EVQ2211-LC-00A

6V, 12A, 2.2MHz, Configurable Current Limit, Synchronous Buck Converter, Evaluation Board, AEC-Q100 Qualified

DESCRIPTION

The EVQ2211-LC-00A evaluation board is designed to demonstrate the capabilities of the MPQ2211, a high-frequency (2.2MHz), synchronous buck converter with integrated, internal high-side and low-side power MOSFETs (HS-FETs and LS-FETs, respectively).

The MPQ2211 operates from a 3V to 3.6V and 4V to 6V input voltage (V_{IN}) range. To support the 3V to 3.6V V_{IN} range, connect VCC to VIN. The device offers a very compact solution to achieve up to 12A of output current (I_{OUT}) across a wide input supply range with excellent load and line regulation. The MPQ2211 operates at high efficiency across a wide I_{OUT} load range.

The MPQ2211 adopts internally compensated constant-on-time (COT) control to provide fast transient response and facilitate loop stabilization. Pulse-skip mode (PSM) enables non-synchronous operation to optimize light-load efficiency.

The MPQ2211 has a fixed 2.2MHz frequency, which allows the MPQ2211's frequency to remain constant regardless of the input and output voltages.

The output voltage (V_{OUT}) start-up ramp is controlled by an internal 0.9ms timer. This time can be lengthened by adding a capacitor on the SSTT pin. An open-drain power good (PG) signal indicates whether output is within its nominal voltage range. The PG pin is clamped to about 0.7V with an external pull-up voltage when the input supply fails to power the MPQ2211.

Fully integrated protection features include over-current protection (OCP), over-voltage protection (OVP), under-voltage protection (UVP), and over-temperature protection (OTP).

The EVQ2211-LC-00A is a fully assembled and tested evaluation board. The MPQ2211 is available in an LGA-19 (3mm x 3.5mm) package. 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		4V to 6V
Output voltage (V_{OUT})	V_{IN} = 4V to 6V, I_{OUT} = 0A to 12A	1.2V
Maximum output current (I_{OUT})	V_{IN} = 4V to 6V	12A
Typical efficiency	V_{IN} = 5V, V_{OUT} = 1.2V, I_{OUT} = 12A	85.3%
Peak efficiency	V_{IN} = 4V, V_{OUT} = 1.2V, I_{OUT} = 4A	91.9%
Switching frequency (f_{SW})		2.2MHz

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EVQ2211-LC-00A EVALUATION BOARD

LxWxH (8.3cmx8.3cmx1.05cm)

Board Number	MPS IC Number
EVQ2211-LC-00A	MPQ2211GLC-AEC1

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QUICK START GUIDE

The EVQ2211-LC-00A evaluation board is easy to set up and use to evaluate the MPQ2211's performance. For the proper measurement equipment set-up, refer to Figure 2 on page 4 and follow the steps below:

1. Preset the power supply to be between 4V and 6V (to support the 3V to 3.6V input voltage (V_{IN}) range, connect VCC to VIN), then turn off the power supply.
2. Set the load current between 0A and 12A. Electronic loads represent a negative impedance to the regulator, and setting the current too high may trigger 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. The board should start up automatically.
7. To use the enable (EN) function, apply a digital input to the EN pin. Drive EN above 1.22V to turn the regulator on; drive EN below 1V to turn it off.
8. The feedback voltage (V_{FB}) is typically 0.5V for the adjustable output version. The external resistor divider connected to FB sets the output voltage (V_{OUT}) (see Figure 1).

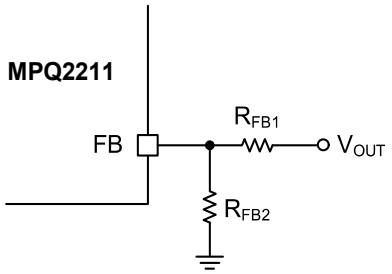

Figure 1: Feedback Divider Network of Adjustable Output

R_{FB1} is selected to be between 10kΩ and 100kΩ. R_{FB2} can then be calculated with Equation (1):

$$R_{FB2} = \frac{0.5(V)}{V_{OUT} - 0.5(V)} \times R_{FB1} \quad (1)$$

Table 1 on page 4 shows the recommended resistances for common output voltages.

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Table 1: Resistances for Common Output Voltages

V_{OUT} (V)	R_{FB1} (kΩ)	R_{FB2} (kΩ)
0.8	60.4(1%)	100 (1%)
1.0	100 (1%)	100 (1%)
1.2	100 (1%)	71.5 (1%)
1.8	100 (1%)	38.3(1%)
2.5	75 (1%)	18.7 (1%)
3.3	100 (1%)	17.8 (1%)

This evaluation board uses CN2 to switch the resistor divider's resistance so that users can choose a V_{OUT} between 1.2V and 1.8V.

9. The MODE pin can be used to select the operating mode under light-load conditions. Floating this pin or pulling this pin high forces the device to operate in pulse-skip mode (PSM), while pulling it low forces the device to work in forced continuous conduction mode (FCCM) (see Table 2).

Table 2: MODE Selection

MODE	Light-Load Mode	Switching Frequency
Float (or VCC)	Pulse skip	2200kHz
GND	FCCM	2200kHz

10. The SSTT pin can be used to set the soft-start time (t_{SS}) by adding a soft-start capacitor (C_{SSTT}) between SSTT and AGND. The minimum t_{SS} is limited at 0.9ms. C_{SSTT} can be estimated with Equation (2):

$$C_{SSTT}\ (nF) = \frac{t_{ss}\ (ms) \times 36\ (\mu A)}{0.5\ (V)} \quad (2)$$

When an external voltage signal is connected to SSTT, the external voltage acts as a reference for the MPQ2211's output voltage. The FB pin's voltage (V_{FB}) follows this external voltage signal exactly; the soft-start settings are ignored. The SSTT input signal can be between 0.3V and 1.4V. During the initial start-up, the SSTT voltage must reach at least 500mV to ensure proper operation.

Refer to the Application Information section in the MPQ2211's datasheet to calculate the inductance and output capacitance for different V_{OUT} values. Figure 2 shows the proper measurement equipment set-up.

