EVQ3414C-J-00A

1.5A, 2.2MHz, 5V_{OUT}, 52µA I_Q, Synchronous Step-Up Converter with Output Disconnect Evaluation Board, AEC-Q100 Qualified

DESCRIPTION

The EVQ3414C-J-00A evaluation board is designed to demonstrate the capabilities of the MPQ3414C, a high-efficiency, synchronous, current-mode step-up converter with output disconnect.

The MPQ3414C can start up from an input voltage (V_{IN}) as low as 1.8V, while also providing inrush current limiting and output short-circuit protection (SCP). The integrated P-channel synchronous rectifier improves efficiency and eliminates the need for an external Schottky diode. If the MPQ3414C shuts down, then the P-channel MOSFET disconnects the output from the input. Output disconnect discharges the output completely, which allows the MPQ3414C to draw a supply current (I_{SD}) below 1µA during shutdown.

The 2.2MHz fixed switching frequency (f_{SW}) allows for the use of small external components. The switching frequency (f_{SW}) can be synchronized to external source from 2MHz to 2.5MHz. Internal compensation and soft start (SS) reduce the number of external components required. These features provide a compact solution for a wide current load range.

The MPQ3414C features an integrated power MOSFET that supports up to 5V of output voltage (V_{OUT}), with up to 1A of average output current (I_{OUT}).

The EVQ3414C-J-00A is a fully assembled and tested evaluation board. The MPQ3414C is available in a compact TSOT23-8 package. It is available in AEC-Q100 Grade 1.

PERFORMANCE SUMMARY

Specifications are at T_A = 25°C, unless otherwise noted.

Parameters	Conditions	Value
Input voltage (V_{IN}) range		1.8V to 4V
Output voltage (V_{OUT})	V_{IN} = 2.2V to 4V, I_{OUT} = 0A to 1A	5V
Maximum output current (I_{OUT})	V_{IN} = 3V to 4V	1.5A
Typical efficiency	V_{IN} = 3.3V, V_{OUT} = 5V, I_{OUT} = 1A	91.5%
Peak efficiency	V_{IN} = 4V, V_{OUT} = 5V, I_{OUT} = 0.5A	95.3%
Switching frequency (f_{SW})		2.2MHz

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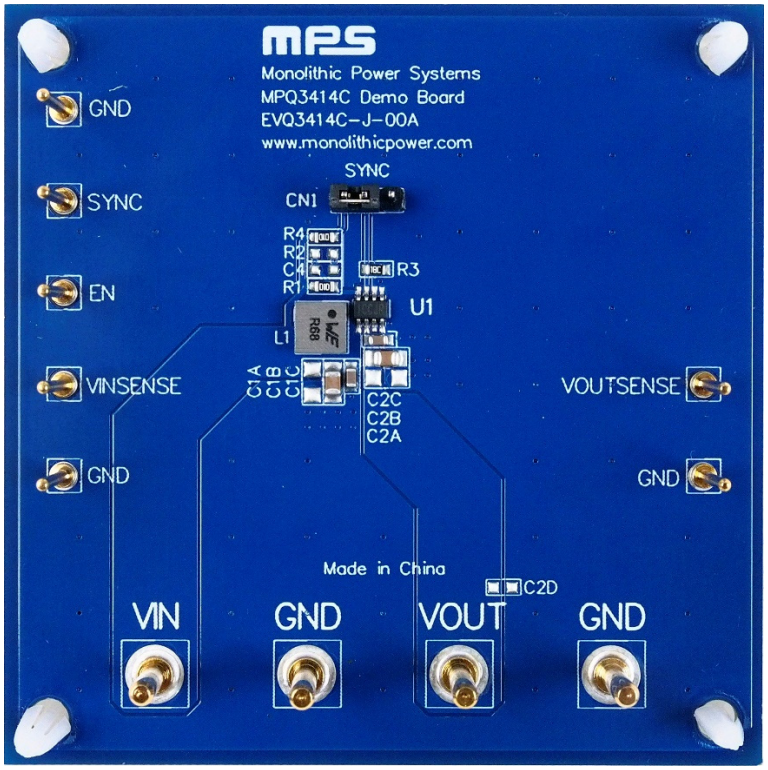
EVQ3414C-J-00A EVALUATION BOARD



LxWxH (6.35cmx6.35cmx1.3cm)

Board Number	MPS IC Number
EVQ3414C-J-00A	MPQ3414CGJ-5-AEC1

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QUICK START GUIDE

The EVQ3414C-J-00A evaluation board is easy to set up and use to evaluate the MPQ3414C's performance. For proper measurement equipment set-up, refer to Figure 1 on page 4 and follow the steps below:

1. Preset the power supply to be between 1.8V and 4V, then turn off the power supply.
2. Set the load current between 0A and 1A. Electronic loads represent a negative impedance to the regulator, and setting the current too high with a low power supply may trigger overload protection (OLP).
3. Connect the power supply terminals to:
   a. Positive (+): VIN
   b. Negative (-): GND
4. Connect the load terminals to:
   a. Positive (+): VOUT
   b. Negative (-): GND
5. CN1 is the mode selection jumper. To use CN1, following the steps below:
   a. Ensure that the power supply is off.
   b. Change the CN1 connection. Connecting pin 1 to pin 2 enables advanced asynchronous modulation (AAM) mode, while connecting pin 2 to pin 3 enables forced continuous conduction mode (FCCM).
6. After making the connections, turn on the power supply. The board should automatically start up.
7. To use the enable (EN) function, apply a digital input to the EN pin. Drive EN above 1.2V to turn the regulator on; drive EN below 0.4V to turn it off. If the enable function is not used, EN can be connected directly to VIN.
8. When the MODE/SYNC pin is used as the SYNC input pin, the switching frequency (f_{SW}) can be synchronized to the rising edge of a clock signal applied to the MODE/SYNC pin. The recommended SYNC input frequency range is between 2MHz to 2.5MHz. When the MODE/SYNC pin is used for mode selection (MODE), pulling this pin high forces the device to operate in AAM mode, while pulling it low forces the device to work in FCCM (see Table 1).

