EVL28167-B-Q-00A

2.8V to 22V V_{IN}, 3A I_{OUT}, 4-Switch, High-Efficiency, Integrated Buck-Boost Converter with PG Indication Evaluation Board

DESCRIPTION

The EVL28167-B-Q-00A is an evaluation board for the MP28167-B, a high-efficiency, synchronous buck-boost converter with four integrated power switches and an I^2C interface. The device can regulate output voltages across a wide 2.8V to 22V input voltage (V_{IN}) range.

In buck mode, the MP28167-B uses constant-on-time (COT) control. In boost mode, it uses constant-off-time control. This provides a fast load transient response and smooth buck-boost mode transient. The MP28167-B features automatic pulse-frequency modulation (PFM) and pulse-width modulation (PWM) modes, forced PWM mode, as well as configurable constant current (CC) limiting and soft start (SS). These features provide flexible design options for different applications.

The MP28167-B's fault protections include over-current protection (OCP), over-voltage protection (OVP), under-voltage protection (UVP), short-circuit protection (SCP), and thermal shutdown (TSD).

The MP28167-B requires a minimal number of readily available, standard external components, and it is available in a QFN-16 (3mmx3mm) package.

It is recommended to read the datasheet for the MP28167-B prior to making any change to the EVL28167-B-Q-00A.

PERFORMANCE SUMMARY (1) (2)

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

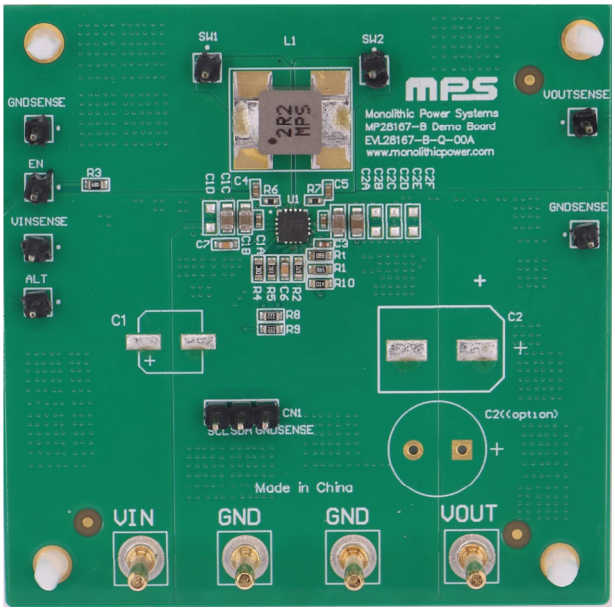
Parameters	Conditions	Value
Input voltage (V_{IN}) range		2.8V to 22V
Output voltage (V_{OUT})	V_{IN} = 2.8V to 22V, I_{OUT} = 0A to 3A	5V in default
Maximum output current (I_{OUT})	V_{IN} = 2.8V to 22V	3A
Maximum input current (I_{IN})	V_{IN} = 2.8V to 22V	4A
Full-load efficiency	V_{IN} = 12V, V_{OUT} = 5V, I_{OUT} = 3A, 1.25MHz	93.0%
Peak efficiency	V_{IN} = 12V, V_{OUT} = 12V, I_{OUT} = 1.5A, 1.25MHz	96.8%
Switching frequency (f_{SW}) (3)	Default	1.25MHz

Notes:

1) For different input/output voltage specifications with different output capacitors/inductors, the application circuit parameters may require changes.
2) For applications where V_{OUT} is below 3V, the switching frequency decreases.
3) The switching frequency can be set to 500kHz, 750kHZ, 1MHz, or 1.25MHz through the 0x04 register.

MPL Optimized Performance with MPS Inductor MPL6050 Series

EVALUATION BOARD



LxWxH (6.35cmx6.35cmx1.6cm)
4 Layers, 2oz/1oz/1oz/2oz

Board Number	MPS IC Number
EVL28167-B-Q-00A	MP28167GQ-B

QUICK START GUIDE

The EVL28167-B-Q-00A is easy to set up to evaluate the performance of the MP28167-B. Refer to Figure 1 for the proper measurement equipment set-up and follow the guidelines below:

1. Preset the power source (V_{IN}) to be between 2.8V and 22V (typically, select a 12V V_{IN}).
2. Turn the power source off.
3. Connect the power source terminals to:
   a. Positive (+): VIN
   b. Negative (-): GND
4. Connect the load (the initial load is no load) to:
   a. Positive (+): VOUT
   b. Negative (-): GND
5. Turn the power supply on after making the connections. The board should automatically start up with its default settings. The related parameters can be changed via the I²C. (4)
6. Check for the appropriate output voltages from the VOUTSENSE to GNDSENSE turrets.
7. Once the proper output voltage is established, adjust the load within the operating range and measure the efficiency, output ripple voltage, and other parameters. (5)
8. After completing all tests, adjust the load to 0A, and turn off the input power supply.

