EVQ2178-LE-00A

5.5V, 2A, 2.4MHz, Synchronous Step-Down Converter with PG and SS Evaluation Board, AEC-Q100 Qualified

DESCRIPTION

The EVQ2178-LE-00A is an evaluation board designed to demonstrate the capabilities of the MPQ2178, a monolithic, step-down switch-mode converter with integrated internal power MOSFETs.

The EVQ2178-LE-00A achieves 2A of continuous output current (I_{OUT}) across a 2.5V to 5.5V input voltage (V_{IN}) range, with excellent load and line regulation. The output voltage (V_{OUT}) can be regulated to as low as 0.6V. Fault protections include cycle-by-cycle current limiting and thermal shutdown.

The EVQ2178-LE-00A is a fully assembled and tested evaluation board. It generates a 1.2V V_{OUT} at load currents up to 2A across a 2.5V to 5.5V V_{IN} range.

The MPQ2178 is available in a compact QFN-8 (1.5mmx2mm) package.

ELECTRICAL SPECIFICATIONS

Parameter	Symbol	Value	Units
Input voltage	V_{IN}	2.5 to 5.5	V
Output voltage	V_{OUT}	1.2	V
Output current	I_{OUT}	2	A

FEATURES

- **Designed for Automotive Applications:**
  - Wide 2.5V to 5.5V Operating Input Voltage (V_{IN}) Range
  - Up to 2A Output Current (I_{OUT})
  - 1% Feedback (FB) Accuracy
- **High Performance for Improved Thermals:**
  - 70mΩ and 40mΩ Integrated Internal Power MOSFETs
- **Optimized for EMC and EMI:**
  - 2.4MHz Switching Frequency (f_{SW})
  - Forced Continuous Conduction Mode (CCM) Across the Full Load Range
- **Optimized for Board Size and BOM:**
  - Integrated Compensation Network
  - Available in a QFN-8 (1.5mmx2mm) Package
  - Available in AEC-Q100 Grade 1
- **Additional Features:**
  - Power Good (PG)
  - External Soft-Start (SS) Control
  - Output Discharge
  - Over-Voltage Protection (OVP) and Short-Circuit Protection (SCP) with Hiccup Mode

APPLICATIONS

- Automotive Clusters, Telematics, and Infotainment Systems
- Camera Modules
- Key Fobs
- Industrial Supplies
- Battery-Powered Devices

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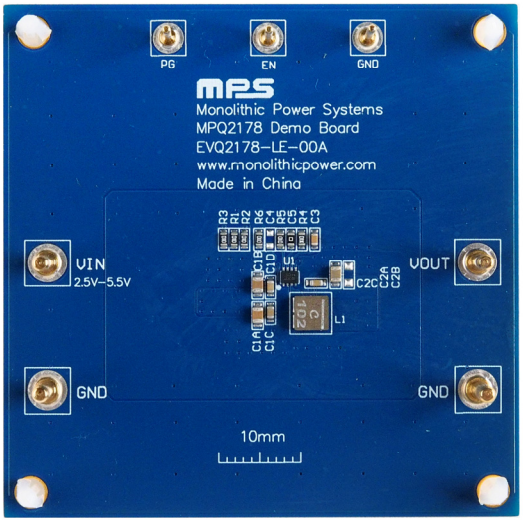
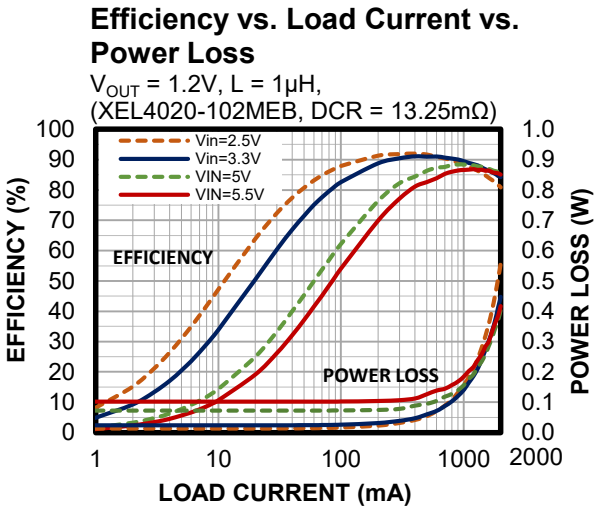
EVQ2178-LE-00A EVALUTION BOARD





LxWxH (6.3cmx6.3cmx0.3cm)

Board Number	MPS IC Number
EVQ2178-LE-00A	MPQ2178GQHE-AEC1

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QUICK START GUIDE

1. Preset the power supply between 2.5V and 5.5V.
2. Connect the power supply terminals to:
   a. Positive (+): VIN
   b. Negative (-): GND
3. Connect the load terminals to:
   a. Positive (+): VOUT
   b. Negative (-): GND
4. After making connections, turn on the power supply.
5. To use the enable function, apply a digital input to the EN pin. Drive EN above 0.9V to turn the regulator on; drive EN below 0.65V to turn it off.
6. The external resistor divider sets the output voltage (V_{OUT}). To adjust the MPQ2178's output, set the feedback resistor (R5) to be between 10kΩ and 100kΩ. R6 can then be calculated with Equation (1):

$$R6 = \frac{R5}{\frac{V_{OUT}}{0.6} - 1} \quad (1)$$

Table 1 shows the recommended resistor values for common output voltages.

