



EVQ2177F-QH-00A

1A, 6V, AAM Mode, 2.5MHz,
Synchronous Step-Down Converter
Evaluation Board, AEC-Q100 Qualified

DESCRIPTION

The EVQ2177F-QH-00A is an evaluation board designed to demonstrate the capabilities of the MPQ2177FGQHE-AEC1, a monolithic, step-down switch-mode converter with built-in internal power MOSFETs.

The MPQ2177F achieves up to 1A of output current (I_{OUT}) across 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. When $V_{IN} > 3V$, a 100% maximum duty cycle can be reached in dropout.

Constant on-time (COT) control offers a simpler control loop and faster transient response. By using V_{IN} feed-forward, the MPQ2177F maintains a nearly constant switching frequency (f_{SW}) across the entire input and load ranges.

Advanced asynchronous modulation (AAM) mode provides high efficiency by reducing switching losses at light loads.

An open-drain power good (PG) signal indicates the nominal voltage after the soft-start time (t_{SS}). PG pulls high once the feedback voltage (V_{FB}) reaches 95.5% of the reference voltage (V_{REF}), and is pulled to GND when V_{FB} drops to 90% of V_{REF} .

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

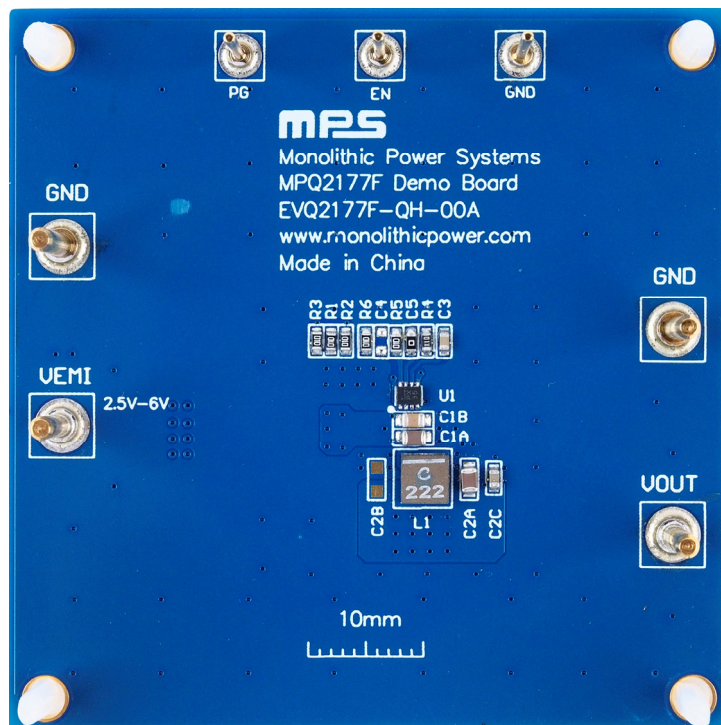
The EVQ2177F-QH-00A is a fully assembled and tested evaluation board. The MPQ2177F is available in a QFN-8 (1.5mmx2mm) package, and it is AEC-Q100 qualified.

PERFORMANCE SUMMARY

Specifications are at $T_A = 25^\circ\text{C}$, 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 $1A$	1.2V
Maximum output current (I_{OUT})	$V_{IN} = 2.5V$ to $6V$	1A
Typical efficiency	$V_{IN} = 3.3V$, $V_{OUT} = 1.2V$, $I_{OUT} = 1A$	89.66%
Peak efficiency	$V_{IN} = 2.5V$, $V_{OUT} = 1.2V$, $I_{OUT} = 0.3A$	94.34%
Switching frequency (f_{SW})		2.5MHz

EVQ2177F-QH-00A EVALUATION BOARD



LxWxH (6.3cmx6.3cmx1cm)

Board Number	MPS IC Number
EVQ2177F-QH-00A	MPQ2177FGQHE-AEC1

QUICK START GUIDE

The EVQ2177F-QH-00A evaluation board is easy to set up and use to evaluate the MPQ2177F'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}) to be between 2.5V and 6V, then turn off the power supply.
2. Set the load current between 0A and 1A. 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 (EN) function, apply a digital input to the EN pin. Pull EN above 0.9V to turn the regulator on; pull EN below 0.65V to turn it off. If the enable function is not used, EN can be connected directly to V_{IN} .
8. The external resistor divider sets the output voltage (V_{OUT}) (see Figure 1).

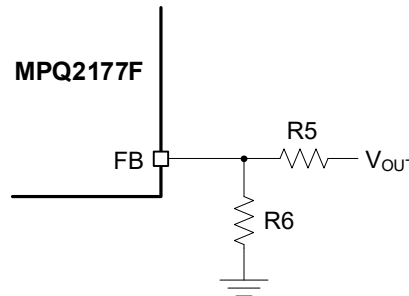


Figure 1: Feedback Divider Network with Adjustable Output

R5 should be between 10k Ω and 100k Ω . Then R6 can be calculated with Equation (1):

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

Refer to the Application Information section in the MPQ2177F's datasheet to calculate the inductance and output capacitance for different output voltages.

