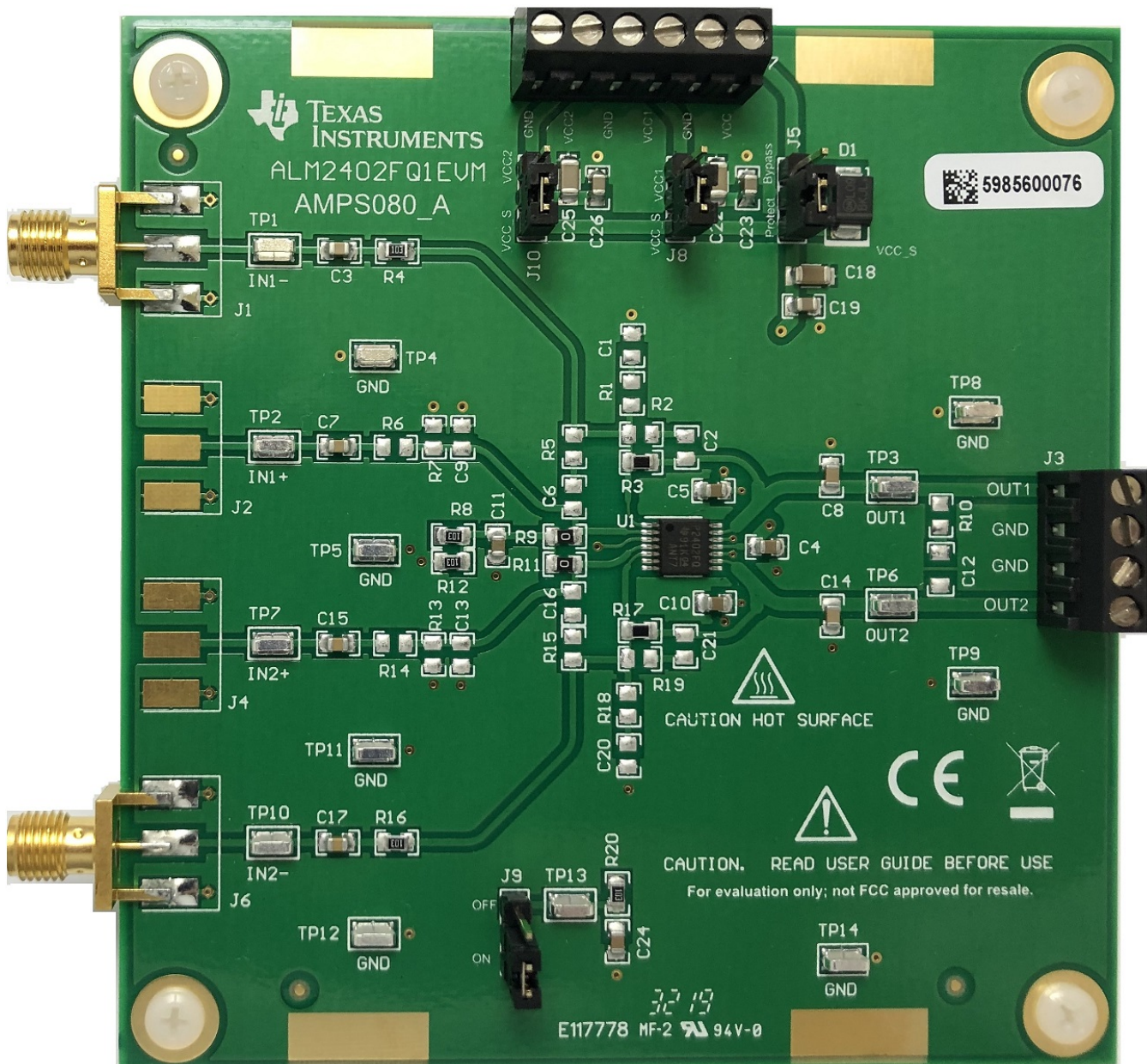


ALM2402F-Q1 Evaluation Module



This user's guide contains information and support documentation for the ALM2402F-Q1 evaluation module (EVM). Included are the circuit description, jumper settings, required connections, printed circuit board (PCB) layout, schematic, and bill of materials of the ALM2402FQ1EVM. Throughout this document, the terms evaluation board, evaluation module, and EVM are synonymous with the ALM2402FQ1EVM.

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1 Introduction

The ALM2402F-Q1 is an automotive-grade, dual high-voltage, high-current operational amplifier (op amp) with protection features from Texas Instruments. For a full list of electrical characteristics for the ALM2402F-Q1, see the [ALM2402F-Q1 Automotive, Dual Operational Amplifier With High Current Output data sheet](#).

2 EVM Circuit Description

This EVM is designed to provide access to the features, and measure the performance, of the ALM2402F-Q1. By default, the ALM2402FQ1EVM has both amplifiers configured in the inverting configuration with a gain of -2.5 V/V. A simplified schematic of the ALM2402FQ1EVM is displayed in [Figure 1](#). For a full schematic of the ALM2402FQ1EVM, see [Section 7.1](#).

