EVQ3445-U-00A

Wide-Input, Synchronous Boost Controller with Low Quiescent Bypass Mode Evaluation Board, AEC-Q100 Qualified

DESCRIPTION

The EVQ3445-U-00A evaluation board is designed to demonstrate the capabilities of the MPQ3445, a high-efficiency, current-mode, synchronous boost controller with a wide input voltage (V_{IN}) range.

The MPQ3445 can be used as a pre-boost controller to maintain the output voltage (V_{OUT}) from a vehicle battery during automotive cranking or from a backup battery. The MPQ3445 has the capability to drive 10V MOSFETs, greatly improving efficiency and minimizing power loss.

The MPQ3445 provides either an I^2C interface (default) or serial peripheral interface (SPI) to configure some key operating parameters, such as the switching frequency (f_{SW}), current limit, light-load mode, frequency spread spectrum (FSS), dead time (DT), soft-start time (t_{SS}), and slope compensation. f_{SW} can be adjusted to be between 250kHz and 2.5MHz, or it can be directly synchronized to the external source.

In the event that V_{OUT} exceeds the preset bypass threshold and V_{IN} exceeds V_{OUT} at the same time, the MPQ3445 operates in low quiescent current (I_Q) bypass mode. When V_{OUT} falls below the wake threshold, the part exits bypass mode and resumes normal operation with the high-side MOSFET and low-side MOSFET (HS-FET and LS-FET, respectively) switching to regulate the output.

The MPQ3445 also includes under-voltage lockout (UVLO), current-limit protection, and thermal shutdown protection.

The EVQ3445-U-00A is a fully assembled and tested evaluation board. The MPQ3445 is available in a QFN-21 (5mmx5mm) package, and is available in AEC-Q100 Grade 1.

PERFORMANCE SUMMARY

Specifications are at T_A = 25°C, unless otherwise noted.

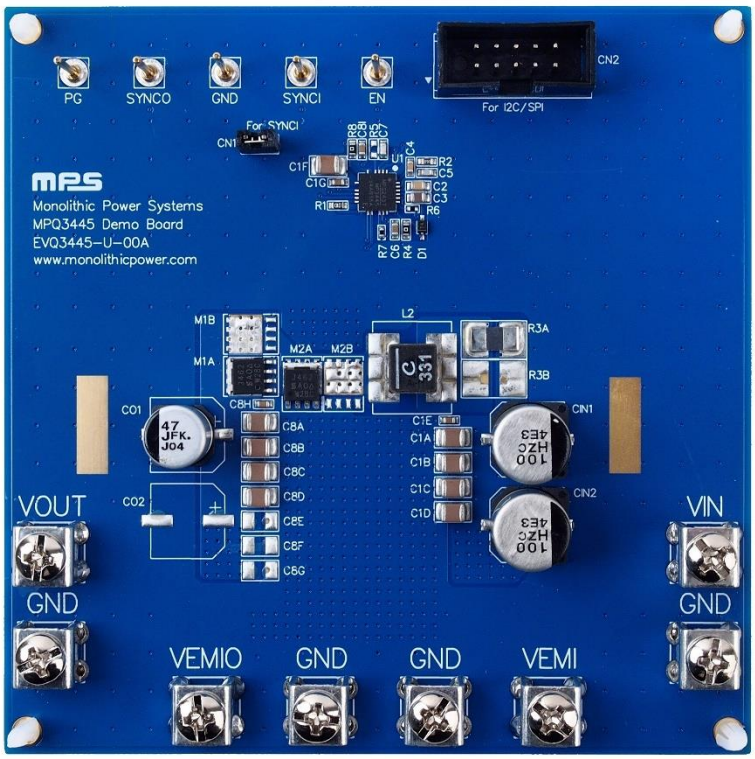
Parameters	Conditions	Value
Input voltage (V_{IN}) range		3V to 42V
Minimum V_{IN} for start-up		6.5V
Output voltage (V_{OUT})	V_{IN} = 3V to 8V, I_{OUT} = 0A to 5A, boost mode	9V (1)
Maximum output current (I_{OUT})	V_{IN} = 3V to 8V, V_{OUT} = 9V, boost mode	5A (2)
Typical efficiency	V_{IN} = 6V, V_{OUT} = 9V, I_{OUT} = 5A	93.8%
Peak efficiency	V_{IN} = 8V, V_{OUT} = 9V, I_{OUT} = 5A, pulse-skip modulation (PSM) disabled	95.2%
Switching frequency (f_{SW})		2.2MHz

Notes:

1) Additional output voltages can be supported. Contact MPS for more details.
2) Higher output power levels may be available. Contact MPS for more details.

MPS Proprietary Information. Patent Protected. Unauthorized Photocopy and Duplication Prohibited.
© 2025 MPS. All Rights Reserved.

EVQ3445-U-00A EVALUATION BOARD



LxWxH (10cmx10cmx1.3cm)

Board Number	MPS IC Number
EVQ3445-U-00A	MPQ3445GUE-0001-AEC1

MPS Proprietary Information. Patent Protected. Unauthorized Photocopy and Duplication Prohibited.
© 2025 MPS. All Rights Reserved.

QUICK START GUIDE

The EVQ3445-U-00A evaluation board is easy to set up and use to evaluate the MPQ3445's performance. For proper measurement equipment set-up, refer to Figure 2 on page 4 and follow the steps below:

1. Preset the power supply to be between 6.5V and 42V, then turn off the power supply.
2. Set the load current between 0A and 5A. Electronic loads represent a negative impedance to the regulator, and setting the current too high with a low power supply may trigger over-current protection (OCP). In addition, the external power MOSFET may be damaged if the heat sink is not applied.
3. Connect the power supply terminals to:
    a. Positive (+): VEMI
    b. Negative (-): GND
4. Connect the load terminals to:
    a. Positive (+): VEMIO
    b. Negative (-): GND
5. CN1 is used for the SYNCI jumper. To connect the SYNCI pin, follow the steps below:
    a. Ensure the power supply is turned off.
    b. If the SYNCI function is not used, use a jumper capacitor to connect the SYNCI pin to GND; if the SYNCI function is used, connect the SYNCI pin to an external clock signal. Do not float the SYNCI pin.
6. After making the connections, turn on the power supply. The board should automatically start up.
7. To use the enable (EN) function, apply a digital input to the EN pin. Pull EN above 1.5V to turn boost operation on; pull EN below 1.3V to turn boost operation off.
8. Evaluate the MPQ3445 with the digital interface following the steps below:
    a. The EVQ3445-U-00A's default digital interface is the I^2C. To use the SPI interface, remove C7 and add R5 (1kΩ) on the board.
    b. Download and install Virtual Bench Pro 4.0 (VBP 4.0) from the MPS website. The MPQ3445's graphical user interface (GUI) is embedded in VBP 4.0.
    c. Connect the EVKT-AUTOMOTIVE-00A (3) to CN2 with three jump wires (for the I^2C interface) or the ribbon cable (for the SPI interface), then connect the EVKT-AUTOMOTIVE-00A to the computer with the USB cable.
    d. Using the MPQ3445's GUI, for the I^2C interface, scan for the evaluation board address, which is 08h by default; for the SPI interface, directly select the SPI option as there is no need to scan the address.
    e. Start evaluating the device using the MPQ3445's GUI, assessing key operating parameters such as the soft-start time (t_{SS}) and slope compensation. Figure 1 on page 4 shows the digital interface evaluation kit set-up.

Note:

3) Contact MPS for more information regarding the EVKT-AUTOMOTIVE-00A.

MPS Proprietary Information. Patent Protected. Unauthorized Photocopy and Duplication Prohibited.
© 2025 MPS. All Rights Reserved.

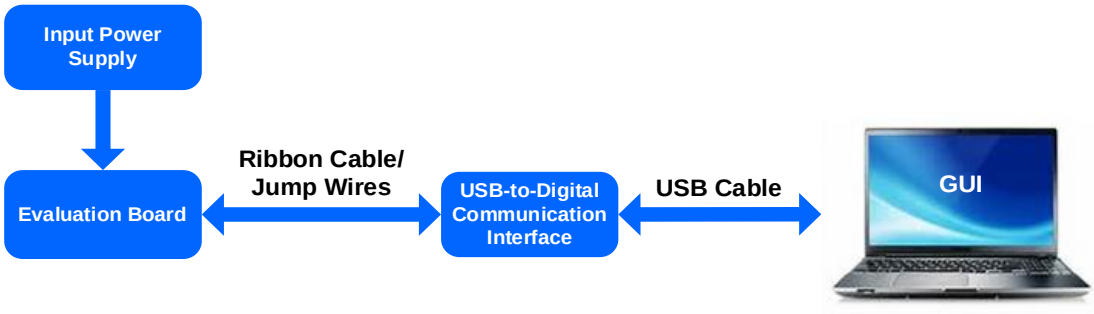


Figure 1: Digital Interface Evaluation Kit Set-Up

9. When the SYNCI function is used, the switching frequency (f_{SW}) can be synchronized to the falling edge of the clock signal applied at SYNCI. The recommended SYNCI frequency range is between 250kHz and 2.5MHz. Ensure that the SYNCI frequency is ±20% of the internal oscillator.

   Refer to the Application Information section in the MPQ3445 datasheet to calculate the inductance and output capacitances.

Figure 2 shows the measurement equipment set-up.

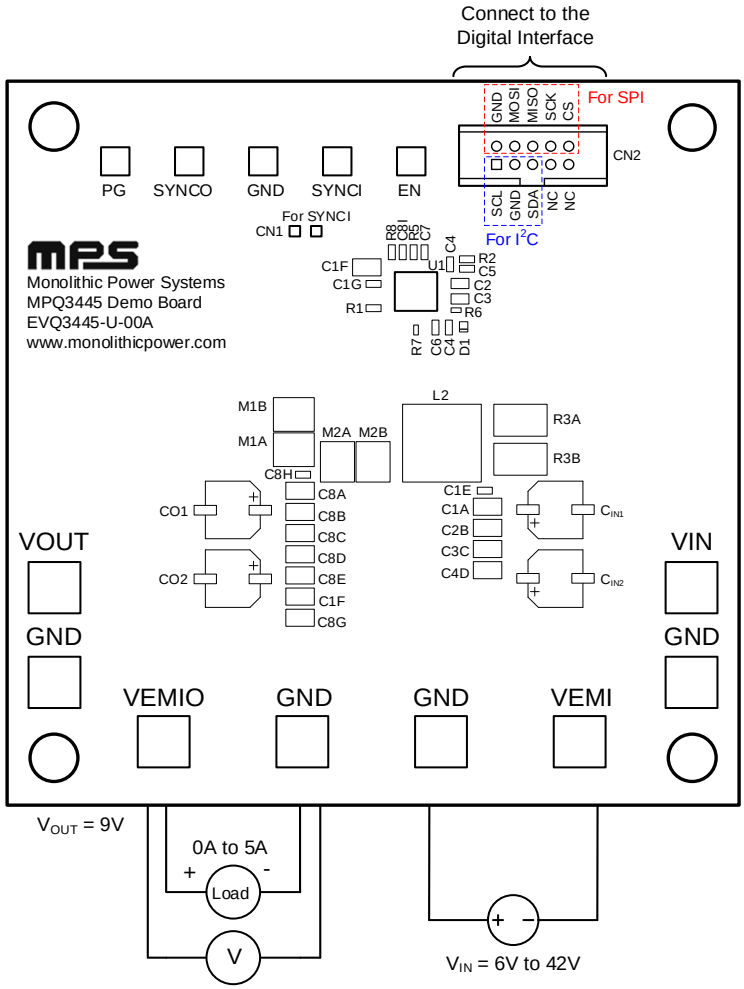


Figure 2: Measurement Equipment Set-Up

MPS Proprietary Information. Patent Protected. Unauthorized Photocopy and Duplication Prohibited.
© 2025 MPS. All Rights Reserved.

