EVM54313-BJ-00A

16V, 3A Triple-Output, Power Module with an I²C Interface Evaluation Board

DESCRIPTION

The EVM54313-BJ-00A evaluation board is designed to demonstrate the capabilities of the MPM54313, a triple-output, fully integrated power module with an I²C interface. Each output can support 3A, for a total of 9A. The MPM54313 offers a complete power solution with built-in, on/off sequencing control, configurable soft start (SS), compensation, and various protection thresholds.

The MPM54313 offers configurable active voltage positioning (AVP) to generate a droop voltage that allows three outputs to operate in parallel with passive current balancing. In addition, two of the outputs can operate in parallel for up to 6A in interleaving mode, which allows for active current balancing.

Constant-on-time (COT) control provides ultra-fast transient response. A 1MHz switching frequency (f_{SW}) greatly reduces the external inductor and capacitor size. Full protection features include under-voltage lockout (UVLO), over-current protection (OCP), over-voltage protection (OVP), under-voltage protection (UVP), and thermal shutdown.

The MPM54313 is available in a BGA (8mmx9mmx2.58mm) package. It is recommended to read the MPM54313 datasheet prior to making any changes to the EVM54313-BJ-00A.

PERFORMANCE SUMMARY (1)

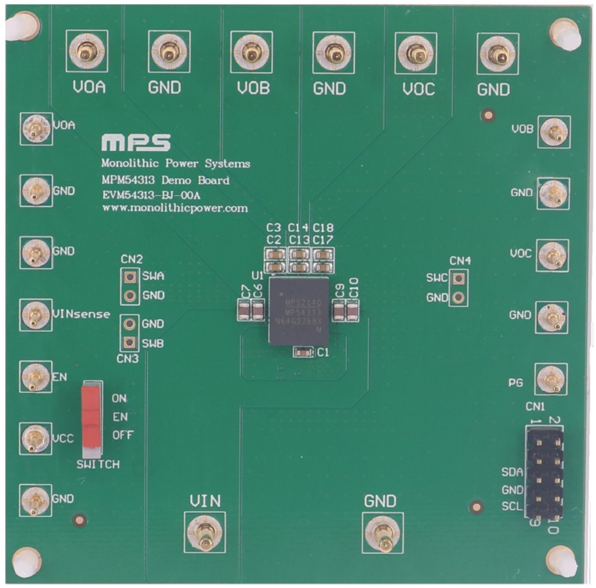
Specifications are at T_A = 25°C.

Parameters	Conditions	Value
Input voltage (V_{IN}) range		4V to 16V (2)
Output voltage (V_{OUT}) (3)	V_{IN} = 4V to 16V, I_{OUT} = 0A to 3A	3.36V
Maximum output current (I_{OUT})	V_{IN} = 4V to 16V	9A
Full load efficiency	V_{IN} = 12V, V_{OUT} = 3.3V, I_{OUT} = 3A, f_{SW} = 750kHz, independent output	91.04%
Peak efficiency	V_{IN} = 12V, V_{OUT} = 3.3V, I_{OUT} = 2.5A, f_{SW} = 750kHz, independent output	91.12%
Default switching frequency (f_{SW})		1000kHz

Notes:

1) For different V_{IN} and V_{OUT} specifications with different output capacitors and inductors, the application circuit parameters may require changes.
2) When V_{IN} < 4V, the enable (EN) resistor divider value must be changed.
3) V_{OUT} is adjustable via an internal or external 0.5V to 5.5V resistor divider range.

EVM54313-BJ-00A EVALUATION BOARD



LxWxH (8cmx8cmx1.5cm)

Board Number	MPS IC Number
EVM54313-BJ-00A	MPM54313

QUICK START GUIDE

The EVM54313-BJ-00A evaluation board is easy to set up, and it can evaluate the MPM54313's performance. For the proper measurement equipment set-up, refer to Figure 1 and follow the steps below.

1. For independent outputs, connect the load terminals to:
    a. Positive (+): VOx (including VOA, VOB, and VOC)
    b. Negative (-): GND
2. For multi-phase outputs, connect VOx first.
3. Preset the power supply output to be between 4V and 16V, then turn off the power supply. (4)
4. Connect the power supply output terminals to:
    a. Positive (+): VIN
    b. Negative (-): GND
5. After making the connections, turn on the power supply and EN switch. The board should automatically start up. (5)

    Figure 1 shows the proper measurement equipment set-up.

Notes:

4) Ensure that V_{IN} does not exceed 16V.
5) When measuring the V_{OUT} or V_{IN} ripple, do not use the oscilloscope probe's long ground lead.

