



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

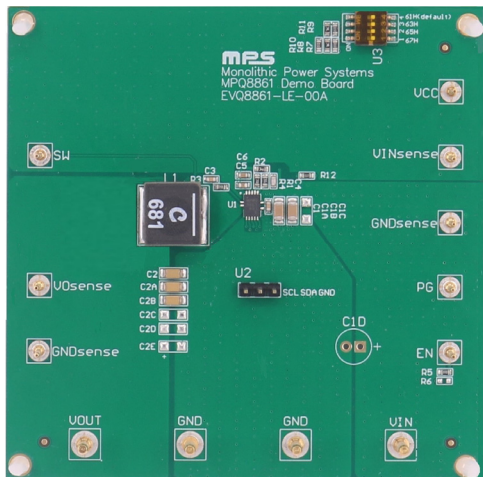
- 2.9V to 18V Input Voltage (V_{IN}) Range
- 0.6V to 5.5V Output Voltage (V_{OUT}) Range
- Up to 12A DC Output Current (I_{OUT})
- Internal Reference Voltage (V_{REF}) with 1% Accuracy
- Slew Rate Control for Dynamic Reference Adjustment in 4mV Steps
- Selectable Auto-PFM/PWM Mode
- Configurable via 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

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EVQ8861-LE-00A EVALUATION BOARD

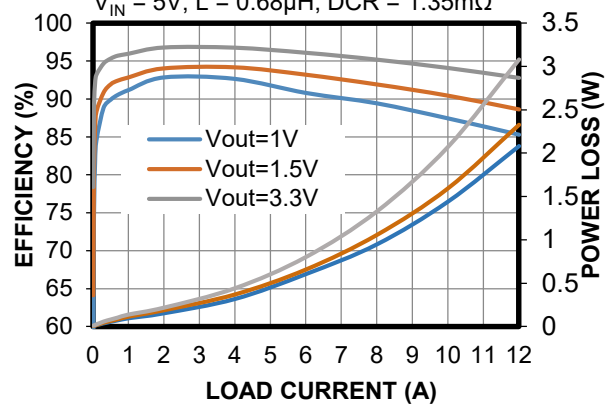


LxWxH (8.55cmx6.35cmx2cm)

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

Efficiency vs. Load Current vs. Power Loss

$V_{IN} = 5V$, $L = 0.68\mu H$, $DCR = 1.35m\Omega$



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-USB I²C-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

