EVQ5852-Q-00A

36V, Smart Diode Controller with Two Voltage Monitors Evaluation Board, AEC-Q100 Qualified

DESCRIPTION

The EVQ5852-Q-00A is an evaluation board designed to demonstrate the capabilities of the MPQ5852, a 36V smart diode controller with two voltage monitors and reverse protection.

The MPQ5852 is a smart diode controller that can drive an external N-channel MOSFET to replace a Schottky diode for reverse input protection. The device's 20mV ultra-low dropout mode minimizes power loss and enables a low minimum input voltage (V_{IN}). Its 4μA standby current makes it ideal for battery-powered applications. The ultra-fast transient response ensures the part to rectify AC frequencies up to 50kHz.

The MPQ5852 integrates an internal boost converter to provide a boost voltage that turns on the external N-channel MOSFET even at a low V_{IN}. With an extremely low under-voltage (UV) threshold, the device provides a wide operation range to meet the harsh start-up conditions defined by the ISO 16750 standard. The device also supports cold-crank voltages down to 0V.

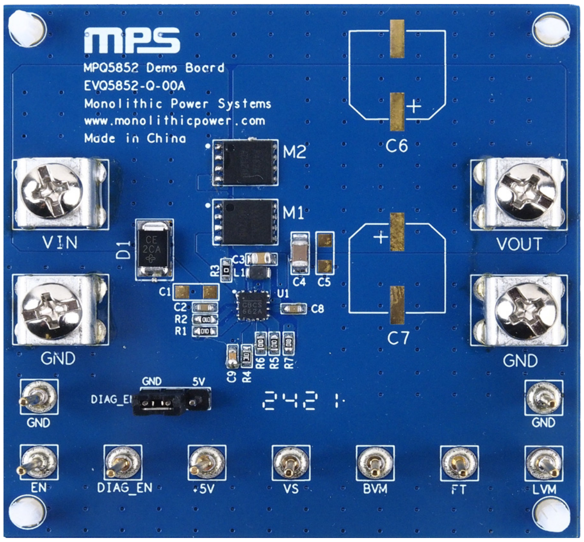
In addition to reverse polarity protection and reverse pulse protection, the MPQ5852 also provides multiple diagnostics for automotive ECUs during fault conditions such as UV, over-voltage (OV), and over-temperature (OT).

The MPQ5852 is available in a QFN-13 (3mmx3mm) package, and is AEC-Q100 qualified.

PERFORMANCE SUMMARY

Parameters	Conditions	Value
Input voltage (V_{IN}) range		5V to 36V
Maximum output current (I_{OUT})	V_{IN} = 5V to 36V	20A

EVQ5852-Q-00A EVALUATION BOARD

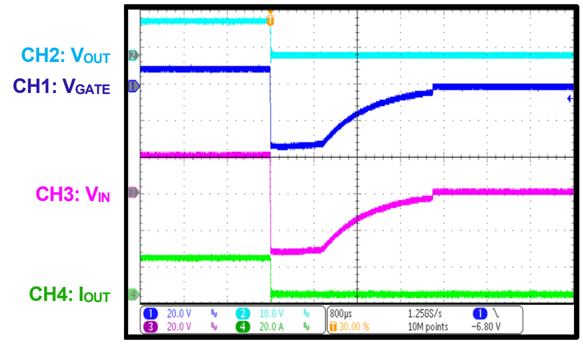


LxWxH (6.35cmx6.35cmx1.8cm)

Board Number	MPS IC Number
EVQ5852-Q-00A	MPQ5852GQE-0000-AEC1

Negative Pulse

V_{OUT} = 12V, I_{OUT} = 20A, SMBJ26CA TVS diode



QUICK START GUIDE

The EVQ5852-Q-00A evaluation board is easy to set up and use to evaluate the MPQ5852's performance. For proper measurement equipment set-up, refer to Figure 1 and follow the steps below:

1. Preset the power supply between 5V and 26V, then turn off the power supply. Electronic loads represent a negative impedance to the regulator, so set the load current between 0A and 20A.
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 the connections, turn on the power supply.
5. To use the enable (EN) function, apply a digital input to the EN pin. Drive EN above 1.2V to turn the regulator on; drive EN below 1V to turn it off. If the enable function is not being used, connect EN directly to VIN.
6. To use the FT function, add a 5V external supply to +5V pin to drive the FT signal.
7. To support cold cranks down to 0V and the short interrupt function, remove R2 and add a 3.3V external supply to the EN terminal.
8. To test load dumps exceeding 36V, change D1 to a TVS diode suitable for the specific application.
9. To support a constant input voltage (V_{IN}) above 26V, it is recommended to remove the input TVS diode (D1).
10. To support the MPQ5852's rectification function, it is recommended to add suitable electrolytic capacitors at C6 and C7. For detailed capacitance information, refer to the MPQ5852 datasheet.
11. It is recommended to add an electrolytic capacitor when testing ISO 7637 pulse 1.