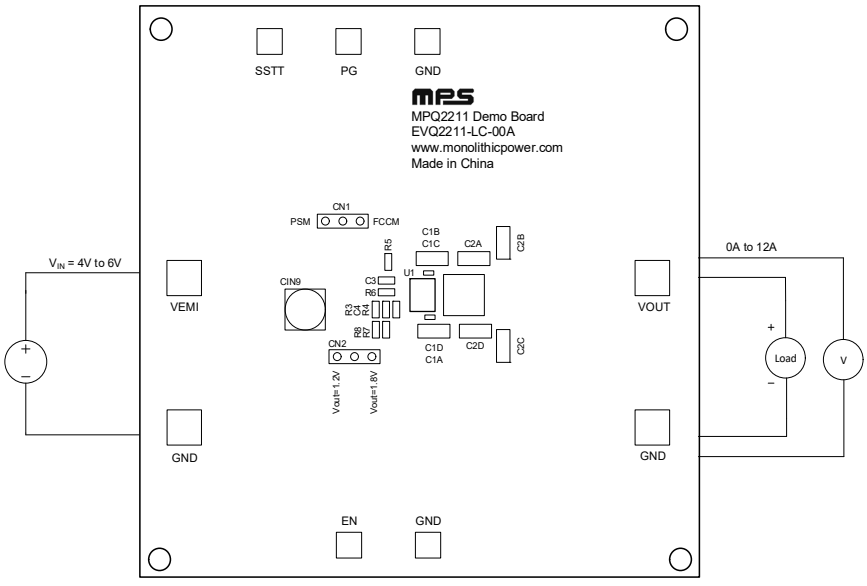

Figure 2: Measurement Equipment Set-Up

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EVALUATION BOARD SCHEMATIC

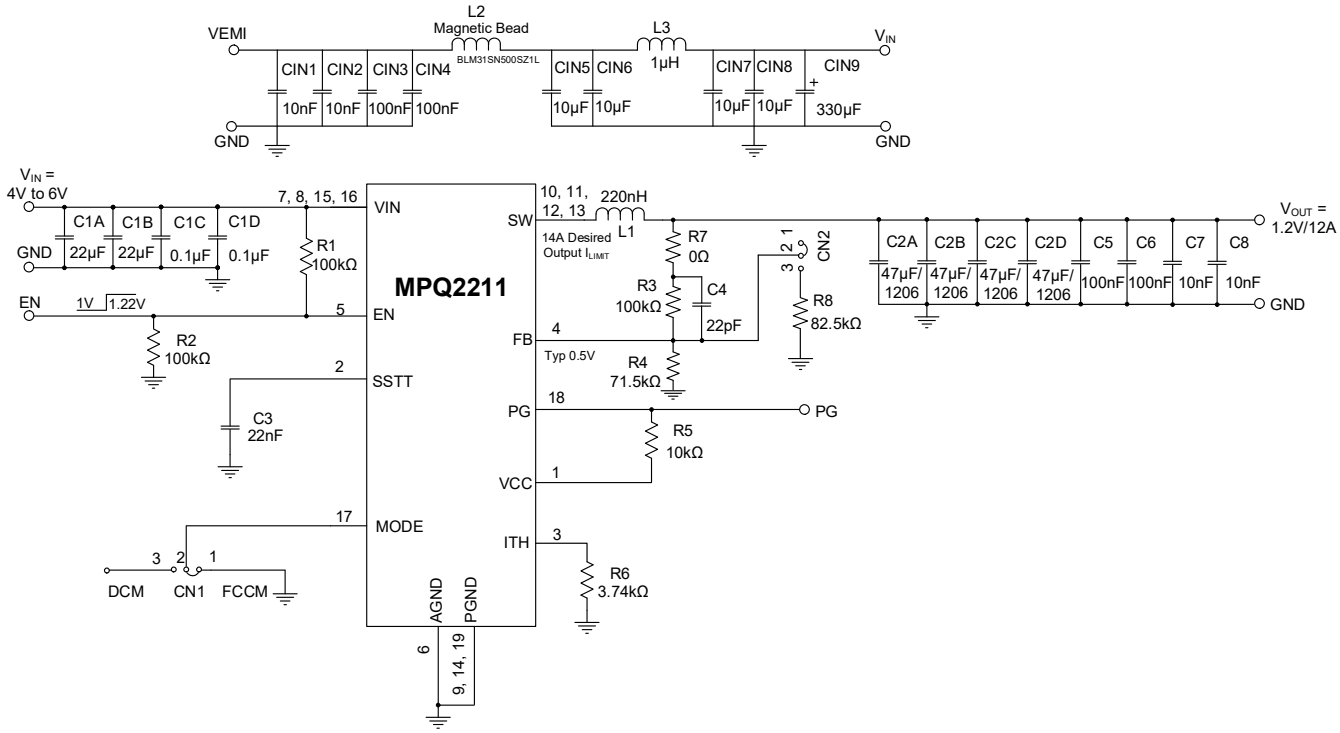
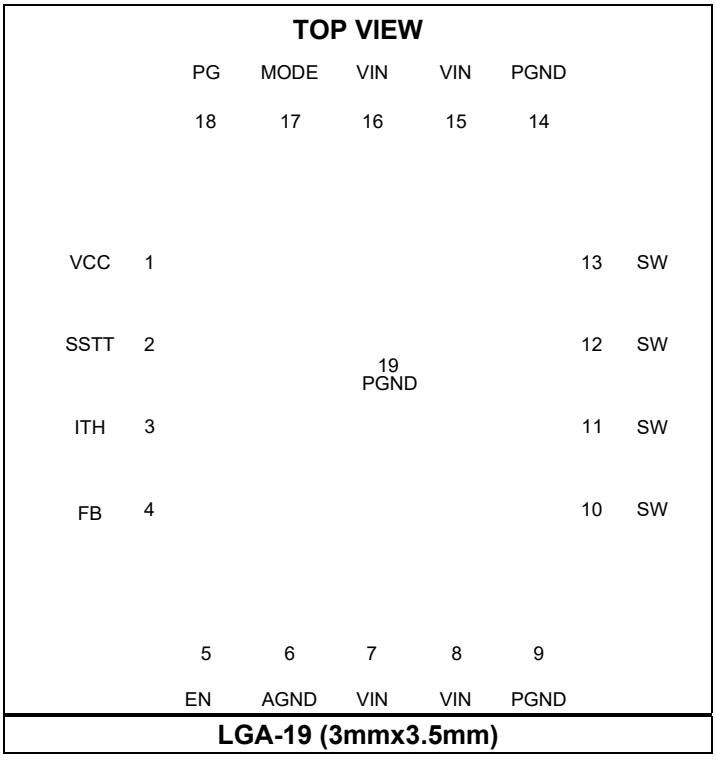


Figure 3: Evaluation Board Schematic

PACKAGE REFERENCE



LGA-19 (3mmx3.5mm)

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EVQ2211-LC-00A BILL OF MATERIALS

Qty	Ref	Value	Description	Package	Manufacturer	Manufacturer PN
4	CIN1, CIN2, C7, C8	10nF	Ceramic capacitor, 50V, C0G	0603	Murata	GRM1885C1H103JA01D
4	CIN3, CIN4, C5, C6	100nF	Ceramic capacitor, 50V, X7R	0603	Murata	GCJ188R71H104KA12D
4	CIN5, CIN6, CIN7, CIN8	10µF	Ceramic capacitor, 25V, X7R	1206	Murata	GRM31CR71E106KA12L
1	CIN9	330µF	Aluminum capacitor, 16V	SMD	Panasonic	16SVPG330M
2	C1A, C1B	22µF	Ceramic capacitor, 10V, X7R	1206	Murata	GCJ31CR71A226ME01L
2	C1C, C1D	0.1µF	Ceramic capacitor, 16V,X7R	0402	Murata	GRM155R71C104KA88D
4	C2A, C2B, C2C, C2D	47µF	Ceramic capacitor, 6.3V, X5R	1206	Murata	GRM31CR60J476KE19L
1	C3	22nF	Ceramic capacitor, 100V, X7R	0603	Murata	GCM188R72A223KA37D
1	C4	22pF	Ceramic capacitor, 50V, C0G	0603	Murata	GRM1885C1H220JA01D
3	R1, R2, R3	100kΩ	Film resistor, 1%	0603	Yageo	RC0603FR-07100KL
1	R4	71.5kΩ	Film resistor, 1%	0603	Yageo	RC0603FR-0771K5L
1	R5	10kΩ	Film resistor, 1%	0603	Yageo	RC0603FR-0710KL
1	R6	3.74kΩ	Film resistor, 1%	0603	Yageo	RC0603FR-073K74L
1	R7	0Ω	Film resistor, 1%	0603	Yageo	RC0603FR-070RL
1	R8	82.5kΩ	Film Resistor, 1%	0603	Yageo	RC0603FR-0782K5L
1	L1	220nH	Inductor, 41.4A, 2mΩ	SMD	Cyntec	HBED052D-R22MSI-99
1	L2	12A	Magnetic bead	1206	Murata	BLM31SN500SZ1L
1	L3	1µH	Inductor, 8.8A, 8.2mΩ	SMD	Coilcraft	XGL4020-102MEB
2	CN1, CN2	3 pins	2.54mm test pin connector, 3 pins	DIP	Any	
4	VEMI, GND, GND, VOUT	2.0mm	Golden pin	DIP	Custom (1)	
5	SSTT, EN, PG, GND, GND	1.0mm	Golden pin	DIP	Custom (1)	
1	U1	MPQ2211-AEc1	6V/12A, synchronous buck converter, AEC0Q100	LGA-19 (3mmx 3.5mm)	MPS	MPQ2211GLC-AEC1

Note:

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

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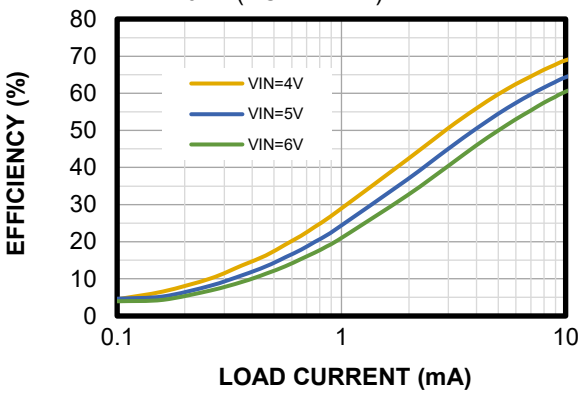
EVB TEST RESULTS

Performance curves and waveforms are tested on the evaluation board. V_{IN} = 5V, V_{OUT} = 1.2V, C_{OUT} = 4 x 47µF, L = 220nH, T_A = 25°C, unless otherwise noted.

Efficiency vs. Load Current
PSM, V_{OUT} = 1.2V, f_{SW} = 2.2MHz,
L = 220nH (DCR = 2mΩ)



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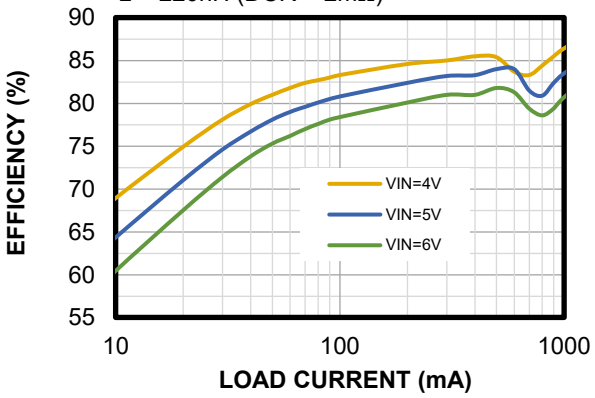

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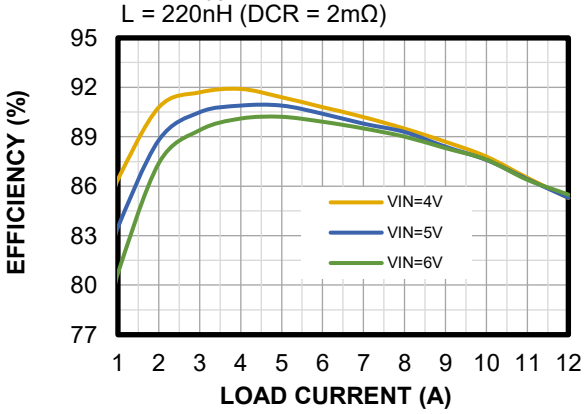

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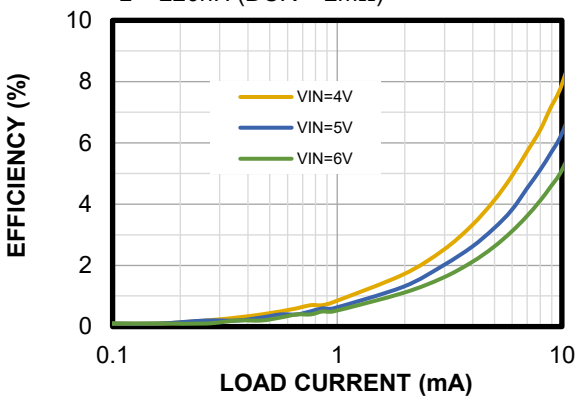