Table 1: Mode Selection

MODE/SYNC Input	Operation
>0.8V	AAM mode
<0.4V	FCCM
External clock in	FCCM

Refer to the Application Information section in the MPQ3414C's datasheet to calculate the inductance (L) and output capacitance (C_{OUT}).

Figure 1 on page 4 shows the measurement equipment set-up.

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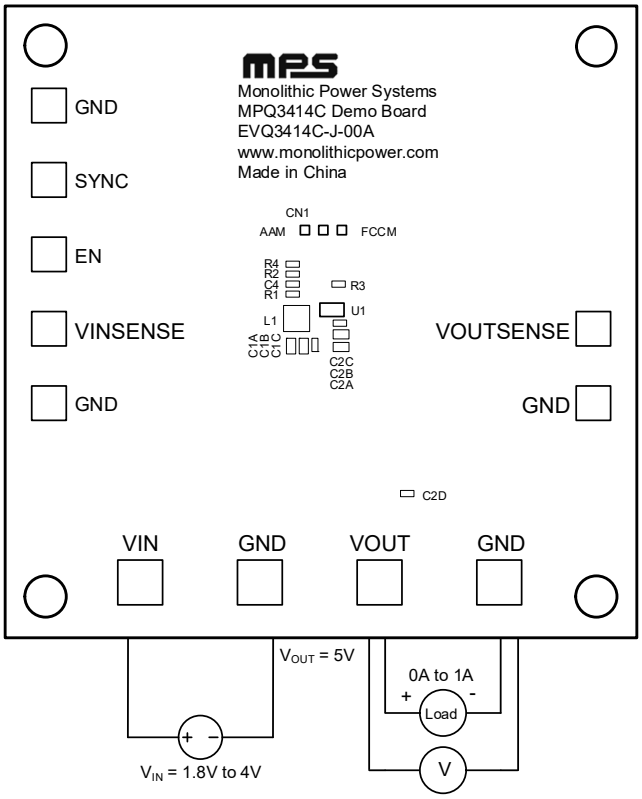

Figure 1: Measurement Equipment Set-Up

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EVALUATION BOARD SCHEMATIC

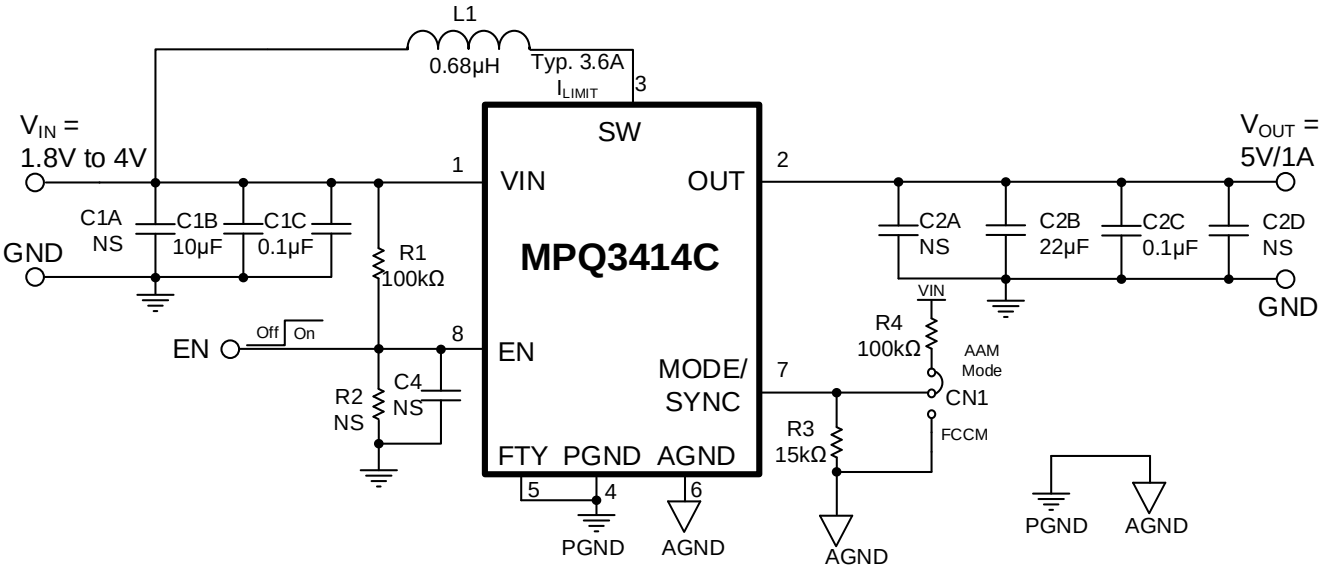
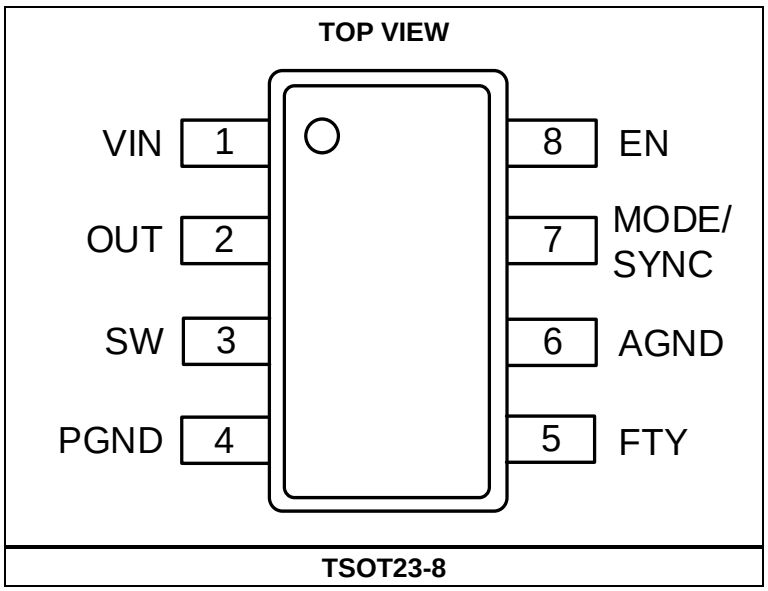


