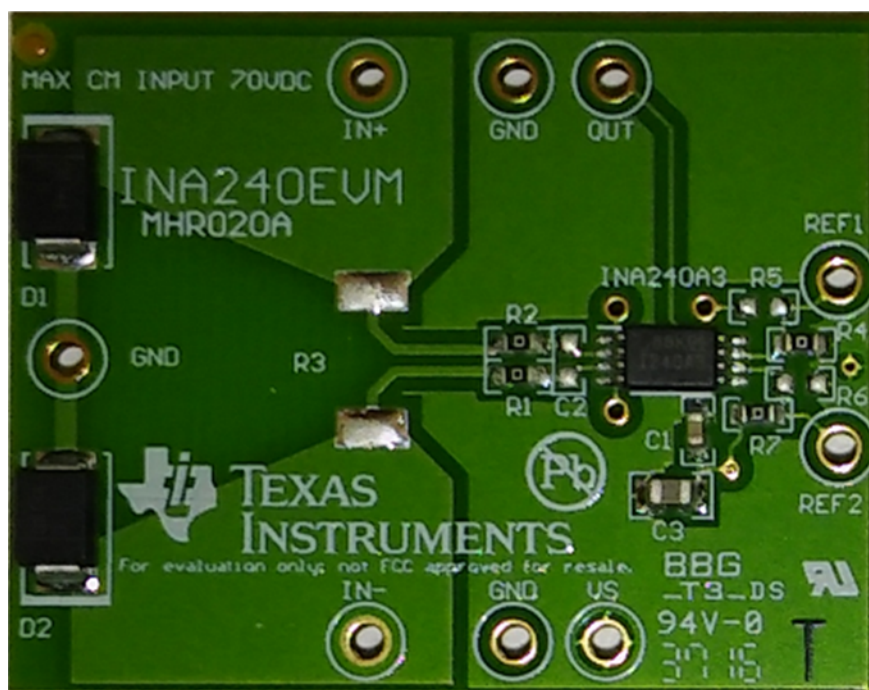


INA240EVM User's Guide

This user's guide describes the characteristics, operation, and use of the INA240EVM evaluation module. This guide discusses how to set up and configure the hardware. Throughout this document, the terms *evaluation board*, *evaluation module*, and *EVM* are synonymous with the *INA240EVM*. This document includes an electrical schematic, printed circuit board (PCB) layout drawings, and a parts list for the EVM.



Contents

1	Overview	2
1.1	INA240EVM Kit Contents	2
1.2	Related Documentation from Texas Instruments	2
2	INA240EVM Hardware	3
2.1	Theory of Operation for the INA240EVM	3
2.2	INA240EVM Features	3
2.3	Quick-Start Setup and Use	4
2.4	Voltage Inputs	4
2.5	Setting the Reference	4
3	Schematic, PCB Layout, and Bill of Materials	5
3.1	Schematic	5
3.2	PCB Layout	6
3.3	Bill of Materials	7

List of Figures

1	INA240EVM Test Board Block Diagram	3
2	INA240EVM Test Board Schematic	5
3	INA240EVM Component Placement	6

4	PCB Top Layer.....	6
5	PCB Bottom Layer.....	6

List of Tables

1	INA240EVM Kit Contents.....	2
2	INA240 Test Board BOM	7

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1 Overview

The [INA240](#) device is a voltage output current shunt monitor that senses drops across shunts at specified common-mode voltages from -4 V to 80 V , independent of the supply voltage.

NOTE: This EVM limits the maximum common-mode voltage to 70 V with clamping diodes D1 and D2.

Remove D1 and D2 when test input signal is non-DC.

The device operates from a single 2.7-V to 5.5-V power supply, drawing a typical supply current of approximately 1 mA . The INA240EVM package includes one large PCB that can be broken apart into four separate PCBs, one for each of the four gain versions (INA240A1/A2/A3/A4). The EVM includes test points for external hardware connections, placeholder pads to add filtering components, and surface-mount resistors for ease of setting the reference.