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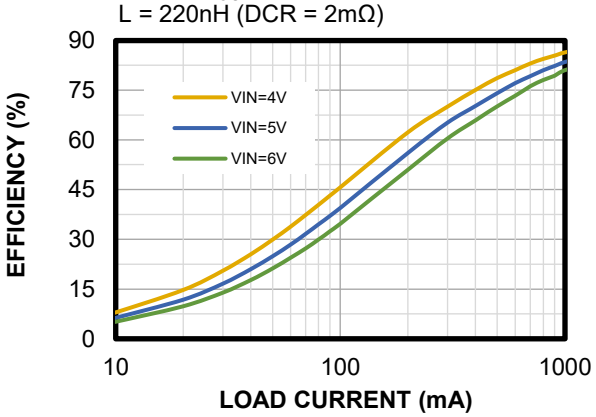

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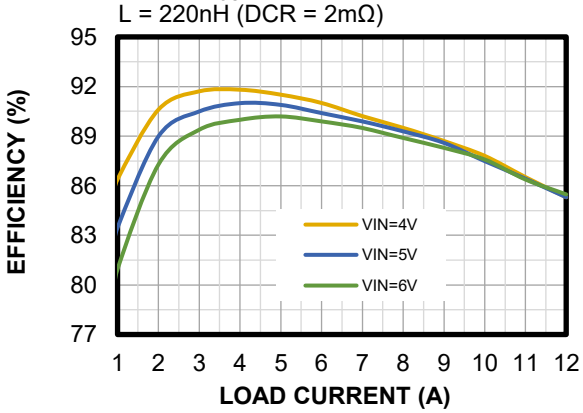

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Efficiency vs. Load Current
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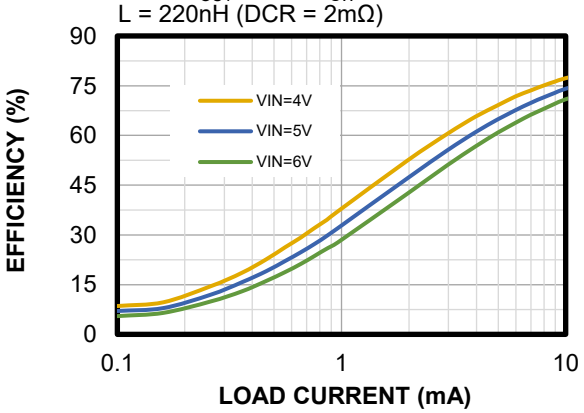

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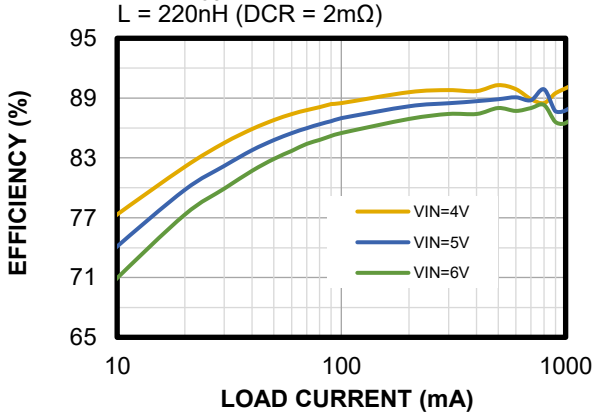

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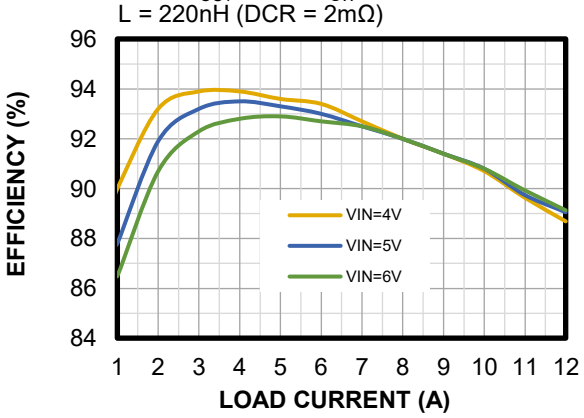

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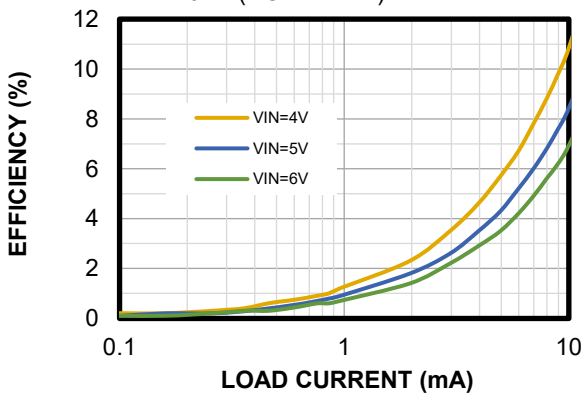

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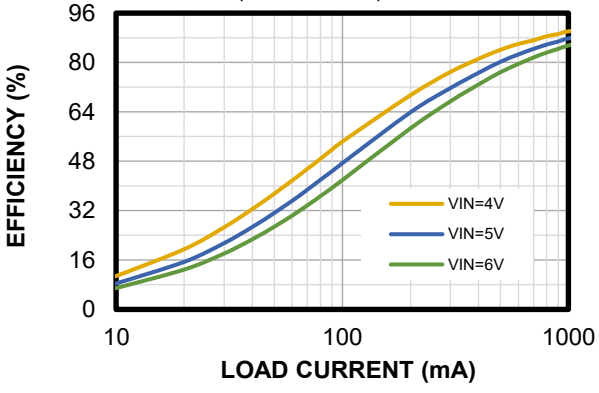

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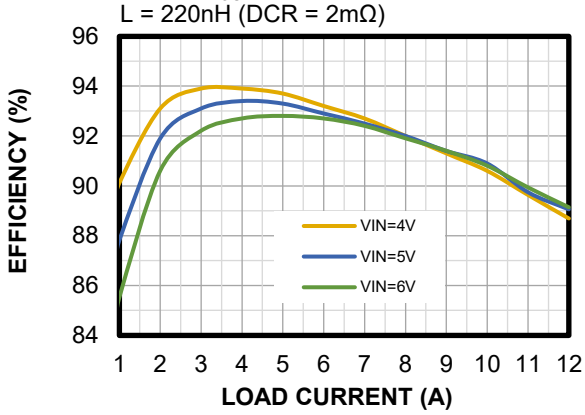

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Load Regulation

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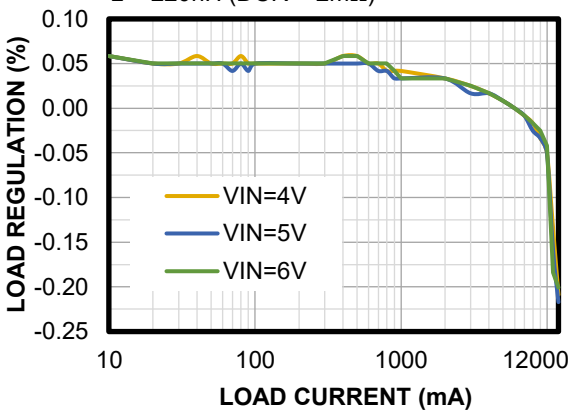

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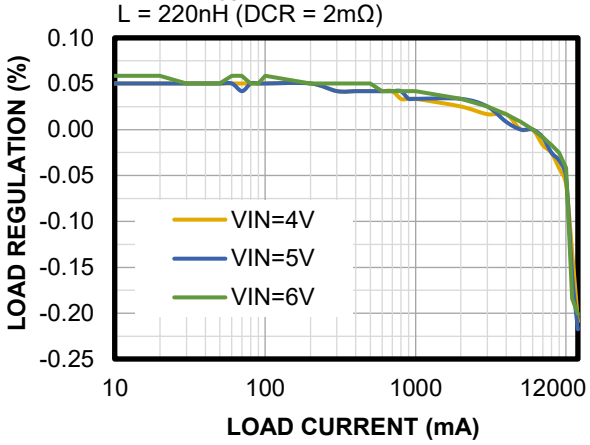

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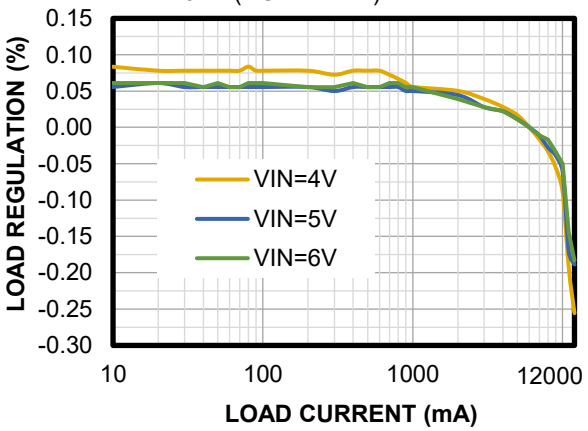

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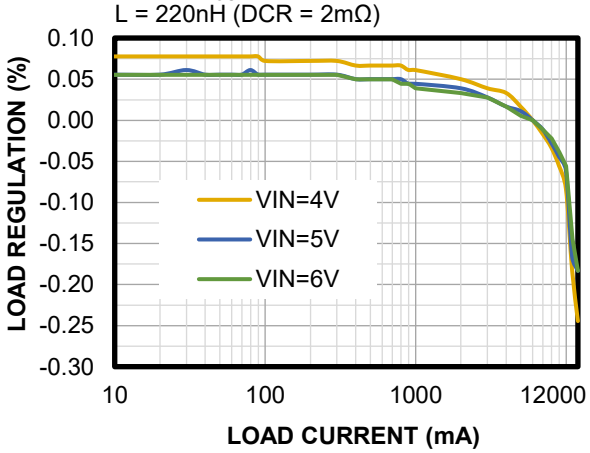

