EVQ6609-L-00A

32V, 1A, Stepper Motor Driver with Stall Detection and Serial Interface Evaluation Board, AEC-Q100 Qualified

DESCRIPTION

The EVQ6609-L-00A is an evaluation board designed to demonstrate the capabilities of the MPQ6609, a stepper motor driver with a built-in indexer and internal current regulation. It is suitable for headlight position adjustment, EXV and ECV stepper motors, HUD, and HVAC stepper motors.

The MPQ6609 operates across a 4V to 32V input voltage (V_{IN}) range. It can deliver up to 1A 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.

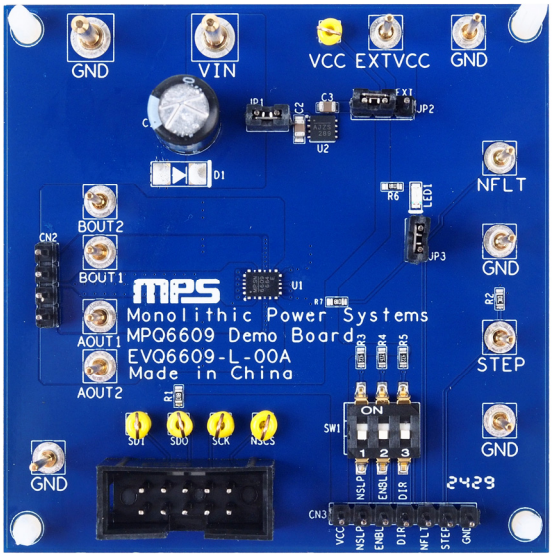
The MPQ6609 has an automatic hold current mode. It can lower the winding current automatically when the full current is not required to save power (e.g. when the motor is stopped or under light-load conditions). This mode maintains the motor step position.

The MPQ6609 features stall detection, which is achieved by measuring the motor's back electromotive force (BEMF) 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), over-temperature shutdown (OTS), and low-temperature detection (LTD).

The MPQ6609 is available in a small QFN-18 (3mmx4mm) package. It features excellent thermal performance, with a temperature rise of about 31°C above the ambient temperature (T_A) while the EVQ6609-L-00A drives 1A of motor current and V_{IN} is equal to 12V.

EVALUATION BOARD



LxWxH (6.5cmx6.5cmx2.5cm)

Board Number	MPS IC Number
EVQ6609-L-00A	MPQ6609GLE

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QUICK START GUIDE

1. Preset power supply to be between 4V and 32V.
2. Connect the serial peripheral interface (SPI) communication interface to CN1.
3. Connect the external step signal terminals to:
   a. Positive (+): STEP
   b. Negative (-): GND
4. Connect the stepper motor to CN2.
5. There is 3.3V output low-dropout (LDO) regulator on the board. Typically, no additional logic power supply is required. If an additional logic power supply is needed, select the external VCC via JP2. 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. Control nSLEEP, ENBL, and DIR 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.

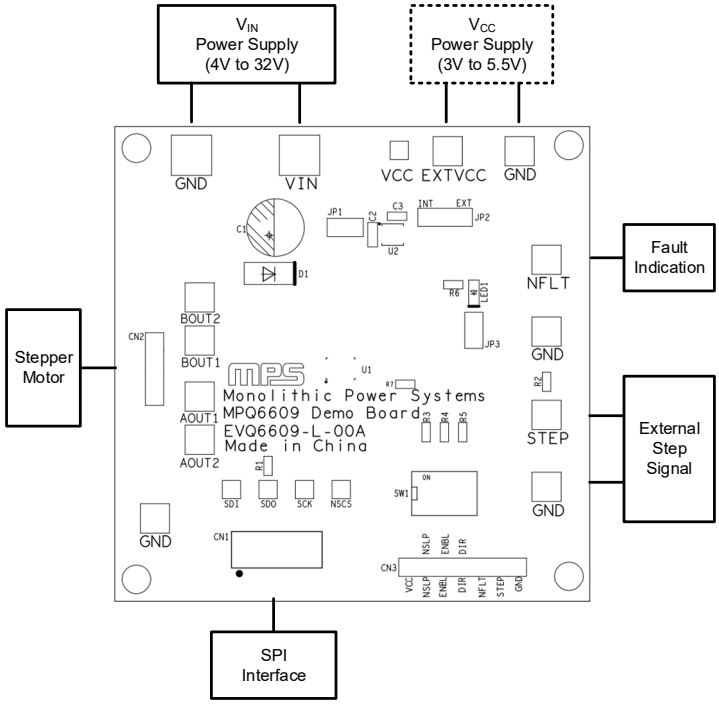

Figure 1: Measurement Equipment Set-Up

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GUI OPERATION

To set up the GUI interface, refer to Figure 3 and follow the guidelines below:

1. Select the drive mode, then enter the main control interface (see Figure 2).

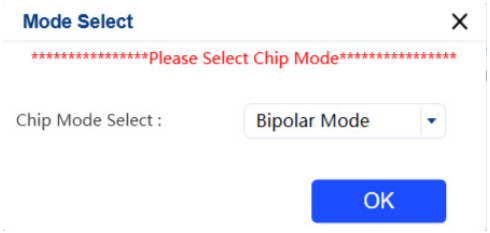

Figure 2: Chip Mode Selection

2. Select the basic configuration options in the Basic Config section. This options include the step mode, peak current (I_{SET}), off time, blanking time, automatic hold function, automatic hold current (I_L), open-load detection (OLD), slew rate, and charge pump frequency.
3. Select the back electromotive force (BEMF) detection and stall detection configurations in the Stall Detection section.
4. Select the SPI clock frequency in the Operation section.
5. Click the “Send” button to send the selected configurations.
6. Click the “Enable” button to enable or disable the part.
7. Click the “CW” button to control the motor direction.
8. 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.

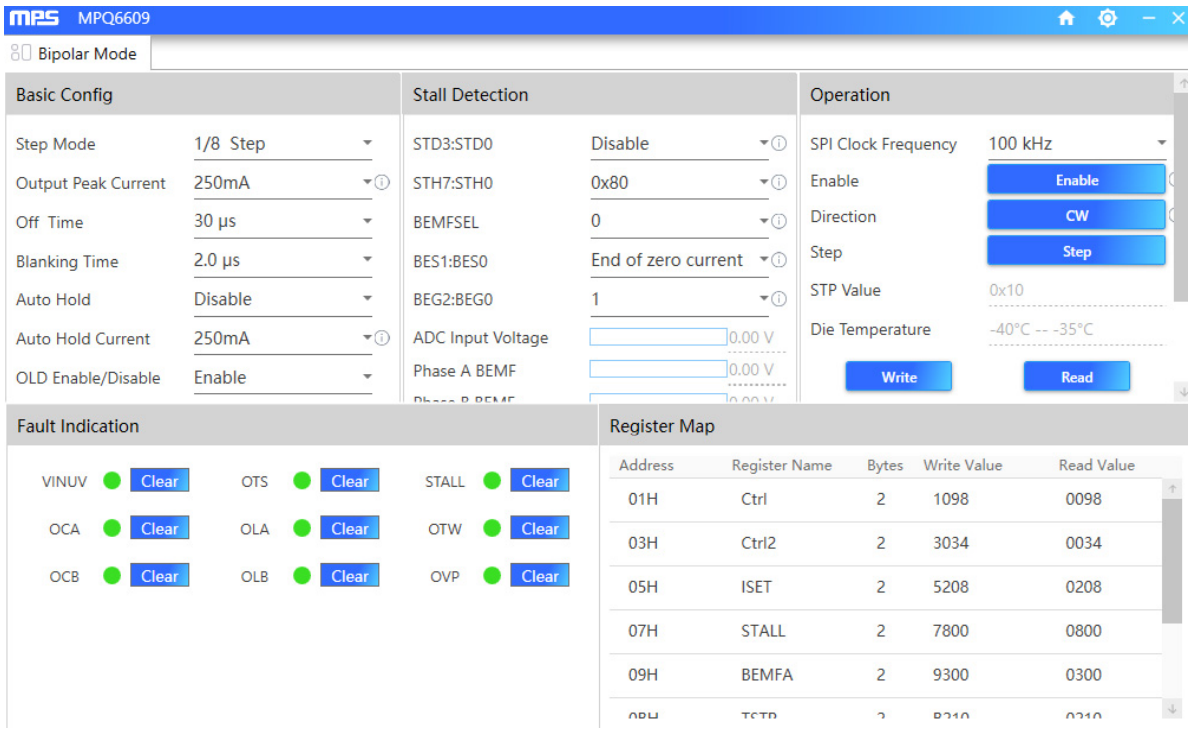

Figure 3: MPQ6609 GUI Interface

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EVALUATION BOARD SCHEMATIC

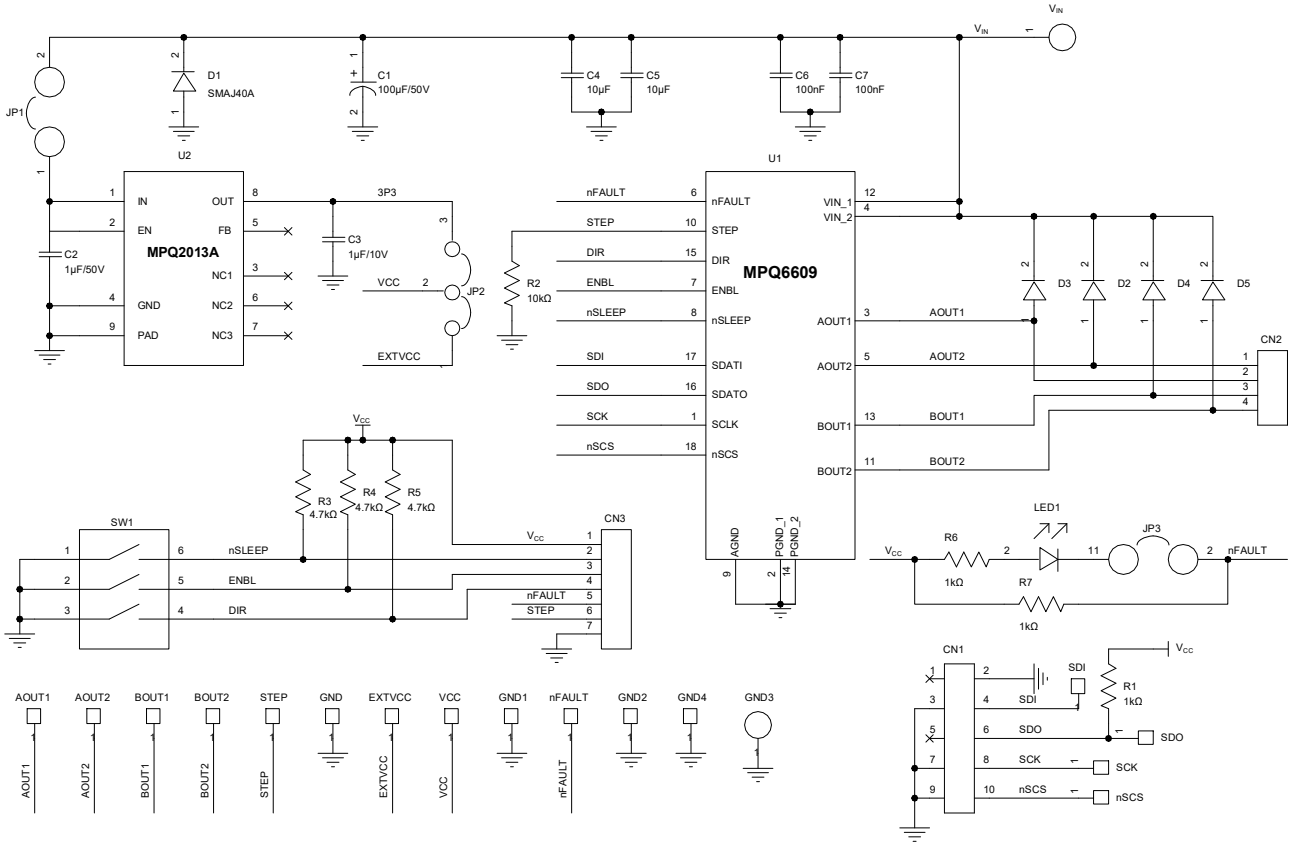

Figure 4: Evaluation Board Schematic

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EVQ6609-L-00A BILL OF MATERIALS

