User's Guide

TPS541620DEVM-050 User's Guide

ABSTRACT

The TPS541620DEVM-050 evaluation module (EVM) features the TPS541620 a highly integrated non-isolated Dual DC-DC converter that is capable of high frequency operation in a 3 mm x 5 mm package. The device can be configured as two single 6-A rails or combined to drive a single 12-A current load. Though the TPS541620 is highly configurable, the TPS541620DEVM-050 is configured for dual output operation only and each of the channels operate independently on this board. The Channel 1 V_{out} is configured for 1.0 V and Channel 2 V_{out} is configured for 3.3 V and each channel can deliver up to 6 A of load current. Input and output capacitors are included on the board. Monitoring test points are provided on the board as well.

The allowed operating conditions on the TPS541620DEVM-050 is listed in Table 1-1

Table 1-1. EVM Allowed Input and Output Range

Ordering Code	Configuration	Input Voltage	Output Voltage	Output Current
TPS541620DEVM-050	Dual Outputs	V_{IN} = 9 V to 15 V	V_{OUT1} = 1.0 V	0 to 6 A
			V_{OUT2} = 3.3 V	0 to 6 A

Note

The EVM has jumpers and test points that allow easy evaluation of steady state measurements such as efficiency, line/load regulation, input/output voltage ripple. Other tests such as frequency response, load transient, startup, and power down can be performed.

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1 Description

The TPS541620 is a configurable dual-output buck converter. The TPS541620DEVM-050 uses a nominal 12-V bus to produce a regulated 1-V and 3.3-V output at up to 6 A of load current each. The TPS541620DEVM-050 only demonstrates the dual output capability.

1.1 Before You Begin

The following warnings and cautions are noted for the safety of anyone using or working close to the TPS541620DEVM-050. Observe all safety precautions.

Warning The TPS541620DEVM-050 engineering verification board may become hot during operation due to power dissipation. Avoid contact with the board. Follow all applicable safety procedures applicable to your laboratory.

Caution Do not leave the EVM board powered when unattended.

WARNING

The circuit board has signal traces, components, and component leads on the bottom of the board. This may result in exposed voltages, hot surfaces or sharp edges. Do not reach under the board during operation.

WARNING

The circuit board surface area may be hot under some operating conditions. To avoid injury, use caution when touching the board during operation.

1.2 Typical Applications

- Wired and Wireless Infrastructure Equipment
- Ethernet Switches
- Router Network
- ASIC, SoC, FPGA, DSP I/O Voltage Rails
- Industrial Test and Measurement Equipment

1.3 Features

- Regulated 1-V and 3.3-V output for TPS541620DEVM-050 up to 6 A each output current
- Convenient test points for probing

2 Electrical Performance Specifications

Table 2-1 lists the electrical performance specifications (TPS541620DEVM-050) under room temperature 25°C.

Table 2-1. TPS541620 Electrical Performance

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNIT
INPUT CHARACTERISTICS					
Voltage range	V_{IN}	9	12	15	V
OUTPUT CHARACTERISTICS					
Output voltage, V_{OUT1}			1		V
Output voltage, V_{OUT2}			3.3		V
Output load current, I_{OUT1}		0		6	A
Output load current, I_{OUT2}		0		6	A
SYSTEMS CHARACTERISTICS					
Switching frequency, f_{SW}	V_{OUT1} = 1 V/6 A, V_{OUT2} = 3.3V/6A		1		MHz

3 Getting Started

Figure 3-1 illustrates the TPS541620DEVM-050 EVM. The EVM is provided with input/output connectors and test points as shown inTable 4-1 . A power supply capable of supplying 4 A or greater must be connected to J1 and/or J3 through a pair of wires 20AWG or lower . The Vout1 load must be connected to J2 through a pair of wires 20 AWG or lower. The Vout2 load must be connected to J4 through a pair of wires 20 AWG or lower. The maximum load current capability of each output is 6A. Wire lengths should be minimized to reduce losses in the wires. The VIN input voltage can be monitored using TP3 with TP5 as the ground reference or using TP4 with TPS6 as the ground reference. TP1 is used to monitor the output voltage VOUT1 with TP24 as the ground reference. TP2 is used to monitor the output voltage VOUT2 with TP25 as the ground reference.

Make sure jumpers J9 and J10 are set in the ON position which enables both the DC/DC converters on the TPS541620. Jumper J9 enables DC/DC1 and jumper J10 enables DC/DC2 of the TPS541620. Setting the jumpers to the OFF position will disable the DC/DC converter. Apply the input voltage supply of 12V to J1 and/or J3. Connect your oscilloscope or multi-meter probes to the appropriate test points to observe.