Notes:

4) Refer to the MP28167-B datasheet for how to change the parameters via the I²C.
5) When measuring the output or input voltage ripple, do not use the long ground lead on the oscilloscope probe.

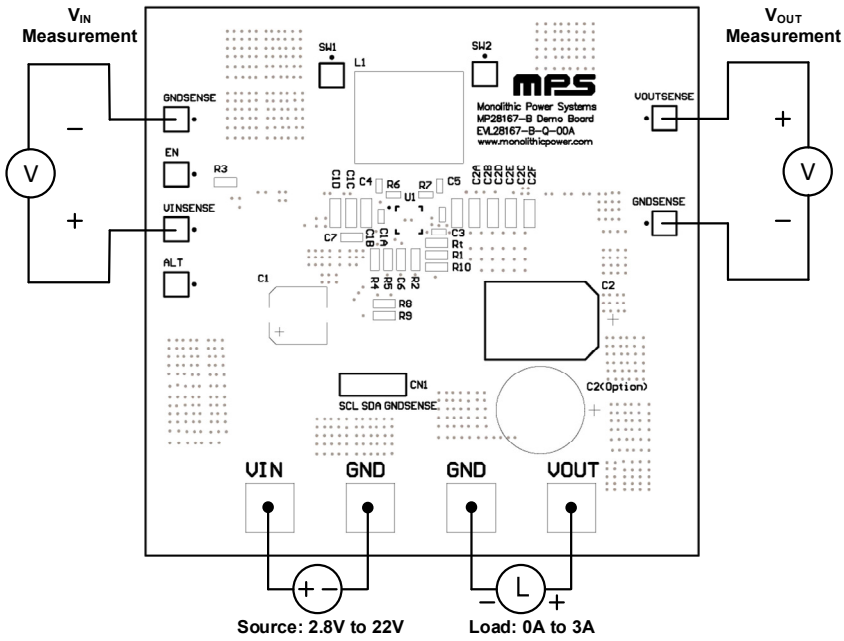


Figure 1: Measurement Equipment Set-Up

EVALUATION BOARD SCHEMATIC

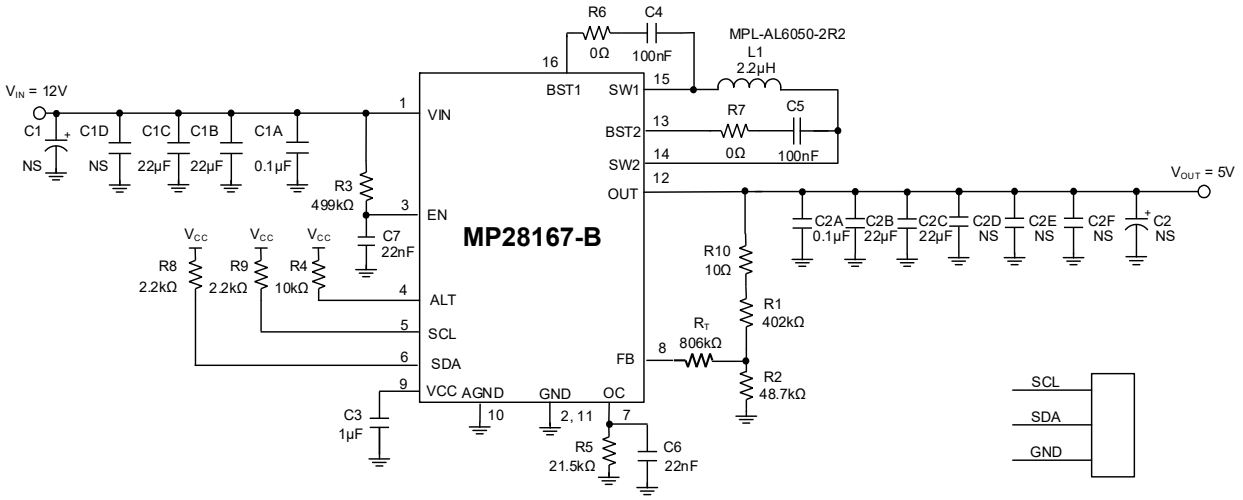


Figure 2: Evaluation Board Schematic

EVL28167-B-Q-00A BILL OF MATERIALS

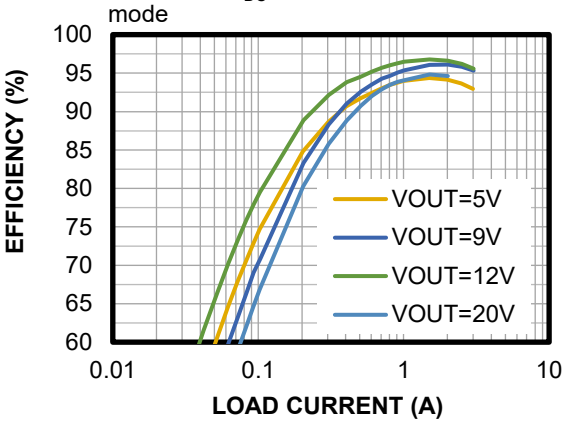
Qty	Ref	Value	Description	Package	Manufacturer	Manufacturer PN
4	C1B, C1C, C2B, C2C	22µF	Ceramic capacitor 25V, X5R	0805	TDK	C2012X5R1E226M
1	C3	1µF	Ceramic capacitor, 16V, X6S	0402	Murata	GRM155C81C105KE11D
4	C1A, C2A, C4, C5	100nF	Ceramic capacitor, 50V, X7R	0402	Samsung	CL05B104KB5NNNC
2	C6, C7	22nF	Ceramic capacitor, 50V, X5R	0603	Murata	GRM188R71H223KA01D
0	C1, C1D, C2, C2D, C2E, C2F	NS				