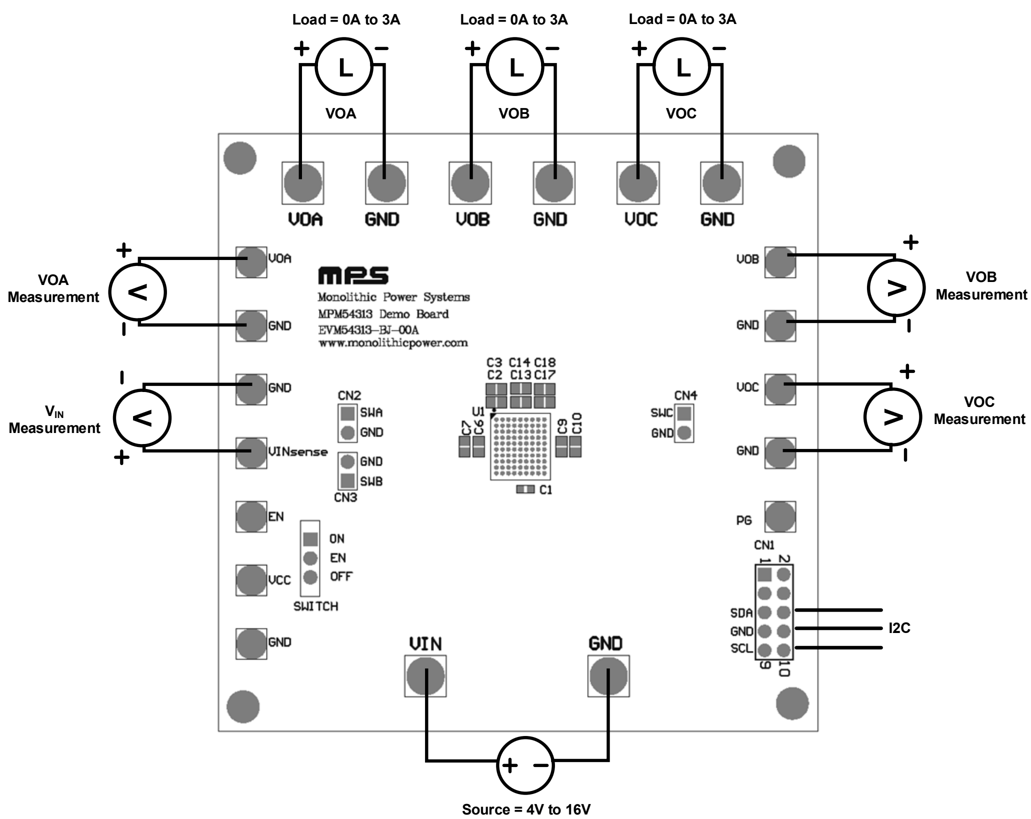


Figure 1: Proper Measurement Equipment Set-Up

Virtual Bench Pro 3.0 Evaluation Software

1. Connect the hardware (see Figure 2).

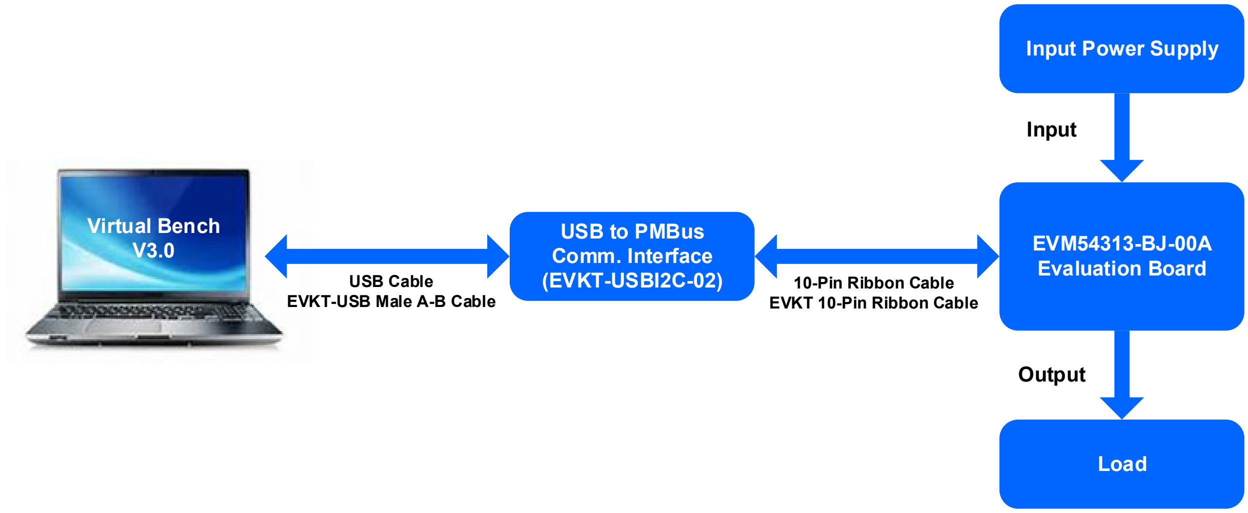


Figure 2: Hardware Set-Up

2. To set up the software with the MPM54313, open Virtual Bench Pro 3.0 to scan the connected power modules. (6)
3. If the GUI detects the power module, then an address should appear next to "MPM54313" on the left panel (e.g. 0x0F), and the indicator to the left should turn green (see Figure 3).

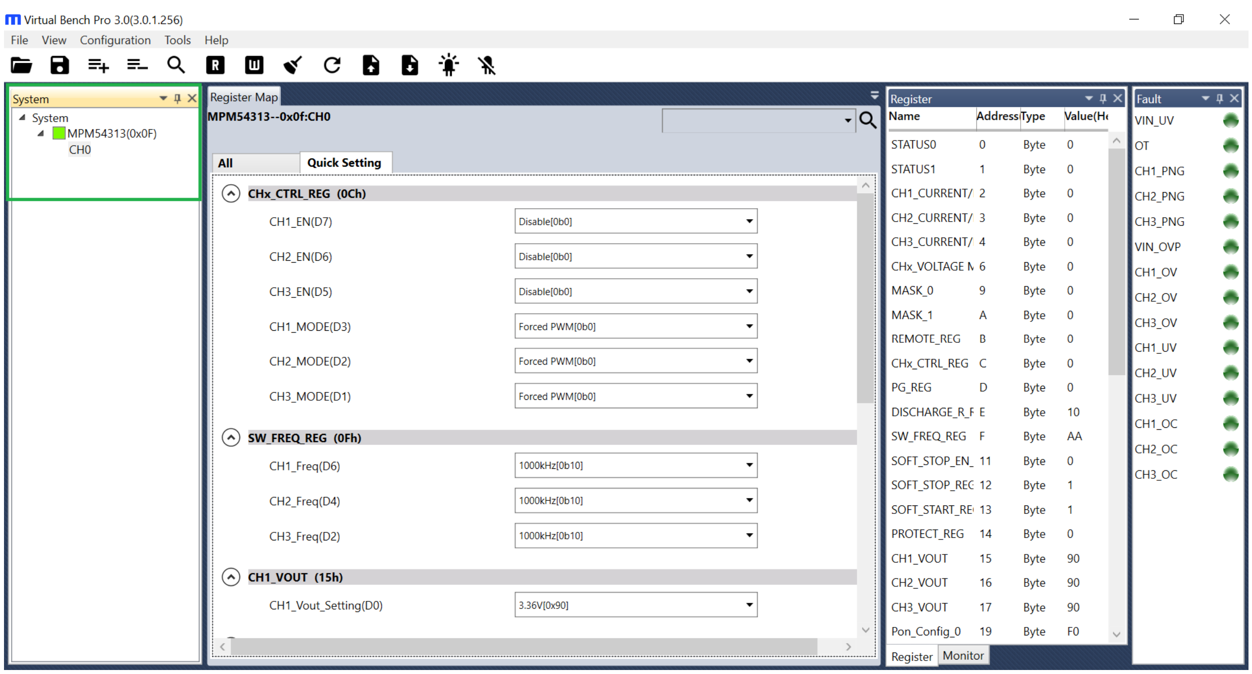


Figure 3: Successful Connection

Note:

6) For more details on using the Virtual Bench GUI, refer to the documentation provided with the GUI download files.

