TEXAS INSTRUMENTS

THS4211/15EVM

User's Guide

DEVICE	EVM TITLE	USER'S GUIDE	DESCRIPTION	SHUTDOWN
THS4211	THS4211EVM	THS4211/15EVM	Configurable for gains ≥ +2/-1	No
THS4215	THS4215EVM	THS4211/15EVM	Configurable for gains ≥ +2/-1	Yes
THS4211	THS4211EVM-UG	THS4211 Unity Gain EVM	Noninverting unity gain configuration only	No

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SLOU149

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EVM WARNINGS AND RESTRICTIONS

It is important to operate this EVM within the specified input and output ranges described in the EVM User's Guide. The input supply voltage ($\pm V_S$) should be no greater than $\pm$7.5 V for dual supply (V_S should be no greater than 15 V for single supply operation). The output current (I_O) should be no greater than 100 mA.

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 60°C. The EVM is designed to operate properly with certain components above 60°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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Preface

Read This First

Information About Cautions and Warnings

This book may contain cautions and warnings.

This is an example of a caution statement.

A caution statement describes a situation that could potentially damage your software or equipment.

This is an example of a warning statement.

A warning statement describes a situation that could potentially cause harm to you.

The information in a caution or a warning is provided for your protection. Please read each caution and warning carefully.

FCC Warning

This equipment is intended for use in a laboratory test environment only. It generates, uses, and can radiate radio frequency energy and has not been tested for compliance with the limits of computing devices pursuant to subpart J of part 15 of FCC rules, which are designed to provide reasonable protection against radio frequency interference. Operation of this equipment in other environments 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.



This EVM contains components that can potentially be damaged by electrostatic discharge. Always transport and store the EVM in its supplied ESD bag when not in use. Handle using an antistatic wristband. Operate on an antistatic work surface. For more information on proper handling, refer to SSYA008.

Related Documentation From Texas Instruments

The URLs below are correct as of the date of publication of this manual. Texas Instruments applications apologizes if they change over time.

- THS4211/THS4215 data sheet (SLOS400)
- Application report (SLMA002), *PowerPAD Thermally Enhanced Package*, http://www-s.ti.com/sc/psheets/slma004/slma002.pdf
- Application report (SLMA004), PowerPAD Made Easy, http://www-s.ti.com/sc/psheets/slma004/slma004.pdf
- Application report (SSYA008), Electrostatic Discharge (ESD), http://www-s.ti.com/sc/psheets/ssya008/ssya008.pdf
- Application report (SLOA102), High Speed PCB Layout Tips, http://www-s.ti.com/sc/psheets/sloa102/sloa102.pdf

Trademarks

PowerPAD is a trademark of Texas Instruments.

Contents

1 Introduction and Description 1-1
1.1 Evaluation Schematic 1-1

2 Using the EVM 2-1

3 EVM Applications 3-1
3.1 Default Configuration 3-1
3.2 Noninverting Gain Stage 3-2
3.3 Inverting Gain Stage 3-3
3.4 Power-Down Reference Operation—THS4215EVM Only 3-3

4 EVM Hardware Description 4-1

Figures

1-1 Schematic of the THS4211/15EVM 1-2
2-1 Test Equipment Connections 2-1
3-1 Default Configuration 3-1
3-2 Noninverting Gain Stage 3-2
3-3 Inverting Gain Stage 3-3
3-4 Power-Down Reference Operation 3-4
4-1 Board Layout Views 4-3

Tables

4-1 THS4211EVM Bill of Materials 4-1
4-2 THS4215EVM Bill of Materials 4-2

Chapter 1

Introduction and Description

This EVM provides a platform for testing the THS4211 and THS4215 in 8-pin MSOP (DGN) and 8-pin LLP (DRB) with and without power down. It contains the high-speed op amp, a number of passive components, and various features and footprints that enable the user to experiment, test, and verify various operational amplifier circuit implementations.