Table 1: Resistor Values for Common Output Voltages

V_{OUT} (V)	R5 (kΩ)	R6 (kΩ)
1.0	30.9 (1%)	47 (1%)
1.2	100 (1%)	100 (1%)
1.8	36 (1%)	18 (1%)
2.5	51 (1%)	16 (1%)
3.3	68 (1%)	15 (1%)

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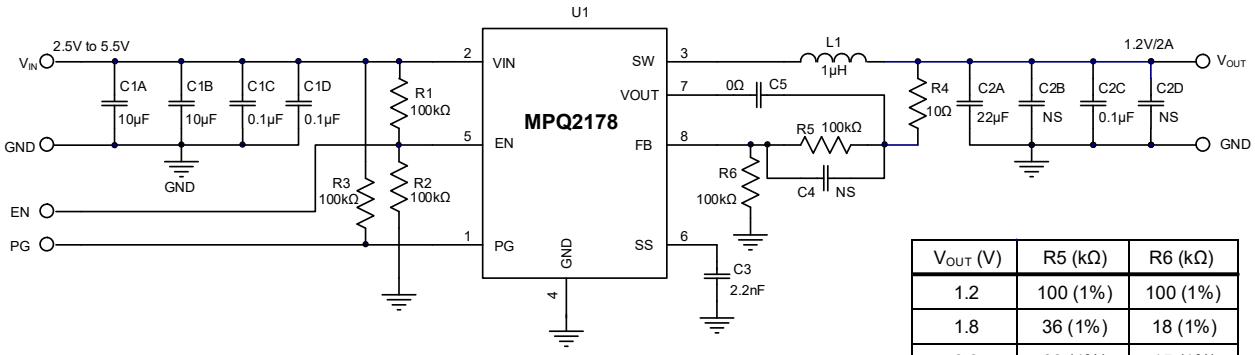
EVALUATION BOARD SCHEMATIC



V_{OUT} (V)	R5 (kΩ)	R6 (kΩ)
1.2	100 (1%)	100 (1%)
1.8	36 (1%)	18 (1%)
3.3	68 (1%)	15 (1%)

Figure 1: Evaluation Board Schematic

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EVQ2178-LE-00A BILL OF MATERIALS

Qty	Designator	Value	Description	Package	Manufacturer	Manufacturer PN
1	CIN1	22µF	Electrolytic capacitor, 63V	SMD	Jianghai	VTD-63V22
2	C1A, C1B	4.7µF	Ceramic capacitor, 16V, X7R	0805	Murata	GCM21BR71C475KA73L
3	C1C, C1D, C2C	0.1µF	Ceramic capacitor, 16V, X7R	0603	TDK	C1608X7R1C104K
1	C2A	22µF	Ceramic capacitor, 6.3V, X5R	0805	Murata	GRM21BR60J226ME39L
1	C5	0Ω	Film resistor, 1%	0603	Yageo	RC0603FR-070RL
0	C4	NS				
1	C3	2.2nF	Ceramic capacitor, 50V, X7R	0603	TDK	C1608X7R1H222K
5	R1, R2, R3, R5, R6	100kΩ	Film resistor, 1%	0603	Yageo	RC0603FR-07100KL
1	R4	10Ω	Film resistor, 1%	0603	Yageo	RC0603FR-0710RL
1	L1	1µH	Inductor, R_{DC} = 14.6mΩ, I_{SAT} = 9.6A	SMD	Coilcraft	XEL4020-102MEB
4	VIN, GND, VOUT, GND	Test point	2.0 golden pin	DIP	Custom	
3	EN, PG, GND	Test point	1.0 golden pin	DIP	Custom	
1	U1	MPQ2178 -AEC1	5.5V, 2A, step-down converter, AEC-Q100 qualified	QFN-8 (1.5mmx 2mm)	MPS	MPQ2178GQHE-AEC1

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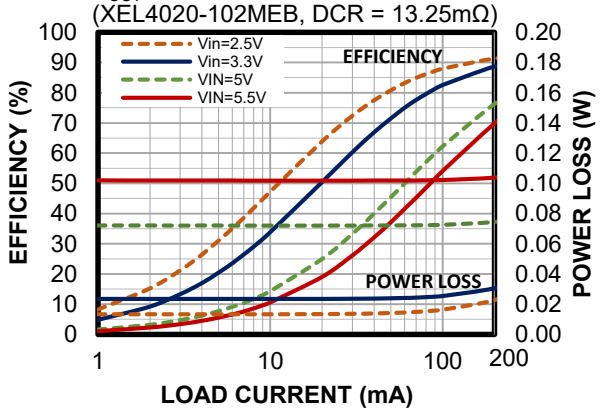
EVB TEST RESULTS

Performance curves and waveforms are tested on the evaluation board. V_{IN} = 3.6V, V_{OUT} = 1.2V, L = 1µH, C_{OUT} = 22µF, T_A = 25°C, unless otherwise noted.

