



# EVQ9842-L-00A

36V, 2A, Low Quiescent Current  
Synchronous Step-Down Converter Evaluation Board

## DESCRIPTION

The EVQ9842-L-00A Evaluation Board is designed to demonstrate the capabilities of MPS' MP/MPQ9842.

MP/MPQ9842GL is a frequency programmable (350kHz to 2.5MHz), synchronous, step-down, switching regulator with integrated internal high-side and low-side power MOSFETs. It provides up to 2A highly efficient output current with current mode control for fast loop response.

The MP/MPQ9842GL employs AAM (Advanced Asynchronous Modulation) mode which helps to achieve high efficiency at light load condition by scaling down the switching frequency to reduce the switching and gate driving losses.

The EVQ9842-L-00A is a fully assembled and tested evaluation board, it generates +5V output voltage at load current up to 2A from a 5V to 36V input range with 450kHz switching frequency.

## ELECTRICAL SPECIFICATION

Parameter	Symbol	Value	Units
Input Voltage	V <sub>EMI</sub>	5 - 36	V
Output Voltage	V <sub>OUT</sub>	5	V
Output Current	I <sub>OUT</sub>	3.5	A

## FEATURES

- Wide 5V to 36V Operating Input Range
- 2A Continuous Output Current
- 2µA Low Shutdown Mode Current
- 14µA Sleep Mode Quiescent Current
- Internal 125mΩ High-Side and 55mΩ Low-Side MOSFETs
- 350kHz to 2.5MHz Programmable Switching Frequency
- Synchronize to External Clock
- Selectable In-Phase or 180° Out-of-Phase
- Power Good Indicator
- Programmable Soft-Start Time
- 80ns Minimum On Time
- Selectable Forced CCM and AAM
- Low Dropout Mode
- Over-Current Protection with Valley-Current Detection and Hiccup
- Thermal Shutdown
- Available in a QFN-16 (3mmx4mm) Package
- Available Wettable Flank
- AEC-Q100 Grade-1

## APPLICATIONS

- Automotive Systems
- Industrial Power Systems

All MPS parts are lead-free, halogen free, and adhere to the RoHS directive. For MPS green status, please visit MPS website under Quality Assurance. "MPS" and "The Future of Analog IC Technology" are Registered Trademarks of Monolithic Power Systems, Inc.

## EVQ9842-L-00A EVALUATION BOARD

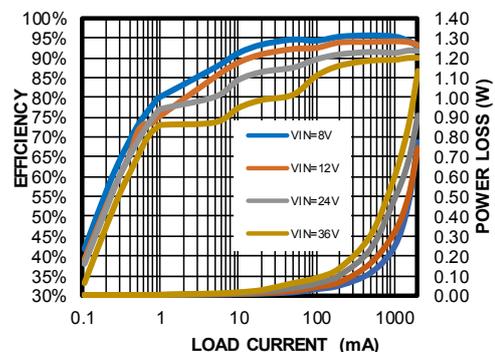


(L × W × H) 8.9cm x 8.9cm x 2cm

Board Number	MPS IC Number
EVQ9842-L-00A	MP/MPQ9842GL

### Efficiency vs. Load Current

V<sub>OUT</sub>=5V, AAM

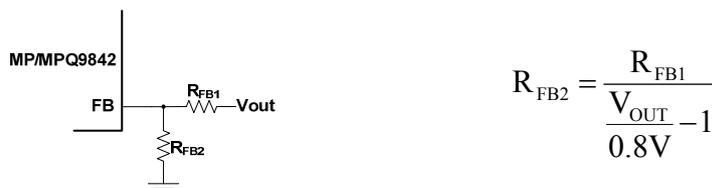


## QUICK START GUIDE

1. Preset power supply to  $5V \leq V_{IN} \leq 36V$ .  
Be aware that electronic loads represent a negative impedance to the regulator and if set to a too high current will trigger Hiccup mode.
2. Turn power supply off.  
If longer cables are used between the source and the EVB (>0.5m total), a damping capacitor should be installed at the input terminals. Especially when  $V_{in}$  is  $\geq 24V$ .
3. Connect power supply terminals to:
  - a. Positive (+): VEMI
  - b. Negative (-): GND
4. Connect load to:
  - a. Positive (+): VOUT
  - b. Negative (-): GND
5. Turn power supply on after making connections.
6. To use the Enable function, apply a digital input to the EN pin. Drive EN higher than 1.05V to turn on the regulator, drive EN less than 0.93V to turn it off.
7. The oscillating frequency of MP/MPQ9842 can be programmed by an external frequency resistor  $R_{FREQ}$ . The value of  $R_{FREQ}$  can be estimated with below equation:

$$R_{FREQ}(\text{k}\Omega) = \frac{170000}{f_{sw}^{1.11}(\text{kHz})}$$

8. To use the Sync function, apply a 350kHz to 2.5MHz clock to the Sync pin to synchronize the internal oscillator frequency to the external clock. The external clock should be at least 250kHz larger than  $R_{FREQ}$  set frequency. The SYNC pin can also be used to select forced CCM mode or AAM mode. Drive it high before the chip starts up to choose forced CCM mode, and drive it low or leave it float to choose AAM mode.
9. 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. For different output voltage,  $R_{FB1}$  and  $R_{FB2}$  can be calculated by below equation:

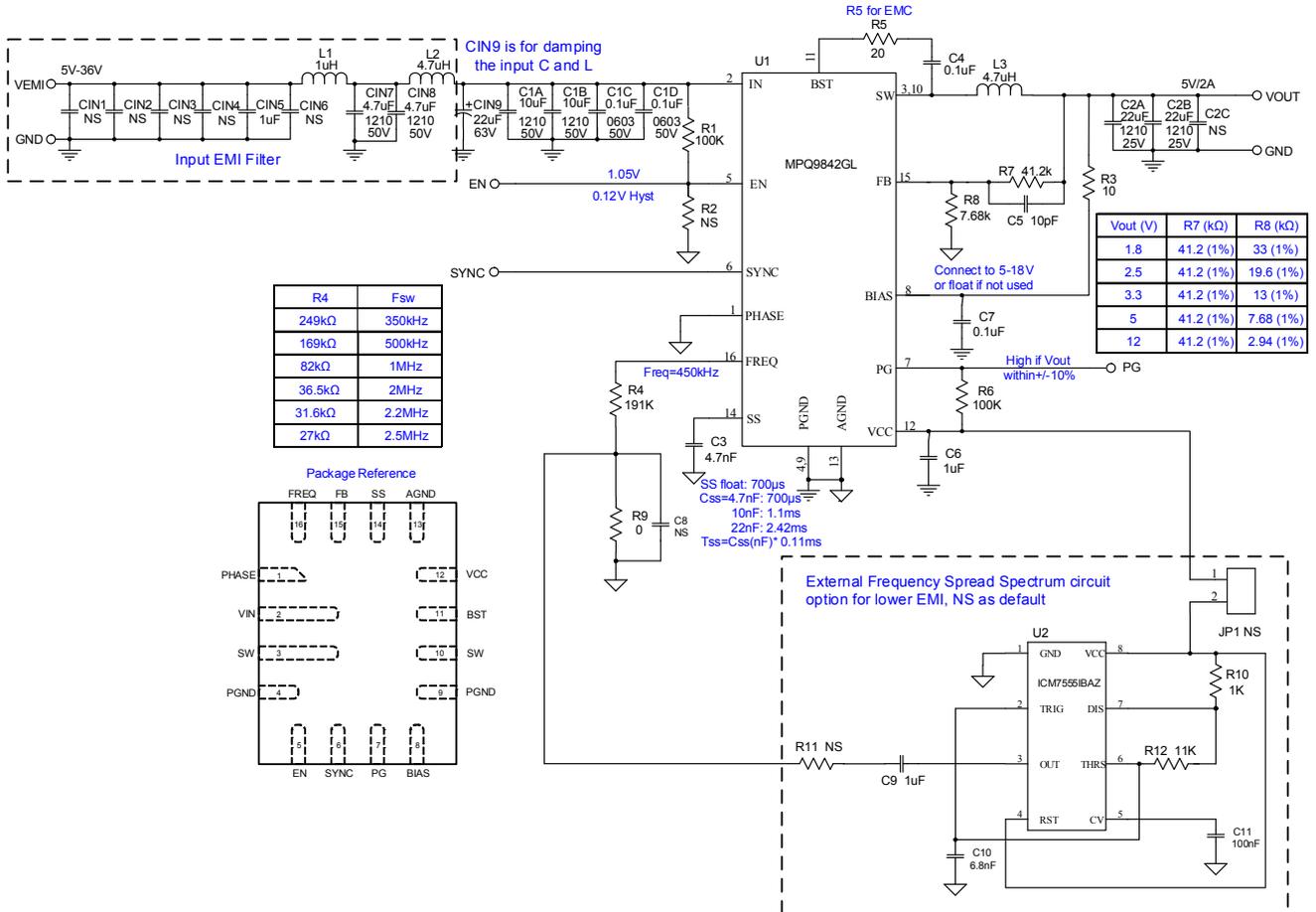


Below table lists the recommended feedback resistor values for common output voltages.

$V_{OUT}$ (V)	$R_{FB1}$ (k $\Omega$ )	$R_{FB2}$ (k $\Omega$ )
1.8	41.2 (1%)	33 (1%)
2.5	41.2 (1%)	19.6 (1%)
3.3	41.2 (1%)	13 (1%)
5	41.2 (1%)	7.68 (1%)
12	41.2 (1%)	2.94 (1%)

