EVL8009-V-00H

Fully Integrated, 802.3af/at Compliant PoE PD Interface with High-Efficiency PSR Flyback Controller Evaluation Board

DESCRIPTION

The EVL8009-V-00H is an evaluation board designed to demonstrate the capabilities of the MP8009, an integrated, IEEE 802.3af/at power over Ethernet (PoE), powered device (PD) power supply converter. It also includes a PD interface and a highly efficient flyback/forward controller.

The PD interface features all IEEE 802.3af/at capabilities, including detection, 1-event classification, 2-event classification, a 120mA inrush current limit, an 840mA operation current limit, and a 100V hot-swap MOSFET.

The flyback/forward controller is a low-cost, small-sized, isolated solution with primary-side regulation (PSR) for flyback applications. It also features high-efficiency secondary-side regulation (SSR) for active-clamp forward applications. The controller can also be used for SSR flyback topologies.

The MP8009 can support a PoE-PD front-end solution with minimal external components, and is available in QFN-28 (4mmx5mm) package.

ELECTRICAL SPECIFICATIONS

Parameter	Symbol	Value	Units
Input voltage	V_{IN}	36 to 57	V
Output voltage	V_{OUT}	12	V
Output current	I_{OUT}	2.1	A

FEATURES

- 36V to 57V Power over Ethernet (PoE) Input or 48V Auxiliary Adapter Input
- 12V Output Voltage (V_{OUT})
- 2.1A Output Current (I_{OUT})
- Primary-Side Regulation (PSR) for Flyback Applications
- 802.3af/at-Compatible
- Frequency Dithering for Electromagnetic Interference (EMI) Reduction
- Overload Protection (OLP), Short-Circuit Protection (SCP), and Over-Voltage Protection (OVP) with Hiccup Mode for Each Protection
- Thermal Shutdown
- Available in QFN-28 (4mmx5mm) Package

MPL Optimized Performance with MPS MPL-AL5050 Inductor Series

APPLICATIONS

- IEEE 802.3af/at-Compatible Devices
- Security Cameras
- Video Phones
- Wireless Local Area Network (WLAN) Access Points
- Internet of Things (IoT) Devices

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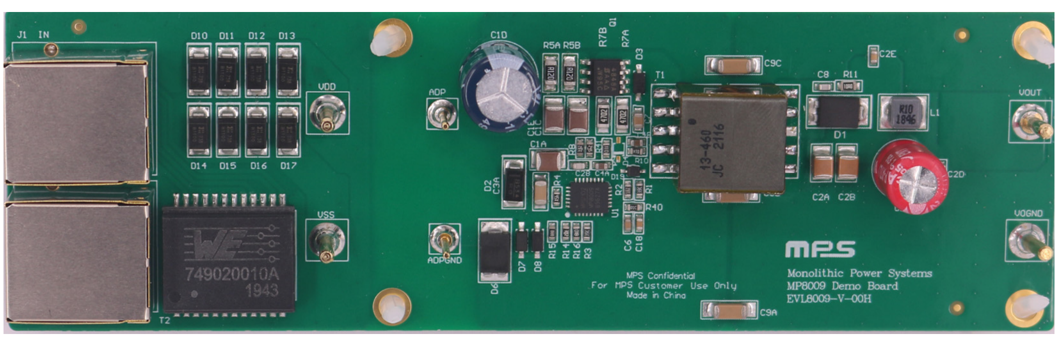
EVL8009-V-00H EVALUATION BOARD



LxWxH (13.9cmx4.2cmx2cm)

Board Number	MPS IC Number	MPS Inductor
EVL8009-V-00H	MP8009GV	MPL-AL5050-100

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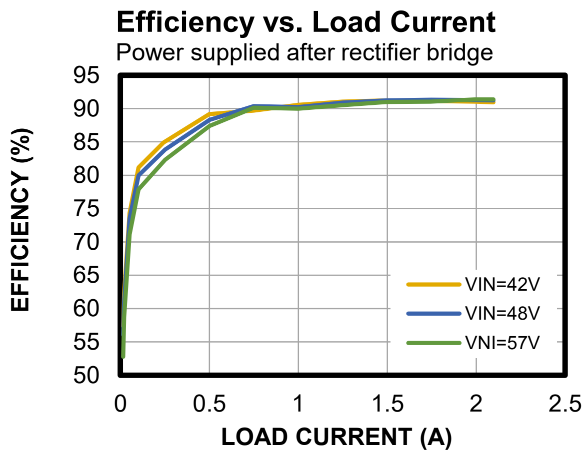

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QUICK START GUIDE

The evaluation board's output voltage (V_{OUT}) is set at 12V. The board layout accommodates most commonly used components. The EVL8009-V-00H has two start-up methods (described below).

Method 1:

1. Connect the load terminals to:
   a. Positive (+): VOUT
   b. Negative (-): VOGND
2. Use the Ethernet cable to connect PSE power to the Ethernet jack (J1). The board should start up automatically.

