INA827EVM

This user's guide describes the characteristics, operation, and use of the evaluation module (EVM) for the INA827. The EVM is designed to evaluate the performance of the device in both single- and dual-supply configurations. This document also includes the schematic, printed circuit board (PCB) layouts, and a complete bill of materials (BOM). Throughout this document the terms *evaluation board*, *evaluation module*, and *EVM* are synonymous with the INA827EVM.

Contents

List of Figures

1 Related Documentation from Texas Instruments

The following documents provide information regarding Texas Instruments' integrated circuits and support tools for the INA827EVM. This user's guide is available from the TI web site under literature number ***SBOU121***. 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, or call 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.

Related Documentation

Document	Literature Number
INA827 Product Data Sheet	SBOS631
OPA376 Product Data Sheet	SBOS406
OPA277 Product Data Sheet	SBOS079
OPA330 Product Data Sheet	SBOS432
OPA378 Product Data Sheet	SBOS417
REF3225 Product Data Sheet	SBVS058

2 Introduction and Overview

2.1 INA827

The INA827 is a low-power, wide-supply voltage instrumentation amplifier that can operate in both single- and dual-supply configurations. A single external resistor sets the gain from 5 to 1000. The device operates with a supply voltage between 2.7 V and 36 V, and is available in an MSOP-8 package.

2.2 INA827EVM

The INA827EVM is intended to provide basic functional evaluation of the INA827. It provides the following features:

- Intuitive evaluation with the silkscreen schematic
- Easy access to nodes with surface-mount test points
- Advanced evaluation with two prototype areas
- Reference voltage source flexibility
- Convenient input and output filtering

The schematic and component sides of the EVM are shown in Figure 1 and Figure 2, respectively.

NOTE: Board layouts are not to scale. These figures are intended to show how the board is laid out; they are not intended to be used for manufacturing INA827EVM PCBs.

