EVQ2246-Q-00A

6A, 6V, Configurable-Frequency Synchronous Buck Converter Evaluation Board, AEC-Q100 Qualified

DESCRIPTION

The EVQ2246-Q-00A is an evaluation board designed to demonstrate the capabilities of the MPQ2246, a configurable-frequency (300kHz to 2.2MHz) synchronous step-down converter. The MPQ2246 integrates a high-side MOSFET (HS-FET) and a synchronous rectifier to achieve high efficiency without an external Schottky diode.

The MPQ2246 can support up to 6A of continuous output current (I_{OUT}) across a 2.7V to 6V input voltage (V_{IN}) range, and generates an output voltage (V_{OUT}) as low as 0.606V. It is ideal for a wide range of applications, including automotive infotainment, clusters, and telematics, as well as portable instruments.

The MPQ2246 can be configured for either advanced asynchronous modulation (AAM) mode or forced continuous conduction mode (FCCM). AMM mode provides high efficiency by reducing switching losses at light loads, while FCCM has a controllable frequency and a lower output ripple. Peak current control mode provides excellent transient response and efficiency performance.

An open-drain power good (PG) signal indicates whether V_{OUT} is within 85% to 115% of its nominal voltage.

Full protection features include over-current protection (OCP) with valley current detection to avoid current runaway, short-circuit protection (SCP), reliable over-voltage protection (OVP), and thermal protection with auto-recovery.

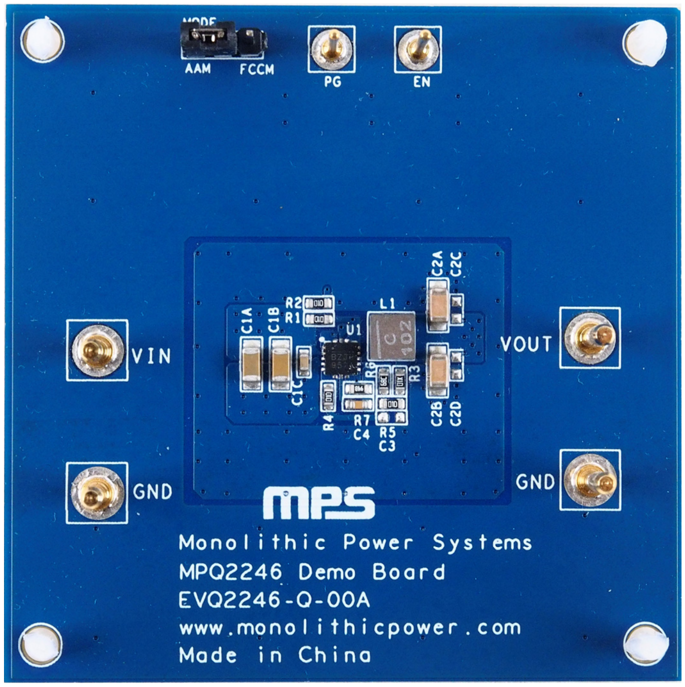
The EVQ2246-Q-00A is fully assembled and tested. The MPQ2246 is available in a QFN-9 (3mmx3mm) package, and is AEC-Q100 qualified.

PERFORMANCE SUMMARY

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

Parameters	Conditions	Value
Input voltage (V_{IN}) range		2.7V to 6V
Output voltage (V_{OUT})	V_{IN} = 2.7V to 6V, I_{OUT} = 0A to 6A	1.8V
Maximum output current (I_{OUT})	V_{IN} = 2.7V to 6V	6A
Typical efficiency	V_{IN} = 5V, V_{OUT} = 1.8V, I_{OUT} = 6A	80.9%
Peak efficiency	V_{IN} = 2.7V, V_{OUT} = 1.8V, I_{OUT} = 0.6A	95.1%
Switching frequency (f_{SW})		2.1MHz

EVQ2246-Q-00A EVALUATION BOARD



LxWxH (6.35cmx6.35cmx0.85cm)

Board Number	MPS IC Number
EVQ2246-Q-00A	MPQ2246GQE-AEC1

QUICK START GUIDE

The EVQ2246-Q-00A evaluation board is easy to set up and use to evaluate the MPQ2246'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 2.7V and 6V, then turn the power supply off.
2. Set the load current between 0A and 6A. Electronic loads represent a negative impedance to the regulator, and setting a current too high can 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 (+): VIN
    b. Negative (-): GND
5. Connect the load terminals to:
    a. Positive (+): VOUT
    b. Negative (-): GND
6. After making the connections, turn the power supply on.
7. To use the enable function, apply a digital input to the EN pin. Drive EN above 1.2V to turn the regulator on; drive EN below 0.4V to turn the regulator off. If the enable function is not used, connect EN directly to VIN.
8. The external resistor divider sets the output voltage (V_{OUT}) (see Figure 1).

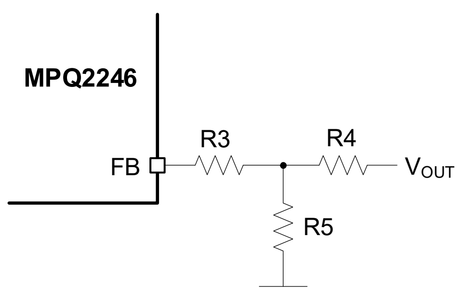


Figure 1: Feedback Divider Network with Adjustable Output

R3 and R4 are selected to be 100kΩ. R5 can then be calculated with Equation (1):

$$R5 = \frac{R4}{\frac{V_{OUT}}{0.606V} - 1} \quad (1)$$

Refer to the Application Information section in the MPQ2246 datasheet to calculate the inductance and output capacitance for different V_{OUT} values.

