EVQ3438-QH-0000-00A

10V, 2A, High-Efficiency, Fully Integrated, Synchronous Boost Converter Evaluation Board, AEC-Q100 Qualified

DESCRIPTION

The EVQ3438-QH-0000-00A is an evaluation board designed to demonstrate the capabilities of the MPQ3438-0000, a highly integrated, 2.6MHz quasi-fixed frequency, boost converter with a wide 0.8V to 10V input voltage (V_{IN}) range. The MPQ3438-0000 starts from a V_{IN} as low as 2.7V, and its integrated, low on resistance ($R_{DS(ON)}$) power MOSFETs support a switching current limit up to 2A. The output voltage (V_{OUT}) ranges between 1.25 x V_{IN} and 16V.

The MPQ3438-0000 adopts an adaptive constant-off-time (COT) control topology to provide fast transient response. An internal frequency loop ensures that the switching frequency (f_{SW}) is fixed during steady state operation. The cycle-by-cycle current limit on the low-side MOSFET (LS-FET) prevents current runaway, and the high-side MOSFET (HS-FET) eliminates the need for an external Schottky diode.

The MPQ3438-0000 works in power-saving mode (PSM) under light-load conditions, which reduces f_{SW} and power loss.

Full protection features include configurable input under-voltage lockout (UVLO) and over-temperature protection (OTP).

The EVQ3438-QH-0000-00A is fully assembled and tested. The MPQ3438-0000 is available in a QFN-8 (1.5mmx2mm) package with wettable flanks. It is available in AEC-Q100 Grade 1.

PERFORMANCE SUMMARY

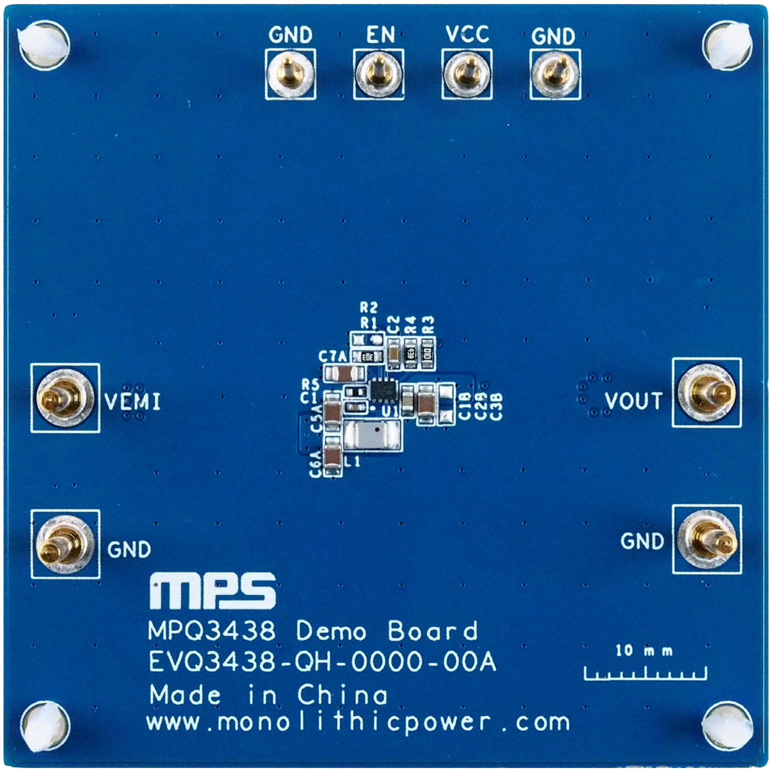
Specifications are at T_A = 25°C, unless otherwise noted.

Parameters	Conditions	Value
Input voltage (V_{IN}) range	V_{OUT} set to 12V	2.7V to 8V (1)
Output voltage (V_{OUT})		12V
Output current (I_{OUT})	V_{IN} = 3.3V, V_{OUT} = 12V	0.3A (2)
Typical efficiency	V_{IN} = 3.3V, V_{OUT} = 12V, I_{OUT} = 0.3A	85.8%
Peak efficiency	V_{IN} = 8V, V_{OUT} = 12V, I_{OUT} = 0.3A	95.1%

Notes:

1) If V_{OUT} is below 1.25 x V_{IN}, the operating frequency folds back to prevent current spikes and provide smooth start-up control. Once V_{OUT} exceeds 1.25 x V_{IN}, f_{SW} returns to the nominal 2.6MHz, so that V_{IN} should be below V_{OUT} / 1.25.
2) Due to the switching current limit (2A), the maximum I_{OUT} range is affected by V_{IN}.

EVQ3438-QH-0000-00A EVALUATION BOARD



LxWxH (6.35cmx6.35cmx1.3cm)

Board Number	MPS IC Number
EVQ3438-QH-0000-00A	MPQ3438GQHE-0000-AEC1

QUICK START GUIDE

The EVQ3438-QH-0000-00A evaluation board is easy to set up and use to evaluate the MPQ3438-0000's performance. For proper measurement equipment set-up, refer to Figure 3 on page 5 and follow the steps below:

1. Preset the power supply between 2.7V and 8V, then turn off the power supply.
2. Set the load current. The maximum I_{OUT} is affected by V_{IN} due to the 2A switching current limit on the integrated low-side MOSFET (LS-FET).

   Table 1 shows the maximum output current (I_{O_MAX}) reference for different input voltages when using L1= 1.5µH, as tested on the EVQ3438-QH-0000-00A.

Table 1: V_{IN} vs. I_{O_MAX}

V_{OUT} (V)	V_{IN} (V)	I_{O_MAX} (A)
12	3.3	0.3
	5	0.5
	6	0.6
	8	0.9

3. Connect the power supply terminals to (see Figure 2 on page 4):
   a. Positive (+): VEMI
   b. Negative (-): GND
4. Connect the load terminals to (see Figure 2 on page 4):
   a. Positive (+): VOUT
   b. Negative (-): GND
5. After making the connections, turn on the power supply. The board should automatically start up.
6. To use the enable function, apply a digital input to the EN pin. Apply a voltage on the EN pin that exceeds its high threshold (1V maximum), and the MPQ3438 starts up some of its internal circuits in micro-power mode. If the EN voltage (V_{EN}) exceeds the turn-on threshold (1.2V), the MPQ3438-0000 enables all functions and starts boost operation. If the enable function is not used, EN can be connected directly to VIN.
7. The 12V output voltage (V_{OUT}) is set by an internal, integrated feedback resistor divider (see Figure 1).

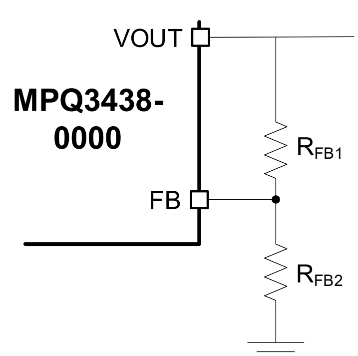


Figure1: Feedback Divider Network

Table 2 lists the recommended feedback resistor values for common V_{OUT} values.