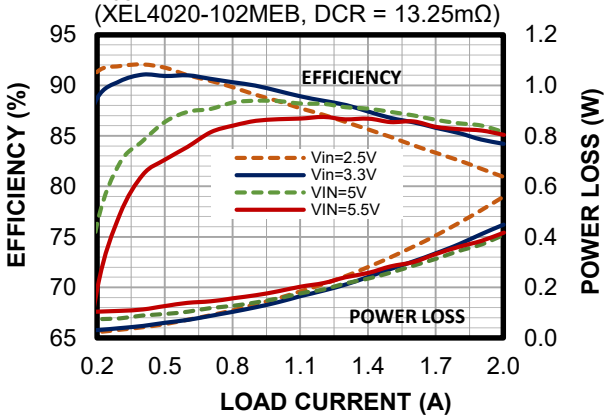
Efficiency vs. Load Current vs. Power Loss

V_{OUT} = 1.2V, L = 1µH,
(XEL4020-102MEB, DCR = 13.25mΩ)



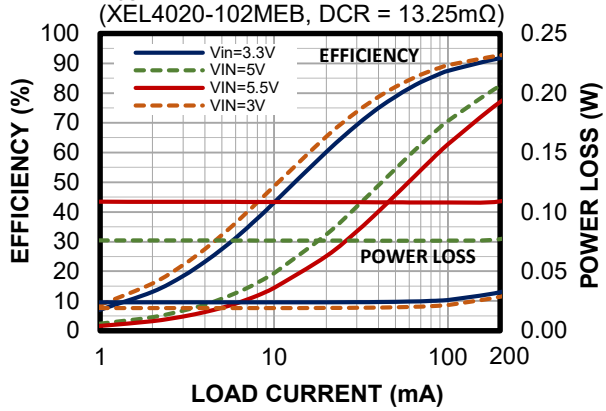
Efficiency vs. Load Current vs. Power Loss

V_{OUT} = 1.2V, L = 1µH,
(XEL4020-102MEB, DCR = 13.25mΩ)



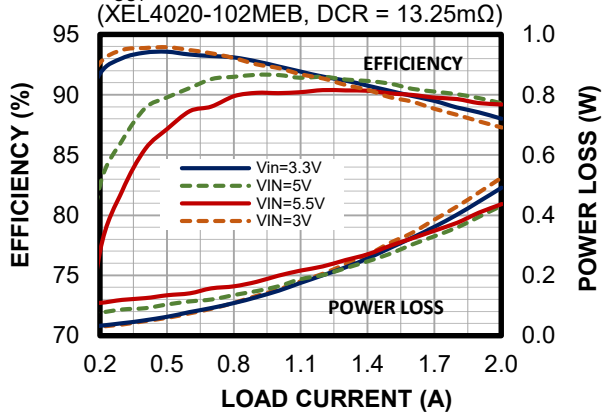
Efficiency vs. Load Current vs. Power Loss

V_{OUT} = 1.8V, L = 1µH,
(XEL4020-102MEB, DCR = 13.25mΩ)



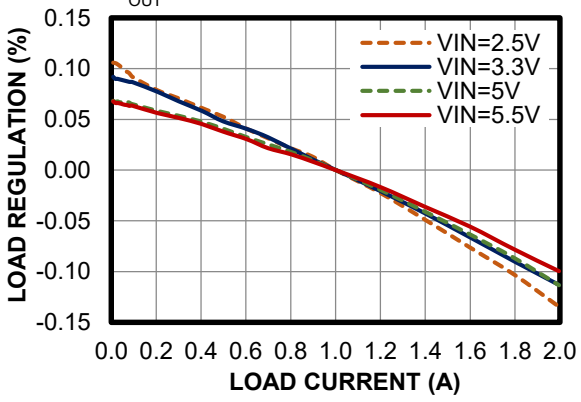
Efficiency vs. Load Current vs. Power Loss

V_{OUT} = 1.8V, L = 1µH,
(XEL4020-102MEB, DCR = 13.25mΩ)



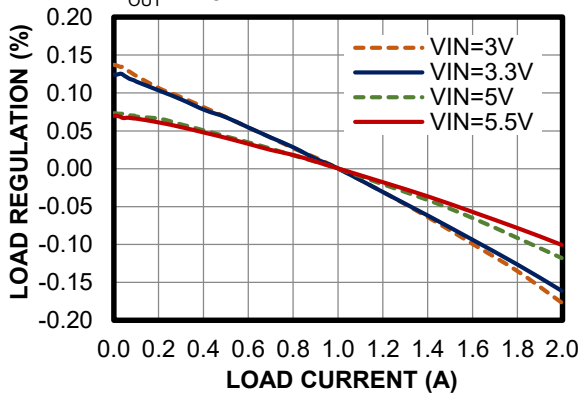
Load Regulation

V_{OUT} = 1.2V



Load Regulation

V_{OUT} = 1.8V



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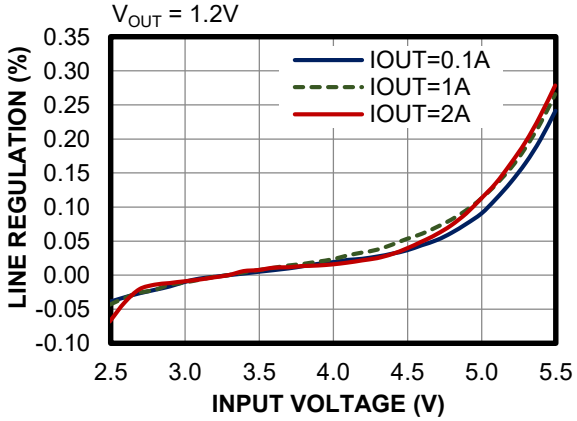
EVB TEST RESULTS *(continued)*

Performance curves and waveforms are tested on the evaluation board. V_{IN} = 3.6V, V_{OUT} = 1.2V, L = 1µH, C_{OUT} = 22µF, T_A = 25°C, unless otherwise noted.

