



EVQ6533-U-01A

40V, Three-Channel Automotive Pre-Driver with Serial Input Control Evaluation Board, AEC-Q100 Qualified

DESCRIPTION

The EVQ6533-U-01A evaluation board is designed to demonstrate the capabilities of the MPQ6533, a three-channel automotive pre-driver with serial input control. The device is suitable for automotive actuators and brushed DC motor driver applications.

The MPQ6533 integrates a low-dropout (LDO) regulator to generate gate drive voltages for the low-side MOSFETs (LS-FETs). It also provides a charge pump that generates a voltage to drive an external N-channel MOSFET for reverse battery protection. The high-side (HS) gate drive voltage is generated by the bootstrap (BST)

capacitors (C_{BST}) and an internal charge pump, which allows for 100% duty cycle operation.

An internal amplifier measures the voltage drop across the LS-FETs. This allows the current to be measured without using shunt resistors.

Internal safety features include configurable over-current protection (OCP), adjustable dead time (DT) control, under-voltage lockout (UVLO) and over-temperature (OT) shutdown.

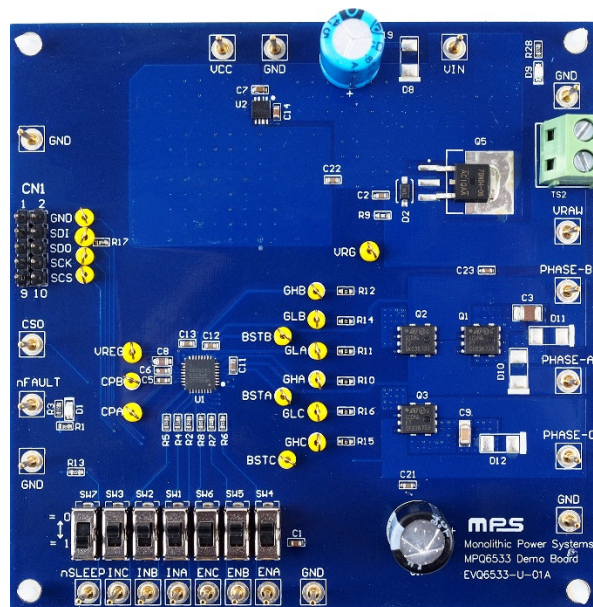
The MPQ6533 is available in a QFN-32 (5mmx5mm) package with an exposed thermal pad, and is AEC-Q100 qualified.

PERFORMANCE SUMMARY

Specifications are at $T_A = 25^\circ\text{C}$, unless otherwise noted.

Parameters	Conditions	Value
Input power supply voltage (V_{IN}) range		6V to 40V

EVQ6533-U-01A EVALUATION BOARD



LxWxH (10cmx10cmx2.5cm)

Board Number	MPS IC Number
EVQ6533-U-01A	MPQ6533GUE-AEC1

QUICK START GUIDE

The EVQ6533-U-01A evaluation board is easy to set up and use to evaluate the MPQ6533's performance. For proper measurement equipment set-up, refer to Figure 1 and follow the steps below:

1. Switch SW7 down to 1 to activate the part.
2. If necessary, connect the external logic control signals to the logic input terminals.
3. Connect the serial peripheral interface (SPI) communication interface to CN1.
4. Connect the loads to the output terminals.
5. Connect the input power supply terminals (where the recommended operating voltage range is between 6V and 40V) to:
 - a. Positive (+): VRAW
 - b. Negative (-): GND
6. Enable the ENVRG bit via the SPI.
7. Set up the functional configurations via the GUI (see the GUI Operation section on page 3 for more details).
8. D1 indicates fault events, and D9 indicates the system power.