Table 2: Feedback Resistor Selection for the MPQ3438-0000

V_{OUT} (V)	R_{FB1} (kΩ)	R_{FB2} (kΩ)
8	100 (1%)	14.3 (1%)
12	100 (1%)	9.09 (1%)
16	100 (1%)	6.65 (1%)

Refer to the Application Information section in the MPQ3438-0000's datasheet to calculate the inductance and output capacitance.

Figure 2 shows the measurement equipment set-up.

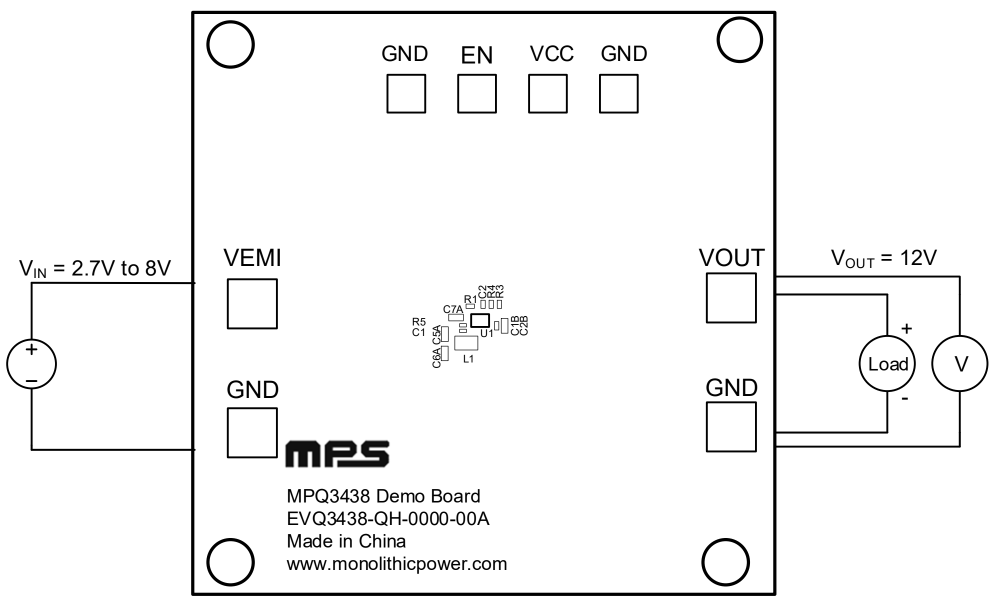


Figure 2: Measurement Equipment Set-Up

EVALUATION BOARD SCHEMATIC

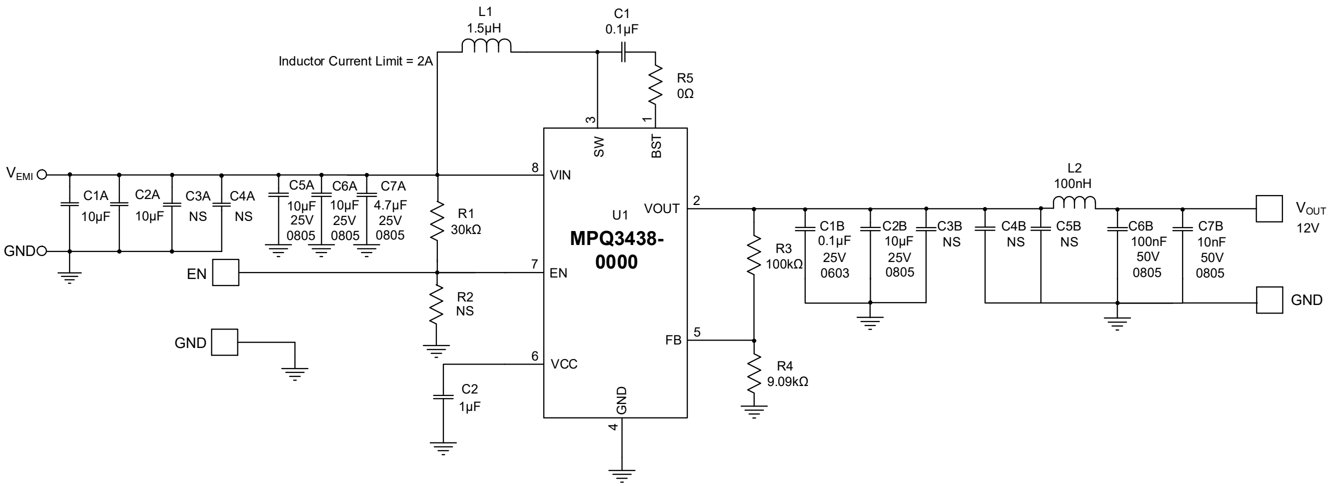
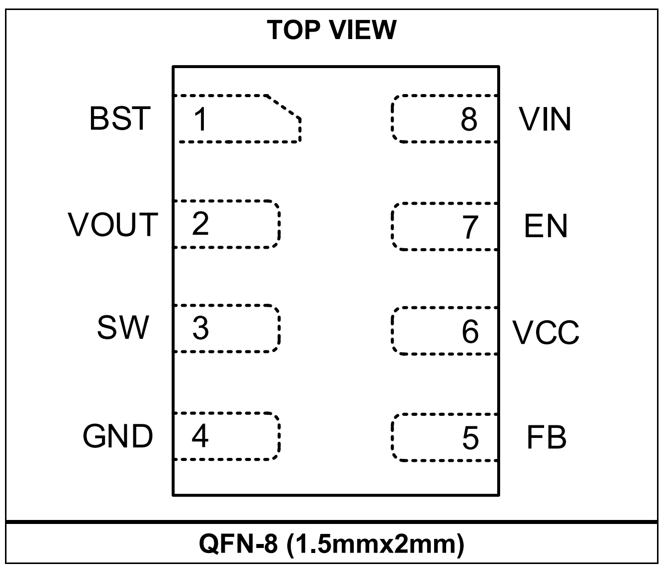