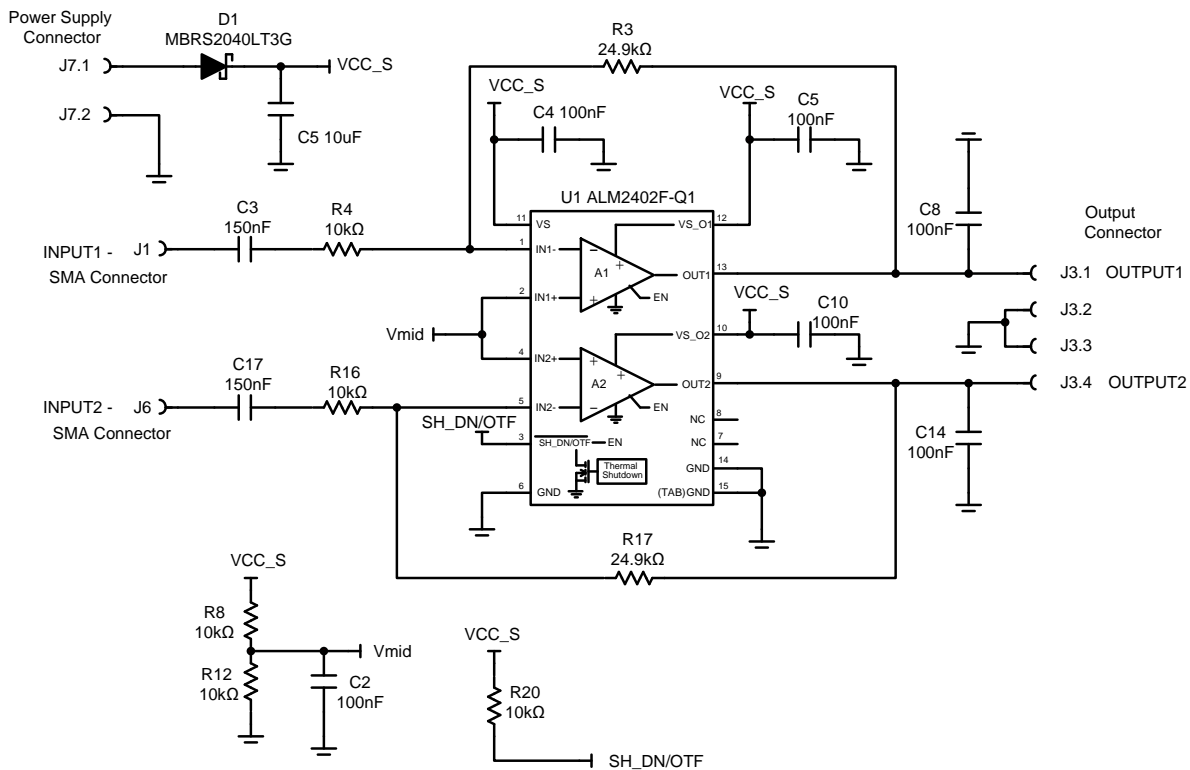


Figure 1. Simplified ALM2402FQ1EVM Schematic

3 Jumper Settings

[Figure 2](#) details the default jumper settings of the ALM2402FQ1EVM. [Table 1](#) explains the configuration for these jumpers.

