



# EVL8009A-V-00A

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

### DESCRIPTION

The EVL8009A-V-00A is an evaluation board designed to demonstrate the capabilities of the MP8009A, 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 MP8009A is available in a 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
- Primary-Side Regulation (PSR) for Flyback Applications
- 802.3af/at Compliant
- 250kHz Fixed Switching Frequency ( $f_{SW}$ )
- 32ms Soft-Start Time ( $t_{SS}$ )
- 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 a QFN-28 (4mmx5mm) Package

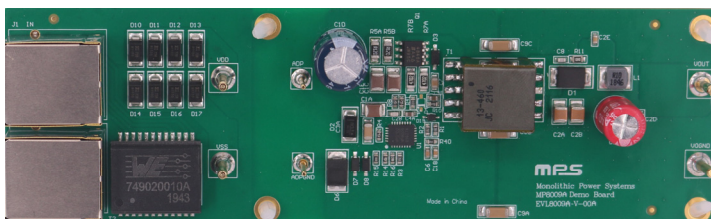
 Optimized Performance with  
MPS MPL-AL5050 Inductor Series

### APPLICATIONS

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

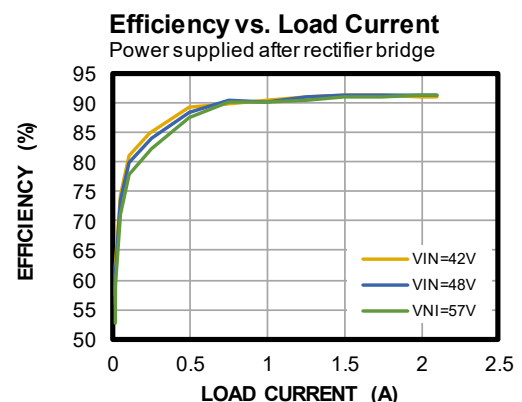
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### EVL8009A-V-00A EVALUATION BOARD



LxWxH (13.9cmx4.2cmx2cm)

Board Number	MPS IC Number	MPS Inductor
EVL8009A-V-00A	MP8009AGV	MPL-AL5050-100





## QUICK START GUIDE

The evaluation board's output voltage ( $V_{OUT}$ ) is set at 12V. The board layout accommodates most commonly used components. The EVL8009A-V-00A has two start-up methods (described below).

### Method 1:

1. Connect the load terminals to:
  - a. Positive (+):  $V_{OUT}$
  - b. Negative (-):  $V_{OGND}$
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. <sup>(1)</sup>
2. Connect the power supply terminals to:
  - a. Positive (+):  $V_{DD}$
  - b. Negative (-):  $V_{SS}$
3. Connect the load terminals to:
  - a. Positive (+):  $V_{OUT}$
  - b. Negative (-):  $V_{OGND}$
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

