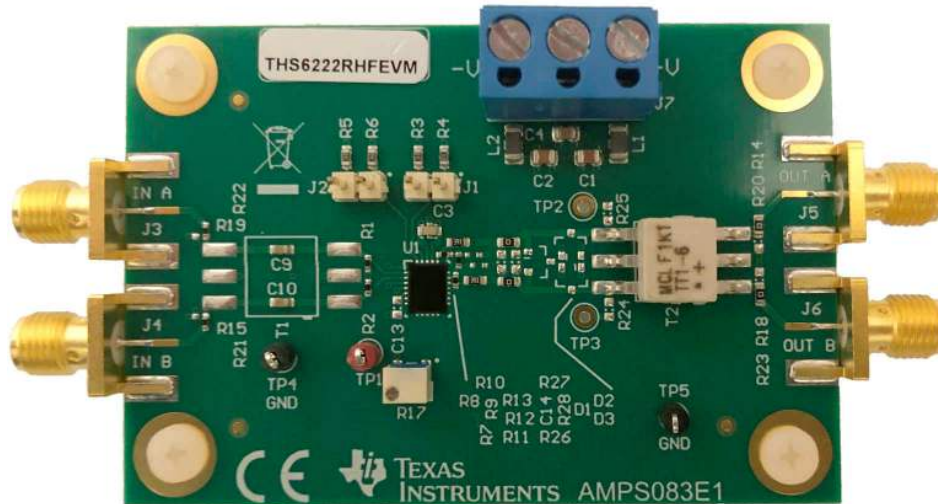


ABSTRACT



This user's guide describes the characteristics, operation, and use of the THS6222RHF EVM. This evaluation module (EVM) is an evaluation and development kit for evaluating the THS6222RHF, a differential line-driver amplifier with a current-feedback architecture that is targeted for use in broadband power line communications (PLC) line driver applications. A complete circuit description as well as schematic diagram and bill of materials are included in this document.

Throughout this document, the abbreviation *EVM* and the term *evaluation module* are synonymous with the THS6222RHF EVM.

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1 Introduction

The THS6222RHFEVM is an evaluation module for the single THS6222 amplifier in the RHF 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 sources, 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 a differential input with a gain of 10 V/V to a differential output. The board includes jumpers to easily switch the device between different bias modes and a potentiometer to set the value of the IADJ pin. The EVM can be easily configured for other gains and for single- or split-supply operation. The output transformer and resistors are configured to present a 50- Ω , single-ended output.

1.1 Features

- Configured for split-supply operation and easily modified for single supply
- Default gain of 10-V/V 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 subminiature version A (SMA) connectors

1.2 EVM Specifications

Table 1-1 lists the typical performance specifications for the THS6222RHFEVM.

Table 1-1. THS6222RHFEVM Specifications

Specification	Typical Value Range
Split-supply voltage range	± 4 V to ± 26 V
Single-supply voltage range (VEE = ground)	8 V to 32 V
Quiescent current (no load, split supply, full-bias mode)	20.5 mA
Output voltage swing (VCC = 12 V, 100- Ω load)	19.6 V _{PP}
Linear output current (VCC = 12 V, 25- Ω load)	355 mA

2 Power Connections

The THS6222RHFEVM is equipped with a wire socket for easy connection of power. The positive supply input is labeled V+, the negative supply input is labeled V–, and ground (GND) is the unlabeled center terminal of the power-supply connector.

For split-supply operation, populating R16 is required and is the default configuration when the board is received.

For single-supply operation, removing R16 is required for correct operation. This configuration is not default and will require a board modification.

2.1 Split-Supply Operation

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

When operating with equal (balanced) split-supplies, the input common mode is held to GND by R16 on the bottom of the THS6222RHFEVM PCB. This configuration is default and will be present upon opening the EVM for the first time.

If operating with uneven supplies, the input common mode must be referenced to midsupply, V+/2. For uneven supplies, this input common mode is not at GND potential. A board modification is required. Follow the steps in *Single-Supply Operation* for implementing uneven supplies on the THS6222RHFEVM.

2.2 Single-Supply Operation

When operating the THS6222RHFEVM in a single-supply configuration, the input common mode must be referenced to midsupply, V+/2. For single-supply operation, the input common mode is not at GND potential.