Figure 3: Evaluation Board Schematic

PACKAGE REFERENCE



EVQ3438-QH-0000-00A BILL OF MATERIALS

Qty	Ref	Value	Description	Package	Manufacturer	Manufacturer PN
1	C1	0.1µF	Capacitor, 50V, X7R	0402	Murata	GRM155R71H104KE14D
1	C2	1µF	Capacitor, 16V, X7R	0603	Murata	GRM188R71C105KA12D
1	C1B	0.1µF	Capacitor, 50V, X7R	0603	Murata	GRM188R71H104KA93D
5	C1A, C2A, C5A, C6A, C2B	10µF	Capacitor, 35V, X7R	0805	Murata	GRM21BR6YA106KE43L
1	C7A	4.7µF	Capacitor, 35V, X7R	0805	Murata	CGA4J1X7R1V475KT000N
1	C6B	10nF	Capacitor, 50V, X7R	0805	TDK	C2012X7R1H103K
1	C7B	100nF	Capacitor, 50V, X7R	0805	Murata	GRM21BR71H104KA01L
0	C3A, C3B, C4A, C4B, C5B	NS	Capacitor, 16V, X7R	0805	Murata	GRM216R71C103KA01D
1	L1	1.5µH	Inductor, 50mΩ, 3.1A	SMD	Cyntec	VCTA25201B-1R5MS6-99
1	L2	100nH	Inductor, 9mΩ, 12.8A	SMD	Cyntec	VCTA25201B-R10MS6-99
1	R1	30kΩ	Film resistor, 1%	0603	Yageo	RC0603FR-0730KL
0	R2	NS	Film resistor, 1%	0603		
1	R3	100kΩ	Film resistor, 1%	0603	Yageo	RC0603FR-07100KL
1	R4	9.09kΩ	Film resistor, 1%	0603	Yageo	RC0603FR-079K09L
1	R5	0Ω	Film resistor, 1%	0402	Yageo	RC0402FR-070RL
4	VCC, EN, GND, GND	1.0mm	Connector, 1.0mm golden pin	DIP	Custom (3)	
4	VOUT, VEMI, GND, GND	2.0mm	Connector, 2.0mm golden pin	DIP	Custom (3)	
1	U1	MPQ3438-0000	Boost converter	QFN-8 (1.5mmx 2mm)	MPS	MPQ3438GQHE-0000

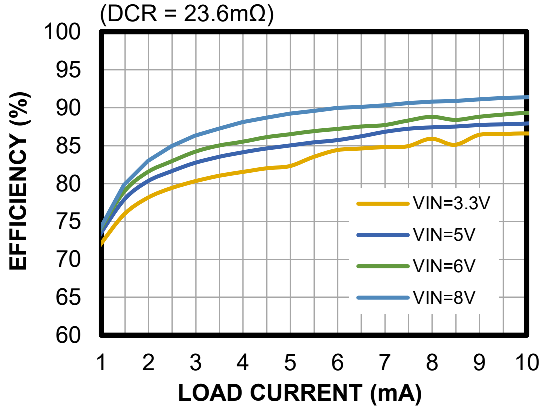
Note:

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

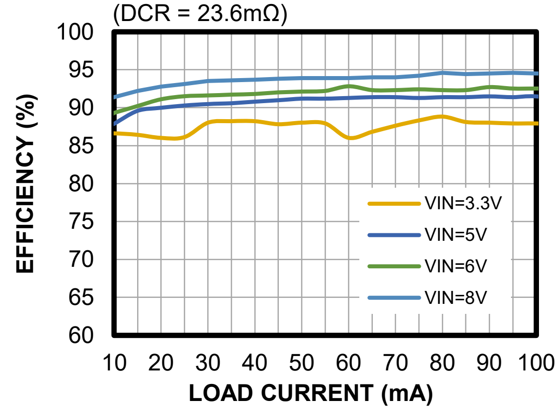
EVB TEST RESULTS

Performance curves and waveforms are tested on the evaluation board. V_{IN} = 3.3V, V_{OUT} = 12V, C_{OUT} = 10µF, L = 1.5µH, T_A = 25°C, unless otherwise noted.

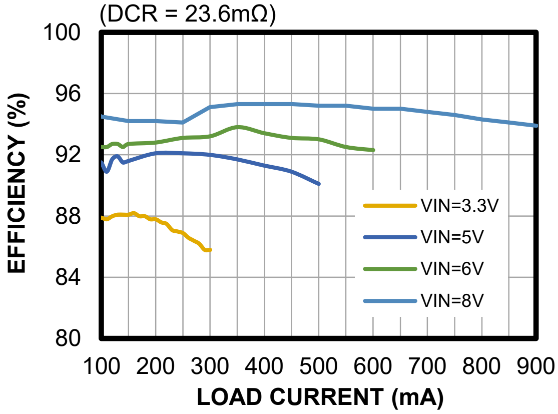
Efficiency vs. Load Current
MPQ3438-0000, V_{OUT} = 12V,
f_{SW} = 2.6MHz, R_{FB1} = 100kΩ,
R_{FB2} = 9.09kΩ, L = 1.5µH
(DCR = 23.6mΩ)



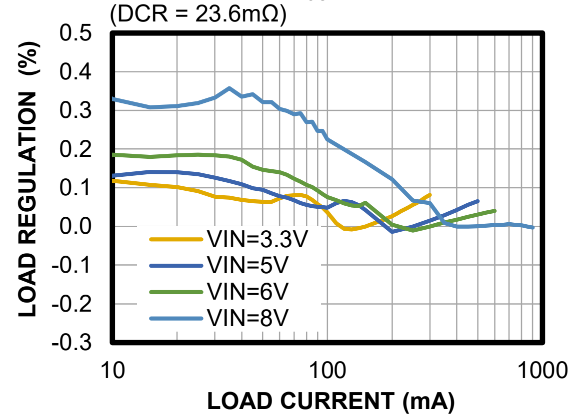
Efficiency vs. Load Current
MPQ3438-0000, V_{OUT} = 12V,
f_{SW} = 2.6MHz, R_{FB1} = 100kΩ,
R_{FB2} = 9.09kΩ, L = 1.5µH
(DCR = 23.6mΩ)



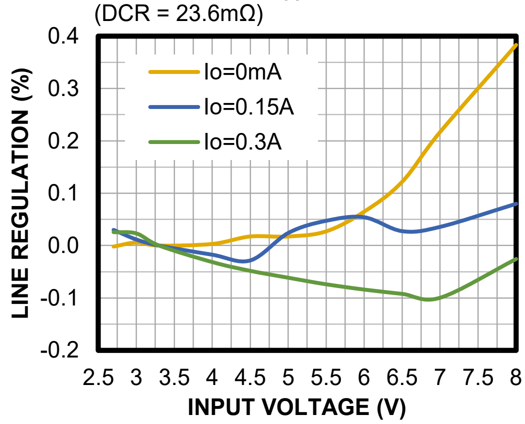
Efficiency vs. Load Current
MPQ3438-0000, V_{OUT} = 12V,
f_{SW} = 2.6MHz, R_{FB1} = 100kΩ,
R_{FB2} = 9.09kΩ, L = 1.5µH
(DCR = 23.6mΩ)



