



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
- 40 μ A Quiescent Current
- Up to 2.2MHz Configurable Frequency
- Internal 250m Ω High-Side MOSFET and 45m Ω Low-Side MOSFET
- Low 2 μ A 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



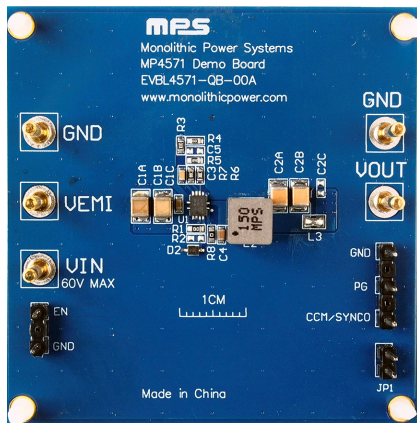
Optimized Performance with MPS Inductor MPL-AL6060 Series

APPLICATIONS

- Automotive Systems
- Industrial Power Systems

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EVBL4571-QB-00A EVALUATION BOARD

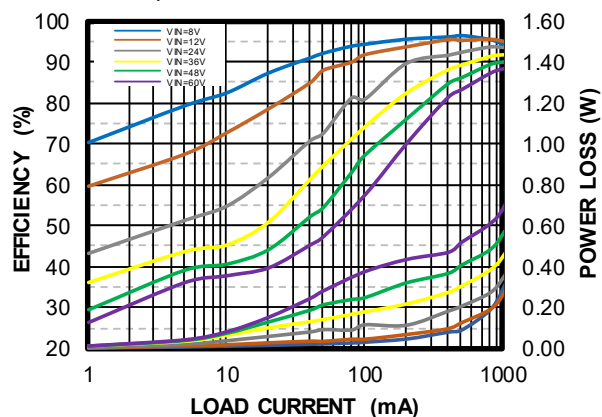


LxWxH (6.35cmx6.35cmx1.3cm)

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

Efficiency vs. Load Current vs. Power Loss

$V_{OUT} = 5V$, $f_{SW} = 450kHz$,
 $L = 15\mu H$, AAM



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 (+): V_{IN}
 - b. Negative (-): GND
4. Connect the load terminals to:
 - a. Positive (+): V_{OUT}
 - 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 (R_4 and R_5). The feedback resistor (R_{FB} , R_4 plus R_6) also sets the feedback loop bandwidth via the internal compensation capacitor. Select R_4 to have a value of about 40k Ω . R_5 can be calculated with Equation (2):

$$R_5 = \frac{R_4}{\frac{V_{OUT}}{0.8} - 1} \quad (2)$$

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

Table 1: Recommended Resistor Voltages

V_{OUT} (V)	R_4 (k Ω)	R_5 (k Ω)	R_6 (k Ω)
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.

EVALUATION BOARD SCHEMATIC

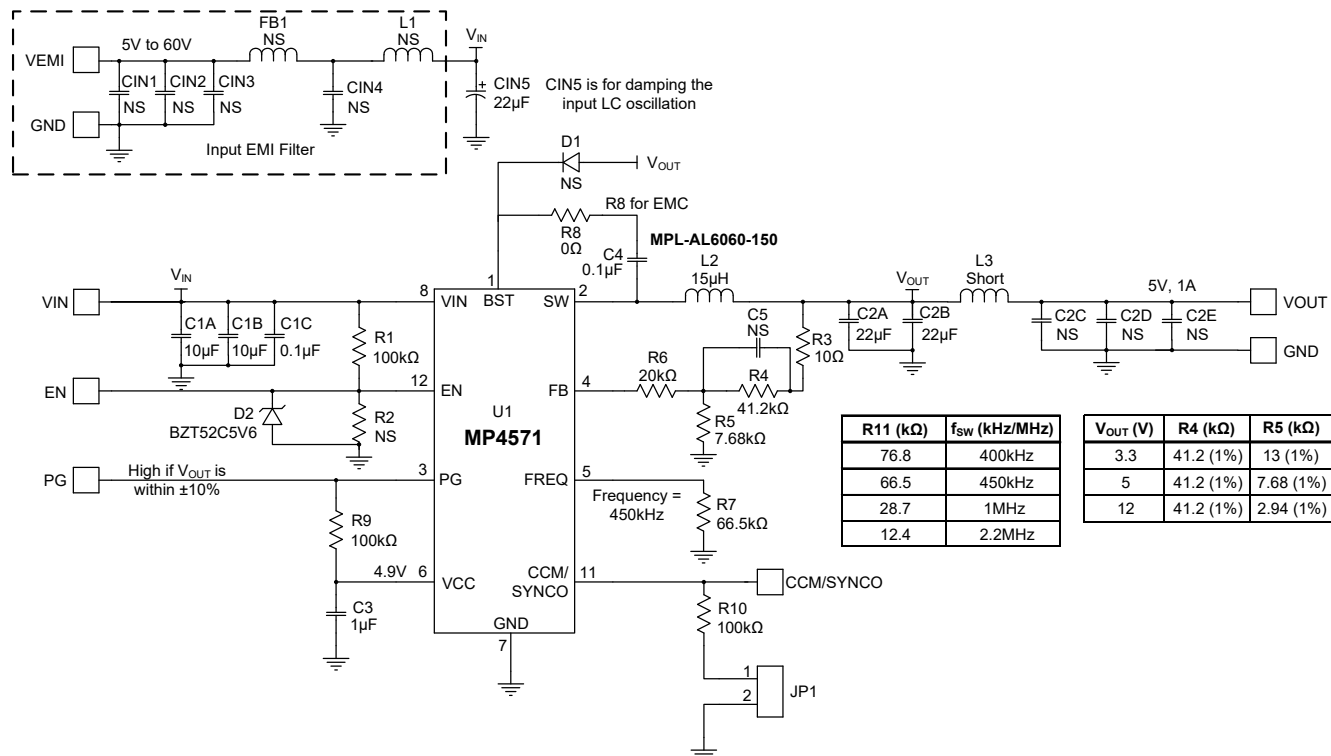
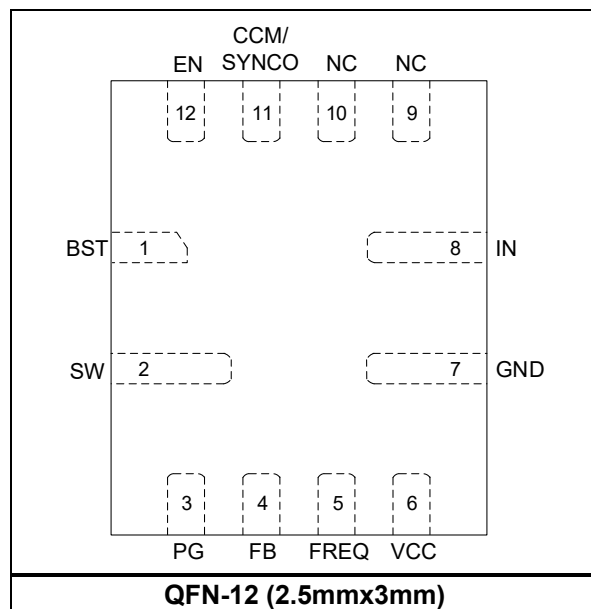


