EVQ8861-LE-00A

18V, 12A, Synchronous Step-Down Converter with I²C Interface, AEC-Q100 Qualified Evaluation Board

DESCRIPTION

The EVQ8861-LE-00A is an evaluation board designed to demonstrate the capabilities of the MPQ8861, a high-frequency, synchronous, rectified, step-down, switch-mode converter with an I²C interface. The MPQ8861 offers a fully integrated solution that can achieve up to 12A of continuous DC output current (I_{OUT}) across a wide 2.9V to 18V input voltage (V_{IN}) range, with excellent load and line regulation.

The output voltage (V_{OUT}) can be controlled on the fly via the I²C interface. The reference voltage (V_{REF}) can be adjusted to be between 0.6V and 1.108V in 4mV steps. The following parameters can also be configured via the I²C: the voltage slew rate, switching frequency (f_{SW}), current limit, hiccup/latch-off protection, enable/disable, and power-save mode.

Constant-on-time (COT) control provides fast transient response. The power good (PG) pin is an open-drain output that indicates whether V_{OUT} is within the nominal range.

Full protection features include over-voltage protection (OVP), over-current protection (OCP), and thermal shutdown.

The MPQ8861 is available in a QFN-14 (3mmx4mm) package with wettable flanks.

ELECTRICAL SPECIFICATIONS

Parameter	Symbol	Value	Units
Input voltage	V_{IN}	5	V
Output voltage	V_{OUT}	1	V
Output current	I_{OUT}	12	A
Switching frequency	f_{SW}	500	kHz

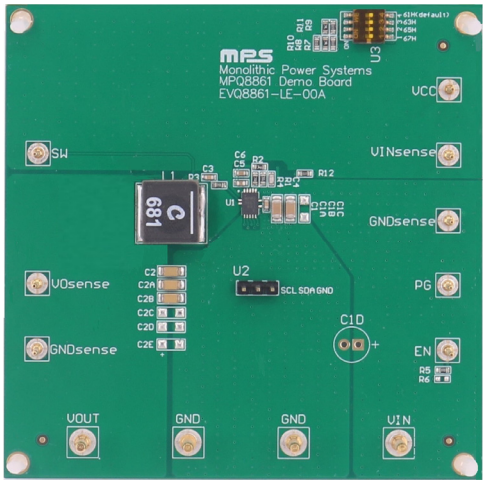
FEATURES

- 2.9V to 18V Input Voltage (V_{IN}) Range
- 0.6V to 5.5V Output Voltage (V_{OUT}) Range
- Up to 12A DC Output Current (I_{OUT})
- Internal Reference Voltage (V_{REF}) with 1% Accuracy
- Slew Rate Control for Dynamic Reference Adjustment in 4mV Steps
- Selectable Auto-PFM/PWM Mode
- Configurable via the I²C: Voltage Slew Rate, Switching Frequency (f_{SW}), Current Limit
- Four Selectable I²C Addresses
- Power Good (PG) Indication
- Over-Current Protection (OCP)
- Over-Voltage Protection (OVP)
- Thermal Shutdown
- Available in a QFN-14 (3mmx4mm) Package
- Available in a Wettable Flank Package
- Available in AEC-Q100 Grade 1

APPLICATIONS

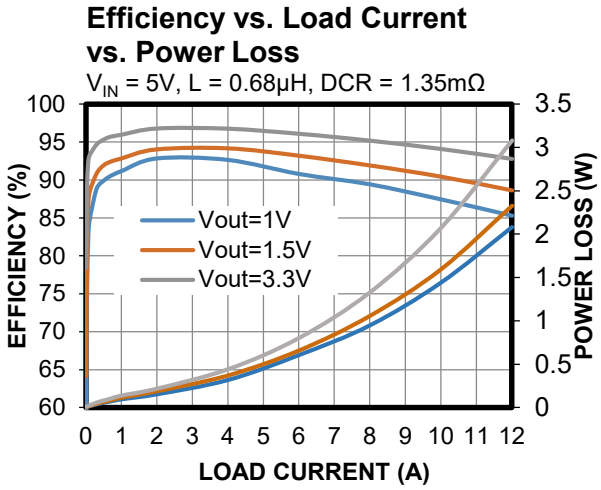
- Automotive Systems
- Industrial Systems

EVQ8861-LE-00A EVALUATION BOARD



LxWxH (8.55cmx6.35cmx2cm)

Board Number	MPS IC Number
EVQ8861-LE-00A	MPQ8861GLE-AEC1



QUICK START GUIDE

1. Connect the load terminals to:
   a. Positive (+): VOUT
   b. Negative (-): GND
2. Preset the power supply to 5V, then turn off the power supply.
3. Connect the power supply terminals to:
   a. Positive (+): VIN
   b. Negative (-): GND
4. Turn on the power supply. The board should start up automatically.
5. To use the enable (EN) function, apply a digital input to the EN pin. Pull EN above 1.3V to turn the converter on; pull EN below 0.99V to turn it off.
6. To program I²C function, connect SCL, SDA and GND to I²C start kit board. Connect EVKT-USBI2C-02 to computer and run MPQ8861 GUI software to program MPQ8861 I²C register. (1)

Note:

1) For more information, refer to the MPQ8861 GUI, which can be downloaded from the MPS website.