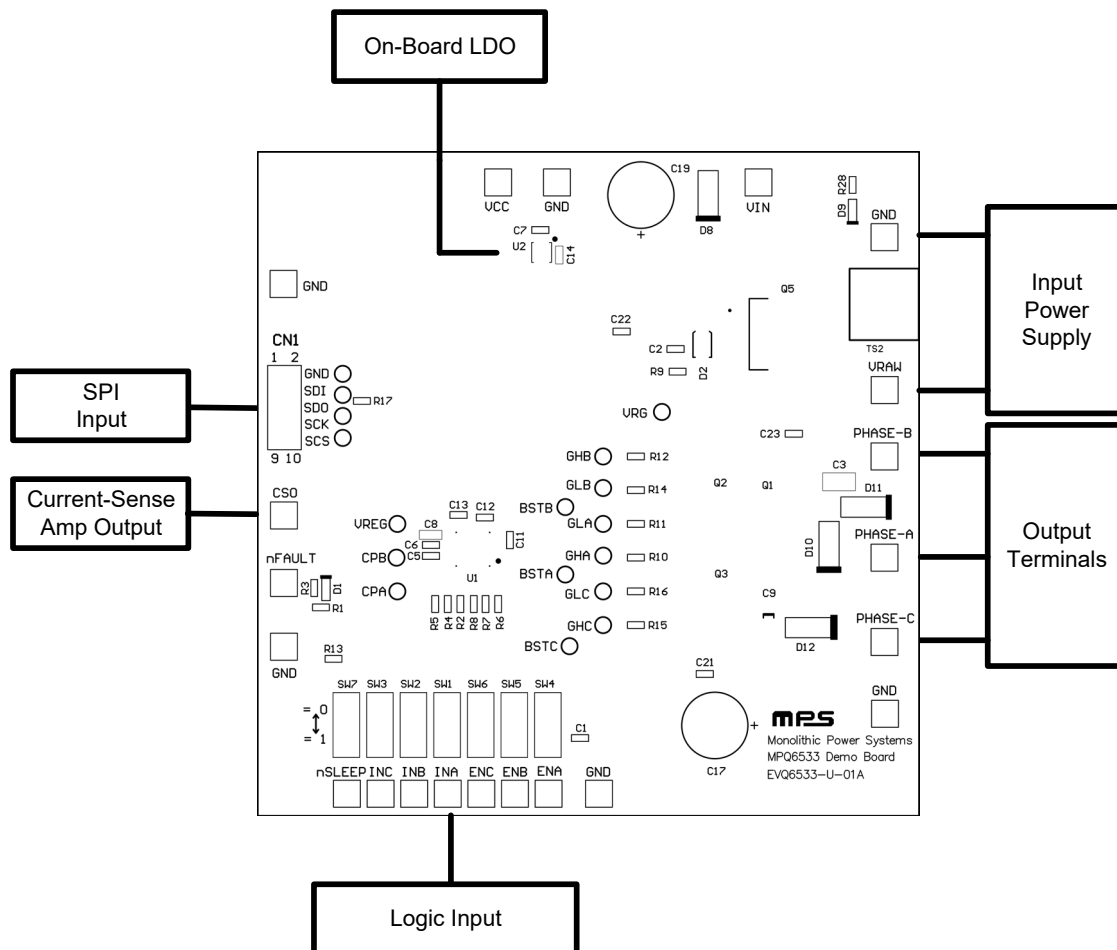


Figure 1: Measurement Equipment Set-Up

GUI Operation

Figure 2 shows the control interface for the three-channel pre-driver.

The screenshot shows a web-based configuration interface for the EVQ6533 pre-driver. The interface is divided into several sections:

- Configuration:** A top bar with the title 'MPS MPQ6533' and 'Confidential - Subject to Confidentiality Agreement/NDA'.
- Channel Parameters:** A table with columns for Channel A, Channel B, and Channel C. Each channel has parameters for ENA/ENB/ENC, INA/INB/INC, Slew Rate, Dead Time, Blanking Time, Amplifier Gain, OCP EN, OCP Threshold, and OLD EN. All parameters are currently set to default values (e.g., 0, Slowest, 6.4µs, 1µs, 20, Enable, 120mV, Enable).
- Global Settings:** A section on the right with parameters for ENVRG (Enable), CSO Multiplexer (Channel A), OCMD (Hiccup), SPI Frequency (100 KHz), and a Send Data button.
- Fault Indication:** A section showing real-time fault status for various channels (UVW, BSUVA, SCHA, SCLA, OUTA, OTW, UVLO, BSUVB, SCHB, SCLB, OUTB, OTS, VGVU, BSUVC, SCHC, SCLC, OUTC). Each fault indicator has a green light and a 'Clear' button.
- Register Map:** A table listing internal registers with columns for Command, Register Name, Bytes, Config Value, and Read Back. The registers shown are OUT, CTRLA, CTRLB, CTRLC, CTRLD, FAULT, and FAULT2.