Qty	Ref	Value	Description	Package	Manufacturer	Manufacturer PN
1	C1	100μF	Electrolytic capacitor, 50V	DIP	Rubycon	50YXF100MEFC
2	C2, C3	1μF	Ceramic capacitor, 50V, X7R	0805	Murata	GCM21BR71H105KA03L
2	C4, C5	10μF	Ceramic capacitor, 50V, X7R	1210	Murata	GRM32ER71H106KA12L
2	C6, C7	100nF	Ceramic capacitor, 50V, X7R	0603	Murata	GRM188R71H104KA93D
3	R1, R6, R7	1kΩ	Film resistor, 1%	0603	Yageo	RC0603FR-071KL
1	R2	10kΩ	Film resistor, 1%	0603	Yageo	RC0603FR-0710KL
3	R3, R4, R5	4.7kΩ	Film resistor, 1%	0603	Yageo	RC0603FR-074K7L
1	D1	NS				
1	LED1	Red	Red LED	0805	Baihong	BL-HUE35A-AV-TRB
1	CN1	2.54mm	Dual-line connector	DIP	Any	
2	CN2,CN3	2.54mm	Single-line connector	SIP	Any	
3	JP1, JP2, JP3	2.54mm	Single-line connector	SIP	Any	
1	SW1	25mA	3-bit switch	SMD	Wurth	418121270803
5	SDI, SDO, SCLK, SCS, GND	1mm	Test point	SIP	Any	
2	VIN, GND	2mm	Golden pin (male)	SIP	Any	
11	AOUT1, AOUT2, BOUT1, BOUT2, STEP, FAULT, VCC, EXTVCC, GNDx3	1mm	Golden pin (male)	SIP	Any	
1	U2	MPQ2013A	2.5V to 40V, low power linear regulator	QFN-8 (3mmx3 mm)	MPS	MPQ2013AGQ-33-Z
1	U1	MPQ6609	4V to 32V,1A, Stepper motor driver	QFN-18 (3mmx4 mm)	MPS	MPQ6609GLE-AEC1

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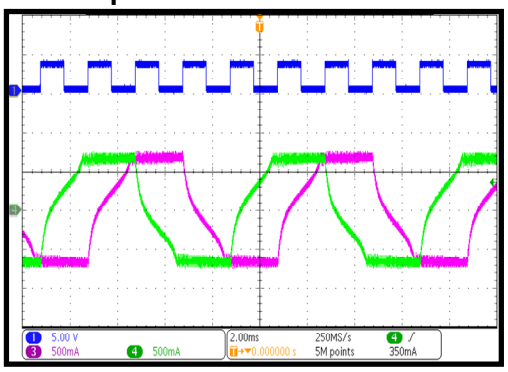
EVB TEST RESULTS

V_{IN} = 12V, I_{PEAK} = 1A, T_A = 25°C, bipolar stepper motor (R = 5.9Ω, L = 13.5mH/phase), unless otherwise noted.

