EVM User's Guide: INA951EVM

INA951-SEP Evaluation Module

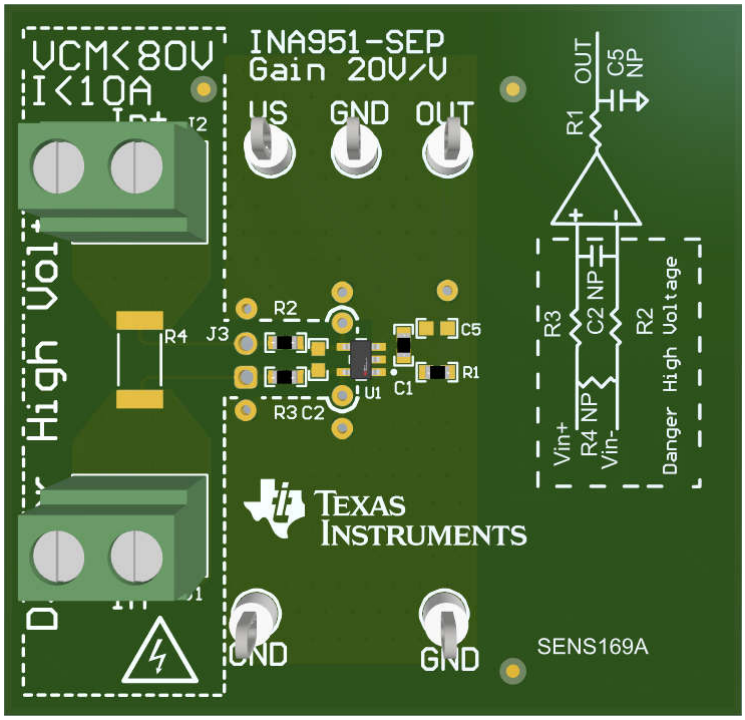
1 Description

The INA951EVM evaluation module (EVM) is a small module with a current measurement input up to 80V common-mode and 10A (onboard shunt) input capability.

Each board provides test points for VS, GND, OUT and a terminal block for In+ and In-. Pads and terminal connectors allow for quick implementation of input and output filtering as well as an onboard 2512-size shunt resistor.

2 Features

- Electrical evaluation of the INA951-SEP current sensor
- Ease of access to device pins with test points
- Pads and sockets for optional filtering at the input pins and output pin
- Multiple input signal options, including a method to solder a shunt resistor (2512) and safely measure current up to 10A



INA951-SEP Hardware Board

3 Evaluation Module Overview

3.1 Introduction

The EVM is an easy-to-use platform for evaluating the main features and performance of the INA951-SEP. The EVM supports current measurements up to 10A through the PCB, and the INA951-SEP supports high voltages up to 80V.

This EVM user's guide describes the characteristics, operation, and use of the INA951EVM modules. This EVM is designed to evaluate the performance of the INA951-SEP voltage-output, current shunt monitor in a variety of configurations. Throughout this document, the terms evaluation board, evaluation module, and EVM are synonymous with the INA951EVM. This document also includes a schematic, reference printed circuit board (PCB) layouts, and a complete bill of materials (BOM).

3.2 Kit Contents

Table 3-1 summarizes the contents of the INA951EVM kits. Contact the nearest Texas Instruments Product Information Center if any component is missing. TI also recommends to check the device product folders at www.ti.com for any further information regarding this product.

Table 3-1. INA951EVM Kit Contents

Item	Item Part Number	Quantity
INA951EVM test board	INA951EVM	1

3.3 Specification

The INA951EVM provides a basic functional evaluation of the INA951-SEP. The fixture layout is not intended to be a model for the target circuit, nor is the layout setup for electromagnetic compatibility (EMC) testing. The INA951EVM is a PCB the engineer can use to test the INA951-SEP device in the end application. Each PCB cutout has the INA951-SEP device, test points and terminals for external hardware connections, and pads to solder down optional circuitry.

3.4 Device Information

The INA951-SEP is a current sense amplifier that can measure voltage drops across shunt resistors over a wide common-mode range from –4V to 80V, independent of the supply voltage. The negative common-mode voltage allows the device to operate below ground, thus accommodating precise measurement of recirculating currents in half-bridge applications. The combination of a low offset voltage, small gain error and high DC CMRR enables highly accurate current measurement. The INA951-SEP is not only designed for DC current measurement, but also for high-speed applications (ex. Fast over-current protection) with a high bandwidth of 1.3MHz and an 85dB AC CMRR (at 50kHz).

