



EVQ2178A-LE-00A

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

DESCRIPTION

The EVQ2178A-LE-00A is an evaluation board designed to demonstrate the capabilities of the MPQ2178A, a monolithic, step-down switch-mode converter with built-in internal power MOSFETs.

The EVQ2178A-LE-00A achieves up to 2A of 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 EVQ2178A-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 and 5.5V V_{IN} range.

The MPQ2178A is available in a compact QFN-8 (1.5mmx2mm) package, and is AEC-Q100 qualified.

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

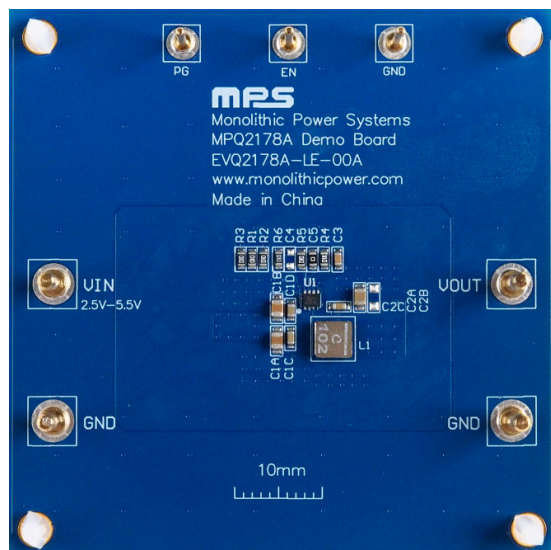
- **Designed for Automotive Applications:**
 - Wide 2.5V to 5.5V Operating Input Voltage (V_{IN}) Range
 - Up to 2A Output Current (I_{OUT})
 - 1% Feedback (FB) Accuracy
- **Increased Battery Life:**
 - 21 μ A Sleep Mode Quiescent Current (I_Q)
 - AAM Mode for Increased Efficiency under Light-Load Conditions
- **High Performance for Improved Thermals:**
 - 70m Ω and 40m Ω Internal Power MOSFETs
- **Optimized for EMC and EMI:**
 - 2.4MHz Switching Frequency (f_{SW})
 - MeshConnect™ Flip-Chip Package
- **Optimized for Board Size and BOM:**
 - Integrated Compensation Network
 - Available in a Compact 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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EVQ2178A-LE-00A EVALUTION BOARD

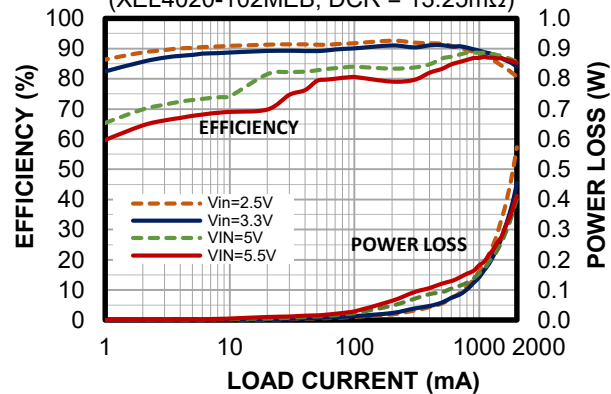


LxWxH (6.3cmx6.3cmx0.3cm)

Board Number	MPS IC Number
EVQ2178A-LE-00A	MPQ2178AGQHE-AEC1

Efficiency vs. Load Current vs. Power Loss

$V_{OUT} = 1.2V$, $L = 1\mu H$,
(XEL4020-102MEB, DCR = 13.25m Ω)



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 MPQ2178A's output, set the feedback resistor (R_5) to be between 10k Ω and 100k Ω . R_6 can then be calculated using Equation (1):

$$R_6 = \frac{R_5}{\frac{V_{OUT}}{0.6} - 1} \quad (1)$$

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

Table 1: Resistor Values for Common Output Voltages

V_{OUT} (V)	R_5 (k Ω)	R_6 (k Ω)
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%)