Figure 2: Evaluation Board Schematic

PACKAGE REFERENCE



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EVQ3414C-J-00A BILL OF MATERIALS

Qty	Ref	Value	Description	Package	Manufacturer	Manufacturer PN
4	C1A, C2A, C2D, C4	NS				
1	C1B	10µF	Ceramic capacitor, 10V, X7R	0805	Murata	GCM21BR71A106KE22L
2	C1C, C2C	100nF	Ceramic capacitor, 25V, X7R	0603	Murata	GCJ188R71E104KA12D
1	C2B	22µF	Ceramic capacitor, 10V, X7R	0805	Murata	GRM21BZ71A226ME15L
1	L1	680nH	Inductor, 9mΩ, 8.2A	SMD	Wurth	744383560068
2	R1, R4	100kΩ	Film resistor, 1%	0603	Yageo	RC0603FR-07100KL
1	R2	NS				
1	R3	15kΩ	Film resistor, 1%	0603	Yageo	RC0603FR-0715KL
1	CN1	2.54mm	Test pin, 3-pin	DIP	Any	
4	VIN, GND, VOUT, GND	2mm	Golden pin	DIP	Custom (1)	
7	SYNC, EN, VINSENSE, VOUTSENSE, GND	1mm	Golden pin	DIP	Custom (1)	
1	U1	MPQ3414C	1.5A, 2.2MHz, 5V V_{OUT}, boost converter, AEC-Q100	TSOT23-8	MPS	MPQ3414CGJ-5-AEC1

Note:

1) MPS custom-produces these pins. Contact an MPS FAE for more information.

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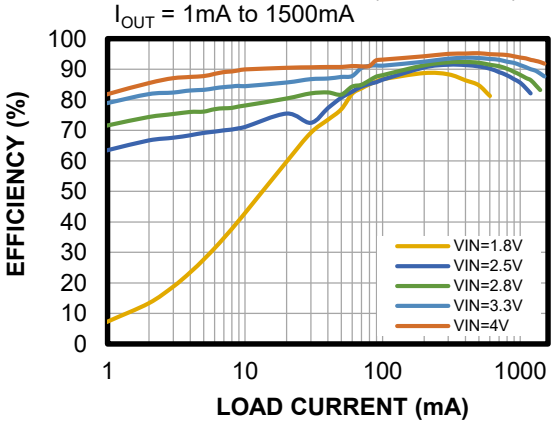
EVB TEST RESULTS *(continued)*

Performance curves and waveforms are tested on the evaluation board. V_{IN} = 3.3V, V_{OUT} = 5V, C_{OUT} = 22µF, L = 0.68µH, T_A = 25°C, unless otherwise noted.

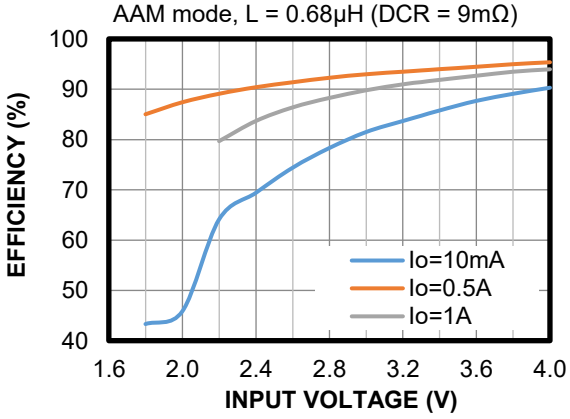
Efficiency vs. Load Current

AAM mode, L = 0.68µH (DCR = 9mΩ),
I_{OUT} = 1mA to 1500mA



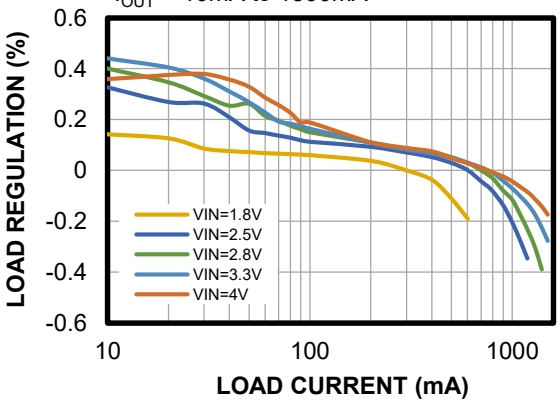
Efficiency vs. Input Voltage

AAM mode, L = 0.68µH (DCR = 9mΩ)