Figure 1: Evaluation Board Schematic

PACKAGE REFERENCE



EVBL4571-QB-00A BILL OF MATERIALS

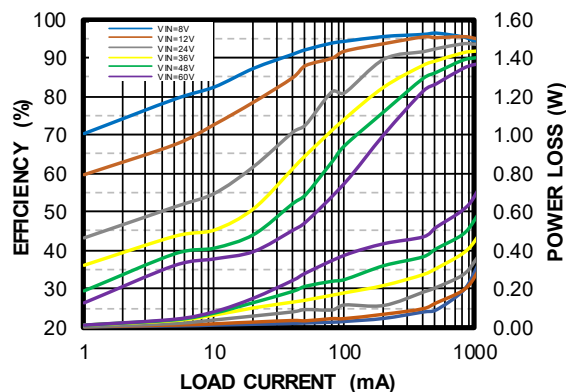
Qty	Ref	Value	Description	Package	Manufacturer	Manufacturer P/N
2	C1A, C1B	10 μ F	Ceramic capacitor, 100V, X7S	1210	Murata	GRM32EC72A106KE05L
1	C1C	0.1 μ F	Ceramic capacitor, 100V, X7R	0603	Murata	GRM188R72A104KA35D
2	C2A, C2B	22 μ F	Ceramic capacitor, 25V, X7R	1210	Murata	GRM32ER71E226KE15L
1	C3	1 μ F	Ceramic capacitor, 25V, X7R	0603	Murata	GRM188R71E105KA12D
1	C4	0.1 μ F	Ceramic capacitor, 16V, X7R	0603	Murata	GRM188R71C104KA01D
1	CIN5	22 μ F	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	15 μ H	Inductor, 35m Ω , DCR, 5.8A	SMD	MPS	MPL-AL6060-150
1	L3	Short		SMD		
3	R1, R9, R10	100k Ω	Film resistor, 1%	0603	Yageo	RC0603FR-07100KL
1	R3	10k Ω	Film resistor, 1%	0603	Yageo	RC0603FR-0710RL
1	R4	41.2k Ω	Film resistor, 1%	0603	Yageo	RC0603FR-0741K2L
1	R5	7.68k Ω	Film resistor, 1%	0603	Yageo	RC0603FR-077K68L
1	R6	20k Ω	Film resistor, 1%	0603	Yageo	RC0603FR-0720KL
1	R7	66.5k Ω	Film resistor, 1%	0603	Yageo	RC0603FR-0766K5L
1	R8	0 Ω	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	

EVB TEST RESULTS

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

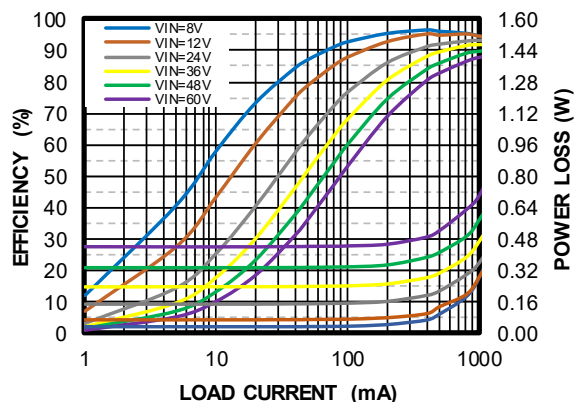
Efficiency vs. Load Current vs. Power Loss

$V_{OUT} = 5V$, $f_{SW} = 450kHz$, $L = 15\mu H$,
AAM



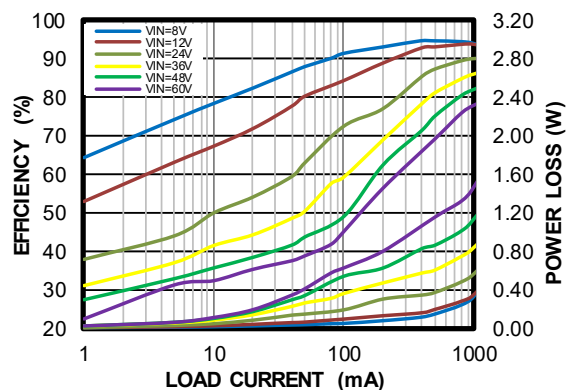
Efficiency vs. Load Current vs. Power Loss

$V_{OUT} = 5V$, $f_{SW} = 450kHz$, $L = 15\mu H$,
FCCM



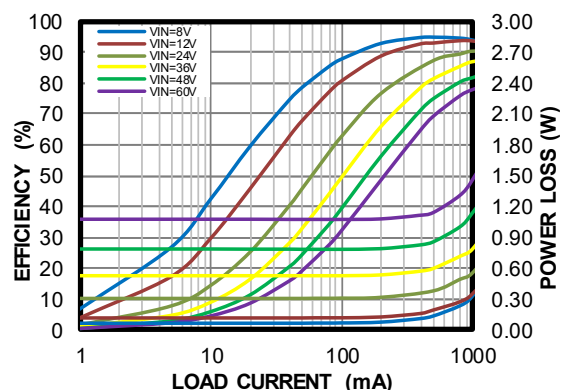
Efficiency vs. Load Current vs. Power Loss