EVALUATION BOARD SCHEMATIC

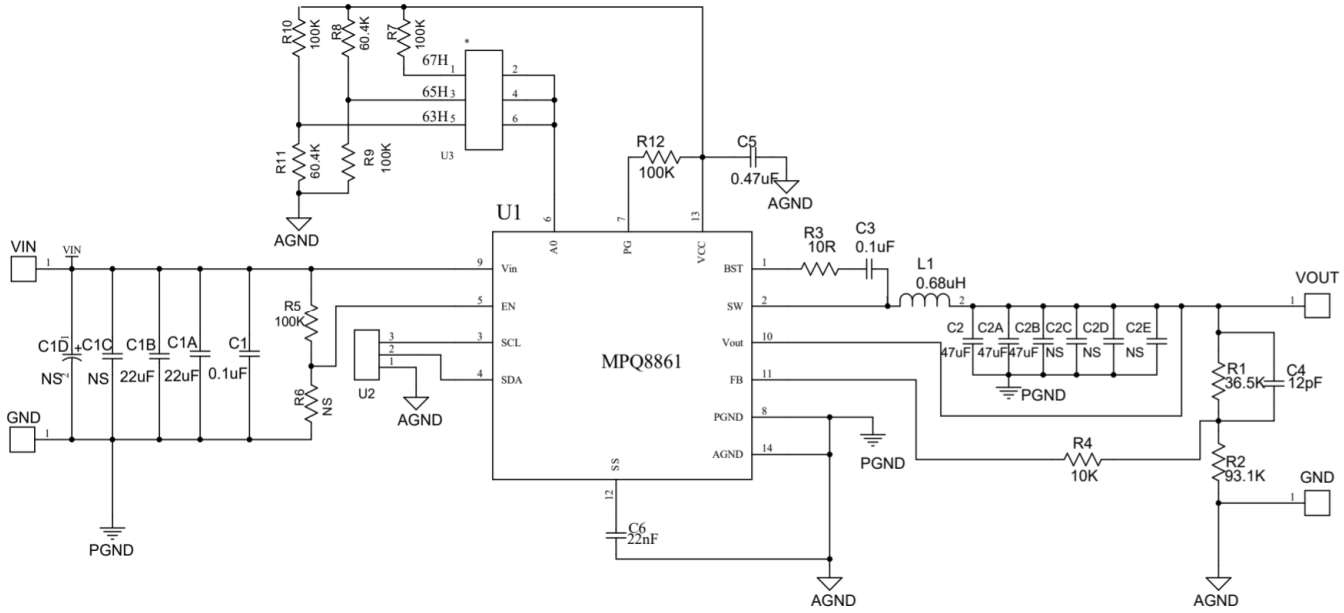


Figure 1: Evaluation Board Schematic

EVQ8861-LE-00A BILL OF MATERIALS

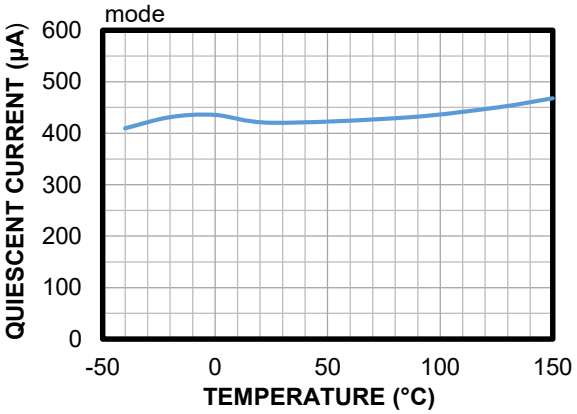
Qty	Ref	Value	Description	Package	Manufacturer	Manufacturer PN
1	R1	36.5kΩ	Film resistor, 1%	0603	Yageo	RC0603FR-0736K5L
1	R2	93.1kΩ	Film resistor, 1%	0603	Yageo	RL0603FR-0793K1L
1	R3	10Ω	Film resistor, 1%	0603	Yageo	RC0603FR-0710RL
1	R4	10kΩ	Film resistor, 1%	0603	Yageo	RL0603FR-0710KL
5	R5, R7, R9, R10, R12	100kΩ	Film resistor, 1%	0603	Yageo	RL0603FR-07100KL
0	R6	NS				
2	R8, R11	60.4kΩ	Film resistor, 1%	0603	Yageo	RL0603FR-0760K4L
2	C1, C3	0.1μF	Ceramic capacitor, 25V, X7R	0603	Murata	GRM188R71E104KA01D
2	C1A, C1B	22μF	Ceramic capacitor, 25V, X5R	1206	Murata	GRM31CR61E226KE15L
3	C2, C2A, C2B	47μF	Ceramic capacitor, 6.3V, X5R	1206	Murata	GRM31CR60J476ME19L
0	C1C, C1D, C2C, C2D, C2E	NS				
1	C4	12pF	Ceramic capacitor, 50V, X7R	0603	Murata	GRM1885C1H120JA01D
1	C5	0.47μF	Ceramic capacitor, 16V, X7R	0603	Murata	GRM188R71C474KA88D
1	C6	22nF	Ceramic capacitor, 16V, X7R	0603	Murata	GRM188R71C223KA01D
1	U2	2.54mm	3-pin jumper	DIP	Any	
1	U3	24V	Switch (switch-4)	SMD	Wurth	416131160804
1	L1	0.68μH	Inductor, R_{DC} = 1.35mΩ	SMD	Coilcraft	XAL1060-681MEC
		0.68μH	Inductor, R_{DC} = 1.6mΩ	SMD	Super World	PIAQ1005SR68MN
1	U1	MPQ8861	Synchronous step-down converter with I²C interface, 18V, 12A	QFN-14 (3mmx 4mm)	MPS	MPQ8861GLE-AEC1

