EVM User's Guide: INA630EVM

INA630 Evaluation Module

Description

The INA630EVM evaluation module (EVM) is designed to allow banana connections for 4.5V to 36V DC power-supplies. Input signal and output signal are also connected with banana connections. Gain on the EVM is set using 0805 discrete resistors or the RES11A resistor network. The voltage reference configuration is configured using a jumper or banana connections. Important signals also can be connected using test point connections.

Get Started

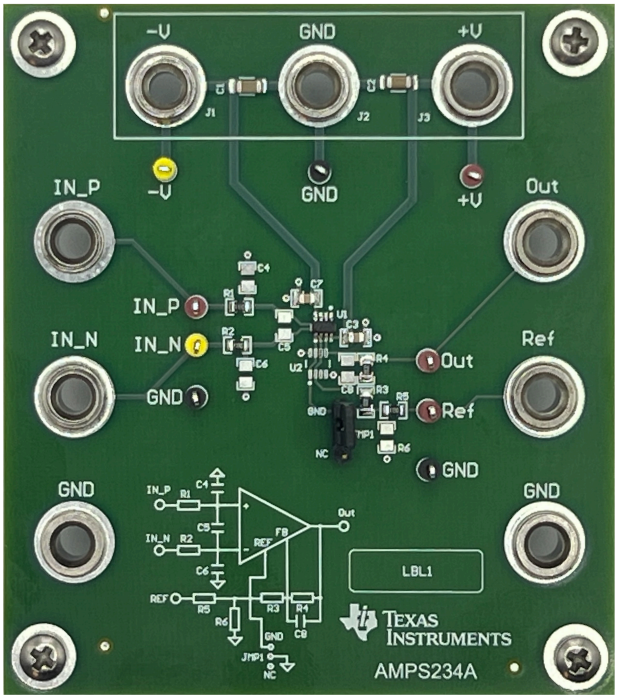
1. Order the INA630EVM from the tool page
2. Review INA630 data sheet for detailed device specification
3. Default gain is 201V/V. Solder different gain set resistors as needed
4. Connect power, input signals, and output equipment

Features

- Input, output and power connected with banana or test point
- Gain adjustment with standard 0805 resistor or RES11A network
- Optional input and output filters

Applications

- Battery cell formation and test equipment
- Flat panel display (FPD) shorting bar pattern generator
- Electrocardiogram (ECG)
- Weigh scale



INA630EVM

1 Evaluation Module Overview

1.1 Introduction

This user's guide contains information and support documentation for the INA630 evaluation module (EVM), included are the circuit description, jumper settings, required connections, printed circuit board (PCB) layout, schematic, and bill of materials of the INA630EVM. This document describes the input, output, and power connections for the INA630EVM. The user's guide also explains how to adjust the INA630 gain by soldering different gain set resistors on the PCB. Other features such as the input filter and reference connection is covered. Throughout this document, the terms *evaluation board*, *evaluation module*, and *EVM* are synonymous with the INA630EVM.

1.2 Kit Contents

This EVM kit includes:

- INA630EVM evaluation module
- EVM Disclaimer Read Me
- Antistatic foam

What is not included:

- 0805 resistors to adjust gain
- Cables for input, output, and power connections
- Test equipment for power, input signals, and output measurements

1.3 Specification

The INA630EVM provides a mechanism for connecting signal in and out of the INA630DDFR device. The printed circuit board (PCB) is 3.00 × 3.35 inch in size using FR4 material. The power supply, input, and output signals are connected using banana cables or mini-clips to test points. The gain is set with resistors on the PCB (default of 201V/V installed on the EVM).

1.4 Device Information

The INA630 is a high-precision instrumentation amplifier that offers low power consumption and operates over a wide single-supply or dual-supply range. The device offers a flexible gain setting from 20V/V to 1000V/V using two discrete resistors to set gain. The inputs include a built-in overvoltage protection of ±40V.

2 Hardware

2.1 EVM General Overview

The INA630 is a monolithic precision instrumentation amplifier that incorporates an indirect current-feedback architecture. The gain is set by the ratio of two external resistors for a gain range of 20V/V to 1000V/V. The ratio gain set method allows for very low gain drift when a TC matched resistor network is used. The device has high precision as a result of super-beta input transistors, which provide low input offset voltage, offset voltage drift, input voltage noise, and current noise. The indirect current feedback architecture offers low gain error and non-linearity and the reference pin impedance does not degrade the common-mode rejection (CMRR) performance. For a full list of electrical characteristics for the INA630, see the *INA630 Precision, Low-Power, Indirect Current Feedback Instrumentation Amplifier* data sheet.