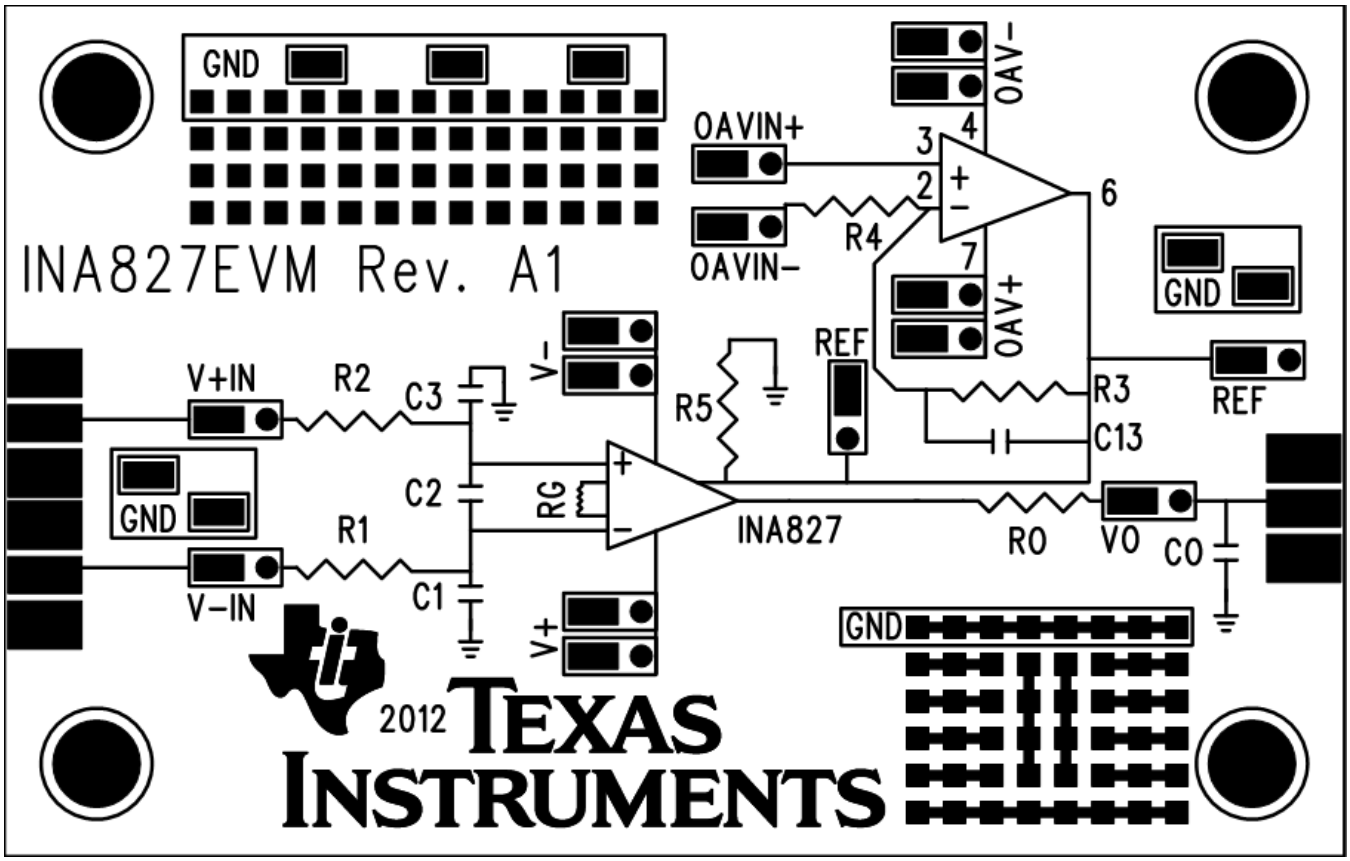

Figure 1. INA827EVM Schematic Side

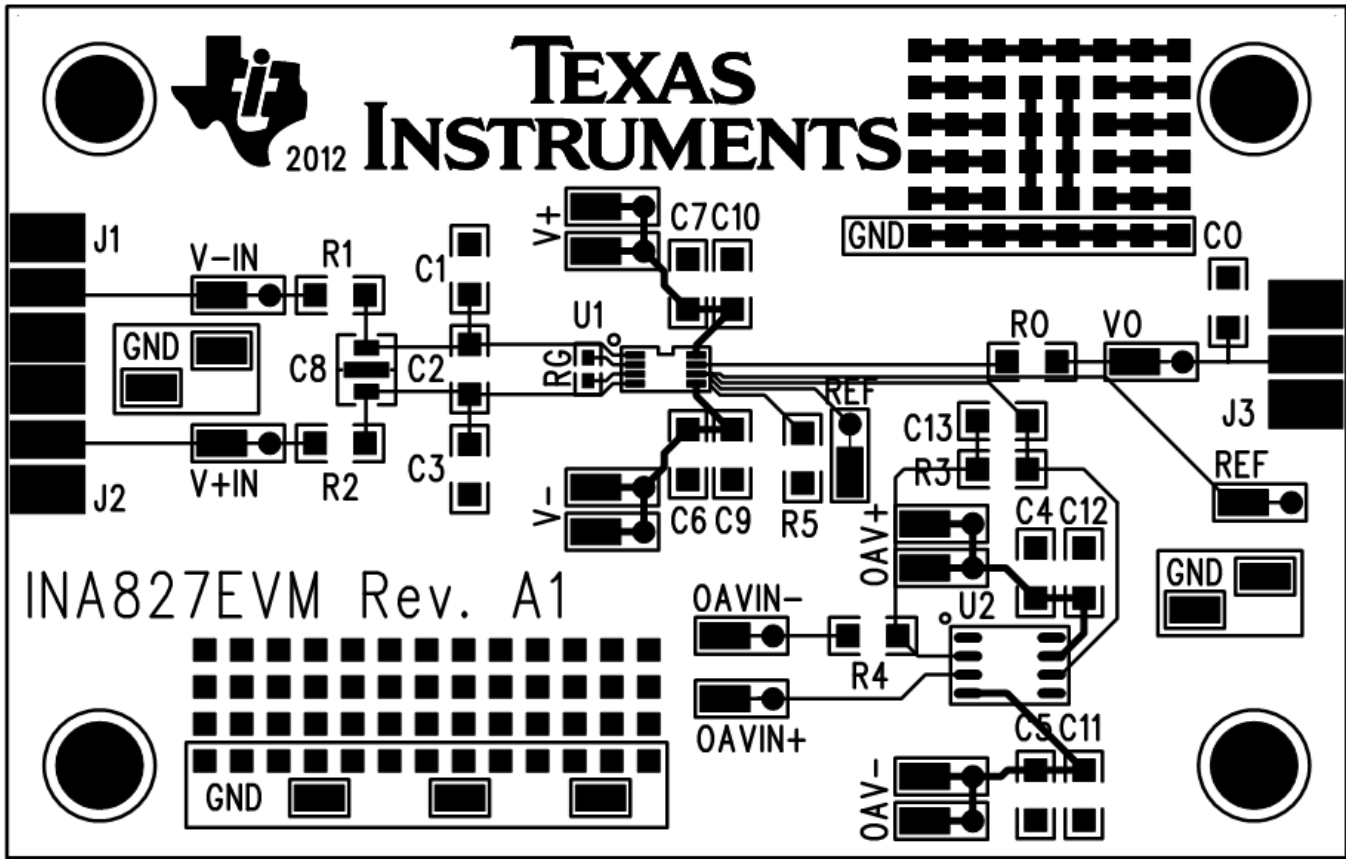

Figure 2. INA827EVM Component Side

3 Quick Start

The procedures presented in this section describe how to quickly set up and use the INA827EVM for evaluation in dual-supply and single-supply configurations.

3.1 Dual Supply

Make the following connections to set up the INA827EVM for dual-supply operation.

1. +15 V to V+ test point.
2. –15 V to V– test point.
3. Ground to REF test point or install a 0-Ω resistor in R5.