10. JP1 and JP2 can be used for adding an external shielding above inductor and IC, NS as default.

### EVALUATION BOARD SCHEMATIC



**EVQ9842-L-00A BILL OF MATERIALS**

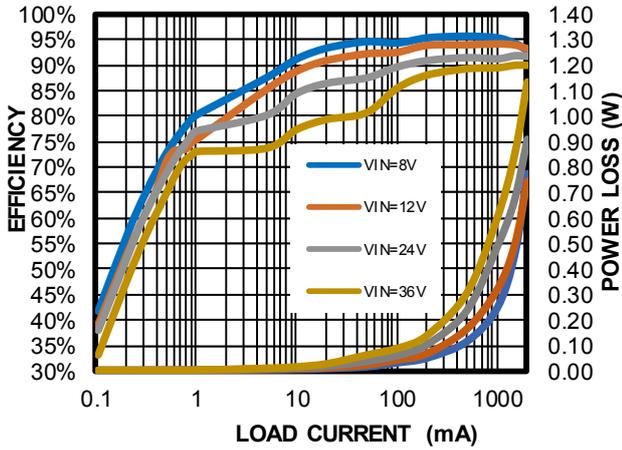
Qty	Ref	Value	Description	Package	Manufacture	Manufacture_PN
1	CIN5	1μF	Ceramic Cap., 50V, X7R	0805	muRata	GRM21BR71H105KA12L
2	CIN7, CIN8	4.7μF	Ceramic Cap., 50V, X7R	1210	muRata	GRM32ER71H475KA88L
1	CIN9	22μF	Electrolytic Capacitor., 63V	SMD	Jianghai	VTD-63V22
2	C1A, C1B	10μF	Ceramic Cap., 50V, X7R	1210	muRata	GRM32ER71H106KA12L
2	C1C, C1D	0.1μF	Ceramic Cap., 50V, X7R	0603	muRata	GRM188R71H104KA93D
2	C2A, C2B	22μF	Ceramic Cap., 25V, X7R	1210	muRata	GRM32ER71H226KE15L
1	C3	4.7nF	Ceramic Cap., 50V, X7R	0603	TDK	C1608X7R1H472K
3	C4, C7, C11	0.1μF	Ceramic Cap., 16V, X7R	0603	muRata	GRM188R71C104KA01D
1	C5	10pF	Ceramic Cap., 50V, C0G	0603	muRata	GRM1885C1H100JA01
2	C6, C9	1μF	Ceramic Cap., 16V, X7R	0603	muRata	GRM188R71C105KA12D
1	C10	6.8nF	Ceramic Cap., 50V, X7R	0603	TDK	C1608X7R1H682K
7	CIN1, CIN2, CIN3, CIN4, CIN6, C2C, C8	NS				
2	JP1, JP2	NS				
1	L1	1μH	Inductor, 41mOhm DCR, 3.1A	SMD	Cyntec	VCTA20161B-1R0MS6-89
1	L2	4.7μH	Inductor, 48.6mOhm DCR, 3.7A	SMD	Cyntec	VCHA042A-4R7MS6-89
1	L3	4.7μH	Inductor, 31.5mOhm DCR, 6A	SMD	Cyntec	VCMT063T-4R7MN5-89
2	R1, R6	100k	Film Res., 1%	0603	Yageo	RC0603FR-07100KL
1	R3	10	Film Res., 1%	0603	Yageo	RC0603FR-0710RL
1	R4	191k	Film Res., 1%	0603	Yageo	RC0603FR-07191KL
1	R5	20	Film Res., 1%	0603	Yageo	RC0603FR-0720RL
1	R7	41.2k	Film Res., 1%	0603	Yageo	RC0603FR-0741K2L
1	R8	7.68k	Film Res., 1%	0603	Yageo	RC0603FR-0713KL
1	R10	1k	Film Res., 1%	0603	Yageo	RC0603FR-071KL
1	R9	0	Film Res., 1%	0603	Yageo	RC0603FR-070RL
1	R12	11k	Film Res., 1%	0603	Yageo	RC0603FR-0711KL
2	R2, R11	NS				
1	U1		Step-Down Regulator	QFN-16 (3mmX4mm)	MPS	MPQ9842GL
1	U2			SOP-8	Intersil	ICM7555IBAZ
4	VEMI, GND, VOUT, GND		2.0 Golden Pin		HZ	
5	EN, GND, SYNC, GND, PG		1.0 Golden Pin		HZ	

### EVB TEST RESULTS

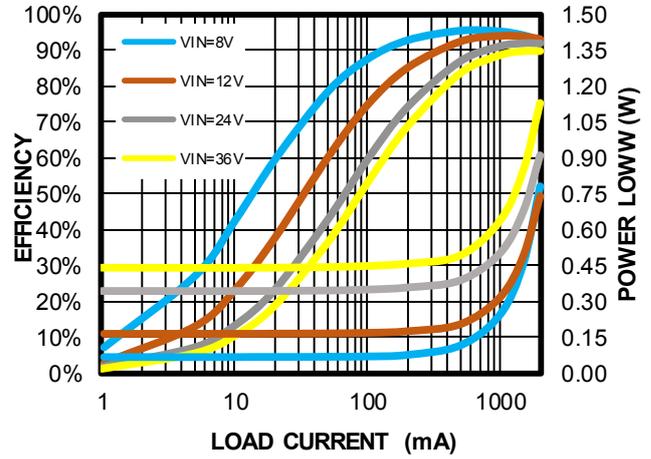
Performance curves and waveforms are tested on the evaluation board.

$V_{IN} = 12V$ ,  $V_{OUT} = 5V$ ,  $L = 4.7\mu H$ ,  $F_{SW} = 450kHz$ ,  $T_A = 25^\circ C$ , unless otherwise noted.

**Efficiency vs. Load Current**  
 $V_{OUT} = 5V$ , AAM



**Efficiency vs. Load Current**  
 $V_{OUT} = 5V$ , CCM



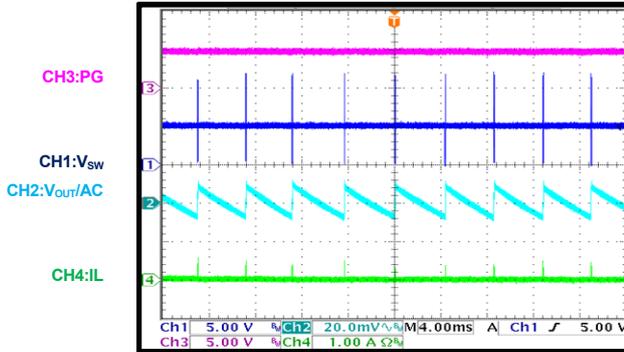
### EVB TEST RESULTS (continued)

Performance curves and waveforms are tested on the evaluation board.

$V_{IN} = 12V$ ,  $V_{OUT} = 5V$ ,  $L = 4.7\mu H$ ,  $F_{SW} = 450kHz$ ,  $T_A = 25^\circ C$ , unless otherwise noted.

