THS4541RGT EVM User's Guide

The THS4541RGT EVM is an evaluation module for the single THS4541 amplifier in the RGT package. This evaluation module is designed to quickly and easily demonstrate the functionality and versatility of the amplifier. The EVM is ready to connect to power, signal source, and test instruments through the use of onboard connectors. The EVM comes configured for easy connection with common 50-Ω laboratory equipment on its inputs and outputs. The amplifier is configured for single-ended input with gain of 2 V/V to differential output at the device pins, which is converted to single-ended via a transformer to the output. It can be easily configured for other functions, gains, and single- or split-supply operation.

The THS4541RGT EVM has an on board load for the amplifier of 500 Ω. The output transformer and resistor network converts this to a 50 Ω single ended output.

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1 Features

- Configured for split-supply operation and easily modified for single supply
- Default gain of 2 configuration can easily be reconfigured for other gains
- Designed for easy connection to standard 50-Ω input/output impedance test equipment
- Inputs and outputs include SMA connectors

2 EVM Specifications

	Single-supply voltage range ($V_{S–}$ = ground)	2.7 to 5.4 V
V_S±	Split-supply voltage range	±1.35 to ±2.7 V
I_S±	Supply current (no load)	10 mA
	Input voltage	V_S±, Max
I_{OUT}	Output drive	±100 mA

3 Power Connections

The THS4541RGT EVM is equipped with banana jacks for easy connection of power. The positive supply input is red and is labeled V_S+. The negative supply input is green and is labeled V_S–. Ground is black and is labeled GND.

3.1 Split-Supply Operation

To operate as split supply, apply the positive supply voltage to V_S+, negative supply voltage to V_S– , and the ground reference from supply to GND.

3.2 Single-Supply Operation

To operate as single supply, connect the V_S– connector and the GND connector both to ground, and apply the positive supply voltage to V_S+. Inputs and outputs must be biased per data-sheet specifications for proper operation. The THS4541 output common mode voltage will default to mid supply if the Vocm connector is left floating. Make sure that R12 is not installed if the default Vocm is desired.

4 Input and Output Connections

The THS4541RGT EVM is equipped with SMA connectors for easy connection of signal generators and analysis equipment. As shipped, the EVM is configured for a gain of 2, split supply, single-ended input and output with 50-Ω termination. For best results, signals must be routed to and from the EVM with cables having 50-Ω characteristic impedance. Either V_{IN+} (J1) or V_{IN-}(J2) can be used for the input. The unused connector should be terminated with a 50 Ohm resistive SMA load. If no SMA load is available the spaces marked C12 or C13 can be loaded with a 0-Ω resistor to terminate the unused input. V_{OUT+} (J10) is the output connector for single-ended output signals. The amplifier converts the single-ended input to a differential signal at its output pins. A resistor network (R13, R14, R15) and transformer on the amplifier's output convert the differential signal to single-ended, and provides 500-Ω load to the amplifier when terminated in 50 Ω. A 50-Ω line impedance match at V_{OUT+} should be preserved. This results in an output measurement loss, and the overall gain is approximately –20 dB. See the following THS4541 data-sheet applications section, schematics, and layouts for more detail and how to reconfigure the EVM.

4.1 Vocm Input Conections

The Vocm input (J7) is optional. This input will set the common mode of the output pins. The THS4541 will automatically self bias the output pins to the mid supply voltage if the Vocm pin is not connected. This is the optimal voltage for maximum output swing and best linearity.

It's valid range is 0.9V above the negative supply to 1.2V below the positive supply. For example, on a ±2.5V split supply the Vocm pin can be set anywhere from -1.6V to 1.3V. With a single 5V supply the valid range would be 0.9V to 3.8V. One thing to keep in mind is that the outputs of the THS4541 can swing from rail to rail, however the maximum output swing available will be reduced when the Vocm pin is set to a voltage other than mid supply .

The resistor R12 is used only when it is desired to provide a load for the Vocm input signal source. It should not be used otherwise. The board is shipped with R12 unpopulated.