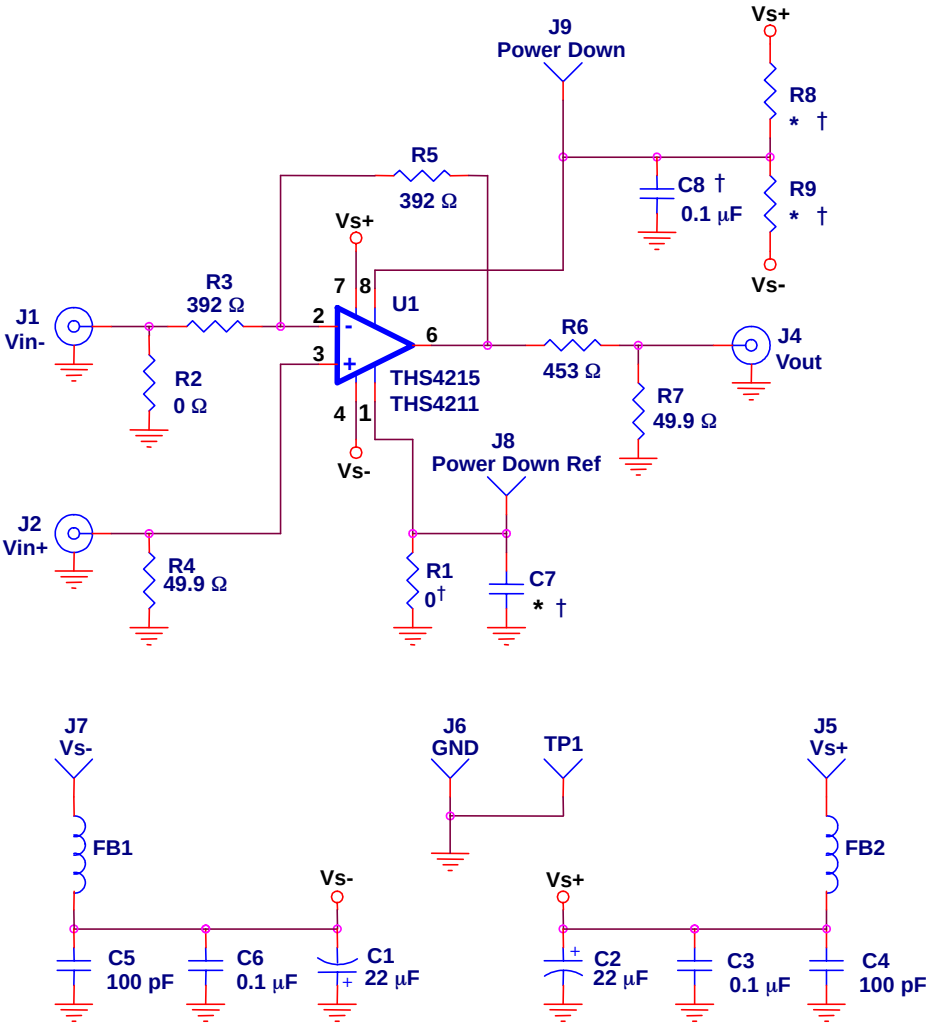
If the user wants to evaluate a unity gain noninverting buffer, that configuration is not recommended with this EVM. The user needs to obtain a THS4211 unity gain EVM, THS4211EVM-UG. See Section 3.2.

1.1 Evaluation Schematic

As delivered, the EVM has a fully functional example circuit—just add power supplies, a signal source, and monitoring instrument. See Figure 1–1 for a complete schematic diagram. EVM features include:

- ❑ Wide operating supply voltage range: single supply 4.5 Vdc to dual supply ±7.5 Vdc operation (see the device data sheet). Single supply operation is obtained by connecting both J6 (GND) and J7 (VS-) to ground.
- ❑ Nominal 50-Ω input impedance (R4). Termination can be configured according to the application requirement.
- ❑ 50-Ω impedance traces on Vin-, Vin+, and Vout (see Figure 4-1—the vias provide the impedance)
- ❑ Power-down input for the THS4215 (J9).
- ❑ Power-down reference for the THS4215 can be changed by removing R1 and supplying the desired reference level to J8.
- ❑ Convenient GND test point (TP1).
- ❑ 453-Ω series matching resistor (R6)—produces a 500-Ω load in combination with resistor R7. 500 Ω is the standard data sheet load impedance.
- ❑ Power supply ripple rejection capacitors (C1 and C2).
- ❑ Decoupling capacitors (C3, C4, C5, C6).
- ❑ PowerPAD™ heatsinking capability.
- ❑ User customizable/configurable component choice.
- ❑ A good example of high-speed amplifier PCB design and layout.

