EVQ2179-QH-00A

3A, 6V, 2.4MHz, Synchronous Step-Down Converter Evaluation Board, AEC-Q100 Qualified

DESCRIPTION

The EVQ2179-QH-00A is an evaluation board designed to demonstrate the capabilities of the MPQ2179GQHE-AEC1, a monolithic, step-down switch-mode converter with built-in internal power MOSFETs.

The MPQ2179 achieves 3A of output current (I_{OUT}) from a 2.5V to 6V input voltage (V_{IN}) range, with excellent load and line regulation. The output voltage (V_{OUT}) can be regulated to as low as 0.6V. A 100% maximum duty cycle can be reached in low-dropout (LDO) mode.

Constant on-time (COT) control offers a simpler control loop and faster transient response. By using V_{IN} feed-forward, the MPQ2179 maintains a nearly constant switching frequency (f_{SW}) across the input and load ranges. Forced continuous conduction mode (FCCM) has a stable frequency and a lower output ripple.

An open-drain power good (PG) signal indicates a nominal voltage after the soft-start time. PG pulls high if the feedback voltage (V_{FB}) reaches 90% of the reference voltage (V_{REF}); PG pulls to GND when V_{FB} drops to 85% of V_{REF}.

Full protection features include cycle-by-cycle current limiting, short-circuit protection (SCP), reliable over-voltage protection (OVP), and thermal protection with automatic recovery.

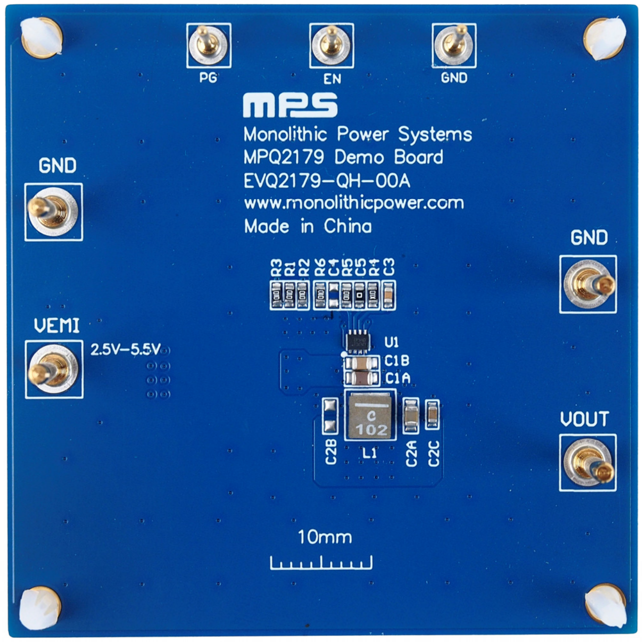
The EVQ2179-QH-00A is a fully assembled and tested evaluation board. The MPQ2179 is available in a QFN-8 (1.5mmx2mm) package, and is available in AEC-Q100 Grade 1.

PERFORMANCE SUMMARY

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

Parameters	Conditions	Value
Input voltage (V_{IN}) range		2.5V to 6V
Output voltage (V_{OUT})	V_{IN} = 2.5V to 6V, I_{OUT} = 0A to 3A	1.2V
Maximum output current (I_{OUT})	V_{IN} = 2.5V to 6V	3A
Typical efficiency	V_{IN} = 3.3V, V_{OUT} = 1.2V, I_{OUT} = 3A	79.1%
Peak efficiency	V_{IN} = 2.5V, V_{OUT} = 1.2V, I_{OUT} = 0.4A	92.2%
Switching frequency (f_{SW})		2.4MHz

EVQ2179-QH-00A EVALUATION BOARD



LxWxH (6.3cmx6.3cmx1cm)

Board Number	MPS IC Number
EVQ2179-QH-00A	MPQ2179GQHE-AEC1

QUICK START GUIDE

The EVQ2179-QH-00A evaluation board is easy to set up and use to evaluate the MPQ2179's performance. For proper measurement equipment set-up, refer to Figure 2 on page 4 and follow the steps below:

1. Preset the power supply (V_{IN}) between 2.5V and 6V, then turn off the power supply.
2. Set the load current between 0A and 3A. Electronic loads represent a negative impedance to the regulator, and setting a current too high may trigger cycle-by-cycle over-current protection (OCP).
3. If longer cables (>0.5m total) are used between the source and the evaluation board, place a damping capacitor at the input terminals.
4. Connect the power supply terminals to:
   a. Positive (+): VEMI
   b. Negative (-): GND
5. Connect the load terminals to:
   a. Positive (+): VOUT
   b. Negative (-): GND
6. After making the connections, turn on the power supply.
7. To use the enable function, apply a digital input to the EN pin. Drive EN above 0.9V to turn the regulator on; drive EN below 0.65V to turn the regulator off. If the enable function is not used, EN can be connected directly to VIN.
8. The external resistor divider sets the output voltage (V_{OUT}) (see Figure 1).

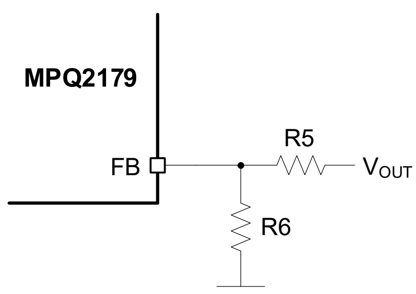


Figure 1: Feedback Divider Network with Adjustable Output

R5 is selected to be between 10kΩ and 100kΩ. R6 can then be calculated with Equation (1):

$$R6 = \frac{R5}{\frac{V_{OUT}}{0.6} - 1} \quad (1)$$

Refer to the Application Information section in the MPQ2179's datasheet to calculate the inductance and output capacitance for different V_{OUT} values. Figure 2 on page 4 shows the proper measurement equipment set-up.