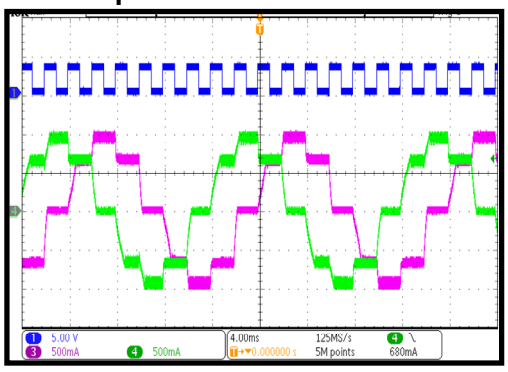
Full Step

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



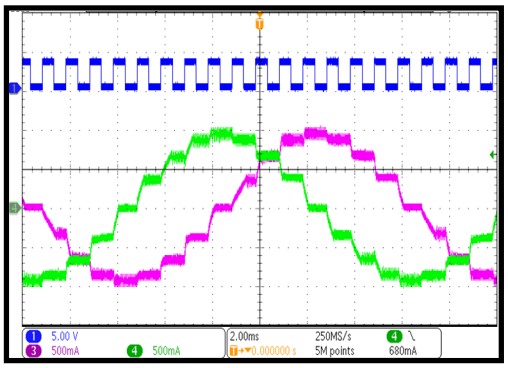
Half-Step

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



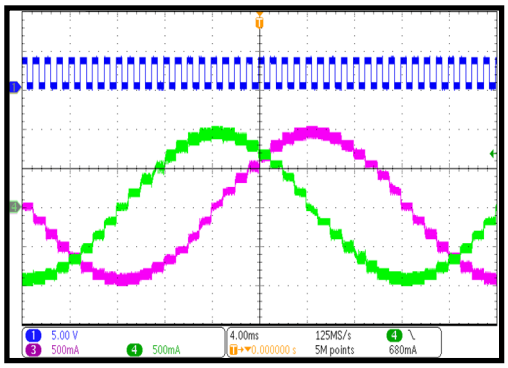
1/4 Microstepping

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



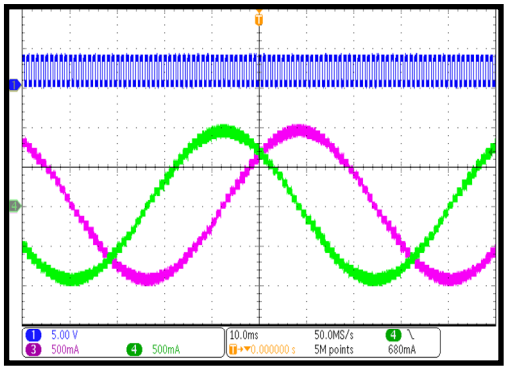
1/8 Microstepping

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



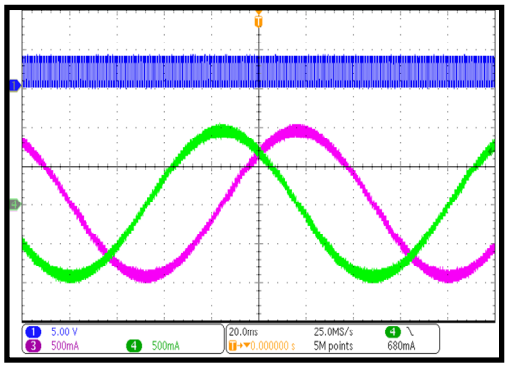
1/16 Microstepping

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



1/32 Microstepping

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



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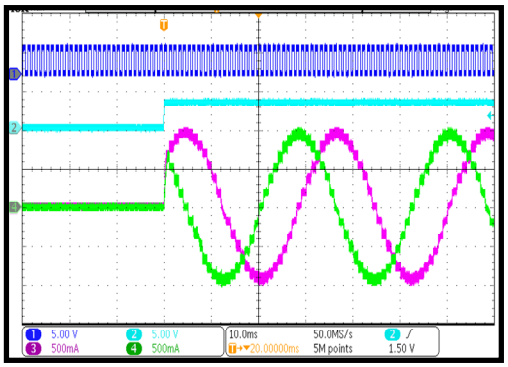
EVB TEST RESULTS *(continued)*

V_{IN} = 12V, I_{PEAK} = 1A, T_A = 25°C, bipolar stepper motor (R = 5.9Ω, L = 13.5mH/phase), unless otherwise noted.

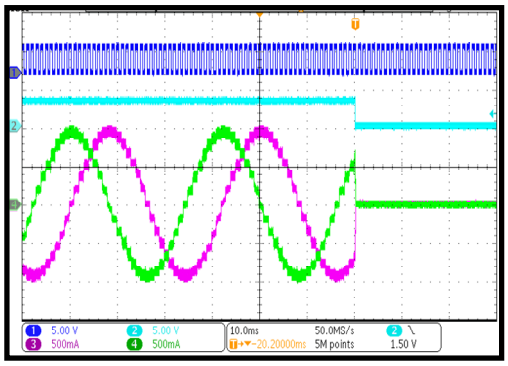
Output Enabled

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



Output Disabled

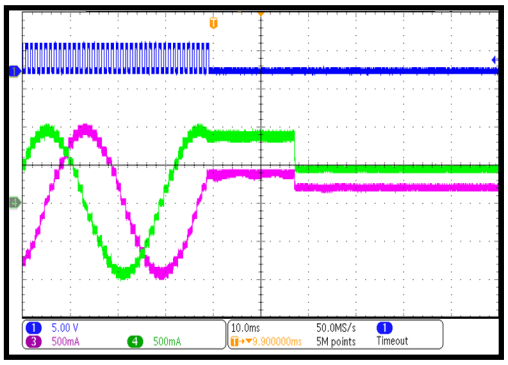
CH1: STEP
CH2: ENBL
CH4: I_{OUT_B}
CH3: I_{OUT_A}