$V_{OUT} = 5V$, $f_{SW} = 1MHz$, $L = 10\mu H$,
AAM



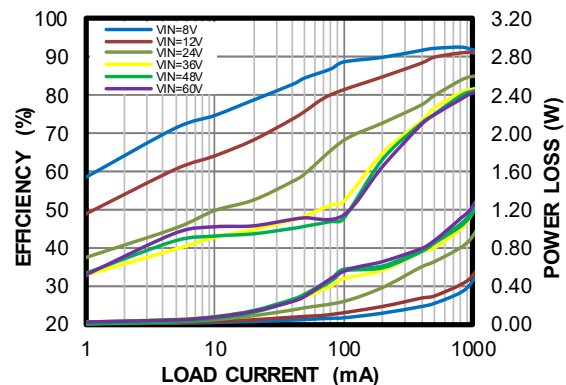
Efficiency vs. Load Current vs. Power Loss

$V_{OUT} = 5V$, $f_{SW} = 1MHz$, $L = 10\mu H$,
FCCM



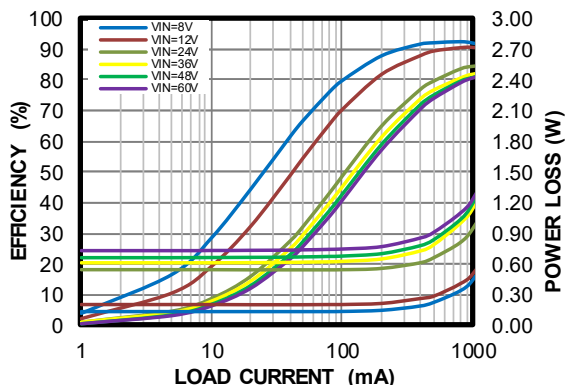
Efficiency vs. Load Current vs. Power Loss