1	R1	402kΩ	Film resistor, 1%	0603	Yageo	RC0603FR-07402KL
1	R2	48.7kΩ	Film resistor, 1%	0603	Yageo	RC0603FR-0748K7L
1	R3	499kΩ	Film resistor, 1%	0603	Yageo	RC0603FR-07499KL
1	R4	10kΩ	Film resistor, 1%	0603	Yageo	RC0603FR-0710KL
1	R5	21.5kΩ	Film resistor, 1%	0603	Yageo	RC0603FR-0721K5RL
2	R6, R7	0Ω	Film resistor, 1%	0402	Yageo	RC0402FR-070RL
2	R8, R9	2.2kΩ	Film resistor, 1%	0603	Yageo	RC0603FR-072K2L
1	R10	10Ω	Film resistor, 1%	0603	Yageo	RC0603FR-0710RL
1	R_T	806kΩ	Film resistor, 1%	0603	Yageo	RC0603FR-07806KL
1	U1	MP28167-B	Synchronous buck-boost converter	QFN-16 (3mmx 3mm)	MPS	MP28167GQ-B
1	L1	2.2µH	Inductor, R_{DC} = 8.3mΩ, I_{SAT} = 15A	SMD	MPS	MPL-AL6050-2R2

EVB TEST RESULTS

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

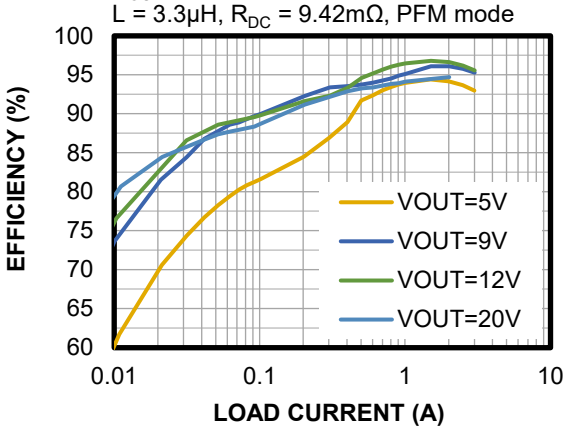
Efficiency vs. Load Current

V_{OUT} = 5V to 20V, f_{SW} = 1.25MHz, L = 3.3µH, R_{DC} = 9.42mΩ, forced PWM mode