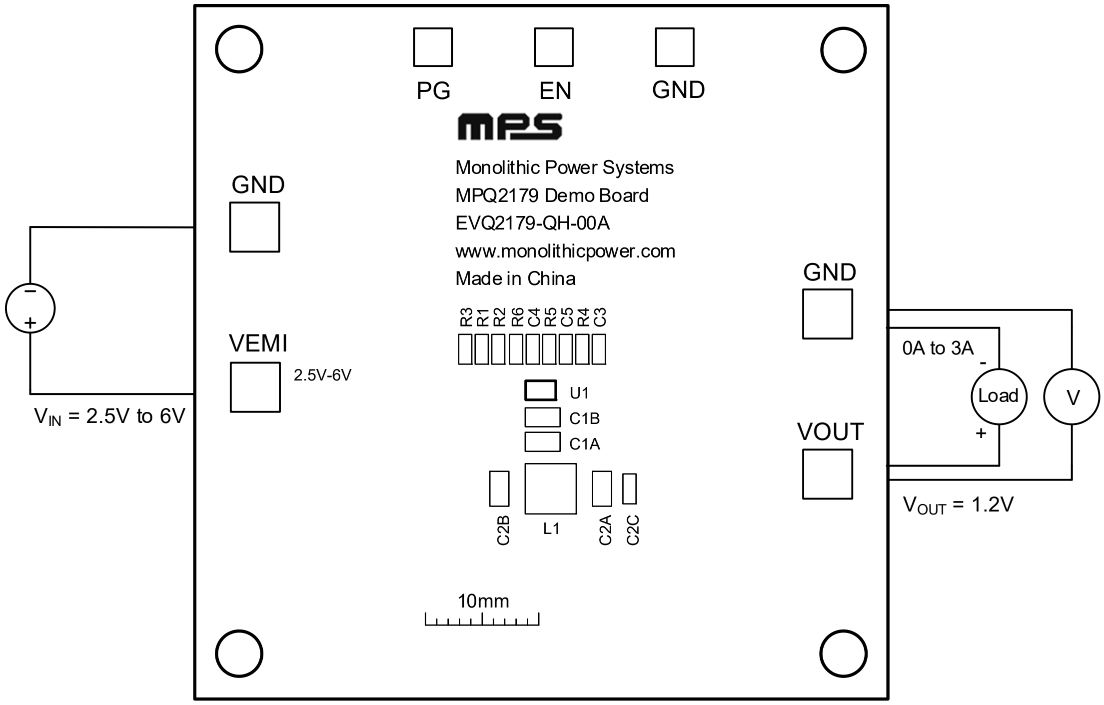
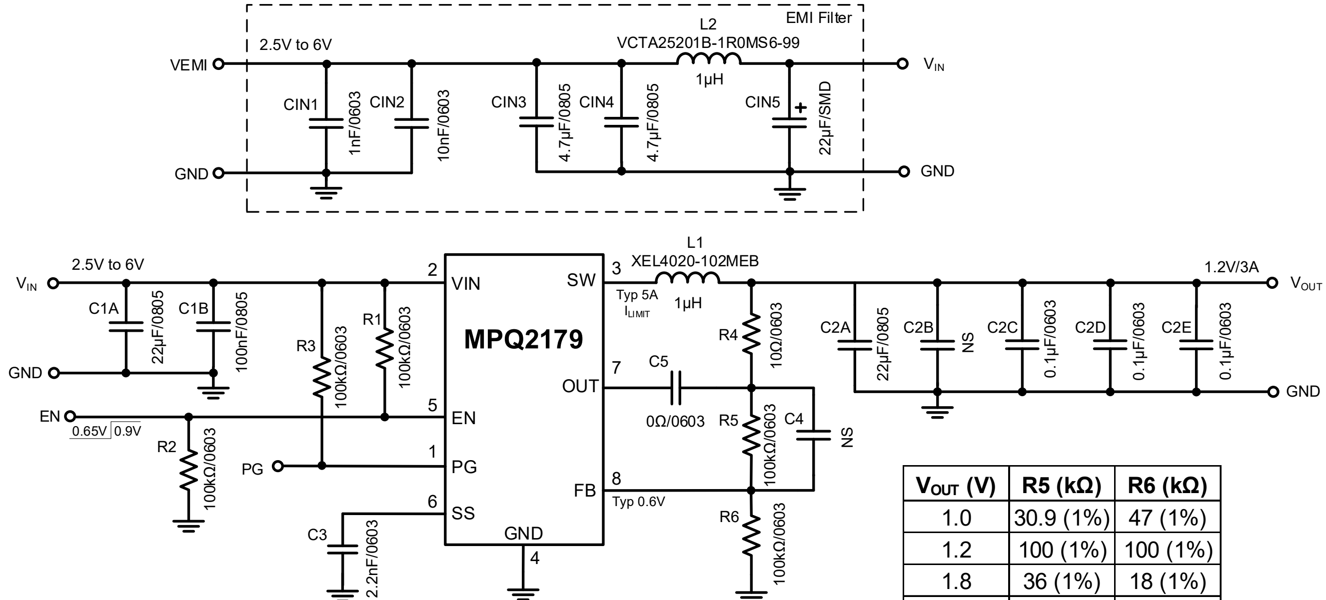


Figure 2: Measurement Equipment Set-Up

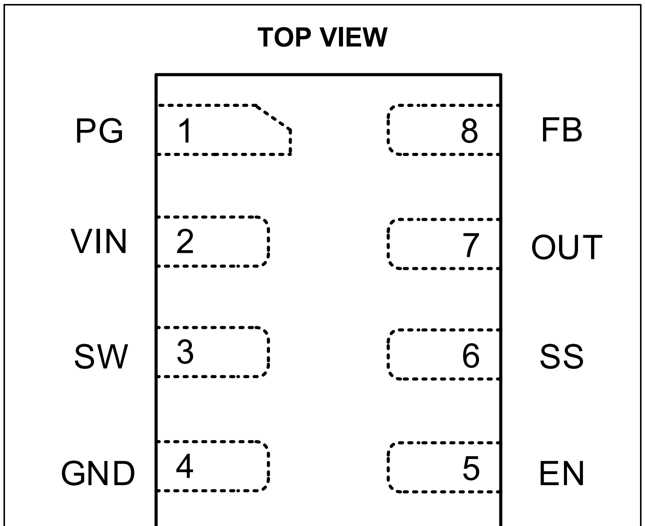
EVALUATION BOARD SCHEMATIC



V_{OUT} (V)	R5 (kΩ)	R6 (kΩ)
1.0	30.9 (1%)	47 (1%)
1.2	100 (1%)	100 (1%)
1.8	36 (1%)	18 (1%)
2.5	51 (1%)	16 (1%)
3.3	68 (1%)	15 (1%)

Figure 3: Evaluation Board Schematic

PACKAGE REFERENCE



QFN-8 (1.5mmx2mm)