Line Regulation

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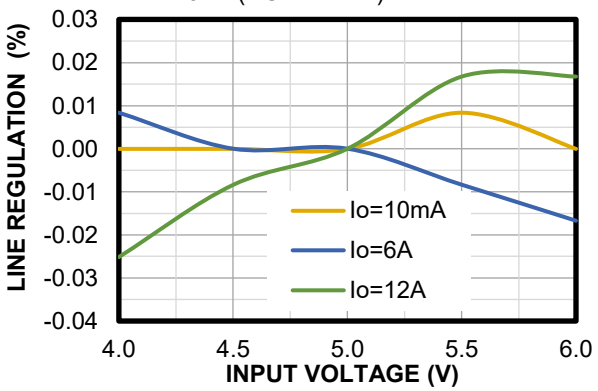

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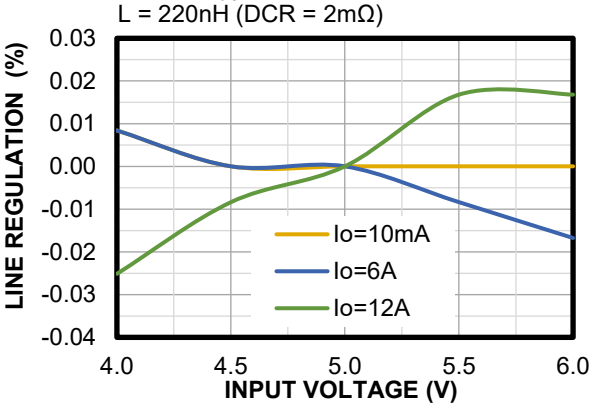
L = 220nH (DCR = 2mΩ)



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EVB TEST RESULTS *(continued)*

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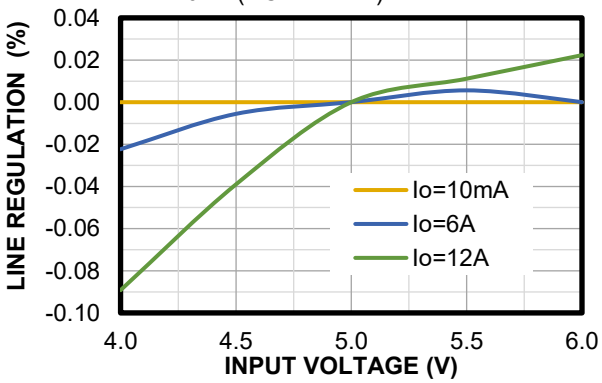

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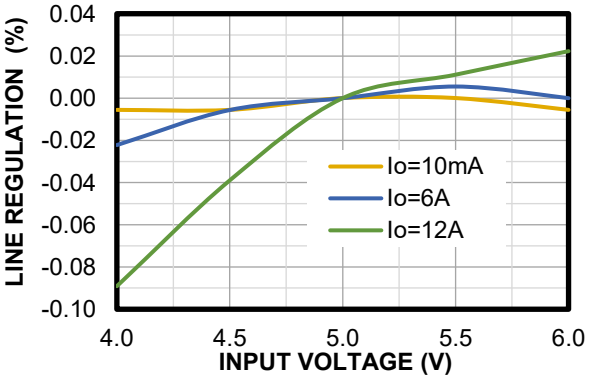
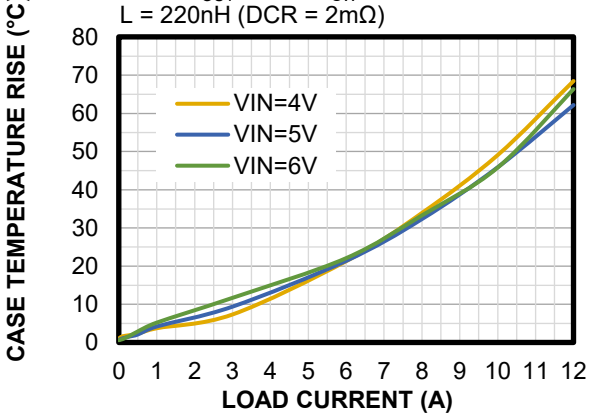


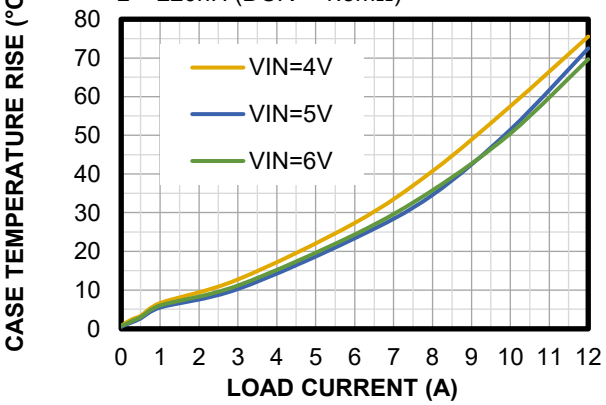
Case Temperature Rise

PSM, V_{OUT} = 1.2V, f_{SW} = 2.2MHz, L = 220nH (DCR = 2mΩ)



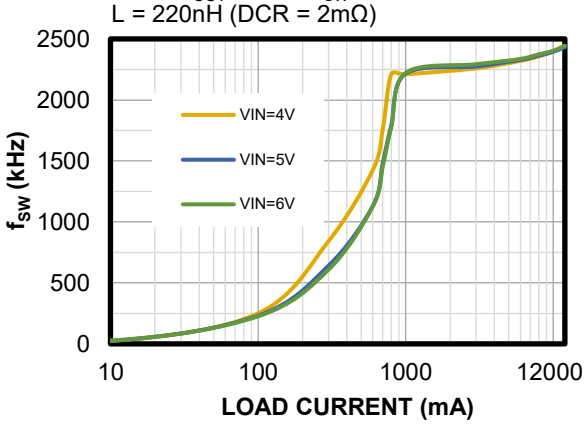
Case Temperature Rise

PSM, V_{OUT} = 1.8V, f_{SW} = 2.2MHz, L = 220nH (DCR = 1.5mΩ)



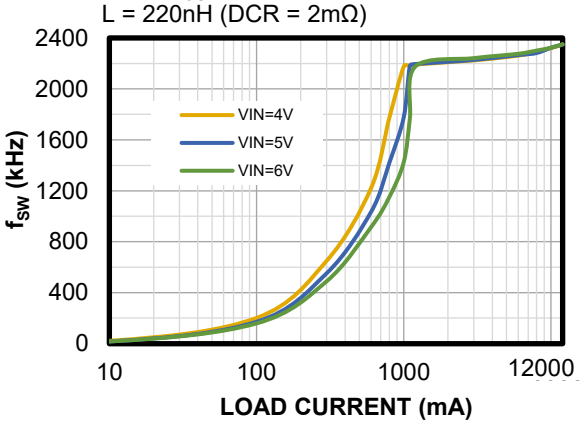
f_{SW} vs. Load Current

PSM, V_{OUT} = 1.2V, f_{SW} = 2.2MHz, L = 220nH (DCR = 2mΩ)



f_{SW} vs. Load Current

PSM, V_{OUT} = 1.8V, f_{SW} = 2.2MHz, L = 220nH (DCR = 2mΩ)



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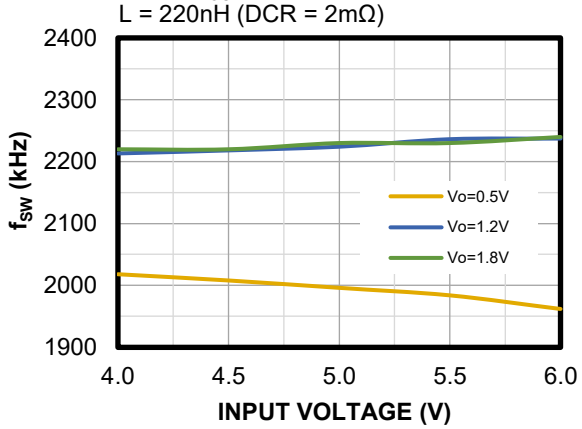
EVB TEST RESULTS *(continued)*

Performance curves and waveforms are tested on the evaluation board. V_{IN} = 5V, V_{OUT} = 1.2V, C_{OUT} = 4 x 47µF, L = 220nH, T_A = 25°C, unless otherwise noted.

f_{SW} vs. Input Voltage

FCCM, I_{OUT} = 0A, f_{SW} = 2.2MHz,
L = 220nH (DCR = 2mΩ)



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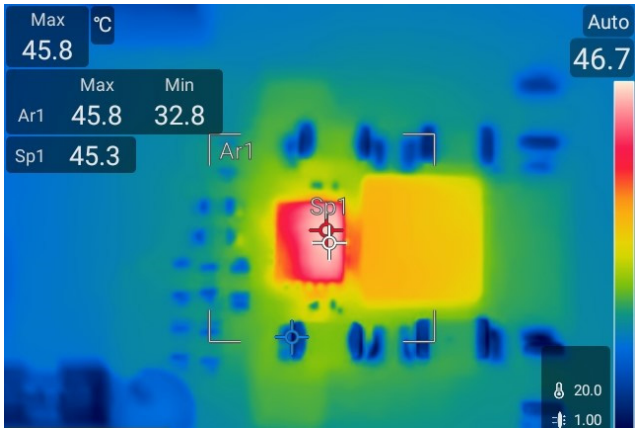
EVB TEST RESULTS *(continued)*

Performance curves and waveforms are tested on the evaluation board. V_{IN} = 5V, V_{OUT} = 1.2V, C_{OUT} = 4 x 47µF, L = 220nH, T_A = 25°C, unless otherwise noted.