MPQ3445-0001 REGISTER DEFAULT VALUES

Command Code	Command Name	Bytes	Value	Description
00h	USER00	2	1450h	• Boost is enabled • Forces VOUT to be the power source of PVCC • PVCC under-voltage lockout (UVLO) = 5V • Forced continuous conduction mode (FCCM) during light-load operation • f_{SW} = 2.2MHz
01h	USER01	2	1B19h	• Current limit threshold = 100mV • Output voltage (V_{OUT}) slew rate = 2.5V/ms during soft start (SS) • Input voltage (V_{IN}) falling UVLO = 2.5V • Bypass threshold threshold = 120% • Slope compensation = 0.2V/T
02h	USER02	2	441Eh	• Turn-on control of the top gate (TG) driver • Dead time = 40ns • Pulse-skip modulation (PSM) mode is disabled • Maximum duty = 86% • V_{OUT} = 9V
03h	USER03	2	8008h	• I^2C address = 08h
06h	SYSTEM00	2	1000h	• Boost over-current protection (OCP) function is enabled • Boost under-voltage protection (UVP) function is disabled
07h	SYSTEM01	2	0008h	• Boost thermal shutdown protection is enabled
1Eh	OTP_USER_ RESERVED	2	0010h	• FSS is disabled

MPS Proprietary Information. Patent Protected. Unauthorized Photocopy and Duplication Prohibited.
© 2025 MPS. All Rights Reserved.

EVALUATION BOARD SCHEMATIC

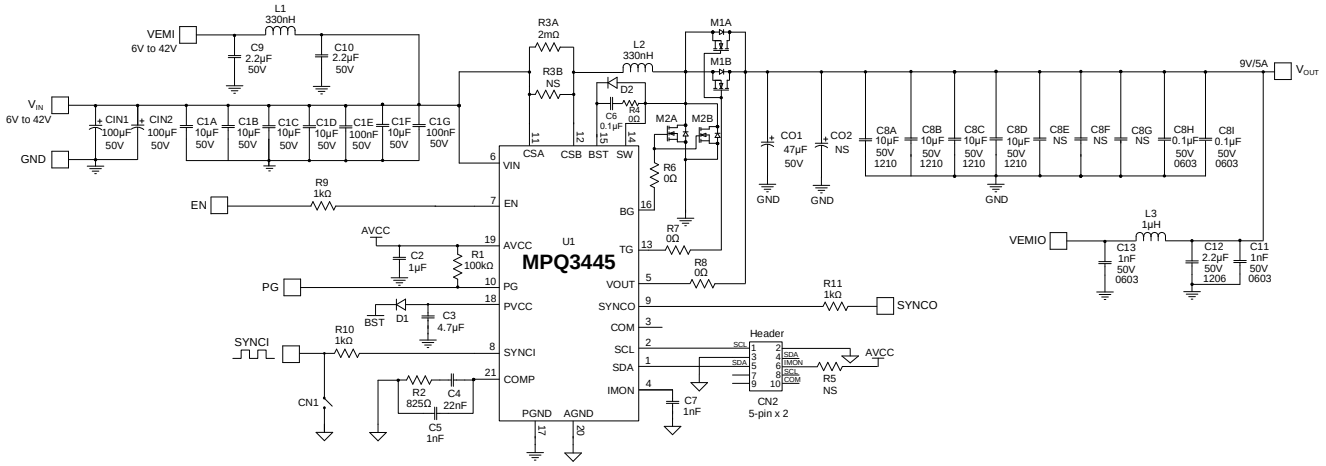
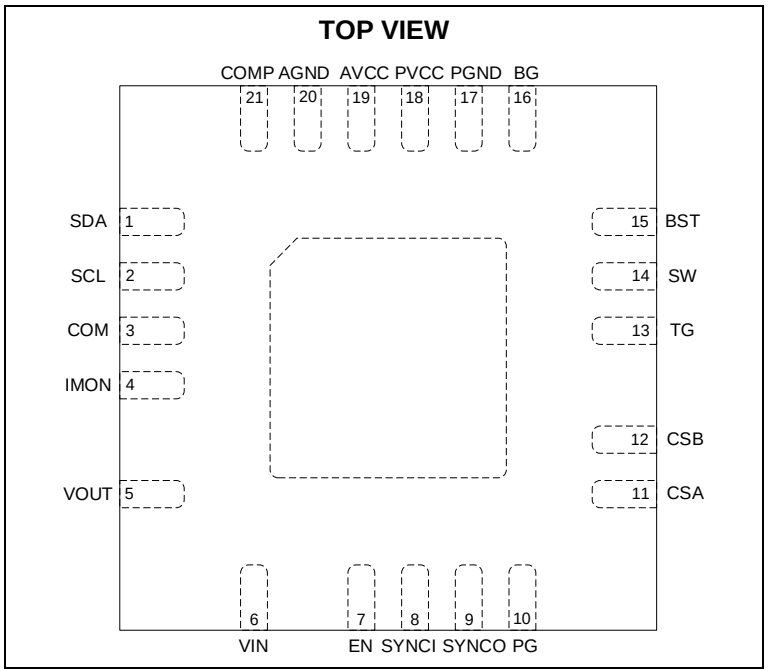


Figure 3: Evaluation Board Schematic

PACKAGE REFERENCE



QFN-21 (5mmx5mm)

MPS Proprietary Information. Patent Protected. Unauthorized Photocopy and Duplication Prohibited.
© 2025 MPS. All Rights Reserved.

EVQ3445-U-00A BILL OF MATERIALS

Qty	Ref	Value	Description	Package	Manufacturer	Manufacturer PN
2	CIN1, CIN2	100µF	Electrolytic capacitor, 50V	SMD	Panasonic	EEHZC1H101P
1	CO1	47µF	Electrolytic capacitor, 50V	SMD	Panasonic	EEEFK1J470P
4	CO2, C8E, C8F, C8G	NS				
9	C1A, C1B, C1C, C1D, C1F, C8A, C8B, C8C, C8D	10µF	Ceramic capacitor, 50V, X7R	1210	Murata	GRM32ER71H106KA12L
5	C1E, C1G, C8H, C8I, C6	100nF	Ceramic capacitor, 100V, X7R	0603	Murata	GRM188R71H104KA93D
1	C2	1µF	Ceramic capacitor, 16V, X7R	0805	Murata	GRM21BR71C105KA01L
1	C3	4.7µF	Ceramic capacitor, 16V, X7R	0805	Murata	GCM21BR71C475KA73L
1	C4	22nF	Ceramic capacitor, 50V, X7R	0603	Wurth	885012206091
4	C5, C7, C11, C13	1nF	Ceramic capacitor, 50V, C0G	0603	Murata	GRM1885C1H102JA01D
2	C9, C10	2.2µF	Ceramic capacitor, 50V, X7R	0805	Murata	C2012X7R1H225KT000E
1	C12	4.7µF	Ceramic capacitor, 50V, X7R	1206	Murata	GCM31CR71H225KA55L
1	R1	100kΩ	Film resistor, 1%	0603	Yageo	RC0603FR-07100KL
1	R2	825Ω	Film resistor, 1%	0603	Yageo	RC0603FR-07825RL
1	R3A	2mΩ	Film resistor, 1%	2512	Vishay	WSLP25122L000FEA
2	R3B, R5	NS				
2	R4, R8	0Ω	Film resistor, 1%	0603	Yageo	RC0603FR-070RL
2	R6, R7	0Ω	Film resistor, 1%	0402	Yageo	RC0402FR-070RL
3	R9, R10, R11	1kΩ	Film resistor, 1%	0603	Yageo	RC0603FR-071KL
1	L1	330nH	Inductor, 3.3mΩ, 38A	SMD	Coilcraft	CMLS063T-R33MS
1	L2	330nH	Inductor, 2mΩ, 30A	SMD	Coilcraft	XEL6060-331MEB
1	L3	1µH	Inductor, 8.2mΩ, 8.8A	SMD	Coilcraft	XGL4020-102MEB
2	M1A, M2A	60V	8mΩ, 46.5A, 9.3nC, N-channel MOSFET	PowerPA K-SO-8L-4	Vishay	SIJ462DP-T1-GE3
2	M1B, M2B	NS				
2	D1, D2	1N4148	Diode, 75V, 250mA	SOD-323F	Diodes, Inc.	1N4148WS
1	CN1	2.54mm	Connector, 2-pin	DIP	Any	
1	CN2	2.54mm	Connector, 180°, 5-pin x 2	DIP	Wurth	61201021621
8	VIN, VOUT, VEMI, VEMIO, GND	6-32	Connector, 4-pin	DIP	Keystone Electronics	8191K-ND

MPS Proprietary Information. Patent Protected. Unauthorized Photocopy and Duplication Prohibited.
© 2025 MPS. All Rights Reserved.

EVQ3445-U-00A BILL OF MATERIALS *(continued)*

Qty	Ref	Value	Description	Package	Manufacturer	Manufacturer PN
5	PG, SYNCO, EN, SYNCI, GND	1mm	Golden pin	DIP	Custom (4)	
1	U1	MPQ3445-AEC1	Wide input, current mode, synchronous boost controller, AEC-Q100 qualified	QFN-21 (5mmx 5mm)	MPS	MPQ3445GUE-0001-AEC1

Note:

4) Contact an MPS FAE for more information regarding custom pins.