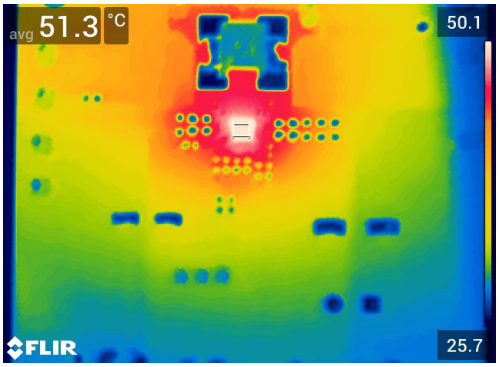
Efficiency vs. Load Current

V_{OUT} = 5V to 20V, f_{SW} = 1.25MHz, L = 3.3µH, R_{DC} = 9.42mΩ, PFM mode



Thermal Performance

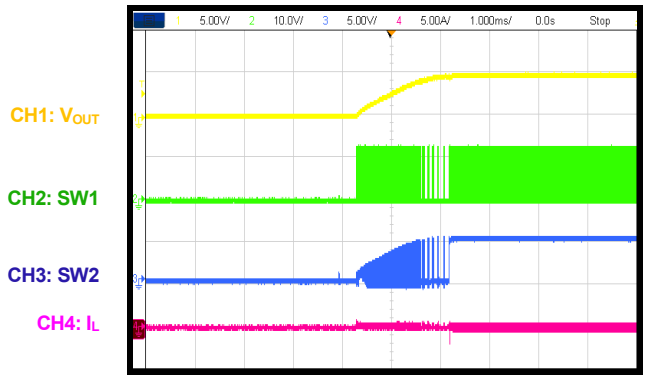
I_{OUT} = 3A, no forced airflow, T_{CASE} = 51.3°C



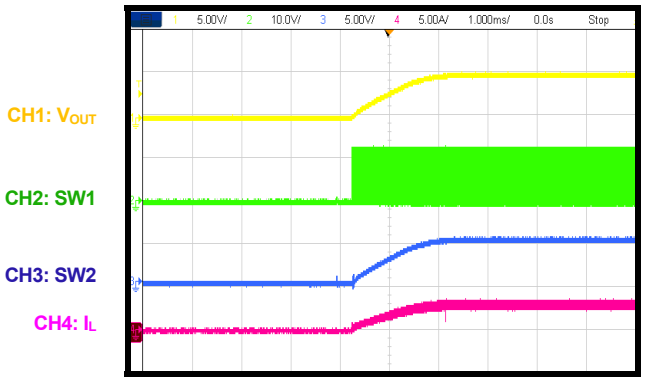
EVB TEST RESULTS *(continued)*

Performance curves and waveforms are tested on the evaluation board. V_{IN} = 12V, V_{OUT} = 5V, L = 2.2µH, T_A = 25°C, unless otherwise noted.

