EV6602-V-01A

35V, 4A, Stepper Motor Driver with Stall Detection and Serial Interface Evaluation Board

DESCRIPTION

The EV6602-V-01A is an evaluation board designed to demonstrate the capabilities of the MP6602, a stepper motor driver with a built-in indexer and internal current regulation. It is suitable for 3D printers, laser printers, copiers and textile machines.

The MP6602 operates across a 4.5V to 35V input voltage (V_{IN}) range. It can deliver up to 4A of motor current per phase, and can operate a bipolar or unipolar stepper motor in full-, half-, quarter-, eighth-, 1/16- and 1/32-step modes.

The MP6602 has an automatic hold current mode. It can lower the winding current automatically when the full current is not required to save power (e.g. when the motor is stopped or under light-load conditions). In this mode, the motor step position is held.

Stall detection is achieved by measuring the motor's back electromotive force (EMF), and comparing it to a preset value.

Internal safety features and diagnostic functions include under-voltage lockout (UVLO) protection, over-voltage protection (OVP), over-current protection (OCP), open-load detection (OLD), stall detection, over-temperature warning (OTW), and over-temperature shutdown (OTS).

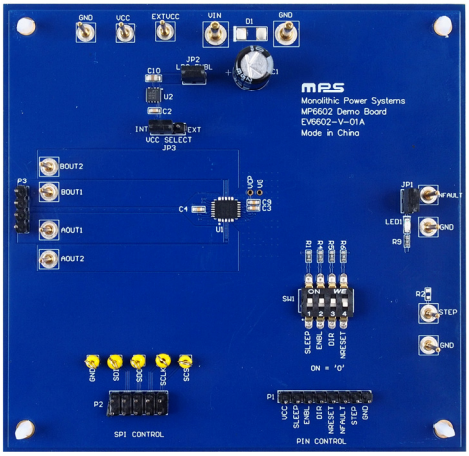
The MP6602 is available in a small QFN-25 (4mmx5mm) package. It has excellent thermal performance, with a temperature rise of only about 26°C above the ambient temperature (while the evaluation board drives 4A of motor current).

PERFORMANCE SUMMARY

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

Parameters	Conditions	Value
Input voltage (V_{IN}) range		4.5V to 35V
VCC voltage (V_{VCC}) range		3V to 5.5V
Maximum output current (I_{OUT})		4A

EVALUATION BOARD



LxWxH (10cmx10cmx2.5cm)

Board Number	MPS IC Number
EV6602-V-01A	MP6602GV

QUICK START GUIDE

1. Preset power supply between 4.5V and 35V.
2. Connect the SPI communication interface to P2.
3. Connect the external step signal terminals to:
   a. Positive (+): STEP
   b. Negative (-): GND
4. Connect the stepper motor to P3.
5. There is 3.3V output LDO on the board. No additional logic power supply is typically required. If an additional logic power supply is desired, select the external VCC via JP3. Connect an external VCC to EXTVCC.
6. Connect the logic power supply terminals to:
   a. Positive (+): EXTVCC
   b. Negative (-): GND
7. Connect the power supply terminals to:
   a. Positive (+): VIN
   b. Negative (-): GND
8. SLEEP, ENBL, DIR, NRESET can be controlled via SW1.
9. LED1 indicates whether a fault has occurred [e.g. a stall, open-load fault, over-current (OC) fault, under-voltage (UV) fault, over-voltage (OV) fault, or over-temperature (OT) fault].

Figure 1 shows the measurement equipment set-up.

