EVBL4423H-Q-00A

36V, 3A, Synchronous, Step-Down Converter Evaluation Board

DESCRIPTION

The EVBL4423H-Q-00A is an evaluation board designed to demonstrate the MP4423H and the MPQ4423H. The MP4423H is a high-frequency, synchronous, rectified, step-down switch-mode converter with built-in power MOSFETs and an integrated MPS power inductor. It offers a compact solution that can achieve up to 3A of continuous output current (I_{OUT}) across a wide 4V to 36V input voltage (V_{IN}) range, with excellent load and line regulation.

Synchronous mode provides high efficiency across the entire I_{OUT} range. Current-mode control provides fast transient response and eases loop stabilization.

Full protection features include over-current protection (OCP) with hiccup mode and thermal shutdown.

The EVBL4423H-Q-00A is a fully assembled and tested evaluation board. The MP4423H is available in a QFN-8 (3mmx3mm) 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}	3	A

FEATURES

- Wide 4V to 36V Operating Input Voltage (V_{IN}) Range
- 85mΩ/55mΩ, Low $R_{DS(ON)}$ Internal Power MOSFETs
- High-Efficiency Synchronous Mode
- 410kHz Default Switching Frequency (f_{SW})
- 200kHz to 2.2MHz Synchronized External Clock
- High Duty Cycle for Automotive Cold-Crank Conditions
- Power-Save Mode (PSM)
- Internal Soft Start (SS)
- Power Good (PG)
- Over-Current Protection (OCP) with Hiccup Mode
- Thermal Shutdown
- Fully Assembled and Tested
- Available in a QFN-8 (3mmx3mm) Package
- Available in AEC-Q100 Grade 1

MPL Optimized Performance with MPS Inductor MPL-AL6060 Series

APPLICATIONS

- Automotive Applications
- Industrial Control Systems
- Distributed Power Systems

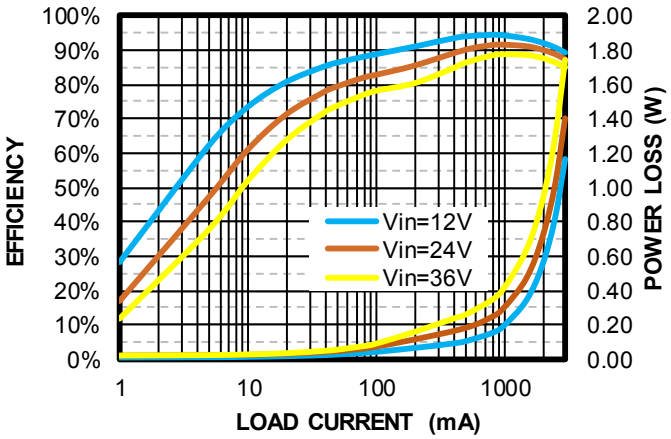
EVBL4423H-Q-00A EVALUATION BOARD

LxWxH (6.35cmx6.35cmx0.5cm)

Board Number	MPS IC Number	MPS Inductor
EVBL4423H-Q-00A	MP4423HGQ, MPQ4423HGQ	MPL-AL6060-100

Efficiency vs. Load Current vs. Power Loss

V_{OUT} = 3.3V



QUICK START GUIDE

1. Connect the load terminals to:
   a. Positive (+): VOUT
   b. Negative (-): GND
2. Preset the power supply between 4V and 36V, then turn the power supply off.
3. Connect the power supply terminals to:
   a. Positive (+): VIN
   b. Negative (-): GND
4. Turn the power supply on. The evaluation board should start up automatically.
5. To use the enable (EN) function, apply a digital input to the EN/SYNC pin. Pull EN/SYNC above 1.65V to turn the converter on; pull EN/SYNC below 1.05V or float EN/SYNC to turn it off. Connect an internal 500kΩ resistor between the EN/SYNC and GND pins to allow EN/SYNC to be floated.
6. Connect the EN/SYNC input pin to any voltage connected to the VIN pin via a pull-up resistor (R1). Ensure that R1 is large enough to limit the EN input current below 150μA. For example, if EN/SYNC is connected to a 12V V_{IN}, then R1 should be ≥36.7kΩ.
7. To connect EN/SYNC directly to a voltage source without using a pull-up resistor, the voltage amplitude should be limited to ≤6V to prevent damage to the internal Zener diode at EN/SYNC.
8. After the output voltage (V_{OUT}) is set, connect the EN/SYNC input pin to a 200kHz to 2.2MHz external clock to synchronize the internal clock's rising edge to the external clock's rising edge. The external clock's pulse-width signal should be below 1.7μs.
9. Use R7 and R8 to set V_{OUT}. R8 can be calculated by Equation (1):

$$R8 = \frac{R7}{\frac{V_{OUT}}{0.792} - 1} \quad (1)$$

   Where R7 is 41.2kΩ, and V_{FB} is 0.792V.