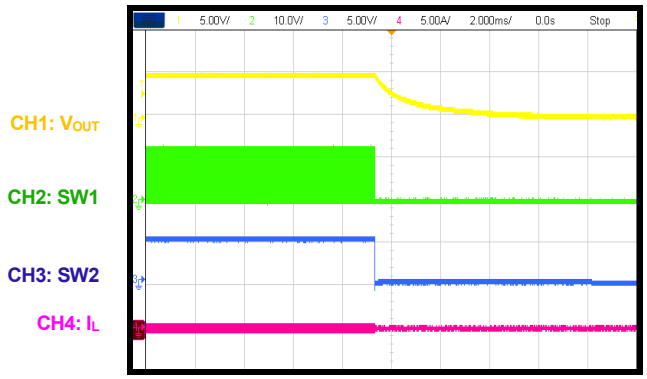
EN Pin Enabled
I_{OUT} = 0A



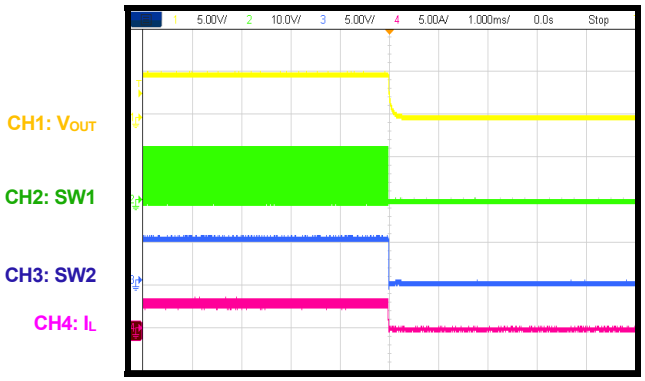
EN Pin Enabled
I_{OUT} = 3A



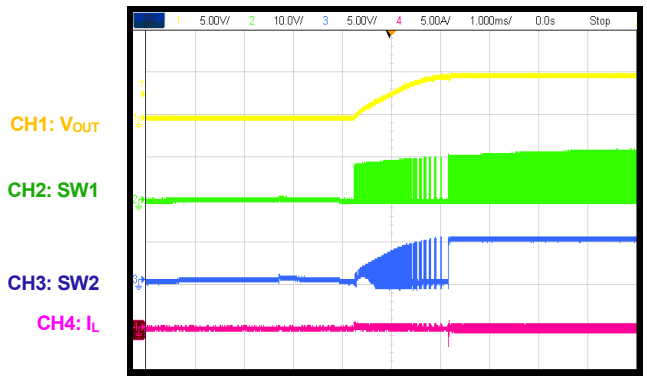
EN Pin Disabled
I_{OUT} = 0A



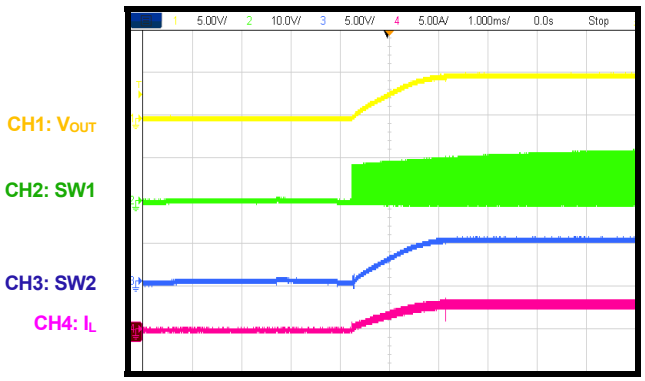
EN Pin Disabled
I_{OUT} = 3A



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



Start-Up through VIN
I_{OUT} = 3A

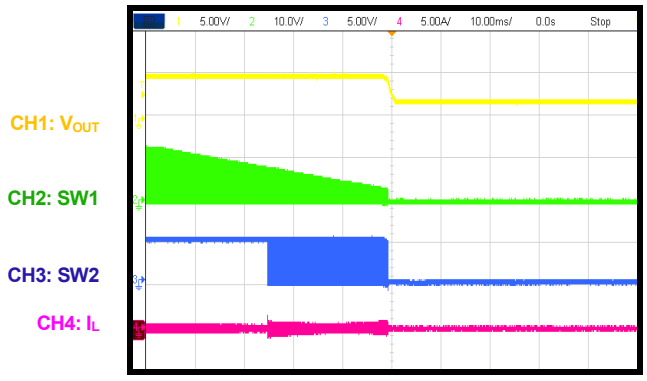


EVB TEST RESULTS *(continued)*

Performance curves and waveforms are tested on the evaluation board. V_{IN} = 12V, V_{OUT} = 5V, L = 2.2µH, T_A = 25°C, unless otherwise noted.

