EVBL4423A-Q-00A

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

DESCRIPTION

The EVBL4423A-Q-00A is an evaluation board for the MP4423A/MPQ4423A with MPS power inductor stuffed. MP4423A/MPQ4423A is a high-frequency, synchronous, rectified, step-down, switch-mode converter with build-in power MOSFETs. It offers a very compact solution to achieve a 3A continuous output current with excellent load and line regulation over a wide input supply range. The MP4423A/MPQ4423A has synchronous mode operation for higher efficiency over the output current load range.

Current-mode operation provides fast transient response and eases loop stabilization.

Full protection features include over-current protection and thermal shut down.

The EVBL4423A-Q-00A is assembled and tested with QFN-8 (3mmx3mm) package.

ELECTRICAL SPECIFICATIONS

Parameter	Symbol	Value	Units
Input Voltage	V_{IN}	4-36	V
Output Voltage	V_{OUT}	3.3	V
Output Current	I_{OUT}	3	A

FEATURES

- Wide 4V to 36V Continuous Operating Input Range
- 85mΩ/55mΩ Low RDS(ON) Internal Power MOSFETs
- High-Efficiency Synchronous Mode Operation
- Forced CCM Mode with default 410kHz Switching Frequency
- Synchronizes to a 200kHz to 2.2MHz External Clock
- High Duty Cycle for Automotive Cold-crank
- Internal Soft-Start
- Power Good
- Over-Current Protection (OCP) and Hiccup
- Thermal Shutdown
- Fully Assembled and Tested
- MPS Power Inductor Stuffed

APPLICATIONS

- Automotive
- Industrial Control System
- Distributed Power Systems

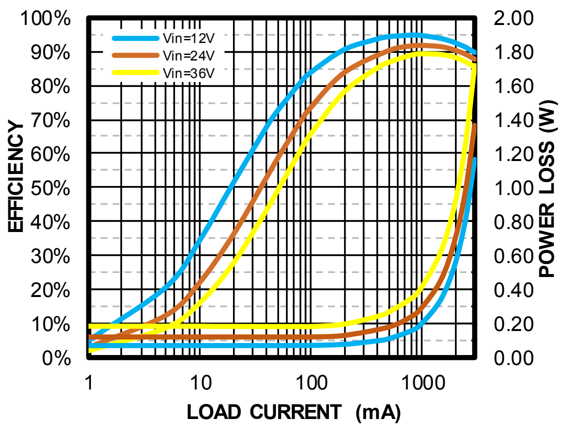
EVBL4423A-Q-00A EVALUATION BOARD

(L x W x H) 2.5” x 2.5” x 0.2”
(6.35cm x 6.35cm x0.5cm)

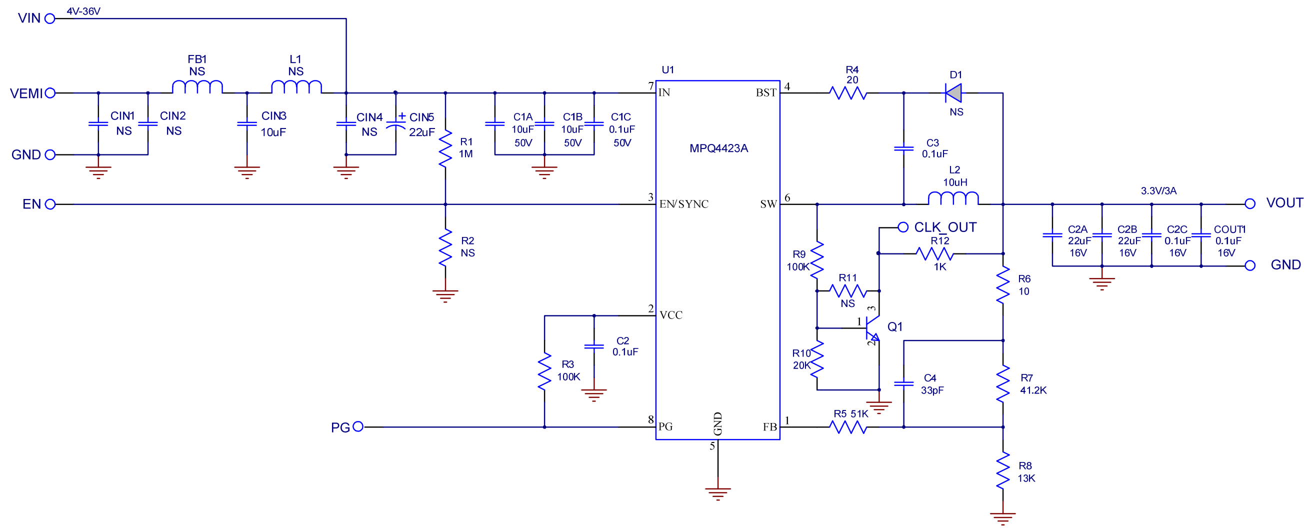
Board Number	MPS IC Number
EVBL4423A-Q-00A	MP4423AGQ