   If V_{OUT} is changed, refer to the Application Information section in the MP4423H/MPQ4423H datasheet to calculate the compensation, inductance, and output capacitance.
10. CLK_OUT is a signal inverted to SW that can be used as another buck's SYNC signal to operate 180° out-of-phase. The CLK_OUT high voltage is equal to V_{OUT}. Ensure that it is safe to operate the synchronized part while V_{OUT} is high.

EVALUATION BOARD SCHEMATIC

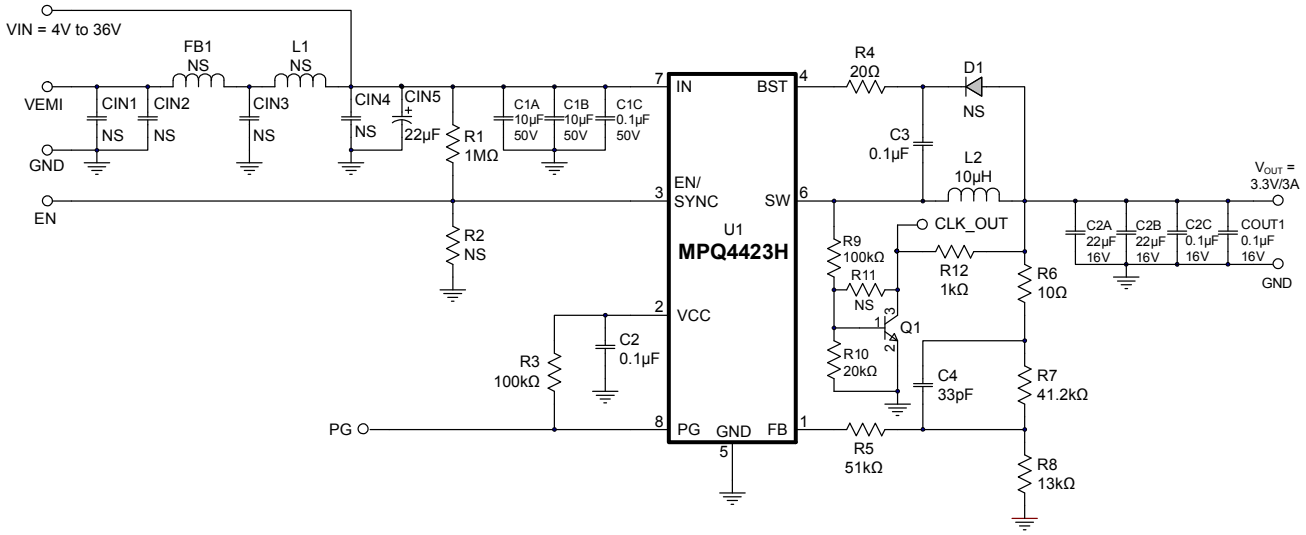


Figure 1: Evaluation Board Schematic

EVBL4423H-Q-00A BILL OF MATERIALS

Qty	Ref	Value	Description	Package	Manufacturer	Manufacturer PN
2	C1A, C1B	10µF	Ceramic capacitor, 50V, X7R	1210	Murata	GRM32ER71H106KA12L
1	C1C	0.1µF	Ceramic capacitor, 50V, X7R	0603	Murata	GRM188R71H104KA93D
2	C2A, C2B	22µF	Ceramic capacitor, 16V, X7R	1210	Murata	GRM32ER71C226KE79
4	C2, C2C, C3, COUT1	0.1µF	Ceramic capacitor, 16V, X7R	0603	Murata	GRM188R71C104KA01D
1	C4	33pF	Ceramic capacitor, 50V, C0G	0603	Murata	GRM1885C1H330JA01D
4	CIN1, CIN2, CIN3, CIN4	NS				
1	CIN5	22µF	Electrolytic capacitor	SMD	Jianghai	VTD-63V22
1	D1	NS				
1	FB1	NS				
1	L1	NS				
1	R1	1MΩ	Film resistor, 5%	0603	Yageo	RC0603JR-071ML
2	R3, R9	100kΩ	Film resistor, 1%	0603	Yageo	RC0603FR-07100KL
1	R4	20Ω	Film resistor, 1%	0603	Yageo	RC0603FR-0720RL
1	R5	51kΩ	Film resistor, 1%	0603	Yageo	RC0603FR-0751KL
1	R6	10Ω	Film resistor, 1%	0603	Yageo	RC0603FR-0710RL
1	R7	41.2kΩ	Film resistor, 1%	0603	Yageo	RC0603FR-0741K2L
1	R8	13kΩ	Film resistor, 1%	0603	Yageo	RC0603FR-0713KL
1	R10	20kΩ	Film resistor, 1%	0603	Yageo	RC0603FR-0720KL
1	R12	1kΩ	Film resistor, 1%	0603	Yageo	RC0603FR-071KL
2	R2, R11	NS				
5	VIN, VEMI, GND, VOUT, GND	2mm	2mm golden test pin	DIP	Custom (1)	
5	EN/SYNC, GND, PG ,GND, CLK_OUT	1mm	1mm golden pin	DIP	Custom (1)	
1	Q1	40V	Transistor, 0.2A	SOT-23	ON Semiconductor	MMBT3904LT1
1	L2	MPL-AL6060-100	Inductor, 10µH, 7A, DCR = 27mΩ	SMD	MPS	MPL-AL6060-100
1	U1	MPQ4423H	Step-down converter, 36V, 3A	QFN-8 (3mmx 3mm)	MPS	MPQ4423HGQ

