

EVM User's Guide: INA151EVM

INA151 Evaluation Module



Description

The INA151EVM is an evaluation module (EVM) designed to test the functionality of the INA151. The board offers flexibility with input and output connections through banana connectors, SMA/SMB connector footprint, test points, and multiple options to connecting a reference voltage.

Get Started

1. Order the [INA151EVM](#) board from the tool page.
2. Optional: If not evaluating INA151B, order alternative INA151 variant.
3. Download the [INA151 data sheet](#) for detailed device specification.

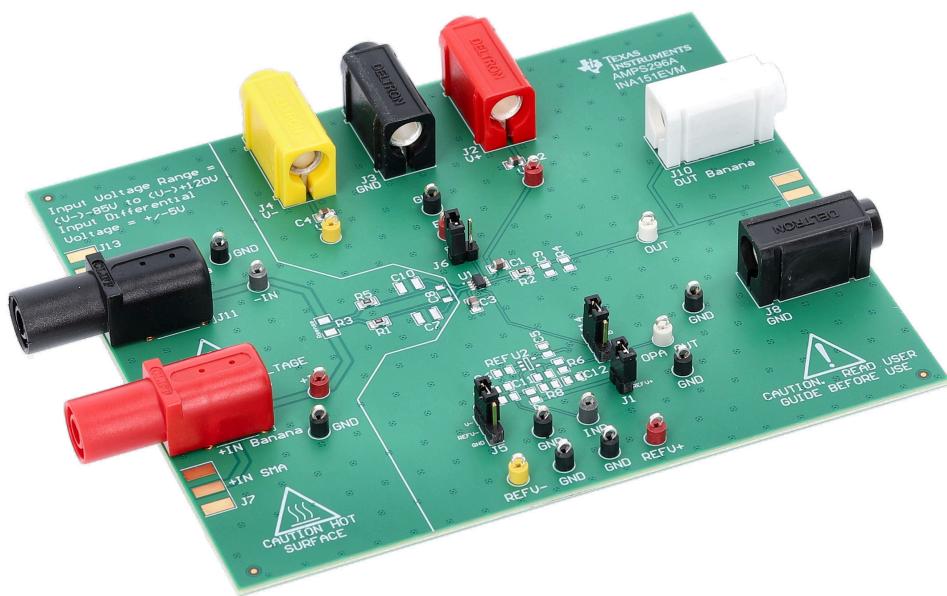
4. Download the EVM user's guide for instructions.

Features

- Flexible input and output connections with banana connectors, test points, and SMB/SMA footprints
- Ease of access to device pins with test points
- Footprints available to populate sense resistor, input filtering, and external reference buffer

Applications

- [Battery cell formation and test equipment](#)
- [Analog input module](#)
- [Mixed module \(AI, AO, DI, DO\)](#)



1 Evaluation Module Overview

1.1 Introduction

This user's guide contains support documentation for the INA151EVM. The EVM is designed to evaluate an INA151 and is populated with the INA151BDDF device. Alternative gain variants of the INA151 can be tested by de-populating the onboard INA151 and replacing with an alternative.

This document includes description of how to use the EVM, high voltage precautions, contents, schematics, printed circuit board (PCB) layouts, and bill of materials (BOM). Throughout the document, the terms evaluation board, evaluation module, and EVM are synonymous with the INA151EVM.

1.2 Kit Contents

This EVM kit includes:

- INA151EVM evaluation module
- EVM Disclaimer Read Me
- High Voltage Read Me

The kit does not include:

- Capacitors and resistors for R_{SENSE} , input filtering, and output load
- Components for external reference circuit
- SMB/SMA connectors

1.3 Specification

The INA151EVM is an evaluation module that provides a method to evaluate the INA151. The EVM is populated with the INA151BDDF. The printed circuit board (PCB) is 4.20in by 5.05in in size.

The EVM offers the following features:

- High voltage input terminals up to -80V to +120V. See the [Section General Texas Instruments High Voltage Evaluation \(TI HV EVM\) User Safety Guidelines](#) on high voltage guidelines.
- Optional reference buffer footprint (single op amp in SOT-23 package)
- Optional sense resistor footprint (1206)
- Footprints for input filtering capacitors (1206 and 1210)
- Footprints for output loads (0805)
- Footprints for SMA/SMB connectors on input and output of PCB
- Option to bias EN to external voltages

1.4 Device Information

The INA151 is a precision difference amplifier used for voltage monitoring with an input common-mode voltage range of $(V-) - 85V$ to $(V-) + 120V$. The INA151 can accurately measure up to $\pm 5V$ differential voltages in the presence of high common-mode voltage with a high common-mode rejection ratio and input impedance of $> 1.4M\Omega$ and an offset voltage drift of $2\mu V/\text{°C}$. More device information can be found in the [INA151 120V, 120dB CMRR Voltage Monitoring Amplifier With Enable/Disable Function](#) data sheet.

Variant	Gain (V/V)
INA151A	1
INA151B	2/3
INA151C	1/2
INA151D	1/4

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



Always follow TI's set-up and application instructions, including use of all interface components within the recommended electrical rated voltage and power limits. Always use electrical safety precautions to verify that your personal safety and those working around you. For further information, contact TI's Product Information Center <http://ti.com/customer support>.

Save all warnings and instructions for future reference.

WARNING

Failure to follow warnings and instructions can 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 suitably qualified, then 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 can 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:

- a. As a precautionary measure, a good engineering practice is to assume that the entire EVM can have fully accessible and active high voltages.
- b. 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.
- c. With the EVM confirmed de-energized, proceed with required electrical circuit configurations, wiring, measurement equipment hook-ups and other application needs, while still assuming the EVM circuit and measuring instruments are electrically live.
- d. Once 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 or the electrical circuits can 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 EVM in an adequate lucent plastic box with interlocks from accidental touch.

Limitation for safe use:

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

2 Hardware

2.1 Power Requirements

The INA151 operates on a power supply voltage range from $\pm 1.35V$ to $\pm 10V$ dual supply or $2.7V$ to $20V$ single supply. The EVM has connections for positive supply (V_+), negative supply (V_-), and ground (GND) as shown in [Figure 2-1](#). Bypass capacitors are populated on the board (C1, C2, C3, C4) for the device supply. The supply connection can be done either using a standard 4mm banana jack or using the power supply test points, both are not required for operation. If using in single supply, connect both (V_-) and GND to ground.