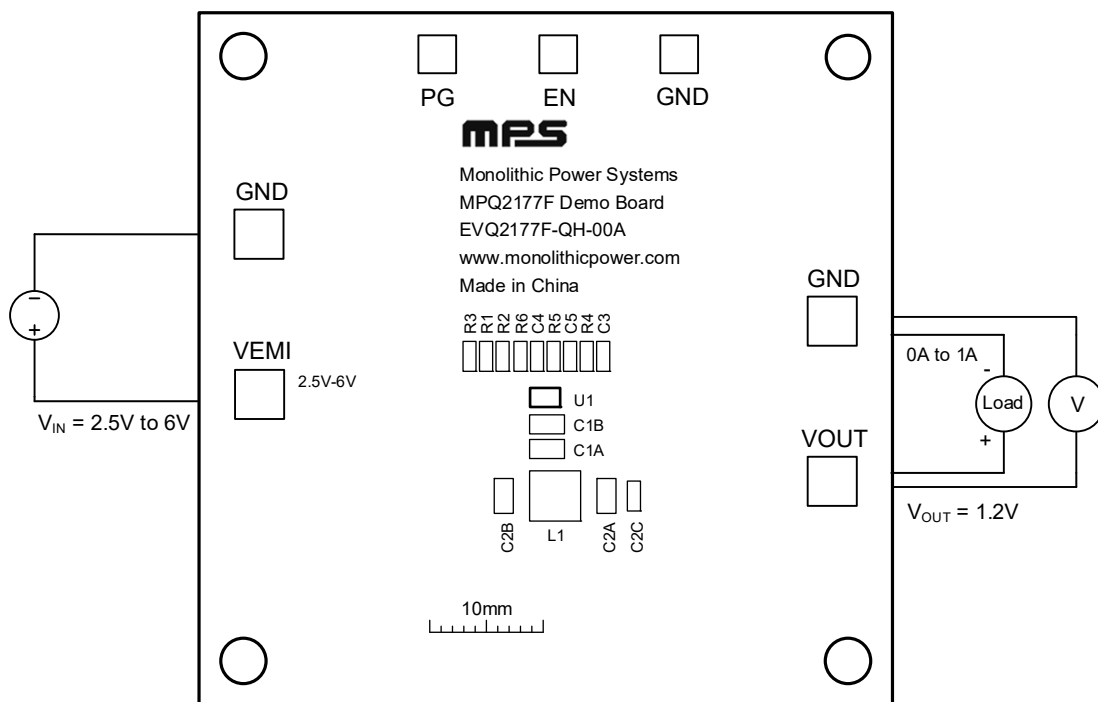


Figure 2: Measurement Equipment Set-Up

EVALUATION BOARD SCHEMATIC

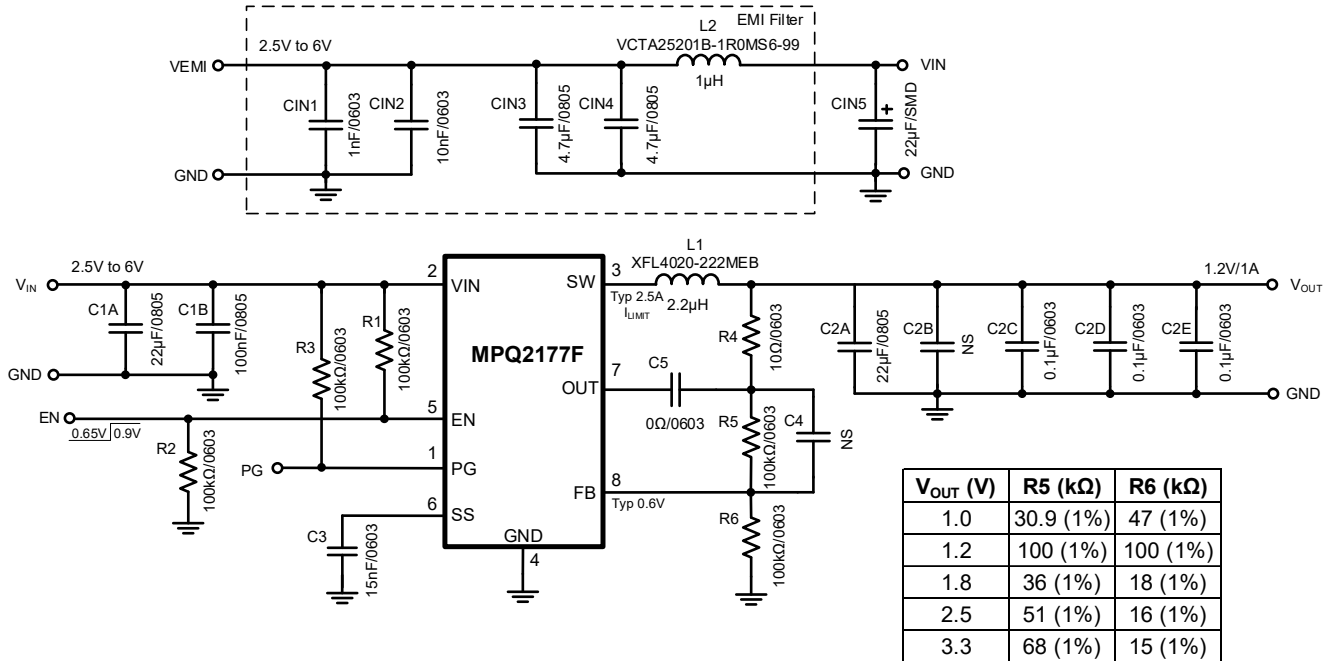
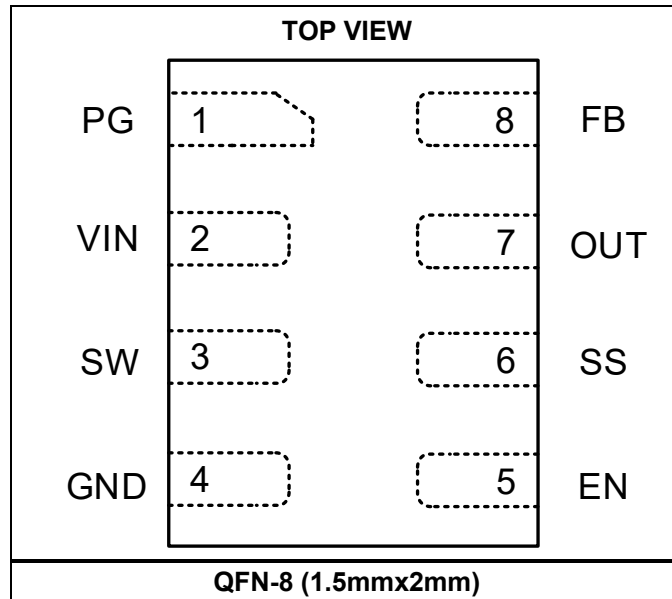


Figure 3: Evaluation Board Schematic

PACKAGE REFERENCE



EVQ2177F-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	15nF	Ceramic capacitor, 50V, X7R	0603	Murata	GRM188R71H153KA01D
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	2.2μH	Inductor, R _{DC} = 21.35mΩ, I _{SAT} = 3.7A	SMD	Coilcraft	XFL4020-222MEB
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	MPQ2177F-AEC1	1A, 6V, step-down converter	QFN-8 (1.5mmx2mm)	MPS	MPQ2177FGQHE-AEC1

Note:

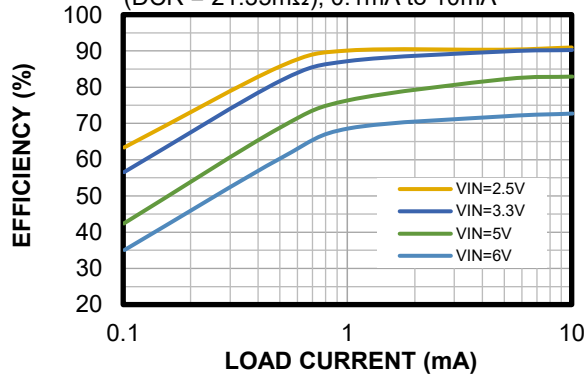
1) MPS custom-produces these pins. Contact an MPS FAE for more information.