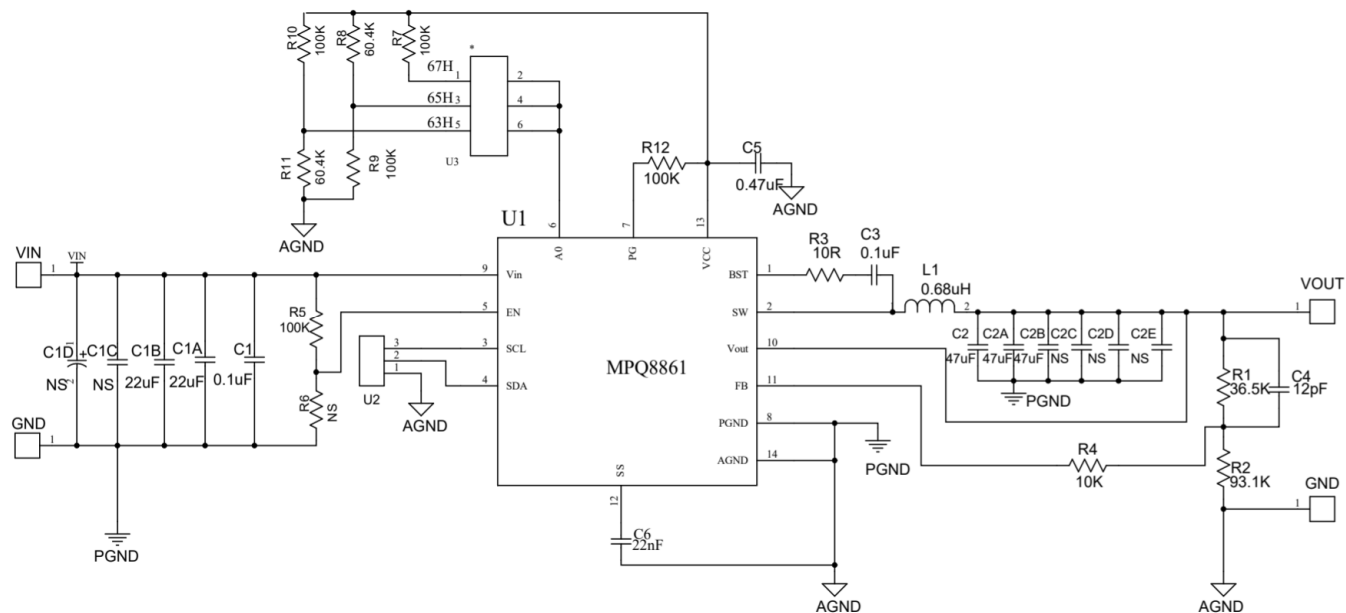


Figure 1: Evaluation Board Schematic

EVQ8861-LE-00A BILL OF MATERIALS

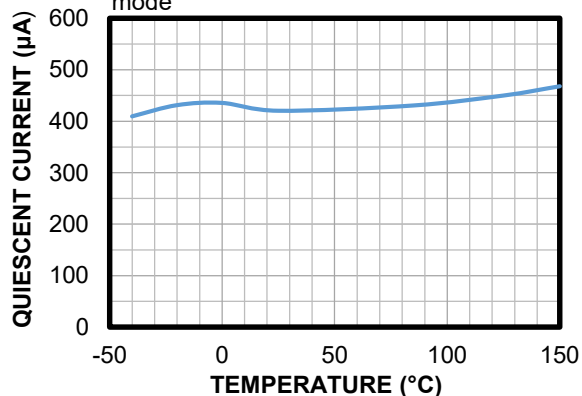
Qty	Ref	Value	Description	Package	Manufacturer	Manufacturer PN
1	R1	36.5kΩ	Film resistor, 1%	0603	Yageo	RC0603FR-0736K5L
1	R2	93.1kΩ	Film resistor, 1%	0603	Yageo	RL0603FR-0793K1L
1	R3	10Ω	Film resistor, 1%	0603	Yageo	RC0603FR-0710RL
1	R4	10kΩ	Film resistor, 1%	0603	Yageo	RL0603FR-0710KL
5	R5, R7, R9, 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 I ² C interface, 18V, 12A	QFN-14 (3mmx4mm)	MPS	MPQ8861GLE-AEC1

EVB TEST RESULTS

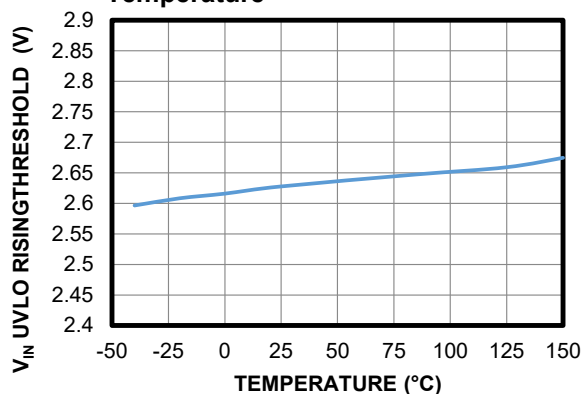
$V_{IN} = 5V$, $V_{OUT} = 1V$, $L = 0.68\mu H$, $f_{SW} = 500kHz$, auto-PFM/PWM mode, $T_A = 25^\circ C$, unless otherwise noted.

Quiescent Current vs. Temperature

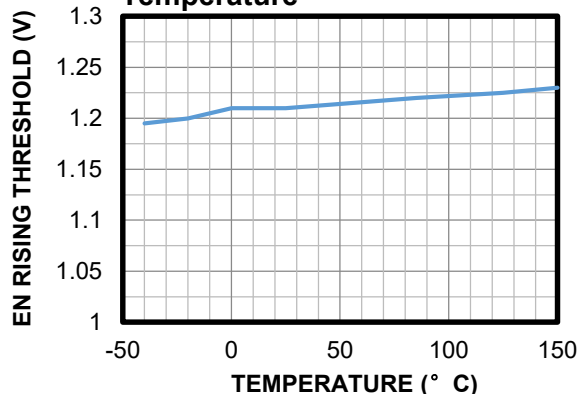
No switching, $V_{FB} = 105\%$ of V_{REF} , PFM mode



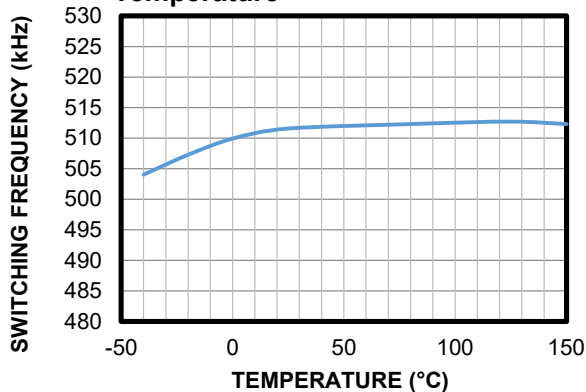
V_{IN} UVLO Rising Threshold vs. Temperature