EVQ2179-QH-00A BILL OF MATERIALS

Qty	Ref	Value	Description	Package	Manufacturer	Manufacturer PN
1	CIN1	1nF	Ceramic capacitor, 50V, C0G	0603	Murata	GRM1885C1H102JA01D
1	CIN2	10nF	Ceramic capacitor, 50V, X7R	0603	Murata	GRM188R71H103KA01D
2	CIN3, CIN4	4.7μF	Ceramic capacitor, 16V, X7R	0805	Murata	GCM21BR71C475KA73L
1	CIN5	22μF	Electrical capacitor; 63V	SMD	Jianghai	VTD-63V22
1	C1A	22μF	Ceramic capacitor, 16V, X5R	0805	Murata	GRM21BR61C226ME44L
1	C1B	100nF	Ceramic capacitor, 16V, X7R	0805	Murata	GRM219R71C104KA01D
3	C2C, C2D, C2E	0.1μF	Ceramic capacitor, 16V, X7R	0603	Murata	GRM188R71C104KA01D
1	C2A	22μF	Ceramic capacitor, 6.3V, X5R	0805	Murata	GRM21BR60J226ME39L
1	C3	2.2nF	Ceramic capacitor, 50V, X7R	0603	Murata	GRM188R71H222KA01D
2	C4, C2B	NS				
1	C5	0Ω	Film resistor, 1%;	0603	Yageo	RC0603FR-070RL
1	R4	10Ω	Film resistor, 1%	0603	Yageo	RC0603FR-0710RL
5	R1, R2, R3, R5, R6	100kΩ	Film resistor, 1%	0603	Yageo	RC0603FR-07100KL
1	L1	1μH	Inductor, 13.25mΩ, 9A	SMD	Coilcraft	XEL4020-102MEB
1	L2	1μH	Inductor, 35mΩ, 3.8A	SMD	Cyntec	VCTA25201B-1R0MS6-99
4	VEMI, GND, VOUT, GND	2mm	Golden pin	DIP	Custom (1)	
3	EN, PG, GND	1mm	Golden pin	DIP	Custom (1)	
1	U1	MPQ2179-AEC1	3A, 6V, step-down converter	QFN-8 (1.5mmx 2mm)	MPS	MPQ2179GQHE-AEC1

Note:

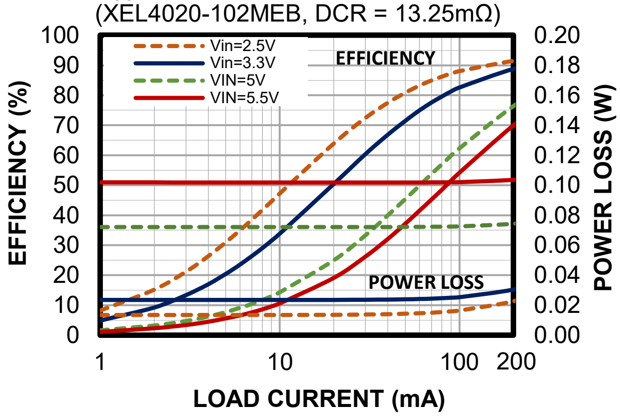
1) MPS custom-produces these pins. Contact an MPS FAE for more information.

EVB TEST RESULTS

Performance curves and waveforms are tested on the evaluation board. V_{IN} = 3.3V, V_{OUT} = 1.2V, T_A = 25°C, unless otherwise noted.

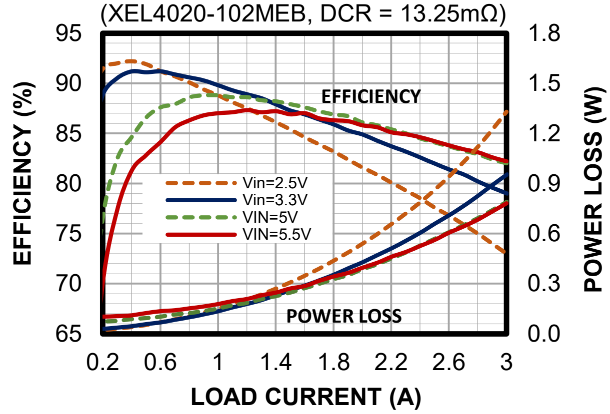
Efficiency vs. Load Current vs. Power Loss (Light Loads)

V_{OUT} = 1.2V, L = 1µH
(XEL4020-102MEB, DCR = 13.25mΩ)



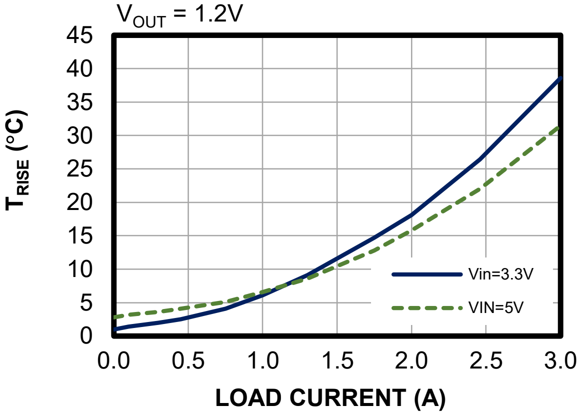
Efficiency vs. Load Current vs. Power Loss

V_{OUT} = 1.2V, L = 1µH
(XEL4020-102MEB, DCR = 13.25mΩ)



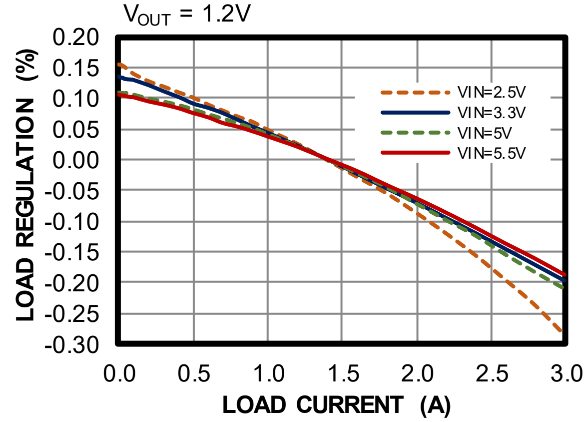
Case Temperature Rise

V_{OUT} = 1.2V



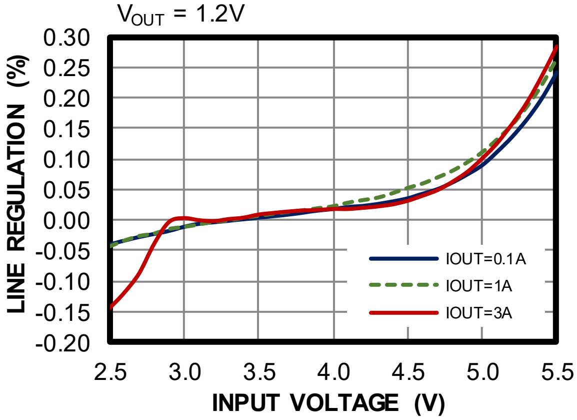
Load Regulation

V_{OUT} = 1.2V



Line Regulation

V_{OUT} = 1.2V

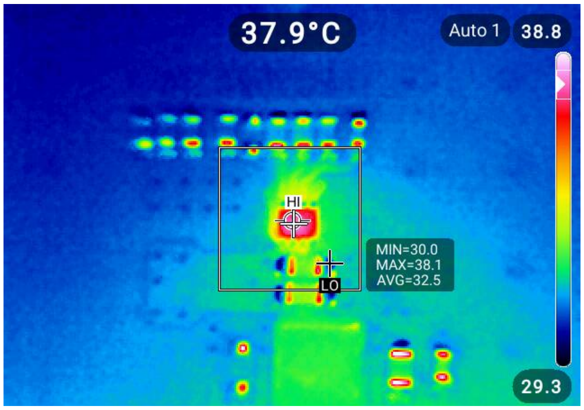


EVB TEST RESULTS *(continued)*

Performance curves and waveforms are tested on the evaluation board. V_{IN} = 3.3V, V_{OUT} = 1.2V, T_A = 25°C, unless otherwise noted.