Figure 3-1 shows the full schematic of the INA630EVM. The components marked with a red X are optional and not installed. The purpose of these components is explained in subsequent sections of this document.

2.2 Setup and Connections

A basic functional test that can be done without any modifications to the hardware is illustrated in Figure 2-1. The ±15V supply allows for a common-mode input range and output range of approximately ±13.25V. The input in the example has a common-mode voltage of 0V, and a differential voltage of ±50mV. The example input signal sets the output signal range to ±10.05V. To achieve good accuracy for this test a low noise precision input source needs to be used.

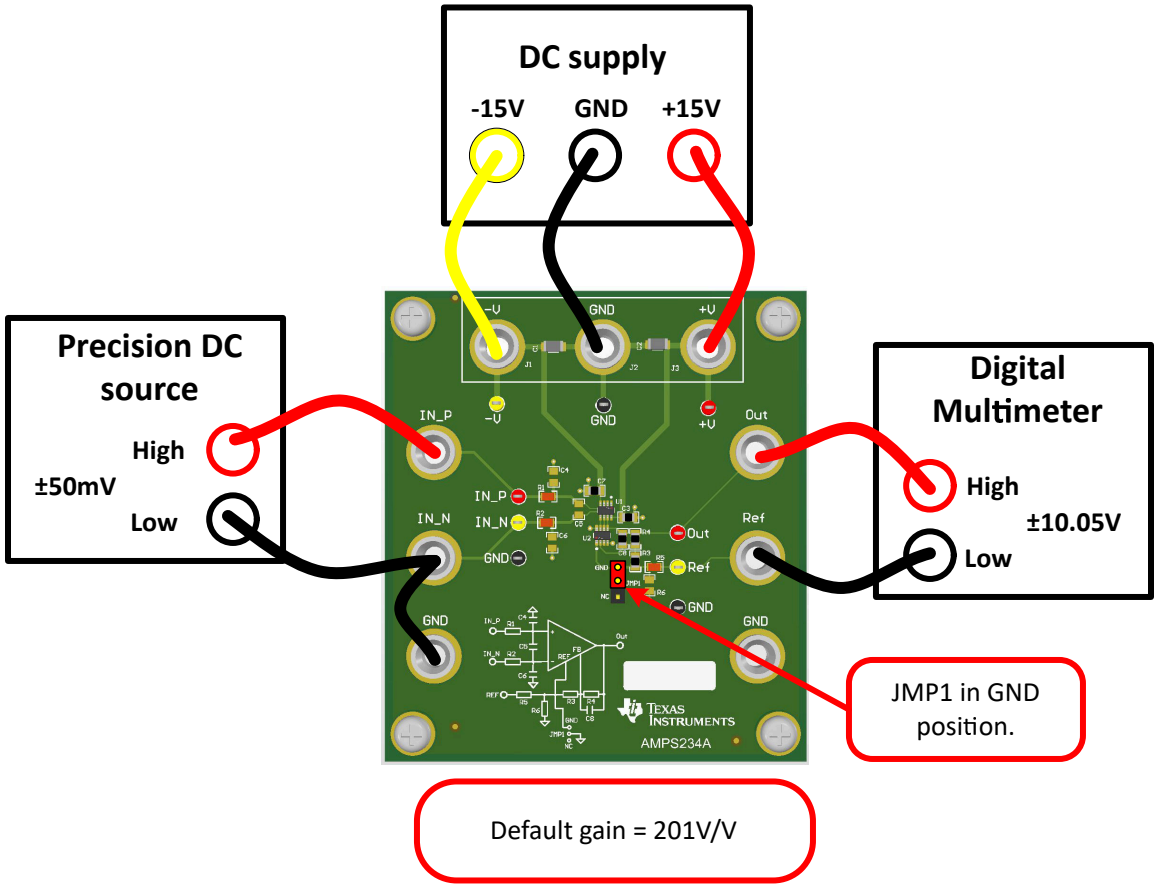


Figure 2-1. Initial Setup

Input capacitors can be added using C4, C5, and C6 to provide common-mode and differential filtering. The external filtering can help filter out common-mode and differential signals and noise. TI recommends to size C4 and C6 at the same magnitude, and C5 must be at least 10 times larger than C4 and C6 to prevent capacitor mismatch and increasing error contributions.