The THS6222 has an internal common mode buffer (see Section 7.1 of THS6222 datasheet); this buffer drives the common mode voltage to midsupply without external circuitry. The input common mode voltage is at the node between R1 & R2 in the THS6222RHFEVM schematic; this node is connected to TP1 as well as GND via R16 by default.

To enable a input common mode of $V+/2$, a board modification is required. Please remove R16 from the bottom side of the PCB: R16 holds the input common mode node, between R1 & R2, to GND. Setting the input common mode to GND for a single supply configuration will not properly operate the amplifier; there will not be device output on the THS6222RHFEVM if R16 is populated. The removal of R16 allows the internal common mode buffer circuit to work as intended during single-supply operation.

After removing R16 from the rear of the PCB, follow these steps for single-supply operation:

- Connect both the V- connector and the GND connector to ground; apply the positive supply voltage to V+
- Optionally use TP1 (red) to confirm the input common mode is at $V+/2$

3 Input and Output Connections

The THS6222RHFEVM is equipped with SMA connectors for easy connection of signal generators and analysis equipment. As shipped, the EVM is configured for a gain of $10\text{-}V/V$, split-supply, differential input and output with $50\text{-}\Omega$ termination. By default, the inputs INA and INB are configured for a differential input connection. To use the device with a single-ended input, either use an external transformer or populate transformer T1 on the board, remove R21, populate R15 with a $0\text{-}\Omega$ resistor, and use INA as the single-ended input. OUTA (J5) is the output connector for single-ended output signals. The output resistors R10 and R11 in combination with the transformer (T2) on the amplifier output provide a $25\text{-}\Omega$ load to the amplifier when terminated in $50\ \Omega$ differentially. To use the EVM with a single-ended output, remove resistor R23 and populate resistor R18 with $0\ \Omega$, which gives a single-ended output on OUTA. The EVM contains provisions for additional output devices to change the loading of the amplifier and to add protection devices. See the [THS6222 data sheet](#) applications section, schematics, and layouts for more detail and how to reconfigure the EVM.

3.1 Bias Mode Control Pins

The amplifier bias modes can be controlled through shorting jumpers J1 and J2. By default, the jumper shorts are left unconnected, which pulls the input signals low, leaving the device in its full-bias mode. Jumper J1 controls pin BIAS-1 and jumper J2 controls pin BIAS-2. In conjunction the jumpers can be used to place the device in its three bias modes or in shutdown.

3.2 IREF Pin Connection

The fine current adjustment (IADJ) pin of the device is controlled using the potentiometer R17 on the board. By default the potentiometer is set to $0\ \Omega$, which yields the maximum quiescent current for each bias mode. By increasing the resistance of the potentiometer, the quiescent current can be reduced to a desired lowered value at the cost of reduced performance.

3.3 Optional VCM Pin Connection

The EVM includes an optional connection on the VCM (pin 5) of the device for a capacitor. The optional VCM capacitor can be added to help filter common-mode noise if needed by the application. VCM is not populated by default on the EVM.

4 Board Layout

The layer plots of Figure 4-1 to Figure 4-4 illustrate the board layers in top to bottom order.