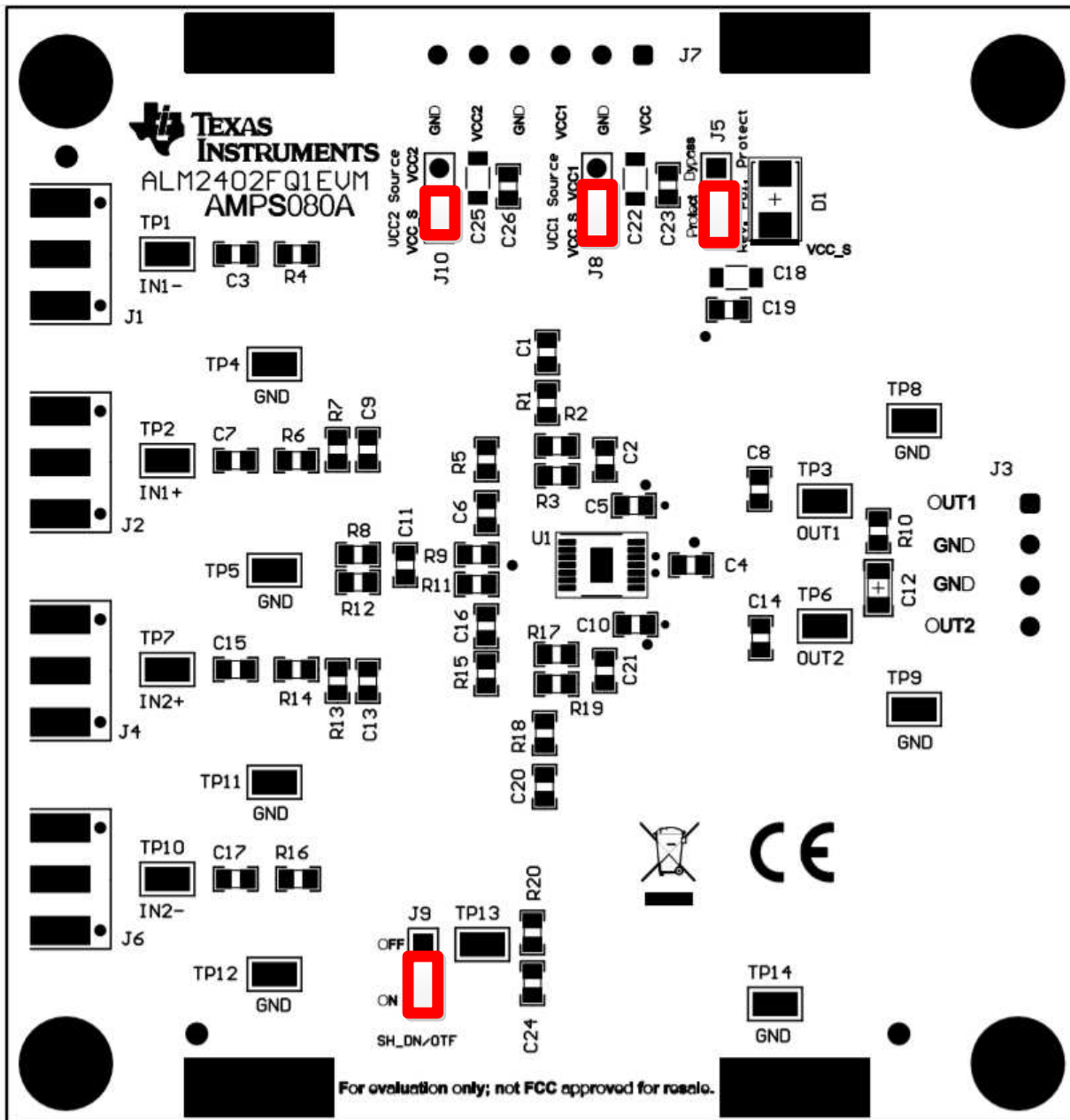


Figure 2. ALM2402FQ1 Evaluation Module Default Jumper Settings

Table 1. Default Jumper Configuration

Jumper	Function	Default Position	Description
J5	VCC_S reverse polarity protection	Shunt 2-3	Shunt 2-3: Schottky diode blocks VCC-S supply reverse current Shunt 1-2 bypasses VCC_S Schottky diode protection
J8	VCC1 source	Shunt 1-2	Shunt 1-2 selects VCC_S for op amp1 output supply Shunt 2-3 selects VCC_1 for op amp 1 output supply
J10	VCC2 source	Shunt 1-2	Shunt 1-2 selects VCC_S for op amp2 output supply Shunt 2-3 selects VCC_2 for op amp 2 output supply
J9	SH_DN / OTF	Shunt 2-3	Overtemperature flag or shutdown: Shunt 2-3 turns on amplifiers; pin works as overtemperature flag Shunt 1-2 shuts down amplifiers

4 Power-Supply Connections

The power-supply connections for the ALM2402FQ1EVM are provided through connector J7 at the top of the EVM. [Table 2](#) summarizes the pin definition for supply connector J7, and the allowed voltage range for each supply connection.

Table 2. ALM2402FQ1EVM Supply-Range Specifications

Pin Number	Supply Connection	Voltage Range
J7.1	Input stage supply (VCC)	4.5 V to 16 V
J7.2, J7.4, J7.6	Ground	0 V
J7.3	Op amp 1 output supply (VCC_1)	3 V to 16 V
J7.5	Op amp 2 output supply (VCC_2)	3 V to 16 V

By default, the ALM2402FQ1 is configured to use a single supply connected through J7.1 (VCC) and J7.2 (GND) with jumpers J8 and J10 set to shunt pins 1-2. Alternatively, the EVM can be configured to use three independent power-supply connections: input stage supply (VCC), op amp 1 output supply (VCC_1), and op amp 2 output supply (VCC_2). Setting jumpers J8 and J10 to shunt pins 2-3 allows the use of independent voltage supplies as indicated in [Figure 3](#).

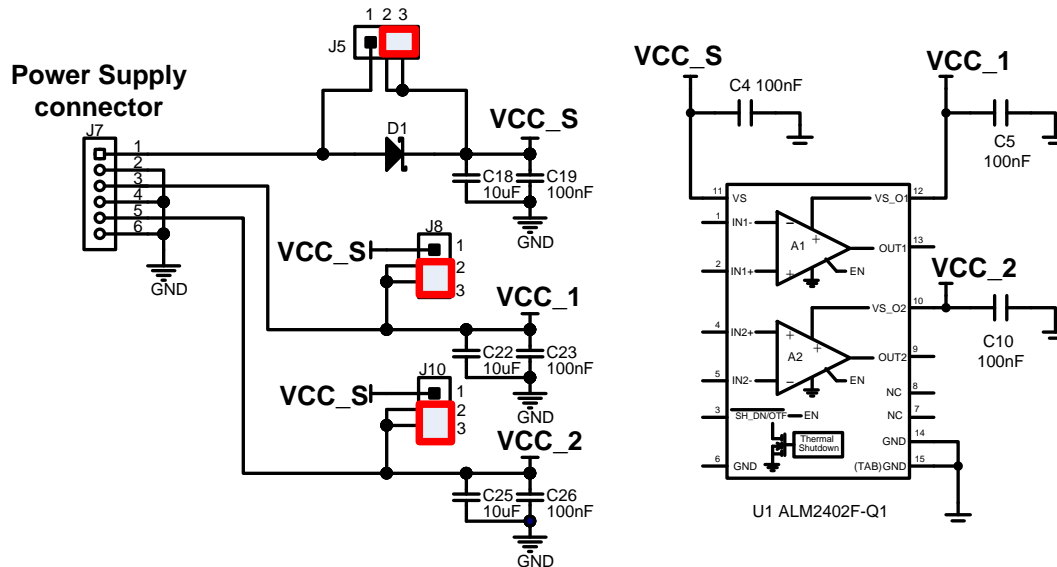


Figure 3. ALM2402FQ1EVM Configured With Independent Input-Stage and Output-Stage Supplies

5 Input and Output Connections

Input signal connections for the ALM2402FQ1EVM are provided through the use of the SMA connectors and test points located at the left of the EVM. The dual output-amplifier connections are provided through connector J3 and test points located at the right side of the EVM. A simplified diagram of the ALM2402FQ1EVM input and output connections is displayed in Figure 4.