4.2 $\overline{PD}$ Input Connections

The $\overline{PD}$ connector (J6) allows the THS4541 to be disabled. A signal for the power down function can be applied through the SMA connector for high speed testing. Normally the jumper JP1 is used to enable or disable (Power Down) the amplifier. When the shorting block is connected to Vs+ the amplifier is NOT Powered Down, so it is enabled. When the shorting block is connected to Vs- the amplifier is powered down.

For high speed testing the resistor R9 is provided to terminate the $\overline{PD}$ SMA. If R9 is installed the shorting block should be removed from JP1. Because R9 terminates to the ground and not to the supplies the state of the amplifier will be undefined when the signal source is disconnected. For this reason R9 should only be used when driving the SMA connector with a high speed, controlled impedance source.

4.3 Using the Optional Differential Otputs (J8, J9)

The THS4541RGT EVM can be reconfigured for fully differential outputs. By removing resistors R13 and R14 the balun circuit is disconnected from the amplifier output. If 50-Ω resistors are loaded in the R16 and R17 resistor positions the J8 and J9 connectors can be used for fully differential output signals. If 50-Ω test equipment is connected to J8 and J9 the total load to the amplifier is 200 Ohms. The datasheet specifications were produced with a 500-Ω load. In order to match a 500-Ω load, R16 and R17 should be loaded with 221-Ω resistors, and then 60.4-Ω resistors need to be soldered to ground on the SMA side of the output transmission line. There are no spaces for these resistors, so the green solder mask must be scraped from the transmission line and the ground layer in order to make a space to solder these resistors. The resistors should be soldered near the "R" for R16 and near the "7" for R17. Placement is not critical but it should be close to the THS4541 outputs instead of near the SMA connectors