Figure 1-1. Schematic of the THS4211/15EVM



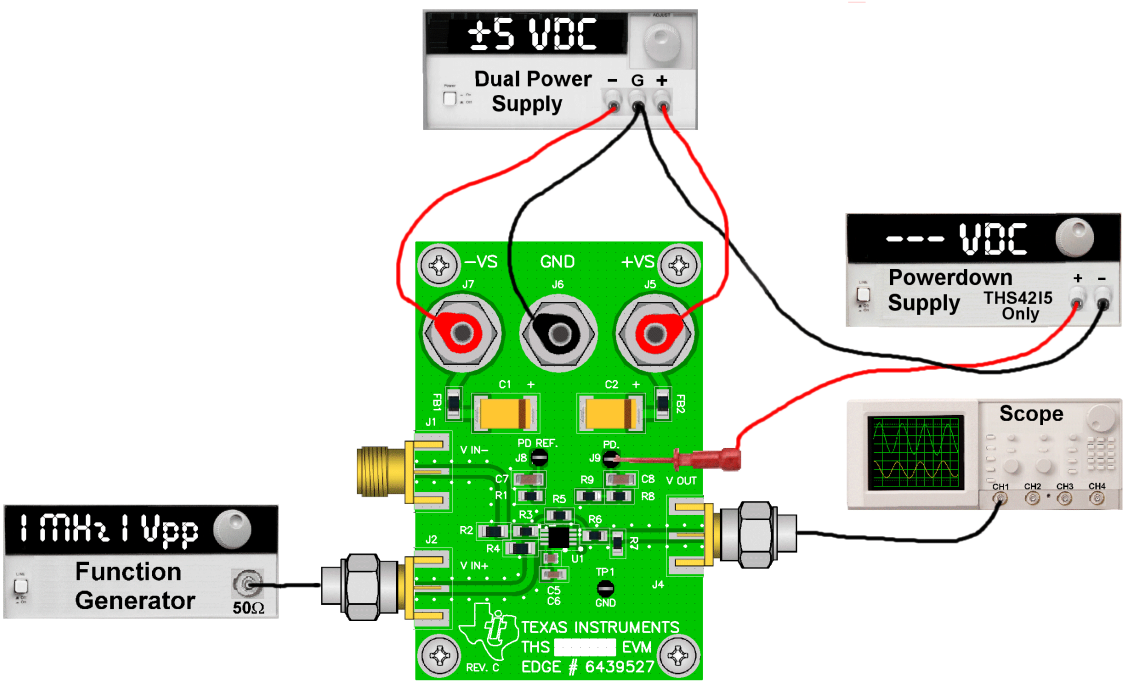
*** Not Installed on the THS4215 EVM**
† Not Installed on the THS4211 EVM

Chapter 2

Using the EVM

Figure 2-1 shows how to connect power supplies, signal source and monitoring instrument. It is recommended that the user connect the EVM as shown to avoid damage to the EVM or the op amp installed on the board.

Figure 2-1. Test Equipment Connections

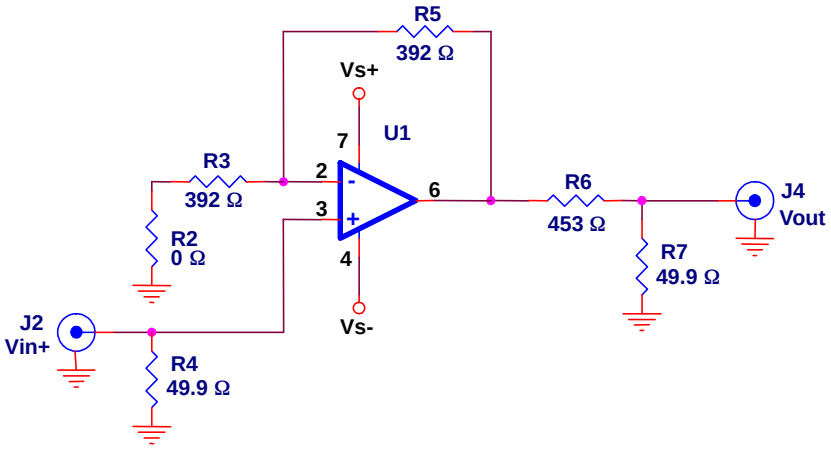


Chapter 3
EVM Applications

Example applications are presented in this chapter. These applications demonstrate the most popular circuits, but many other circuits can be constructed. The purpose of the EVM board is for the user to experiment with different circuits, exploring new and creative design techniques, which is the function of an evaluation board.

