EVM54304-MN-01A

4V to 16V Input, Four-Channel Output Power Module with an I²C Interface and MTP Evaluation Board

DESCRIPTION

The EVM54304-MN-01A is an evaluation board designed to demonstrate the capabilities of the MPM54304, a four-channel output power module with an I²C interface. Channels 1 and 2 can deliver up to 3A (or a shared 6A) of continuous output current. Channels 3 and 4 can deliver up to 2A (or a shared 4A) of continuous output current. The MPM54304 integrates four high-efficiency, step-down DC/DC converters, four inductors, and an I²C interface.

Channels 1 and 2 can be paralleled to provide up to 6A of output current. Channels 3 and 4 can be paralleled to provide up to 4A of output current. The MPM54304 features constant-on-time (COT) control to provide fast load transient response.

The output voltage (V_{OUT}) can be configured via the I²C bus or preset two times by the multiple-time programmable (MTP) e-fuse. V_{OUT} can also be adjusted via the external resistor divider. When V_{OUT} is set via the resistor divider, each channel's soft-start time is the same. The start-up and shutdown sequences are configurable via the MTP.

The MPM54304 requires a minimal number of external components, and is available in a space-saving LGA (7mmx7mmx2mm) package.

ELECTRICAL SPECIFICATIONS

Parameter	Symbol	Value	Units
Input voltage	V_{IN}	12	V
Output voltage (channels 1, 2, 3, and 4)	V_{OUT}	1, 3.3, 1.8, 1.5 (1)	V
Output current (channels 1, 2, 3, and 4)	I_{OUT}	3, 3, 1, 1 (2)	A

Notes:

1) The evaluation board's default voltage value can be configured by the I²C.
2) The output current can also be set to 3A, 2A, 2A, 2A.

FEATURES

- 4V to 16V Operating Input Voltage Range
- Wide Output Voltage Range
- 0.55V to 5.4V Configurable I²C Interface
- 0.6V to 7V or V_{IN} x D_{MAX} (If V_{IN} Exceeds 7V) External Resistor Divider
- Continuous Output Current (I_{OUT})
  - Channels 1 and 2: 3A, Shared 6A
  - Channels 3 and 4: 2A, Shared 4A
- Interleaved Operation
- Configurable, Multi-Functional GPIO Pin
- I²C Interface and Configurable Parameters
  - Paralleled Channels 1 and 2
  - Paralleled Channels 3 and 4
  - Switching Frequency (f_{sw})
  - Output Voltage (V_{OUT})
  - Over-Current Protection (OCP) Threshold
  - Over-Voltage Protection (OVP) Threshold
  - Start-Up and Shutdown Sequencing
  - Forced Pulse-Width Modulation (PWM), Auto-PWM, and Auto-Pulse Frequency Modulation (Auto-PFM) Modes
- Preset to MPM54304GMN-0000 Configuration
- Available in an LGA (7mmx7mmx2mm) Package

APPLICATIONS

- Field-Programmable Gate Arrays (FPGAs)
- Multi-Rail Power Systems
- Microcontroller (MCU) Power Supplies
- Digital Signal Processors (DSPs)

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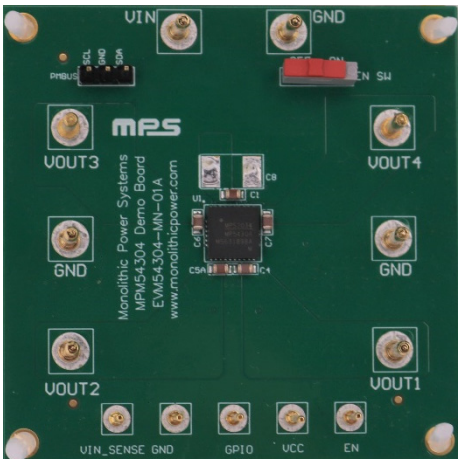
EVM54304-MN-01A EVALUATION BOARD

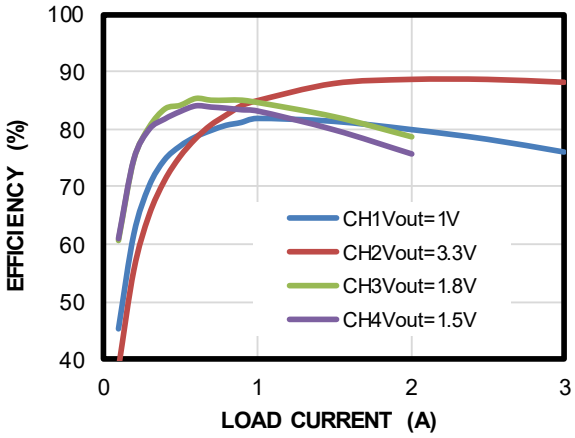


LxW (63.5mmx63.5mm)

