

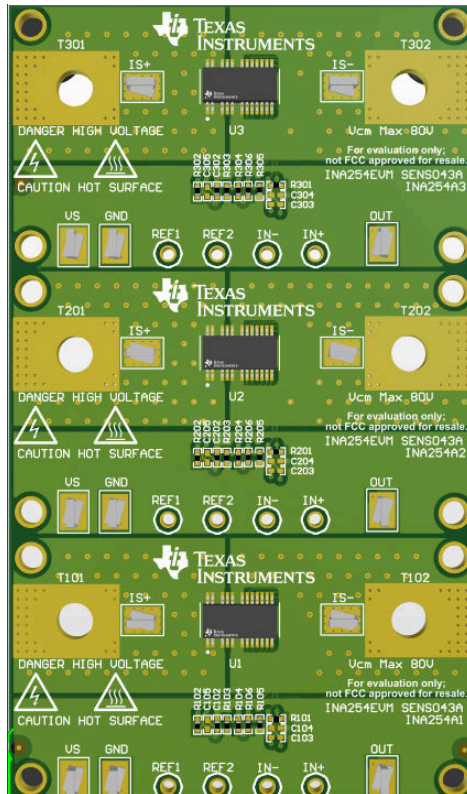
# User's Guide

## INA254 EVM User's Guide



### ABSTRACT

This user's guide describes the characteristics, operation, and use of the INA254 evaluation modules (EVMs). Throughout this document, the terms evaluation board, evaluation module, and EVM are synonymous with the INA254EVM. This document includes a schematic, reference printed-circuit board (PCB) layouts, and a complete bill of materials (BOM).



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## Trademarks

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# 1 General Texas Instruments High Voltage Evaluation (TI HV EVM) User Safety Guidelines



Always follow TI's setup and application instructions, including use of all interface components within their recommended electrical rated voltage and power limits. Always use electrical safety precautions to help ensure your personal safety and those working around you. Contact TI's Product Information Center <http://support/ti.com> for further information.

**Save all warnings and instructions for future reference.**

## WARNING

Failure to follow warnings and instructions may result in personal injury, property damage or death due to electrical shock and burn hazards.

The term TI HV EVM refers to an electronic device typically provided as an open-framed, unenclosed printed-circuit board assembly. It is intended strictly for use in development laboratory environments, solely for qualified professional users having training, expertise, and knowledge of electrical safety risks in development and application of high-voltage electrical circuits. Any other use and/or application are strictly prohibited by Texas Instruments. If you are not suitable-qualified, you should immediately stop from further use of the HV EVM.

### 1. Work Area Safety

- a. Keep work area clean and orderly.
- b. Qualified observer(s) must be present anytime circuits are energized.
- c. Effective barriers and signage must be present in the area where the TI HV EVM and its interface electronics are energized, indicating operation of accessible high voltages may be present, for the purpose of protecting inadvertent access.
- d. All interface circuits, power supplies, evaluation modules, instruments, meters, scopes and other related apparatus used in a development environment exceeding 50Vrms/75VDC must be electrically located within a protected Emergency Power Off EPO protected power strip.
- e. Use stable and nonconductive work surface.
- f. Use adequately insulated clamps and wires to attach measurement probes and instruments. No freehand testing whenever possible.

### 2. Electrical Safety

As a precautionary measure, it is always a good engineering practice to assume that the entire EVM may have fully accessible and active high voltages.

- a. De-energize the TI HV EVM and all its inputs, outputs, and electrical loads before performing any electrical or other diagnostic measurements. Revalidate that TI HV EVM power has been safely de-energized.
- b. With the EVM confirmed de-energized, proceed with required electrical circuit configurations, wiring, measurement equipment connection, and other application needs, while still assuming the EVM circuit and measuring instruments are electrically live.
- c. After EVM readiness is complete, energize the EVM as intended.

## WARNING

While the EVM is energized, never touch the EVM or its electrical circuits, as they could be at high voltages capable of causing electrical shock hazard.