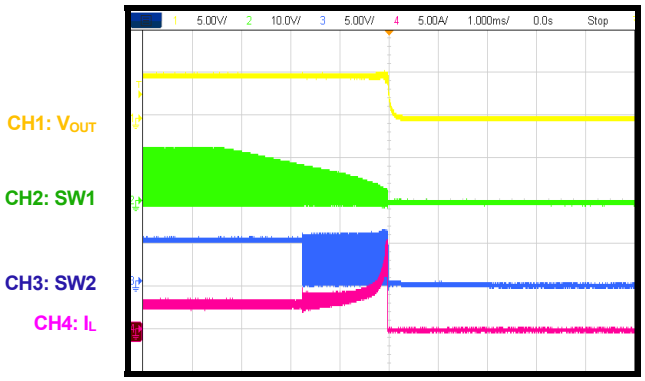
Shutdown through VIN

I_{OUT} = 0A



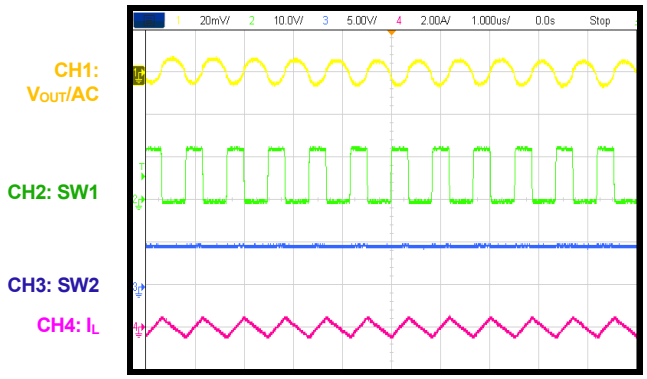
Shutdown through VIN

I_{OUT} = 3A



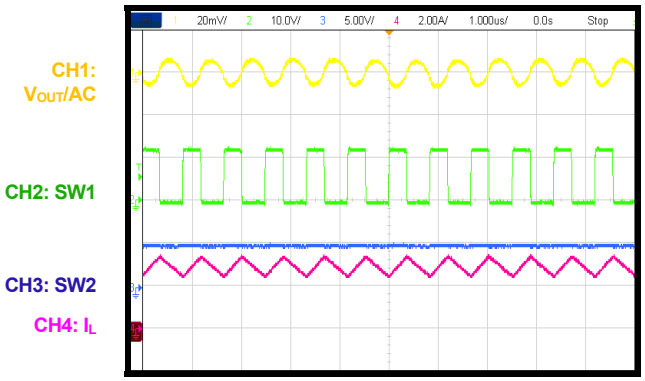
Steady State

I_{OUT} = 0A



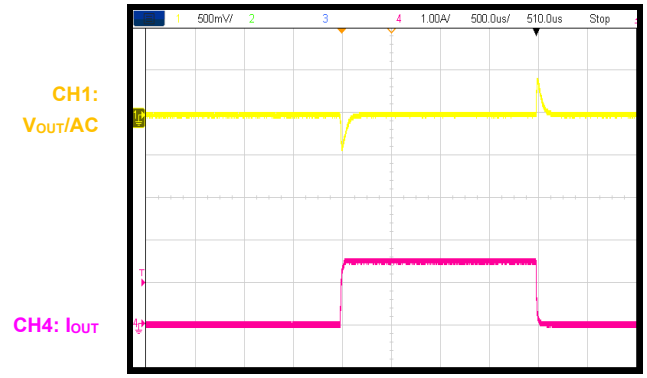
Steady State

I_{OUT} = 3A



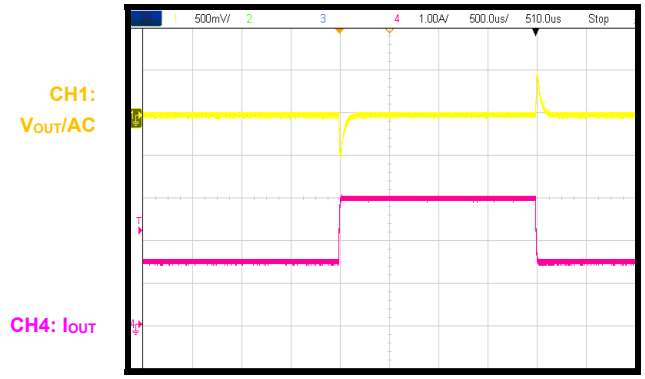
Load Transient Response

V_{IN} = 12V, V_{OUT} = 5V, I_{OUT} = 0A to 1.5A, e-load 2.5A/µs



Load Transient Response

V_{IN} = 12V, V_{OUT} = 5V, I_{OUT} = 1.5A to 3A, e-load 2.5A/µs



