EVBL4415A-QB-00A

High-Efficiency, 1.5A, 36V, 2.2MHz Synchronous Step-Down Converter Evaluation Board

DESCRIPTION

The EVBL4415A-QB-00A is an evaluation board designed for the MP4415A and MPQ4415A. It features and MPS inductor.

The MP4415A is a synchronous, rectified, step-down switch-mode converter with build-in power MOSFETs. The device offers a very compact solution to achieve 1.5A of continuous output current with excellent load and line regulation across a wide input supply range. The MP4415A uses synchronous mode operation to achieve high efficiency across the output current load range.

The MP4415A is available in a QFN-13 (2.5mmx3mm) package.

ELECTRICAL SPECIFICATIONS

Parameter	Symbol	Value	Units
Input voltage	V_{IN}	4 to 36	V
Output voltage	V_{OUT}	3.3	V
Output current	I_{OUT}	1.5	A

FEATURES

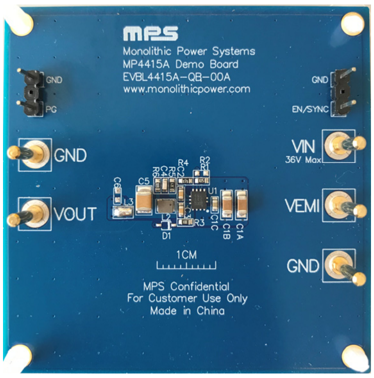
- Wide 4V to 36V Operating Input Range
- 90mΩ High-Side/50mΩ Low-Side Internal Power MOSFETs
- High-Efficiency Synchronous Mode Operation
- Default 2.2MHz Switching Frequency
- 450kHz to 2.2MHz Frequency Sync
- Forced Continuous Conduction Mode (FCCM)
- High Duty Cycle for Automotive Cold Crank
- Internal Soft Start (SS)
- Power Good (PG) Indicator
- Over-Current Protection (OCP) with Valley Current Detection and Hiccup Mode
- Thermal Shutdown
- Output Adjustable from 0.8V
- Available in a QFN-13 (2.5mmx3mm) Package

MPL Optimized Performance with MPS Inductor MPL-AT2514 Series

APPLICATIONS

- Automotive
- Industrial Control System
- Distributed Power Systems

EVBL4415A-QB-00A EVALUATION BOARD

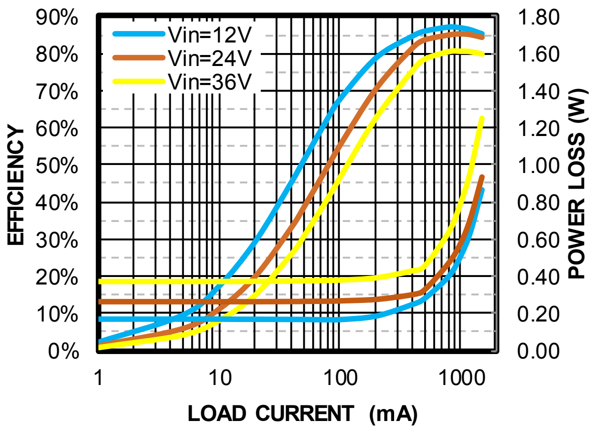


LxWxH (6.35cmx6.35cmx0.5cm)

Board Number	MPS IC Number
EVBL4415A-QB-00A	MP4415AGQB, MPQ4415AGQB

Efficiency vs. Load Current

V_{OUT} = 3.3V



QUICK START GUIDE

1. Connect the load terminals to:
   a. Positive (+): VOUT
   b. Negative (-): GND

   Note that electronic loads represent a negative impedance to the regulator, so a high current can trigger hiccup mode.
2. Preset the power supply output to be between 4 and 36V, then turn it off.

   If longer cables (>0.5m total) are used between the source and the EVB, install a damping capacitor at the input terminals, especially when V_{IN} is greater than or equal to 24V.
3. Connect the power supply output terminals to:
   a. Positive (+): VIN
   b. Negative (-): GND.
4. Turn the power supply on. The MP4415A should automatically start up.
5. To use the enable function, apply a digital input to the EN/SYNC pin. Drive EN/SYNC above 1.45V to turn the regulator on; drive EN below 1V to turn it off.
6. To use the sync function, apply a 450kHz to 2.2MHz external clock to the EN/SYNC pin to synchronize the internal clock rising edge.
7. The output voltage is set by the external resistor divider. The feedback resistor (R_{FB1}) also sets the feedback loop bandwidth with the internal compensation capacitor. Choose R_{FB1} to be around 40kΩ when V_{OUT} ≥1V. R_{FB2} can then be calculated with Equation (1):