3.1 Default Configuration

Figure 3-1. Default Configuration



Note: This schematic reflects the default THS4211EVM configuration. Power supply decoupling not shown.

The EVM output provides a 500-Ω load to the output of the EVM to provide optimum performance (per the data sheet). The load is implemented as a 453-Ω resistor (R6) in series with the output to J4 (V_{out}), and a 49.9-Ω output load resistor (R7) from J4 to ground. The total of these two resistors is close to 500 Ω, which is the standard load impedance.

When the EVM is monitored with a high input impedance instrument, R7 can remain on the board, and the EVM provides a 10:1 attenuation of the input signal.

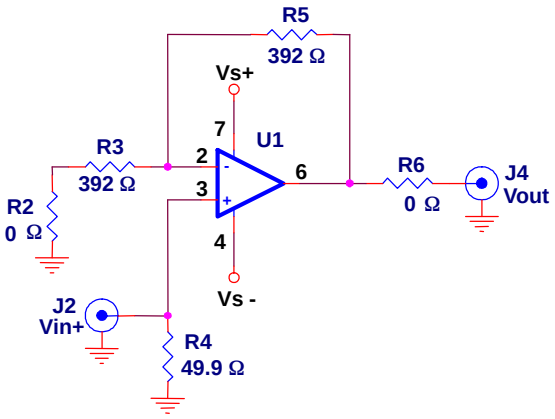
When the EVM is monitored with an instrument that has an input impedance of 50 Ω, R7 must be removed. The EVM again provides a 10:1 attenuation.

If the user provides an external load, R7 may be removed, and R6 replaced with a 0-Ω jumper. The EVM then provides a gain of 2 (6 dB) at the output connector J4. A gain of 2 is often used to compensate for the voltage division effect when series and termination resistors are used for stage impedance matching.

3.2 Noninverting Gain Stage

The default configuration of the EVM is a noninverting gain stage with a voltage divider on the output. If a gain of 2 is desired, the user should change R6 to 0 Ω, and remove R7 as shown in Figure 3-2:

Figure 3-2. Noninverting Gain Stage



Note: Power supply decoupling not shown.

Gain for this circuit is:

$$\frac{V_O}{V_I} = 1 + \frac{R5}{R3}$$

for R2 = 0, when the input voltage is measured at J2.

Changing R6 to 49.9 Ω in this and the subsequent section, allows the EVM to connect to a 50-Ω load. This amplifier is designed to attain optimum performance driving 500-Ω loads, but also drives 100-Ω loads—refer to data sheet characteristics.

Note:

The unity gain noninverting buffer configuration can be implemented by removing R3 and R2. This configuration, however, requires a 392-Ω resistor to be installed in location R5 on the EVM. A resistor less than the recommended value may cause the EVM to become unstable due to inductance on the PCB trace. Texas Instruments manufactures a different EVM for customers who wish to evaluate the noninverting buffer configuration. This EVM is optimized for low inductance traces on the op amp output. It is implemented on THS4211EVM-UG.

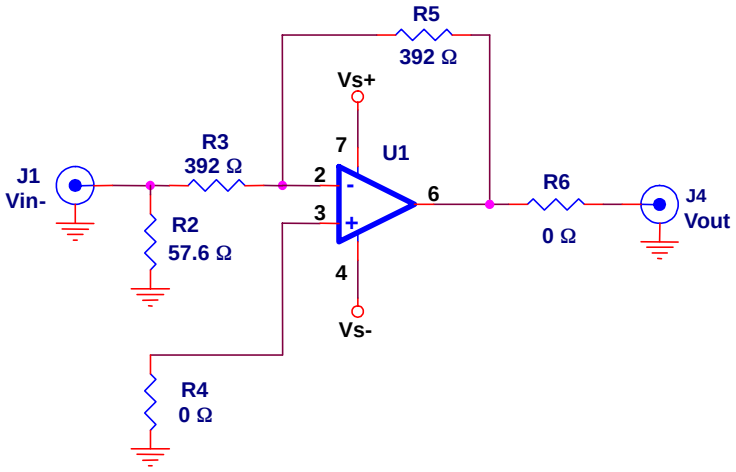
3.3 Inverting Gain Stage

If unity gain inverting operation is desired, the user should:

- ❑ Change R6 to 0 Ω
- ❑ Remove R7
- ❑ Change R4 to 0 Ω
- ❑ Change R2 to 57.6 Ω (R3 in parallel with R2 equals 50 Ω for termination of the input)

as shown in Figure 3-3.