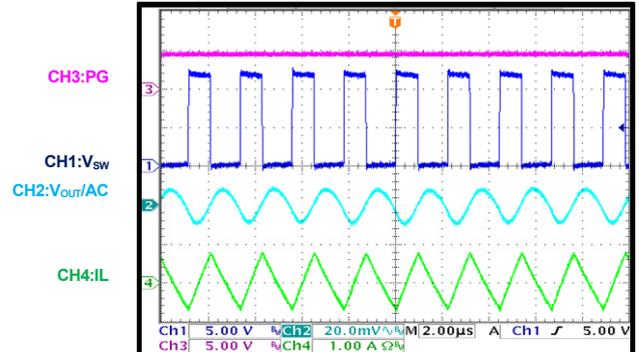
#### Steady State

$V_{IN} = 12V$ ,  $V_{OUT} = 5V$ ,  $I_{OUT} = 0A$ , AAM



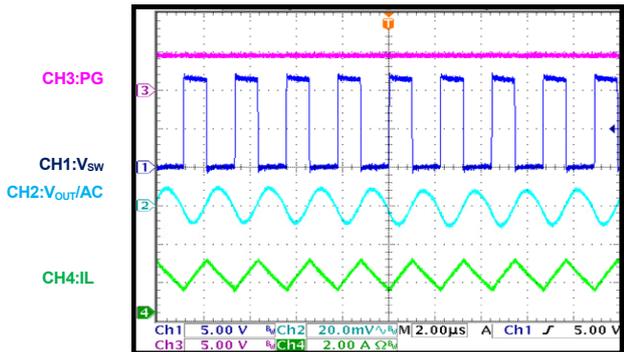
#### Steady State

$V_{IN} = 12V$ ,  $V_{OUT} = 5V$ ,  $I_{OUT} = 0A$ , CCM



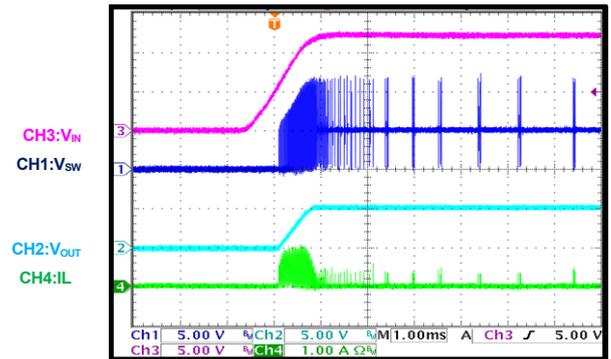
#### Steady State

$V_{IN} = 12V$ ,  $V_{OUT} = 5V$ ,  $I_{OUT} = 2A$



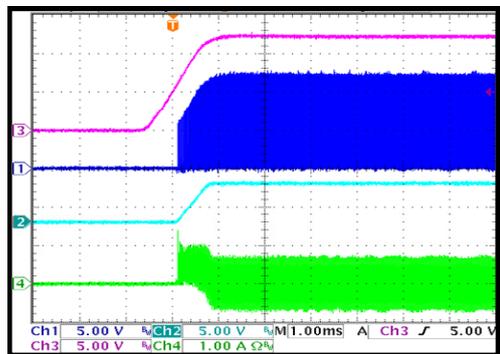
#### Power On

$V_{IN} = 12V$ ,  $V_{OUT} = 5V$ ,  $I_{OUT} = 0A$ , AAM



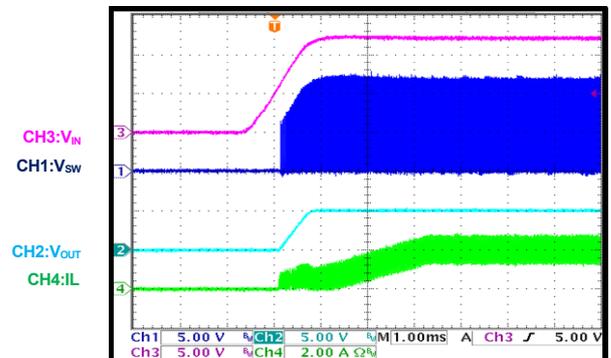
#### Power On

$V_{IN} = 12V$ ,  $V_{OUT} = 5V$ ,  $I_{OUT} = 0A$ , CCM



#### Power On

$V_{IN} = 12V$ ,  $V_{OUT} = 2V$ ,  $I_{OUT} = 2A$



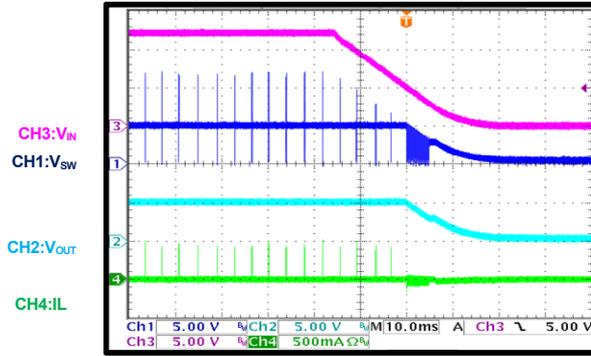
### EVB TEST RESULTS (continued)

Performance curves and waveforms are tested on the evaluation board.

$V_{IN} = 12V$ ,  $V_{OUT} = 5V$ ,  $L = 4.7\mu H$ ,  $F_{SW} = 450kHz$ ,  $T_A = 25^\circ C$ , unless otherwise noted.