Figure 2: EVQ6533-U-01A GUI Interface

1. Set the individual parameters (e.g. slew rate, dead time, and blanking time) for channels A, B, C.
2. Select the current-sense output channel and over-current protection (OCP) mode for the MPQ6533 under the Global section.
3. Select the SPI clock frequency, then click the “Send” button to send the configurations.
4. View the fault diagnosis results in real time under the the Fault Indication section.
5. Use OUTA, OUTB, and OUTC to report whether there is an open-load condition for channels A, B, and C, respectively. There are two different methods to report an open-load condition, described below:
 - a. If the load is connected between the output switching node (SHx) and VIN or GND, then OUTA, OUTB, and OUTC display a red light to indicate whether an open-load condition occurs in the corresponding channel.
 - b. If the load is connected between two outputs, then OUTA, OUTB, and OUTC display a green light to indicate whether an open-load condition occurs.
6. All of the internal registers can be viewed under the Register Map section.

EVALUATION BOARD SCHEMATIC

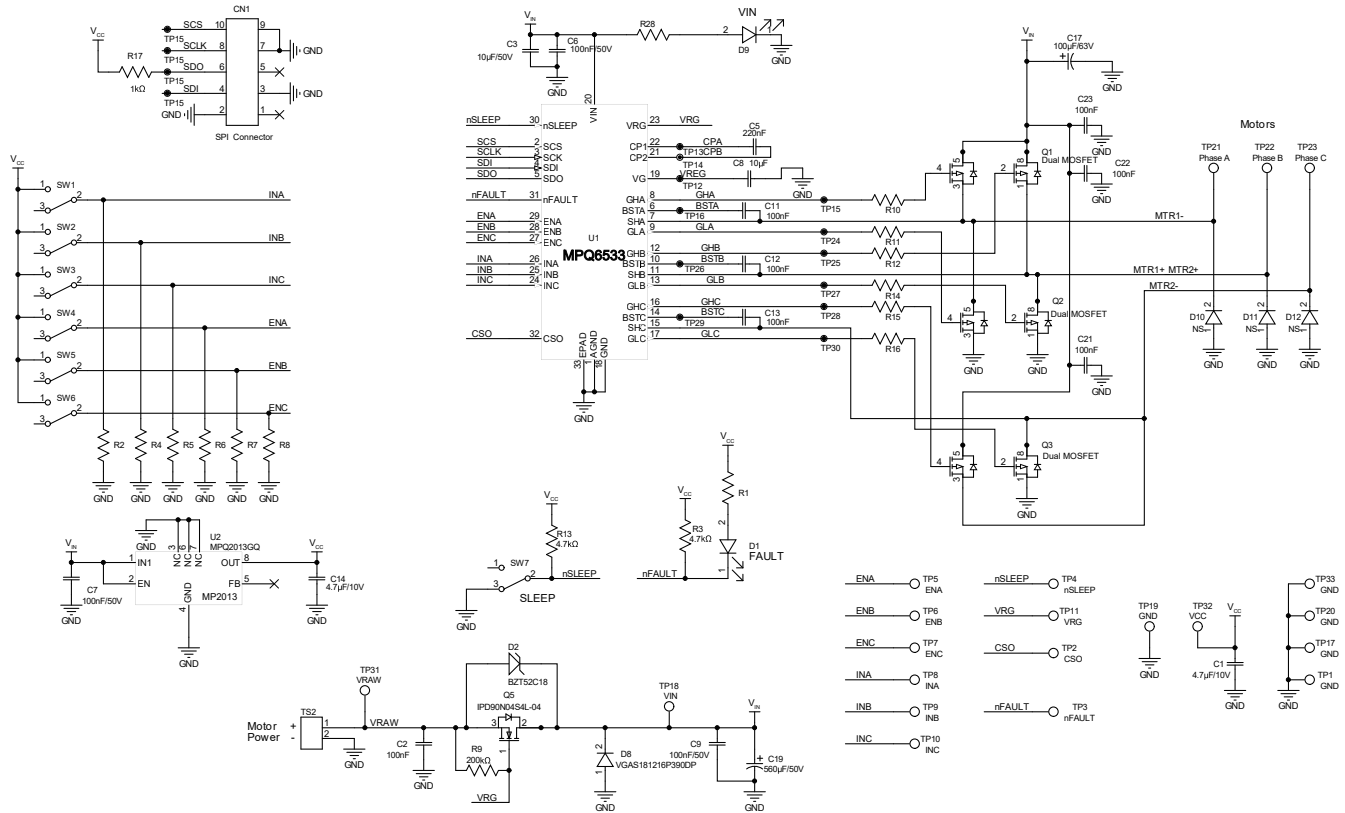


Figure 3: Evaluation Board Schematic

EVQ6533-U-01A BILL OF MATERIALS

Qty	Ref	Value	Description	Package	Manufacturer	Manufacturer PN
7	SW1, SW2, SW3, SW4, SW5, SW6, SW7	500mA	Switch	SIP	Custom	