Board Number	MPS IC Number
EVM54304-MN-01A	MPM54304GMN-0000

Efficiency vs. Load Current

V_{IN} = 12V



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QUICK START GUIDE

1. Preset the power supply to 12V, then turn off the power supply.
2. Connect the power supply terminals to:
   a. Positive (+): VIN
   b. Negative (-): GND
3. Connect VOUT1, VOUT2, VOUT3, VOUT4, and GND to the load terminals:
   a. Positive (+): VOUT1, VOUT2, VOUT3, and VOUT4
   b. Negative (-): GND
4. After making the connections, turn on the power supply and the EN switch. The board should automatically start up.
5. To configure the I^2C interface:
   a. Connect the SCL, SDA, and GND pins to the I^2C start kit board.
   b. Connect the I^2C start kit board to a PC.
   c. Run the MPM54304 GUI software to program the MPM54304 I^2C registers. (3)

Notes:

3) The GUI software can be downloaded from the MPS website.

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EVALUATION BOARD SCHEMATIC

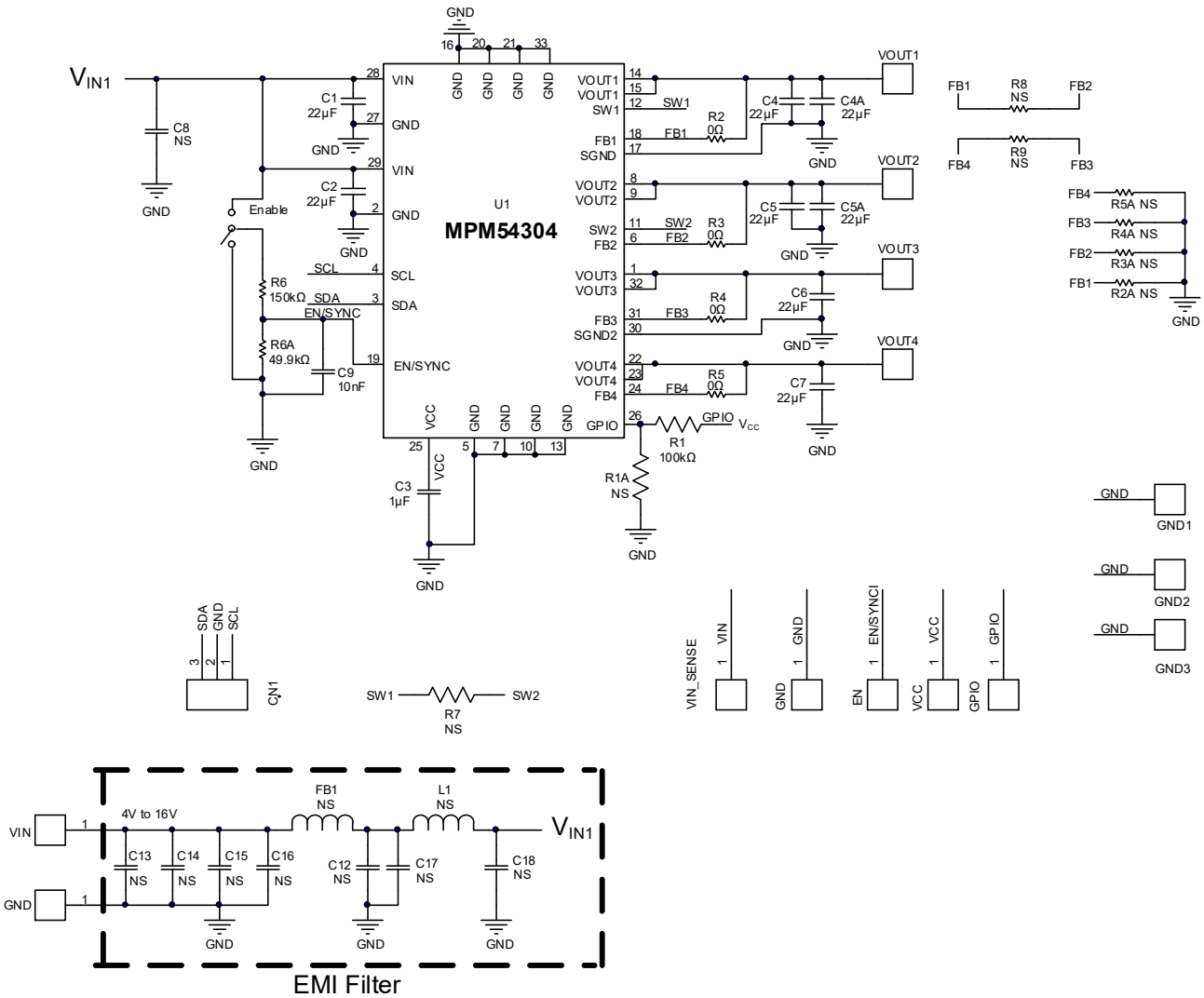

Figure 1: Evaluation Board Schematic

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EVM54304-MN-01A BILL OF MATERIALS

