# 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.

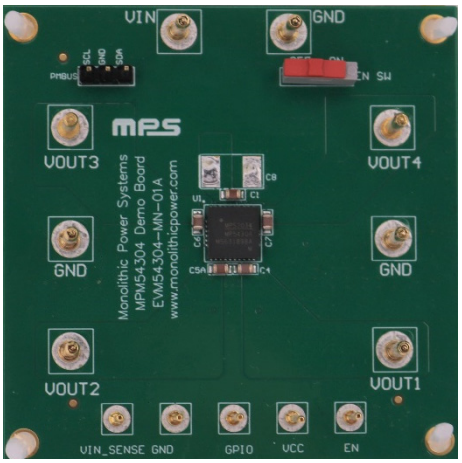
## FEATURES

- 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

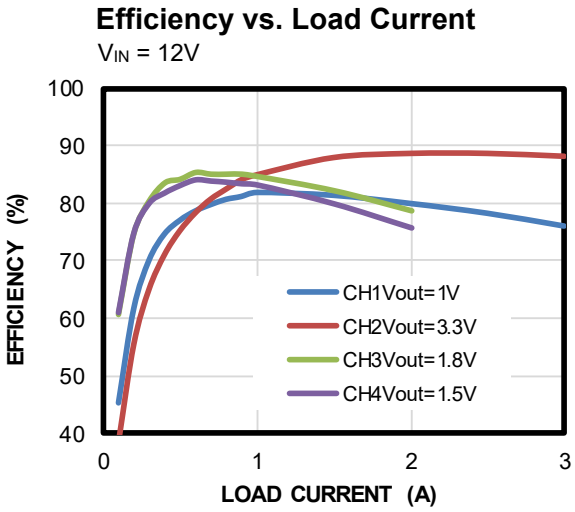
- Field-Programmable Gate Arrays (FPGAs)
- Multi-Rail Power Systems
- Microcontroller (MCU) Power Supplies
- Digital Signal Processors (DSPs)

# EVM54304-MN-01A EVALUATION BOARD




**LxW (63.5mmx63.5mm)**

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



## 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 I²C interface:
   a. Connect the SCL, SDA, and GND pins to the I²C start kit board.
   b. Connect the I²C start kit board to a PC.
   c. Run the MPM54304 GUI software to program the MPM54304 I²C registers. (3)

