Texas Instruments

THS3061EVM

User's Guide

September 2002 High Performance Linear Products

SLOU145

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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 ±15 V for dual supply or 30 V for single supply. The differential input signal (V_{ID}) should be no greater than ±3 V. The output current (I_O) should be no greater than 150 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

How to Use This Manual

This document contains the following chapters:

- Chapter 1—Introduction and Description
- Chapter 2—Using the THS3061EVM
- Chapter 3—THS3061EVM Applications
- Chapter 4—EVM Hardware Description

Information About Cautions and Warnings

This book may contain cautions and warnings.

CAUTION

This is an example of a caution statement.

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

WARNING

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.

CAUTION

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. Go to the TI website at www.ti.com and search on the literature number (e.g., SLOS394).

- THS3061 data sheet (SLOS394)
- Application report (SLOA069), *How (Not) to Decouple High Speed Op Amp Circuits,* http://www-s.ti.com/sc/psheets/sloa069/sloa069.pdf
- Application report (SLMA002), *Power Pad Thermally Enhanced Package*, http://www-s.ti.com/sc/psheets/slma004/slma002.pdf
- Application report (SLMA004), Power Pad 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
- High-Speed Amplifier PCB Layout Tips, http://www-s.ti.com/sc/psheets/sloa102/sloa102.pdf

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Chapter 1

Introduction and Description

The Texas Instruments THS3061 evaluation module (EVM) helps designers evaluate the performance of the THS3061 operational amplifier. Also, this EVM is a good example of high-speed PCB design.

This document details the THS3061EVM. It includes a list of EVM features, a brief description of the module illustrated with a series of schematic diagrams, EVM specifications, details on connecting and using the EVM, and a discussion of high-speed amplifier design considerations.

This EVM enables the user to implement various circuits to clarify the available configurations presented by the schematic of the EVM. The user is not limited to the circuit configurations presented here. The EVM provides enough hardware hooks that the only limitation should be the creativity of the user.

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 the complete (default) EVM schematic showing all component locations. The user can change the gain by changing the ratios of the feedback and gain resistors (see the device data sheet for recommended resistor values).

The default configuration is designed to provide for a voltage gain of –1 and about +2 depending on which input is connected to the signal source. This voltage gain is the ratio of the voltage at the output pin of the amplifier (pin 6) to the voltage at the input at J1 or J2 respectively.

For optimum frequency response and stability at either –1 or +2 gain, a 562-Ω feedback resistor was chosen for R5. The same value is set for R3 to provide a gain in the inverting configuration of –1. To match the signal generator source impedance, R2 is set to 54.9 Ω. This is the closest value, when placed in parallel with R3 (562 Ω) that terminates the inverting input to 50 Ω).

Output series resistor R6 is set to 49.9 Ω. This value terminates the output correctly for connection to a 50-Ω input device, as shown in the applications described in Chapter 3. Setting R7 to 953 Ω loads the amplifier at about 1 kΩ, to match a high-impedance instrument connected to the output connector J4.

When used as an inverting amplifier in the default configuration connected to a 50-Ω input measurement instrument, R7 causes a slight gain error. The total voltage gain is the negative ratio of the feedback resistor R5 and the gain resistor R3, times the voltage divider created by R6-R7, and the measurement device input termination resistance. This gain follows the equation:

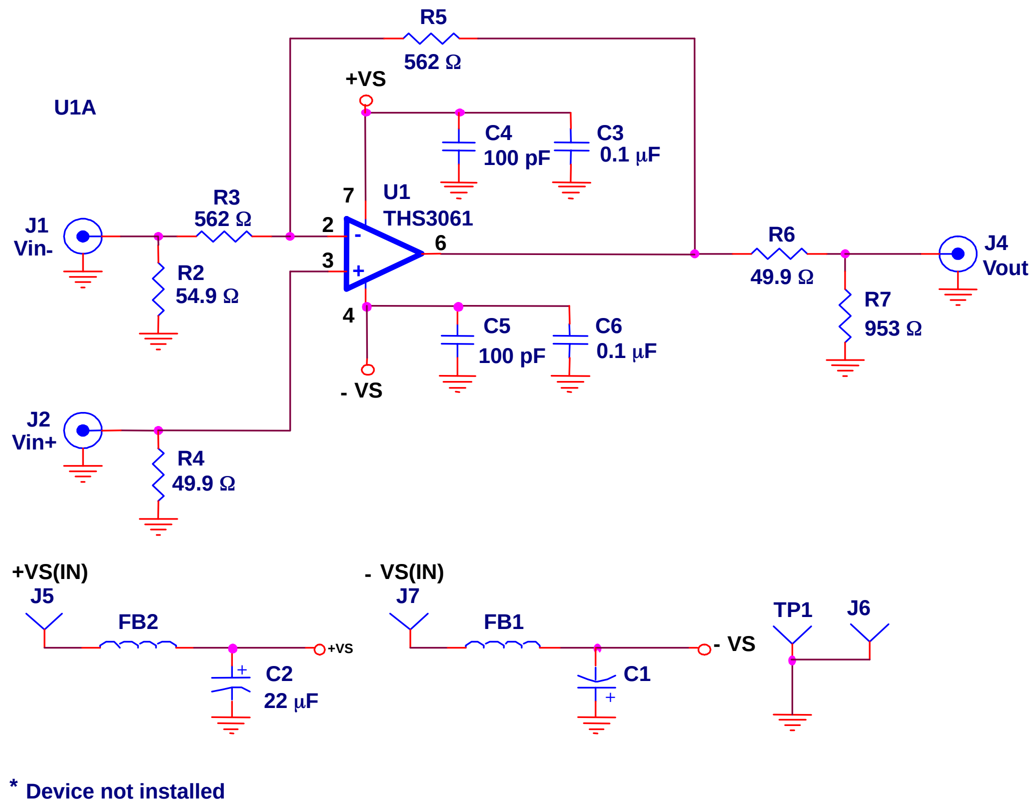
$$\frac{V_O}{V_I} = -\frac{R5}{R3}\left(\frac{R7 \parallel 50\ \Omega}{R7 \parallel 50\ \Omega + R6}\right) = -0.475 \qquad (1)$$

When using the default configuration, the noninverting gain of the amplifier is affected by the same slight gain error, plus the gain error imposed by the inverting input termination resistor R2. The following equation shows the gain for this situation.

$$\frac{V_O}{V_I} = \left(1 + \frac{R5}{R3 + R2}\right)\left(\frac{R7 \parallel 50\ \Omega}{R7 \parallel 50\ \Omega + R6}\right) = 0.908 \qquad (2)$$

Some components such as C1, C2, C3, C4, C5, C6, TP1, J5, J6, and J7 are omitted on the application schematics of Chapter 3 for clarity.

Figure 1-1. Schematic of the Populated Circuit on the EVM (Default Configuration)



Chapter 2

Using the THS3061 EVM

This section shows how to connect the THS3061EVM to test equipment. It is recommended that the user connect the EVM as shown in this section to avoid damage to the EVM or the THS3061 installed on the board.