Efficiency vs. Load Current

V_{OUT} = 3.3V



EVALUATION BOARD SCHEMETIC



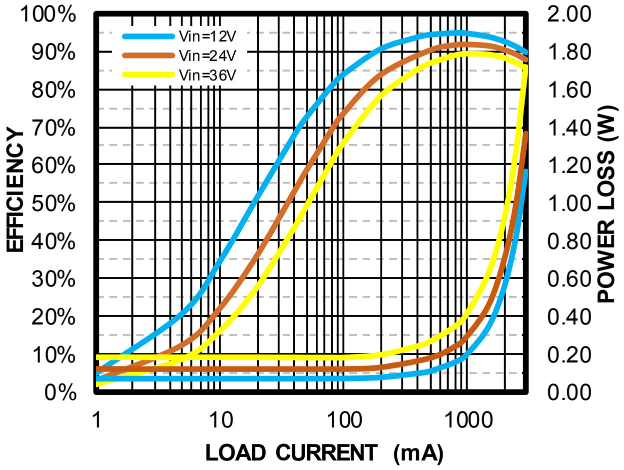
EVBL4423A-Q-00A BILL OF MATERIALS

Qty	RefDes	Value	Description	Package	Manufacturer	Manufactuer_P/N
2	C1A,C1B	10uF	Ceramic Cap., 50V, X7R	1210	muRata	GRM32ER71H106KA12L
1	C1C	0.1uF	Ceramic Cap., 50V, X7R	0603	muRata	GRM188R71H104KA93D
2	C2A,C2B	22uF	Ceramic Cap., 16V, X7R	1210	muRata	GRM32ER71C226KE79
4	C2,C2C,C3,COUT1	0.1uF	Ceramic Cap., 16V, X7R	0603	muRata	GRM188R71C104KA01D
1	C4	33pF	Ceramic Cap., 50V, C0G	0603	muRata	GRM1885C1H330JA01D
4	CIN1-CIN4	NS				
1	CIN5	22uF	Electrolytic Cap.	SMD	Jianghai	VTD-63V22
1	D1	NS				
1	FB1	NS				
1	L1	NS				
1	L2	10uH	Inductor, 27mOhm DCR, 7A	SMD	MPS	MPL-AL6060-100
1	R1	1M	Film Res., 5%	0603	Yageo	RC0603JR-071ML
2	R3,R9	100K	Film Res., 1%	0603	Yageo	RC0603FR-07100KL
1	R4	20	Film Res., 1%	0603	Yageo	RC0603FR-0720RL
1	R5	51K	Film Res., 1%	0603	Yageo	RC0603FR-0751KL
1	R6	10	Film Res., 1%	0603	Yageo	RC0603FR-0710RL
1	R7	41.2K	Film Res., 1%	0603	Yageo	RC0603FR-0741K2L
1	R8	13K	Film Res., 1%	0603	Yageo	RC0603FR-0713KL
1	R10	20K	Film Res., 1%	0603	Yageo	RC0603FR-0720KL
1	R12	1K	Film Res., 1%	0603	Yageo	RC0603FR-071KL
2	R2,R11	NS				
1	Q1		Transistor, 40V, 0.2A	SOT-23	ON Semiconductor	MMBT3904LT1
1	U1		Step-Down Regulator	QFN3X3-8	MPS	MP4423AGQ
5	VIN, VEMI, GND, VOUT, GND		2.0 Golden Pin		HZ	
5	EN/SYNC,GND,PG, GND,CLK_OUT		1.0 Golden Pin		HZ	