4. Differential input (for example, a 1-V_{PP} sine wave) to V–IN and V+IN test points.
5. Oscilloscope to VO test point.

Ensure that R1 = R2 = RO = 0 Ω and that R_G and CO are not populated. Figure 3 depicts a proper dual-supply configuration.

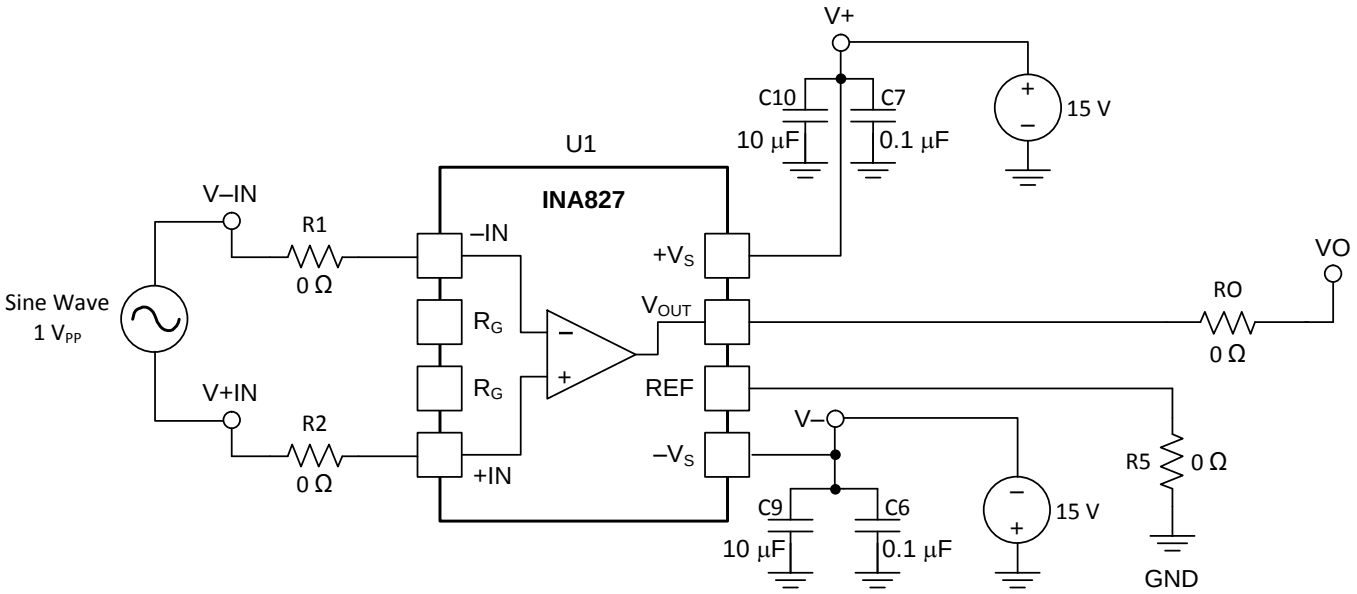

Figure 3. INA827EVM: Dual-Supply Configuration

3.2 Single Supply

Make the following connections to set up the INA827EVM for single-supply operation with a direct connection for the reference voltage.