3. Personal Safety

- a. Wear personal protective equipment (for example, latex gloves or safety glasses with side shields) or protect the EVM in an adequate lucent plastic box with interlocks to protect from accidental touch.

**Limitation for safe use:**

EVMs are not to be used as all or part of a production unit.

## 2 Overview

The INA254 is a voltage-output, current sense amplifier with an integrated shunt resistor. The INA254 is designed to monitor bidirectional currents over a wide common-mode range from  $-4\text{ V}$  to  $+80\text{ V}$ , independent of the supply voltage. Three fixed gains are available. The integration of the precision resistor with a zero-drift chopped amplifier provides calibration equivalent measurement accuracy, ultra-low temperature drift performance, and an optimized Kelvin layout for the sensing resistor.

The INA254 is designed with enhanced PWM rejection circuitry to suppress large  $(dv/dt)$  signals that enable real-time continuous current measurements. The measurements are critical for inline current measurements in a motor-drive application, and for solenoid valve control applications

This device operates from a single 2.7-V to 5.5-V power supply, drawing a maximum of 3 mA of supply current. All gain versions are specified over the extended operating temperature range ( $-40^{\circ}\text{C}$  to  $+125^{\circ}\text{C}$ ), and are available in a 24-pin TSSOP package..

### 2.1 Kit Contents

[Table 2-1](#) lists the contents of the EVM kit. Contact the nearest [Texas Instruments Product Information Center](#) if any component is missing.

**Table 2-1. Kit Contents**

ITEM	QUANTITY
INA254EVM test board	1

### 2.2 Related Documentation From Texas Instruments

This user's guide is available from the TI website under literature number [SLOU514](#). 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 are available from [www.ti.com](#) or 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 both title and literature number. [Table 2-2](#) lists documentation related to the EVM. Click the links in [Table 2-2](#) for further information. The device name links to the product web folder on [www.ti.com](#). The literature number links to the document PDF.

**Table 2-2. Related Documentation**

DOCUMENT TITLE	DOCUMENT LITERATURE NUMBER
<a href="#">INA254</a> data sheet	<a href="#">SLOS974</a>

## 3 Hardware

Each of the PCBs on the INA254EVM requires a 2.7-V to 5.5-V power supply connected between the VS and GND test points.

The INA254 family of devices have an integrated shunt of value  $0.4\text{ m}\Omega$  between the IS+ and IS- pins. Connect a current source and an optional load in series with test points IS+ and IS-. Use a voltmeter on the OUT test point to measure the voltage output of the INA254. Keep the voltage on the IS+ and IS- in the range of  $-4\text{ V}$  to  $+80\text{ V}$  at all times.

For the following components,  $x = 1$  to 3, respective to the INA254A1, A2, or A3 devices.

Cx02 are supply bypass capacitors for the INA254Ax.

Rx01 is a  $0\text{-}\Omega$  resistor that ties SH+ to IN+.

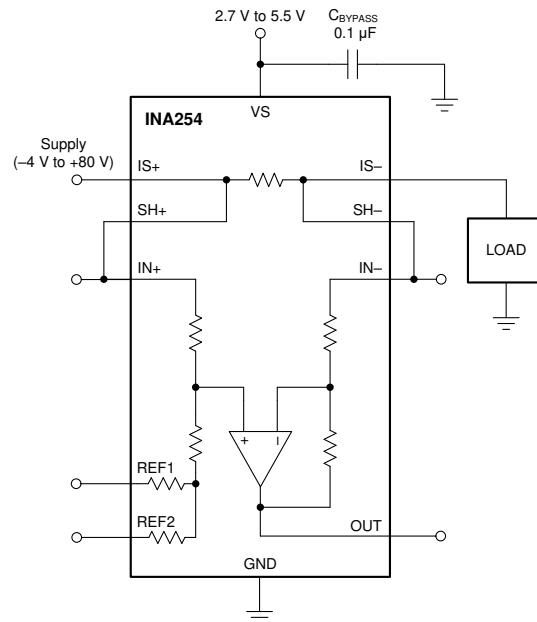
Rx02 is a  $0\text{-}\Omega$  resistor that ties SH- to IN-.