Automatic Hold Current Entry

Peak hold current = 500mA

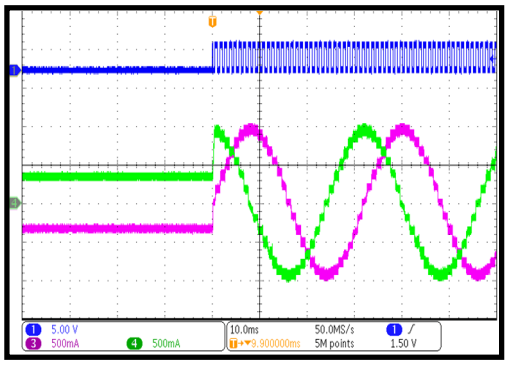
CH1: STEP
CH4: I_{OUT_B}
CH3: I_{OUT_A}



Automatic Hold Current Exit

Peak hold current = 500mA

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



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PCB LAYOUT

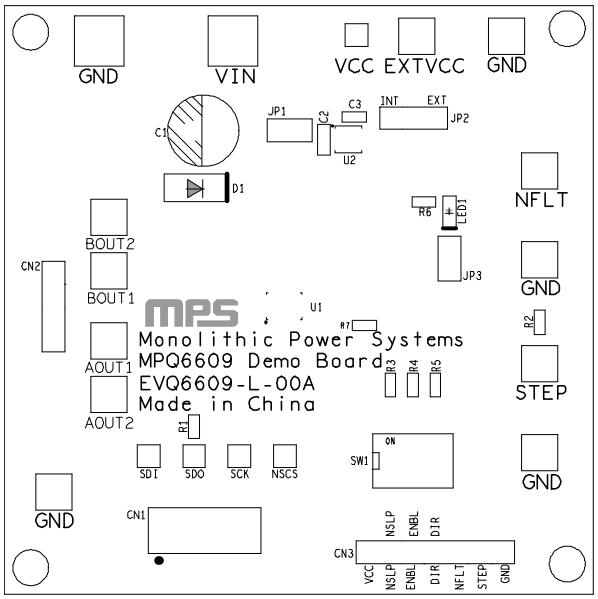

Figure 5: Top Silk

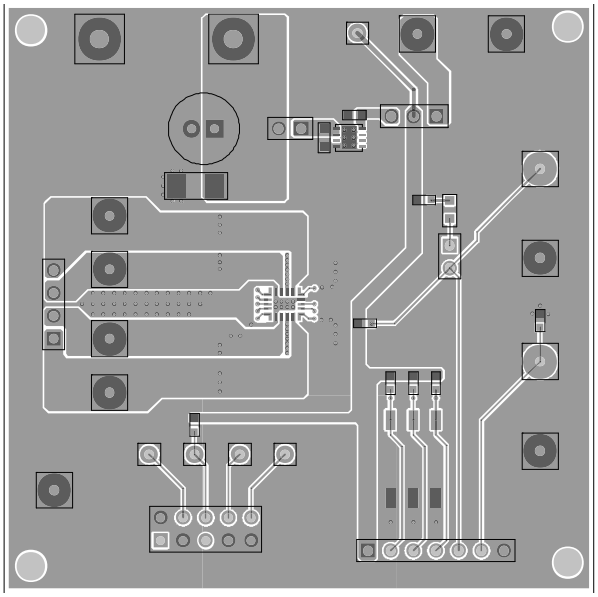

Figure 6: Top Layer

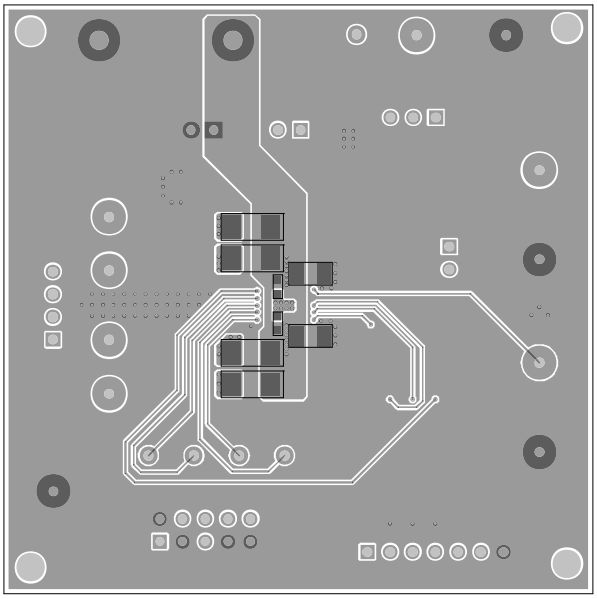

Figure 7: Bottom Layer

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REVISION HISTORY

Revision #	Revision Date	Description	Pages Updated
1.0	11/12/2024	Initial Release	-

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