Note:

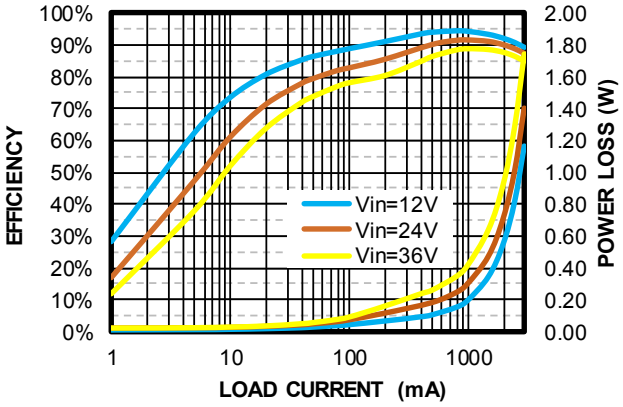
1) These pins are custom-made by MPS. Contact an MPS FAE for more information.

EVB TEST RESULTS

V_{IN} = 12V, V_{OUT} = 3.3V, C_{OUT} = 2 x 22µF, L = 10µH, T_A = 25°C, unless otherwise noted.

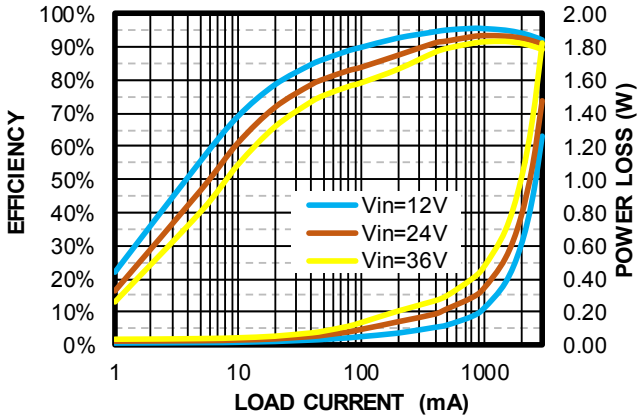
Efficiency vs. Load Current vs. Power Loss

V_{OUT} = 3.3V



Efficiency vs. Load Current vs. Power Loss

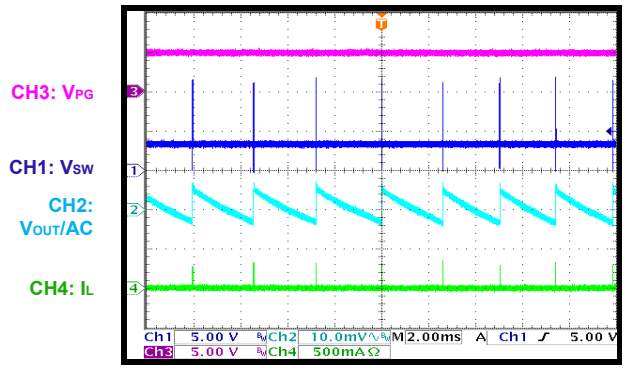
V_{OUT} = 5V



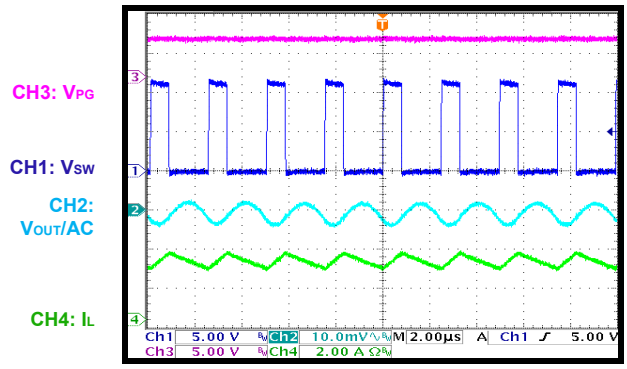
EVB TEST RESULTS *(continued)*

V_{IN} = 12V, V_{OUT} = 3.3V, C_{OUT} = 2 x 22µF, L = 10µH, T_A = 25°C, unless otherwise noted.