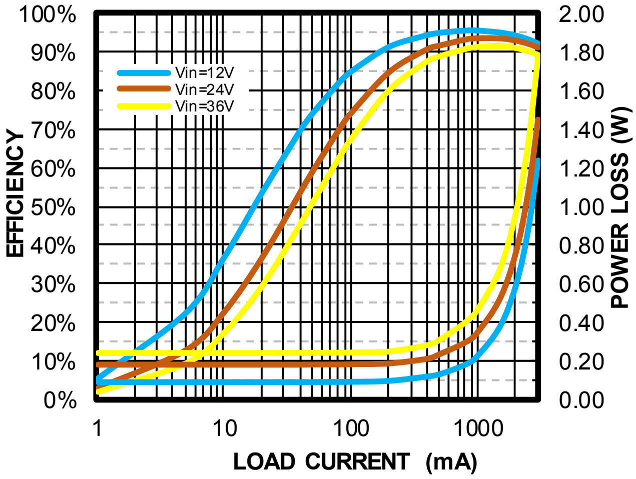
EVB TEST RESULTS

V_{IN} = 12V, V_{OUT} =3.3V, C_{OUT} = 2x22µF, L = 10µH, T_A = +25°C, unless otherwise noted.

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



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

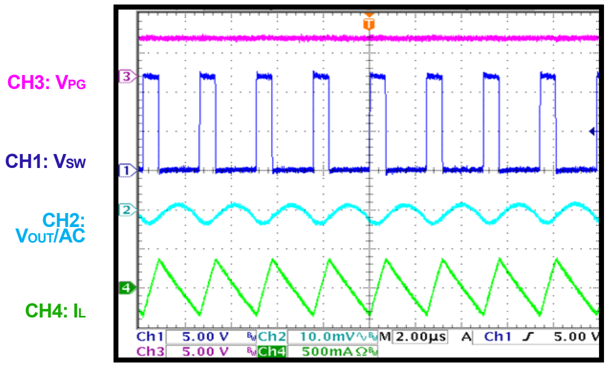


EVB TEST RESULTS *(continued)*

V_{IN} = 12V, V_{OUT} =3.3V, C_{OUT} = 2x22µF, L = 10µH, T_A = +25°C, unless otherwise noted.