EN Rising Threshold vs. Temperature

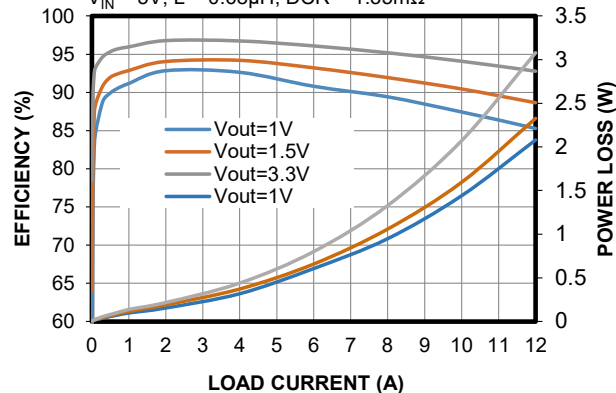


Switching Frequency vs. Temperature



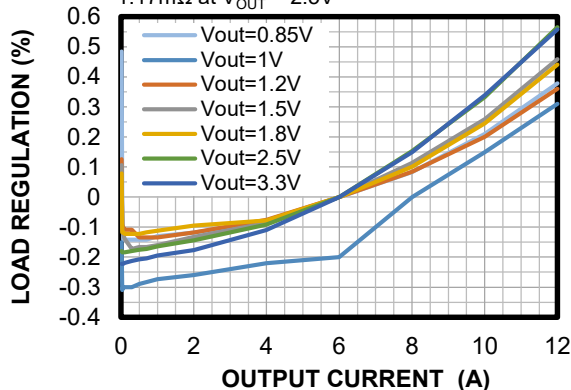
Efficiency vs. Load Current vs. Power Loss

$V_{IN} = 5V$, $L = 0.68\mu H$, $DCR = 1.35m\Omega$



Load Regulation

$V_{IN} = 5V$; $L = 0.68\mu H$, $DCR = 1.35m\Omega$ at $V_{OUT} = 1V/1.2V/1.8V/3.3V$; $L = 0.47\mu H$, $DCR = 1.53m\Omega$ at $V_{OUT} = 0.85V$, $L = 1\mu H$, $DCR = 1.17m\Omega$ at $V_{OUT} = 2.5V$

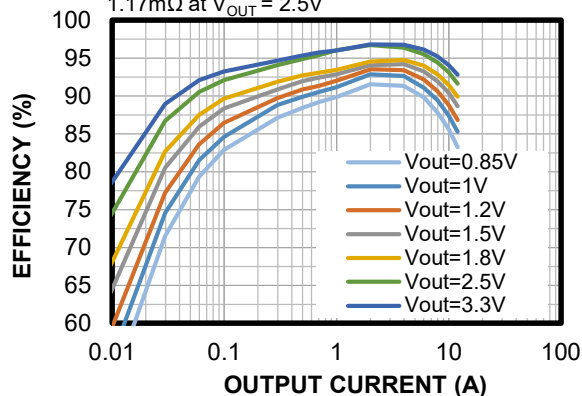


EVB TEST RESULTS

$V_{IN} = 5V$, $V_{OUT} = 1V$, $L = 0.68\mu H$, $f_{SW} = 500kHz$, auto-PFM/PWM mode, $T_A = 25^\circ C$, unless otherwise noted.

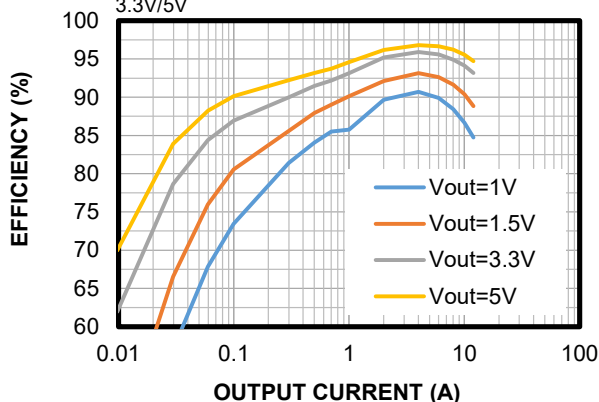
Efficiency vs. Load Current

$V_{IN} = 5V$; $L = 0.68\mu H$, DCR = 1.35m Ω at
 $V_{OUT} = 1V/1.2V/1.8V/3.3V$; $L = 0.47\mu H$, DCR =
1.53m Ω at $V_{OUT} = 0.85V$, $L = 1\mu H$, DCR =
1.17m Ω at $V_{OUT} = 2.5V$