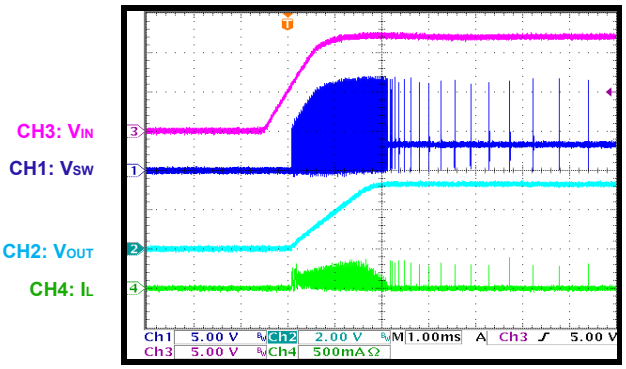
Steady State
I_{OUT} = 0A



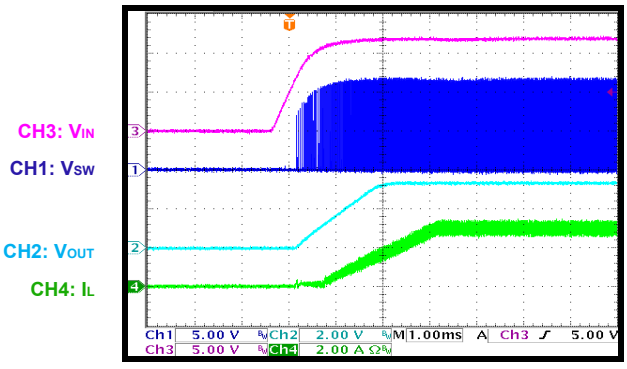
Steady State
I_{OUT} = 3A



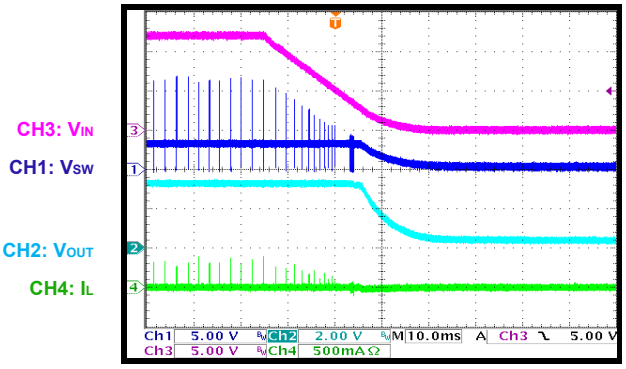
Start-Up
I_{OUT} = 0A



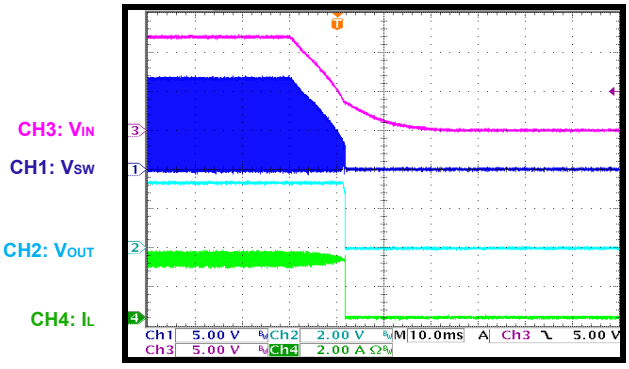
Start-Up
I_{OUT} = 3A



Shutdown
I_{OUT} = 0A



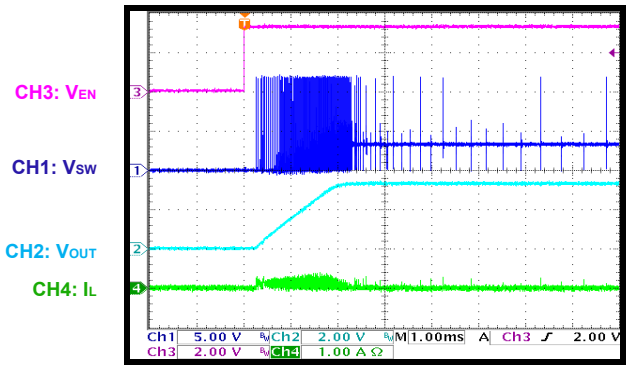
Shutdown
I_{OUT} = 3A



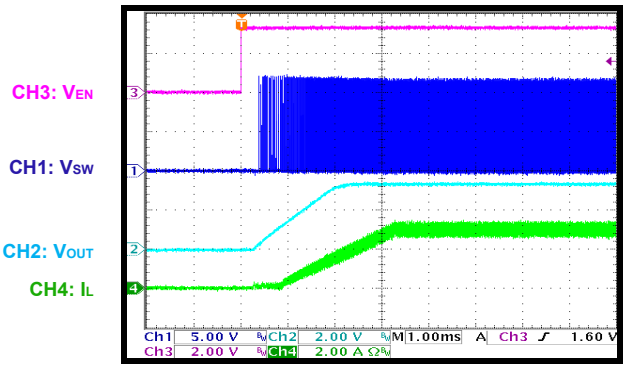
EVB TEST RESULTS *(continued)*

V_{IN} = 12V, V_{OUT} = 3.3V, C_{OUT} = 2 x 22µF, L = 10µH, T_A = 25°C, unless otherwise noted.