1. +5 V to V+ test point.
2. GND to V– test point.
3. +2.5 V to REF test point.
4. Differential input (for example, a 0.1-V_{PP} sine wave) to V–IN and V+IN test points.
5. Oscilloscope to VO test point.

Ensure that R1 = R2 = RO = 0 Ω and that R_G , R5, and CO are not populated. Figure 4 depicts a proper single-supply configuration with a direct REF connection.

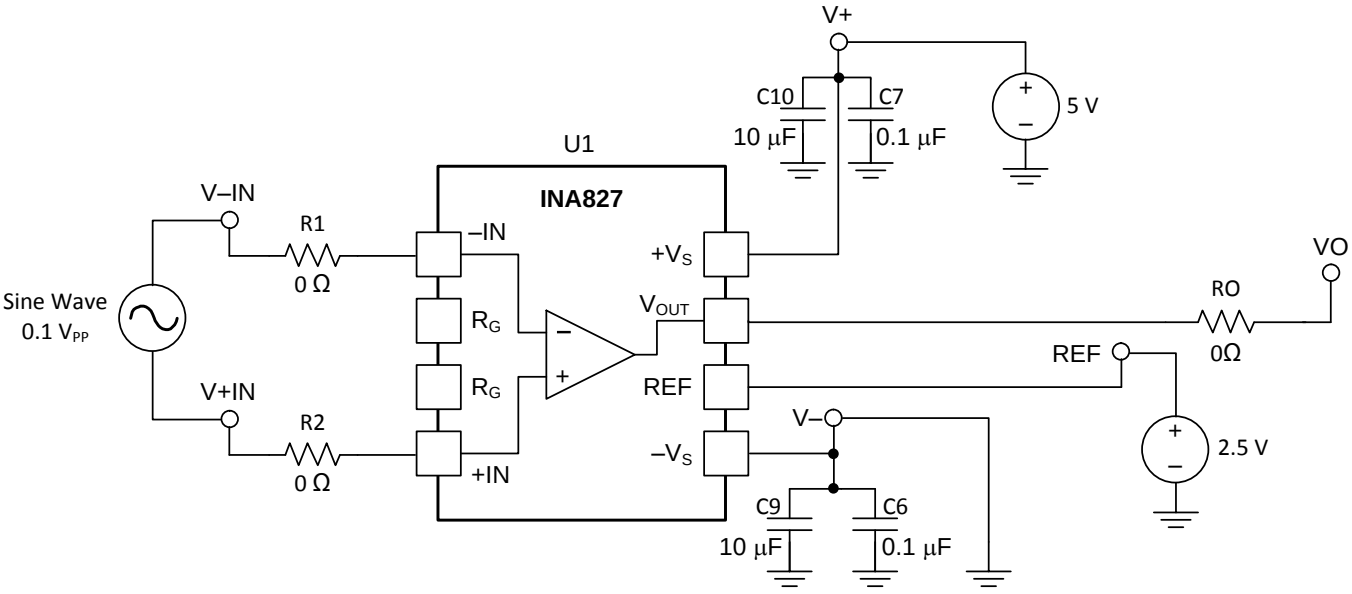

Figure 4. INA827EVM: Single-Supply Configuration, Direct REF Connection

Make the following connections to set up the INA827EVM for single-supply operation with a buffered reference voltage. This example uses an OPA376 as the buffer operational amplifier. Depending on the application, alternative single-supply buffer operational amplifiers include the OPA330 and OPA378. The OPA277 is a good choice for high-voltage applications. A buffered configuration is useful when the source impedance is high (for example, a voltage divider). Buffering a high-impedance source with an operational amplifier provides a low-impedance source, and thus preserves common-mode rejection.

1. +5 V to V+ and OAV+ test points.
2. GND to V– and OAV– test points.
3. +2.5 V to OAVIN+ test point.
4. Populate R3 with a 0-Ω resistor.
5. Populate C4, C5, C11, and C12 with bypass capacitors.
6. Differential input (for example, a 0.1-V_{PP} sine wave) to V–IN and V+IN test points.
7. Oscilloscope to VO test point.

Ensure that R1 = R2 = RO = 0 Ω and that R_G, CO, R4, and R5 are not populated. Figure 5 depicts a proper dual-supply configuration with a buffered REF voltage.