1.1 INA240EVM Kit Contents

[Table 1](#) lists the contents of the INA240EVM kit. The included hardware is pictured on the front page that shows only one of the four INA240 devices and the associated EVM hardware. Contact the nearest [Texas Instruments Product Information Center](#) if any component is missing. Take care to check the [INA240 Product Folder](#) on the TI web site at www.ti.com for any further information regarding this product.

Table 1. INA240EVM Kit Contents

ITEM	QUANTITY
INA240A1 EVM test board	1
INA240A2 EVM test board	1
INA240A3 EVM test board	1
INA240A4 EVM test board	1

1.2 Related Documentation from Texas Instruments

The following documents provide information regarding Texas Instruments' integrated circuits used in the assembly of the INA240EVM. This user's guide is available from the TI web site under literature number [SBOU177](#). Any letter appended to the literature number corresponds to the document revision that is current at the time of the writing of this document. Newer revisions may be available from the TI web site (www.ti.com), or by calling the Texas Instruments' Literature Response Center at (800) 477-8924 or the Product Information Center at (972) 644-5580. When ordering, identify the document by title and literature number.

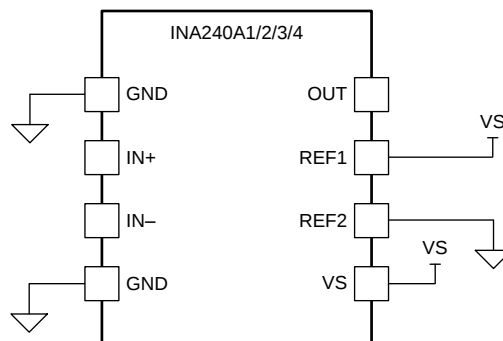
For related documentation, refer to [INA240 Wide Common-Mode Range, Voltage Output, High- or Low-Side Bidirectional, Zero-Drift, Current-Shunt Monitor](#) (SBOS662)

2 INA240EVM Hardware

The INA240EVM requires a 2.7-V to 5.5-V power supply. Connect the VIN+ and VIN– pins across an external shunt resistor in series with a –4-V to 70-V supply to determine the current flowing through the resistor. Use a voltmeter on the OUT pin to measure the voltage output. The REF1 and REF2 pins set the output reference.

2.1 Theory of Operation for the INA240EVM

A block diagram of the INA240EVM test board hardware is shown in [Figure 1](#). The INA240 test board contains test points that provide access to all eight pins of the INA240 device for evaluation. A footprint is provided for the input filtering circuitry. The REF1 and REF2 pins are equipped with jumpers to set the output reference to VS, GND, half VS, or any desired external reference level.



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Figure 1. INA240EVM Test Board Block Diagram

2.2 INA240EVM Features

The INA240EVM provides a basic functional evaluation of the INA240. The fixture layout is not intended to be a model for the target circuit, or laid out for electromagnetic compatibility (EMC) testing.

The layout of the INA240EVM printed circuit board (PCB) provides the following features:

- Simple access to all device pins
- Multiple input signal options
- Space for optional input filtering
- Configurable reference pins

The INA240EVM connects to both sides of a remote shunt resistor to measure current, or omits the shunt resistor and applies a differential voltage directly to the device inputs. This flexibility allows the testing of device operation in a simulated manner and an actual application.

See [INA240 Wide Common-Mode Range, Voltage Output, High- or Low-Side Bidirectional, Zero-Drift, Current-Shunt Monitor \(SBOS662\)](#) for comprehensive information about the [INA240](#) family.

2.3 Quick-Start Setup and Use

Follow the procedure listed below to set up and use the INA240EVM:

1. Connect an external dc supply voltage between 2.7-V and 5.5-V to the VS test point.
2. Connect the desired input to input test points, IN+ and IN-. This input is a remote shunt resistor or a differential voltage source with a common-mode voltage of -4 V to 70 V referenced to GND. Note that the INA240 device has a rated common-mode voltage of 80 V , however the full 80 V is unavailable on the EVM because the input is limited by the D1 and D2 clamping diodes.