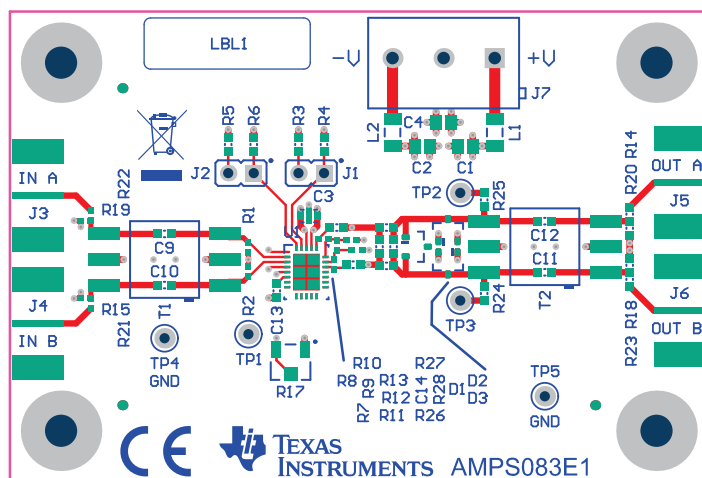


Figure 4-1. Top Layer

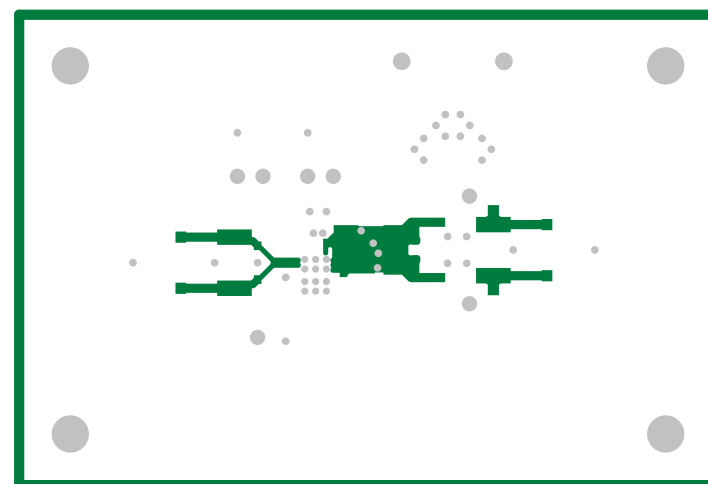


Figure 4-2. Ground Layer

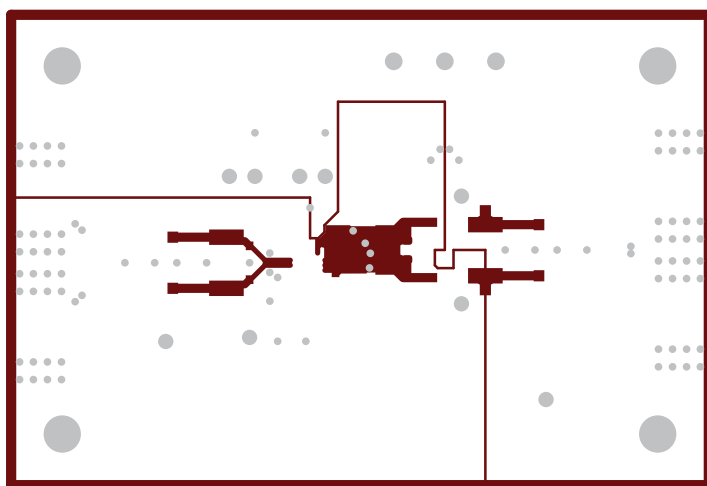


Figure 4-3. Power Layer

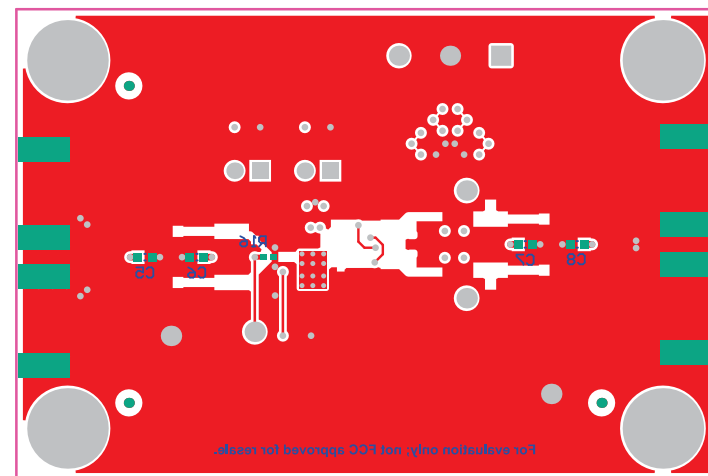


Figure 4-4. Bottom Layer

5 Schematic and Bill of Materials

This section provides the schematic and bill of materials (BOM) for the THS6222RHF EVM.

5.1 Schematic

Figure 5-1 shows the EVM schematic.

