EV2167A-Q-00A

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

DESCRIPTION

The EV2167A-Q-00A evaluation board is designed to demonstrate the capabilities of the MPQ2167A-AEC1.

MPQ2167A-AEC1 is a configurable- frequency (300kHz to 2.2MHz), synchronous, step-down switching regulator with integrated internal high-side and low-side power MOSFETs. It provides up to 6A of continuous output current with peak current control for excellent transient response.

The MPQ2167A-AEC1 can be configured for advanced asynchronous mode (AAM) or forced continuous conduction mode (FCCM) operation at light loads. AAM provides high efficiency by reducing switching losses under light-load conditions, while FCCM has controllable frequency and a lower output ripple.

The EV2167A-Q-00A is a fully assembled and tested evaluation board. It generates a 1.8V output voltage at load currents up to 6A from a 2.7V to 6V input range with a 2.1MHz switching frequency.

ELECTRICAL SPECIFICATIONS

Parameter	Symbol	Value	Units
Input voltage	V_{EMI}	2.7 to 6	V
Output voltage	V_{OUT}	1.8	V
Output current	I_{OUT}	6	A

FEATURES

- 2.7V to 6.0V Operating Input Range
- Adjustable Output from 0.606V
- Up to 6A Continuous Output Current
- High-Efficiency Synchronous Mode Control
- 35mΩ and 25mΩ Internal Power MOSFETs
- Configurable Frequency Up to 2.2MHz
- External SYNC Clock Up to 2.2MHz
- 42µA Quiescent Current
- Low Shutdown Mode Current
- 100% Duty Cycle Operation
- Internal Compensation Mode
- Selectable AAM or FCCM Operation
- External Soft Start
- Remote EN Control
- Power Good Indicator
- Cycle-by-Cycle OCP, SCP, V_{IN} ULVO, V_{OUT} OVP, and Thermal Shutdown
- Available in a Wettable Flank, QFN-14 (3mmx3mm) Package
- Available in AEC-Q100 Grade 1

APPLICATIONS

- Automotive Infotainment
- Automotive Clusters
- Automotive Telematics
- Industrial Supplies
- Battery-Powered Devices

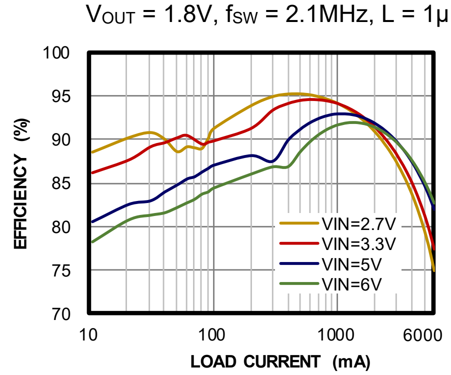
EV2167A-Q-00A EVALUATION BOARD

(LxWxH) 6.3cmx6.3cmx1cm

Board Number	MPS IC Number
EV2167A-Q-00A	MPQ2167AGQE-AEC1

Efficiency vs. Load Current

V_{OUT} = 1.8V, f_{SW} = 2.1MHz, L = 1µH, AAM



QUICK START GUIDE

1. Preset the power supply to 2.7V ≤ V_{IN} ≤ 6.0V. Be aware that electronic loads represent a negative impedance to the regulator, and if set to too high of a current, may trigger hiccup mode.
2. Turn the power supply off. If longer cables (>0.5m total) are used between the source and the EVB, C1D can be used to damp input spike when plugged in. For regular operation, it is not required to use C1D for damping.
3. Connect the power supply terminals to:
   a. Positive (+): VIN
   b. Negative (-): GND
4. Connect the load terminals to:
   a. Positive (+): VOUT
   b. Negative (-): GND
5. After making the connections, turn the power supply on. The board should automatically start up.
6. 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 0.8V to turn it off.
7. Figure 1 shows the relationship between the external frequency resistor (R_{FREQ}) and the MPQ2167A’s switching frequency.

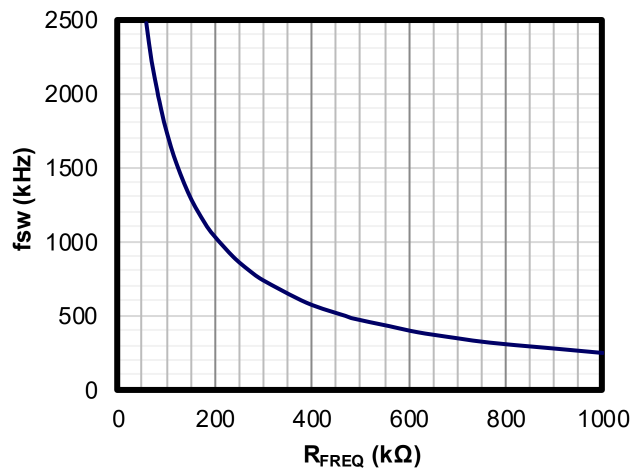


Figure 1: f_{SW} vs. R_{FREQ}

8. The FREQ/SYNC pin can be synchronized by the external clock. The sync frequency range 300kHz to 2.2MHz.
9. The MODE pin can be used to select advanced asynchronous mode (AAM) or forced continuous conduction mode (FCCM). Connect it to logic high or V_{IN} to choose FCCM. Connect it to logic low or GND to choose AAM. Do not float this pin.

10. The external resistor divider connected to FB sets the output voltage (V_{OUT}). The feedback resistor (R1) must account for both stability and dynamic response, so it should not be too large or too small. R1 is recommended to be 100kΩ. R2 can then be estimated with Equation (1):

$$R2 = \frac{R1}{\frac{V_{OUT}}{0.606} - 1} \tag{1}$$

A T-type feedback network is highly recommended (see Figure 2).

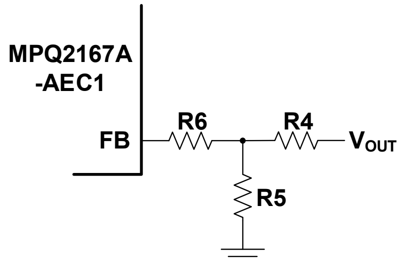


Figure 2: T-Type Feedback Network

The R6 and R4 resistors are used to set the loop bandwidth. A higher R6 + R4 value leads to lower bandwidth. Table 1 lists the recommended feedback resistor values for common output voltages.