Method 2:

1. Preset the power supply between 40V and 57V, then turn off the power supply. (1)
2. Connect the power supply terminals to:
   a. Positive (+): VDD
   b. Negative (-): VSS
3. Connect the load terminals to:
   a. Positive (+): VOUT
   b. Negative (-): VOGND
4. After making the connections, turn on the power supply. The board should start up automatically.
5. To use the adapter supply function, connect the 48V adapter terminals to:
   a. Positive (+): ADP
   b. Negative (-): ADPGND
6. After making the connections, turn on the adapter. The board should automatically use the adapter as its power supply.

Note:

1) After start-up, the board can operate between 36V and 57V.

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EVALUATION BOARD SCHEMATIC

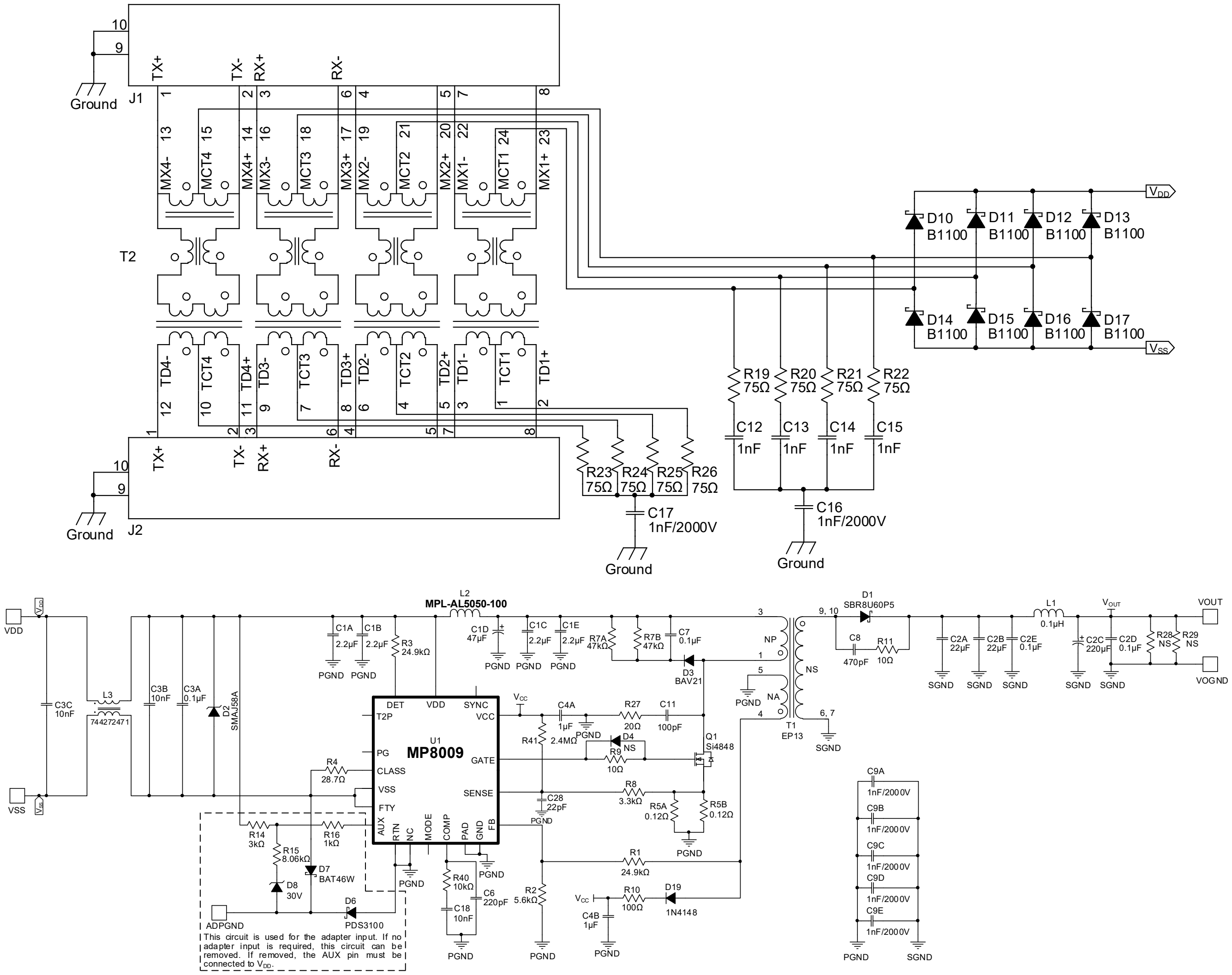

Figure 1: Evaluation Board Schematic (2) (3)

Notes:

2) For improved EMI performance, the evaluation board's frequency dithering setting is on by default. If a stable switching test is required, set R8 below 1kΩ. Set R41 accordingly to maintain the original R41:R8 ratio.
3) Primary-side regulation (PSR) flyback topologies require a minimum load on the isolated V_{OUT}. If the system does not sink a current from V_{OUT}, then a dummy load (I_{LOAD} > 30mA) with R28 and R29 (both 820Ω with a 1206 package) is required; otherwise, the circuit may trigger over-voltage protection (OVP).