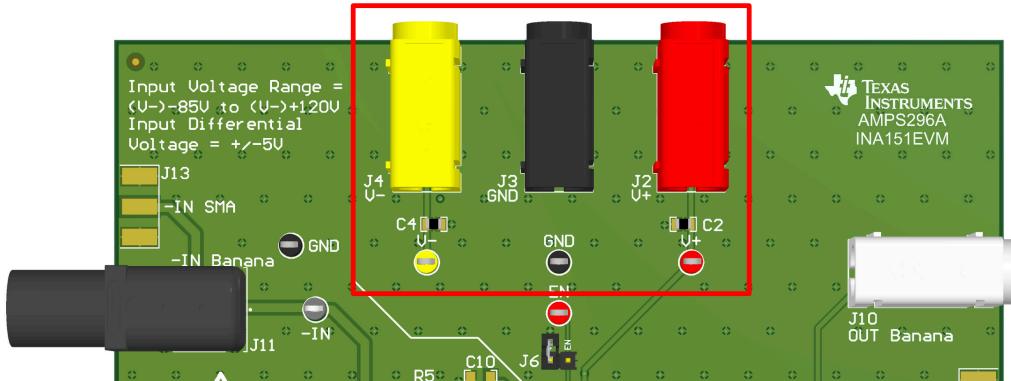


Figure 2-1. Power Connectors and Test Points

[Figure 2-2](#) shows the high voltage section on the board is denoted by the silkscreen and the high voltage-rated banana jack connectors (J9, J11). The silkscreen portion is to show where the PCB traces have been optimized for high voltage clearance and design rules to withstand the maximum voltage rating of $-80V$ to $+120V$ per device rating. All other banana jack connectors are rated for less than 50V.

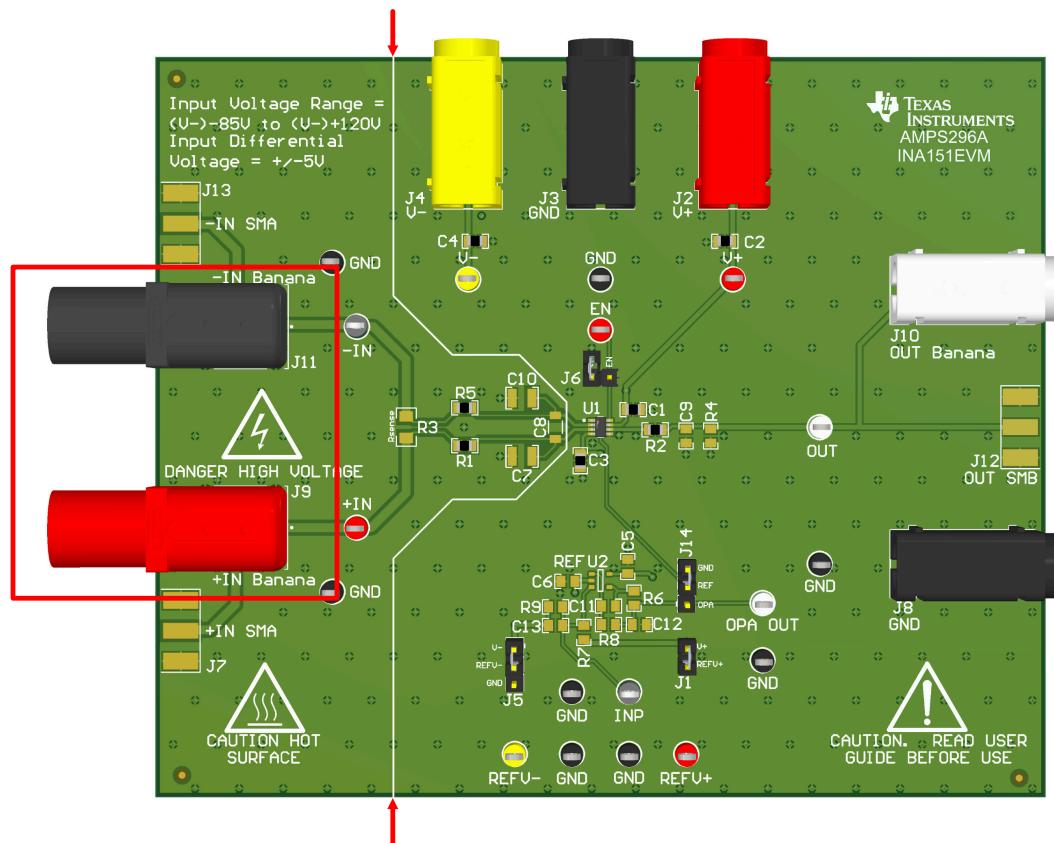


Figure 2-2. High Voltage Section of the Evaluation Board

When using an external reference buffer, the supply voltage for the reference buffer (REFV+ and REFV-) can be either tied to the board supply (V+ and V- or GND) through J1 and J5 or connected externally by the test points REFV- and REFV+, both are not required for operation. Location of the test points and headers are indicated in [Figure 2-3](#). If REFV+ and REFV- are driven externally, remove shunts from J1 and J5. Do not connect the board supplies (V+ and V-) and REF supplies (REFV+ and REFV-) together if driving externally. See [Table 2-1](#) for more information.

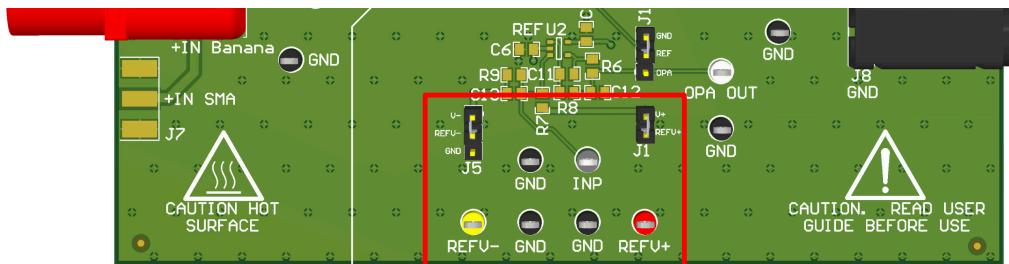


Figure 2-3. Reference Power Pin Headers and Test Points

Table 2-1. Reference Buffer Supply Headers

Header Name	Function	Setting	Description
J1	REFV+	Closed	REFV+ is shorted to V+. Do not apply an external voltage to REFV+ test point.
		Open	REFV+ is floating and must be biased externally with REFV+ test point.
J5	REFV-	Closed (REFV- to V-)	REFV- is shorted to V-. Do not apply an external voltage to REFV- test point.
		Closed (REFV- to GND)	REFV- is shorted to GND. Do not apply an external voltage to REFV- test point.
		Open	REFV- is floating and must be biased externally with REFV- test point.