**Notes:**

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

# EVALUATION BOARD SCHEMATIC

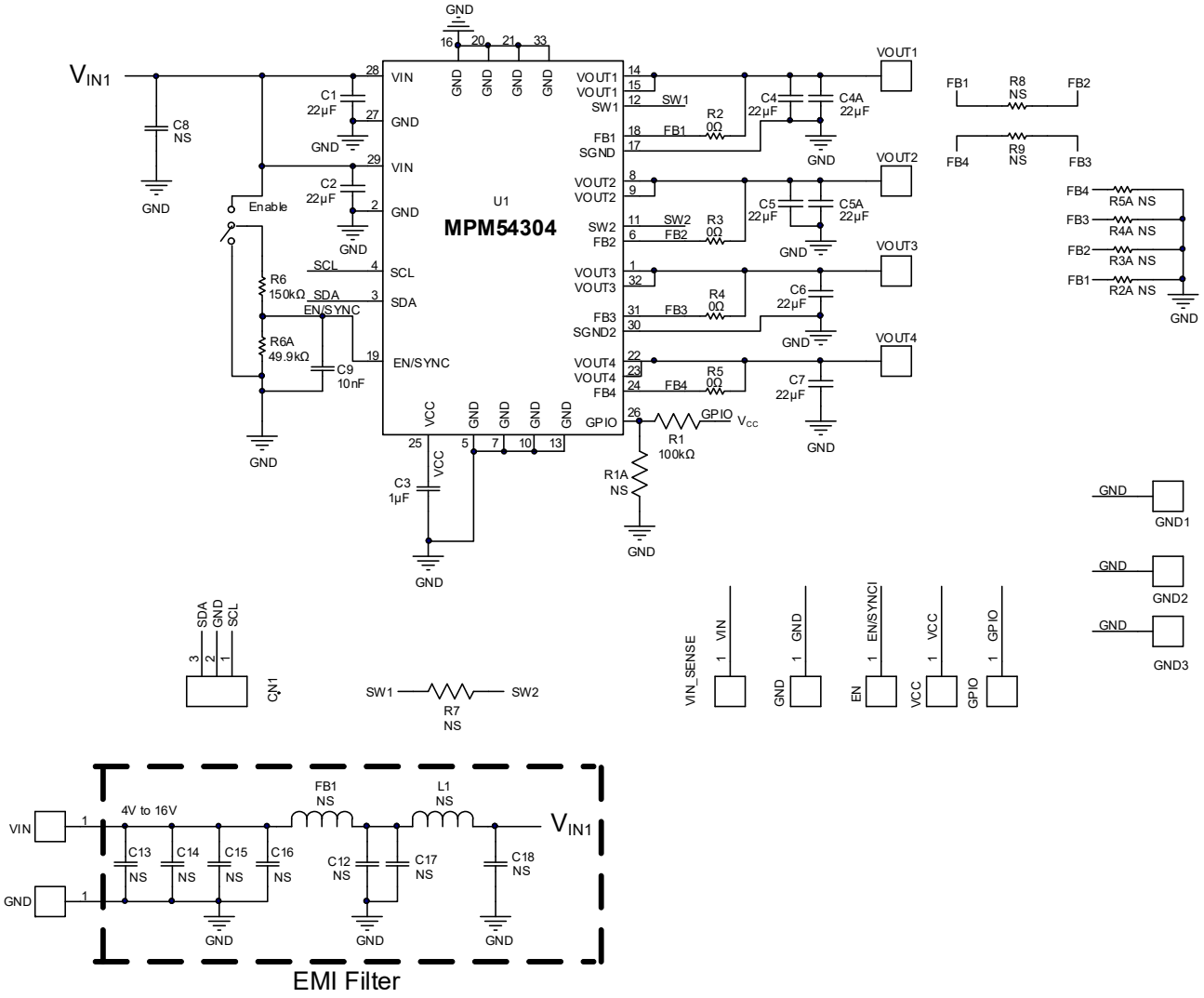



**Figure 1: Evaluation Board Schematic**

## EVM54304-MN-01A BILL OF MATERIALS

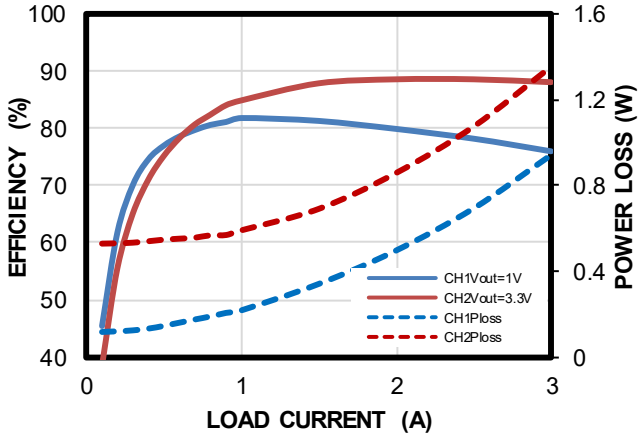
| Qty | Ref | Value | Description | Package | Manufacturer | Manufacturer PN |
|---|---|---|---|---|---|---|
| 8 | C1, C2, C4, C5, C6, C7, C4A, C5A | 22µF | Ceramic capacitor, 25V, X5R | 0805 | Murata | GRM21BR61E226ME44L |
| 1 | C3 | 1µF | Ceramic capacitor, 16V, X6S | 0402 | Murata | GRM155C81C105KE11D |
| 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 |

## 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.**

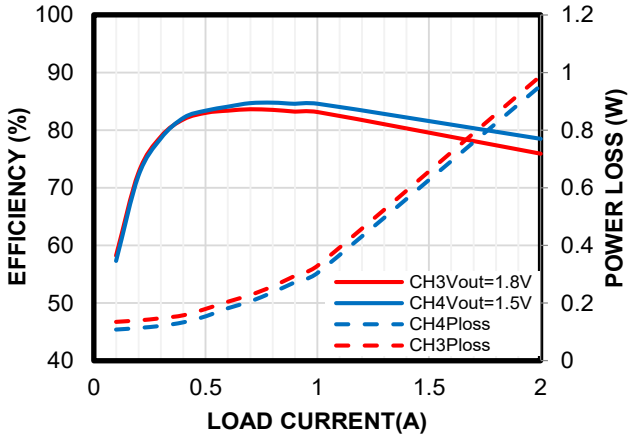
**Efficiency vs. Load Current vs. Power Loss**