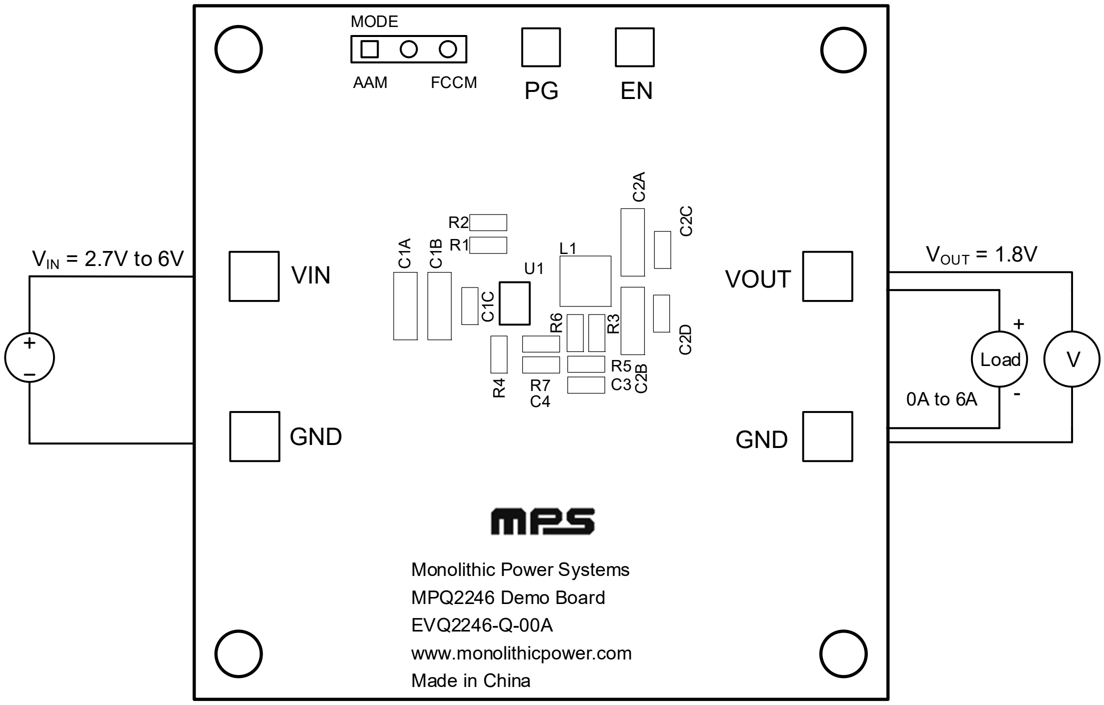
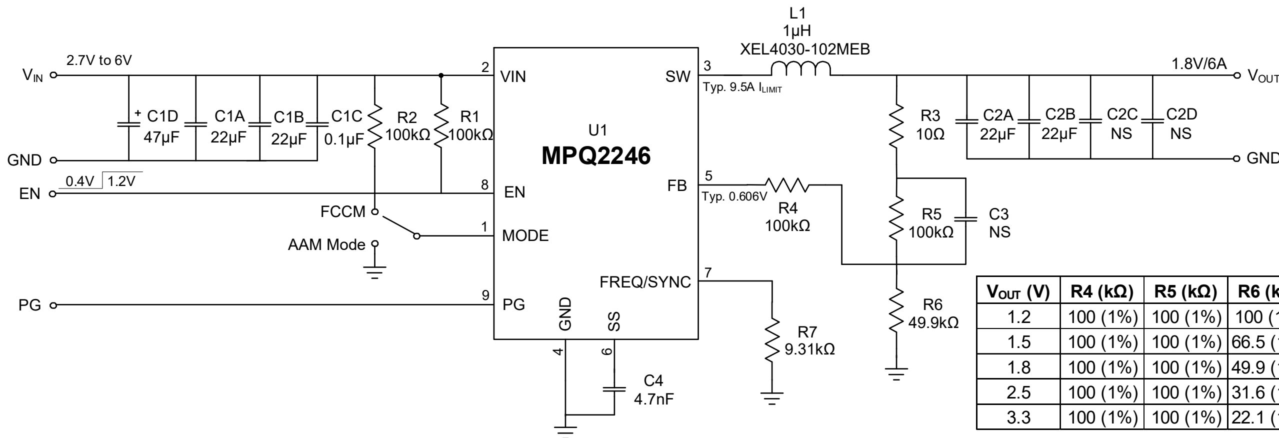


Figure 2: Measurement Equipment Set-Up

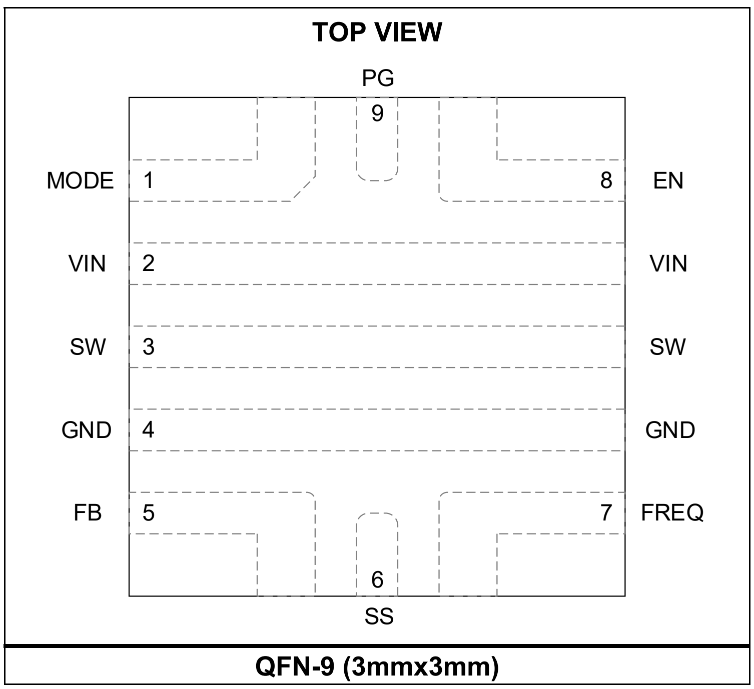
EVALUATION BOARD SCHEMATIC



V_{OUT} (V)	R4 (kΩ)	R5 (kΩ)	R6 (kΩ)
1.2	100 (1%)	100 (1%)	100 (1%)
1.5	100 (1%)	100 (1%)	66.5 (1%)
1.8	100 (1%)	100 (1%)	49.9 (1%)
2.5	100 (1%)	100 (1%)	31.6 (1%)
3.3	100 (1%)	100 (1%)	22.1 (1%)

Figure 3: Evaluation Board Schematic

PACKAGE REFERENCE



EVQ2246-Q-00A BILL OF MATERIALS

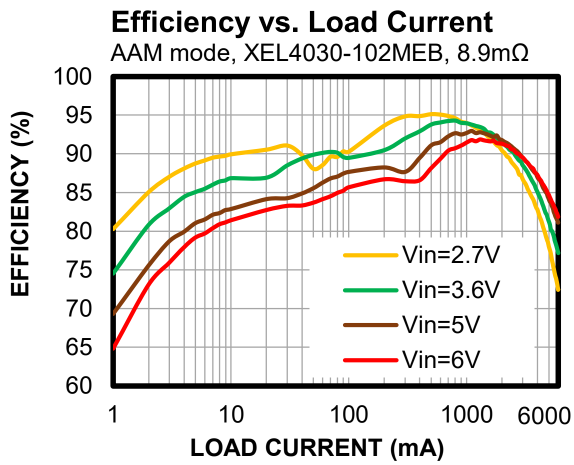
Qty	Ref	Value	Description	Package	Manufacturer	Manufacturer PN
1	C4	4.7nF	Ceramic capacitor, 50V, X7R	0603	Wurth	885012206087
2	C1A, C1B	22µF	Ceramic capacitor, 16V, X5R	1206	Murata	GRM31CR61C226ME15L
1	C1C	0.1µF	Ceramic capacitor, 16V, X7R	0603	Murata	GRM188R71C104KA01D
1	C1D	47µF	Electrolytic capacitor, 16V	SMD	Jianghai	VZ2-16V47
2	C2A, C2B	22µF	Ceramic capacitor, 10V, X7R	1206	Murata	GCJ31CR71A226ME01L
3	C3, C2C, C2D	NS				
1	L1	1µH	Inductor, 8.9mΩ, 9A	SMD	Coilcraft	XEL4030-102MEB
4	R1, R2, R4, R5	100kΩ	Film resistor, 1%	0603	Yageo	RC0603FR-07100KL
1	R3	10Ω	Film resistor, 1%	0603	Yageo	RC0603FR-0710RL
1	R6	49.9kΩ	Film resistor, 1%	0603	Yageo	RC0603FR-0749K9L
1	R7	9.31kΩ	Film resistor, 1%	0603	Yageo	RC0603FR-079K31L
4	VIN, GND, GND, VOUT	2mm	Golden pin	DIP	Custom (1)	
2	PG, EN	1mm	Golden pin	DIP	Custom (1)	
1	MODE	2.54mm	Test pin, 3 pin	DIP	Custom (1)	
1	U1	MPQ2246	6A, 6V, synchronous buck converter, AEC-Q100	QFN-9 (3mmx 3mm)	MPS	MPQ2246GQE-AEC1