Table 1: Recommended Resistor Values for Common Output Voltages

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

EVALUATION BOARD SCHEMATIC

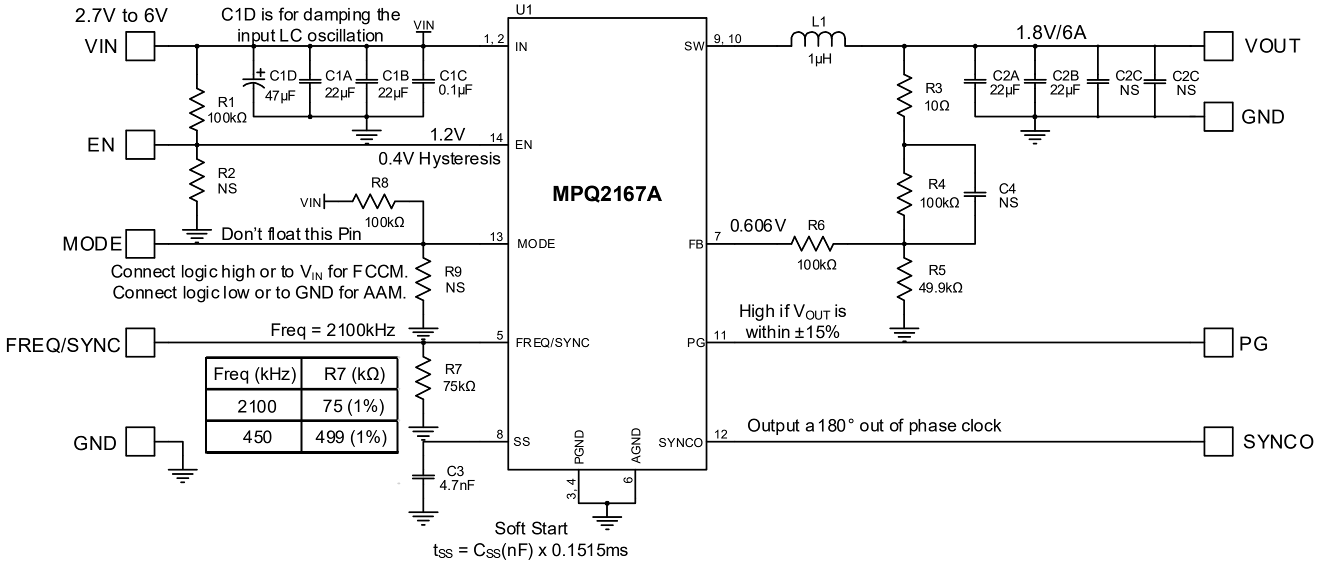


Figure 3: Evaluation Board Schematic

PACKAGE REFERENCE

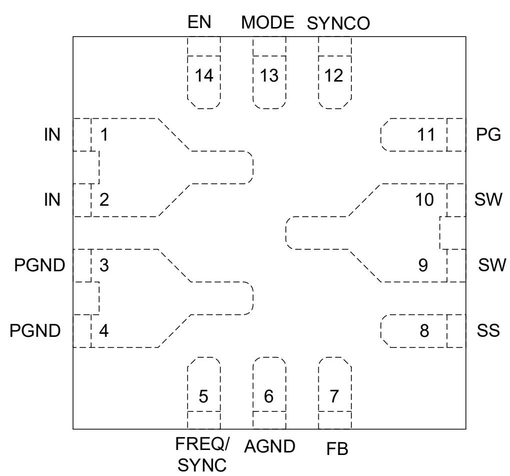


Figure 4: Package Reference

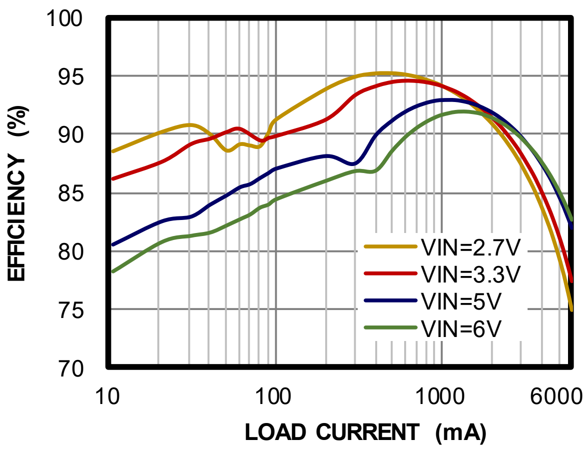
EV2167A-Q-00A BILL OF MATERIALS

Qty	Ref	Value	Description	Package	Manufacturer	Manufacturer P/N
1	C1A	0.1μF	Ceramic capacitor, 16V, X7R	0603	Murata	GRM188R71C104KA01D
2	C1B, C1C	10μF	Ceramic capacitor, 16V, X7R	1206	Murata	GRM31CR71A106KAC7L
1	C1D	47μF	Electrolytic capacitor, 16V	SMD	Jianghai	VZ1-16V47
2	C2A, C2B	22μF	Ceramic capacitor, 10V, X7R	1206	Murata	GCJ31CR71A226ME01L
1	C3	4.7nF	Ceramic capacitor, 50V, X7R	0603	Murata	GRM188R71H472KA01D
1	L1	1μH	Inductor, 9.4mΩ, DCR, 11.4A	SMD	Coilcraft	XEL5030-102MEC
3	R1, R4, R6	100kΩ	Film resistor, 1%	0603	Yageo	RC0603FR-07100KL
1	R2	NS				
1	R3	10Ω	Film resistor, 1%	0603	Yageo	RC0603FR-0710RL
1	R5	49.9kΩ	Film resistor, 1%	0603	Yageo	RC0603FR-0749K9L
1	R7	75kΩ	Film resistor, 1%	0603	Yageo	RC0603FR-0775KL
1	U1	MPQ2167A	Step-down converter	QFN-14 (3mmx3mm)	MPS	MPQ2167AGQE-AEC1
1	JP1		2.54mm test pin, 3 pins		Any	
4	VIN, GND, GND, VOUT	Test point	2.0mm golden pin		Custom	
7	MODE, GND, EN, SYNCO, PG, GND, FREQ/SYNC	Test point	1.0mm golden pin		Custom	

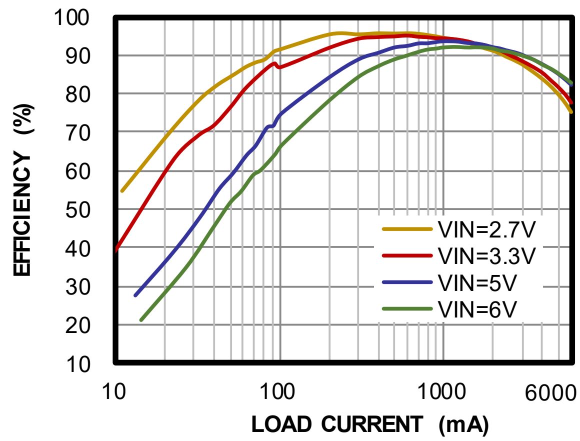
EVB TEST RESULTS

Performance curves and waveforms are tested on the evaluation board. V_{IN} = 5V, V_{OUT} = 1.8V, L = 1µH, C_{OUT} = 44µF, f_{SW} = 2.1MHz, T_A = 25°C, unless otherwise noted.

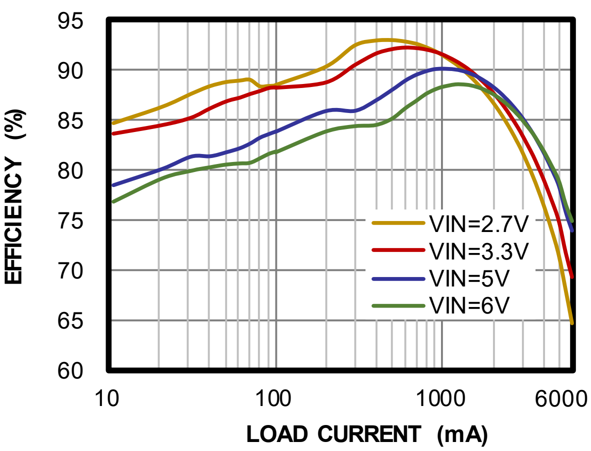
Efficiency vs. Load Current
V_{OUT} = 1.8V, AAM