Rx03 and Rx06 are  $0\text{-}\Omega$  resistors that tie REF1 and REF2 pins to VS and GND respectively, thereby creating a midsupply reference voltage.

Components Rx01, Rx02, Cx03, Cx04, and Cx05 can be added or replaced to provide optional filtering of the voltages out of the SH+ and SH- pins, and into the IN+ and IN- pins of the INA254.

### 3.1 Theory of Operation

A block diagram of the INA254 device is shown in [Figure 3-1](#). There are test points located on each of the PCB boards that access the functional pins of the device. Minimal support circuitry is included on the PCB, and can be reconfigured, removed, or bypassed as needed.



**Figure 3-1. INA254 Block Diagram**

### 3.2 Features

The INA254EVM provides basic functional evaluation of this device family. The fixture layout is not intended for electromagnetic compatibility (EMC) testing.

The INA254EVM PCB provides the following features:

- All INA254 devices are provided
- Easy access to all pins
- Board layout and construction that supports  $\pm 50$ -A current through the device across the full  $-40^{\circ}\text{C}$  to  $+85^{\circ}\text{C}$  temperature range
- Place holders on the PCB for configurations other than the default configuration

For comprehensive information about this family of current sense amplifiers, refer to the INA254 data sheet ([SLOS974](#)).

### 3.3 Quick Start Setup

The following instructions describe how to set up and use the EVM.

1. Connect an external dc supply voltage between 2.7 V and 5.5 V to the VS test point, and connect the ground reference of that supply to the GND test point.
2. Connect a current source across the IS+ and IS- test points, to provide current flowing through the integrated shunt resistor. The common-mode voltage on the IS+ and IS- pins must be between  $-4$  V and  $+80$  V (referenced to the GND pin).
3. The OUT pin quiescent voltage level is midsupply, and increases or decreases when there is a current load flowing through IS+ and IS-, as set up in the previous step.

### 3.4 Current Input

The current flowing across the IS+ and IS– pins develops a differential voltage across the 0.4 mΩ shunt and is amplified by the current shunt amplifier. The current flowing across this integrated shunt is multiplied by the current gain of the INA254A1 (20 mV/A), INA254A2 (40 mV/A), or INA254A3 (75 mV/A). Do not use this integrated shunt resistor as a stand-alone component. See the Integrated Shunt Resistor section of the INA254 data sheet (SLOS974) for more information.

## 4 Schematics, PCB Layout, and Bill of Materials

### Note

Board layouts are not to scale. These figures are intended to show how the board is laid out. The figures are not intended to be used for manufacturing EVM PCBs.

### 4.1 Schematic

Figure 4-1 shows the complete schematic of the INA254Ax test board. The functional pins are accessed through test points. The IS+ and IS– pins are shorted to VIN+ and VIN– using 0-Ω resistors, respectively. The reference pins are in the split supply configuration through installed 0-Ω resistors Rx03 and Rx06 the schematic of the EVM.