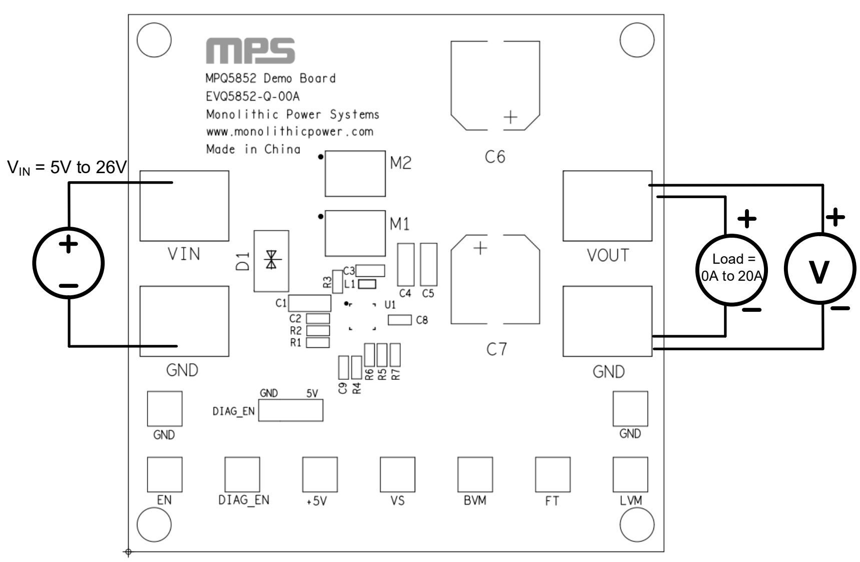


Figure 1: Measurement Equipment Set-Up

EVALUATION BOARD SCHEMATIC

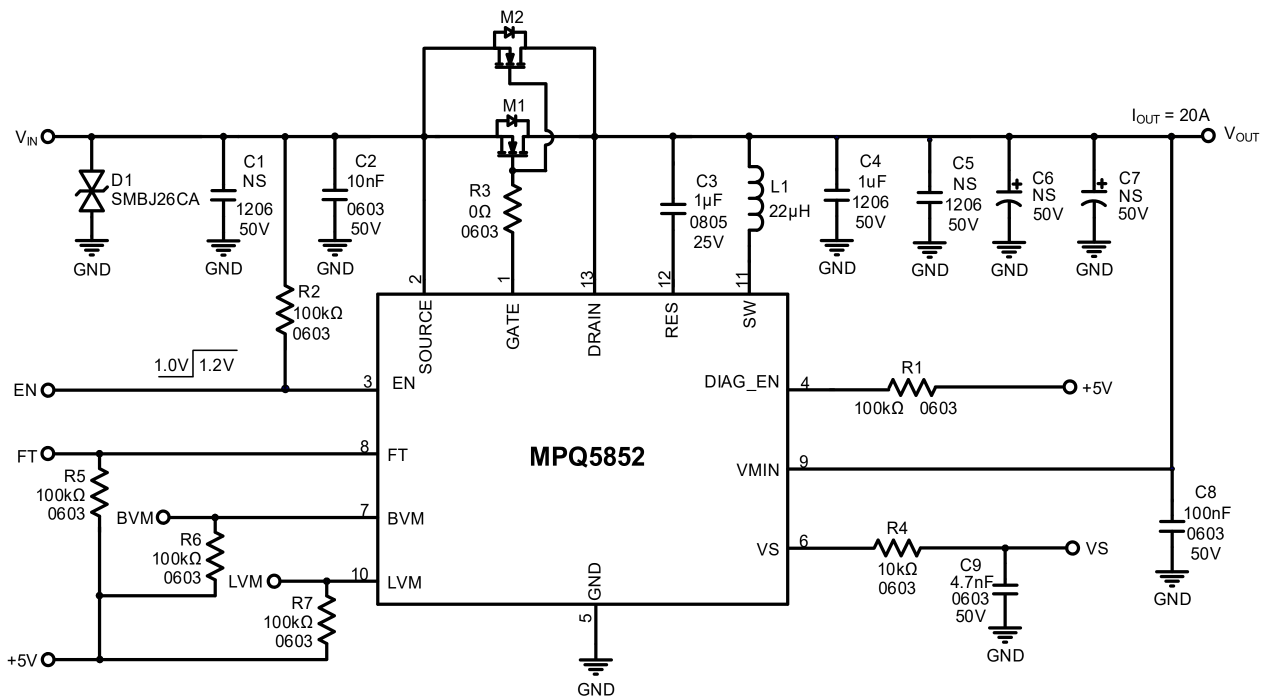


Figure 2: Evaluation Board Schematic

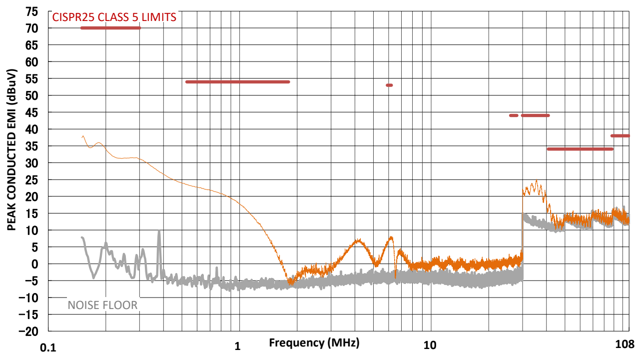
EVQ5852-Q-00A BILL OF MATERIALS

Qty	Ref	Value	Description	Package	Manufacturer	Manufacturer PN
9	VS, VMB, FT, EN, DIAG_EN, GND, VM1, +5V	1mm male	Connector	DIP	Qianjiang	
4	C1, C5, C6, C7	NC				
1	C2	10nF	Capacitor, 50V, X7R	0603	Murata	GRM188R71H103KA01D
1	C3	1μF	Capacitor, 25V, X7R	0805	Murata	GCM21BR71E105KA56L
1	C4	1μF	Capacitor, 50V, X7R	1206	Wurth	885012208093
1	C8	100nF	Capacitor, 50V, X7R	0603	Murata	GRM188R71H104KA93D
1	C9	4.7nF	Capacitor, 50V, X7R	0603	Wurth	885012206087
1	D1	26V	TVS diode	DO-214AA-2	Vishay	SMBJ26CA-E3/52
4	VOUT, VIN, GND, GND	4 pin	6-32 term screw connector	DIP	Keystone Electronics	8191K-ND
1	L1	22μH	Inductor, 2.1Ω, 410mA	0806	Murata	LQH2MPZ220MGRL
2	M1, M2	60V	N-channel MOSFET, 60V, 3.9Ω, 80A, 25nC	SOIC-8PP	Analog Power	AMR462N-T1-PF
5	R1, R2, R5, R6, R7	100kΩ	Film resistor, 1%	0603	Yageo	RC0603FR-07100KL
1	R3	0Ω	Film resistor, 1%	0603	Yageo	RC0603FR-070RL
1	R4	10kΩ	Film resistor, 1%	0603	Yageo	RC0603FR-0710KL
1	DIAG_EN	2.54mm	3-position connector	DIP	Electrical Market	
1	U1	MPQ5852-AEC1	36V smart diode controller, AEC-Q100 qualified	QFN-13 (3mmx 3mm)	MPS	MPQ5852GQE-0000-AEC1

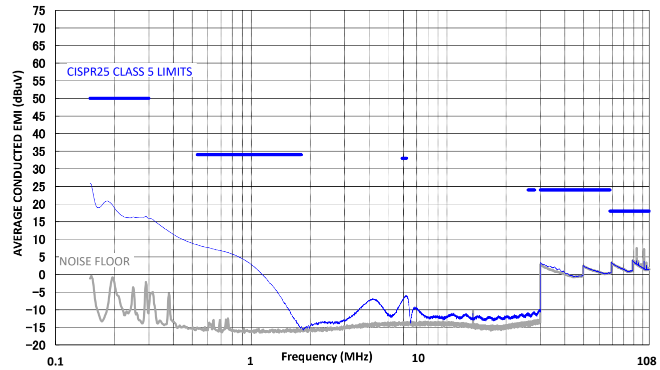
EVB TEST RESULTS *(continued)*

Performance curves and waveforms are tested on the evaluation board. V_{IN} = 12V, C_{OUT} = 440µF, L = 22µH, T_A = 25°C, unless otherwise noted.

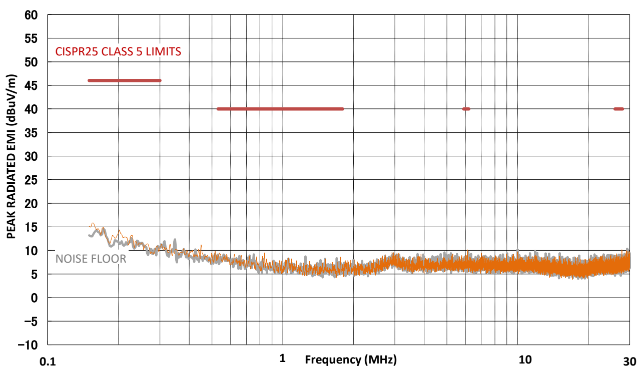
CISPR 25 Class 5 Peak Conducted Emissions
150kHz to 108MHz



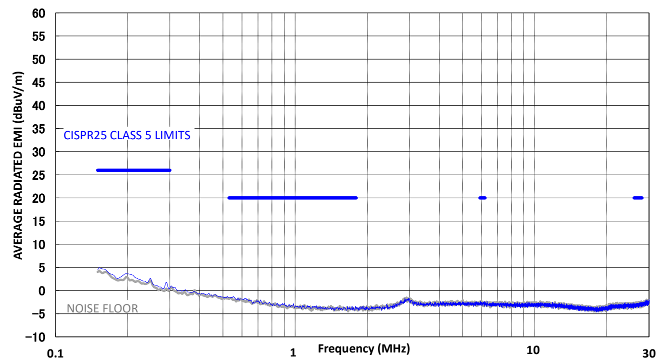
CISPR 25 Class 5 Average Conducted Emissions
150kHz to 108MHz



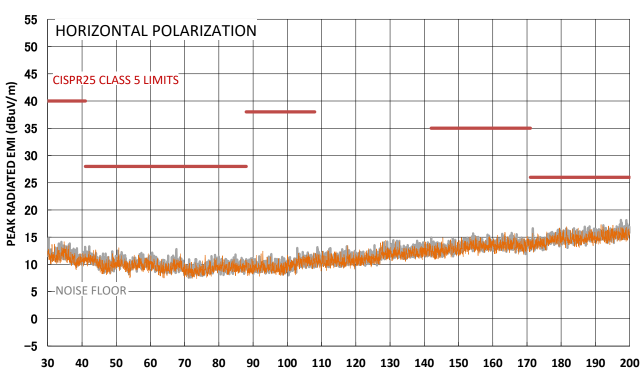
CISPR 25 Class 5 Peak Radiated Emissions
150kHz to 30MHz



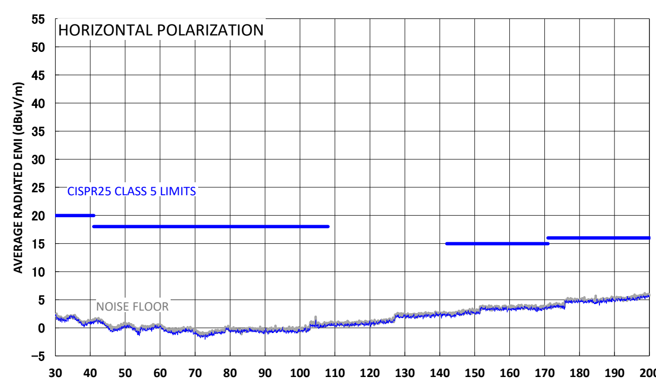
CISPR 25 Class 5 Average Radiated Emissions
150kHz to 30MHz



CISPR 25 Class 5 Peak Radiated Emissions
Horizontal, 30MHz to 200MHz



CISPR 25 Class 5 Average Radiated Emissions
Horizontal, 30MHz to 200MHz

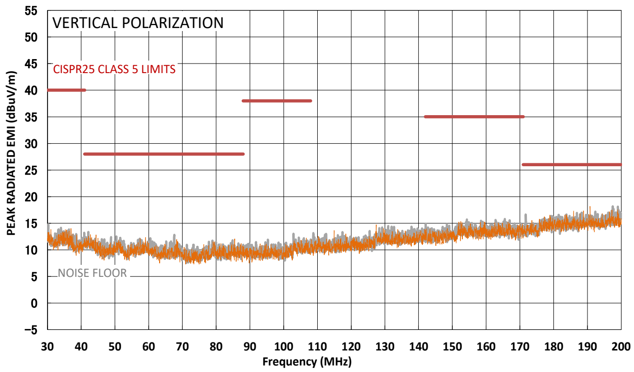


EVB TEST RESULTS *(continued)*

Performance curves and waveforms are tested on the evaluation board. V_{IN} = 12V, C_{OUT} = 440µF, L = 22µH, T_A = 25°C, unless otherwise noted.

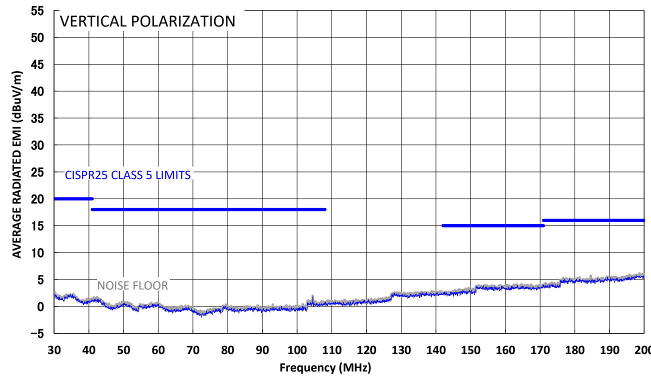
CISPR 25 Class 5 Peak Radiated Emissions

Vertical, 30MHz to 200MHz



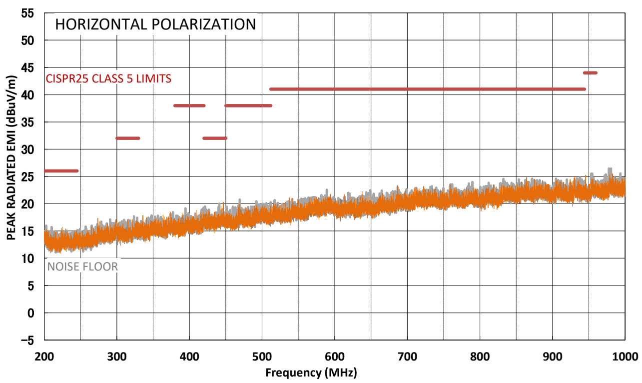
CISPR 25 Class 5 Average Radiated Emissions