4. The Register Control menu should appear in the middle panel (marked in red), and the values stored in the module registers should be read automatically (see Figure 4).

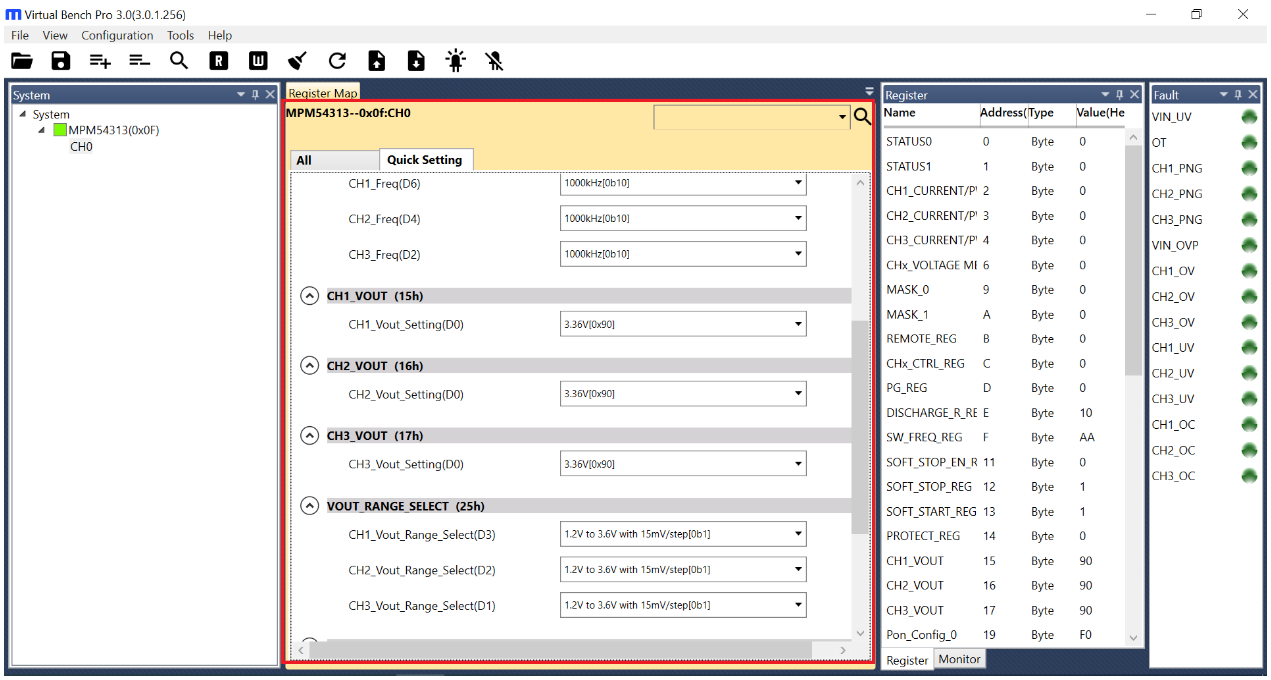


Figure 4: The Register Control Menu

5. Change the register values to their required value. A valid input must be entered; otherwise, an alert appears and the entered value is not accepted (see Figure 5).