EVALUATION BOARD SCHEMATIC

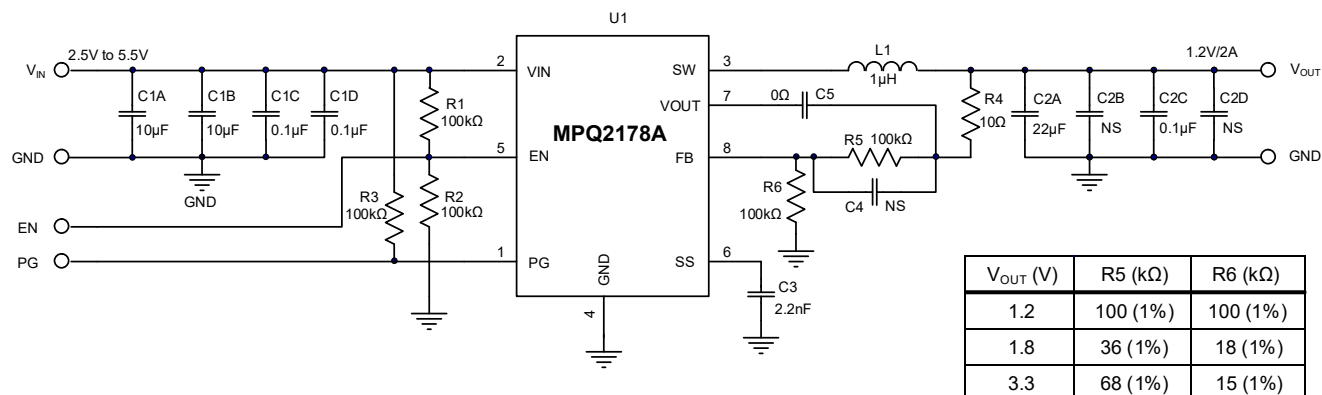


Figure 1: Evaluation Board Schematic

EVQ2178A-LE-00A BILL OF MATERIALS

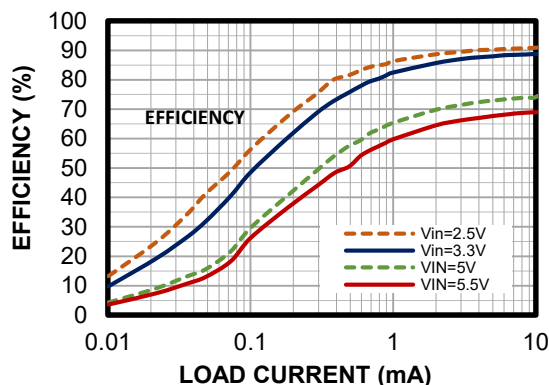
Qty	Ref	Value	Description	Package	Manufacturer	Manufacturer PN
1	CIN1	22 μ F	Electrolytic capacitor, 63V	SMD	Jianghai	VTD-63V22
2	C1A, C1B	4.7 μ F	Ceramic capacitor, 16V, X7R	0805	Murata	GCM21BR71C475KA73L
3	C1C, C1D, C2C	0.1 μ F	Ceramic capacitor, 16V, X7R	0603	TDK	C1608X7R1C104K
1	C2A	22 μ F	Ceramic capacitor, 6.3V, X5R	0805	Murata	GRM21BR60J226ME39L
1	C5	0 Ω	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	100k Ω	Film resistor, 1%	0603	Yageo	RC0603FR-07100KL
1	R4	10 Ω	Film resistor, 1%	0603	Yageo	RC0603FR-0710RL
1	L1	1 μ H	Inductor, $R_{DC} = 14.6m\Omega$, $I_{SAT} = 9.6A$	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	MPQ2178A -AEC1	5.5V, 2A, step-down converter, AEC-Q100 qualified	QFN-8 (1.5mmx 2mm)	MPS	MPQ2178AGQHE-AEC1

EVB TEST RESULTS

Performance curves and waveforms are tested on the evaluation board. $V_{IN} = 3.6V$, $V_{OUT} = 1.2V$, $L = 1\mu H$, $C_{OUT} = 22\mu F$, $T_A = 25^\circ C$, unless otherwise noted.

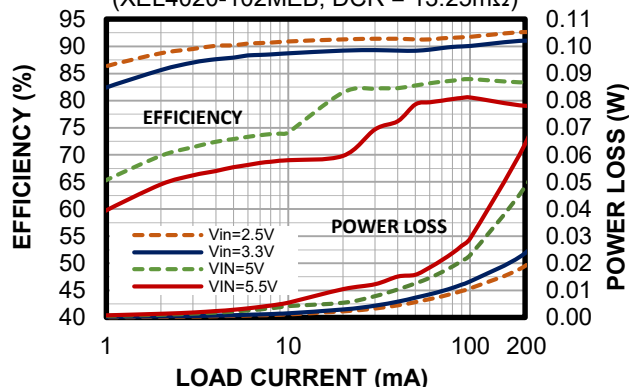
Efficiency vs. Load

$V_{OUT} = 1.2V$, $L = 1\mu H$,
(XEL4020-102MEB, DCR = 13.25mΩ)



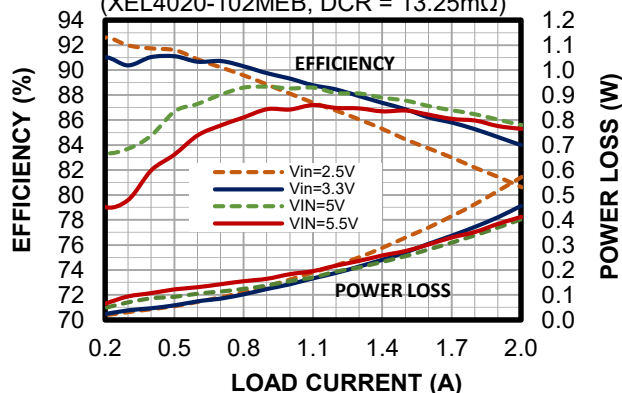
Efficiency vs. Load Current vs. Power Loss