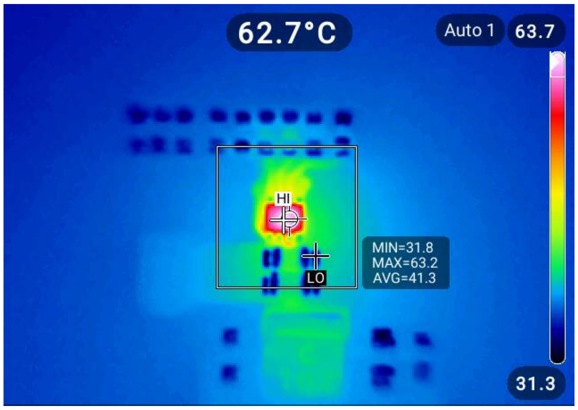
Thermal Performance

I_{OUT} = 1.5A, no forced airflow, T_{CASE} = 38.1°C



Thermal Performance

I_{OUT} = 3A, no forced airflow, T_{CASE} = 63.2°C

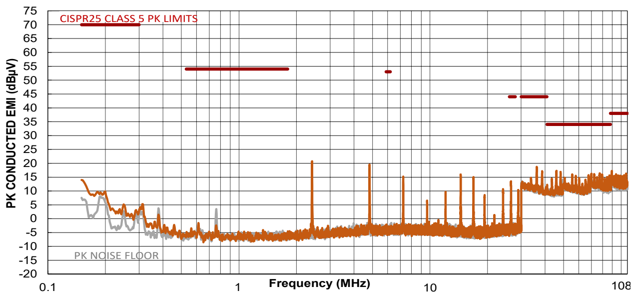


EVB TEST RESULTS *(continued)*

Performance curves and waveforms are tested on the evaluation board. V_{IN} = 6V, V_{OUT} = 1.2V, T_A = 25°C, unless otherwise noted.

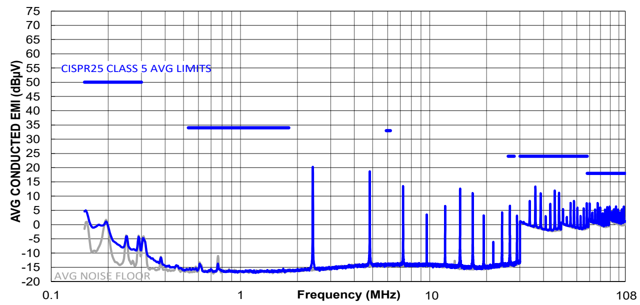
CISPR25 Class 5 Peak Conducted Emissions

150kHz to 108MHz



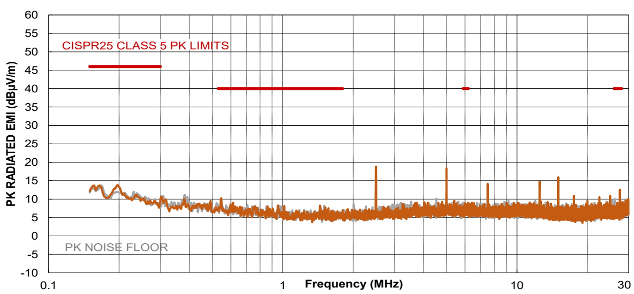
CISPR25 Class 5 Average Conducted Emissions

150kHz to 108MHz



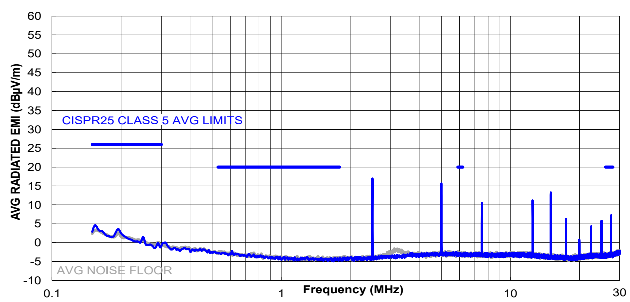
CISPR25 Class 5 Peak Radiated Emissions

150kHz to 30MHz



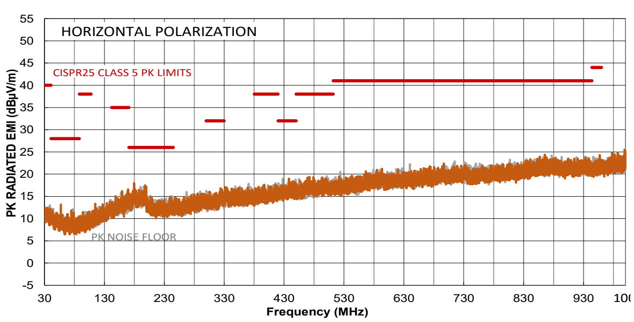
CISPR25 Class 5 Average Radiated Emissions

150kHz to 30MHz



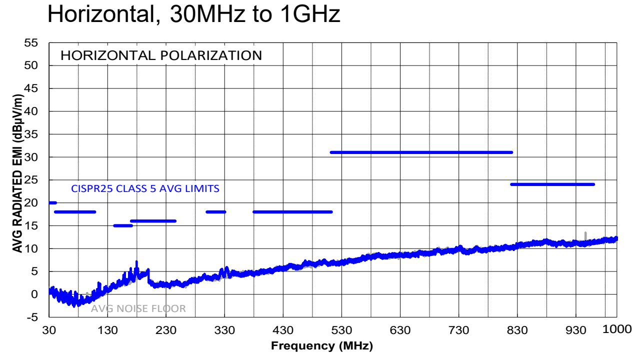
CISPR25 Class 5 Peak Radiated Emissions

Horizontal, 30MHz to 1GHz



CISPR25 Class 5 Average Radiated Emissions

Horizontal, 30MHz to 1GHz

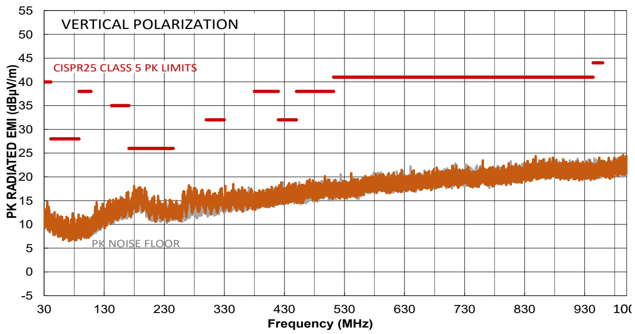


EVB TEST RESULTS *(continued)*

Performance curves and waveforms are tested on the evaluation board. V_{IN} = 6V, V_{OUT} = 1.2V, T_A = 25°C, unless otherwise noted.