EVB TEST RESULTS

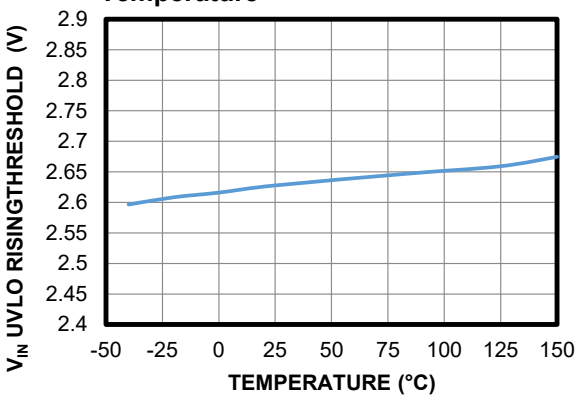
V_{IN} = 5V, V_{OUT} = 1V, L = 0.68µH, f_{SW} = 500kHz, auto-PFM/PWM mode, T_A = 25°C, unless otherwise noted.

Quiescent Current vs. Temperature

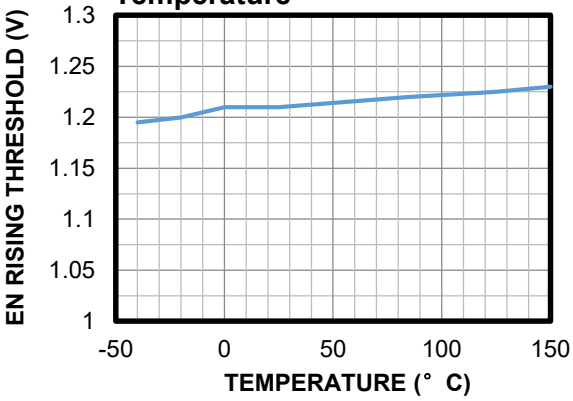
No switching, V_{FB} = 105% of V_{REF}, PFM mode



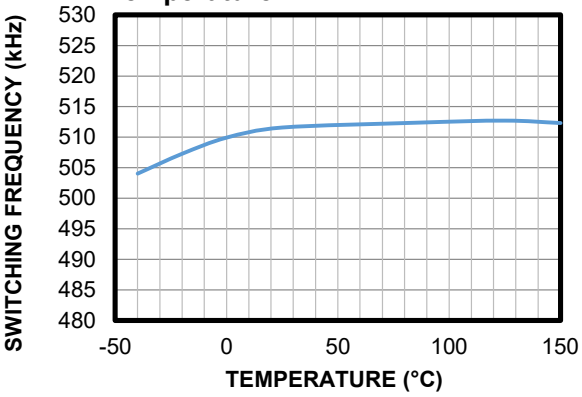
V_{IN} UVLO Rising Threshold vs. Temperature



EN Rising Threshold vs. Temperature

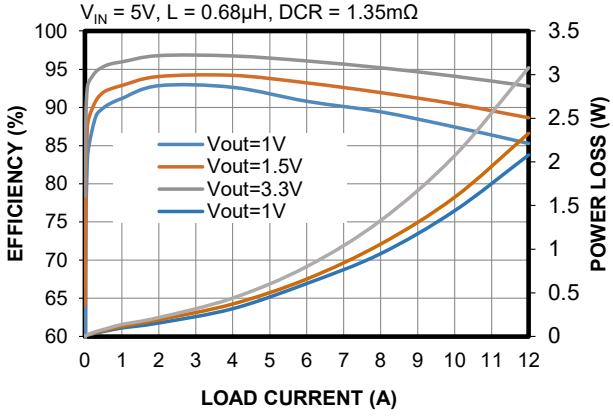


Switching Frequency vs. Temperature



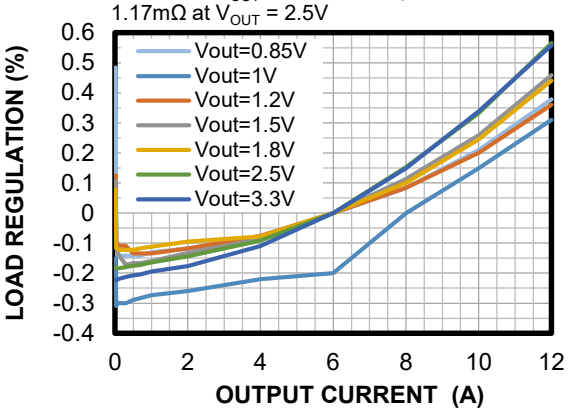
Efficiency vs. Load Current vs. Power Loss

V_{IN} = 5V, L = 0.68µH, DCR = 1.35mΩ



Load Regulation

V_{IN} = 5V; L = 0.68µH, DCR = 1.35mΩ at V_{OUT} = 1V/1.2V/1.8V/3.3V; L = 0.47µH, DCR = 1.53mΩ at V_{OUT} = 0.85V, L = 1µH, DCR = 1.17mΩ at V_{OUT} = 2.5V