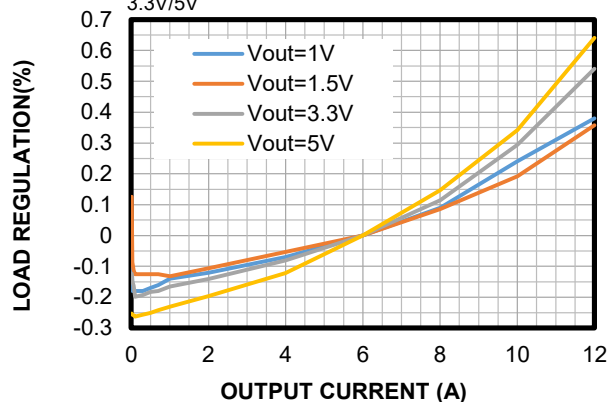
Efficiency vs. Output Current

$V_{IN} = 12V$; $L = 1\mu H$, DCR = 1.17m Ω at
 $V_{OUT} = 1V/1.5V$, $L = 2.2\mu H$, DCR = 3.05m Ω at $V_{OUT} =$
3.3V/5V



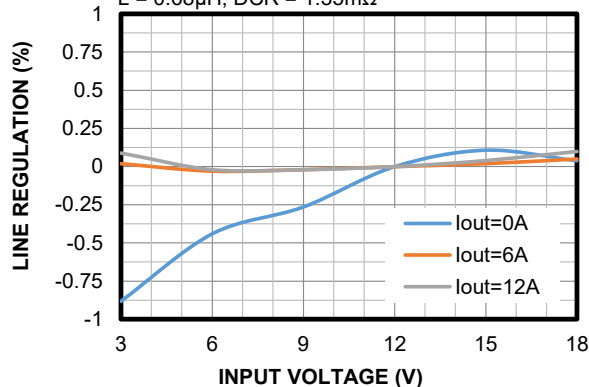
Load Regulation

$V_{IN} = 12V$; $L = 1\mu H$, DCR = 1.17m Ω at
 $V_{OUT} = 1V/1.5V$; $L = 2.2\mu H$, DCR = 3.05m Ω at $V_{OUT} =$
3.3V/5V



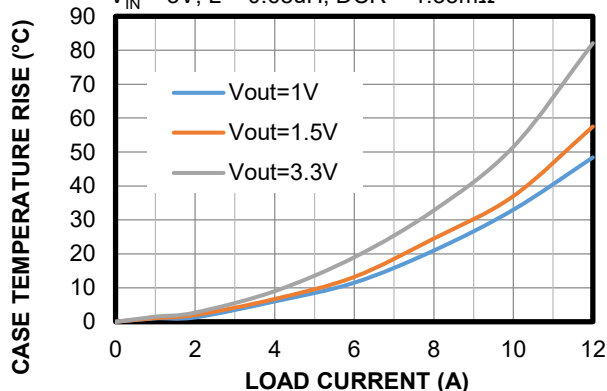
Line Regulation

$L = 0.68\mu H$, DCR = 1.35m Ω



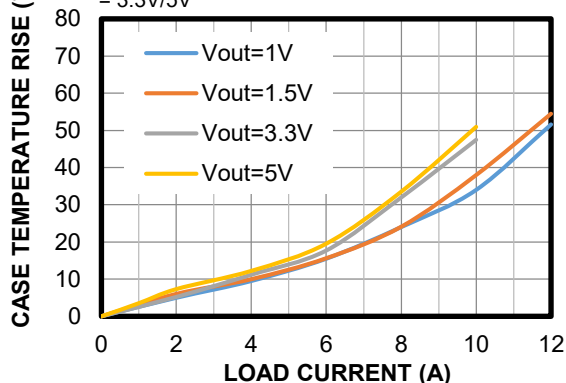
Case Temperature Rise

$V_{IN} = 5V$, $L = 0.68\mu H$, DCR = 1.35m Ω



Case Temperature Rise

$V_{IN} = 12V$; $L = 1\mu H$, DCR = 1.35m Ω at
 $V_{OUT} = 1V/1.5V$; $L = 2.2\mu H$, DCR = 3.05m Ω $V_{OUT} =$
3.3V/5V

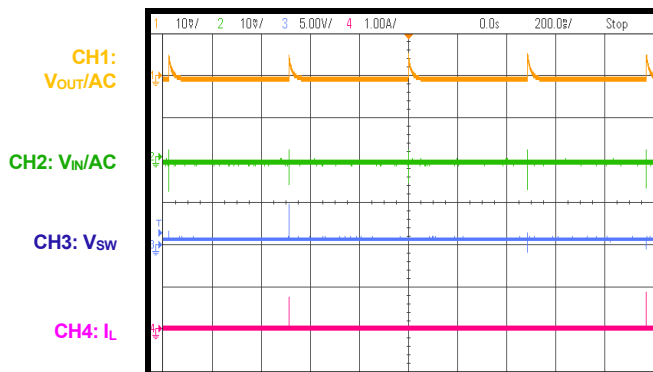


EVB TEST RESULTS

$V_{IN} = 5V$, $V_{OUT} = 1V$, $L = 0.68\mu H$, $f_{SW} = 500kHz$, auto-PFM/PWM mode, $T_A = 25^\circ C$, unless otherwise noted.