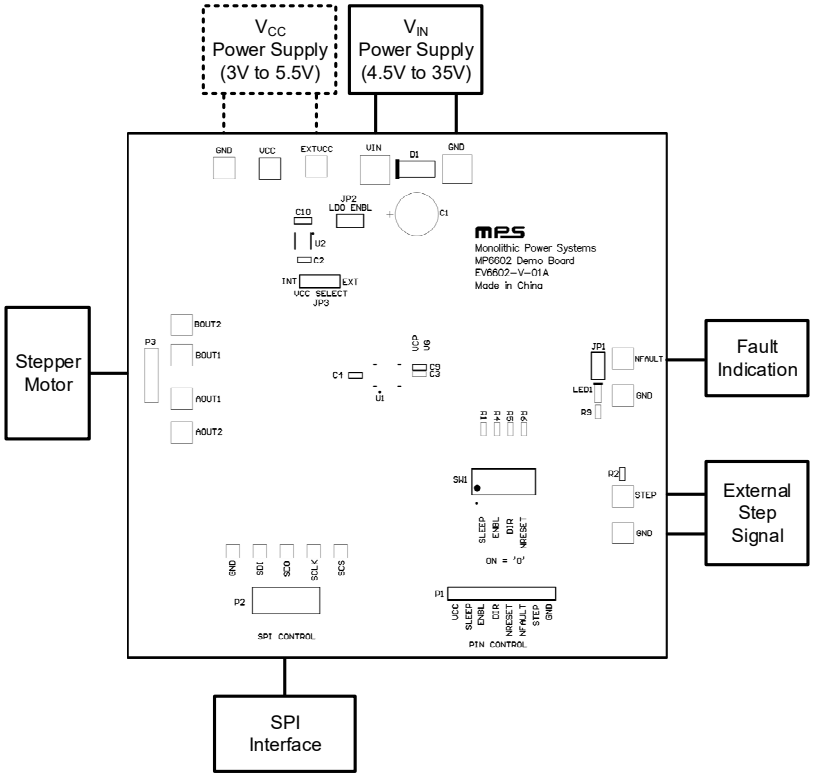


Figure 1: Measurement Equipment Set-Up

GUI OPERATION

To set up the GUI interface, refer to Figure 2 and follow the guidelines below:

1. Select the basic configuration options [step mode, peak current (I_{SET}), off time, blanking time, automatic hold function, automatic hold current (I_L), open-load detection (OLD), and unipolar mode] in the Basic Config section.
2. Select the back electromotive force (EMF) detection and stall detection configurations in the Stall Detection section.
3. Select the SPI clock frequency in the Operation section.
4. Click the “Send” button to send the selected configurations.
5. Click the “Enable” button to enable or disable the part.
6. Click the “CW” button to control the motor direction.
7. Click the “Step” button to increment or decrement the contents of the STSP register.

The fault diagnosis results can be viewed in real time in the Fault Indication section. All of the internal registers can be viewed under the Register Map section.

