



EVQ2177-LE-00A

5.5V, 1A, 2.4MHz, Synchronous Step-Down Converter with PG and SS Evaluation Board, AEC-Q100 Qualified

DESCRIPTION

The EVQ2177-LE-00A is an evaluation board designed to demonstrate the capabilities of the MPQ2177, a monolithic, step-down switch-mode converter with integrated internal power MOSFETs.

The EVQ2177-LE-00A achieves 1A 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 EVQ2177-LE-00A is a fully assembled and tested evaluation board. It generates a 1.2V V_{OUT} at load currents up to 1A across a 2.5V to 5.5V V_{IN} range.

The MPQ2177 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}	1	A

FEATURES

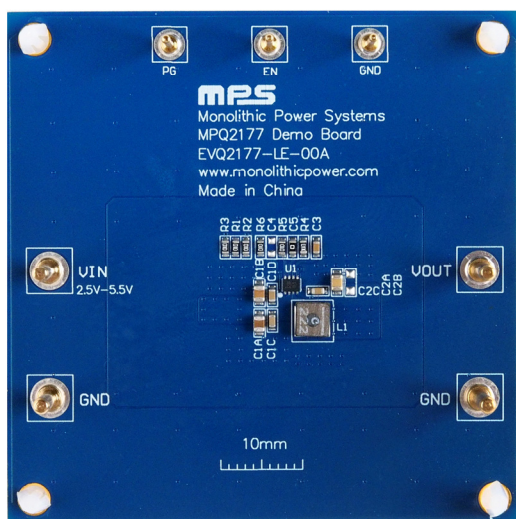
- **Designed for Automotive Applications:**
 - Wide 2.5V to 5.5V Operating Input Voltage (V_{IN}) Range
 - Up to 1A Output Current
 - 1% Feedback (FB) Accuracy
- **High Performance for Improved Thermals:**
 - 75mΩ and 45mΩ Integrated Internal Power MOSFETs
- **Optimized for EMC and EMI:**
 - 2.4MHz Switching 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 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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EVQ2177-LE-00A EVALUTION BOARD

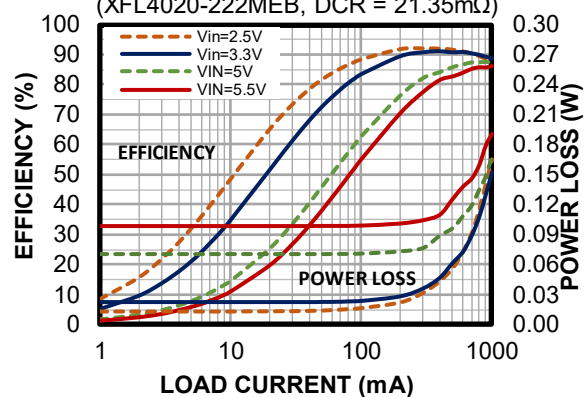


LxWxH (6.3cmx6.3cmx0.3cm)

Board Number	MPS IC Number
EVQ2177-LE-00A	MPQ2177GQHE-AEC1

Efficiency vs. Load Current vs. Power Loss

$V_{OUT} = 1.2V$, $L = 2.2\mu H$,
(XFL4020-222MEB, DCR = 21.35m 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 MPQ2177's output, set the feedback resistor ($R5$) to be between 10k Ω and 100k Ω . $R6$ can then be calculated using 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)	$R5$ (k Ω)	$R6$ (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