$V_{IN}$ = 12V



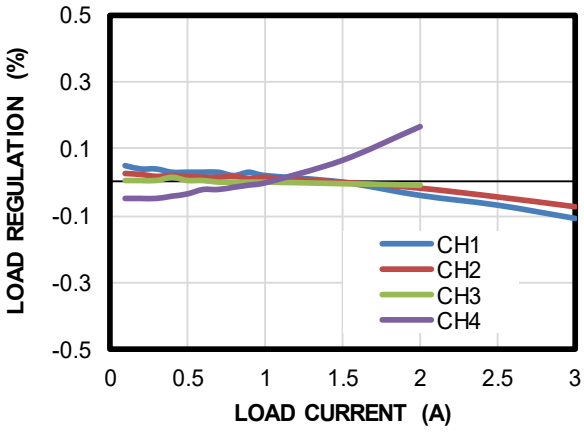

**Efficiency vs. Load Current**

$V_{IN}$ = 12V

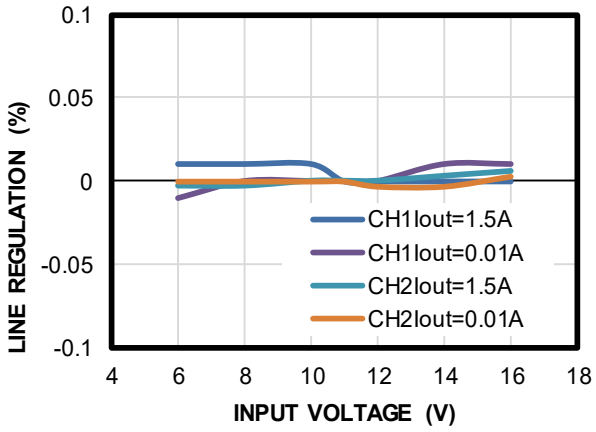



**Load Regulation vs. Load Current**

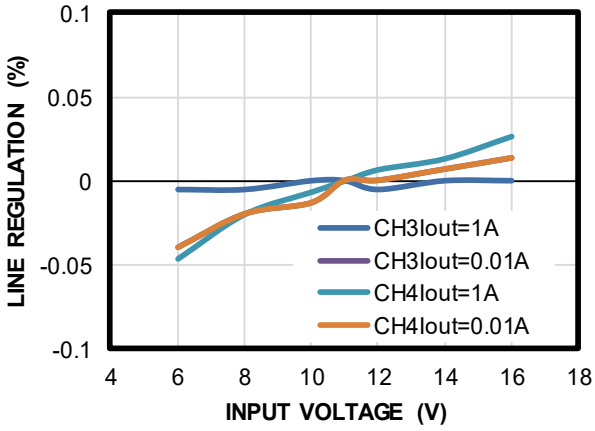
$V_{IN}$ = 12V



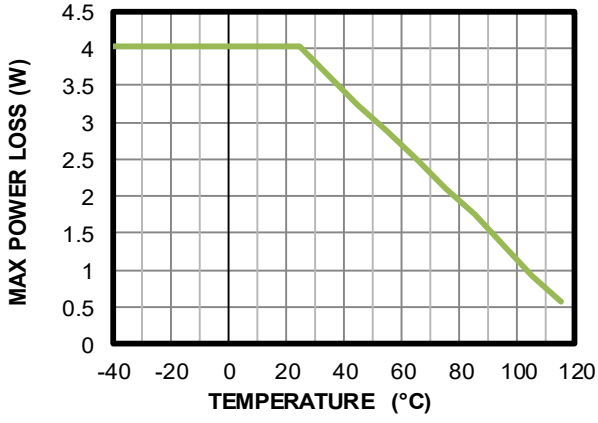

**Line Regulation vs. Input Voltage**




**Line Regulation vs. Input Voltage**



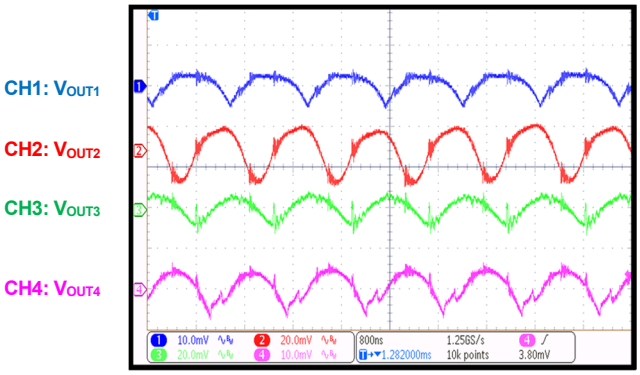