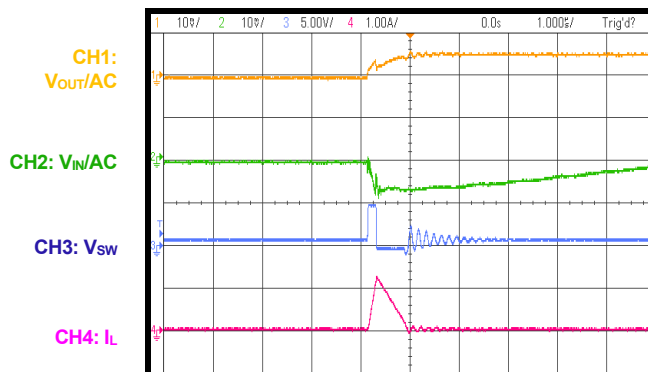
Steady State

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



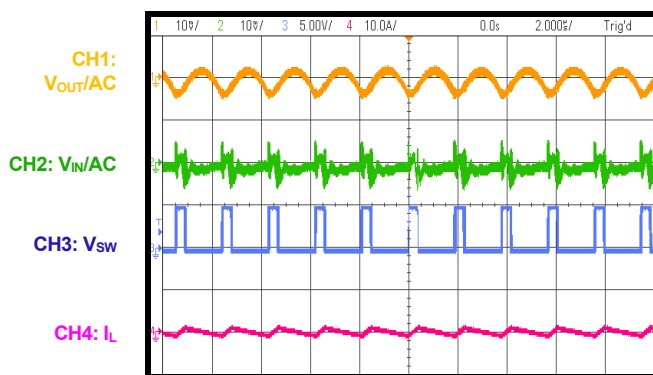
Steady State

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



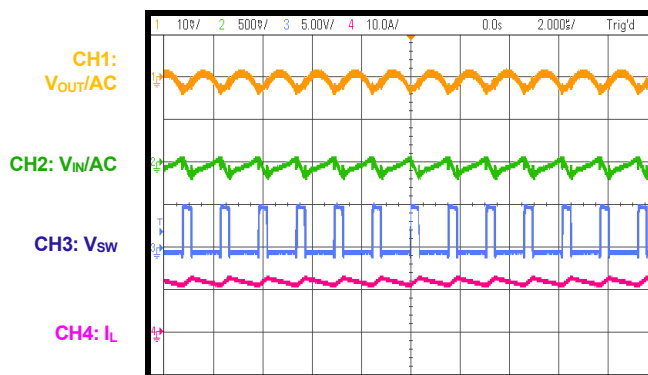
Steady State

Forced PWM Mode, $I_{OUT} = 0A$



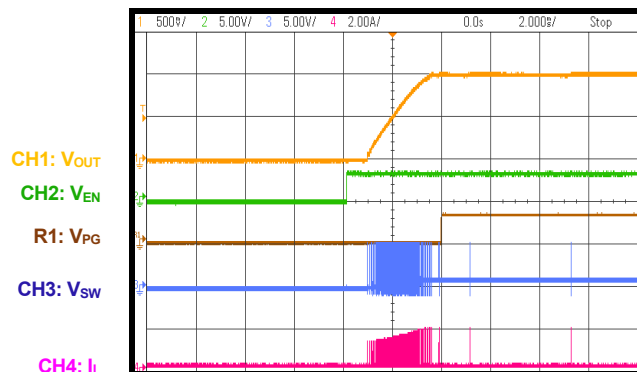
Steady State

$I_{OUT} = 12A$



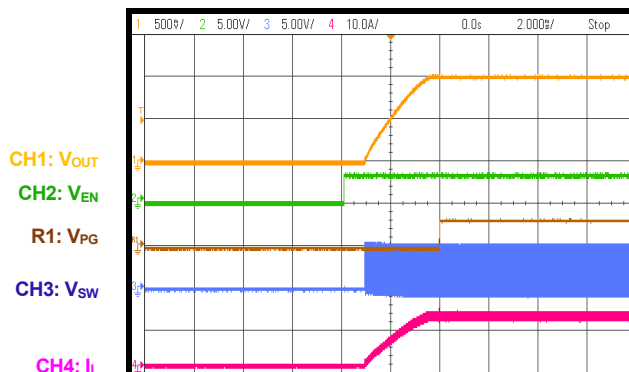
Start-Up through EN

$I_{OUT} = 0A$



Start-Up through EN

$I_{OUT} = 12A$

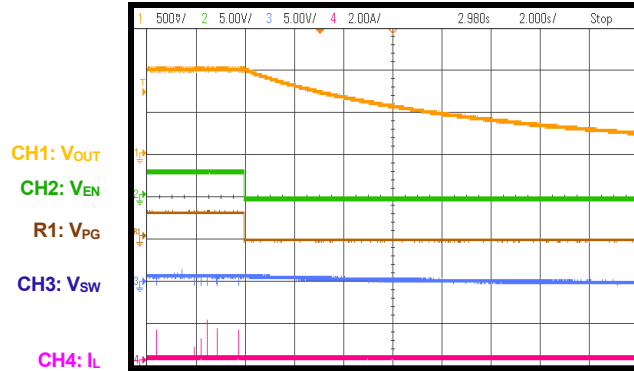


EVB TEST RESULTS

$V_{IN} = 5V$, $V_{OUT} = 1V$, $L = 0.68\mu H$, $f_{SW} = 500kHz$, auto-PFM/PWM mode, $T_A = 25^\circ C$, unless otherwise noted.