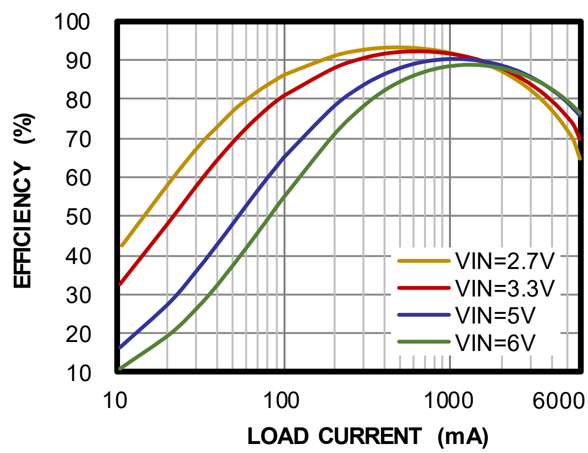
Efficiency vs. Load Current
V_{OUT} = 1.8V, FCCM



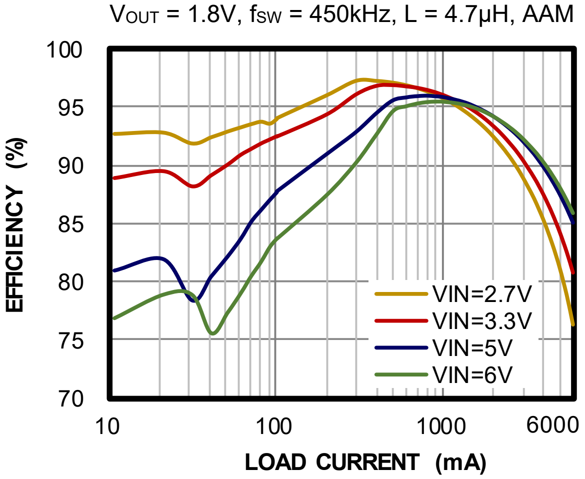
Efficiency vs. Load Current
V_{OUT} = 1.2V, AAM



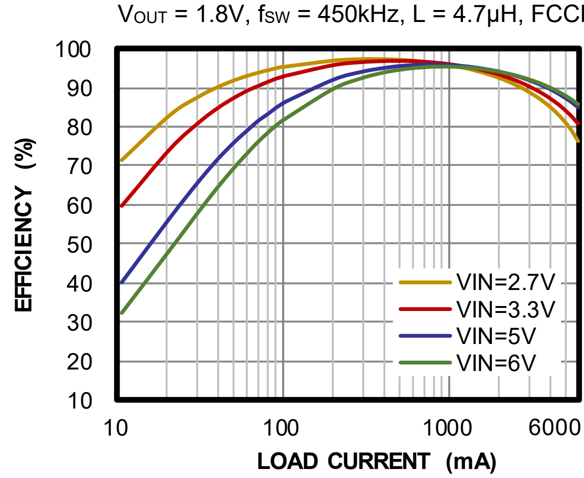
Efficiency vs. Load Current
V_{OUT} = 1.2V, FCCM



Efficiency vs. Load Current
V_{OUT} = 1.8V, f_{SW} = 450kHz, L = 4.7µH, AAM



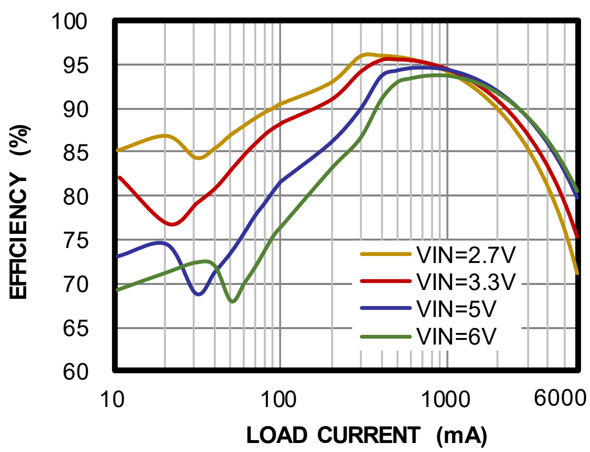
Efficiency vs. Load Current
V_{OUT} = 1.8V, f_{SW} = 450kHz, L = 4.7µH, FCCM



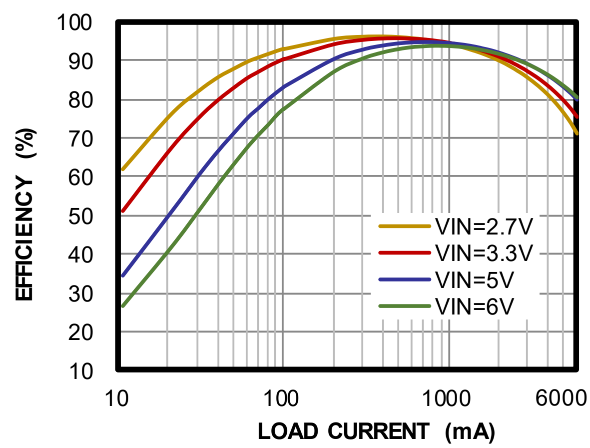
EVB TEST RESULTS *(continued)*

Performance curves and waveforms are tested on the evaluation board. V_{IN} = 5V, V_{OUT} = 1.8V, L = 1µH, C_{OUT} = 44µF, f_{SW} = 2.1MHz, T_A = 25°C, unless otherwise noted.

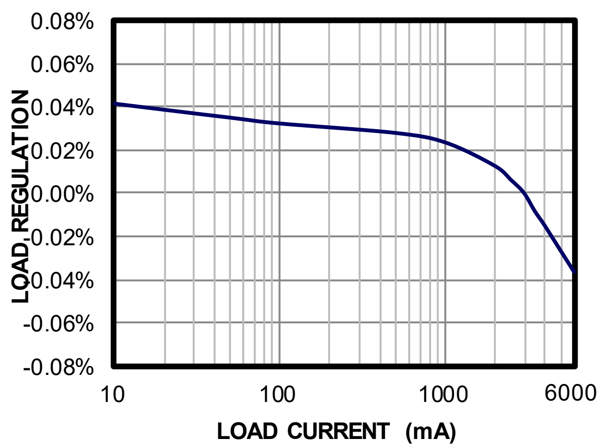
Efficiency vs. Load Current
V_{OUT} = 1.2V, f_{SW} = 450kHz, L = 4.7µH, AAM



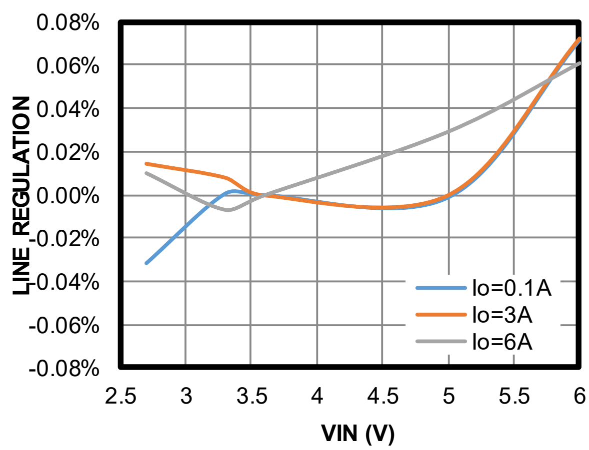
Efficiency vs. Load Current
V_{OUT} = 1.2V, f_{SW} = 450kHz, L = 4.7µH, FCCM