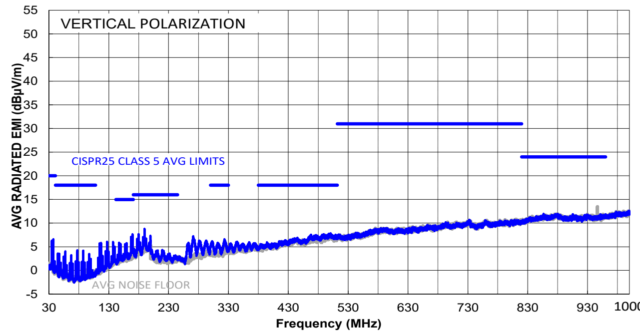
CISPR25 Class 5 Peak Radiated Emissions

Vertical, 30MHz to 1GHz



CISPR25 Class 5 Average Radiated Emissions

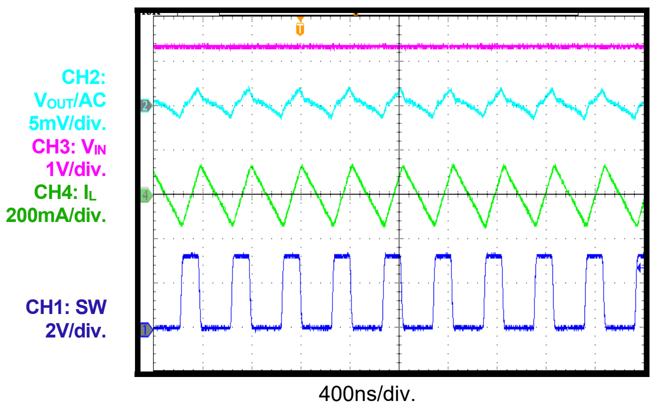
Vertical, 30MHz to 1GHz



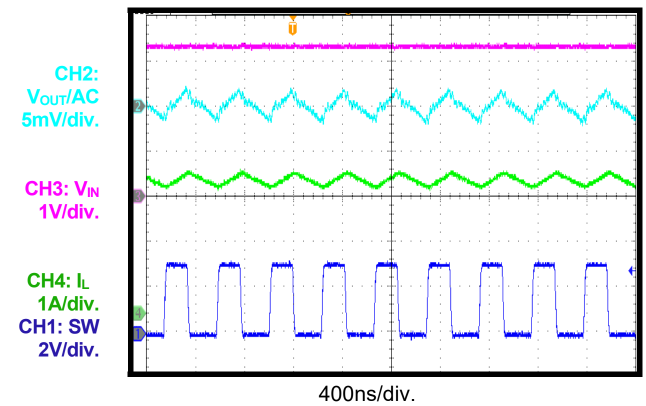
EVB TEST RESULTS *(continued)*

Performance curves and waveforms are tested on the evaluation board. V_{IN} = 3.3V, V_{OUT} = 1.2V, T_A = 25°C, unless otherwise noted.