## EVALUATION BOARD SCHEMATIC

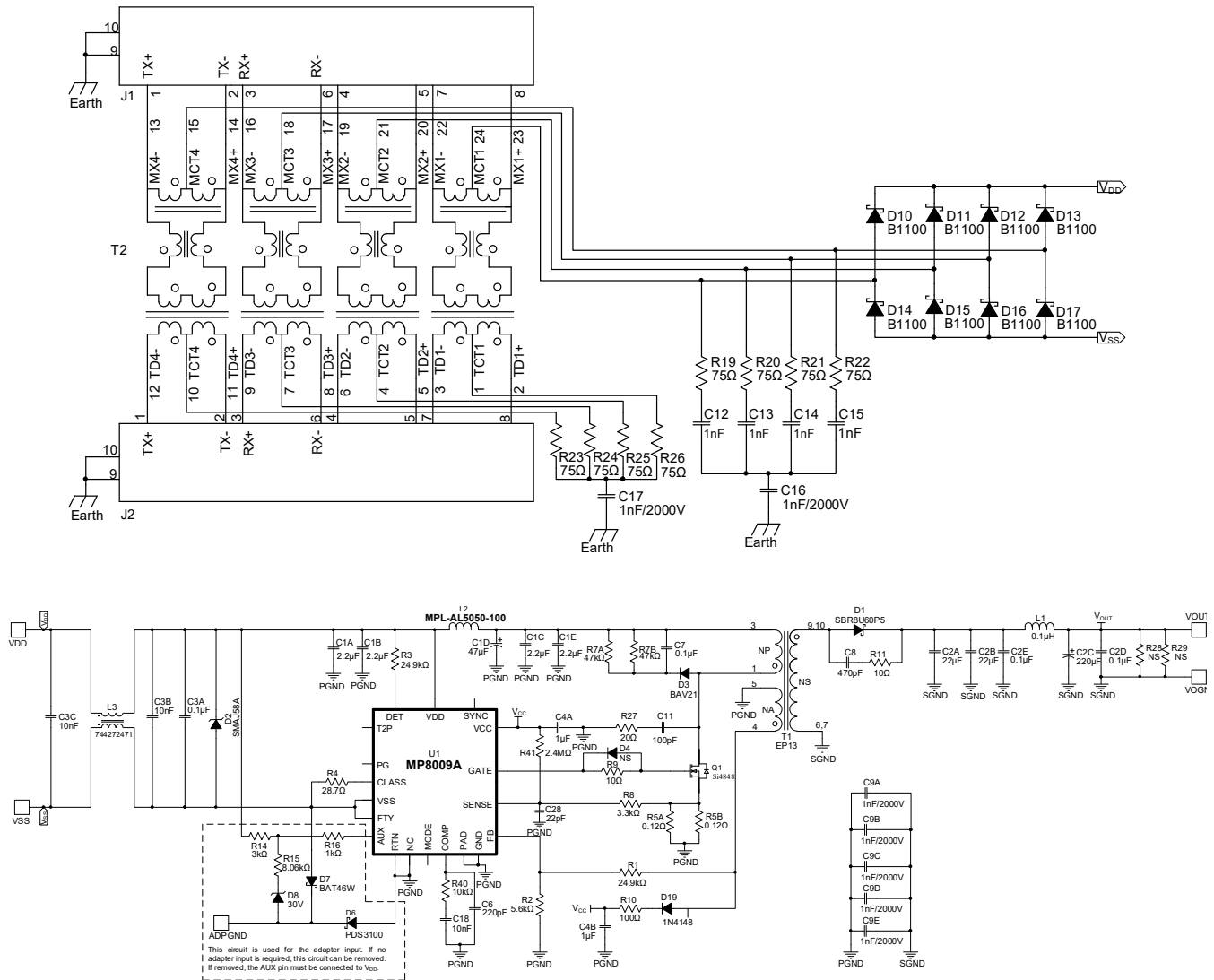


Figure 1: Evaluation Board Schematic (2) (3)

### Notes:

- For improved EMI performance, the evaluation board's frequency dithering is set to on by default. If a stable switching test is required, set R8 below 1k $\Omega$ . Set R41 accordingly to maintain the original R41:R8 ratio.
- 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 820 $\Omega$  with a 1206 package) is required; otherwise, the circuit may trigger over-voltage protection (OVP).



## EVL8009-V-00A BILL OF MATERIALS

Qty	Ref	Value	Description	Package	Manufacturer	Manufacturer PN
1	L2	10 $\mu$ H	Inductor, I <sub>RATED</sub> = 4.8A, I <sub>SAT</sub> = 5.5A, R <sub>DC</sub> = 43.5m $\Omega$	SMD	MPS	MPL-AL5050-100
4	C1A, C1B, C1C, C1E	2.2 $\mu$ F	Ceramic capacitor, 100V, X7R	1210	Murata	GRM32ER72A225KA88L
1	C1D	47 $\mu$ F	CD284, 105°C	DIP	Jianghai	ECR2AXY470MLB100012
2	C2A, C2B	22 $\mu$ F	Ceramic capacitor, 25V, X7R	1210	Murata	GRM32ER71E226KA88L
1	C2C	220 $\mu$ F	Electrolytic capacitor, 220 $\mu$ F/25V	DIP	Wurth	860080474010
2	C2D, C2E	0.1 $\mu$ F	Ceramic capacitor, 25V, X7R	0603	Murata	GRM188R71E104KA01D
1	C3A	0.1 $\mu$ F	Ceramic capacitor, 100V, X7R	1206	Murata	GRM319R72A104KA01D
2	C3B, C3C	10nF	Ceramic capacitor, 100V, X7R	0603	Murata	GRM188R72A103KA01D
2	C4A, C4B	1 $\mu$ F	Ceramic capacitor, 25V, X7R	0603	Murata	GRM188R71E105KA01D
1	C6	220pF	Ceramic capacitor, 16V, X7R	0603	Murata	GRM188R71C221KA01D
1	C7	0.1 $\mu$ F	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	58V	TVS diode	SMA	Diodes, Inc.	SMAJ58A
1	D3	200V	Switching diode	SOD-123	Diodes, Inc.	BAV21W-7-F
1	D6	100V	Switching diode, 3A	Power DI 5	Diodes, Inc.	PDS3100