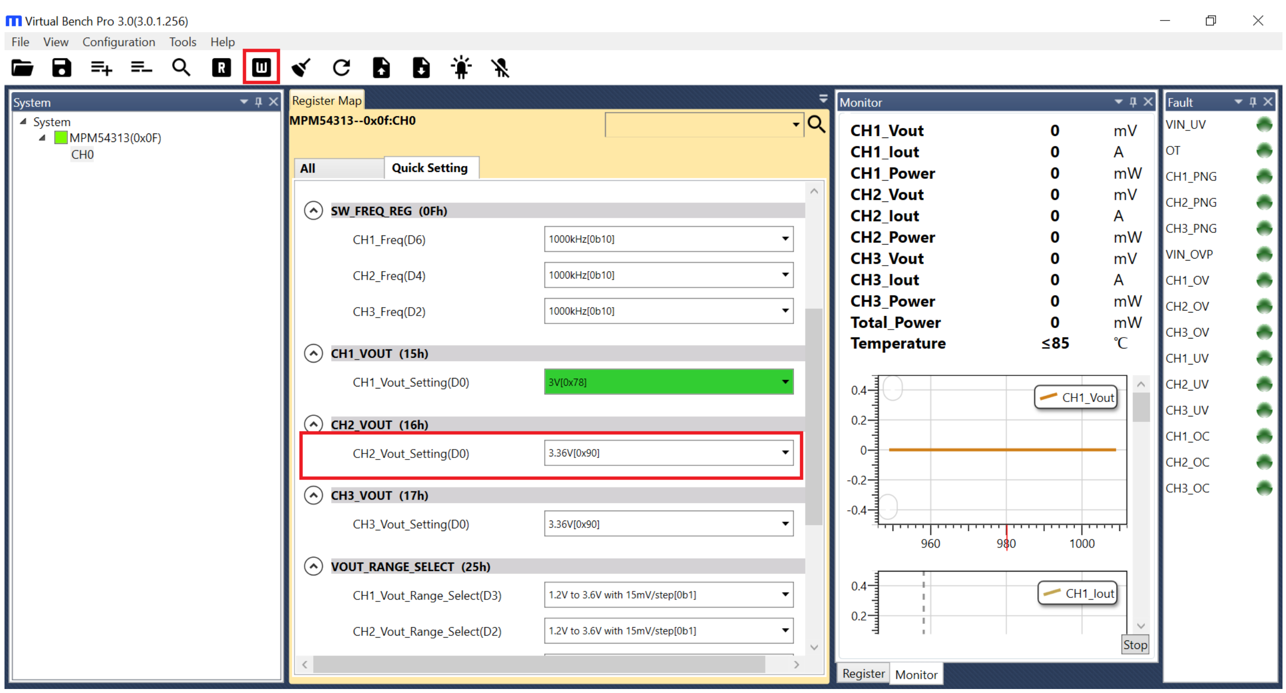


Figure 5: Modify the Register Values

6. Click the "Write to Chip" button to modify the register.
7. Click the "Write to MTP" button and wait until the writing action completes (see Figure 6).

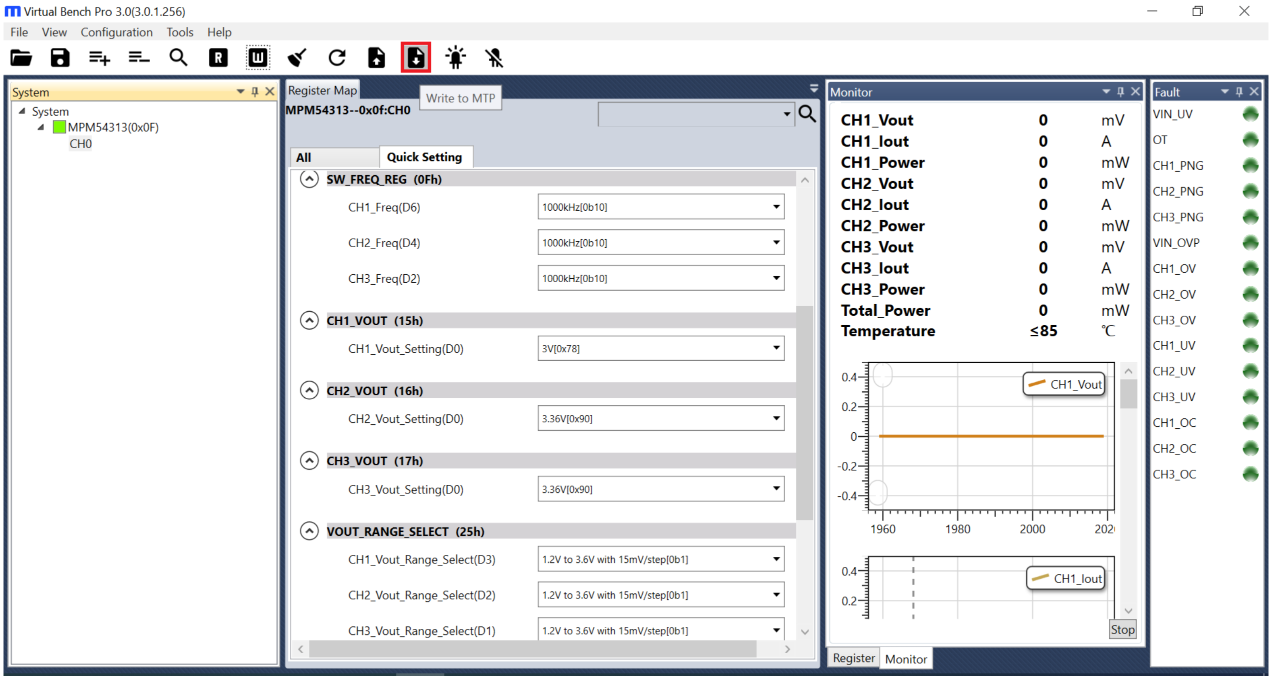


Figure 6: Writing to the MTP

8. Turn off the power supply.
9. Wait three seconds, and then turn on the power supply. The new configuration should take effect.