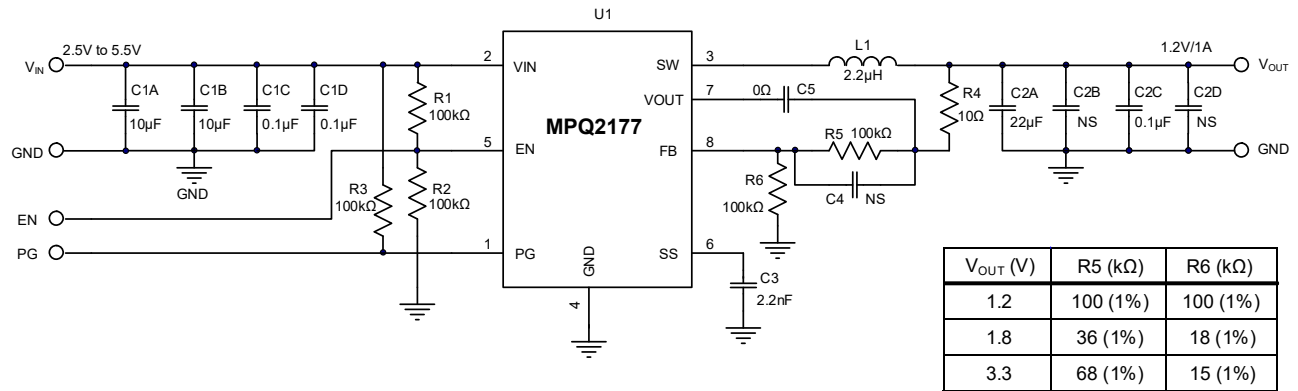


Figure 1: Evaluation Board Schematic

EVQ2177-LE-00A BILL OF MATERIALS

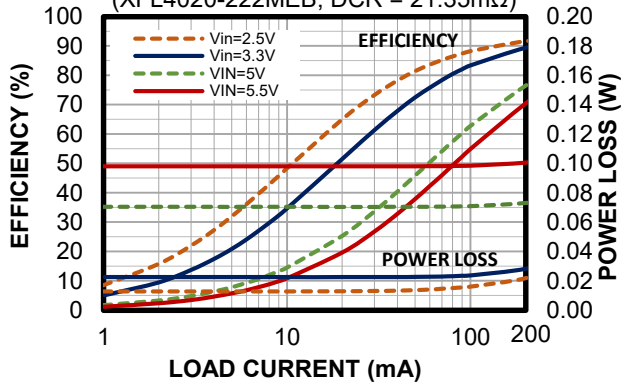
Qty	Ref	Value	Description	Package	Manufacturer	Manufacturer PN
1	CIN1	22 μ F	Electrolytic capacitor, 63V	SMD	Jianghai	VTD-63V22
2	C1A, C1B	4.7 μ F	Ceramic capacitor, 16V, X7R	0805	Murata	GCM21BR71C475KA73L
3	C1C, C1D, C2C	0.1 μ F	Ceramic capacitor, 16V, X7R	0603	TDK	C1608X7R1C104K
1	C2A	22 μ F	Ceramic 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	2.2 μ H	Inductor, $R_{DC} = 21.35m\Omega$, $I_{SAT} = 3.7A$	SMD	Coilcraft	XFL4020-222MEB
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	MPQ2177-AEC1	5.5V, 1A, step-down converter, AEC-Q100 qualified	QFN-8 (1.5mmx2mm)	MPS	MPQ2177GQHE-AEC1

EVB TEST RESULTS

Performance curves and waveforms are tested on the evaluation board. $V_{IN} = 3.6V$, $V_{OUT} = 1.2V$, $L = 2.2\mu H$, $C_{OUT} = 22\mu F$, $T_A = 25^\circ C$, unless otherwise noted.

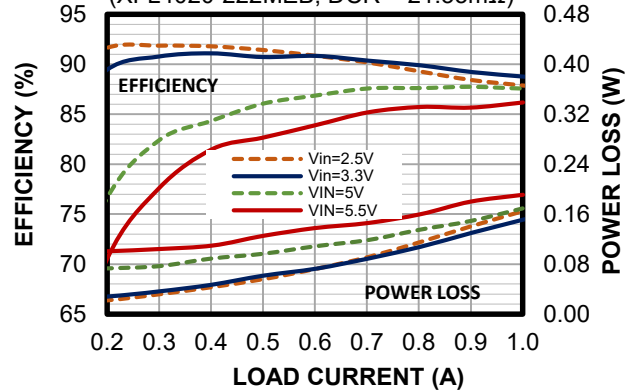
Efficiency vs. Load Current vs. Power Loss

$V_{OUT} = 1.2V$, $L = 2.2\mu H$,
(XFL4020-222MEB, DCR = 21.35m Ω)



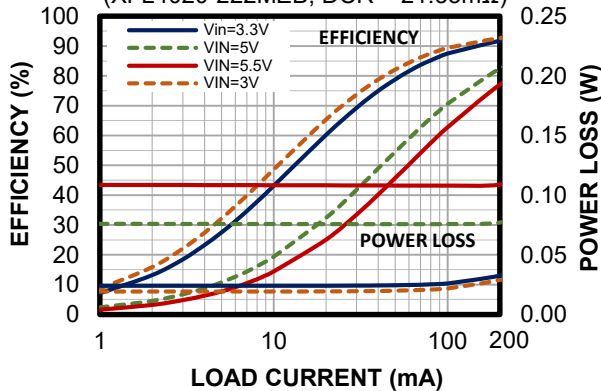
Efficiency vs. Load Current vs. Power Loss

$V_{OUT} = 1.2V$, $L = 2.2\mu H$,
(XFL4020-222MEB, DCR = 21.35m Ω)



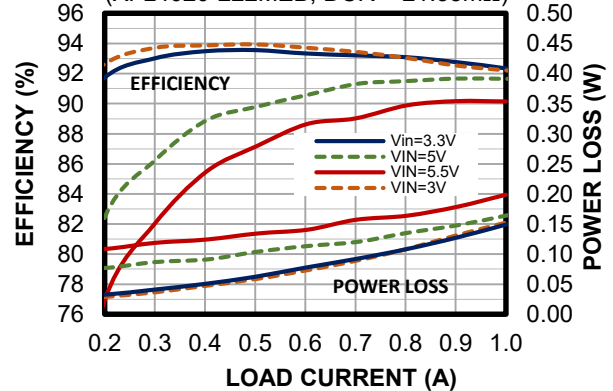
Efficiency vs. Load Current vs. Power Loss