The INA951-SEP operates from a single 2.7V to 10V supply, drawing 1.5mA of supply current. The INA951-SEP has a fixed 20V/V gain.

The INA951-SEP is specified over an operating temperature range of -55°C to +125°C and available in a space-saving SOT-32 package.

4 Hardware

4.1 Setup

4.1.1 Quick Start Setup

Follow these procedures to set up and use the INA951EVM.

1. Connect an external DC supply voltage (between 2.7V and 10V) to the VS test point. Connect the ground reference of that supply to a GND test point.
2. Provide a differential input voltage signal to the In+ and In– nodes by connecting the signal leads to the J2 and J1 on the EVM, as explained in Measurements.

CAUTION

Do not leave EVM powered when unattended.

4.1.2 Measurements

The user can either emulate the voltage developed across a sense resistor based on a given set of system conditions with the INA951EVM, or connect the device inputs to an external shunt. The user can also solder a surface-mount technology (SMT) shunt resistor across the In+ and In– pads, and these inputs can be connected in series with the external system and load.

To configure a measurement evaluation without a shunt resistor, follow this procedure:

1. Connect an external DC supply voltage (between 2.7V and 10V) to the VS test point and connect the supply ground to a GND test point
2. Connect a differential voltage across the In+ (J2) and In– (J1) connectors
3. Connect a -4V to 80V common-mode voltage to the inputs given the differential voltage supply is a floating supply. Connect the positive lead of the external voltage source to the In– (J1) connector and the ground lead to a GND test point. This setup effectively moves the absolute common-mode voltage of the input pins while keeping the differential voltage the same (See Figure 4-1)
4. Measure the output voltage at the OUT test point with respect to GND