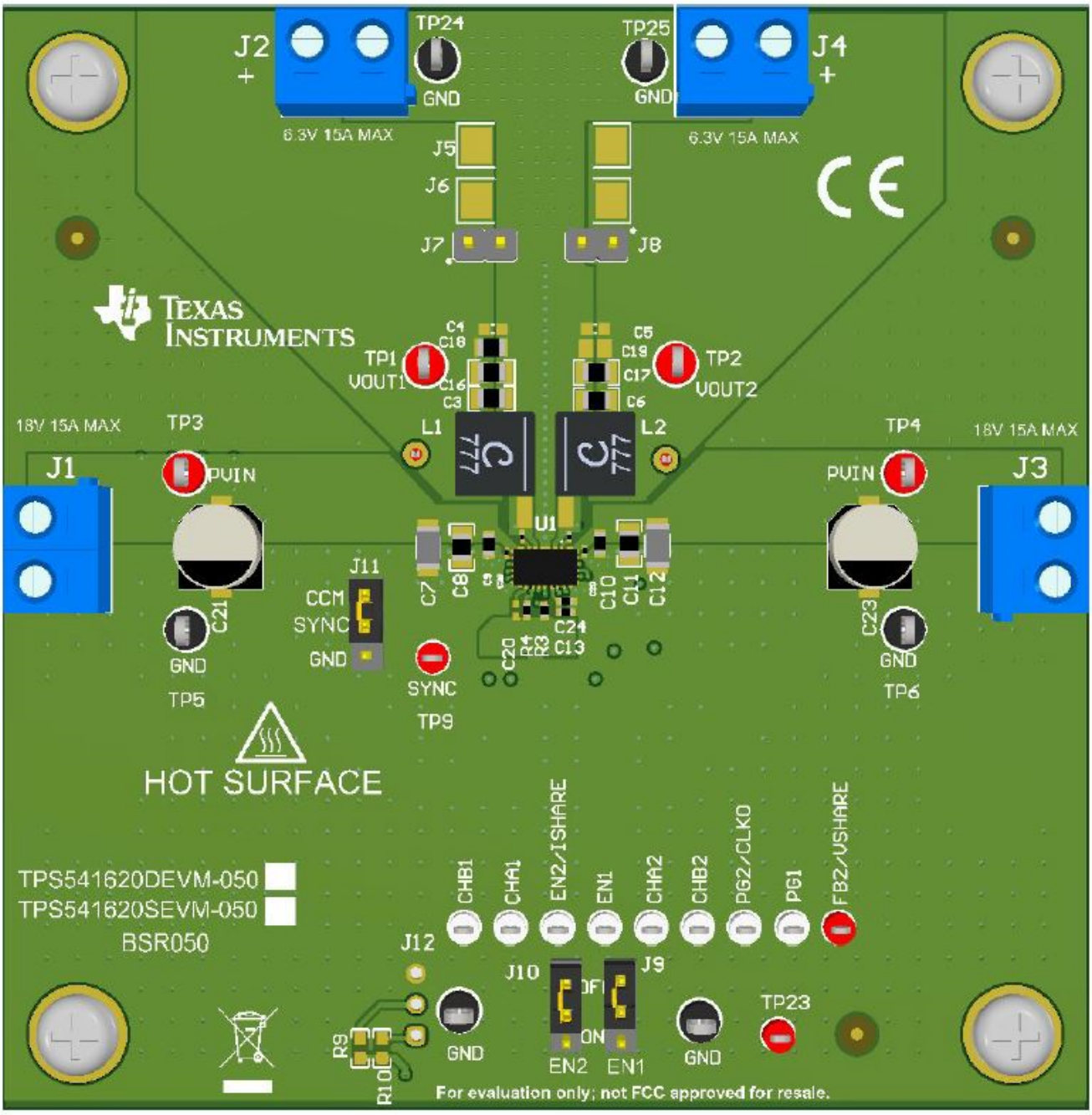

Figure 3-1. TPS541620DEVM-050 PCB Board

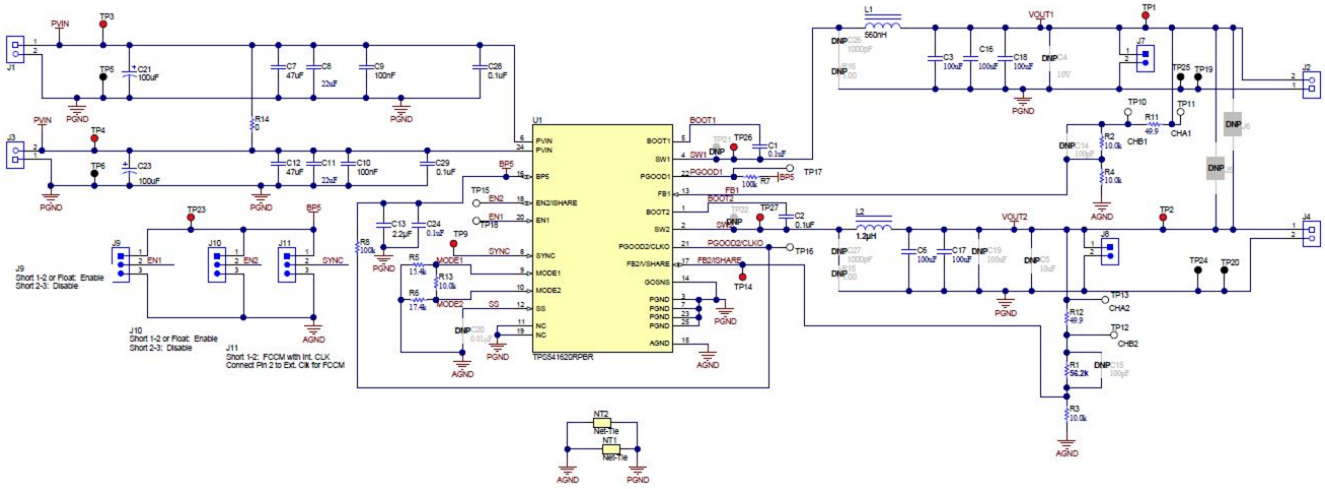

Figure 3-2. TPS541620DEVM-050 Schematic

4 Test Setup

The EVM has jumpers and test points that allow easy evaluation of efficiency, frequency response, load transient, output ripple, startup, and power down.

4.1 List of Test Points, Jumpers and Connectors

Table 4-1 lists the test point, jumpers, and connector functions.

Table 4-1. Test Point Functions

Reference Designator	Description
J1	VIN, Input Voltage Supply
J2	VOUT1, 1.0 V up to 6 A
J3	VIN, Input Voltage Supply
J4	VOUT2, 1.8 V up to 6 A
J9	Enable for Vout1, connects EN1 to BP5 or AGND
J10	Enable for Vout2, connects EN2 to BP5 or AGND
J11	Connect Sync to BP5 for Float for using external Sync
TP1, TP24	Vout1 sensing test points
TP2, TP25	Vout2 sensing test points
TP3, TP5, TP4, TP6	VIN sensing test points
TP23	BP5 sensing test point
SYNC	External Synchronization Input connection
CHA, CHB	Loop measurement test points
EN1	Enable for Vout1
EN2/ISHARE	Enable for Vout2
PG1	Power good for Vout1, connected to BP5 through 100kOhm
PG2/CLKO	Power good for Vout2, connected to BP5 through 100kOhm
FB2/VSHARE	FB2 test point

5 EVM Assembly Drawing and PCB Layout

Figure 5-1 through Figure 5-8 show the design of the EVM printed circuit board.