$V_{OUT} = 1.8V$, $L = 2.2\mu H$,
(XFL4020-222MEB, DCR = 21.35m Ω)



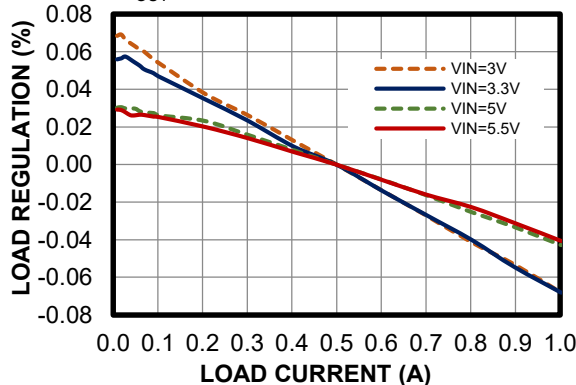
Efficiency vs. Load Current vs. Power Loss

$V_{OUT} = 1.8V$, $L = 2.2\mu H$,
(XFL4020-222MEB, DCR = 21.35m Ω)



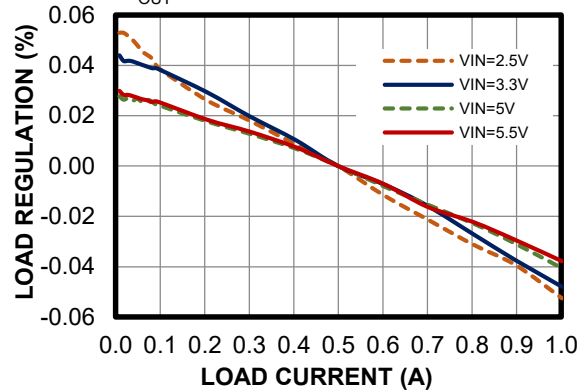
Load Regulation

$V_{OUT} = 1.8V$



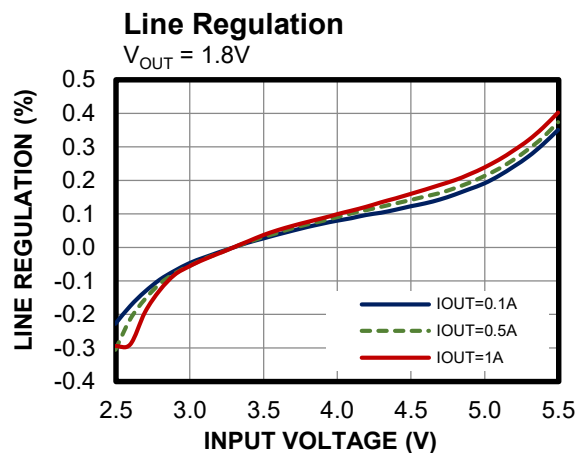
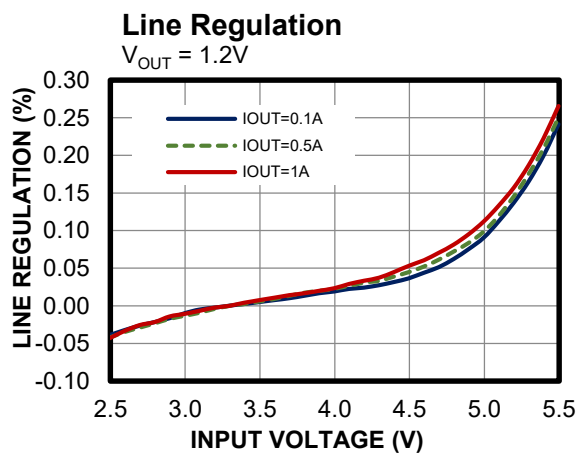
Load Regulation

$V_{OUT} = 1.2V$



EVB TEST RESULTS *(continued)*

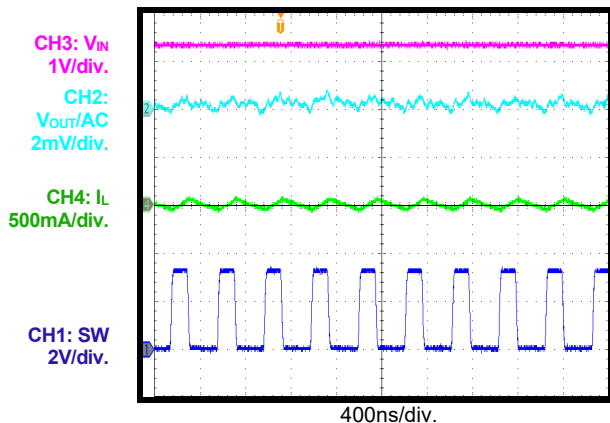
Performance curves and waveforms are tested on the evaluation board. $V_{IN} = 3.6V$, $V_{OUT} = 1.2V$, $L = 2.2\mu H$, $C_{OUT} = 22\mu F$, $T_A = 25^\circ C$, unless otherwise noted.