Figure 3-3. Inverting Gain Stage



The gain for this circuit with a 50-Ω source is:

$$\frac{V_O}{V_I} = -\frac{R5}{R3}$$

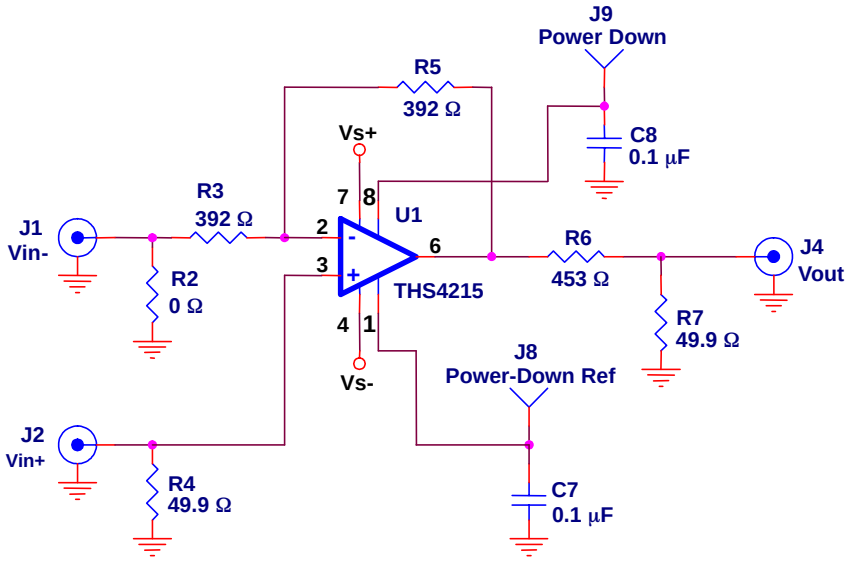
when the input voltage is measured at J1.

The input impedance of the stage is 50 Ω, as determined by R2 in parallel with R3.

3.4 Power-Down Reference Operation—THS4215EVM Only

For the default EVM configuration, power-down reference level is set to ground through R1. This reference can be set to a different level if R1 is removed and an external voltage is supplied to J8 as shown in Figure 3-4.

Figure 3-4. Power-Down Reference Operation



Note: This schematic reflects the default THS4215EVM configuration.

The reference pin allows the user to control the logic levels of the power-down pin. The reference pin is mainly designed for systems with supply voltages higher than 5 V; however, it works with any voltage within the amplifier's voltage range. In most cases, the reference pin is connected to a digital ground or to ground. For example, a customer is using a 3-V microcontroller to control the power-down pin of an amplifier that is operating from a ±5 V power supply. Using the traditional power-down circuit, the customer has to buffer/boost the 3-V signal from the microcontroller to a higher level to ensure the proper voltage level for the amplifier to toggle between enable and disable. With the reference circuit, the customer can connect the 3-V signal directly to the power-down pin.

When the reference pin is connected to ground, the power-down voltage applied to the power-down pin must be greater than Ref +1.8 V (GND +1.8 V) for the amplifier to be active (enable). To place the device into power-down mode (disable) the voltage applied to the power-down pin must be less than Ref +1 V (GND+1 V).

Now, when the reference pin is connected to the positive supply or allowed to float, the power-down logic levels are referenced to the positive supply. Therefore, if a system is operating on a split supply of 5 V and the reference pin is left floating (not connected), the power-down pin voltage must be greater than Ref –1 V (5 V–1; V = 4 V) for the amplifier to be active (enable). To place the device into power-down mode (disable) the voltage applied to the power-down pin must be less than Ref –1.5 V (5 V–1.5; V = 3.5 V).

Chapter 4

EVM Hardware Description

This chapter describes the EVM hardware. It includes the EVM parts list, and printed circuit board layout.