$V_{OUT} = 5V$, $f_{SW} = 2.2MHz$, $L = 4.7\mu H$,
AAM



Efficiency vs. Load Current vs. Power Loss

$V_{OUT} = 5V$, $f_{SW} = 2.2MHz$, $L = 4.7\mu H$,
FCCM

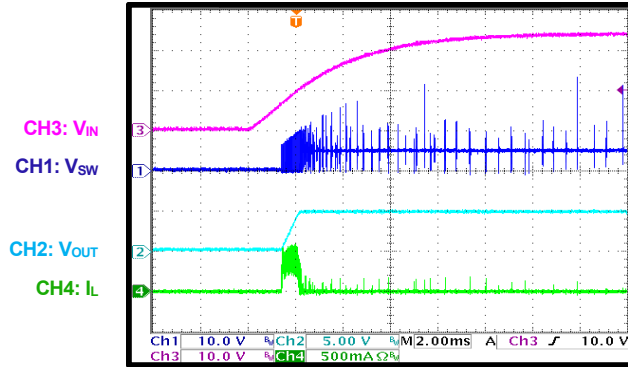


EVb TEST RESULTS *(continued)*

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

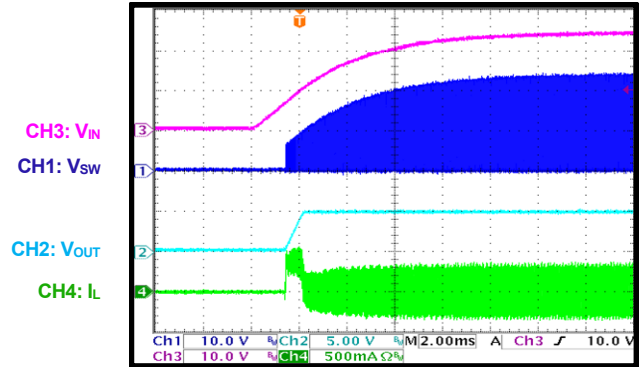
Start-Up through VIN

$I_{OUT} = 0A$, AAM



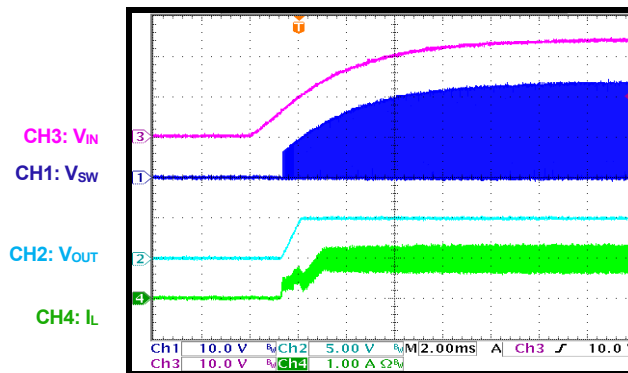
Start-Up through VIN

$I_{OUT} = 0A$, FCCM



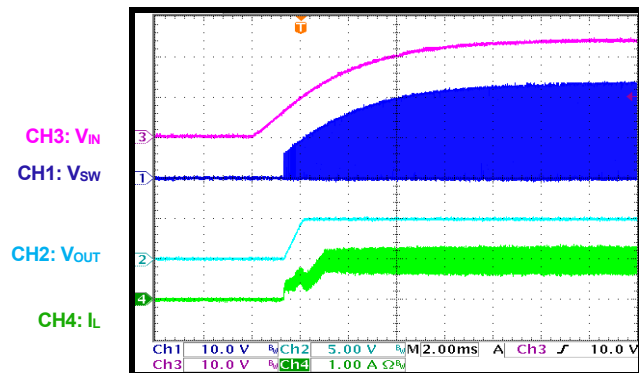
Start-Up through VIN

$I_{OUT} = 1A$, AAM



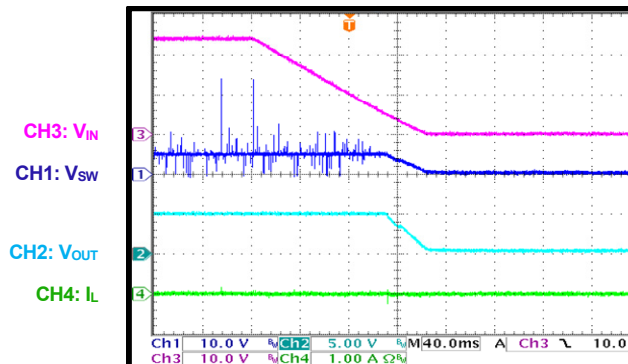
Start-Up through VIN

$I_{OUT} = 1A$, FCCM



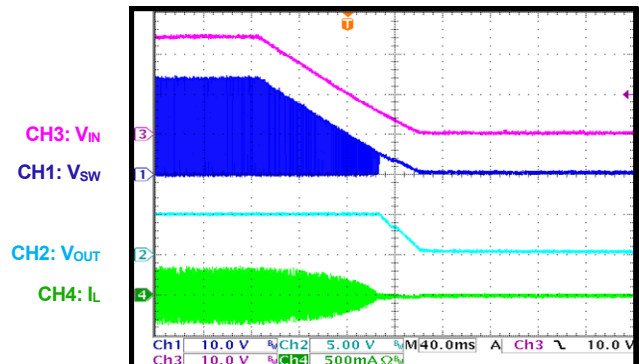
Shutdown through VIN

$I_{OUT} = 0A$, AAM



Shutdown through VIN

$I_{OUT} = 0A$, FCCM