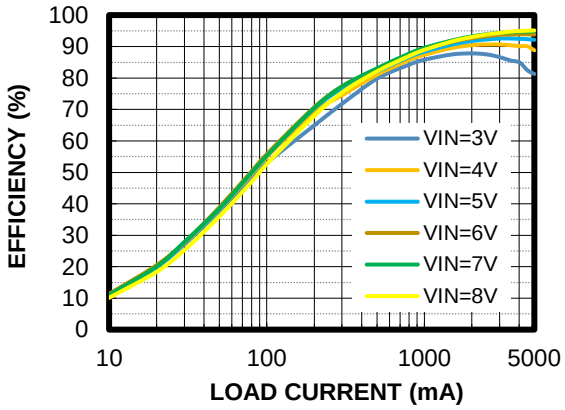
MPS Proprietary Information. Patent Protected. Unauthorized Photocopy and Duplication Prohibited.
© 2025 MPS. All Rights Reserved.

EVB TEST RESULTS

Performance curves and waveforms are tested on the evaluation board. V_{EN} = 5V, V_{IN} = 6V, V_{OUT} = 9V, L = 330nH, T_A = 25°C, unless otherwise noted.

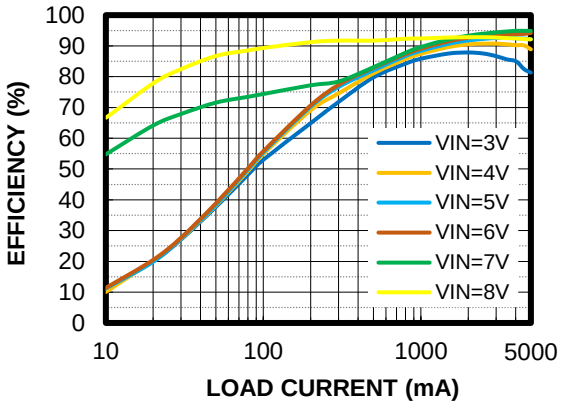
Efficiency vs. Load Current

f_{SW} = 2.2MHz, L = 330nH, FCCM, PSM disabled



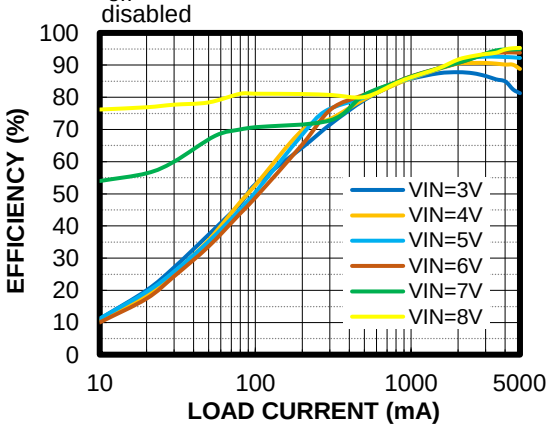
Efficiency vs. Load Current

f_{SW} = 2.2MHz, L = 330nH, FCCM, PSM enabled



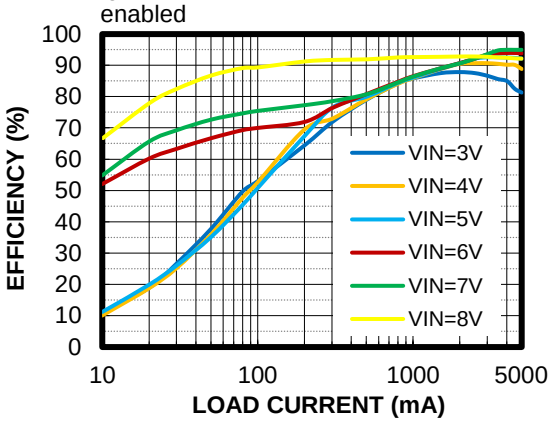
Efficiency vs. Load Current

f_{SW} = 2.2MHz, L = 330nH, DCM, PSM disabled



Efficiency vs. Load Current

f_{SW} = 2.2MHz, L = 330nH, DCM, PSM enabled



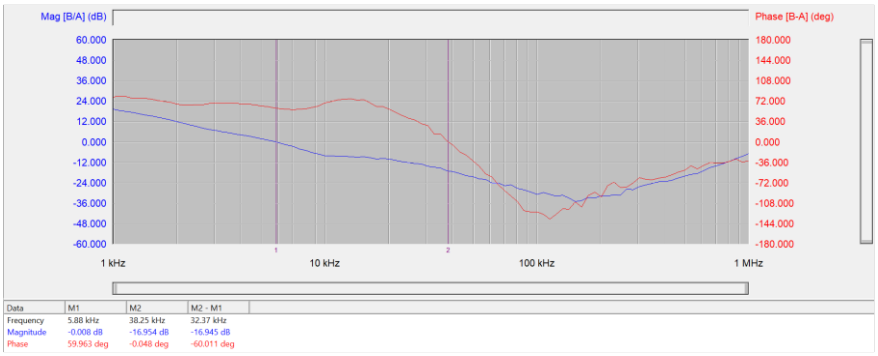
MPS Proprietary Information. Patent Protected. Unauthorized Photocopy and Duplication Prohibited.
© 2025 MPS. All Rights Reserved.

EVB TEST RESULTS *(continued)*

Performance curves and waveforms are tested on the evaluation board. V_{EN} = 5V, V_{IN} = 6V, V_{OUT} = 9V, L = 330nH, T_A = 25°C, unless otherwise noted.

Loop Performance

I_{OUT} = 5A, T_A = 25°C



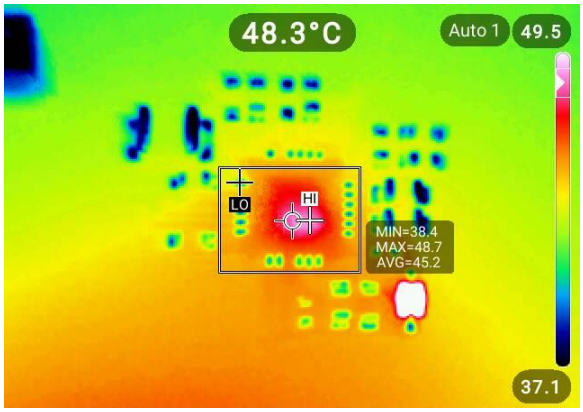
MPS Proprietary Information. Patent Protected. Unauthorized Photocopy and Duplication Prohibited.
© 2025 MPS. All Rights Reserved.

EVB TEST RESULTS *(continued)*

Performance curves and waveforms are tested on the evaluation board. V_{EN} = 5V, V_{IN} = 3V, V_{OUT} = 9V, L = 330nH, T_A = 25°C, unless otherwise noted.

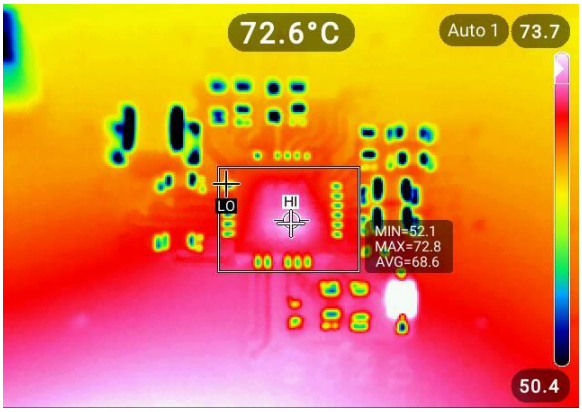
Thermal Performance

I_{OUT} = 2.5A, no forced airflow, IC T_{CASE} = 48.7°C



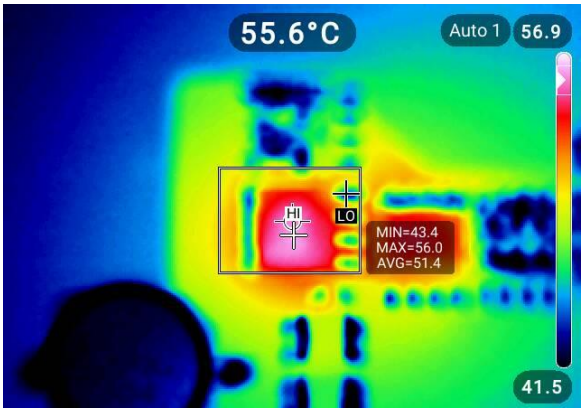
Thermal Performance

I_{OUT} = 5A, no forced airflow, IC T_{CASE} = 72.8°C



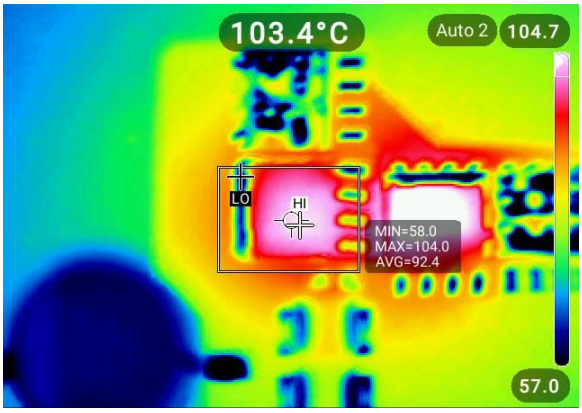
Thermal Performance

I_{OUT} = 2.5A, no forced airflow, HS-FET T_{CASE} = 56°C



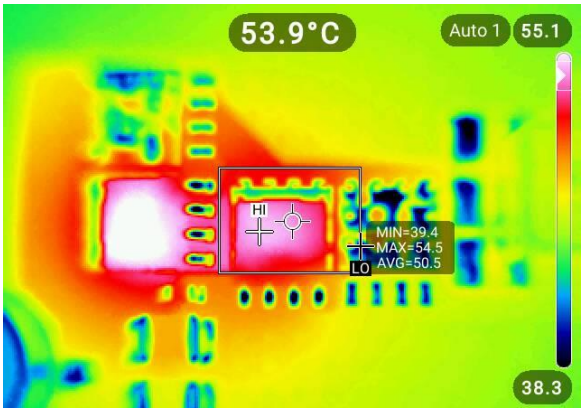
Thermal Performance

I_{OUT} = 5A, no forced airflow, HS-FET T_{CASE} = 104°C



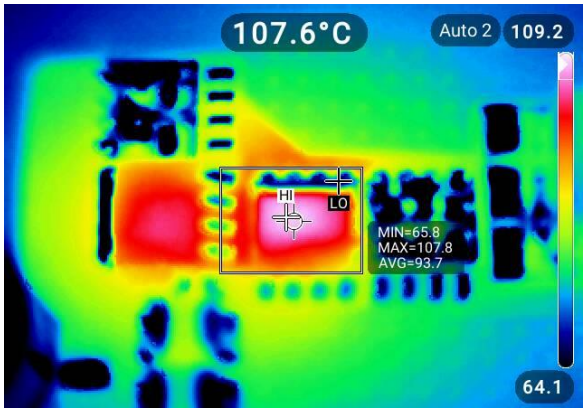
Thermal Performance

I_{OUT} = 2.5A, no forced airflow, LS- FET T_{CASE} = 54.5°C



Thermal Performance

I_{OUT} = 5A, no forced airflow, LS-FET T_{CASE} = 107.8°C



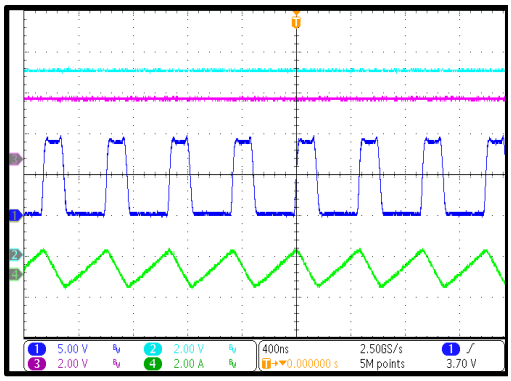
MPS Proprietary Information. Patent Protected. Unauthorized Photocopy and Duplication Prohibited.
© 2025 MPS. All Rights Reserved.