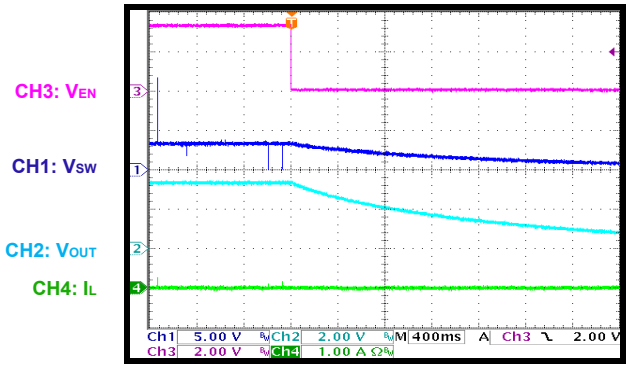
Start-Up through EN
I_{OUT} = 0A



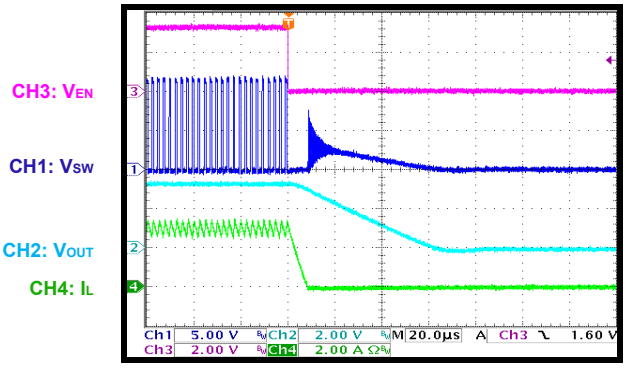
Start-Up through EN
I_{OUT} = 3A



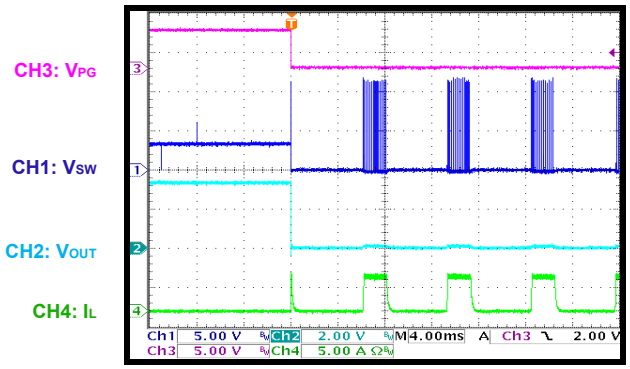
Shutdown through EN
I_{OUT} = 0A



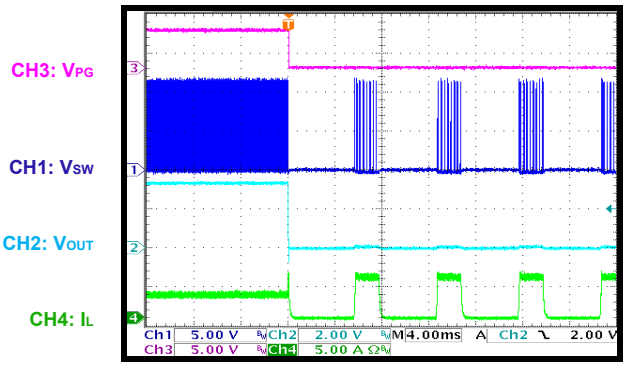
Shutdown through EN
I_{OUT} = 3A



SCP Entry
I_{OUT} = 0A



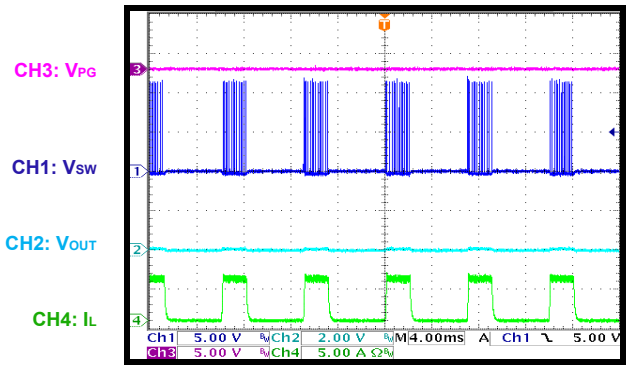
SCP Entry
I_{OUT} = 3A



EVB TEST RESULTS *(continued)*

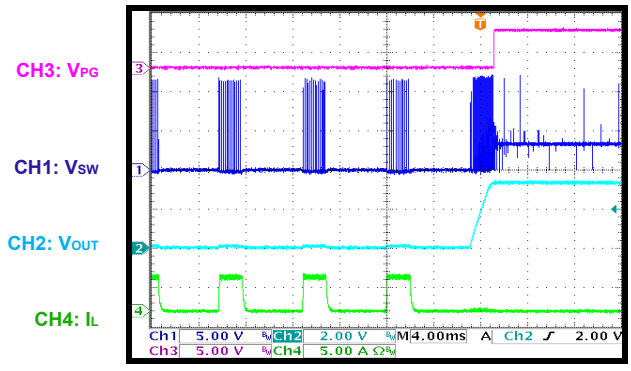
V_{IN} = 12V, V_{OUT} = 3.3V, C_{OUT} = 2 x 22µF, L = 10µH, T_A = 25°C, unless otherwise noted.