5 THS4541RGT EVM Schematic, Layout, and Bill of Materials

5.1 Schematic

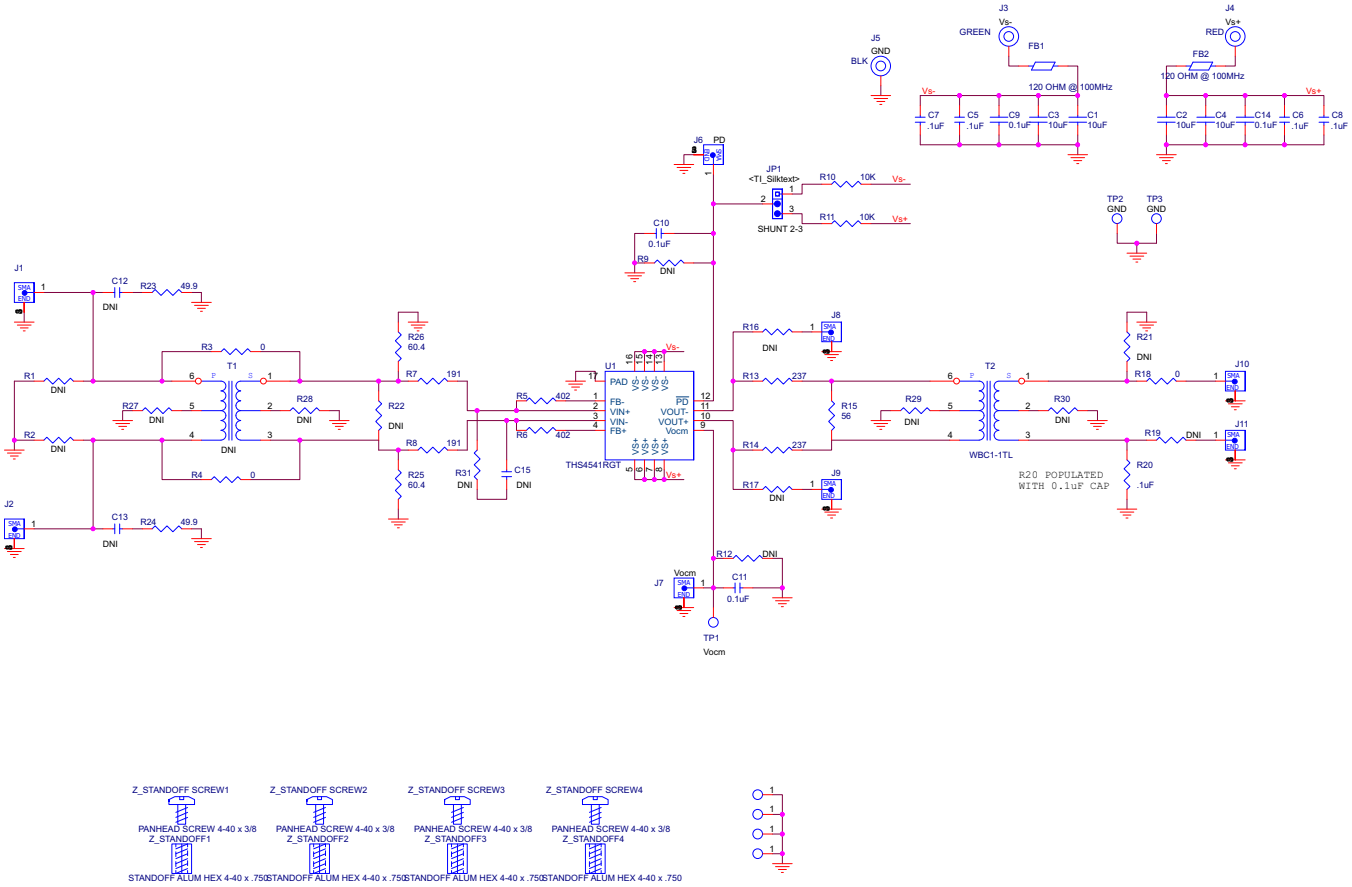

Figure 1. THS4541RGT EVM Schematic

5.2 THS4541RGT EVM Layers

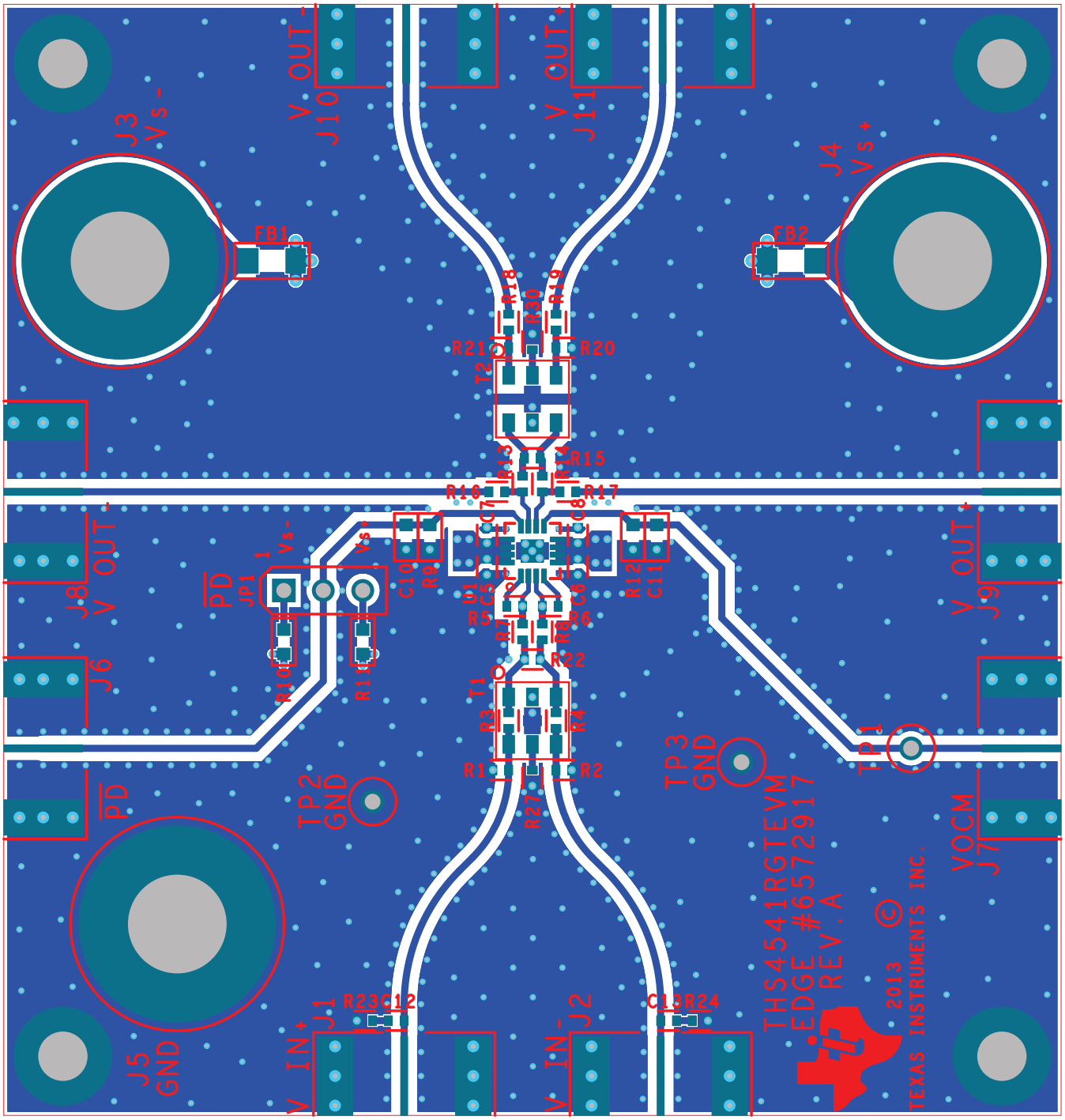

Figure 2. THS4541RGT EVM Top Layer, Signal

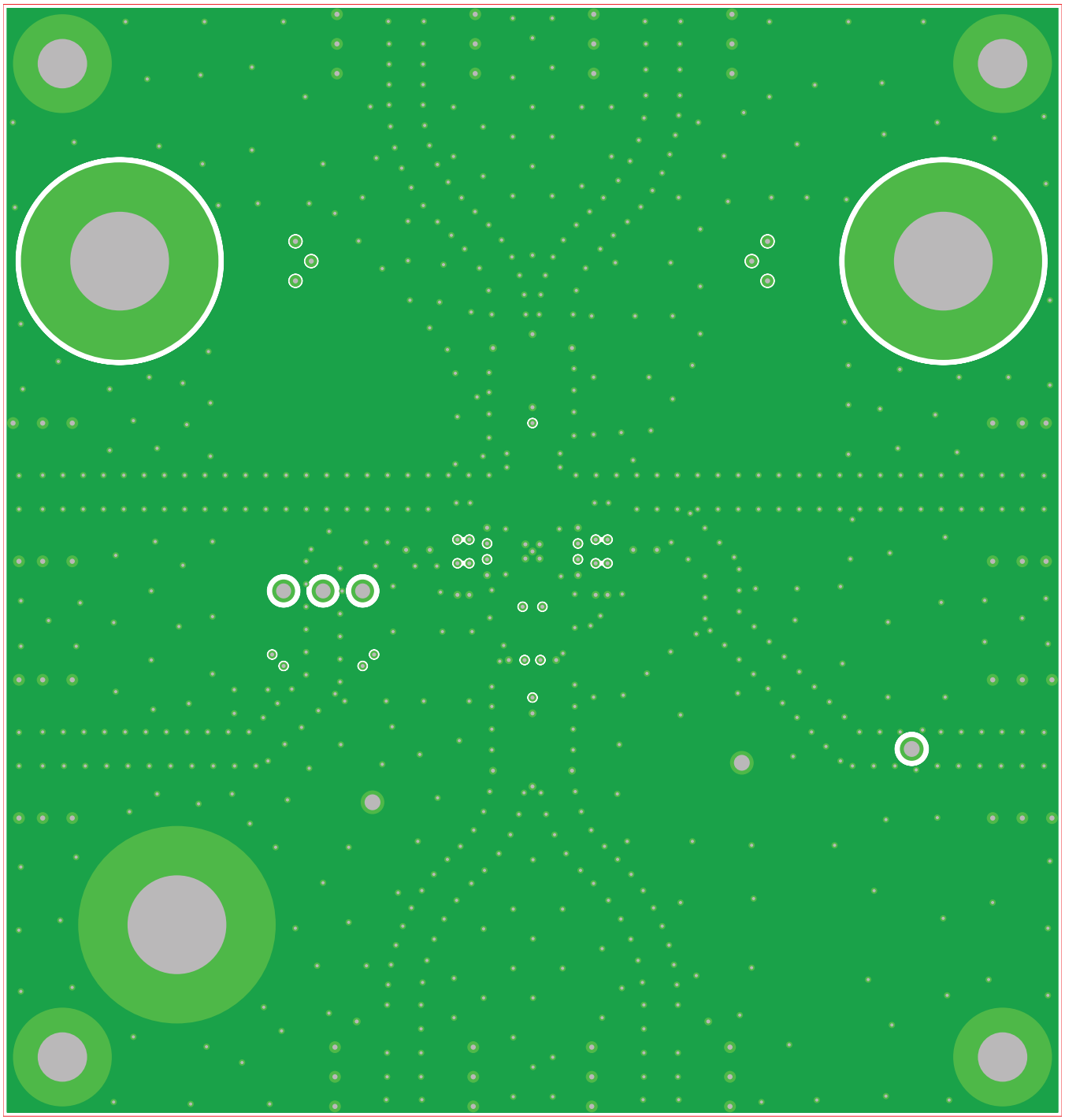

Figure 3. THS4541RGT EVM Layer 2, Ground

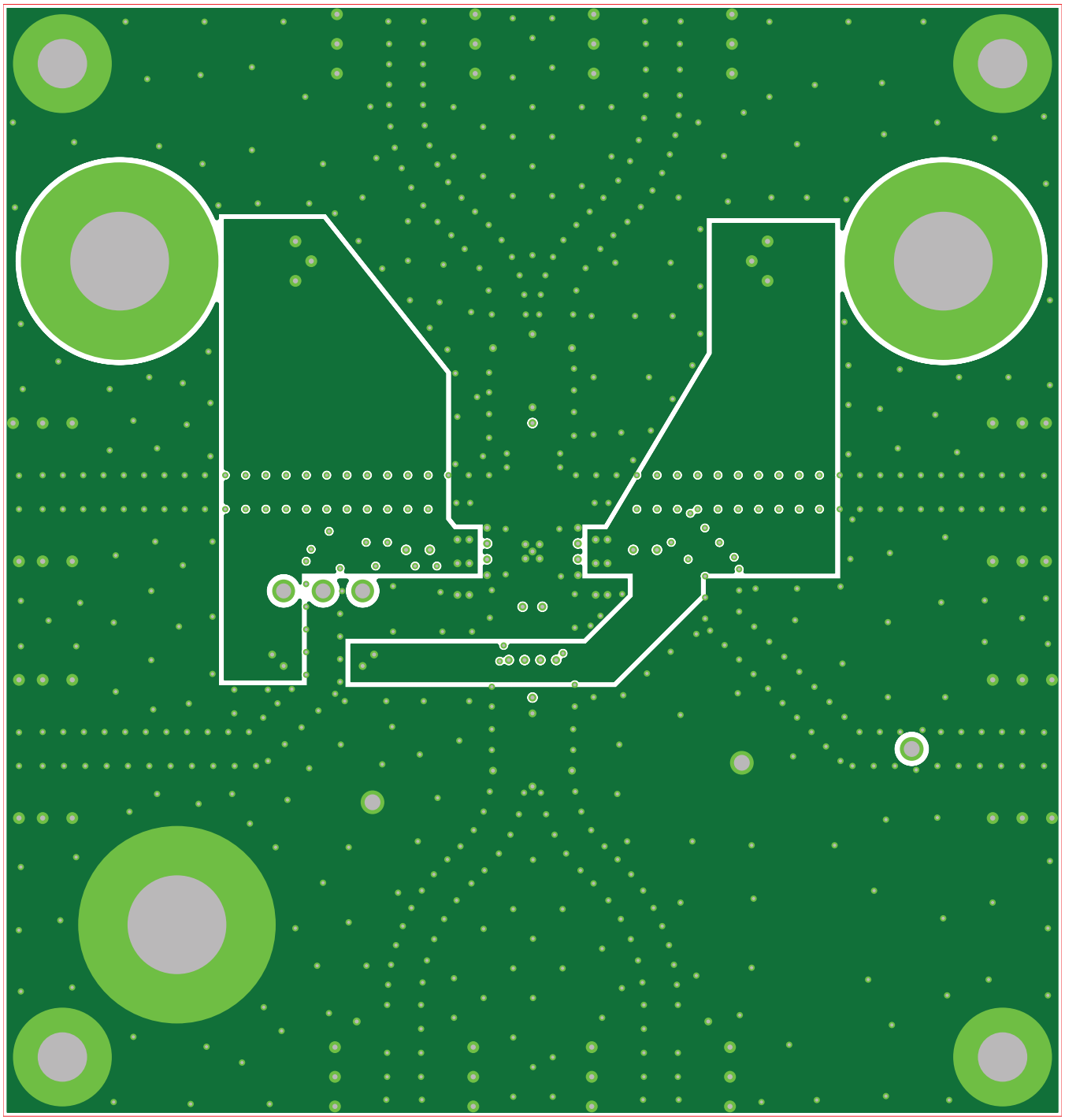

Figure 4. THS4541RGT EVM Layer 3, Power

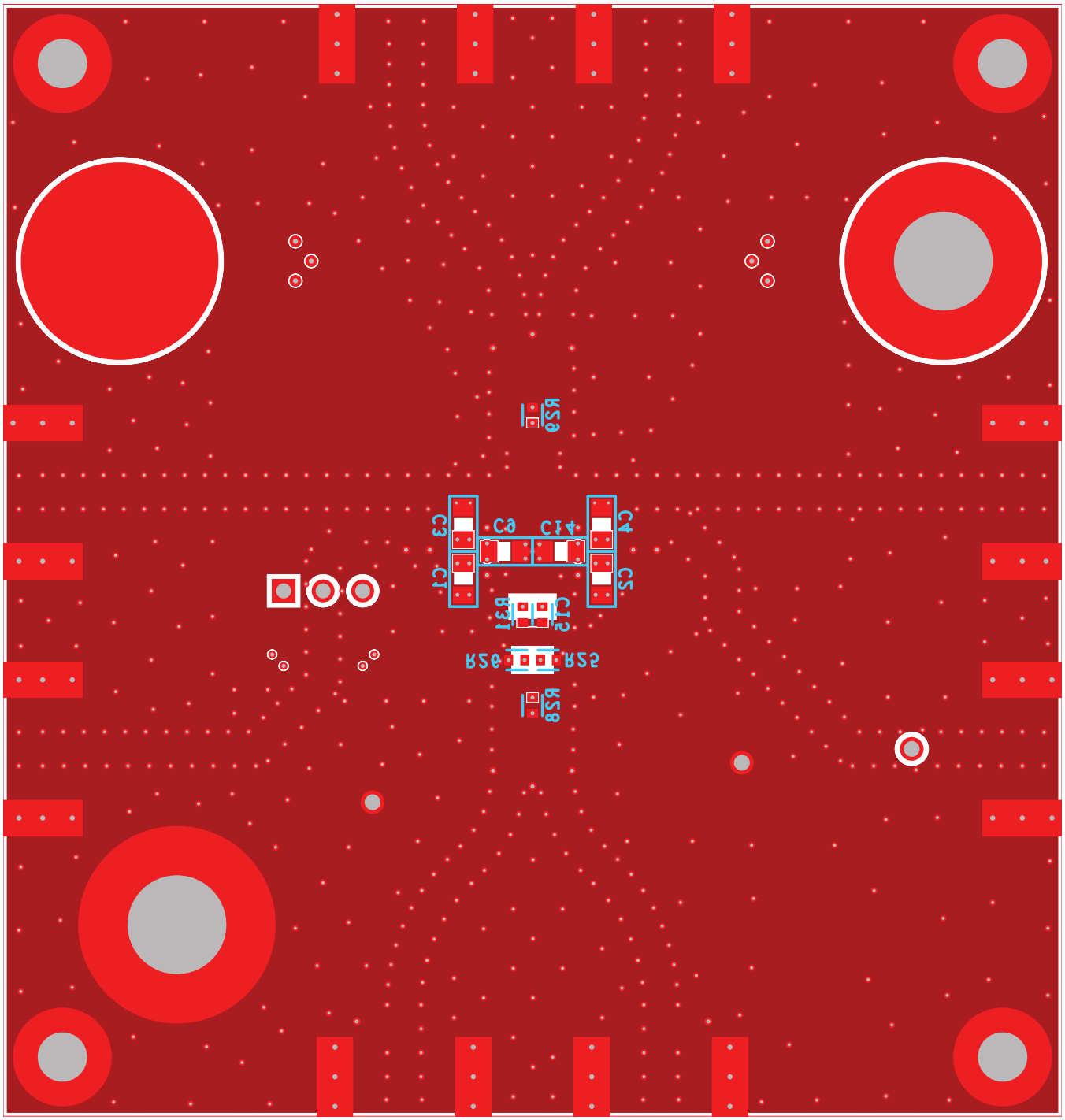

Figure 5. THS4541RGT EVM Bottom Layer

5.3 Bill of Materials