2.2 Test Points

Test points are located throughout the board to access across the signal path and supplies. Test points can also be used to bias voltages directly on the inputs, reference voltages, or supply voltages. GND points are also included for ease of use. See [Section 3.1](#) for all test point locations.

2.3 Setup

The default configuration of the EVM can test the INA151 without any modifications and following the connections shown in [Figure 2-4](#) to test basic device characteristics with standard lab equipment. Modifications that can be made to circuit are shown from [Section 2.3.1](#) to [Section 2.3.5](#).

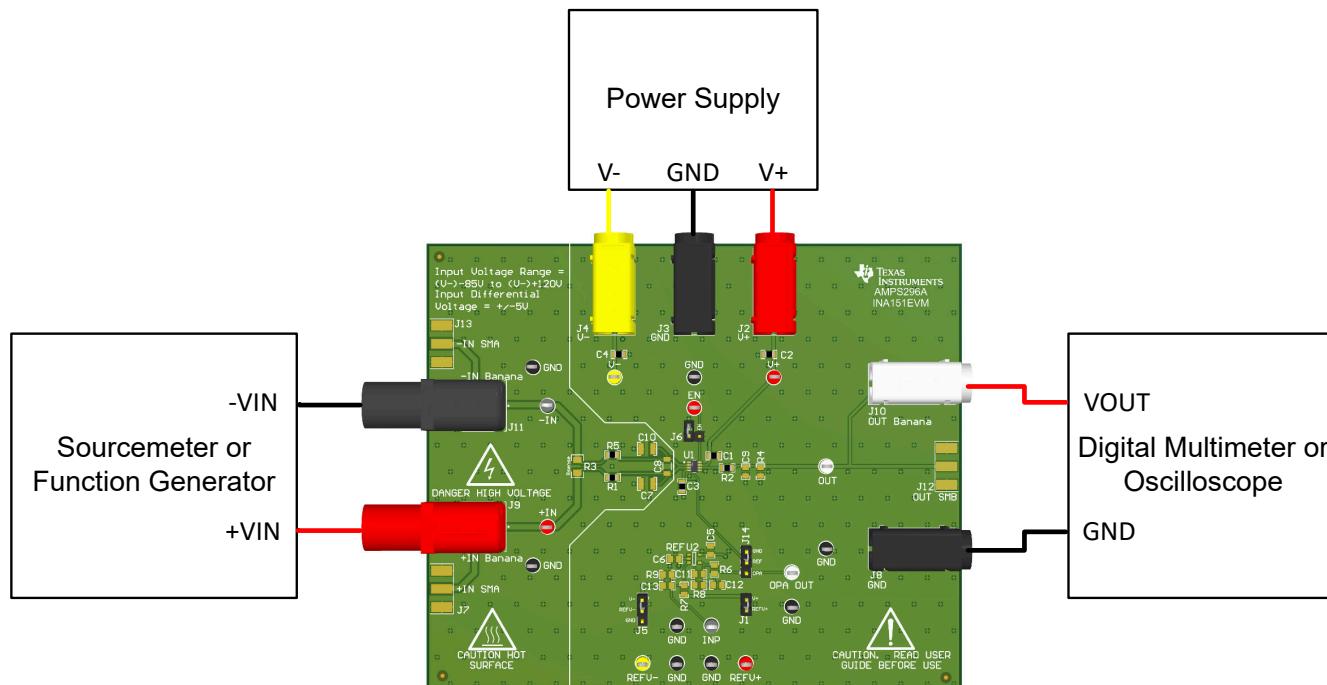


Figure 2-4. Simplified Bench Configuration using Default Setup

Table 2-2. Default Header Settings

Header Name	Setting
J1	Closed
J5	Closed (REFV- to V-)
J6	Open
J14	Closed (REF to GND)

See [Section 3.1](#) for a detailed schematic of the INA151EVM.

2.3.1 Reference Voltage

The EVM has an optional reference buffer footprint to allow the reference pin to be biased to different voltage potential. Header J14 allows flexibility for the reference circuitry to drive the reference pin (REF) to either ground or an external reference buffer circuitry. Information on the different configuration options are shown in [Table 2-3](#). By default, this circuit is left unpopulated and the headers set up the device REF pin to be grounded.

Table 2-3. Header J14 Configurations for REF Pin

Setting	Description
REF to GND	REF is connected to GND.
REF to OPA	REF is connected to the output of reference buffer.

To control the REF voltage externally, do not populate the REF circuitry, set J14 REF to OPA, and connect the external voltage to the OPA_OUT test point.

For options on how to supply power to the reference buffer circuit, see [Section 2.1](#).

The OPA191 is selected for the reference buffer (U2) in the schematic. Most single channel operational amplifier in SOT-23 (DDF) package can be used as an alternative when using the reference circuit.

2.3.2 Enable, Disable

The EN pin controls whether the INA151 is in enable or disable mode. Header J6 can be configured to enable or disable the INA151 as shown in [Table 2-4](#). When J6 is closed, the amplifier output is disabled. When J6 is opened, the EN has a weak pullup resistor that allows enable operation to occur without an applied voltage.

Table 2-4. Header J6 Configurations for EN Pin

Setting	Description
Open	Enables INA151 output
Closed	Disables INA151 output

Alternatively, if J6 is open, an external voltage can be applied directly to the EN test point. The EN logic range can be seen in [Table 2-5](#). DGND is tied to GND on the EVM.

Table 2-5. Enable Voltage Logic

EN Pin Logic State	Minimum Voltage	Maximum Voltage
Logic low	DGND	DGND + 0.9
Logic high	DGND + 2	DGND + 5

2.3.3 Current Sensing

A R_{SENSE} resistor footprint (R3) is designed in the EVM layout to evaluate current-sensing applications. If using R_{SENSE} , this resistor must be rated for the inputs being selected and range from 0603 to 1206 in size. The trace width provides for evaluation of load currents up to 5A. See [Section General Texas Instruments High Voltage Evaluation \(TI HV EVM\) User Safety Guidelines](#) for all precautions on high-voltage safety use.