$V_{OUT} = 1.2V$, $L = 1\mu H$,
(XEL4020-102MEB, DCR = 13.25mΩ)



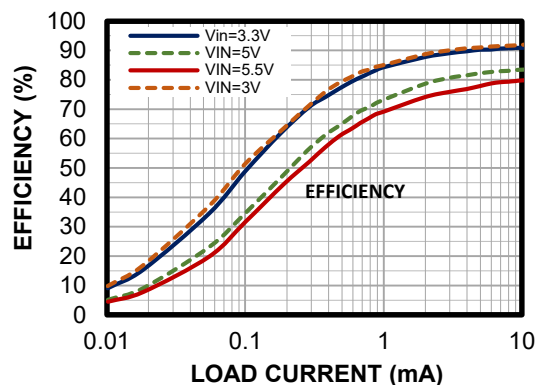
Efficiency vs. Load Current vs. Power Loss

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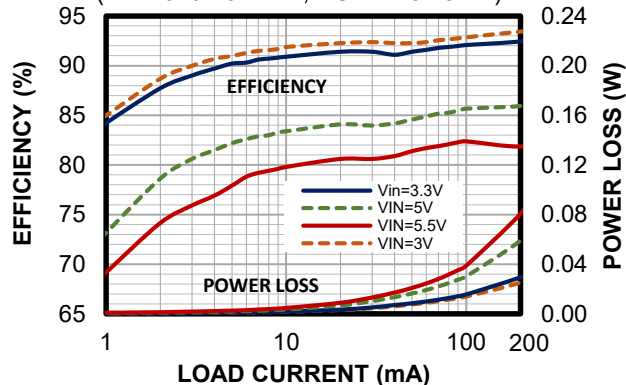
Efficiency vs. Load Current

$V_{OUT} = 1.8V$, $L = 1\mu H$,
(XEL4020-102MEB, DCR = 13.25mΩ)



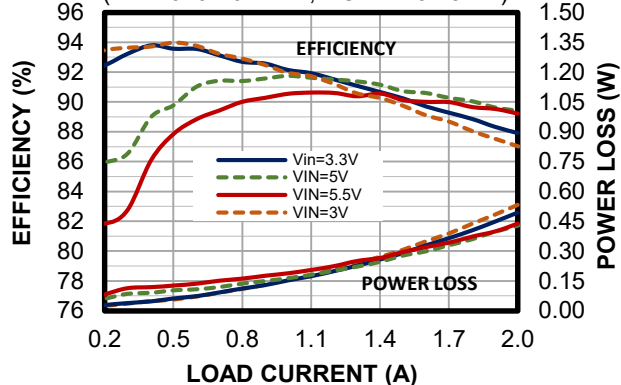
Efficiency vs. Load Current vs. Power Loss

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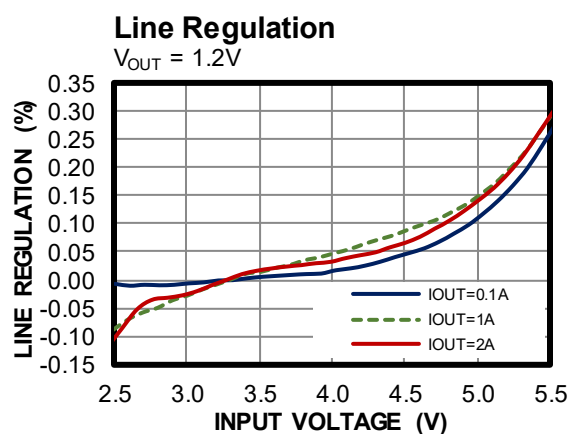
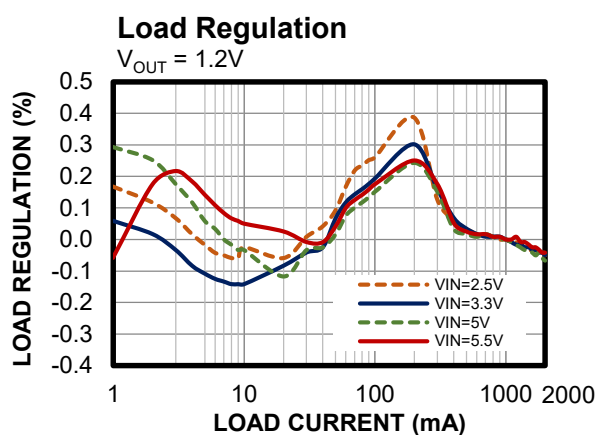
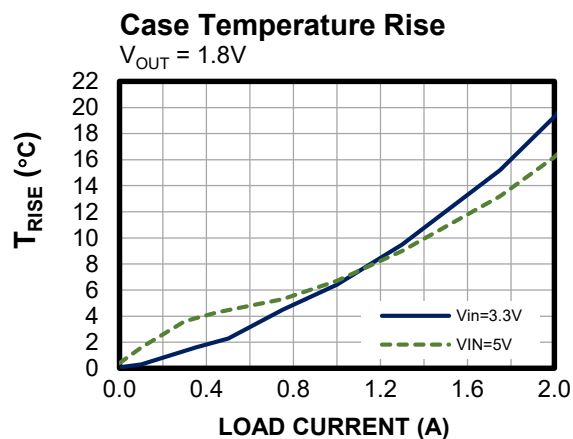
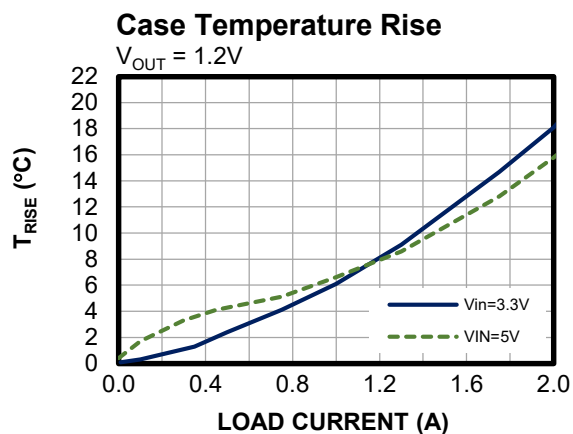
Efficiency vs. Load Current vs. Power Loss

