EV4423A-Q-00A

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

The Future of Analog IC Technology®

DESCRIPTION

The EV4423A-Q-00A is an evaluation board for the MP4423A, MPQ4423A and MPQ4423A-AEC1, 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/MPQ4423A-AEC1 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 EV4423A-Q-00A uses a minimal number of readily-available standard components, and is assembled and tested in space-saving QFN-8 (3mmx3mm) package.

ELECTRICAL SPECIFICATIONS

Parameter	Symbol	Value	Units
Input Voltage	V_{IN}	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
- Default 410kHz Switching Frequency
- Synchronizes to a 200kHz to 2.2MHz External Clock
- High Duty Cycle for Automotive Cold-crank
- Forced CCM
- Internal Soft-Start
- Power Good
- OCP Protection and Hiccup
- Thermal Shutdown
- Output Adjustable from 0.8V
- Available in an QFN-8 (3mmx3mm) package
- Fully assembled and tested

APPLICATIONS

- Automotive
- Industrial Control System
- Distributed Power Systems

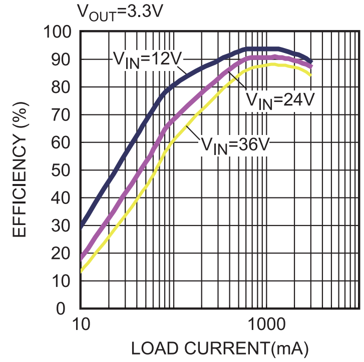
EV4423A-Q-00A EVALUATION BOARD

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

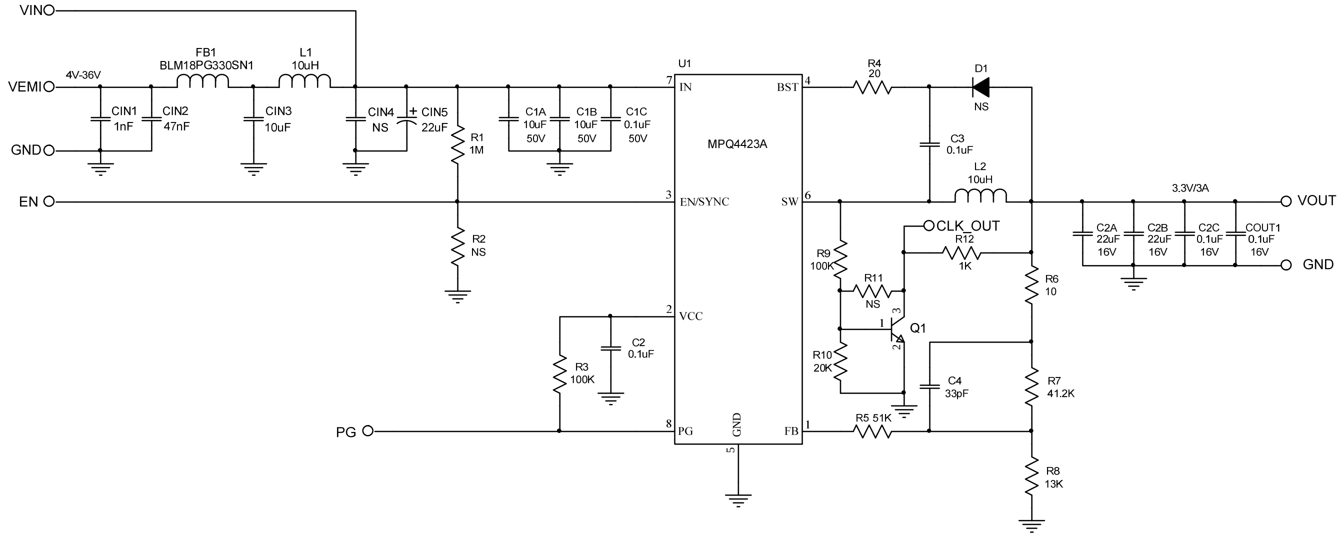
Board Number	MPS IC Number
EV4423A-Q-00A	MPQ4423AGQ-AEC1