2.3.4 Input Filtering

Common-mode and differential input filtering can be applied to the circuit using C7, C8, C10. These components are unpopulated by default. When selecting component values for the capacitors, the recommendation is to make C8 approximately ten times larger than C7 and C10. [Analog Engineer's Calculator](#) tool, can be used to calculate the needed resistor and capacitor values for a given cutoff frequency. Note that any capacitor and resistors selected must be rated for the inputs being applied.

2.3.5 Output Load

An output load can be applied to the circuit using R4 and C9, for resistive load and capacitive load respectively. R2 can be used with C9 for an output filter. By default, R2 is populated with 0Ω while R4 and C9 are left unpopulated.

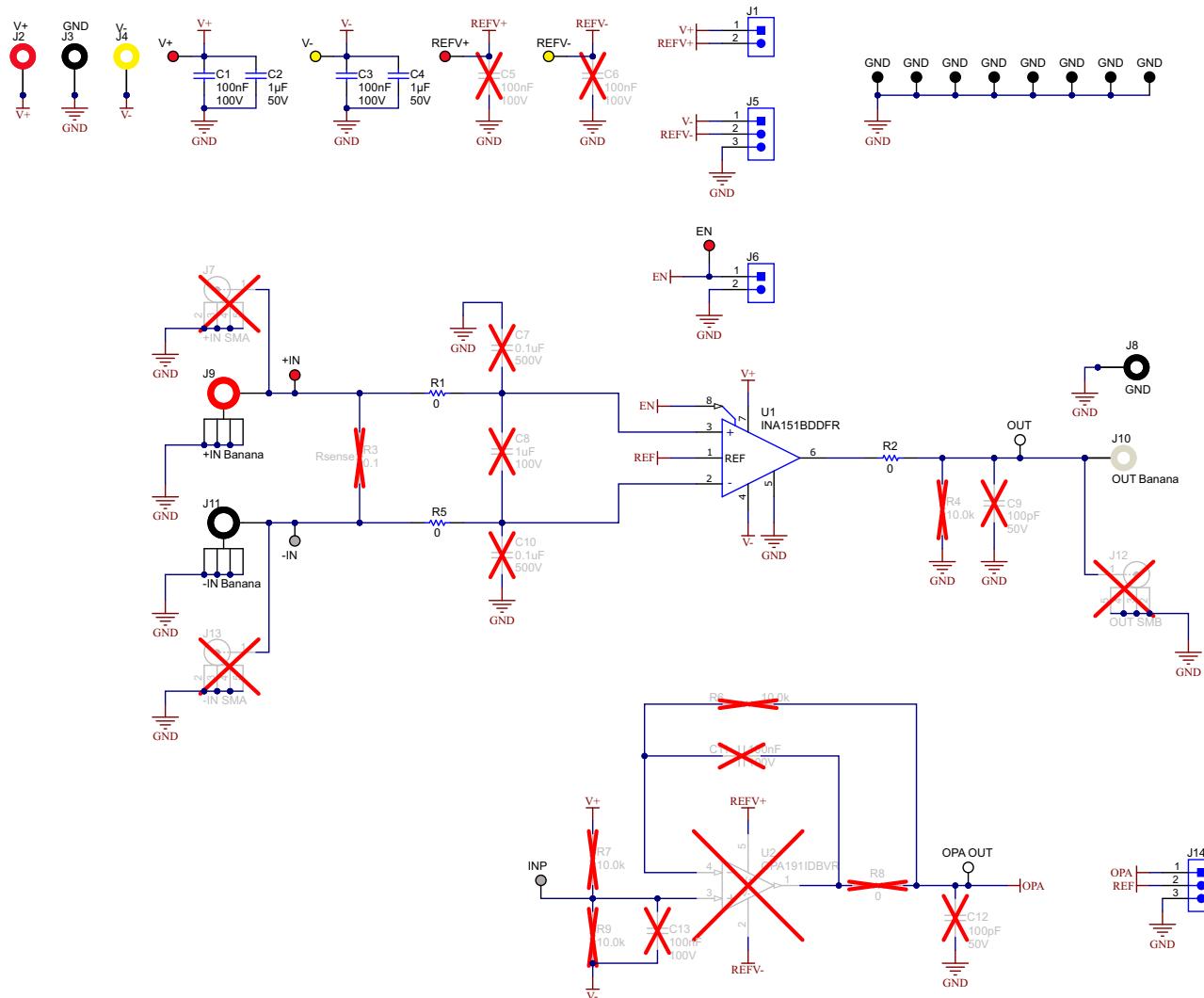
2.4 Best Practices

For best practices:

- Reference the [INA151 120V, 120dB CMRR Voltage Monitoring Amplifier with Enable/Disable Function data sheet](#).
- Review [Section General Texas Instruments High Voltage Evaluation \(TI HV EVM\) User Safety Guidelines](#).
- Note that the EVM and all components on board are intended for evaluation only.

