THS4532 EVM Evaluation Module

The THS4532 EVM is an evaluation module for the dual THS4532 amplifier in the PW [16-lead TSSOP] 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 1 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.

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1 Features

- Configured for split-supply operation and easily modified for single supply
- Default gain of 1 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)	2.5 V to 5.5 V
V_S±	Split-supply voltage range	±1.25 V to ±2.75 V
I_S±	Supply current	250 µA
	Input voltage	V_S±, Max
I_{OUT}	Output drive	±25 mA

3 Power Connections

The THS4532 EVM is equipped with banana jacks for easy connection of power. The positive supply input is labeled V_S+. The negative supply input is labeled V_S–. Ground 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 jumper V_S– to GND, and apply the positive supply voltage to V_S+. Inputs and outputs must be biased per data-sheet specifications for proper operation.

4 Input and Output Connections

The THS4532 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 1, 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. V_{IN1+} (J2) and V_{IN2+} (J9) are the input connectors for single-ended input signals for channel 1 and 2 respectively. V_{OUT1+} (J6) and V_{OUT1+} (J10) are the output connectors for single-ended output signals for channels 1 and 2 respectively. V_{IN1-}(J1) and V_{IN2-}(J8) are not intended for use with single-ended input signals and has C2 and R9 added for channel 1 and C18 and R35 for channel 2 to approximate the impedance of an ac-coupled 50-Ω source and to balance the amplifier when V_{IN1+} or V_{IN2+} is driven from an ac-coupled, 50-Ω source. The amplifier converts the single-ended input to a differential signal at its output pins. A resistor network (R16, R17, R18 for channel 1 and R42,R43,R44 for channel 2) and transformer on the amplifier's output convert the differential signal to single-ended, provides 2-kΩ load to the amplifier when terminated in 50 Ω, and 50-Ω line impedance match at V_{OUT1+} and V_{OUT2+} . This results in loss, and the overall gain is approximately –38 dB. See the following THS4532 data-sheet applications section, schematics, and layouts for more detail and how to reconfigure the EVM.

5 THS4532 EVM Schematic, Layout, and Bill of Materials

5.1 Schematics

Figure 1 and Figure 2 illustrate the EVM schematics.