Efficiency vs. Load Current

V_{OUT}=3.3V



EVALUATION BOARD SCHEMATIC



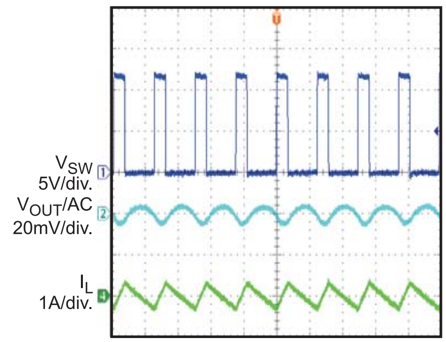
EV4423A-Q-00A BILL OF MATERIALS

Qty	Ref	Value	Description	Package	Manufacture	Part Number
3	C1A,C1B,CI3	10µF	Ceramic Cap., 50V, X7R	1210	muRata	GRM32ER71H106KA12L
1	C1C	0.1µF	Ceramic Cap., 50V, X7R	0603	muRata	GRM188R71H104KA93D
2	C2A,C2B	22µF	Ceramic Cap., 16V, X7R	1210	muRata	GRM32ER71C226KE79
4	C2,C2C, C3,COUT1	0.1µF	Ceramic Cap., 16V, X7R	0603	muRata	GRM188R71C104KA01D
1	C4	33pF	Ceramic Cap., 50V, C0G	0603	muRata	GRM1885C1H330JA01D
1	CIN1	1nF	Ceramic Cap., 50V, X7R	0603	muRata	GRM188R71H102KA01D
1	CIN2	47nF	Ceramic Cap., 50V, X7R	0603	muRata	GRM188R71H473KA61D
1	CIN5	22µF	Electrolytic Cap.	SMD	Jianghai	VTD-63V22
2	CIN4,COUT1	NS				
1	D1	NS				
1	FB1		Magnetic Bead, 3A	0603	muRata	BLM18PG330SN1
2	L1,L2	10µH	Inductor, 40.9mOhm DCR, 4.9A	SMD	Coilcraft	XAL5050-103ME
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	MPQ4423AGQ-AEC1
5	VIN, VEMI, GND, VOUT, GND		2.0 Golden Pin		HZ	
5	EN/SYNC,GND,PG,GND, CLK_OUT		1.0 Golden Pin		HZ	