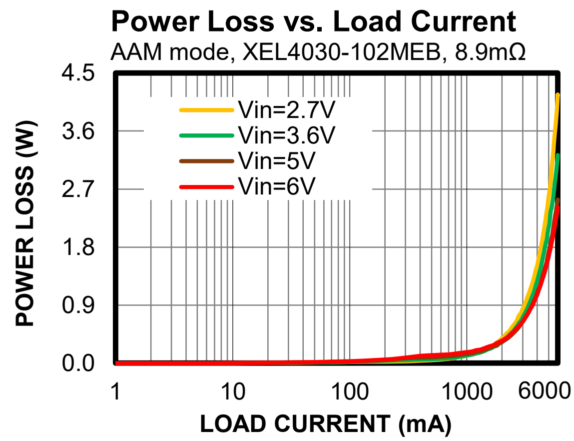
Note:

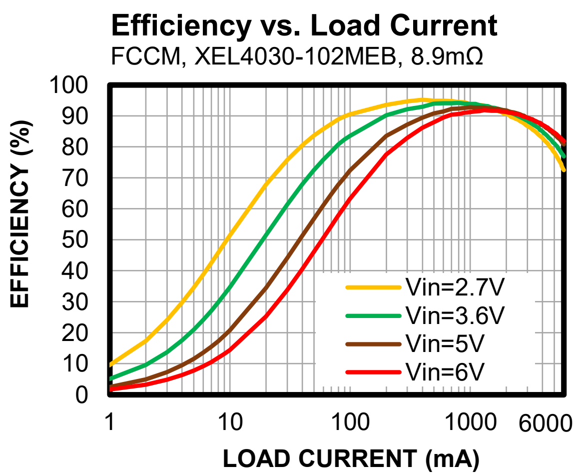
1) Contact an MPS FAE for more information regarding custom pins.

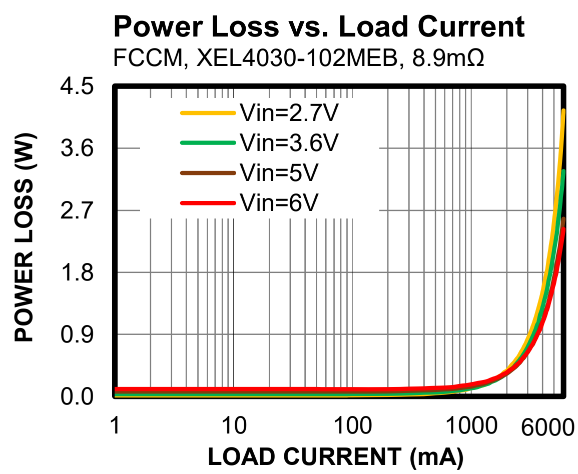
EVB TEST RESULTS

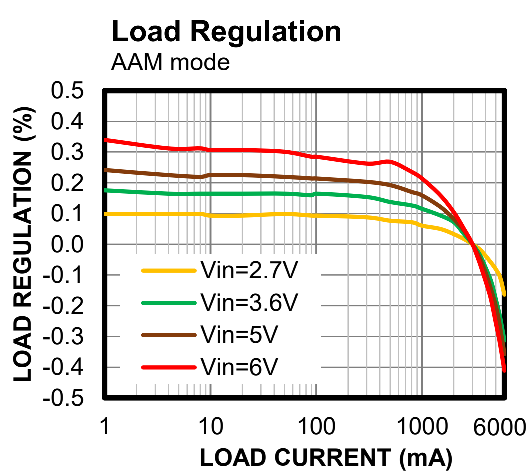
Performance curves and waveforms are tested on the evaluation board. V_{IN} = 5V, V_{OUT} = 1.8V, T_A = 25°C, unless otherwise noted.