3 Hardware Design Files

3.1 Schematics



3.2 PCB Layout

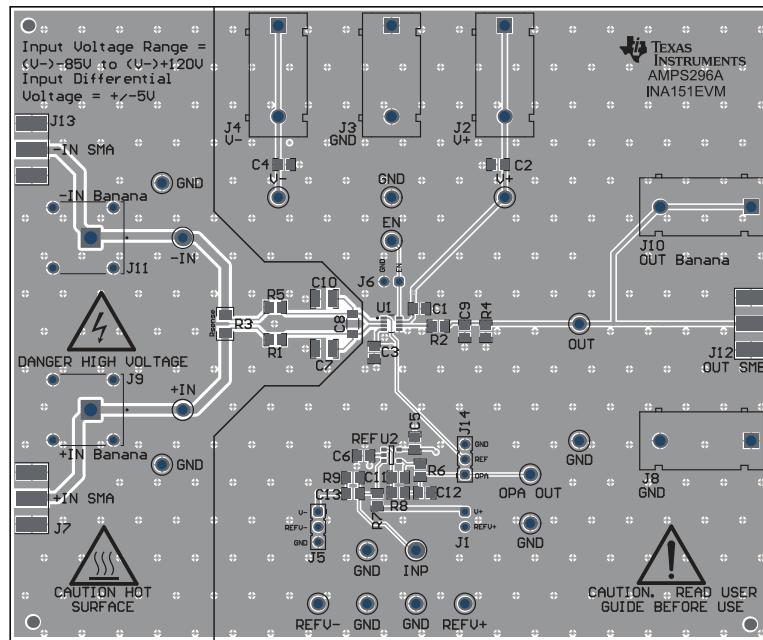


Figure 3-1. Top Layer Silkscreen

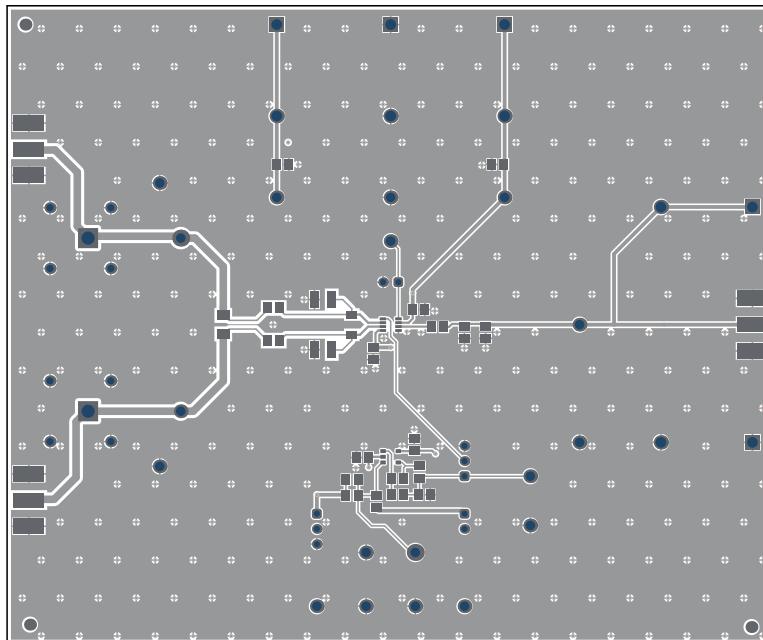


Figure 3-2. Top Layer Mask

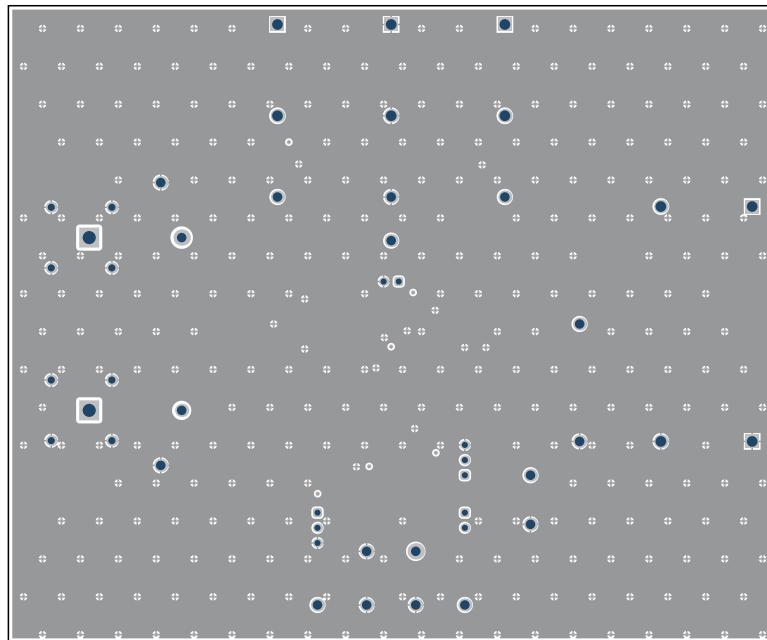


Figure 3-3. GND Layer Mask

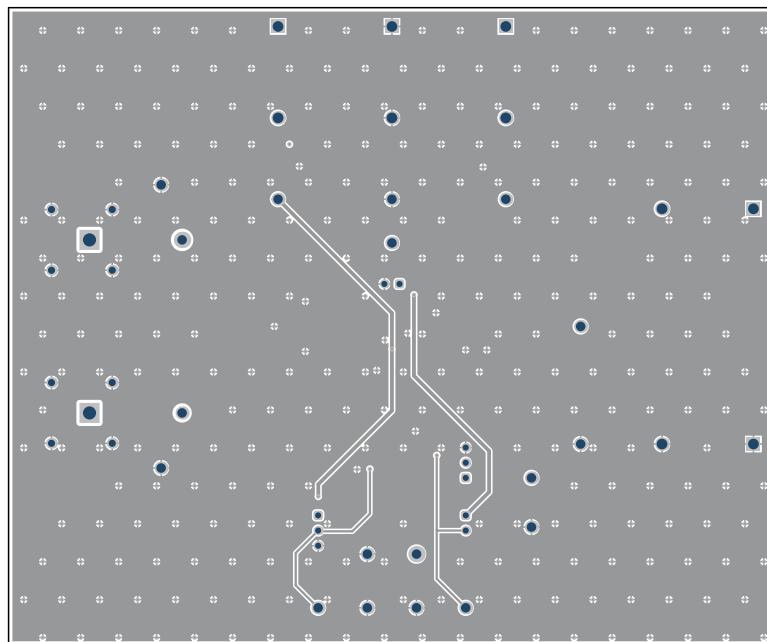


Figure 3-4. Power Layer Mask

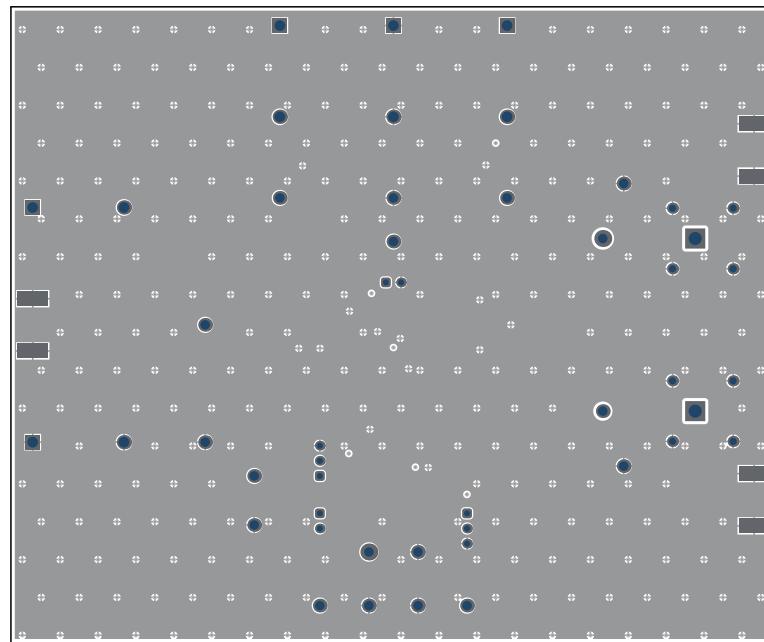


Figure 3-5. Bottom Layer Mask

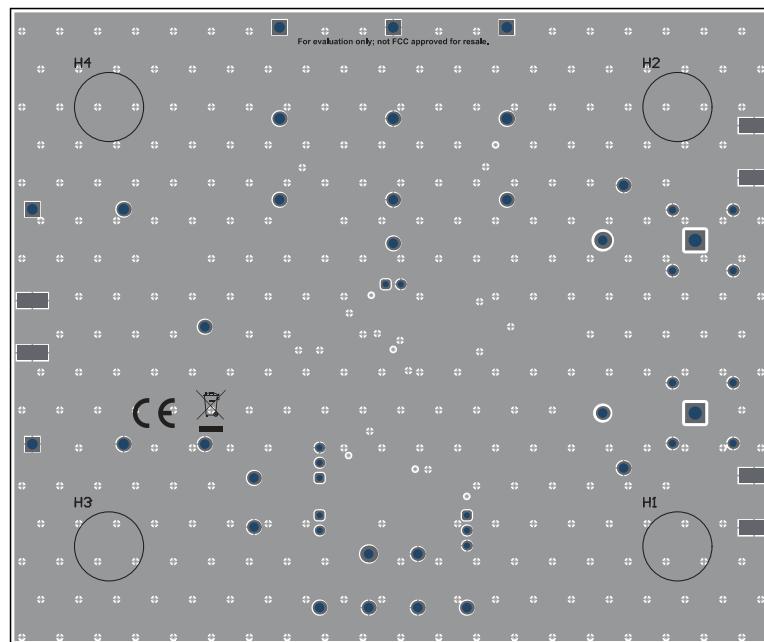


Figure 3-6. Bottom Layer Silkscreen

3.3 Bill of Materials (BOM)

Table 3-1. Bill of Materials

Designator	Quantity	Value	Description	Package Reference	Part Number	Manufacturer
!PCB1	1		Printed Circuit Board		AMPS296	Any
C1, C3	2	0.1uF	CAP, CERM, 0.1 μ F, 100V, +/- 10%, X7R, AEC-Q200 Grade 1, 0805	0805	GCM21BR72A104KA37L	MuRata
C2, C4	2	1uF	CAP, CERM, 1 μ F, 50V, +/- 20%, X7R, AEC-Q200 Grade 1, 0805	0805	GCJ21BR71H105MA01L	MuRata
H1, H2, H3, H4	4		Bumpon, Hemisphere, 0.44X 0.20, Clear	Transparent Bumpon	SJ-5303 (CLEAR)	3M
J1, J6	2		Header, 2.54mm, 2x1, Tin, TH	Header, 2.54mm, 2x1, TH	TSW-102-23T-S	Samtec
J2	1		Standard Banana Jack, insulated, 10A, red	571-0500	571-0500	DEM Manufacturing
J3, J8	2		Standard Banana Jack, insulated, 10A, black	571-0100	571-0100	DEM Manufacturing
J4	1		Standard Banana Jack, insulated, 10A, yellow	571-0700	571-0700	DEM Manufacturing
J5, J14	2		Header, 2.54mm, 3x1, Gold, TH	Header, 2.54mm, 3x1, TH	HMTSW-103-07G-S-240	Samtec
J9	1		Banana Jack Connector Standard Banana Solder Red	CONN_BANANA_JACK	FCR7350R	CLIFF Electronic Components
J10	1		Standard Banana Jack, insulated, 10A, white	571-0600	571-0600	DEM Manufacturing
J11	1		Banana Jack Connector Standard Banana Solder Black	CONN_BANANA_JACK	FCR7350B	CLIFF Electronic Components
R1, R2, R5	3	0	RES, 0, 5%, 0.125W, AEC-Q200 Grade 0, 0805	0805	ERJ-6GEY0R00V	Panasonic