Qty	Ref	Value	Description	Package	Manufacturer	Manufacturer PN
8	C1, C2, C4, C5, C6, C7, C4A, C5A	22µF	Ceramic capacitor, 25V, X5R	0805	Murata	GRM21BR61E226ME44L
1	C3	1µF	Ceramic capacitor, 16V, X6S	0402	Murata	GRM155C81C105KE11D
1	C9	10nF	Ceramic capacitor, 16V, X7R	0402	Murata	GRM155R71C103KA01D
1	R6	150kΩ	Film resistor, 1%	0603	Yageo	RC0603FR-07150KL
1	R6A	49.9kΩ	Film resistor, 1%	0603	Yageo	RC0603FR-0749K9L
4	R2, R3, R4, R5	0Ω	Film resistor, 1%	0603	Yageo	RC0603FR-070RL
1	R1	100kΩ	Film resistor, 1%	0402	Yageo	RC0402FR-07100KL
1	PMBus		3 pins, 1 row, straight	DIP	Wurth	61300311121
1	Switch		Tact switch, on-on, vertical type, through hole technology, bulk	DIP	Wurth	450301014042
1	U1	MPM54304	PMIC module	LGA (7mmx 7mmx2mm)	MPS	MPM54304GMN-0000

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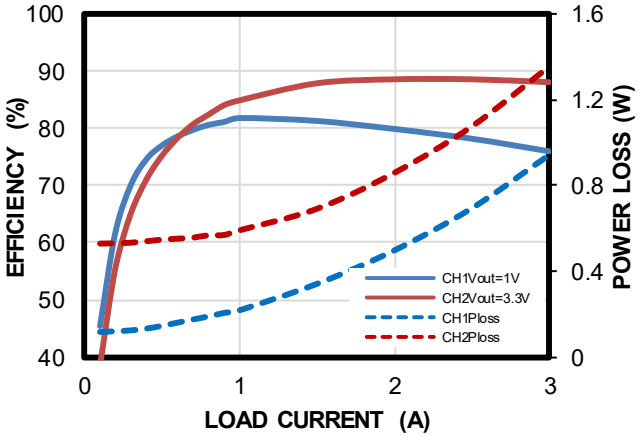
EVB TEST RESULTS

Performance curves and waveforms are tested on the evaluation board. V_{IN} = 12V, V_{OUT1} = 1V, V_{OUT2} = 3.3V, V_{OUT3} = 1.8V, V_{OUT4} = 1.5V, f_{SW} = 800kHz, T_A = 25°C, continuous conduction mode (CCM), unless otherwise noted.

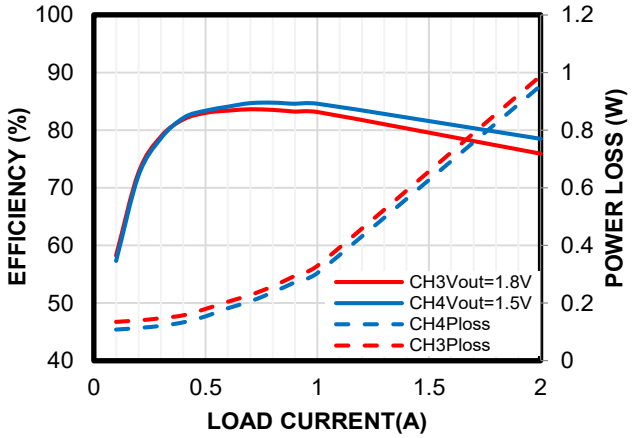
Efficiency vs. Load Current vs. Power Loss