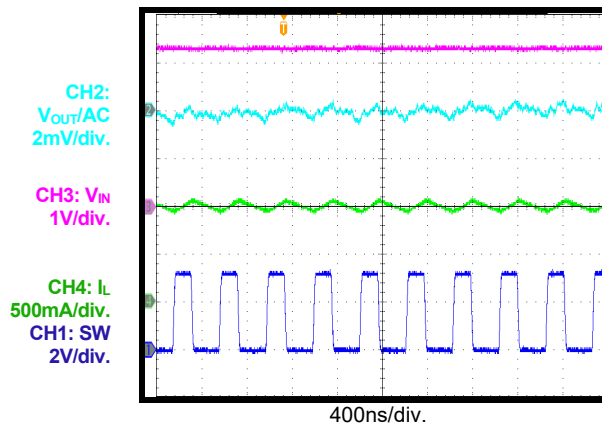
EVB TEST RESULTS *(continued)*

Performance curves and waveforms are tested on the evaluation board. $V_{IN} = 3.6V$, $V_{OUT} = 1.2V$, $L = 2.2\mu H$, $C_{OUT} = 22\mu F$, $T_A = 25^\circ C$, unless otherwise noted.

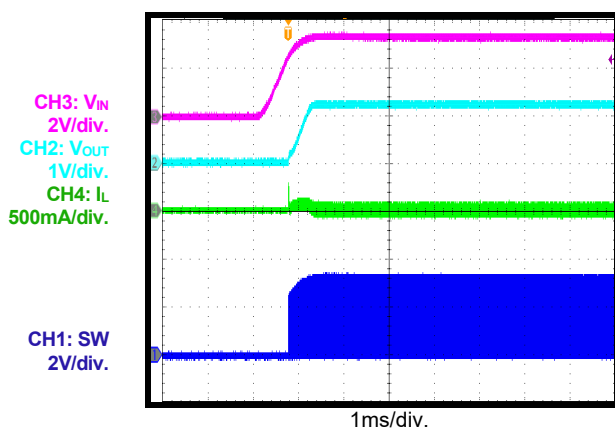
Steady State

 $I_{OUT} = 0A$


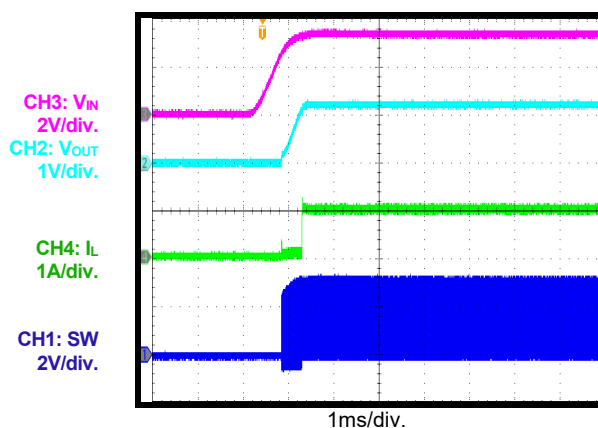
Steady State

 $I_{OUT} = 1A$


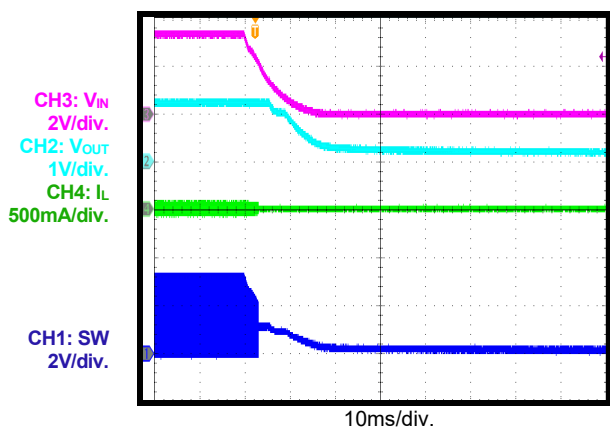
Start-Up through VIN

