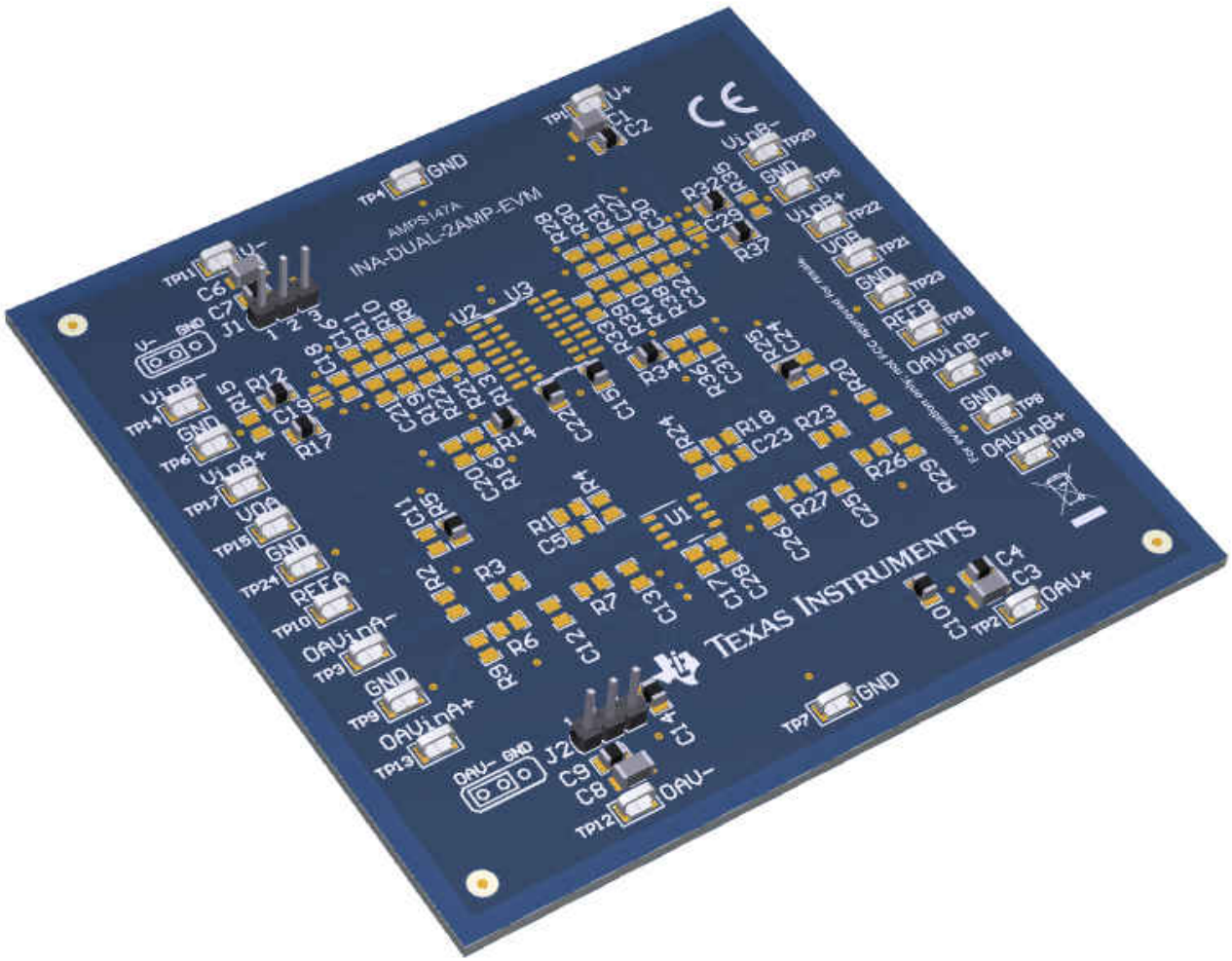
User's Guide

INA-DUAL-2AMP-EVM

TEXAS INSTRUMENTS

ABSTRACT



This user's guide describes the characteristics, operation, and use of the INA-DUAL-2AMP-EVM, an evaluation module (EVM) that is compatible with a variety of instrumentation amplifiers (INAs). This EVM is compatible with the SOIC-16 (D) and SOIC-16 (DW) INA packages, and is designed to evaluate the performance of the devices in both single-supply and dual-supply configurations. This document includes the schematic, printed circuit board (PCB) layouts, and BOM. Throughout this document the terms evaluation board, evaluation module, and EVM are synonymous with the INA-DUAL-2AMP-EVM.

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1 Overview

1.1 Features

This EVM is intended to provide basic functional evaluation of the instrumentation amplifiers shown in Table 1-1 with the pinout shown in Figure 1-1. The EVM provides the following features:

- Easy access to nodes with surface-mount test points
- Reference voltage source flexibility
- Convenient input and output filtering

1.2 INA Pinout

The INA-DUAL-2AMP-EVM evaluates INAs that have the pinout shown in Figure 1-1.

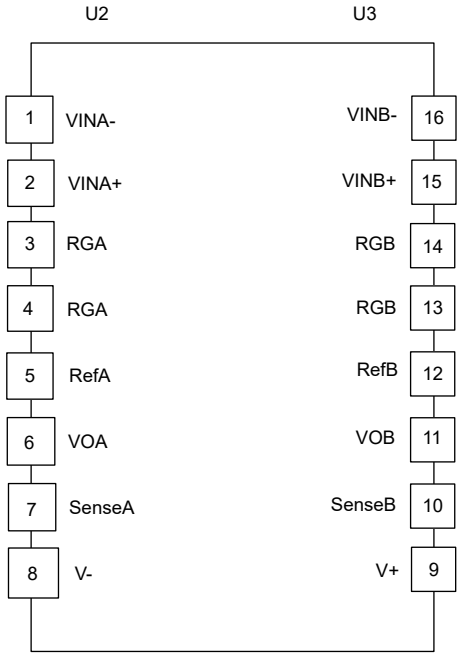

Figure 1-1. INA-DUAL-2AMP-EVM Pinout

1.3 Compatible Devices

Devices that are compatible with the INA-DUAL-2AMP-EVM are shown in Table 1-1.