Table 1. THS4541RGT EVM Bill of Materials

Item	Manufacturer	Quantity	Part Reference	Value	Part Number	Footprint	Note
1	Kemet	4	C1, C2, C3, C4	10uF	C0805C106K8RACTU	0805	
2	MURATA	4	C5, C6, C7, C8	.1uF	GRM155R61A104KA01D	0402	
3	AVX	2	C9, C14	0.1uF	08055C104KAT2A	0805	
4	AVX	2	C10, C11	0.1uF	0603YC104KAT2A	0603	
5	MURATA	3	C12, C13, C15	.1uF	GRM155R61A104KA01D_DNI	0402	DNI
6	MURATA	2	FB1, FB2	120 OHM @ 100MHz	BLM31PG121SN1	1206	
7	Johnson Components	8	J1, J2, J6, J7, J8, J9, J10, J11	SMA_END_JACK_RND	142-0701-801	SMA_SMEL_373x312	
8	SPC Technology	1	J3	GREEN	845-G	CON_THVT_BANANA_JACK_250DIA	
9	SPC Technology	1	J4	RED	845-R	CON_THVT_BANANA_JACK_250DIA	
10	SPC Technology	1	J5	BLK	845-B	CON_THVT_BANANA_JACK_250DIA	
11	SAMTEC	1	JP1	HEADER_1x3_100_430L	HMTSW-103-07-G-S-.240	HDR_THVT_1x3_100_M	SHUNT 2-3
12		4	MTG1, MTG2, MTG3, MTG4	MTG125_PTH		MTG125_PTH	
13	PANASONIC	8	R1, R2, R21, R22, R27, R28, R30, R31	0	ERJ-2GE0R00X_DNI	0402	DNI
14	PANASONIC	3	R3, R4, R18	0	ERJ-2GE0R00X	0402	
15	PANASONIC	2	R5, R6	402	ERJ-2RKF4020X	0402	
16	PANASONIC	2	R7, R8	191	ERJ-2RKF1910X	0402	