3	Q1, Q2, Q3	60V	Dual N-channel MOSFET, 57A	PowerFlat (5mmx6mm)	ST Microelectronics	STL50DN6F7
1	Q5	40V	N-channel power MOSFET	TO-252	Analog Power	AM70N04-06D
1	D1	30mA	Red LED	0805	Baihong	BL-HUE35A-AV-TRB
1	D9	30mA	Green LED	0805	Baihong	BL-HGE35A-AV-TRB
1	D2	500mW	Zener diode, 18V	SOD-123	Diodes, Inc.	BZT52C18
1	D8	NS				
3	D10, D11, D12	NS				
2	C1, C14	4.7 μ F	Ceramic capacitor, 25V	0603	Murata	GRM188C81E475KE11D
9	C2, C6, C7, C11, C12, C13, C21, C22, C23	100nF	Ceramic capacitor, 50V	0603	Murata	GCJ188R71H104KA12D
1	C9	100nF	Ceramic capacitor, 50V	1206	Murata	GCM31ML81H104KA37L
1	C3	10 μ F	Ceramic capacitor, 50V	1210	Murata	GRM32ER71H106KA12L
1	C5	220nF	Ceramic capacitor, 25V	0603	Murata	GRM188R71E224KA88
1	C8	10 μ F	Ceramic capacitor, 25V	0805	Murata	GRM21BC71E106KE11L
1	C17	220 μ F	Electrolytic capacitor, 50V	DIP	Rubycon	50YXF220MEFC
1	C19	470 μ F	Electrolytic capacitor, 50V	DIP	Jianghai	CD110-50V470
1	R1	1k Ω	Film resistor, 1%	0603	Yageo	RC0603FR-71KL
9	R2, R3, R4, R5, R6, R7, R8, R13, R28	4.7k Ω	Film resistor, 1%	0603	Yageo	RC0603FR-74K7L
1	R9	200k Ω	Film resistor, 1%	0603	Yageo	RC0603FR-7200KL
6	R10, R11, R12, R14, R15, R16	0 Ω	Film resistor	0603	Yageo	RC0603FR-070RL
1	R17	1k Ω	Film resistor, 1%	0603	Yageo	RC0603FR-071KL
1	CN1	2.54mm	Connector, 5-pin	DIP	Custom	Custom
1	TS2	5.08mm	Connector	DIP	Custom	Custom

EVQ6533-U-01A BILL OF MATERIALS (continued)