Load Regulation
V_{OUT} = 1.8V, AAM



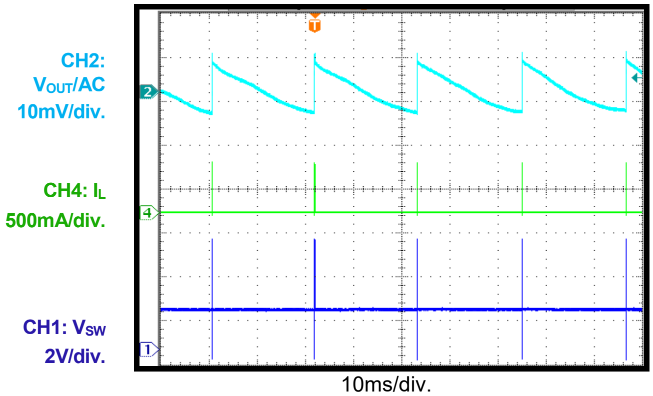
Line Regulation
V_{OUT} = 1.8V, AAM



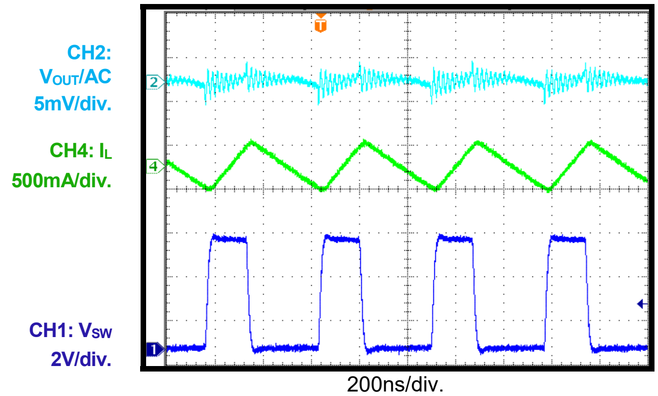
EVB TEST RESULTS *(continued)*

Performance curves and waveforms are tested on the evaluation board. V_{IN} = 5V, V_{OUT} = 1.8V, L = 1µH, C_{OUT} = 44µF, f_{SW} = 2.1MHz, T_A = 25°C, unless otherwise noted.

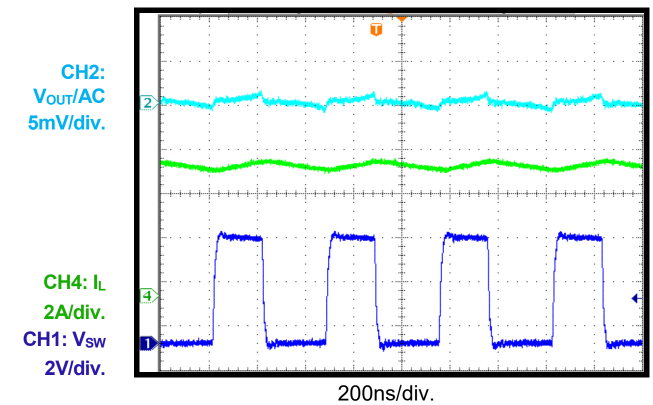
Steady State
I_{OUT} = 0A, AAM



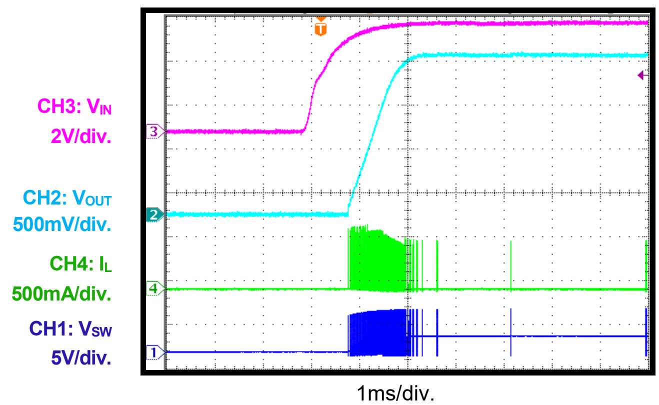
Steady State
I_{OUT} = 0A, CCM



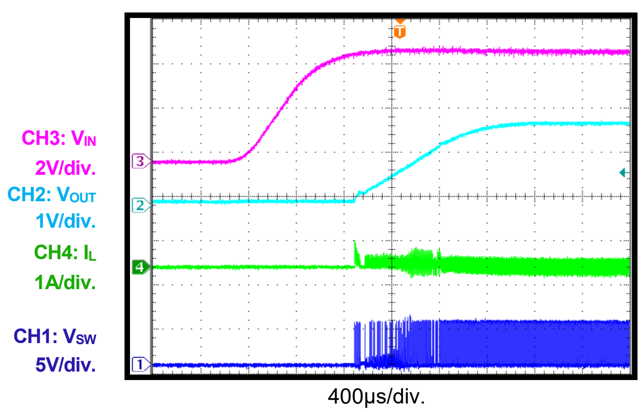
Steady State
I_{OUT} = 6A



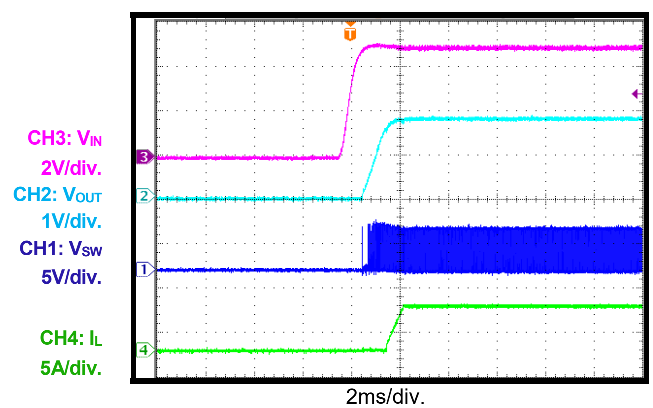
Start-Up through VIN
I_{OUT} = 0A, AAM



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



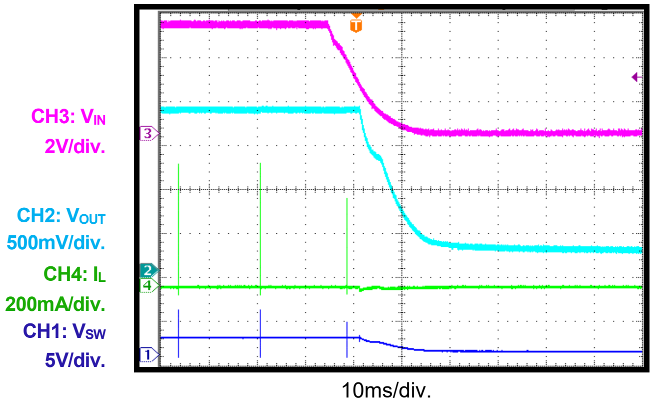
Start-Up through VIN
I_{OUT} = 6A



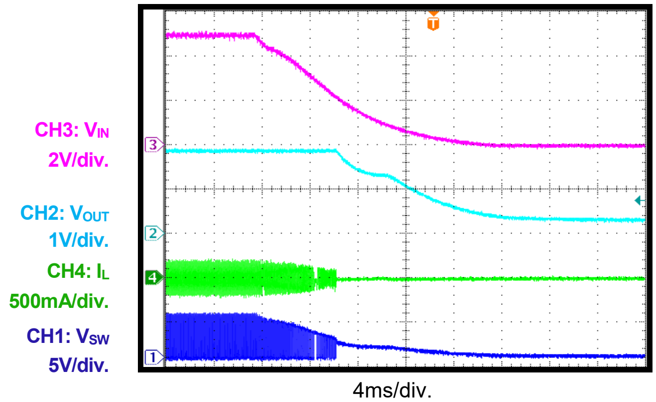
EVB TEST RESULTS *(continued)*

Performance curves and waveforms are tested on the evaluation board. V_{IN} = 5V, V_{OUT} = 1.8V, L = 1µH, C_{OUT} = 44µF, f_{SW} = 2.1MHz, T_A = 25°C, unless otherwise noted.