$$R_{FB2} = \frac{R_{FB1}}{\frac{V_{OUT}}{0.807V} - 1} \quad (1)$$

8. The T-type network is highly recommended when V_{OUT} is low (see Figure 1)

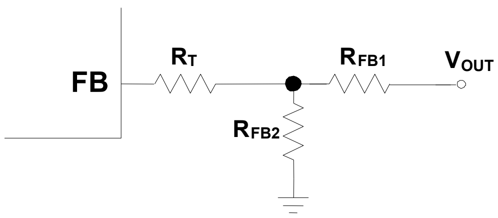


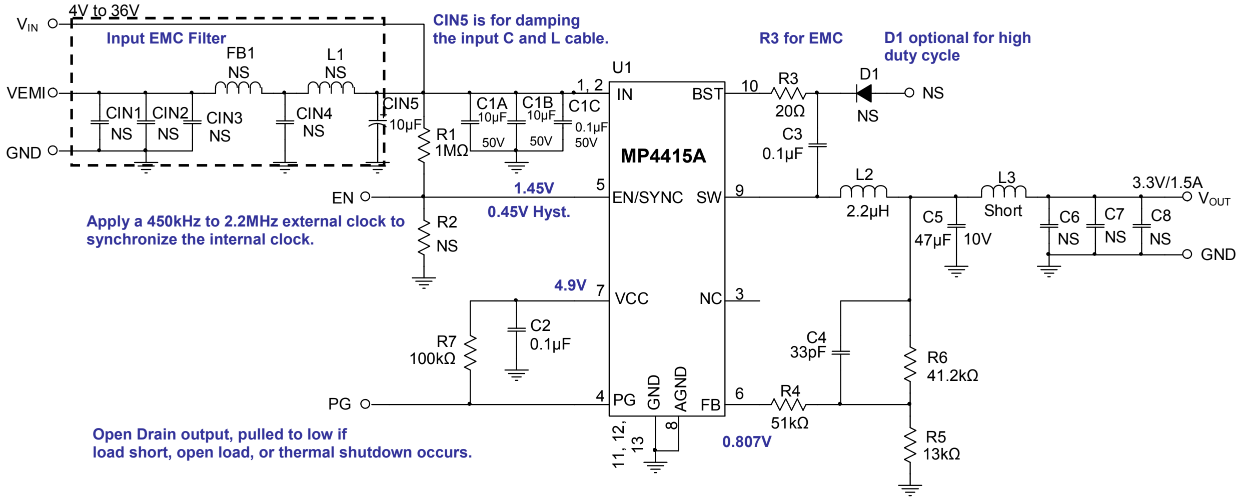
Figure 1: T-Type Network

9. R_T and R_{FB1} are used to set the loop bandwidth. The lower R_T and R_{FB1} is, the higher the bandwidth. However, a high bandwidth may cause an insufficient phase margin, which results in an unstable loop. Select an appropriate value for R_T to make a tradeoff between the bandwidth and phase margin. Table 1 lists the recommended feedback resistor and R_T values for common output voltages.

Table 1: Recommended Feedback Resistors and Output Voltages

V_{OUT} (V)	R_{FB1} (kΩ)	R_{FB2} (kΩ)	R_T (kΩ)
3.3	41.2 (1%)	13 (1%)	51 (1%)
5	41.2 (1%)	7.68 (1%)	51 (1%)

EVALUATION BOARD SCHEMATIC

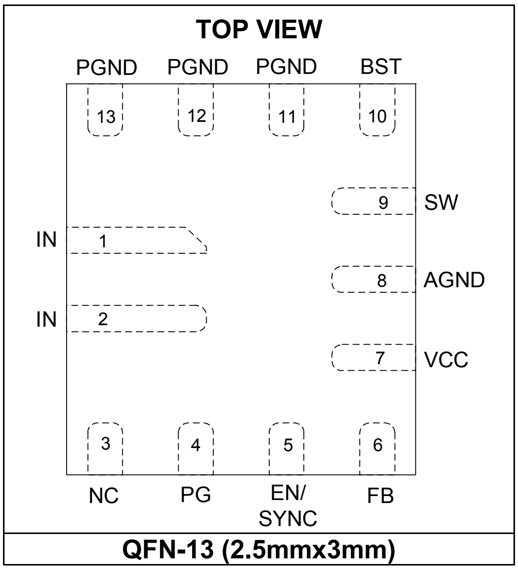


Reference for FB divider selection

VOUT (V)	R6 (kΩ)	R5 (kΩ)
5	41.2(1%)	7.68(1%)
2.5	41.2(1%)	19.6(1%)
1.8	41.2(1%)	33.5(1%)