## EVL8009-V-00A BILL OF MATERIALS (continued)

Qty	Ref	Value	Description	Package	Manufacturer	Manufacturer PN
1	D7	100V	Diode	SOD-123	Diodes, Inc.	BAT46W
1	D8	30V	Zener diode, 500mW, 30V	SOD-123	Diodes, Inc.	BZT52C30V-7
8	D10, D11, D12, D13, D14, D15, D16, D17	100V	Schottky diode, 1A	SMA	Diodes, Inc.	B1100
1	D19	75V	Switching diode, 200mW	SOD-323	Diodes, Inc.	1N4148WS
2	J1, J2	1.5A	Rear-post jack modular connector, 120V <sub>AC</sub>	8P8C	Würth	615008140121
1	L1	0.1μH	I <sub>RATED</sub> = 11.5A, I <sub>SAT</sub> = 25A, R <sub>DC</sub> = 5.5mΩ	SMD	Vishay	IHLP1616ABERR10M01
			I <sub>RATED</sub> = 12A, I <sub>SAT</sub> = 30A, R <sub>DC</sub> = 3.2mΩ	SMD	Würth	744373240010
1	L3	2 x 470μH	Common filter, R <sub>DC</sub> = 2 x 65mΩ	SMD	Würth	744272471
1	Q1	84mΩ	N-channel MOSFET, 150V, 5.5A, Q <sub>G</sub> = 4.4nC	SO-8	Vishay	Si4848ADY
2	R1, R3	24.9kΩ	Film resistor, 1%	0603	Royal Ohm	RC0603FR-0724K9L
1	R2	5.6kΩ	Film resistor, 1%	0603	Royal Ohm	RC0603FR-075K6L
1	R4	28.7Ω	Film resistor, 1%	0603	Royal Ohm	RC0603FR-0728R7L
2	R5A, R5B	0.12Ω	Film resistor, 1%	1206	Royal Ohm	RC1206FR-070R12L
2	R7A, R7B	47kΩ	Film resistor, 1%	1206	Royal Ohm	RC1206FR-0747KL
1	R8	3.3kΩ	Film resistor, 1%	0603	Royal Ohm	RC0603FR-073K3L
1	R9	10Ω	Film resistor, 1%	0603	Royal Ohm	RC0603FR-0710RL
1	R10	100Ω	Film resistor, 1%	0603	Royal Ohm	RC0603FR-07100RL
1	R11	10Ω	Film resistor, 1%	0805	Royal Ohm	RC0805FR-0710RL
1	R14	3kΩ	Film resistor, 1%	0603	Royal Ohm	RC0603FR-073KL
1	R15	8.06kΩ	Film resistor, 1%	0603	Royal Ohm	RC0603FR-078K06L
1	R16	1kΩ	Film resistor, 1%	0603	Royal Ohm	RC0603FR-071KL
8	R19, R20, R21, R22, R23, R24, R25, R26	75Ω	Film resistor, 1%	0603	Royal Ohm	RC0603FR-0775RL
1	R27	20Ω	Film resistor, 1%	0805	Royal Ohm	RC0805FR-0720RL
1	R40	10kΩ	Film resistor, 1%	0603	Royal Ohm	RC0603FR-0710KL
1	R41	2.4MΩ	Film resistor, 1%	0603	Royal Ohm	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	Würth	749020010A
1	U1	MP8009A	Flyback/forward controller	QFN-28 (4mmx5mm)	MPS	MP8009AGV