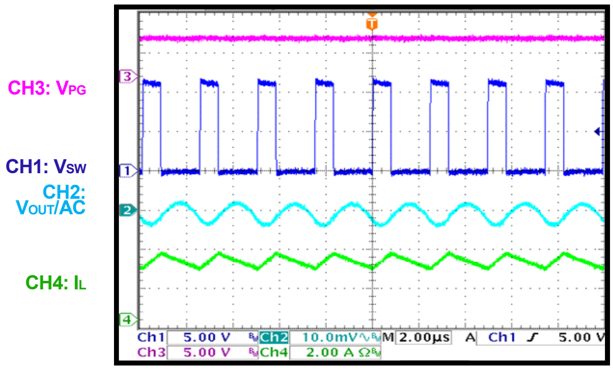
Steady State

V_{IN}=12V, V_{OUT}=3.3V,I_{OUT}=0A



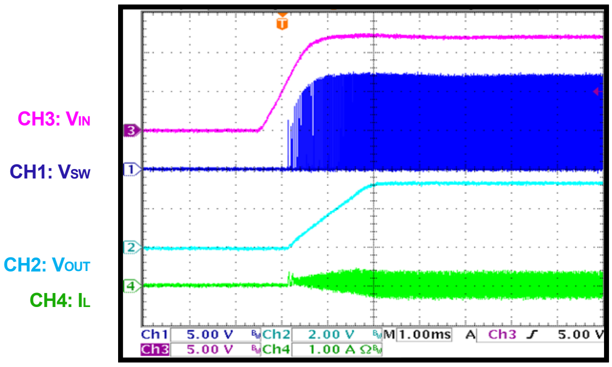
Steady State

V_{IN}=12V, V_{OUT}=3.3V, I_{OUT}=3A



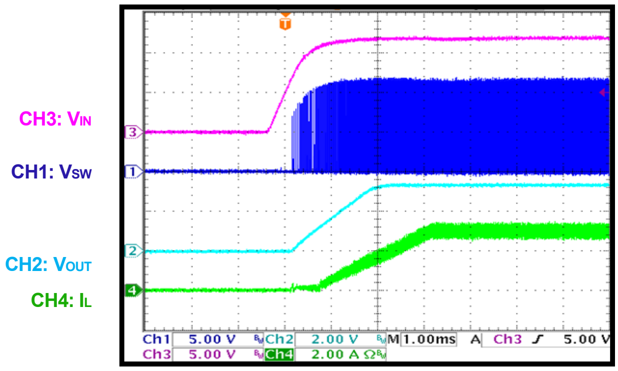
Power On

V_{IN}=12V,V_{OUT}=3.3V,I_{OUT} = 0A



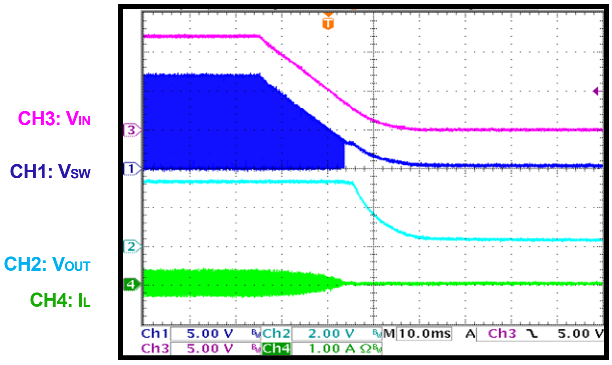
Power On

V_{IN}=12V,V_{OUT}=3.3V,I_{OUT} = 3A



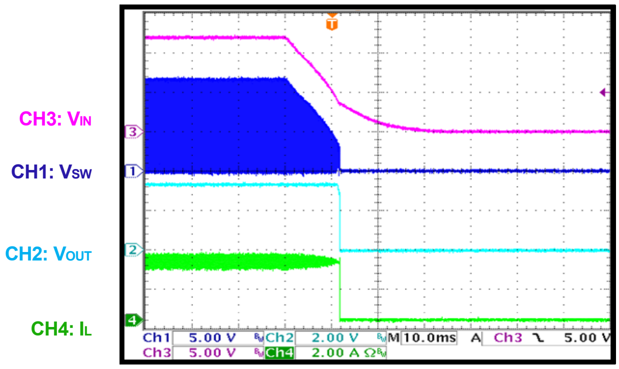
Power Off

V_{IN}=12V,V_{OUT}=3.3V,I_{OUT} = 0A



Power Off

V_{IN}=12V,V_{OUT}=3.3V,I_{OUT} = 3A

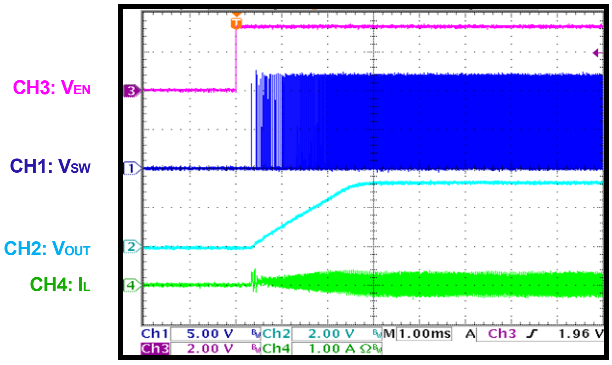


EVB TEST RESULTS *(continued)*

V_{IN} = 12V, V_{OUT} =3.3V, C_{OUT} = 2x22μF, L = 10μH, T_A = +25°C, unless otherwise noted.

