EVBL4571-QB-00A

1A, 60V, High-Efficiency, Synchronous Step-Down Converter Evaluation Board

DESCRIPTION

The EVBL4571-QB-00A is an evaluation board designed to demonstrate the capabilities of the MP4571, a high-efficiency, synchronous step-down converter with integrated internal power MOSFETs (HS-FET and LS-FET, respectively). It can deliver up to 1A of continuous output current, with peak current control for excellent transient response and an integrated MPS power inductor.

The MP4571 features advanced asynchronous mode (AAM) and forced continuous condition mode (FCCM). AAM helps achieve high efficiency under light-load conditions by scaling back the switching frequency (f_{SW}) to reduce switching and gate driver losses.

The EVBL4571-QB-00A is a fully assembled and tested evaluation board. It generates 5V of output voltage (V_{OUT}) and 1A of continuous output current across a wide 5V to 60V input range.

ELECTRICAL SPECIFICATIONS

Parameter	Symbol	Value	Units
Input voltage	V_{IN}	5 to 60	V
Output voltage	V_{OUT}	5	V
Output current	I_{OUT}	1	A

FEATURES

- Wide 5V to 60V Operating Input Range
- 1A Continuous Output Current
- 40µA Quiescent Current
- Up to 2.2MHz Configurable Frequency
- Internal 250mΩ High-Side MOSFET and 45mΩ Low-Side MOSFET
- Low 2µA Shutdown Current
- 0.45ms Internal Soft Start (SS)
- 180° Out-of-Phase SYNCOUT Clock
- Synchronous Mode for High-Efficiency Operation
- Selectable Advanced Asynchronous Mode (AAM) or Forced Continuous Conduction Mode (FCCM) for Light-Load Operation
- EN Remote Control
- Power Good (PG) Indicator
- Low-Dropout (LDO) Mode
- Over-Current Protection (OCP)
- Thermal Shutdown (TSD)
- Available in a QFN-12 (2.5mmx3mm) Package

MPL Optimized Performance with MPS Inductor MPL-AL6060 Series

APPLICATIONS

- Automotive Systems
- Industrial Power Systems

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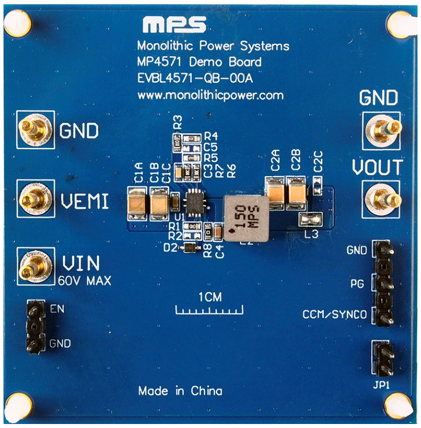
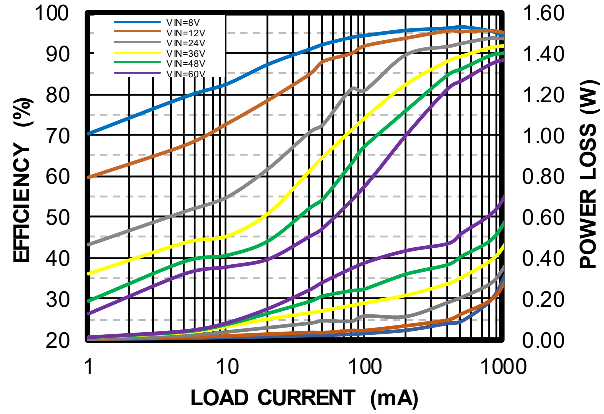
EVBL4571-QB-00A EVALUATION BOARD



LxWxH (6.35cmx6.35cmx1.3cm)

Board Number	MPS IC Number	MPS Inductor
EVBL4571-QB-00A	MP4571GQB	MPL-AL6060-150

Efficiency vs. Load Current vs. Power Loss
V_{OUT} = 5V, f_{SW} = 450kHz,
L = 15µH, AAM



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QUICK START GUIDE

1. Preset the power supply between 5V and 60V, then turn off the power supply. (1)
2. If longer cables (>0.5m total) are being used between the source and the evaluation board, install a damping capacitor at the input terminals. This is critical when V_{IN} exceeds 24V.
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 on the power supply.
6. To use the enable (EN) function, apply a digital input to the EN pin. Drive EN above 1.45V to turn the regulator on; drive EN below 1.12V to turn it off.
7. The oscillating frequency can be configured by the external frequency resistor (R_{FREQ}), which can be estimated with Equation (1):

$$R_{FREQ}(M\Omega) = \frac{30}{f_{SW}(kHz)} \quad (1)$$

8. The output voltage (V_{OUT}) is set by the external resistor dividers (R4 and R5). The feedback resistor (R_{FB}, R4 plus R6) also sets the feedback loop bandwidth via the internal compensation capacitor. Select R4 to have a value of about 40kΩ. R5 can be calculated with Equation (2):

$$R5 = \frac{R4}{\frac{V_{OUT}}{0.8} - 1} \quad (2)$$

Table 1 shows the recommended R_{FB} values for common output voltages.

Table 1: Recommended Resistor Voltages

V_{OUT} (V)	R4 (kΩ)	R5 (kΩ)	R6 (kΩ)
3.3	41.2 (1%)	13 (1%)	20 (1%)
5	41.2 (1%)	7.68 (1%)	20 (1%)
12	41.2 (1%)	2.94 (1%)	20 (1%)

Notes:

1) Electronic loads represent a negative impedance to the regulator. If the current is too high, hiccup mode is triggered.