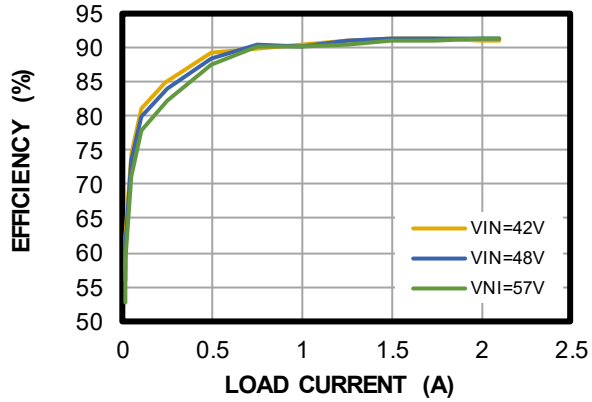


## EVB TEST RESULTS

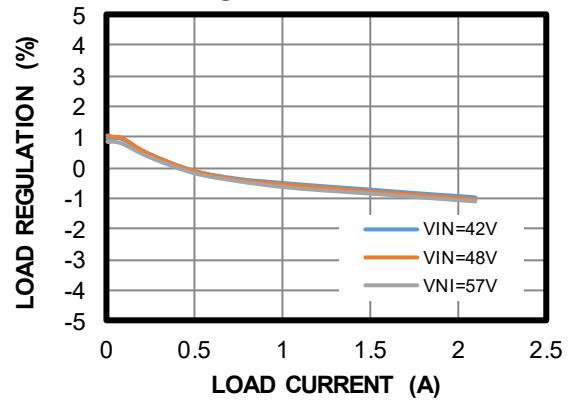
$V_{IN} = 48V$ ,  $V_{OUT} = 12V$ ,  $I_{OUT} = 2.1A$ ,  $T_A = 25^{\circ}C$ , unless otherwise noted.