**Max Power Loss vs. Temperature**



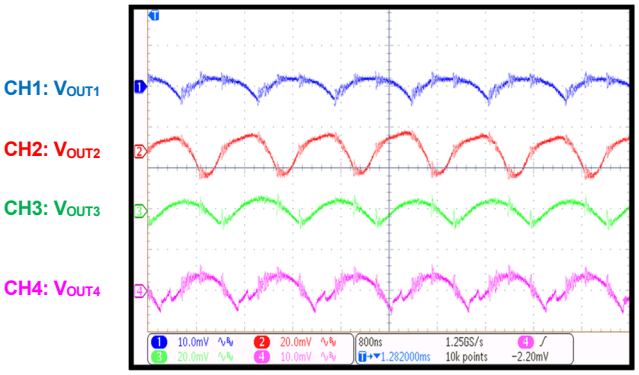
## EVB TEST RESULTS *(continued)*

**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.**

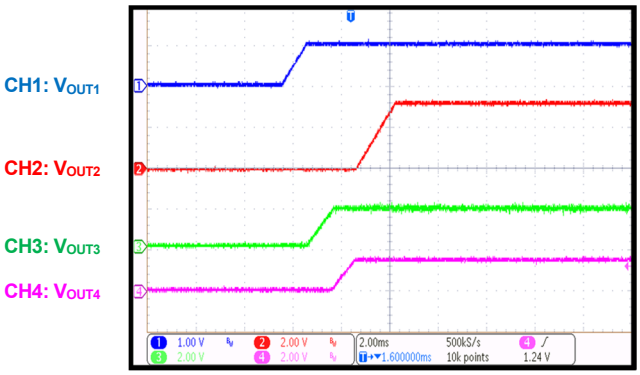
### Steady State
Full load



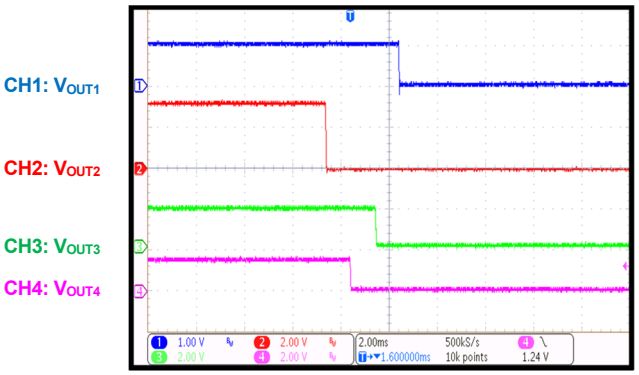

### Steady State
No load



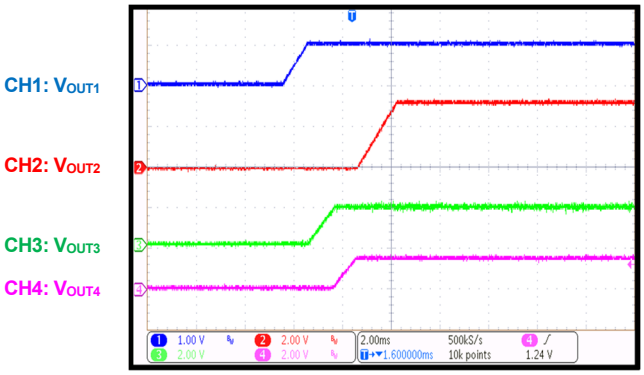

### Start-Up through EN
Full load



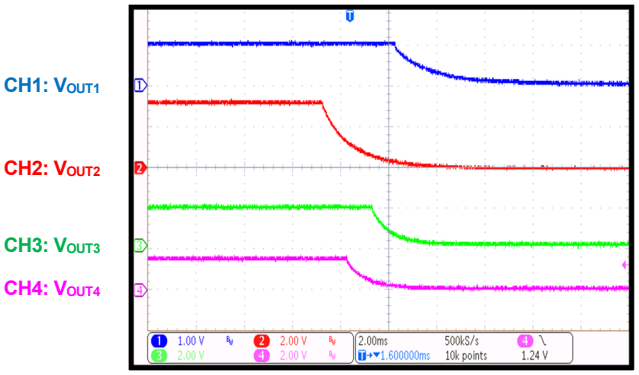

### Shutdown through EN
Full load