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EVL8009-V-00H BILL OF MATERIALS

Qty	Ref	Value	Description	Package	Manufacturer	Manufacturer PN
1	L2	10µH	Inductor, I_{RATED} = 4.8A, I_{SAT} = 5.5A, RDC = 43.5mΩ	5050	MPS	MPL-AL5050-100
4	C1A, C1B, C1C, C1E	2.2µF	Ceramic capacitor, 100V, X7R	1210	Murata	GRM32ER72A225KA88L
1	C1D	47µF	CD284, 105°C	DIP	Jianghai	ECR2AXY470MLB100012
2	C2A, C2B	22µF	Ceramic capacitor, 25V, X7R	1210	Murata	GRM32ER71E226KA88L
1	C2C	220µF	Electrolytic capacitor, 25V	DIP	Wurth	860080474010
2	C2D, C2E	0.1µF	Ceramic capacitor, 25V, X7R	0603	Murata	GRM188R71E104KA01D
1	C3A	0.1µF	Ceramic capacitor, 100V, X7R	1206	Murata	GRM319R72A104KA01D
2	C3B, C3C	10nF	Ceramic capacitor, 100V, X7R	0603	Murata	GRM188R72A103KA01D
2	C4A, C4B	1µF	Ceramic capacitor, 25V, X7R	0603	Murata	GRM188R71E105KA01D
1	C6	220pF	Ceramic capacitor, 16V, X7R	0603	Murata	GRM188R71C221KA01D
1	C7	0.1µF	Ceramic capacitor, 100V, X7R	0805	Murata	GRM21BR72A104KA01D
1	C8	470pF	Ceramic capacitor, 100V, X7R	0603	Murata	GRM188R72A471KA01D
3	D4, R28, R29	NS				
7	C9A, C9B, C9C, C9D, C9E, C16, C17	1nF	Ceramic capacitor, 2000V, X7R	1808	Murata	GR442QR73D102KW01L
1	C11	100pF	Ceramic capacitor, 250V, X7R	0805	Murata	GRM21BR72E101KA01D
4	C12, C13, C14, C15	1nF	Ceramic capacitor, 100V, X7R	0603	Murata	GRM188R72A102KA01D
1	C18	10nF	Ceramic capacitor, 16V, X7R	0603	Murata	GRM188R71C103KA01D
1	C28	22pF	Ceramic capacitor, 50V, X7R	0603	Murata	GRM188R71H220KA01D
1	D1	60V	Schottky diode, 8A	Power DI 5	Diodes, Inc.	SBR8U60P5
1	D2	400W	TVS diode, 4.3A	SMA	Littelfuse, Inc.	SMAJ58A
1	D3	200V	Switching diode, 200mA	SOD-123	Diodes, Inc.	BAV21W-7-F
1	D6	100V	Diode, 3A	Power DI 5	Diodes, Inc.	PDS3100
1	D7	100V	Diode, 150mA	SOD-123	Diodes, Inc.	BAT46W
1	D8	30V	Zener diode, 500mW	SOD-123	Diodes, Inc.	BZT52C30-7-F
8	D10, D11, D12, D13, D14, D15, D16, D17	100V	Schottky diode, 1A	SMA	Diodes, Inc.	B1100
1	D19	75V	Switching diode, 150mA, 200mW	SOD-323	ON Semiconductor	1N4148WS
2	J1, J2	1.5A	Rear-post jack modular connector, 120V_{AC}	8P8C	Wurth	615008140121
1	L1	0.1µH	I_{RATED} = 11.5A, I_{SAT} = 25A, RDC = 5.5mΩ	SMD	Vishay	IHLP1616ABERR10M01
			I_{RATED} = 12A, I_{SAT} = 30A, RDC = 3.2mΩ	SMD	Wurth	744373240010
1	L3	2 x 470µH	Common filter, RDC = 2 x 65mΩ	SMD	Wurth	744272471
1	Q1	84mΩ	N-channel MOSFET, 5.5A	SO-8	Vishay	Si4848ADY
2	R1, R3	24.9kΩ	Film resistor, 1%	0603	Yageo	RC0603FR-0724K9L

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EVL8009-V-00H BILL OF MATERIALS *(continued)*