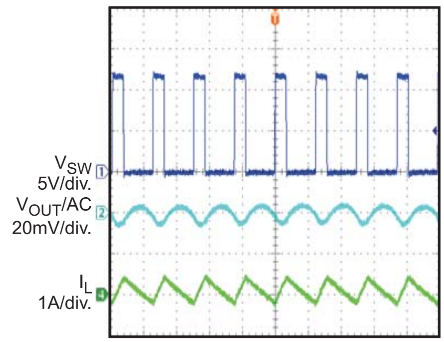
EVB TEST RESULTS

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

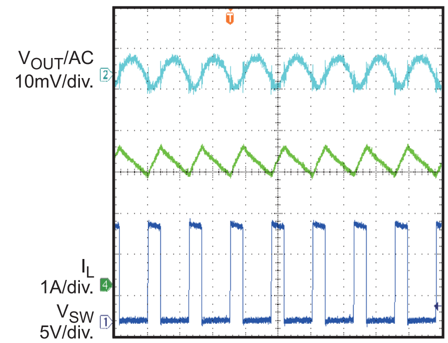
Steady State
I_{OUT}=0A



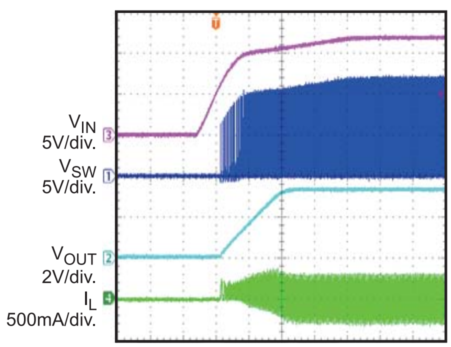
Steady State
I_{OUT} = 0.1A



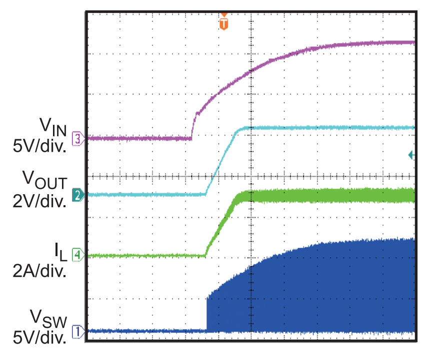
Steady State
I_{OUT}=3A



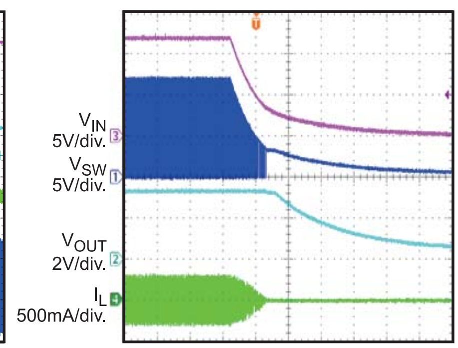
Start-Up through V_{IN}
I_{OUT}=0A



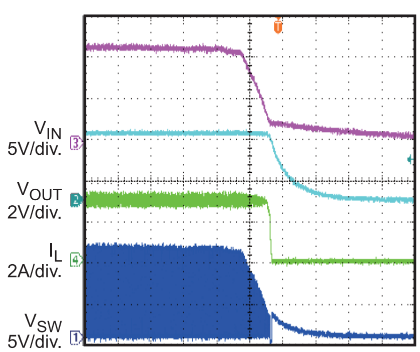
Start-Up through V_{IN}
I_{OUT}=3A



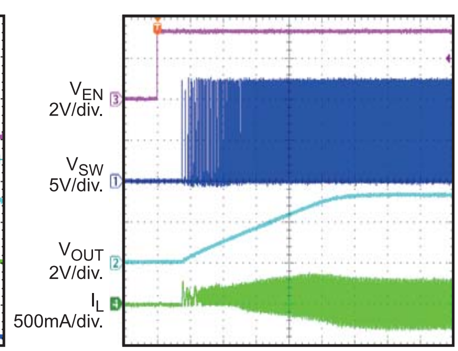
Shutdown through V_{IN}
I_{OUT}=0A



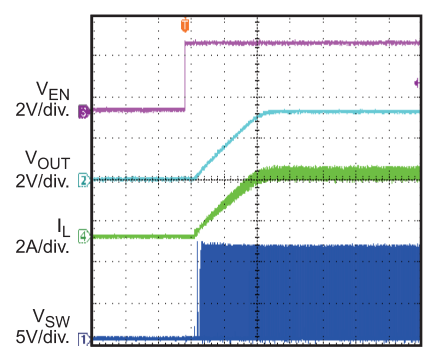
Shutdown through V_{IN}
I_{OUT}=3A



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



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

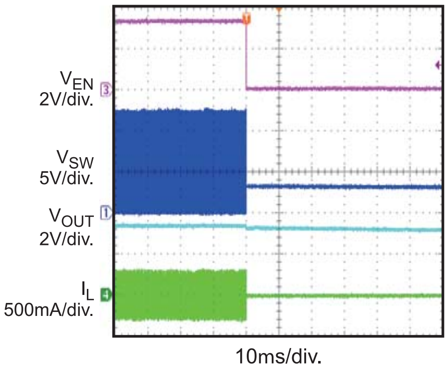


EVB TEST RESULTS *(continued)*

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

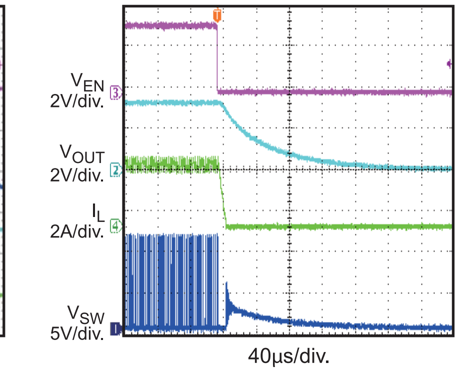
Shutdown through EN

I_{OUT}=0A



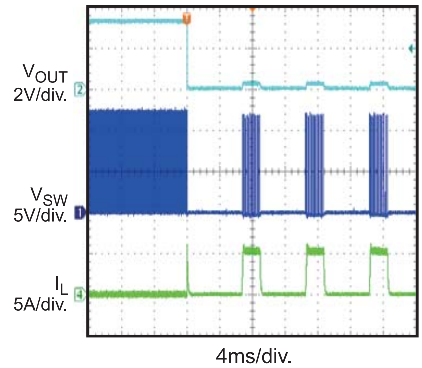