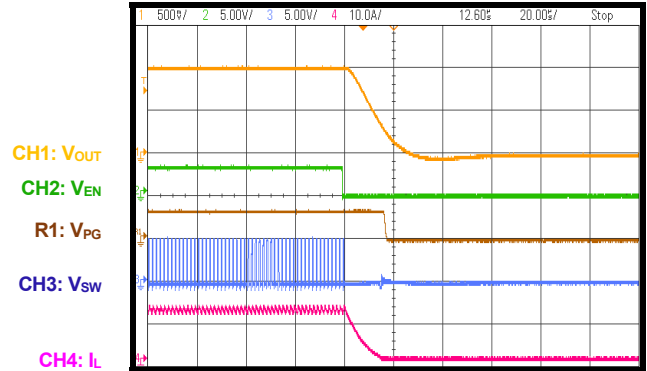
Shutdown through EN

$I_{OUT} = 0A$



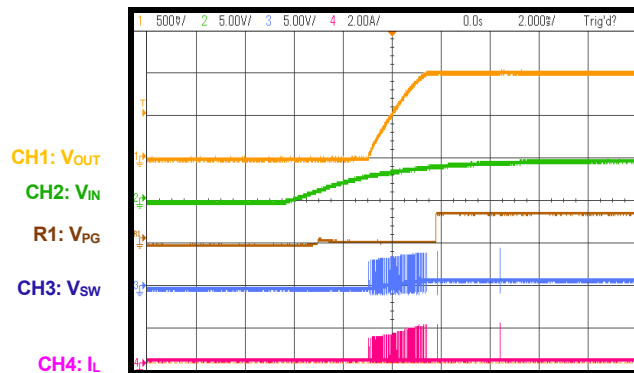
Shutdown through EN

$I_{OUT} = 12A$



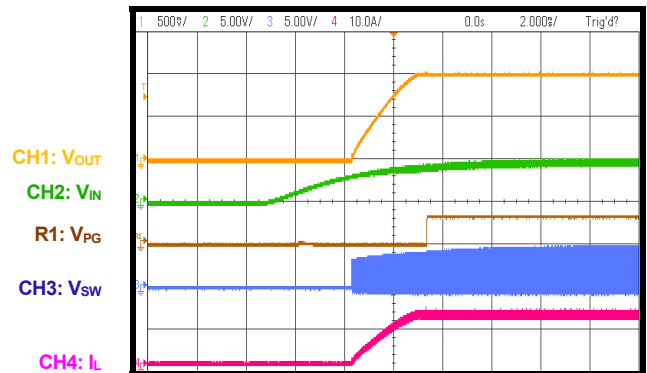
Start-Up

$I_{OUT} = 0A$



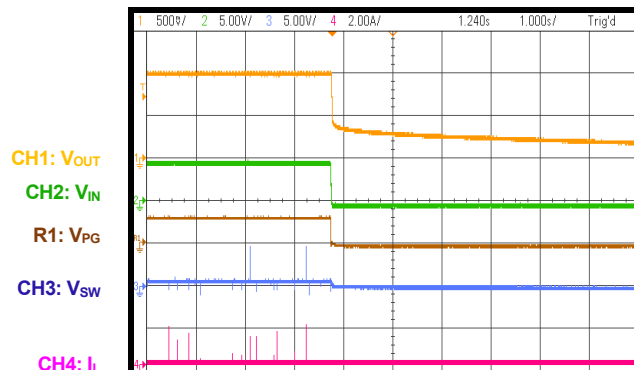
Start-Up

$I_{OUT} = 12A$



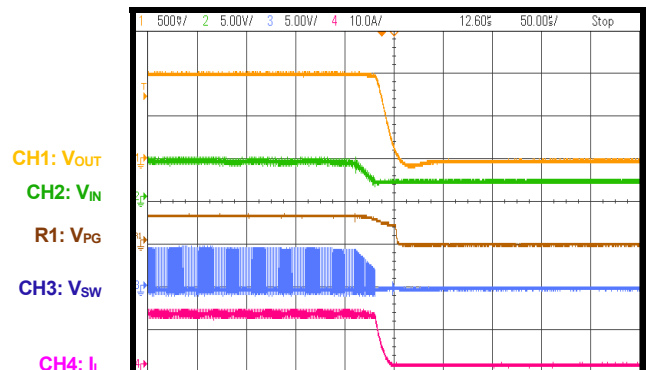
Shutdown

$I_{OUT} = 0A$



Shutdown

$I_{OUT} = 12A$

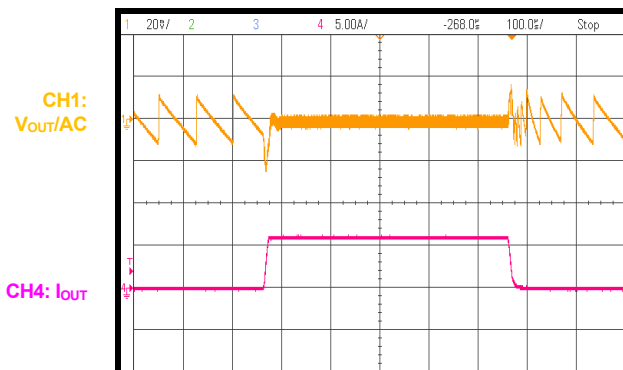


EVB TEST RESULTS

$V_{IN} = 5V$, $V_{OUT} = 1V$, $L = 0.68\mu H$, $f_{SW} = 500kHz$, auto-PFM/PWM mode, $T_A = 25^\circ C$, unless otherwise noted.

