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:**
  - 21μA Sleep Mode Quiescent Current (I_Q)
  - AAM Mode for Increased Efficiency under Light-Load Conditions
- **High Performance for Improved Thermals:**
  - 70mΩ and 40mΩ 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

All MPS parts are lead-free, halogen-free, and adhere to the RoHS directive. For MPS green status, please visit the MPS website under Quality Assurance. “MPS”, the MPS logo, and “Simple, Easy Solutions” are trademarks of Monolithic Power Systems, Inc. or its subsidiaries.

MPS Proprietary Information. Patent Protected. Unauthorized Photocopy and Duplication Prohibited.
© 2021 MPS. All Rights Reserved.

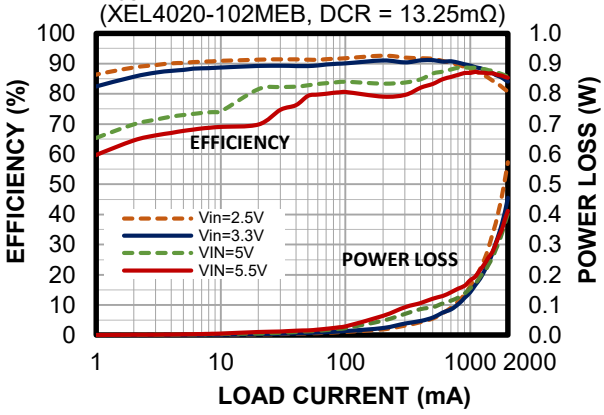
EVQ2178A-LE-00A EVALUTION BOARD

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 = 1µH,
(XEL4020-102MEB, DCR = 13.25mΩ)



MPS Proprietary Information. Patent Protected. Unauthorized Photocopy and Duplication Prohibited.
© 2021 MPS. All Rights Reserved.

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 (R5) to be between 10kΩ and 100kΩ. R6 can then be calculated using Equation (1):

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

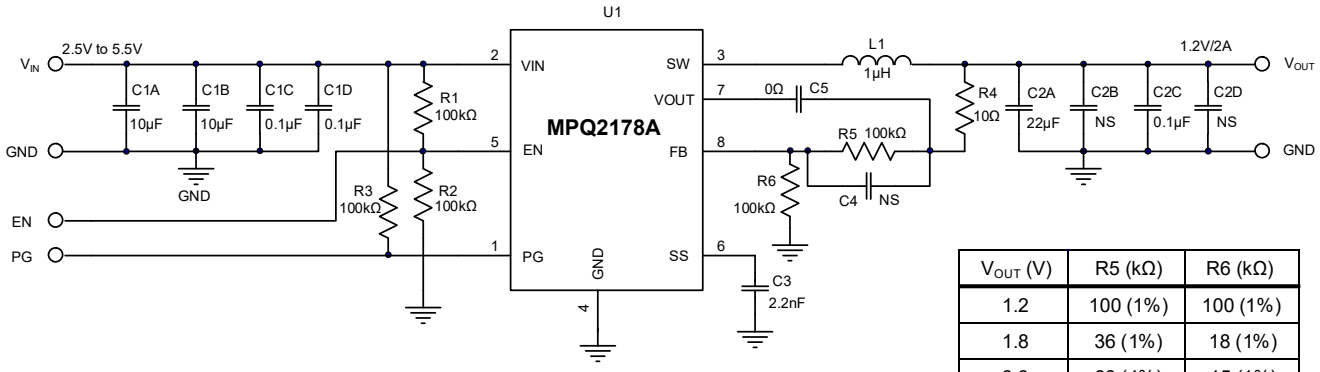
Table 1 lists the recommended resistor values for common output voltages.

Table 1: Resistor Values for Common Output Voltages

V_{OUT} (V)	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%)

MPS Proprietary Information. Patent Protected. Unauthorized Photocopy and Duplication Prohibited.
© 2021 MPS. All Rights Reserved.

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

MPS Proprietary Information. Patent Protected. Unauthorized Photocopy and Duplication Prohibited.
© 2021 MPS. All Rights Reserved.

EVQ2178A-LE-00A BILL OF MATERIALS

Qty	Ref	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	MPQ2178A-AEC1	5.5V, 2A, step-down converter, AEC-Q100 qualified	QFN-8 (1.5mmx 2mm)	MPS	MPQ2178AGQHE-AEC1

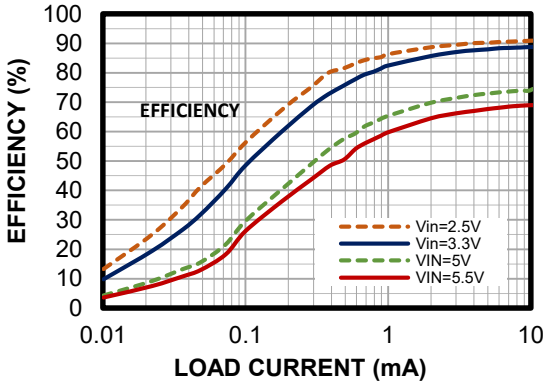
MPS Proprietary Information. Patent Protected. Unauthorized Photocopy and Duplication Prohibited.
© 2021 MPS. All Rights Reserved.