EVB TEST RESULTS *(continued)*

Performance curves and waveforms are tested on the evaluation board. V_{EN} = 5V, V_{IN} = 6V, V_{OUT} = 9V, L = 330nH, T_A = 25°C, unless otherwise noted.

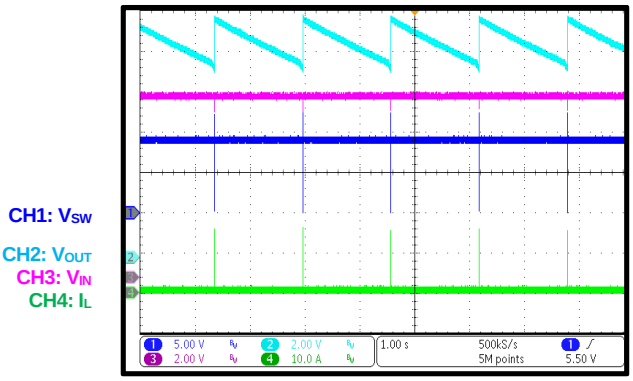
Steady State

V_{IN} = 3V, I_{OUT} = 0A, FCCM



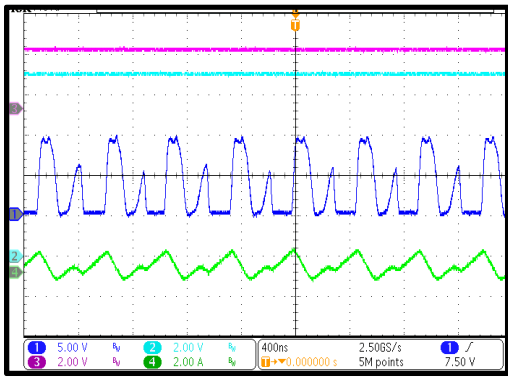
Steady State

V_{IN} = 8.5V, I_{OUT} = 0A, FCCM



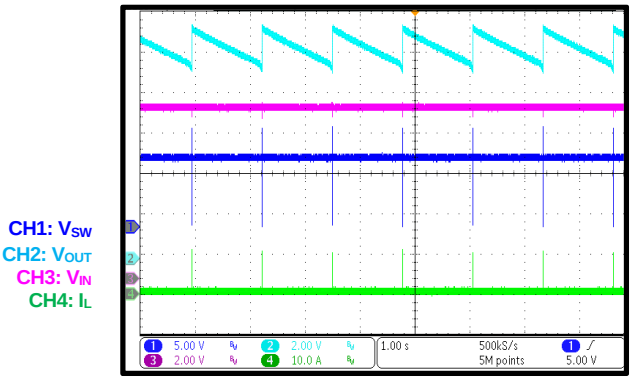
Steady State

V_{IN} = 3V, I_{OUT} = 0A, DCM



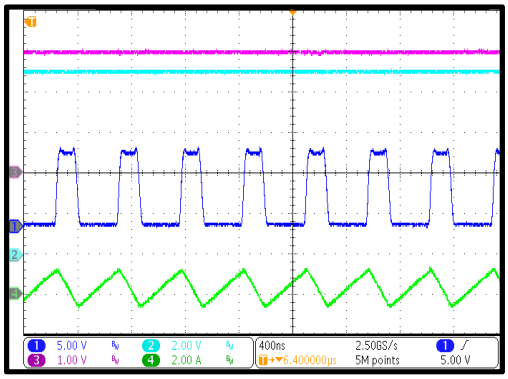
Steady State

V_{IN} = 8.5V, I_{OUT} = 0A, DCM



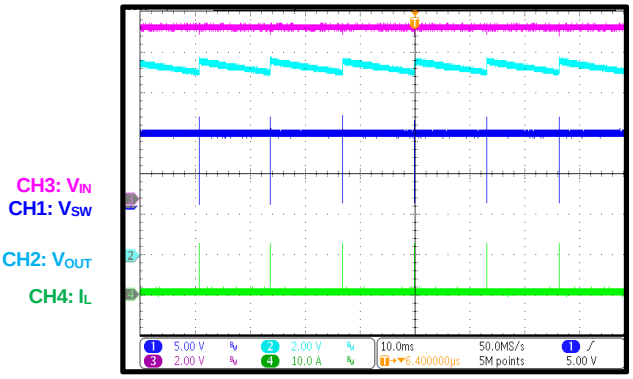
Steady State

V_{IN} = 3V, I_{OUT} = 0A, FCCM, PSM enabled



Steady State

V_{IN} = 8.5V, I_{OUT} = 0A, FCCM, PSM enabled

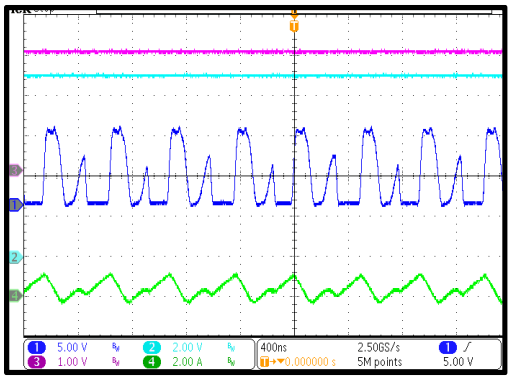


MPS Proprietary Information. Patent Protected. Unauthorized Photocopy and Duplication Prohibited.
© 2025 MPS. All Rights Reserved.

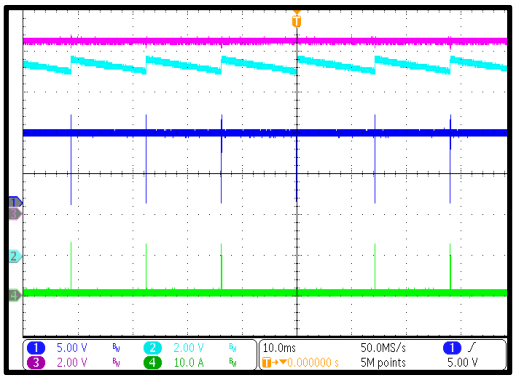
EVB TEST RESULTS *(continued)*

Performance curves and waveforms are tested on the evaluation board. V_{EN} = 5V, V_{IN} = 6V, V_{OUT} = 9V, L = 330nH, T_A = 25°C, unless otherwise noted.

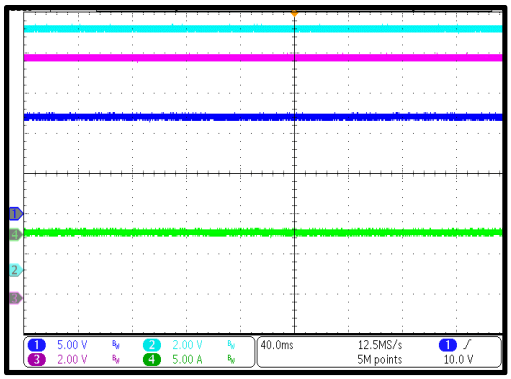
Steady State
V_{IN} = 3V, I_{OUT} = 0A, DCM, PSM enabled



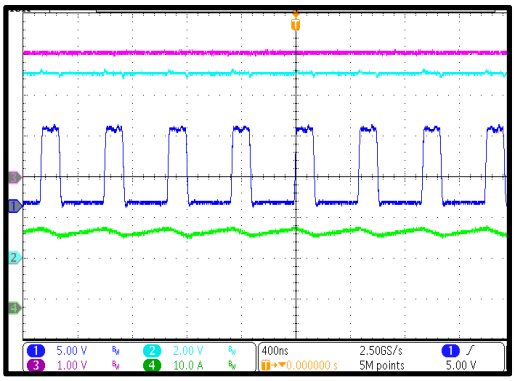
Steady State
V_{IN} = 8.5V, I_{OUT} = 0A, DCM, PSM enabled



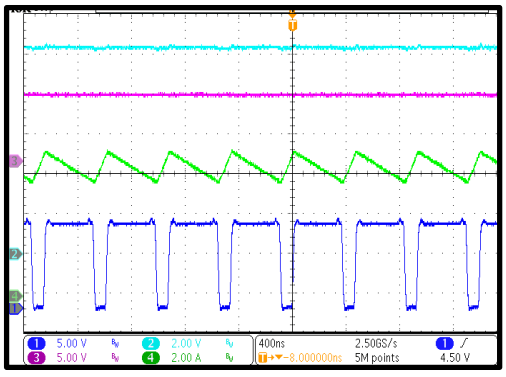
Steady State
V_{IN} = 12V, I_{OUT} = 0A



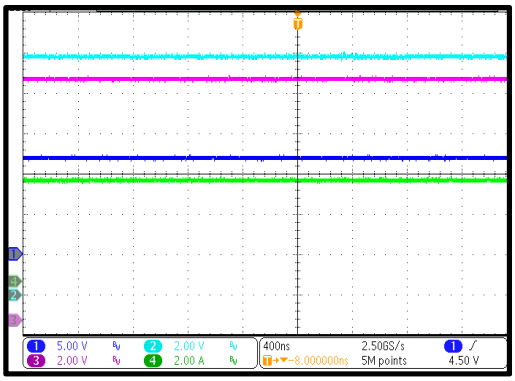
Steady State
V_{IN} = 3V, I_{OUT} = 5A



Steady State
V_{IN} = 8.5V, I_{OUT} = 5A



Steady State
V_{IN} = 12V, I_{OUT} = 5A



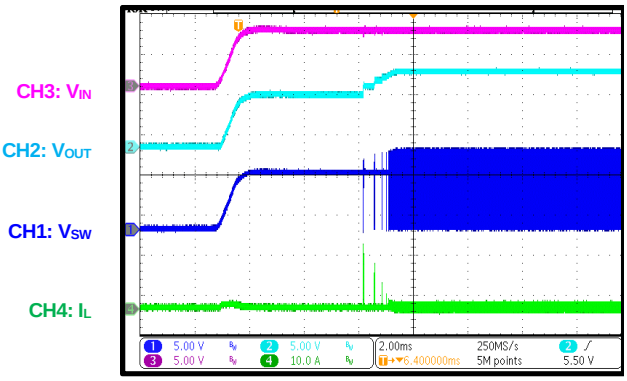
MPS Proprietary Information. Patent Protected. Unauthorized Photocopy and Duplication Prohibited.
© 2025 MPS. All Rights Reserved.