2.3 Power Requirements

The INA630 device allows for total power supply voltage from 4.5V to 36V. The board has connections for positive supply (+V), negative supply (–V), and ground (GND). The total supply voltage is the difference of the two supplies ((+V) – (–V)), so a ±15V supply has a total voltage of 30V (+15V – (–15V)). Bypass capacitors (C3 and C7) are populated on board. The device can be operated in single or dual supplies. The supply connection can be done either using a standard 4mm banana jack or connecting to power supply test points with mini-hook type connectors, both are not required. If using in single supply, connect both (–V) and GND to ground.

2.4 Jumper and Vref Input Information

The output of the INA630 is given by: Vout = Vin·Gain + Vref. When JMP1 is in the GND position, the INA630 REF pin is connected to GND (see Figure 2-2). When JMP1 is in the NC position the Ref input (J8) is used to apply and external reverence voltage (see Figure 2-3). By default R6 is not installed, so any signal applied to J8 is directly applied to the INA630 Vref pin. The resistors R5 and R6 can be used as a voltage divider to set the Vref signal (see Figure 2-4).

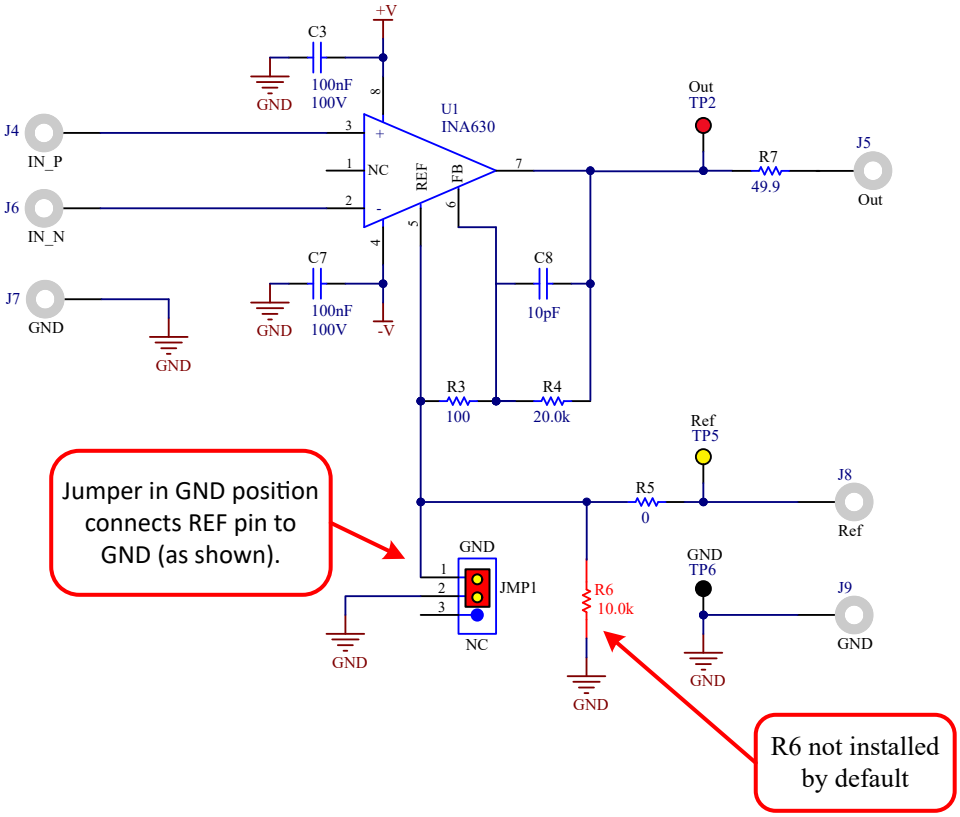


Figure 2-2. Jumper and REF Connection For Grounded REF pin

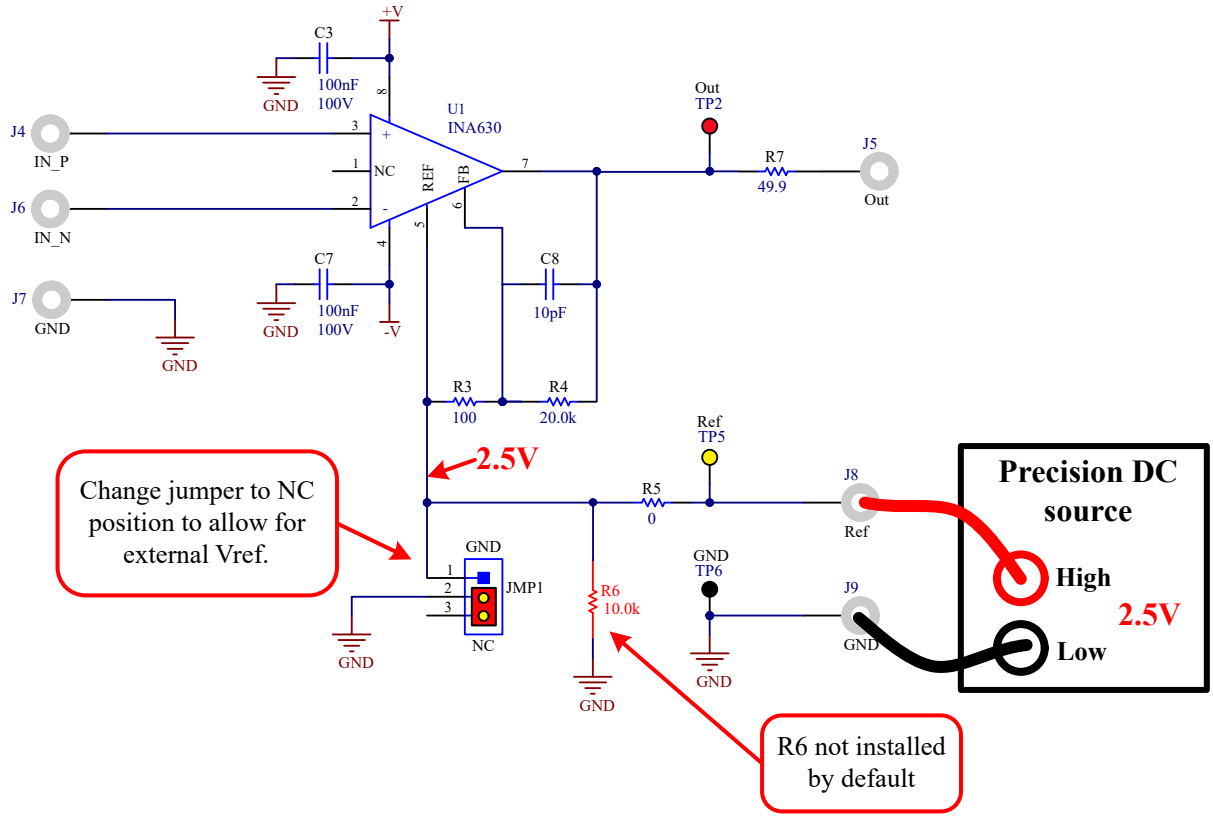


Figure 2-3. Jumper and REF Connection For External Signal Applied to REF Pin

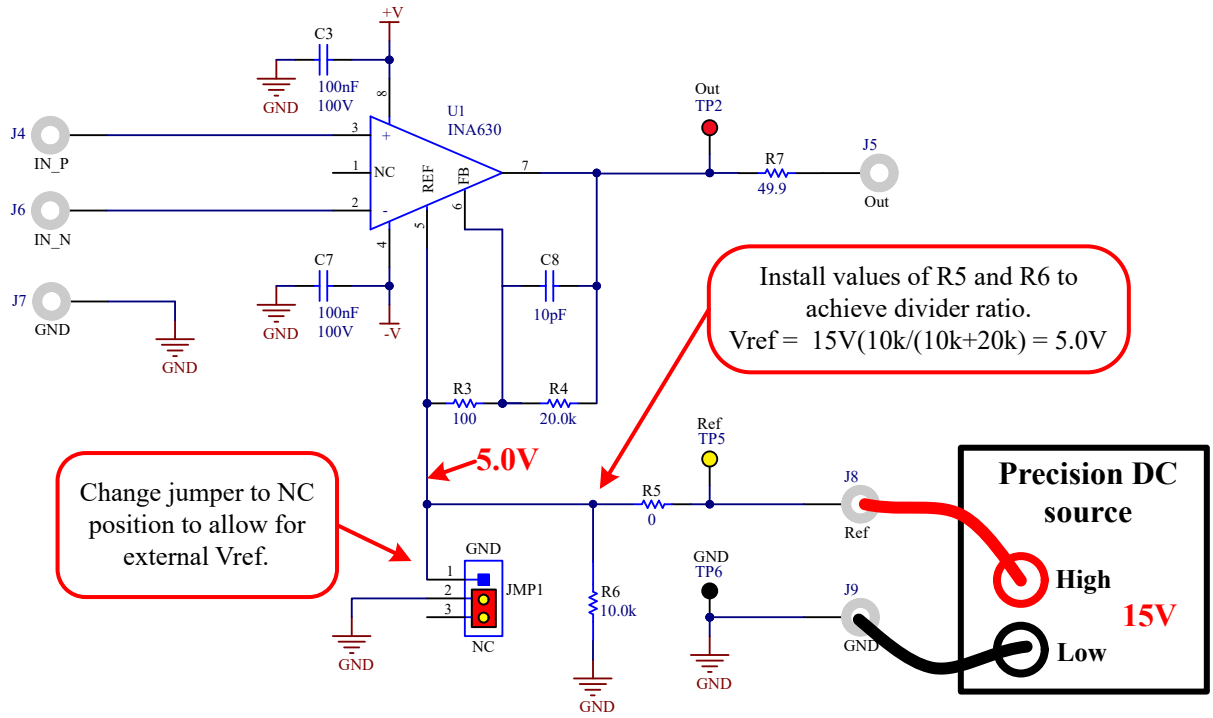


Figure 2-4. Jumper and REF Connection For Voltage Divider And External Signal Applied to REF Pin

2.5 Test Points

Test points are located on the inputs, outputs, and power supply connections. The test points can be used for monitoring signals or applying signals using mini-grabber type connectors. Test points are indicated on the schematic with the reference designator TP.

2.6 Adjusting INA630 Gain