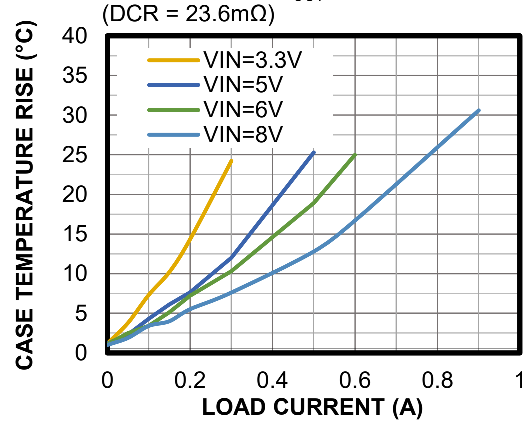
Load Regulation
MPQ3438-0000, V_{OUT} = 12V, L = 1.5µH
(DCR = 23.6mΩ)



Line Regulation
MPQ3438-0000, V_{OUT} = 12V, L = 1.5µH
(DCR = 23.6mΩ)



Case Temperature Rise
MPQ3438-0000, V_{OUT} = 12V, L = 1.5µH
(DCR = 23.6mΩ)

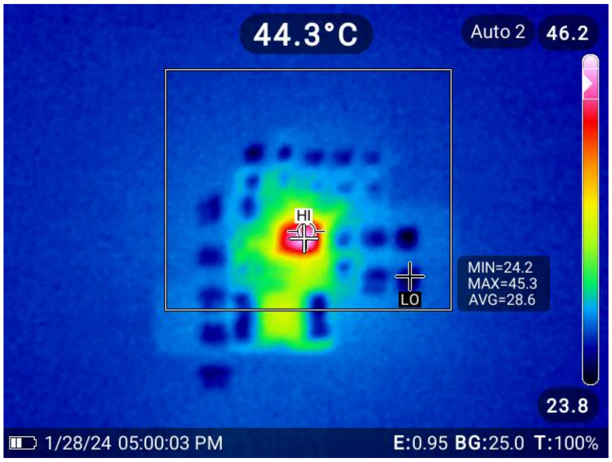


EVB TEST RESULTS *(continued)*

Performance curves and waveforms are tested on the evaluation board. V_{IN} = 3.3V, V_{OUT} = 12V, C_{OUT} = 10μF, L = 1.5μH, T_A = 25°C, unless otherwise noted.

Thermal Performance

V_{IN} = 3.3V, I_{OUT} = 0.3A, no forced airflow, T_{CASE} = 44.3°C

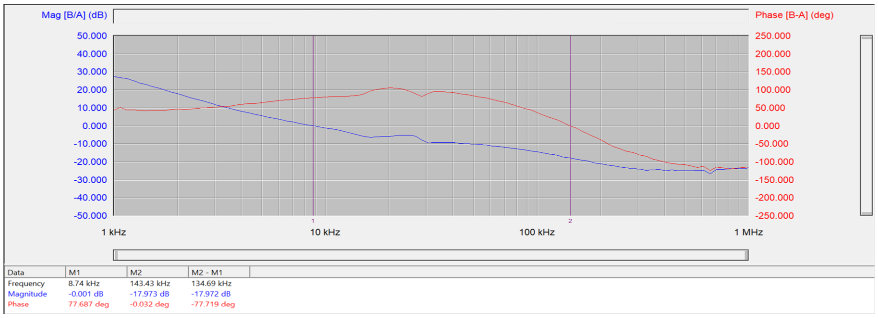


EVB TEST RESULTS *(continued)*

Performance curves and waveforms are tested on the evaluation board. V_{IN} = 3.3V, V_{OUT} = 12V, C_{OUT} = 10µF, L = 1.5µH, T_A = 25°C, unless otherwise noted.

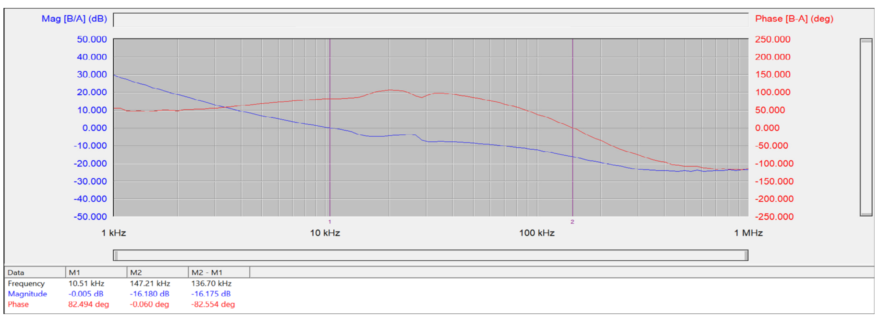
Loop Performance

I_{OUT} = 0.3A, T_A = 25°C



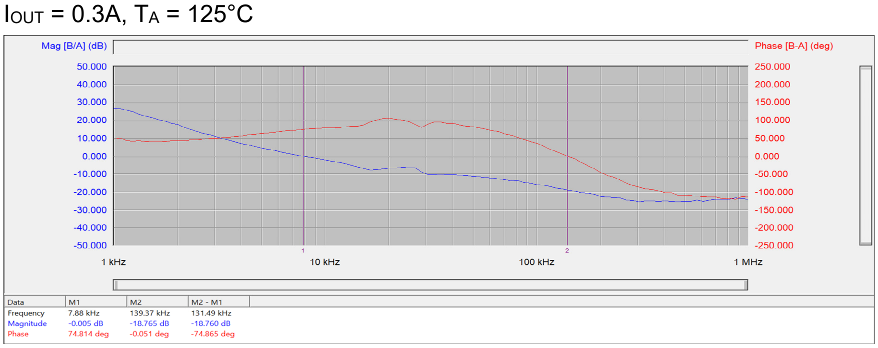
Loop Performance

I_{OUT} = 0.3A, T_A = -40°C



Loop Performance

I_{OUT} = 0.3A, T_A = 125°C

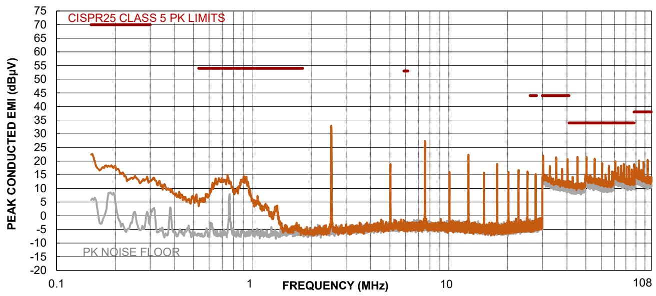


EVB TEST RESULTS *(continued)*

Performance curves and waveforms are tested on the evaluation board. V_{IN} = 6V, V_{OUT} = 12V, C_{OUT} = 10μF, L = 1.5μH, I_{OUT} = 500mA, T_A = 25°C, unless otherwise noted.