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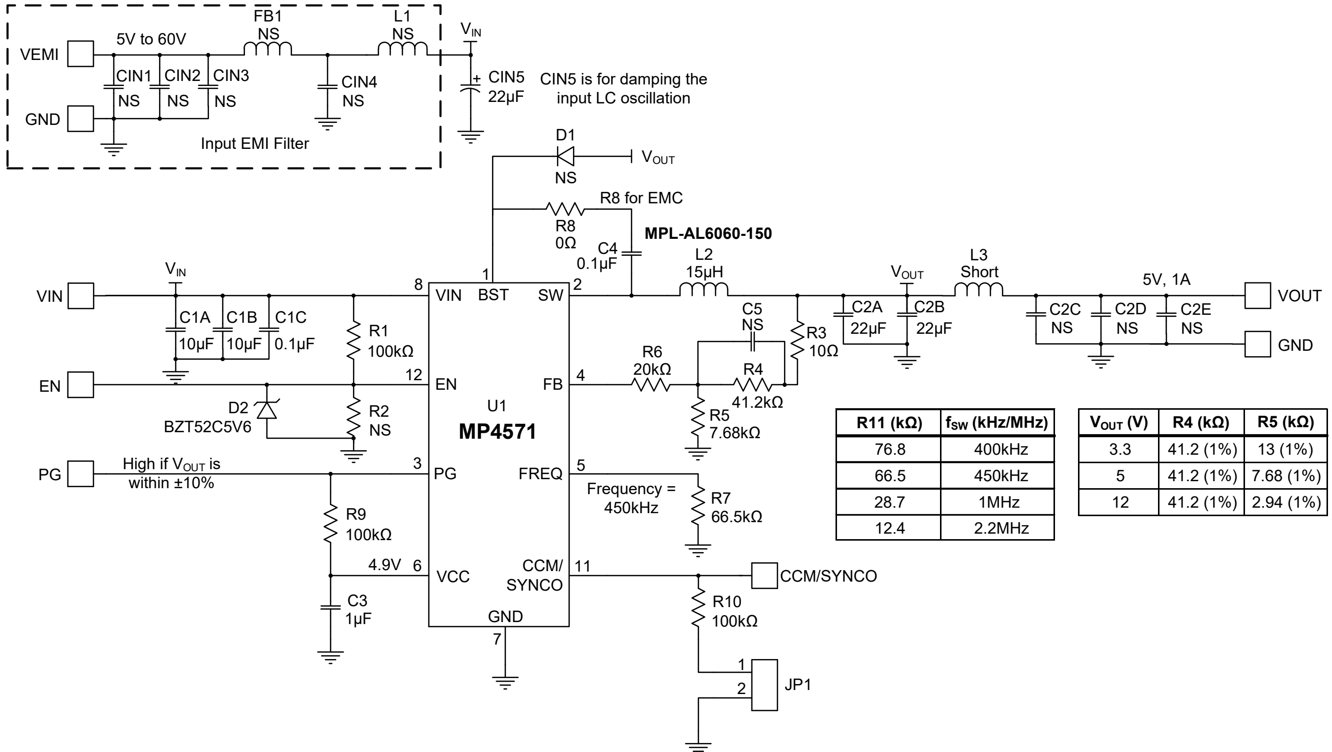
EVALUATION BOARD SCHEMATIC

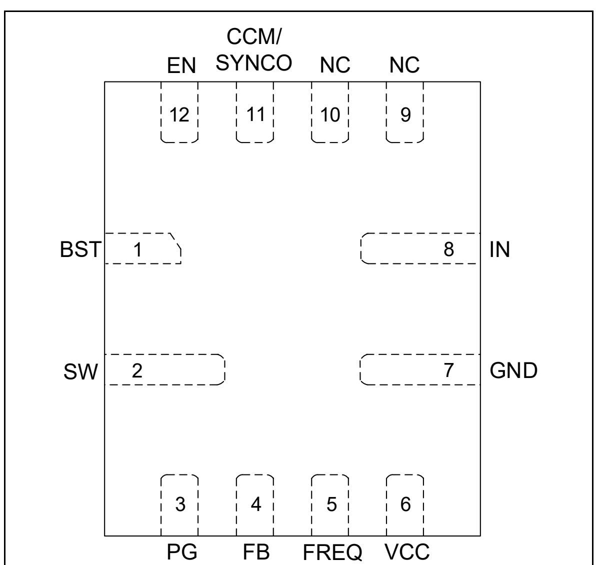


R11 (kΩ)	f_{SW} (kHz/MHz)
76.8	400kHz
66.5	450kHz
28.7	1MHz
12.4	2.2MHz

V_{OUT} (V)	R4 (kΩ)	R5 (kΩ)
3.3	41.2 (1%)	13 (1%)
5	41.2 (1%)	7.68 (1%)
12	41.2 (1%)	2.94 (1%)

Figure 1: Evaluation Board Schematic

PACKAGE REFERENCE



QFN-12 (2.5mmx3mm)

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EVBL4571-QB-00A BILL OF MATERIALS

Qty	Ref	Value	Description	Package	Manufacturer	Manufacturer P/N
2	C1A, C1B	10µF	Ceramic capacitor, 100V, X7S	1210	Murata	GRM32EC72A106KE05L
1	C1C	0.1µF	Ceramic capacitor, 100V, X7R	0603	Murata	GRM188R72A104KA35D
2	C2A, C2B	22µF	Ceramic capacitor, 25V, X7R	1210	Murata	GRM32ER71E226KE15L
1	C3	1µF	Ceramic capacitor, 25V, X7R	0603	Murata	GRM188R71E105KA12D
1	C4	0.1µF	Ceramic capacitor, 16V, X7R	0603	Murata	GRM188R71C104KA01D
1	CIN5	22µF	Electrolytic capacitor, 63V	SMD	Jianghai	VTD-63V22
8	CIN1, CIN2, CIN3, CIN4, C2C, C2D, C2E, C5	NS				
1	D1	NS				
1	D2	5.6V	Zener diode, 5.6V	SOD323	Diodes, Inc.	BZT52C5V6S
1	FB1	NS				
1	L1	NS				
1	L2	15µH	Inductor, 35mΩ, DCR, 5.8A	SMD	MPS	MPL-AL6060-150
1	L3	Short		SMD		
3	R1, R9, R10	100kΩ	Film resistor, 1%	0603	Yageo	RC0603FR-07100KL
1	R3	10kΩ	Film resistor, 1%	0603	Yageo	RC0603FR-0710RL
1	R4	41.2kΩ	Film resistor, 1%	0603	Yageo	RC0603FR-0741K2L
1	R5	7.68kΩ	Film resistor, 1%	0603	Yageo	RC0603FR-077K68L
1	R6	20kΩ	Film resistor, 1%	0603	Yageo	RC0603FR-0720KL
1	R7	66.5kΩ	Film resistor, 1%	0603	Yageo	RC0603FR-0766K5L
1	R8	0Ω	Film resistor, 1%	0603	Yageo	RC0603FR-070RL
1	R2	NS				
1	U1	MP4571	Step-down regulator	QFN-12 (2.5mmx3mm)	MPS	MP4571GQB
1	JP1	2.54mm	Test pin	DIP	Custom	
5	VIN, VEMI, VOUT, GND, GND	2mm	2 golden pins	DIP	Custom	
5	CCM/ SYNCO, PG, EN, GND, GND	2.54mm	Test pin	DIP	Custom	