2.4 Voltage Inputs

The IN+ and IN- test points connect to a remote shunt resistor or a differential voltage source. The voltage differential is multiplied by the device gain of the INA240 device. There are four devices in this family, which include: the INA240A1 with 20-V/V gain, the INA240A2 with 50-V/V gain, the INA240A3 with 100-V/V gain, and the INA240A4 with 200-V/V gain. The full-scale sense input voltage (V_{SENSE}) is defined as $V_{\text{IN+}} - V_{\text{IN-}}$, and has a maximum input of $(V+ - 0.20)$ per gain to achieve linear output. The minimum voltage output is 10 mV.

2.5 Setting the Reference

The INA240 output is referenced to the voltage level defined by the REF1 and REF2 pins. The two reference pins independently connect to VS, GND, or an external source. It is possible to set the reference level to VS, GND, half VS, or an arbitrary level through external sources.

3 Schematic, PCB Layout, and Bill of Materials

3.1 Schematic

Figure 2 shows the complete schematic of the INA240 test board. Only the EVM associated with INA240A1 is shown. C1 and C3 are bypass capacitors for VS. C2, R1, and R2 create an optional filter for the VIN+ and VIN– inputs. R3 is an optional shunt resistor for the INA input. R4 through R7 are jumpers that enable the flexibility in configuring the reference level. The reference is set by splitting VS by default. D1 and D2 are clamps that limit the maximum common-mode voltage to 70 V, although the INA240 is rated at 80 V.