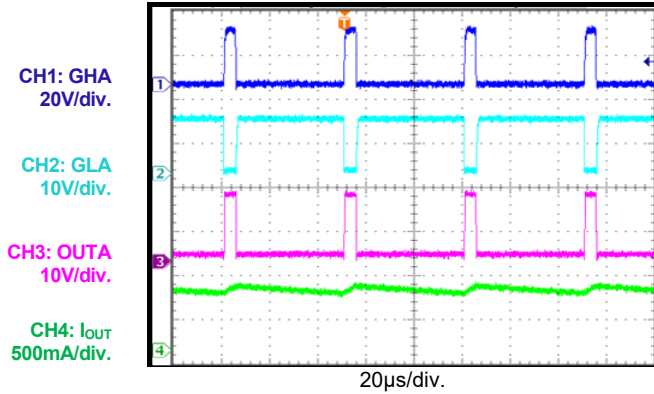
Qty	Ref	Value	Description	Package	Manufacturer	Manufacturer PN
17	SDI, SDO, SCK, SCS, GND, VREG, CPA, CPB, BSTA, BSTB, BSTC, GHA, GHB, GHC, GLA, GLB, GLC, VRG	1mm	Test point	SIP	Custom	
20	VIN, VCC, VRAW, PHASE- A, PHASE-B, PHASE-C, nSLEEP, INA, INB, INC, ENA, ENB, ENC, CSO, nFAULT, GND	1mm	Golden pin	SIP	Custom	
1	U1	MPQ6533	Three-channel automotive pre- driver, AEC-Q100 qualified	QFN-32 (5mmx 5mm)	MPS	MPQ6533GUE- AEC1
1	U2	MPQ2013	Low quiescent current linear regulator, AEC- Q100 qualified	QFN-8 (3mmx 3mm)	MPS	MPQ2013AGQ-33-Z

EVB TEST RESULTS

$V_{IN} = 14V$, $T_A = 25^\circ C$, resistor + inductor load: $R = 2\Omega$, $L = 700\mu H$, unless otherwise noted.