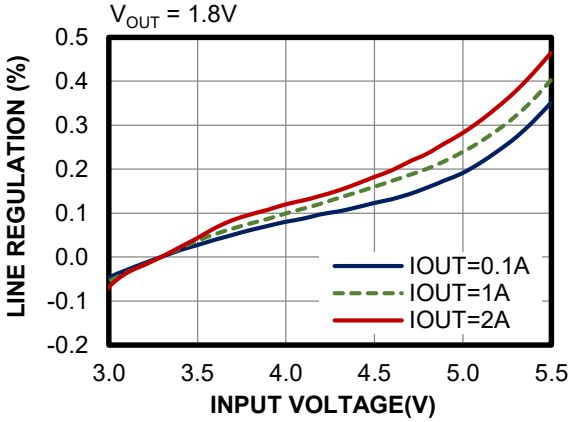
Line Regulation

V_{OUT} = 1.2V



Line Regulation

V_{OUT} = 1.8V



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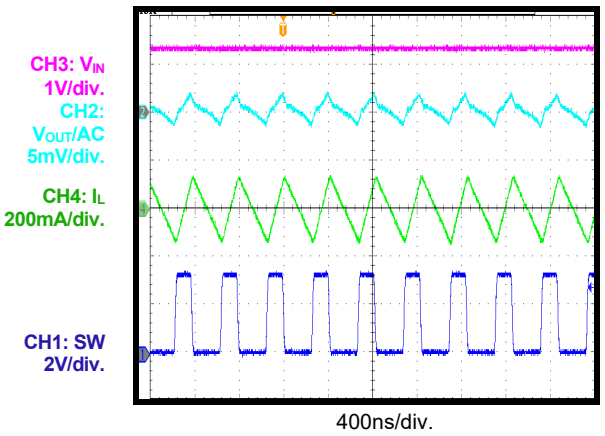
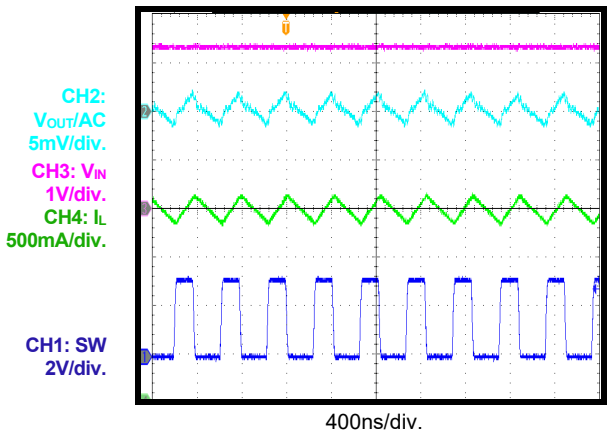
EVB TEST RESULTS *(continued)*

Performance curves and waveforms are tested on the evaluation board. V_{IN} = 3.6V, V_{OUT} = 1.2V, L = 1µH, C_{OUT} = 22µF, T_A = 25°C, unless otherwise noted.