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.

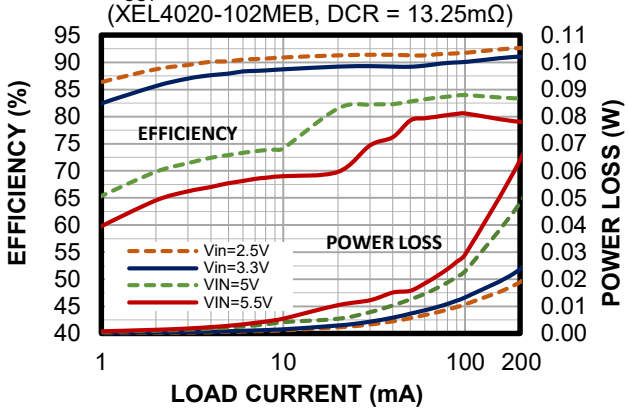
Efficiency vs. Load

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



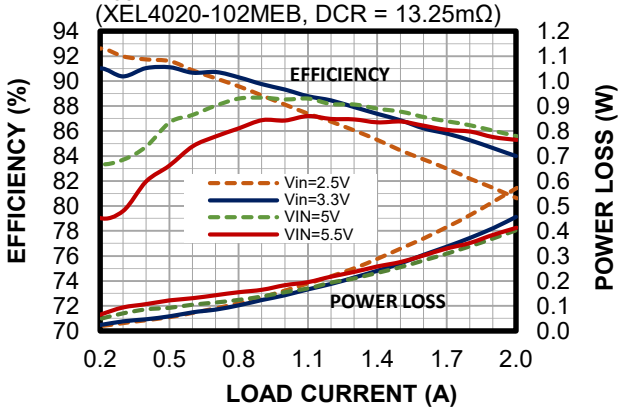
Efficiency vs. Load Current vs. Power Loss

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



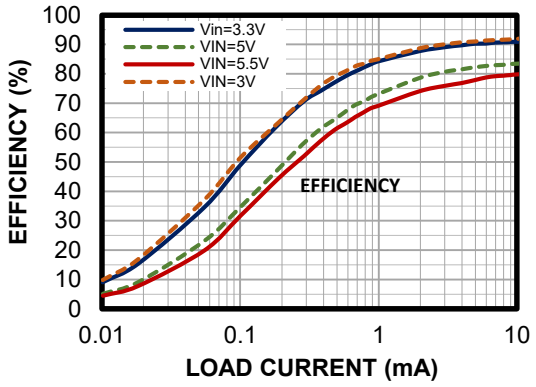
Efficiency vs. Load Current vs. Power Loss

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



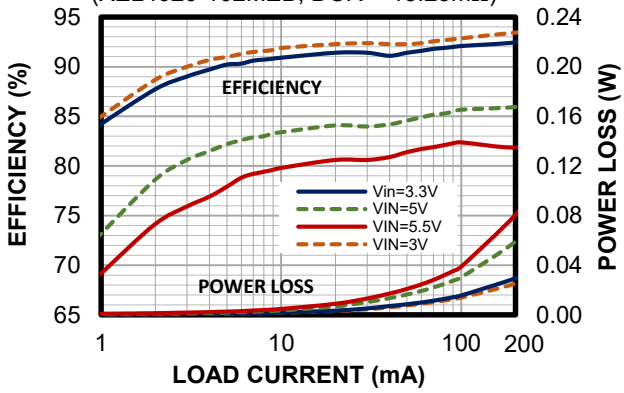
Efficiency vs. Load Current

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



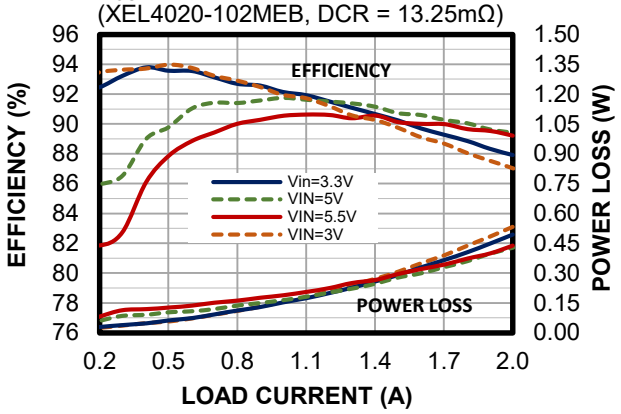
Efficiency vs. Load Current vs. Power Loss