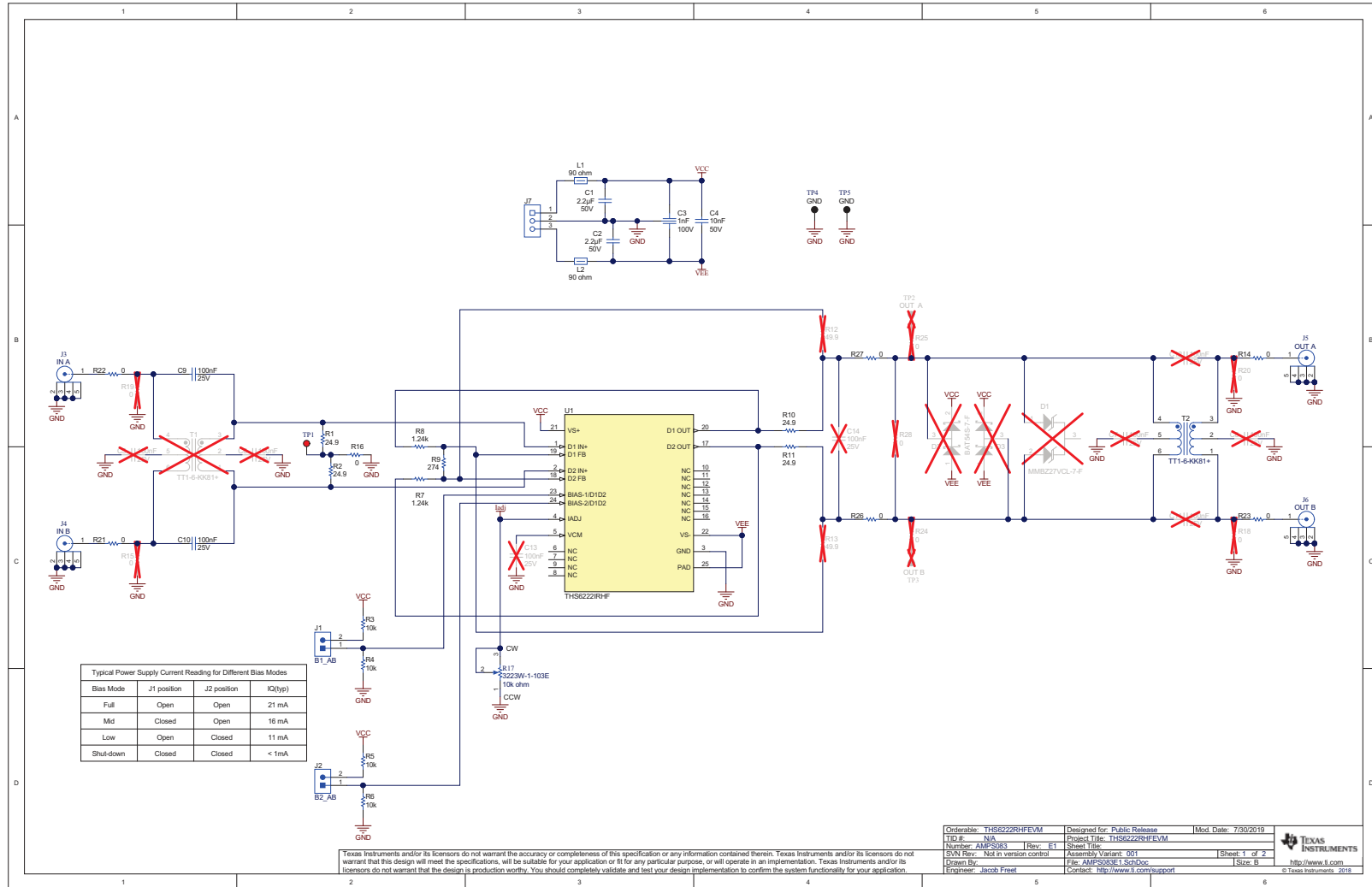


Figure 5-1. THS6222RHF EVM Schematic

5.2 Bill of Materials

Table 5-1 lists the EVM BOM.