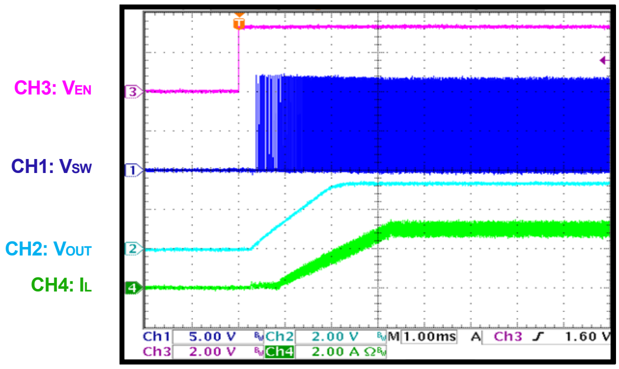
En On

V_{IN}=12V,V_{OUT}=3.3V,I_{OUT} = 0A



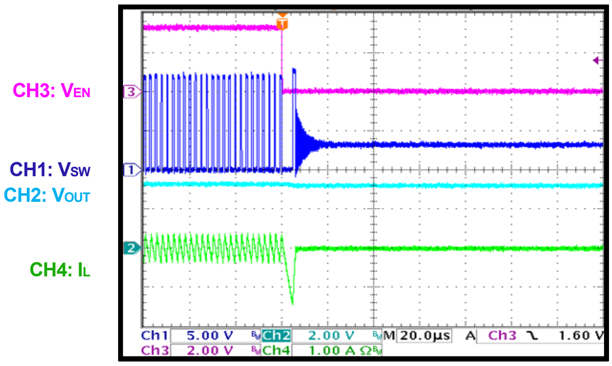
En On

V_{IN}=12V,V_{OUT}=3.3V,I_{OUT} = 3A



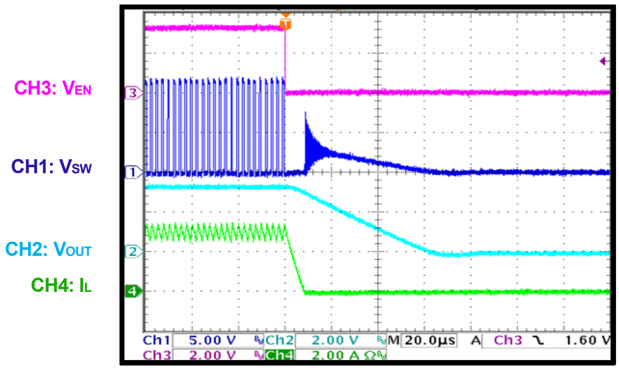
En Off

I_{OUT} = 0A



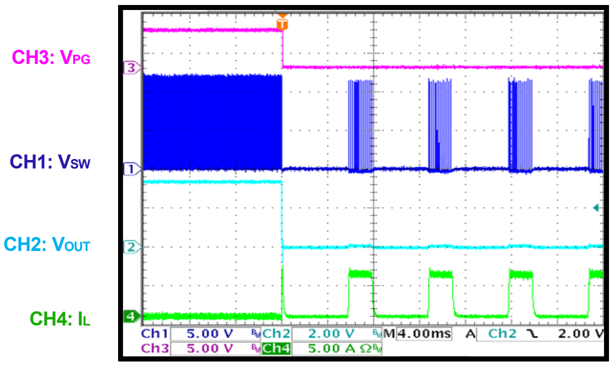
En Off

I_{OUT} = 3A



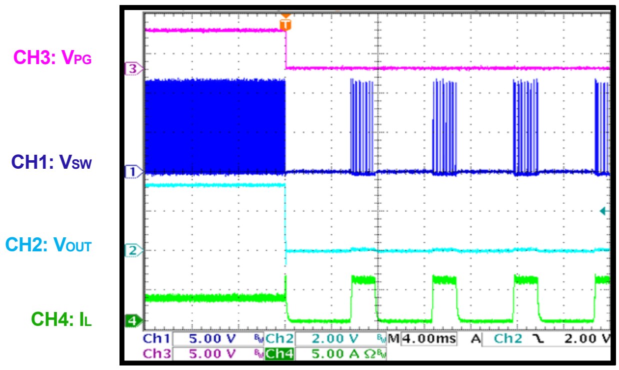
SCP Entry

V_{IN}=12V,V_{OUT}=3.3V,I_{OUT} = 0A



SCP Entry

V_{IN}=12V,V_{OUT}=3.3V,I_{OUT} = 3A

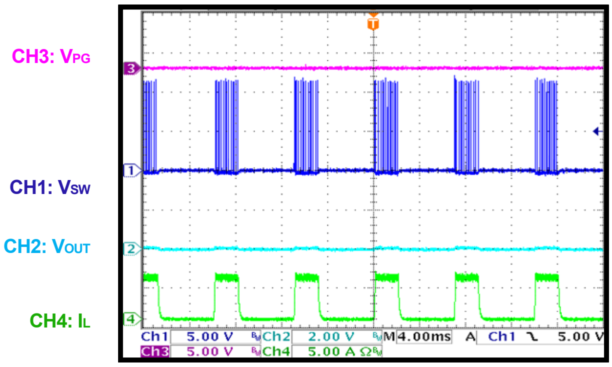


EVB TEST RESULTS *(continued)*

V_{IN} = 12V, V_{OUT} =3.3V, C_{OUT} = 2x22µF, L = 10µH, T_A = +25°C, unless otherwise noted.