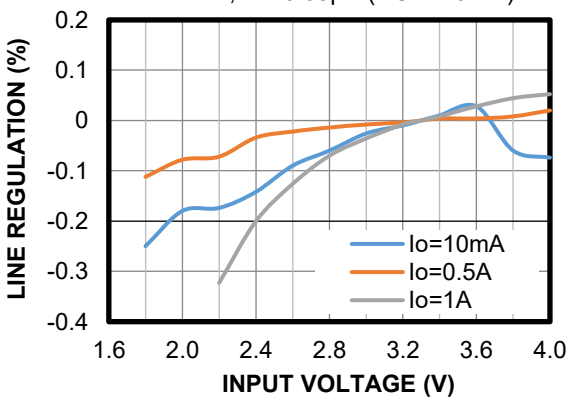
Load Regulation

AAM mode, L = 0.68µH (DCR = 9mΩ),
I_{OUT} = 10mA to 1500mA



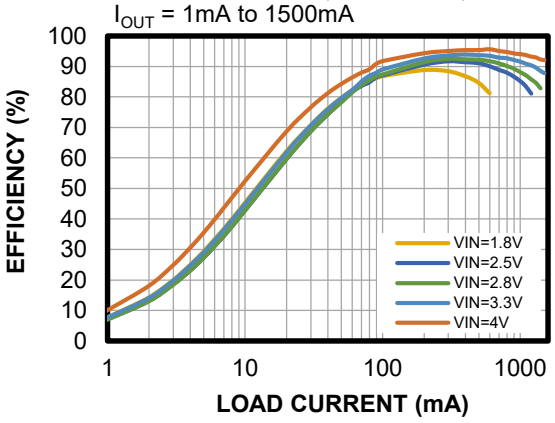
Line Regulation

AAM mode, L = 0.68µH (DCR = 9mΩ)



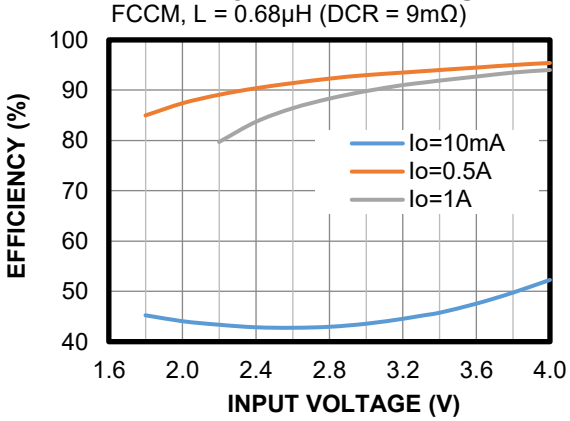
Efficiency vs. Load Current

FCCM, L = 0.68µH (DCR = 9mΩ),
I_{OUT} = 1mA to 1500mA



Efficiency vs. Input Voltage

FCCM, L = 0.68µH (DCR = 9mΩ)



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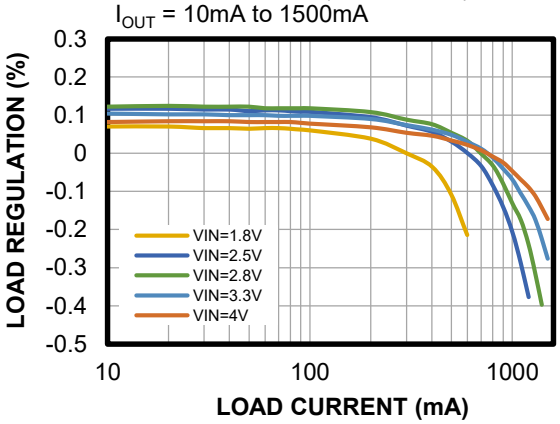
EVB TEST RESULTS *(continued)*

Performance curves and waveforms are tested on the evaluation board. V_{IN} = 3.3V, V_{OUT} = 5V, C_{OUT} = 22µF, L = 0.68µH, T_A = 25°C, unless otherwise noted.