### Efficiency vs. Load Current

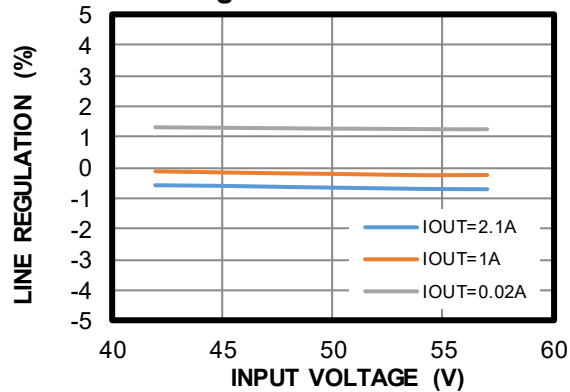
Power supplied after rectifier bridge



### Load Regulation

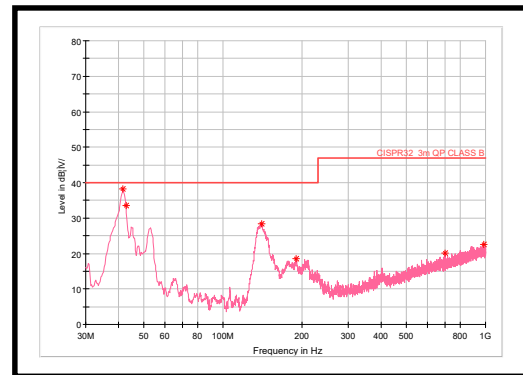


### Line Regulation



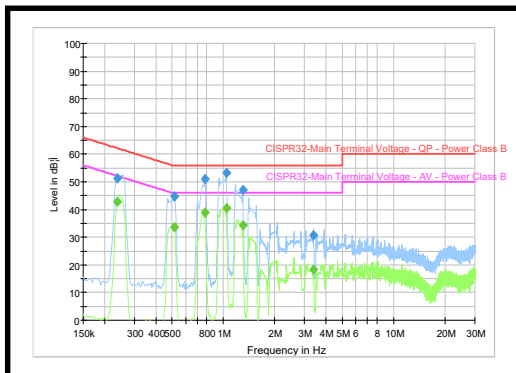
### Radiated Emission Results

$I_{OUT} = 2.1A$



### Conducted Emission Results

$I_{OUT} = 2.1A$



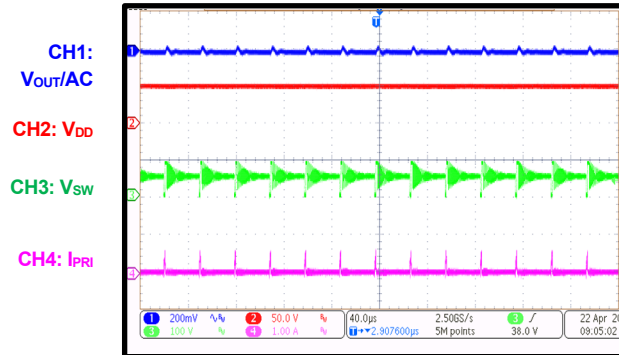


## EVB TEST RESULTS (continued)

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

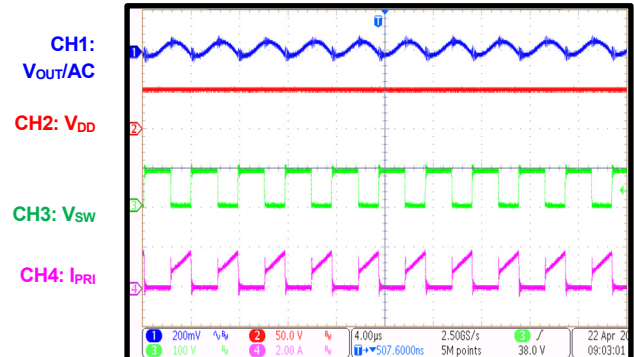
### Steady State

$I_{OUT} = 30mA$



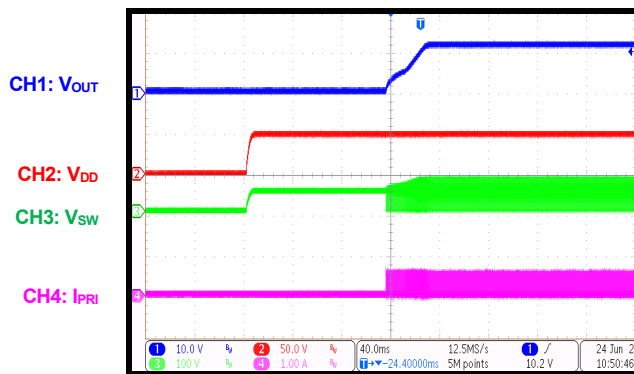