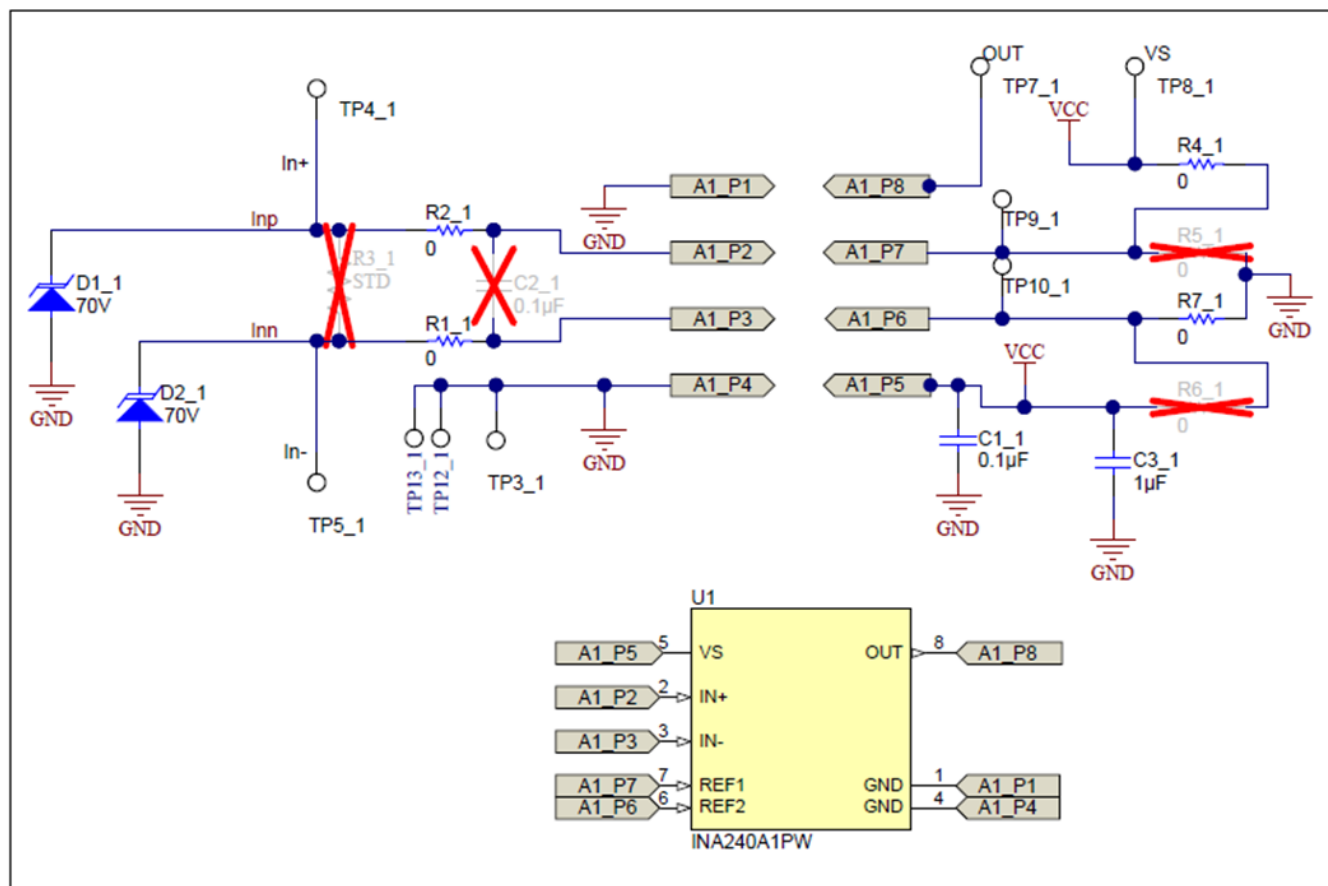


Figure 2. INA240EVM Test Board Schematic

3.2 PCB Layout

Figure 3 shows the component placement on the INA240EVM test board. There are no components on the bottom layer. Figure 4 and Figure 5 show the top and bottom layers of the test board, respectively.