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(XEL4020-102MEB, DCR = 13.25mΩ)



EVB TEST RESULTS *(continued)*

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EVB TEST RESULTS *(continued)*

Performance curves and waveforms are tested on the evaluation board. $V_{IN} = 3.6V$, $V_{OUT} = 1.2V$, $L = 1\mu H$, $C_{OUT} = 22\mu F$, $T_A = 25^\circ C$, unless otherwise noted.

Steady State

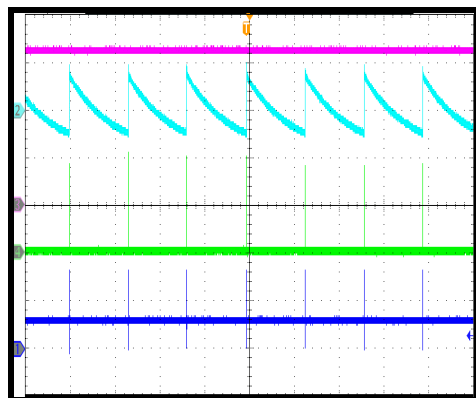
$I_{OUT} = 0A$

CH2: V_{OUT}/AC
10mV/div.

CH3: V_{IN}
1V/div.

CH4: I_L
200mA/div.

CH1: SW
2V/div.



20ms/div.

Steady State

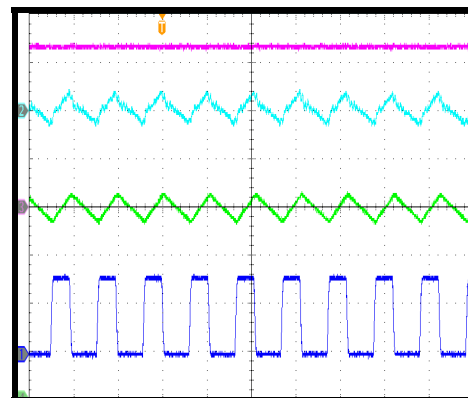
$I_{OUT} = 2A$

CH2: V_{OUT}/AC
5mV/div.

CH3: V_{IN}
1V/div.

CH4: I_L
500mA/div.

CH1: SW
2V/div.



400ns/div.

Start-Up through VIN

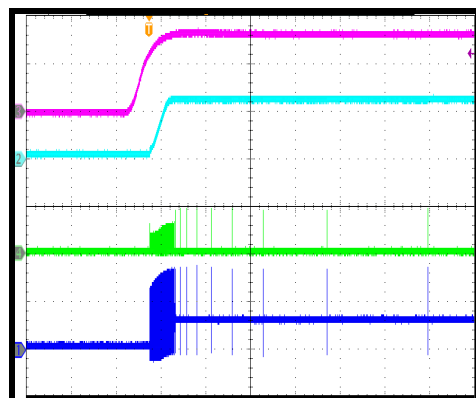
$I_{OUT} = 0A$

CH3: V_{IN}
2V/div.

CH2: V_{OUT}
1V/div.

CH4: I_L
500mA/div.

CH1: SW
2V/div.



1ms/div.

Start-Up through VIN

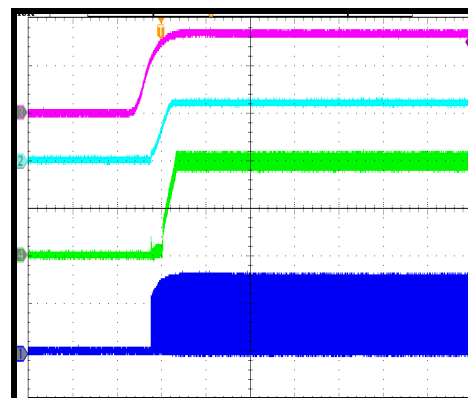
$I_{OUT} = 2A$

CH3: V_{IN}
2V/div.

CH2: V_{OUT}
1V/div.

