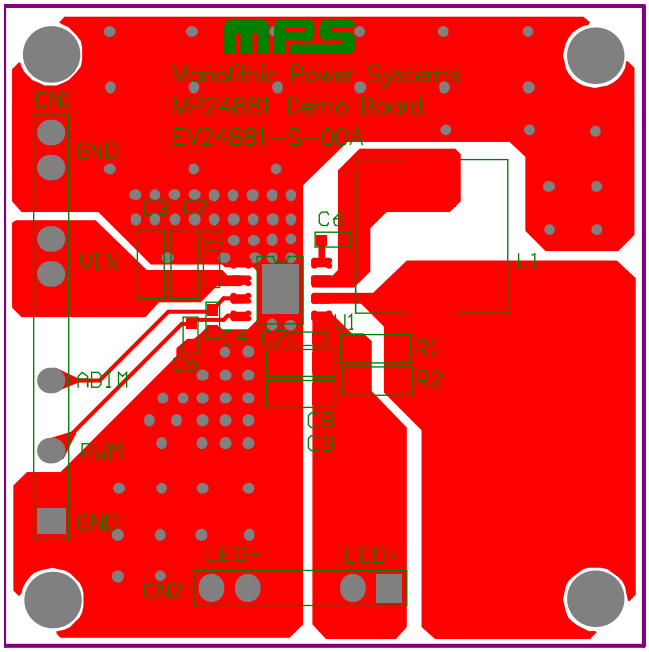


Figure 3: Top Layer

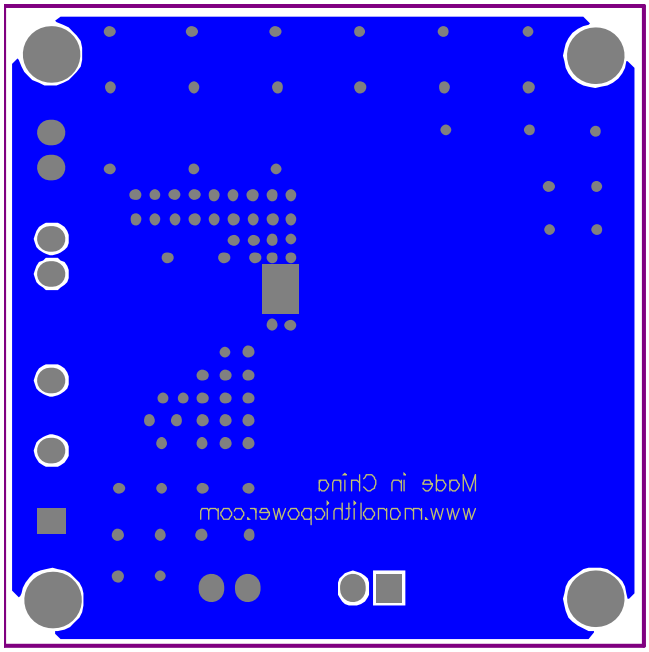


Figure 4: Bottom Layer

PCB Layout Guidelines

For the best results, refer to Figure 5 and follow the guidelines below:

1. Place the VIN decoupling capacitor close to the VIN and GND pins. The capacitor (C_{IN2}) is recommended to be a 1nF, 0603 ceramic capacitor.
2. Place the inductor close to the SW pin to shorten the SW connection and improve the EMI environment.
3. Place the current-sense resistor close to the output capacitor and the ICS+ and ICS- pins to improve noise coupling.
4. Connect the thermal pad to GND.
5. Minimize the GND loop to optimize the switching loop's EMI environment.

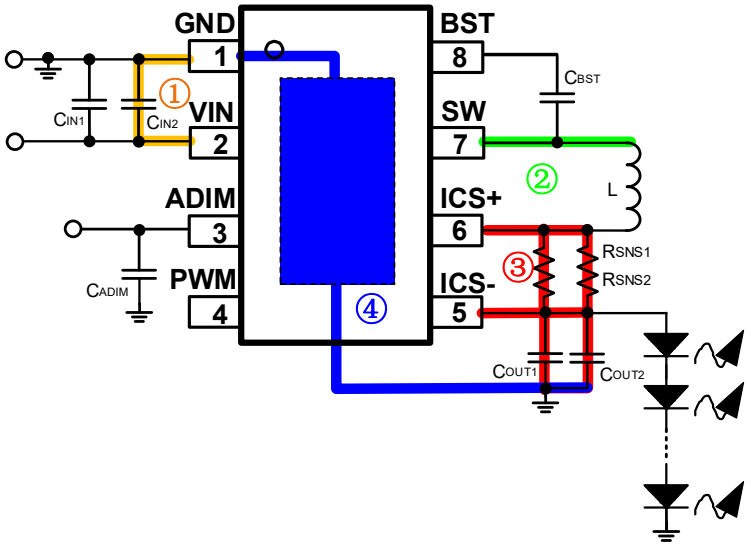


Figure 5: PCB Layout Guidelines

REVISION HISTORY

Revision #	Revision Date	Description	Pages Updated
1.0	8/15/2023	Initial Release	-