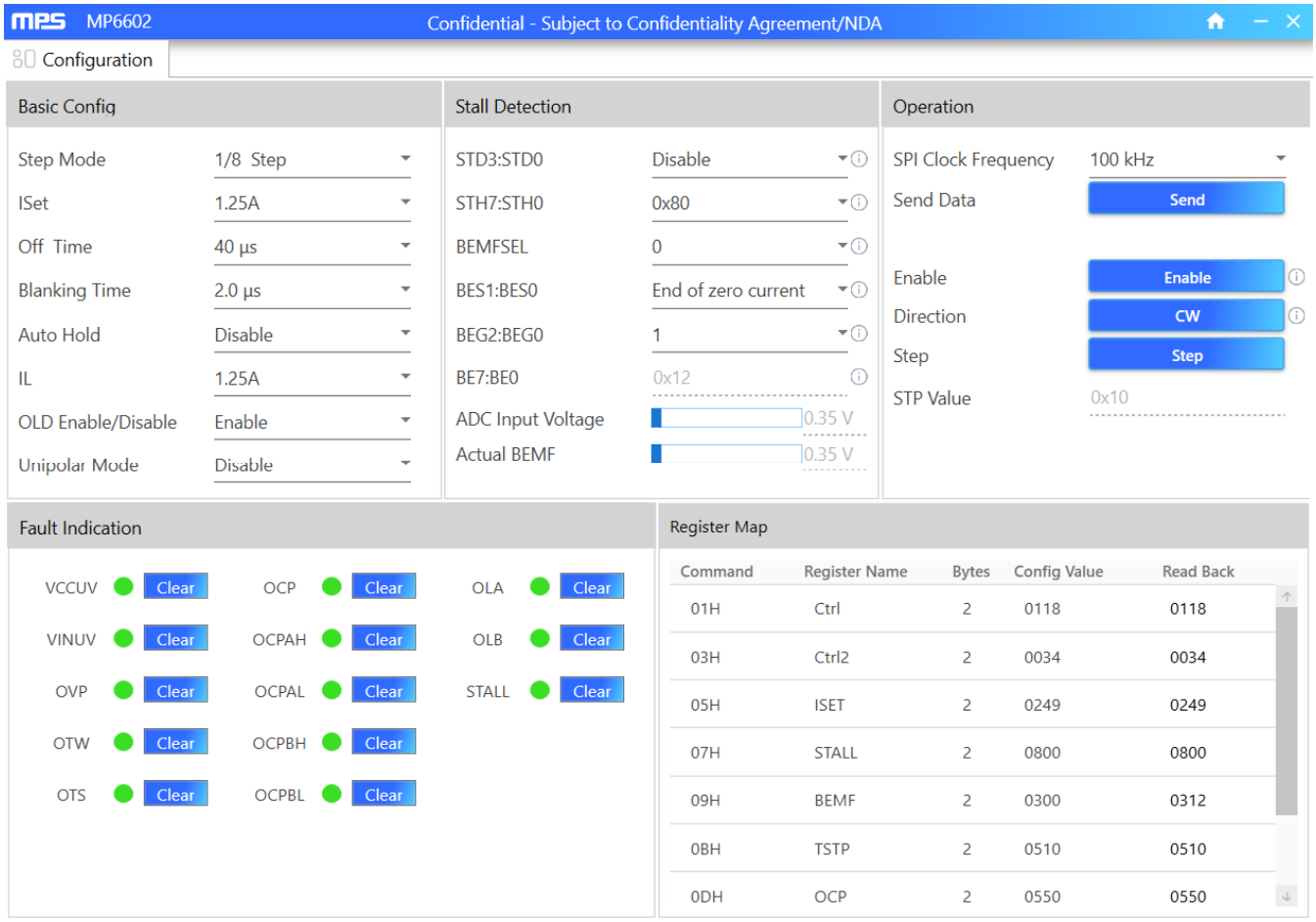


Figure 2: MP6602 GUI Interface

EVALUATION BOARD SCHEMATIC

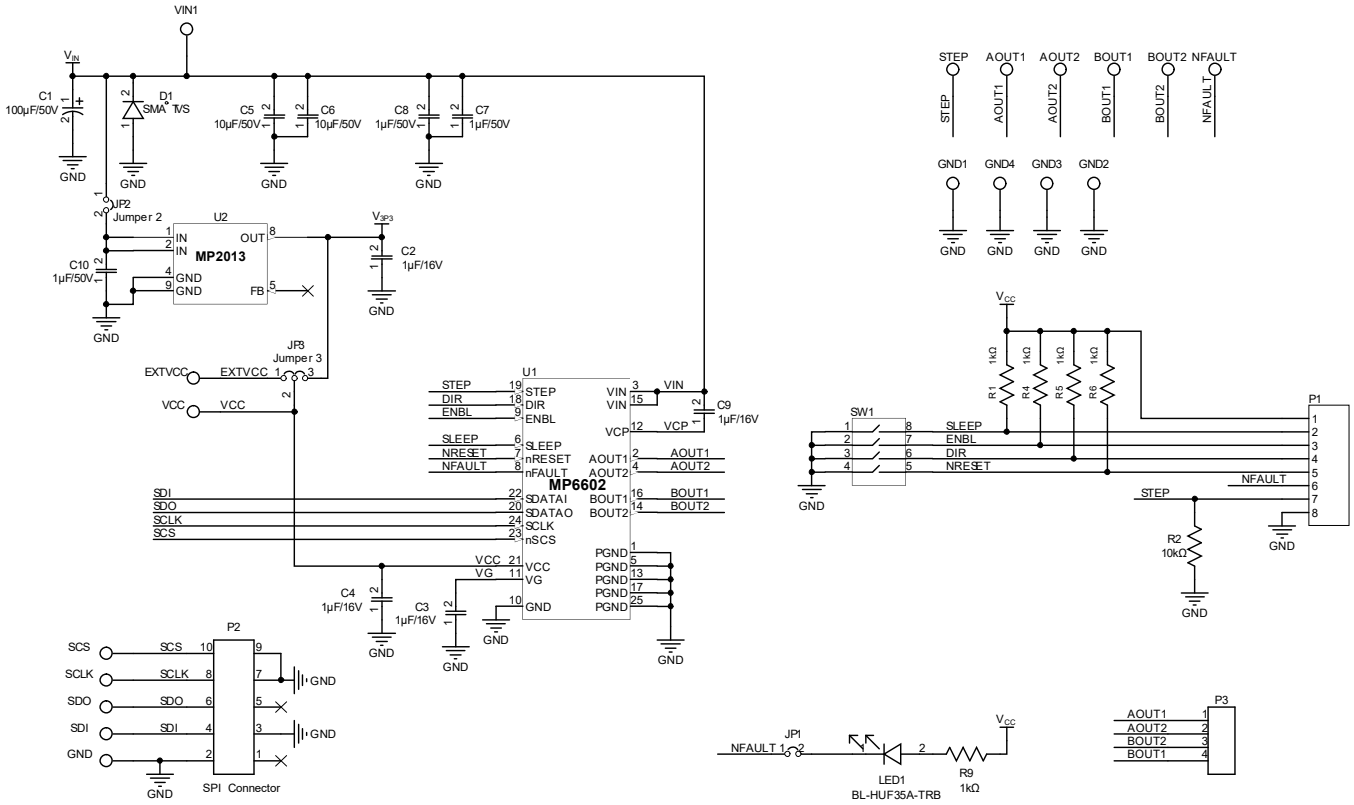


Figure 3: Evaluation Board Schematic

EV6602-V-01A BILL OF MATERIALS

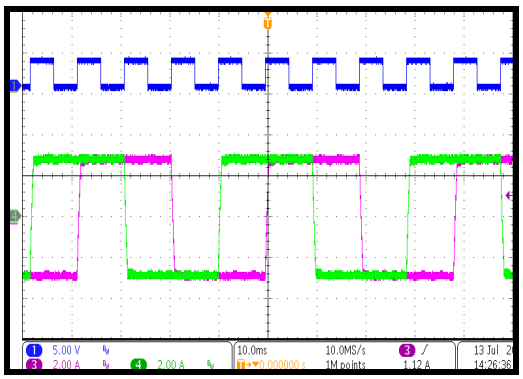
Qty	Ref	Value	Description	Package	Manufacturer	Manufacturer PN
1	C1	100µF	Electrolytic capacitor, 50V	DIP	Rubycon	50YXF100MEFC
4	C2, C3, C4, C9	1µF	Ceramic capacitor, 16V, X7R	0603	Wurth	885012206052
2	C5,C6	10µF	Ceramic capacitor, 50V, X7R	1210	Murata	GRM32ER71H106 KA12L
3	C7, C8, C10	1µF	Ceramic capacitor, 50V, X7R	0805	Wurth	885012207103
5	R1, R4, R5, R6, R9	1kΩ	Film resistor, 1%,	0603	Yageo	RC0603FR-071KL
	R2	NS				
	D1	NS				
1	LED1	Red	Red LED	0805	Baihong	BL-HUE35A-AV-TRB
5	JP1, JP2, JP3, P1, P3	2.54mm	Single-line connector	SIP	Custom	
1	P2	2.54mm	Dual-line connector	DIP	Custom	
1	SW1	25mA	4-bit switch	SMD	Wurth	418121270804
5	SDI, SDO, SCLK, SCS, GND	1mm	Test point	SIP	Custom	
2	VIN, GND	2mm	Pin (male)	SIP	Custom	
11	AOUT1, AOUT2, BOUT1, BOUT2, STEP, FAULT, VCC, EXTVCC, GND, GND, GND	1mm	Pin (male)	SIP	Custom	
1	U1	MP6602	Stepper motor driver	QFN-25 (4mmx 5mm)	MPS	MP6602GV
1	U2	MPQ2013A	LDO regulator	QFN-8 (3mmx 3mm)	MPS	MPQ2013AGQ-33-Z