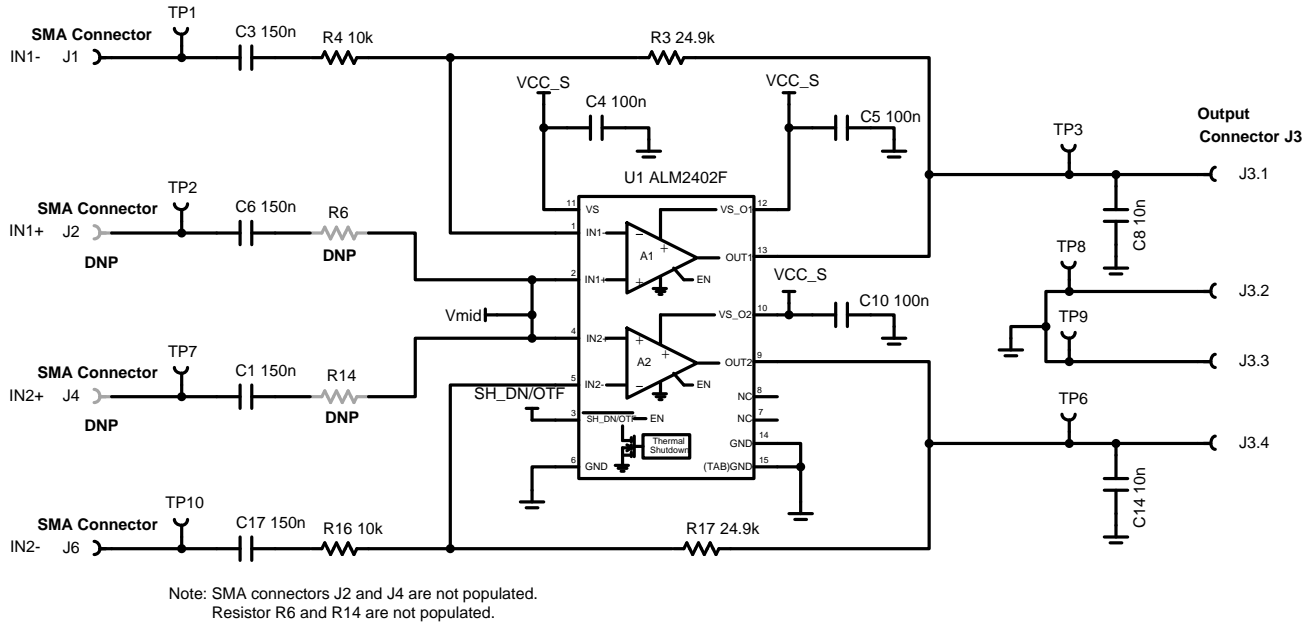


Figure 4. ALM2402FQ1EVM Input and Output Connections

Table 3 summarizes the input and output connectors and corresponding test points.

Table 3. ALM2402FQ1EVM Input and Output Connections

Connector Designator	Signal	Comment	Test Point
J1	IN1-	SMA	TP1
J2	IN1+	SMA (not populated)	TP2
J4	IN2+	SMA (not populated)	TP7
J6	IN2-	SMA	TP10
J3.1	OUT1	Screw terminal	TP3
J3.2	GND	Screw terminal	TP8
J3.3	GND	Screw terminal	TP9
J3.4	OUT2	Screw terminal	TP6

6 Modifications

By default, the ALM2402FQ1EVM is populated with both amplifiers set to the inverting configuration. However, for flexibility, the PCB layout has additional unpopulated passive component footprints, and additional input connections. These additional component footprints in the layout allow the user to change the ALM2402FQ1 circuit to other common configurations, such as the buffer and noninverting amplifier configurations. For a full schematic of the ALM2402FQ1EVM, see Figure 5.

7 Schematic, PCB Layout, and Bill of Materials

This section contains the schematic, bill of materials, and references for the ALM2402FQ1EVM.

7.1 Schematic

Figure 5 illustrates the EVM schematic.

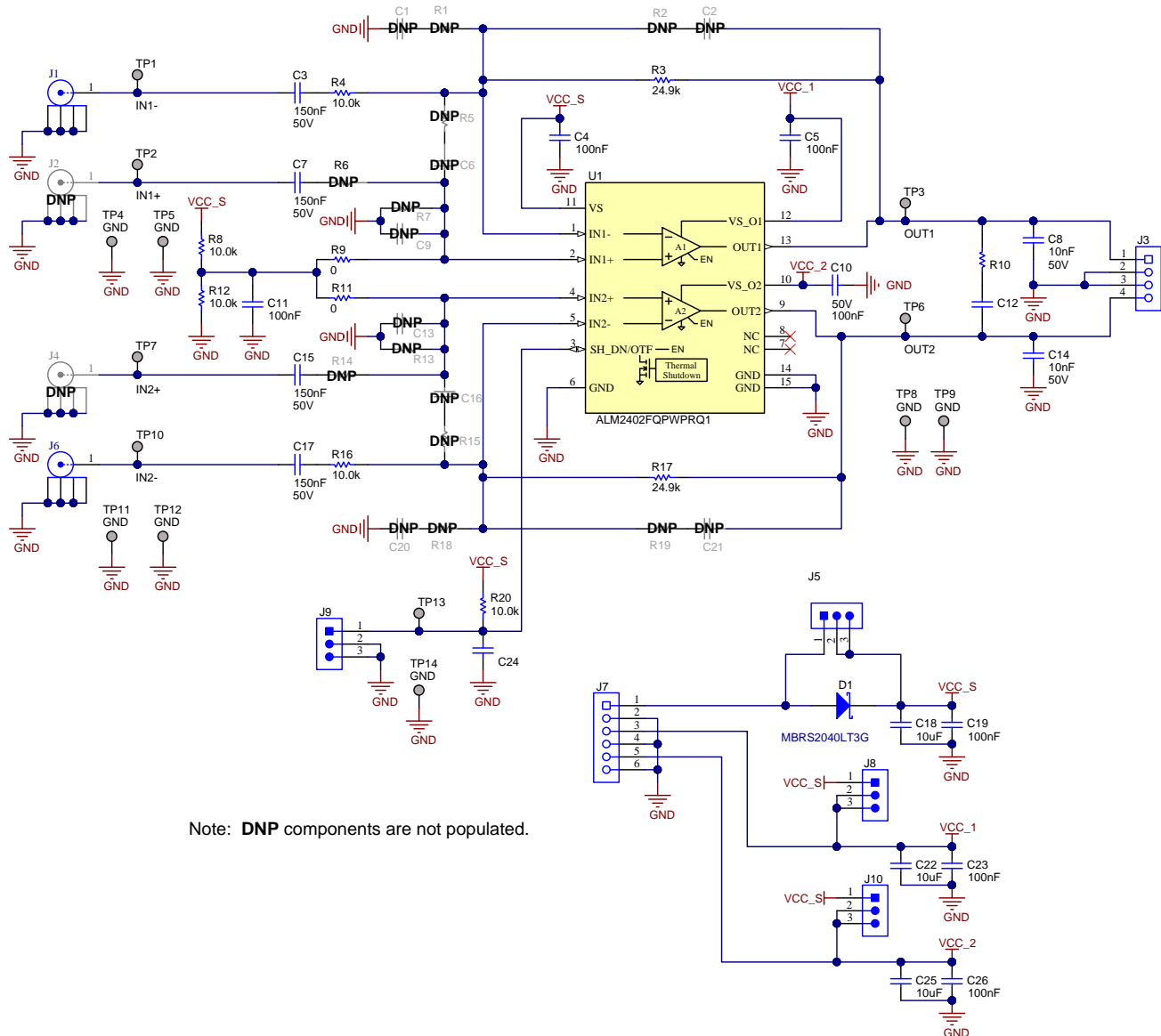


Figure 5. ALM2402FQ1EVM Schematic

7.2 PCB Layout

The ALM2402FQ1EVM is a four-layer PCB design. Figure 6 to Figure 9 show the PCB layer illustrations. The top layer consists of all signal path traces, and is poured with a solid ground plane. A symmetrical board layout is used on amplifier 1 and amplifier 2 to keep good performance matching. Decoupling capacitors C4, C5, and C10 are positioned on the top layer as close as possible to the power supply pins of the device. The second internal layer is a dedicated solid GND plane. Independent vias are placed at the ground connection of every component to provide a low-impedance path to ground. The third internal layer and the bottom layer route the power-supply connections.