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



Efficiency vs. Load Current vs. Power Loss

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



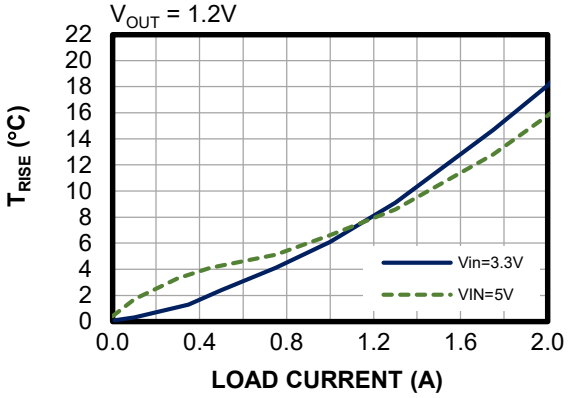
MPS Proprietary Information. Patent Protected. Unauthorized Photocopy and Duplication Prohibited.
© 2021 MPS. All Rights Reserved.

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.

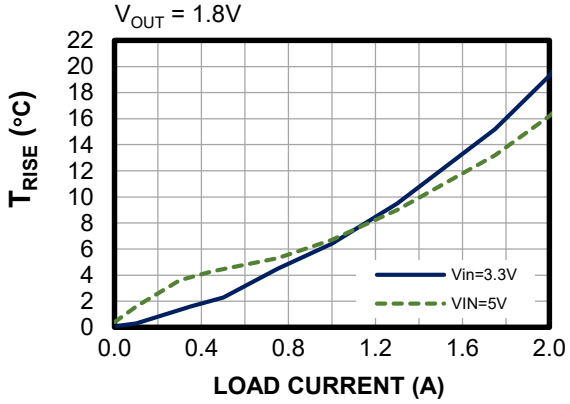
Case Temperature Rise

V_{OUT} = 1.2V



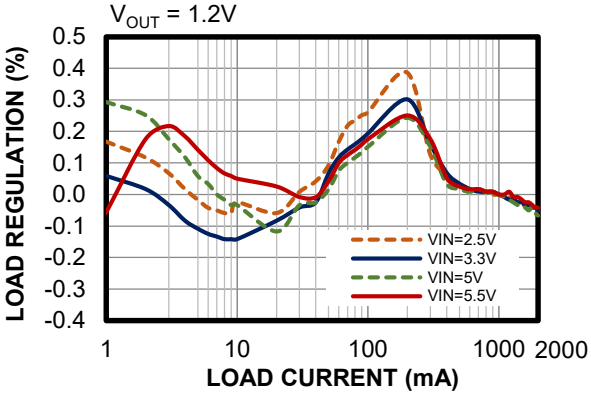
Case Temperature Rise

V_{OUT} = 1.8V



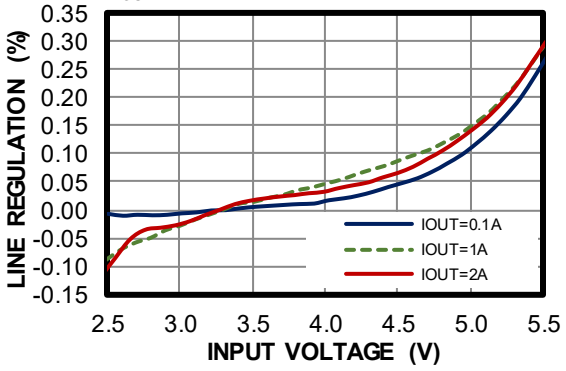
Load Regulation

V_{OUT} = 1.2V



Line Regulation

V_{OUT} = 1.2V

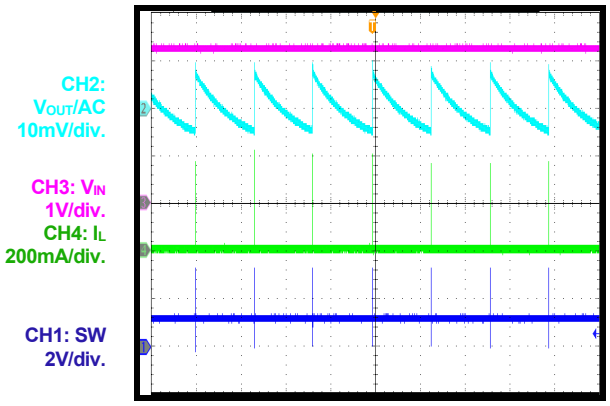


MPS Proprietary Information. Patent Protected. Unauthorized Photocopy and Duplication Prohibited.
© 2021 MPS. All Rights Reserved.