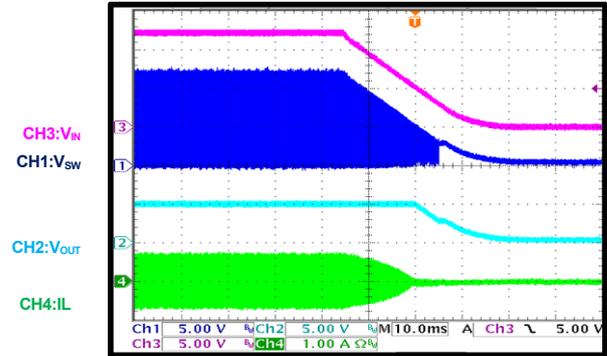
#### Power Off

$V_{IN} = 12V$ ,  $V_{OUT} = 5V$ ,  $I_{OUT} = 0A$ , AAM



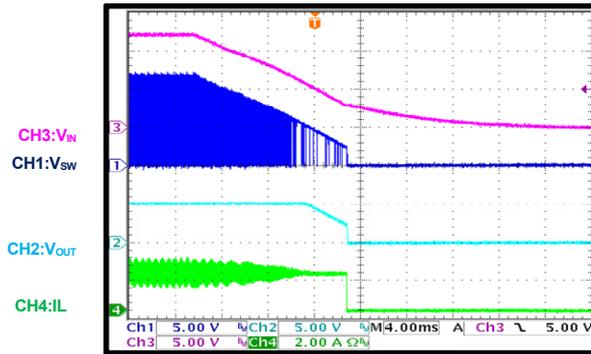
#### Power Off

$V_{IN} = 12V$ ,  $V_{OUT} = 5V$ ,  $I_{OUT} = 0A$ , CCM



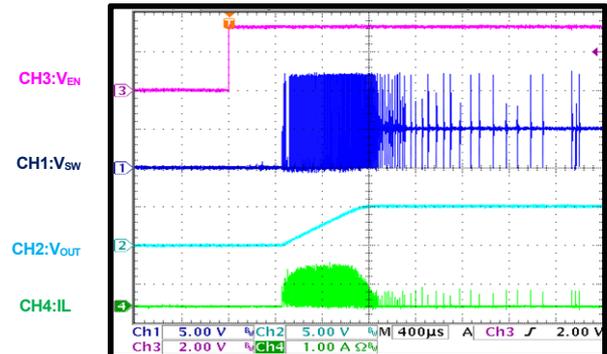
#### Power Off

$V_{IN} = 12V$ ,  $V_{OUT} = 5V$ ,  $I_{OUT} = 2A$



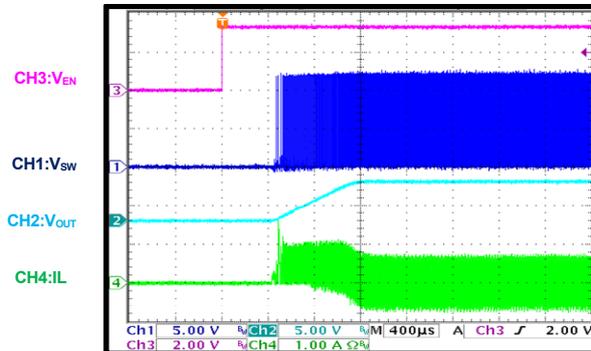
#### EN ON

$V_{IN} = 12V$ ,  $V_{OUT} = 5V$ ,  $I_{OUT} = 0A$ , AAM



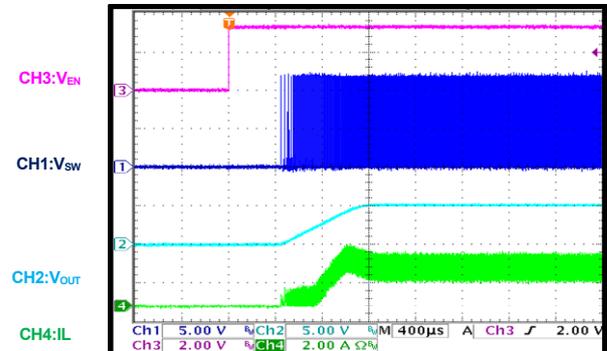
#### EN ON

$V_{IN} = 12V$ ,  $V_{OUT} = 5V$ ,  $I_{OUT} = 0A$ , CCM



#### EN ON

$V_{IN} = 12V$ ,  $V_{OUT} = 5V$ ,  $I_{OUT} = 2A$



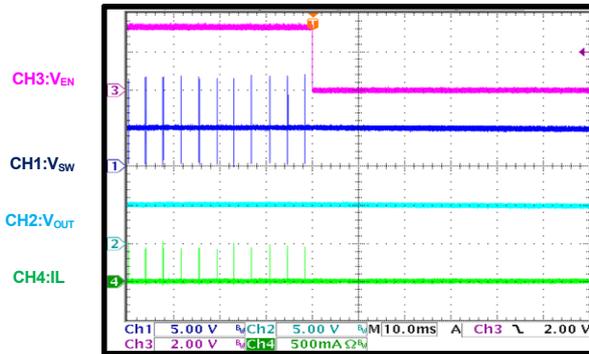
## EVB TEST RESULTS (continued)

Performance curves and waveforms are tested on the evaluation board.

$V_{IN} = 12V$ ,  $V_{OUT} = 5V$ ,  $L = 4.7\mu H$ ,  $F_{SW} = 450kHz$ ,  $T_A = 25^\circ C$ , unless otherwise noted.