Vertical, 30MHz to 200MHz



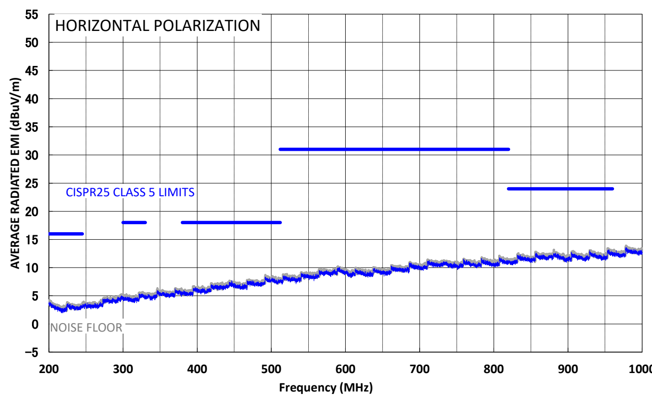
CISPR 25 Class 5 Peak Radiated Emissions

Horizontal, 200MHz to 1GHz



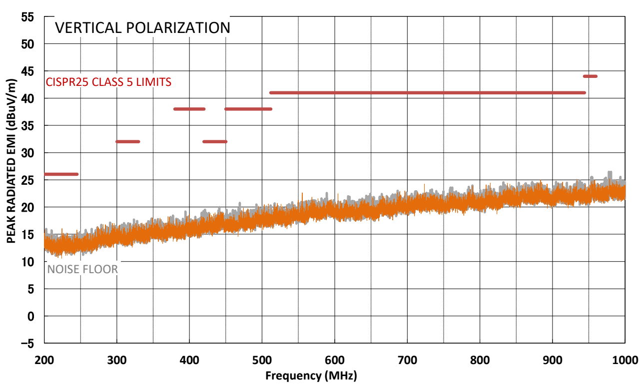
CISPR 25 Class 5 Average Radiated Emissions

Horizontal, 200MHz to 1GHz



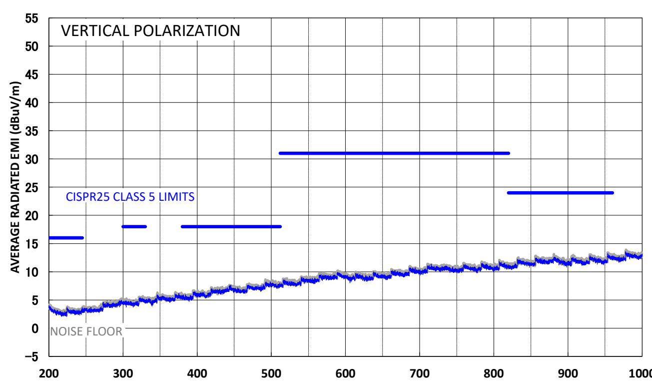
CISPR 25 Class 5 Peak Radiated Emissions

Vertical, 200MHz to 1GHz



CISPR 25 Class 5 Average Radiated Emissions

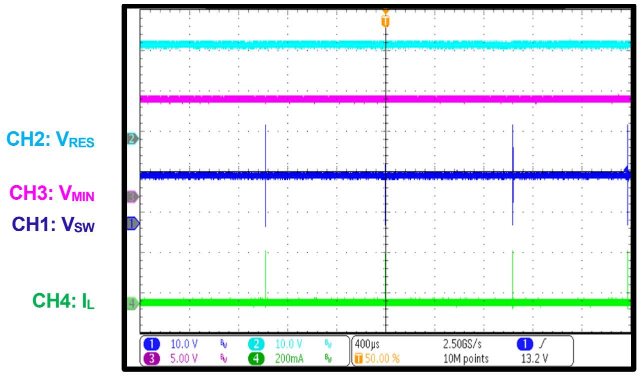
Vertical, 200MHz to 1GHz



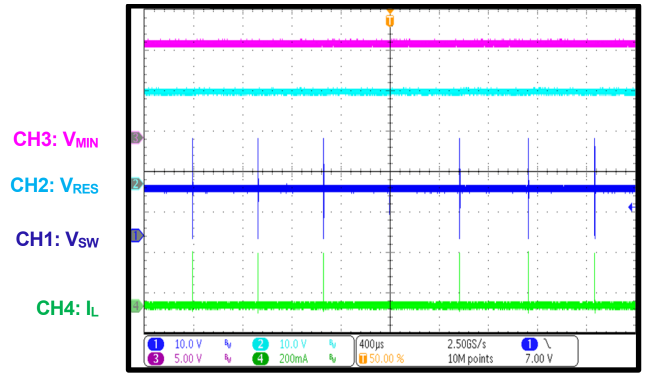
EVB TEST RESULTS *(continued)*

Performance curves and waveforms are tested on the evaluation board. V_{IN} = 12V, I_{OUT} = 20A, L = 22µH, T_A = 25°C, unless otherwise noted.

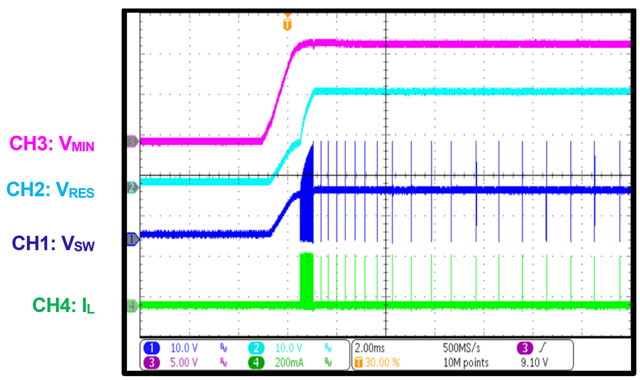
Steady State (for Internal Boost Converter)
I_{OUT} = 0A



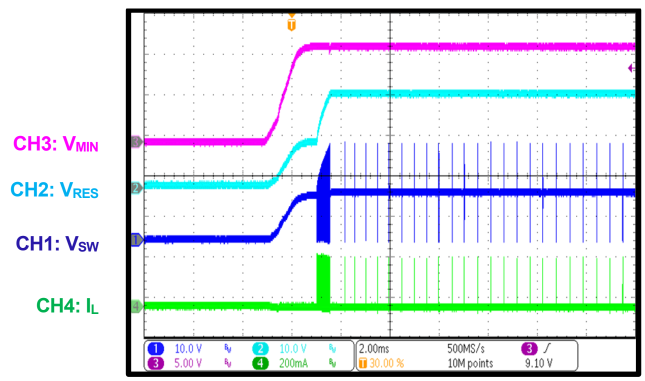
Steady State (for Internal Boost Converter)
I_{OUT} = 20A



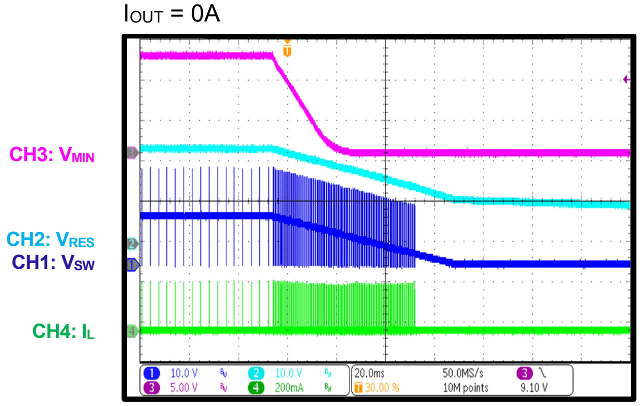
Start-Up through VIN (for Internal Boost Converter)
I_{OUT} = 0A



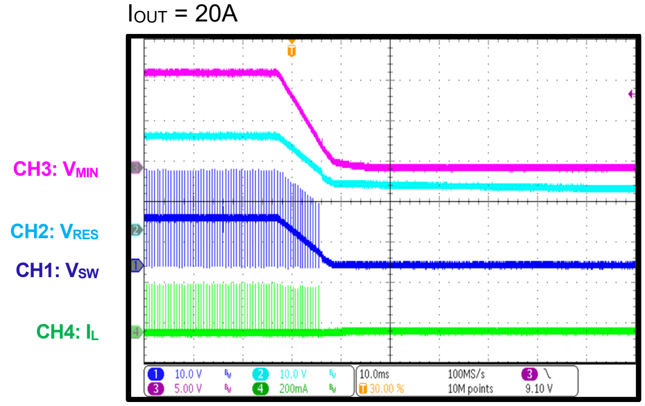
Start-Up through VIN (for Internal Boost Converter)
I_{OUT} = 20A



Shutdown through VIN (for Internal Boost Converter)
I_{OUT} = 0A



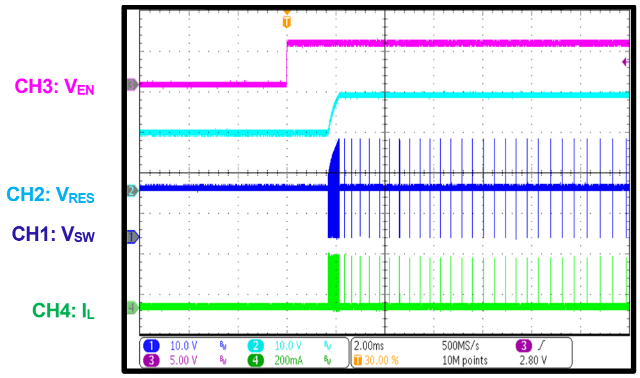
Shutdown through VIN (for Internal Boost Converter)
I_{OUT} = 20A



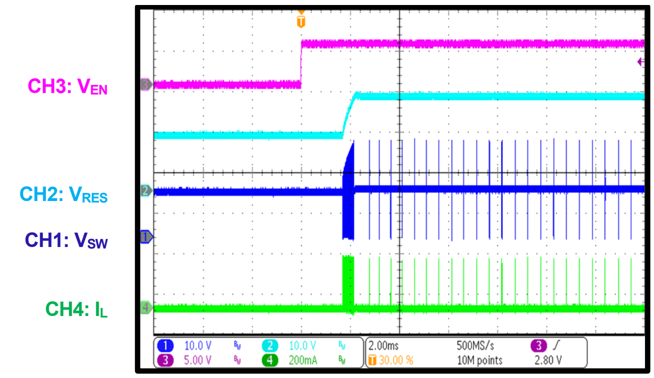
EVB TEST RESULTS *(continued)*

Performance curves and waveforms are tested on the evaluation board. V_{IN} = 12V, I_{OUT} = 20A, L = 22µH, T_A = 25°C, unless otherwise noted.