Shutdown through EN

I_{OUT}=3A



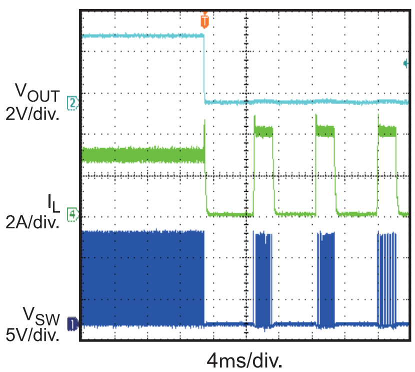
SCP Entry

I_{OUT}=0A to Short Circuit

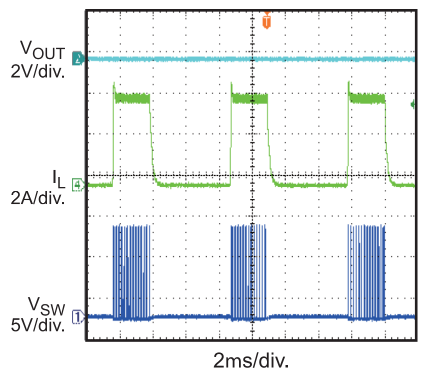


SCP Entry

I_{OUT}=3A to Short Circuit

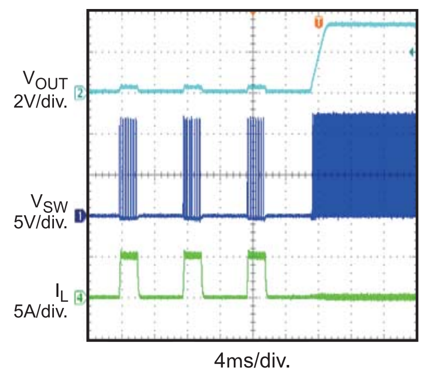


SCP Steady State



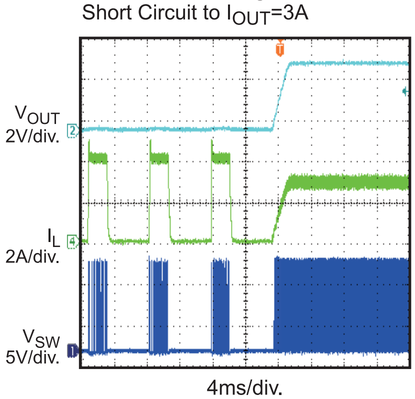
SCP Recovery

Short Circuit to I_{OUT}=0A



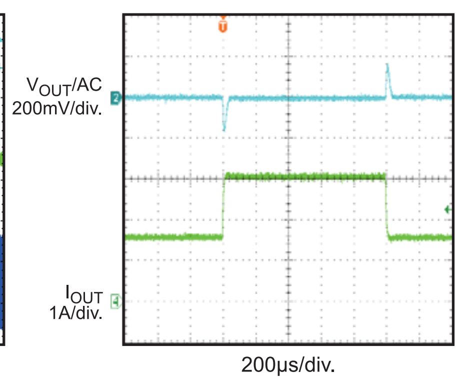
SCP Recovery

Short Circuit to I_{OUT}=3A



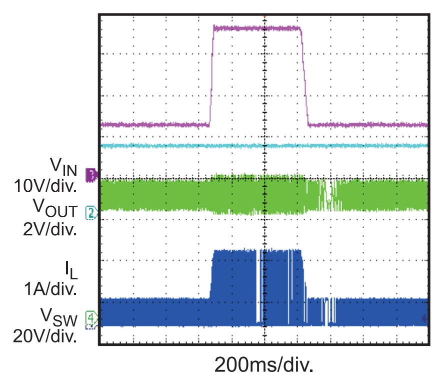
Load Transient

I_{OUT}=1.5A<->3A, 1.6A/μs



Load Dump

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

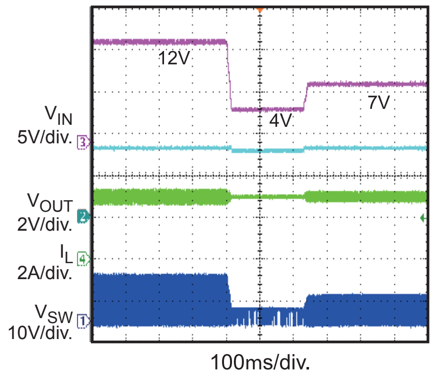


EVB TEST RESULTS *(continued)*

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

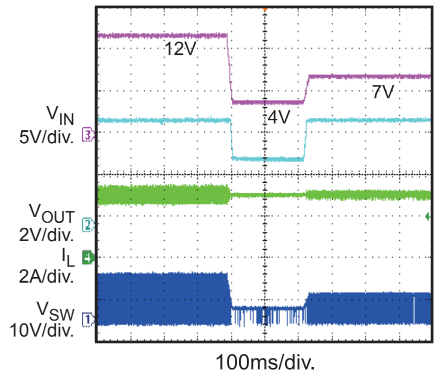
Cold Crank

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



Cold Crank

V_{OUT}=5V, I_{OUT}=3A



PRINTED CIRCUIT LAYOUT

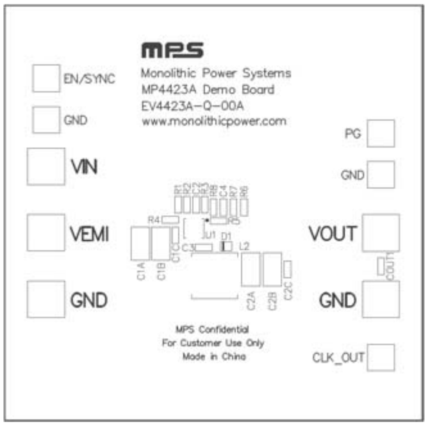


Figure1 – Top Silk Layer