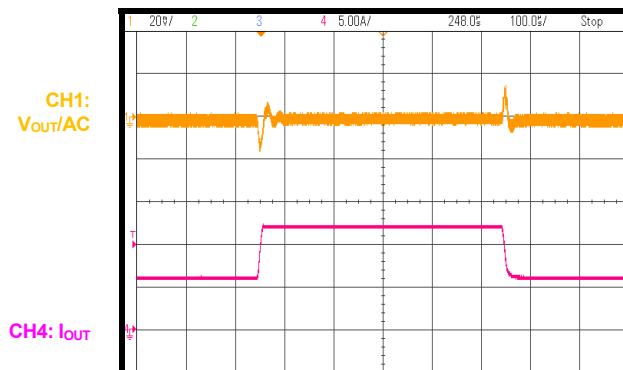
Load Transient

$I_{OUT} = 0A$ to $6A$, $0.6A/\mu s$ slew rate



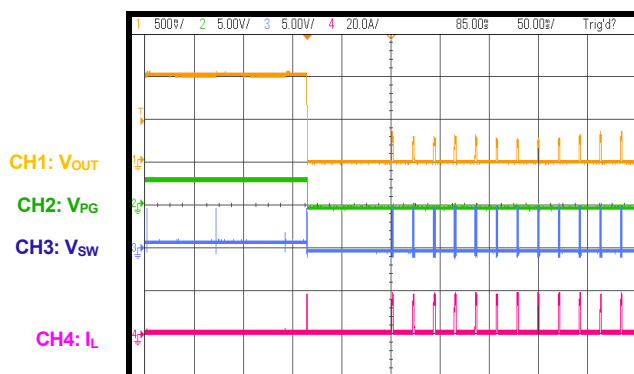
Load Transient

$I_{OUT} = 6A$ to $12A$, $0.6A/\mu s$ slew rate



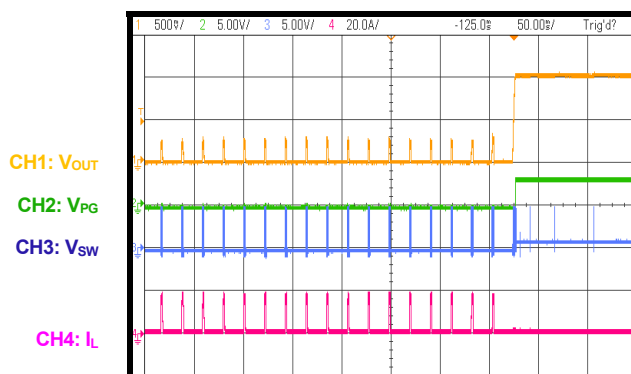
SCP Entry

Hiccup mode, $I_{OUT} = 0A$



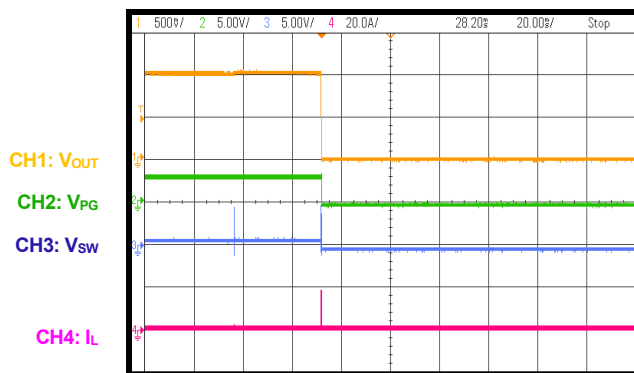
SCP Recovery

Hiccup mode, $I_{OUT} = 0A$



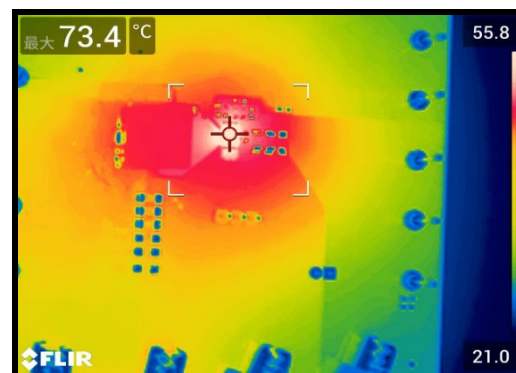
SCP Entry

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, $T_A = 25^\circ C$