EVB TEST RESULTS

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

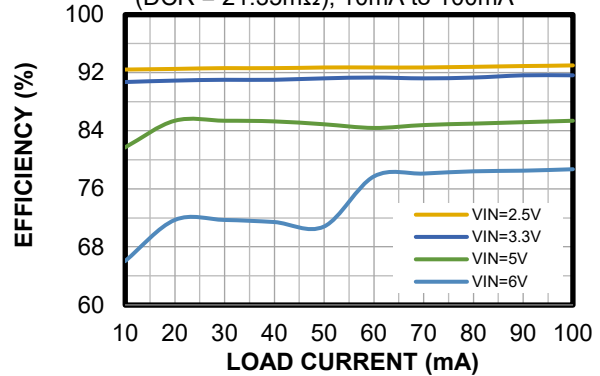
Efficiency vs. Load Current

AAM mode, $V_{OUT} = 1.2V$,
 $f_{SW} = 2.5MHz$, $L = 2.2\mu H$
(DCR = 21.35m Ω), 0.1mA to 10mA



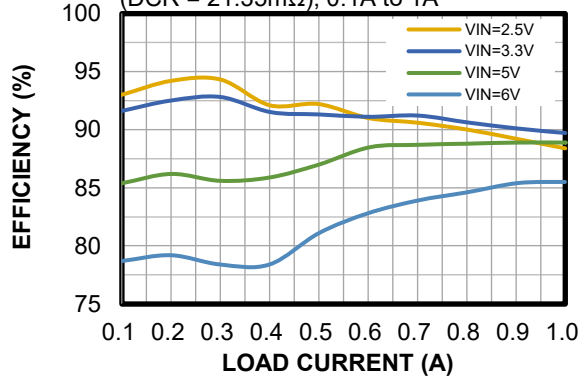
Efficiency vs. Load Current

AAM mode, $V_{OUT} = 1.2V$,
 $f_{SW} = 2.5MHz$, $L = 2.2\mu H$
(DCR = 21.35m Ω), 10mA to 100mA



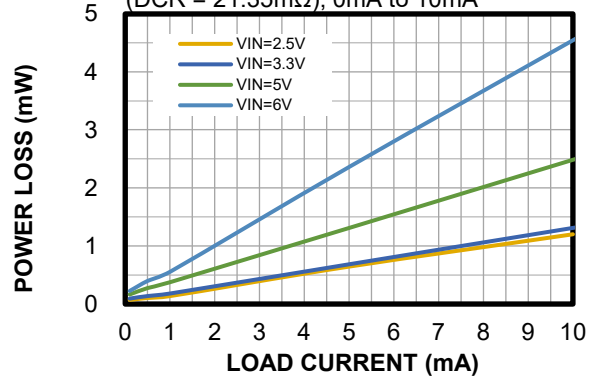
Efficiency vs. Load Current

AAM mode, $V_{OUT} = 1.2V$,
 $f_{SW} = 2.5MHz$, $L = 2.2\mu H$
(DCR = 21.35m Ω), 0.1A to 1A



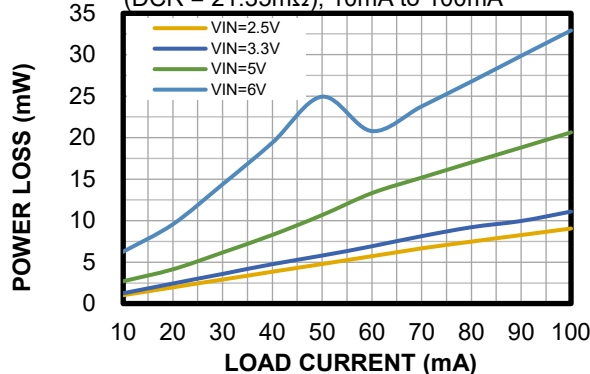
Power Loss vs. Load Current

AAM mode, $V_{OUT} = 1.2V$,
 $f_{SW} = 2.5MHz$, $L = 2.2\mu H$
(DCR = 21.35m Ω), 0mA to 10mA



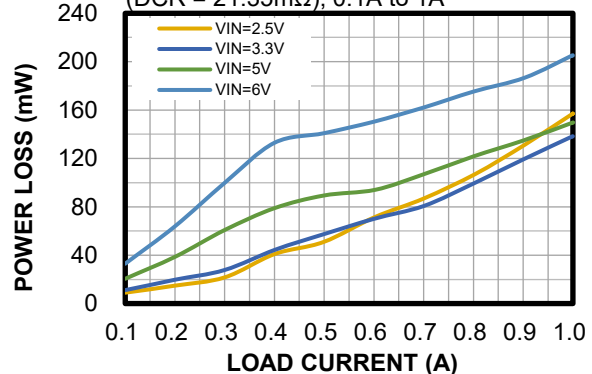
Power Loss vs. Load Current

AAM mode, $V_{OUT} = 1.2V$,
 $f_{SW} = 2.5MHz$, $L = 2.2\mu H$
(DCR = 21.35m Ω), 10mA to 100mA



Power Loss vs. Load Current

AAM mode, $V_{OUT} = 1.2V$,
 $f_{SW} = 2.5MHz$, $L = 2.2\mu H$
(DCR = 21.35m Ω), 0.1A to 1A

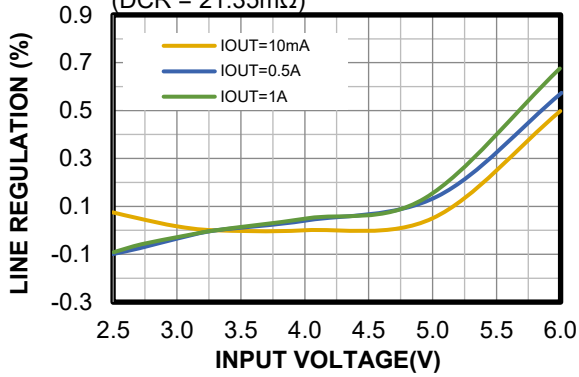


EVB TEST RESULTS *(continued)*

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

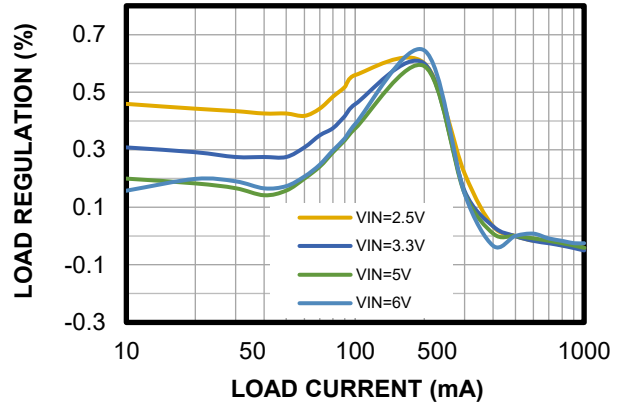
Line Regulation

AAM mode, $V_{OUT} = 1.2V$,
 $f_{SW} = 2.5MHz$, $L = 2.2\mu H$
(DCR = 21.35m Ω)