Figure 2: Evaluation Board Schematic

PACKAGE REFERENCE



EVBL4415A-QB-00A BILL OF MATERIALS

Qty	Designator	Value	Description	Package	Manufacture	Manufacturer PN
5	CIN1, CIN2, CIN3, CIN4, CIN5	NS				
2	C1A, C1B	10µF	Ceramic capacitor, 50V, X5R	1206	Murata	GRM31CR61H106KA12L
1	C1C	0.1µF	Ceramic capacitor, 50V, X7R	0603	Murata	GRM188R71H104KA93D
2	C2, C3	0.1µF	Ceramic capacitor, 16V, X7R	0603	Murata	GRM188R71C104KA01D
1	C4	33pF	Ceramic capacitor, 50V, C0G	0603	Murata	GRM1885C1H330JA01D
1	C5	47µF	Ceramic capacitor, 10V, X5R	1210	Murata	GRM32ER61A476KE20L
3	C6, C7, C8	NS				
1	D1	NS				
1	FB1	NS				
1	L1	NS				
1	L2	2.2µH	Inductor, 70mΩ DCR, 2.5A	SMD	MPS	MPL-AT2514-2R2
1	L3	NS				
1	R1	1MΩ	Film resistor, 5%	0603	Yageo	RC0603JR-071ML
1	R3	20Ω	Film resistor, 1%	0603	Yageo	RC0603FR-0720RL
1	R4	51kΩ	Film resistor, 1%	0603	Yageo	RC0603FR-0751KL
1	R5	13kΩ	Film resistor, 1%	0603	Yageo	RC0603FR-0713KL
1	R6	41.2kΩ	Film resistor, 1%	0603	Yageo	RC0603FR-0741K2L
1	R7	100kΩ	Film resistor, 1%	0603	Yageo	RC0603FR-07100KL
1	R2	NS				
1	U1	MP4415A	Step-down converter	QFN-13 (2mmx 3mm)	MPS	MP4415AGQB
5	VIN, VEMI, GND, GND, VOUT	2.0	2.0 golden pin	DIP	MPS (1)	
4	PG, GND, EN/SYNC, GND	2.54mm	2.54mm test pin	DIP	Any	

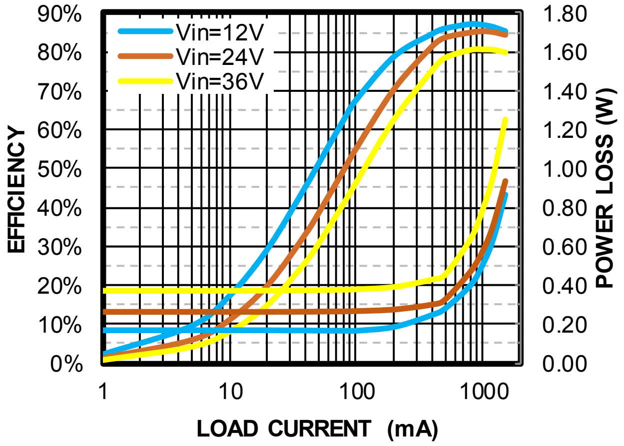
Note:

1) Contact an MPS FAE for more information regarding these pins.

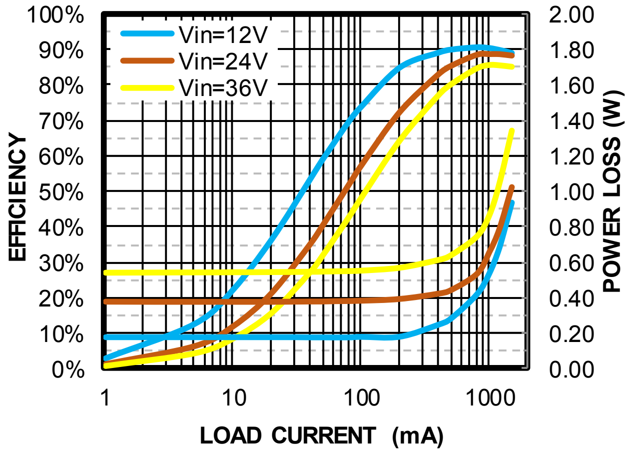
EVB TEST RESULTS

V_{IN} = 12V, V_{OUT} = 3.3V, L = 2.2µH, f_{SW} = 2.2MHz, T_A = 25°C, unless otherwise noted.