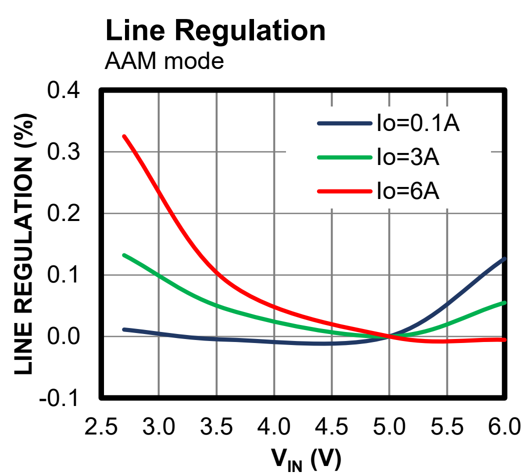






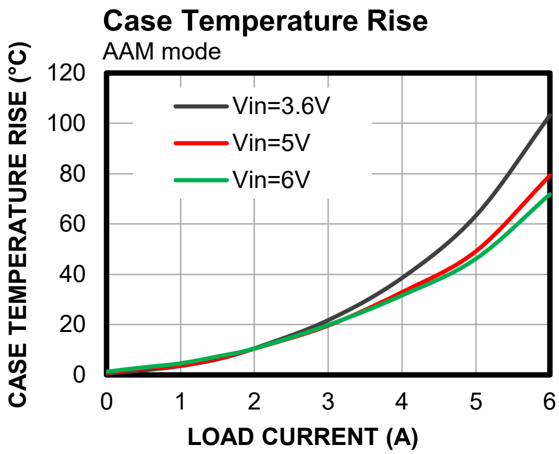


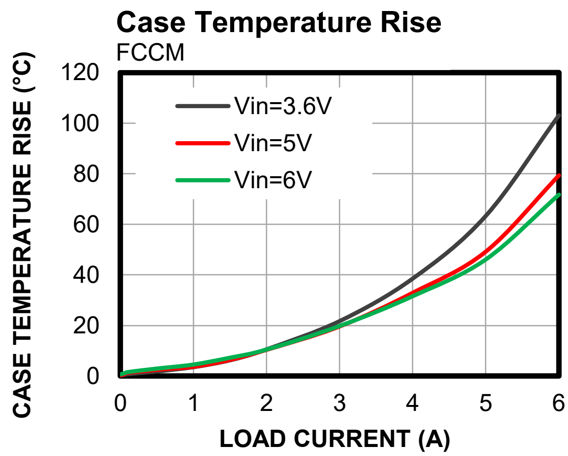


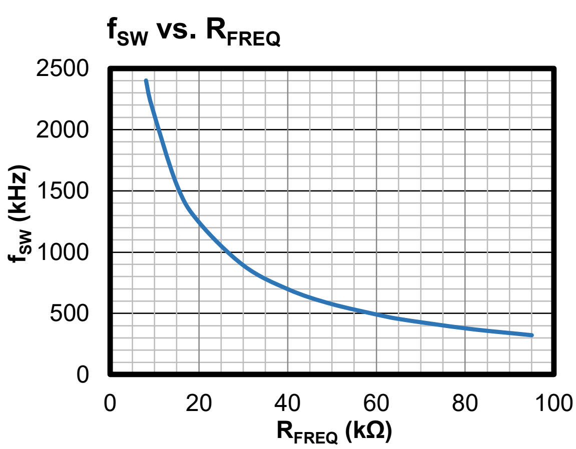


EVB TEST RESULTS *(continued)*

Performance curves and waveforms are tested on the evaluation board. V_{IN} = 5V, V_{OUT} = 1.8V, T_A = 25°C, unless otherwise noted.





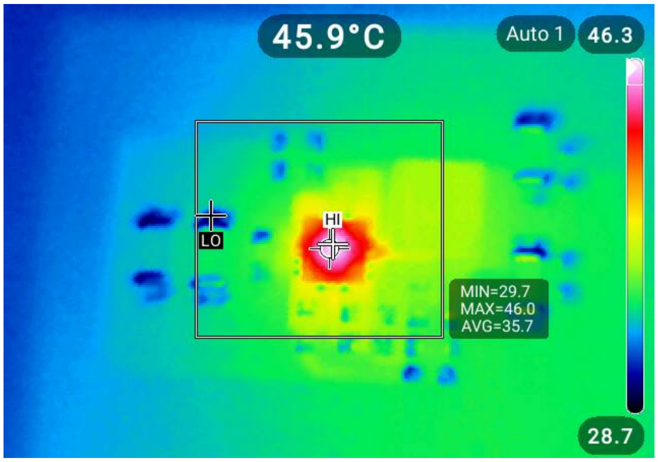


EVB TEST RESULTS *(continued)*

Performance curves and waveforms are tested on the evaluation board. V_{IN} = 5V, V_{OUT} = 1.8V, T_A = 25°C, unless otherwise noted.

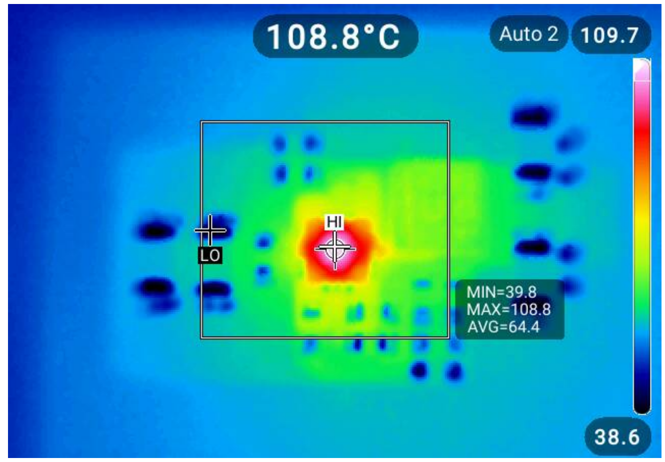
Thermal Performance

I_{OUT} = 3A, no forced airflow, T_{CASE} = 45.9°C



Thermal Performance

I_{OUT} = 6A, no forced airflow, T_{CASE} = 108.8°C

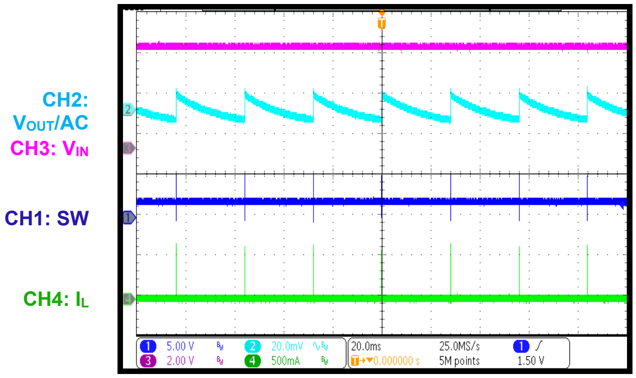


EVB TEST RESULTS *(continued)*

Performance curves and waveforms are tested on the evaluation board. V_{IN} = 5V, V_{OUT} = 1.8V, T_A = 25°C, unless otherwise noted.