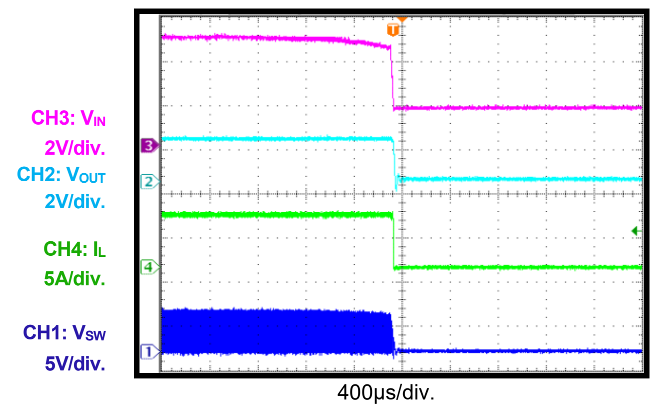
Shutdown through VIN
I_{OUT} = 0A, AAM



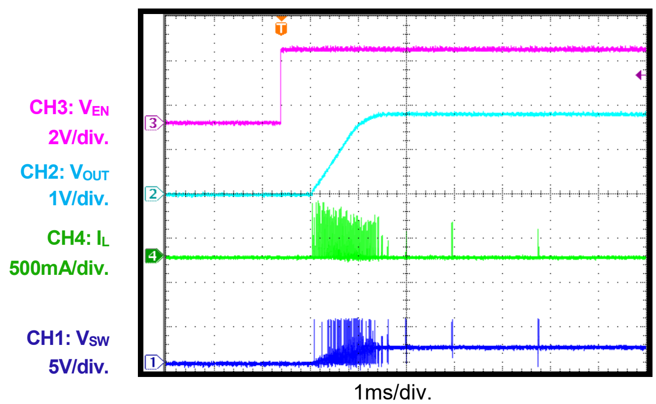
Shutdown through VIN
I_{OUT} = 0A, CCM



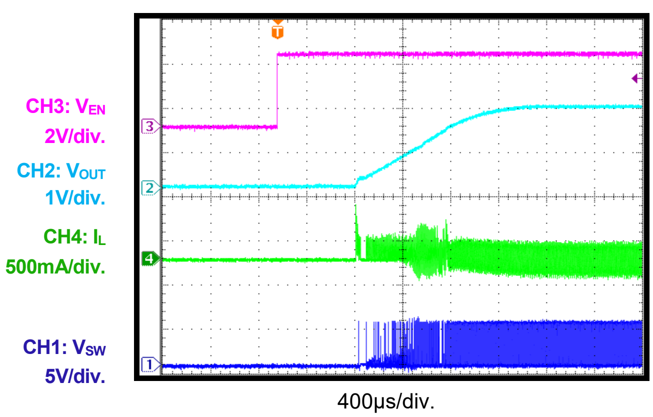
Shutdown through VIN
I_{OUT} = 6A



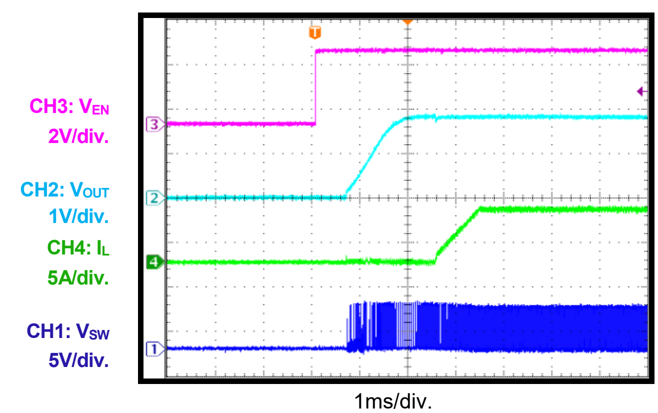
Start-Up through EN
I_{OUT} = 0A, AAM



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



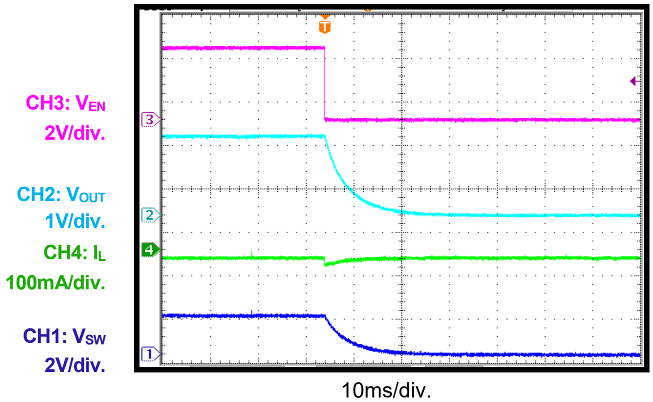
Start-Up through EN
I_{OUT} = 6A



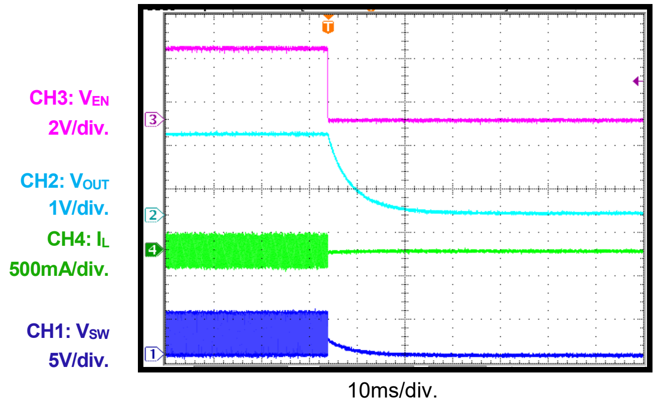
EVB TEST RESULTS *(continued)*

Performance curves and waveforms are tested on the evaluation board. V_{IN} = 5V, V_{OUT} = 1.8V, L = 1µH, C_{OUT} = 44µF, f_{SW} = 2.1MHz, T_A = 25°C, unless otherwise noted.