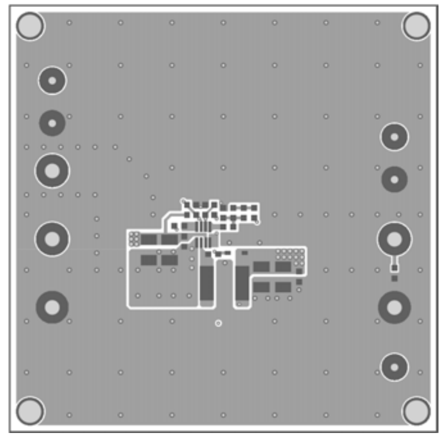


Figure 2 – Top Layer

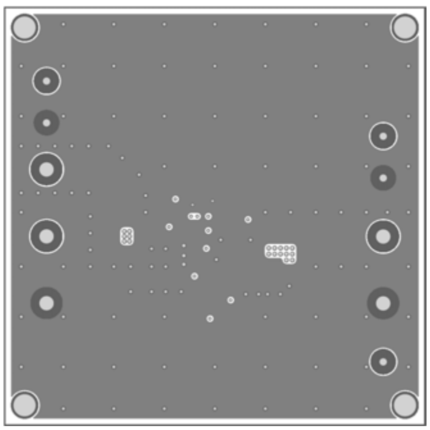


Figure3 – Inner Layer 1

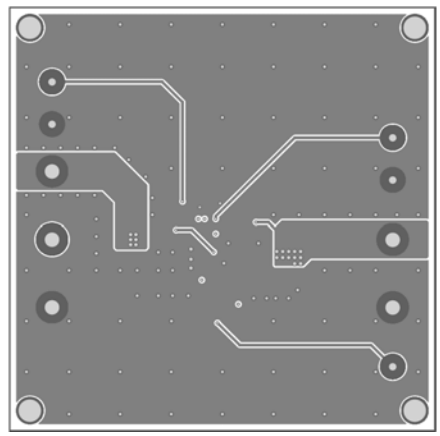


Figure 4 – Inner Layer 2

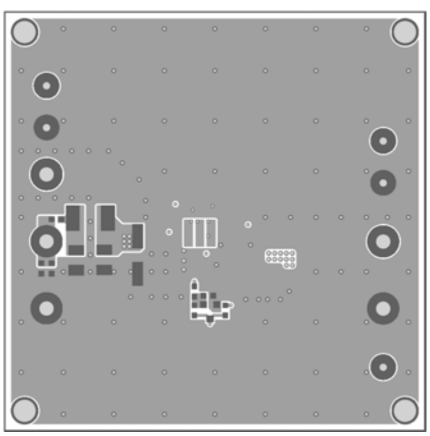


Figure5 – Bottom Layer

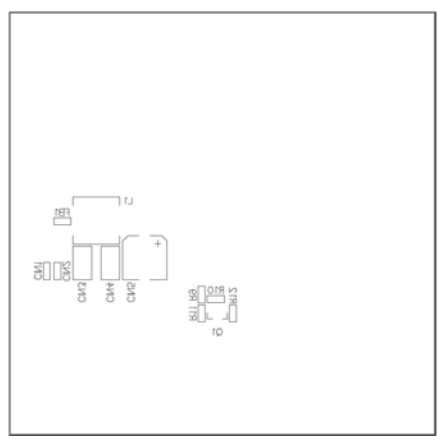


Figure 6 – Bottom Silk Layer

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 MPQ4423A-AEC1 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.
6. Connect the EN input pin through a pull-up resistor to any voltage connected to the VIN pin. Make sure the pull-up resistor big enough to limit the EN input current to less than 150µA. For example, with 12V connected to V_{IN}, $R_{PULLUP} \geq (12V - 6.5V) \div 150\mu A = 36.7k\Omega$.
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 Zener diode.
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:

$$R8 = \frac{0.792*41.2}{V_{OUT} - 0.792} k\Omega$$

   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.