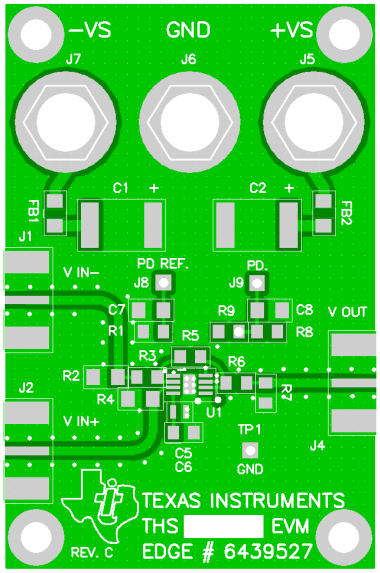
Table 4-1. THS4211EVM Bill of Materials

Item	Description	SMD Size	Reference Designator	PCB QTY	Manufacturer's Part Number	Distributor's Part Number
1	Bead, ferrite, 3A, 80 Ω	1206	FB1, FB2	2	(Steward) HI1206N800R-00	(Digi-Key) 240-1010-1-ND
2	Cap., 22 µF, tantalum, 25 V, 10%	D	C1, C2	2	(AVX) TAJD226K025R	(Garrett) TAJD226K025R
3	Cap., 100 pF, ceramic, 5%, 150 V	AQ12	C4, C5	2	(AVX) AQ12EM101JAJME	(TTI) AQ12EM101JAJME
4	Cap., 0.1 µF, ceramic, X7R, 50 V	0805	C3, C6	2	(AVX) 08055C104KAT2A	(Garrett) 08055C104KAT2A
6	Open	0805	R1, R8, R9	2		
7	Resistor, 49.9 Ω, 1/8 W, 1%	0805	R7	1	(PHYCOMP) 9C08092A49R9FKHFT	(Garrett) 9C08052A49R9FKHFT
8	Resistor, 392 Ω, 1/8 W, 1%	0805	R3, R5	2	(PHYCOMP) 9C08052A3920FKHFT	(Garrett) 9C08052A3920FKHFT
9	Resistor, 453 Ω, 1/8 W, 1%	0805	R6	1	(PHYCOMP) 9C08052A4530FKHFT	(Garrett) 9C08052A4530FKHFT
10	Open	1206	C7, C8	2		
11	Resistor, 0 Ω, 1/4 W	1206	R2	1	(PHYCOMP) 9C12063A0R00JLHFT	(Garrett) 9C12063A0R00JLHFT
12	Resistor, 49.9 Ω, 1/4 W, 1%	1206	R4	1	(PHYCOMP) 9C12063A49R9FKRFT	(Garrett) 9C12063A49R9FKRFT
13	Test point, black		TP1	1	(Keystone) 5001	(Allied) 839-3601
14	Open		J8, J9	2		
15	Jack, banana receptacle, 0.25" diameter hole		J5, J6, J7	3	(HH Smith) 101	(Newark) 35F865
16	Connector, edge, SMA PCB jack		J1, J2, J4	3	(Johnson) 142-0701-801	(Allied) 528-0238
17	Standoff, 4-40 hex, 0.625" length			4	(Keystone) 1804	(Allied) 839-2089
18	Screw, Phillips, 4-40, .250"			4	SHR-0440-016-SN	
19	IC, THS4211		U1	1	(TI) THS4211DGN	
20	Board, printed circuit			1	(TI) Edge #6439527 Rev.C	