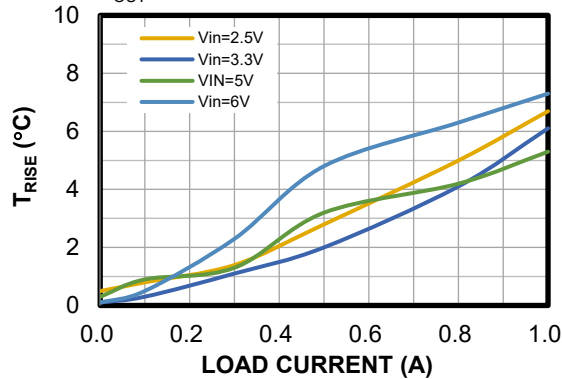
Load Regulation

AAM mode, $V_{OUT} = 1.2V$, $f_{SW} = 2.5MHz$,
 $L = 2.2\mu H$ (DCR = 21.35m Ω)



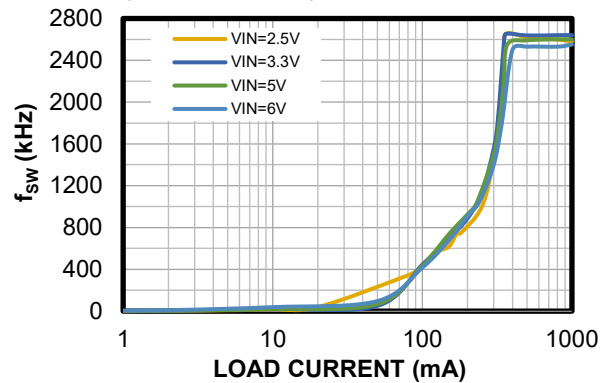
Case Thermal Rise

$V_{OUT} = 1.2V$



f_{SW} vs. Load Current

AAM mode, $V_{OUT} = 1.2V$,
 $f_{SW} = 2.5MHz$, $L = 2.2\mu H$
(DCR = 21.35m Ω), 1mA to 1000mA

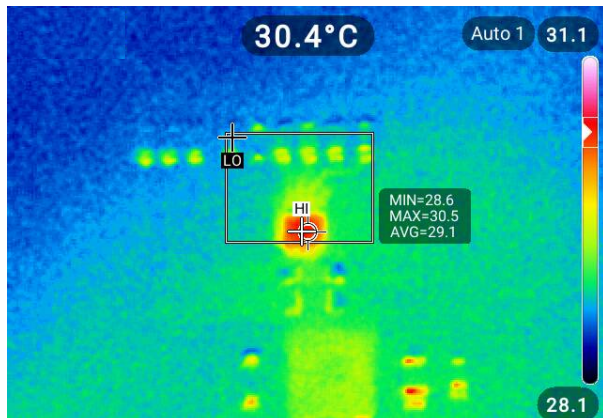


EVB TEST RESULTS *(continued)*

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

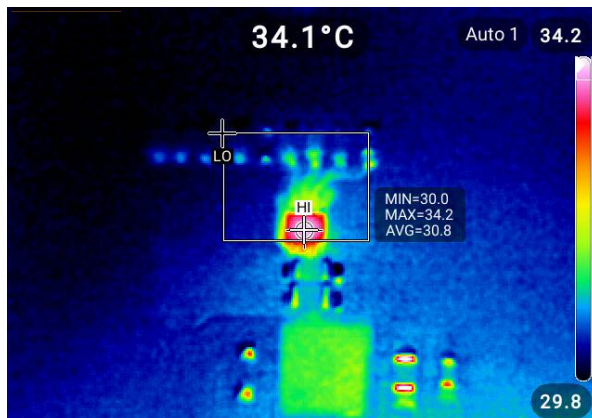
Thermal Performance

$I_{OUT} = 0.5A$, no forced airflow, $T_{CASE} = 30.5^{\circ}C$



Thermal Performance

$I_{OUT} = 1A$, no forced airflow, $T_{CASE} = 34.2^{\circ}C$

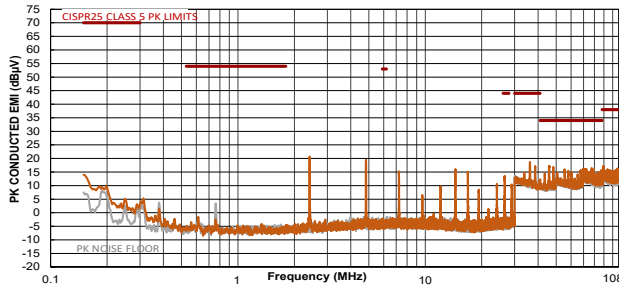


EVB TEST RESULTS (continued)

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

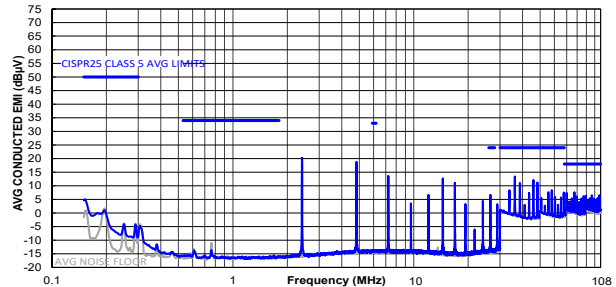
CISPR 25 Class 5 Peak Conducted Emissions

150kHz to 108MHz



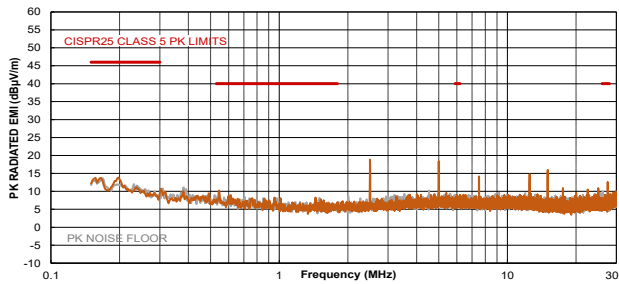
CISPR 25 Class 5 Average Conducted Emissions

150kHz to 108MHz



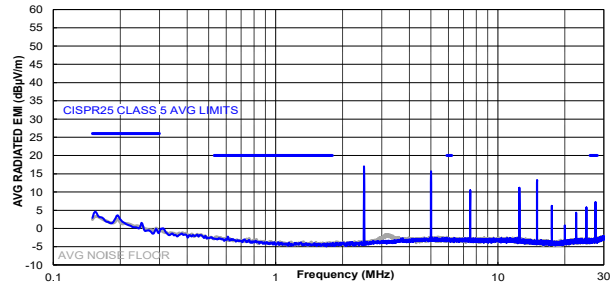
CISPR 25 Class 5 Peak Radiated Emissions

150kHz to 30MHz



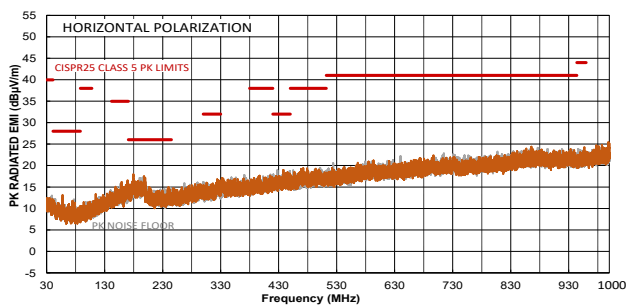
CISPR 25 Class 5 Average Radiated Emissions