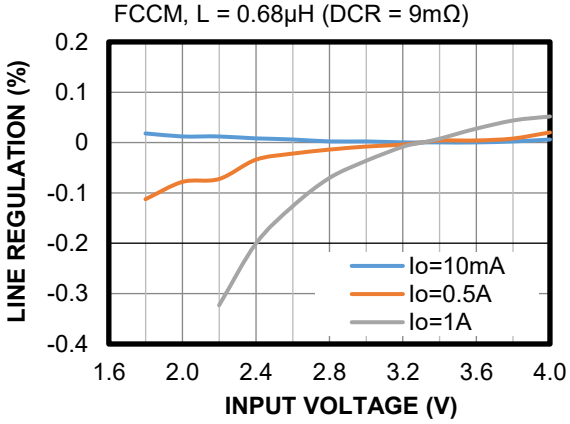
Load Regulation

FCCM, L = 0.68µH (DCR = 9mΩ),
I_{OUT} = 10mA to 1500mA



Line Regulation

FCCM, L = 0.68µH (DCR = 9mΩ)



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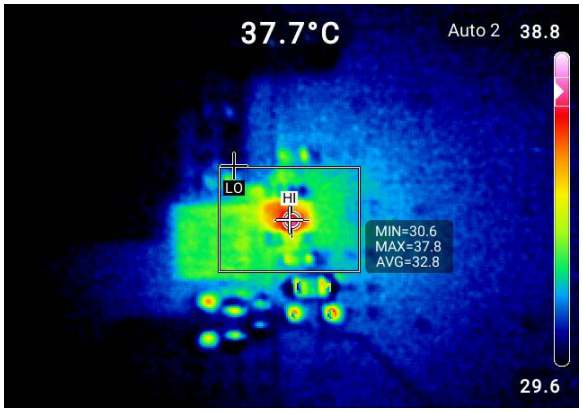
VB TEST RESULTS *(continued)*

Performance curves and waveforms are tested on the evaluation board. V_{IN} = 3.3V, V_{OUT} = 5V, C_{OUT} = 22µF, L = 0.68µH, T_A = 25°C, unless otherwise noted.

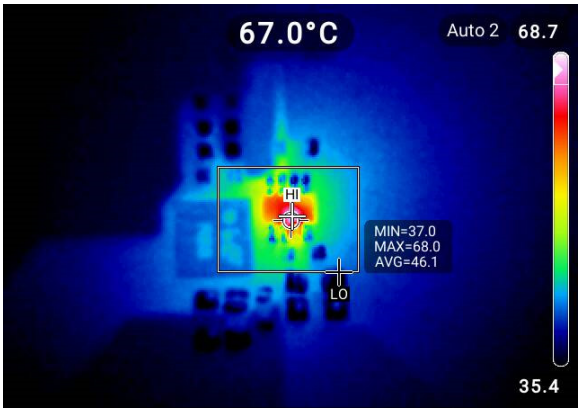
Thermal Performance

I_{OUT} = 0.75A, no forced airflow, T_{CASE} = 37.8°C



Thermal Performance

I_{OUT} = 1.5A, no forced airflow, T_{CASE} = 68.0°C



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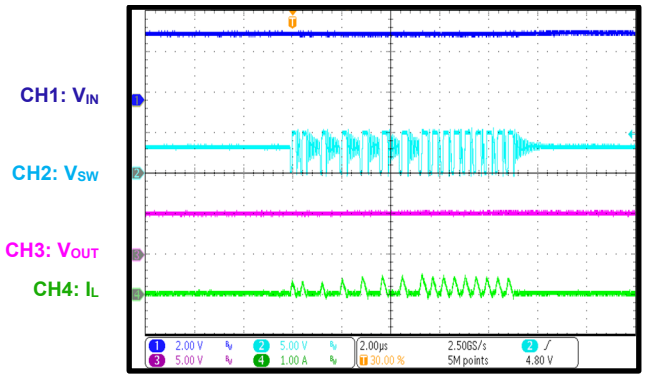
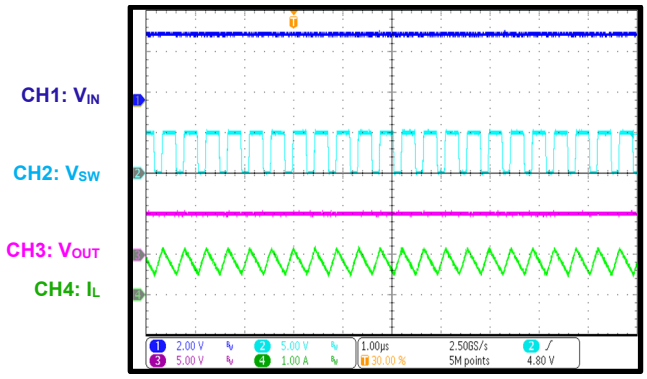
EVB TEST RESULTS *(continued)*

Performance curves and waveforms are tested on the evaluation board. V_{IN} = 3.3V, V_{OUT} = 5V, C_{OUT} = 22µF, L = 0.68µH, T_A = 25°C, unless otherwise noted.