CH4: I_L
1A/div.

CH1: SW
2V/div.



1ms/div.

Shutdown through VIN

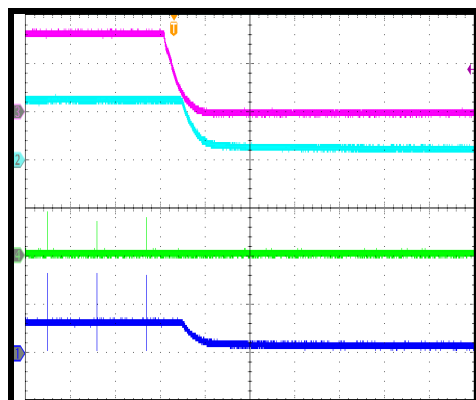
$I_{OUT} = 0A$

CH3: V_{IN}
2V/div.

CH2: V_{OUT}
1V/div.

CH4: I_L
500mA/div.

CH1: SW
2V/div.



20ms/div.

Shutdown through VIN

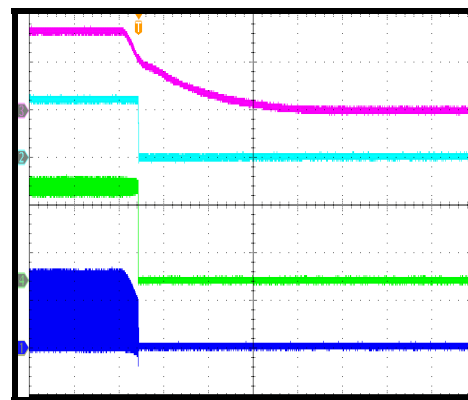
$I_{OUT} = 2A$

CH3: V_{IN}
2V/div.

CH2: V_{OUT}
1V/div.

CH4: I_L
1A/div.

CH1: SW
2V/div.

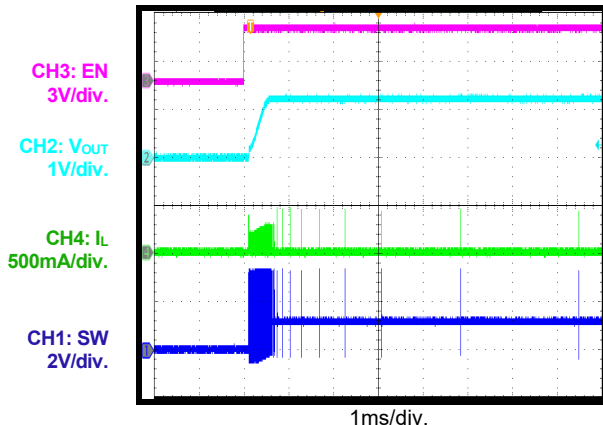


4ms/div.

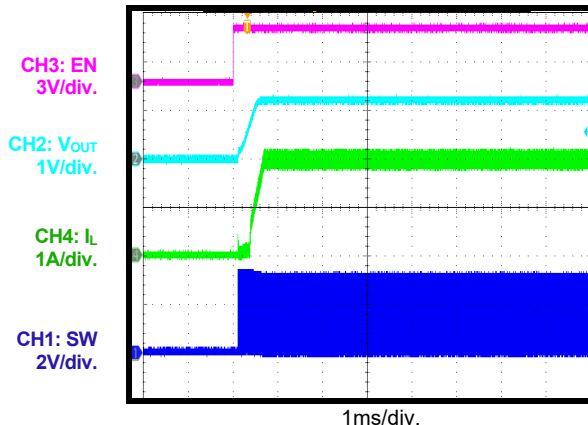
EVB TEST RESULTS *(continued)*

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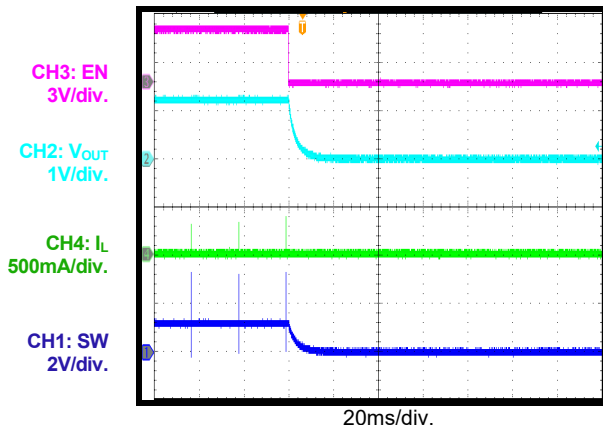
Start-Up through EN