17	PANASONIC	1	R9	Res_0603_Zero_H_DNI		0603	DNI
18	PANASONIC	2	R10, R11	10K	ERJ-3EKF1002V	0603	
19	PANASONIC	1	R12	49.9	ERJ-3EKF49R9V_DNI	0603	DNI
20	PANASONIC	2	R13. R14	237	ERJ-2RKF2370X	0402	
21	PANASONIC	1	R15	56	ERJ-2RKF56R0X	0402	
22	PANASONIC	4	R16, R17, R18, R19	49.9	ERJ-2RKF49R9X_DNI	0402	DNI
23	MURATA	1	R20	.1uF	GRM155R61A104KA01D	0402	CAP PLACE FOR R20
24	PANASONIC	2	R23, R24	49.9	ERJ-2RKF49R9X	0402	
25	PANASONIC	2	R25, R26	60.4	ERJ-2RKF60R4X	0402	
26	Coilcraft	1	T1	WBC1-1TL	WBC1-1TL_DNI	XFMR_6_165X175_60	DNI
27	Coilcraft	1	T2	WBC1-1TL	WBC1-1TL	XFMR_6_165X175_60	
28	Keystone	1	TP1	TP_THVT_060_RND-RED	5000	TP_THVT_060_RND	
29	Keystone	2	TP2, TP3	TP_THVT_060_RND-BLK	5001	TP_THVT_060_RND	
30	Texas Instruments	1	U1	THS4541RGT	THS4541RGT	QFN_16_124x124_pwrpad	
31	Keltron	1	Z_SHUNT-H1	SHUNT-HEADER	MJ-5.97-G or equivalent		SHUNT FOR HEADER
32	Building Fasteners	4	Z_STANDOFF SCREW1-Z_STANDOFF SCREW4	PANHEAD SCREW 4-40 x 3/8	PMS 440 0038 PH		SCREW FOR STANDOFF
33	Keystone	4	Z_STANDOFF1-Z_STANDOFF4	STANDOFF ALUM HEX 4-40 x .750	2204		STANDOFF