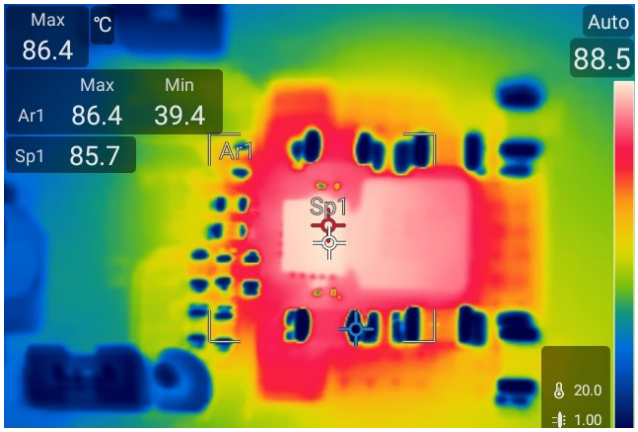
Thermal Performance

I_{OUT} = 6A, no forced airflow, T_{CASE} = 45.8°C



Thermal Performance

I_{OUT} = 12A, no forced airflow, T_{CASE} = 86.4°C



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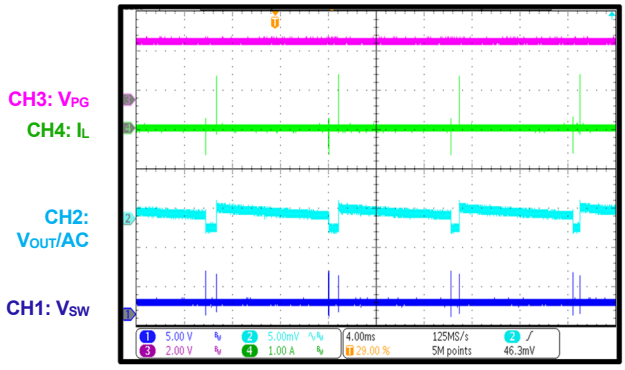
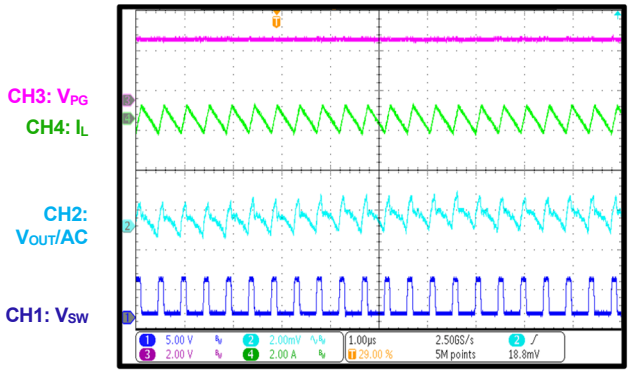
EVB TEST RESULTS *(continued)*

Performance curves and waveforms are tested on the evaluation board. V_{IN} = 5V, V_{OUT} = 1.2V, C_{OUT} = 4 x 47µF, L = 220nH, T_A = 25°C, unless otherwise noted.

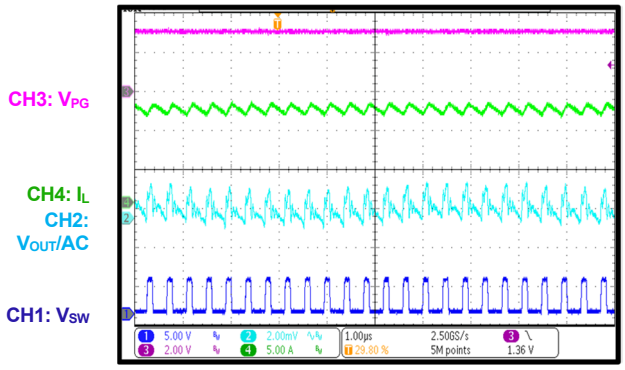
Steady State
I_{OUT} = 0A, PSM



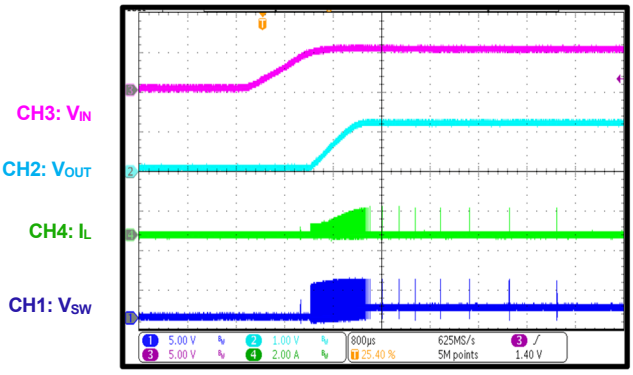
Steady State
I_{OUT} = 0A, FCCM



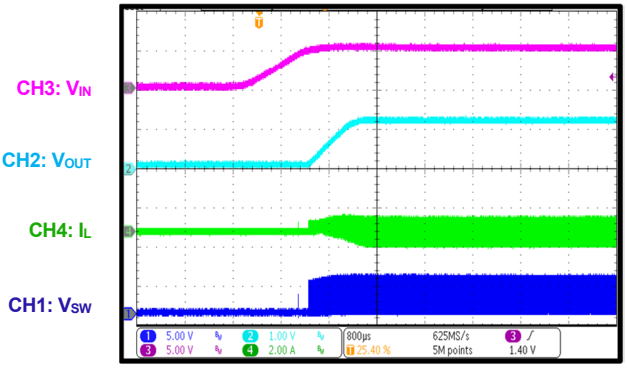
Steady State
I_{OUT} = 12A



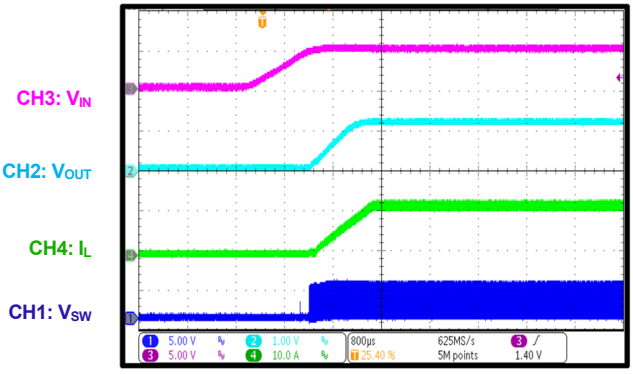
Start-Up through VIN
I_{OUT} = 0A, PSM



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



Start-Up through VIN
I_{OUT} = 12A



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EVB TEST RESULTS *(continued)*

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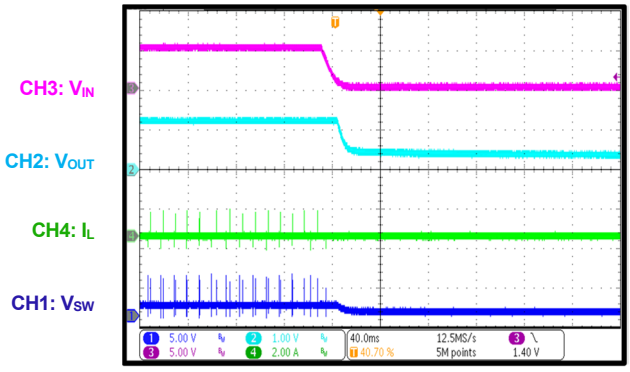
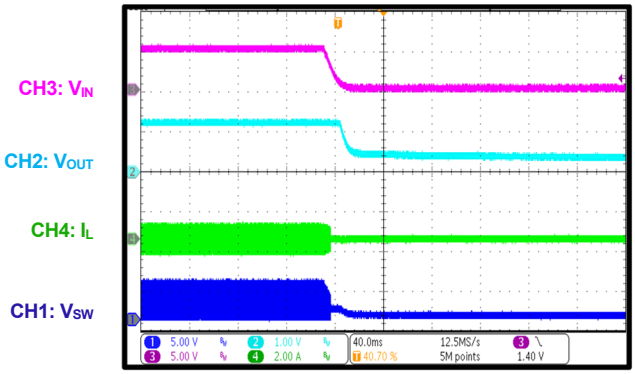
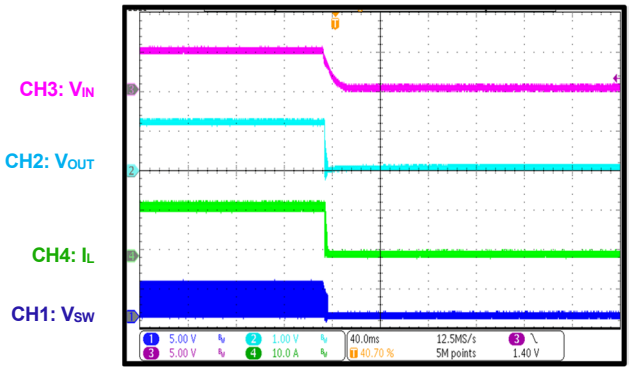
Shutdown through VIN
I_{OUT} = 0A, PSM