### Start-Up through EN
No load



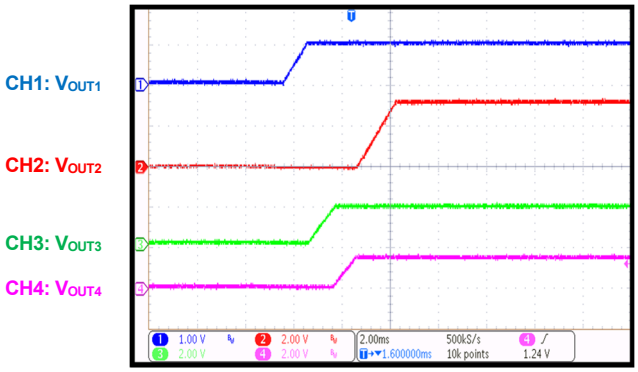

### Shutdown through EN
No load



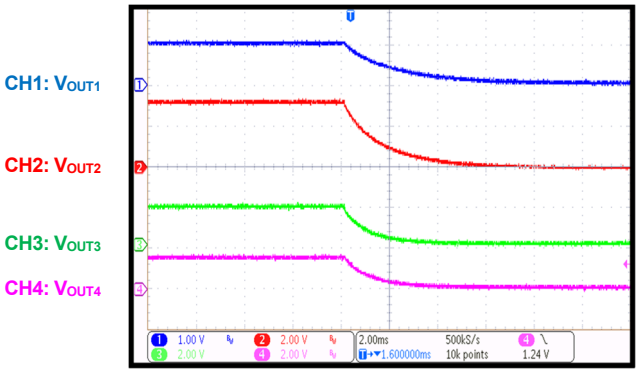
## EVB TEST RESULTS *(continued)*

**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.**

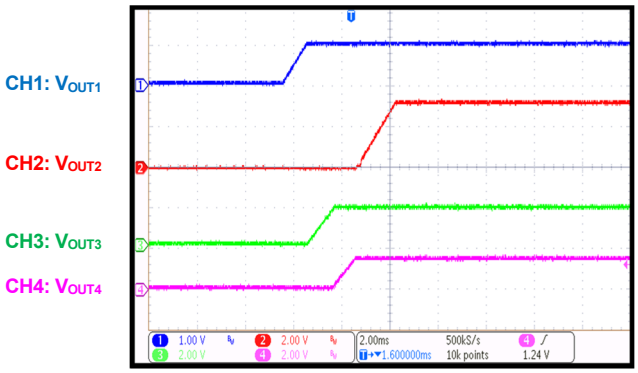
### Start-Up through VIN
No load



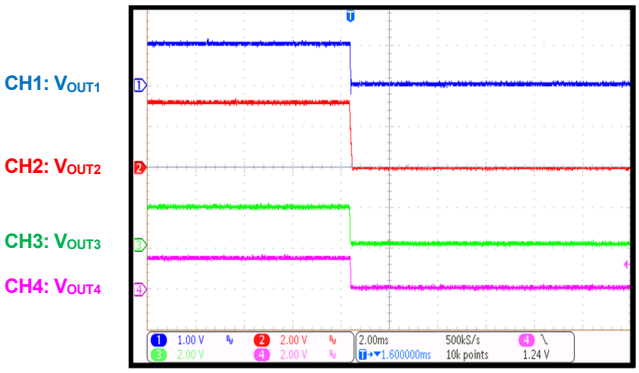

### Shutdown through VIN
No load



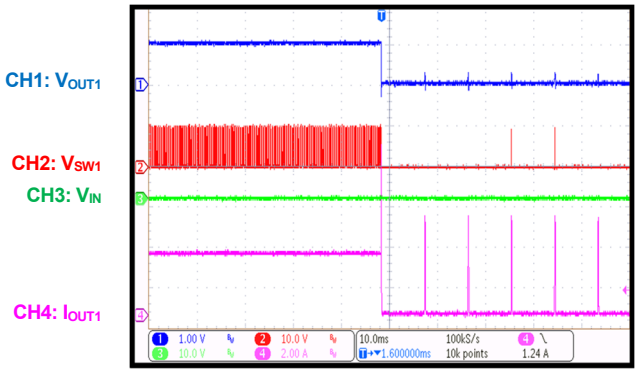