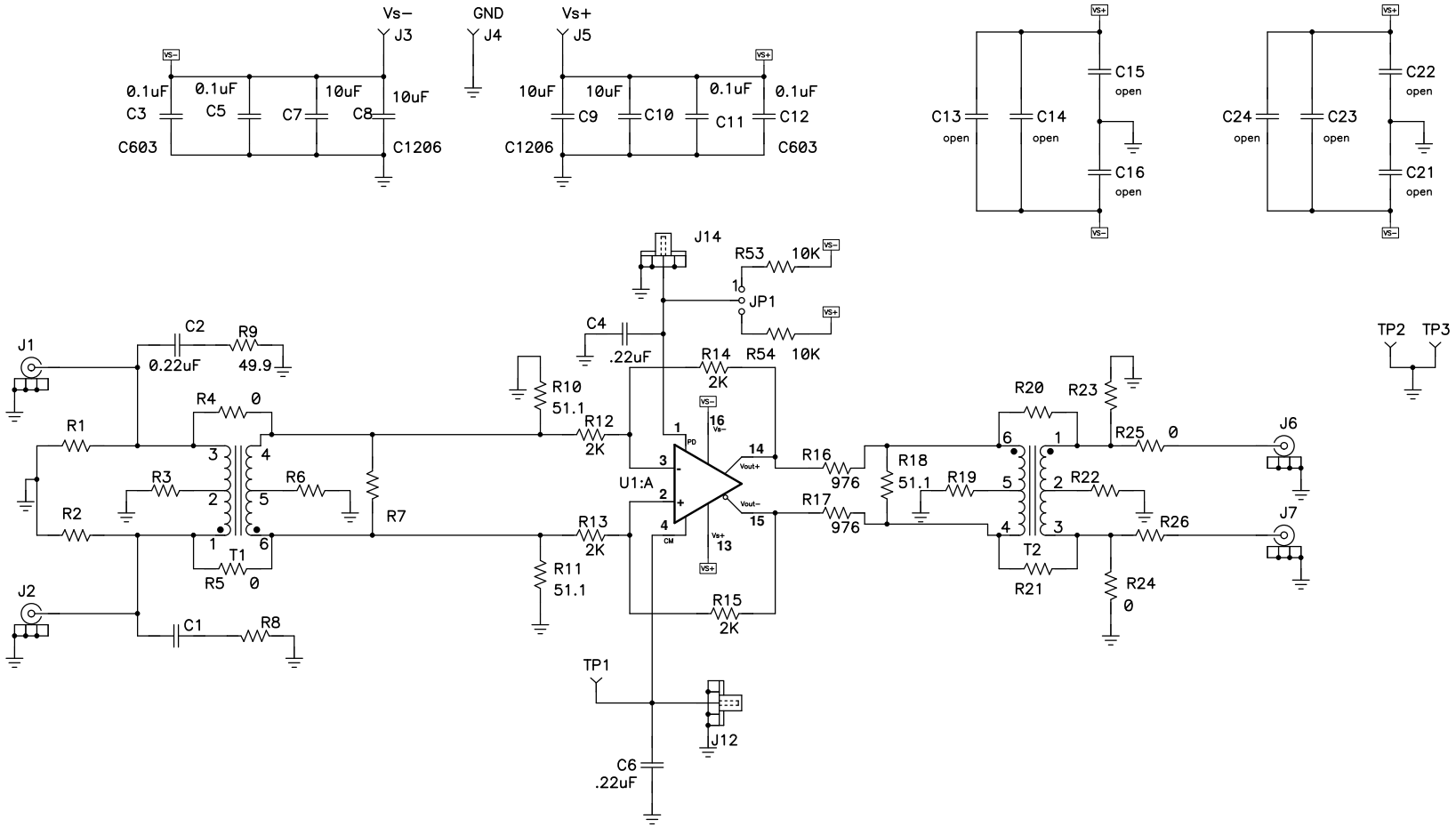

Figure 1. THS4532 EVM Schematic 1 of 2

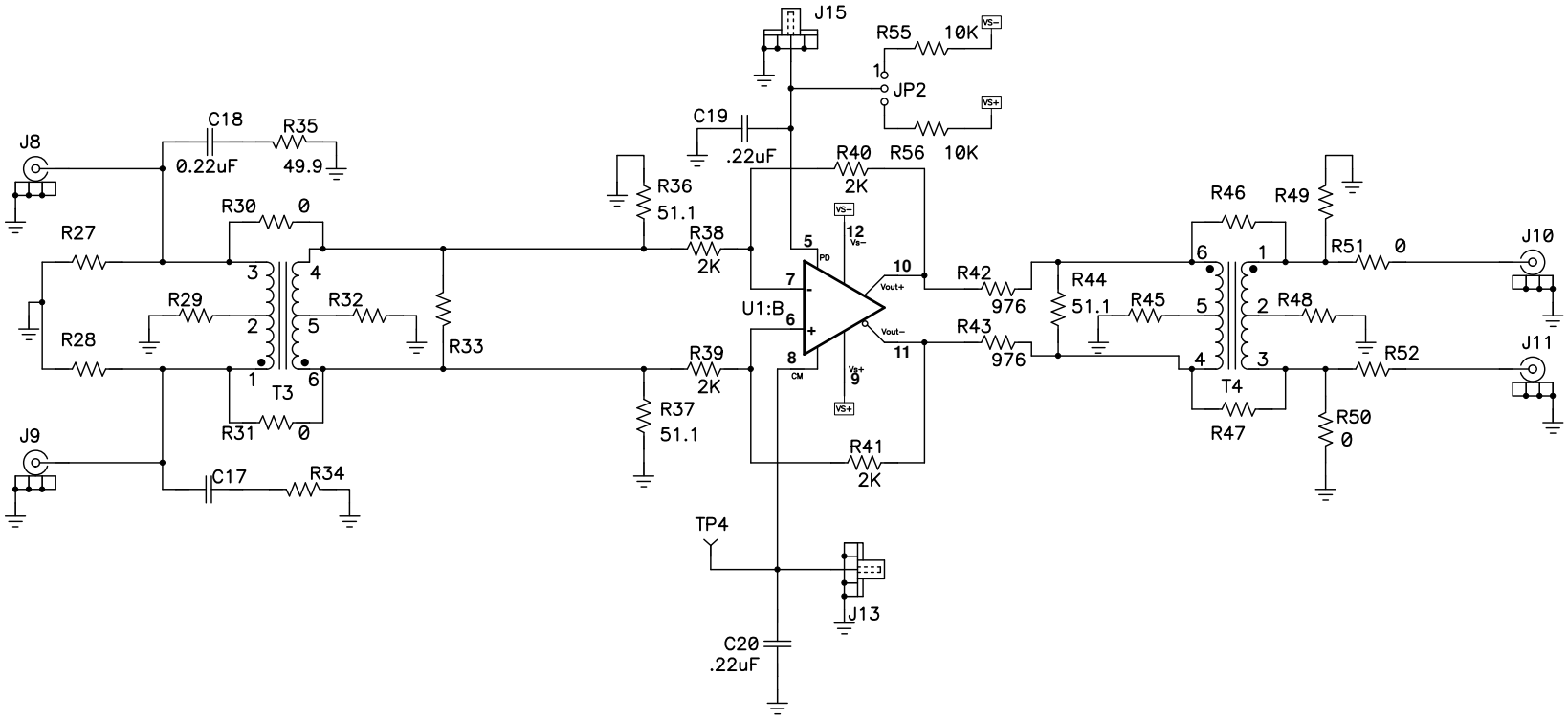

Figure 2. THS4532 EVM Schematic 2 of 2

5.2 THS4532 EVM Layers

Figure 3 through Figure 5 illustrate the PCB layers of the EVM.