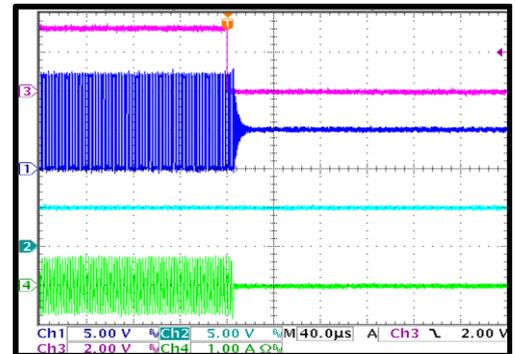
### EN OFF

$V_{IN} = 12V$ ,  $V_{OUT} = 5V$ ,  $I_{OUT} = 0A$ , AAM



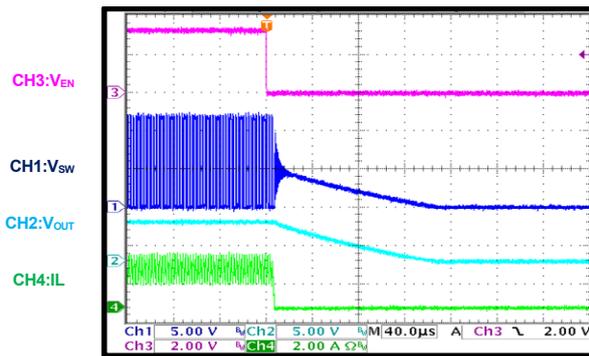
### EN OFF

$V_{IN} = 12V$ ,  $V_{OUT} = 5V$ ,  $I_{OUT} = 0A$ , CCM



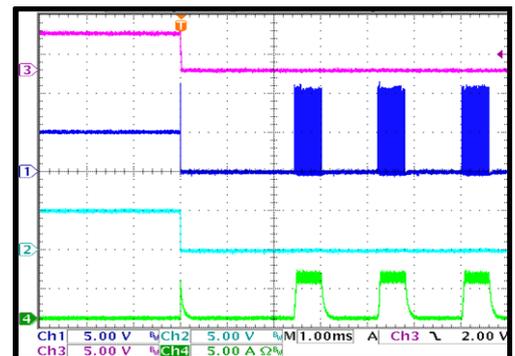
### EN OFF

$V_{IN} = 12V$ ,  $V_{OUT} = 5V$ ,  $I_{OUT} = 0A$ , CCM



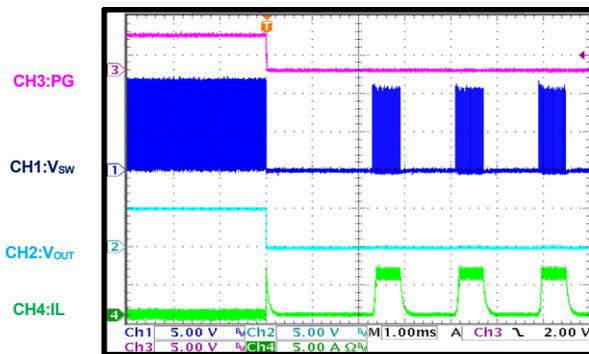
### SCP Entry

$V_{IN} = 12V$ ,  $V_{OUT} = 5V$ ,  $I_{OUT} = 0A$ , AAM



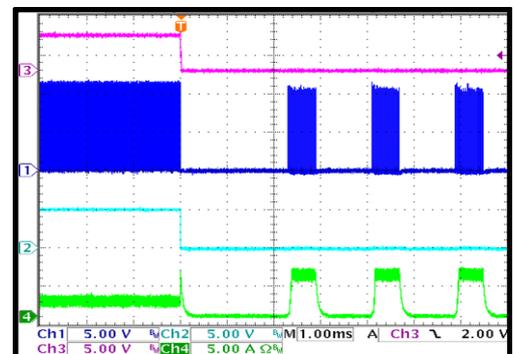
### SCP Entry

$V_{IN} = 12V$ ,  $V_{OUT} = 5V$ ,  $I_{OUT} = 0A$ , CCM



### SCP Entry

$V_{IN} = 12V$ ,  $V_{OUT} = 5V$ ,  $I_{OUT} = 2A$



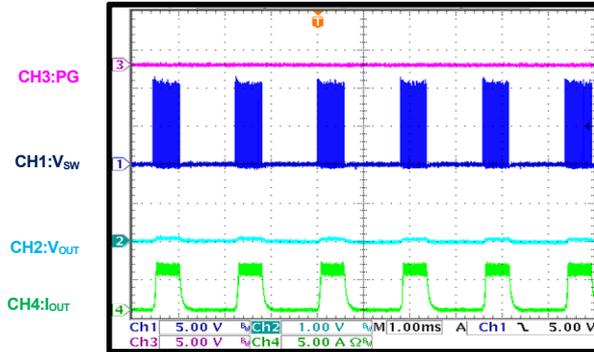
## EVB TEST RESULTS (continued)

Performance curves and waveforms are tested on the evaluation board.

$V_{IN} = 12V$ ,  $V_{OUT} = 5V$ ,  $L = 4.7\mu H$ ,  $F_{SW} = 450kHz$ ,  $T_A = 25^\circ C$ , unless otherwise noted.