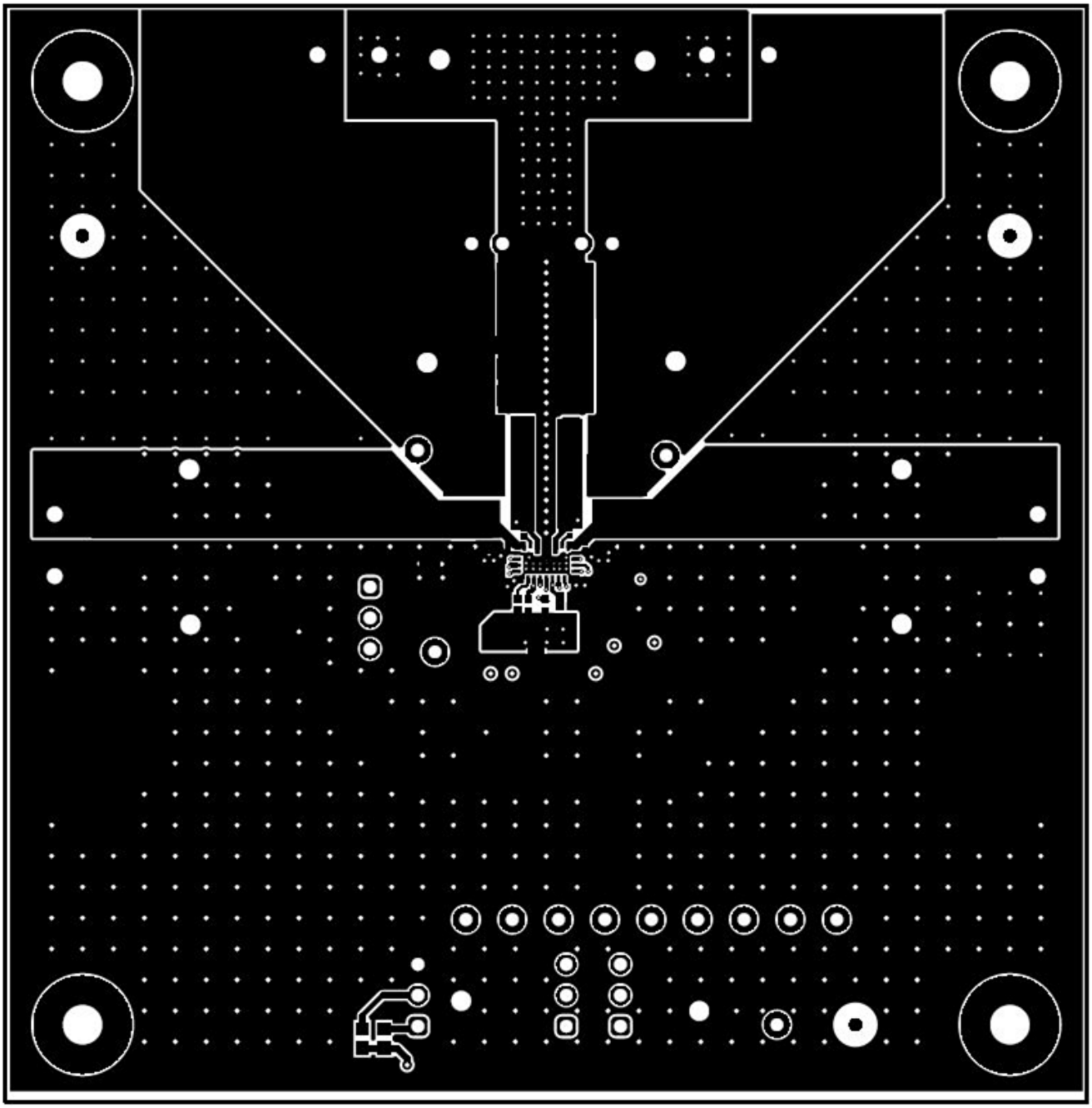

Figure 5-1. Top Layer PCB Drawing

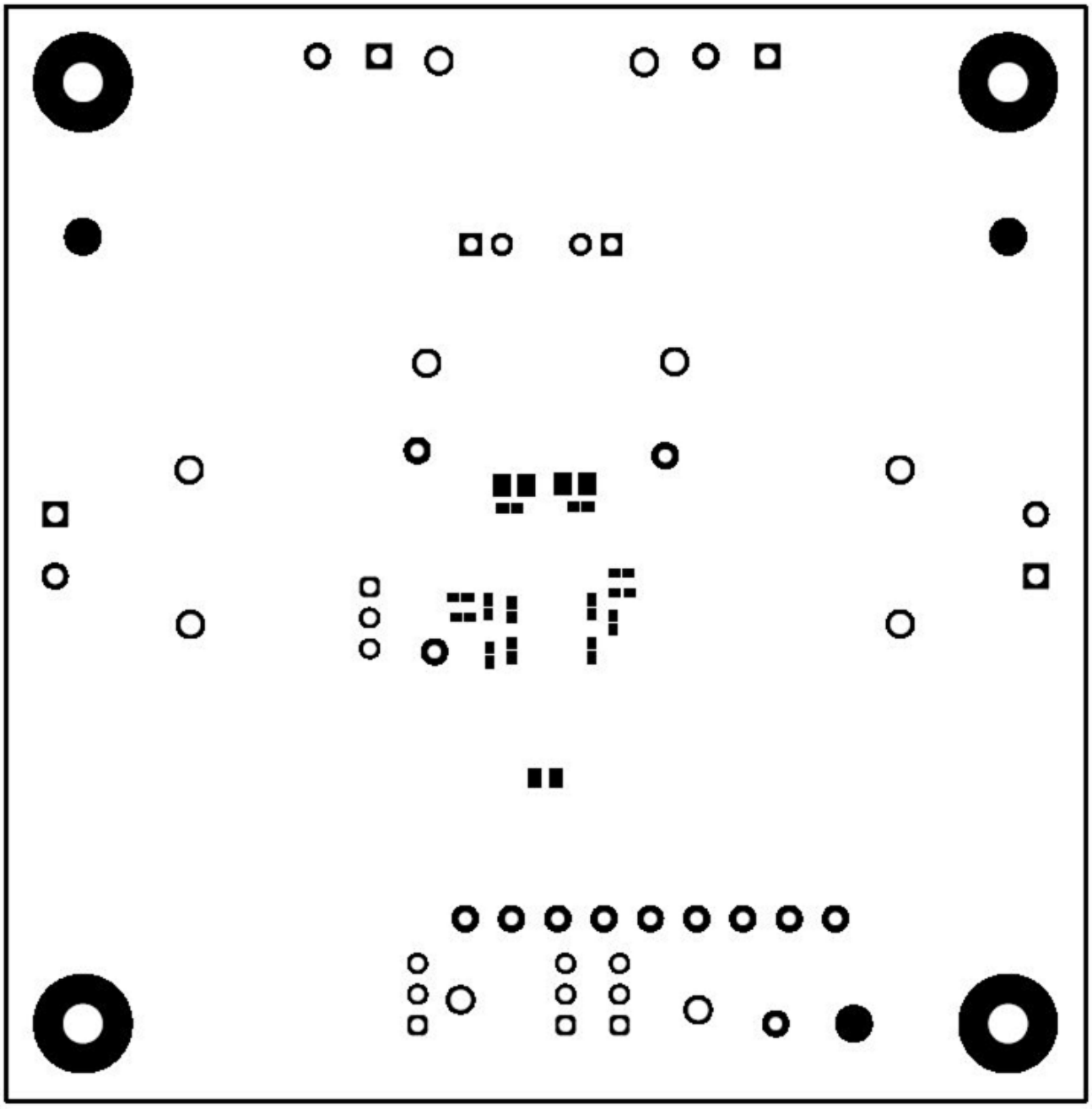

Figure 5-2. Top Layer Solder Layout

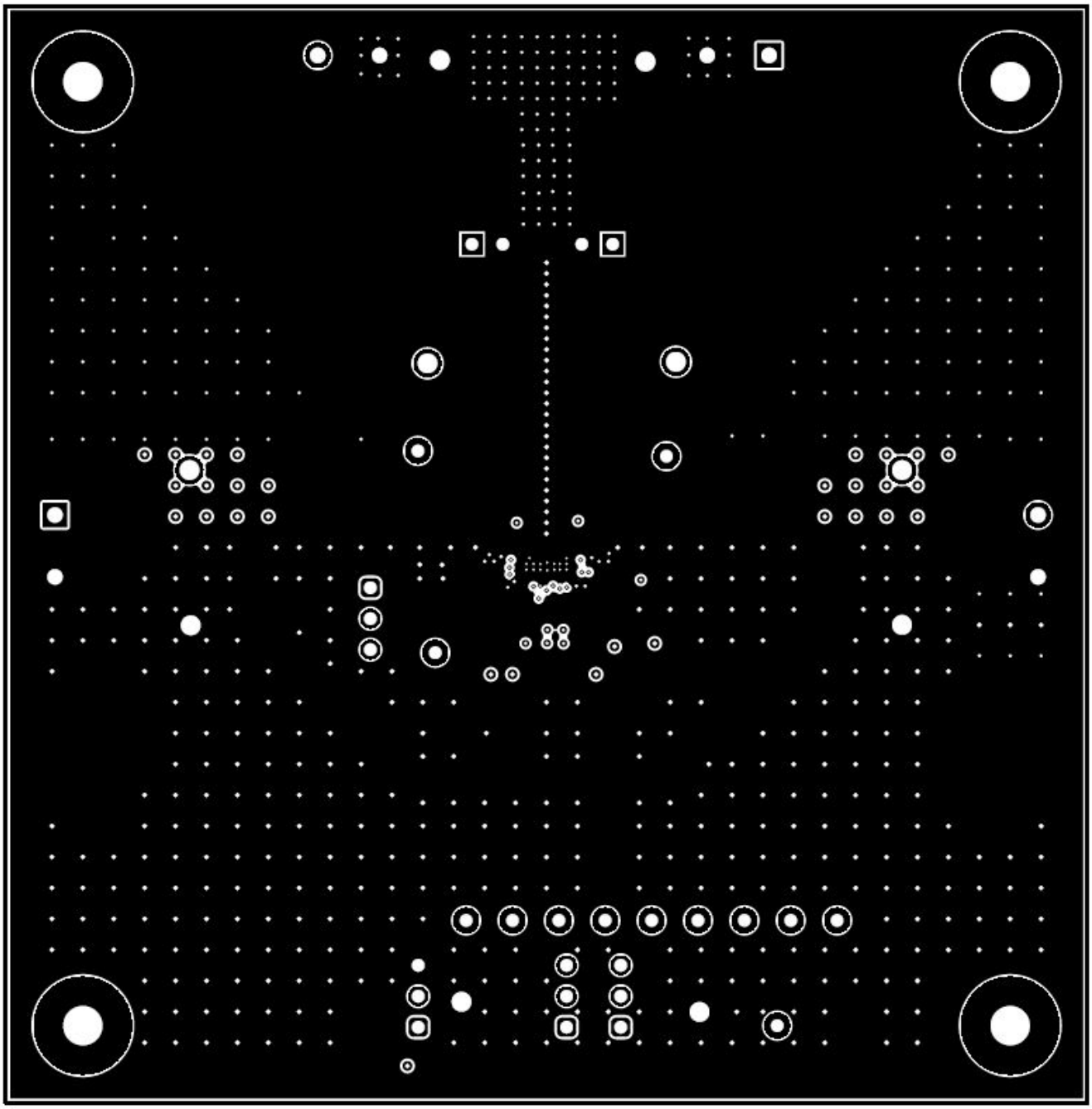

Figure 5-3. Signal Layer 1

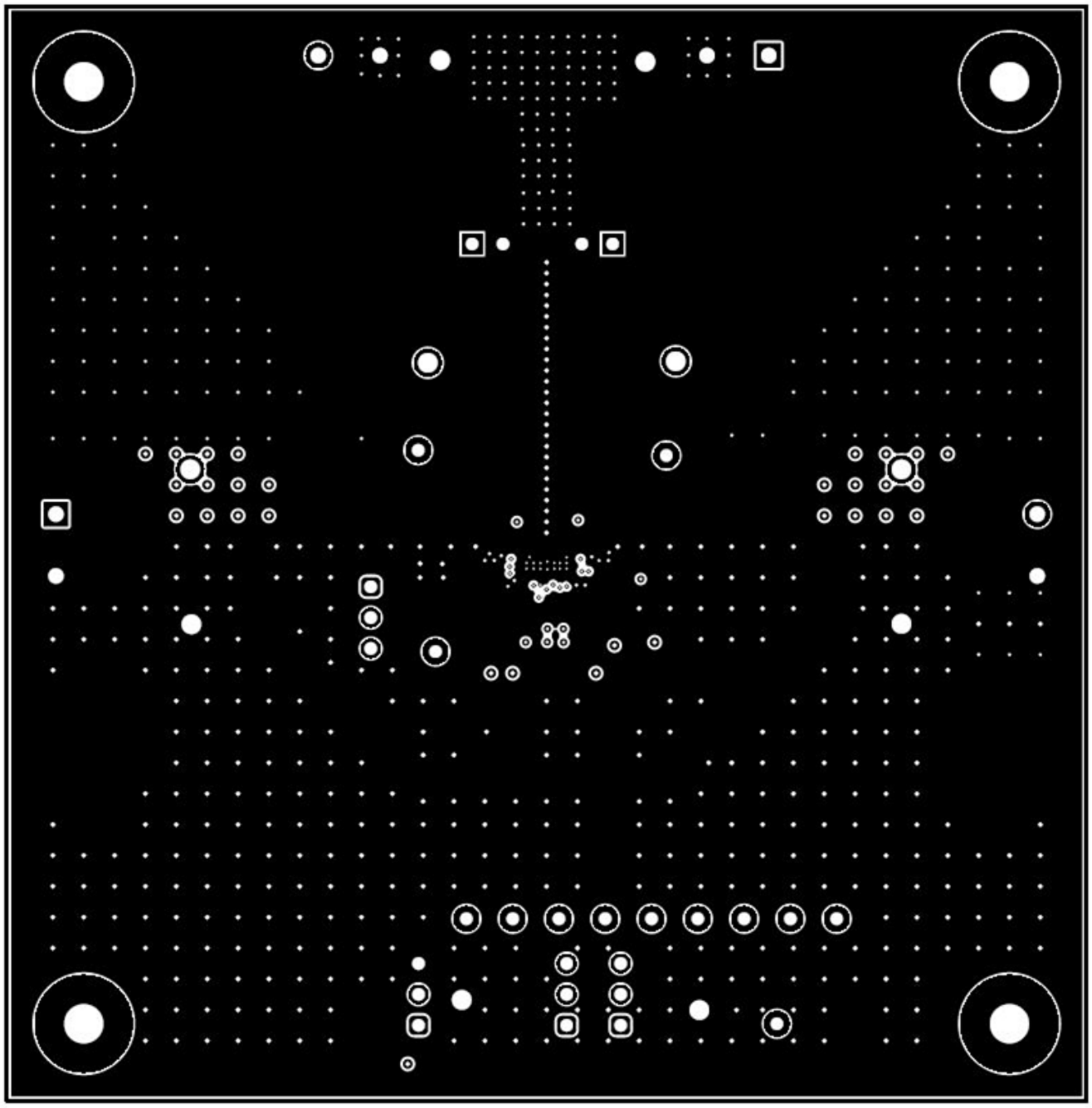

Figure 5-4. Signal Layer 2

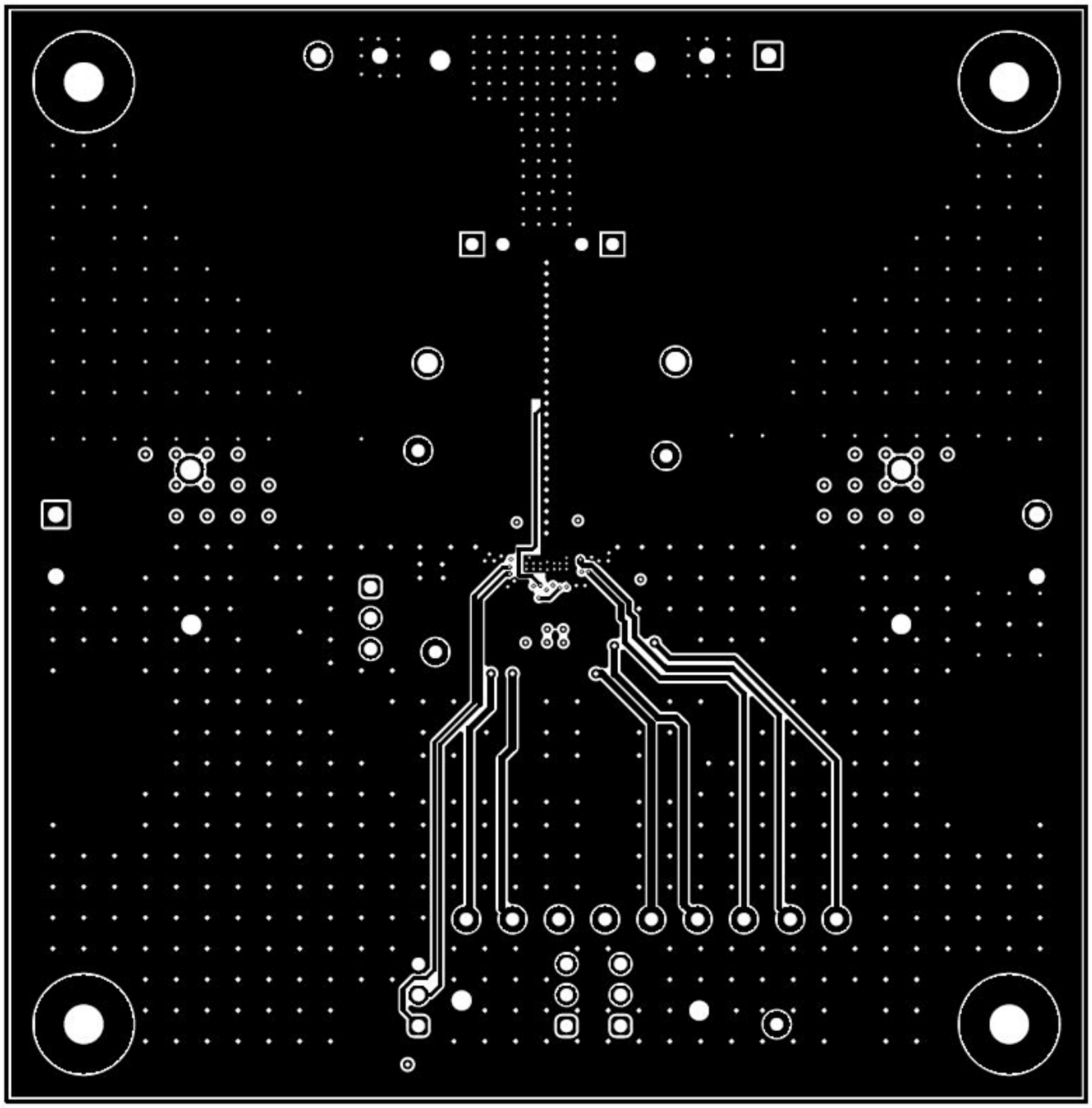

Figure 5-5. Signal Layer 3

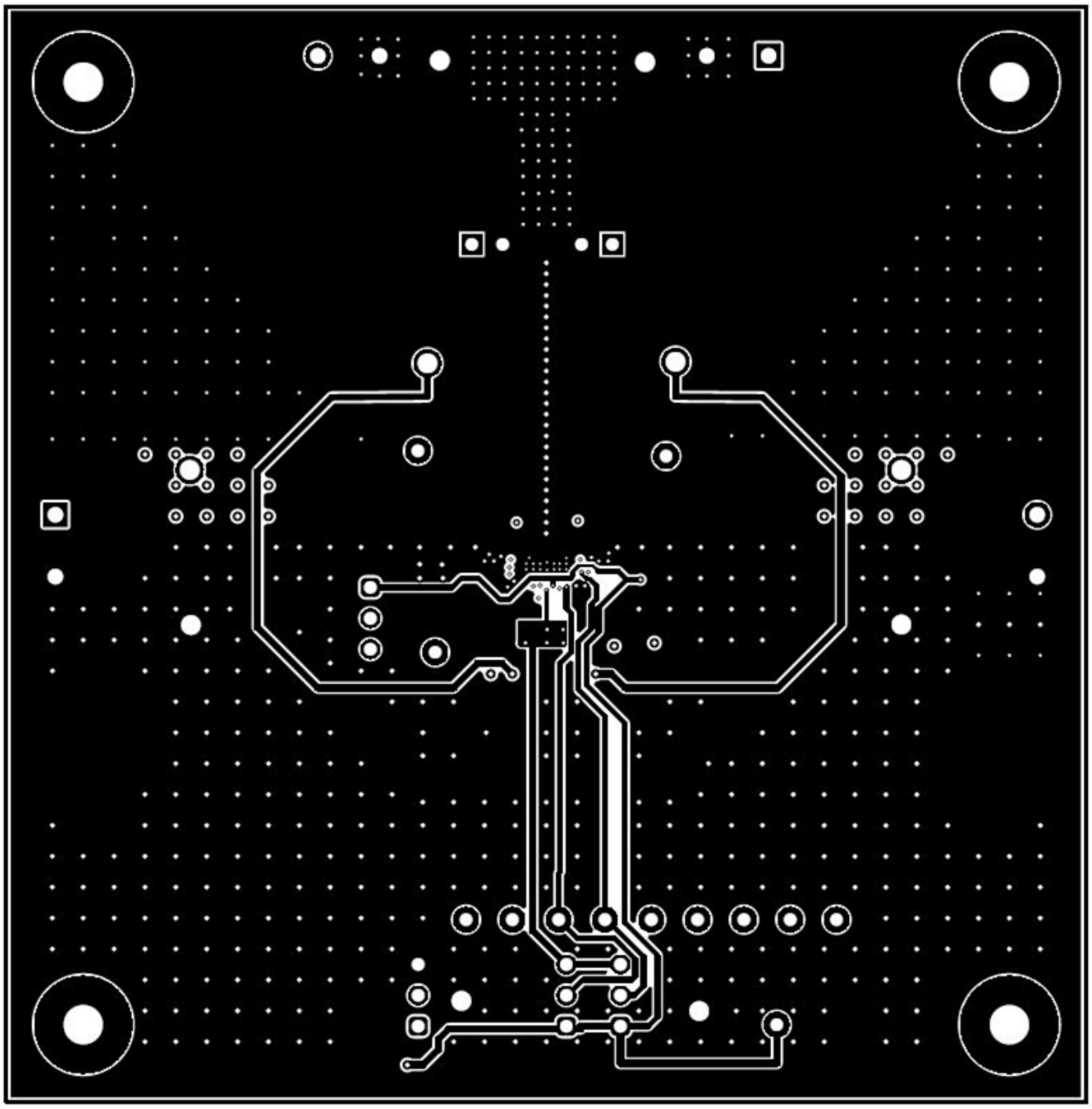

Figure 5-6. Signal Layer 4

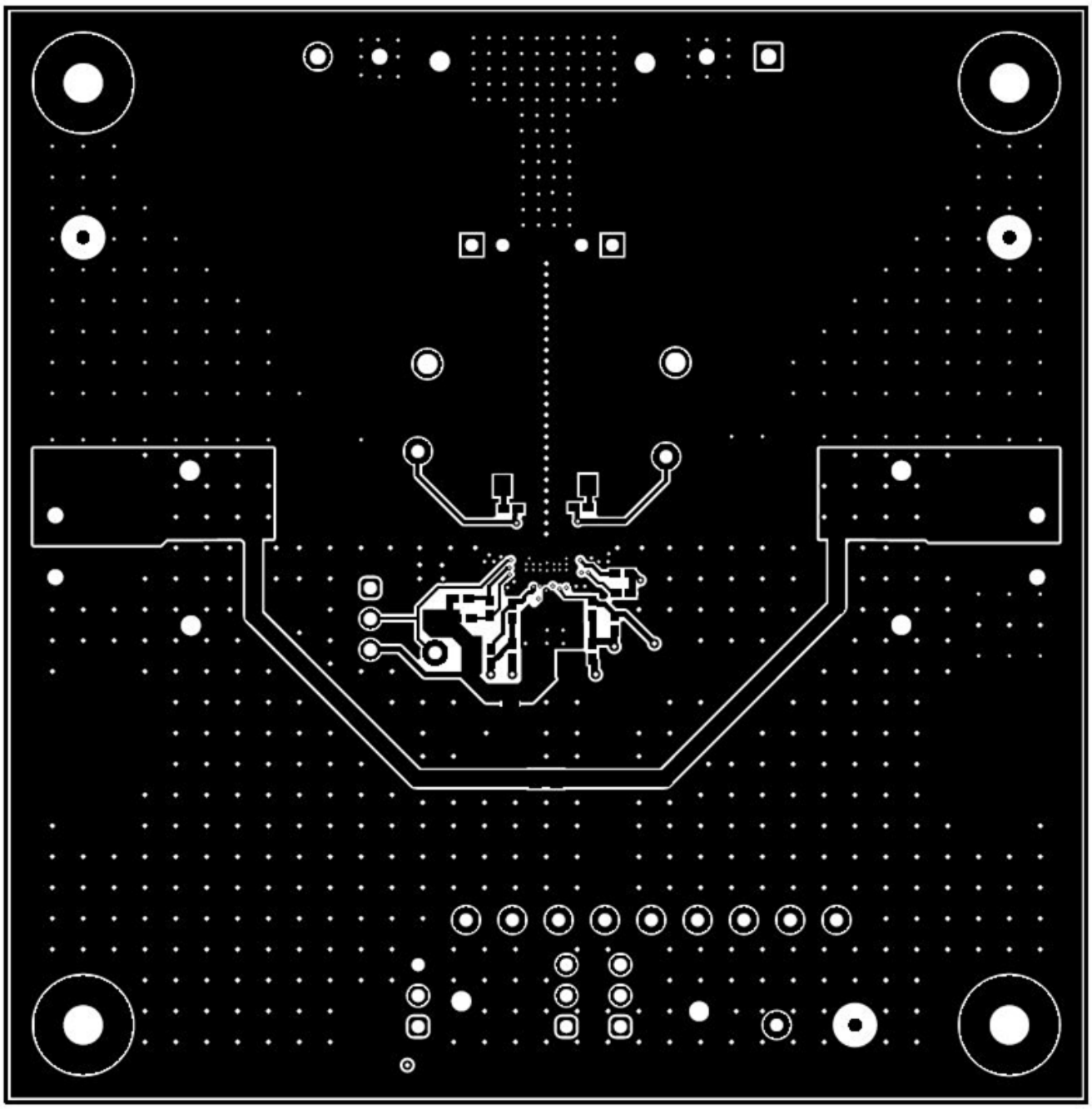