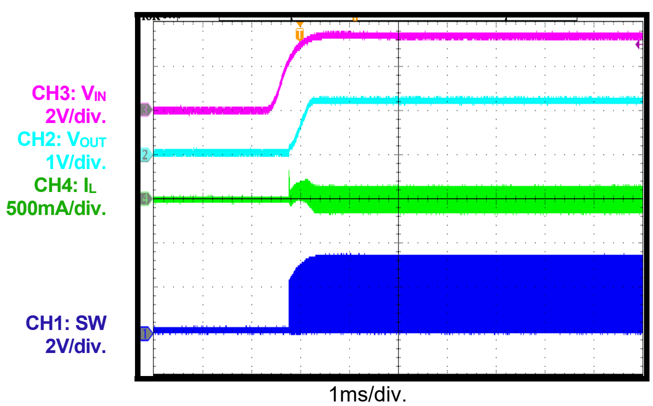
Steady State
I_{OUT} = 0A



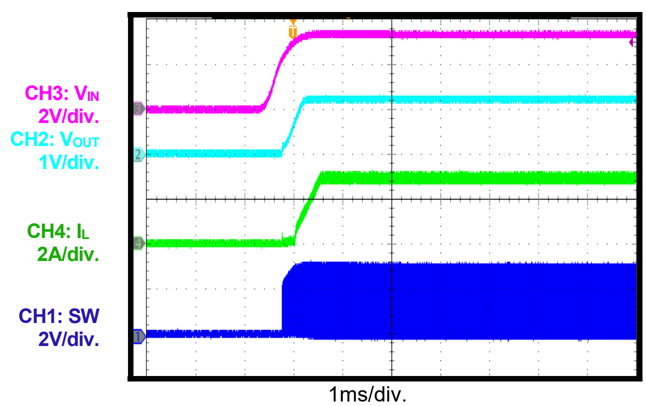
Steady State
I_{OUT} = 3A



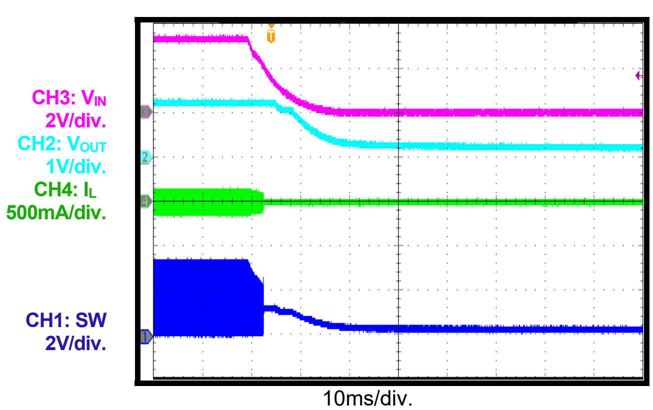
Start-Up through VIN
I_{OUT} = 0A



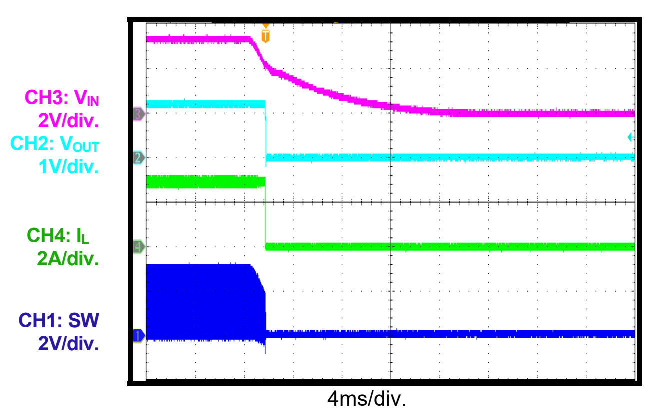
Start-Up through VIN
I_{OUT} = 3A



Shutdown through VIN
I_{OUT} = 0A



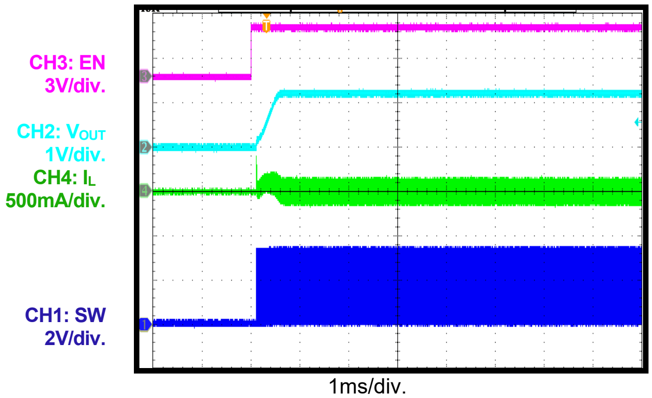
Shutdown through VIN
I_{OUT} = 3A



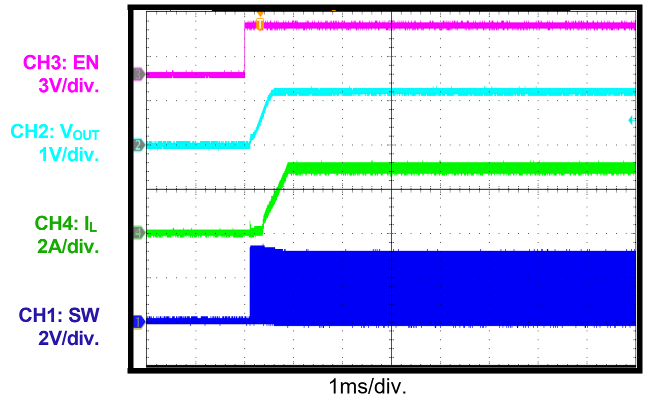
EVB TEST RESULTS *(continued)*

Performance curves and waveforms are tested on the evaluation board. V_{IN} = 3.3V, V_{OUT} = 1.2V, T_A = 25°C, unless otherwise noted.