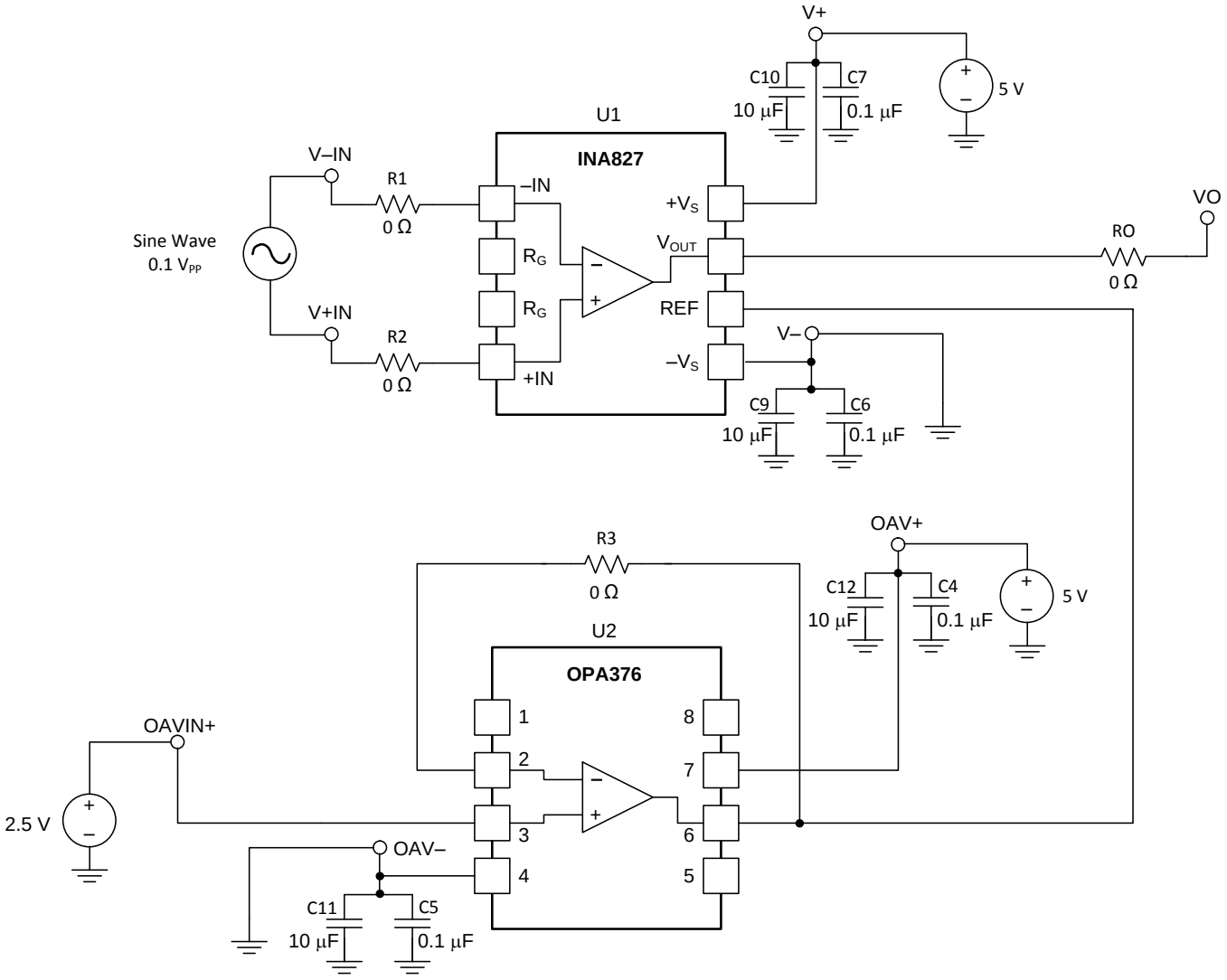

Figure 5. INA827EVM: Single-Supply Configuration, Buffered REF Connection

4 EVM Components

This section summarizes the INA827EVM components.

4.1 Power

Power is applied to the INA827 with test points V+ and V–. For the unpopulated device (U2), power is applied using test points OAV+ and OAV–.