EVB TEST RESULTS *(continued)*

Performance curves and waveforms are tested on the evaluation board. V_{EN} = 5V, V_{IN} = 6V, V_{OUT} = 9V, L = 330nH, T_A = 25°C, unless otherwise noted.

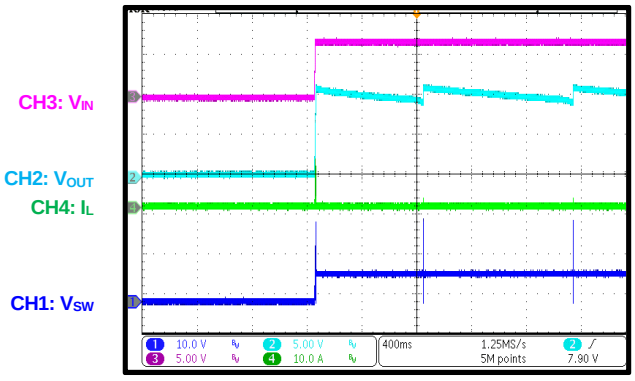
Start-Up through VIN

V_{IN} = 7V, FCCM, I_{OUT} = 0A



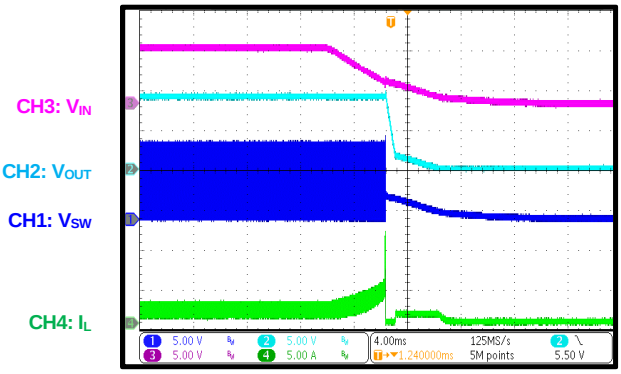
Start-Up through VIN

V_{IN} = 7V, DCM, I_{OUT} = 0A



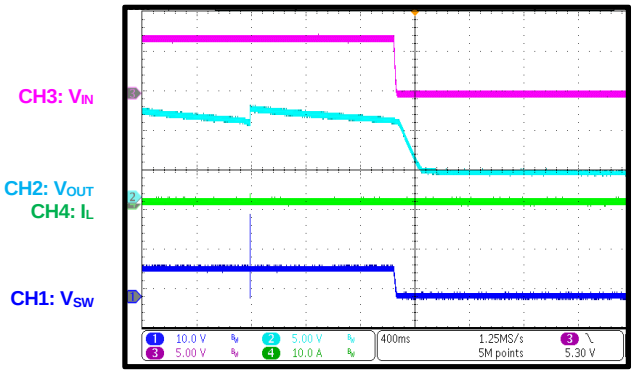
Shutdown through VIN

V_{IN} = 7V, FCCM, I_{OUT} = 0A



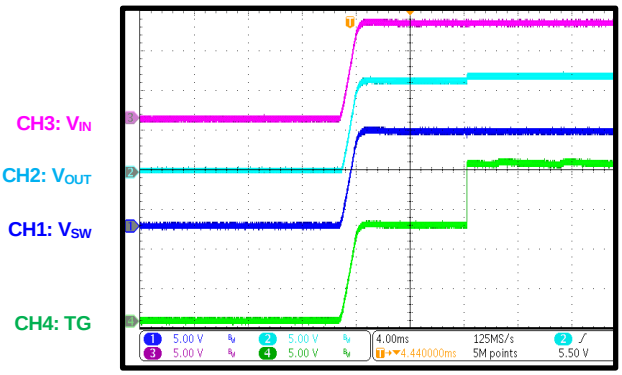
Shutdown through VIN

V_{IN} = 7V, DCM, I_{OUT} = 0A



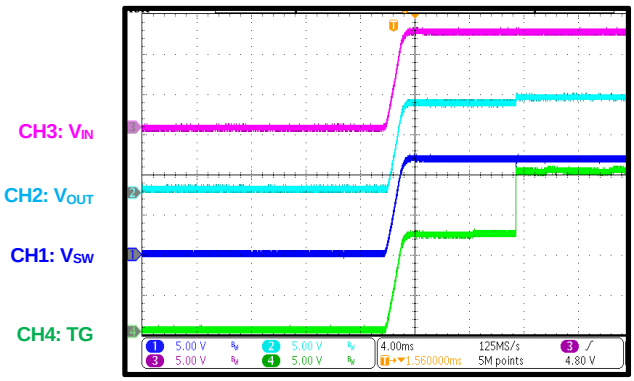
Start-Up through VIN

V_{IN} = 12V, I_{OUT} = 0A



Start-Up through VIN

V_{IN} = 12V, I_{OUT} = 5A



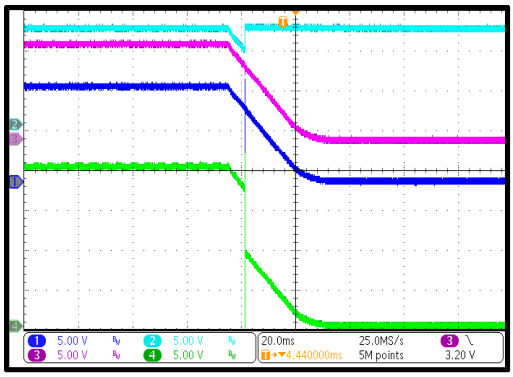
MPS Proprietary Information. Patent Protected. Unauthorized Photocopy and Duplication Prohibited.
© 2025 MPS. All Rights Reserved.

EVB TEST RESULTS *(continued)*

Performance curves and waveforms are tested on the evaluation board. V_{EN} = 5V, V_{IN} = 6V, V_{OUT} = 9V, L = 330nH, T_A = 25°C, unless otherwise noted.

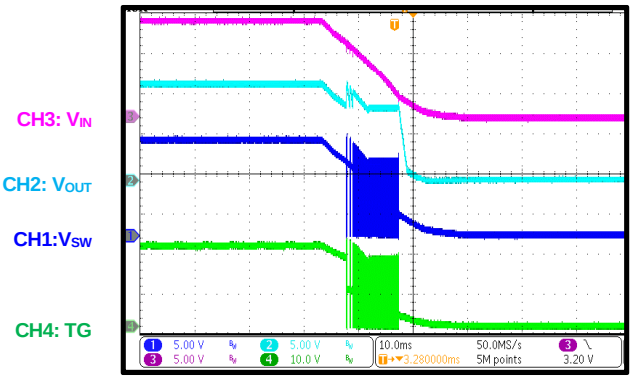
Shutdown through VIN

V_{IN} = 12V, I_{OUT} = 0A



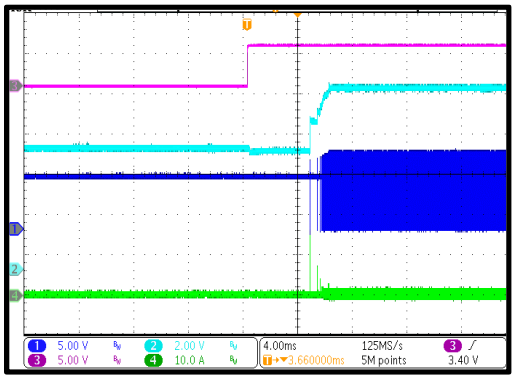
Shutdown through VIN

V_{IN} = 12V, I_{OUT} = 5A



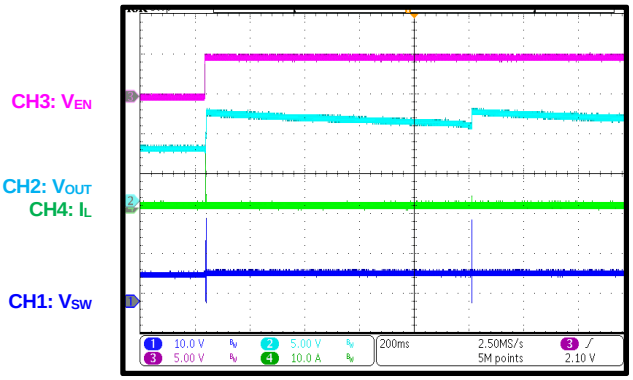
Start-Up through EN

V_{IN} = 7V, FCCM, I_{OUT} = 0A



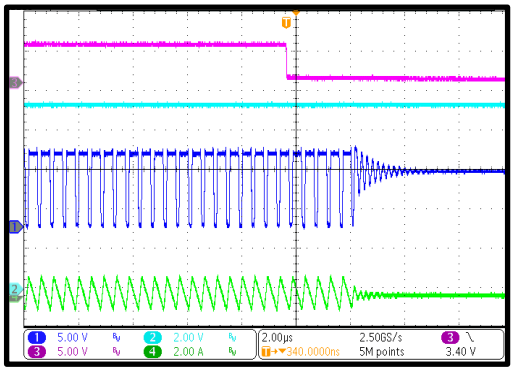
Start-Up through EN

V_{IN} = 7V, DCM, I_{OUT} = 0A



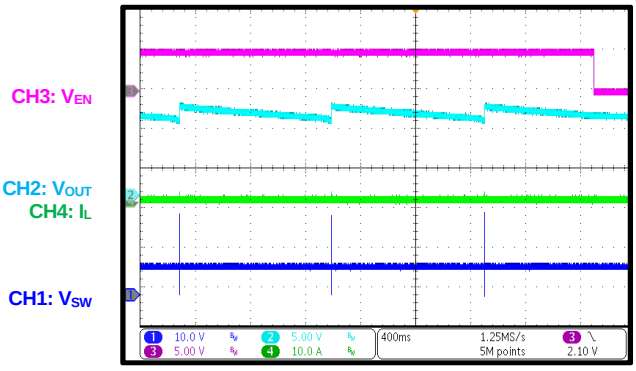
Shutdown through EN

V_{IN} = 7V, FCCM, I_{OUT} = 0A



Shutdown through EN

V_{IN} = 7V, DCM, I_{OUT} = 0A



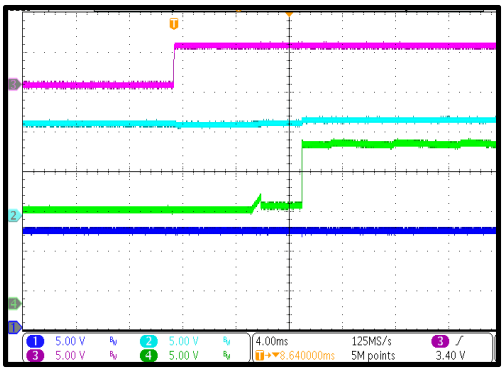
MPS Proprietary Information. Patent Protected. Unauthorized Photocopy and Duplication Prohibited.
© 2025 MPS. All Rights Reserved.