 $I_{OUT} = 0A$


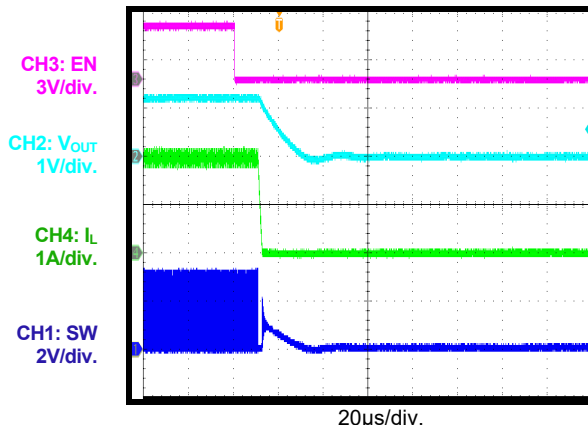
Start-Up through EN

 $I_{OUT} = 2A$


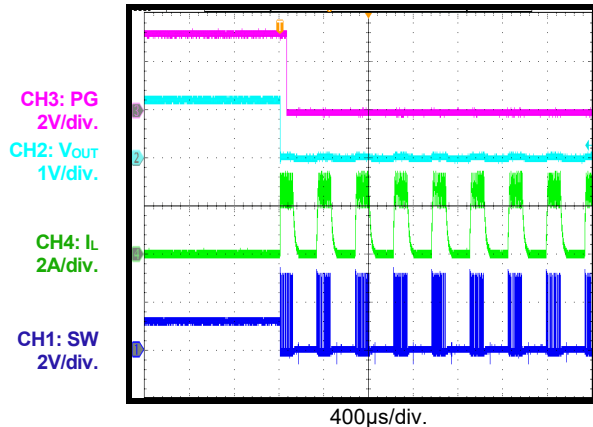
Shutdown through EN

 $I_{OUT} = 0A$


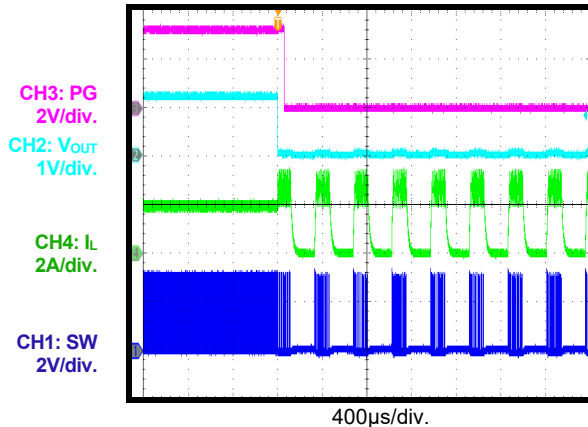
Shutdown through EN

 $I_{OUT} = 2A$


SCP Entry

 $I_{OUT} = 0A$


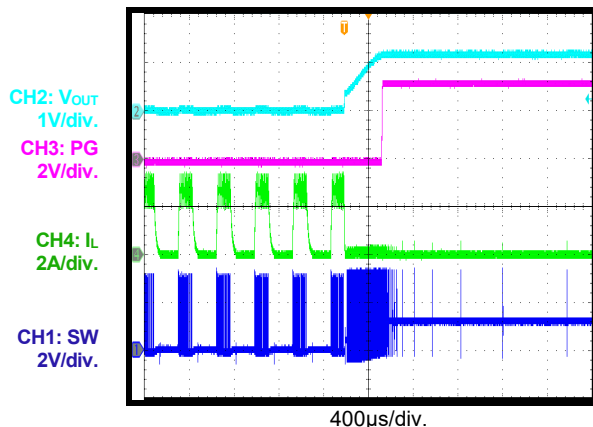
SCP Entry

 $I_{OUT} = 2A$


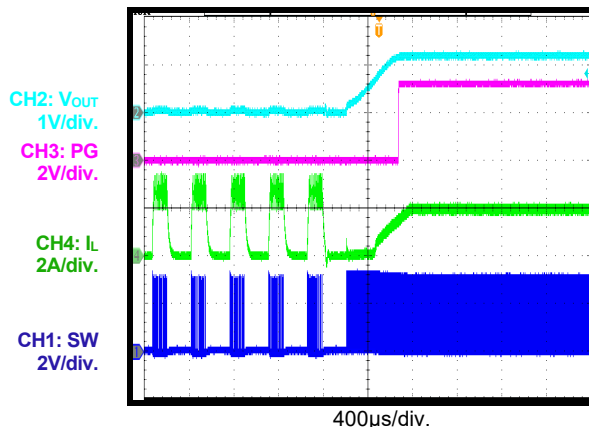
EVB TEST RESULTS *(continued)*

Performance curves and waveforms are tested on the evaluation board. $V_{IN} = 3.6V$, $V_{OUT} = 1.2V$, $L = 1\mu H$, $C_{OUT} = 22\mu F$, $T_A = 25^\circ C$, unless otherwise noted.