PCB LAYOUT

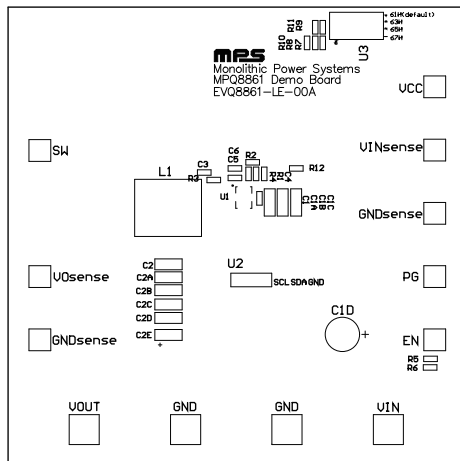


Figure 2: Top Silk

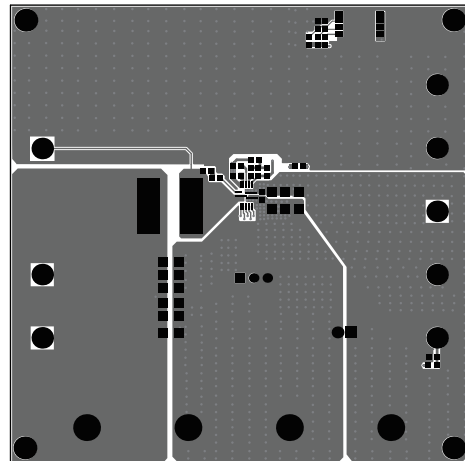


Figure 3: Top Layer

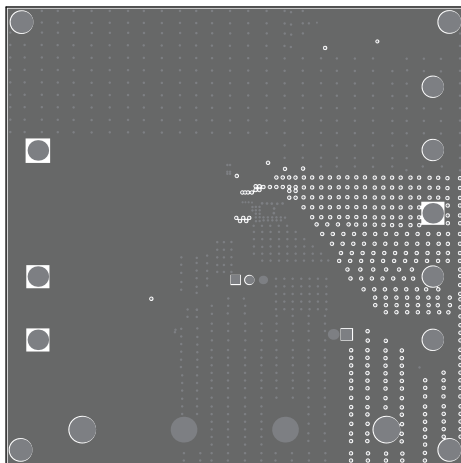


Figure 4: Mid-Layer 1

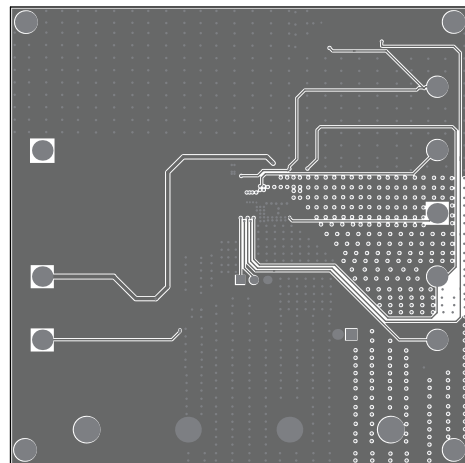


Figure 5: Mid-Layer 2

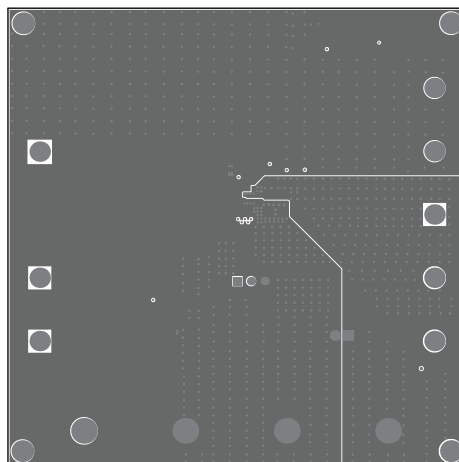


Figure 6: Bottom Layer



REVISION HISTORY

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

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