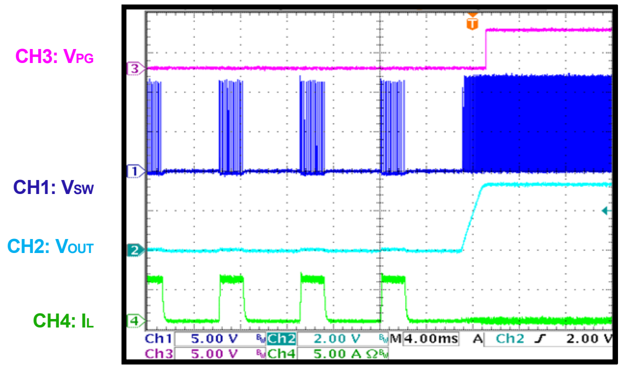
SCP Steady State

V_{IN}=12V



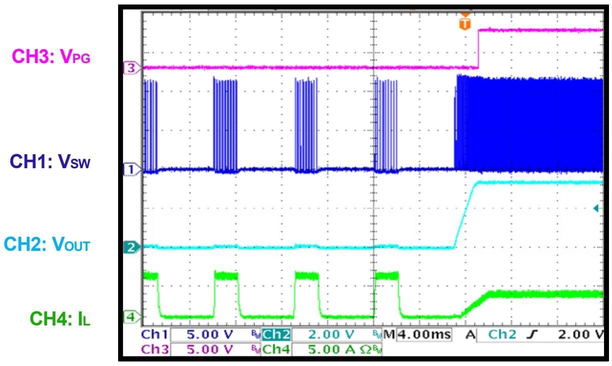
SCP Recovery

V_{IN}=12V,V_{OUT}=3.3V,I_{OUT} = 0A



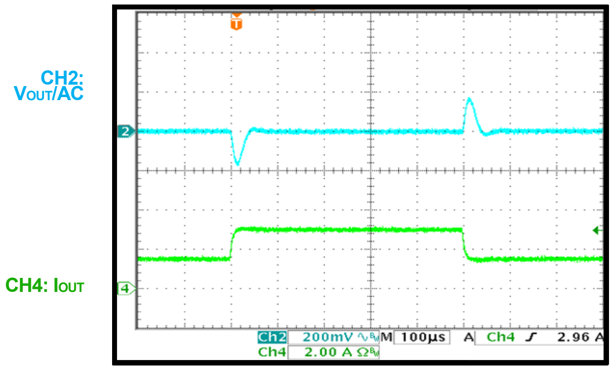
SCP Recovery

V_{IN}=12V,V_{OUT}=3.3V,I_{OUT} = 3A



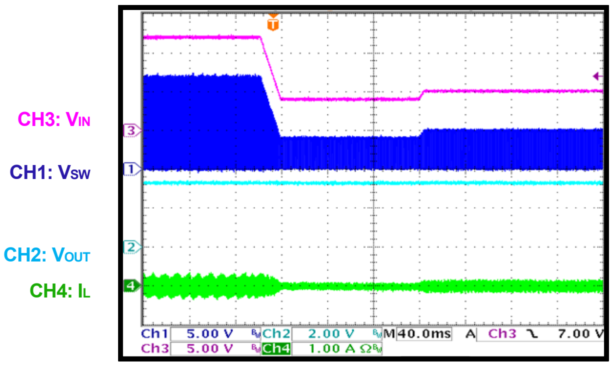
Load Transient

V_{IN}=12V,V_{OUT}=3.3V,I_{OUT} =1.5A - 3A



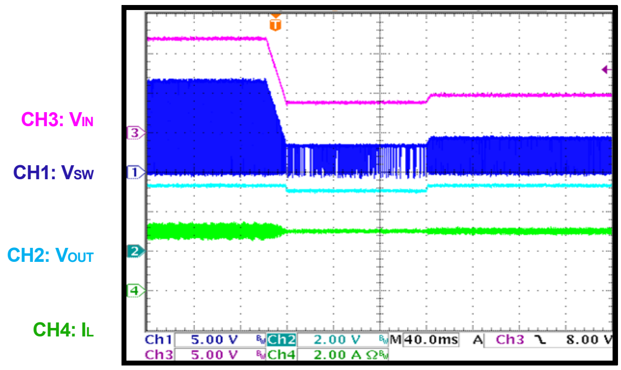
Cold Crank