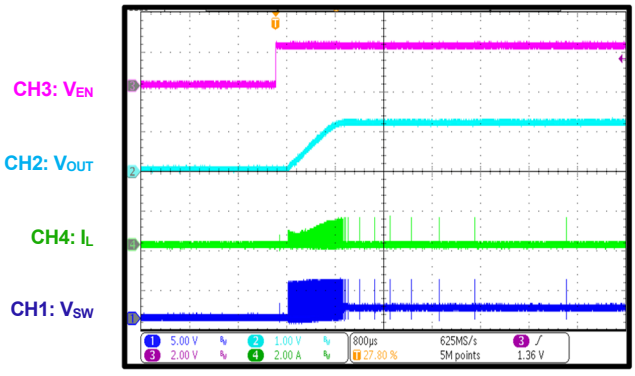
Shutdown through VIN
I_{OUT} = 0A, FCCM



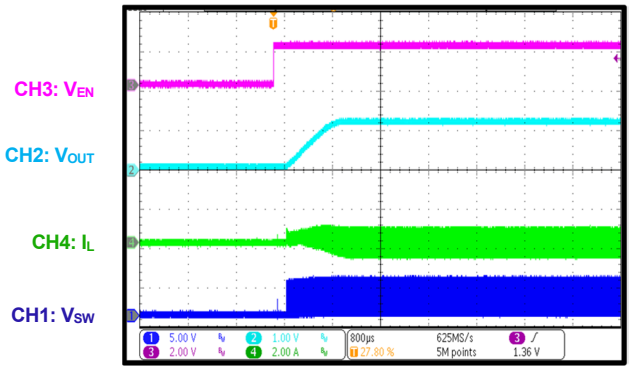
Shutdown through VIN
I_{OUT} = 12A



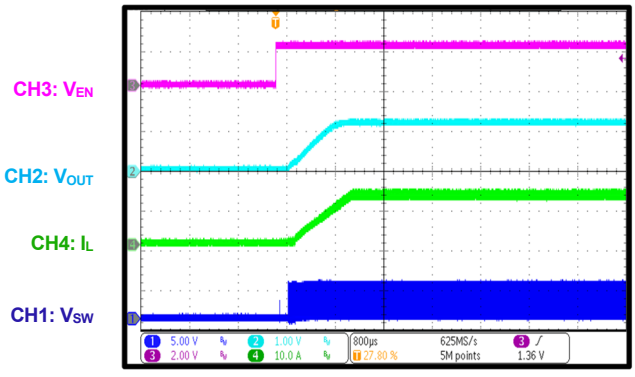
Start-Up through EN
I_{OUT} = 0A, PSM



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



Start-Up through EN
I_{OUT} = 12A



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EVB TEST RESULTS *(continued)*

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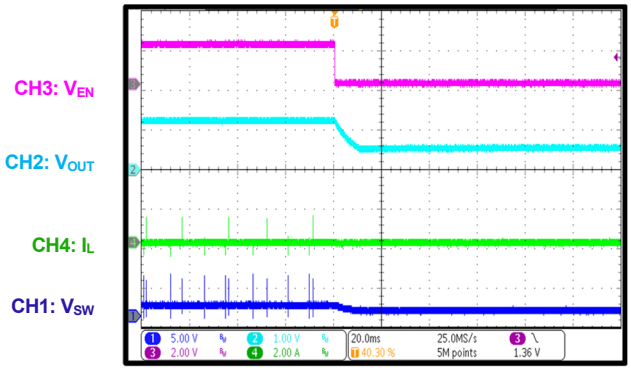
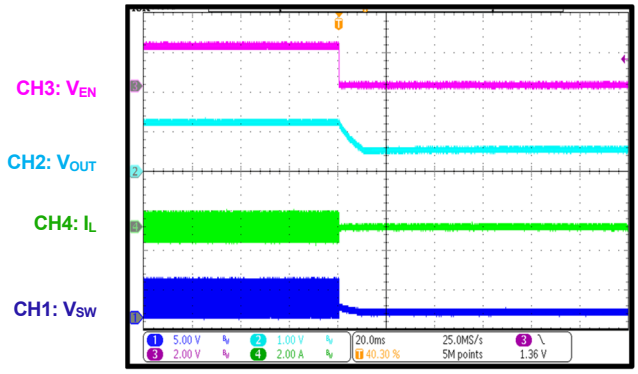
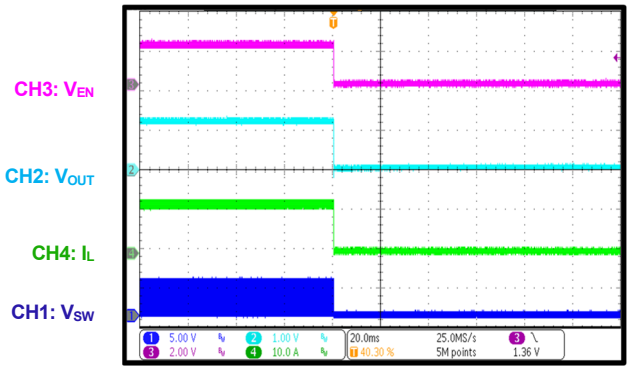
Shutdown through EN
I_{OUT} = 0A, PSM



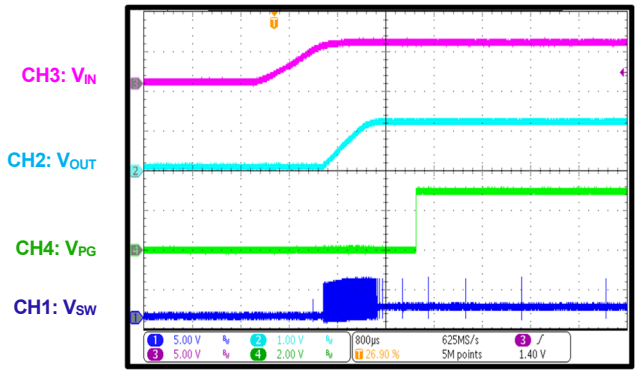
Shutdown through EN
I_{OUT} = 0A, FCCM



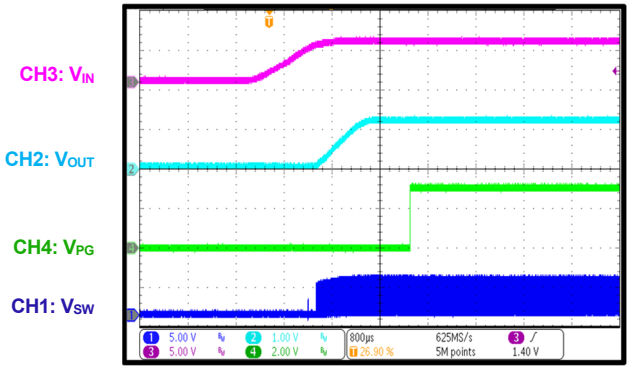
Shutdown through EN
I_{OUT} = 12A



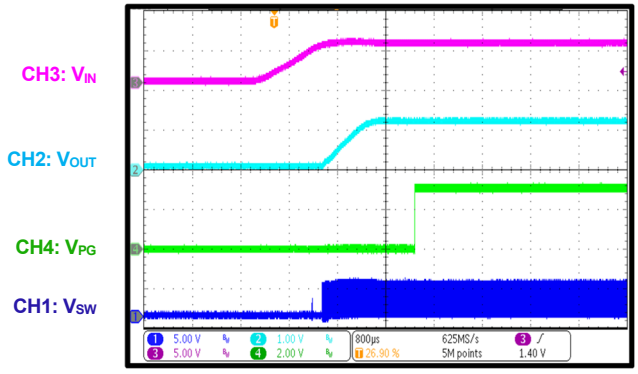
PG in Start-Up through VIN
I_{OUT} = 0A, PSM



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



PG in Start-Up through VIN
I_{OUT} = 12A



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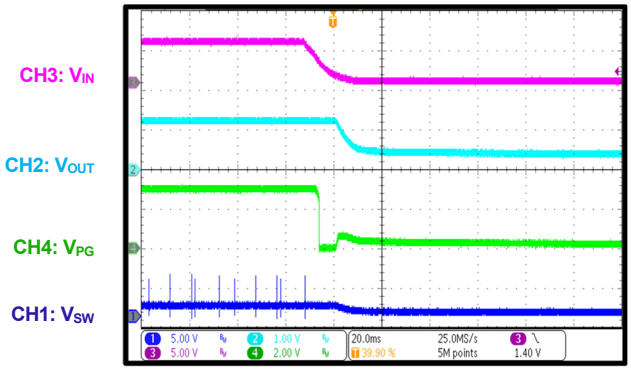
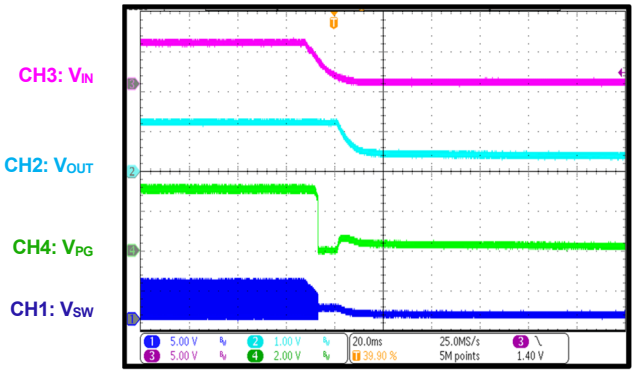
EVB TEST RESULTS *(continued)*

Performance curves and waveforms are tested on the evaluation board. V_{IN} = 5V, V_{OUT} = 1.2V, C_{OUT} = 4 x 47µF, L = 220nH, T_A = 25°C, unless otherwise noted.