Qty	Ref	Value	Description	Package	Manufacturer	Manufacturer PN
1	R2	5.6kΩ	Film resistor, 1%	0603	Yageo	RC0603FR-075K6L
1	R4	28.7Ω	Film resistor, 1%	0603	Yageo	RC0603FR-0728R7L
2	R5A, R5B	0.12Ω	Film resistor, 1%	1206	Yageo	RC1206FR-070R12L
2	R7A, R7B	47kΩ	Film resistor, 1%	1206	Yageo	RC1206FR-0747KL
1	R8	3.3kΩ	Film resistor, 1%	0603	Yageo	RC0603FR-073K3L
1	R9	10Ω	Film resistor, 1%	0603	Yageo	RC0603FR-0710RL
1	R10	100Ω	Film resistor, 1%	0603	Yageo	RC0603FR-07100RL
1	R11	10Ω	Film resistor, 1%	0805	Yageo	RC0805FR-0710RL
1	R14	3kΩ	Film resistor, 1%	0603	Yageo	RC0603FR-073KL
1	R15	8.06kΩ	Film resistor, 1%	0603	Yageo	RC0603FR-078K06L
1	R16	1kΩ	Film resistor, 1%	0603	Yageo	RC0603FR-071KL
8	R19, R20, R21, R22, R23, R24, R25, R26	75Ω	Film resistor, 1%	0603	Yageo	RC0603FR-0775RL
1	R27	20Ω	Film resistor, 1%	0805	Yageo	RC0805FR-0720RL
1	R40	10kΩ	Film resistor, 1%	0603	Yageo	RC0603FR-0710KL
1	R41	2.4MΩ	Film resistor, 1%	0603	Yageo	RC0603FR-072M4L
1	T1	70µH	Transformer, NS:NP:NS:NA = 9:26:9:8	EP13	Chengdu Jinzhichuan	TBSG13-460
1	T2	350µH	LAN transformer, WE-LAN series	SMD	Wurth	749020010A
1	U1	MP8009	Flyback/forward controller	QFN-28 (4mmx 5mm)	MPS	MP8009GV

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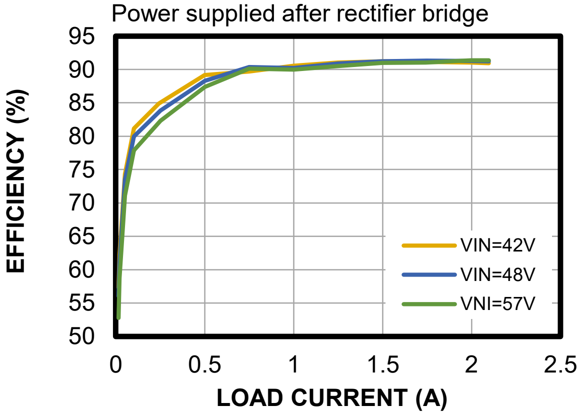
EVB TEST RESULTS

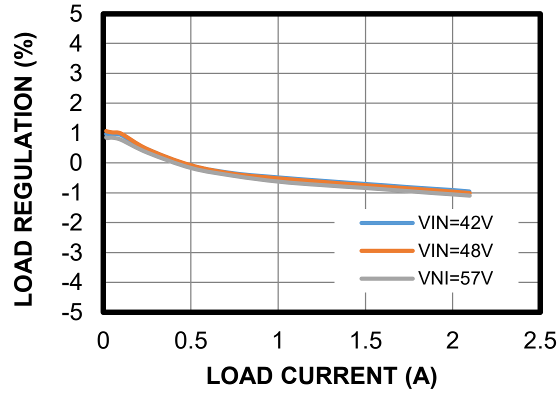
V_{IN} = 48V, V_{OUT} = 12V, I_{OUT} = 2.1A, T_A = 25°C, unless otherwise noted.