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



Cold Crank

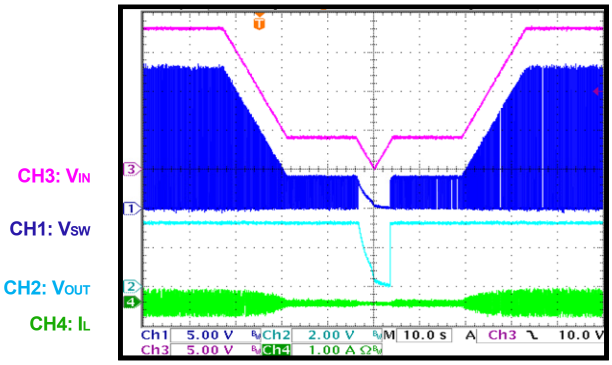
V_{IN} = 12V->4V->5V, I_{OUT} = 3A



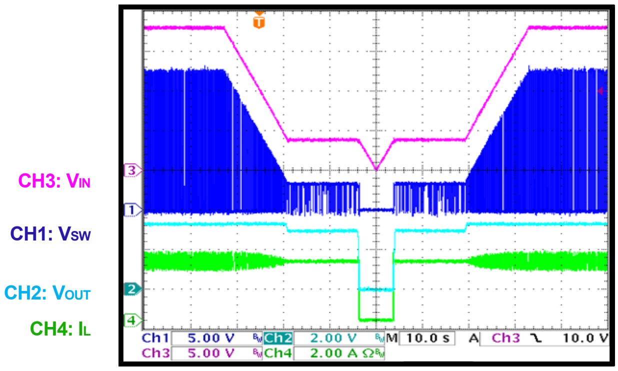
EVB TEST RESULTS *(continued)*

V_{IN} = 12V, V_{OUT} =3.3V, C_{OUT} = 2x22µF, L = 10µH, T_A = +25°C, unless otherwise noted.

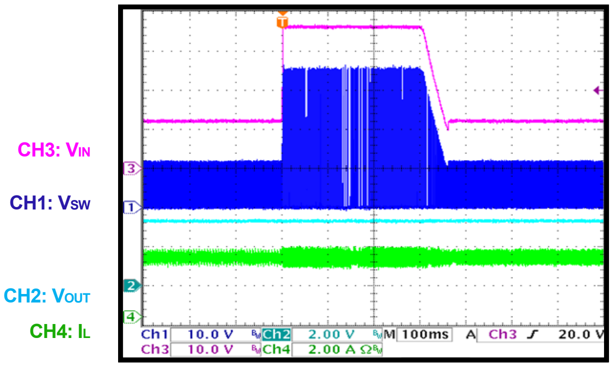
V_{IN} Ramp Down and Up
V_{IN} = 18V->4V->0V->4V->18V, I_{OUT} = 0A