V_{IN} = 12V



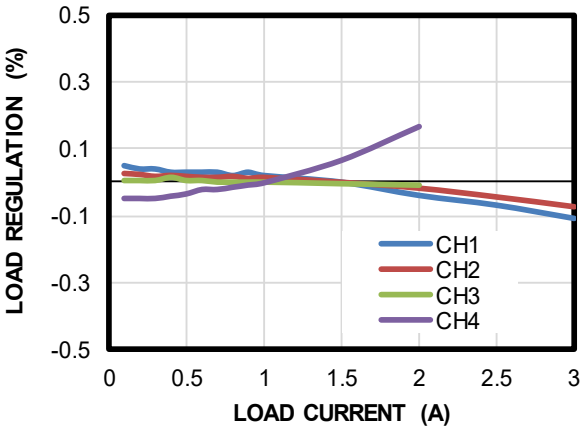
Efficiency vs. Load Current

V_{IN} = 12V

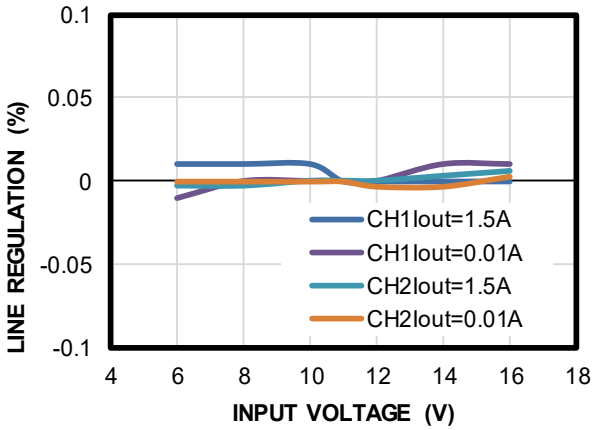


Load Regulation vs. Load Current

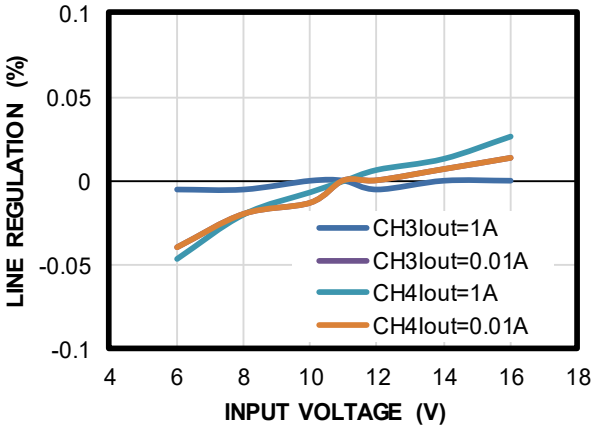
V_{IN} = 12V



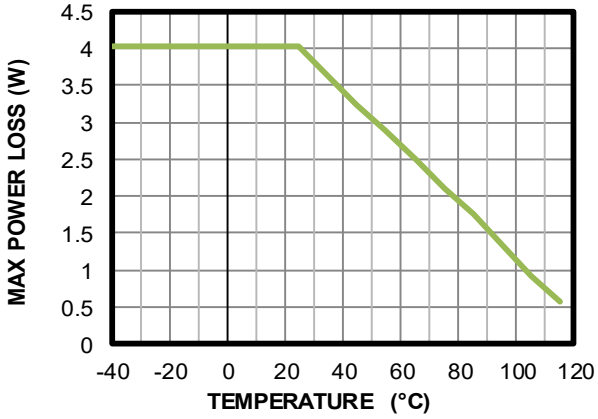
Line Regulation vs. Input Voltage



Line Regulation vs. Input Voltage



Max Power Loss vs. Temperature



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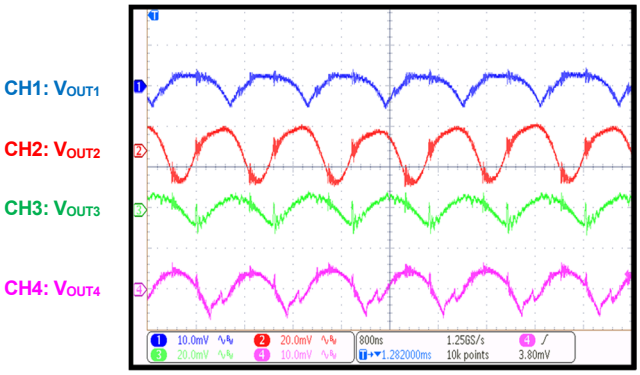
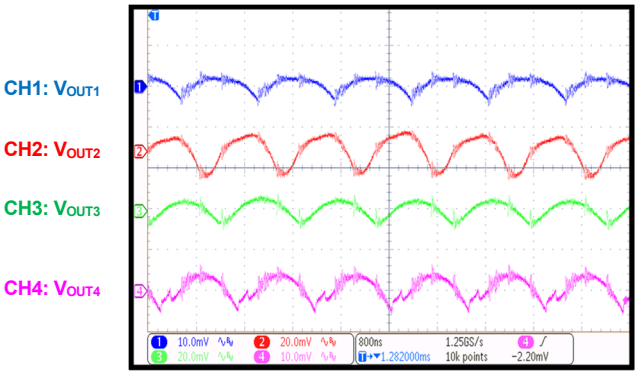
EVB TEST RESULTS *(continued)*

Performance curves and waveforms are tested on the evaluation board. V_{IN} = 12V, V_{OUT1} = 1V, V_{OUT2} = 3.3V, V_{OUT3} = 1.8V, V_{OUT4} = 1.5V, f_{SW} = 800kHz, T_A = 25°C, CCM mode, unless otherwise noted.