### Start-Up through VIN
With load



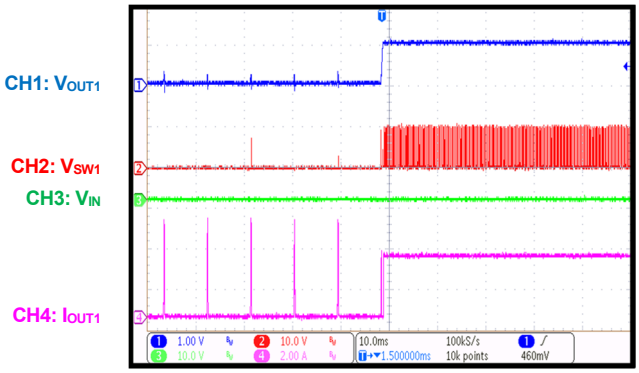

### Shutdown through VIN
With load




### SCP Entry
With load



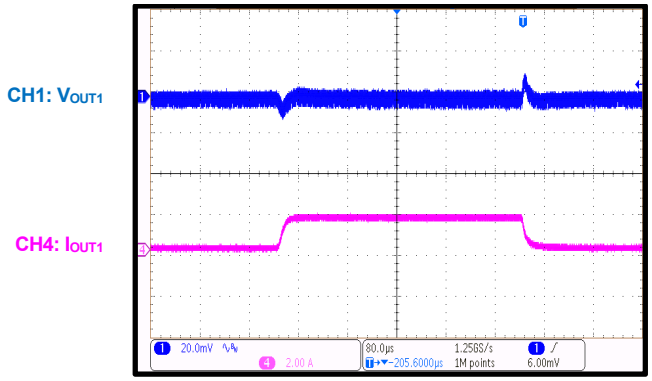

### SCP Recovery
Full load



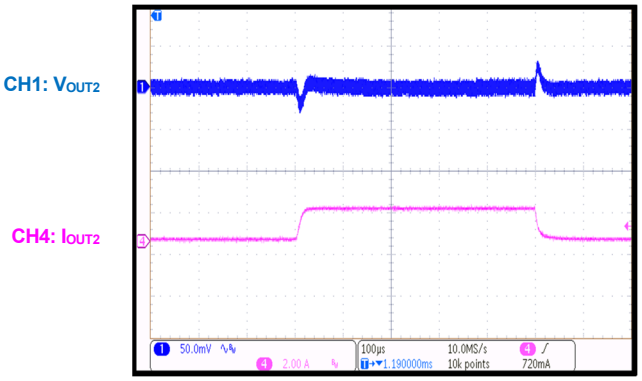
## EVB TEST RESULTS *(continued)*

**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.**

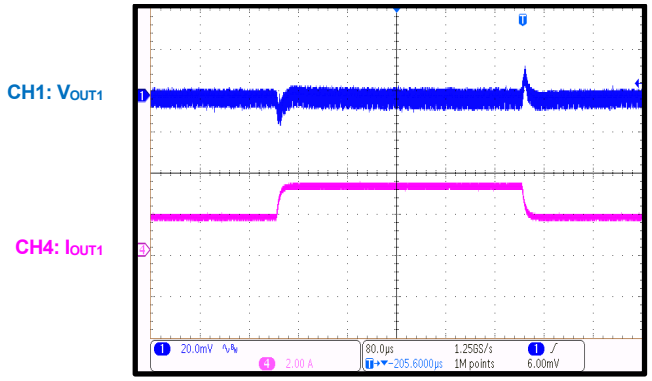
### Load Transient
0A to 1.5A



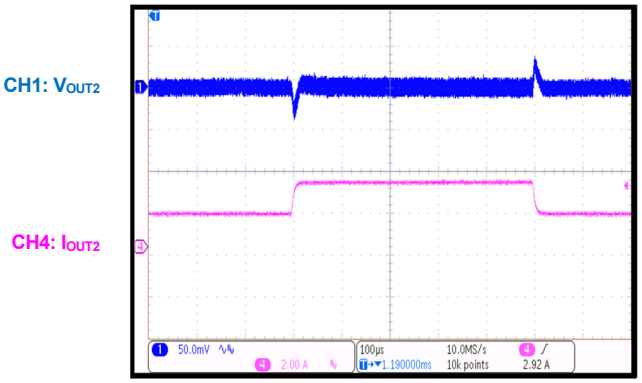