Efficiency vs. Load Current
V_{OUT} = 3.3V



Efficiency vs. Load Current
V_{OUT} = 5V

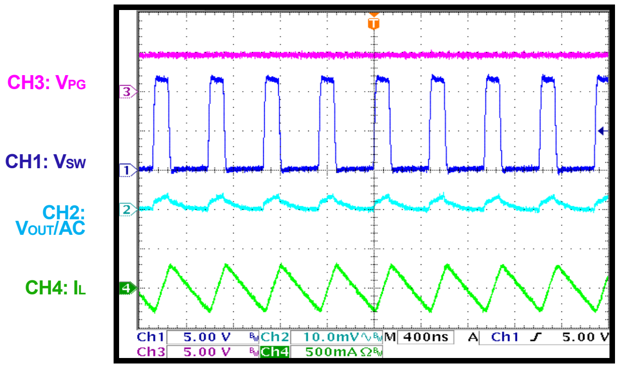


EVB TEST RESULTS *(continued)*

V_{IN} = 12V, V_{OUT} = 3.3V, L = 2.2µH, f_{SW} = 2.2MHz, T_A = 25°C, unless otherwise noted.

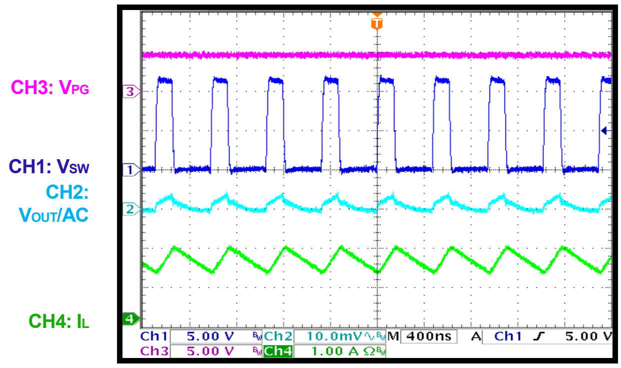
Steady State

I_{OUT} = 0A



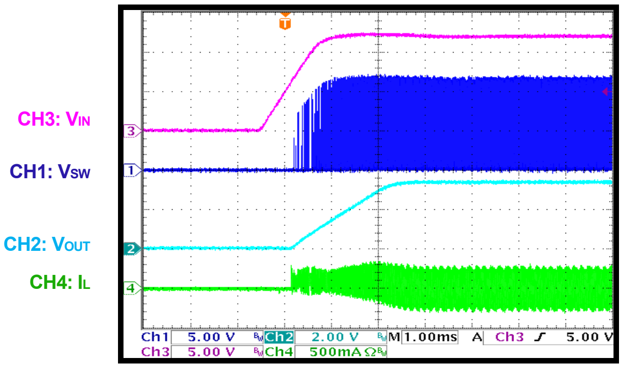
Steady State

I_{OUT} = 1.5A