EVB TEST RESULTS

V_{IN} = 24V, I_{PEAK} = 4A, T_A = 25°C, bipolar stepper motor (R = 0.8Ω, L = 7mH/phase), unless otherwise noted.

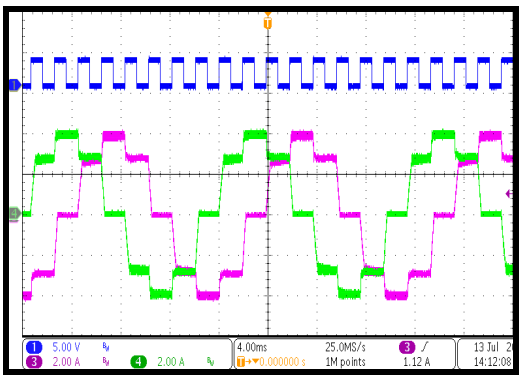
Full Step

CH1: V_{STEP}
CH3: I_{OUT_A}
CH4: I_{OUT_B}



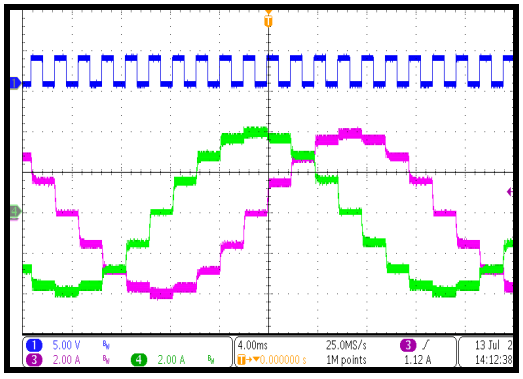
Half Step

CH1: V_{STEP}
CH3: I_{OUT_A}
CH4: I_{OUT_B}



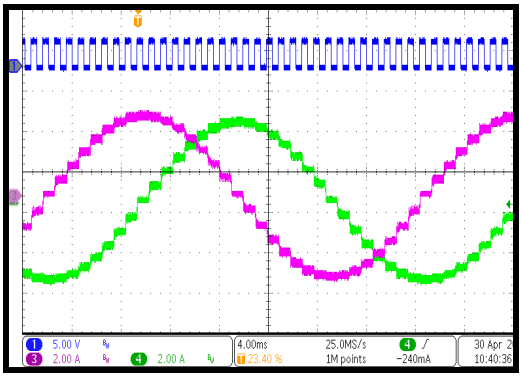
1/4 Microstepping

CH1: V_{STEP}
CH3: I_{OUT_A}
CH4: I_{OUT_B}



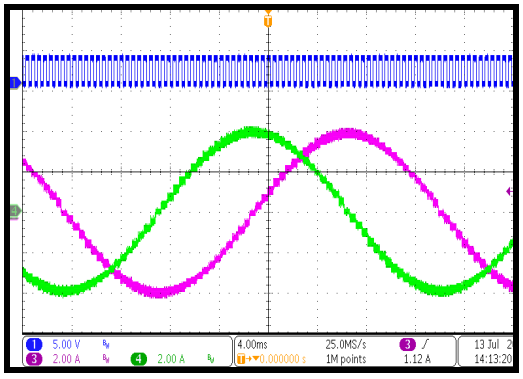
1/8 Microstepping

CH1: V_{STEP}
CH3: I_{OUT_A}
CH4: I_{OUT_B}



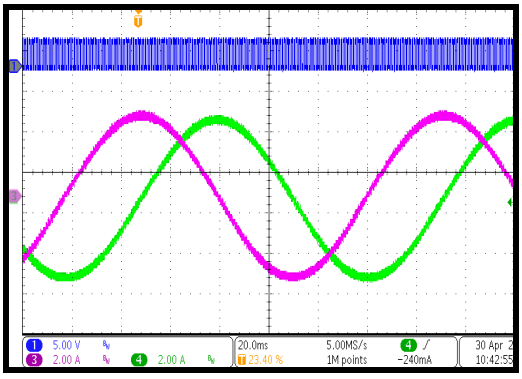
1/16 Microstepping

CH1: V_{STEP}
CH3: I_{OUT_A}