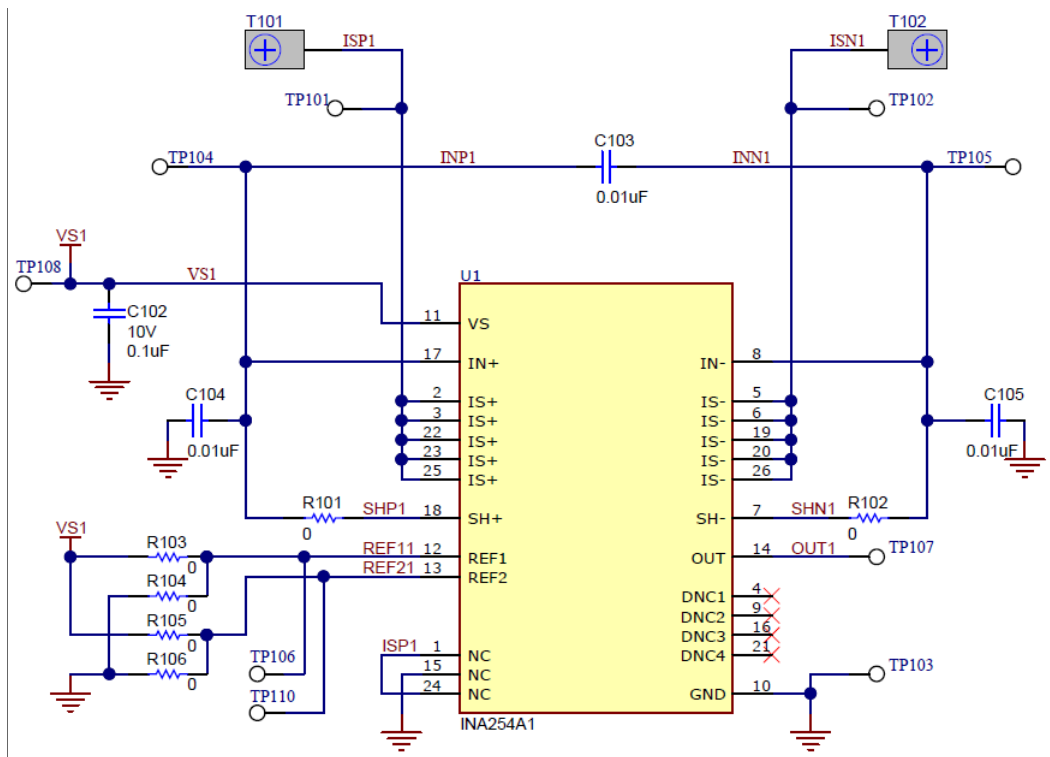


Figure 4-1. INA254EVM Schematic

## 4.2 Layout

Figure 4-2 through Figure 4-5 illustrate the PCB layers of the EVM.