The default gain of the INA630EVM is 201V/V (Gain = R4/R3 + 1 = 20k/100 + 1 = 201V/V). The gain can be adjusted by replacing R3 AND R4 (0805 footprint) with the desired resistor ratio. Example resistor ratios are listed in Table 2-1, and more information can be found in *Detailed Description* section of INA630 data sheet.

Table 2-1. Examples for Feedback Resistor Values (0.05%)

DESIRED GAIN	R_3 (Ω) (0.05%)	R_4 (Ω) (0.05%)	GAIN ERROR (WORST-CASE) (%)
20	1k	18.88k	0.5
50	1k	49.28k	0.28
80	1k	78.67k	0.23
100	1k	98.81k	0.09
120	1k	118.35k	0.54
150	1k	148.6k	0.24
200	1k	198.1k	0.4
500	1k	498.8k	0.01
1000	1k	1M	0.1

Alternatively, the gain can be set using the RES11A resistor network. This resistor network has the advantage of excellent ratio accuracy (0.05% maximum), and an excellent divider temperature coefficient (2ppm/°C maximum). Achieving this level of accuracy without using a matched resistor network is challenging. The RES11A package contains two resistor networks. To double the gain range the input resistors are placed in parallel (G = Rg/(Rin || Rin) + 1). The PCB location and wiring of the RES11A is shown in Figure 2-5.