 $I_{OUT} = 0A$


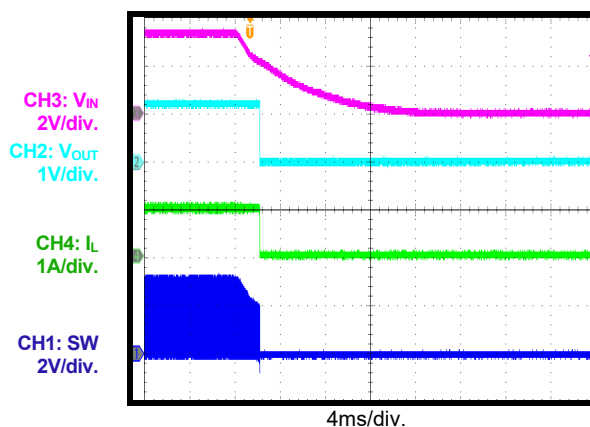
Start-Up through VIN

 $I_{OUT} = 1A$


Shutdown through VIN

 $I_{OUT} = 0A$


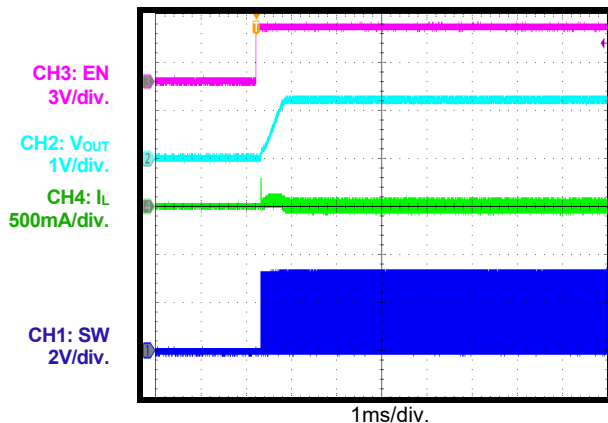
Shutdown through VIN

 $I_{OUT} = 1A$


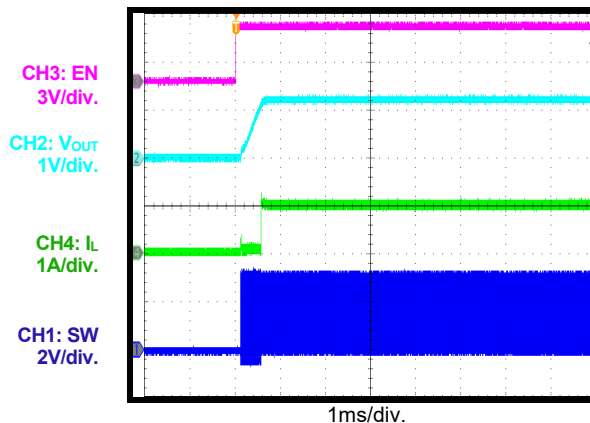
EVB TEST RESULTS (continued)

Performance curves and waveforms are tested on the evaluation board. $V_{IN} = 3.6V$, $V_{OUT} = 1.2V$, $L = 2.2\mu H$, $C_{OUT} = 22\mu F$, $T_A = 25^\circ C$, unless otherwise noted.