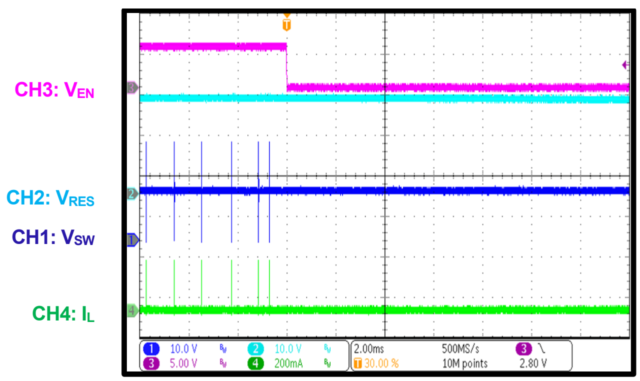
Start-Up through EN (for Internal Boost Converter)
I_{OUT} = 0A



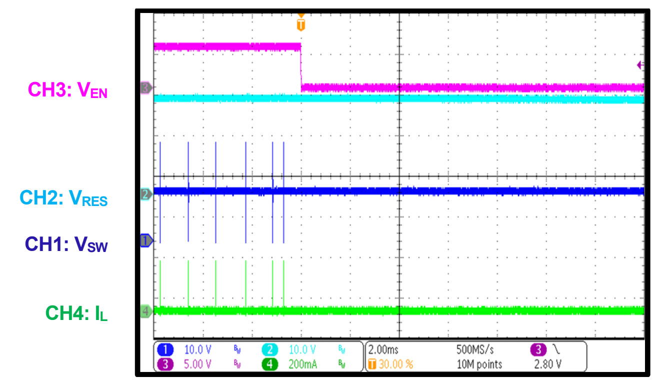
Start-Up through EN (for Internal Boost Converter)
I_{OUT} = 20A



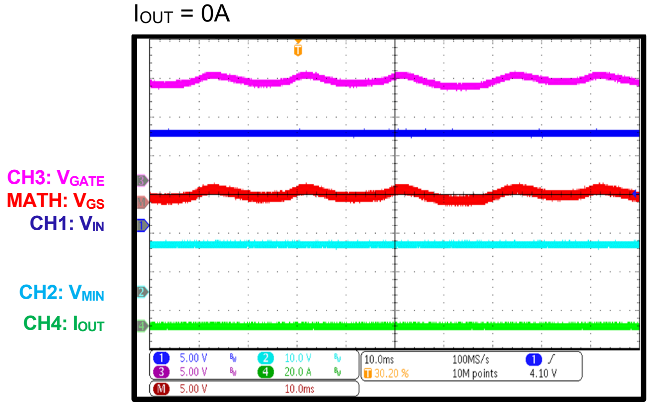
Shutdown through EN (for Internal Boost Converter)
I_{OUT} = 0A



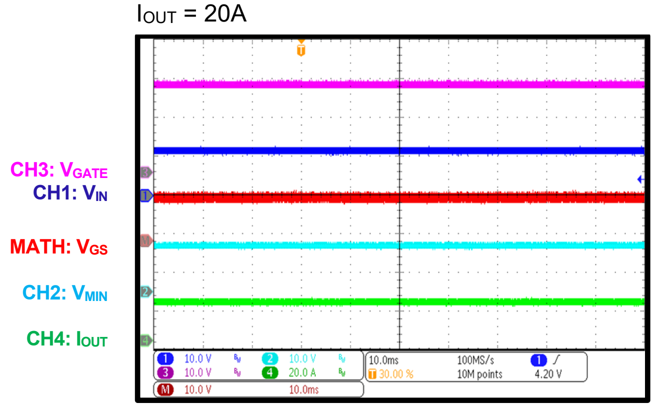
Shutdown through EN (for Internal Boost Converter)
I_{OUT} = 20A



Steady State (for Smart Diode)
I_{OUT} = 0A



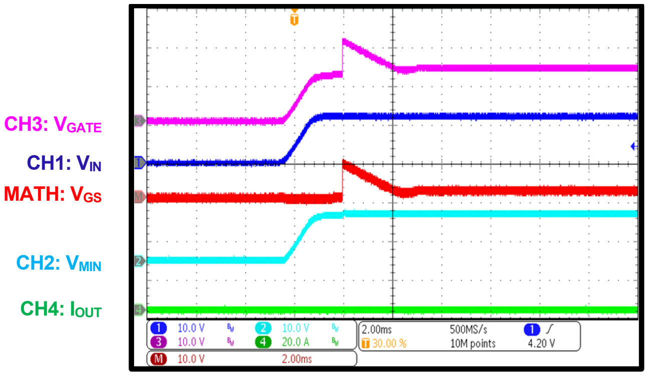
Steady State (for Smart Diode)
I_{OUT} = 20A



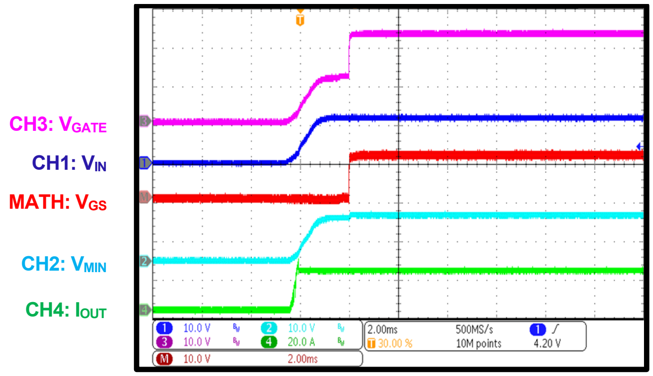
EVB TEST RESULTS *(continued)*

Performance curves and waveforms are tested on the evaluation board. V_{IN} = 12V, I_{OUT} = 20A, L = 22µH, T_A = 25°C, unless otherwise noted.

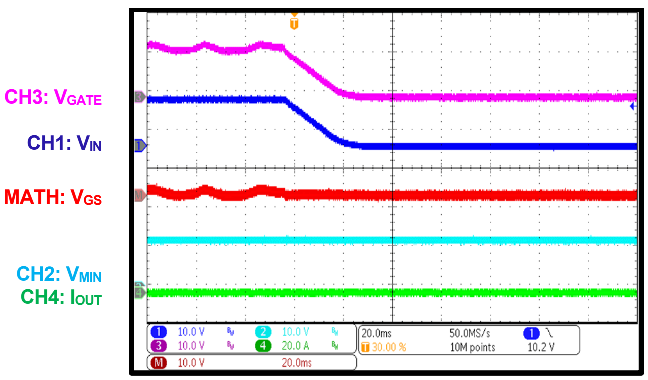
Start-Up through VIN
I_{OUT} = 0A



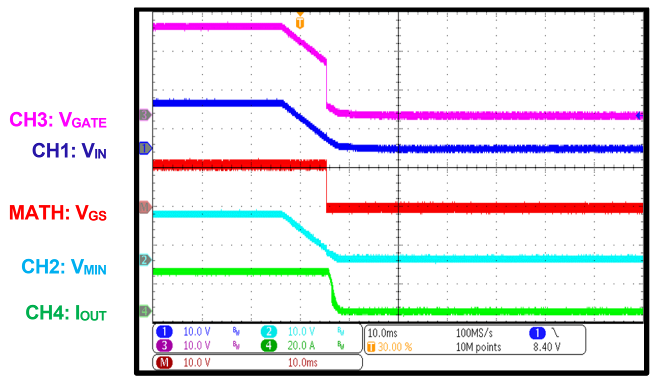
Start-Up through VIN
I_{OUT} = 20A



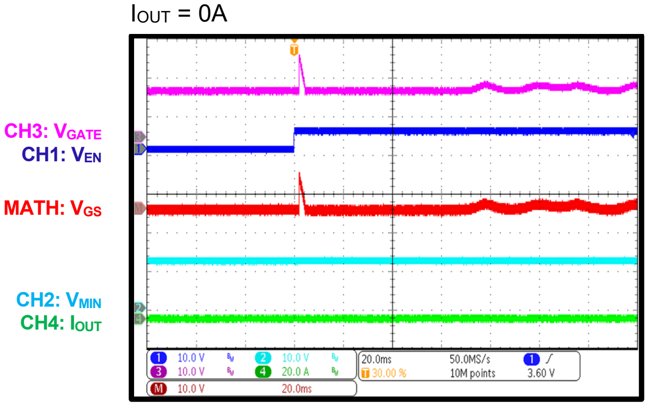
Shutdown through VIN
I_{OUT} = 0A



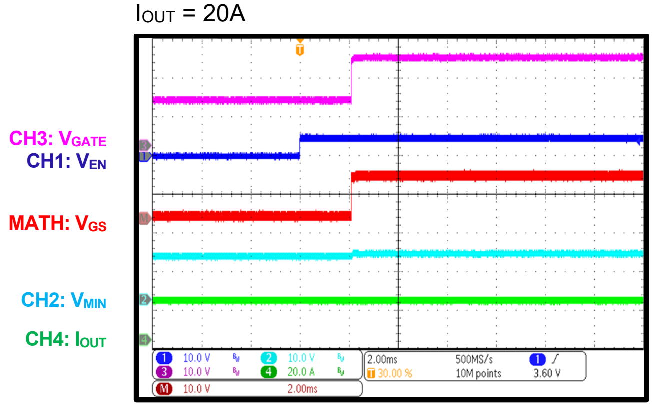
Shutdown through VIN
I_{OUT} = 20A



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



Start-Up through EN
I_{OUT} = 20A

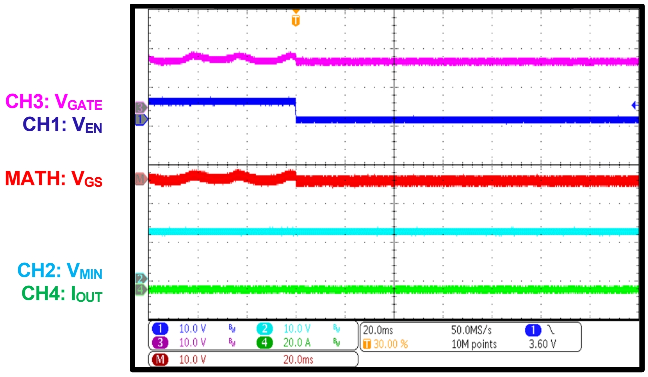


EVB TEST RESULTS *(continued)*

Performance curves and waveforms are tested on the evaluation board. V_{IN} = 12V, I_{OUT} = 20A, L = 22µH, T_A = 25°C, unless otherwise noted.