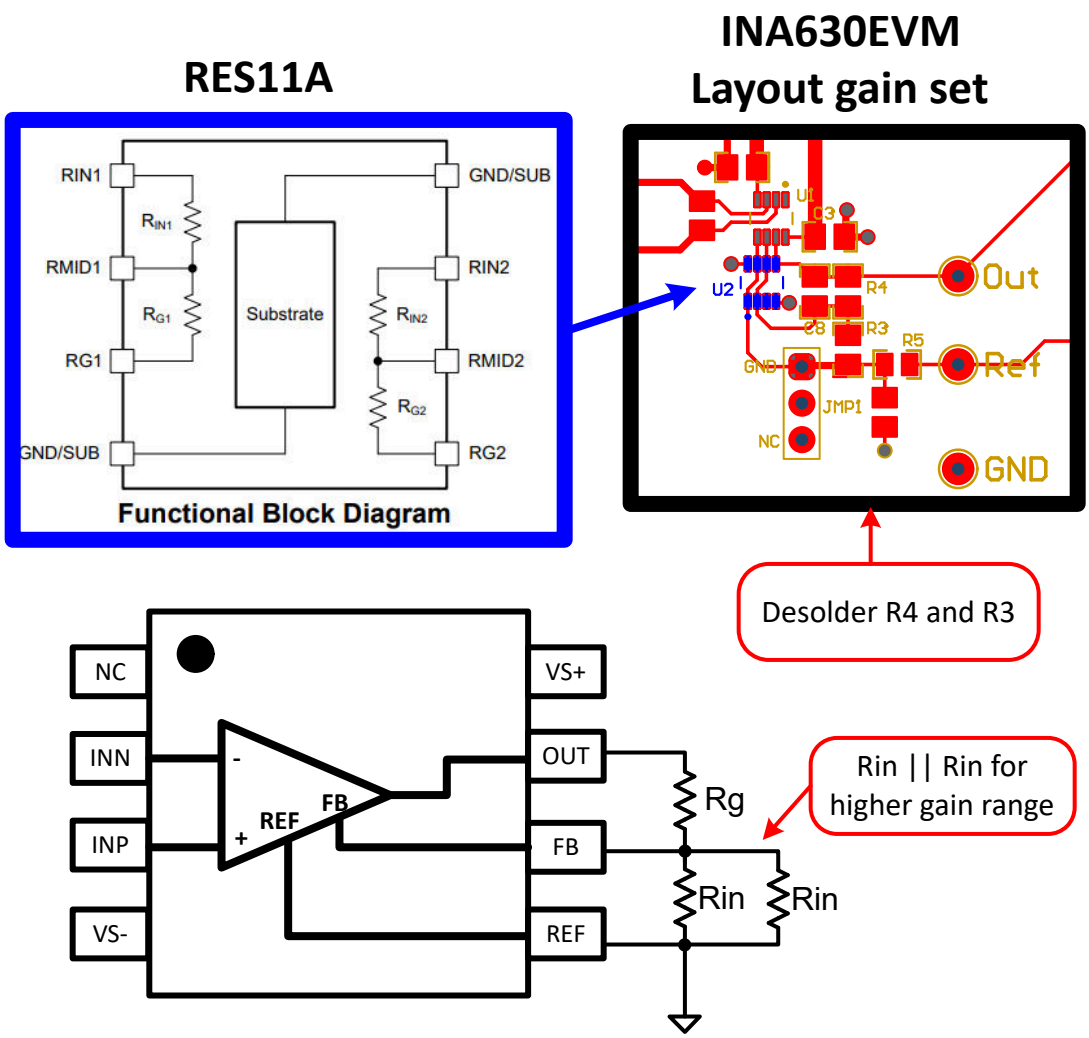


Figure 2-5. Using RES11A to Set Gain

3 Hardware Design Files

3.1 Schematics

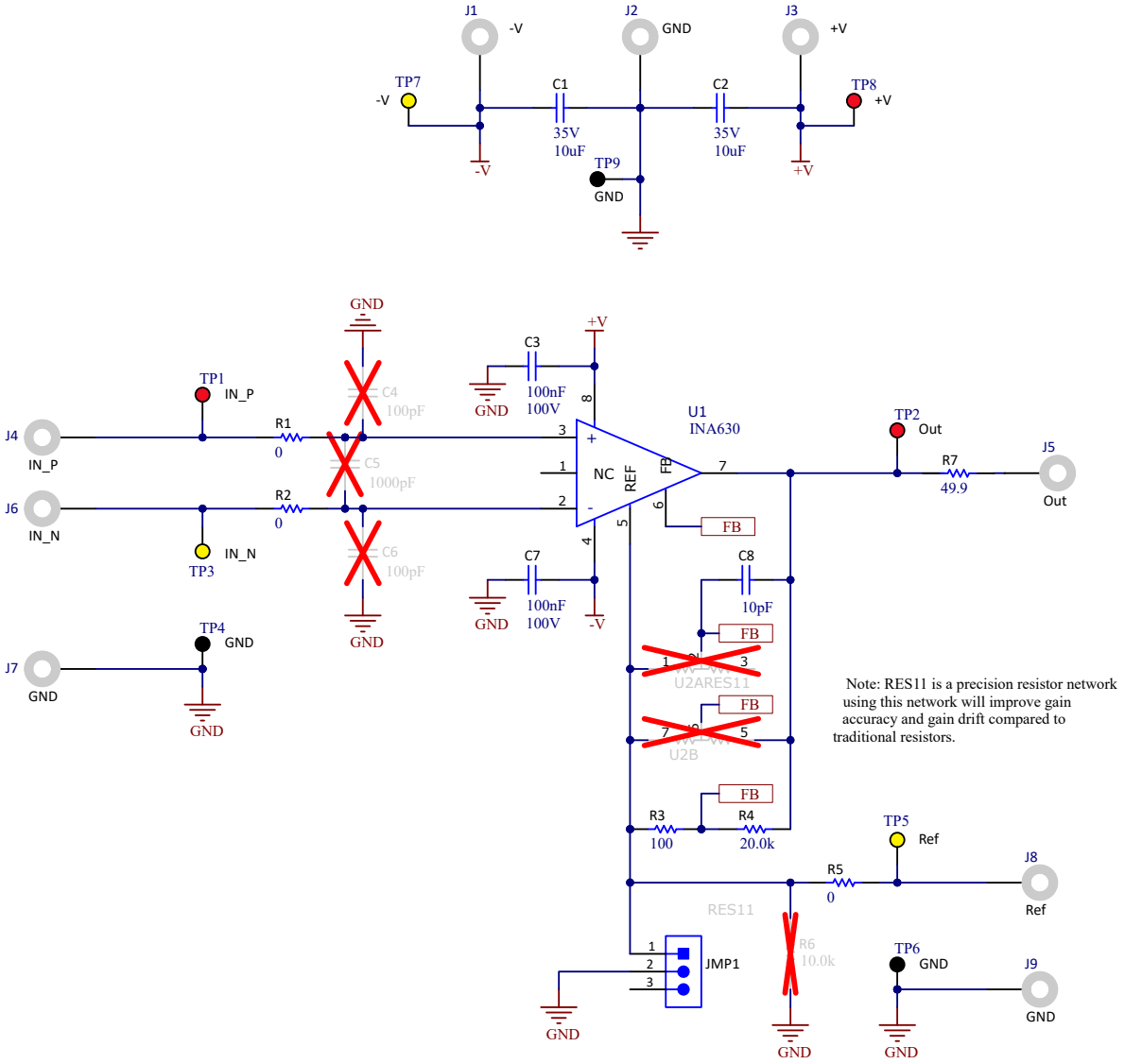


Figure 3-1. INA630EVM Schematic