Figure 5-7. Bottom Layer PCB Layout

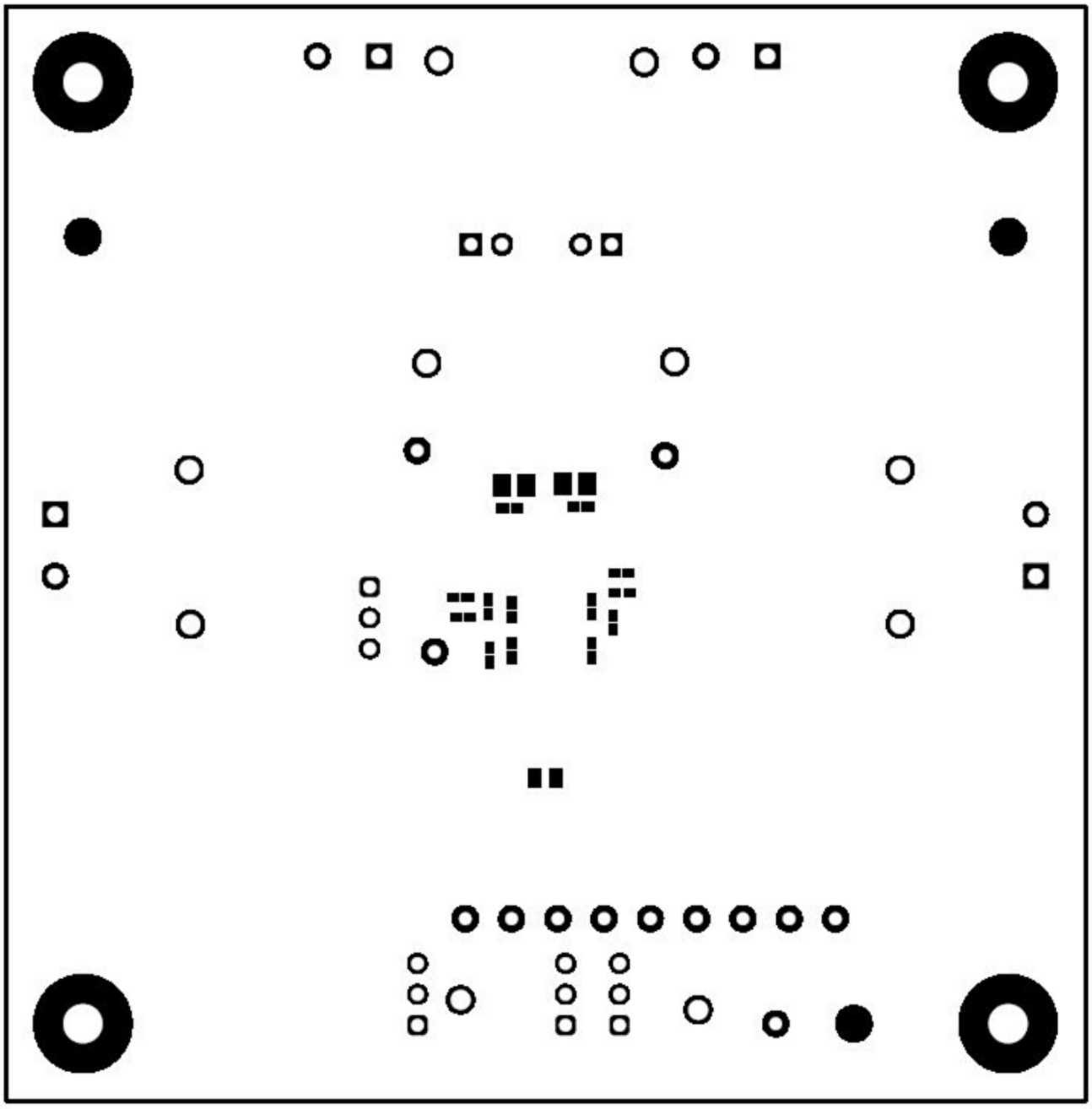

Figure 5-8. Bottom Solder

6 Bill of Materials

Table 6-1 lists the BOM for the (EVM).

Table 6-1. BOM for TPS541620DEVM (Dual Output)

QTY	DESIGNATOR	DESCRIPTION	PARTNUMBER	MANUFACTURER
2	C1, C2	CAP, CERM, 0.1 uF, 16 V, +/- 10%, X5R, 0201	MuRata	GRM033C71C104KE14D
5	C3, C6, C16, C17, C18	CAP, CERM, 100 uF, 6.3 V, +/- 20%, X5r,0805	MuRata	GRM21BR60J107M
2	C7, C12	CAP, CERM, 47 uF, 25 V, +/- 20%, X5R, 1206_190	TDK	C3216X5R1E476M160AC