EVB TEST RESULTS *(continued)*

Performance curves and waveforms are tested on the evaluation board. V_{EN} = 5V, V_{IN} = 6V, V_{OUT} = 9V, L = 330nH, T_A = 25°C, unless otherwise noted.

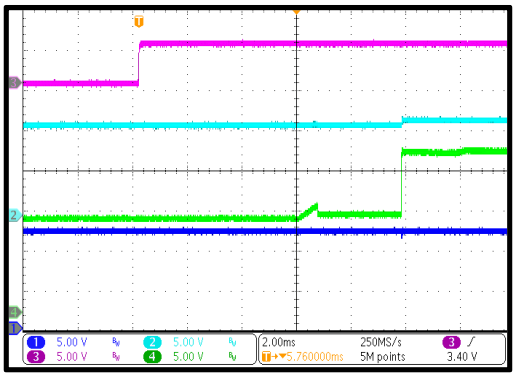
Start-Up through EN

V_{IN} = 12V, I_{OUT} = 0A



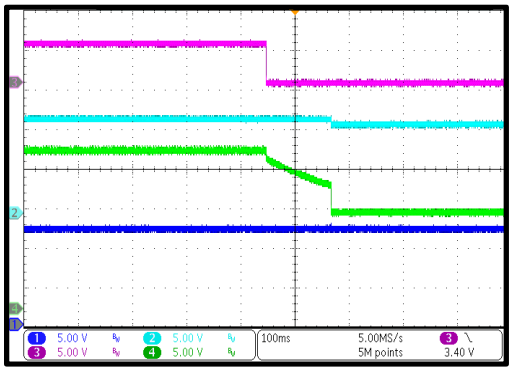
Start-Up through EN

V_{IN} = 12V, I_{OUT} = 5A



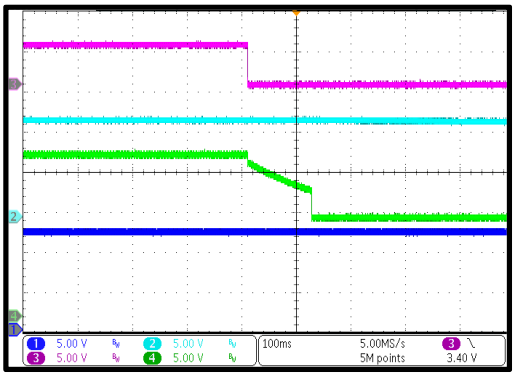
Shutdown through EN

V_{IN} = 12V, I_{OUT} = 0A



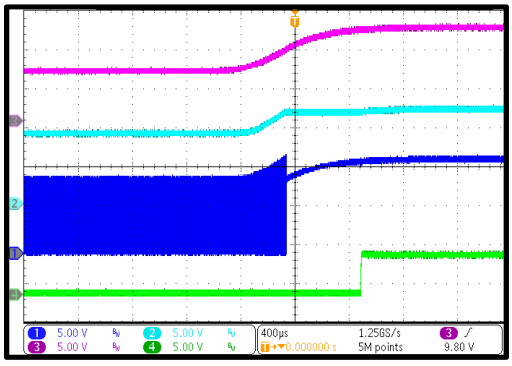
Shutdown through EN

V_{IN} = 12V, I_{OUT} = 5A



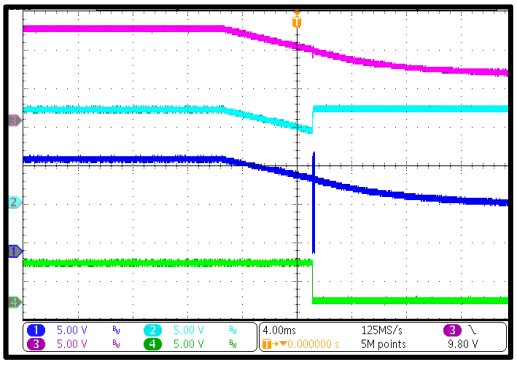
PG Performance for Status Function

V_{IN} = 7V to 12V, I_{OUT} = 0A



PG Performance for Status Function

V_{IN} = 12V to 7V, I_{OUT} = 0A



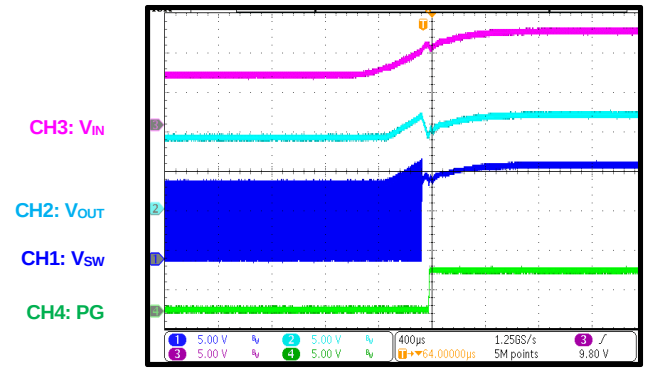
MPS Proprietary Information. Patent Protected. Unauthorized Photocopy and Duplication Prohibited.
© 2025 MPS. All Rights Reserved.

EVB TEST RESULTS *(continued)*

Performance curves and waveforms are tested on the evaluation board. V_{EN} = 5V, V_{IN} = 6V, V_{OUT} = 9V, L = 330nH, T_A = 25°C, unless otherwise noted.

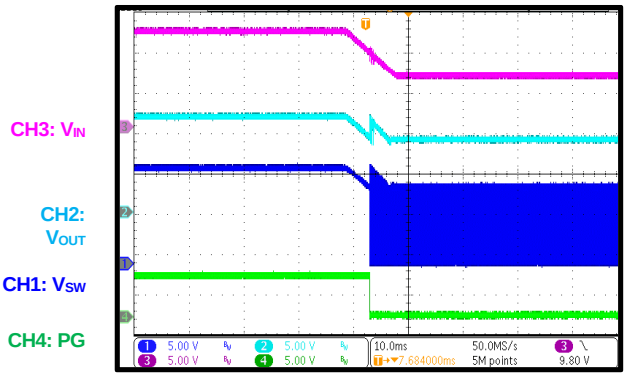
PG Performance for Status Function

V_{IN} = 7V to 12V, I_{OUT} = 5A



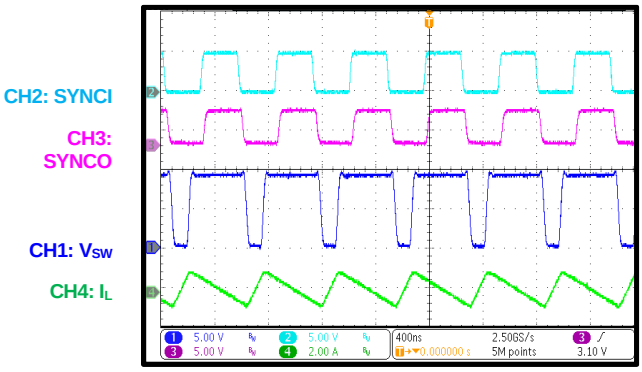
PG Performance for Status Function

V_{IN} = 12V to 7V, I_{OUT} = 5A



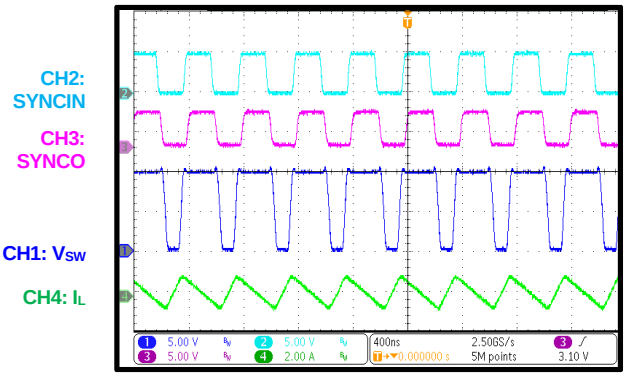
SYNCI and SYNCO Operation

V_{IN} = 7V, I_{OUT} = 0A, SYNCIN = 1.8MHz



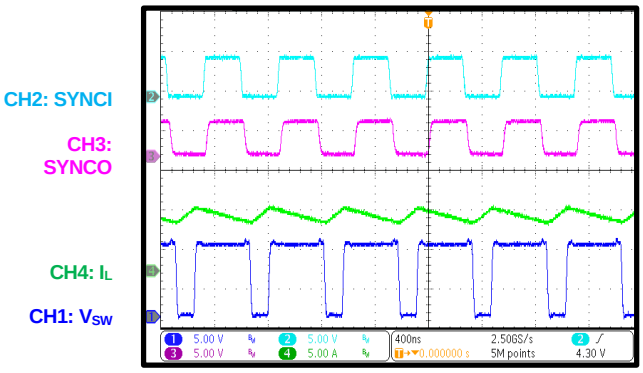
SYNCI and SYNCO Operation

V_{IN} = 7V, I_{OUT} = 0A, SYNCIN = 2.5MHz



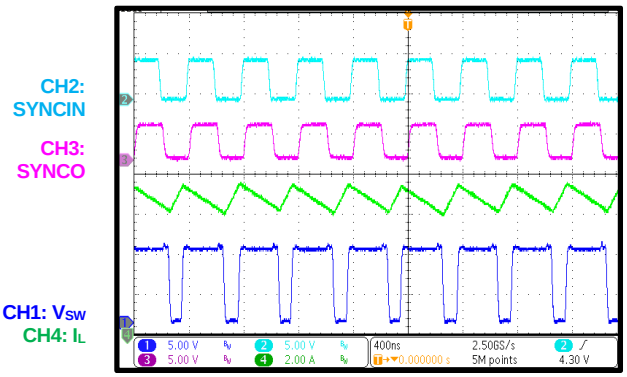
SYNCI and SYNCO Operation

V_{IN} = 7V, I_{OUT} = 5A, SYNCIN = 1.8MHz



SYNCI and SYNCO Operation

V_{IN} = 7V, I_{OUT} = 5A, SYNCIN = 2.5MHz



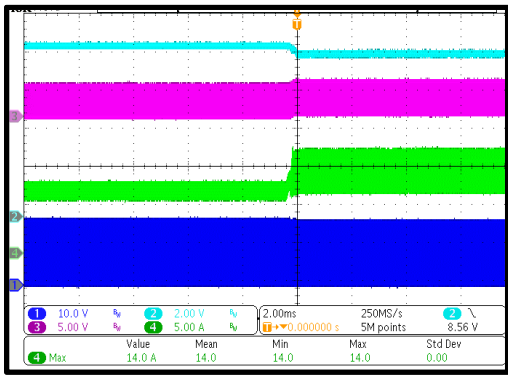
MPS Proprietary Information. Patent Protected. Unauthorized Photocopy and Duplication Prohibited.
© 2025 MPS. All Rights Reserved.