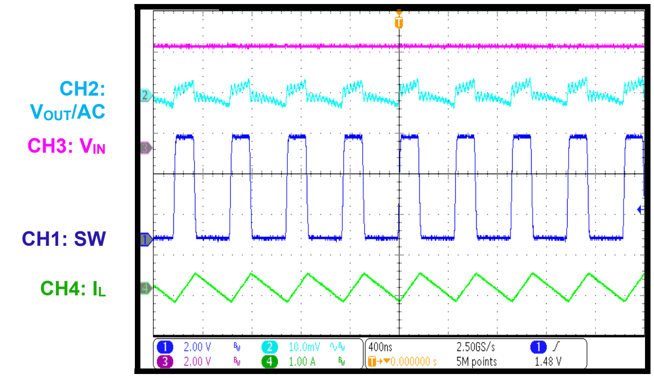
Steady State

I_{OUT} = 0A, AAM mode



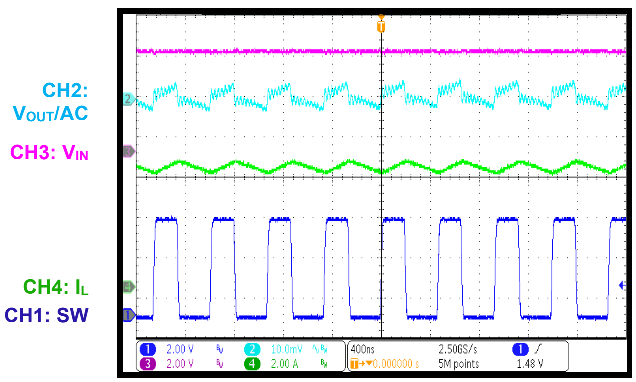
Steady State

I_{OUT} = 0A, FCCM



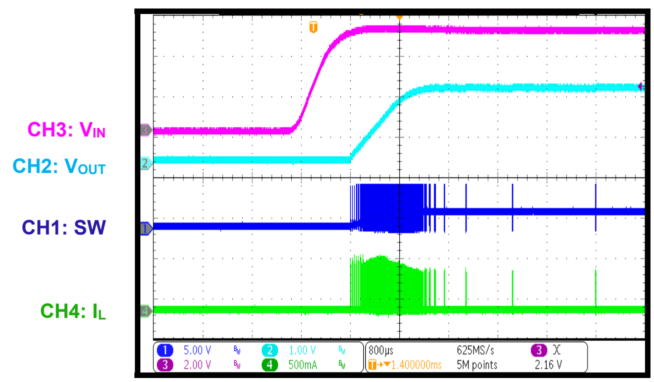
Steady State

I_{OUT} = 6A



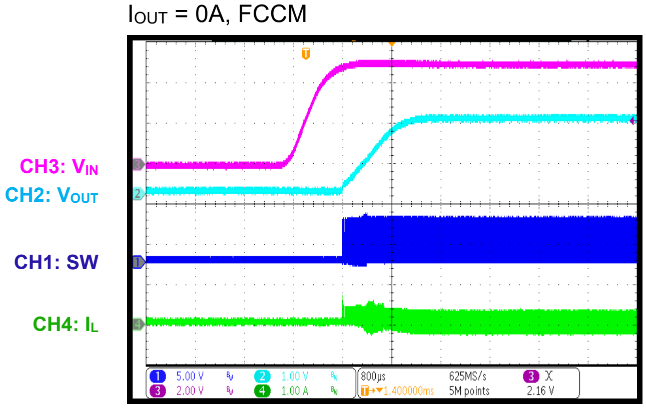
Start-Up through VIN

I_{OUT} = 0A, AAM mode



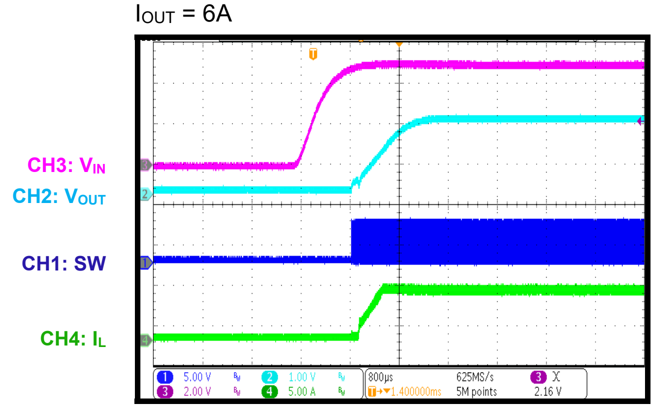
Start-Up through VIN

I_{OUT} = 0A, FCCM



Start-Up through VIN

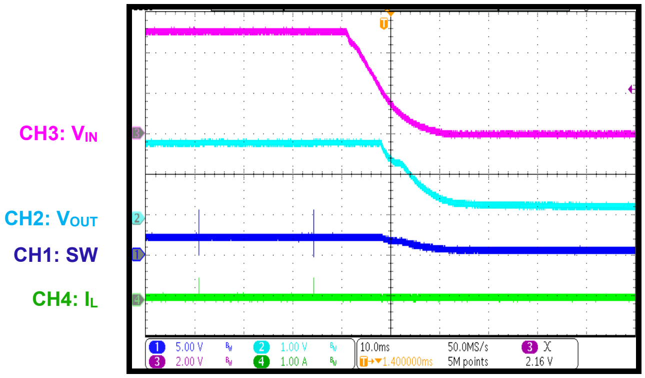
I_{OUT} = 6A



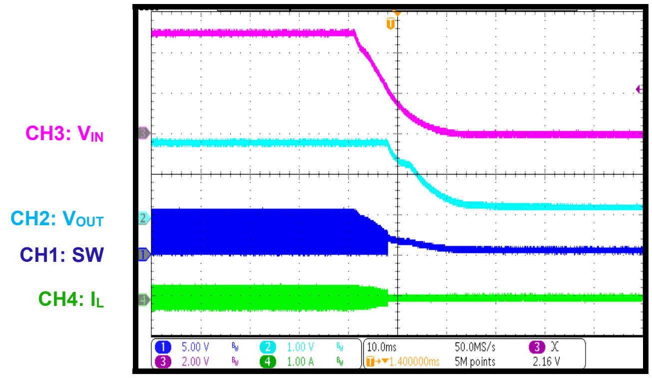
EVB TEST RESULTS *(continued)*

Performance curves and waveforms are tested on the evaluation board. V_{IN} = 5V, V_{OUT} = 1.8V, T_A = 25°C, unless otherwise noted.

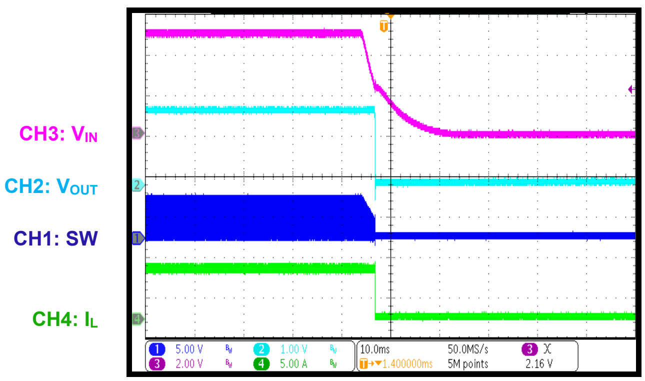
Shutdown through VIN
I_{OUT} = 0A, AAM mode



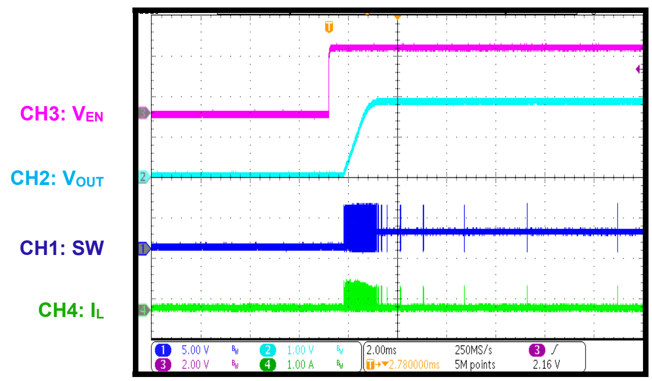
Shutdown through VIN
I_{OUT} = 0A, FCCM



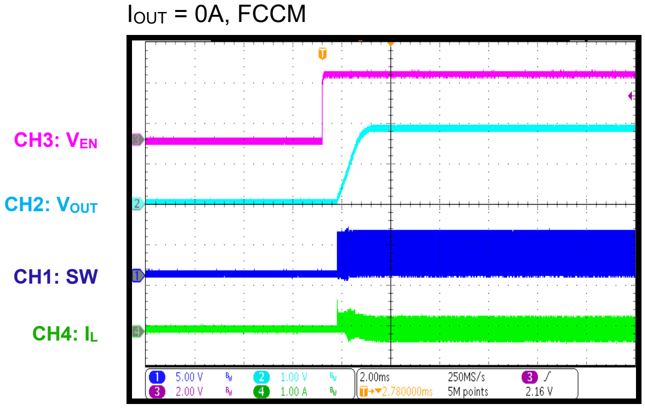
Shutdown through VIN
I_{OUT} = 6A



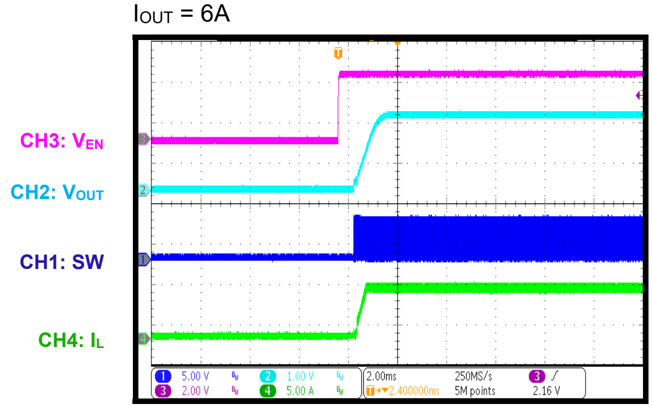
Start-Up through EN
I_{OUT} = 0A, AAM mode