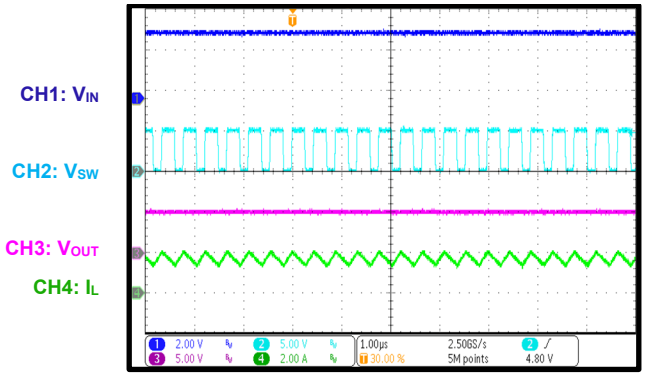
Steady State
AAM mode, I_{OUT} = 0A



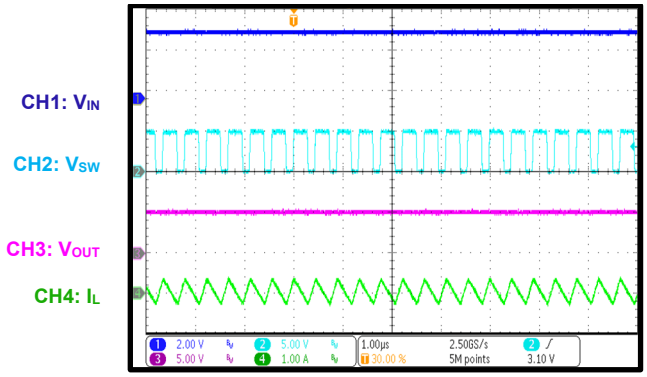
Steady State
AAM mode, I_{OUT} = 0.5A



Steady State
AAM mode, I_{OUT} = 1A



Steady State
FCCM, I_{OUT} = 0A



Steady State
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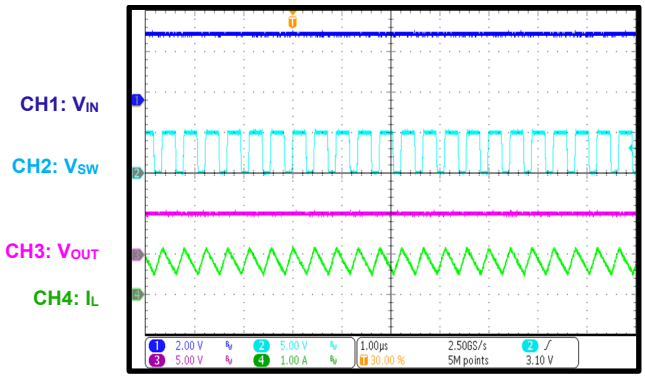
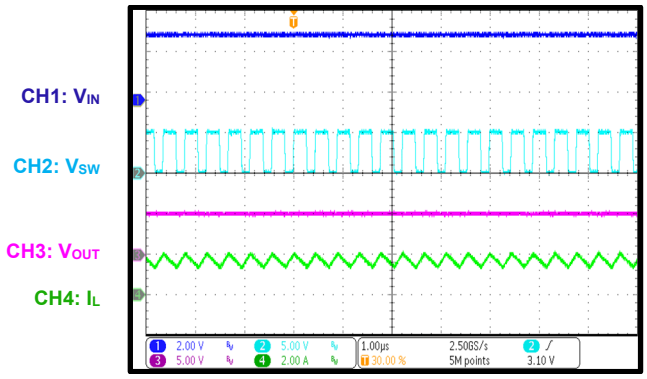


Steady State
FCCM, I_{OUT} = 1A



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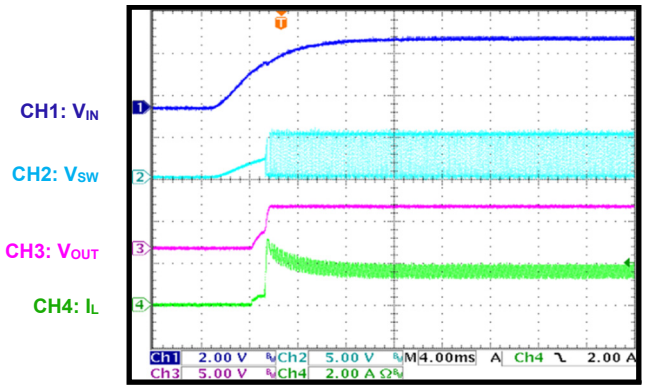
EVB TEST RESULTS *(continued)*

Performance curves and waveforms are tested on the evaluation board. V_{IN} = 3.3V, V_{OUT} = 5V, C_{OUT} = 22µF, L = 0.68µH, T_A = 25°C, unless otherwise noted.