2	C8, C11	CAP, CERM, 22 uF, 25 V, +/- 20%, X5R, 0805	MuRata	GRM21BR61E226ME44L
2	C9, C10	CAP, CERM, 0.1 µF, 50 V,+/- 10%, X7R, AEC-Q200 Grade 1, 0603	Kemet	C0603C104K5RACAUTO 2
1	C13	CAP, CERM, 2.2 µF, 6.3 V,+/- 20%, X5R, 0402	MuRata	GRM153R60J225ME95D 1
2	C21, C23	CAP, AL, 100 uF, 25 V, +/- 20%, 0.34 ohm, AEC-Q200 Grade 2, SMD	Panasonic	EEE-FK1E101XP
1	C24	CAP, CERM, 0.1 uF, 16 V, +/- 10%, X7R, 0402	AVX	0402YC104KAT2A
2	C28, C29	CAP, CERM, 0.1 uF, 25 V, +/- 10%, X6S, 0201	MuRata	GRM033C81E104KE14D
4	J1, J2, J3, J4	Terminal Block, 5.08 mm, 2x1, Brass, TH	On-Shore Technology	ED120/2DS
2	J7, J8	Header, 100mil, 2x1, Gold, TH	Sullins Connector Solutions	PBC02SAAN
3	J9, J10, J11	Header, 2.54mm, 3x1, Gold, TH	Samtec	TSW-103-08-G-S
1	L1	Inductor, Shielded, Composite, 560 nH, 22 A, 0.00331 ohm, AEC-Q200,SMD	Coilcraft	XAL6030-561MEB 1
1	L2	Inductor, Shielded, Composite, 1.2 µH, 16 A, 0.0075 ohm, AEC-Q200 Grade 1, SMD	Coilcraft	XAL6030-122MEB
1	R1	RES, 56.2 k, 1%, 0.063 W, 0402	Vishay-Dale	CRCW040256K2FKED