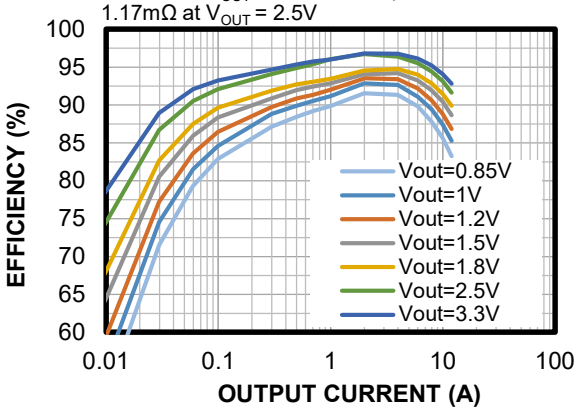


EVB TEST RESULTS

V_{IN} = 5V, V_{OUT} = 1V, L = 0.68µH, f_{SW} = 500kHz, auto-PFM/PWM mode, T_A = 25°C, unless otherwise noted.

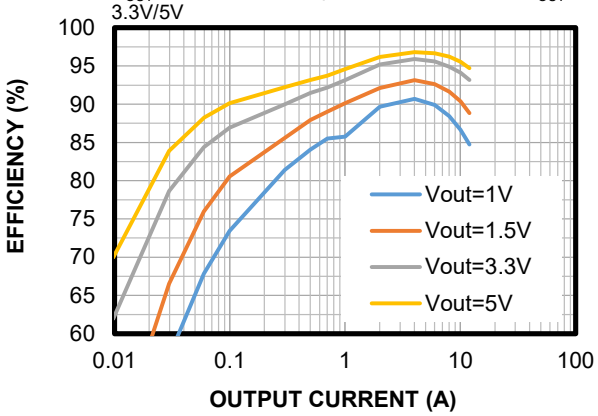
Efficiency vs. Load Current

V_{IN} = 5V; L = 0.68µH, DCR = 1.35mΩ at V_{OUT} = 1V/1.2V/1.8V/3.3V; L = 0.47µH, DCR = 1.53mΩ at V_{OUT} = 0.85V, L = 1µH, DCR = 1.17mΩ at V_{OUT} = 2.5V



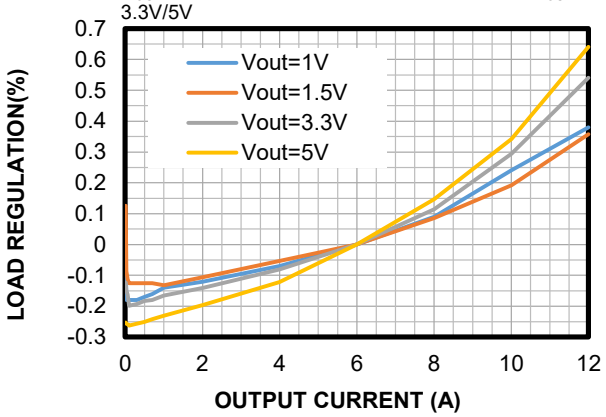
Efficiency vs. Ouput Current

V_{IN} = 12V; L = 1µH, DCR =1.17mΩ at V_{OUT} = 1V/1.5V, L = 2.2µH, DCR = 3.05mΩ at V_{OUT} = 3.3V/5V



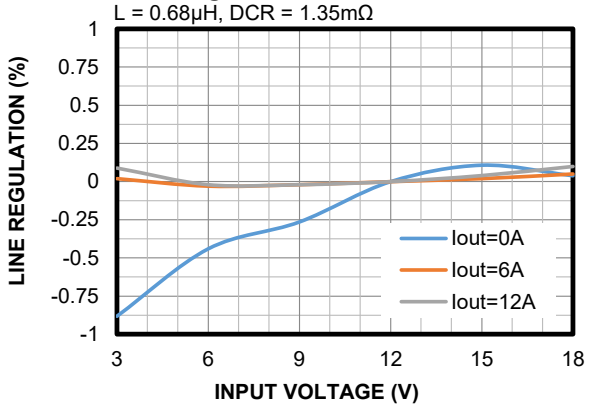
Load Regulation

V_{IN} = 12V; L = 1µH, DCR = 1.17mΩ at V_{OUT} = 1V/1.5V; L = 2.2µH, DCR = 3.05mΩ at V_{OUT} = 3.3V/5V