EVALUATION BOARD SCHEMATIC

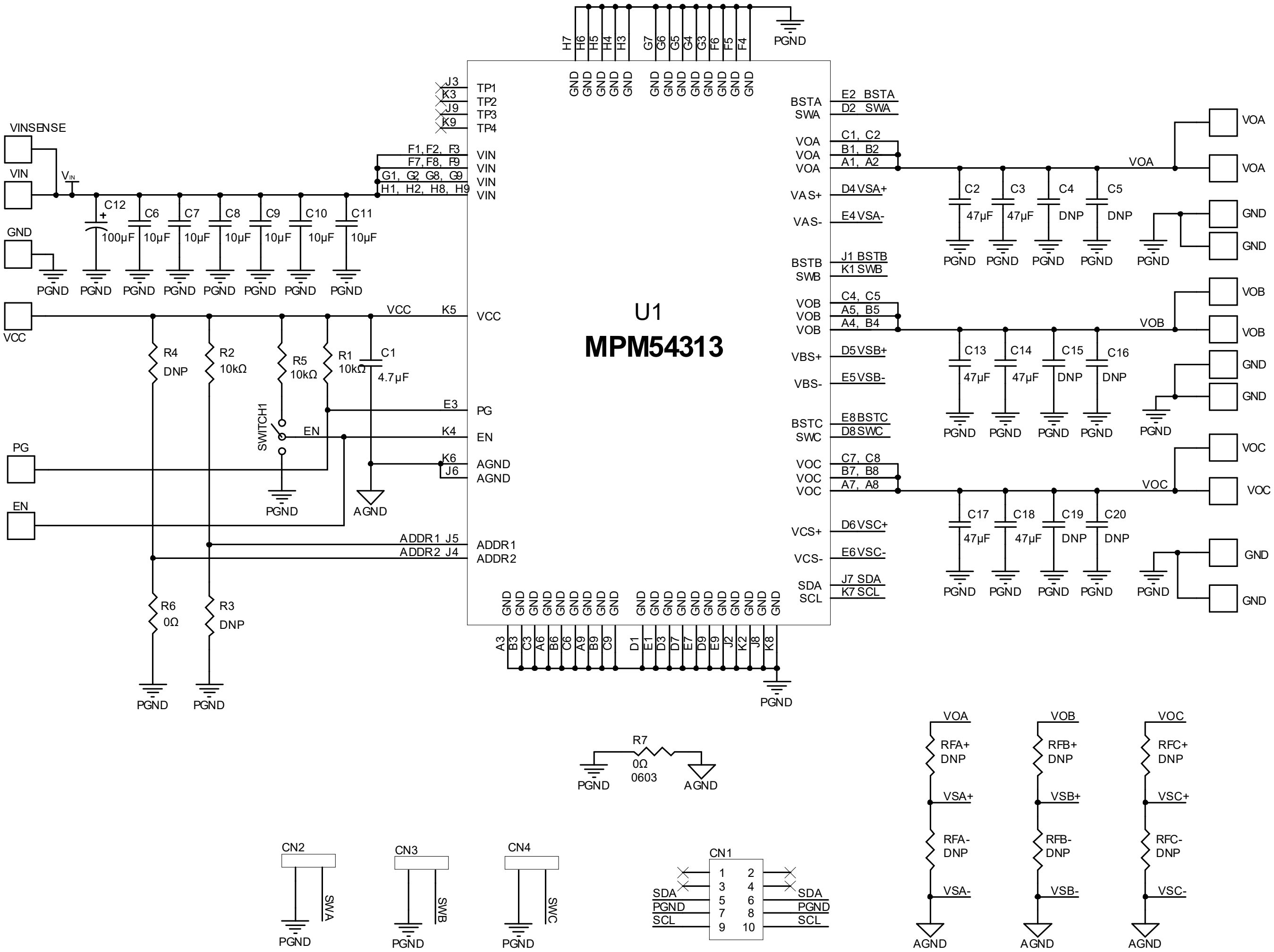


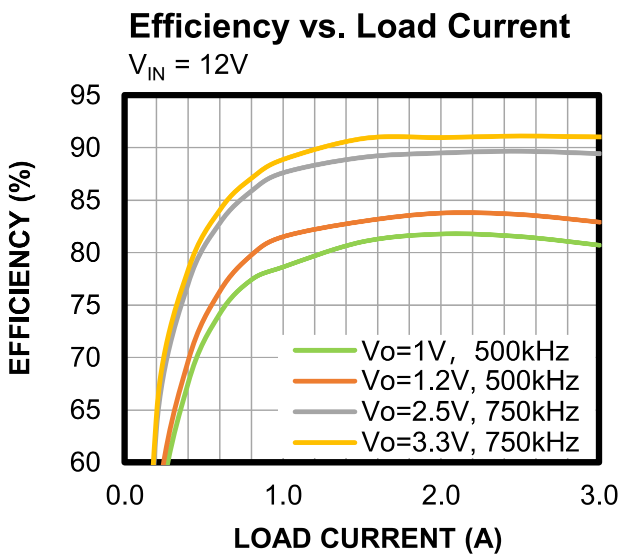
Figure 7: Evaluation Board Schematic

EVM54313-BJ-00A BILL OF MATERIALS

Qty	Ref	Value	Description	Package	Manufacturer	Manufacturer PN
6	C6, C7, C8, C9, C10, C11	10µF	Ceramic capacitor, 25V, X7S	0805	Murata	GRM21BC71E106KE11L
1	C12	100µF	Electrolytic capacitor, 100µF, 25V	SMD	Wurth	865080449011
1	C1	4.7µF	Ceramic capacitor, 10V, X5R	0603	Murata	GRM155R61A475MEAAD
2	R6, R7	0Ω	Film resistor, 1%	0603	Yageo	RC0603FR070RL
12	C2, C3, C5, C13, C14, C16, C17, C18, C20	22µF	Ceramic capacitor, 6.3V, X5R	0603	Murata	GRM188R60J226MEA0D
3	R1, R2, R5	10kΩ	Film resistor, 1%	0603	Yageo	RC0603FR0710KL
1	SWITCH1	2.54mm	3-pin connector	DIP	Wurth	450301014042
1	CN1	2.54mm	2-row, 5-pin connector	DIP	Wurth	61201021621
3	CN2, CN3, CN4	NS				
0	R3, R4	NS				
3	RFA+, RFB+, RFC+,	0	Film resistor, 1%	0402	Yageo	1PRC0402FR-070RL
3	RFA-, RFB-, RFC-	NS				
8	VIN, GND, VOA, VOB, BOC	2mm	Copper pin, φ = 2mm	DIP	Custom	
12	VCC, GND, EN, VINSENSE, VOA, VOB, VOC, PG	1mm	Copper pin, φ = 1mm	DIP	Custom	
1	U1	MPM54313	16V, triple-output 3A power module with I2C interface	BGA (8mmx 9mmx 2.58mm)	MPS	MPM54313GBJ-0000

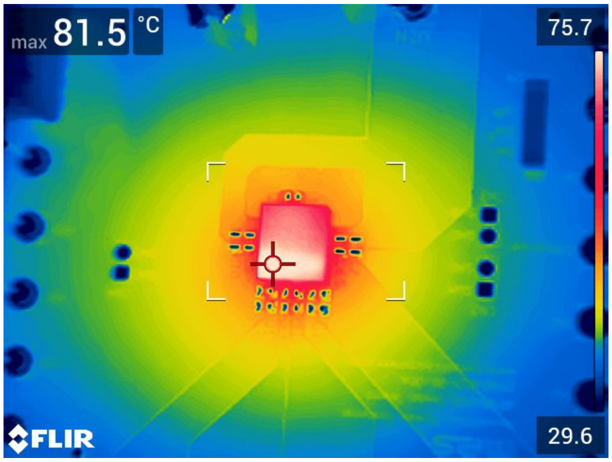
EVB TEST RESULTS

Performance curves and waveforms are tested on the evaluation board. V_{IN} = 12V, V_{OUT} = 3.3V, f_{SW} = 1000kHz, T_A = 25°C, unless otherwise noted.