4	R2, R3, R4, R13	RES, 10.0 k, 1%, 0.063 W, 0402	Yageo America	'RC0402FR-0710KL
1	R5	RES, 15.4 k, 1%, 0.1 W, 0402	Vishay-Dale	CRCW040215K4FKED
1	R6	RES, 17.4 k, 1%, 0.1 W, 0402	Vishay-Dale	CRCW040217K4FKED
1	R7, R8	RES, 100 k, 1%, 0.1 W, 0402	Vishay-Dale	CRCW0402100KFKED
2	R11, R12	RES, 49.9, 1%, 0.1 W, 0402	Vishay-Dale	CRCW040249R9FKED
1	R14	RES, 0, 1%, 0.5 W, 0805	Keystone	5106
3	SH-J1, SH-J2, SH-J3	Shunt, 100mil, Gold plated, Black	Samtec	SNT-100-BK-G
4	TP1, TP2, TP3, TP4	Test Point, Multipurpose, Red, TH	Keystone	5010
6	TP5, TP6, TP19, TP20, TP24, TP25	Test Point, Multipurpose, Black, TH	Keystone	5011
3	TP9, TP14, TP23	Test Point, Miniature, Red, TH	Keystone	5000
8	TP10, TP11, TP12, TP13, TP15, TP16, TP17, TP18	Test Point, Miniature, White, TH	Keystone	5002
2	TP21, TP22	PC Test Point, SMT	TE Connectivity	RCU-0C
1	U1	TPS541620RPBR, RPB0025A (VQFN-HR-25)	Texas Instruments	TPS541620RPBR

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