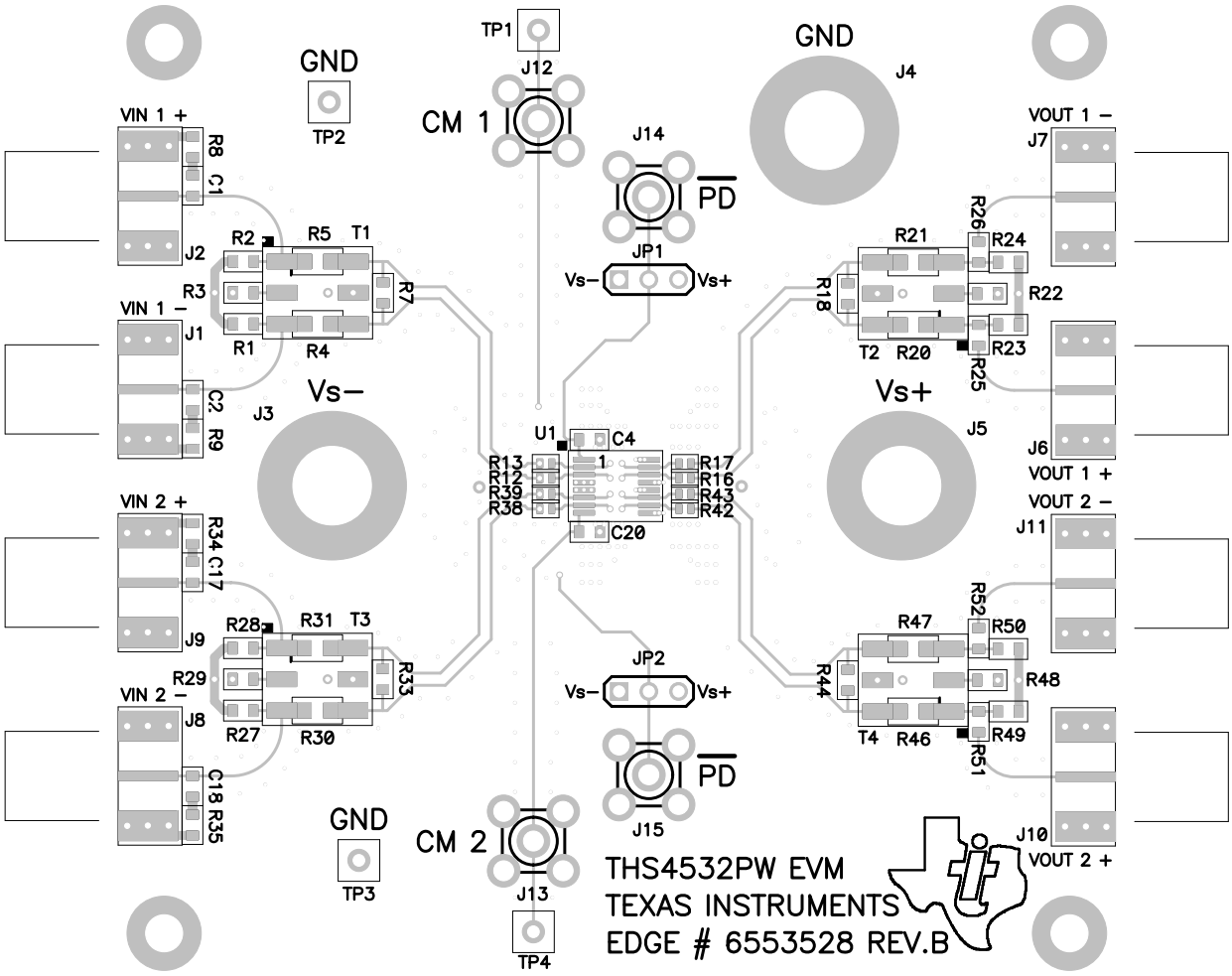

Figure 3. THS4532 EVM Top Layer 1

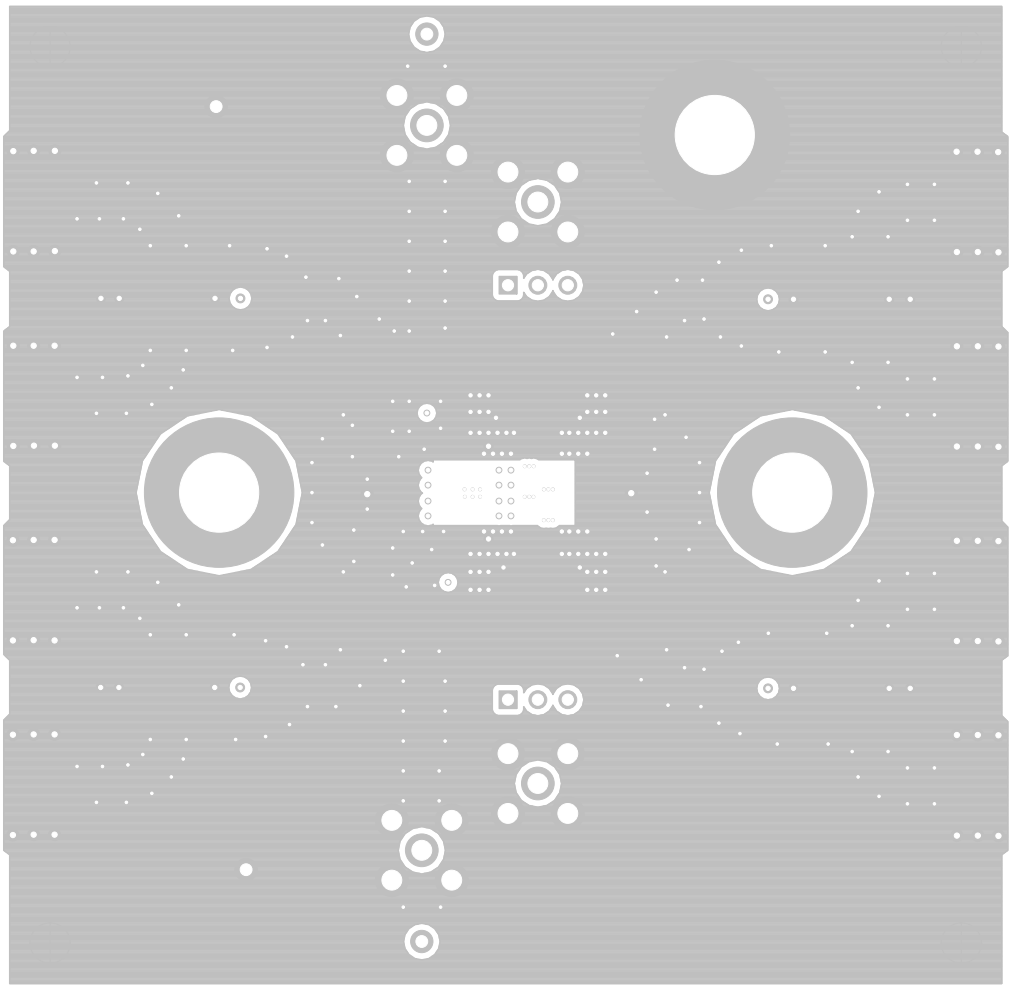

Figure 4. THS4532 EVM Ground Layer 2

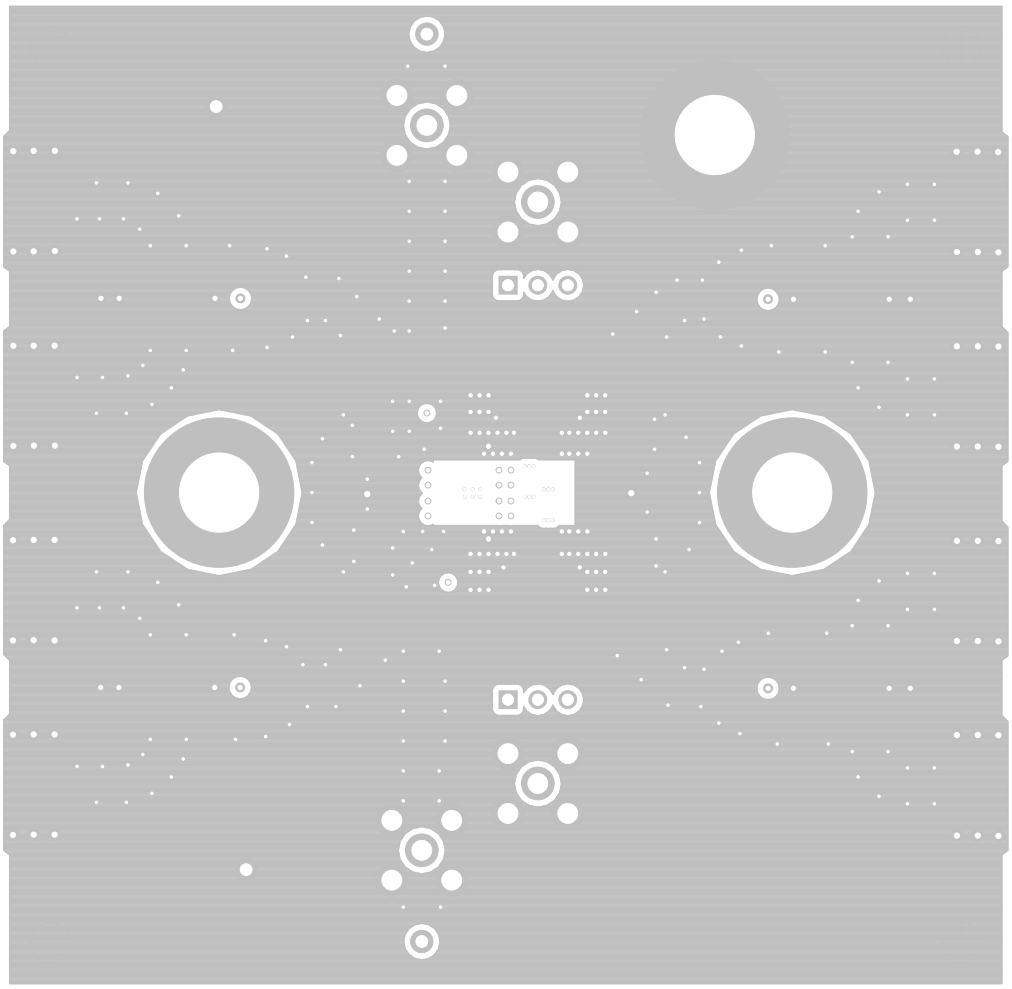

Figure 5. THS4532 EVM Ground Layer 3

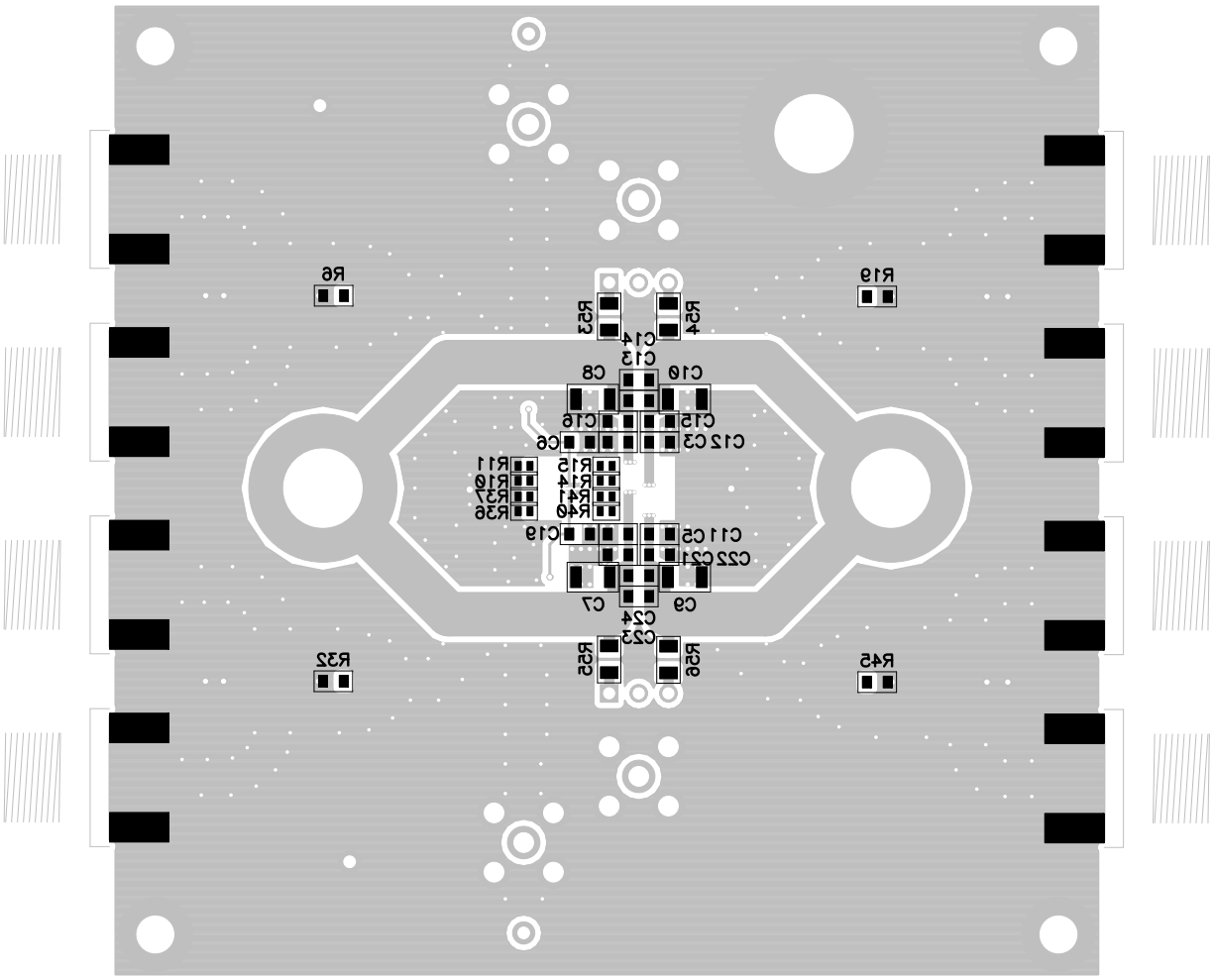

Figure 6. THS4532 EVM Bottom Layer 4

5.3 Bill of Materials

Table 1. THS4532 EVM Bill of Materials

ITEM	QTY	REFERENCE	VALUE	DESCRIPTION	PKG/CASE	MANUFACTURER	MANUFACTURER	DISTRIBUTOR	DISTRIBUTOR
		DESIGNATOR					PART NUMBER		PART NUMBER
1	4	C7, C8, C9, C10	10.0uF	CAP, TAN, 16V, X7R	1206	AVX	1206YC106KAT2A	DIGI-KEY	478-5725-1-ND
2	4	C3, C5, C11, C12	0.1uF	CAP, CERAMIC, 16V, X7R	0603	AVX	0603YC104KAT2A	DIGI-KEY	478-1239-1-ND
3	6	C2, C4, C6, C18, C19, C20	0.22uF	CAP, CERAMIC, 10V, X7R	0603	AVX	0603ZC224KAT2A	DIGI-KEY	478-1243-1-ND
4	10	C1, C13, C14, C15, C16, C17, C21, C22, C23, C24		OPEN	0603				
5	4	R10, R11, R36, R37	51.1	RESISTOR, 1/16W, 1%	0402	PANASONIC	ERJ-2RKF51R1X	DIGI-KEY	P51.1LCT-ND
6	4	R16, R17, R42, R43	976	RESISTOR, 1/16W, 1%	0402	PANASONIC	ERJ-2RKF9760X	DIGI-KEY	P976LCT-ND