3.2 PCB Layouts

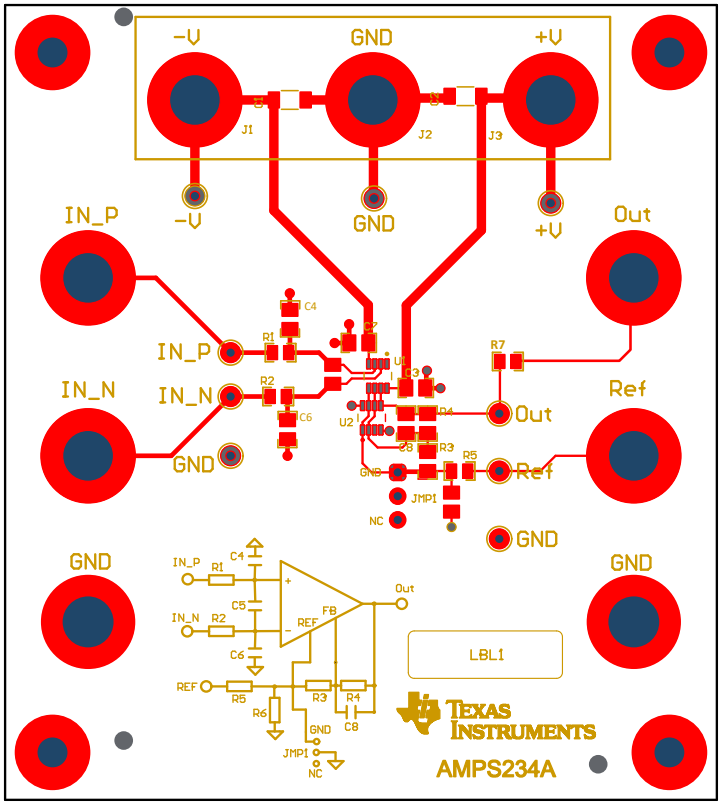


Figure 3-2. INA630EVM Layout (Top View)

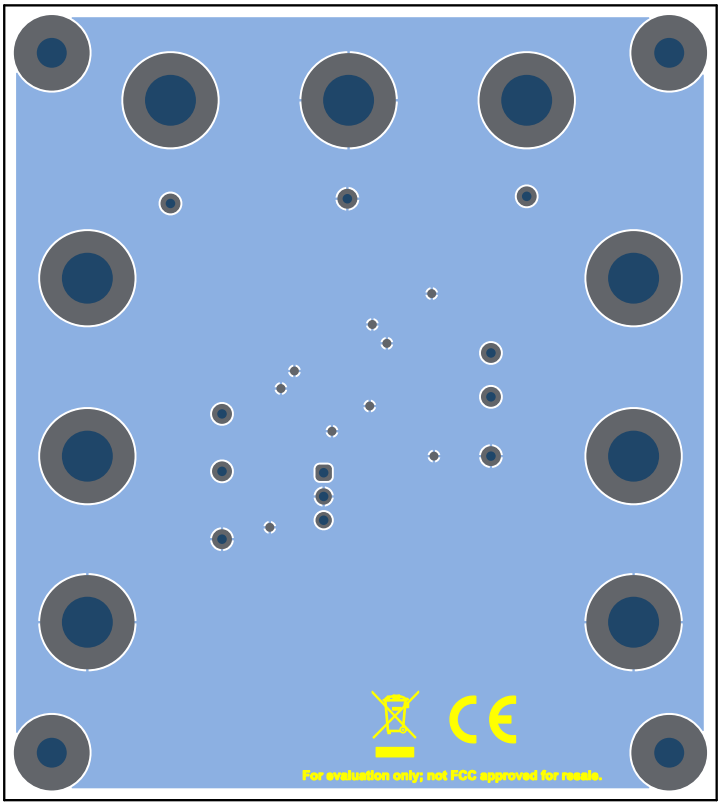


Figure 3-3. INA630EVM Layout (Bottom View)