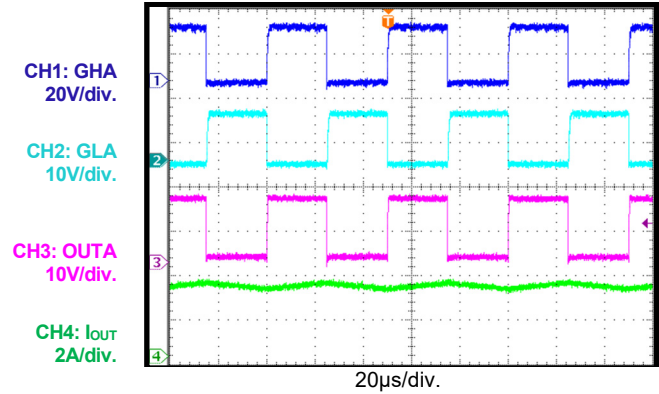
Normal Operation

20kHz, 10% duty cycle



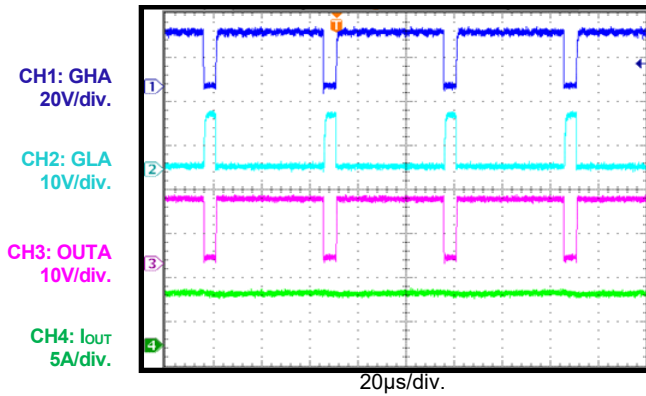
Normal Operation

20kHz, 50% duty cycle



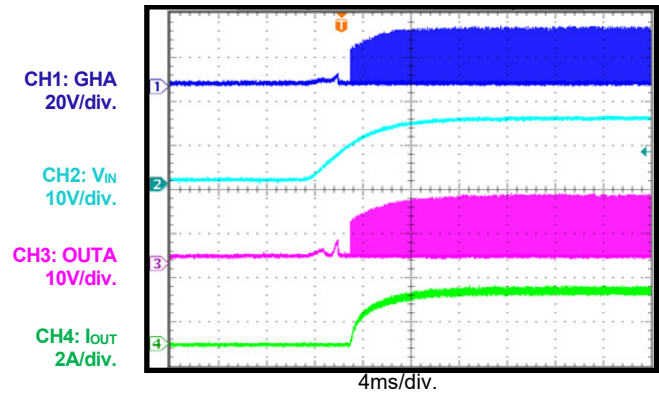
Normal Operation

20kHz, 90% duty cycle



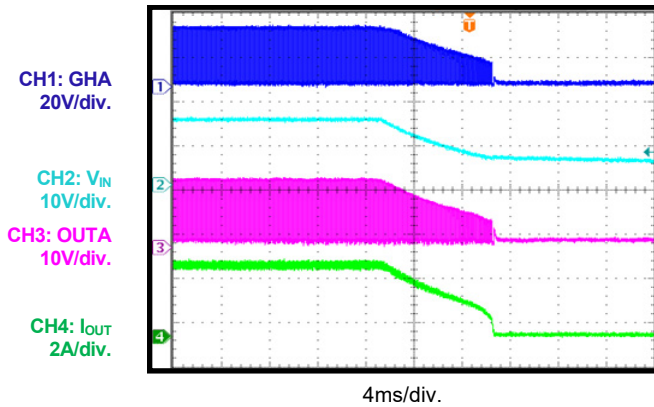
Start-Up through VIN

20kHz, 50% duty cycle



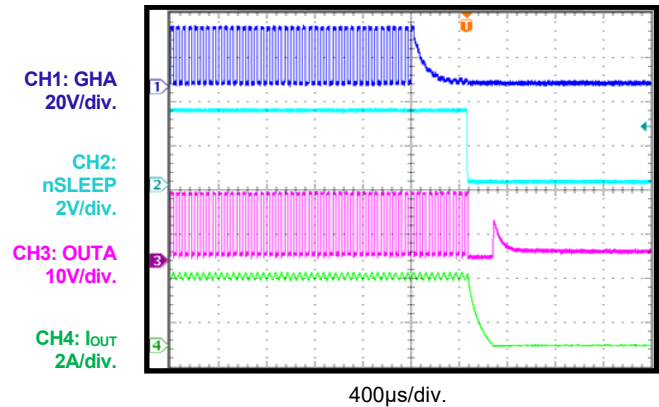
Shutdown through VIN

20kHz, 50% duty cycle



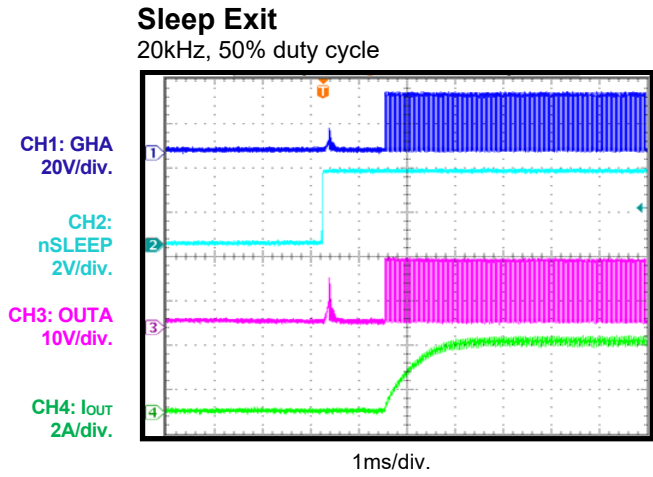
Sleep Entry

20kHz, 50% duty cycle



EVB TEST RESULTS *(continued)*

$V_{IN} = 14V$, $T_A = 25^\circ C$, resistor + inductor load: $R = 2\Omega$, $L = 700\mu H$, unless otherwise noted.