SH-J1, SH-J2, SH-J3, SH-J4	4		Shunt, 2.54mm, Gold, Black	Shunt, 2.54mm, Black	60900213421	Wurth Elektronik
TP1, TP3, TP13, TP14	4		Test Point, Compact, Red, TH	Red Compact Testpoint	5005	Keystone Electronics
TP2, TP4	2		Test Point, Compact, Yellow, TH	Yellow Compact Testpoint	5009	Keystone Electronics
TP5, TP6, TP7, TP8, TP9, TP10, TP11, TP12	8		Test Point, Compact, Black, TH	Black Compact Testpoint	5006	Keystone Electronics
TP15, TP17	2		Test Point, Compact, White, TH	White Compact Testpoint	5007	Keystone Electronics
TP16, TP18	2		Test Point, Compact, Grey, TH	TestPoint, Grey, 220mil, TH	5123	Keystone Electronics
U1	1		INA151BDDFR	SOT-23	INA151BDDFR	Texas Instruments
C5, C6, C11, C13	0	0.1uF	CAP, CERM, 0.1 μ F, 100V, +/- 10%, X7R, AEC-Q200 Grade 1, 0805	0805	GCM21BR72A104KA37L	MuRata
C7, C10	0	0.1uF	CAP, CERM, 0.1 μ F, 500V, +/- 10%, X7R,		C1210X104KCRAC TU	Kemet
C8	0	1uF	CAP, CERM, 1 μ F, 100V, +/- 10%, X7R, 1206	1206	GRM31CR72A105KA01L	MuRata
C9, C12	0	100pF	CAP, CERM, 100pF, 50V, +/- 5%, C0G/NP0, 0805	0805	8.85012E+11	Wurth Elektronik

Table 3-1. Bill of Materials (continued)

Designator	Quantity	Value	Description	Package Reference	Part Number	Manufacturer
FID1, FID2, FID3	0		Fiducial mark. There is nothing to buy or mount.	N/A	N/A	N/A
J7, J12, J13	0		Connector, End launch SMA, 50ohm, SMT	SMA End Launch	142-0701-851	Cinch Connectivity
R3	0	0.1	RES, 0.1, 1%, 0.5W, AEC-Q200 Grade 1, 1206	1206	UR73V2BTTDR100F	KOA Speer
R4, R6, R7, R9	0	10.0k	RES, 10.0k, 0.1%, 0.125W, 0805	0805	RT0805BRD0710KL	Yageo America
R8	0	0	RES, 0, 5%, 0.125W, AEC-Q200 Grade 0, 0805	0805	ERJ-6GEY0R00V	Panasonic
U2	0		36V, Low Power, Precision, CMOS, Rail-to-Rail Input/Output, Low Offset Voltage, Low Input Bias Current Op Amp, DBV0005A (SOT-23-5)	DBV0005A	OPA191IDBVR	Texas Instruments

4 Additional Information

4.1 Trademarks

All trademarks are the property of their respective owners.