SCP Steady State



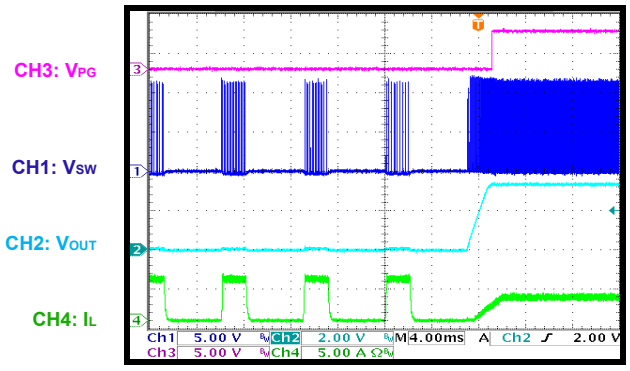
SCP Recovery

I_{OUT} = 0A



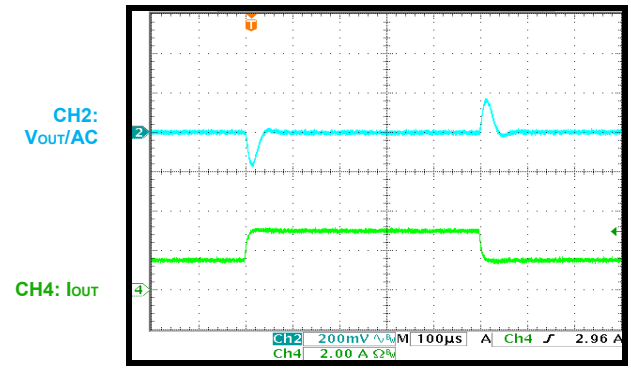
SCP Recovery

I_{OUT} = 3A



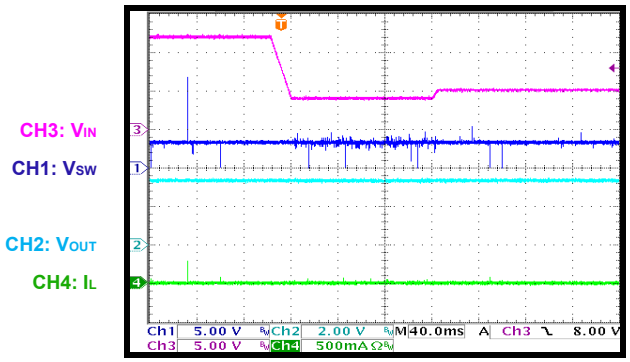
Load Transient

I_{OUT} = 1.5A to 3A



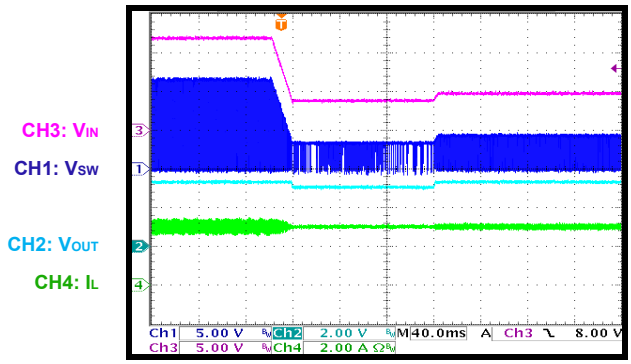
Cold Crank

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



Cold Crank

V_{IN} = 12V to 4V to 5V, I_{OUT} = 3A

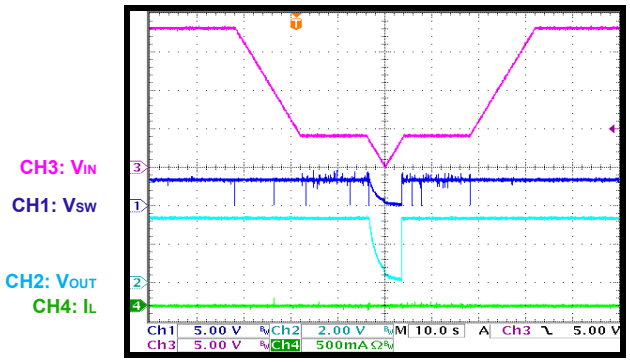


EVB TEST RESULTS *(continued)*

V_{IN} = 12V, V_{OUT} = 3.3V, C_{OUT} = 2 x 22µF, L = 10µH, T_A = 25°C, unless otherwise noted.