Figure 2-1. THS3061EVM Interconnection Diagram

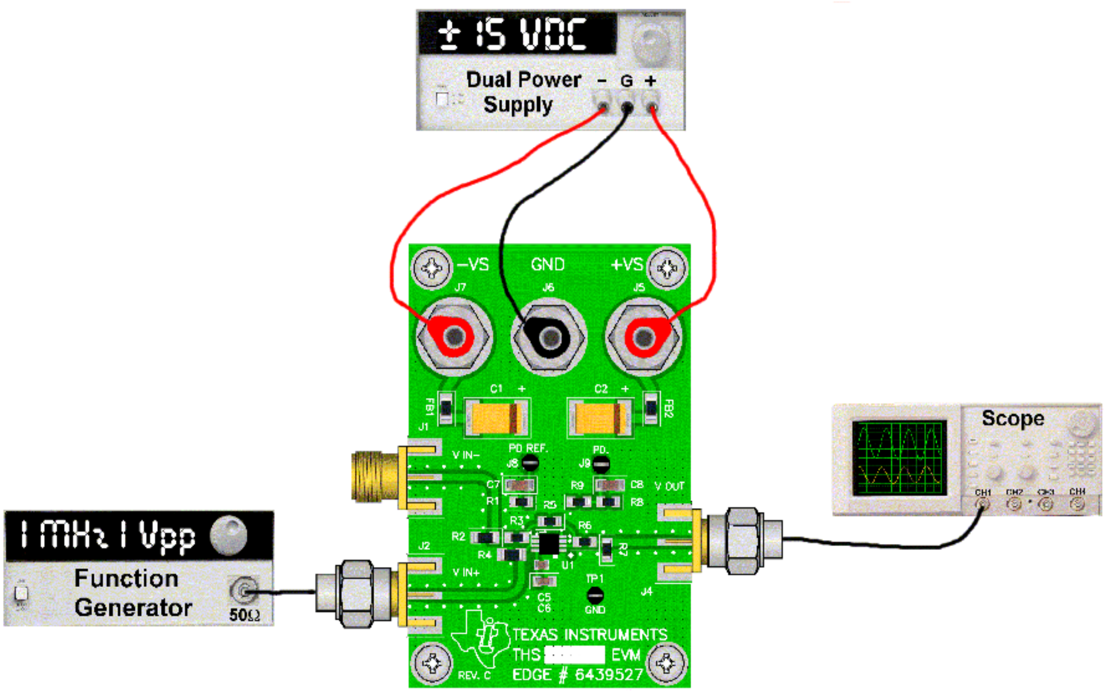


Figure 2-1 shows the connections to measure the output while a signal is inserted into EVM's noninverting input. For an inverting signal path, the signal source can be connected to J1 instead.

Chapter 3

THS3061EVM 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.

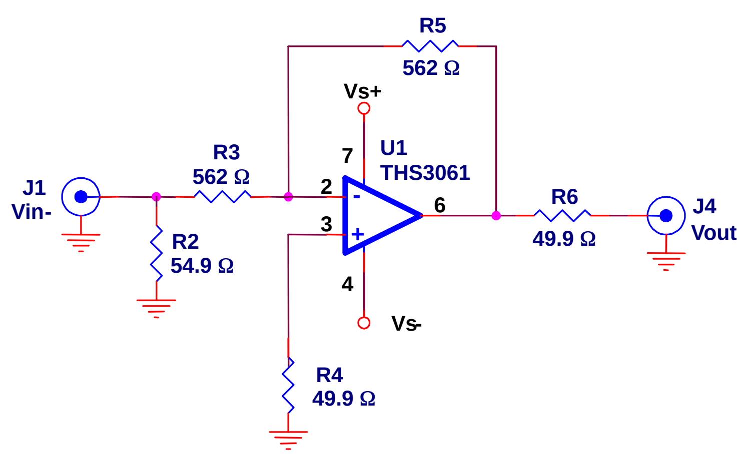
3.1 Inverting Gain Stage

The circuit described in Chapter 1 is an inverting gain stage with a voltage divider on the output. Equation 1 (Chapter 1) indicates the gain when connected to a 50-Ω measurement input device. The 953-Ω R7 is included to provide a 1-kΩ load to the amplifier—the user may remove it, as shown in Figure 3-1. When this is done the voltage gain equation from J1 to J4 is simplified, as shown here:

$$\frac{V_O}{V_I} = -\frac{R5}{R3}\left(\frac{50\ \Omega}{50\ \Omega + R6}\right) = 0.5 \qquad (1)$$

R6 is used to match the output impedance of the amplifier to the line being driven and the instrument taking measurements. For high impedance and short transmission line length, R6 can be removed. R6 can also be used to isolate the amplifier from extremely large capacitive loads.

Figure 3-1. Inverting Gain Stage

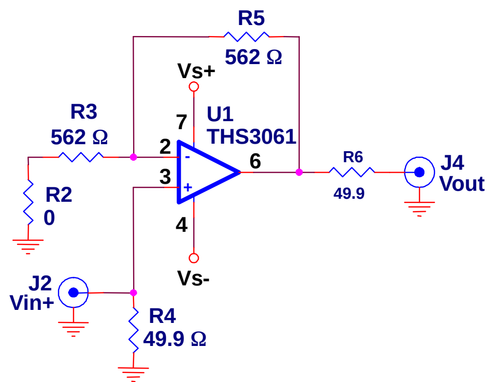


3.2 Noninverting Gain Stage

The EVM can be modified to eliminate the gain error imposed by R2 by replacing R2 with a 0-Ω resistor. This is shown in Figure 3-2. R7 has been removed, as it was in the inverting gain stage shown above. The following equation indicates the voltage gain from J2 to J4:

$$\frac{V_O}{V_I} = \left(1 + \frac{R5}{R3}\right)\left(\frac{50\ \Omega}{50\ \Omega + R6}\right) = 1 \quad (2)$$

Figure 3-2. Noninverting Gain Stage



This is a common amplifier configuration used to drive video or VDSL lines, for example. The 49.9-Ω resistor in series with the output, matches the effective output impedance of the amplifier to the line impedance. In test and measurement instruments the nominal line impedance is assumed to be 50 Ω; for video the nominal line impedance is assumed to be 75 Ω. If testing this device as a video linear driver, we recommend changing the value of R6 to 75 Ω. Due to the nature of current-feedback high-speed amplifiers, the gain of the THS3061 can be increased by changing the values of R5 and R3 with little change in bandwidth. R5 should be reduced to maintain optimum compensation. Refer to the data sheet for recommended resistor values.