Efficiency vs. Load Current

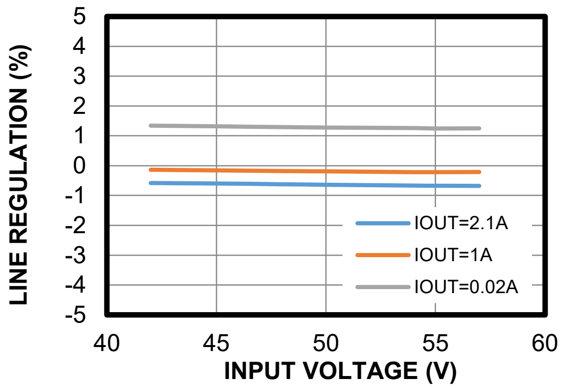
Power supplied after rectifier bridge



Load Regulation

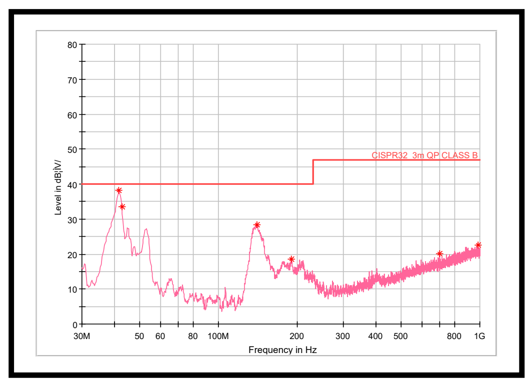


Line Regulation



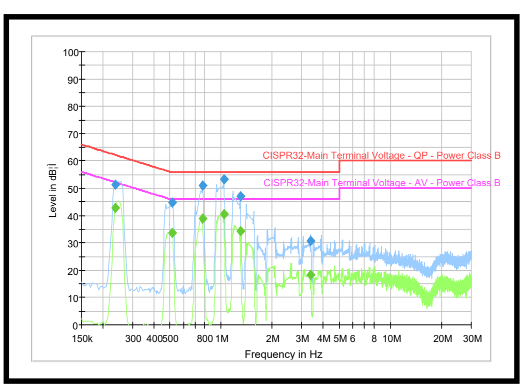
Radiated Emissions Results

I_{OUT} = 2.1A



Conducted Emissions Results

I_{OUT} = 2.1A



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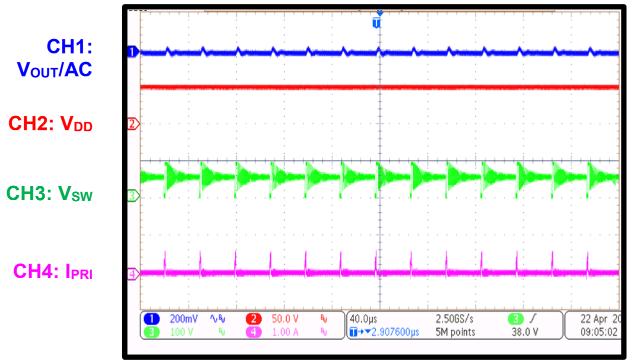
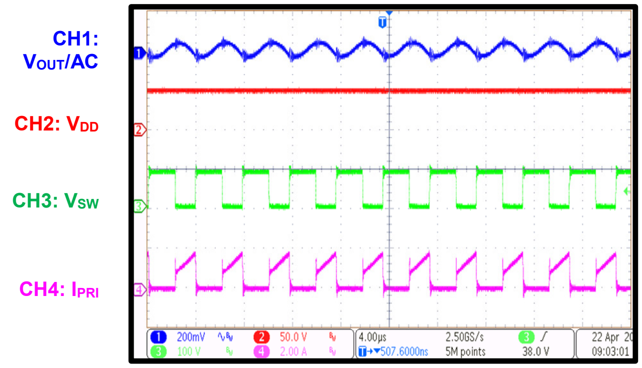
EVB TEST RESULTS *(continued)*

V_{IN} = 48V, V_{OUT} = 12V, I_{OUT} = 2.1A, T_A = 25°C, unless otherwise noted.