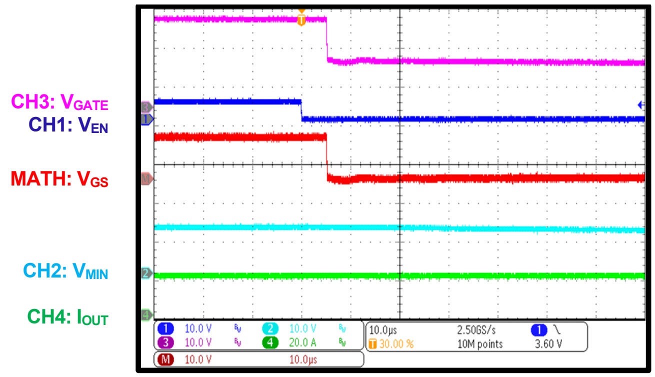
Shutdown through EN

I_{OUT} = 0A



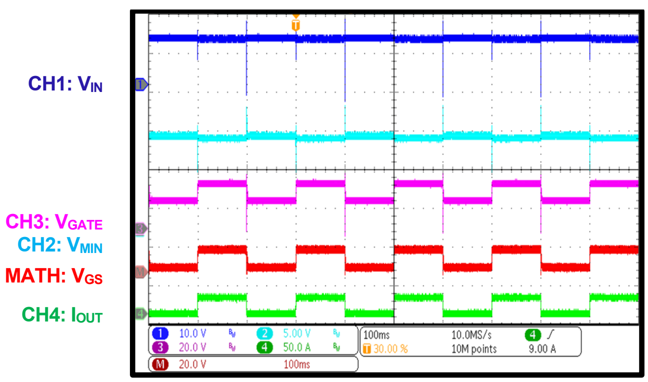
Shutdown through EN

I_{OUT} = 20A



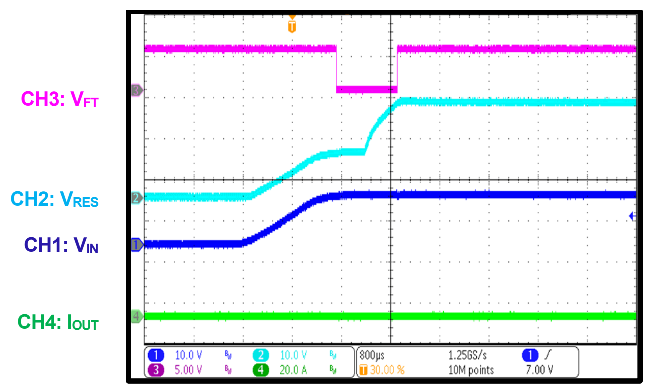
Load Transient

I_{OUT} = 0A to 20A



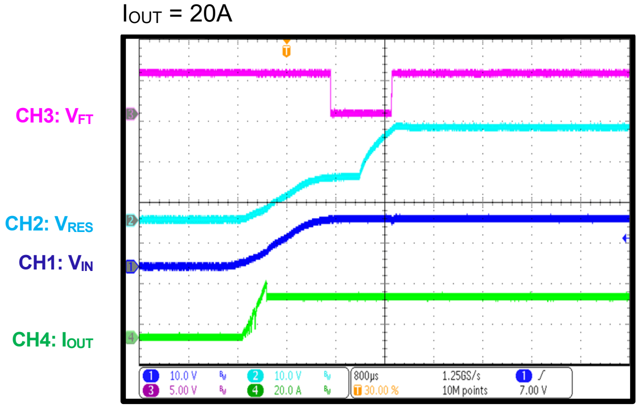
FT Start-Up through VIN

I_{OUT} = 0A



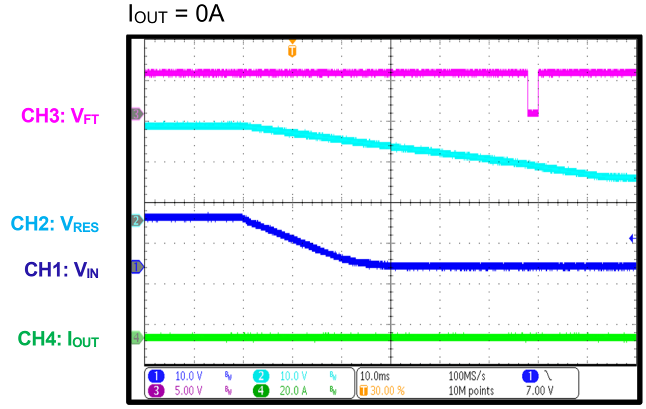
FT Start-Up through VIN

I_{OUT} = 20A



FT Shutdown through VIN

I_{OUT} = 0A

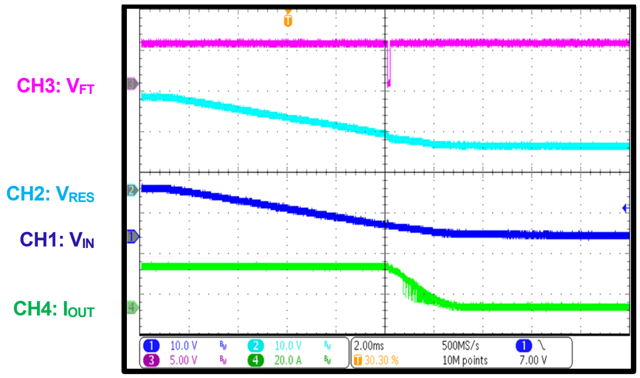


EVB TEST RESULTS *(continued)*

Performance curves and waveforms are tested on the evaluation board. V_{IN} = 12V, I_{OUT} = 20A, L = 22µH, T_A = 25°C, unless otherwise noted.