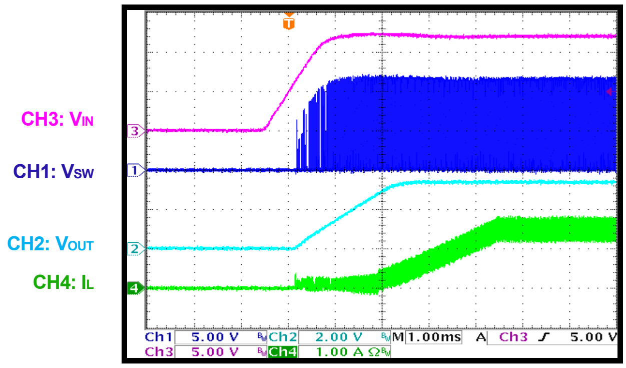
Start-Up

I_{OUT} = 0A



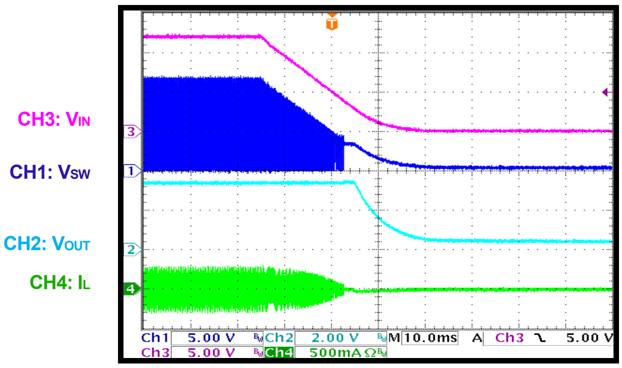
Start-Up

I_{OUT} = 1.5A



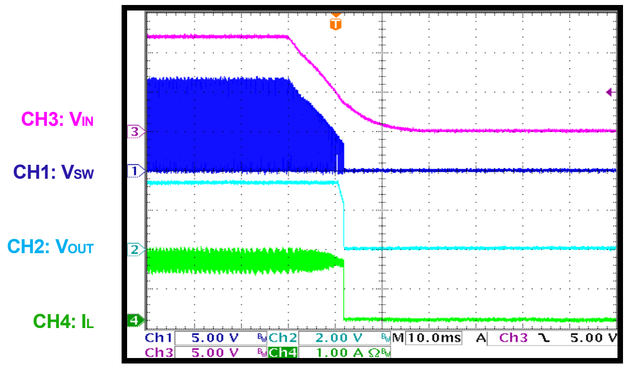
Shutdown

I_{OUT} = 0A



Shutdown

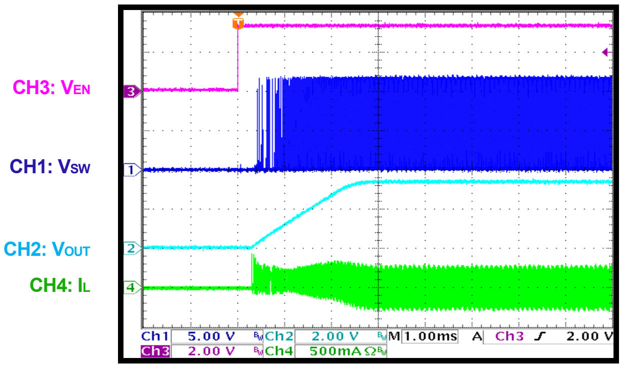
I_{OUT} = 1.5A



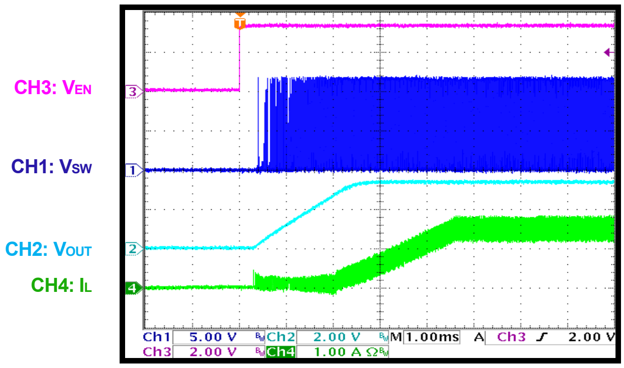
EVB TEST RESULTS *(continued)*

V_{IN} = 12V, V_{OUT} = 3.3V, L = 2.2µH, f_{SW} = 2.2MHz, T_A = 25°C, unless otherwise noted.