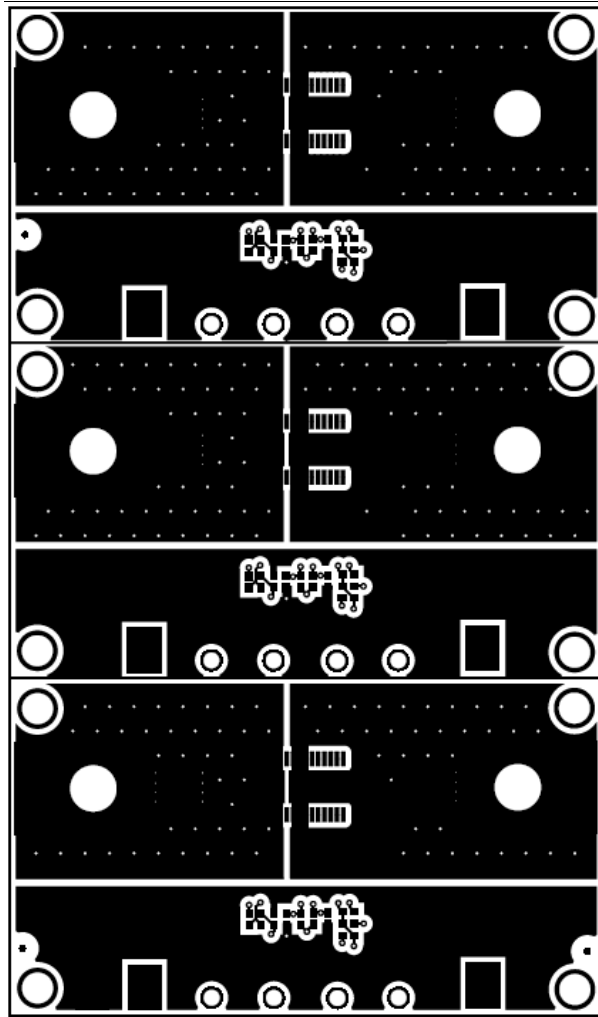


Figure 4-2. Top Layer

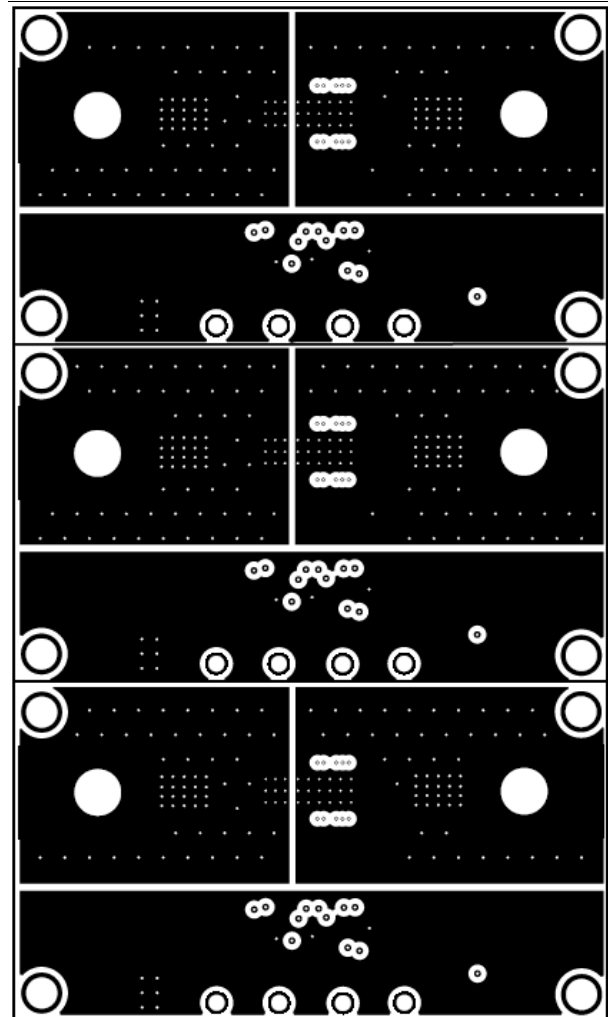


Figure 4-3. Bottom Layer



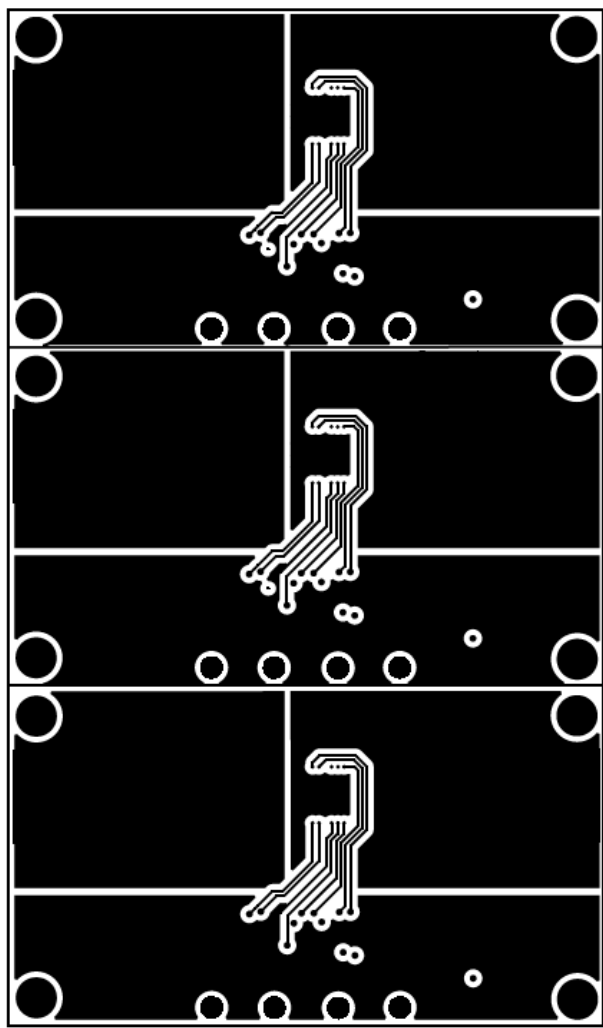


Figure 4-4. Internal Layer 1

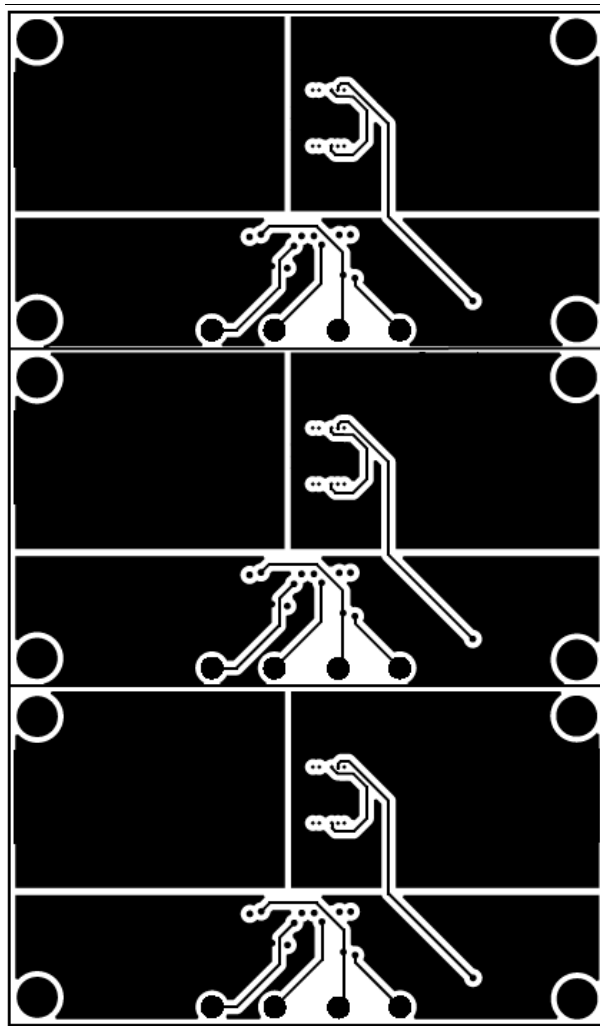


Figure 4-5. Internal Layer 2

### 4.3 Bill of Material

Table 4-1 shows the bill of materials (BOM) for the INA254EVM.

**Table 4-1. Bill of Materials**

Designator	QTY	Value	Description	Package Reference	Part Number	Manufacturer
!PCB1	1		Printed Circuit Board		SENS043	Any
C102, C202, C302	3	0.1uF	CAP, CERM, 0.1 uF, 10 V, +/- 10%, X7R, AEC-Q200 Grade 1, 0402	0402	GCM155R71A104KA55D	MuRata
H9, H10, H11, H12	4		Bumpon, Hemisphere, 0.375 X 0.235, Black	Black Bumpon	SJ61A2	3M
R101, R102, R103, R106, R201, R202, R203, R206, R301, R302, R303, R306	12	0	RES, 0, 5%, 0.063 W, 0402	0402	RC0402JR-070RL	Yageo America
TP101, TP102, TP103, TP107, TP108, TP201, TP202, TP203, TP207, TP208, TP301, TP302, TP303, TP307, TP308	15		Test Point, Compact, SMT	Testpoint_Keystone_Compact	5016	Keystone
U1	1		80-V, High-Voltage, $\pm$ 50A Integrated Precision Shunt, Bidirectional, Zero-Drift Current-Shunt Monitor	HTSSOP24	INA254A1	Texas Instruments
U2	1		80-V, High-Voltage, $\pm$ 50A Integrated Precision Shunt, Bidirectional, Zero-Drift Current-Shunt Monitor	HTSSOP24	INA254A2	Texas Instruments
U3	1		80-V, High-Voltage, $\pm$ 50A Integrated Precision Shunt, Bidirectional, Zero-Drift Current-Shunt Monitor	HTSSOP24	INA254A3	Texas Instruments

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