3.3 Bill of Materials (BOM)

Table 3-1. Bill of Materials

Designator	Quantity	Value	Description	Part Number	Manufacturer
!PCB1	1		Printed Circuit Board	AMPS234	Any
C1, C2	2	10uF	CAP, CERM, 10uF, 35V, +/- 10%, X7R, AEC-Q200 Grade 1, 1206_190	CGA5L1X7R1V106K160AC	TDK
C3, C7	2	0.1uF	CAP, CERM, 0.1uF, 100V, +/- 10%, X7R, 0805	C2012X7R2A104K125AA	TDK
C8	1	10pF	CAP, CERM, 10pF, 250V, +/- 5%, C0G/NP0, 0805	GRM21A5C2E100JW01D	MuRata
H1, H2, H3, H4	4		Machine Screw, Round, #4-40 x 1/4, Nylon, Philips panhead	NY PMS 440 0025 PH	B&F Fastener Supply
H5, H6, H7, H8	4		Standoff, Hex, 0.5"L #4-40 Nylon	1902C	Keystone
J1, J2, J3, J4, J5, J6, J7, J8, J9	9		Standard Banana Jack, Uninsulated, 5.5mm	575-4	Keystone
JMP1	1		Header, 100mil, 3x1, Gold, TH	TSW-103-07-G-S	Samtec
LBL1	1		Thermal Transfer Printable Labels, 0.650" W x 0.200" H - 10,000 per roll	THT-14-423-10	Brady
R1, R2, R5	3	0	RES, 0, 1%, 0.5 W, 0805	5106	Keystone
R3	1	100	RES, 100, 0.1%, 0.125 W, 0805	RT0805BRD07100RL	Yageo America
R4	1	20.0k	RES, 20.0 k, 0.1%, 0.125 W, 0805	RT0805BRD0720KL	Yageo America
R7	1	49.9	RES, 49.9, 0.1%, 0.125 W, 0805	RT0805BRD0749R9L	Yageo America
TP1, TP2, TP8	3		Test Point, Miniature, Red, TH	5000	Keystone Electronics
SH-J1	1		Shunt, 2.54mm, Gold, Black	60900213421	Wurth Elektronik
TP3, TP5, TP7	3		Test Point, Miniature, Yellow, TH	5004	Keystone
TP4, TP6, TP9	3		Test Point, Miniature, Black, TH	5001	Keystone Electronics
U1	1		Precision, Low-Power, Indirect Current Feedback Instrumentation Amplifier	INA630	Texas Instruments
U2	0		Automotive, Low-Noise, Precision, Matched, Thin-Film Resistor Pairs	RES11A40QDDFRQ1	Texas Instruments
C4, C6	0	100pF	CAP, CERM, 100pF, 250V,+/- 5%, C0G/NP0, 0805	CL21C101JECNNWC	Samsung Electro-Mechanics
C5	0	1000pF	CAP, CERM, 1000pF, 50V, +/- 2%, C0G/NP0, 0805	08055A102GAT2A	AVX
FID1, FID2, FID3	0		Fiducial mark. There is nothing to buy or mount.	N/A	N/A
R6	0	10.0k	RES, 10.0 k, 0.1%, 0.2 W, AEC-Q200 Grade 0, 0805	MCU0805MD1002BP100	Vishay/Beyschlag

4 Additional Information

4.1 Trademarks

All trademarks are the property of their respective owners.

5 Revision History

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

Changes from Revision * (September 2024) to Revision A (June 2025)	Page
• Changed the default gain setting in the *Specification* section from: 101V/V to: 201V/V	2
• Updated the *Device Information* section to match the device data sheet	2
• Added capacitor recommendations to *Setup and Connections*	3
• Changed the quantity of U2 in the *Bill of Materials* table from: 1 to: 0	10
• Added shunt (SH-J1) to the *Bill of Materials* table	10

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   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 DEGREDATION 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 isotrope 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/lsds/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。
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3.3.3 *Notice for EVMs for Power Line Communication:* Please see http://www.tij.co.jp/lsds/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:*

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