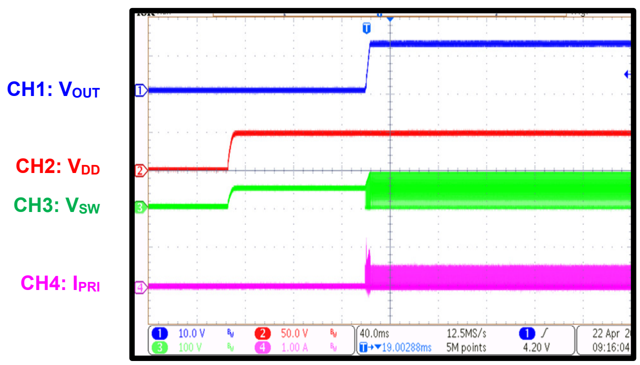
Steady State
I_{OUT} = 30mA



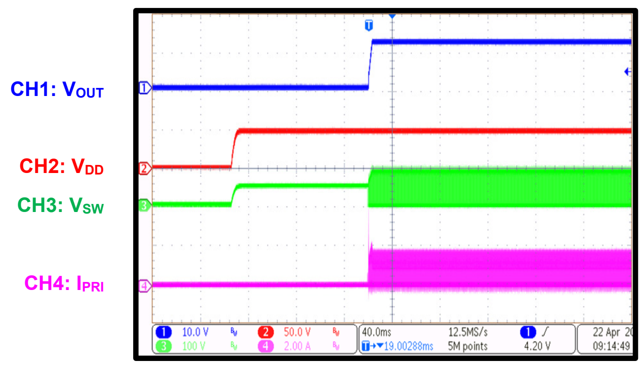
Steady State
I_{OUT} = 2.1A



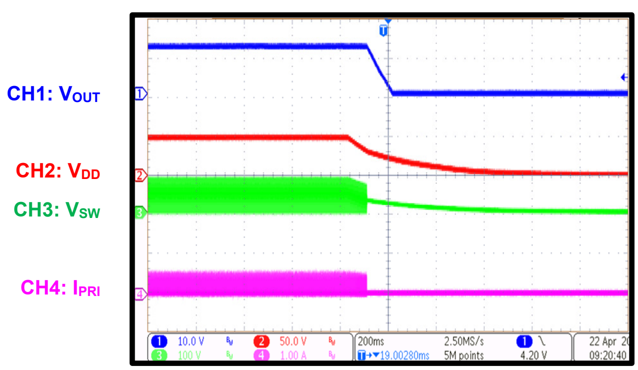
Start-Up through VDD
I_{OUT} = 30mA



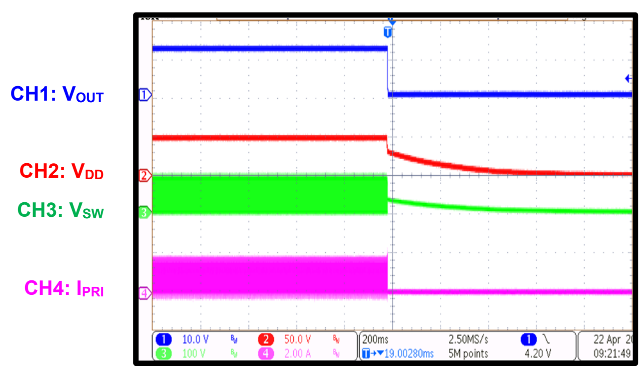
Start-Up through VDD
I_{OUT} = 2.1A



Shutdown through VDD
I_{OUT} = 30mA



Shutdown through VDD
I_{OUT} = 2.1A



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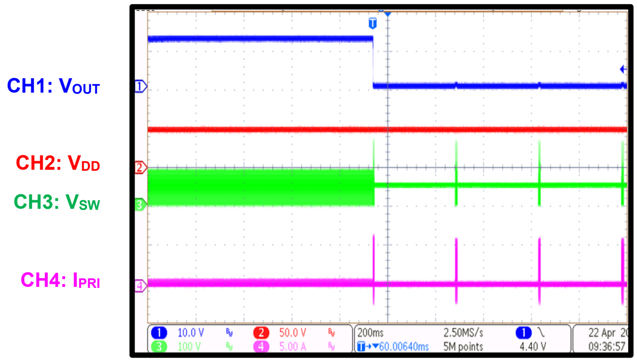
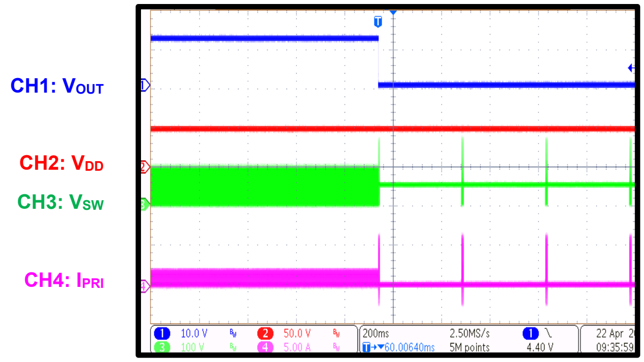
EVB TEST RESULTS *(continued)*

V_{IN} = 48V, V_{OUT} = 12V, I_{OUT} = 2.1A, T_A = 25°C, unless otherwise noted.