150kHz to 30MHz



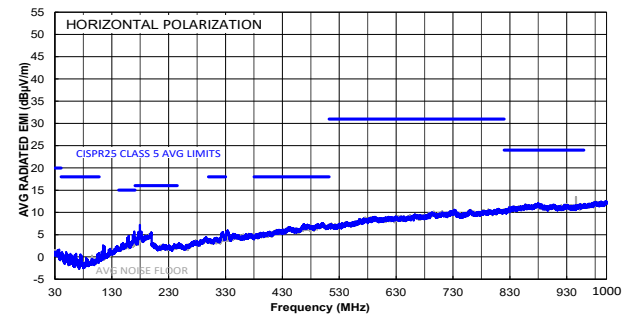
CISPR 25 Class 5 Peak Radiated Emissions

Horizontal, 30MHz to 1GHz



CISPR 25 Class 5 Average Radiated Emissions

Horizontal, 30MHz to 1GHz

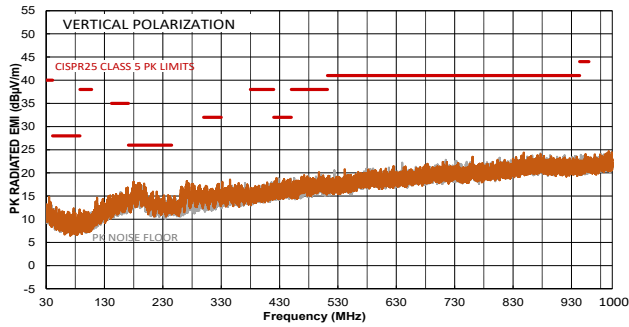


EVB TEST RESULTS *(continued)*

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

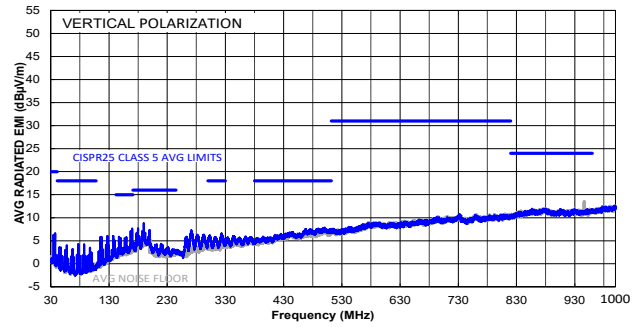
CISPR 25 Class 5 Peak Radiated Emissions