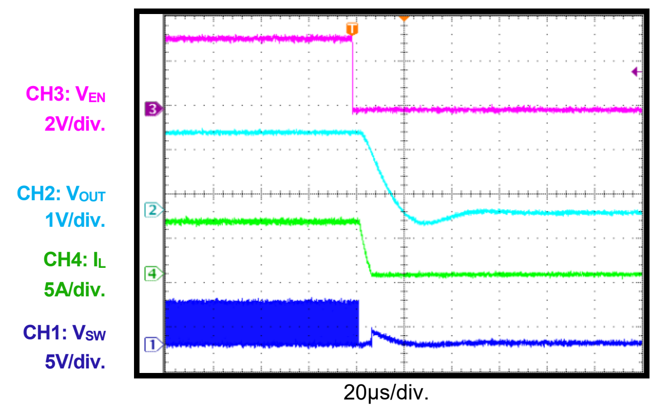
Shutdown through EN
I_{OUT} = 0A, AAM



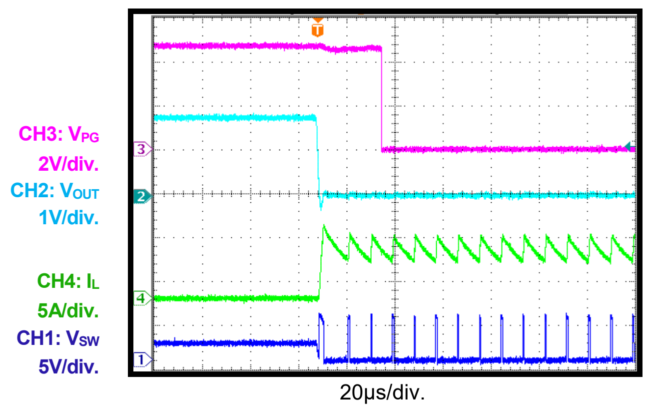
Shutdown through EN
I_{OUT} = 0A, CCM



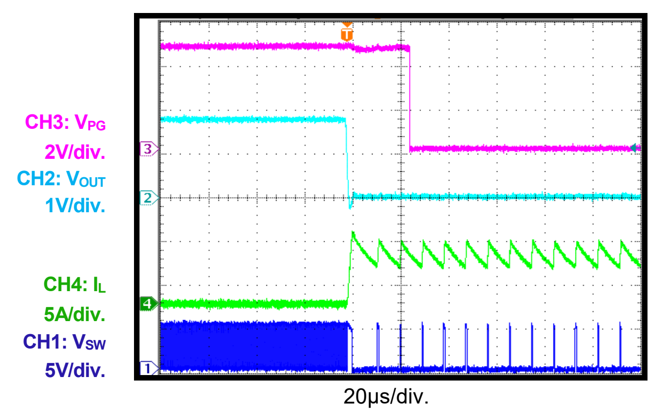
Shutdown through EN
I_{OUT} = 6A



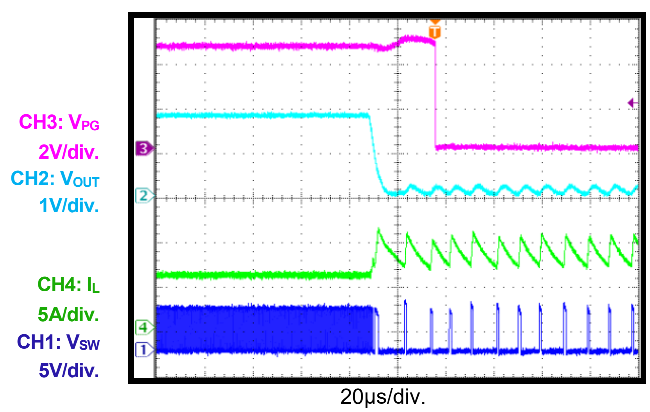
SCP Entry
I_{OUT} = 0A, AAM



SCP Entry
I_{OUT} = 0A, CCM



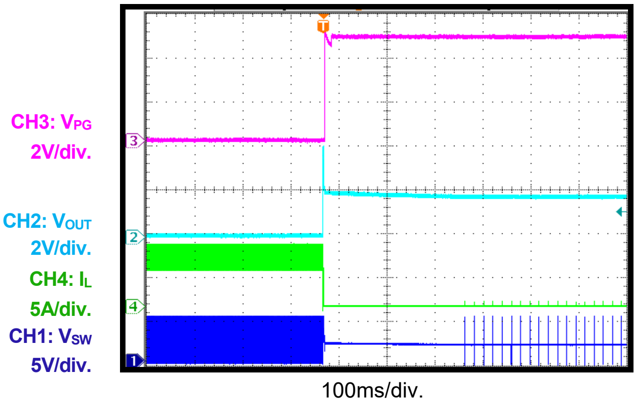
SCP Entry
I_{OUT} = 6A



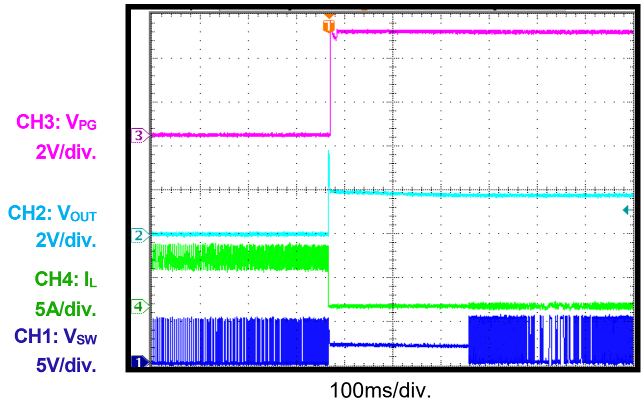
EVB TEST RESULTS *(continued)*

Performance curves and waveforms are tested on the evaluation board. V_{IN} = 5V, V_{OUT} = 1.8V, L = 1µH, C_{OUT} = 44µF, f_{SW} = 2.1MHz, T_A = 25°C, unless otherwise noted.