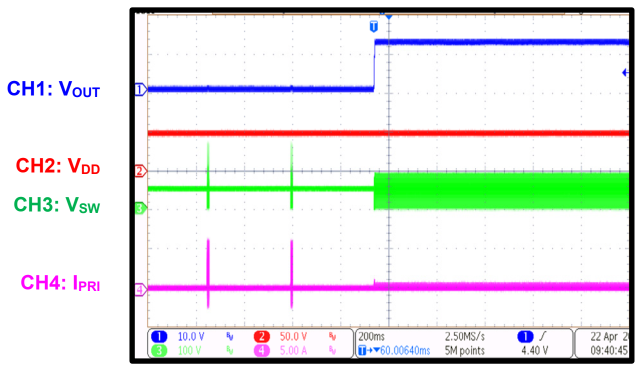
SCP Entry
I_{OUT} = 30mA to short



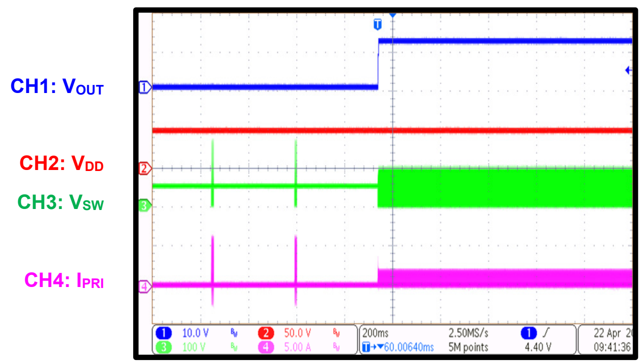
SCP Entry
I_{OUT} = 2.1A to short



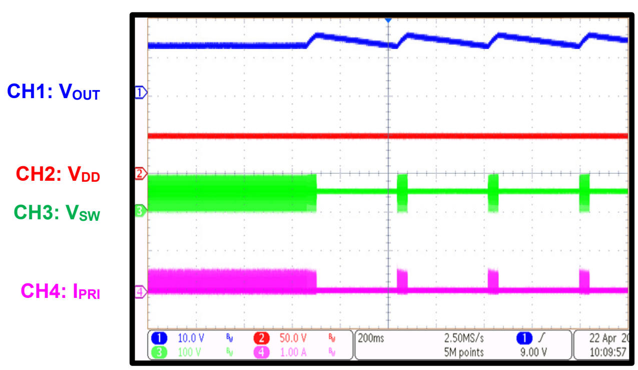
SCP Recovery
I_{OUT} = short to 30mA



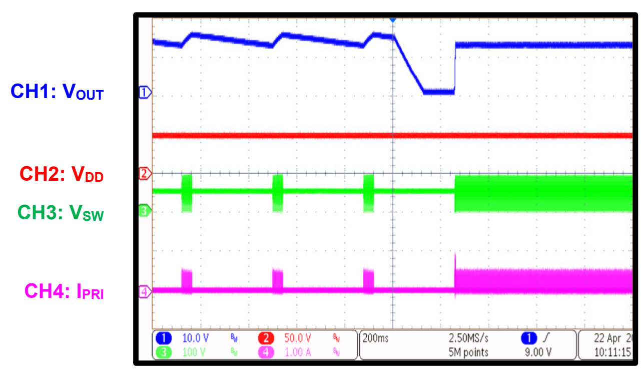
SCP Recovery
I_{OUT} = short to 2.1A



OVP Entry
I_{OUT} = 30mA to 2mA



OVP Recovery
I_{OUT} = 2mA to 30mA



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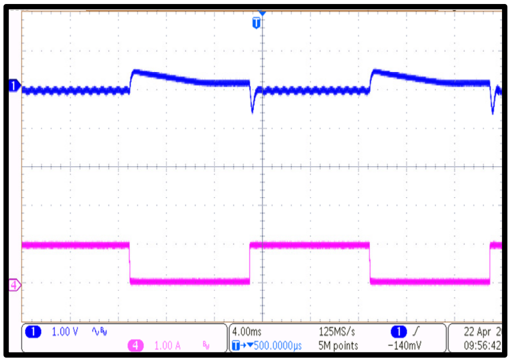
EVB TEST RESULTS *(continued)*

V_{IN} = 48V, V_{OUT} = 12V, I_{OUT} = 2.1A, T_A = 25°C, unless otherwise noted.