1 Glossary

SLYZ022 — *TI Glossary*.

This glossary lists and explains terms, acronyms, and definitions.

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This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation. Changes or modifications could void the user's authority to operate the equipment.

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- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

Industry Canada Compliance (English)

For EVMs Annotated as IC – INDUSTRY CANADA Compliant:

This Class A or B digital apparatus complies with Canadian ICES-003.

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

Concerning EVMs Including Radio Transmitters

This device complies with Industry Canada licence-exempt RSS standard(s). Operation is subject to the following two conditions: (1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.

Concerning EVMs Including Detachable Antennas

Under Industry Canada regulations, this radio transmitter may only operate using an antenna of a type and maximum (or lesser) gain approved for the transmitter by Industry Canada. To reduce potential radio interference to other users, the antenna type and its gain should be so chosen that the equivalent isotropically radiated power (e.i.r.p.) is not more than that necessary for successful communication.

This radio transmitter has been approved by Industry Canada to operate with the antenna types listed in the user guide with the maximum permissible gain and required antenna impedance for each antenna type indicated. Antenna types not included in this list, having a gain greater than the maximum gain indicated for that type, are strictly prohibited for use with this device.

Canada Industry Canada Compliance (French)

Cet appareil numérique de la classe A ou B est conforme à la norme NMB-003 du Canada

Les changements ou les modifications pas expressément approuvés par la partie responsable de la conformité ont pu vider l'autorité de l'utilisateur pour actionner l'équipement.

Concernant les EVMs avec appareils radio

Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes : (1) l'appareil ne doit pas produire de brouillage, et (2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

Concernant les EVMs avec antennes détachables

Conformément à la réglementation d'Industrie Canada, le présent émetteur radio peut fonctionner avec une antenne d'un type et d'un gain maximal (ou inférieur) approuvé pour l'émetteur par Industrie Canada. Dans le but de réduire les risques de brouillage radioélectrique à l'intention des autres utilisateurs, il faut choisir le type d'antenne et son gain de sorte que la puissance isotrope rayonnée équivalente (p.i.r.e.) ne dépasse pas l'intensité nécessaire à l'établissement d'une communication satisfaisante.

Le présent émetteur radio a été approuvé par Industrie Canada pour fonctionner avec les types d'antenne énumérés dans le manuel d'usage et ayant un gain admissible maximal et l'impédance requise pour chaque type d'antenne. Les types d'antenne non inclus dans cette liste, ou dont le gain est supérieur au gain maximal indiqué, sont strictement interdits pour l'exploitation de l'émetteur.

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If user uses EVMs in Japan, user is required by Radio Law of Japan to follow the instructions below with respect to EVMs:

1. Use EVMs in a shielded room or any other test facility as defined in the notification #173 issued by Ministry of Internal Affairs and Communications on March 28, 2006, based on Sub-section 1.1 of Article 6 of the Ministry's Rule for Enforcement of Radio Law of Japan,
2. Use EVMs only after user obtains the license of Test Radio Station as provided in Radio Law of Japan with respect to EVMs, or
3. Use of EVMs only after user obtains the Technical Regulations Conformity Certification as provided in Radio Law of Japan with respect to EVMs. Also, do not transfer EVMs, unless user gives the same notice above to the transferee. Please note that if user does not follow the instructions above, user will be subject to penalties of Radio Law of Japan.

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