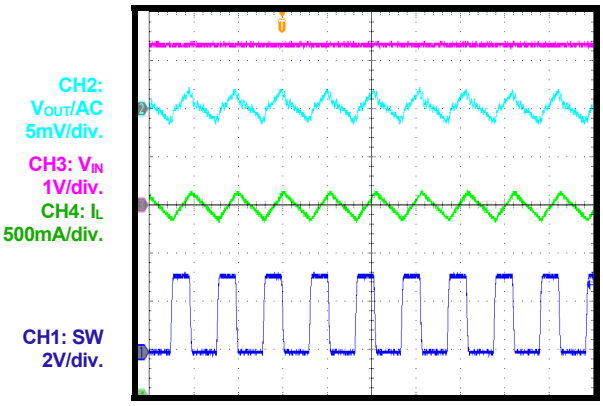
EVB TEST RESULTS *(continued)*

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.

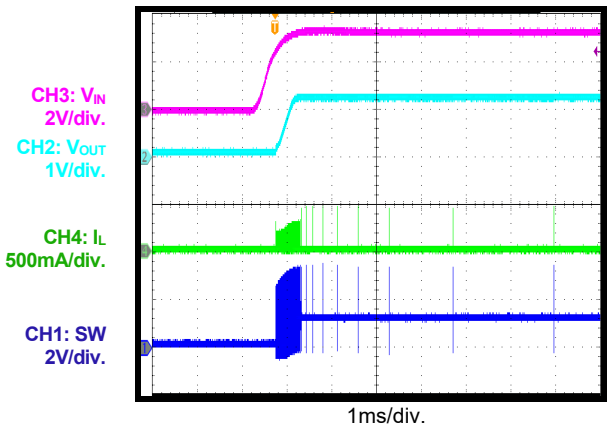
Steady State
I_{OUT} = 0A



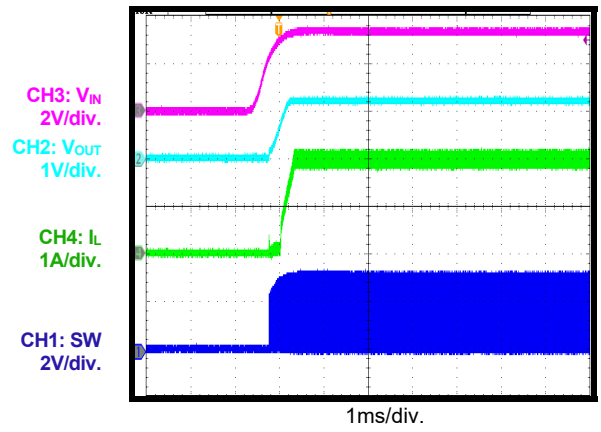
Steady State
I_{OUT} = 2A



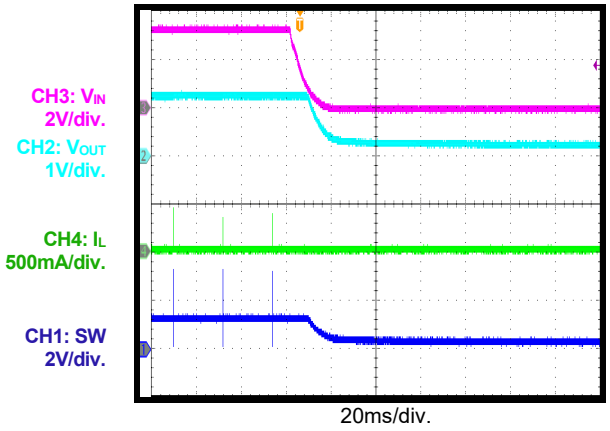
Start-Up through VIN
I_{OUT} = 0A



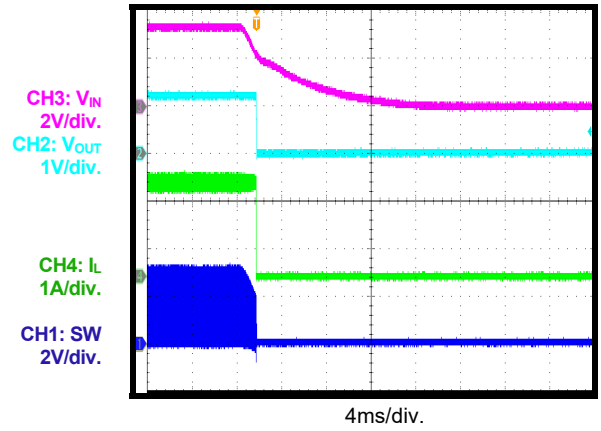
Start-Up through VIN
I_{OUT} = 2A



Shutdown through VIN
I_{OUT} = 0A



Shutdown through VIN
I_{OUT} = 2A



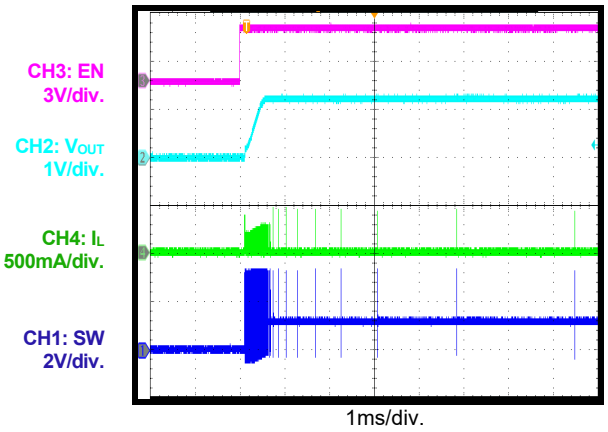
MPS Proprietary Information. Patent Protected. Unauthorized Photocopy and Duplication Prohibited.
© 2021 MPS. All Rights Reserved.

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.