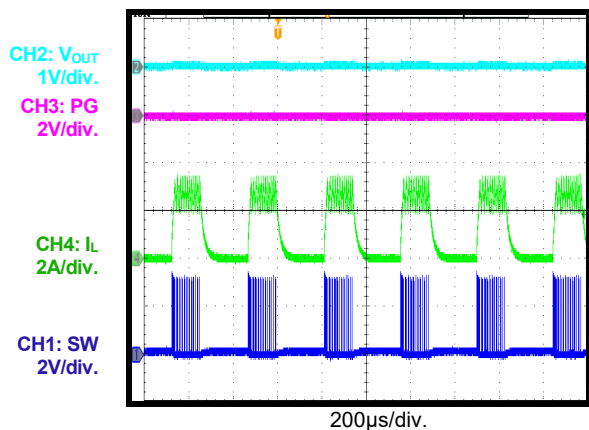
SCP Recovery

 $I_{OUT} = 0A$


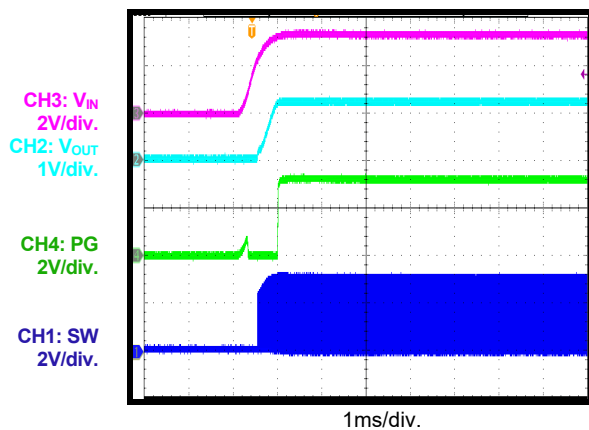
SCP Recovery

 $I_{OUT} = 2A$


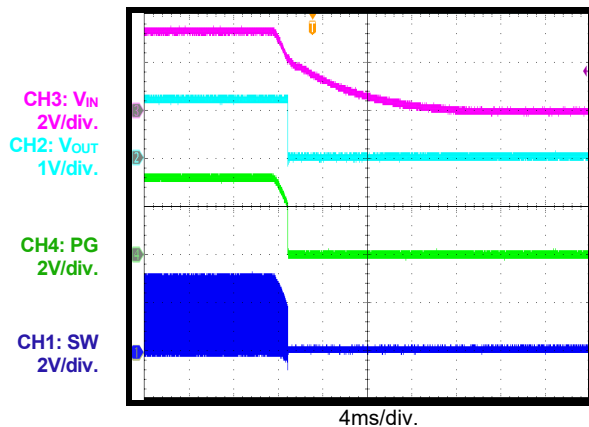
Short-Circuit Protection



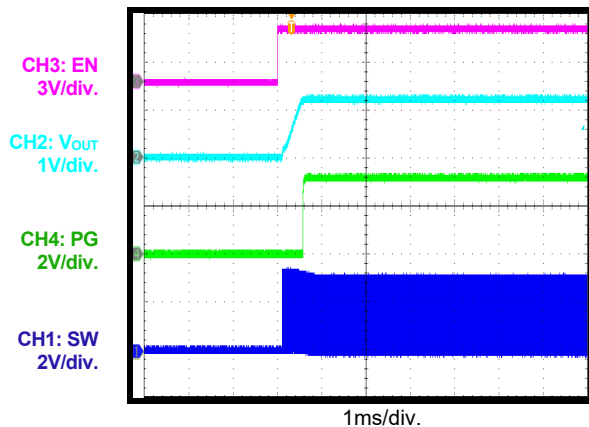
PG Start-Up through VIN

 $I_{OUT} = 2A$


PG Shutdown through VIN

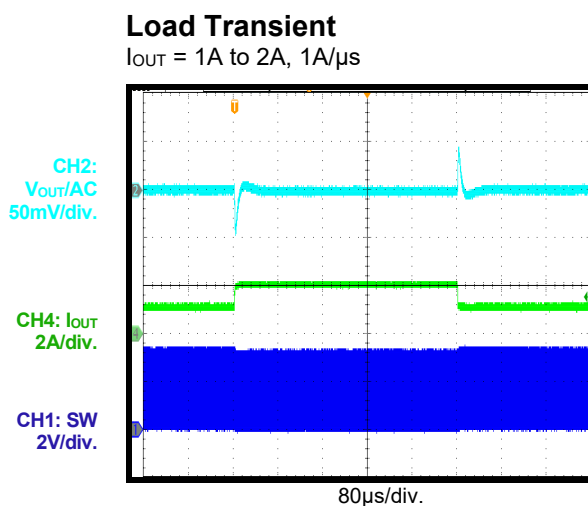
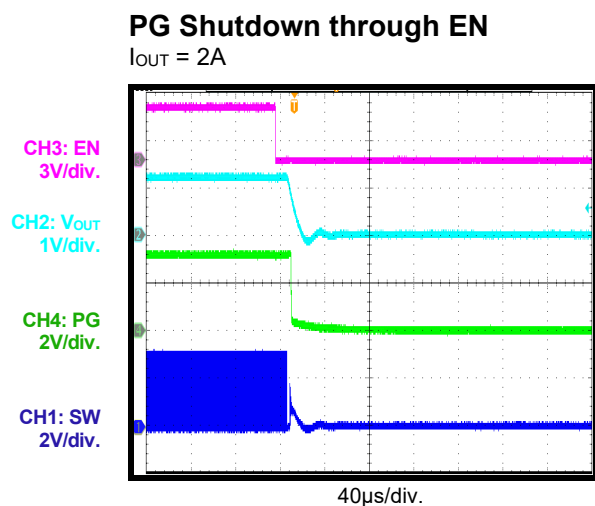
 $I_{OUT} = 2A$


PG Start-Up through EN

 $I_{OUT} = 2A$


EVB TEST RESULTS *(continued)*

Performance curves and waveforms are tested on the evaluation board. $V_{IN} = 3.6V$, $V_{OUT} = 1.2V$, $L = 1\mu H$, $C_{OUT} = 22\mu F$, $T_A = 25^\circ C$, unless otherwise noted.