Vertical, 30MHz to 1GHz



CISPR 25 Class 5 Average Radiated Emissions

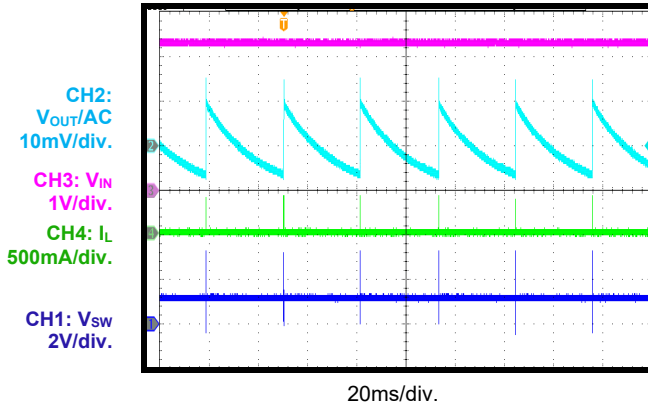
Vertical, 30MHz to 1GHz



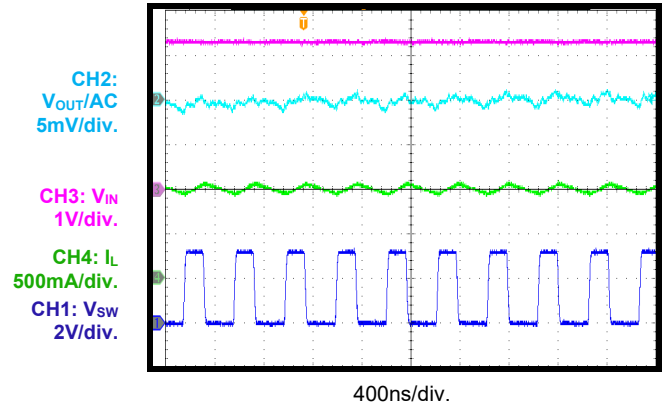
EVB TEST RESULTS *(continued)*

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

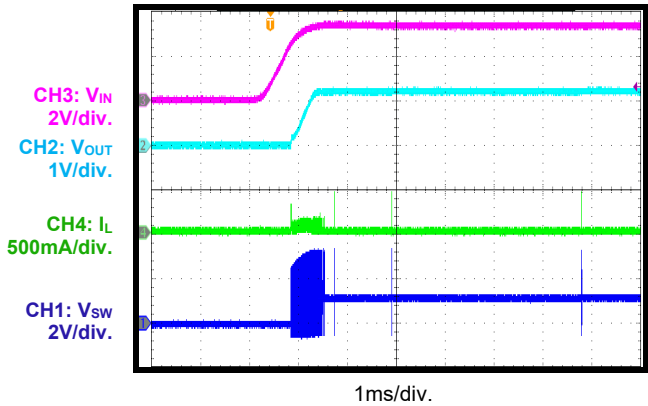
Steady State

 $I_{OUT} = 0A$


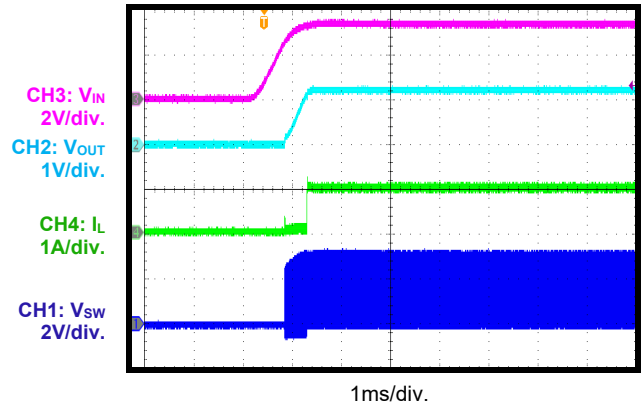
Steady State

 $I_{OUT} = 1A$


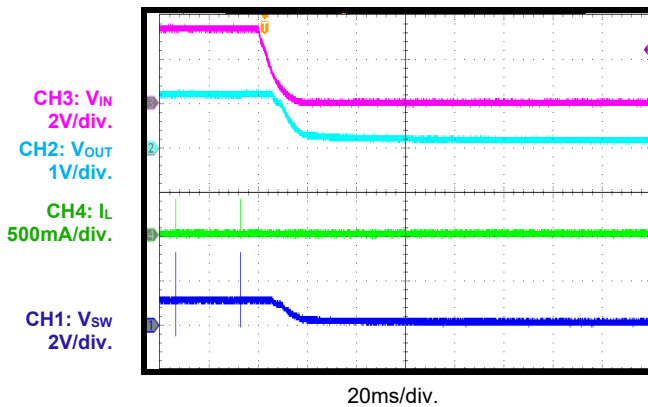
Start-Up through VIN

 $I_{OUT} = 0A$


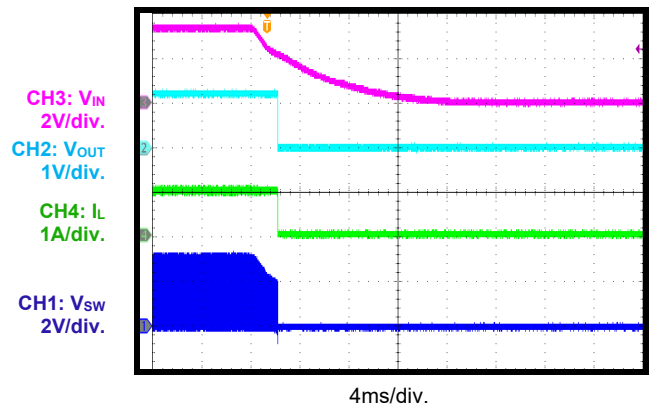
Start-Up through VIN

 $I_{OUT} = 1A$


Shutdown through VIN

 $I_{OUT} = 0A$


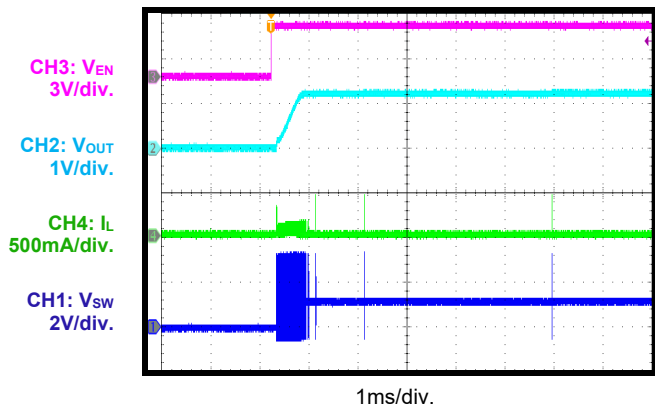
Shutdown through VIN

 $I_{OUT} = 1A$


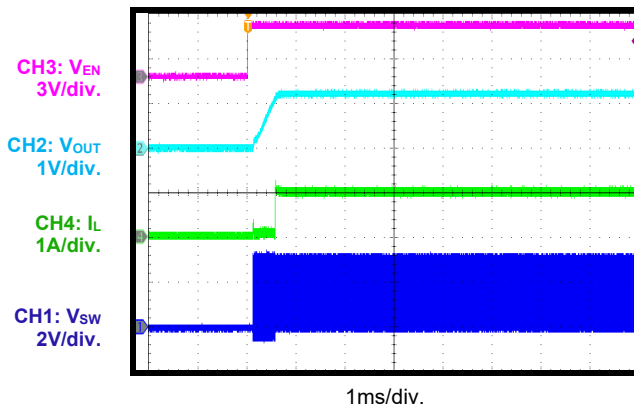
EVB TEST RESULTS *(continued)*

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

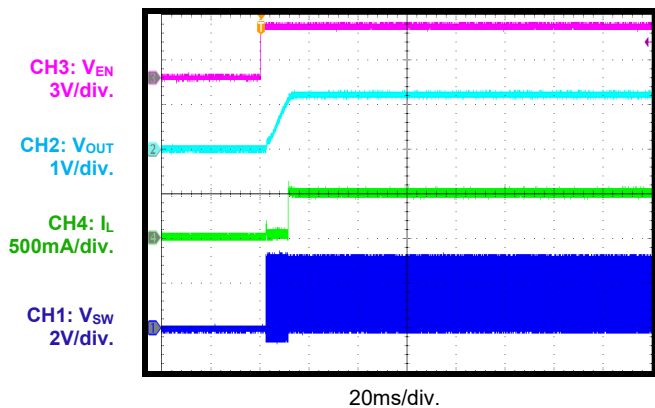
Start-Up through EN

 $I_{OUT} = 0A$