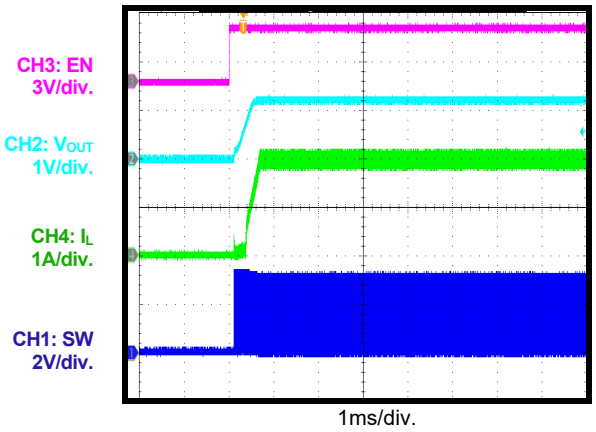
Start-Up through EN

I_{OUT} = 0A



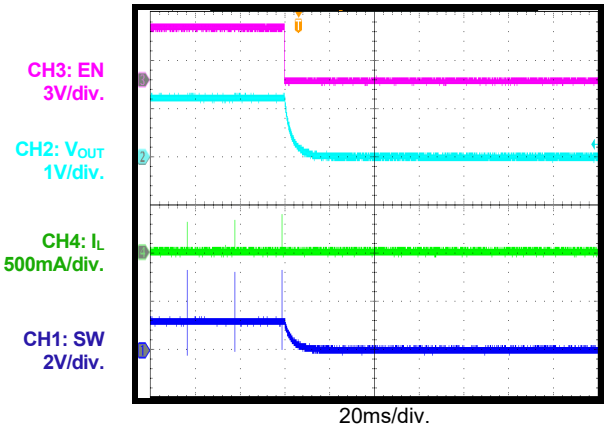
Start-Up through EN

I_{OUT} = 2A



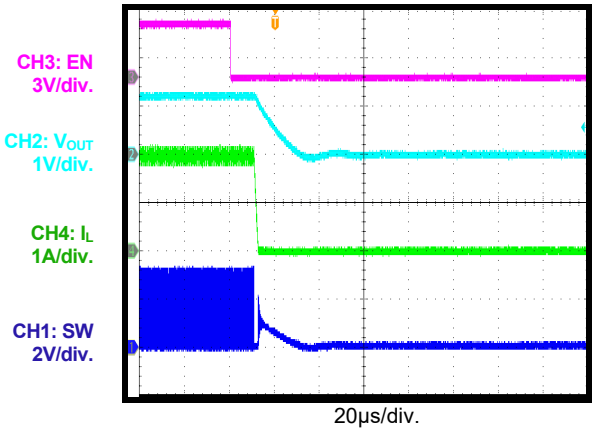
Shutdown through EN

I_{OUT} = 0A



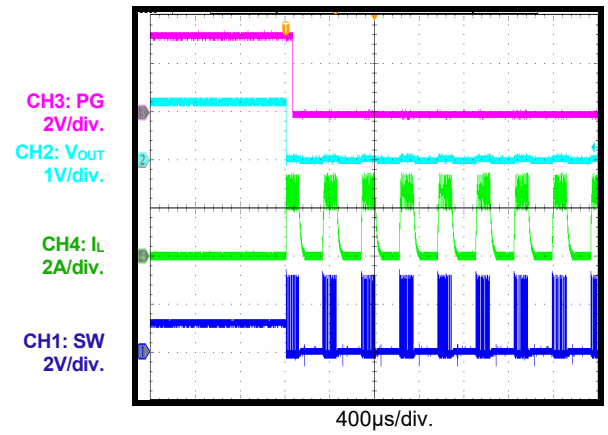
Shutdown through EN

I_{OUT} = 2A



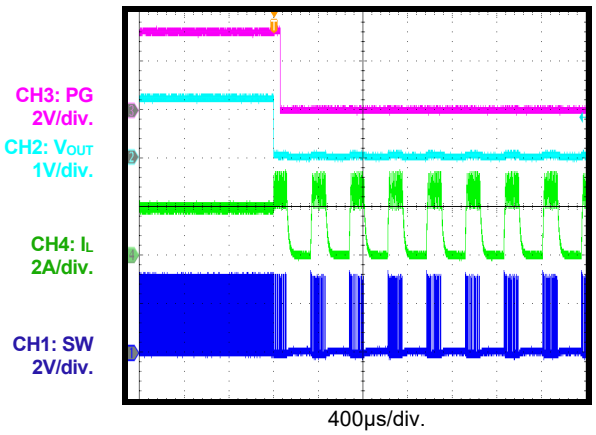
SCP Entry

I_{OUT} = 0A



SCP Entry

I_{OUT} = 2A



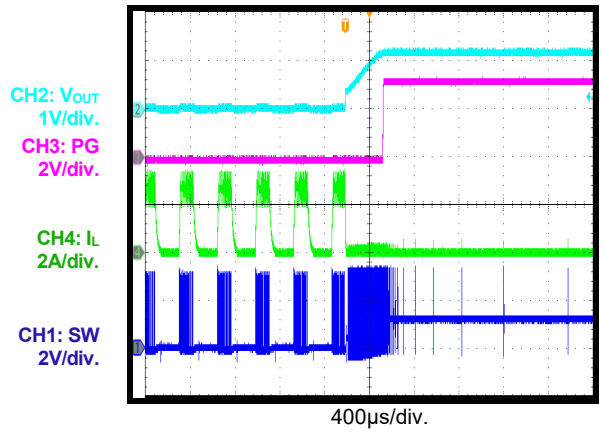
MPS Proprietary Information. Patent Protected. Unauthorized Photocopy and Duplication Prohibited.
© 2021 MPS. All Rights Reserved.

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.