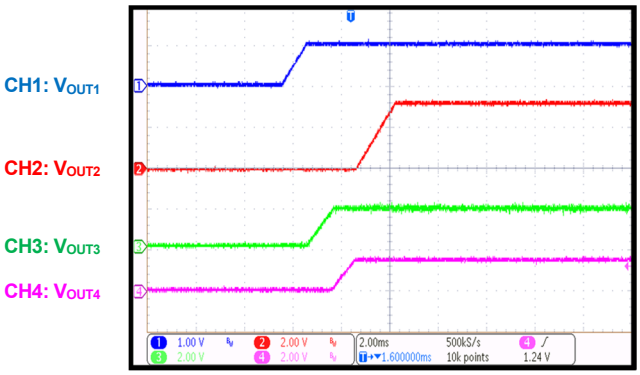
Steady State
Full load



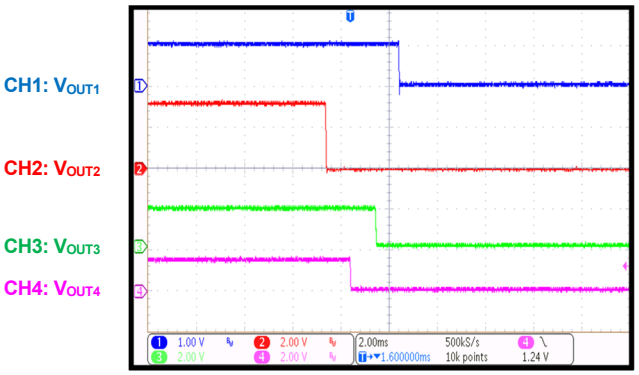
Steady State
No load



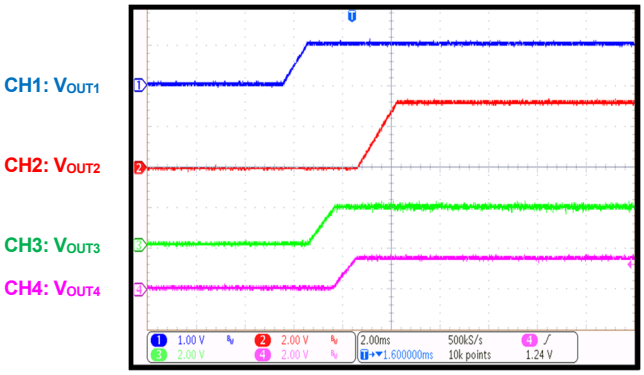
Start-Up through EN
Full load



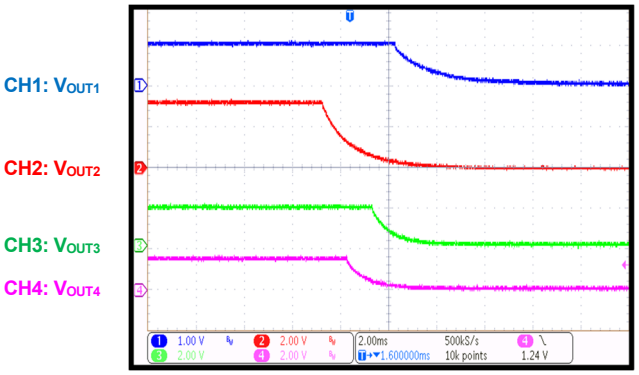
Shutdown through EN
Full load



Start-Up through EN
No load



Shutdown through EN
No load



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EVB TEST RESULTS *(continued)*

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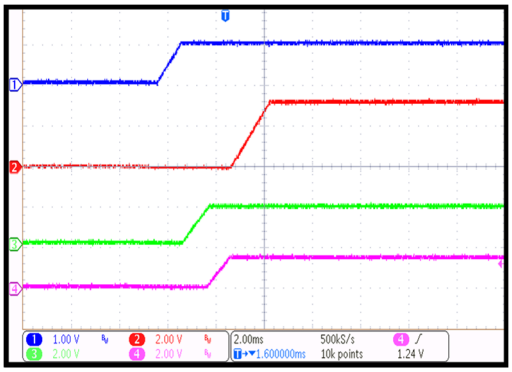
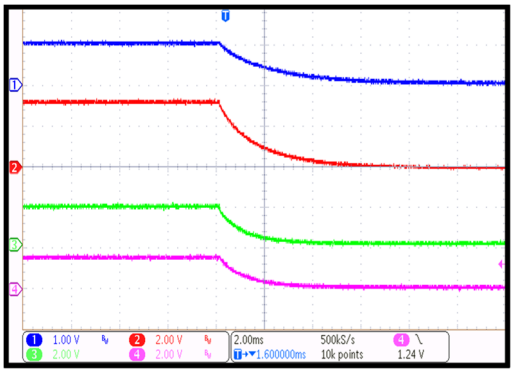
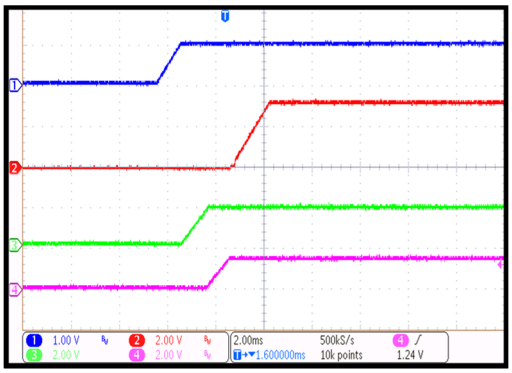
Start-Up through VIN
No load