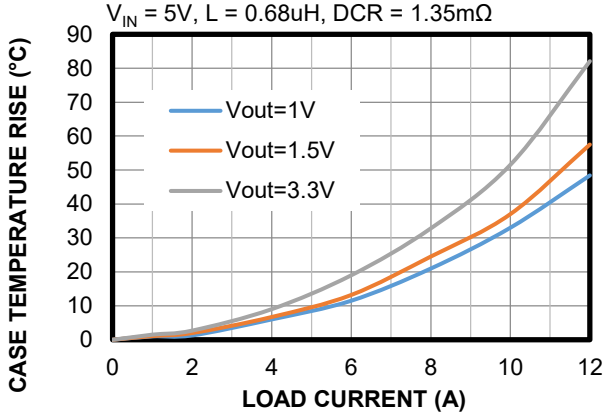
Line Regulation

L = 0.68µH, DCR = 1.35mΩ



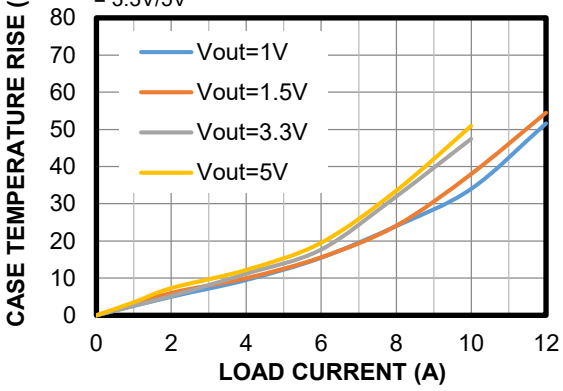
Case Temperature Rise

V_{IN} = 5V, L = 0.68uH, DCR = 1.35mΩ



Case Temperature Rise

V_{IN} = 12V; L = 1µH, DCR = 1.35mΩ at V_{OUT} = 1V/1.5V; L = 2.2µH, DCR = 3.05mΩ V_{OUT} = 3.3V/5V

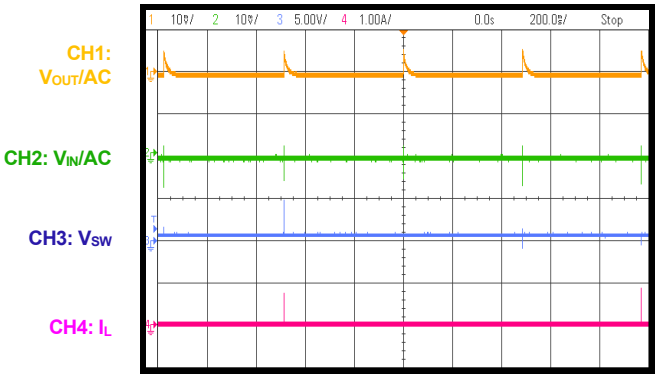


EVB TEST RESULTS

V_{IN} = 5V, V_{OUT} = 1V, L = 0.68µH, f_{SW} = 500kHz, auto-PFM/PWM mode, T_A = 25°C, unless otherwise noted.