7	8	R12, R13, R14, R15, R38, R39, R40, R41	2K	RESISTOR, 1/16W, 1%	0402	PANASONIC	ERJ-2RKF2001X	DIGI-KEY	P2.00KLCT-ND
8	20	R1, R2, R3, R6, R7, R8, R19, R22, R23, R26, R27, R28, R29, R32, R33, R34, R45, R48, R49, R52		OPEN	0603				
9	4	R24, R25, R50, R51	0	RESISTOR	0603	ROHM	TRR03EZPJ000	DIGI-KEY	RHM0.0BKCT-ND
10	2	R9, R35	49.9	RESISTOR, 1/10W, 1%	0603	ROHM	MCR03ERTF49R9	DIGI-KEY	RHM49.9CFCT-ND
11	2	R18, R44	51.1	RESISTOR, 1/10W, 1%	0603	PANASONIC	ERJ-3EKF51R1V	DIGI-KEY	P51.1HCT-ND
12	4	R20, R21, R46, R47		OPEN					
13	4	R4, R5, R30, R31	0	RESISTOR	0805	ROHM	MCR10EZPJ000	DIGI-KEY	RHM0.0ARCT-ND
14	4	R53, R54, R55, R56	10K	RESISTOR	0805	ROHM	MCR10ERTF1002	DIGI-KEY	RHM10.0KCHCT-ND
15	2	T1, T3		OPEN					
16	2	T2, T4		TRANSFORMER, RF		MINI-CIRCUITS	ADT1-1WT+		
17	8	J1, J7, J8, J11, J12, J13, J14, J15		OPEN					
18	3	J3, J4, J5		JACK, BANANA RECEPTANCE		TENMA	SPC15459	NEWARK	79K5034
19	4	J2, J6, J9, J10		CONNECTOR, EDGE, SMA PCB JACK		JOHNSON	142-0701-801	NEWARK	90F2624
20	2	JP1, JP2	3POS	HEADER, 0.1" CTRS, 0.025" SQ. PINS		SULLINS	PBC03SAAN	DIGI-KEY	S1011E-03-ND