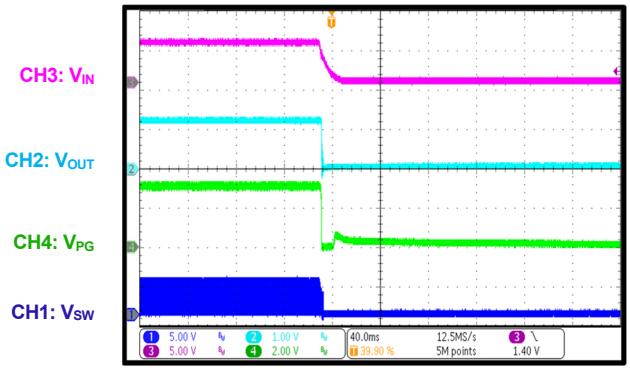
PG in Shutdown through VIN
I_{OUT} = 0A, PSM



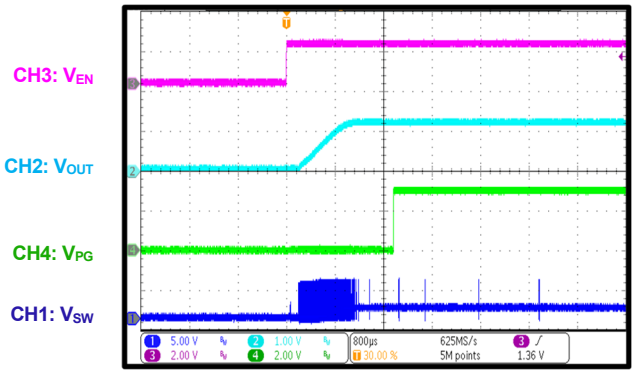
PG in Shutdown through VIN
I_{OUT} = 0A, FCCM



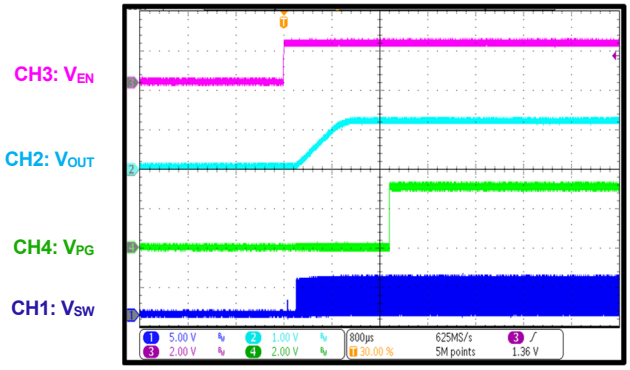
PG in Shutdown through VIN
I_{OUT} = 12A



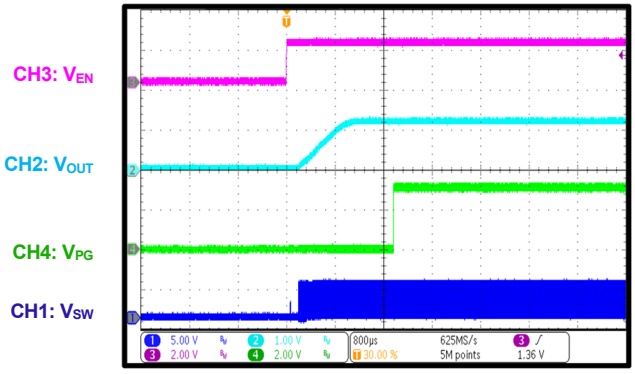
PG in Start-Up through EN
I_{OUT} = 0A, PSM



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



PG in Start-Up through EN
I_{OUT} = 12A



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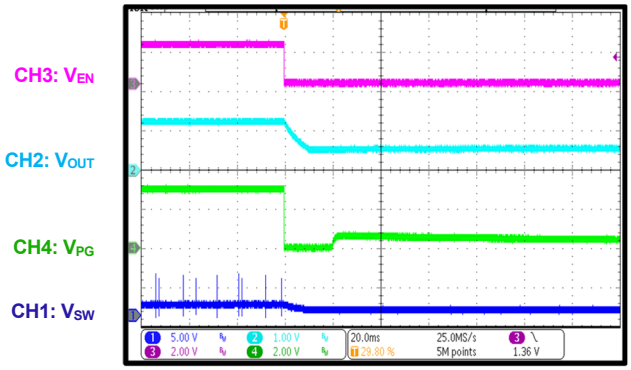
EVB TEST RESULTS *(continued)*

Performance curves and waveforms are tested on the evaluation board. V_{IN} = 5V, V_{OUT} = 1.2V, C_{OUT} = 4 x 47µF, L = 220nH, T_A = 25°C, unless otherwise noted.

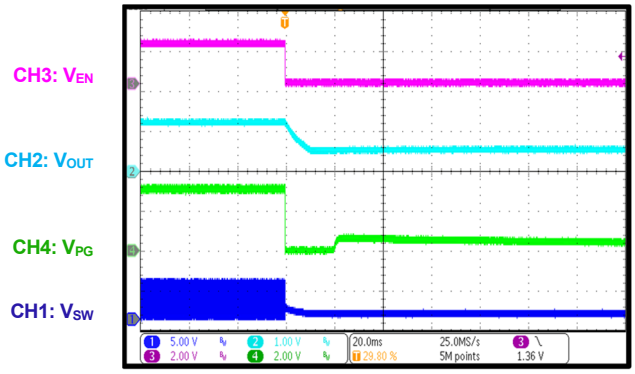
PG In Shutdown through EN

I_{OUT} = 0A, PSM



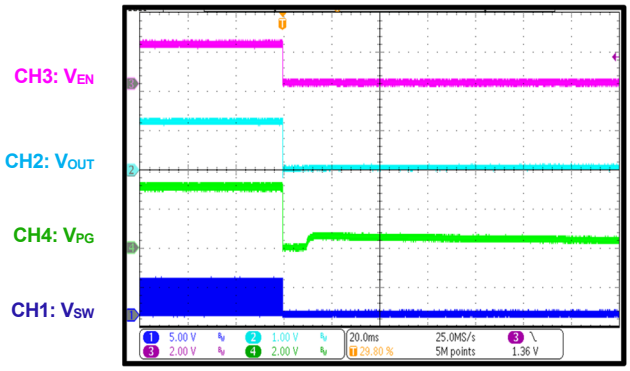
PG in Shutdown through EN

I_{OUT} = 0A, FCCM



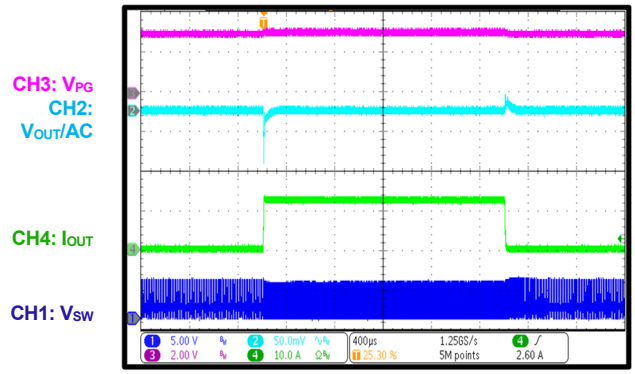
PG In Shutdown through EN

I_{OUT} = 12A



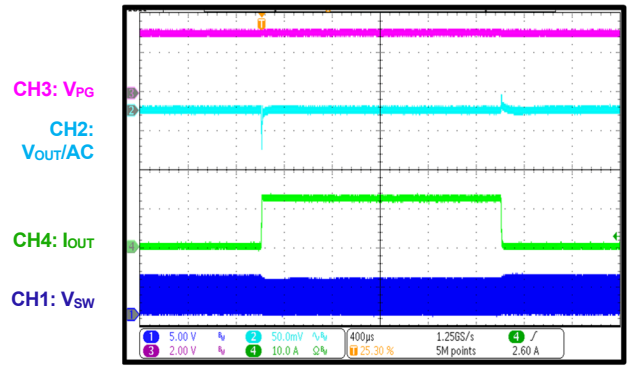
Load Transient Response

I_{OUT} = 0A to 12A, 1.6A/µs, PSM



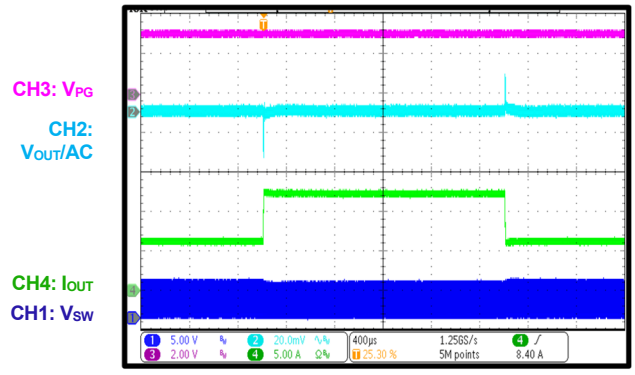
Load Transient Response

I_{OUT} = 0A to 12A, 1.6A/µs, FCCM



Load Transient Response

I_{OUT} = 6A to 12A, 1.6A/µs



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EVB TEST RESULTS *(continued)*

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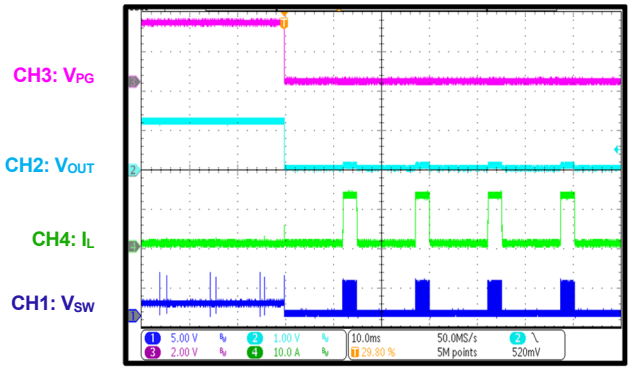
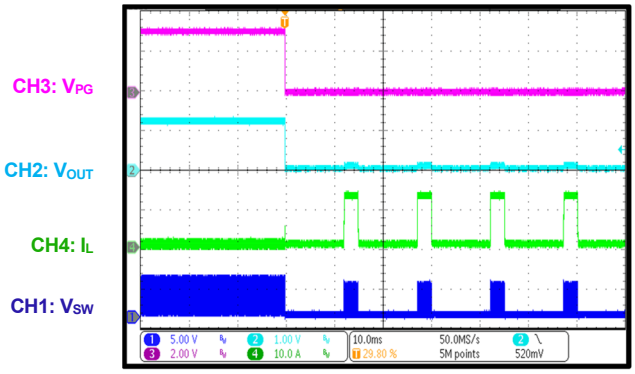
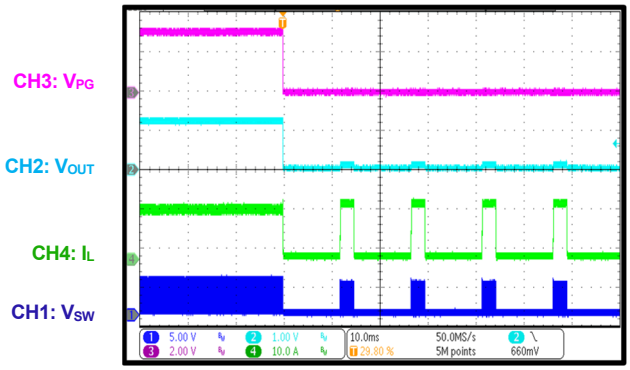
SCP Entry
I_{OUT} = 0A, PSM