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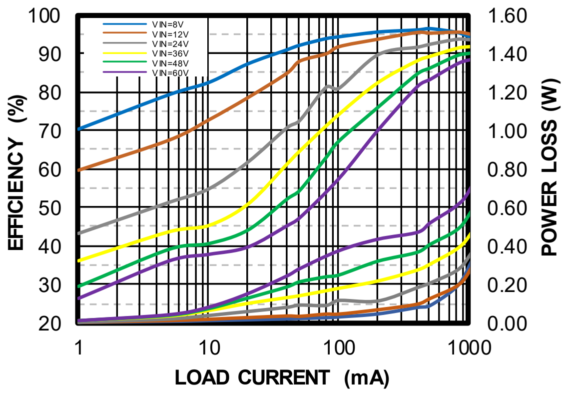
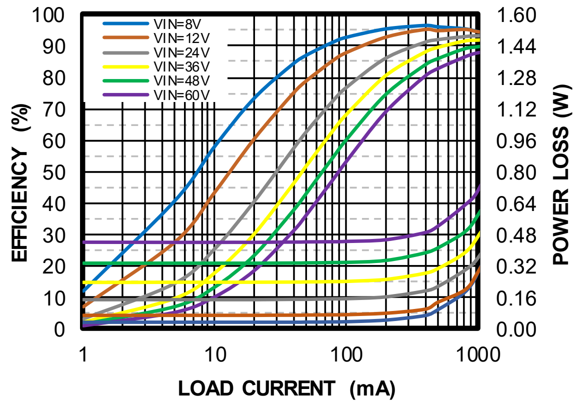
EVB TEST RESULTS

Performance curves and waveforms are tested on the evaluation board. V_{IN} = 24V, V_{OUT} = 5V, L = 15µH, f_{SW} = 450kHz, T_A = 25°C, unless otherwise noted.

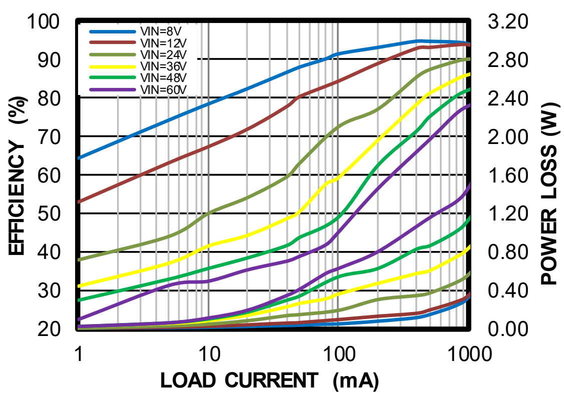
Efficiency vs. Load Current vs. Power Loss
V_{OUT} = 5V, f_{SW} = 450kHz, L = 15µH, AAM



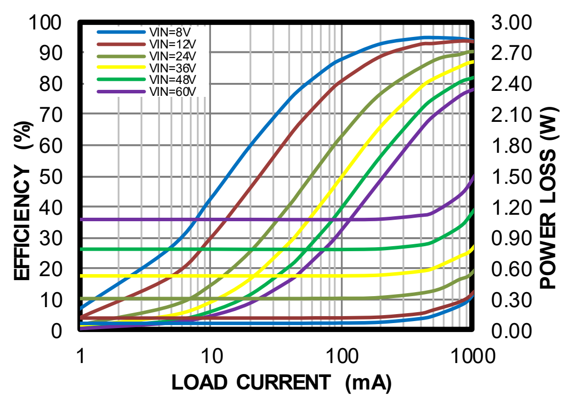
Efficiency vs. Load Current vs. Power Loss
V_{OUT} = 5V, f_{SW} = 450kHz, L = 15µH, FCCM



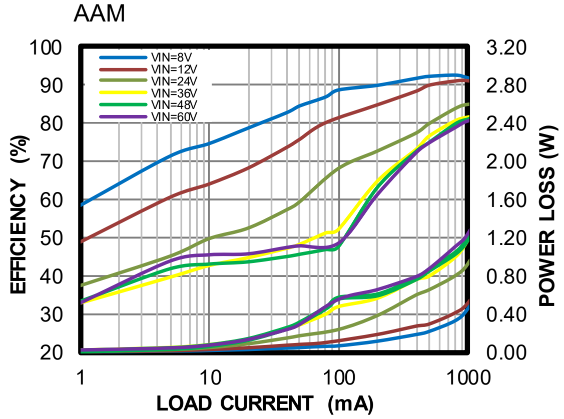
Efficiency vs. Load Current vs. Power Loss
V_{OUT} = 5V, f_{SW} = 1MHz, L = 10µH, AAM



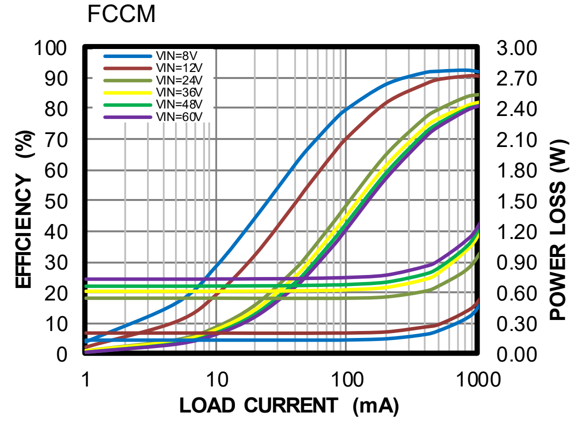
Efficiency vs. Load Current vs. Power Loss
V_{OUT} = 5V, f_{SW} = 1MHz, L = 10µH, FCCM



Efficiency vs. Load Current vs. Power Loss
V_{OUT} = 5V, f_{SW} = 2.2MHz, L = 4.7µH, AAM



Efficiency vs. Load Current vs. Power Loss
V_{OUT} = 5V, f_{SW} = 2.2MHz, L = 4.7µH, FCCM



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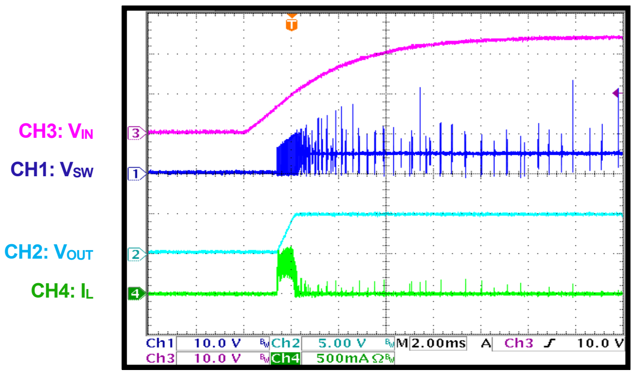
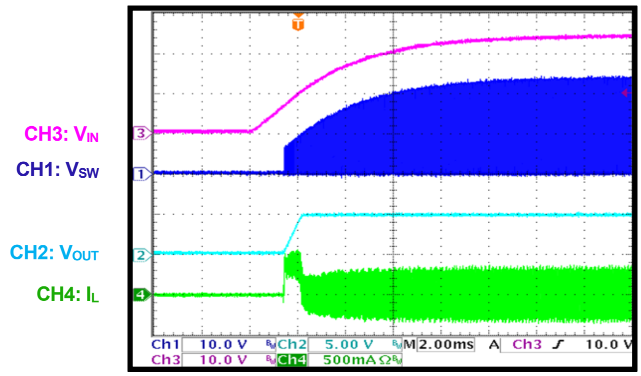
EVB TEST RESULTS *(continued)*

Performance curves and waveforms are tested on the evaluation board. V_{IN} = 24V, V_{OUT} = 5V, L = 15µH, f_{SW} = 450kHz, T_A = 25°C, unless otherwise noted.