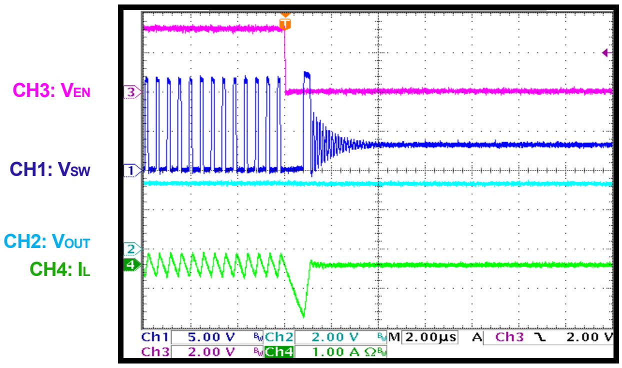
EN On
I_{OUT} = 0A



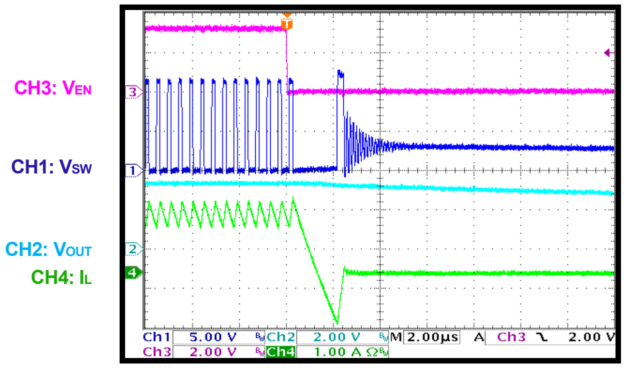
EN On
I_{OUT} = 1.5A



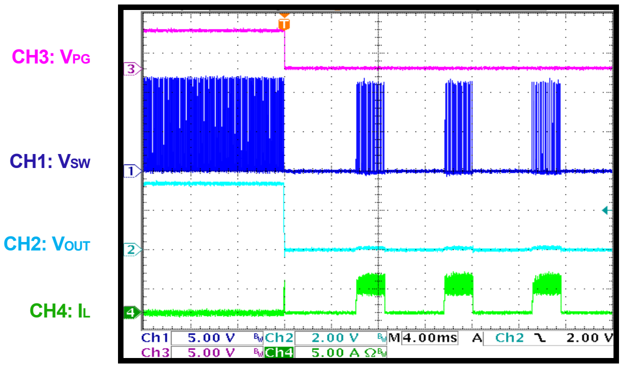
EN Off
I_{OUT} = 0A



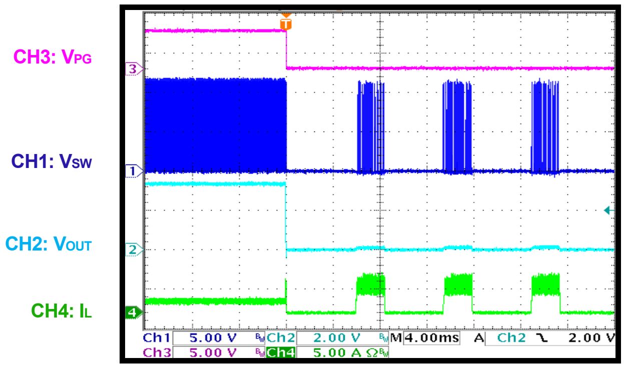
EN Off
I_{OUT} = 1.5A



SCP Entry
I_{OUT} = 0A



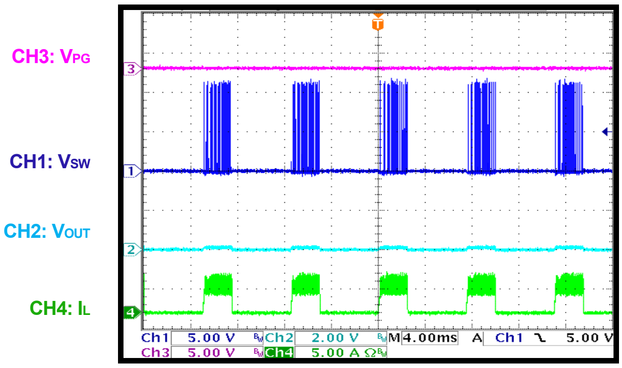
SCP Entry
I_{OUT} = 1.5A



EVB TEST RESULTS *(continued)*

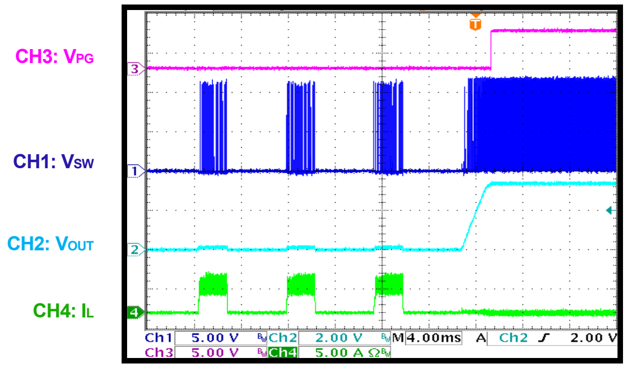
V_{IN} = 12V, V_{OUT} = 3.3V, L = 2.2µH, f_{SW} = 2.2MHz, T_A = 25°C, unless otherwise noted.