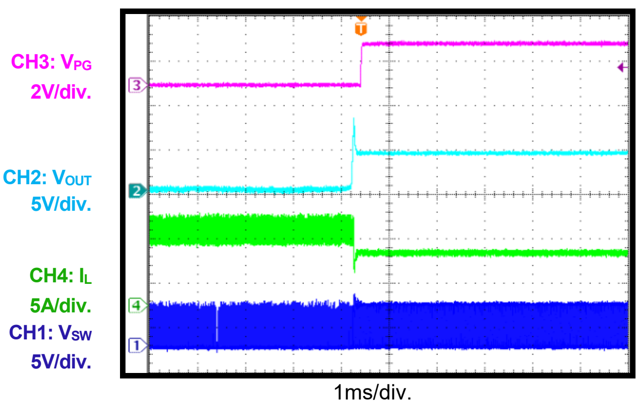
SCP Recovery
I_{OUT} = 0A, AAM



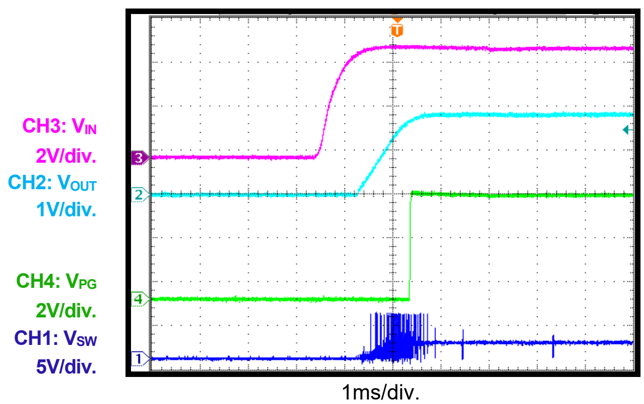
SCP Recovery
I_{OUT} = 0A, CCM



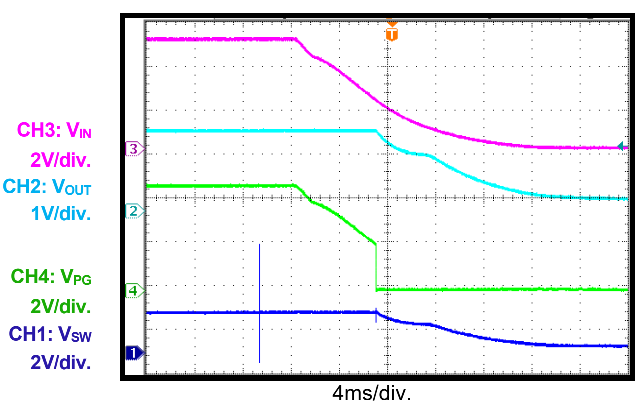
SCP Recovery
I_{OUT} = 6A



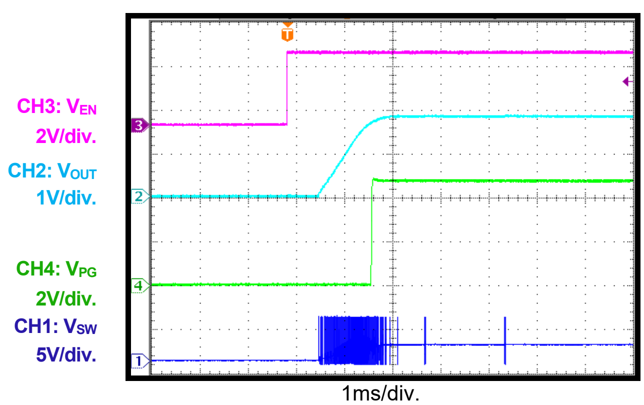
PG Start-Up through VIN
I_{OUT} = 0A, AAM



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



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

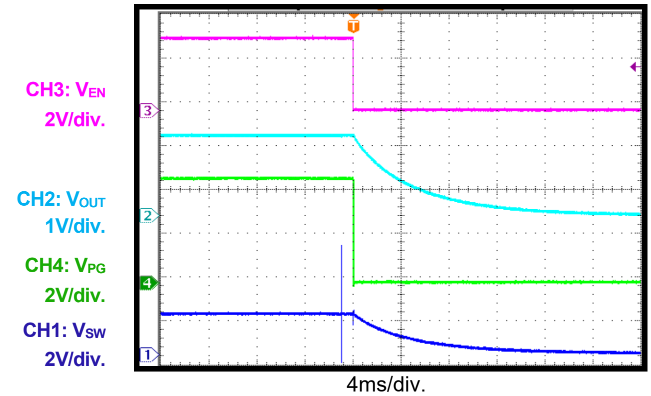


EVB TEST RESULTS *(continued)*

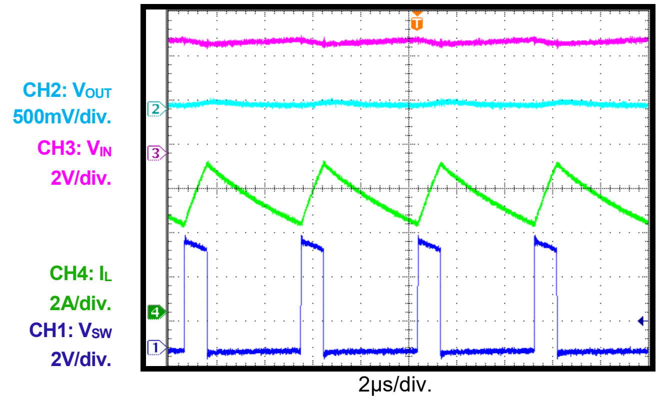
Performance curves and waveforms are tested on the evaluation board. V_{IN} = 5V, V_{OUT} = 1.8V, L = 1µH, C_{OUT} = 44µF, f_{SW} = 2.1MHz, T_A = 25°C, unless otherwise noted.