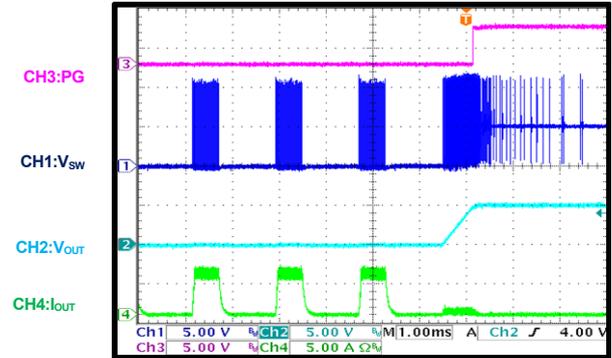
### SCP Steady State

$V_{IN} = 12V$



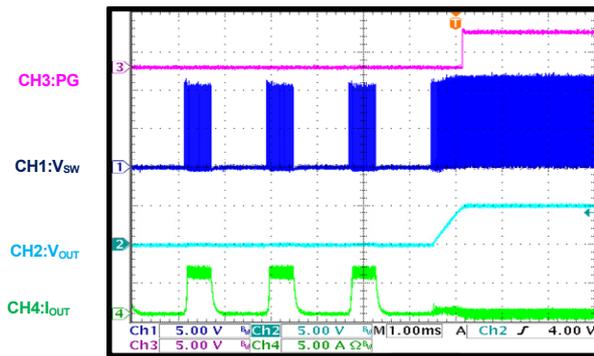
### SCP Recovery

$V_{IN} = 12V$ ,  $V_{OUT} = 5V$ ,  $I_{OUT} = 0A$ , AAM



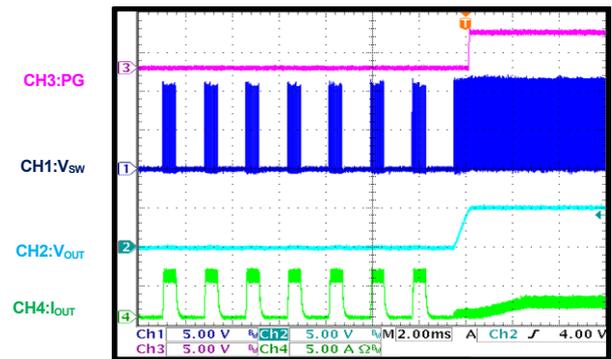
### SCP Recovery

$V_{IN} = 12V$ ,  $V_{OUT} = 5V$ ,  $I_{OUT} = 0A$ , CCM



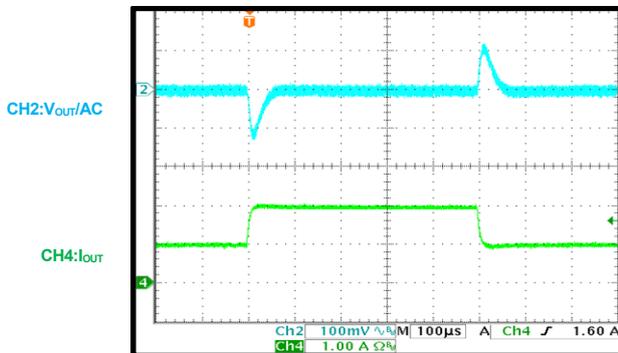
### SCP Recovery

$V_{IN} = 12V$ ,  $V_{OUT} = 5V$ ,  $I_{OUT} = 2A$



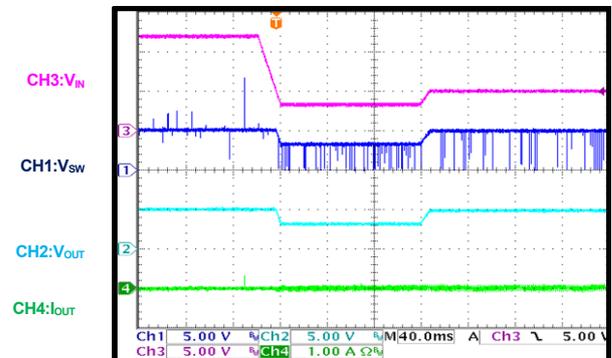
### Load Transient

$V_{IN} = 12V$ ,  $V_{OUT} = 5V$ ,  $I_{OUT} = 1A-2A$



### Cold Crank

$V_{IN} = 12 \rightarrow 3.3V \rightarrow 5V$ ,  $I_{OUT} = 0A$



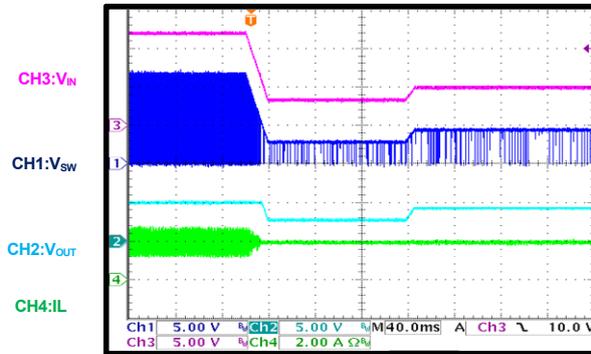
### EVB TEST RESULTS (continued)

Performance curves and waveforms are tested on the evaluation board.

$V_{IN} = 12V$ ,  $V_{OUT} = 5V$ ,  $L = 4.7\mu H$ ,  $F_{SW} = 450kHz$ ,  $T_A = 25^\circ C$ , unless otherwise noted.

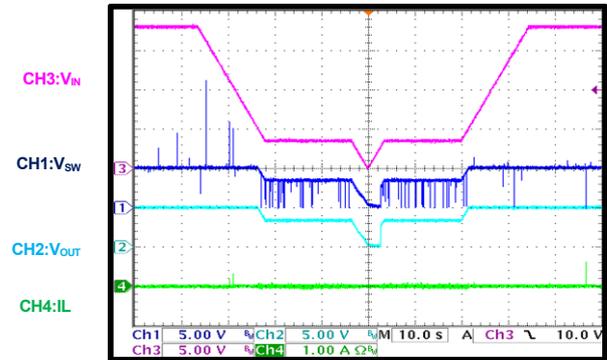
#### Cold Crank

$V_{IN} = 12 \rightarrow 3.3V \rightarrow 5V$ ,  $I_{OUT} = 2A$



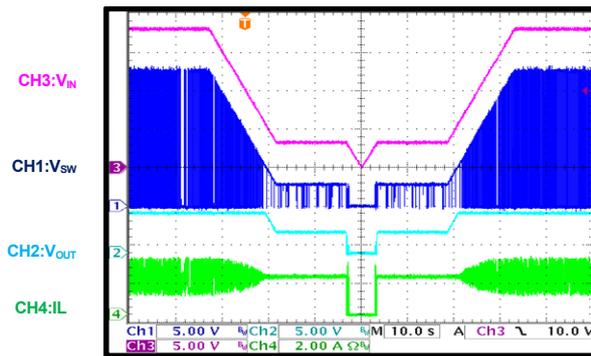
#### Vin Ramp Down and Up

$V_{IN} = 18 \rightarrow 3.3V \rightarrow 0V \rightarrow 3.3V \rightarrow 18V$ ,  $I_{OUT} = 0A$