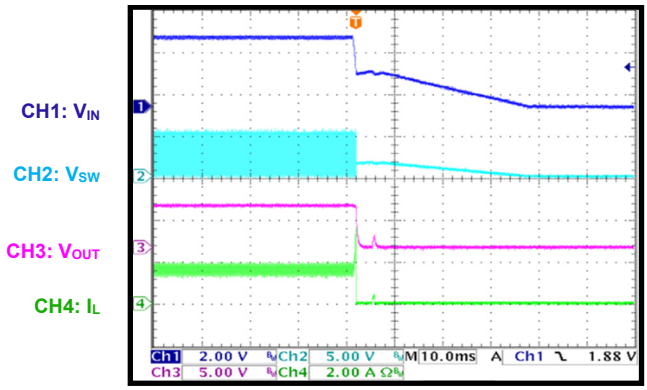
Start-Up through VIN

FCCM, I_{OUT} = 1A



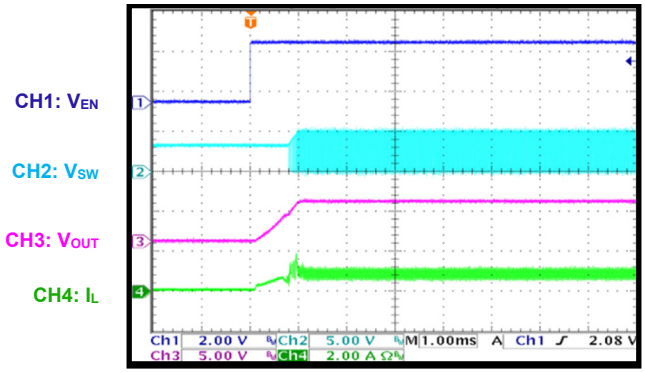
Shutdown through VIN

FCCM, I_{OUT} = 1A



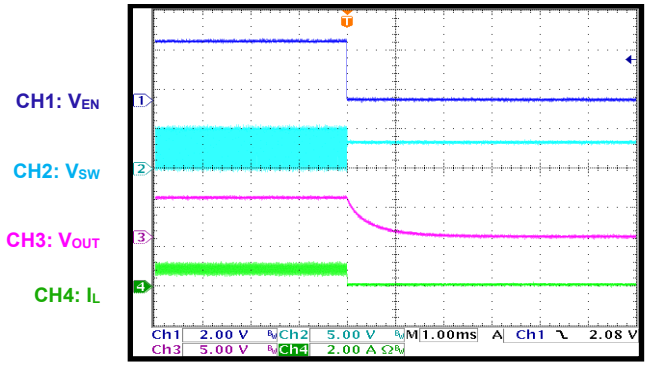
Start-Up through EN

FCCM, I_{OUT} = 0.5A



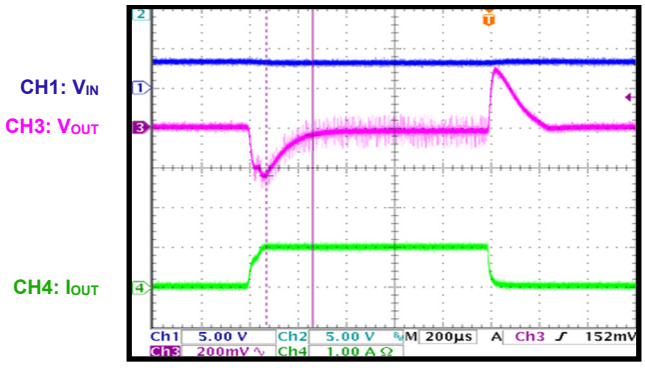
Shutdown through EN

FCCM, I_{OUT} = 0.5A



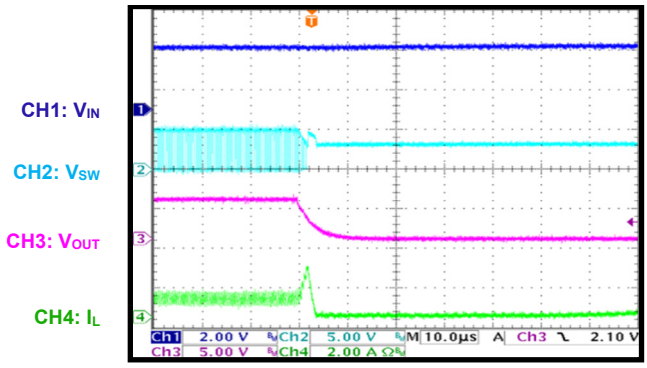
Load Transient

FCCM, I_{OUT} = 0A to 1A, 2.5A/µs slew rate



Short-Circuit Protection

FCCM, I_{OUT} = 0.5A



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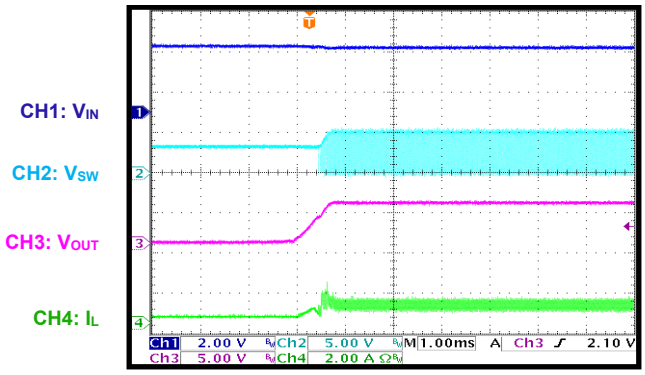
EVB TEST RESULTS *(continued)*

Performance curves and waveforms are tested on the evaluation board. V_{IN} = 3.3V, V_{OUT} = 5V, C_{OUT} = 22µF, L = 0.68µH, T_A = 25°C, unless otherwise noted.