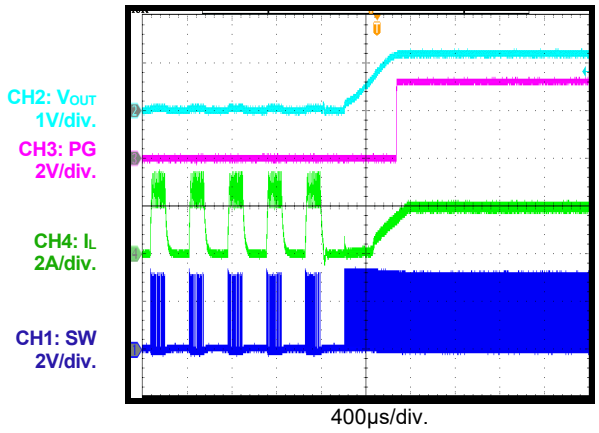
SCP Recovery

I_{OUT} = 0A

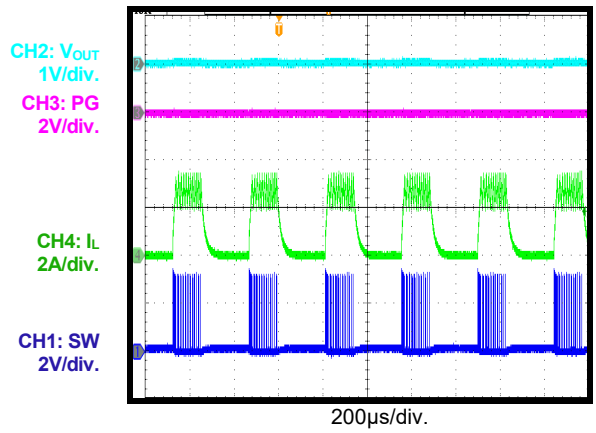


SCP Recovery

I_{OUT} = 2A

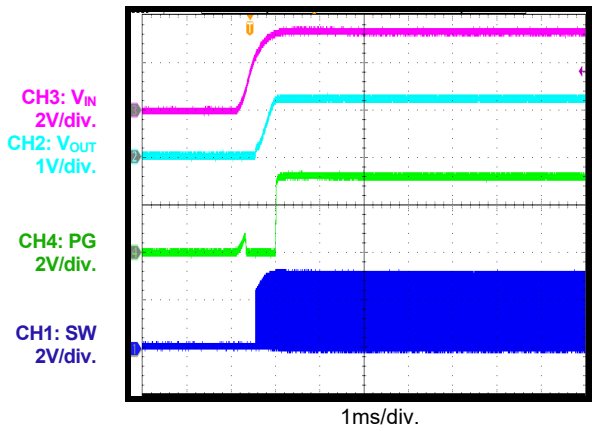


Short-Circuit Protection



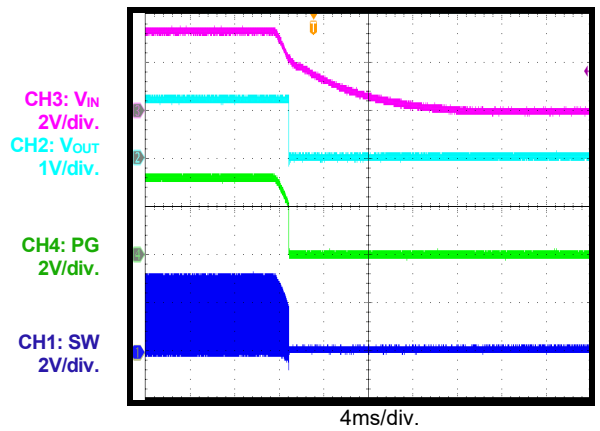
PG Start-Up through VIN

I_{OUT} = 2A



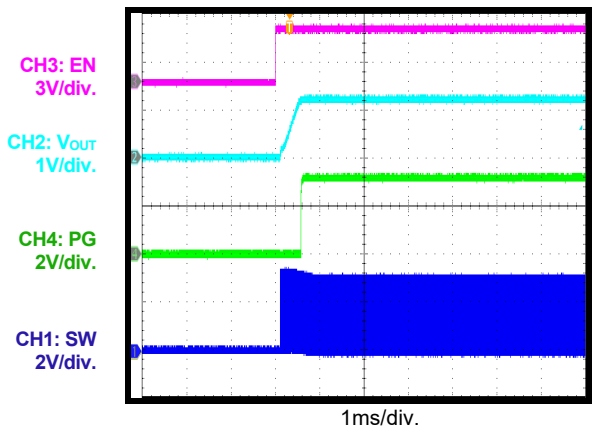
PG Shutdown through VIN

I_{OUT} = 2A



PG Start-Up through EN

I_{OUT} = 2A



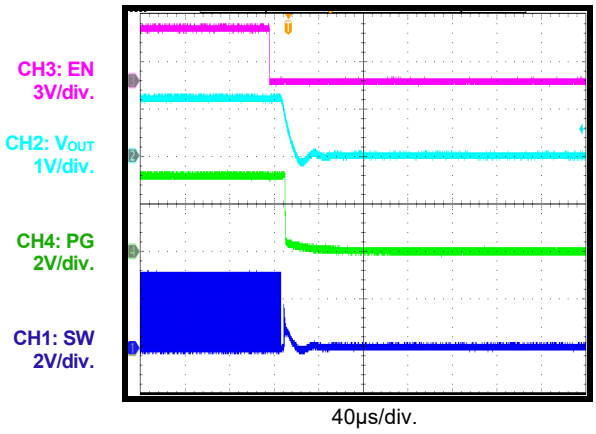