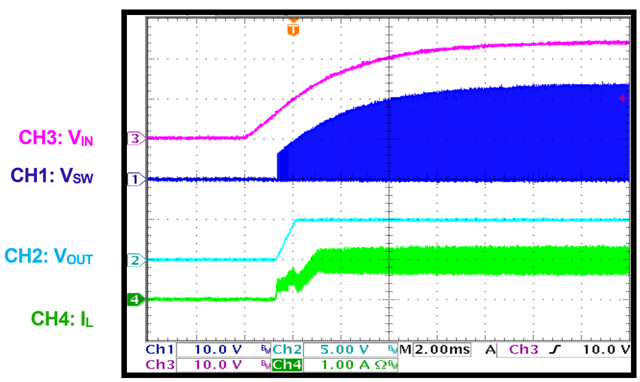
Start-Up through VIN
I_{OUT} = 0A, AAM



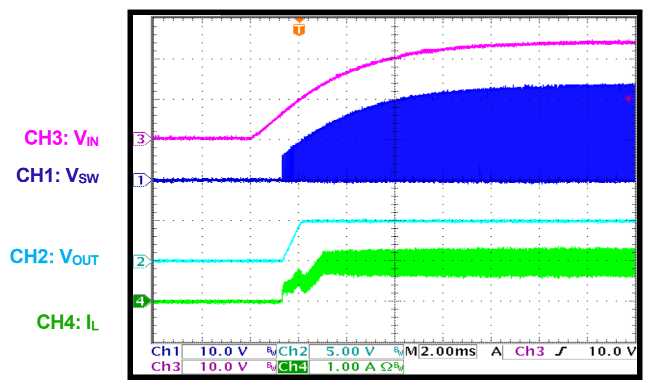
Start-Up through VIN
I_{OUT} = 0A, FCCM



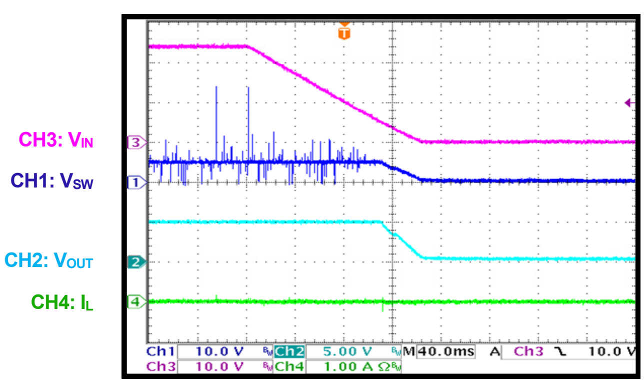
Start-Up through VIN
I_{OUT} = 1A, AAM



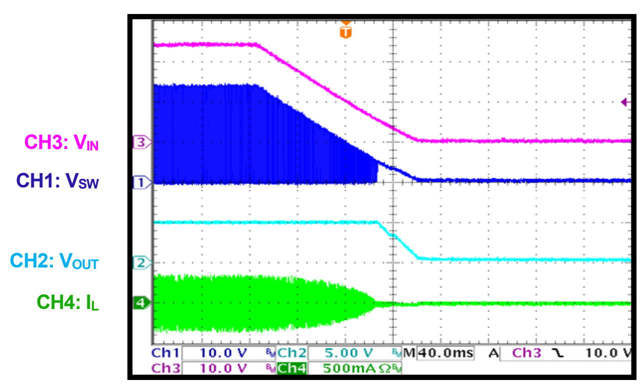
Start-Up through VIN
I_{OUT} = 1A, FCCM



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



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



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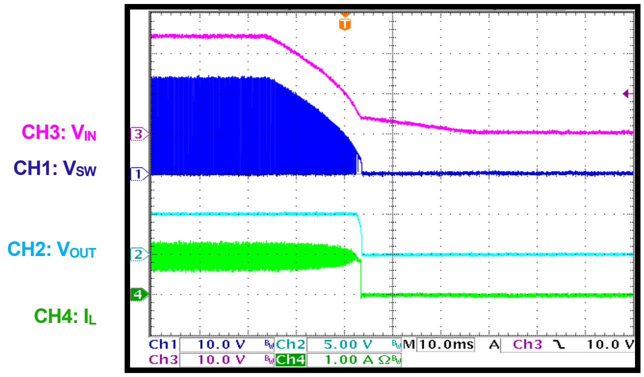
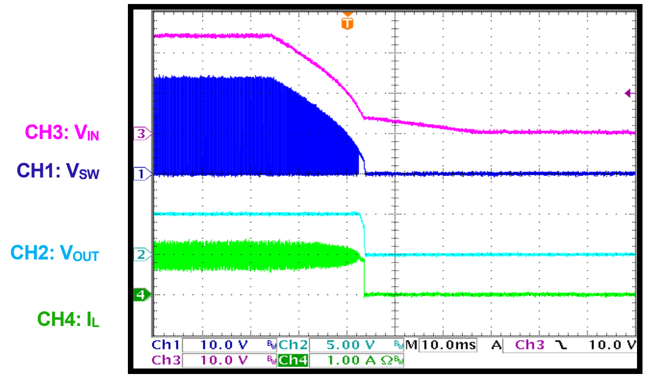
EVB TEST RESULTS *(continued)*

Performance curves and waveforms are tested on the evaluation board. V_{IN} = 24V, V_{OUT} = 5V, L = 15µH, f_{SW} = 450kHz, T_A = 25°C, unless otherwise noted.