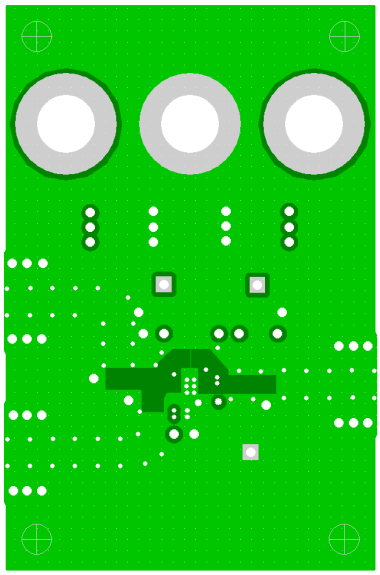
Table 4-2. THS4215EVM Bill of Materials

Item	Description	SMD Size	Reference Designator	PCB QTY	Manufacturer's Part Number	Distributor's Part Number
1	Bead, ferrite, 3A, 80 Ω	1206	FB1, FB2	2	(Steward) HI1206N800R-00	(Digi-Key) 240-1010-1-ND
2	Capacitor, 22 µF, tantalum, 25 V, 10%	D	C1, C2	2	(AVX) TAJD226K025R	(Garrett) TAJD226K025R
3	Capacitor, 100 pF, ceramic, 150 V, 5%,	AQ12	C4, C5	2	(AVX) AQ12EM101JAJME	(TTI) AQ12EM101JAJME
4	Open	1206	C7	1		
5	Capacitor, 0.1 µF, ceramic, X7R, 50 V	0805	C3, C6	2	(AVX) 08055C104KAT2A	(Garrett) 08055C104KAT2A
6	Capacitor, 0.1 µF, ceramic, X7R, 50 V	1206	C8	1	(AVX) 12065C104KAT2A	(Garrett) 12065C104KAT2A
7	Open	0805	R8, R9	2		
8	Resistor, 0 Ω, 1/8W, 1%	0805	R1	1	(Phycomp) 9C08052A0R00JLHFT	(Garrett) 9C08052A0R00JLHFT
9	Resistor, 49.9 Ω, 1/8W, 1%	0805	R7	1	(Phycomp) 9C08052A49R9FKHFT	(Garrett) 9C08052A49R9FKHFT
10	Resistor, 392 Ω, 1/8W, 1%	0805	R3, R5	2	(Phycomp) 9C08052A3920FKHFT	(Garrett) 9C08052A3920FKHFT
11	Resistor, 453 Ω, 1/8W, 1%	0805	R6	1	(Phycomp) 9C08052A4530FKHFT	(Garrett) 9C08052A4530FKHFT
12	Resistor, 0 Ω, 1/4W	1206	R2	1	(Phycomp) 9C12063A0R00JLHFT	(Garrett) 9C12063A0R00JLHFT
13	Resistor, 49.9 Ω, 1/4W, 1%	1206	R4	1	(Phycomp) 9C12063A49R9FKRFT	(Garrett) 9C12063A49R9FKRFT
14	Test point, black		TP1, J8, J9	3	(Keystone) 5001	(Allied) 839-3601
15	Jack, banana receptacle, 0.25" diameter hole		J5, J6, J7	3	(HH Smith) 101	(Newark) 35F865
16	Connector, edge, SMA PCB jack		J1, J2, J4	3	(Johnson) 142-0701-801	(Allied) 528-0238
17	Standoff, 4-40 Hex, 0.625" length			4	(Keystone) 1804	(Allied) 839-2089
18	Screw, Phillips, 4-40, .250"			4	SHR-0440-016-SN	
19	IC, THS4215		U1	1	(TI) THS4215DGN	
20	Board, printed circuit			1	(TI) Edge #6439527 Rev.C	

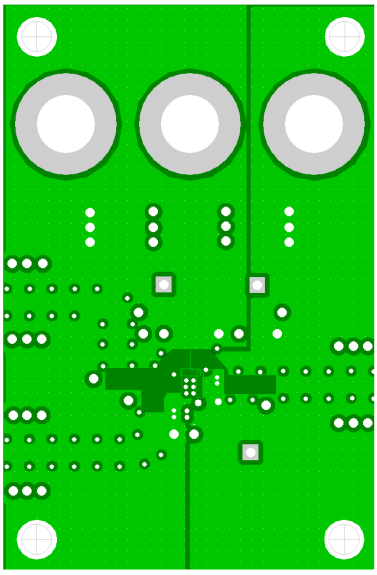
Figure 4-1. Board Layout Views



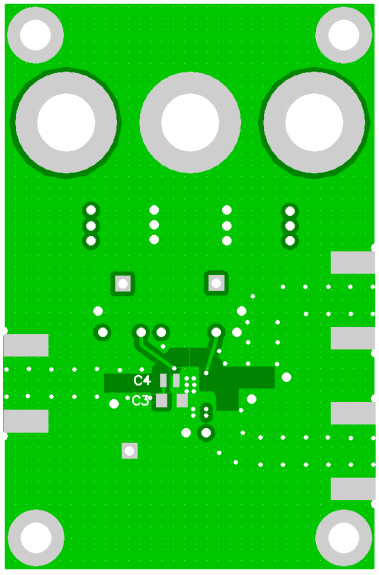
Top



Layer 2 - Ground



Layer 3 - Power



Bottom