### Load Transient
0A to 1.5A



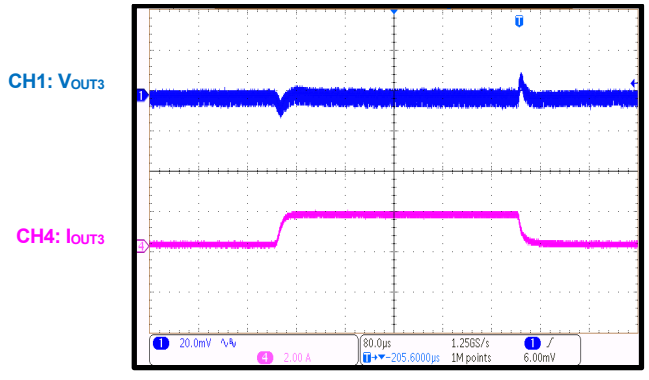

### Load Transient
1.5A to 3A



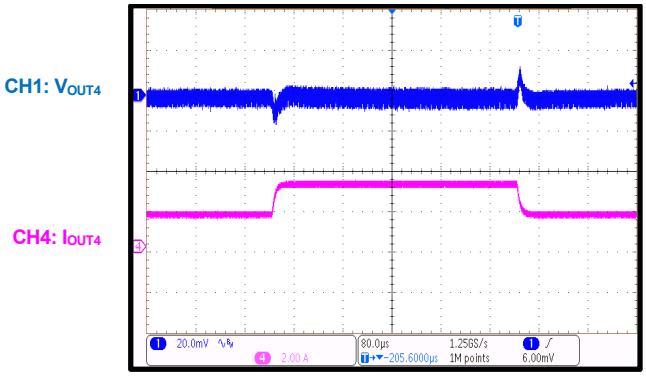

### Load Transient
1.5A to 3A




### Load Transient
0A to 1A




### Load Transient
0A to 1A



## EVB TEST RESULTS *(continued)*

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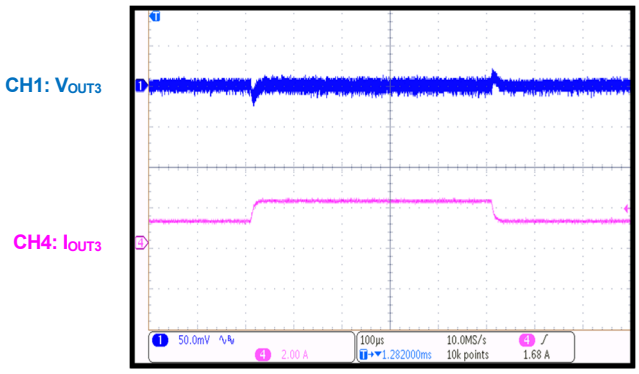
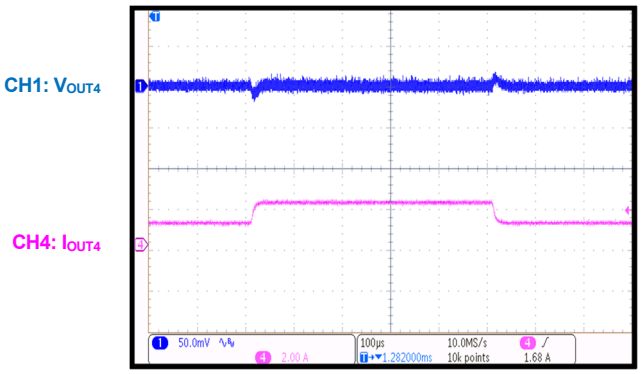
**Load Transient**
1A to 2A