CH4: I_{OUT_B}



1/32 Microstepping

CH1: V_{STEP}
CH3: I_{OUT_A}
CH4: I_{OUT_B}

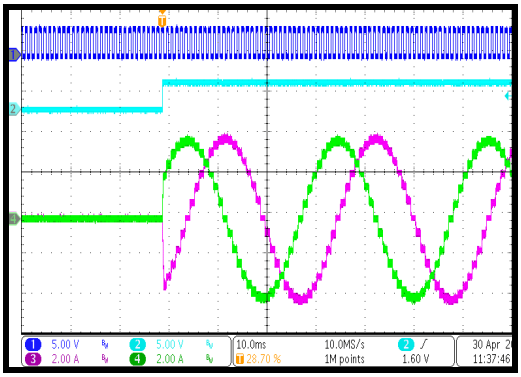


EVB TEST RESULTS *(continued)*

V_{IN} = 24V, I_{PEAK} = 4A, T_A = 25°C, bipolar stepper motor (R = 0.8Ω, L = 7mH/phase), unless otherwise noted.

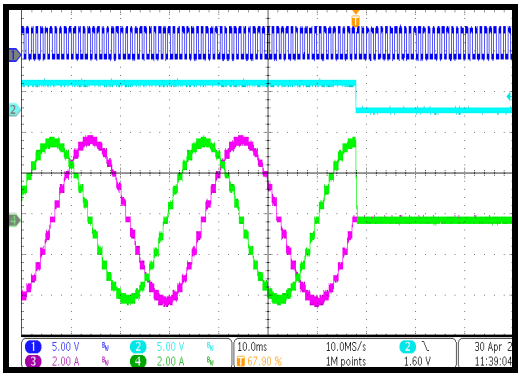
Output Enabled

CH1: V_{STEP}
CH2: V_{ENBL}
CH3: I_{OUT_A}
CH4: I_{OUT_B}



Output Disabled

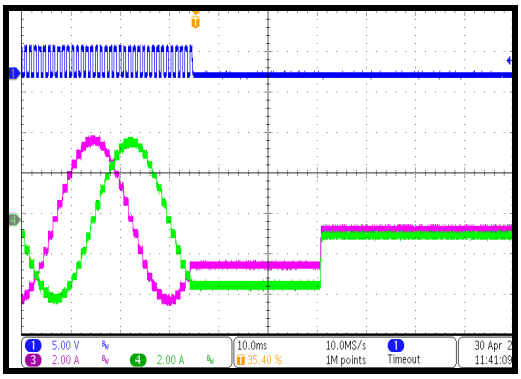
CH1: V_{STEP}
CH2: V_{ENBL}
CH4: I_{OUT_B}
CH3: I_{OUT_A}



Automatic Hold Current Entry

Peak hold current = 1A

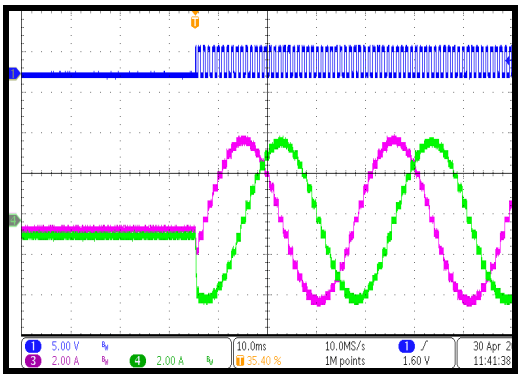
CH1: V_{STEP}
CH4: I_{OUT-B}
CH3: I_{OUT-A}