4.2 Inputs

Inputs are applied to the INA827 using test points V+IN and V–IN. Alternately, they can be applied by populating the input SMA connectors (J1 and J2). The inputs for U2 are applied through test points OAVIN+ and OAVIN–.

4.2.1 Input Filtering

R1, R2, and C1 through C3 provide the ability to apply common-mode and differential-mode filtering to the inputs. The cutoff frequencies for the filters are shown in Equation 1 and Equation 2. It is recommended to make C2 approximately ten times larger than C1 and C3. These calculations presume R1 = R2 and C1 = C3.

Common-mode cutoff frequency:

$$f_{c-cm} = \frac{1}{2\pi \cdot R1 \cdot C1} \tag{1}$$

Differential-mode cutoff frequency:

$$f_{c-dm} = \frac{1}{2\pi(R1+R2)\left(C2+\frac{C1}{2}\right)} \tag{2}$$

4.3 Outputs

The output of the INA827 can be accessed with test point VO. Alternately, it can be accessed by populating the output SMA connector (J3).

4.3.1 Output Filtering

RO and CO provide the ability to apply a single-pole RC output filter. The cutoff frequency of the output filter can be calculated as shown in Equation 3.

$$f_{c-o} = \frac{1}{2\pi \cdot RO \cdot CO} \tag{3}$$

4.4 Reference

There are multiple methods of applying a reference voltage to the INA827. A straightforward approach is to apply a voltage to the REF test point with U2 not populated. If a buffered voltage is desired, U2 can be populated with an operational amplifier in an appropriate SO-8 package and pinout.

4.5 Prototype Area

Two prototype areas are provided for flexible evaluation. For example, they can be used to prototype a voltage divider for a buffered reference voltage or to supply a direct reference voltage with a device such as the REF3225.

4.6 Miscellaneous

C6, C7, C9, and C10 are the supply bypass capacitors for the INA827. Similarly, C4, C5, C11, and C12 can be populated to provide supply bypassing for U2. C8 is available for the use of an X2Y® capacitor.

5 Schematic

Figure 6 shows the schematic for the INA827EVM PCB.