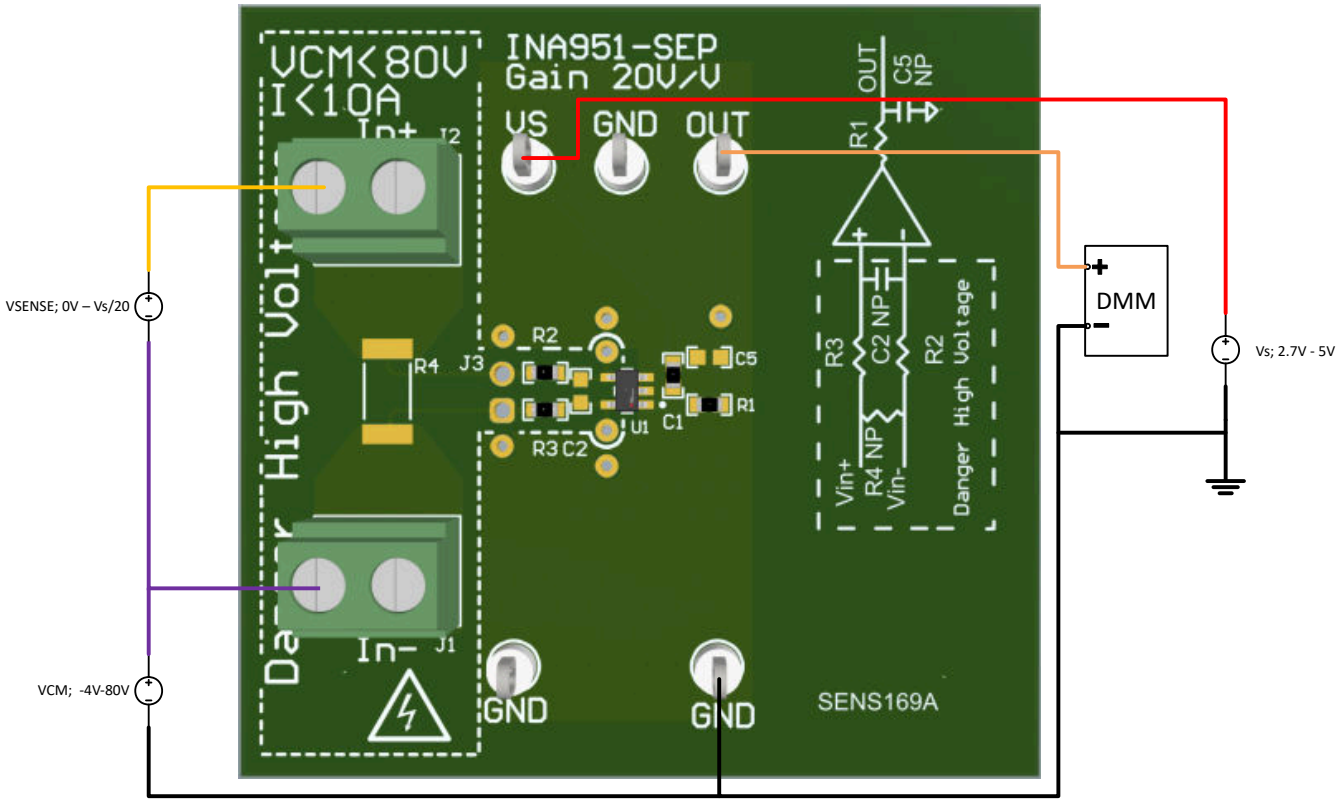


Figure 4-1. Connection Without Shunt Resistor

To configure a measurement evaluation with a shunt resistor, follow this procedure:

1. Solder a 2512 resistor at the R4 pads that connects the In+ (J2) and In– (J1) inputs
2. Connect the In+ (J2) and In– (J1) tabs in series with the load and bus voltage sources while powered off.

> **WARNING**
>
> Make sure that the equipment (shunt resistor, wires, connectors, and so on) can support the amperage and power dissipation first before you measure the current. Also make sure that the current flowing through J1 and J2 does not exceed 10A. Failure to do so can result in hot surfaces (> 55°C), damage to the EVM, or personal injury.

3. Power on the system and measure the output voltage at the OUT test point. The output voltage is equal to the gain of the device multiplied by the differential voltage measured directly at the device input pins. The output is referenced to the ground input of the EVM.

4.2 Circuitry

This section summarizes the INA951EVM components.

4.2.1 R1, R2, R3, C2, C5

R1, R2, and R3 are factory-installed 0Ω 0603 resistors.

C2 and C5, are not populated.

Collectively, these pads allow user-defined filters for the input pins (IN+ and IN–) and the output pin (OUT) of the EVMs. If a filter is desired, remove these resistors and replace them with > 0Ω SMT resistors and populate the capacitor pads with capacitors. Consider the input bias current of the device when using input filtering.

4.2.2 C1

C1 is a 0.1µF, power-supply bypass capacitor. C1 is located close to the Vs pin for better power supply filtering.

4.2.3 R4

R4 is unpopulated, but allows the user to solder down a surface-mount shunt resistor between the In+ and In– pads sensed by IN+ and IN– input pins. If used, make sure R4 has proper power dissipation for the selected current load. The chosen resistor must have a 2512 footprint.

4.2.4 U1

Table 4-1. INA951EVM

Designator	QTY	Value	Description	Package Reference	Part Number	Manufacturer
U1	1		-4V to 80V, 1.3MHz, Current Sense Amplifier	DBV (SOT-23, 5)	INA951A1MDB VTSEP	Texas Instruments

U1 is the location for the INA951-SEP test device.

4.2.4.1 J3

J3 is unpopulated by default, but can be populated with header pins to allow for sensing the voltage across the device shunt inputs closer to the device. Although test points are populated for all device pins, untented vias on the board can be used to take measurements closer to the device.

4.3 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 the recommended electrical rated voltage and power limits. Always use electrical safety precautions to help reinforce 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 observers must be present anytime circuits are energized.
   c. Effective barriers and signage must be present in the area where the TI HV EVM and the 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 non-conductive 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, good engineering practice is to always assume that the entire EVM can have fully accessible and active high voltages.
   a. De-energize the TI HV EVM and all the 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 the electrical circuits, as the EVM can have 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 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.

5 Hardware Design Files

Note

Board layouts are not to scale. These figures are intended to show how the board is laid out. The evaluation module layouts are not intended to be used for INA951EVM PCB manufacturing.

5.1 Schematics

Figure 5-1 shows the schematic for the INA951EVM PCB.