Thermal Performance of a Three-Phase Single Output in Parallel

V_{IN} = 12V, V_{OUT} = 3.3V, f_{SW} = 100kHz, I_{OUT} = 9A, no forced airflow, T_A = 26.7°C, T_{CASE} = 81.5°C

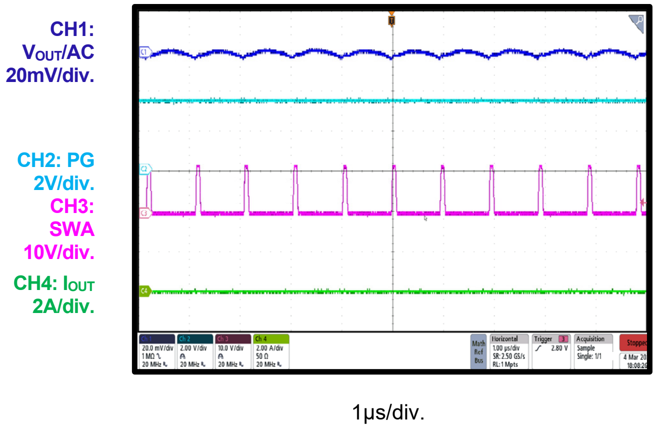


EVB TEST RESULTS *(continued)*

V_{IN} = 12V, T_J = -40°C to +125°C, typical value is tested at T_J = 25°C, the over-temperature limit is guaranteed by characterization, unless otherwise noted.

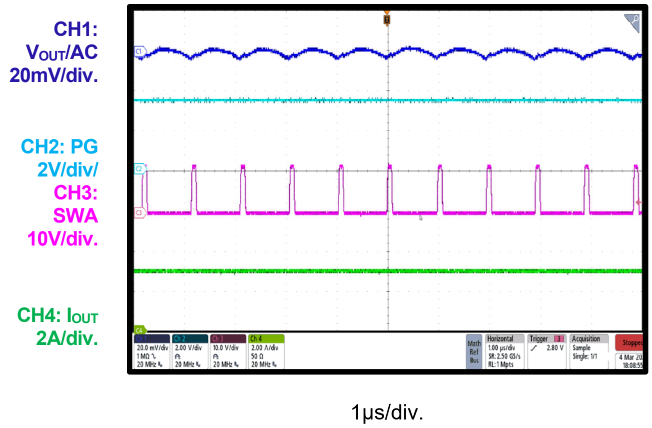
Steady State

V_{IN} = 12V, V_{OUT} = 1V, I_{OUT} = 0A, C_{OUT} = 3 x 22µF, voltage ripple = 4.6mV, single-channel



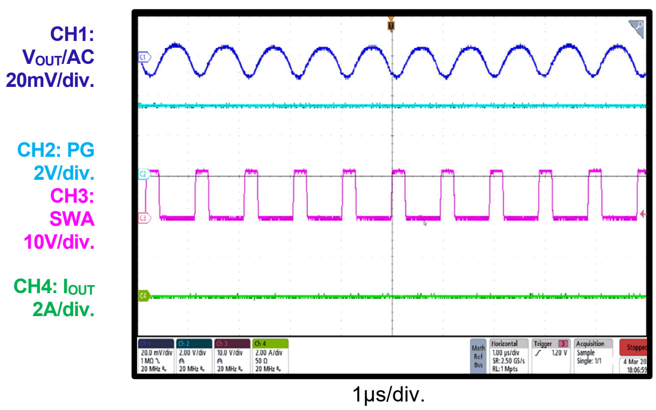
Steady State

V_{IN} = 12V, V_{OUT} = 1V, I_{OUT} = 3A, C_{OUT} = 3 x 22µF, voltage ripple = 5.6mV, single-channel



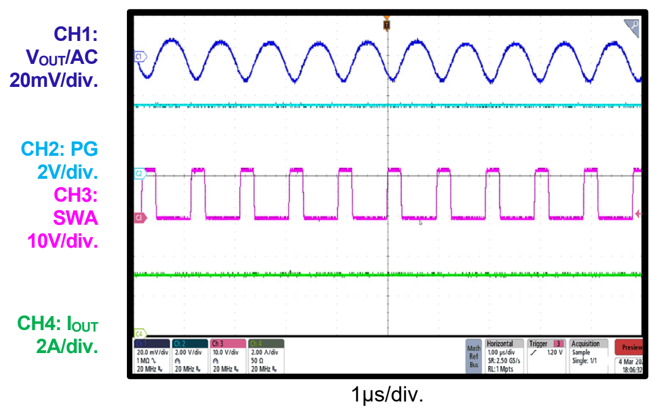
Steady State

V_{IN} = 12V, V_{OUT} = 3.3V, I_{OUT} = 0A, C_{OUT} = 3 x 22µF, voltage ripple = 15.8mV, single-channel



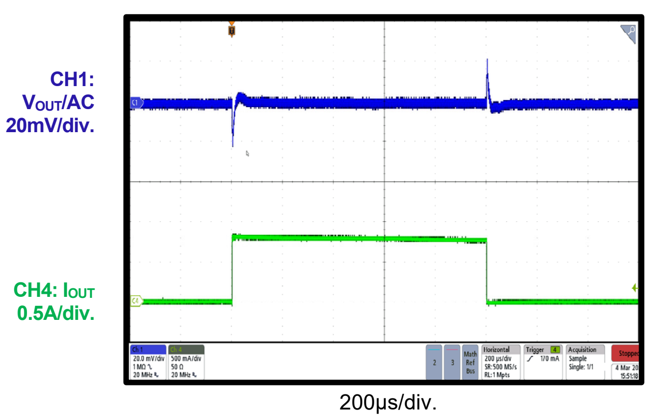
Steady State

V_{IN} = 12V, V_{OUT} = 3.3V, I_{OUT} = 3A, C_{OUT} = 3 x 22µF, voltage ripple = 16.4mV, single-channel