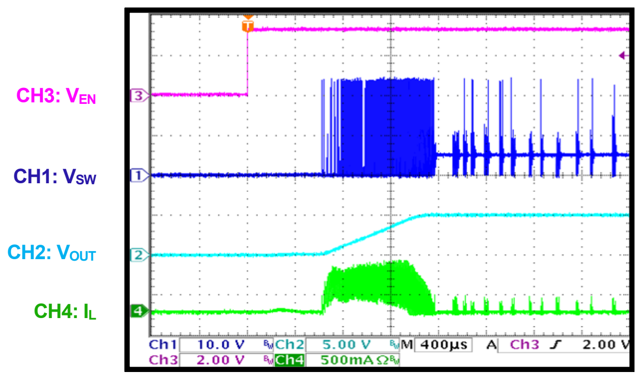
Shutdown through VIN
I_{OUT} = 1A, AAM



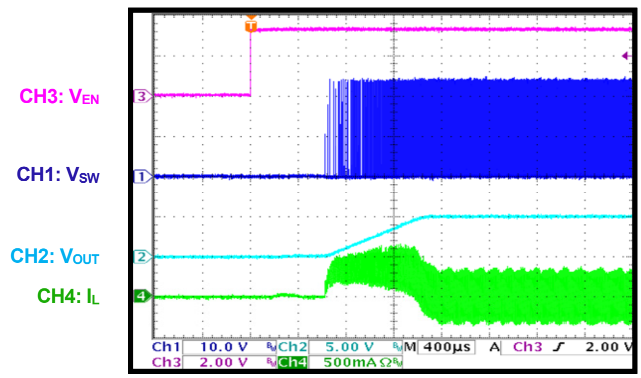
Shutdown through VIN
I_{OUT} = 1A, FCCM



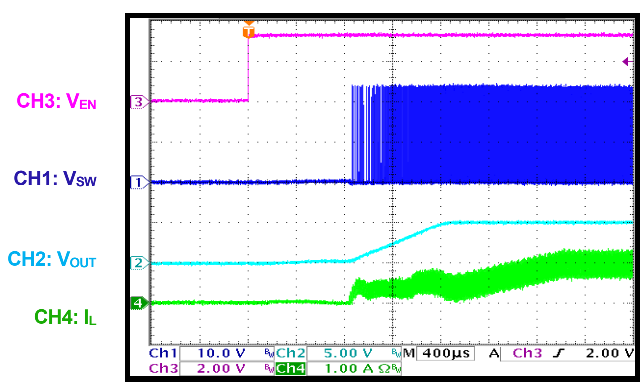
Start-Up through EN
I_{OUT} = 0A, AAM



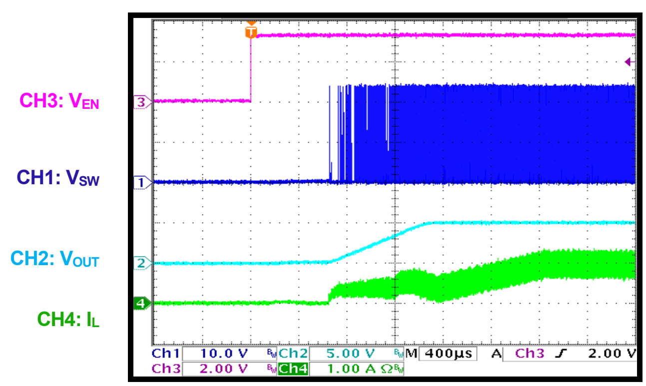
Start-Up through EN
I_{OUT} = 0A, FCCM



Start-Up through EN
I_{OUT} = 1A, AAM



Start-Up through EN
I_{OUT} = 1A, FCCM



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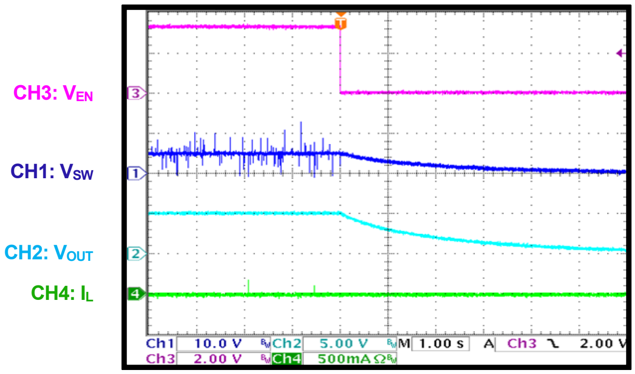
EVB TEST RESULTS *(continued)*

Performance curves and waveforms are tested on the evaluation board. V_{IN} = 24V, V_{OUT} = 5V, L = 15µH, f_{SW} = 450kHz, T_A = 25°C, unless otherwise noted.