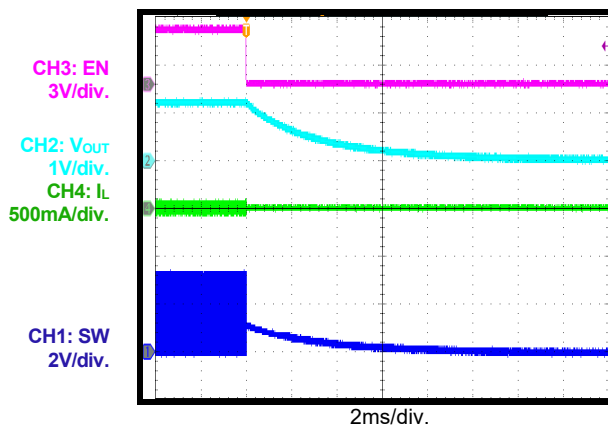
Start-Up through EN

 $I_{OUT} = 0A$


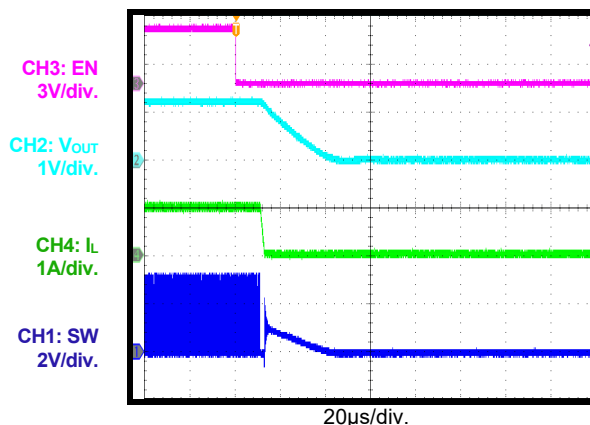
Start-Up through EN

 $I_{OUT} = 1A$


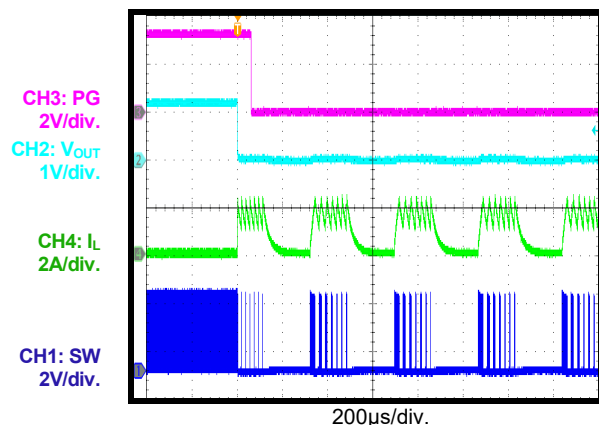
Shutdown through EN

 $I_{OUT} = 0A$


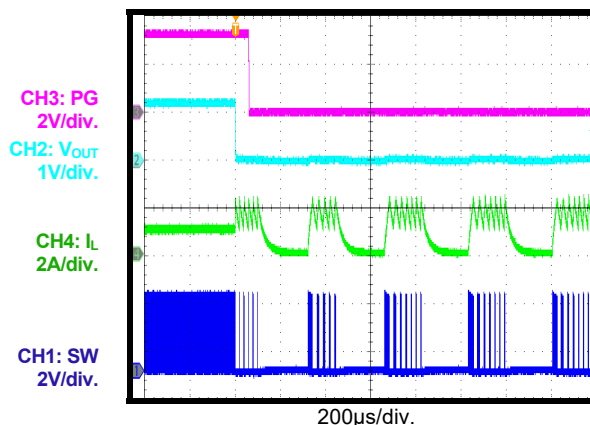
Shutdown through EN

 $I_{OUT} = 1A$


SCP Entry

 $I_{OUT} = 0A$


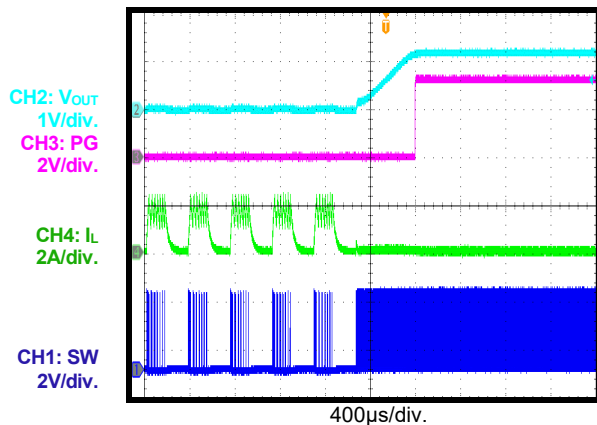
SCP Entry

 $I_{OUT} = 1A$


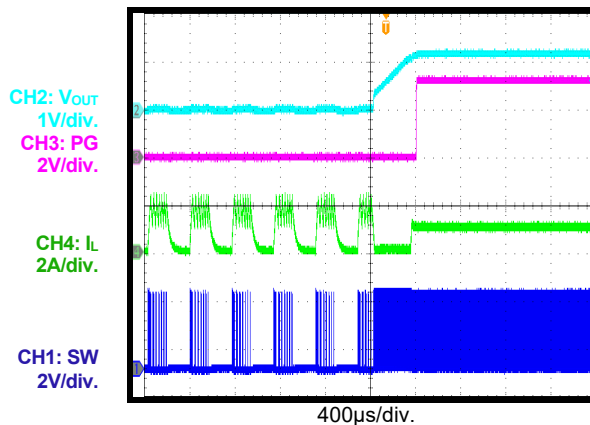
EVB TEST RESULTS *(continued)*

Performance curves and waveforms are tested on the evaluation board. $V_{IN} = 3.6V$, $V_{OUT} = 1.2V$, $L = 2.2\mu H$, $C_{OUT} = 22\mu F$, $T_A = 25^\circ C$, unless otherwise noted.