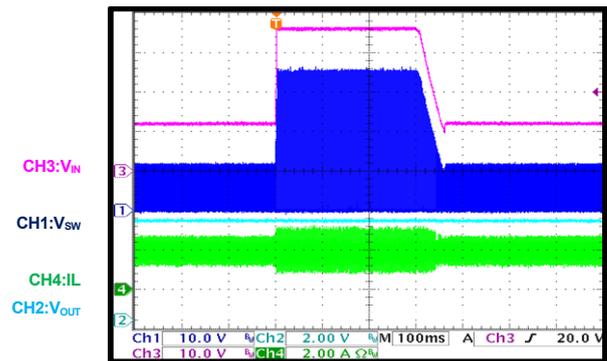
#### Vin Ramp Down and Up

$V_{IN} = 18 \rightarrow 3.5V \rightarrow 0V \rightarrow 3.5V \rightarrow 18V$ ,  $I_{OUT} = 2A$



#### Load Dump

$V_{IN} = 12V \rightarrow 36V \rightarrow 12V$ ,  $I_{OUT} = 2A$



## PRINTED CIRCUIT BOARD LAYOUT

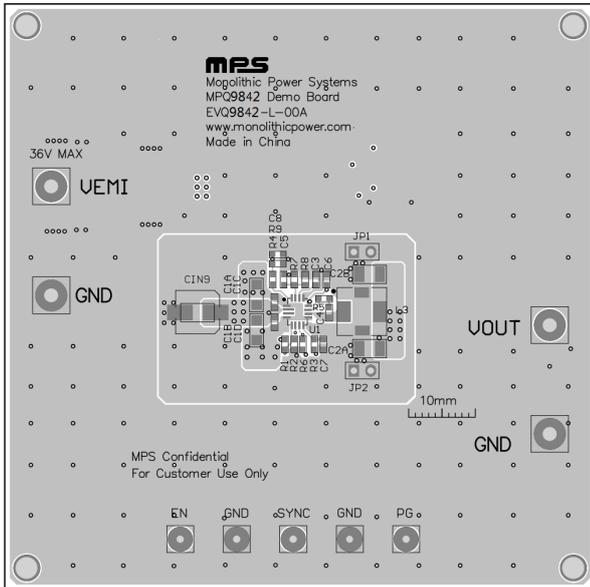


Figure 1: Top Silk Layer and Top Layer

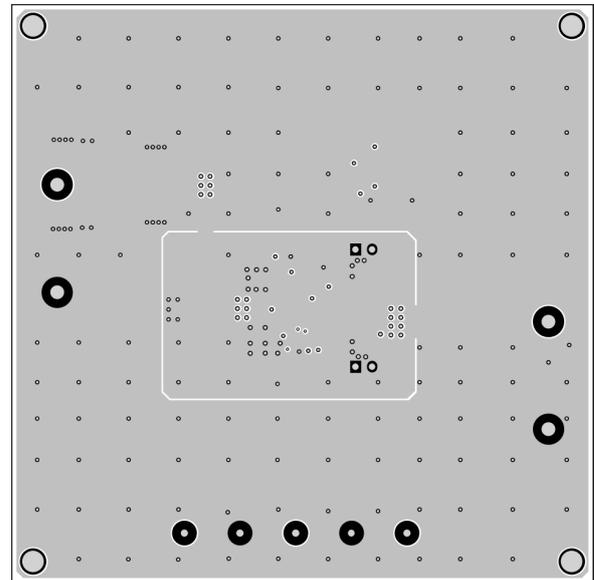


Figure 2: Inner 1 Layer

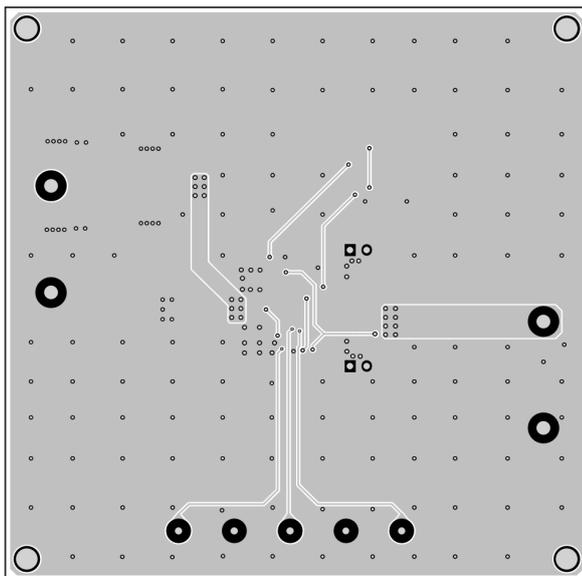


Figure 3: Inner 2 Layer

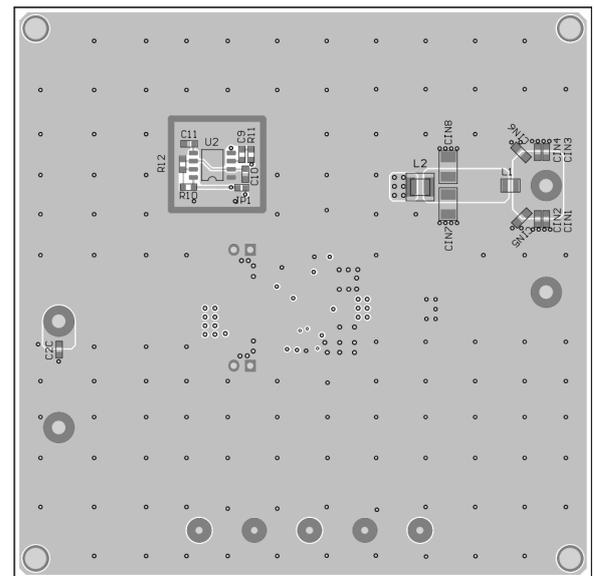


Figure 4: Bottom Silk Layer and Bottom Layer

**NOTICE:** The information in this document is subject to change without notice. Please contact MPS for current specifications. Users should warrant and guarantee that third party Intellectual Property rights are not infringed upon when integrating MPS products into any application. MPS will not assume any legal responsibility for any said applications.