Chapter 4

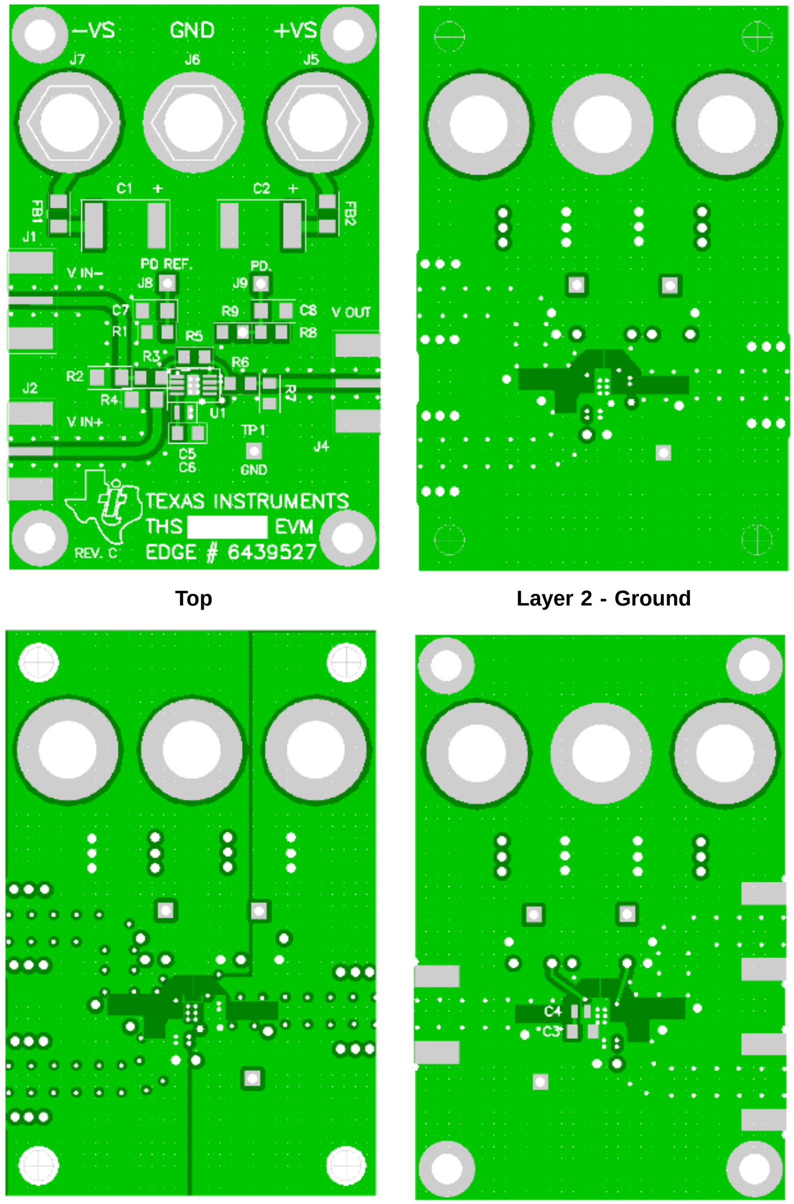
EVM Hardware Description

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

Table 4-1. THS3061EVM Bill of Materials

Item	Description	SMD Size	Reference Designator	PCB	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, tanatalum, 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	3		
7	Resistor, 49.9 Ω, 1/8 W, 1%	0805	R6	1	(Phycomp) 9C08052A49R9FKHFT	(Garrett) 9C08052A49R9FKHFT
8	Resistor, 953 Ω, 1/8 W, 1%	0805	R7	1	(Phycomp) 9C08052A9530FKHFT	(Garrett) 9C08052A9530FKHFT
9	Resistor, 562 Ω, 1/8 W, 1%	0805	R3, R5	2	(Phycomp) 9C08052A5620FKHFT	(Garrett) 9C08052A5620FKHFT
10	Open	1206	C7, C8	2		
11	Resistor, 54.9 Ω, 1/4W, 1%	1206	R2	1	(Phycomp) 9C12063A54R9FKRFT	(Garrett) 9C12063A54R9FKRFT
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		(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, 0.250"			4	SHR-0440-016-SN	
19	IC, THS3061		U1	1	(TI) THS3061DGN	
20	Printed-circuit board			1	(TI) EDGE #6439527 Rev.C	

Figure 4-1. Board Layout Views for THS3061EVM



Top

Layer 2 - Ground

Layer 3 - Power

Bottom