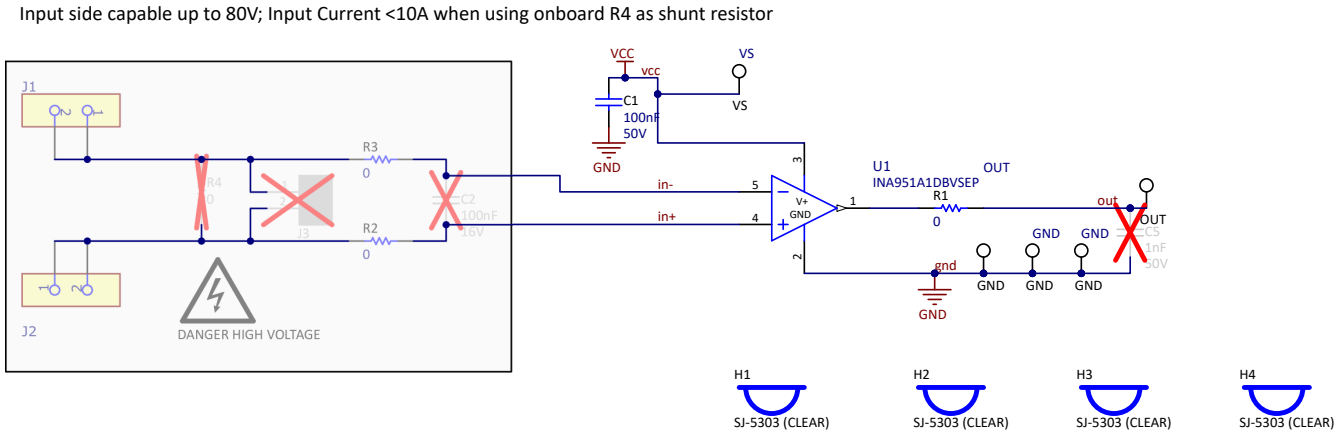


Figure 5-1. INA951EVM Schematic

5.2 PCB Layout

Figure 5-2 through Figure 5-5 show the PCB layout for the INA951EVM.