21	2	JP1, JP2		SHUNTS		SULLINS	SSC02SYAN	DIGI-KEY	S9002-ND
22	2	TP1, TP4		TESTPOINT, RED		KEYSTONE	5000	DIGI-KEY	5000K-ND
23	2	TP2, TP3		TESTPOINT, BLACK		KEYSTONE	5001	DIGI-KEY	5001K-ND
24	1	U1		IC, THS4532	PW	TI	THS4532IPW		
25	4			STANDOFF, 4-40 HEX, 0.625" LENGTH		KEYSTONE	1808	DIGI-KEY	1808K-ND
26	4			SCREW, PHILLIPS, 4-40, .250"			PMSSS 440 0025 PH	DIGI-KEY	H703-ND
27	1			BOARD, PRINTED CIRCUIT		TI	EDGE # 6553528		
	Notes:	1. These assemblies are ESD sensitive, observe ESD precautions. Use of no-clean flux is not acceptable.							
		2. These assemblies must be clean and free from flux and all contaminants.							
		3. These assemblies must comply with workmanship standards IPC-A-610 Class 2.							
		4. Ref designators marked with an asterisk ('**') cannot be substituted. All other components can be substituted with equivalent MFG's components.							

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EVM Warnings and Restrictions

It is important to operate this EVM within the input voltage range of 2.5 V to 5.5 V and the output voltage range of 2.5 V to 5.5 V.