PCB LAYOUT

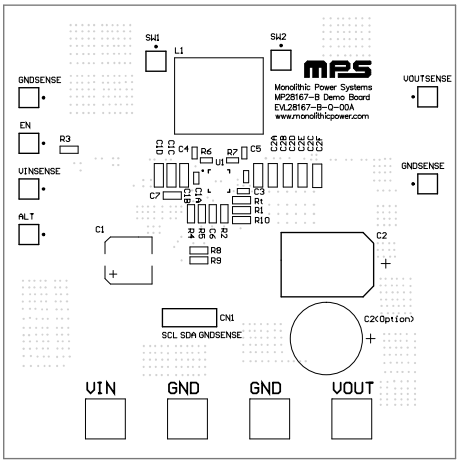


Figure 3: Top Silk

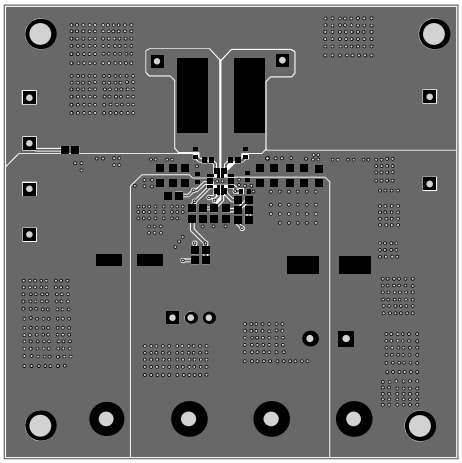


Figure 4: Top Layer

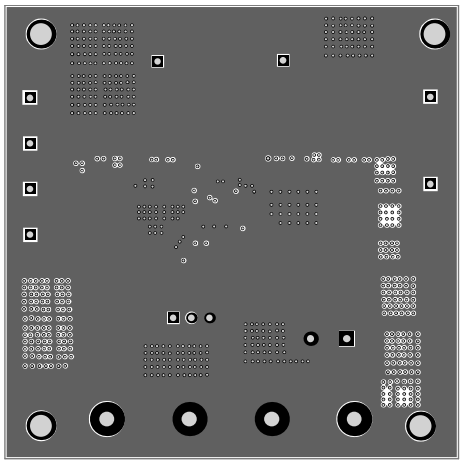


Figure 5: Mid-Layer 1

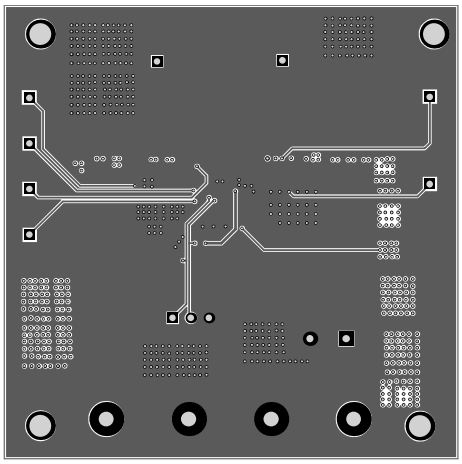


Figure 6: Mid-Layer 2

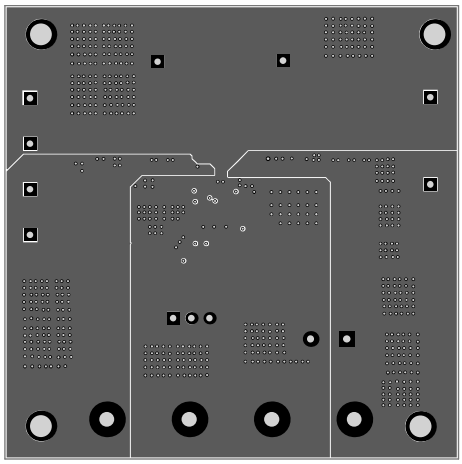


Figure 7: Bottom Layer

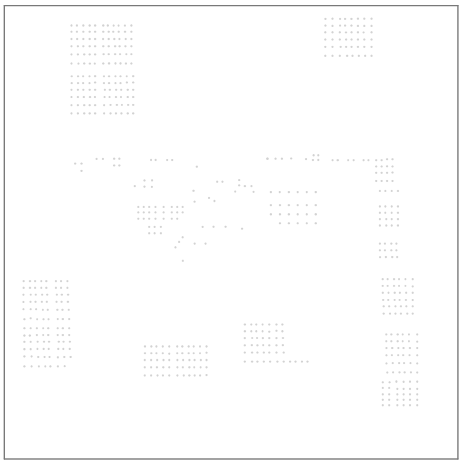


Figure 8: Bottom Silk

REVISION HISTORY

Revision #	Revision Date	Description	Pages Updated
1.0	5/22/2024	Initial Release	-