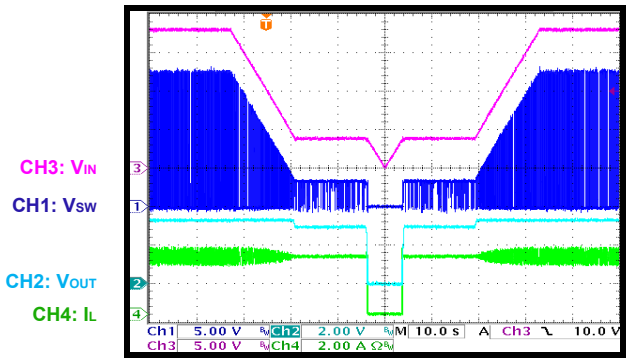
V_{IN} Ramps Down and Up

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



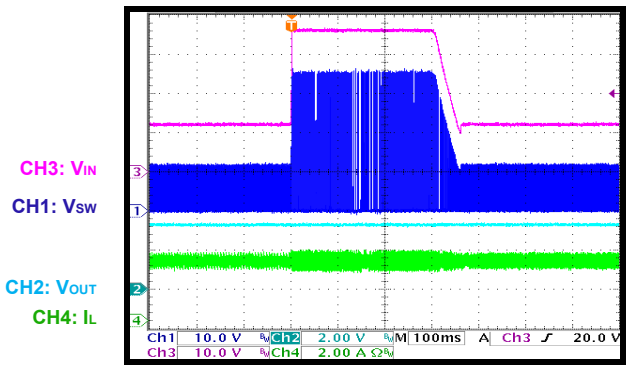
V_{IN} Ramps Down and Up

V_{IN} = 18V to 4V to 0V to 4V to 18V, I_{OUT} = 3A



Load Dump

V_{IN} = 12V to 36V to 12V, I_{OUT} = 3A



PCB LAYOUT

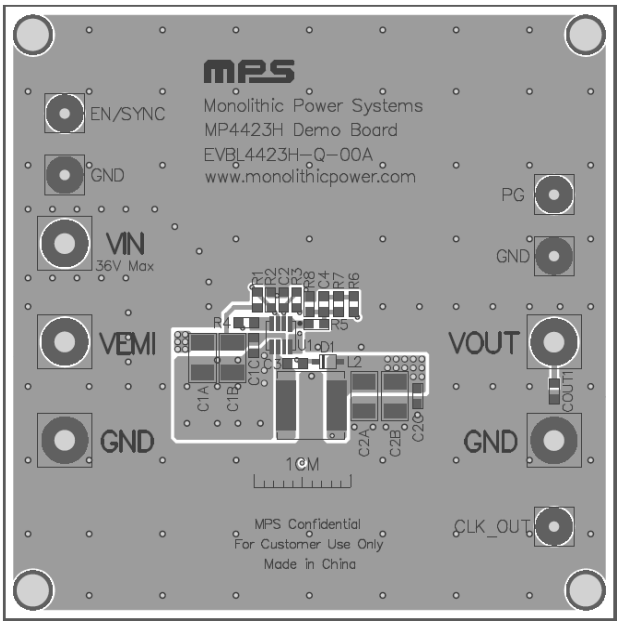


Figure 2: Top Silk and Top Layer

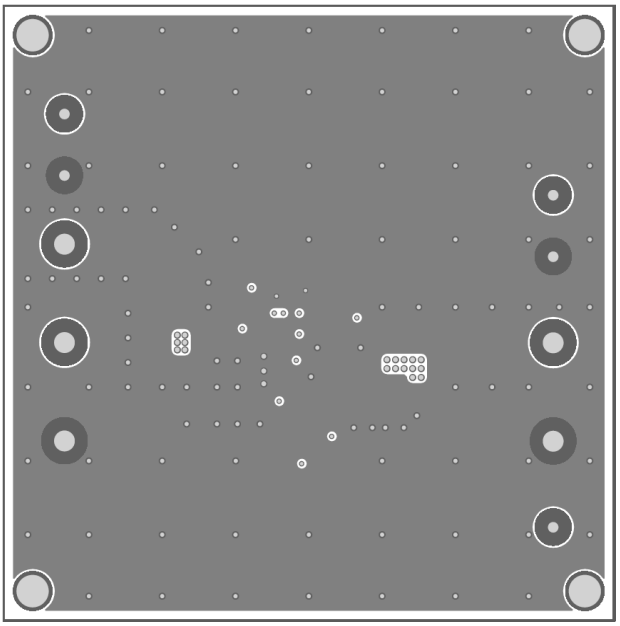


Figure 3: Mid-Layer 1

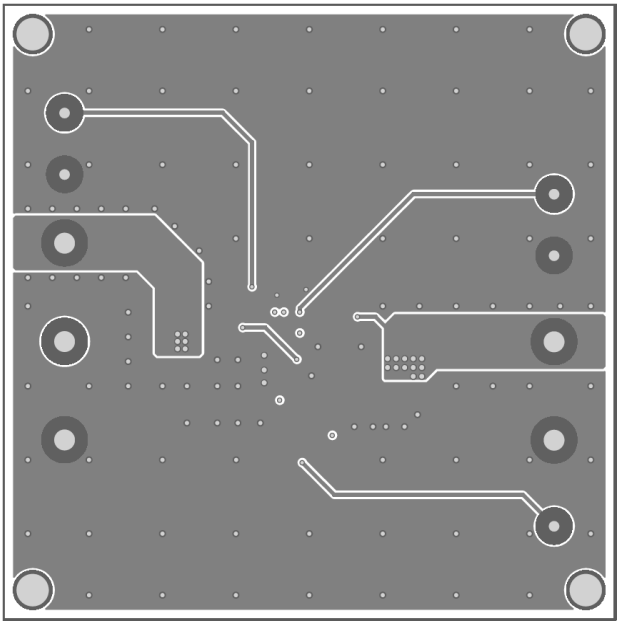