### Steady State

$I_{OUT} = 2.1A$



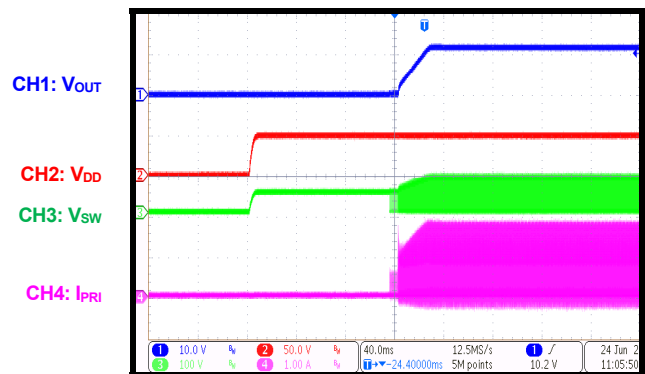
### Start-Up through VDD

$I_{OUT} = 30mA$



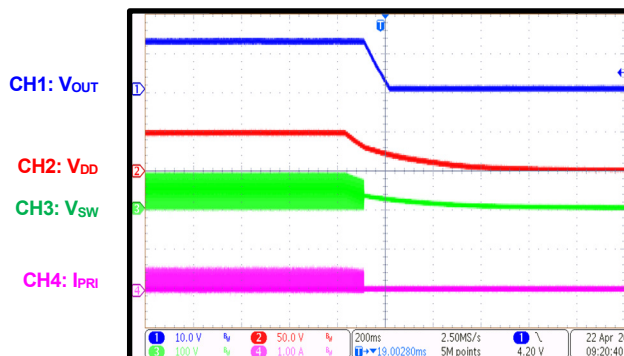
### Start-Up through VDD

$I_{OUT} = 2.1A$



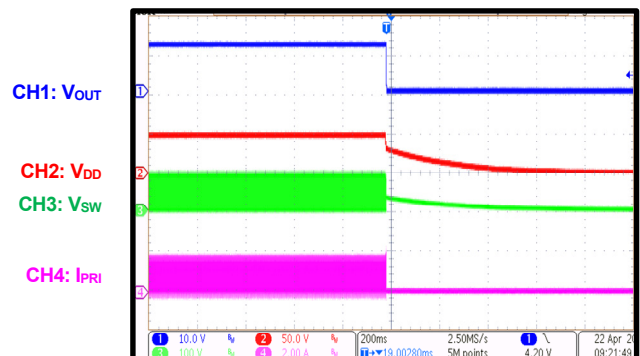
### Shutdown through VDD

$I_{OUT} = 30mA$



### Shutdown through VDD

$I_{OUT} = 2.1A$





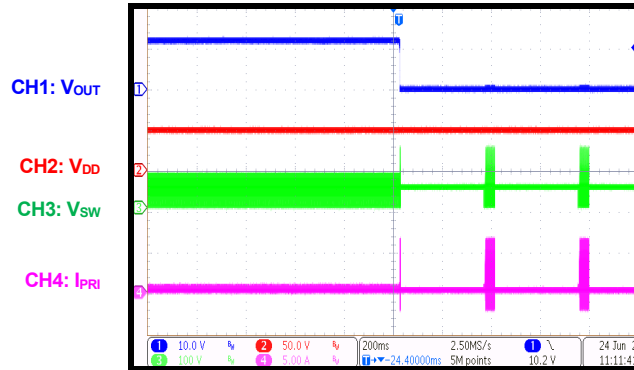


## EVB TEST RESULTS (continued)

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

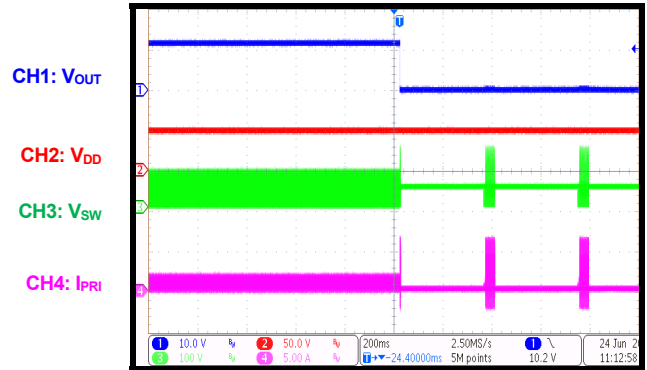
### SCP Entry

$I_{OUT} = 30mA$  to short



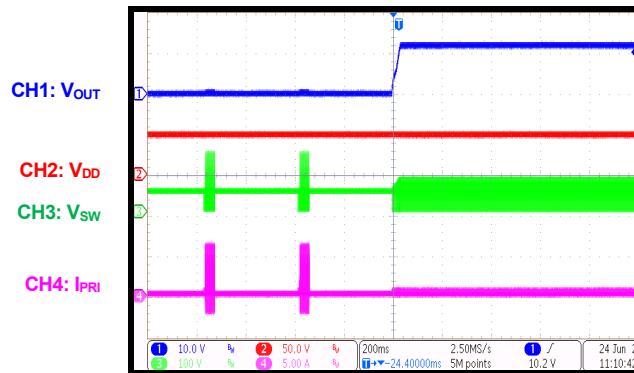