MPS Proprietary Information. Patent Protected. Unauthorized Photocopy and Duplication Prohibited.
© 2021 MPS. All Rights Reserved.

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.

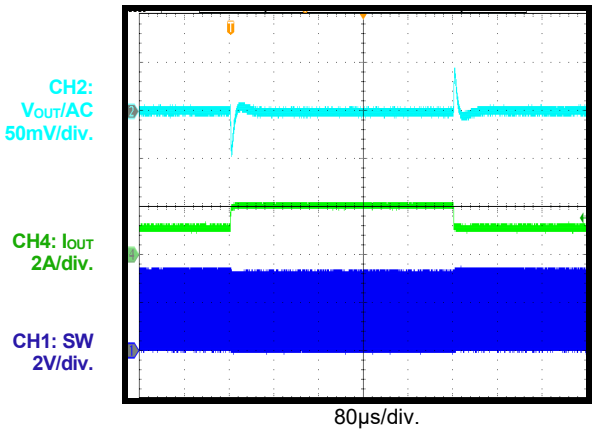
PG Shutdown through EN

I_{OUT} = 2A



Load Transient

I_{OUT} = 1A to 2A, 1A/µs



MPS Proprietary Information. Patent Protected. Unauthorized Photocopy and Duplication Prohibited.
© 2021 MPS. All Rights Reserved.