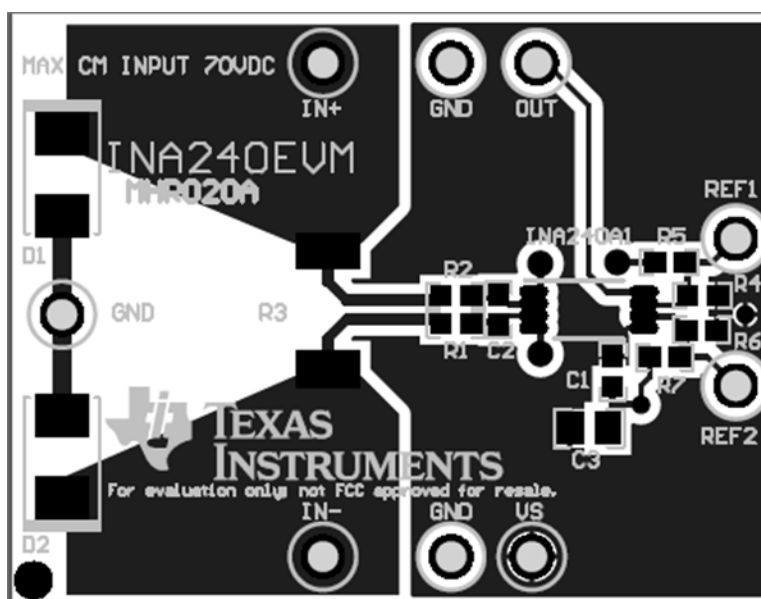


Figure 3. INA240EVM Component Placement

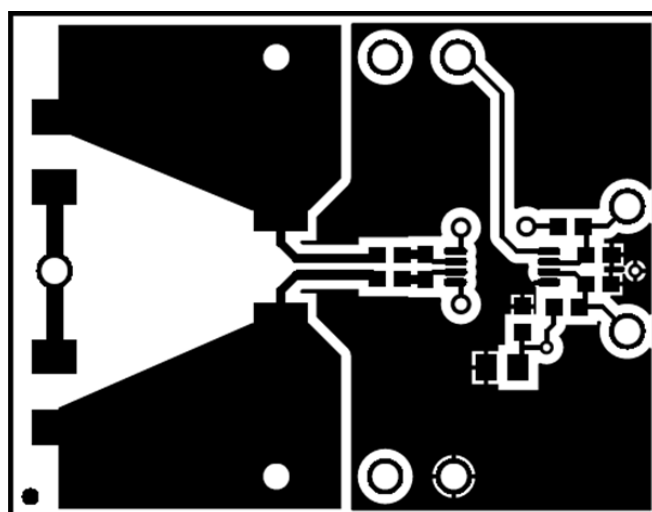


Figure 4. PCB Top Layer

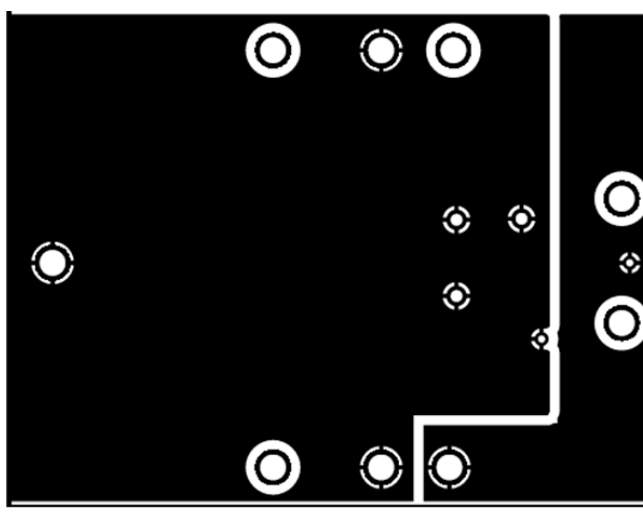


Figure 5. PCB Bottom Layer

3.3 Bill of Materials

Table 2 lists the bill of materials (BOM) for the INA240 test board, which includes four identical PCBs, one for each of the gain versions in the INA240 family.

Table 2. INA240 Test Board BOM

QUANTITY	REFDES	DESCRIPTION	PART NUMBER	MANUFACTURER
4	C1	CAP, CERM, 0.1 μ F, 16 V, +/- 5%, X7R, 0603	0603YC104JAT2A	AVX
4	C3	CAP, CERM, 1 μ F, 25 V, +/- 10%, X5R, 0805	08053D105KAT2A	AVX
8	D1, D2	Diode, TVS, Uni, 70 V, 600 W, SMB	SMBJ70A-13-F	Diodes Inc.
16	R1, R2, R4, R7	RES, 0, 5%, 0.1 W, 0603	ERJ-3GEY0R00V	Panasonic
16	H9,H10,H11,H12	Bumpon, Hemisphere, 0.44 $\times$ 0.20, Clear	SJ-5303 (CLEAR)	3M
1	U1	Wide Common-Mode Range, Voltage Output, High or Low-Side Bi-Directional Zero-Drift Current Shunt Monitor, PW0008A	INA240A1PW	ERJ-6GEY0R00V
1	U2	Wide Common-Mode Range, Voltage Output, High or Low-Side Bi-Directional Zero-Drift Current Shunt Monitor, PW0008A	INA240A2PW	Texas Instruments
1	U3	Wide Common-Mode Range, Voltage Output, High or Low-Side Bi-Directional Zero-Drift Current Shunt Monitor, PW0008A	INA240A3PW	Texas Instruments
1	U4	Wide Common-Mode Range, Voltage Output, High or Low-Side Bi-Directional Zero-Drift Current Shunt Monitor, PW0008A	INA240A4PW	Texas Instruments

Revision History

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

Changes from Original (September 2016) to A Revision	Page
• Added note to remove D1 and D2 for non-DC test input signal	2

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