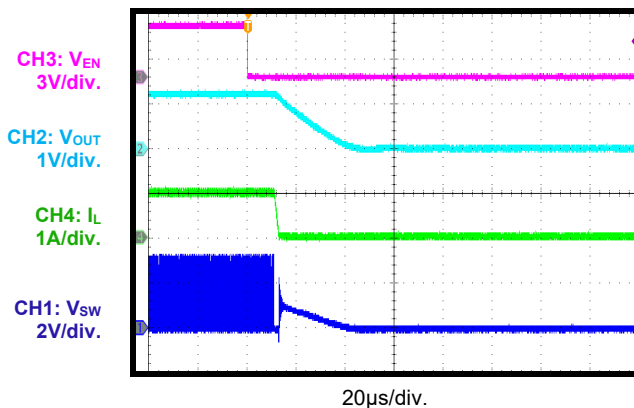
Start-Up through EN

 $I_{OUT} = 1A$


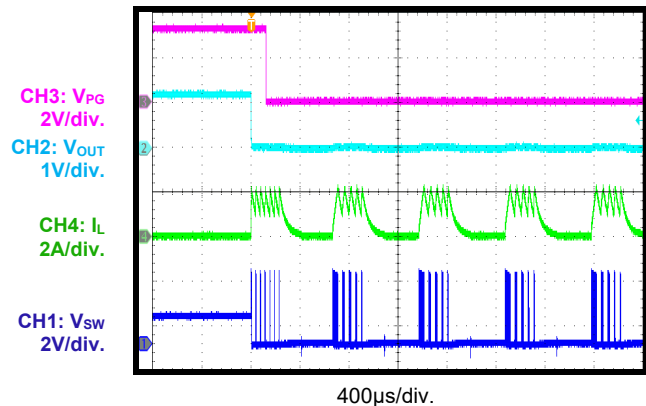
Shutdown through EN

 $I_{OUT} = 0A$


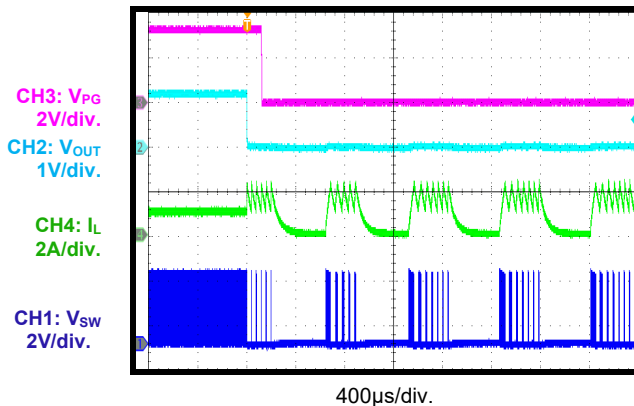
Shutdown through EN

 $I_{OUT} = 1A$


SCP Entry

 $I_{OUT} = 0A$


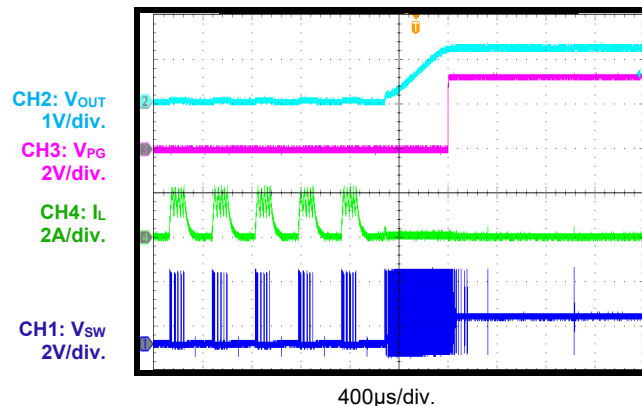
SCP Entry

 $I_{OUT} = 1A$


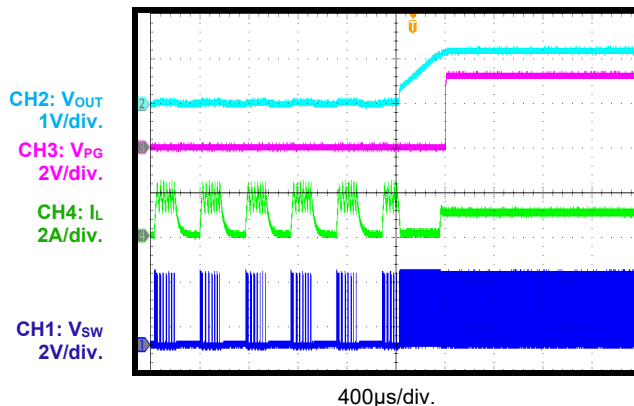
EVB TEST RESULTS *(continued)*

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

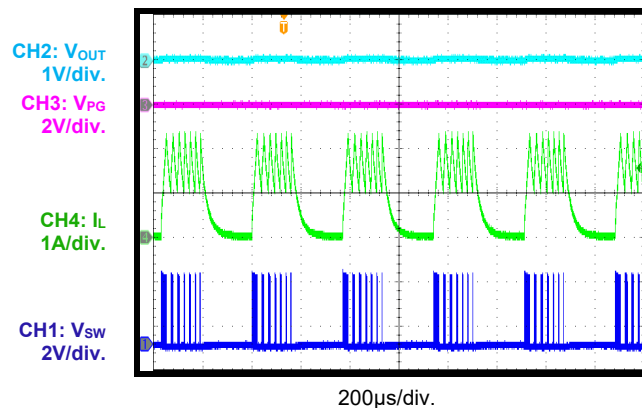
SCP Recovery

 $I_{OUT} = 0A$


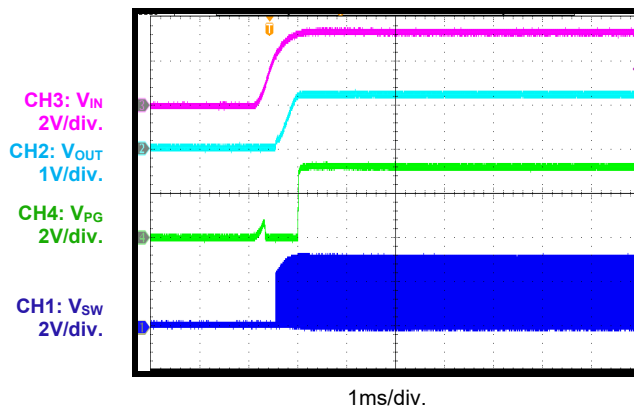
SCP Recovery

 $I_{OUT} = 1A$


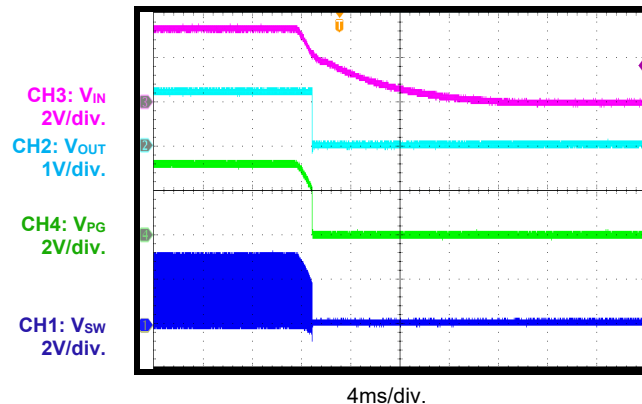
Short-Circuit Protection



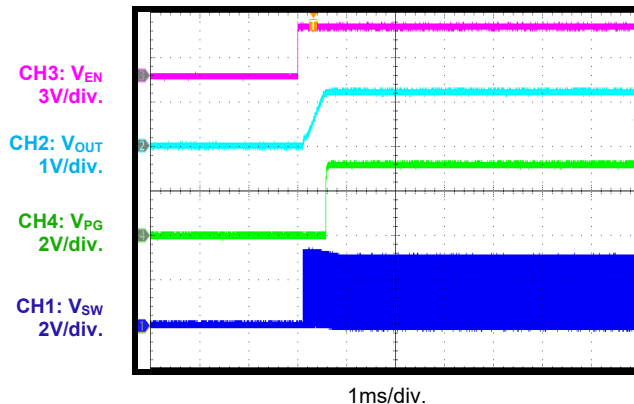
PG Start-Up through VIN

 $I_{OUT} = 1A$


PG Shutdown through VIN

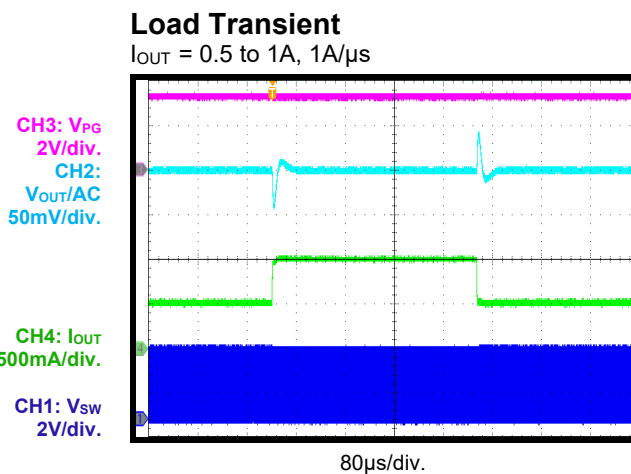
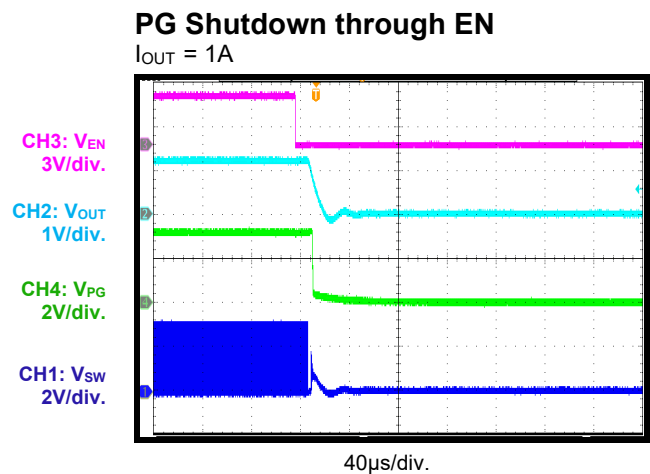
 $I_{OUT} = 1A$