### SCP Entry

$I_{OUT} = 2.1A$  to short



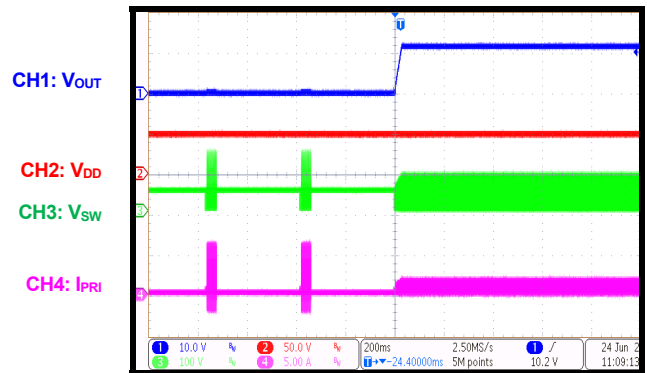
### SCP Recovery

$I_{OUT} = \text{short to } 30mA$



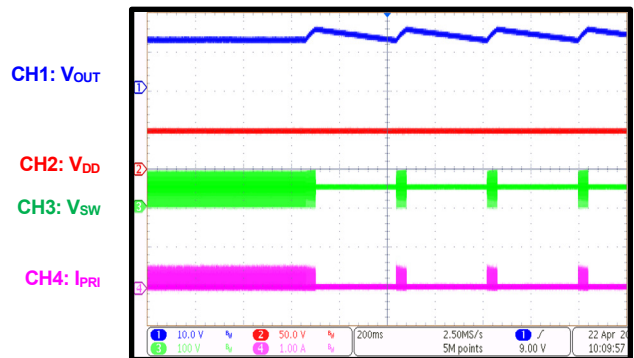
### SCP Recovery

$I_{OUT} = \text{short to } 2.1A$



### OVP Entry

$I_{OUT} = 30mA$  to  $2mA$



### OVP Recovery

$I_{OUT} = 2mA$  to  $30mA$





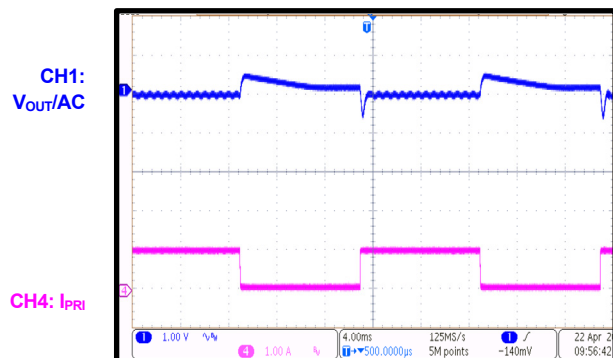


## EVB TEST RESULTS *(continued)*

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

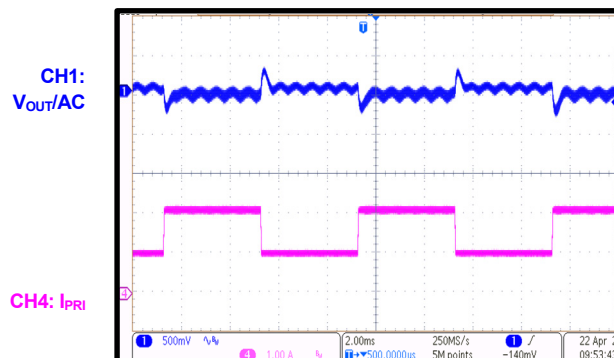
### Load Transient

$I_{OUT} = 30mA$  to  $1A$ ,  $I_{RAMP} = 50mA/\mu s$



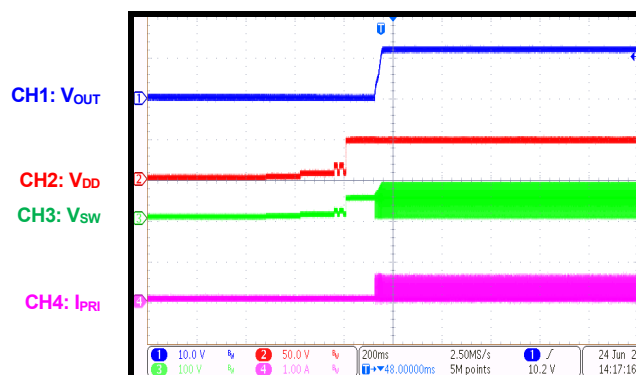