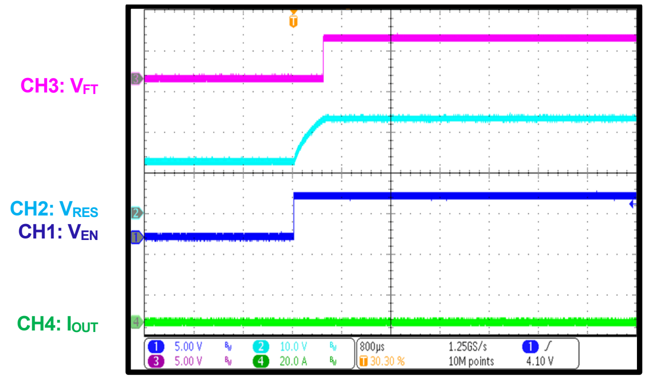
FT Shutdown through VIN

I_{OUT} = 20A



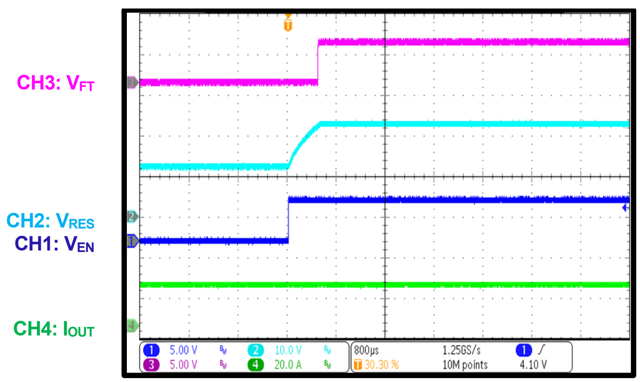
FT Start-Up through EN

I_{OUT} = 0A



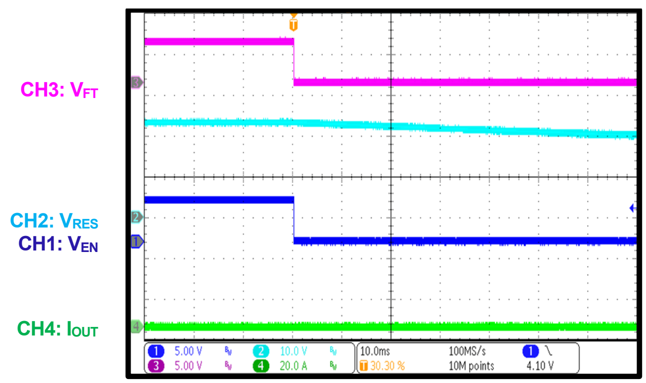
FT Start-Up through EN

I_{OUT} = 20A



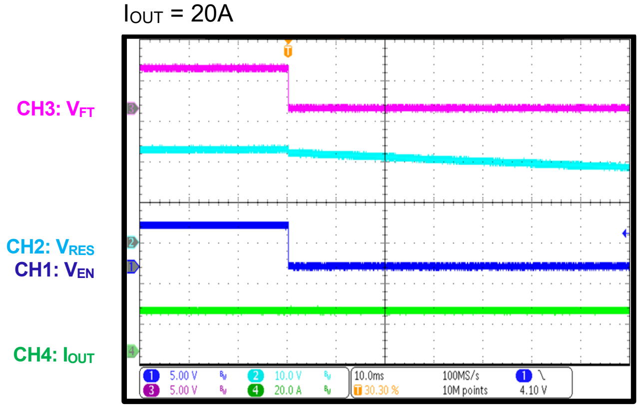
FT Shutdown through EN

I_{OUT} = 0A



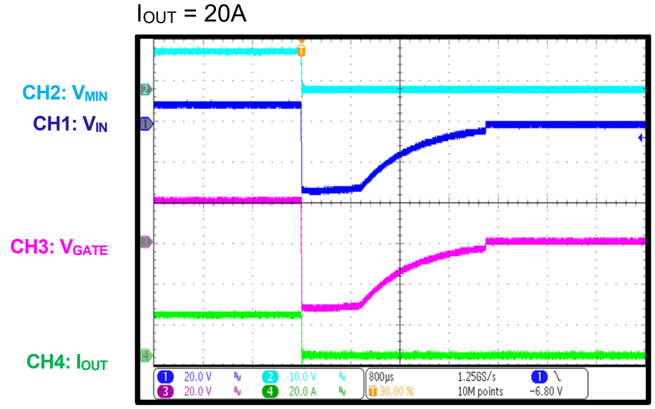
FT Shutdown through EN

I_{OUT} = 20A



Negative Pulse

I_{OUT} = 20A

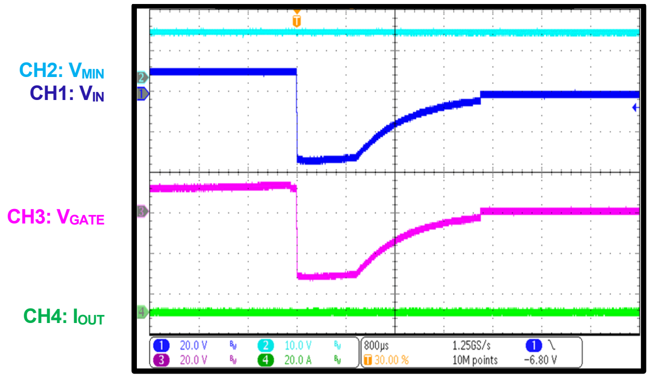


EVB TEST RESULTS *(continued)*

Performance curves and waveforms are tested on the evaluation board. V_{IN} = 12V, I_{OUT} = 20A, L = 22µH, T_A = 25°C, unless otherwise noted.

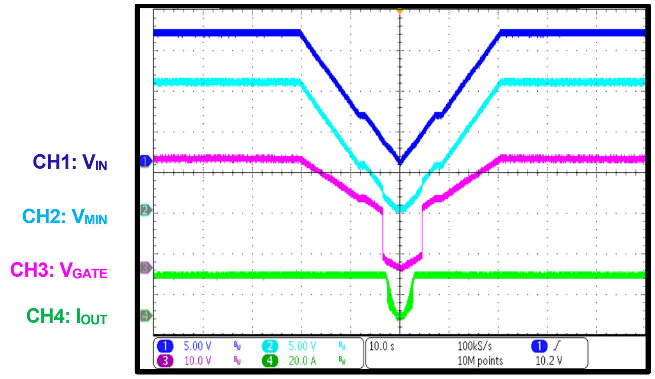
Negative Pulse

I_{OUT} = 0A



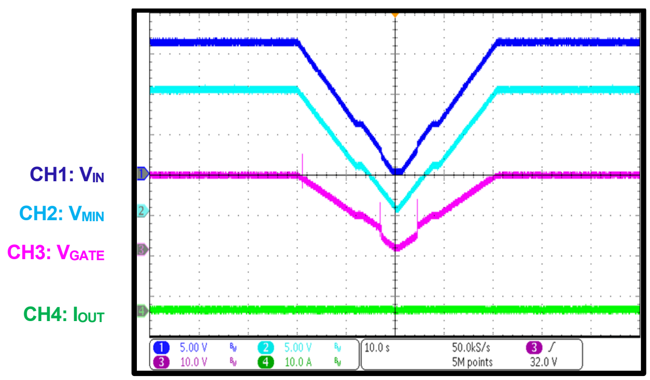
Supply Voltage Ramps Up and Down Slowly

I_{OUT} = 20A



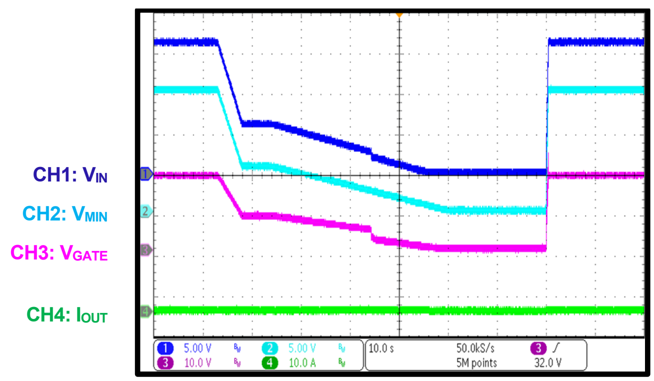
Supply Voltage Ramps Up and Down Slowly

I_{OUT} = 0A



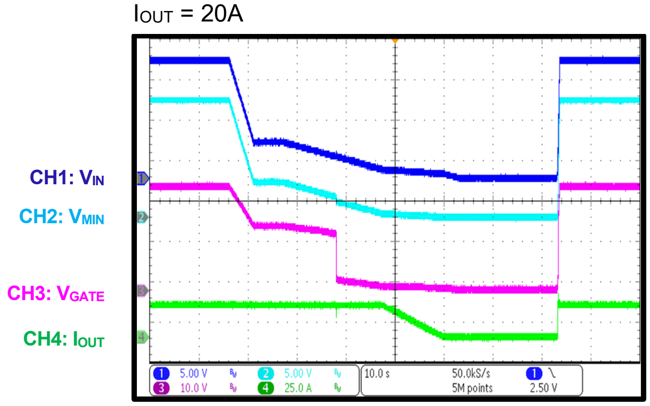
Supply Voltage Ramps Up Quickly and Down Slowly

I_{OUT} = 0A



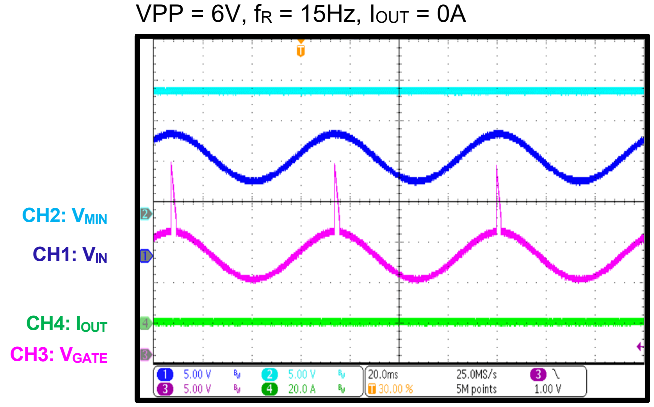
Supply Voltage Ramps Up Quickly and Down Slowly

I_{OUT} = 20A



Superimposed Alternating Voltage

VPP = 6V, f_R = 15Hz, I_{OUT} = 0A



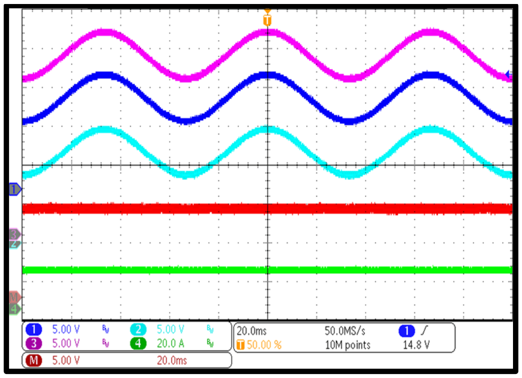
EVB TEST RESULTS *(continued)*

Performance curves and waveforms are tested on the evaluation board. V_{IN} = 12V, I_{OUT} = 20A, L = 22µH, T_A = 25°C, unless otherwise noted.

Superimposed Alternating Voltage

VPP = 6V, f_R = 15Hz, I_{OUT} = 20A

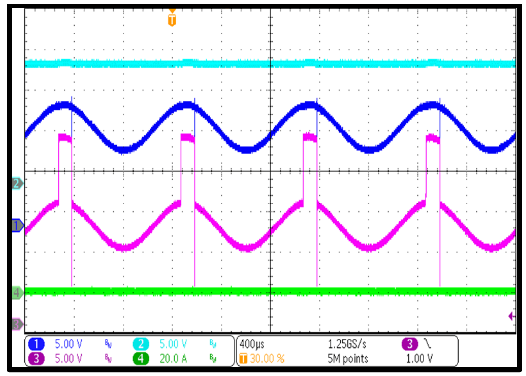
CH1: V_{IN}
CH3: V_{GATE}
CH2: V_{MIN}
MATH: V_{GS}
CH4: I_{OUT}



Superimposed Alternating Voltage

VPP = 6V, f_R = 1kHz, I_{OUT} = 0A

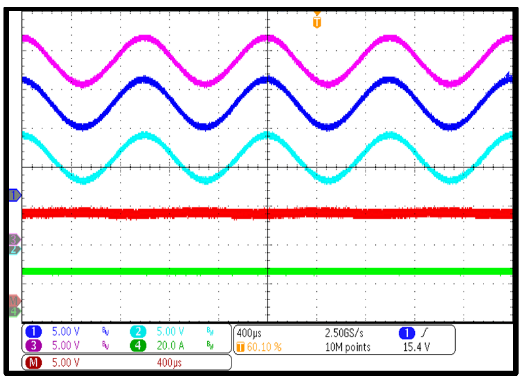
CH2: V_{MIN}
CH1: V_{IN}
CH4: I_{OUT}
CH3: V_{GATE}