PG Shutdown through EN

I_{OUT} = 0A, AAM

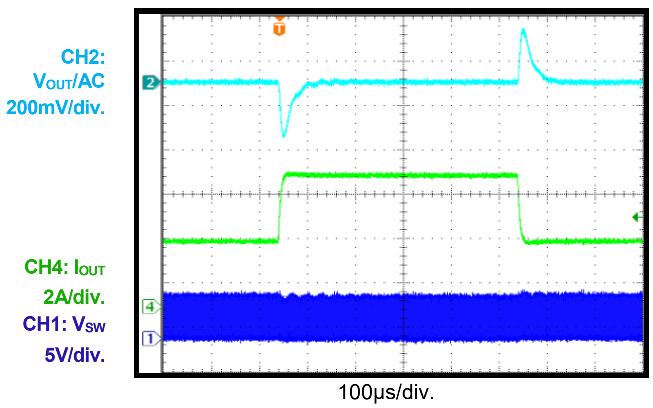


SCP Steady State



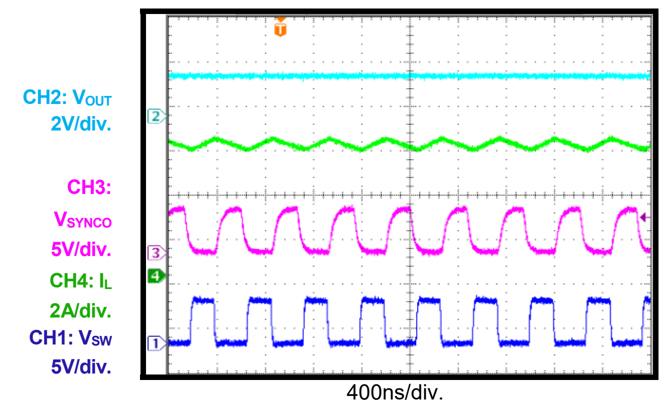
Load Transient

I_{OUT} = 3A to 6A, 1.6A/µs



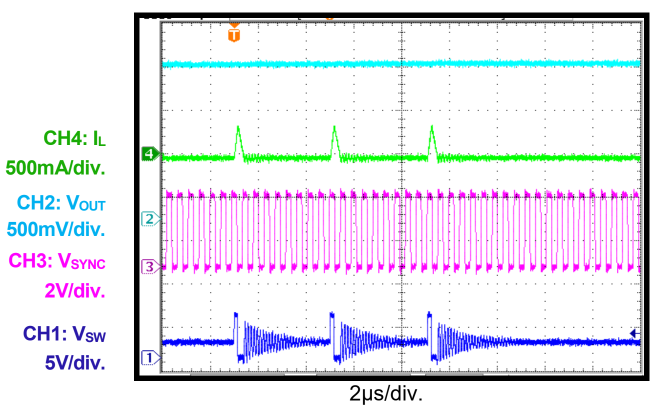
SYNCO

I_{OUT} = 6A



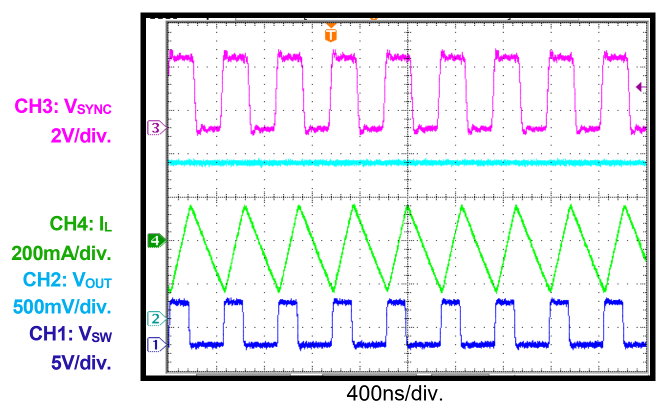
SYNCIN

I_{OUT} = 0A, AAM, SYNC clock = 2.2MHz



SYNCIN

I_{OUT} = 0A, FCCM, SYNC clock = 2.2MHz

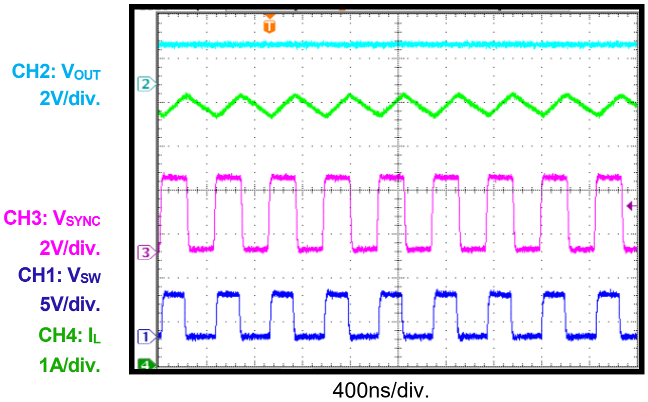


EVB TEST RESULTS *(continued)*

Performance curves and waveforms are tested on the evaluation board. V_{IN} = 5V, V_{OUT} = 1.8V, L = 1µH, C_{OUT} = 44µF, f_{SW} = 2.1MHz, T_A = 25°C, unless otherwise noted.

SYNCIN

I_{OUT} = 6A, SYNC clock = 2.2MHz



PCB LAYOUT

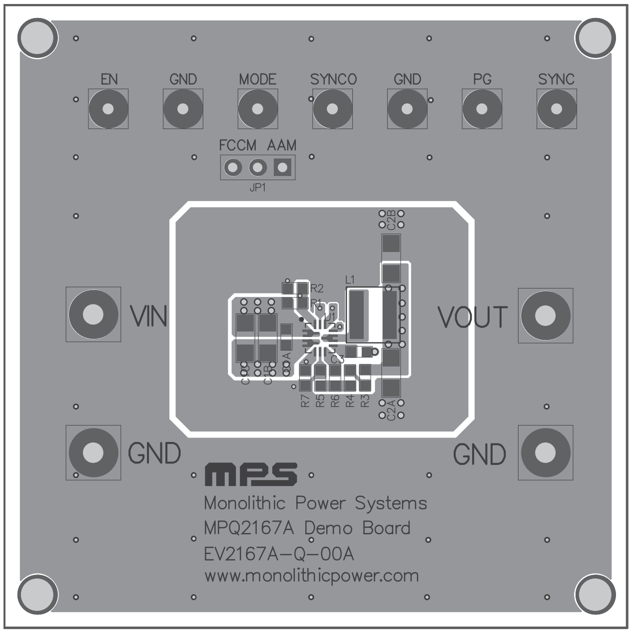


Figure 5: Top Silk and Top Layer

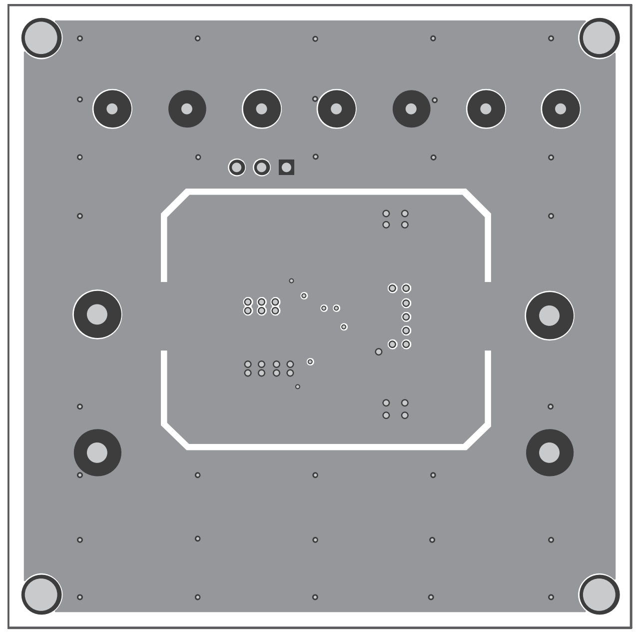


Figure 6: Mid-Layer 1

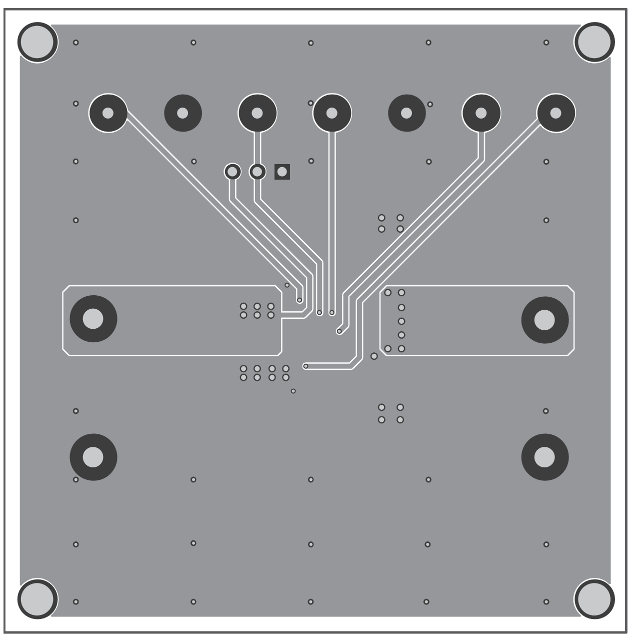


Figure 7: Mid-Layer 2

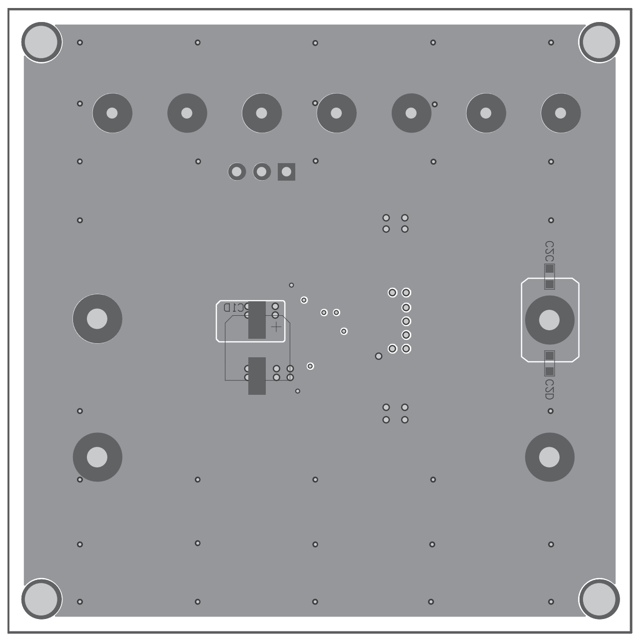


Figure 8: Bottom Layer and Bottom Silk

REVISION HISTORY

Revision #	Revision Date	Description	Pages Updated
1.0	1/4/2021	Initial Release	-