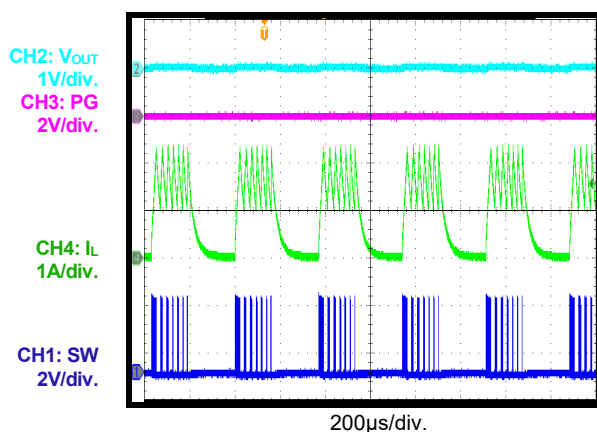
SCP Recovery

 $I_{OUT} = 0A$


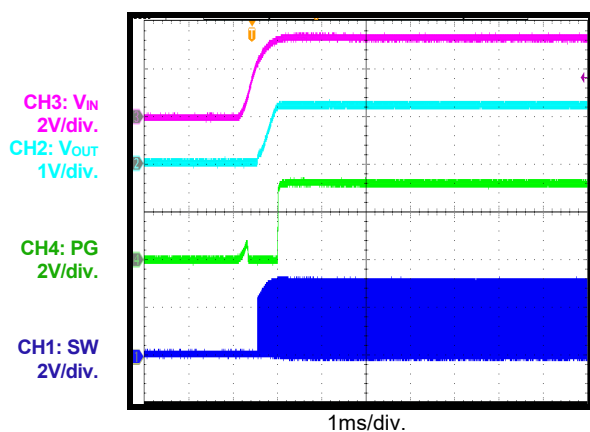
SCP Recovery

 $I_{OUT} = 1A$


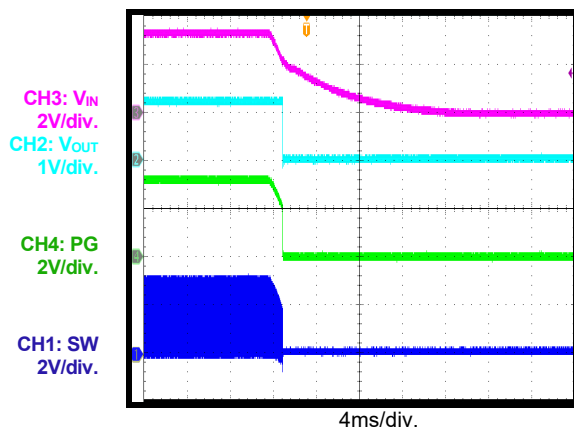
Short Circuit



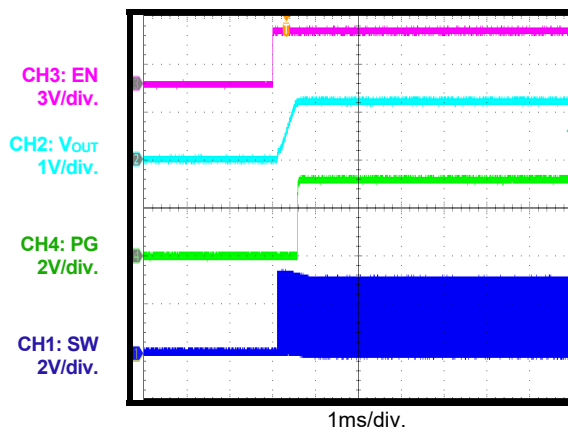
PG in Start-Up through VIN

 $I_{OUT} = 1A$


PG in Shutdown through VIN

 $I_{OUT} = 1A$


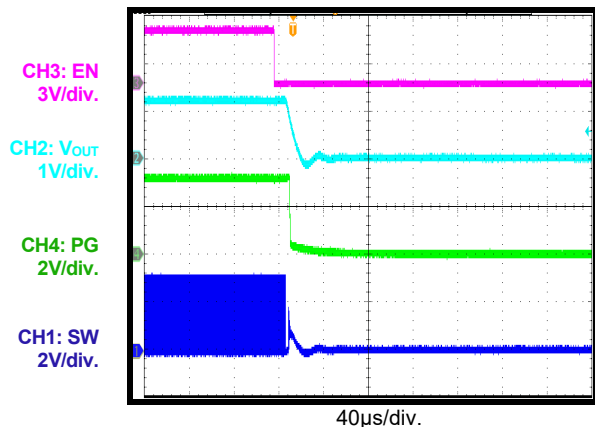
PG in Start-Up through EN

 $I_{OUT} = 1A$


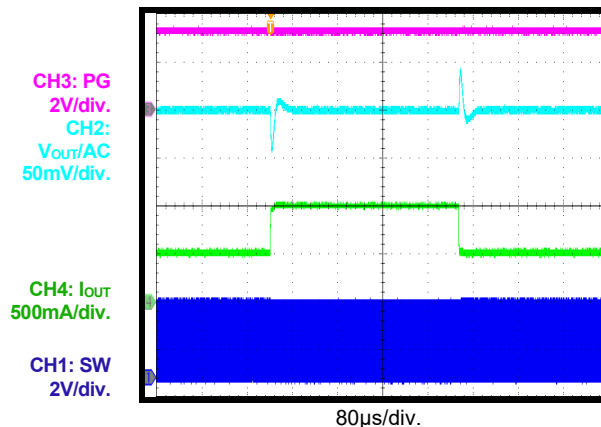
EVB TEST RESULTS *(continued)*

Performance curves and waveforms are tested on the evaluation board. $V_{IN} = 3.6V$, $V_{OUT} = 1.2V$, $L = 2.2\mu H$, $C_{OUT} = 22\mu F$, $T_A = 25^\circ C$, unless otherwise noted.