SCP Steady State



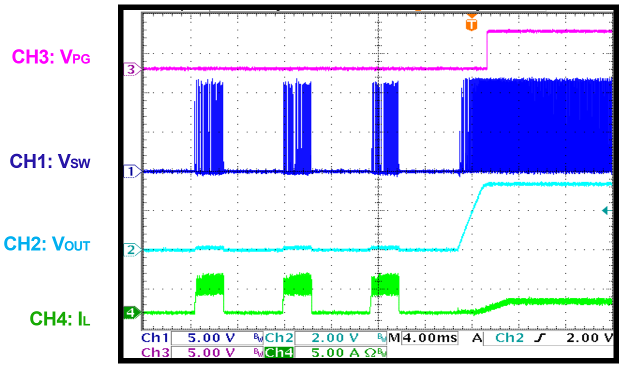
SCP Recovery

I_{OUT} = 0A



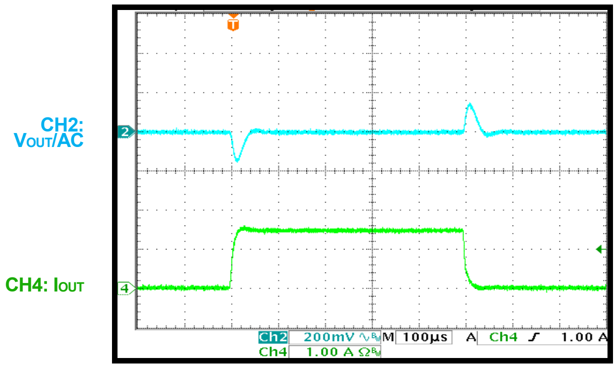
SCP Recovery

I_{OUT} = 1.5A



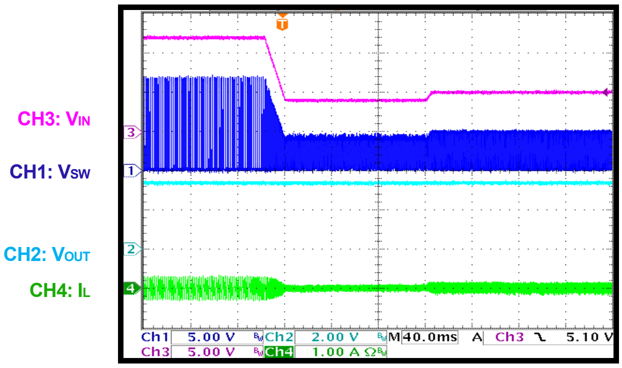
Load Transient

I_{OUT} = 0A to 1.5A



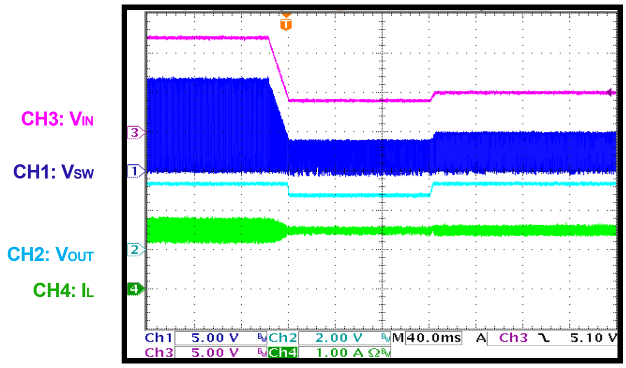
Cold Crank

V_{IN} = 12V to 4V to 5V, I_{OUT} = 0A



Cold Crank

V_{IN} = 12V to 4V to 5V, I_{OUT} = 1.5A

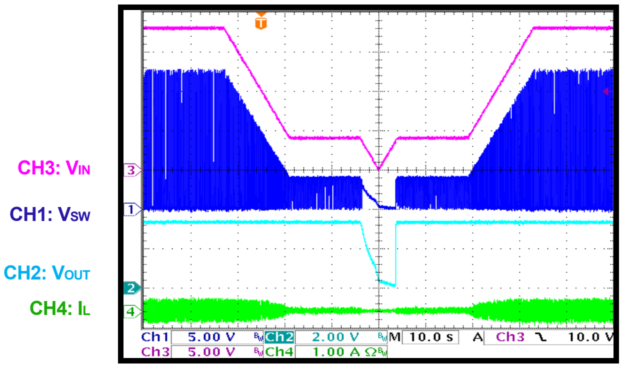


EVB TEST RESULTS *(continued)*

V_{IN} = 12V, V_{OUT} = 3.3V, L = 2.2µH, f_{SW} = 2.2MHz, T_A = 25°C, unless otherwise noted.

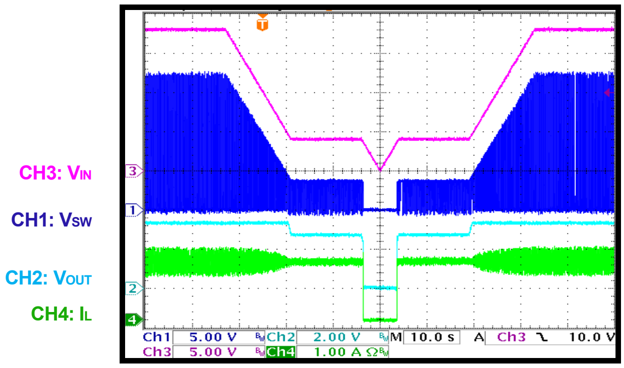
VIN Ramp Down and Up

V_{IN} = 18V to 4.5V to 0V to 4.5V to 18V, I_{OUT} = 0A, V_{OUT} connected to a diode with BST