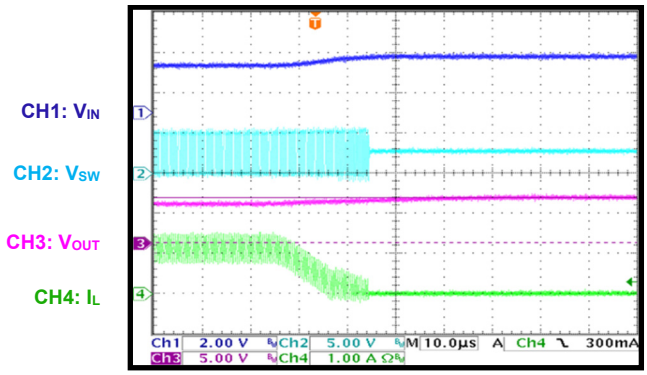
SCP Recovery

FCCM, I_{OUT} = 0.5A



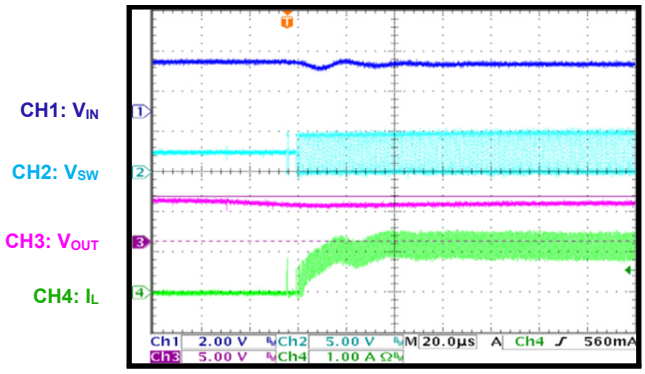
Over-Voltage Protection

V_{IN} = 2.5V, I_{OUT} = 0.5A



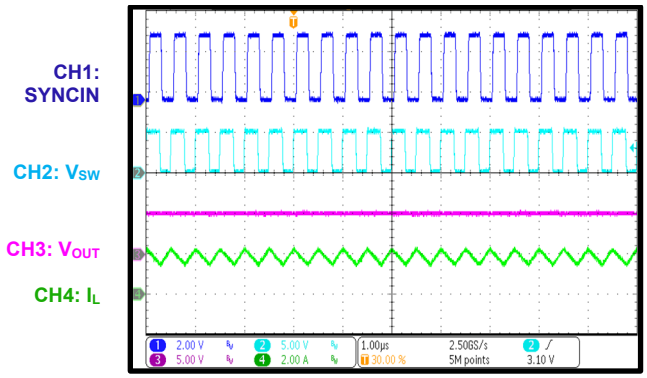
OVP Recovery

V_{IN} = 2.5V, I_{OUT} = 0.5A



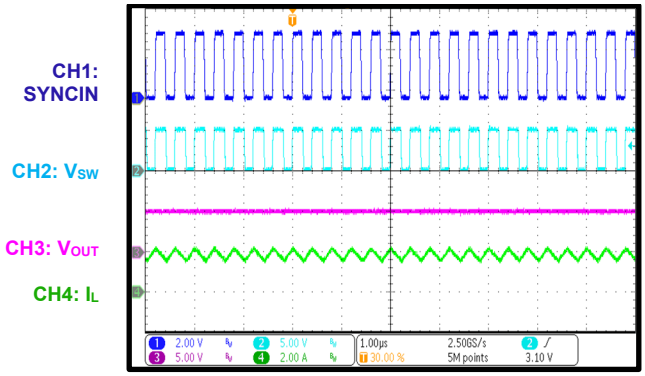
SYNC Operation

I_{OUT} = 1A, SYNC frequency = 2000kHz



SYNC Operation

I_{OUT} = 1A, SYNC frequency = 2500kHz



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PCB LAYOUT (2)

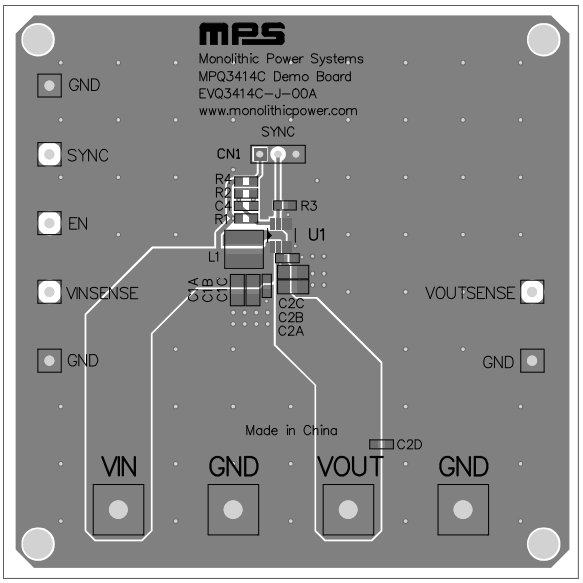

Figure 3: Top Silk and Top Layer

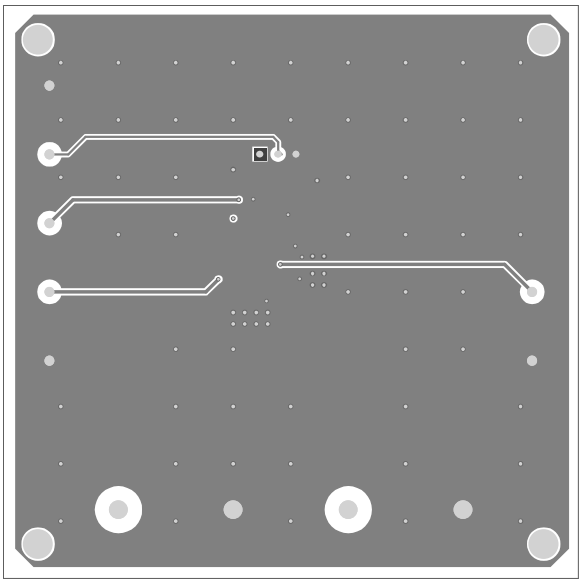

Figure 4: Bottom Layer

Note:

2) The copper thickness is 2oz.

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REVISION HISTORY

Revision #	Revision Date	Description	Pages Updated
1.0	10/23/2024	Initial Release	-

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