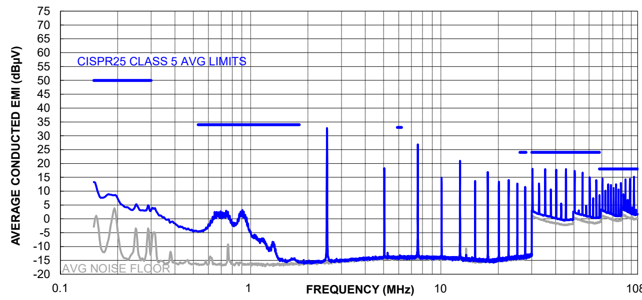
CISPR25 Class 5 Peak Conducted Emissions

150kHz to 108MHz



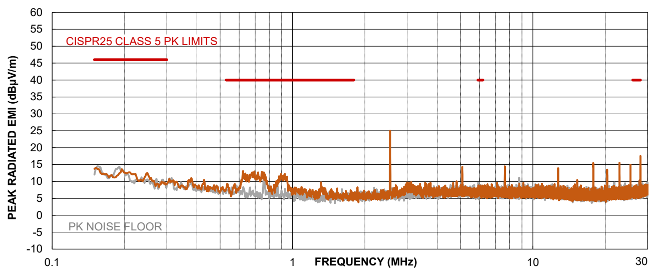
CISPR25 Class 5 Average Conducted Emissions

150kHz to 108MHz



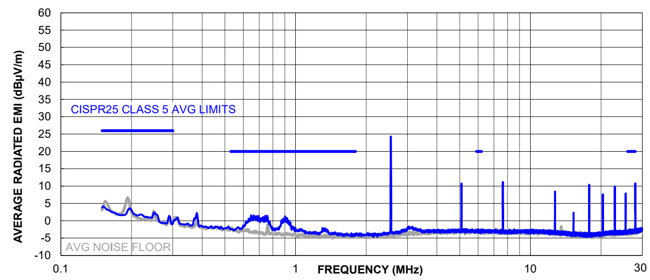
CISPR25 Class 5 Peak Radiated Emissions

150kHz to 30MHz



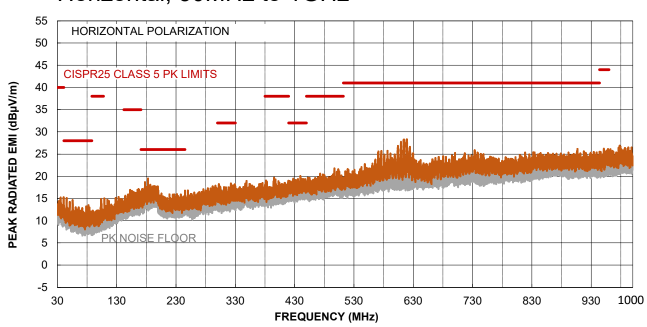
CISPR25 Class 5 Average Radiated Emissions

150kHz to 30MHz



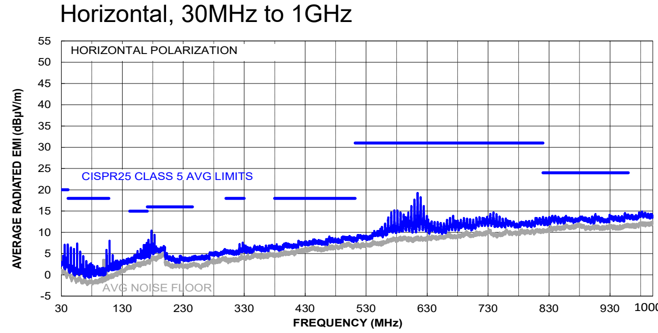
CISPR25 Class 5 Peak Radiated Emissions

Horizontal, 30MHz to 1GHz



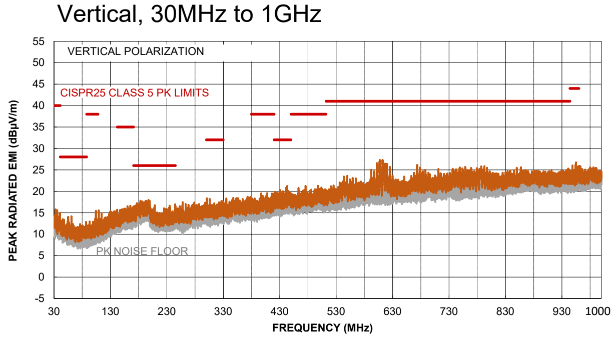
CISPR25 Class 5 Average Radiated Emissions

Horizontal, 30MHz to 1GHz



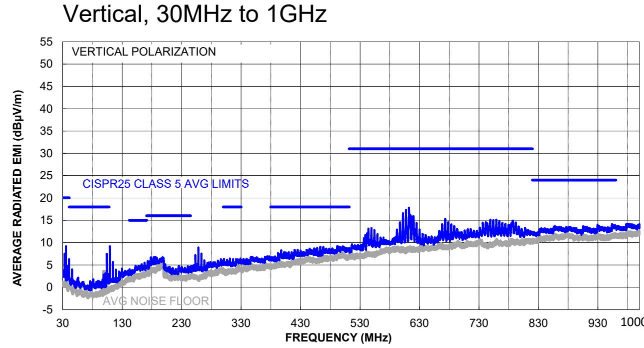
CISPR25 Class 5 Peak Radiated Emissions

Vertical, 30MHz to 1GHz



CISPR25 Class 5 Average Radiated Emissions

Vertical, 30MHz to 1GHz

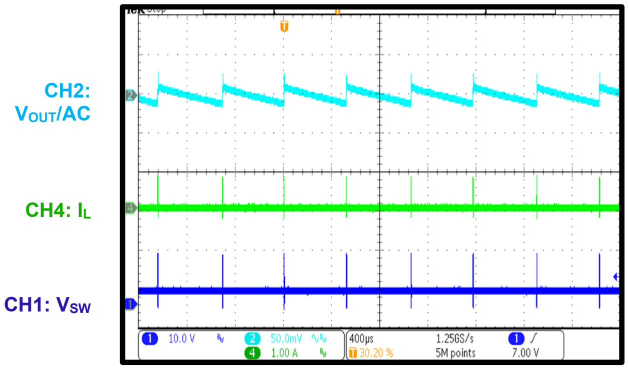


EVB TEST RESULTS *(continued)*

Performance curves and waveforms are tested on the evaluation board. V_{IN} = 3.3V, V_{OUT} = 12V, L = 1.5µH, I_{OUT} = 300mA, T_A = 25°C, unless otherwise noted.