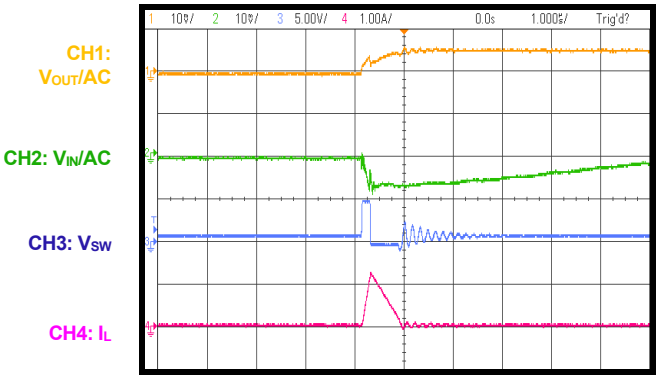
Steady State

Auto-PFM/PWM mode, I_{OUT} = 0A



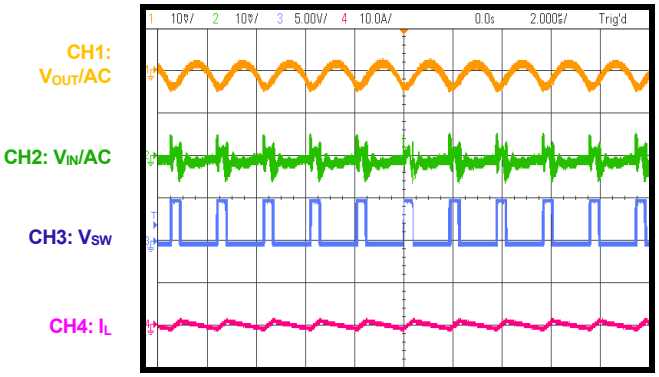
Steady State

Auto-PFM/PWM mode, I_{OUT} = 0A



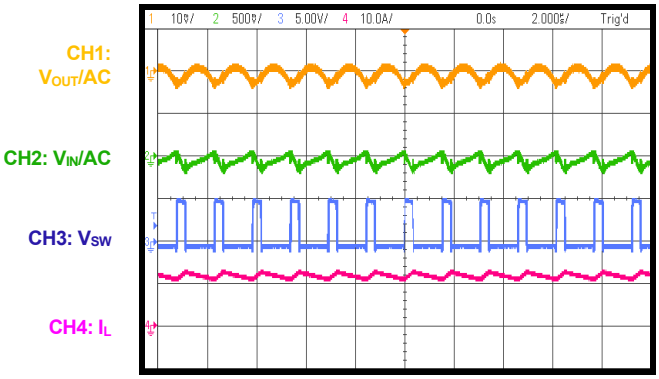
Steady State

Forced PWM Mode, I_{OUT} = 0A



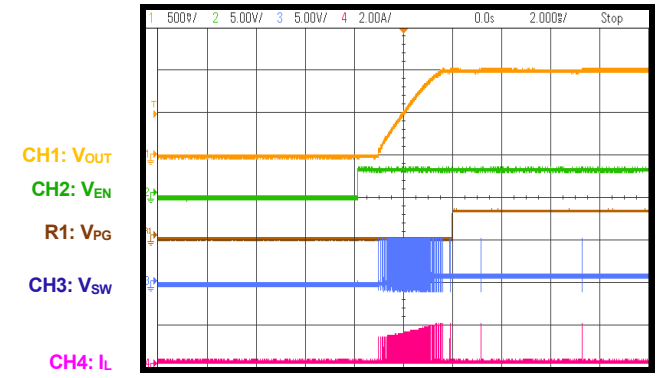
Steady State

I_{OUT} = 12A



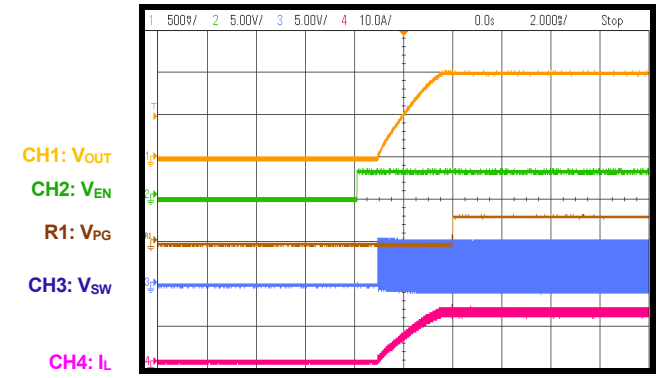
Start-Up through EN

I_{OUT} = 0A



Start-Up through EN

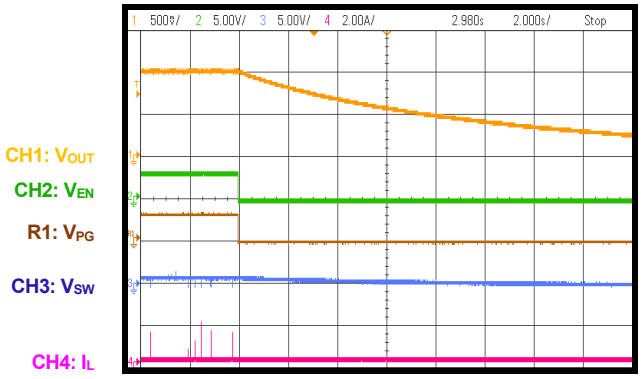
I_{OUT} = 12A



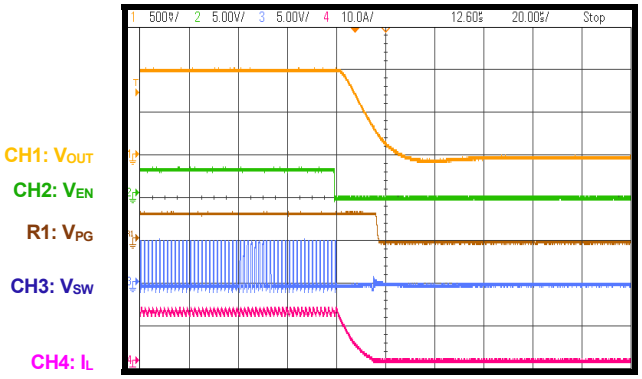
EVB TEST RESULTS

V_{IN} = 5V, V_{OUT} = 1V, L = 0.68µH, f_{SW} = 500kHz, auto-PFM/PWM mode, T_A = 25°C, unless otherwise noted.