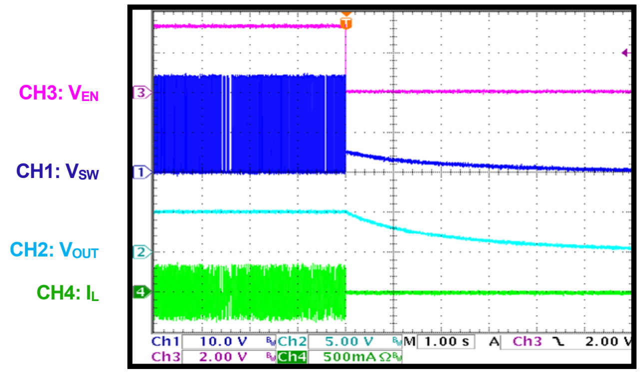
Shutdown through EN

I_{OUT} = 0A, AAM



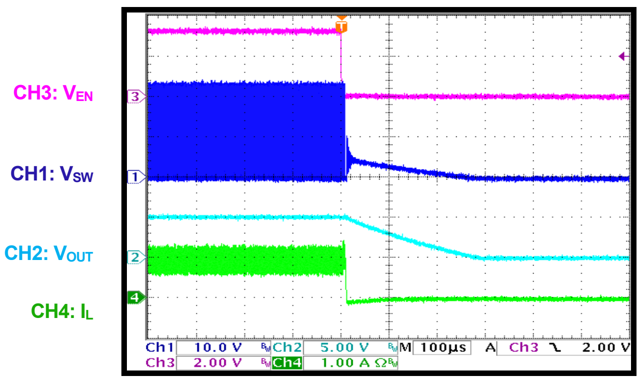
Shutdown through EN

I_{OUT} = 0A, FCCM



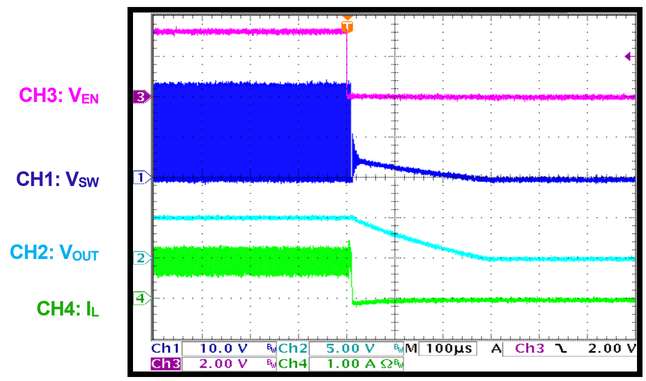
Shutdown through EN

I_{OUT} = 1A, AAM



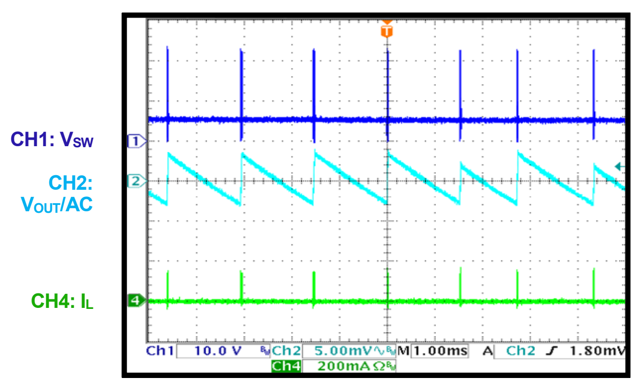
Shutdown through EN

I_{OUT} = 1A, FCCM



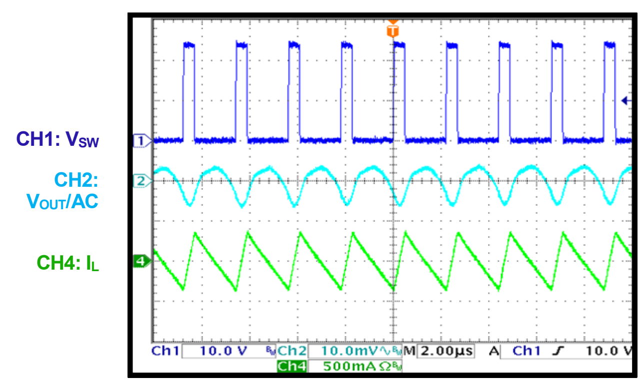
Output Ripple

I_{OUT} = 0A, AAM



Output Ripple

I_{OUT} = 0A, FCCM



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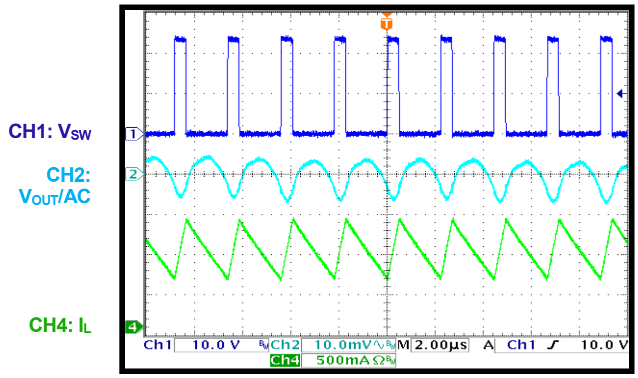
EVB TEST RESULTS *(continued)*

Performance curves and waveforms are tested on the evaluation board. V_{IN} = 24V, V_{OUT} = 5V, L = 15µH, f_{SW} = 450kHz, T_A = 25°C, unless otherwise noted.

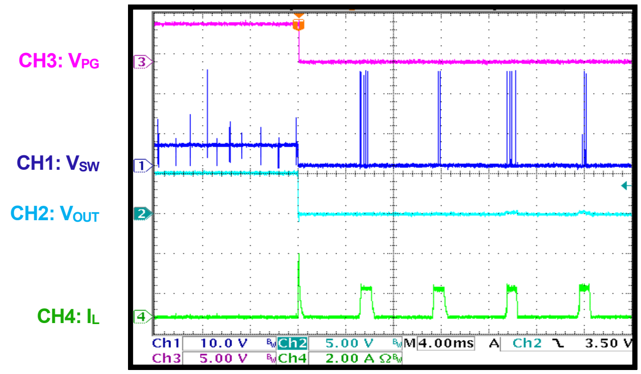
Output Ripple

I_{OUT} = 1A



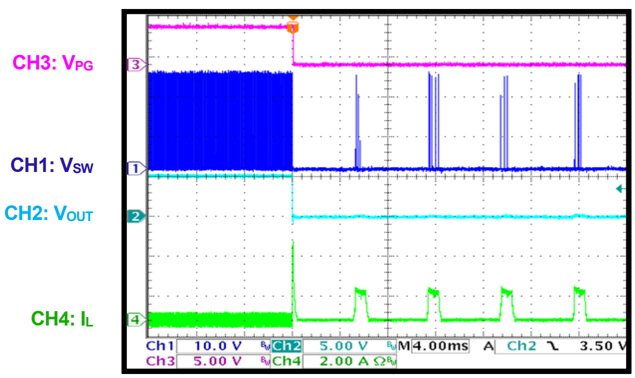
SCP Entry in AAM

I_{OUT} = 0A



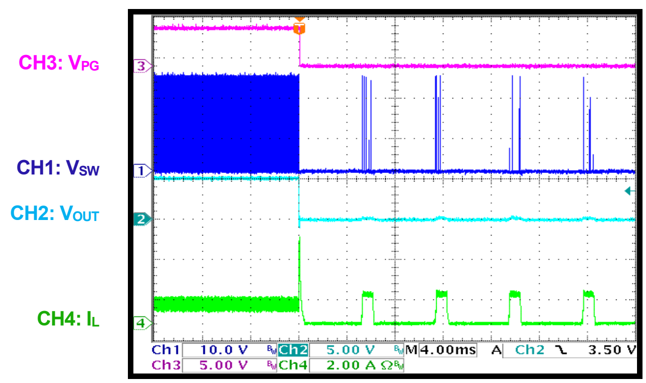
SCP Entry in FCCM

I_{OUT} = 0A

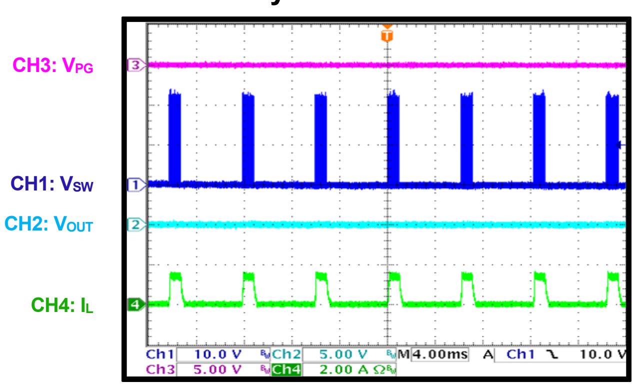


SCP Entry

I_{OUT} = 1A

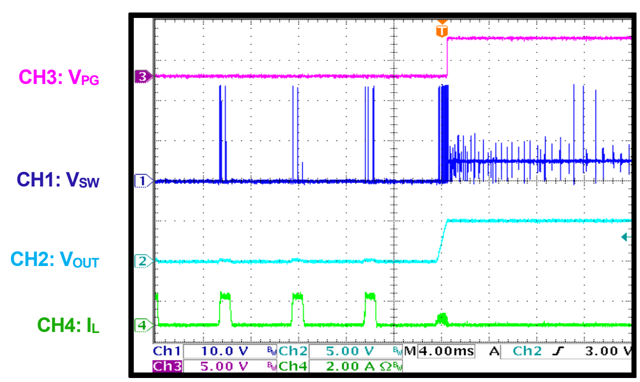


SCP Steady State



SCP Recovery in AAM

I_{OUT} = 0A



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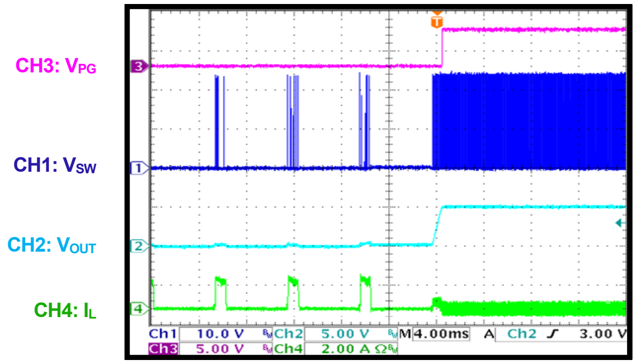
EVB TEST RESULTS *(continued)*

Performance curves and waveforms are tested on the evaluation board. V_{IN} = 24V, V_{OUT} = 5V, L = 15µH, f_{SW} = 450kHz, T_A = 25°C, unless otherwise noted.