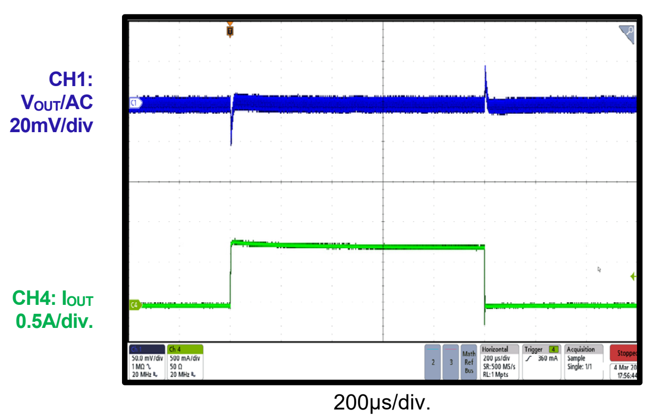
Load Transient

V_{IN} = 12V, V_{OUT} = 1V, I_{OUT} = 0A to 0.75A, slew rate = 10A/µs, C_{OUT} = 3 x 22µF, single-channel



Load Transient

V_{IN} = 12V, V_{OUT} = 3.3V, I_{OUT} = 0A to 0.75A, slew rate = 10A/µs, C_{OUT} = 3 x 22µF, single-channel



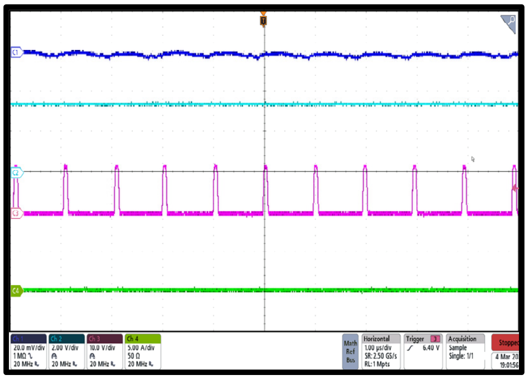
EVB TEST RESULTS *(continued)*

V_{IN} = 12V, T_J = -40°C to +125°C, typical value is tested at T_J = 25°C, the over-temperature limit is guaranteed by characterization, unless otherwise noted.

Steady State

V_{IN} = 12V, V_{OUT} = 1V, I_{OUT} = 0A,
voltage ripple = 3.1mV, three outputs in parallel

CH1: V_{OUT}/AC 20mV/div.
CH2: PG 2V/div.
CH3: SWA 10V/div.
CH4: I_{OUT} 5A/div.

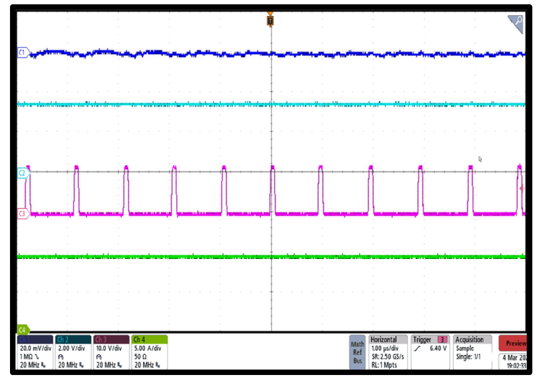


1µs/div.

Steady State

V_{IN} = 12V, V_{OUT} = 1V, I_{OUT} = 9A,
voltage ripple = 3.5mV, three outputs in parallel

CH1: V_{OUT}/AC 20mV/div.
CH2: PG 2V/div.
CH3: SWA 10V/div.
CH4: I_{OUT} 5A/div

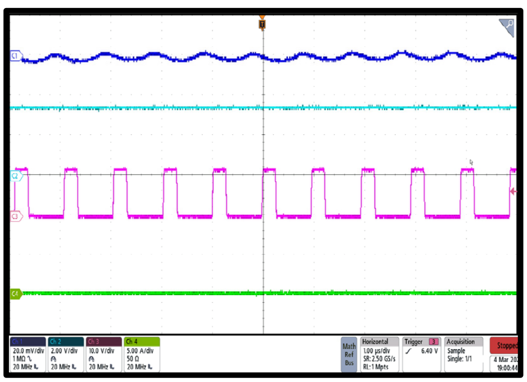


1µs/div.

Steady State

V_{IN} = 12V, V_{OUT} = 3.3V, I_{OUT} = 0A,
voltage ripple = 5.8mV, three outputs in parallel

CH1: V_{OUT}/AC 20mV/div
CH2: PG 2V/div
CH3: SWA 10V/div
CH4: I_{OUT} 5A/div

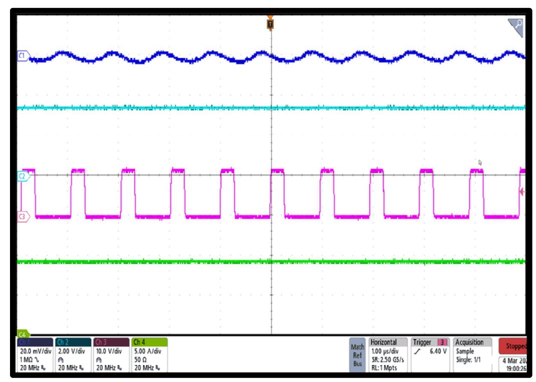


1µs/div.

Steady State

V_{IN} = 12V, V_{OUT} = 3.3V, I_{OUT} = 9A,
voltage ripple = 6.2mV, three outputs in parallel

CH1: V_{OUT}/AC 20mV/div.
CH2: PG 2V/div.
CH3: SWA 10V/div.
CH4: I_{OUT} 5A/div.

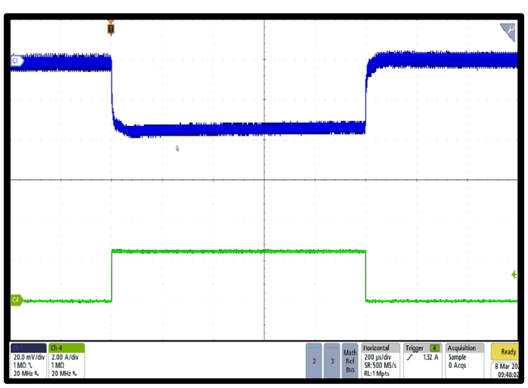


1µs/div.