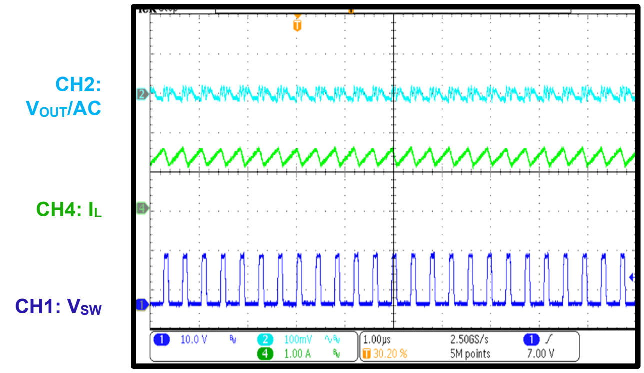
Steady State

I_{OUT} = 0A



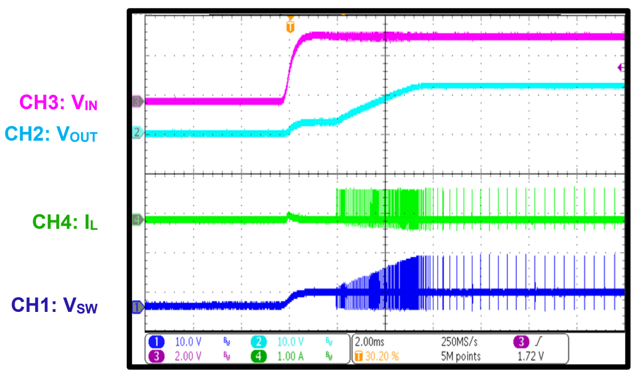
Steady State

I_{OUT} = 0.3A



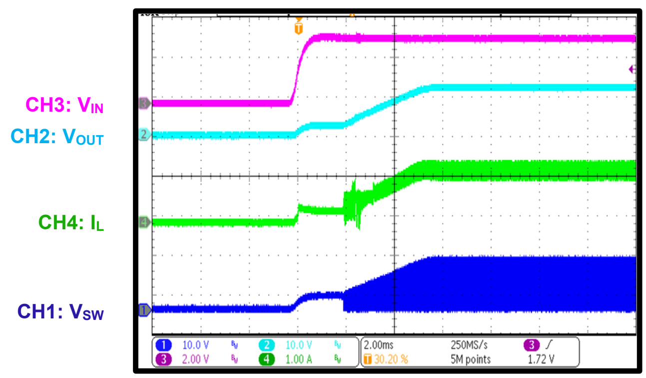
Start-Up through VIN

I_{OUT} = 0A



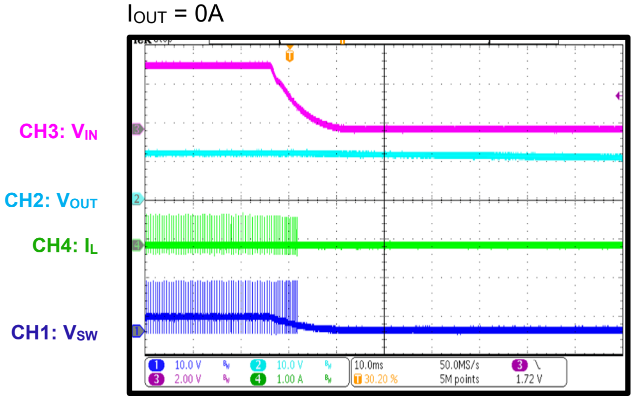
Start-Up through VIN

I_{OUT} = 0.3A



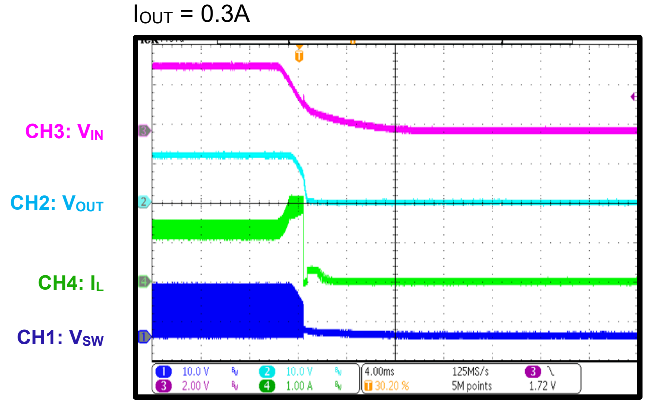
Shutdown through VIN

I_{OUT} = 0A



Shutdown through VIN

I_{OUT} = 0.3A

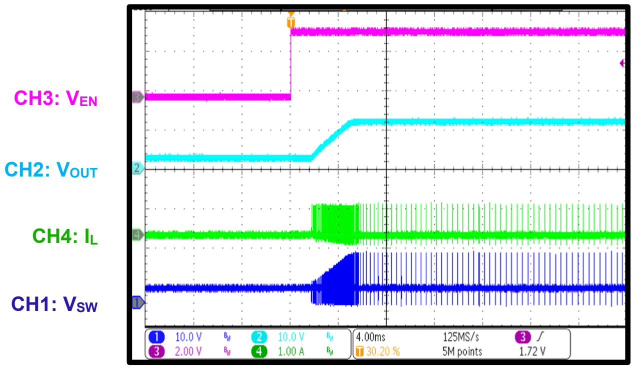


EVB TEST RESULTS *(continued)*

Performance curves and waveforms are tested on the evaluation board. V_{IN} = 3.3V, V_{OUT} = 12V, L = 1.5µH, I_{OUT} = 300mA, T_A = 25°C, unless otherwise noted.