5 Related Documentation

5.1 Supplemental Content

For related documentation, see the following:

- Texas Instruments, [*INA151 120V, 120dB CMRR Voltage Monitoring Amplifier with Enable/Disable Function data sheet*](#)
- Texas Instruments, [*ANALOG-ENGINEER-CALC*](#)

STANDARD TERMS FOR EVALUATION MODULES

1. *Delivery:* TI delivers TI evaluation boards, kits, or modules, including any accompanying demonstration software, components, and/or documentation which may be provided together or separately (collectively, an "EVM" or "EVMs") to the User ("User") in accordance with the terms set forth herein. User's acceptance of the EVM is expressly subject to the following terms.
 - 1.1 EVMs are intended solely for product or software developers for use in a research and development setting to facilitate feasibility evaluation, experimentation, or scientific analysis of TI semiconductors products. EVMs have no direct function and are not finished products. EVMs shall not be directly or indirectly assembled as a part or subassembly in any finished product. For clarification, any software or software tools provided with the EVM ("Software") shall not be subject to the terms and conditions set forth herein but rather shall be subject to the applicable terms that accompany such Software
 - 1.2 EVMs are not intended for consumer or household use. EVMs may not be sold, sublicensed, leased, rented, loaned, assigned, or otherwise distributed for commercial purposes by Users, in whole or in part, or used in any finished product or production system.
- 2 *Limited Warranty and Related Remedies/Disclaimers:*
 - 2.1 These terms do not apply to Software. The warranty, if any, for Software is covered in the applicable Software License Agreement.
 - 2.2 TI warrants that the TI EVM will conform to TI's published specifications for ninety (90) days after the date TI delivers such EVM to User. Notwithstanding the foregoing, TI shall not be liable for a nonconforming EVM if (a) the nonconformity was caused by neglect, misuse or mistreatment by an entity other than TI, including improper installation or testing, or for any EVMs that have been altered or modified in any way by an entity other than TI, (b) the nonconformity resulted from User's design, specifications or instructions for such EVMs or improper system design, or (c) User has not paid on time. Testing and other quality control techniques are used to the extent TI deems necessary. TI does not test all parameters of each EVM. User's claims against TI under this Section 2 are void if User fails to notify TI of any apparent defects in the EVMs within ten (10) business days after delivery, or of any hidden defects with ten (10) business days after the defect has been detected.
 - 2.3 TI's sole liability shall be at its option to repair or replace EVMs that fail to conform to the warranty set forth above, or credit User's account for such EVM. TI's liability under this warranty shall be limited to EVMs that are returned during the warranty period to the address designated by TI and that are determined by TI not to conform to such warranty. If TI elects to repair or replace such EVM, TI shall have a reasonable time to repair such EVM or provide replacements. Repaired EVMs shall be warranted for the remainder of the original warranty period. Replaced EVMs shall be warranted for a new full ninety (90) day warranty period.

WARNING

Evaluation Kits are intended solely for use by technically qualified, professional electronics experts who are familiar with the dangers and application risks associated with handling electrical mechanical components, systems, and subsystems.

User shall operate the Evaluation Kit within TI's recommended guidelines and any applicable legal or environmental requirements as well as reasonable and customary safeguards. Failure to set up and/or operate the Evaluation Kit within TI's recommended guidelines may result in personal injury or death or property damage. Proper set up entails following TI's instructions for electrical ratings of interface circuits such as input, output and electrical loads.

NOTE:

EXPOSURE TO ELECTROSTATIC DISCHARGE (ESD) MAY CAUSE DEGRADATION OR FAILURE OF THE EVALUATION KIT; TI RECOMMENDS STORAGE OF THE EVALUATION KIT IN A PROTECTIVE ESD BAG.

3 Regulatory Notices:

3.1 United States

3.1.1 Notice applicable to EVMs not FCC-Approved:

FCC NOTICE: This kit is designed to allow product developers to evaluate electronic components, circuitry, or software associated with the kit to determine whether to incorporate such items in a finished product and software developers to write software applications for use with the end product. This kit is not a finished product and when assembled may not be resold or otherwise marketed unless all required FCC equipment authorizations are first obtained. Operation is subject to the condition that this product not cause harmful interference to licensed radio stations and that this product accept harmful interference. Unless the assembled kit is designed to operate under part 15, part 18 or part 95 of this chapter, the operator of the kit must operate under the authority of an FCC license holder or must secure an experimental authorization under part 5 of this chapter.

3.1.2 For EVMs annotated as FCC – FEDERAL COMMUNICATIONS COMMISSION Part 15 Compliant:

CAUTION

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

FCC Interference Statement for Class A EVM devices

NOTE: This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

FCC Interference Statement for Class B EVM devices

NOTE: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

3.2 Canada

3.2.1 For EVMs issued with an Industry Canada Certificate of Conformance to RSS-210 or RSS-247

Concerning EVMs Including Radio Transmitters:

This device complies with Industry Canada license-exempt RSSs. Operation is subject to the following two conditions:

(1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.

Concernant les EVMs avec appareils radio:

Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes: (1) l'appareil ne doit pas produire de brouillage, et (2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

Concerning EVMs Including Detachable Antennas:

Under Industry Canada regulations, this radio transmitter may only operate using an antenna of a type and maximum (or lesser) gain approved for the transmitter by Industry Canada. To reduce potential radio interference to other users, the antenna type and its gain should be so chosen that the equivalent isotropically radiated power (e.i.r.p.) is not more than that necessary for successful communication. This radio transmitter has been approved by Industry Canada to operate with the antenna types listed in the user guide with the maximum permissible gain and required antenna impedance for each antenna type indicated. Antenna types not included in this list, having a gain greater than the maximum gain indicated for that type, are strictly prohibited for use with this device.