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



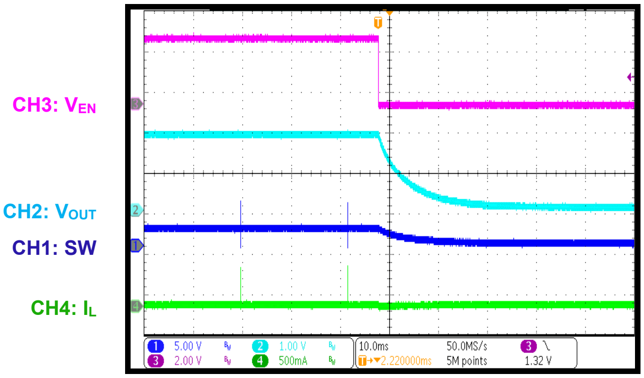
Start-Up through EN
I_{OUT} = 6A



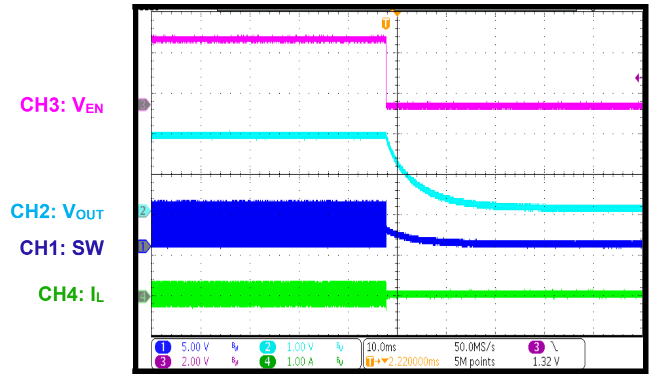
EVB TEST RESULTS *(continued)*

Performance curves and waveforms are tested on the evaluation board. V_{IN} = 5V, V_{OUT} = 1.8V, T_A = 25°C, unless otherwise noted.

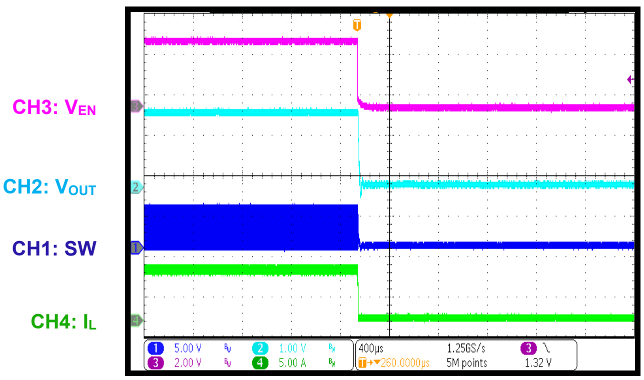
Shutdown through EN
I_{OUT} = 0A, AAM mode