Superimposed Alternating Voltage

VPP = 6V, f_R = 1kHz, I_{OUT} = 20A

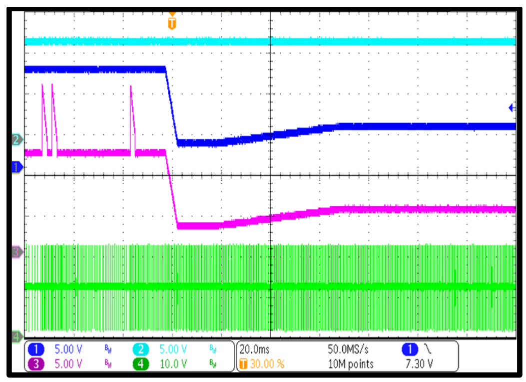
CH1: V_{IN}
CH3: V_{GATE}
CH2: V_{MIN}
MATH: V_{GS}
CH4: I_{OUT}



Cold Crank

I_{OUT} = 0A

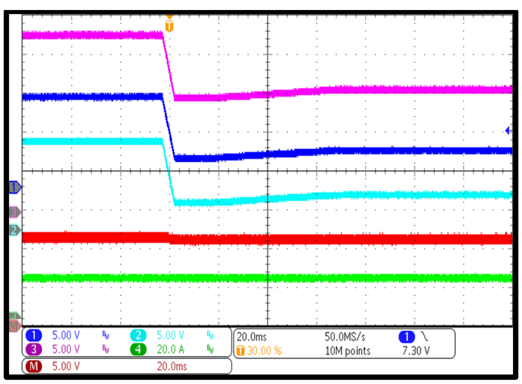
CH2: V_{MIN}
CH1: V_{IN}
CH3: V_{GATE}
CH4: V_{SW}



Cold Crank

I_{OUT} = 20A

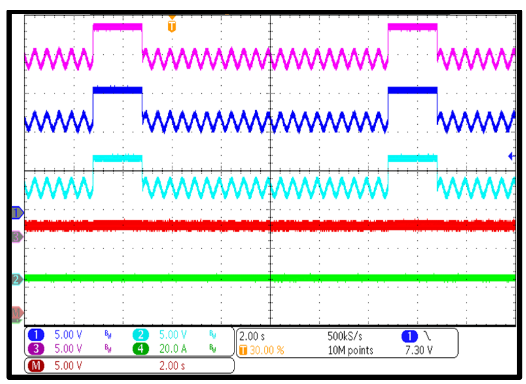
CH1: V_{IN}
CH3: V_{GATE}
CH2: V_{MIN}
CH4: I_{OUT}
MATH: V_{GS}



Start Pulse

I_{OUT} = 20A

CH1: V_{IN}
CH3: V_{GATE}
CH4: I_{OUT}
MATH: V_{GS}
CH2: V_{MIN}

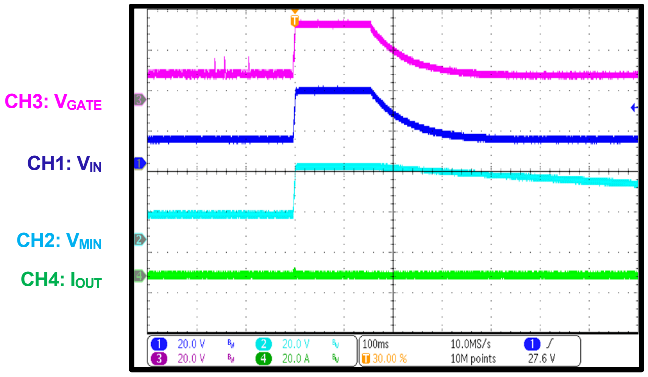


EVB TEST RESULTS *(continued)*

Performance curves and waveforms are tested on the evaluation board. V_{IN} = 12V, I_{OUT} = 20A, L = 22µH, T_A = 25°C, unless otherwise noted.

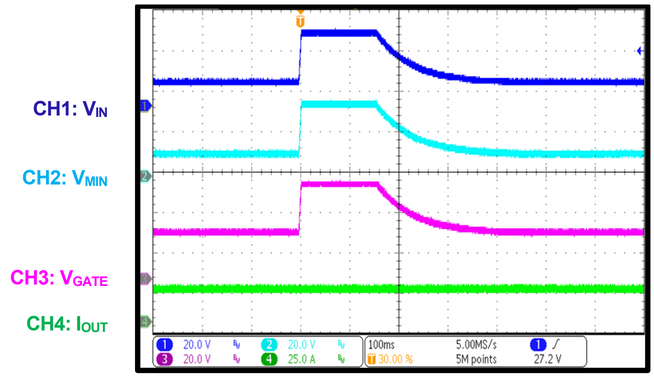
Load Dump

I_{OUT} = 0A



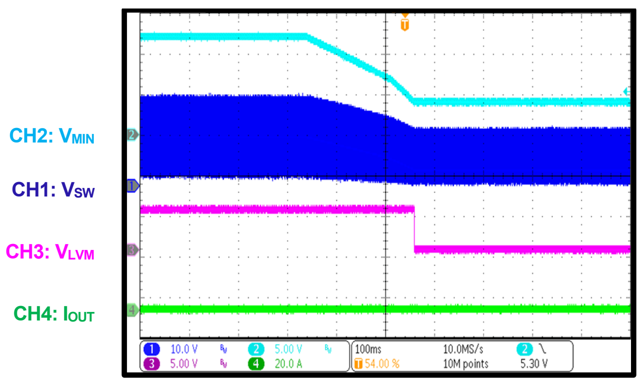
Load Dump

I_{OUT} = 20A



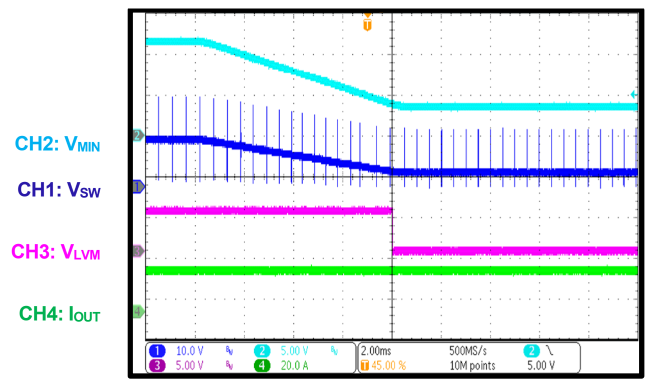
VMIN UV Warning Entry

I_{OUT} = 0A



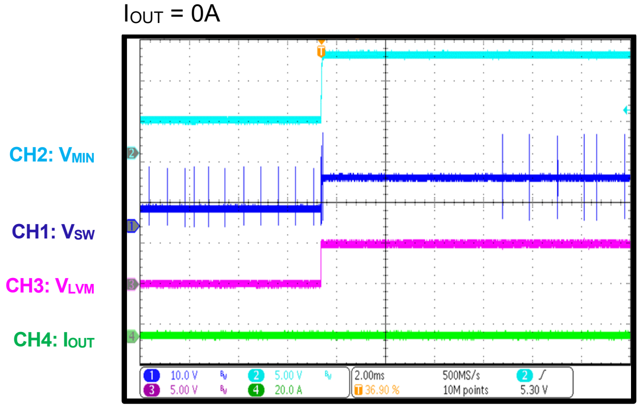
VMIN UV Warning Entry

I_{OUT} = 20A



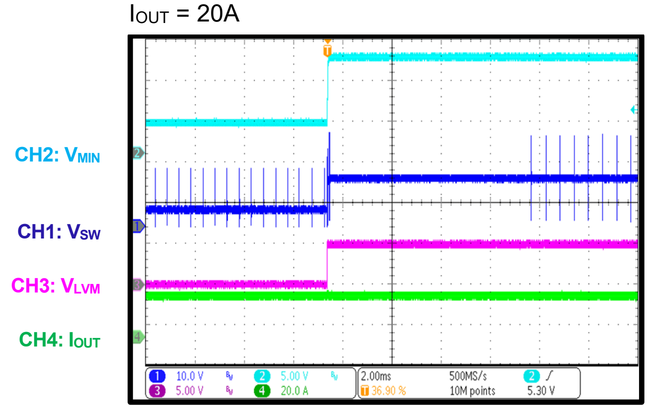
VMIN UV Warning Recovery

I_{OUT} = 0A



VMIN UV Warning Recovery

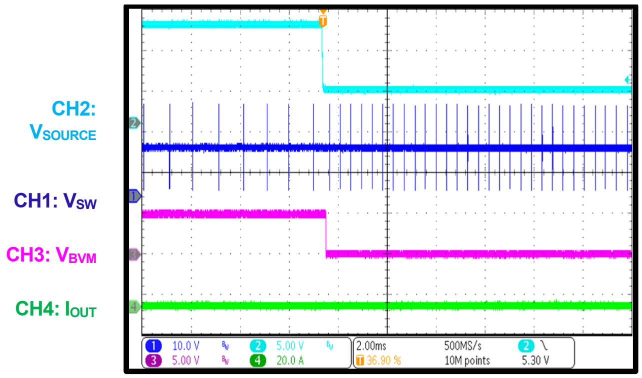
I_{OUT} = 20A



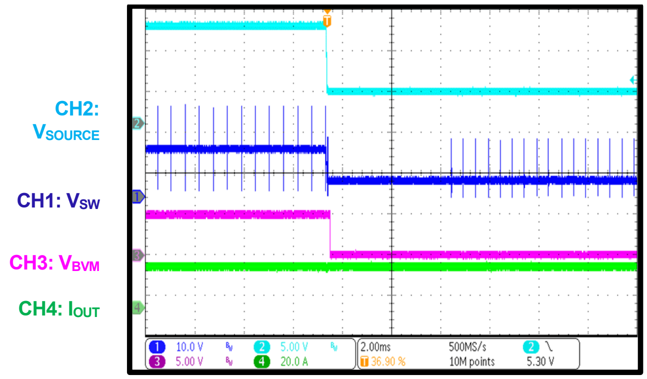
EVB TEST RESULTS *(continued)*

Performance curves and waveforms are tested on the evaluation board. V_{IN} = 12V, I_{OUT} = 20A, L = 22µH, T_A = 25°C, unless otherwise noted.