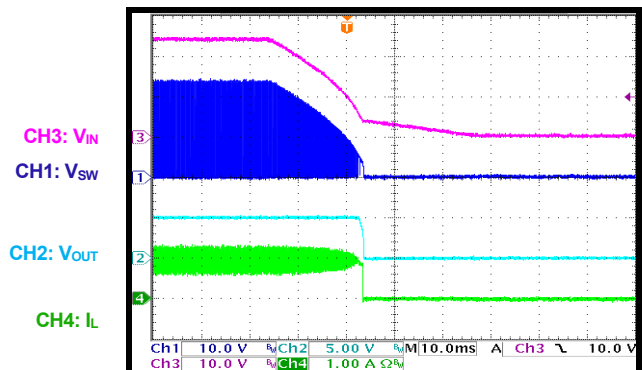


EVB TEST RESULTS *(continued)*

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

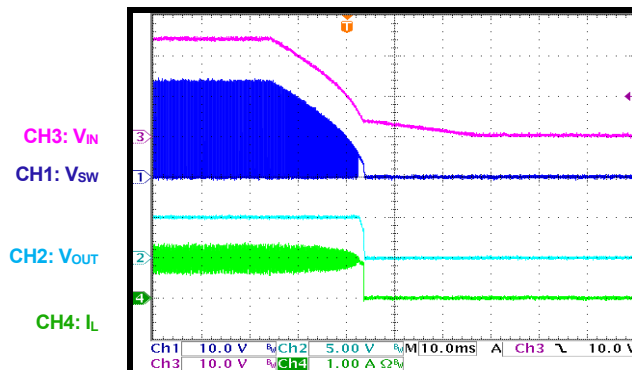
Shutdown through VIN

$I_{OUT} = 1A$, AAM



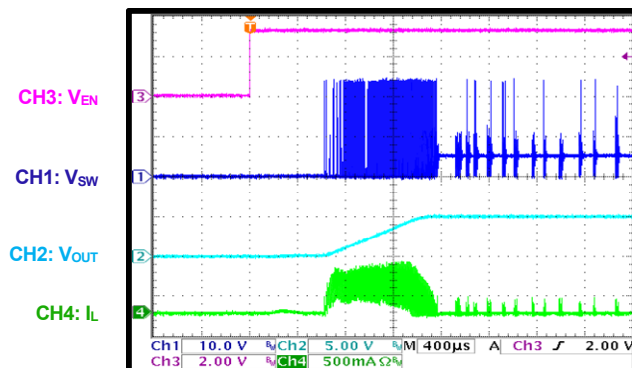
Shutdown through VIN

$I_{OUT} = 1A$, FCCM



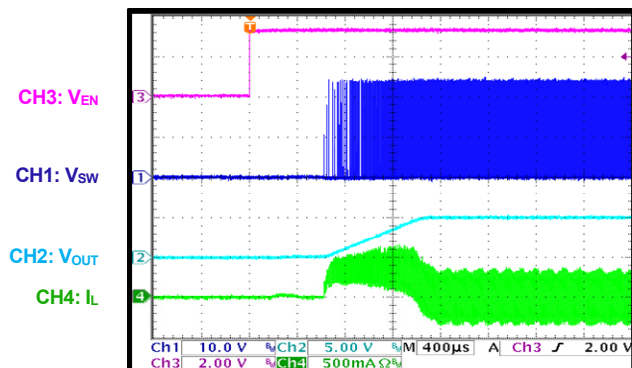
Start-Up through EN

$I_{OUT} = 0A$, AAM



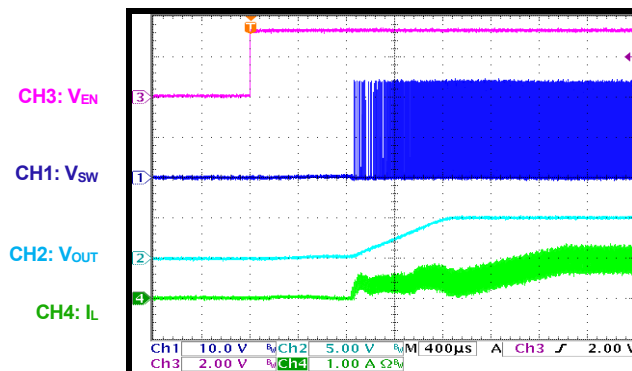
Start-Up through EN

$I_{OUT} = 0A$, FCCM



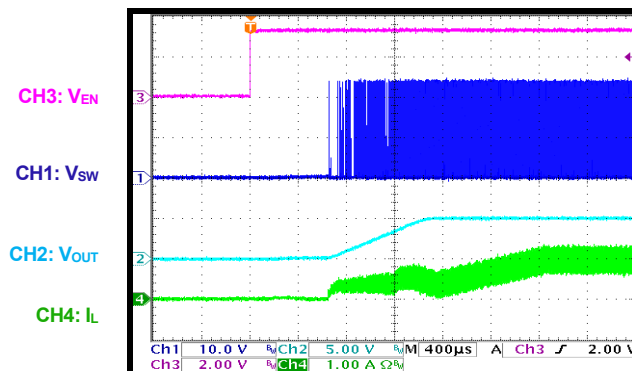
Start-Up through EN

$I_{OUT} = 1A$, AAM



Start-Up through EN

$I_{OUT} = 1A$, FCCM

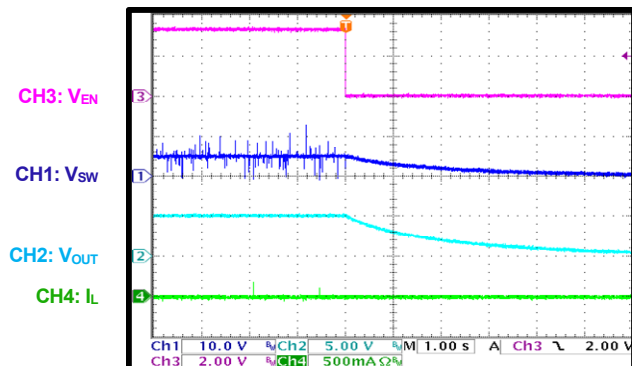


EVb TEST RESULTS *(continued)*

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

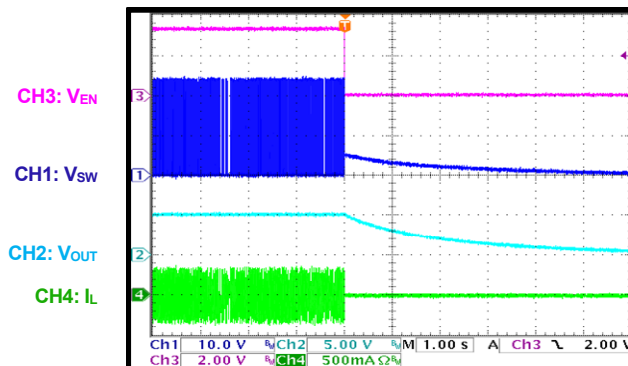
Shutdown through EN