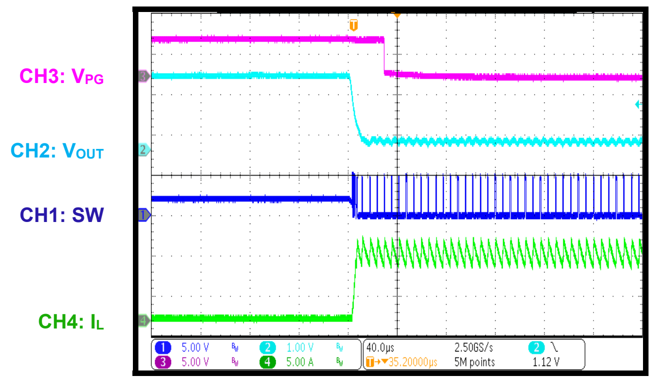
Shutdown through EN
I_{OUT} = 0A, FCCM



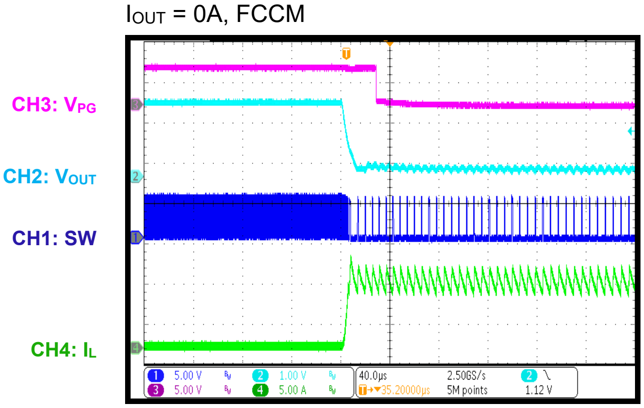
Shutdown through EN
I_{OUT} = 6A



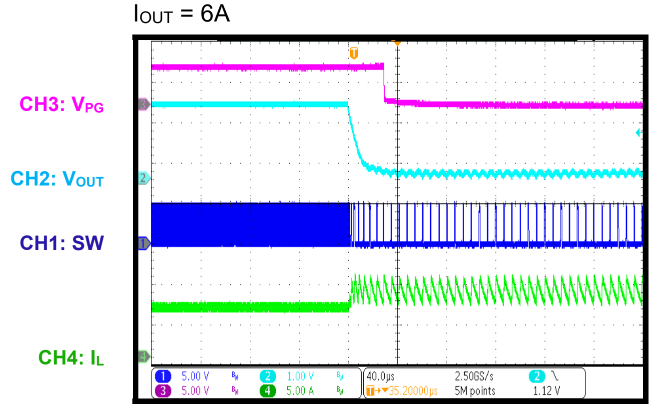
SCP Entry
I_{OUT} = 0A, AAM mode



SCP Entry
I_{OUT} = 0A, FCCM



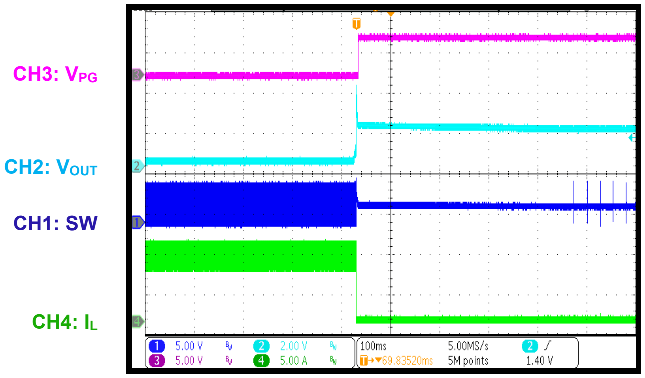
SCP Entry
I_{OUT} = 6A



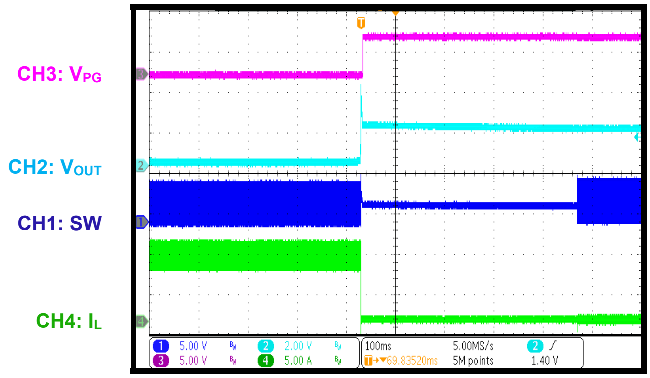
EVB TEST RESULTS *(continued)*

Performance curves and waveforms are tested on the evaluation board. V_{IN} = 5V, V_{OUT} = 1.8V, T_A = 25°C, unless otherwise noted.

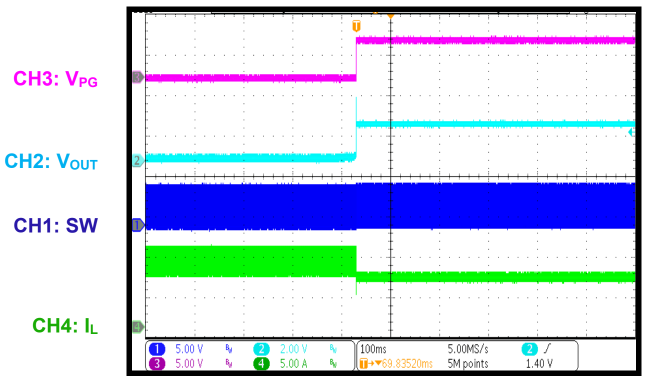
SCP Recovery
I_{OUT} = 0A, AAM mode



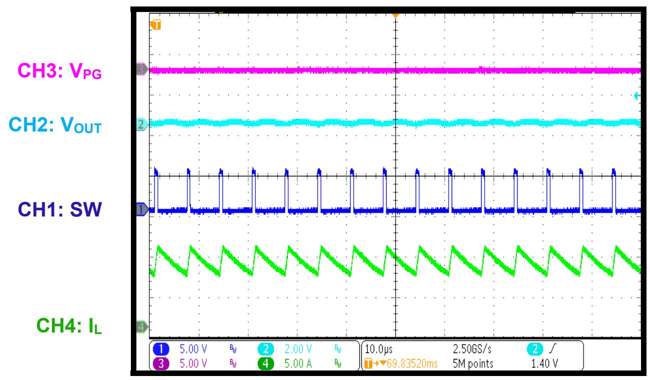
SCP Recovery
I_{OUT} = 0A, FCCM



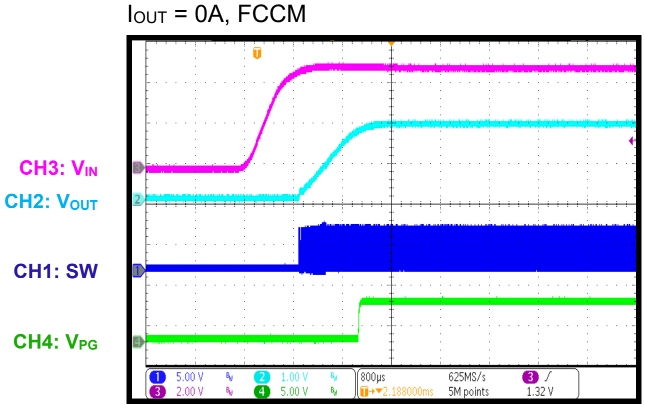
SCP Recovery
I_{OUT} = 6A



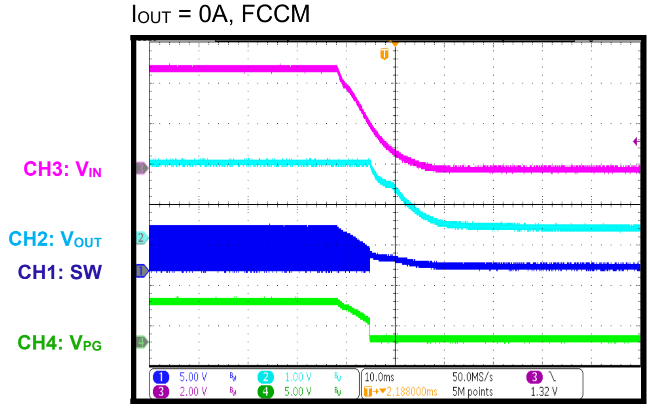
Short-Circuit Protection



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



PG Shutdown through VIN
I_{OUT} = 0A, FCCM

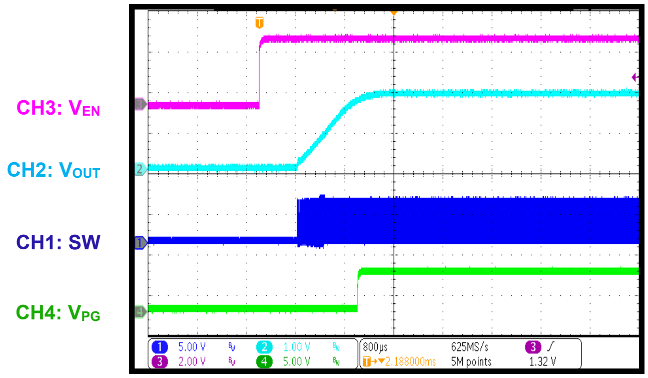


EVB TEST RESULTS *(continued)*

Performance curves and waveforms are tested on the evaluation board. V_{IN} = 5V, V_{OUT} = 1.8V, T_A = 25°C, unless otherwise noted.