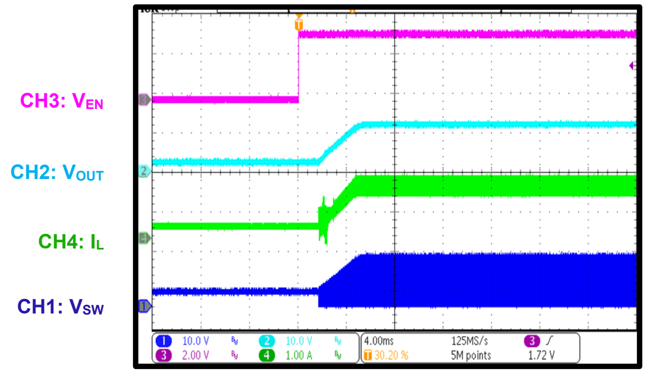
Start-Up through EN

I_{OUT} = 0A, AAM mode



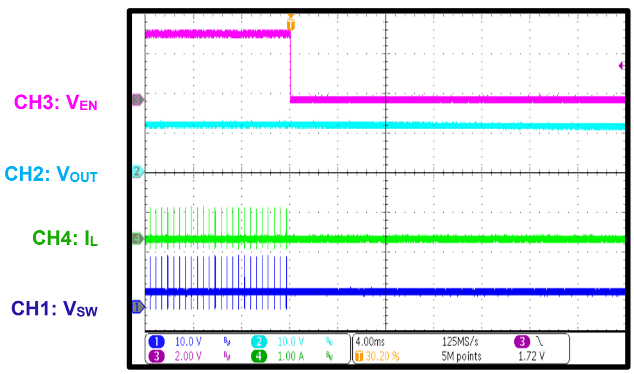
Start-Up through EN

I_{OUT} = 0.3A



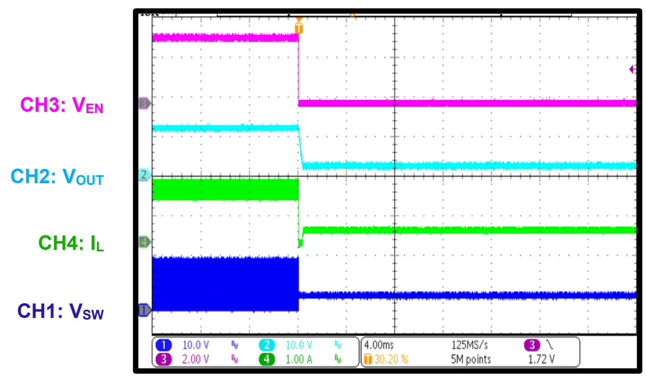
Shutdown through EN

I_{OUT} = 0A



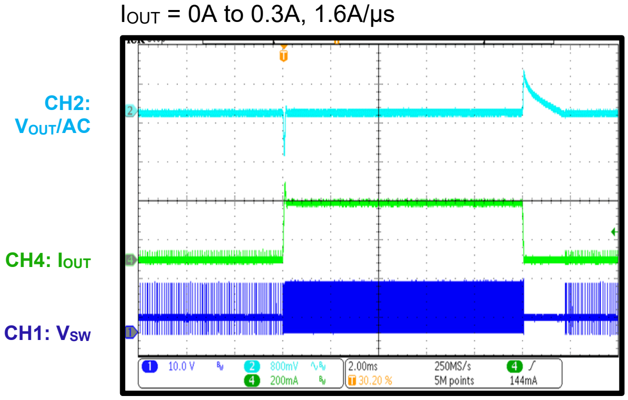
Shutdown through EN

I_{OUT} = 0.3A



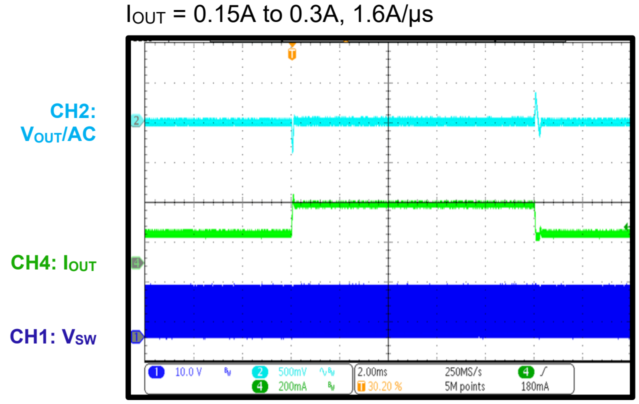
Load Transient Response

I_{OUT} = 0A to 0.3A, 1.6A/µs



Load Transient Response

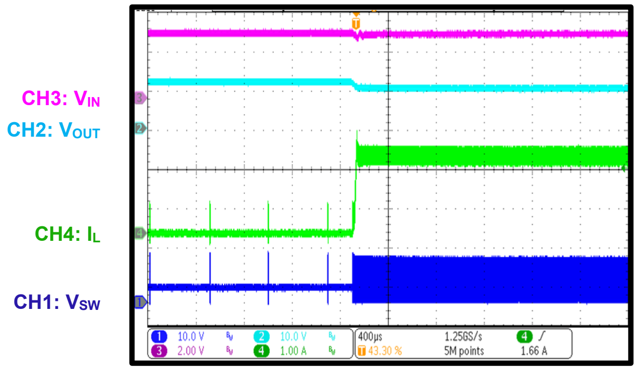
I_{OUT} = 0.15A to 0.3A, 1.6A/µs



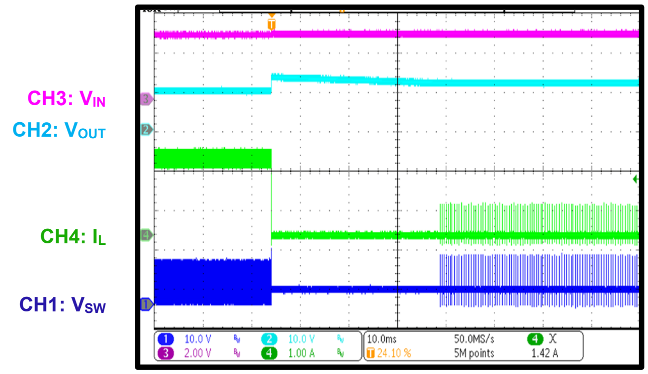
EVB TEST RESULTS *(continued)*

Performance curves and waveforms are tested on the evaluation board. V_{IN} = 3.3V, V_{OUT} = 12V, L = 1.5µH, I_{OUT} = 300mA, T_A = 25°C, unless otherwise noted.

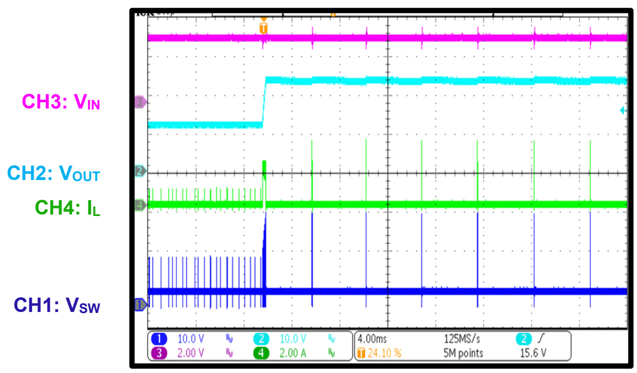
OCP Entry
Increase the load current to the overload threshold



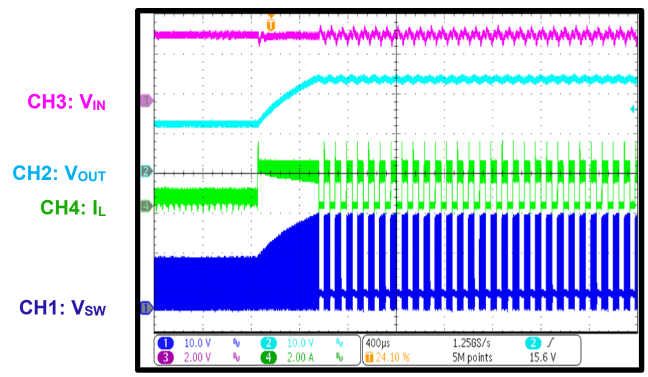
OCP Recovery
Decrease the load current to 0A