Table 5-1. Bill of Materials

Designator	Qty	Value	Description	Package Reference	Part Number	Manufacturer
C1, C2	2	2.2 μ F	CAP, CERM, 2.2 μ F, 50 V, \pm 10%, X7R, 0805	805	C2012X7R1H225K125AC	TDK
C3	1	1000 pF	CAP, CERM, 1000 pF, 100 V, \pm 20%, X7R, 0603	603	CX0603MRX7R0BB102	Yageo America
C4	1	0.01 μ F	CAP, CERM, 0.01 μ F, 50 V, \pm 10%, X7R, 0805	805	08055C103KAT2A	AVX
C9, C10	2	0.1 μ F	CAP, CERM, 0.1 μ F, 25 V, \pm 5%, X7R, 0603	603	C0603C104J3RACTU	Kemet
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	2		Header, 100mil, 2x1, Gold, TH	Sullins 100mil, 1x2, 230 mil above insulator	PBC02SAAN	Sullins Connector Solutions
J3, J4, J5, J6	4		Connector, End launch SMA, 50 Ω , SMT	SMA End Launch	142-0701-851	Cinch Connectivity
J7	1		Terminal Block, 5.08 mm, 3x1, Brass, TH	3x1 5.08 mm Terminal Block	ED120/3DS	On-Shore Technology
L1, L2	2	90 Ω	Ferrite Bead, 90 Ω at 100 MHz, 1.5 A, 1206	1206	MI1206K900R-10	Laird-Signal Integrity Products
LBL1	1		Thermal Transfer Printable Labels, 0.650" W x 0.200" H - 10,000 per roll	PCB Label 0.650 x 0.200 inch	THT-14-423-10	Brady
R1, R2	2	24.9	RES, 24.9, 1%, 0.1 W, AEC-Q200 Grade 0, 0402	402	ERJ-2RKF24R9X	Panasonic
R3, R4, R5, R6	4	10 k	RES, 10 k, 5%, 0.1 W, 0603	603	RC1608J103CS	Samsung Electro-Mechanics
R7, R8	2	1.24 k	RES, 1.24 k, 1%, 0.063 W, AEC-Q200 Grade 0, 0402	402	CRCW04021K24FKED	Vishay-Dale
R9	1	274	RES, 274, 1%, 0.063 W, AEC-Q200 Grade 0, 0402	402	CRCW0402274RFKED	Vishay-Dale
R10, R11	2	24.9	RES, 24.9, 1%, 0.1 W, 0603	603	RC0603FR-0724R9L	Yageo
R14, R23, R26, R27	4	0	RES, 0, 5%, 0.1 W, 0603	603	RC0603JR-070RL	Yageo
R16, R21, R22	3	0	RES, 0, 5%, 0.063 W, 0402	402	RC0402JR-070RL	Yageo America
R17	1	10 k Ω	TRIMMER 10k Ω 0.125W SMD	3.52 x 4.16 x 3.94 mm	3223W-1-103E	Bourns
T2	1		RF Transformer, 50 Ω , 0.004 to 300 MHz, SMT	7.62 x 6.86 mm	TT1-6-KK81+	Minicircuits
TP1	1		Test Point, Miniature, Red, TH	Red Miniature Testpoint	5000	Keystone
TP4, TP5	2		Test Point, Miniature, Black, TH	Black Miniature Testpoint	5001	Keystone
U1	1		THS6222IRHF, RHF0024A (VQFN-24)	RHF0024A	THS6222IRHF	Texas Instruments
C5, C6, C7, C8, C11, C12, C13, C14	0	0.1 μ F	CAP, CERM, 0.1 μ F, 25 V, \pm 5%, X7R, 0603	603	C0603C104J3RACTU	Kemet
D1	0	27 V	Diode, TVS, Uni, 27 V, 38 Vc, SOT-23	SOT-23	MMBZ27VCL-7-F	Diodes Inc.
D2, D3	0	30 V	Diode, Schottky, 30 V, 0.2 A, SOT-23	SOT-23	BAT54S-7-F	Diodes Inc.

Table 5-1. Bill of Materials (continued)

Designator	Qty	Value	Description	Package Reference	Part Number	Manufacturer
R12, R13	0	49.9	RES, 49.9, 1%, 0.063 W, AEC-Q200 Grade 0, 0402	402	CRCW040249R9FKED	Vishay-Dale
R15, R19	0	0	RES, 0, 5%, 0.063 W, 0402	402	RC0402JR-070RL	Yageo America
R18, R20, R24, R25, R28	0	0	RES, 0, 5%, 0.1 W, 0603	603	RC0603JR-070RL	Yageo
T1	0		RF Transformer, 50 Ω , 0.004 to 300 MHz, SMT	7.62 \times 6.86 mm	TT1-6-KK81+	Minicircuits
TP2, TP3	0		Test Point, Miniature, Red, TH	Red Miniature Testpoint	5000	Keystone

6 Related Documentation

For related documentation, see the following:

- Texas Instruments, [THS6222 8 V to 32 V, Differential HPLC Line Driver with Common-Mode Buffer data sheet](#)

7 Revision History

NOTE: Page numbers for previous revisions may differ from page numbers in the current version.

Changes from Revision * (August 2019) to Revision A (April 2022)	Page
• Updated the numbering format for tables, figures, and cross-references throughout the document.....	2
• Updated the <i>Power Connections</i> section.....	2
• Updated the <i>Split-Supply Operation</i> section.....	2
• Updated the <i>Single-Supply Operation</i> section.....	2

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