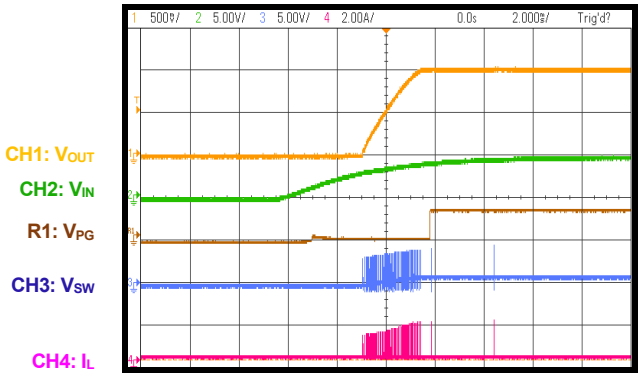
Shutdown through EN
I_{OUT} = 0A



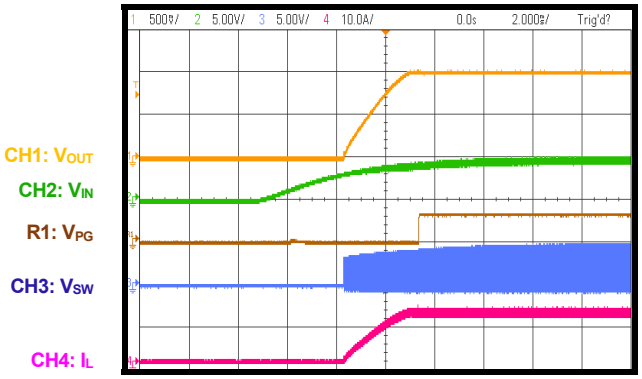
Shutdown through EN
I_{OUT} = 12A



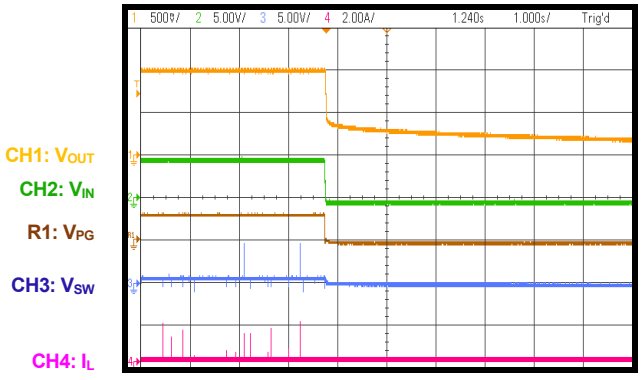
Start-Up
I_{OUT} = 0A



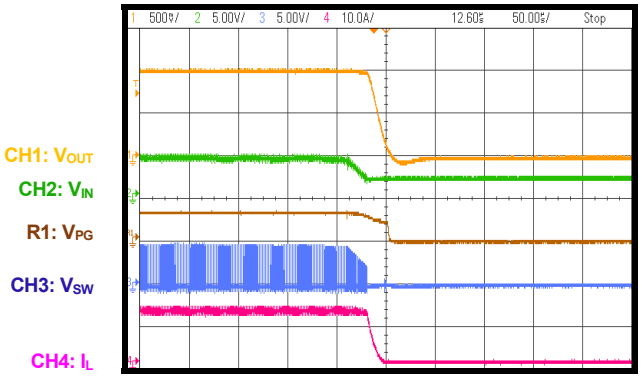
Start-Up
I_{OUT} = 12A



Shutdown
I_{OUT} = 0A



Shutdown
I_{OUT} = 12A

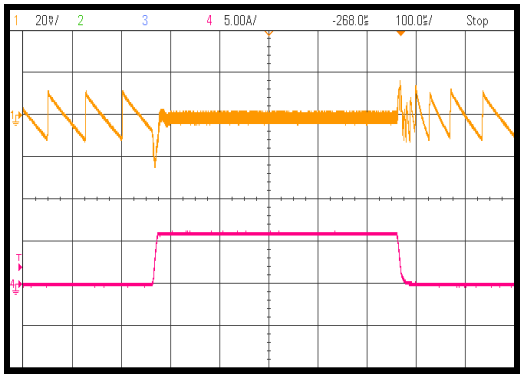


EVB TEST RESULTS

V_{IN} = 5V, V_{OUT} = 1V, L = 0.68µH, f_{SW} = 500kHz, auto-PFM/PWM mode, T_A = 25°C, unless otherwise noted.