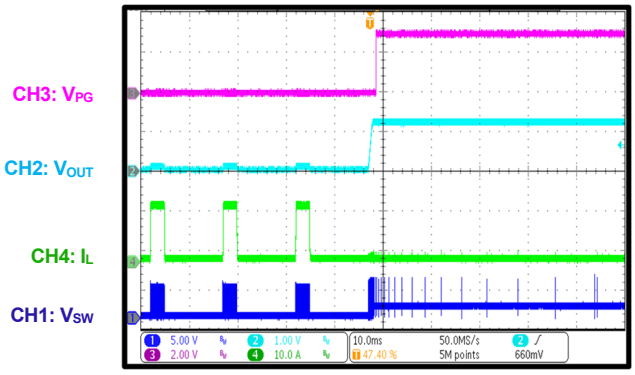
SCP Entry
I_{OUT} = 0A, FCCM



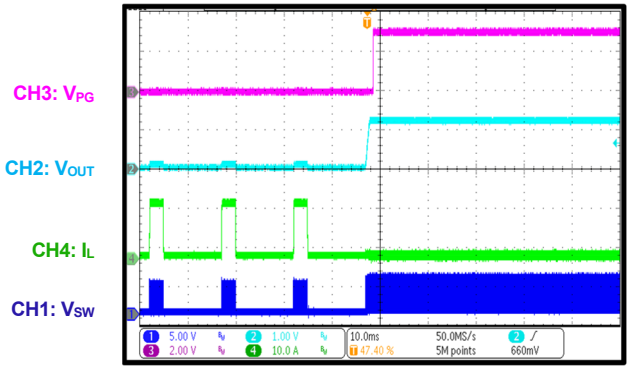
SCP Entry
I_{OUT} = 12A



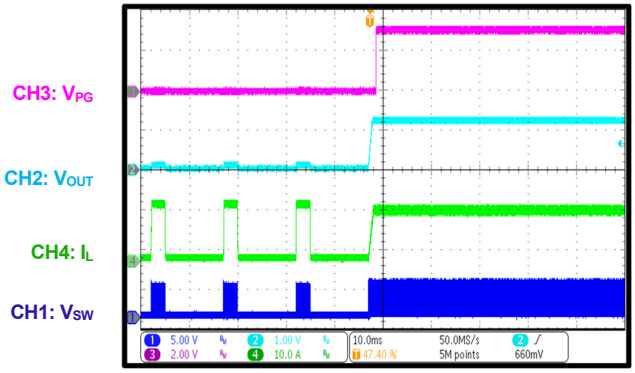
SCP Recovery
I_{OUT} = 0A, PSM



SCP Recovery
I_{OUT} = 0A, FCCM



SCP Recovery
I_{OUT} = 12A



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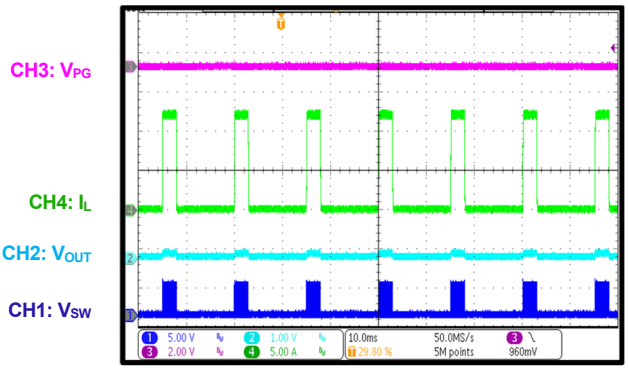
EVB TEST RESULTS *(continued)*

Performance curves and waveforms are tested on the evaluation board. V_{IN} = 5V, V_{OUT} = 1.2V, C_{OUT} = 4 x 47µF, L = 220nH, T_A = 25°C, unless otherwise noted.

SCP Steady State



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PCB LAYOUT (2)

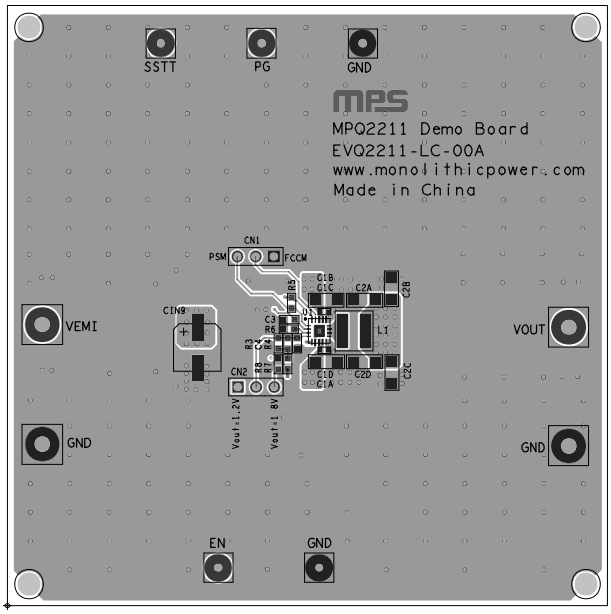

Figure 4: Top Silk and Top Layer

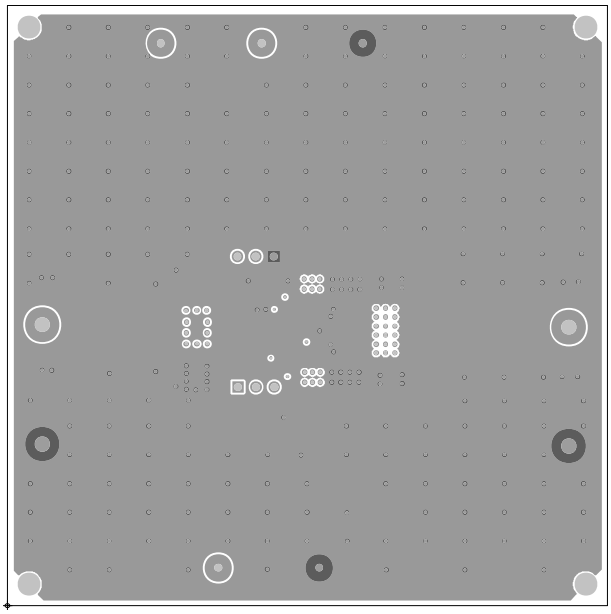

Figure 5: Mid-Layer 1

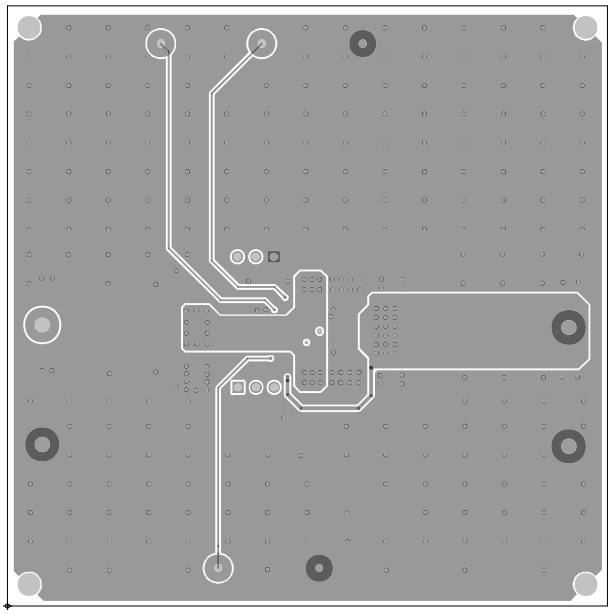

Figure 6: Mid-Layer 2

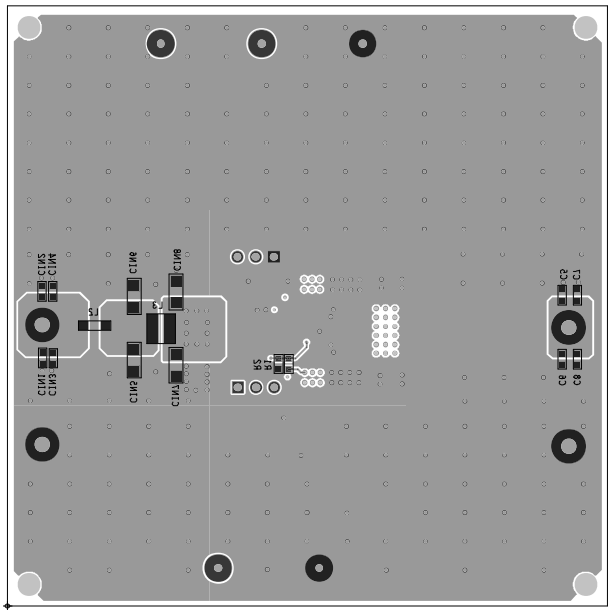

Figure 7: Bottom Layer and Bottom Silk

Note:

2) The copper thickness is 2oz.

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REVISION HISTORY

Revision #	Revision Date	Description	Pages Updated
1.0	9/29/2025	Initial Release	-

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