**Load Transient**
1A to 2A



## PCB LAYOUT

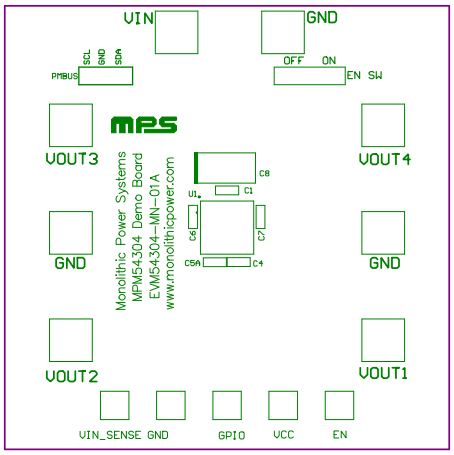



Figure 2: Top Silk

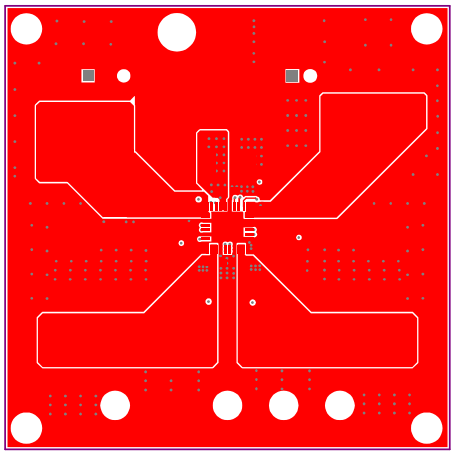


Figure 3: Top Layer

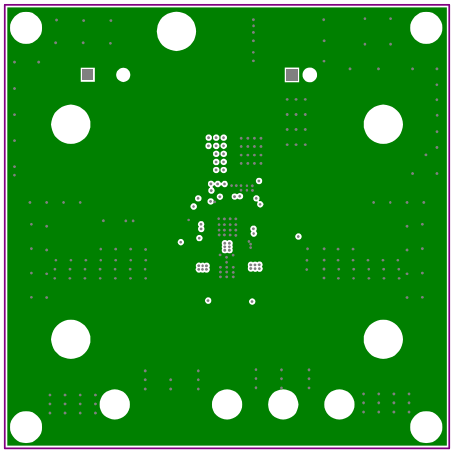


Figure 4: Mid-Layer 1

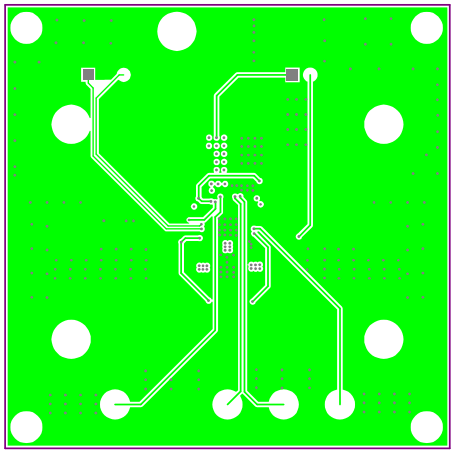


Figure 5: Mid-Layer 2

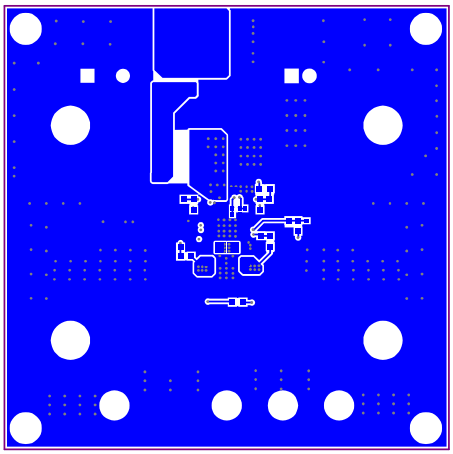


Figure 6: Bottom Layer

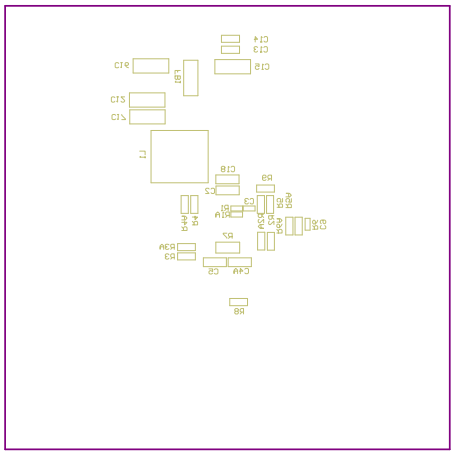


Figure 7: Bottom Silk

## REVISION HISTORY

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