Automatic Hold Current Exit

Peak hold current = 1A

CH1: V_{ENBL}
CH3: V_{CLAMP}
CH4: I_{OUT}



PCB LAYOUT

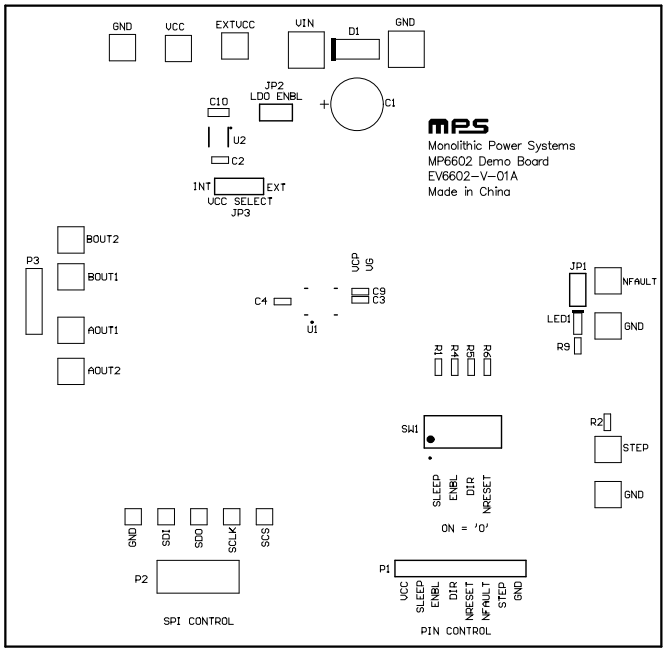


Figure 4: Top Silk

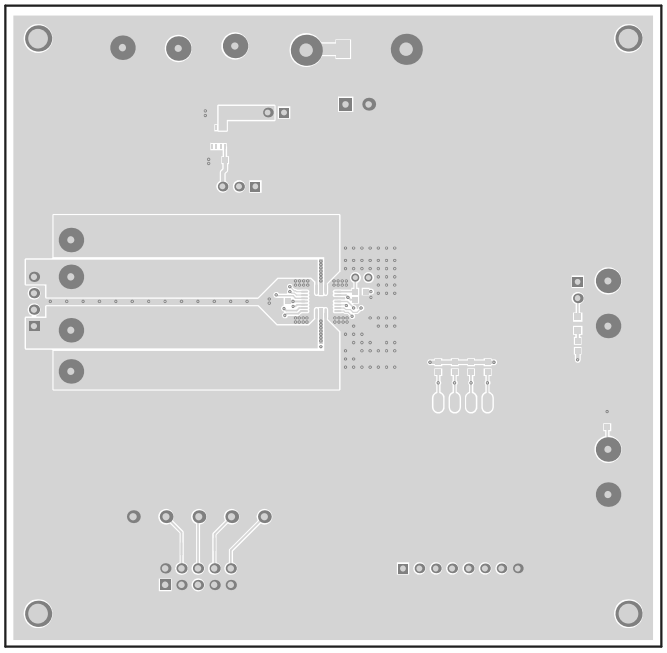


Figure 5: Top Layer

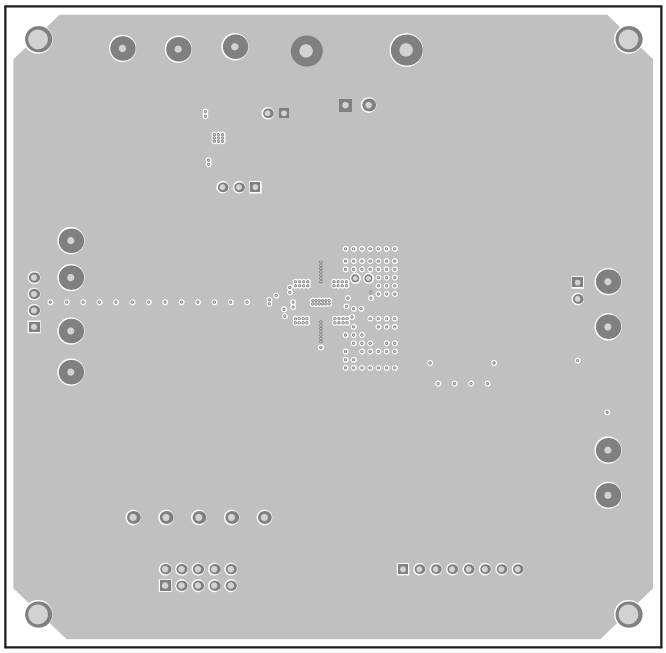


Figure 6: Mid-Layer 1