### Load Transient

$I_{OUT} = 1A$  to  $2.1A$ ,  $I_{RAMP} = 50mA/\mu s$



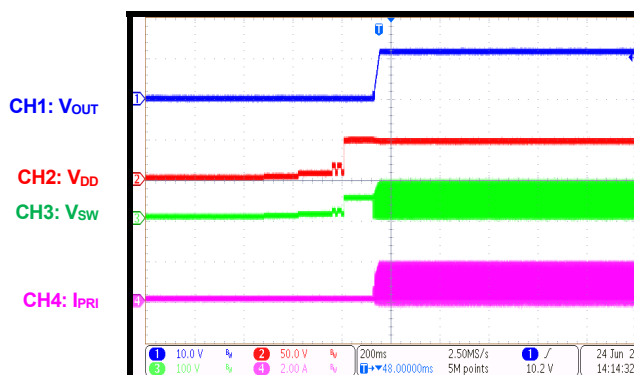
### Start-Up through PSE

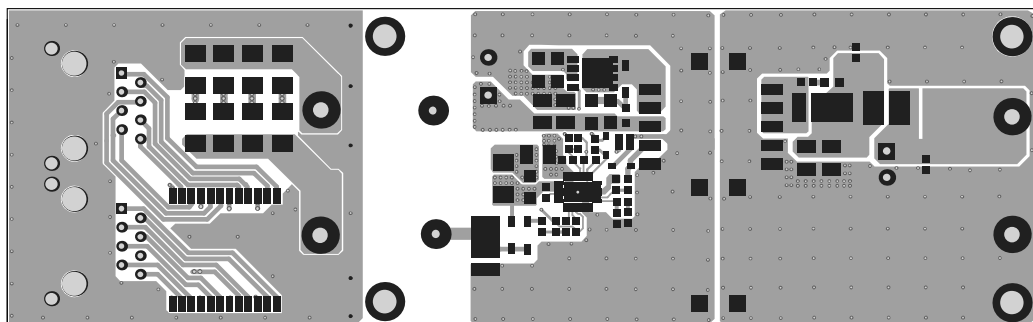
$I_{OUT} = 30mA$



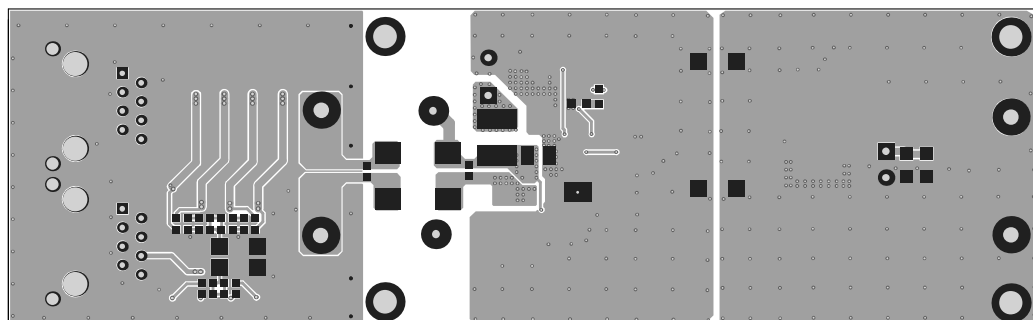
### Start-Up through PSE

$I_{OUT} = 2.1A$

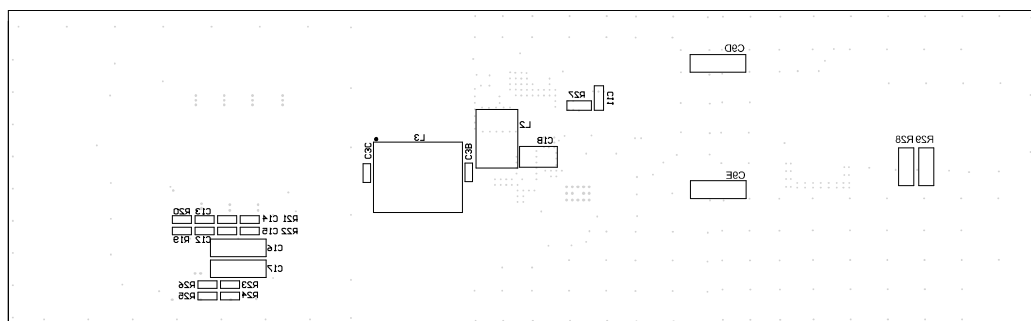




### Figure 3: Top Layer



### Figure 4: Bottom Layer



### Figure 5: Bottom Silk



## **REVISION HISTORY**

<b>Revision #</b>	<b>Revision Date</b>	<b>Description</b>	<b>Pages Updated</b>
1.0	08/26/2021	Initial Release	-

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