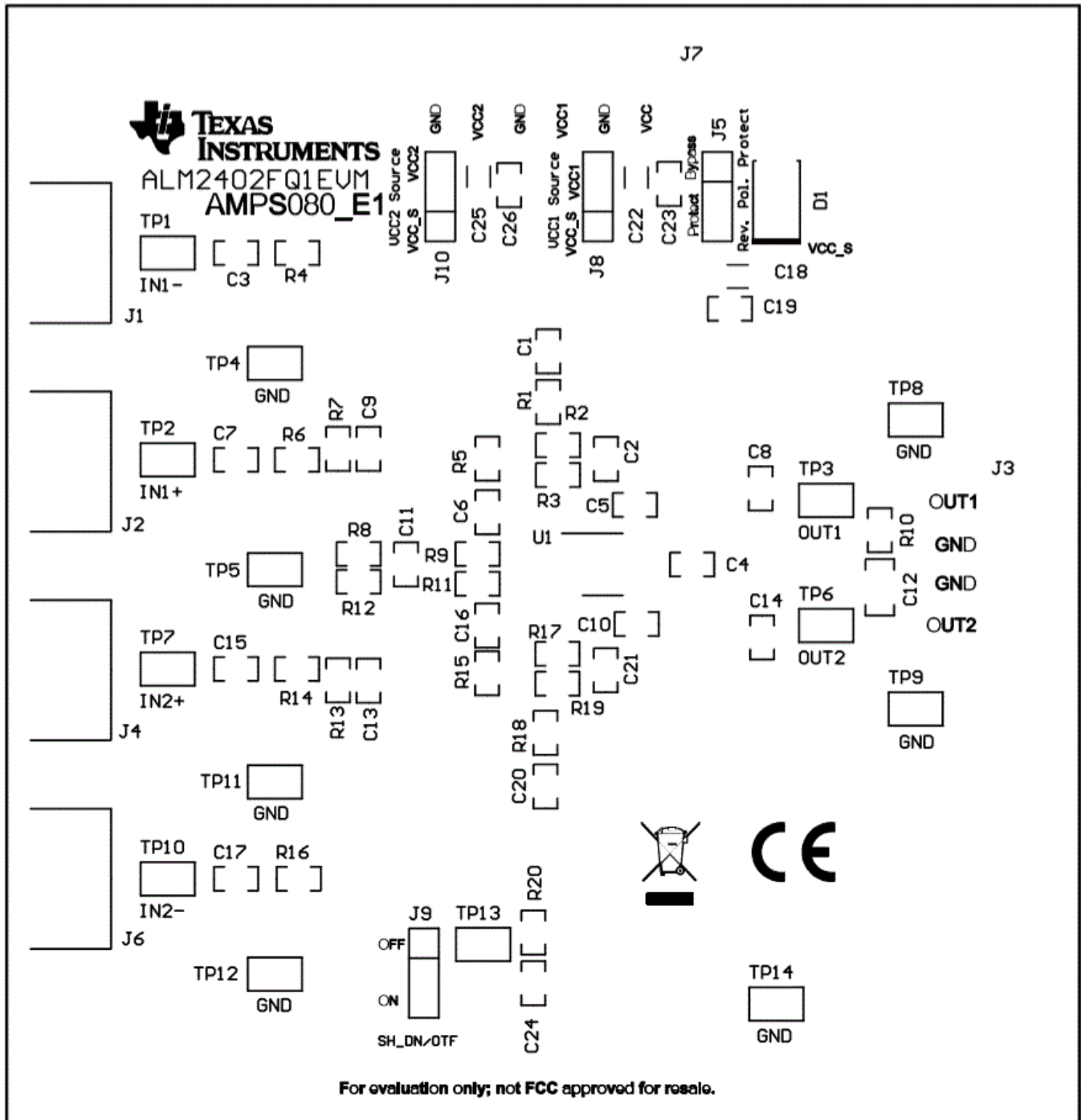


Figure 6. Top Overlay PCB Layout

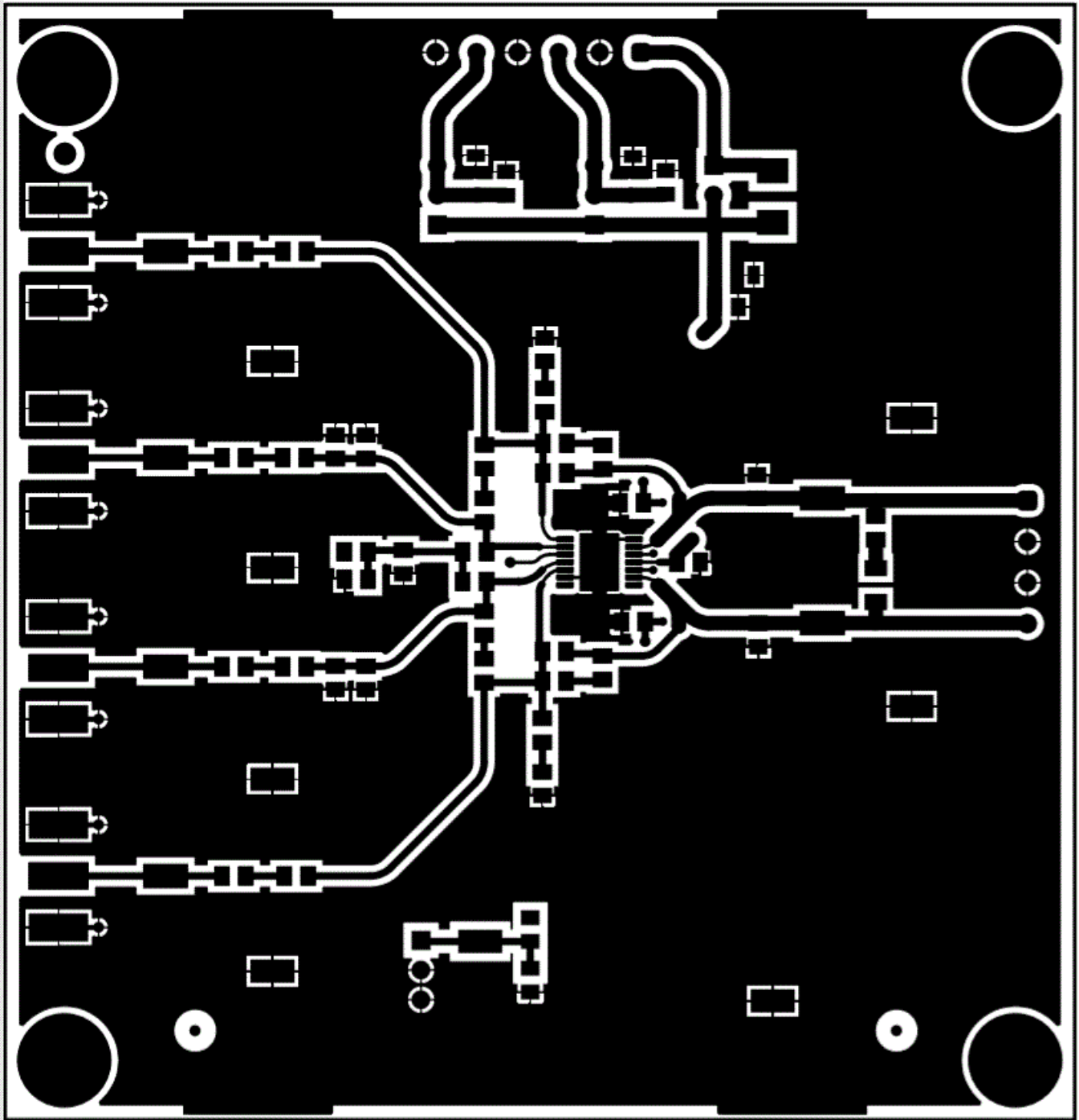


Figure 7. Top Layer PCB Layout

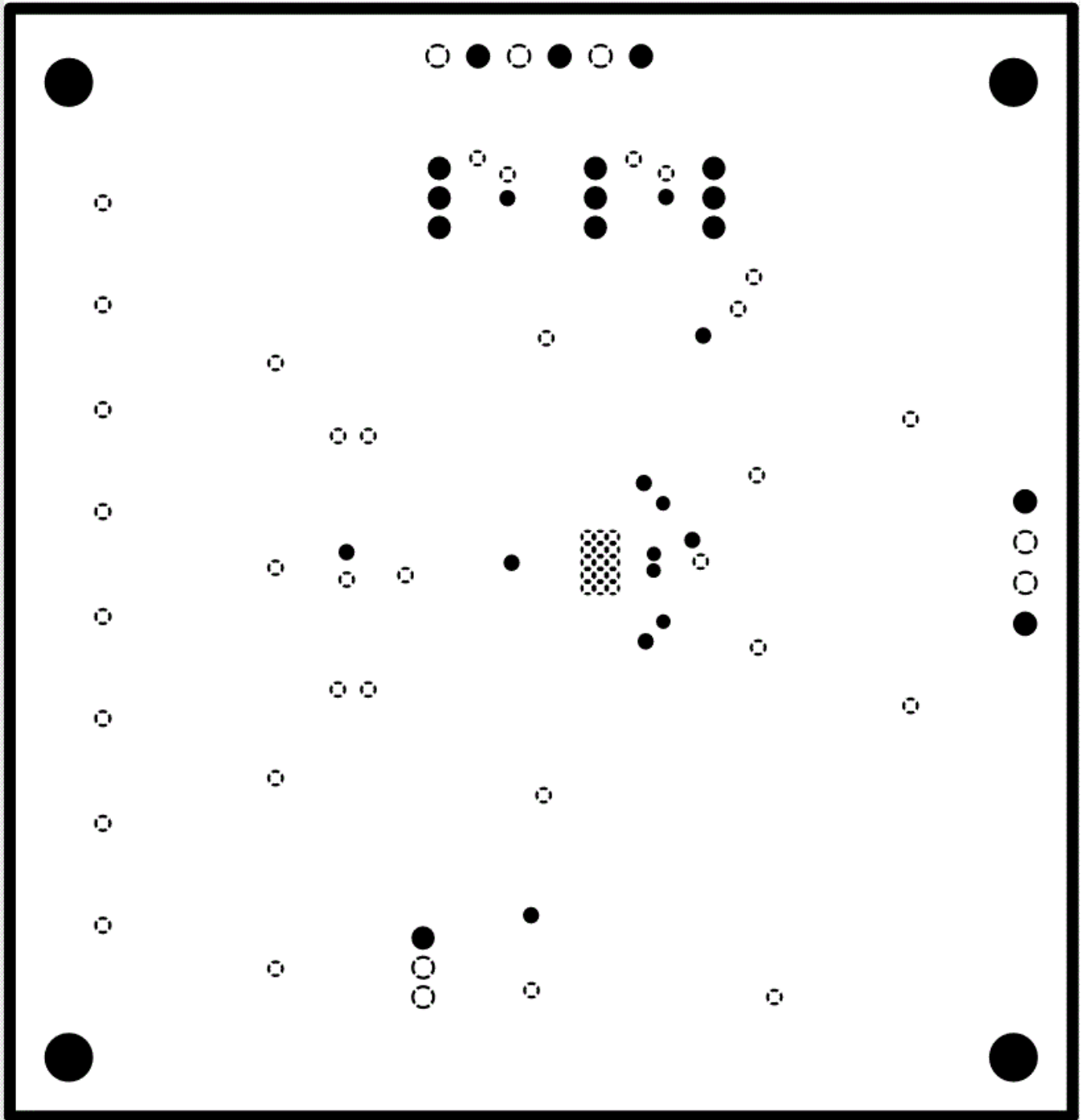


Figure 8. Ground Layer PCB Layout

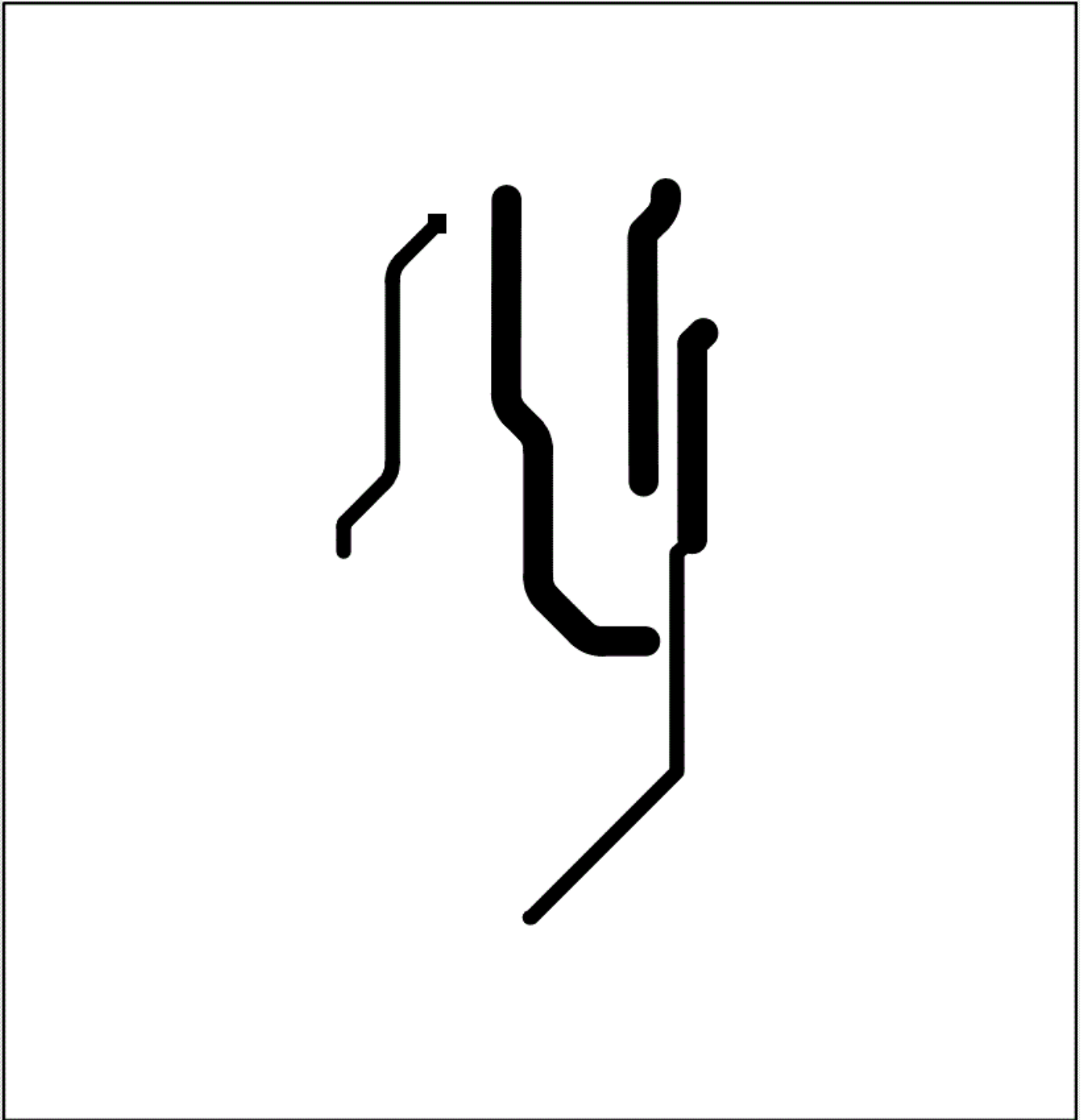


Figure 9. Power Layer PCB Layout

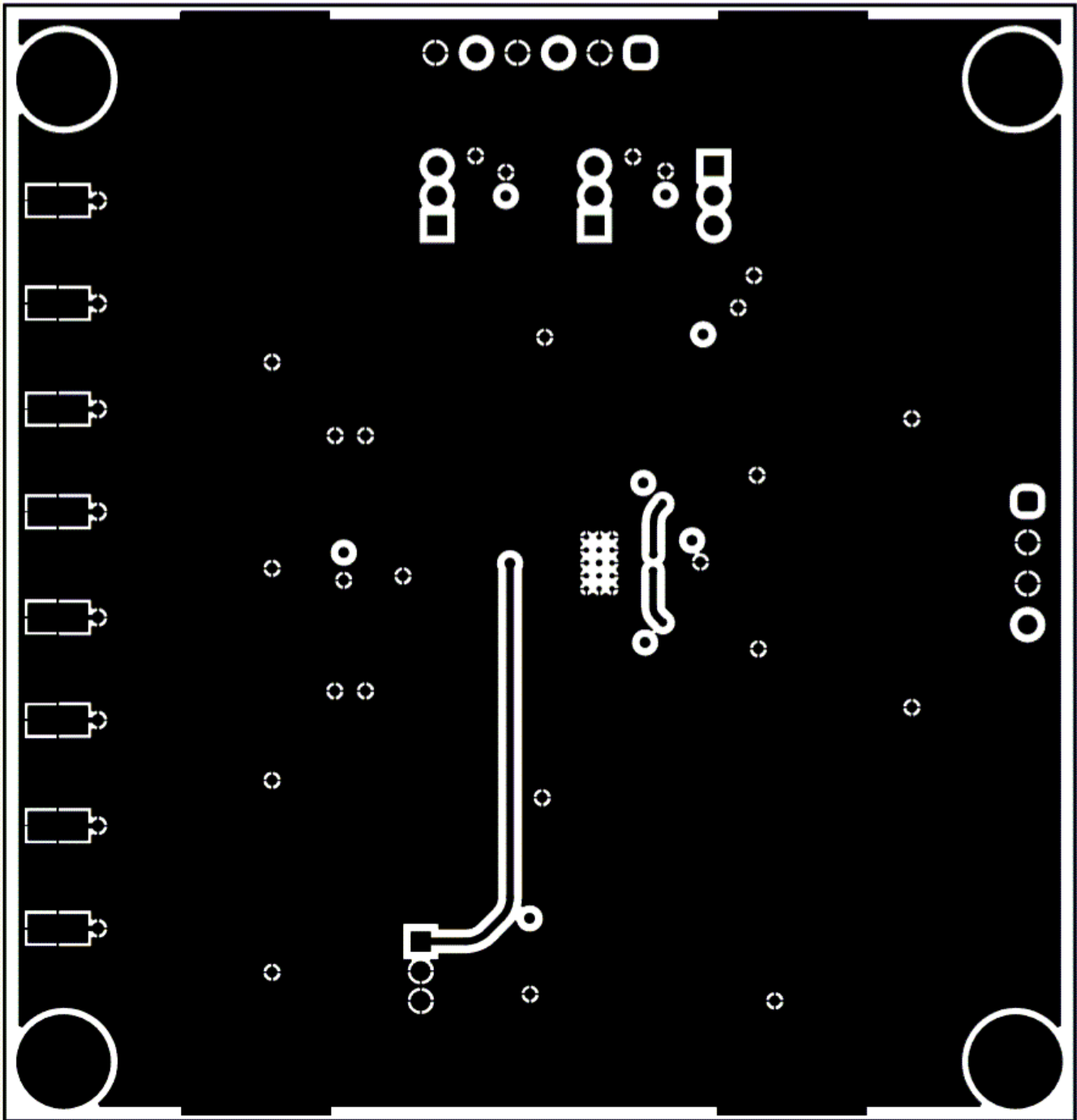


Figure 10. Bottom Layer PCB Layout

7.3 Bill of Materials

Table 4 lists the ALM2402FQ1EVM bill of materials (BOM).

Table 4. ALM2402FQ1EVM Bill of Materials

Designator	Qty	Value	Description	Package Reference	Part Number	Manufacturer
!PCB1	1		Printed Circuit Board		AMPS080	Any