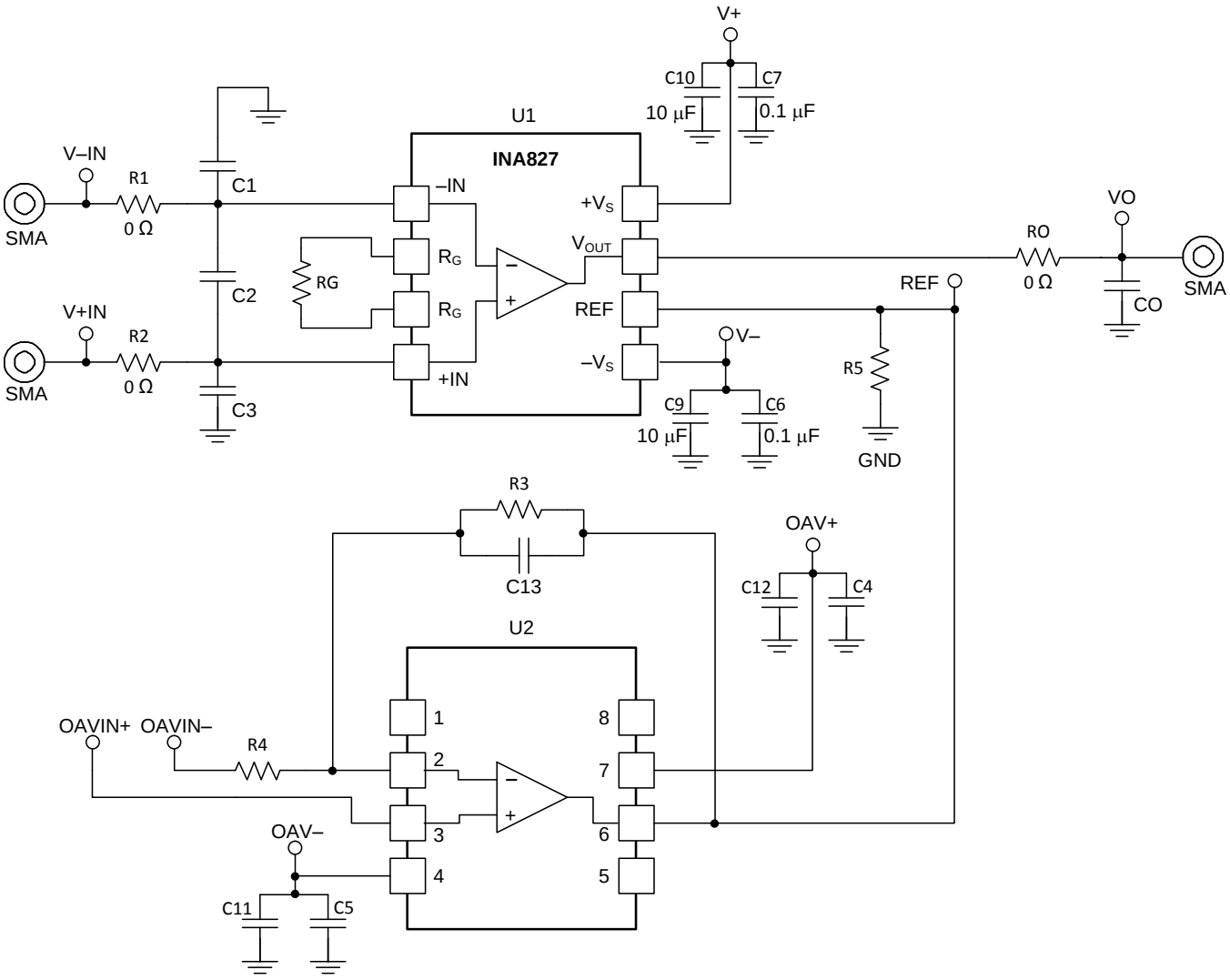

Figure 6. INA827EVM Schematic

6 Bill of Materials

Table 1 provides the parts list for the INA827EVM.

Table 1. INA827EVM Bill of Materials

Count	RefDes	Value	Description	Part Number	MFR
1	U1	N/A	INA827, MSOP-8	INA827AIDGK	Texas Instruments
3	R1, R2, RO	0 Ω	Resistor, 1/4W, 1206	RMCF1206ZT0R00	Stackpole Electronics
2	C9, C10	10 µF	Ceramic bypass capacitors, 50 V, X5R, 10%, 1206	GRM31CR61H106KA2L	Murata
2	C6, C7	0.1 µF	Ceramic bypass capacitors, 50 V, X7R, 20%, 1206	12065C104MAT2A	AVX Corporation
34	Various	N/A	Surface mount test points	5015	Keystone Electronics
8	N/A	N/A	Bumpon, cylindrical, 0.375 X 0.135, Black	SJ61A8	3M

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Exceeding the specified input range may cause unexpected operation and/or irreversible damage to the EVM. If there are questions concerning the input range, please contact a TI field representative prior to connecting the input power.

Applying loads outside of the specified output range may result in unintended operation and/or possible permanent damage to the EVM. Please consult the EVM User's 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, some circuit components may have case temperatures greater than +30°C. The EVM is designed to operate properly with certain components above +30°C as long as the input and output ranges are maintained. These components include but are not limited to linear regulators, switching transistors, pass transistors, and current sense resistors. These types of devices can be identified using the EVM schematic located in the EVM User's Guide. When placing measurement probes near these devices during operation, please be aware that these devices may be very warm to the touch.

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General Statement for EVMs including a radio

User Power/Frequency Use Obligations: This radio is intended for development/professional use only in legally allocated frequency and power limits. Any use of radio frequencies and/or power availability of this EVM and its development application(s) must comply with local laws governing radio spectrum allocation and power limits for this evaluation module. It is the user's sole responsibility to only operate this radio in legally acceptable frequency space and within legally mandated power limitations. Any exceptions to this are strictly prohibited and unauthorized by Texas Instruments unless user has obtained appropriate experimental/development licenses from local regulatory authorities, which is responsibility of user including its acceptable authorization.

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

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

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.

For EVMs annotated as IC – INDUSTRY CANADA Compliant

This Class A or B digital apparatus complies with Canadian ICES-003.

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

Concerning EVMs including radio transmitters

This device complies with Industry Canada licence-exempt RSS standard(s). 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.

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.

Cet appareil numérique de la classe A ou B est conforme à la norme NMB-003 du Canada.

Les changements ou les modifications pas expressément approuvés par la partie responsable de la conformité ont pu vider l'autorité de l'utilisateur pour actionner l'équipement.

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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.

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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.

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