$I_{OUT} = 0A$, AAM



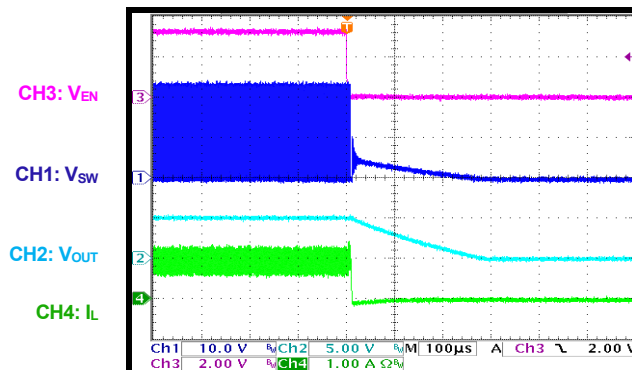
Shutdown through EN

$I_{OUT} = 0A$, FCCM



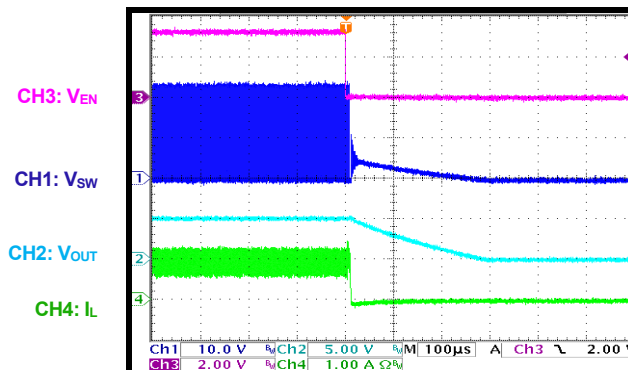
Shutdown through EN

$I_{OUT} = 1A$, AAM



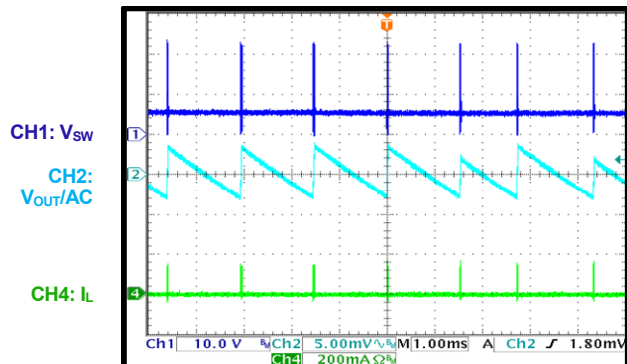
Shutdown through EN

$I_{OUT} = 1A$, FCCM



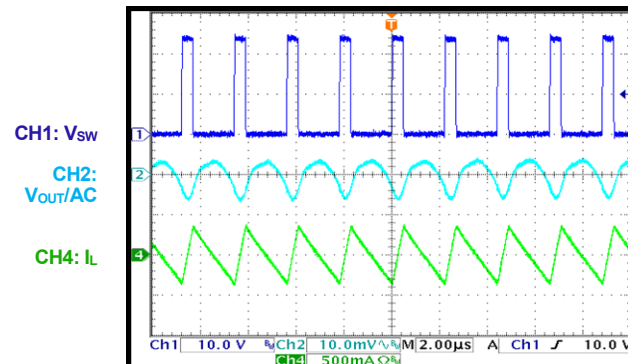
Output Ripple

$I_{OUT} = 0A$, AAM



Output Ripple

$I_{OUT} = 0A$, FCCM

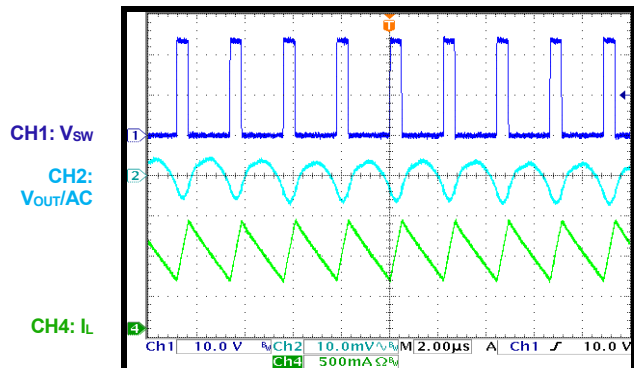


EVB TEST RESULTS *(continued)*

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

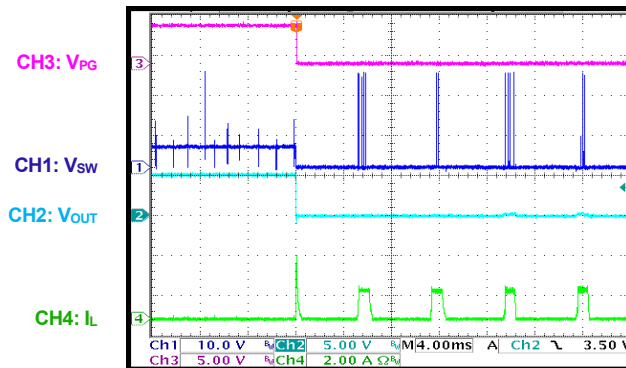
Output Ripple

$I_{OUT} = 1A$



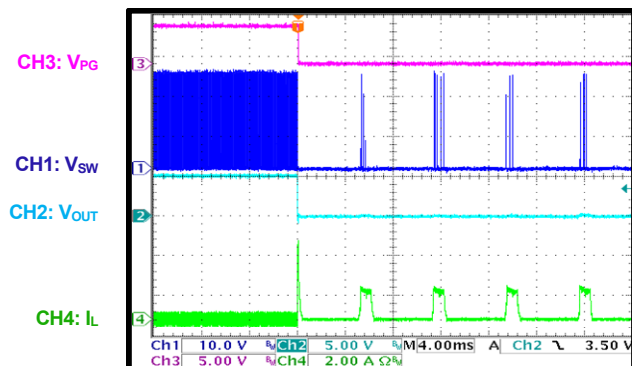
SCP Entry in AAM

$I_{OUT} = 0A$



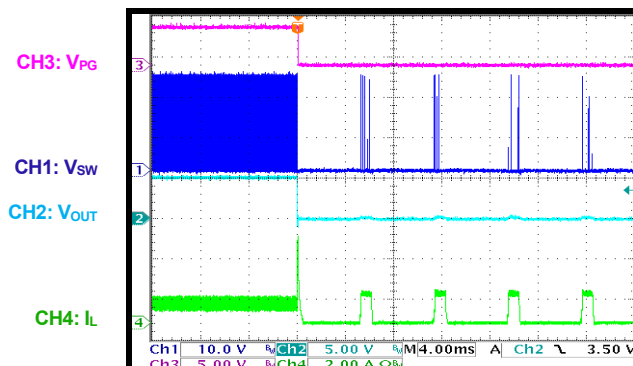
SCP Entry in FCCM

$I_{OUT} = 0A$