Exceeding the specified input range may cause unexpected operation and/or irreversible damage to the EVM. If there are questions concerning the input range, please contact a TI field representative prior to connecting the input power.

Applying loads outside of the specified output range may result in unintended operation and/or possible permanent damage to the EVM. Please consult the EVM User's Guide prior to connecting any load to the EVM output. If there is uncertainty as to the load specification, please contact a TI field representative.

During normal operation, some circuit components may have case temperatures greater than 85°C. The EVM is designed to operate properly with certain components above 85°C as long as the input and output ranges are maintained. These components include but are not limited to linear regulators, switching transistors, pass transistors, and current sense resistors. These types of devices can be identified using the EVM schematic located in the EVM User's Guide. When placing measurement probes near these devices during operation, please be aware that these devices may be very warm to the touch.

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As noted in the EVM User's Guide and/or EVM itself, this EVM and/or accompanying hardware may or may not be subject to the Federal Communications Commission (FCC) and Industry Canada (IC) rules.

For EVMs **not** subject to the above rules, this evaluation board/kit/module is intended for use for ENGINEERING DEVELOPMENT, DEMONSTRATION OR EVALUATION PURPOSES ONLY and is not considered by TI to be a finished end product fit for general consumer use. It generates, uses, and can radiate radio frequency energy and has not been tested for compliance with the limits of computing devices pursuant to part 15 of FCC or ICES-003 rules, which are designed to provide reasonable protection against radio frequency interference. Operation of the equipment may cause interference with radio communications, in which case the user at his own expense will be required to take whatever measures may be required to correct this interference.