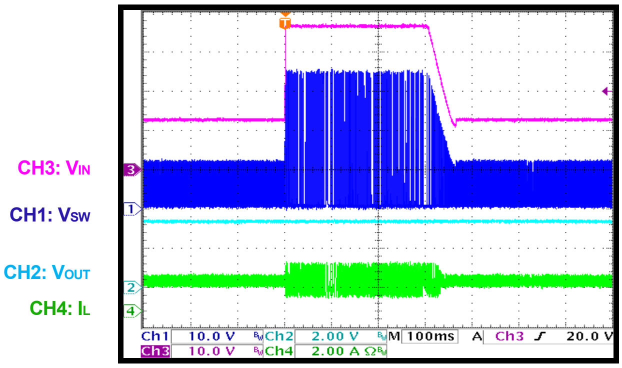
VIN Ramp Down and Up

V_{IN} = 18V to 4V to 0V to 4V to 18V, I_{OUT} = 1.5A



Load Dump

V_{IN} = 12V to 36V to 12V, I_{OUT} = 1.5A



PCB LAYOUT

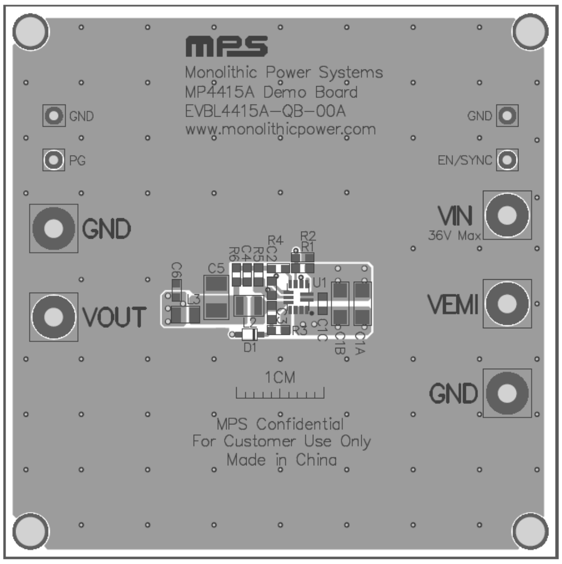


Figure 3: Top Silk Layer and Top Layer

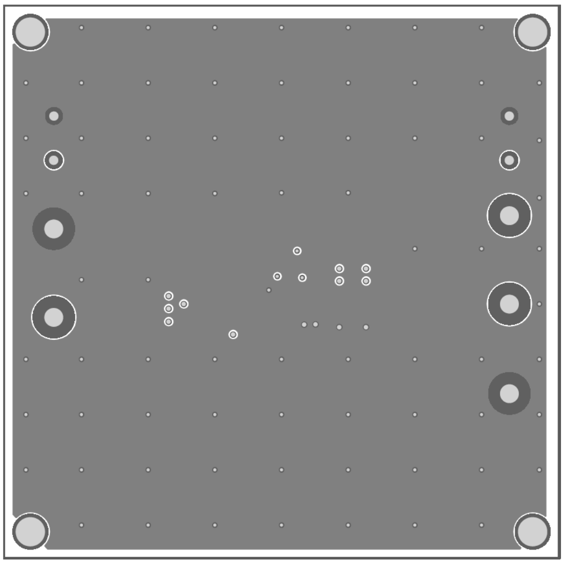


Figure 4: Inner Layer 1

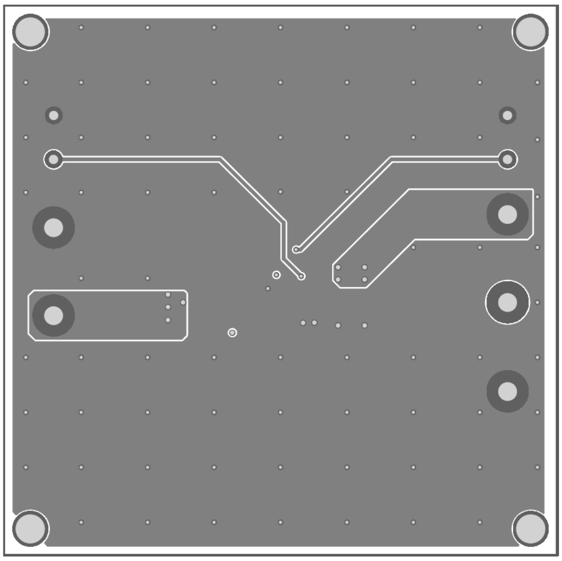


Figure 5: Inner Layer 2

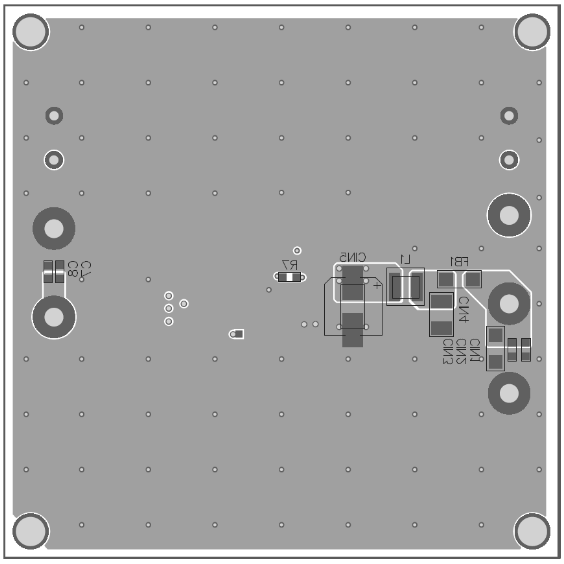


Figure 6: Bottom Silk Layer and Bottom Layer

REVISION HISTORY

Revision #	Revision Date	Description	Pages Updated
1.0	10/8/2019	Initial Release	-
1.1	9/10/2021	Updated BOM	Page 5
		Grammatical and clerical updates	All