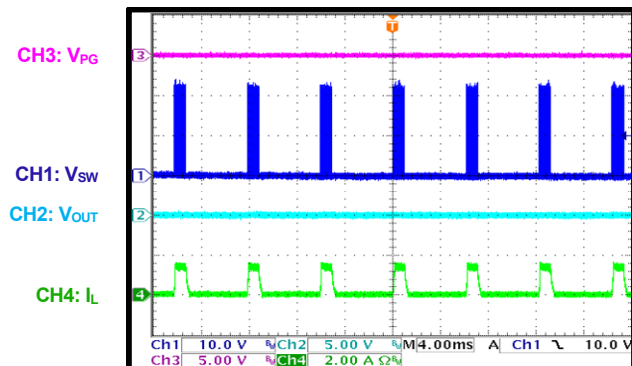


SCP Entry

$I_{OUT} = 1A$

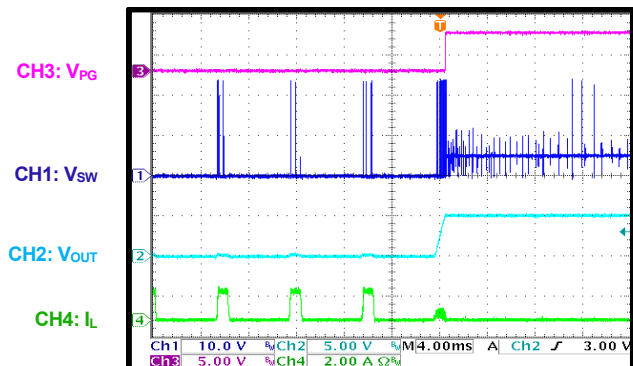


SCP Steady State



SCP Recovery in AAM

$I_{OUT} = 0A$

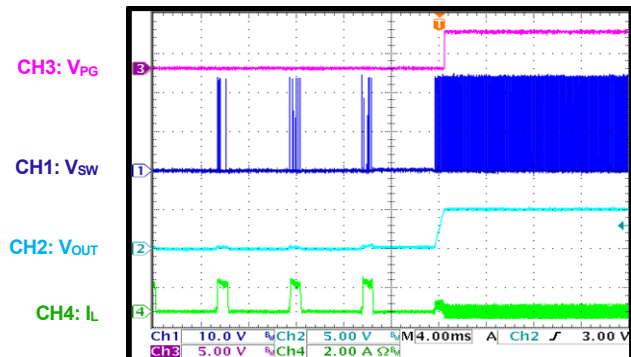


EVB TEST RESULTS *(continued)*

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

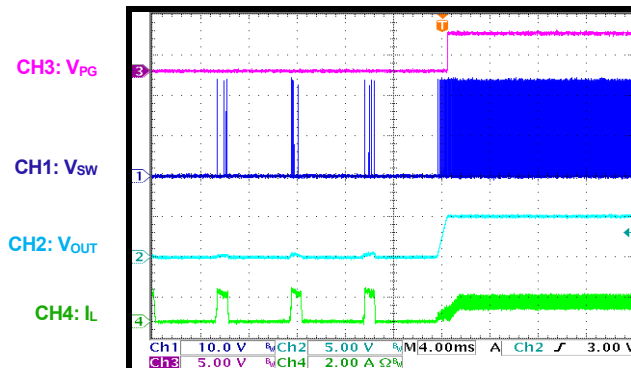
SCP Recovery in FCCM

$I_{OUT} = 0A$



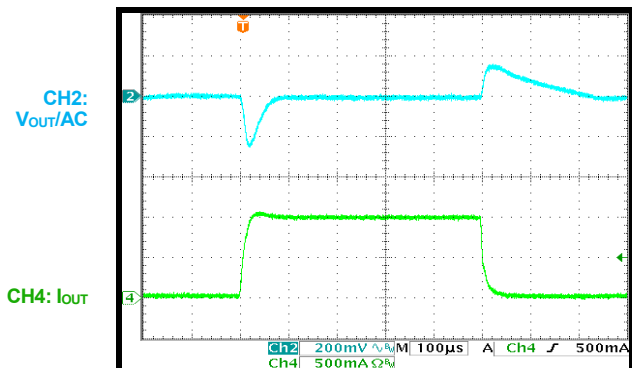
SCP Recovery

$I_{OUT} = 1A$



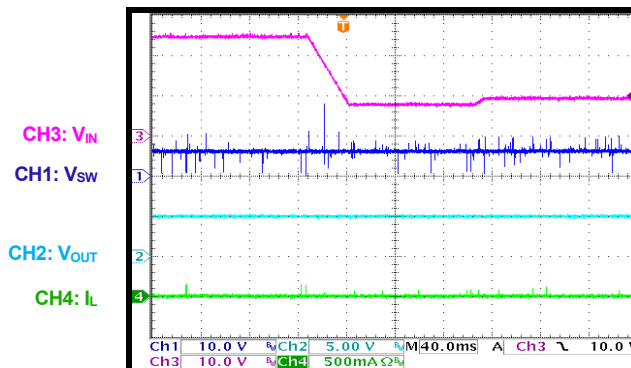
Load Transient

$I_{OUT} = 0A$ to $1A$



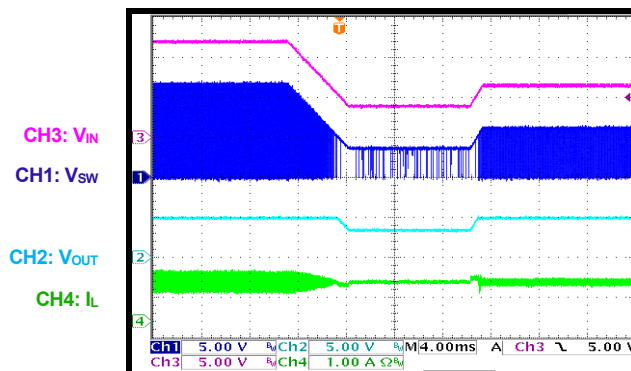
Cold Crank

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



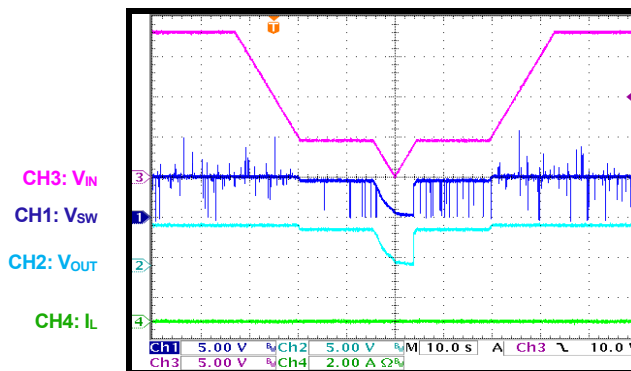
Cold Crank

$V_{IN} = 24V$ 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 $18V$, $I_{OUT} = 0A$