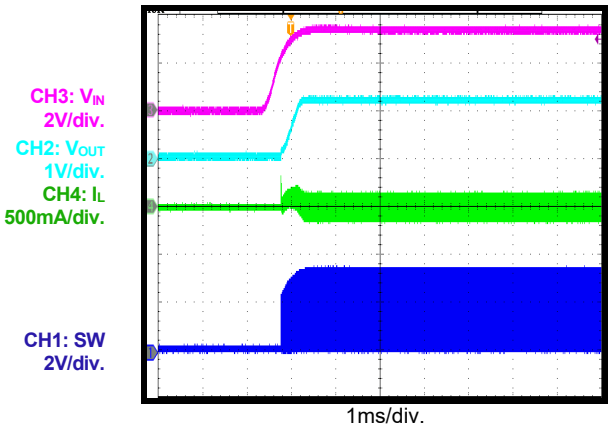
Steady State
I_{OUT} = 0A



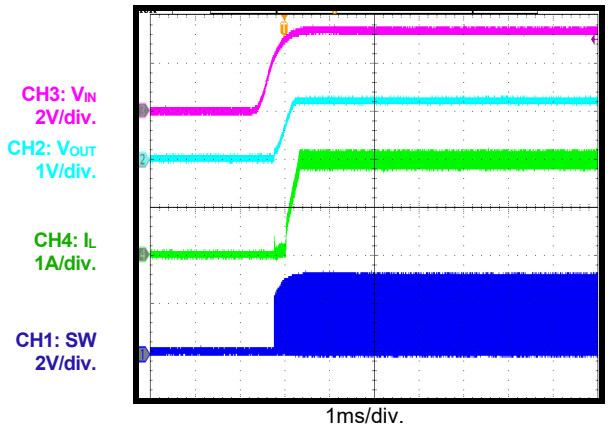
Steady State
I_{OUT} = 2A



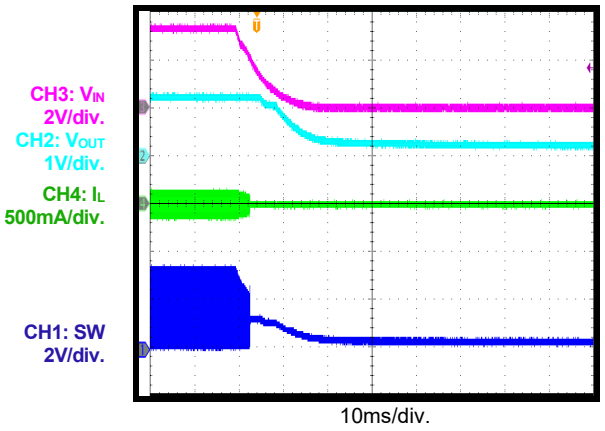
Start-Up through VIN
I_{OUT} = 0A



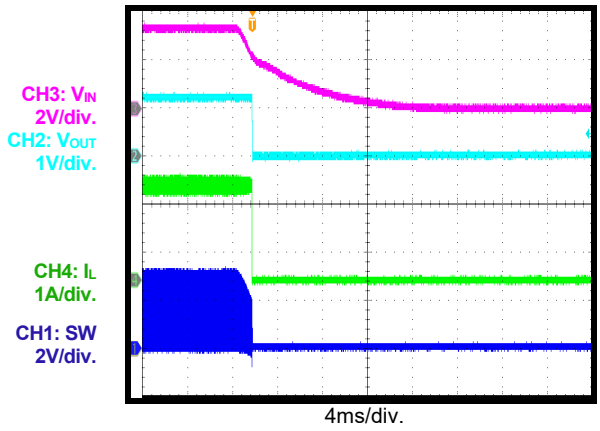
Start-Up through VIN
I_{OUT} = 2A



Shutdown through VIN
I_{OUT} = 0A



Shutdown through VIN
I_{OUT} = 2A



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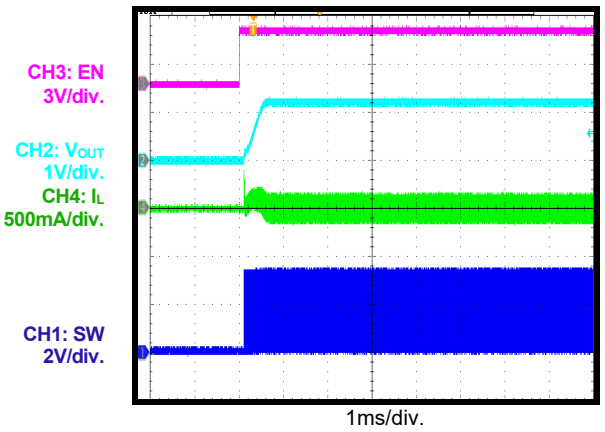
EVB TEST RESULTS *(continued)*

Performance curves and waveforms are tested on the evaluation board. V_{IN} = 3.6V, V_{OUT} = 1.2V, L = 1µH, C_{OUT} = 22µF, T_A = 25°C, unless otherwise noted.