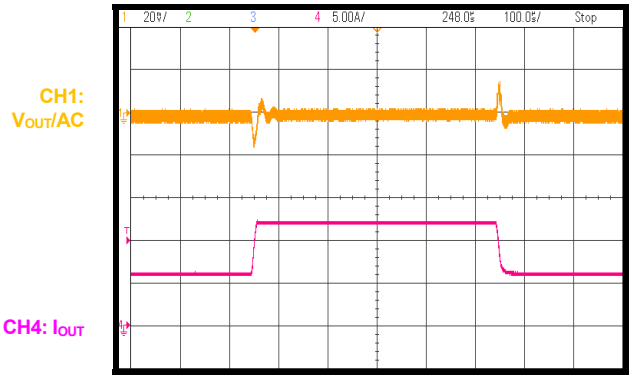
Load Transient

I_{OUT} = 0A to 6A, 0.6A/µs slew rate



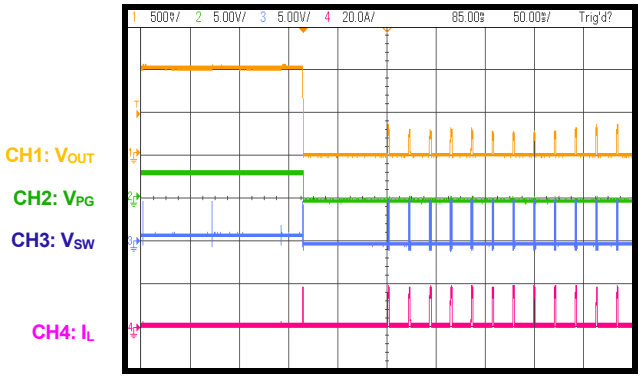
Load Transient

I_{OUT} = 6A to 12A, 0.6A/µs slew rate



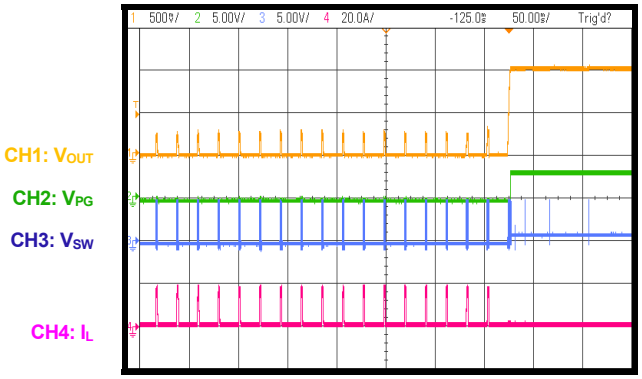
SCP Entry

Hiccup mode, I_{OUT} = 0A



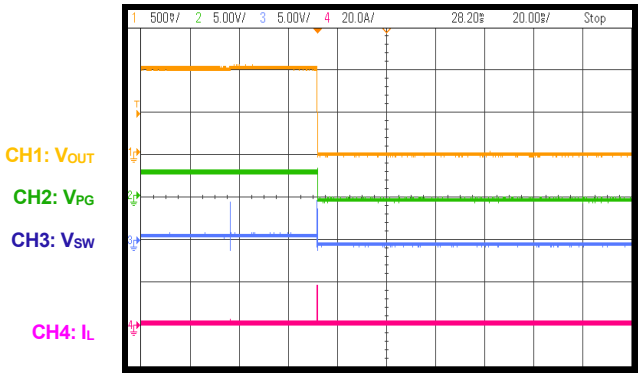
SCP Recovery

Hiccup mode, I_{OUT} = 0A



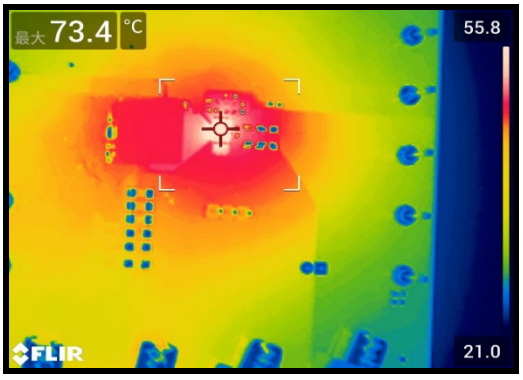
SCP Entry

Latched off, I_{OUT} = 0A



Thermal Image

V_{IN} = 5V, V_{OUT} = 1V, I_{OUT} = 12A, measured on 4-layer PCB (85.5mmx63.5mm), 2oz top/bottom layers, 1oz mid-layers, T_A = 25°C



PCB LAYOUT

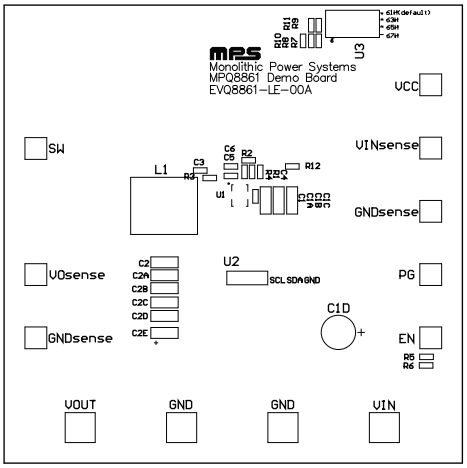


Figure 2: Top Silk

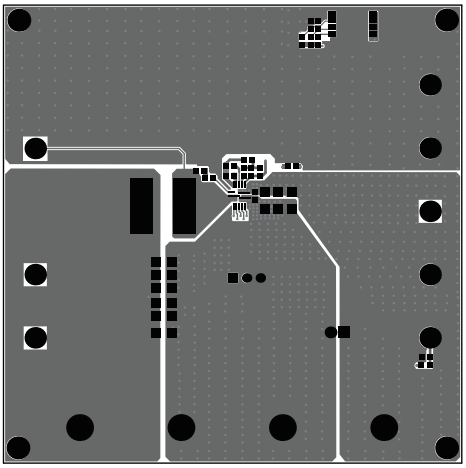


Figure 3: Top Layer

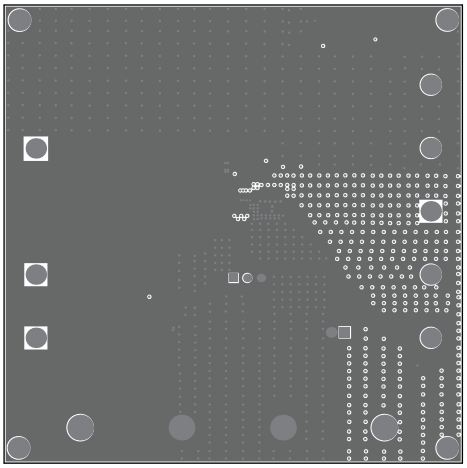


Figure 4: Mid-Layer 1

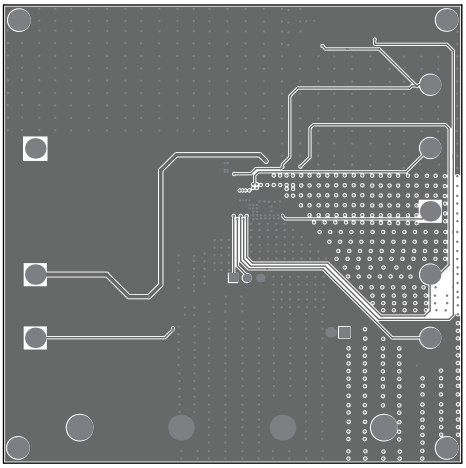


Figure 5: Mid-Layer 2

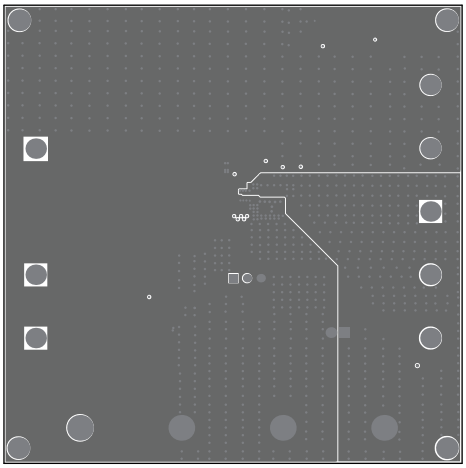


Figure 6: Bottom Layer

REVISION HISTORY

Revision #	Revision Date	Description	Pages Updated
1.0	11/03/2021	Initial Release	-