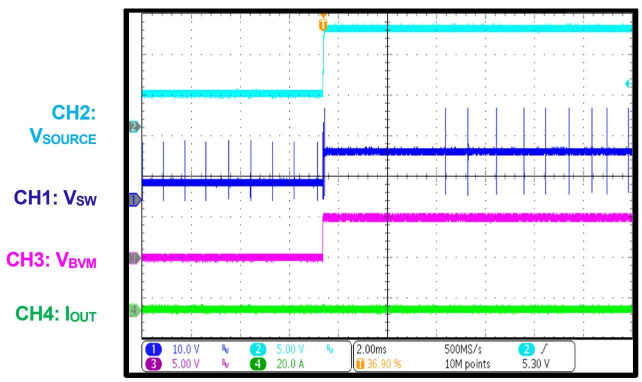
Source UV Warning Entry
I_{OUT} = 0A



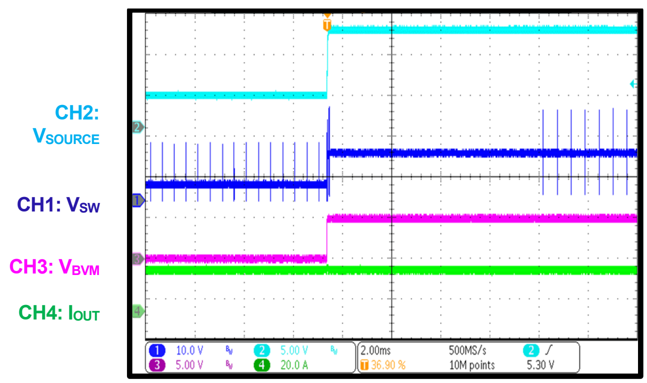
Source UV Warning Entry
I_{OUT} = 20A



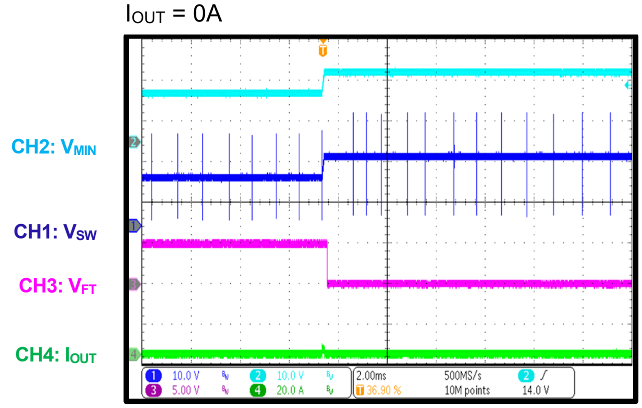
Source UV Warning Recovery
I_{OUT} = 0A



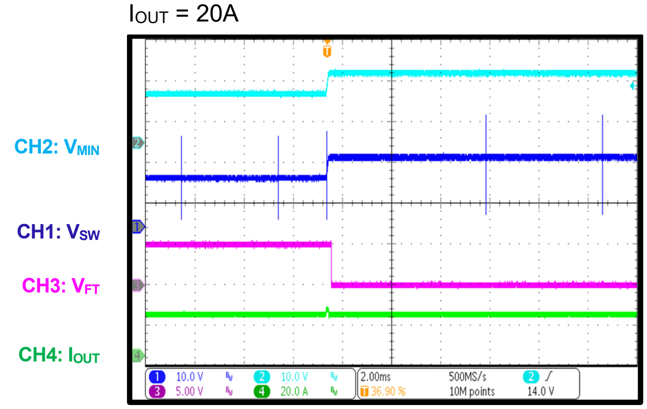
Source UV Warning Recovery
I_{OUT} = 20A



VMIN OV Warning Entry
I_{OUT} = 0A



VMIN OV Warning Entry
I_{OUT} = 20A

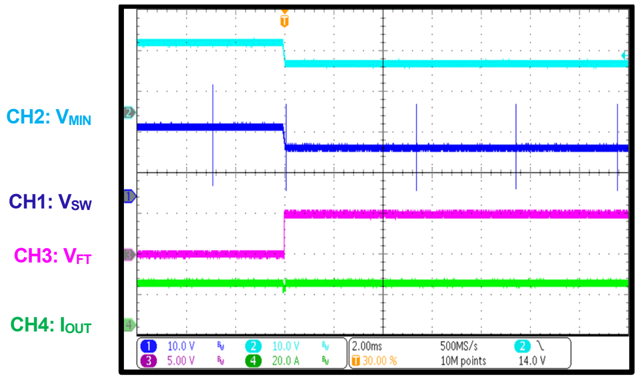


EVB TEST RESULTS *(continued)*

Performance curves and waveforms are tested on the evaluation board. V_{IN} = 12V, I_{OUT} = 20A, L = 22µH, T_A = 25°C, unless otherwise noted.

VMIN OV Warning Recovery

I_{OUT} = 20A



PCB LAYOUT

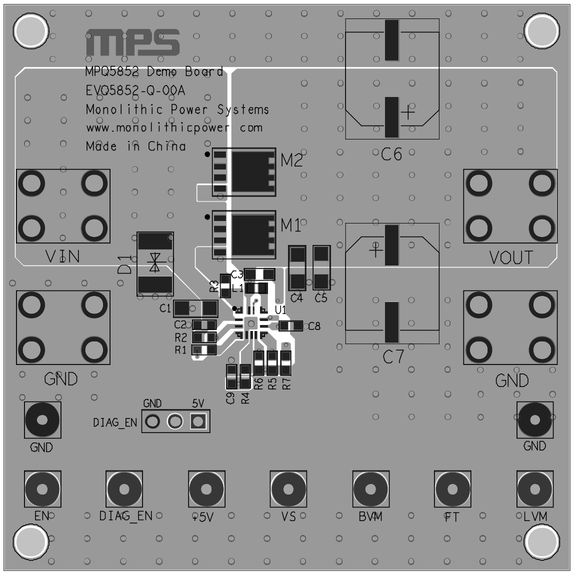


Figure 3: Top Silk and Top Layer

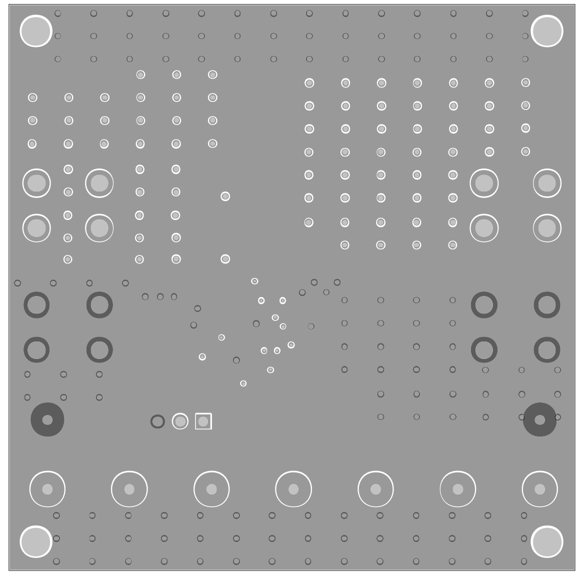


Figure 4: Mid-Layer 1

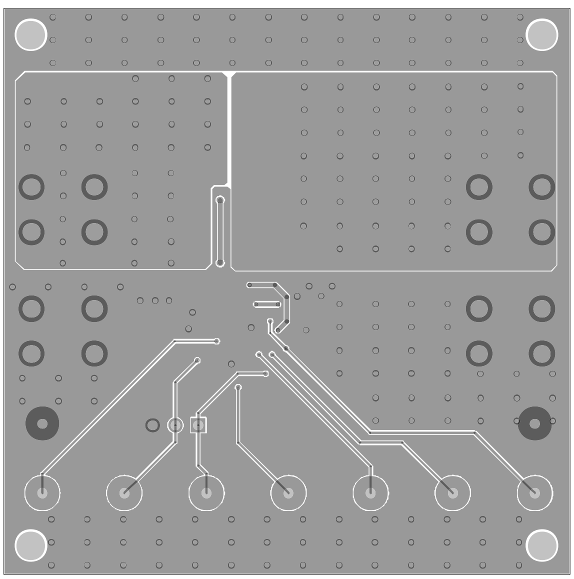


Figure 5: Mid-Layer 2

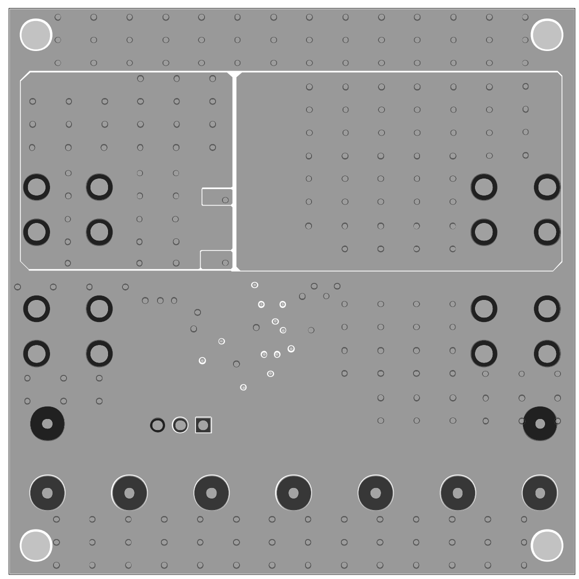


Figure 6: Bottom Layer and Bottom Silk

REVISION HISTORY

Revision #	Revision Date	Description	Pages Updated
1.0	4/16/2025	Initial Release	-