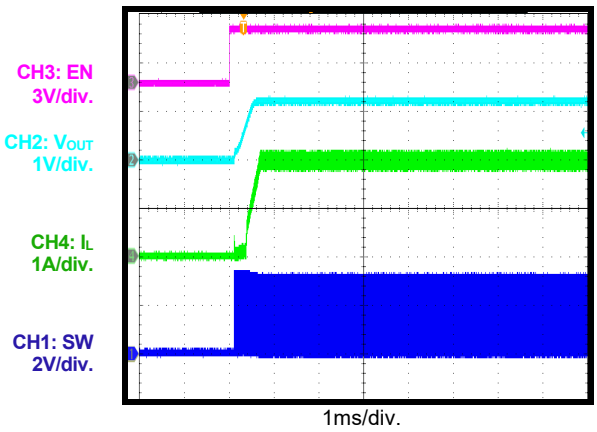
Start-Up through EN

I_{OUT} = 0A



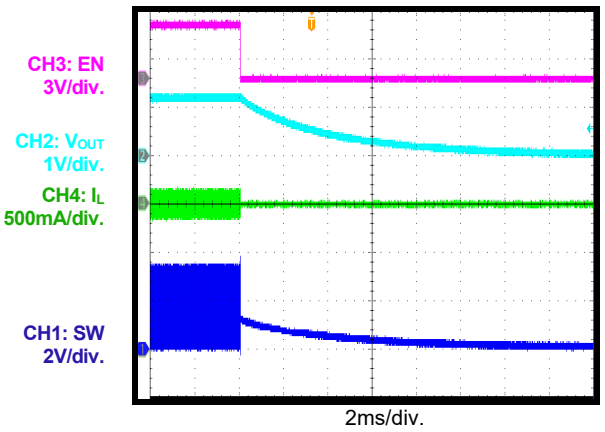
Start-Up through EN

I_{OUT} = 2A



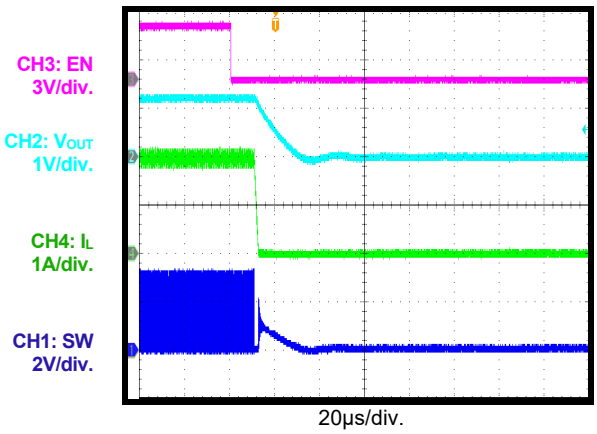
Shutdown through EN

I_{OUT} = 0A



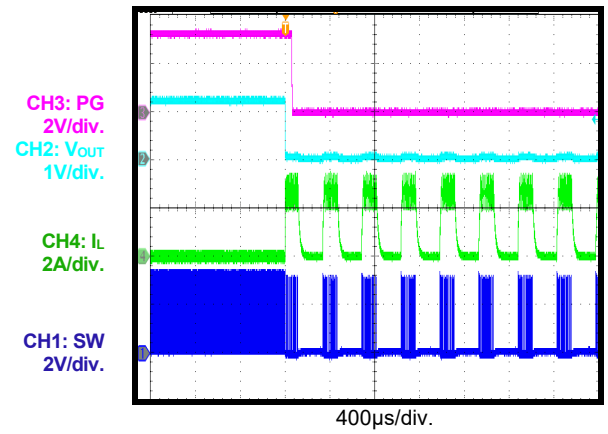
Shutdown through EN

I_{OUT} = 2A



SCP Entry

I_{OUT} = 0A



SCP Entry

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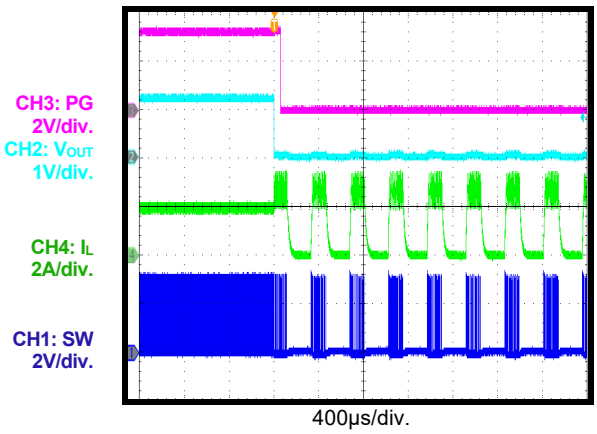

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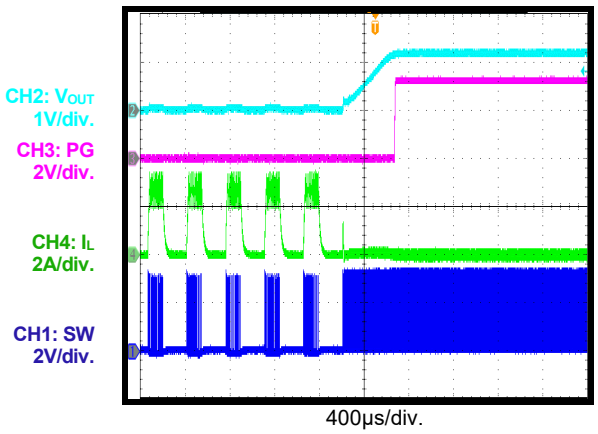
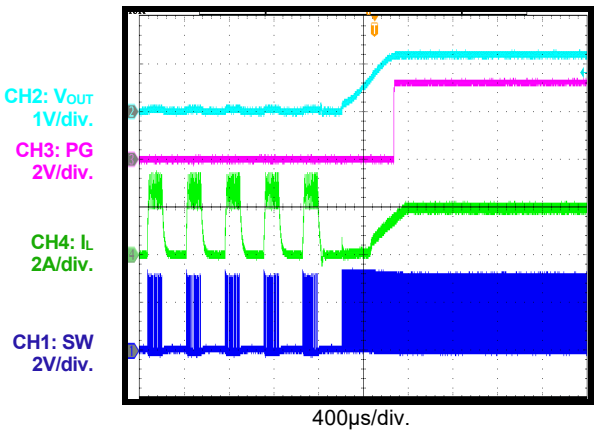
EVB TEST RESULTS *(continued)*

Performance curves and waveforms are tested on the evaluation board. V_{IN} = 3.6V, V_{OUT} = 1.2V, L = 1µH, C_{OUT} = 22µF, T_A = 25°C, unless otherwise noted.