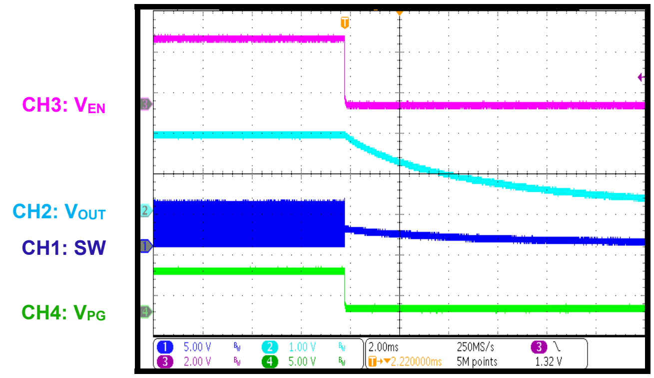
PG Start-Up through EN

I_{OUT} = 0A, FCCM



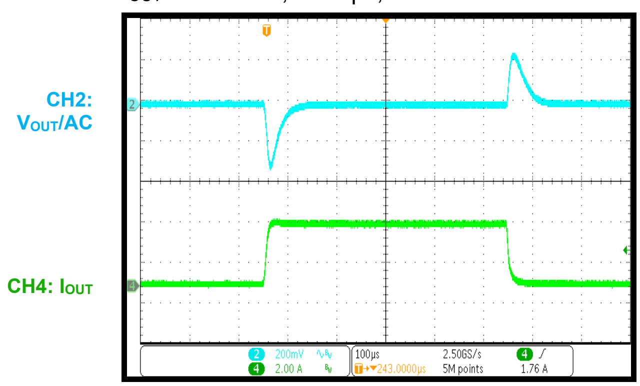
PG Shutdown through EN

I_{OUT} = 0A, FCCM



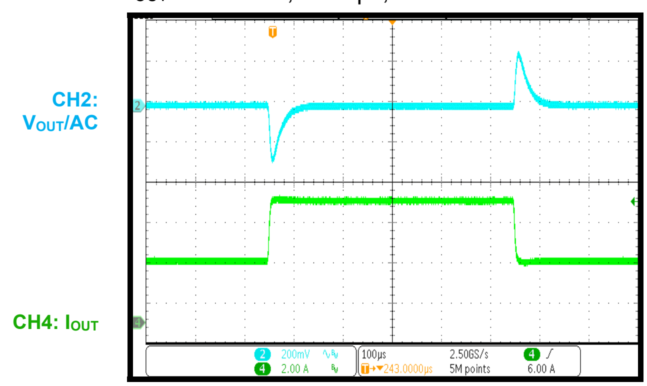
Load Transient

I_{OUT} = 0A to 3A, 1.6A/μs, AAM mode



Load Transient

I_{OUT} = 3A to 6A, 1.6A/μs, AAM mode



PCB LAYOUT (2)

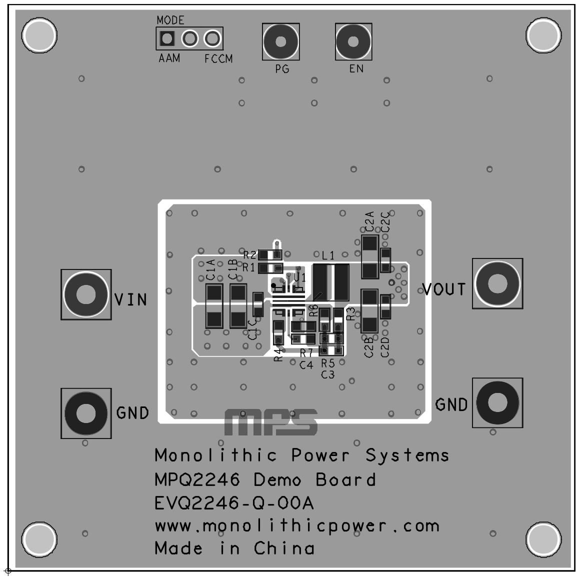


Figure 4: Top Silk and Top Layer

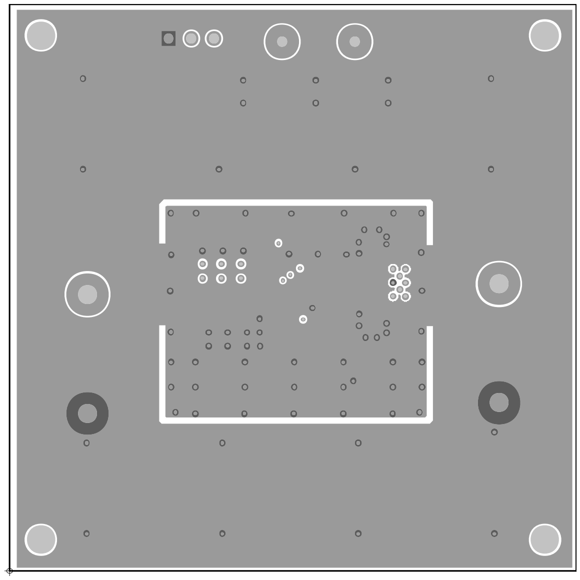


Figure 5: Mid-Layer 1

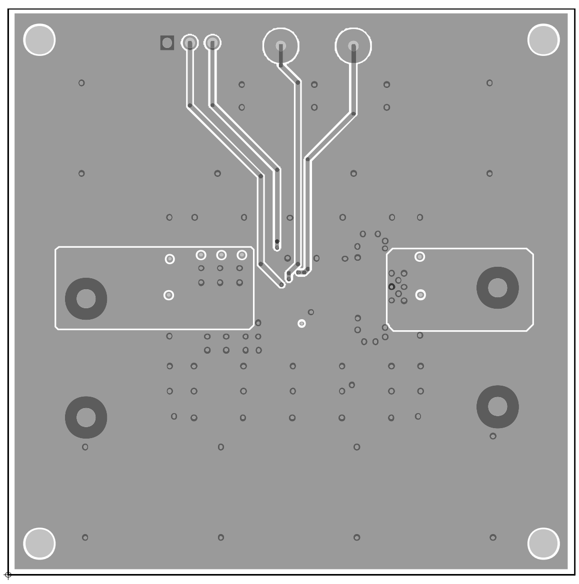


Figure 6: Mid-Layer 2

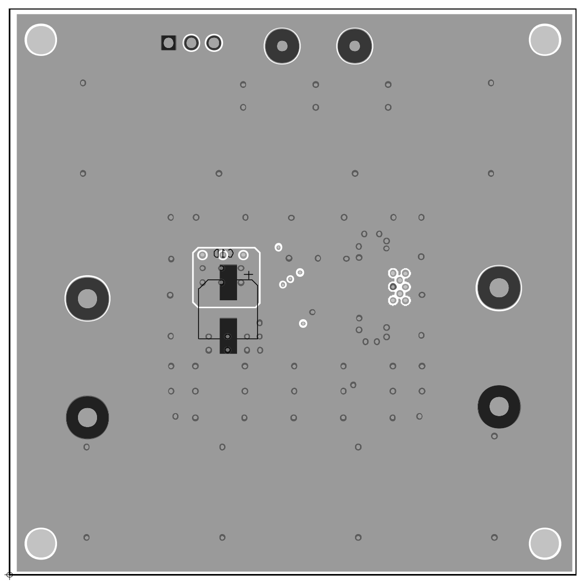


Figure 7: Bottom Layer and Bottom Silk

Note:

2) The copper thickness is 2oz.

REVISION HISTORY

Revision #	Revision Date	Description	Pages Updated
1.0	2/24/2023	Initial Release	-