Load Transient

V_{IN} = 12V, V_{OUT} = 1V, I_{OUT} = 0A to 2.25A,
slew rate = 10A/µs, C_{OUT} = 9 x 22µF,
three outputs in parallel

CH1: V_{OUT}/AC 20mV/div.
CH4: I_{OUT} 2A/div

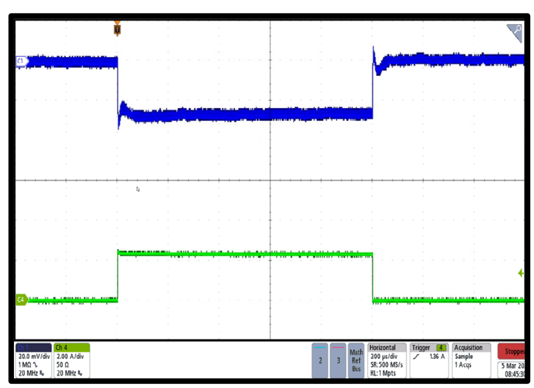


200µs/div.

Load Transient

V_{IN} = 12V, V_{OUT} = 3.3V, I_{OUT} = 0A to 2.25A,
slew rate = 10A/µs, C_{OUT} = 9 x 22µF,
three outputs in parallel

CH1: V_{OUT}/AC 20mV/div
CH4: I_{OUT} 2A/div



200µs/div.

PCB LAYOUT

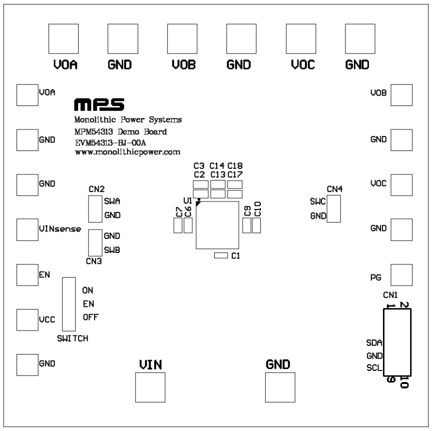


Figure 8: Top Silk

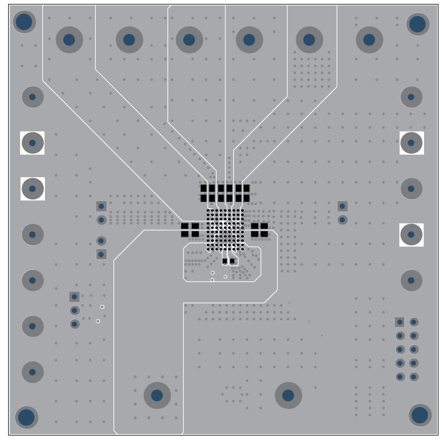


Figure 9: Top Layer

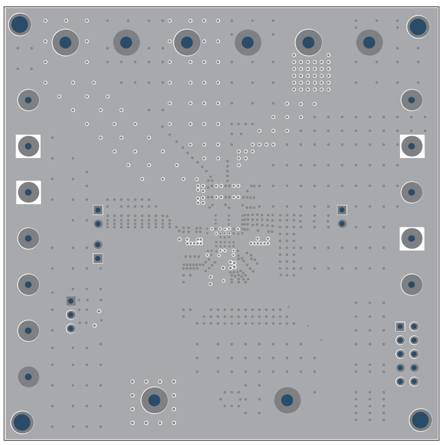


Figure 10: Mid-Layer 1

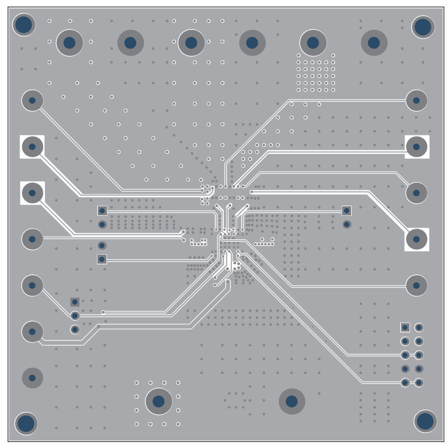


Figure 11: Mid-Layer 2

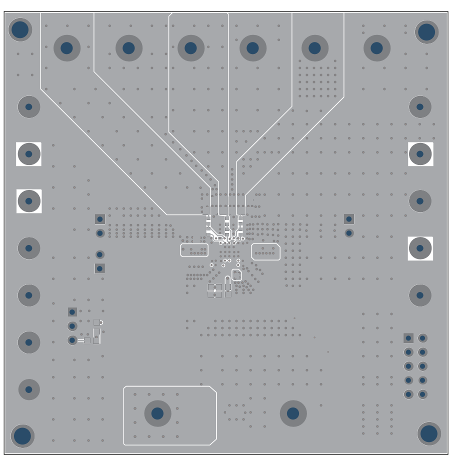


Figure 12: Bottom Layer

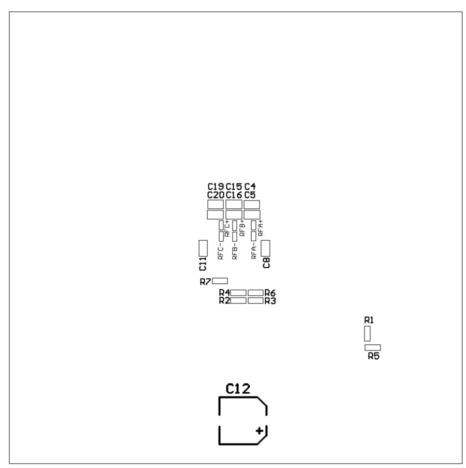


Figure 13: Bottom Silk

REVISION HISTORY

Revision #	Revision Date	Description	Pages Updated
1.0	4/26/2022	Initial Release	-