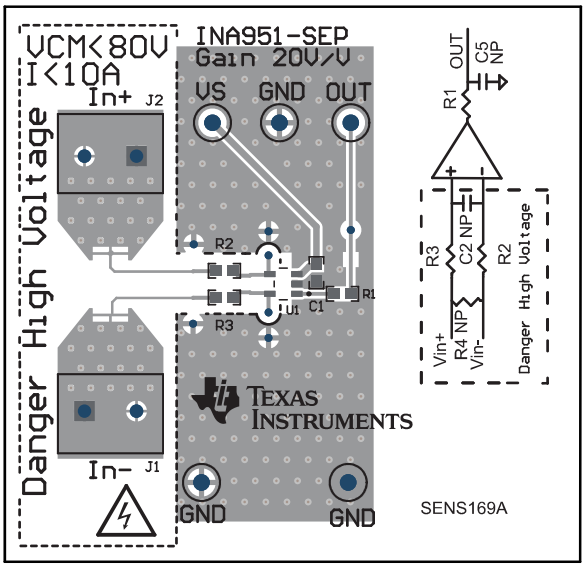


Figure 5-2. INA951EVM Top Overlay

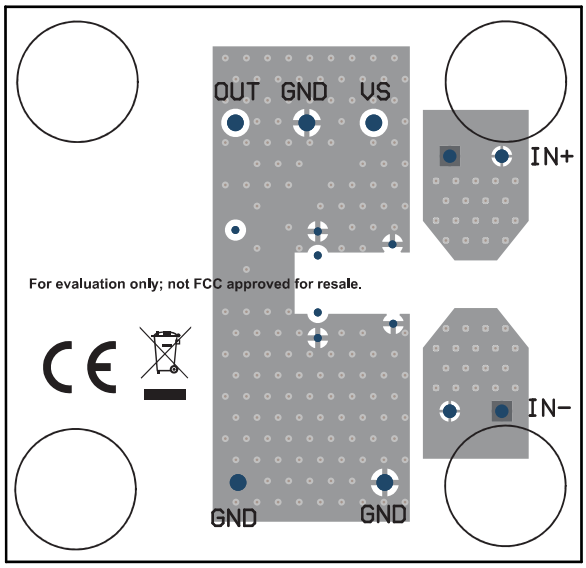


Figure 5-3. INA951EVM Bottom Overlay

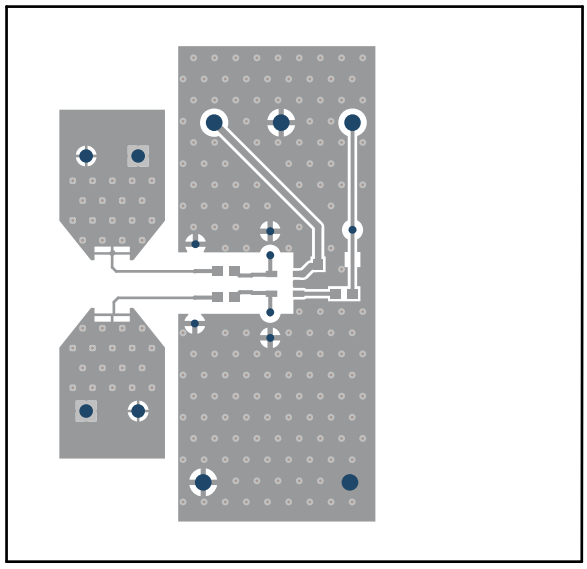


Figure 5-4. INA951EVM Top Layer

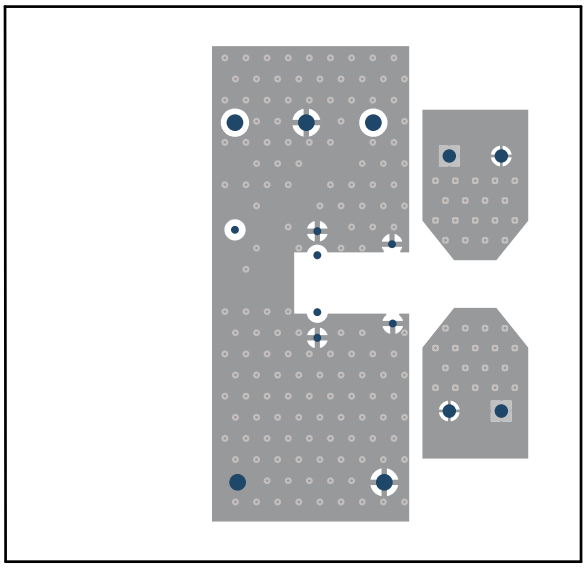


Figure 5-5. INA951EVM Bottom Layer

5.3 Bill of Materials

Table 5-1 provides the parts list for the INA951EVM.

Table 5-1. Bill of Materials

Designator	Quantity	Value	Description	Package Reference	Part Number	Manufacturer
C1	1	0.1uF	CAP, CERM, 0.1 µF, 50V,+/- 10%, X7R, AEC-Q200 Grade 1, 0603	0603	C0603C104K5RACAUTO	Kemet
H1, H2, H3, H4	4		Bumpon, Hemisphere, 0.44X 0.20, Clear	Transparent Bumpon	SJ-5303 (CLEAR)	3M
J1, J2	2		TERM BLK 2POS SIDE ENTRY 5MM PCB	HDR2	6.91138E+11	Würth Elektronik
R1, R2, R3	3	0	RES, 0, 5%, 0.1W, 0603	0603	RC0603JR-070RL	Yageo
TP1, TP3, TP5, TP6, TP7	5		Test Point, Multipurpose, White, TH	White Multipurpose Testpoint	5012	Keystone Electronics
U1	1		-4V to 80V, 1.3MHz, Current Sense Amplifier	SOT23-5	INA951A1MDBVTSEP(1)	Texas Instruments
C2	0	0.1uF	CAP, CERM, 0.1uF, 16V, +/- 5%, X7R, 0603	0603	0603YC104JAT2A	AVX
C5	0	1000pF	CAP, CERM, 1000pF, 50V, +/- 10%, X7R, 0603	0603	C0603X102K5RACTU	Kemet
J3	0		Header, 2.54mm, 2x1, Gold, TH	Header, 2.54mm, 2x1, TH	61300211121	Wurth Elektronik
R4	0	0	RES, 0, 0.05%, 2W, AEC-Q200 Grade 0, 2512	2512	HCJ2512ZT0R00	Stackpole Electronics Inc

(1) The INA951EVM can be populated with INA951-SEP (U1) devices that do not contain the correct top-side markings on the top of the device. These devices are still fully-tested INA951-SEP devices.

6 Additional Information

6.1 Trademarks

All trademarks are the property of their respective owners.

7 Related Documentation

This document provides information regarding Texas Instruments' integrated circuits used in the assembly of the INA951EVM.

Table 7-1. Related Documentation

Document	Literature Number
INA951-SEP product datasheet	SLVSJ50

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