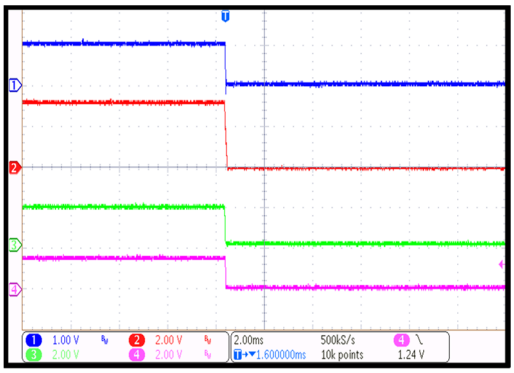
Shutdown through VIN
No load



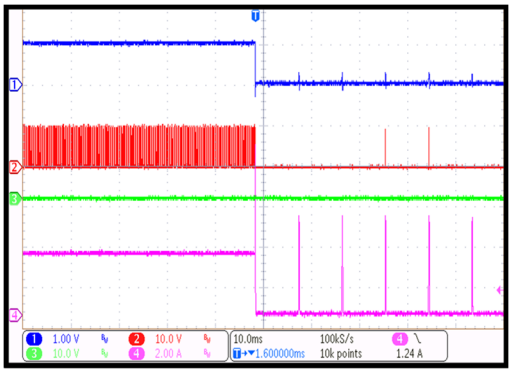
Start-Up through VIN
With load



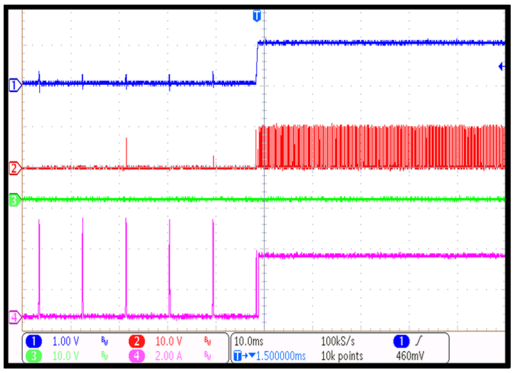
Shutdown through VIN
With load



SCP Entry
With load



SCP Recovery
Full load



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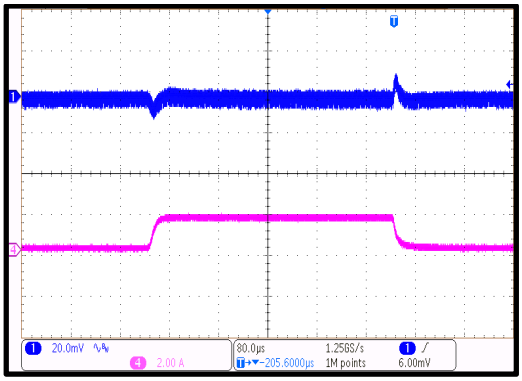
EVB TEST RESULTS *(continued)*

Performance curves and waveforms are tested on the evaluation board. V_{IN} = 12V, V_{OUT1} = 1V, V_{OUT2} = 3.3V, V_{OUT3} = 1.8V, V_{OUT4} = 1.5V, f_{SW} = 800kHz, T_A = 25°C, CCM mode, unless otherwise noted.