PG in Shutdown through EN

 $I_{OUT} = 1A$


Load Transient

 $I_{OUT} = 0.5A \text{ to } 1A, 1A/\mu s$


PCB LAYOUT

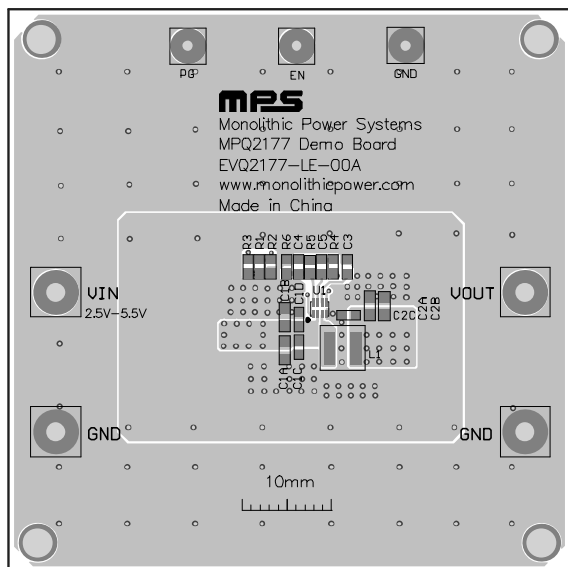


Figure 2: Top Silk and Top Layer

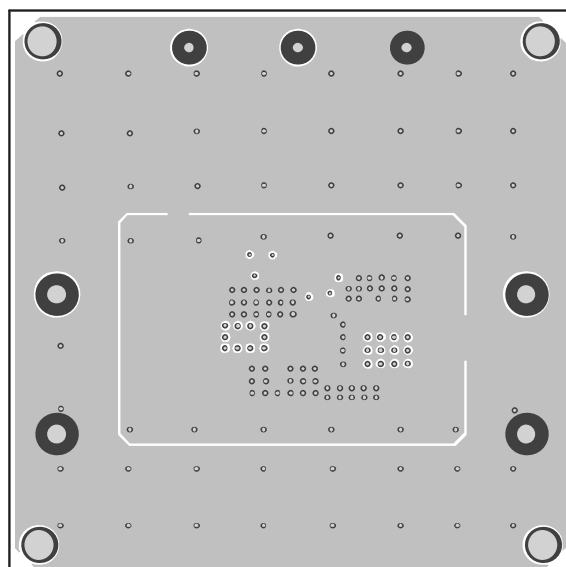


Figure 3: Mid-Layer 1

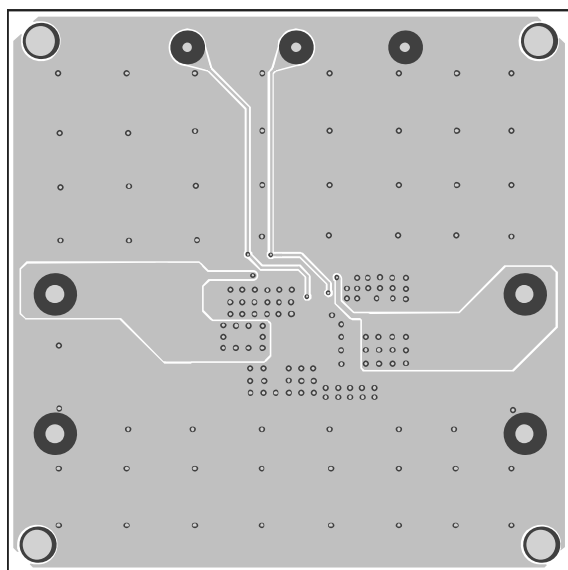


Figure 4: Mid-Layer 2

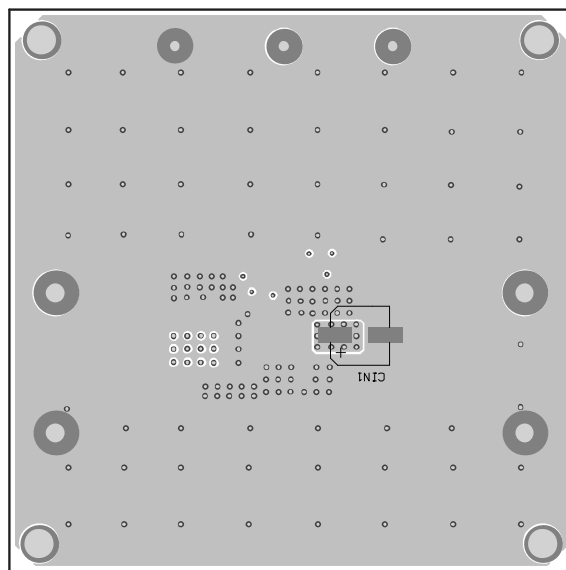


Figure 5: Bottom Layer and Bottom Silk



REVISION HISTORY

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

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