Figure 4: Mid-Layer 2

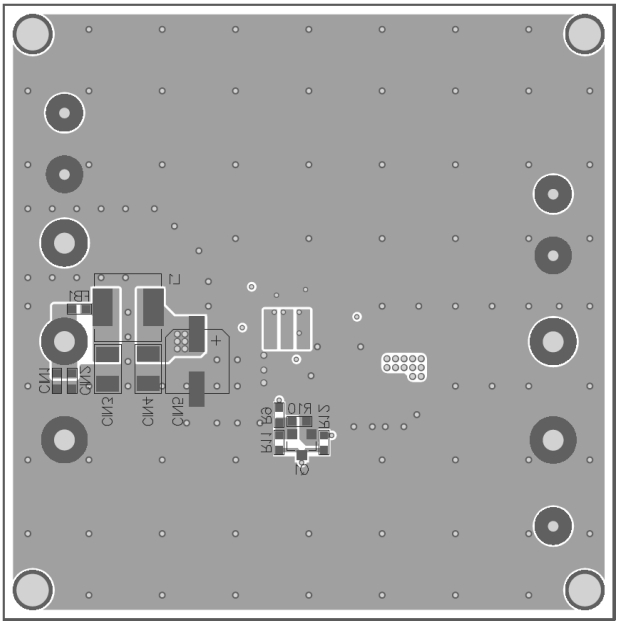


Figure 5: Bottom Silk Layer and Bottom Layer

REVISION HISTORY

Revision #	Revision Date	Description	Pages Updated
1.0	9/29/2019	Initial Release	-
1.1	10/21/2021	Updated the footnote below the Applications section	1
		Updated the Quick Start Guide section	2
		Updated the graph and waveform titles in the EVB Test Results section	6–10
		Grammar and formatting updates; updated pagination; updated figure titles; updated headers	All