General Statement for EVMs including a radio

User Power/Frequency Use Obligations: This radio is intended for development/professional use only in legally allocated frequency and power limits. Any use of radio frequencies and/or power availability of this EVM and its development application(s) must comply with local laws governing radio spectrum allocation and power limits for this evaluation module. It is the user's sole responsibility to only operate this radio in legally acceptable frequency space and within legally mandated power limitations. Any exceptions to this are strictly prohibited and unauthorized by Texas Instruments unless user has obtained appropriate experimental/development licenses from local regulatory authorities, which is responsibility of user including its acceptable authorization.

For EVMs annotated as FCC – FEDERAL COMMUNICATIONS COMMISSION Part 15 Compliant

Caution

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

FCC Interference Statement for Class A EVM devices

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

FCC Interference Statement for Class B EVM devices

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- 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.

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.

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.

【Important Notice for Users of this Product in Japan】

This development kit is NOT certified as Confirming to Technical Regulations of Radio Law of Japan

If you use this product in Japan, you are required by Radio Law of Japan to follow the instructions below with respect to this product:

1. Use this product 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 this product only after you obtained the license of Test Radio Station as provided in Radio Law of Japan with respect to this product, or
3. Use of this product only after you obtained the Technical Regulations Conformity Certification as provided in Radio Law of Japan with respect to this product. Also, please do not transfer this product, unless you give the same notice above to the transferee. Please note that if you could not follow the instructions above, you will be subject to penalties of Radio Law of Japan.

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For Feasibility Evaluation Only, in Laboratory/Development Environments. Unless otherwise indicated, this EVM is not a finished electrical equipment and not intended for consumer use. It is intended solely for use for preliminary feasibility evaluation in laboratory/development environments by technically qualified electronics experts who are familiar with the dangers and application risks associated with handling electrical mechanical components, systems and subsystems. It should not be used as all or part of a finished end product.

Your Sole Responsibility and Risk. You acknowledge, represent and agree that:

1. You have unique knowledge concerning Federal, State and local regulatory requirements (including but not limited to Food and Drug Administration regulations, if applicable) which relate to your products and which relate to your use (and/or that of your employees, affiliates, contractors or designees) of the EVM for evaluation, testing and other purposes.
2. You have full and exclusive responsibility to assure the safety and compliance of your products with all such laws and other applicable regulatory requirements, and also to assure the safety of any activities to be conducted by you and/or your employees, affiliates, contractors or designees, using the EVM. Further, you are responsible to assure that any interfaces (electronic and/or mechanical) between the EVM and any human body are designed with suitable isolation and means to safely limit accessible leakage currents to minimize the risk of electrical shock hazard.
3. You will employ reasonable safeguards to ensure that your use of the EVM will not result in any property damage, injury or death, even if the EVM should fail to perform as described or expected.
4. You will take care of proper disposal and recycling of the EVM's electronic components and packing materials.

Certain Instructions. It is important to operate this EVM within TI's recommended specifications and environmental considerations per the user guidelines. Exceeding the specified EVM ratings (including but not limited to input and output voltage, current, power, and environmental ranges) may cause property damage, personal injury or death. If there are questions concerning these ratings please contact a TI field representative prior to connecting interface electronics including input power and intended loads. Any loads applied outside of the specified output range may result in unintended and/or inaccurate operation and/or possible permanent damage to the EVM and/or interface electronics. Please consult the EVM User's Guide prior to connecting any load to the EVM output. If there is uncertainty as to the load specification, please contact a TI field representative. During normal operation, some circuit components may have case temperatures greater than 60°C as long as the input and output are maintained at a normal ambient operating temperature. These components include but are not limited to linear regulators, switching transistors, pass transistors, and current sense resistors which can be identified using the EVM schematic located in the EVM User's Guide. When placing measurement probes near these devices during normal operation, please be aware that these devices may be very warm to the touch. As with all electronic evaluation tools, only qualified personnel knowledgeable in electronic measurement and diagnostics normally found in development environments should use these EVMs.

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Safety-Critical or Life-Critical Applications. If you intend to evaluate the components for possible use in safety critical applications (such as life support) where a failure of the TI product would reasonably be expected to cause severe personal injury or death, such as devices which are classified as FDA Class III or similar classification, then you must specifically notify TI of such intent and enter into a separate Assurance and Indemnity Agreement.

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