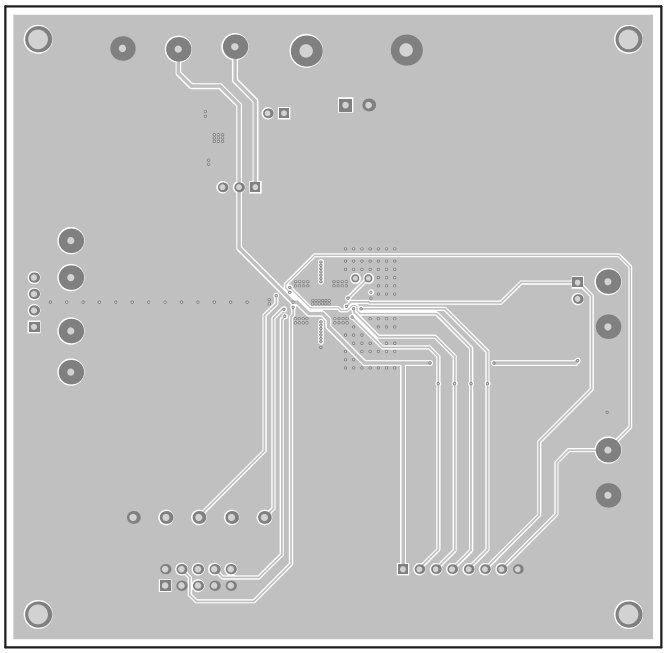


Figure 7: Mid-Layer 2

PCB LAYOUT *(continued)*

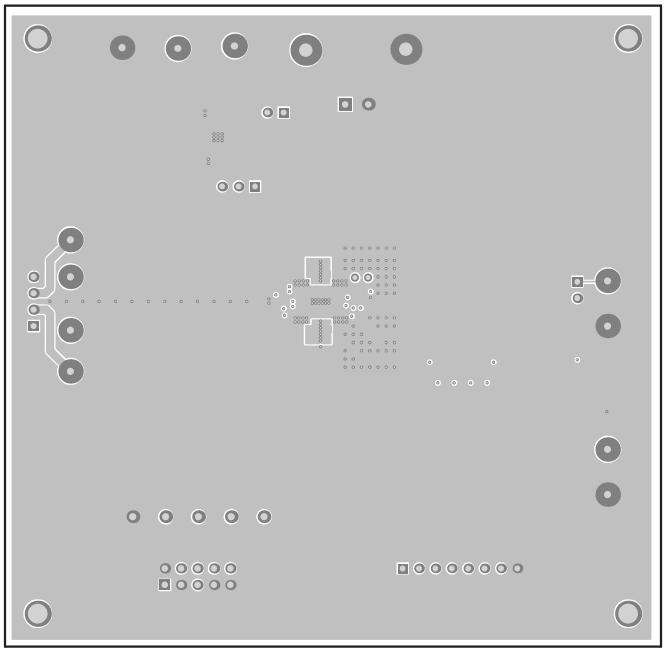


Figure 8: Bottom Layer

REVISION HISTORY

Revision #	Revision Date	Description	Pages Updated
1.0	9/21/2022	Initial Release	-

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