PCB LAYOUT

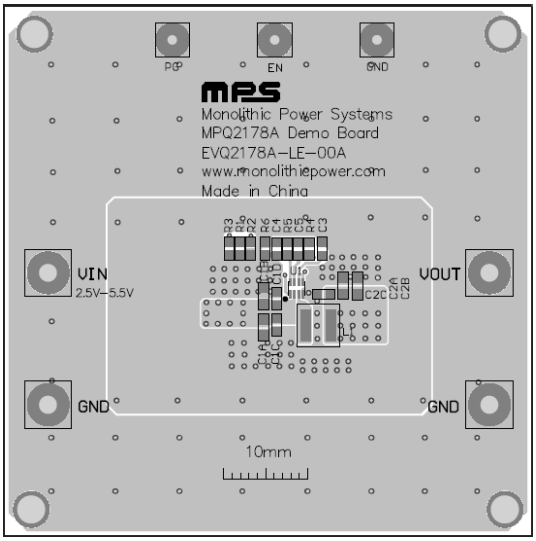


Figure 2: Top Silk and Top Layer

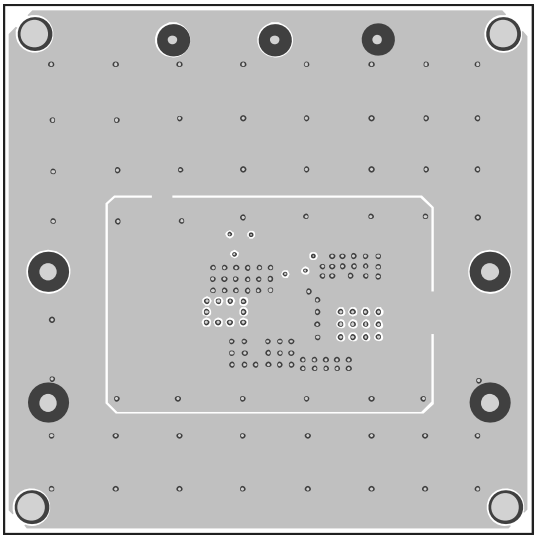


Figure 3: Mid-Layer 1

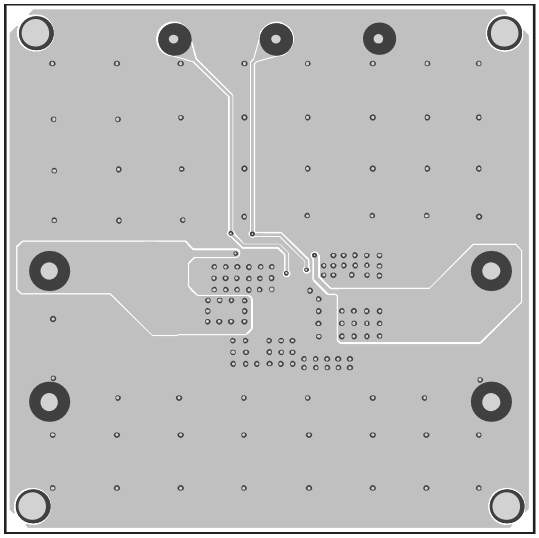


Figure 4: Mid-Layer 2

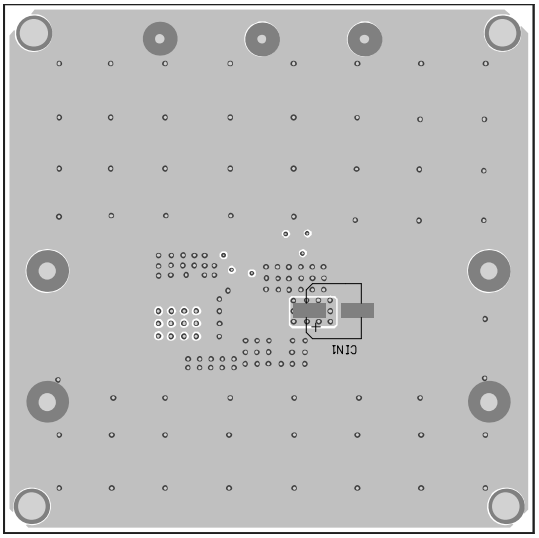


Figure 5: Bottom Layer and Bottom Silk

MPS Proprietary Information. Patent Protected. Unauthorized Photocopy and Duplication Prohibited.
© 2021 MPS. All Rights Reserved.

REVISION HISTORY

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

Notice: The information in this document is subject to change without notice. Please contact MPS for current specifications. Users should warrant and guarantee that third-party Intellectual Property rights are not infringed upon when integrating MPS products into any application. MPS will not assume any legal responsibility for any said applications.

MPS Proprietary Information. Patent Protected. Unauthorized Photocopy and Duplication Prohibited.
© 2021 MPS. All Rights Reserved.