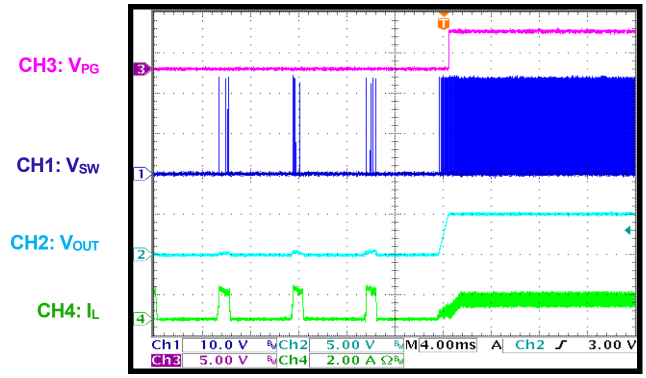
SCP Recovery in FCCM

I_{OUT} = 0A



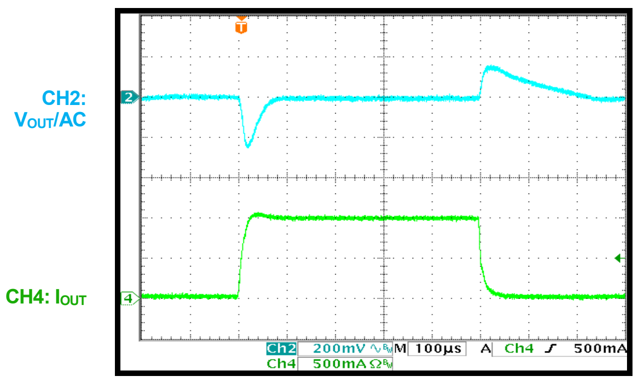
SCP Recovery

I_{OUT} = 1A



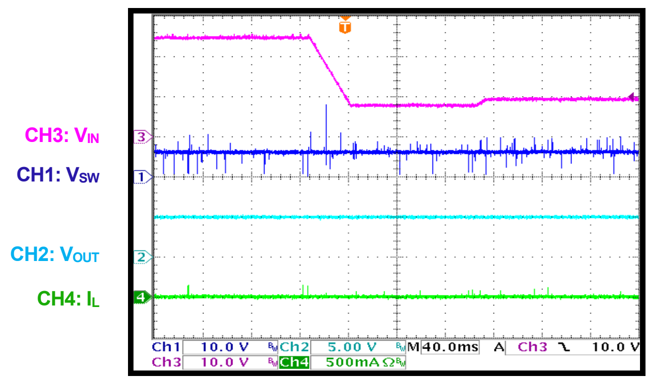
Load Transient

I_{OUT} = 0A to 1A



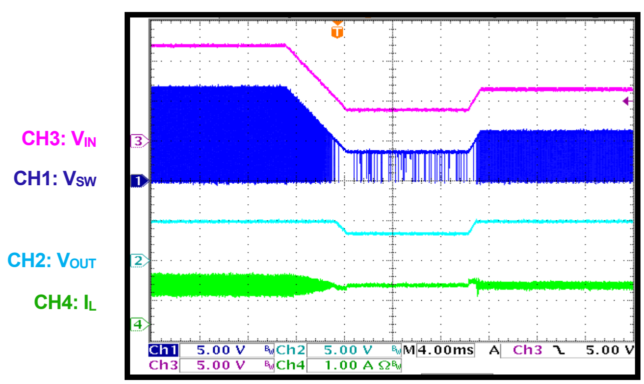
Cold Crank

V_{IN} = 24V to 4V to 5V, I_{OUT} = 0A



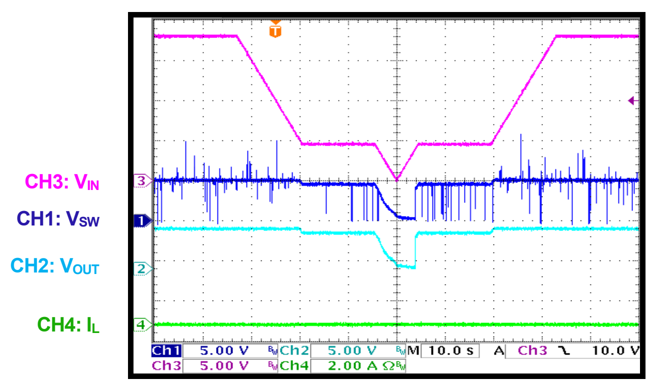
Cold Crank

V_{IN} = 24V to 4V to 6.5V, I_{OUT} = 1A



V_{IN} Ramping Down and Up

V_{IN} = 18V to 4.5V to 0V to 4.5V to 18V, I_{OUT} = 0A



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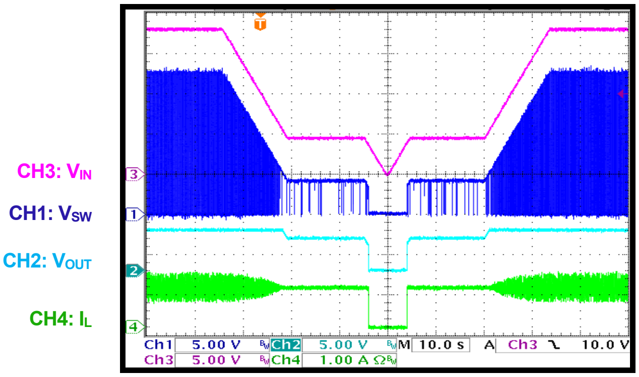
EVB TEST RESULTS *(continued)*

Performance curves and waveforms are tested on the evaluation board. V_{IN} = 24V, V_{OUT} = 5V, L = 15µH, f_{SW} = 450kHz, T_A = 25°C, unless otherwise noted.