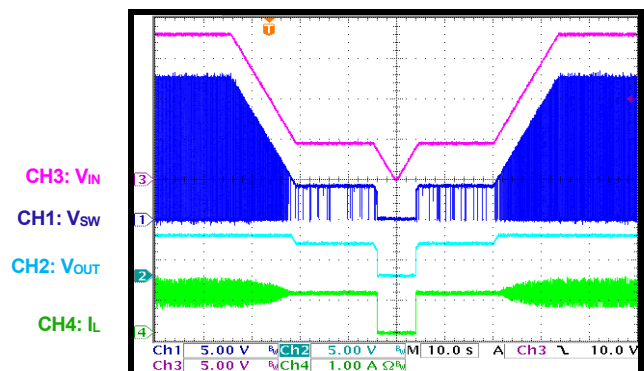


EVB TEST RESULTS *(continued)*

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

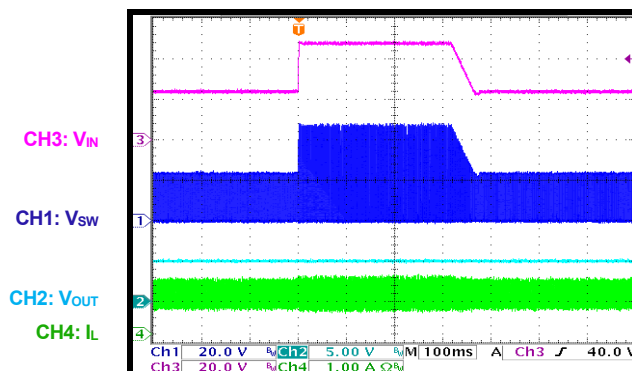
V_{IN} Ramping Down and Up

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



Load Dump

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



PCB LAYOUT

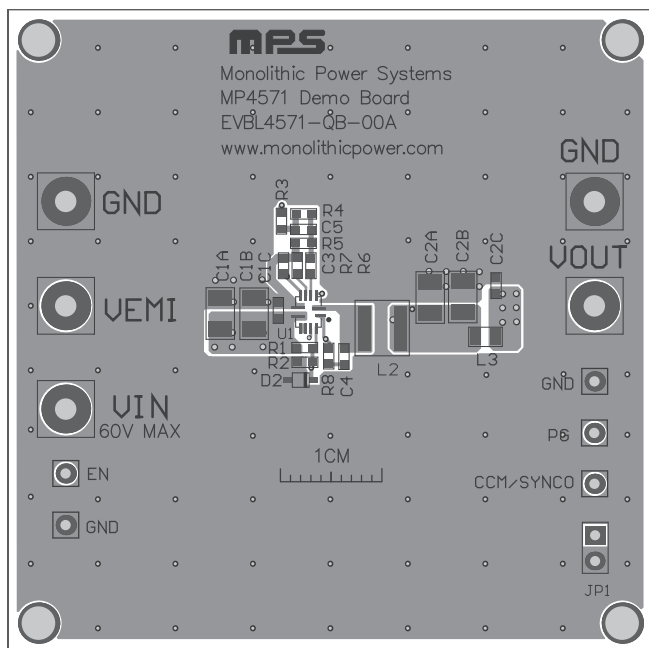


Figure 2: Top Silk and Top Layer

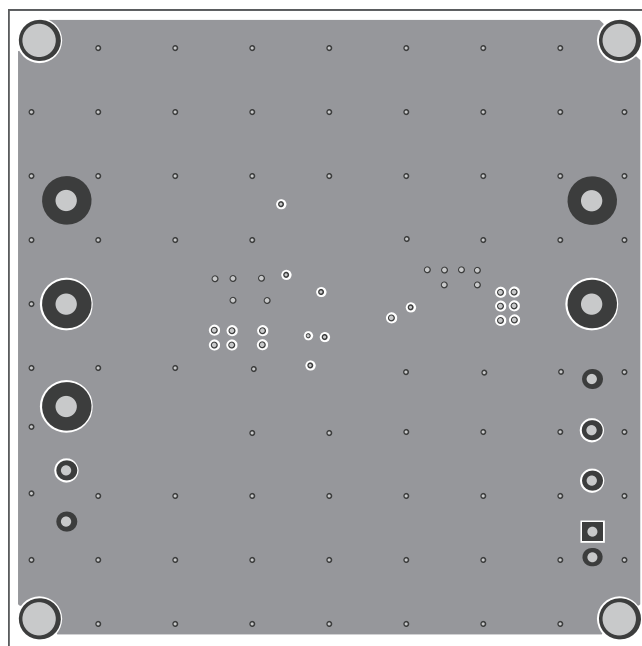


Figure 3: Mid-Layer 1

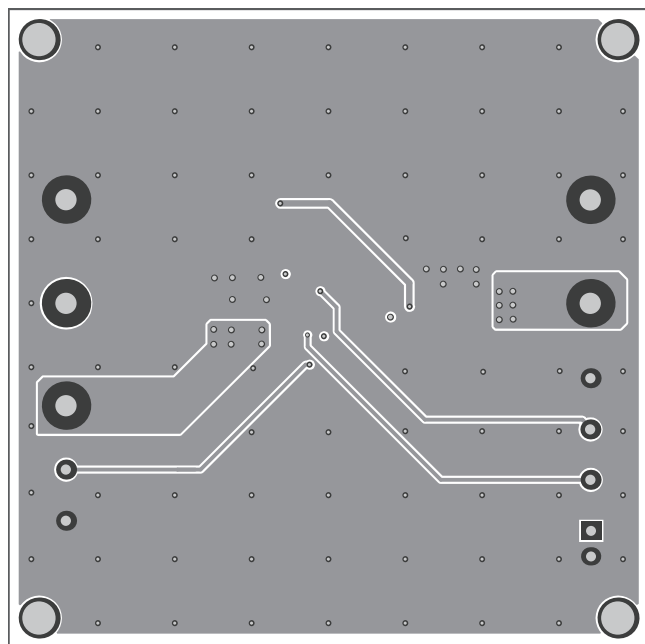


Figure 4: Mid-Layer 2

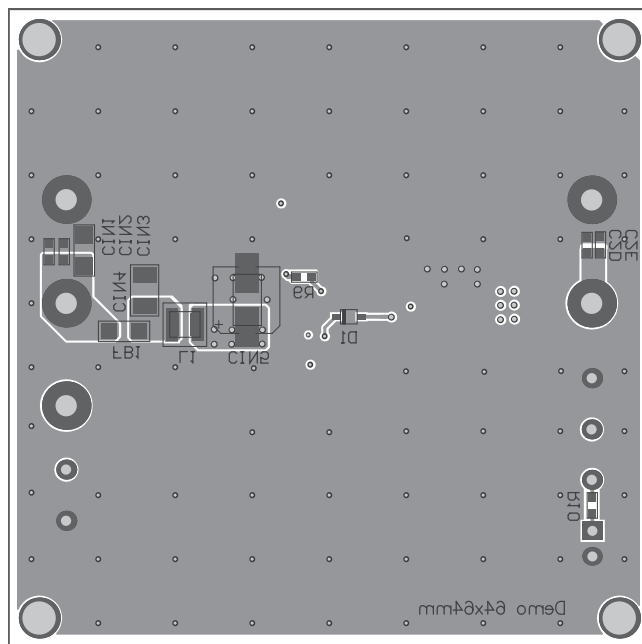


Figure 5: Bottom Layer and Bottom Silk

REVISION HISTORY

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

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