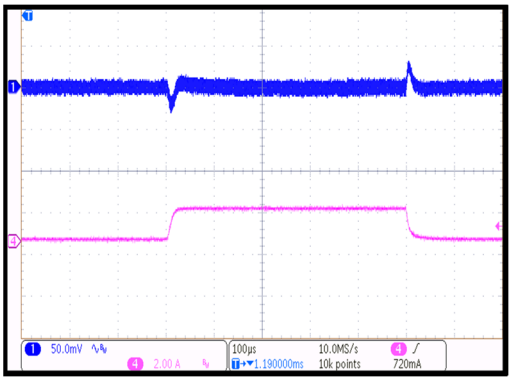
Load Transient
0A to 1.5A

CH1: V_{OUT1}
CH4: I_{OUT1}



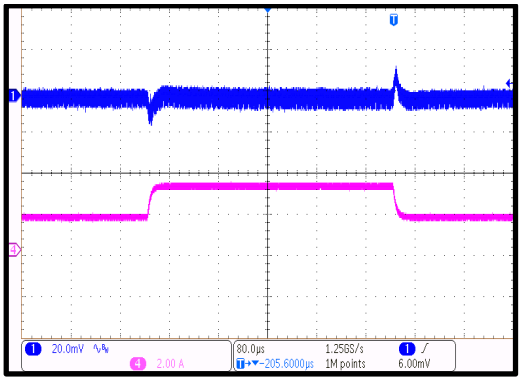
Load Transient
0A to 1.5A

CH1: V_{OUT2}
CH4: I_{OUT2}



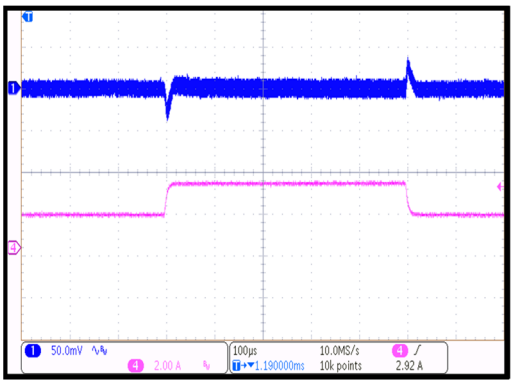
Load Transient
1.5A to 3A

CH1: V_{OUT1}
CH4: I_{OUT1}



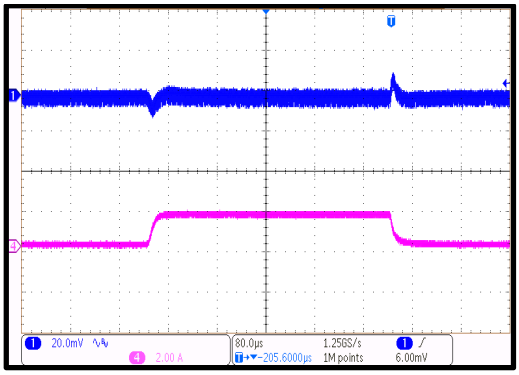
Load Transient
1.5A to 3A

CH1: V_{OUT2}
CH4: I_{OUT2}



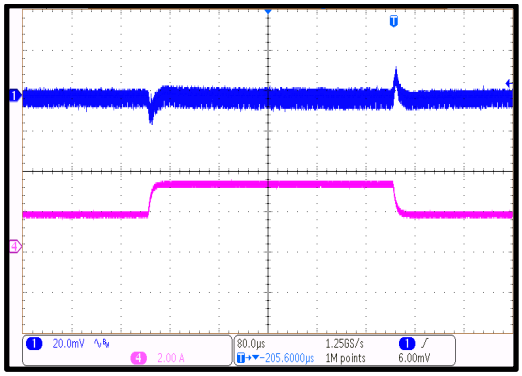
Load Transient
0A to 1A

CH1: V_{OUT3}
CH4: I_{OUT3}



Load Transient
0A to 1A

CH1: V_{OUT4}
CH4: I_{OUT4}



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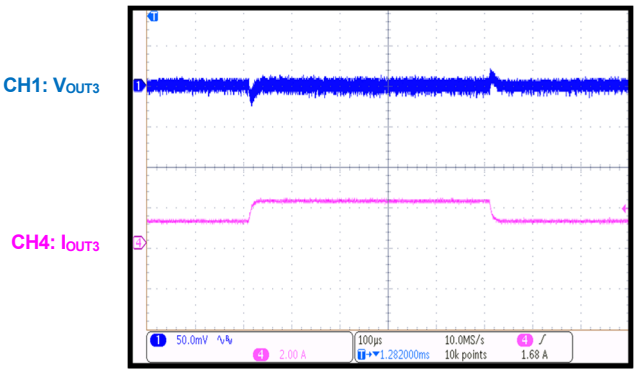
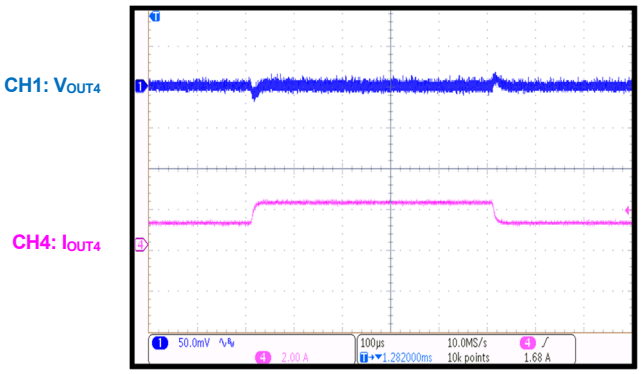
EVB TEST RESULTS *(continued)*

Performance curves and waveforms are tested on the evaluation board. V_{IN} = 12V, V_{OUT1} = 1V, V_{OUT2} = 3.3V, V_{OUT3} = 1.8V, V_{OUT4} = 1.5V, f_{SW} = 800kHz, T_A = 25°C, CCM mode, unless otherwise noted.