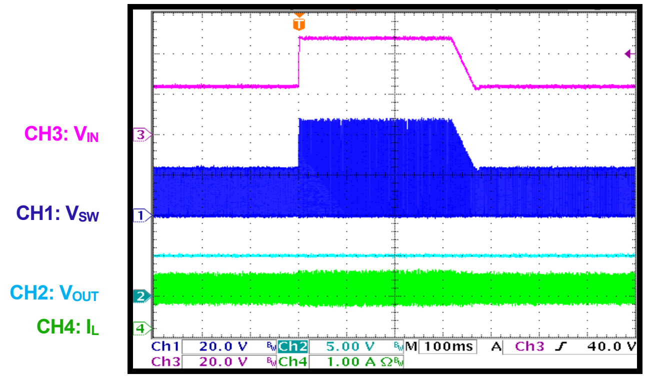
V_{IN} Ramping Down and Up

V_{IN} = 18V to 4.5V to 0V to 4.5V to 18V, I_{OUT} = 1A



Load Dump

V_{IN} = 24V to 48V to 24V, I_{OUT} = 1A



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PCB LAYOUT

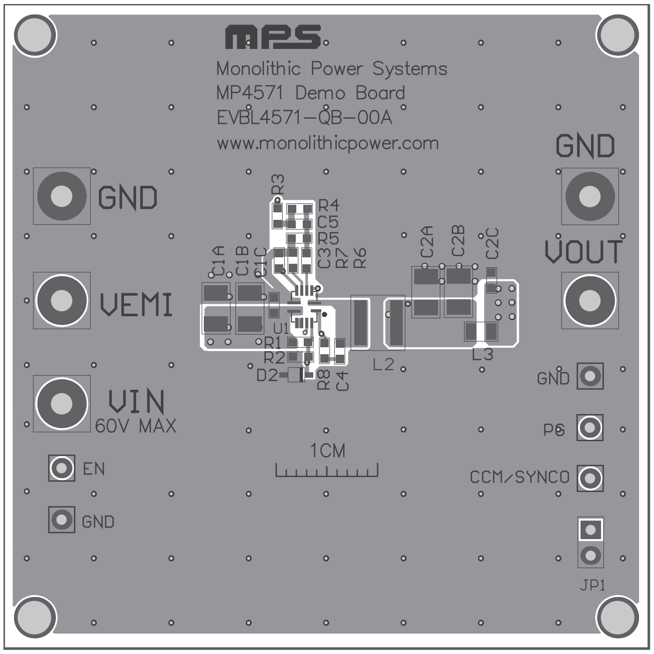

Figure 2: Top Silk and Top Layer

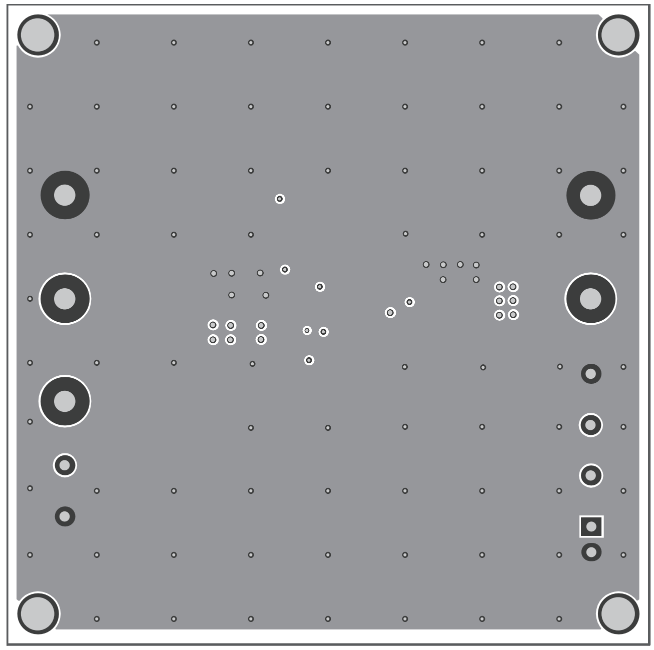

Figure 3: Mid-Layer 1

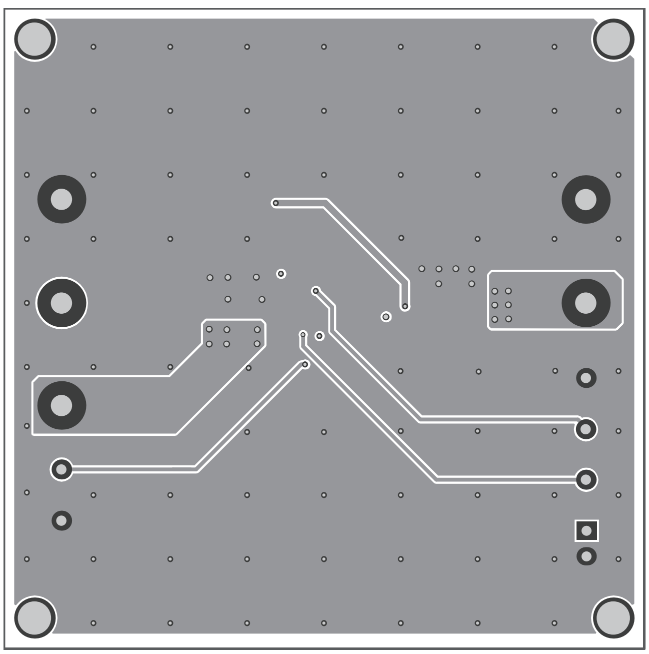

Figure 4: Mid-Layer 2

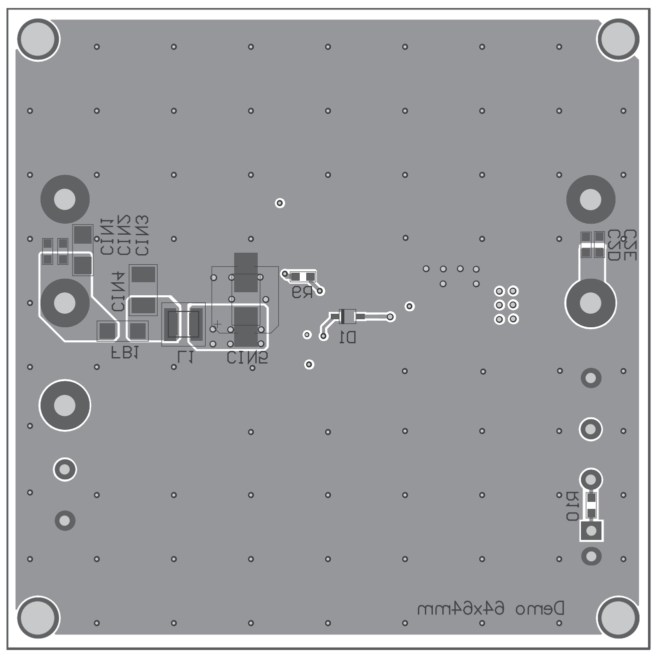

Figure 5: Bottom Layer and Bottom Silk

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REVISION HISTORY

Revision #	Revision Date	Description	Pages Updated
1.0	2/18/2021	Initial Release	-

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