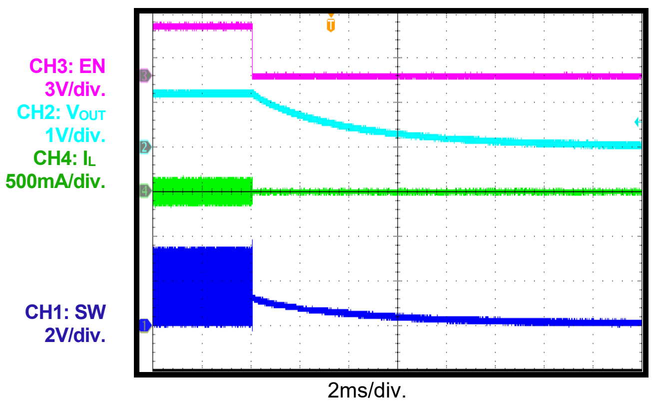
Start-Up through EN
I_{OUT} = 0A



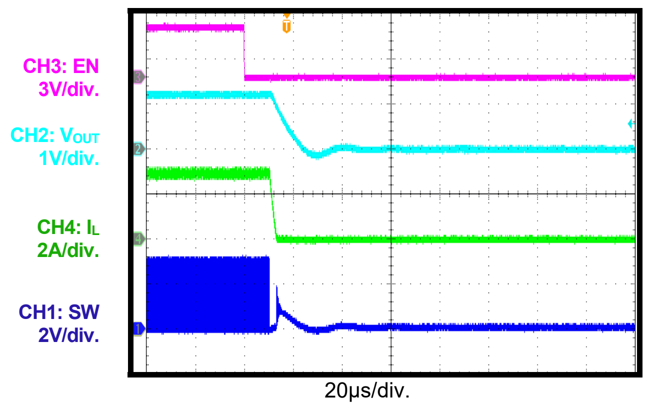
Start-Up through EN
I_{OUT} = 3A



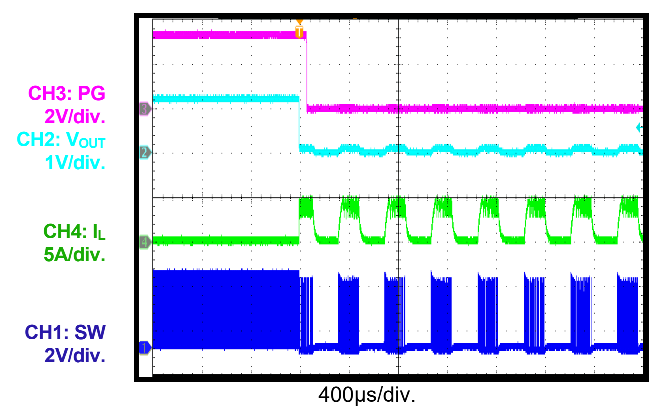
Shutdown through EN
I_{OUT} = 0A



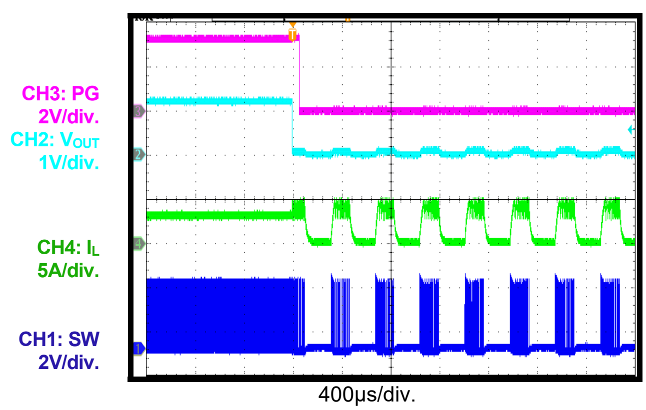
Shutdown through EN
I_{OUT} = 3A



SCP Entry
I_{OUT} = 0A



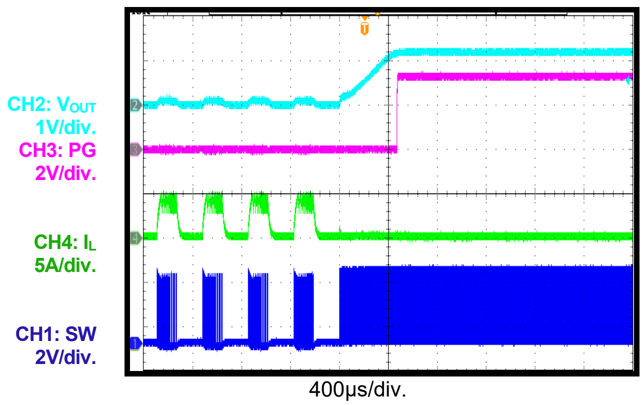
SCP Entry
I_{OUT} = 3A



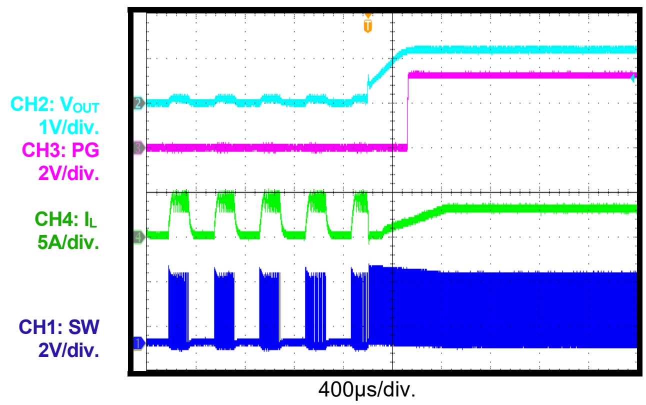
EVB TEST RESULTS *(continued)*

Performance curves and waveforms are tested on the evaluation board. V_{IN} = 3.3V, V_{OUT} = 1.2V, T_A = 25°C, unless otherwise noted.

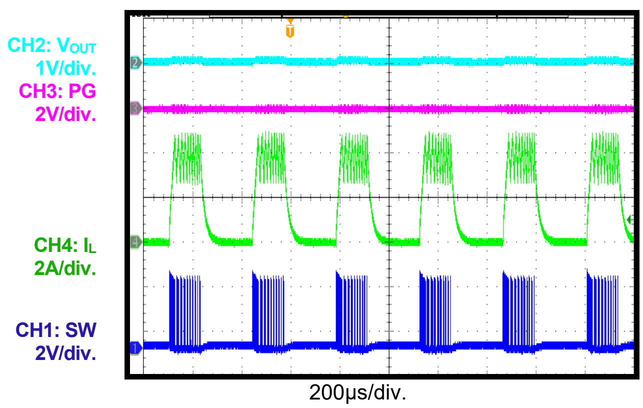
SCP Recovery
I_{OUT} = 0A



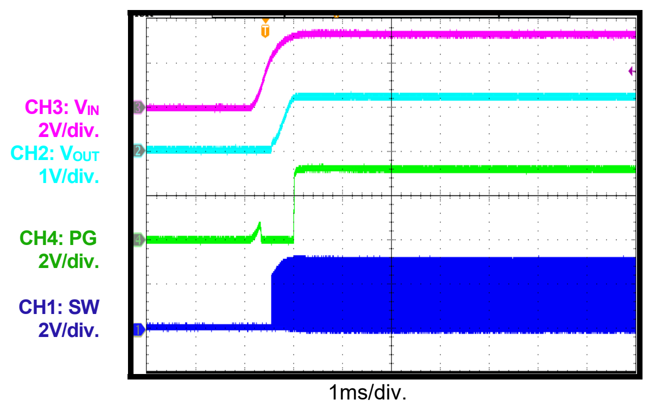
SCP Recovery
I_{OUT} = 3A



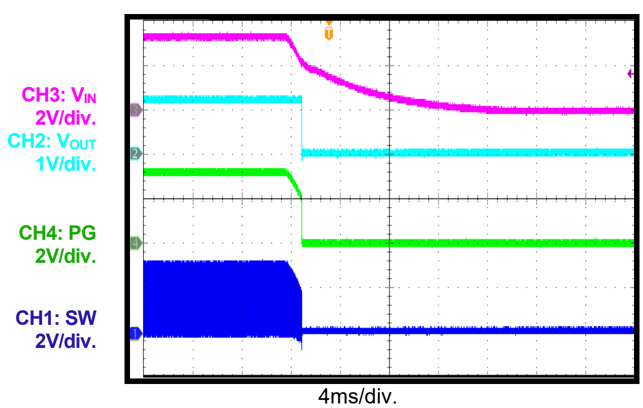
Short Circuit



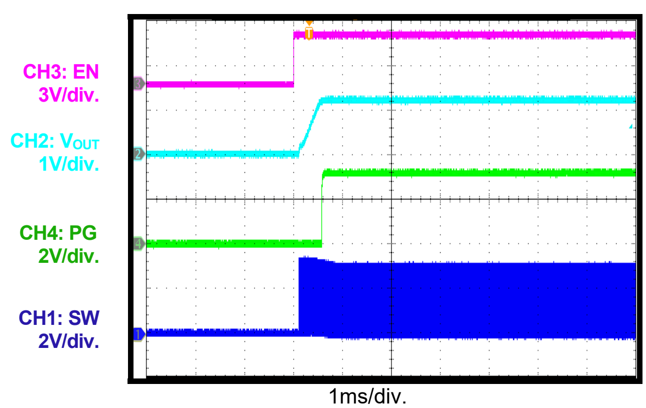
PG Start-Up through VIN
I_{OUT} = 3A



PG Shutdown through VIN
I_{OUT} = 3A



PG Start-Up through EN
I_{OUT} = 3A

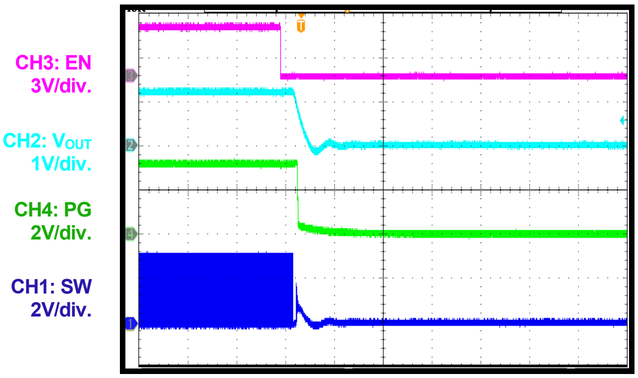


EVB TEST RESULTS *(continued)*

Performance curves and waveforms are tested on the evaluation board. V_{IN} = 3.3V, V_{OUT} = 1.2V, T_A = 25°C, unless otherwise noted.