EVB TEST RESULTS *(continued)*

Performance curves and waveforms are tested on the evaluation board. V_{EN} = 5V, V_{IN} = 6V, V_{OUT} = 9V, L = 330nH, T_A = 25°C, unless otherwise noted.

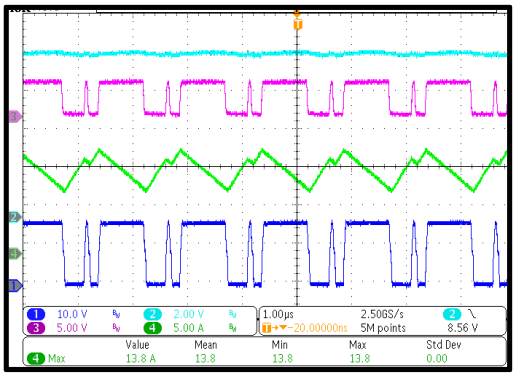
Over-Current Protection Entry

V_{IN} = 6V, I_{LIM} = 25mV, R_{SENSE} = 2mΩ,
I_{OUT} = 5A to 7A



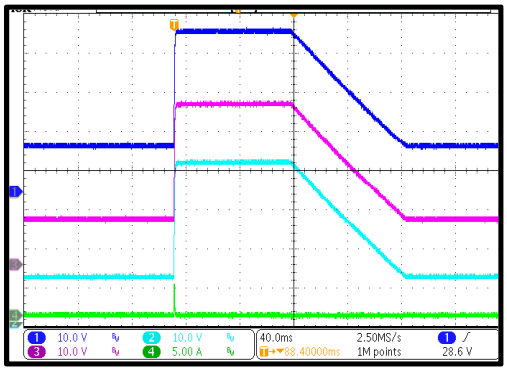
Over-Current Protection Steady State

V_{IN} = 6V, I_{LIM} = 25mV, R_{SENSE} = 2mΩ



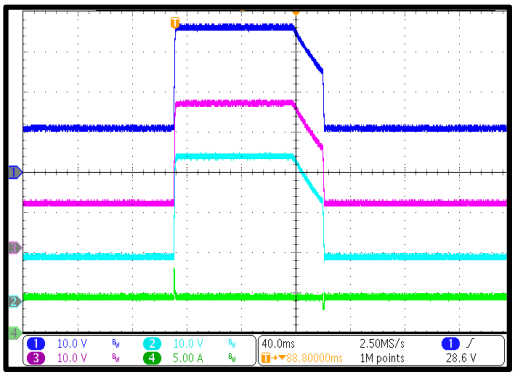
Load Dump

V_{IN} = 12V to 42V, I_{OUT} = 0.1A



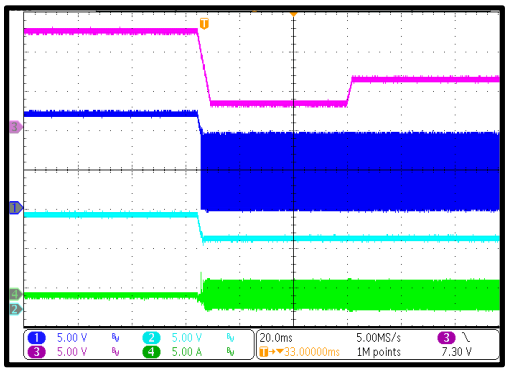
Load Dump

V_{IN} = 12V to 42V, I_{OUT} = 5A



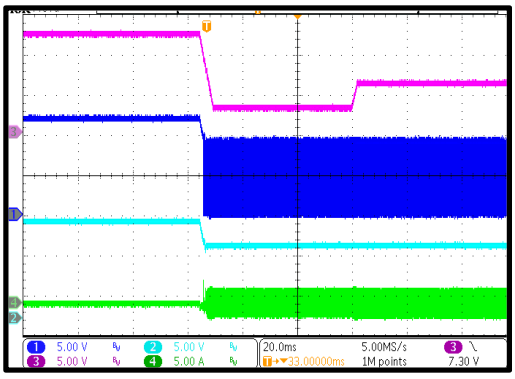
Cold Crank

V_{IN} = 12V to 2.9V to 6V, I_{OUT} = 0A



Cold Crank

V_{IN} = 12V to 2.9V to 6V, I_{OUT} = 3A



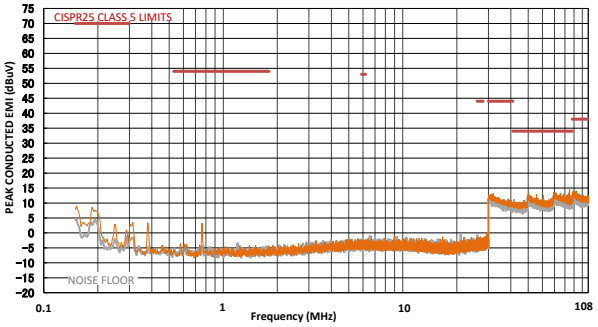
MPS Proprietary Information. Patent Protected. Unauthorized Photocopy and Duplication Prohibited.
© 2025 MPS. All Rights Reserved.

EVB TEST RESULTS *(continued)*

Performance curves and waveforms are tested on the evaluation board. V_{EN} = 5V, V_{IN} = 12V, V_{OUT} = 9V, L = 330nH, bypass mode, T_A = 25°C, unless otherwise noted.

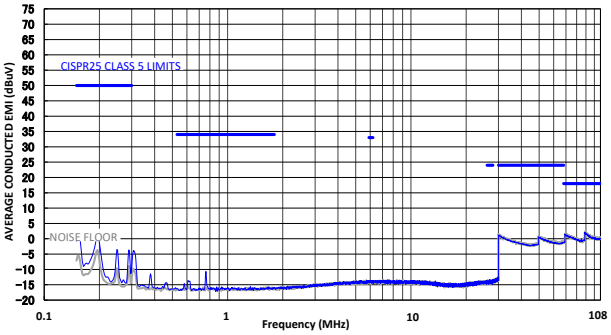
CISPR 25 Class 5 Peak Conducted Emissions

150kHz to 108MHz



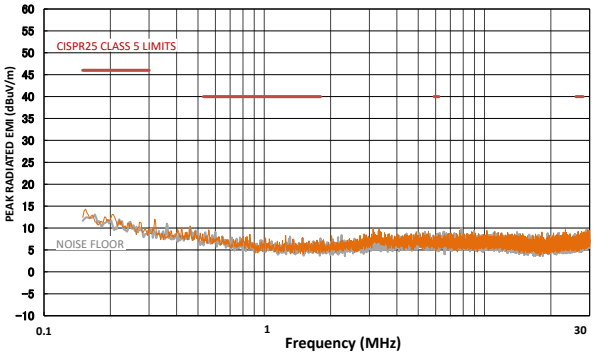
CISPR 25 Class 5 Average Conducted Emissions

150kHz to 108MHz



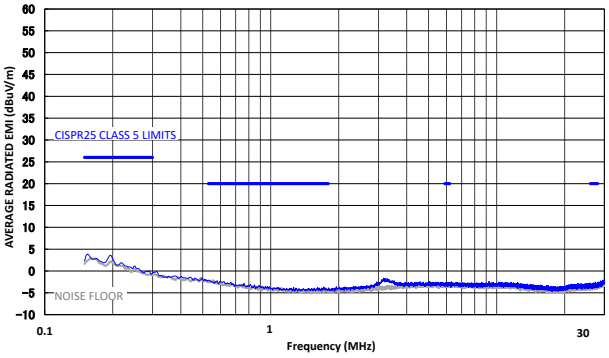
CISPR 25 Class 5 Peak Radiated Emissions

150kHz to 30MHz



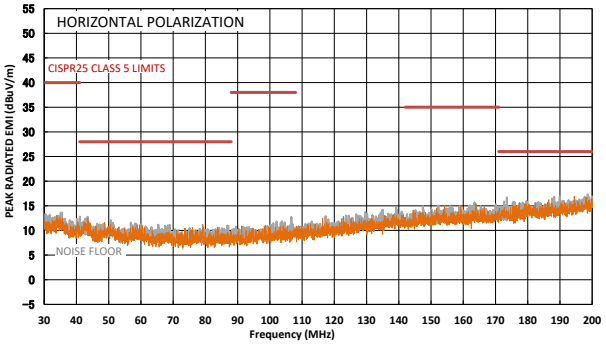
CISPR 25 Class 5 Average Radiated Emissions

150kHz to 30MHz



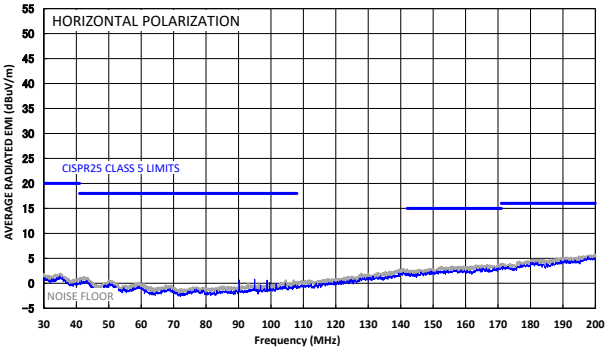
CISPR 25 Class 5 Peak Radiated Emissions

Horizontal, 30MHz to 200MHz



CISPR 25 Class 5 Average Radiated Emissions

Horizontal, 30MHz to 200MHz



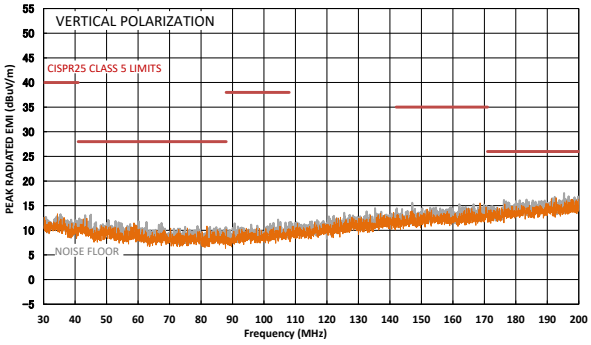
MPS Proprietary Information. Patent Protected. Unauthorized Photocopy and Duplication Prohibited.
© 2025 MPS. All Rights Reserved.