PG Start-Up through EN

 $I_{OUT} = 1A$


EVB TEST RESULTS *(continued)*

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



PCB LAYOUT (2)

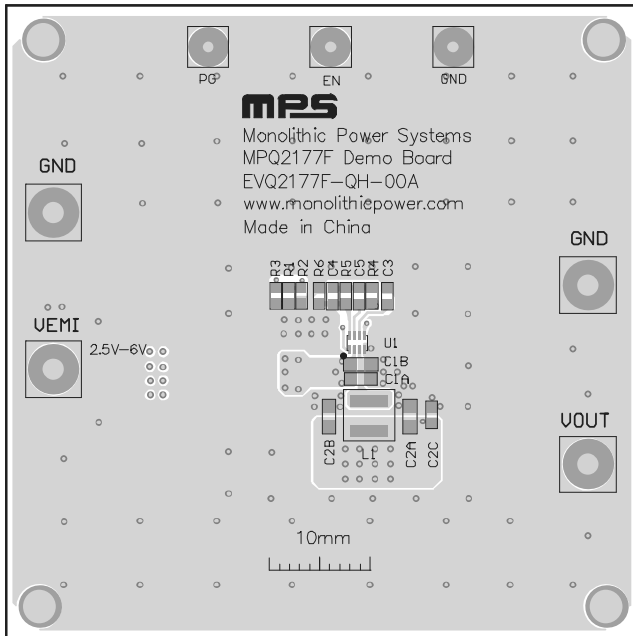


Figure 4: Top Silk and Top Layer

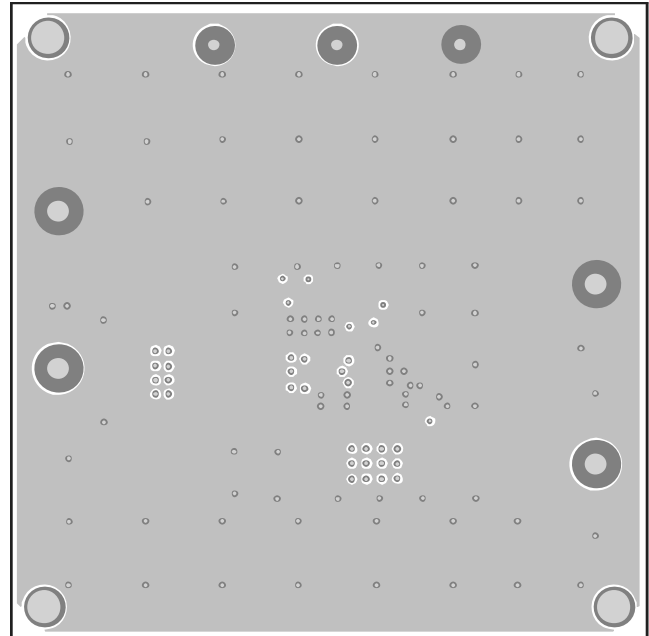


Figure 5: Mid-Layer 1

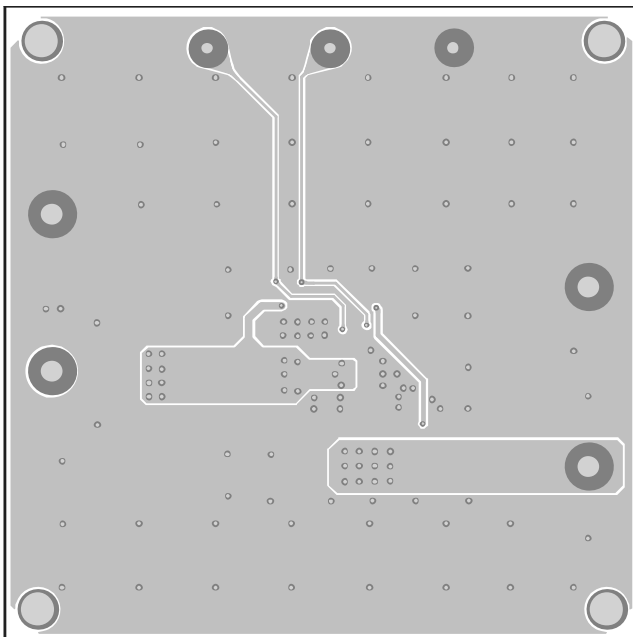


Figure 6: Mid-Layer 2

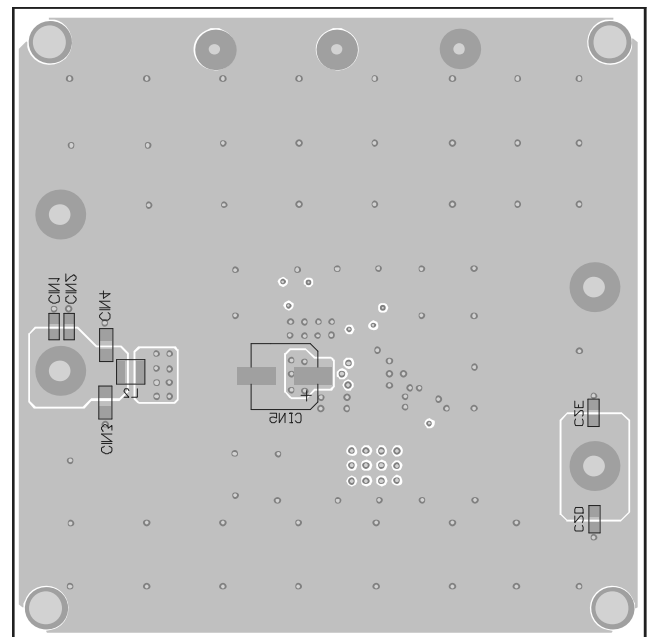


Figure 7: Bottom Layer and Bottom Silk

Note:

2) The copper thickness is 2oz.



REVISION HISTORY

Revision #	Revision Date	Description	Pages Updated
1.0	10/31/2024	Initial Release	-

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