PCB LAYOUT

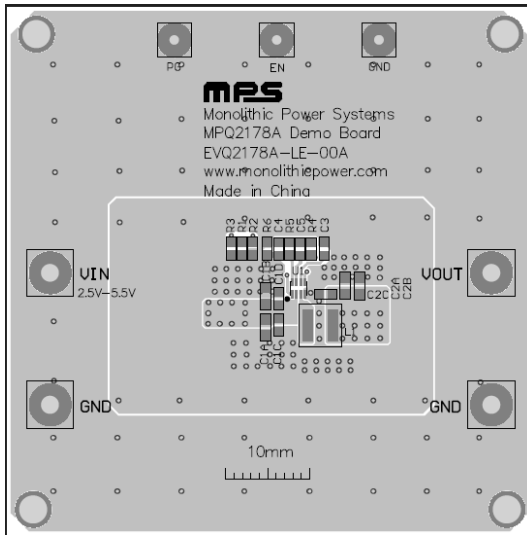


Figure 2: Top Silk and Top Layer

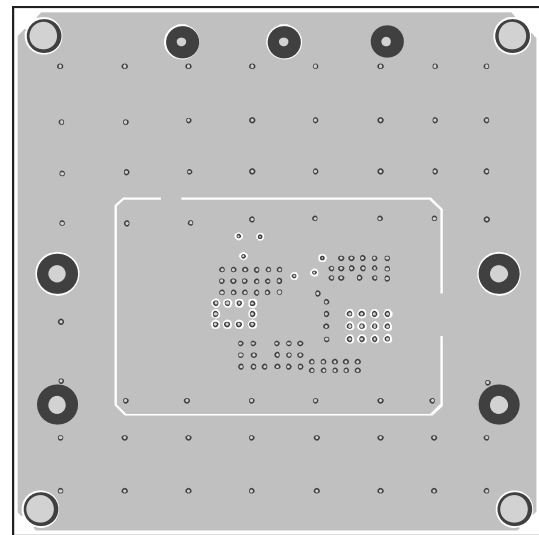


Figure 3: Mid-Layer 1

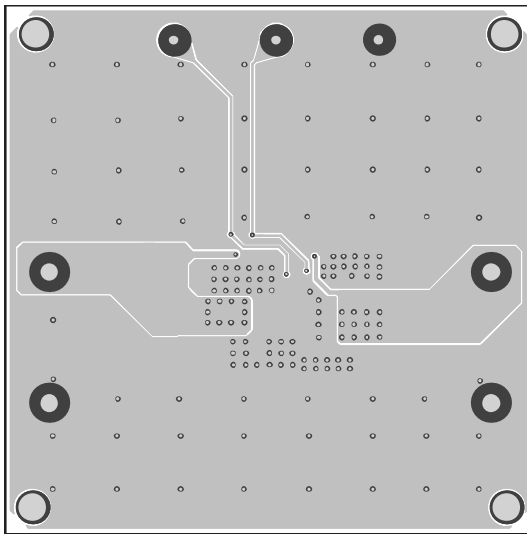


Figure 4: Mid-Layer 2

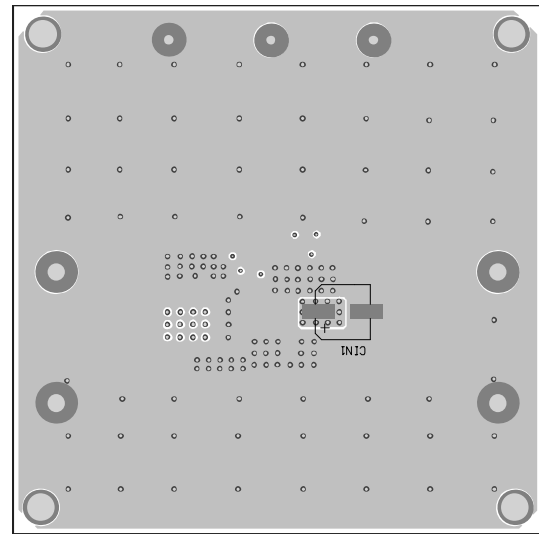


Figure 5: Bottom Layer and Bottom Silk



REVISION HISTORY

Revision #	Revision Date	Description	Pages Updated
1.0	10/29/2021	Initial Release	-

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