V_{IN} Ramp Down and Up
V_{IN} = 18V->4V->0V->4V->18V, I_{OUT} = 3A



Load Dump
V_{IN} = 12V->36V->12V, I_{OUT} = 3A



PRINTED CIRCUIT LAYOUT

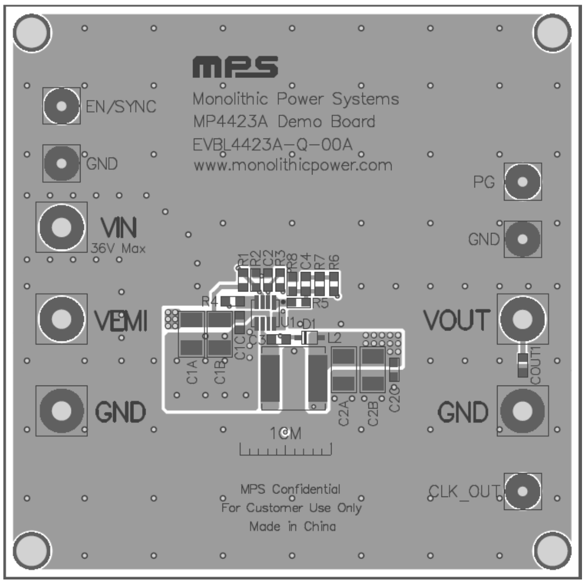


Figure 1: Top Silk Layer And Top Layer

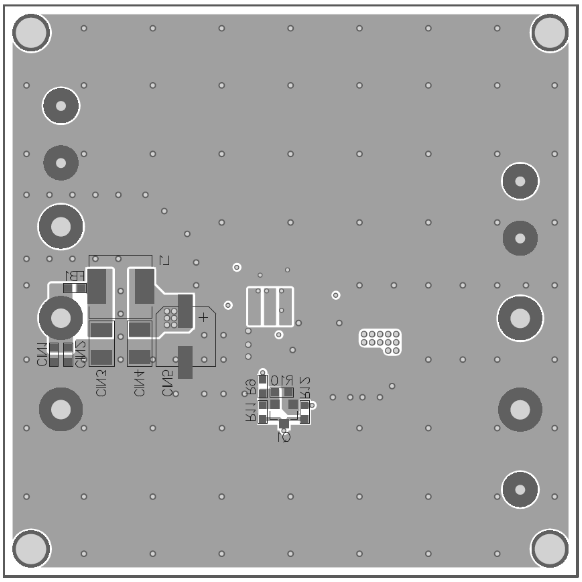


Figure 2: Bottom Silk Layer And Bottom Layer

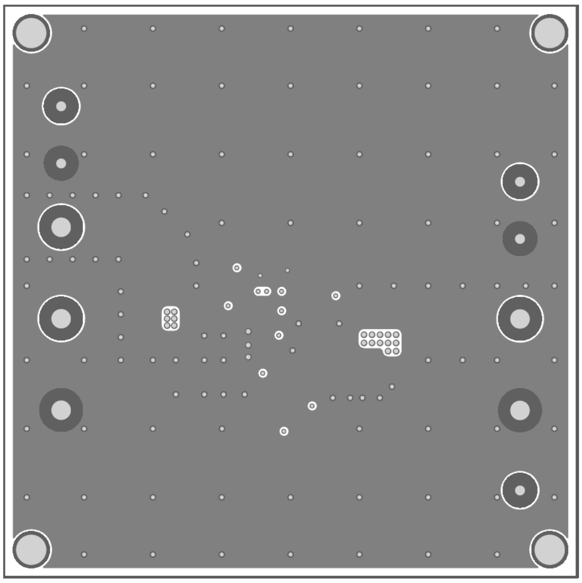


Figure 3: Inner1 Layer

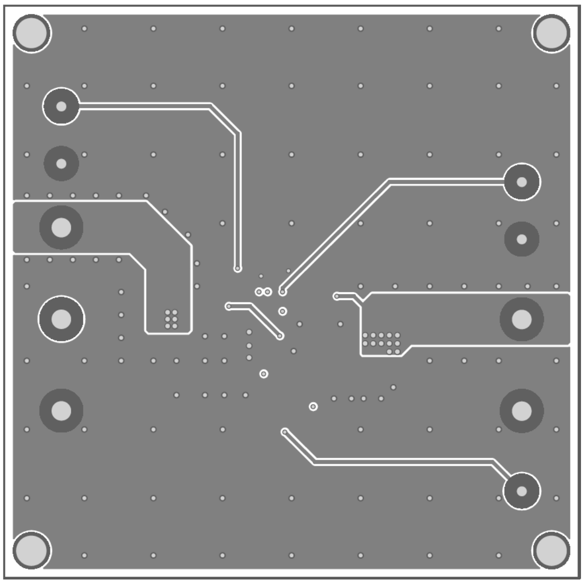


Figure 4: Inner2 Layer

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QUICK START GUIDE

1. Connect the positive and negative terminals of the load to the VOUT and GND pins respectively.
2. Preset the power supply output to between 4V to 36V, and then turn it off.
3. Connect the positive and negative terminals of the power supply output to the VIN and GND pins respectively.
4. Turn the power supply on. The MP4423A/MPQ4423A will automatically startup.
5. To use the Enable function, apply a digital input to the EN pin. Drive EN higher than 1.65V to turn on the regulator, drive EN less than 1.05V to turn it off. An internal 500kΩ resistor from EN/SYNC to GND allows EN/SYNC to be floated to shut down the chip.
6. Connect the EN input pin through a pull-up resistor (R1) to any voltage connected to the VIN pin. Make sure R1 big enough to limit the EN input current to less than 150µA. For example, with 12V connected to VIN, make sure R1 ≥ (12V – 6.5V) ÷ 150µA = 36.7kΩ.
7. Connect the EN pin directly to a voltage source without any pull-up resistor requires limiting voltage amplitude to ≤6V to prevent damage to the internal zener diode at EN pin.
8. Connect the EN input pin with an external clock with a range of 200kHz to 2.2MHz after output voltage is set to synchronize the internal clock rising edge to the external clock rising edge. The pulse width of external clock signal should be less than 1.7µs.
9. Use R7 and R8 to set the output voltage with V_{FB}=0.792V. For R7=41.2kΩ, R8 can be determined by:

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

   Follow the Application Information section in the device datasheet to recalculate the compensation, inductor and output capacitor values when output voltage is changed.
10. CLK_OUT is a signal inverted to SW and can be used as other buck’s sync signal to get 180 degree out of phase. The high voltage of CLK_OUT is equal to the output voltage of the board, so make sure it is safe for the synchronized part when the output voltage setting value is high.