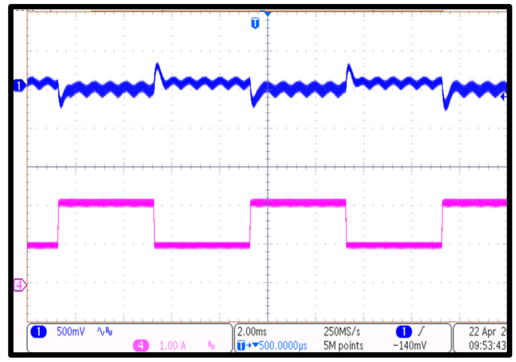
Load Transient

I_{OUT} = 30mA to 1A, I_{RAMP} = 50mA/μs



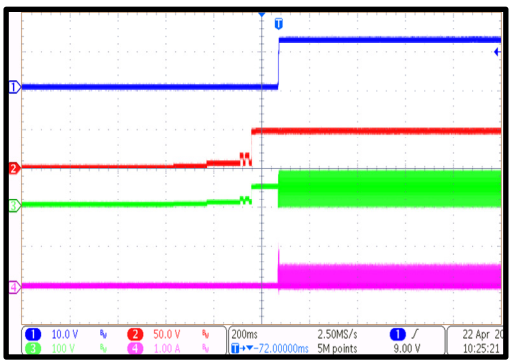
Load Transient

I_{OUT} = 1A to 2.1A, I_{RAMP} = 50mA/μs



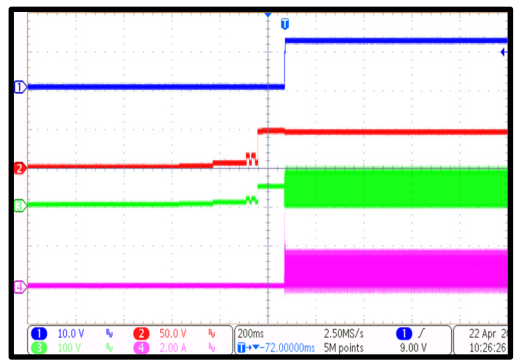
Start-Up through PSE

I_{OUT} = 30mA



Start-Up through PSE

I_{OUT} = 2.1A



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PCB LAYOUT

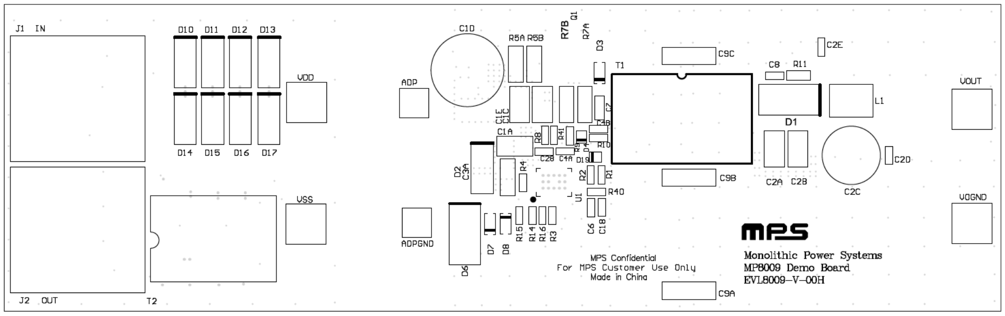

Figure 2: Top Silk

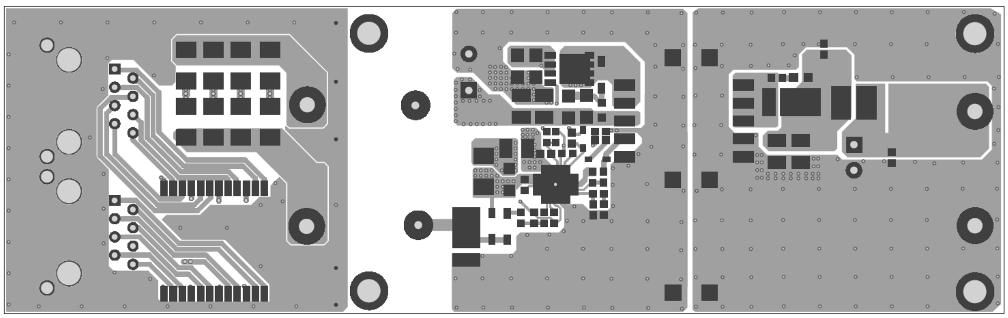

Figure 3: Top Layer

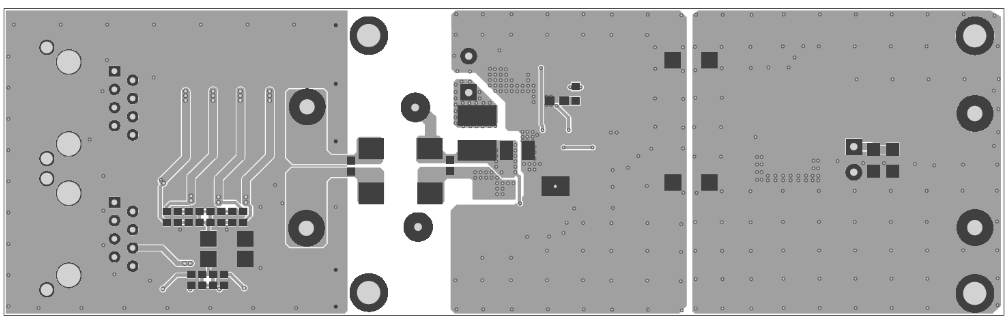

Figure 4: Bottom Layer

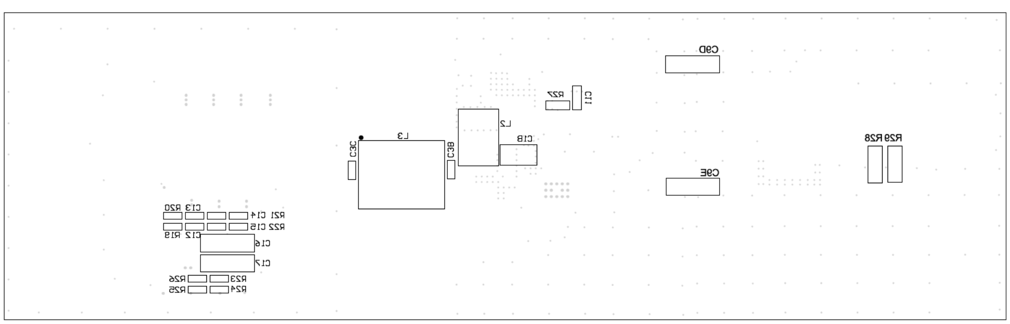

Figure 5: Bottom Silk

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REVISION HISTORY

Revision #	Revision Date	Description	Pages Updated
1.0	07/29/2021	Initial Release	-

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