C3, C7, C15, C17	4	0.15uF	CAP, CERM, 0.15 uF, 50 V, +/- 10%, X7R, 0805	0805	C0805C154K5RACTU	Kemet
C4, C5, C10, C11, C19, C23, C26	7	0.1uF	CAP, CERM, 0.1 uF, 50 V, +/- 10%, X7R, 0805	0805	08055C104KAT2A	AVX
C8, C14, C24	3	0.01uF	CAP, CERM, 0.01 uF, 50 V, +/- 10%, X7R, 0805	0805	08055C103KAT2A	AVX
C18, C22, C25	3	10uF	CAP, CERM, 10 uF, 35 V, +/- 10%, X7R, 1206	1206	'C3216X7R1V106K160AC	TDK
D1	1	40V	Diode, Schottky, 40 V, 2 A, SMB	SMB	MBRS2040LT3G	ON Semiconductor
H1, H2, H3, H4	4		Machine Screw, Round, #4-40 x 1/4, Nylon, Philips panhead	Screw	NY PMS 440 0025 PH	B&F Fastener Supply
H5, H6, H7, H8	4		Standoff, Hex, 0.5"L #4-40 Nylon	Standoff	1902C	Keystone
J1, J2, J4, J6	4		Connector, End launch SMA, 50 ohm, SMT	End Launch SMA	142-0701-801	Cinch Connectivity
J3	1		Terminal Block, 3.5mm, 4x1, Tin, TH	Terminal Block, 3.5mm, 4x1, TH	0393570004	Molex
J5, J8, J9, J10	4		Header, 100mil, 3x1, Gold, TH	PBC03SAAN	PBC03SAAN	Sullins Connector Solutions
J7	1		Terminal Block, 3.5mm, 6x1, Tin, TH	Terminal Block, 3.5mm, 6x1, TH	0393570006	Molex
R3, R17	2	24.9k	RES, 24.9 k, 0.5%, 0.1 W, 0805	0805	RR1220P-2492-D-M	Susumu Co Ltd
R4, R8, R12, R16, R20	5	10.0k	RES, 10.0 k, 0.5%, 0.125 W, 0805	0805	RT0805DRE0710KL	Yageo America
R9, R11	2	0	RES, 0, 5%, 0.125 W, AEC-Q200 Grade 0, 0805	0805	ERJ-6GEY0R00V	Panasonic
TP1, TP2, TP3, TP4, TP5, TP6, TP7, TP8, TP9, TP10, TP11, TP12, TP13, TP14	14		Test Point, Miniature, SMT	Test Point, Miniature, SMT	5019	Keystone
U1	1		Automotive, Dual Operational Amplifier With High Current Output, PWP0014H (HTSSOP-14)	PWP0014H	ALM2402FQPWPRQ1	Texas Instruments
C1, C2, C6, C9, C13, C16, C20, C21, C24	0	0.01uF	CAP, CERM, 0.01 uF, 50 V, +/- 10%, X7R, 0805	0805	08055C103KAT2A	AVX
C12	0	0.22uF	CAP, CERM, 0.22 uF, 50 V, +/- 5%, X7R, 1206	1206	C1206C224J5RACTU	Kemet
R1, R2, R5, R7, R10, R13, R15, R18, R19	0	24.9k	RES, 24.9 k, 0.5%, 0.1 W, 0805	0805	RR1220P-2492-D-M	Susumu Co Ltd
R6, R14	0	10.0k	RES, 10.0 k, 0.5%, 0.125 W, 0805	0805	RT0805DRE0710KL	Yageo America

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