Concernant les EVMs avec antennes détachables

Conformément à la réglementation d'Industrie Canada, le présent émetteur radio peut fonctionner avec une antenne d'un type et d'un gain maximal (ou inférieur) approuvé pour l'émetteur par Industrie Canada. Dans le but de réduire les risques de brouillage radioélectrique à l'intention des autres utilisateurs, il faut choisir le type d'antenne et son gain de sorte que la puissance isotope rayonnée équivalente (p.i.r.e.) ne dépasse pas l'intensité nécessaire à l'établissement d'une communication satisfaisante. Le présent émetteur radio a été approuvé par Industrie Canada pour fonctionner avec les types d'antenne énumérés dans le manuel d'usage et ayant un gain admissible maximal et l'impédance requise pour chaque type d'antenne. Les types d'antenne non inclus dans cette liste, ou dont le gain est supérieur au gain maximal indiqué, sont strictement interdits pour l'exploitation de l'émetteur

3.3 Japan

3.3.1 *Notice for EVMs delivered in Japan:* Please see http://www.tij.co.jp/lsts/ti_ja/general/eStore/notice_01.page 日本国内に輸入される評価用キット、ボードについては、次のところをご覧ください。

<https://www.ti.com/ja-jp/legal/notice-for-evaluation-kits-delivered-in-japan.html>

3.3.2 *Notice for Users of EVMs Considered "Radio Frequency Products" in Japan:* EVMs entering Japan may not be certified by TI as conforming to Technical Regulations of Radio Law of Japan.

If User uses EVMs in Japan, not certified to Technical Regulations of Radio Law of Japan, User is required to follow the instructions set forth by Radio Law of Japan, which includes, but is not limited to, the instructions below with respect to EVMs (which for the avoidance of doubt are stated strictly for convenience and should be verified by User):

1. Use EVMs in a shielded room or any other test facility as defined in the notification #173 issued by Ministry of Internal Affairs and Communications on March 28, 2006, based on Sub-section 1.1 of Article 6 of the Ministry's Rule for Enforcement of Radio Law of Japan,
2. Use EVMs only after User obtains the license of Test Radio Station as provided in Radio Law of Japan with respect to EVMs, or
3. Use of EVMs only after User obtains the Technical Regulations Conformity Certification as provided in Radio Law of Japan with respect to EVMs. Also, do not transfer EVMs, unless User gives the same notice above to the transferee. Please note that if User does not follow the instructions above, User will be subject to penalties of Radio Law of Japan.

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1. 電波法施行規則第6条第1項第1号に基づく平成18年3月28日総務省告示第173号で定められた電波暗室等の試験設備でご使用いただく。
2. 実験局の免許を取得後ご使用いただく。
3. 技術基準適合証明を取得後ご使用いただく。

なお、本製品は、上記の「ご使用にあたっての注意」を譲渡先、移転先に通知しない限り、譲渡、移転できないものとします。

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3.3.3 *Notice for EVMs for Power Line Communication:* Please see http://www.tij.co.jp/lsts/ti_ja/general/eStore/notice_02.page
電力線搬送波通信についての開発キットをお使いになる際の注意事項については、次のところをご覧ください。<https://www.ti.com/ja-jp/legal/notice-for-evaluation-kits-for-power-line-communication.html>

3.4 European Union

3.4.1 *For EVMs subject to EU Directive 2014/30/EU (Electromagnetic Compatibility Directive):*

This is a class A product intended for use in environments other than domestic environments that are connected to a low-voltage power-supply network that supplies buildings used for domestic purposes. In a domestic environment this product may cause radio interference in which case the user may be required to take adequate measures.

4 *EVM Use Restrictions and Warnings:*

- 4.1 EVMS ARE NOT FOR USE IN FUNCTIONAL SAFETY AND/OR SAFETY CRITICAL EVALUATIONS, INCLUDING BUT NOT LIMITED TO EVALUATIONS OF LIFE SUPPORT APPLICATIONS.
- 4.2 User must read and apply the user guide and other available documentation provided by TI regarding the EVM prior to handling or using the EVM, including without limitation any warning or restriction notices. The notices contain important safety information related to, for example, temperatures and voltages.
- 4.3 *Safety-Related Warnings and Restrictions:*
 - 4.3.1 User shall operate the EVM within TI's recommended specifications and environmental considerations stated in the user guide, other available documentation provided by TI, and any other applicable requirements and employ reasonable and customary safeguards. Exceeding the specified performance ratings and specifications (including but not limited to input and output voltage, current, power, and environmental ranges) for the EVM may cause personal injury or death, or property damage. If there are questions concerning performance ratings and specifications, User should contact a TI field representative prior to connecting interface electronics including input power and intended loads. Any loads applied outside of the specified output range may also result in unintended and/or inaccurate operation and/or possible permanent damage to the EVM and/or interface electronics. Please consult the EVM user 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, even with the inputs and outputs kept within the specified allowable ranges, some circuit components may have elevated case temperatures. These components include but are not limited to linear regulators, switching transistors, pass transistors, current sense resistors, and heat sinks, which can be identified using the information in the associated documentation. When working with the EVM, please be aware that the EVM may become very warm.
 - 4.3.2 EVMs are intended solely for use by technically qualified, professional electronics experts who are familiar with the dangers and application risks associated with handling electrical mechanical components, systems, and subsystems. User assumes all responsibility and liability for proper and safe handling and use of the EVM by User or its employees, affiliates, contractors or designees. User assumes all responsibility and liability to ensure that any interfaces (electronic and/or mechanical) between the EVM and any human body are designed with suitable isolation and means to safely limit accessible leakage currents to minimize the risk of electrical shock hazard. User assumes all responsibility and liability for any improper or unsafe handling or use of the EVM by User or its employees, affiliates, contractors or designees.
- 4.4 User assumes all responsibility and liability to determine whether the EVM is subject to any applicable international, federal, state, or local laws and regulations related to User's handling and use of the EVM and, if applicable, User assumes all responsibility and liability for compliance in all respects with such laws and regulations. User assumes all responsibility and liability for proper disposal and recycling of the EVM consistent with all applicable international, federal, state, and local requirements.

5. *Accuracy of Information:* To the extent TI provides information on the availability and function of EVMs, TI attempts to be as accurate as possible. However, TI does not warrant the accuracy of EVM descriptions, EVM availability or other information on its websites as accurate, complete, reliable, current, or error-free.

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