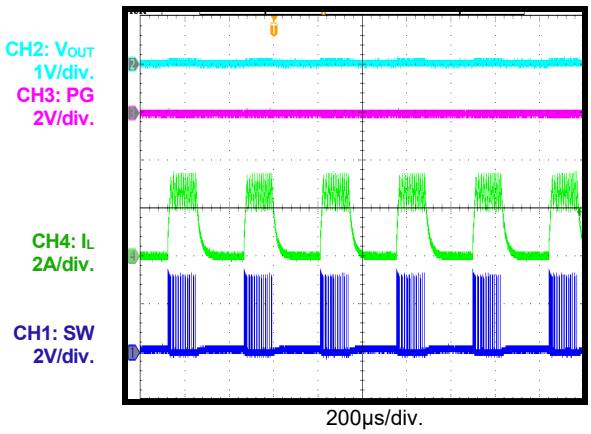
SCP Recovery
I_{OUT} = 0A



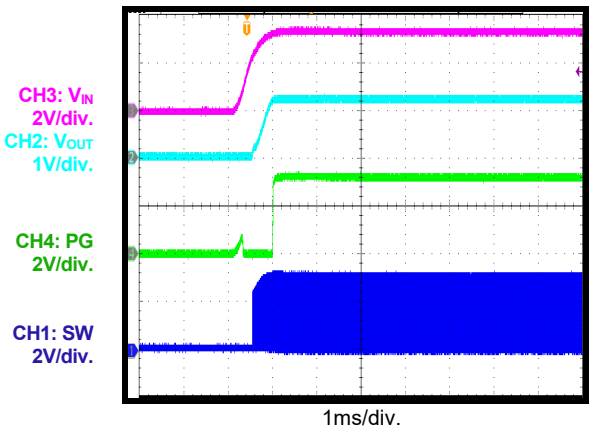
SCP Recovery
I_{OUT} = 2A



Short Circuit



PG in Start-Up through VIN
I_{OUT} = 2A



PG in Shutdown through VIN
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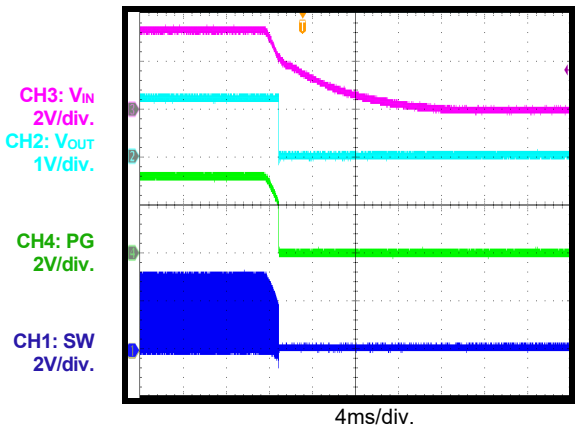

PG in Start-Up through EN
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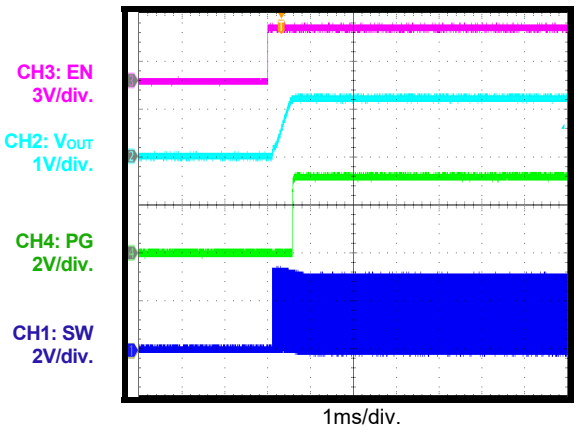

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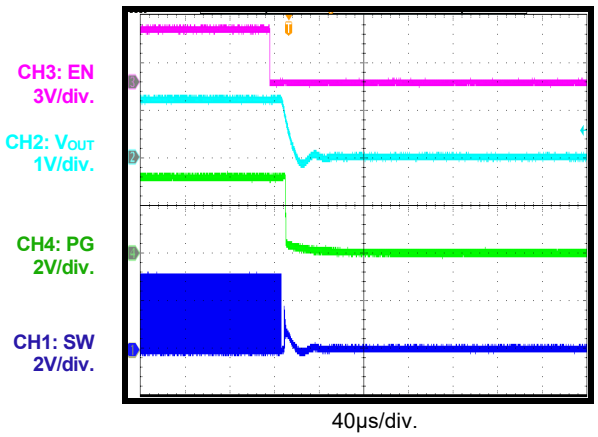
EVB TEST RESULTS *(continued)*

Performance curves and waveforms are tested on the evaluation board. V_{IN} = 3.6V, V_{OUT} = 1.2V, L = 1µH, C_{OUT} = 22µF, T_A = 25°C, unless otherwise noted.

PG in Shutdown through EN

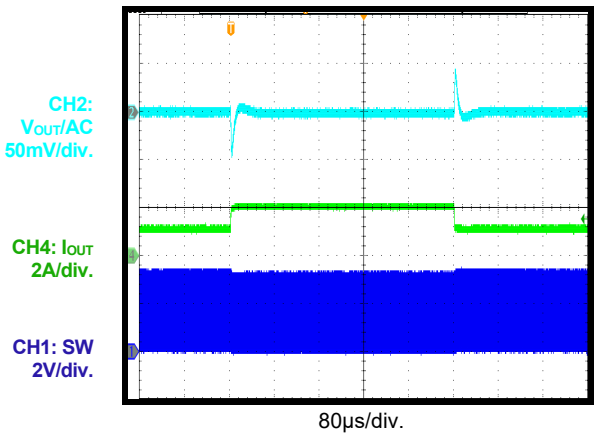
I_{OUT} = 2A



40µs/div.