Load Transient
1A to 2A



Load Transient
1A to 2A



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PCB LAYOUT

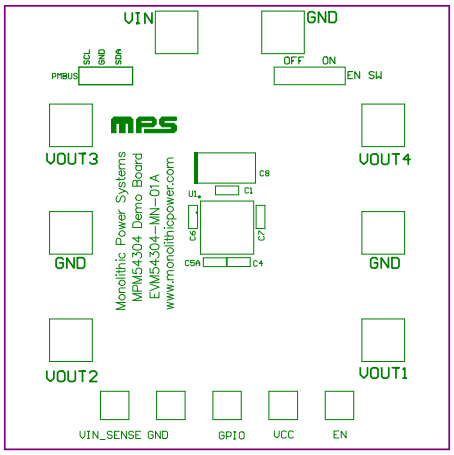

Figure 2: Top Silk

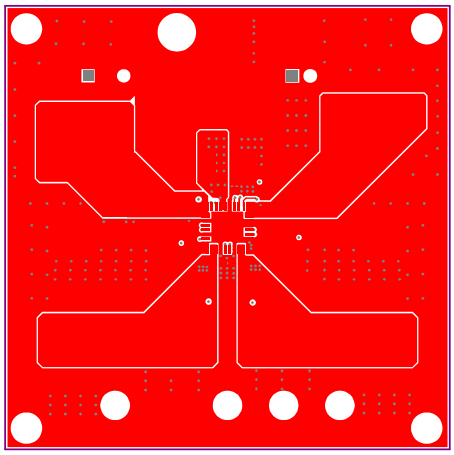

Figure 3: Top Layer

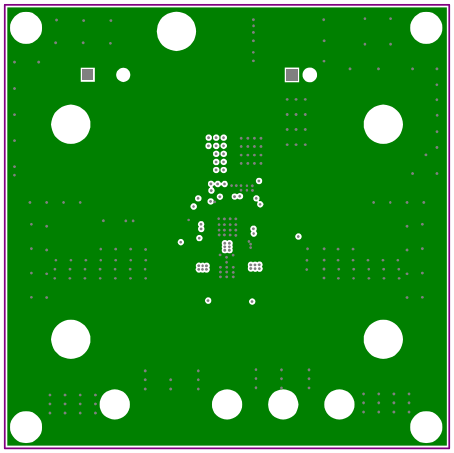

Figure 4: Mid-Layer 1

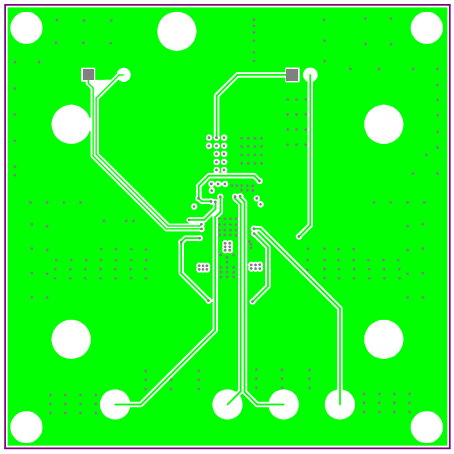

Figure 5: Mid-Layer 2

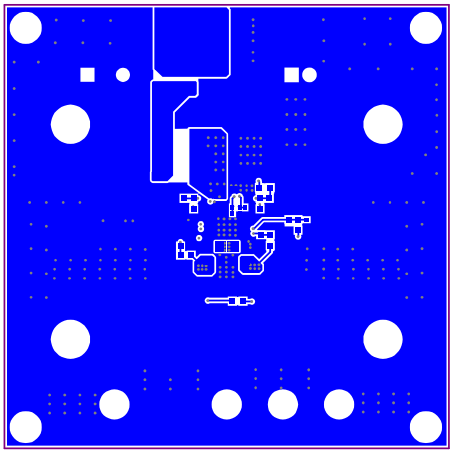

Figure 6: Bottom Layer

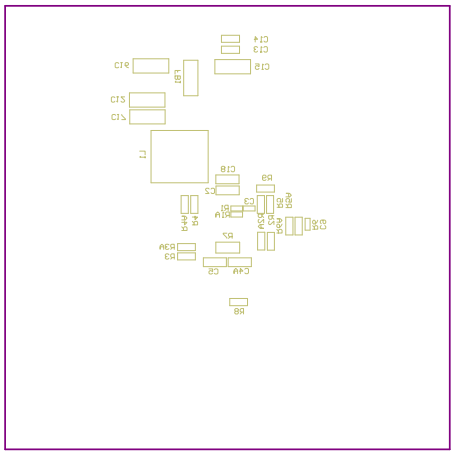

Figure 7: Bottom Silk

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REVISION HISTORY

Revision #	Revision Date	Description	Pages Updated
1.0	3/12/2021	Initial Release	-

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