EVB TEST RESULTS *(continued)*

Performance curves and waveforms are tested on the evaluation board. V_{EN} = 5V, V_{IN} = 12V, V_{OUT} = 9V, L = 330nH, bypass mode, T_A = 25°C, unless otherwise noted.

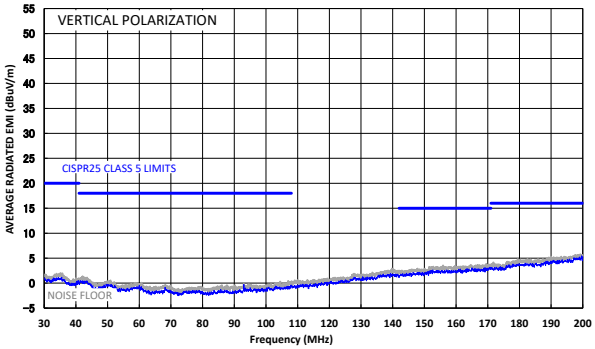
CISPR 25 Class 5 Peak Radiated Emissions

Vertical, 30MHz to 200MHz



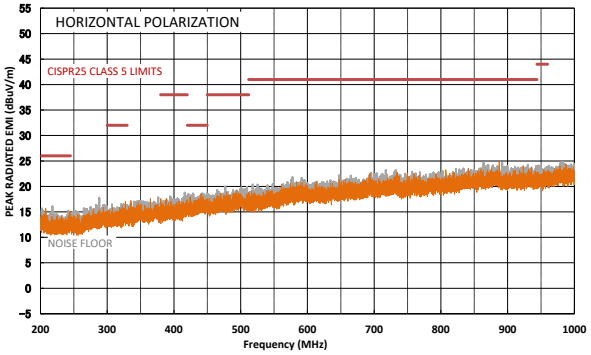
CISPR 25 Class 5 Average Radiated Emissions

Vertical, 30MHz to 200MHz



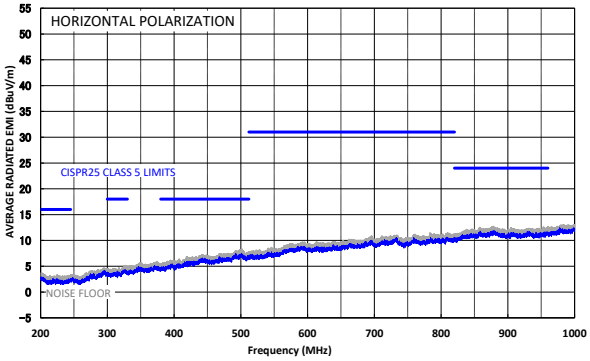
CISPR 25 Class 5 Peak Radiated Emissions

Horizontal, 200MHz to 1GHz



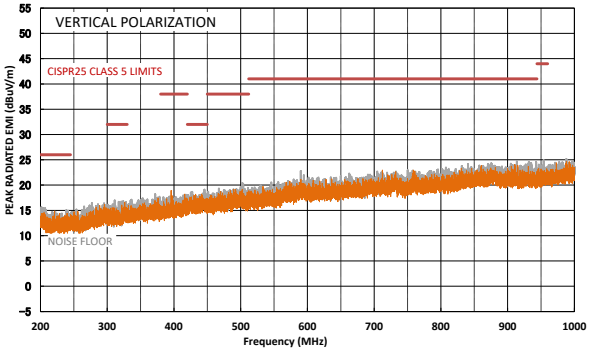
CISPR 25 Class 5 Average Radiated Emissions

Horizontal, 200MHz to 1GHz



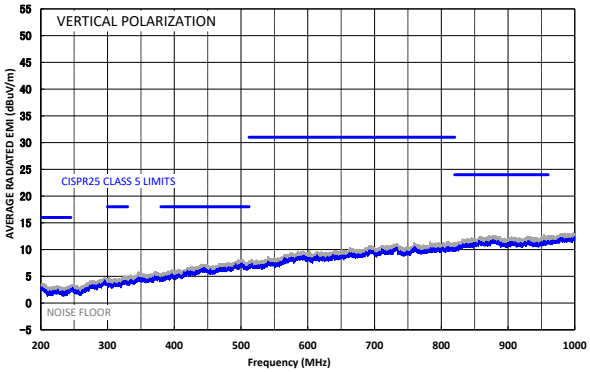
CISPR 25 Class 5 Peak Radiated Emissions

Vertical, 200MHz to 1GHz



CISPR 25 Class 5 Average Radiated Emissions

Vertical, 200MHz to 1GHz



MPS Proprietary Information. Patent Protected. Unauthorized Photocopy and Duplication Prohibited.
© 2025 MPS. All Rights Reserved.

PCB LAYOUT (5)

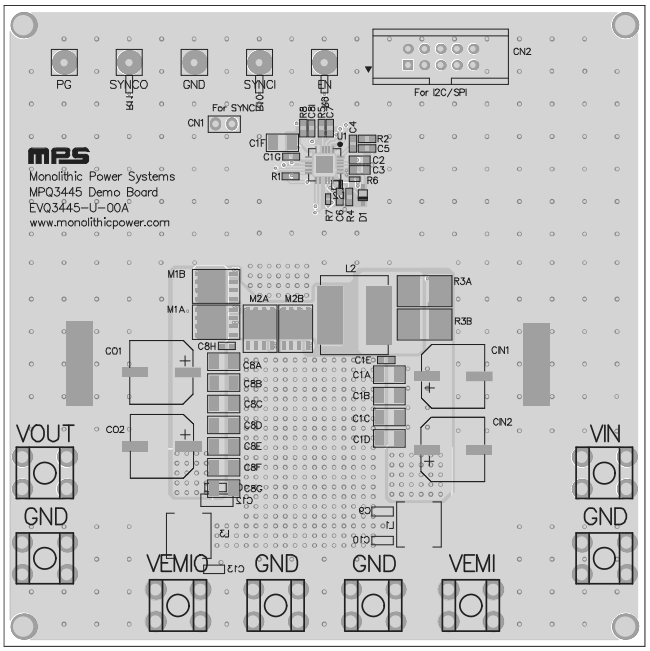


Figure 4: Top Silk and Top Layer

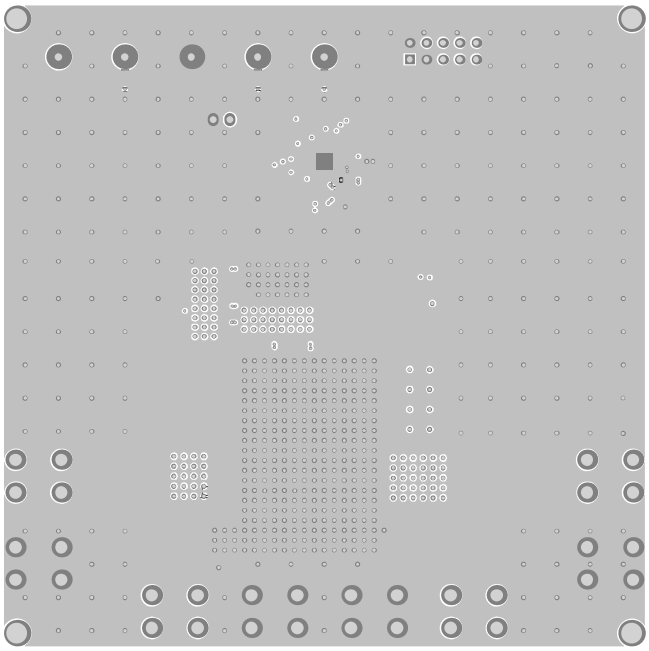


Figure 5: Mid-Layer 1

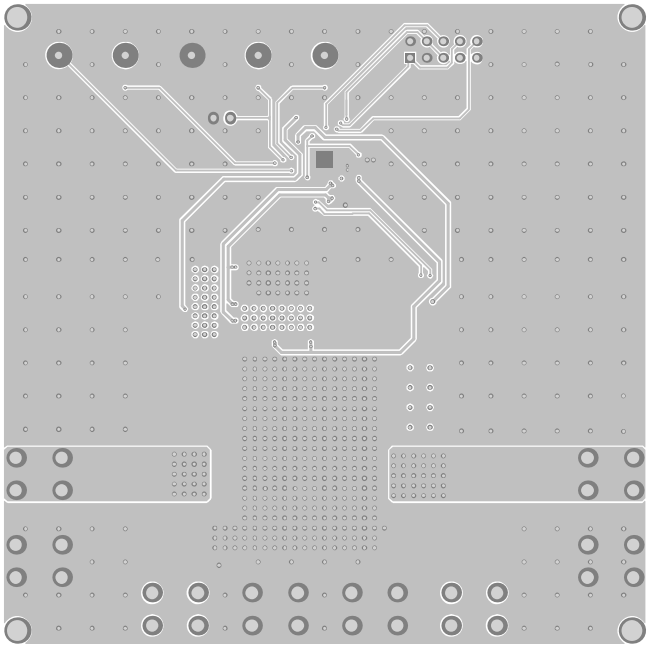


Figure 6: Mid-Layer 2

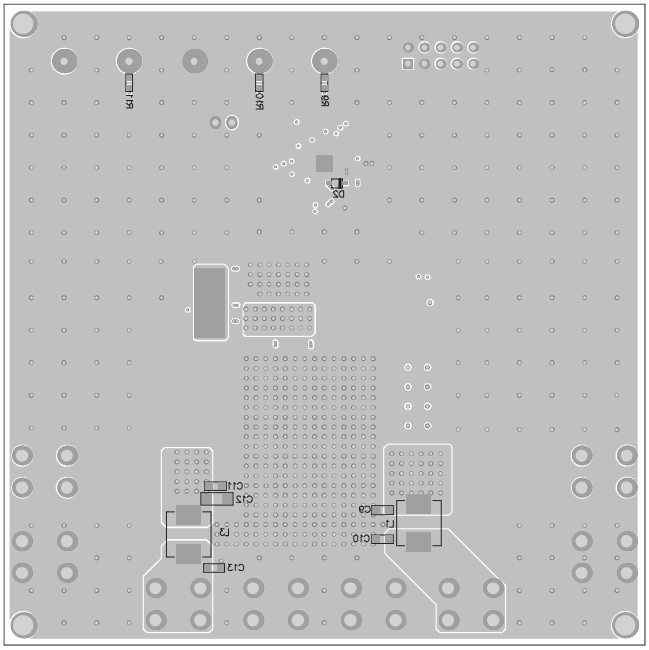


Figure 7: Bottom Layer

Note:

5) The copper thickness is 2oz.

MPS Proprietary Information. Patent Protected. Unauthorized Photocopy and Duplication Prohibited.
© 2025 MPS. All Rights Reserved.

REVISION HISTORY

Revision #	Revision Date	Description	Pages Updated
1.0	9/10/2025	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.
© 2025 MPS. All Rights Reserved.