Load Transient

I_{OUT} = 1A to 2A, 1A/µs



80µs/div.

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PCB LAYOUT

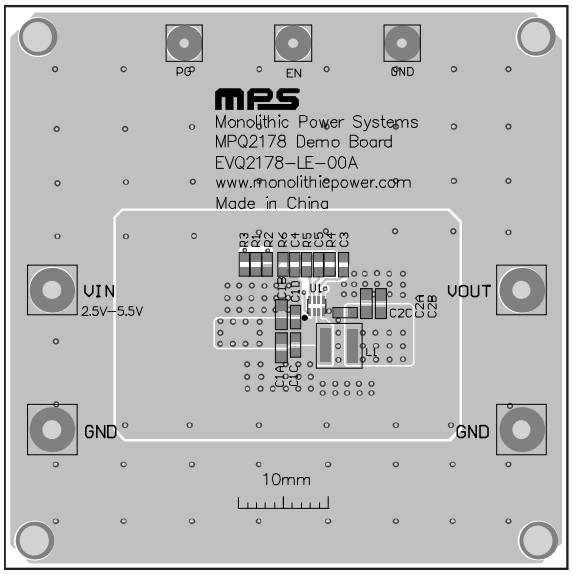

Figure 2: Top Silk and Top Layer

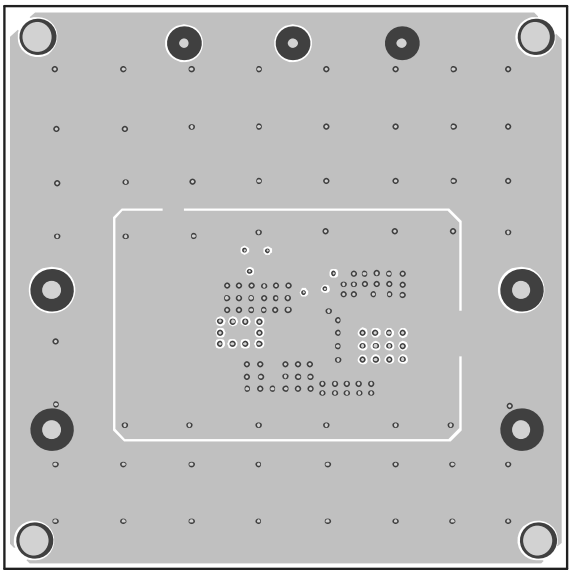

Figure 3: Mid-Layer 1

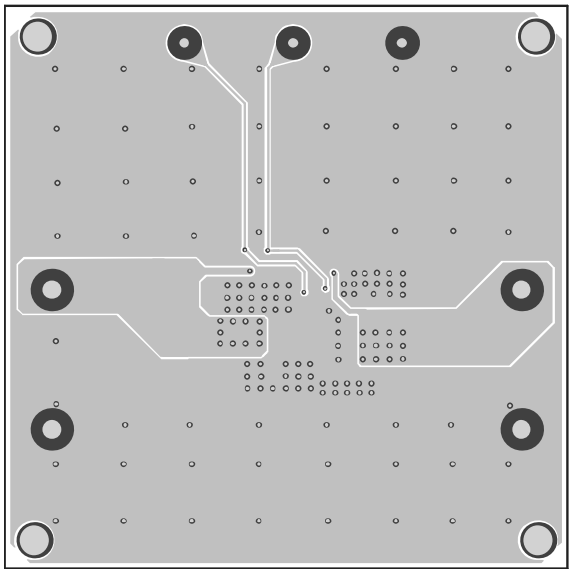

Figure 4: Mid-Layer 2

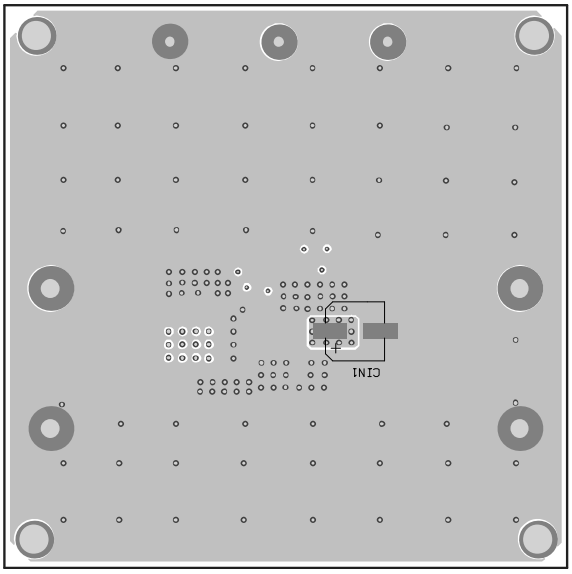

Figure 5: Bottom Layer and Bottom Silk

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REVISION HISTORY

Revision #	Revision Date	Description	Pages Updated
1.0	09/29/2021	Initial Release	-

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