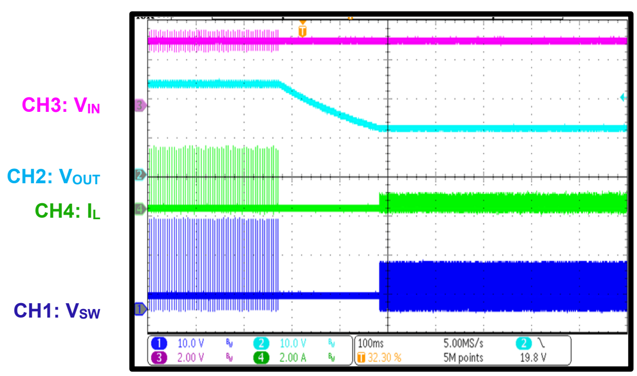
OVP Entry
I_{OUT} = 0A



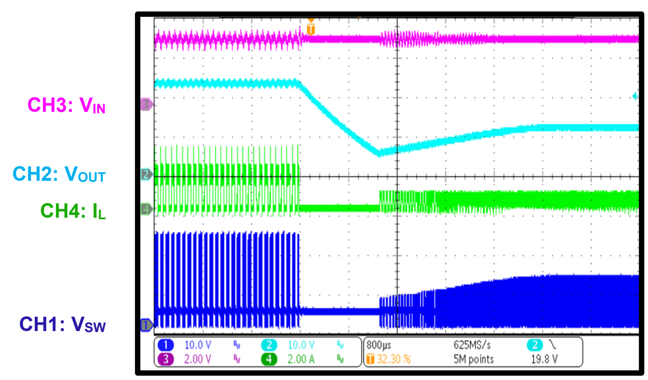
OVP Entry
I_{OUT} = 0.1A



OVP Recovery
I_{OUT} = 0A



OVP Recovery
I_{OUT} = 0.1A



PCB LAYOUT (4)

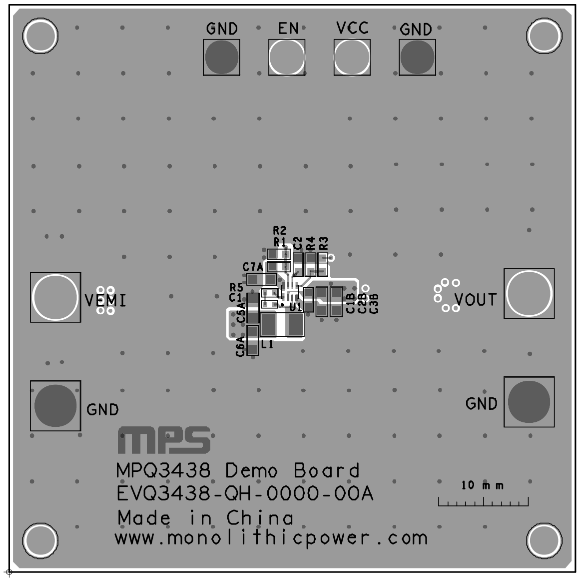


Figure 4: Top Silk and Top Layer

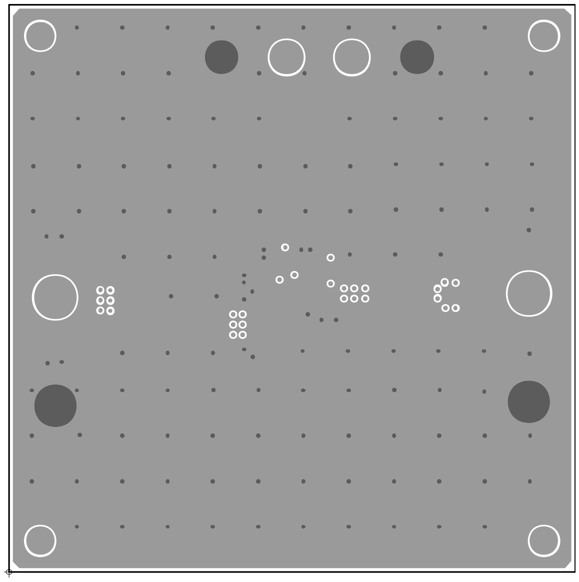


Figure 5: Mid-Layer 1

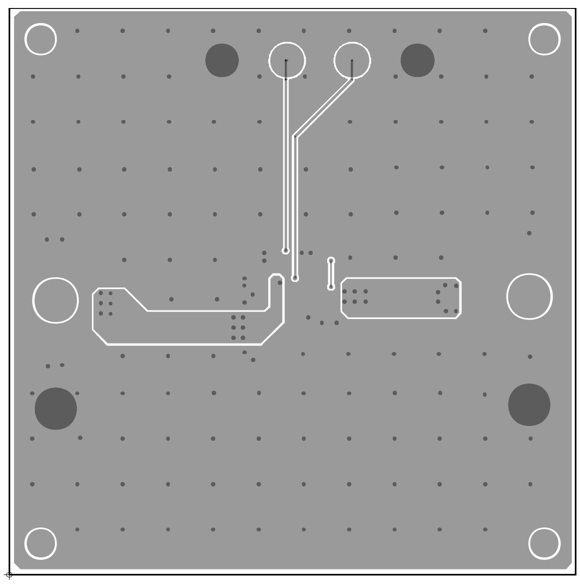


Figure 6: Mid-Layer 2

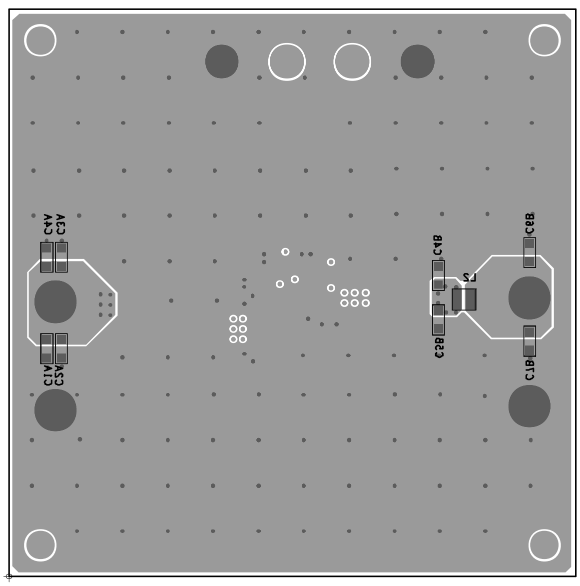


Figure 7: Bottom Layer and Bottom Silk

Note:

4) The copper thickness is 2oz.

REVISION HISTORY

Revision #	Revision Date	Description	Pages Updated
1.0	2/23/2024	Initial Release	-