PG Shutdown through EN

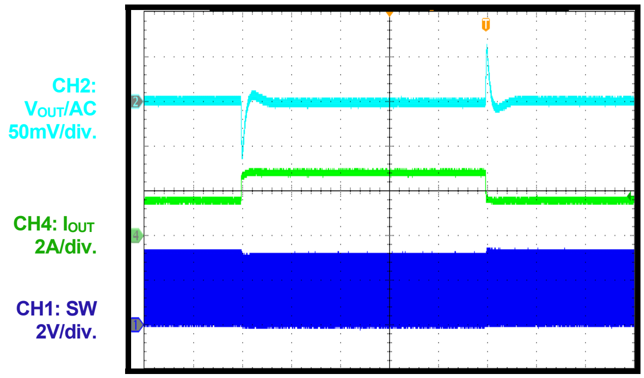
I_{OUT} = 3A



40μs/div.

Load Transient Response

I_{OUT} = 1.5 to 3A, 1A/μs



80μs/div.

PCB LAYOUT (2)

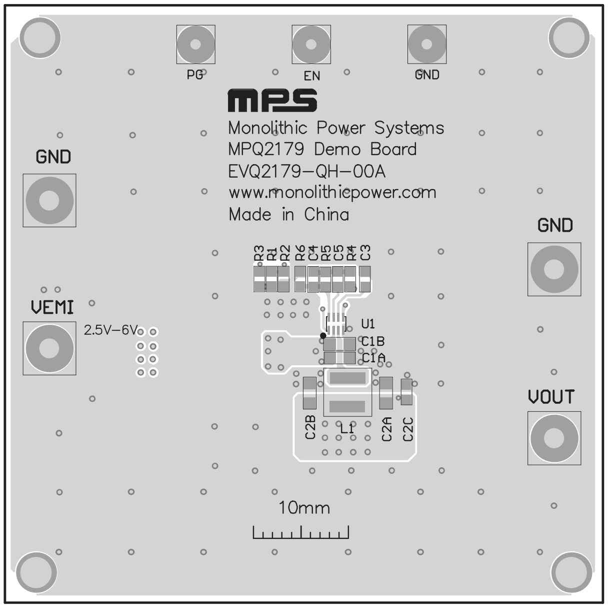


Figure 4: Top Silk and Top Layer

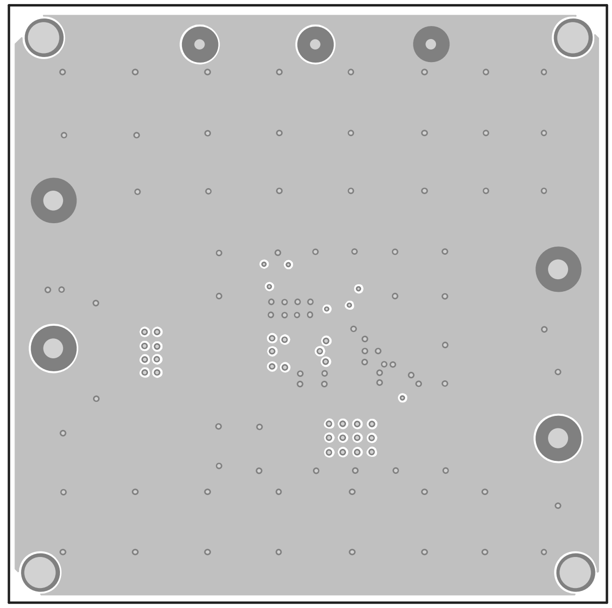


Figure 5: Mid-Layer 1

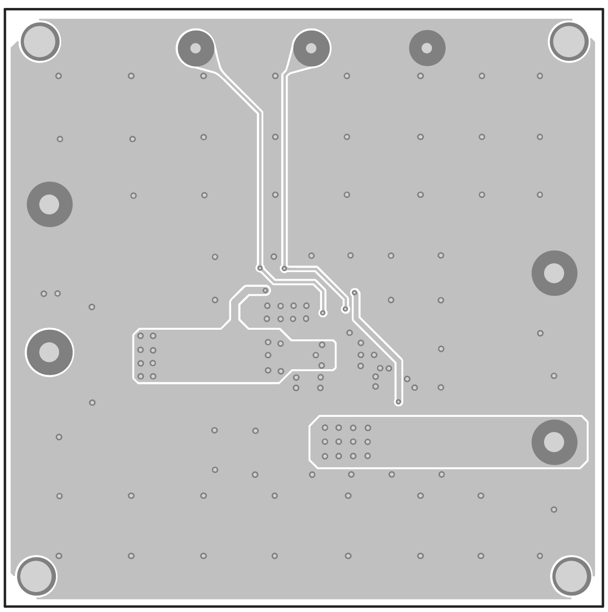


Figure 6: Mid-Layer 2

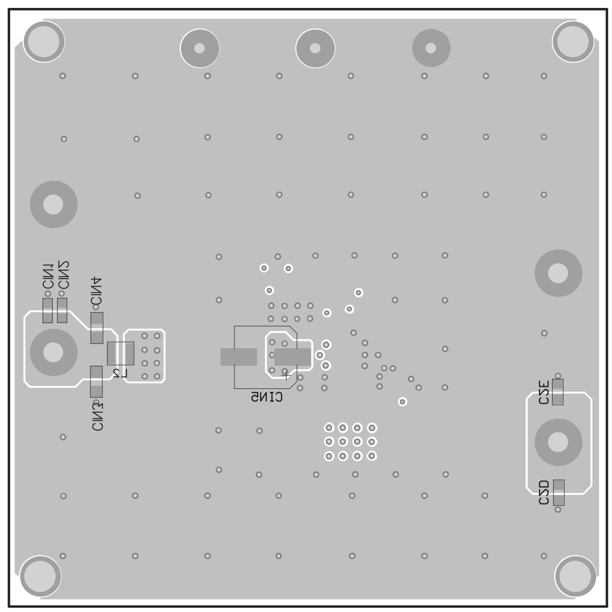


Figure 7: Bottom Layer and Bottom Silk

Note:

2) The copper thickness is 2oz.

REVISION HISTORY

Revision #	Revision Date	Description	Pages Updated
1.0	11/6/2023	Initial Release	-