PCB LAYOUT

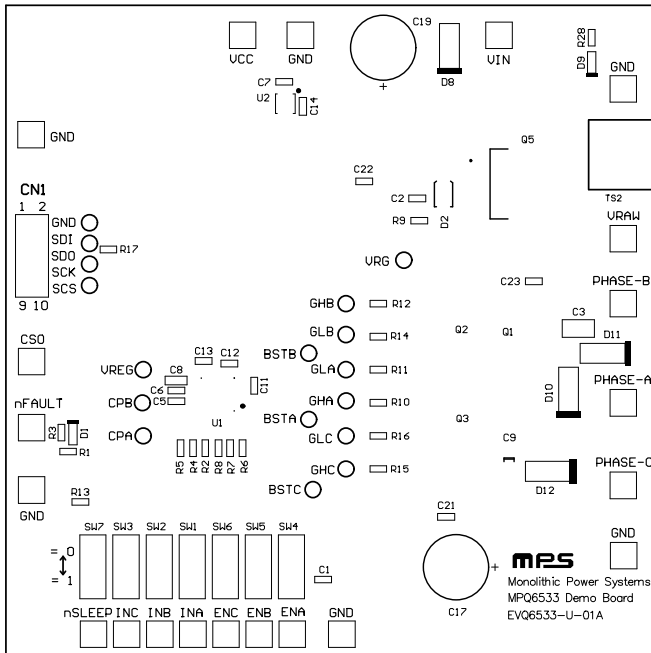


Figure 4: Top Silk

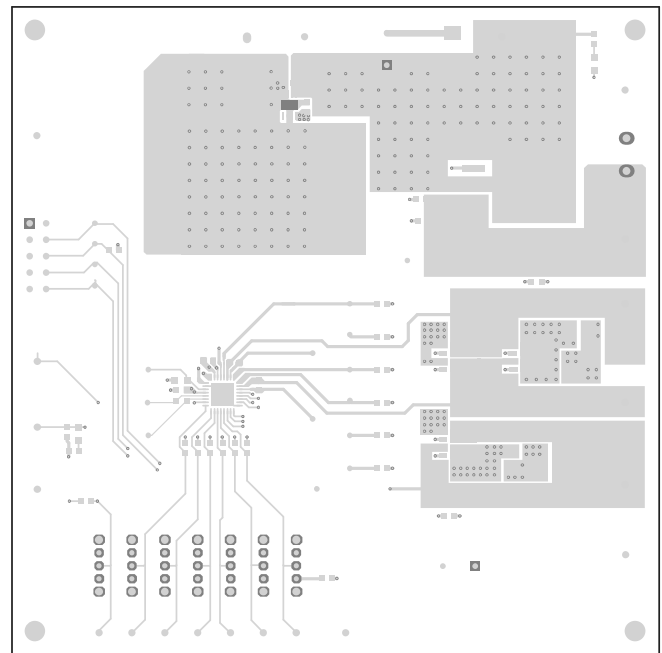


Figure 5: Top Layer

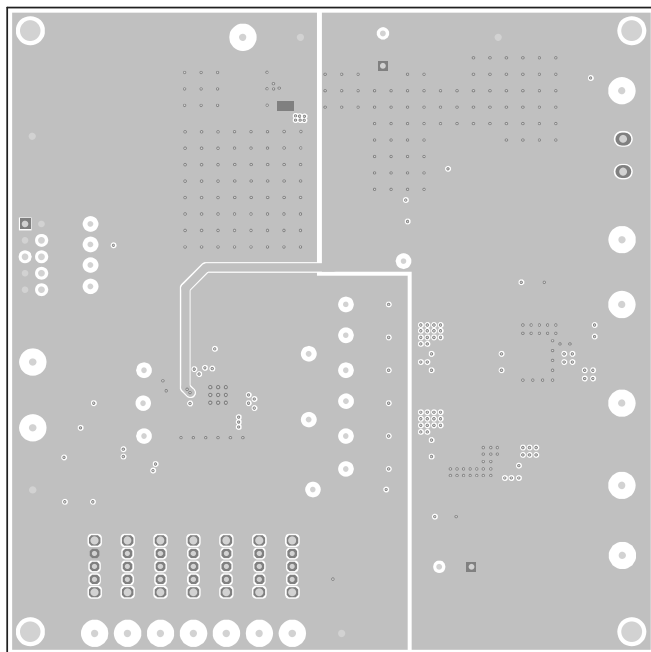


Figure 6: Mid-Layer 1

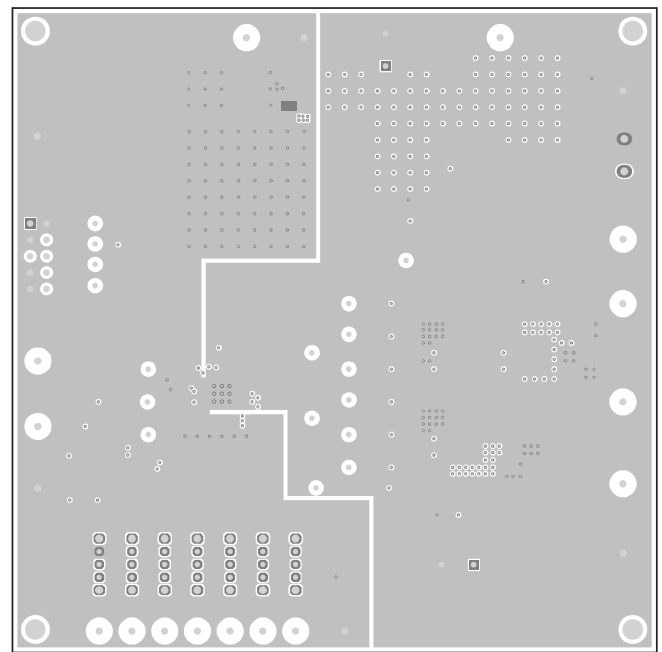


Figure 7: Mid-Layer 2

PCB LAYOUT (continued)

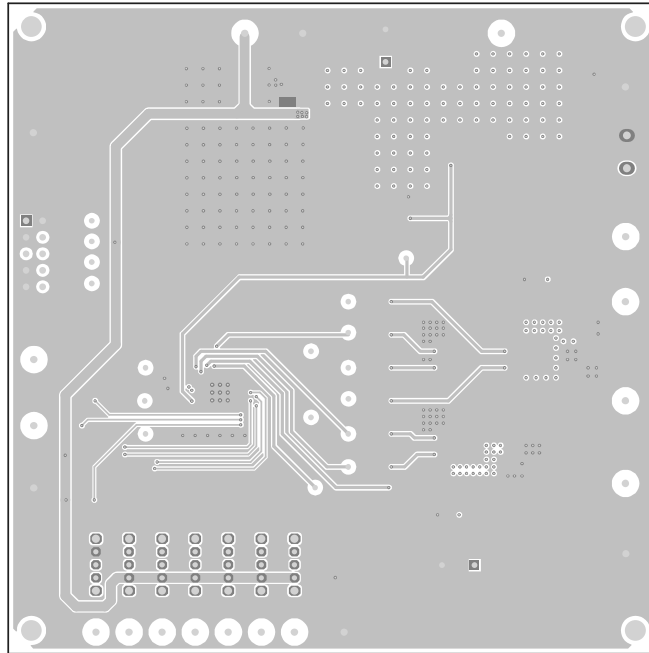


Figure 8: Bottom Layer

REVISION HISTORY

Revision #	Revision Date	Description	Pages Updated
1.0	7/25/2022	Initial Release	-
1.1	12/4/2023	Corrected the MPS IC number to “MPQ6533GUE-AEC1” in the EVQ6533-U-01A Evaluation Board section	1
		Updated the MPQ6533’s description and corrected the manufacturer PN to “MPQ6533GUE-AEC1” in the EVQ6533-U-01A Bill of Materials section	6

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