Table 1-1. Compatible Devices

Device	Package
INA2126	SOIC (D)
INA2128	SOIC (DW)
INA2141	SOIC (DW)

2 Quick Start

2.1 Dual-Supply Configuration

Figure 2-1 shows an example of how to set up the EVM for dual-supply operation. These steps can be applied to channel A or channel B of the dual INA.

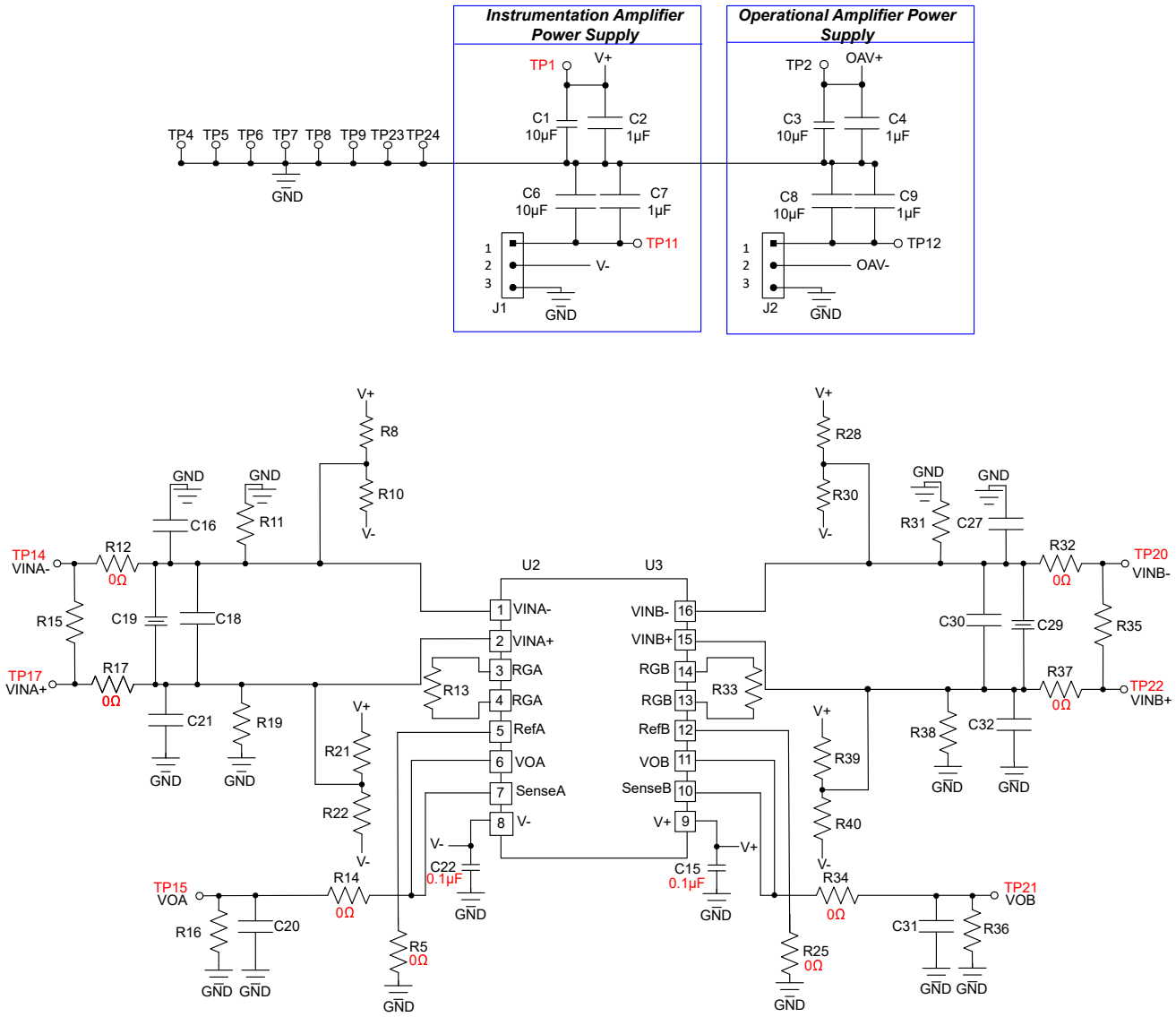

Figure 2-1. Dual-Supply Configuration

1. +VS to test point TP1
2. –VS to test point TP11
3. Install jumper shunt to position 1 and 2 on J1
4. Differential input signal connect to test points VinA– (TP14) and VinA+ (TP17) of channel A
   a. Differential input signal connect to test points VinB– (TP20) and VinB+ (TP22) of channel B
5. Observe output at test point VOA (TP15)
   a. Observe output at test point VOB (TP21)

Note

C15 and C22 are prepopulated with 0.1-µF power-supply decoupling capacitors. See the respective device data sheet for additional power-supply decoupling information.

2.2 Single-Supply Configuration

2.2.1 Direct Reference Connection

Figure 2-2 shows an example of how to set up the EVM for single-supply operation with a direct voltage connection to the reference pin.

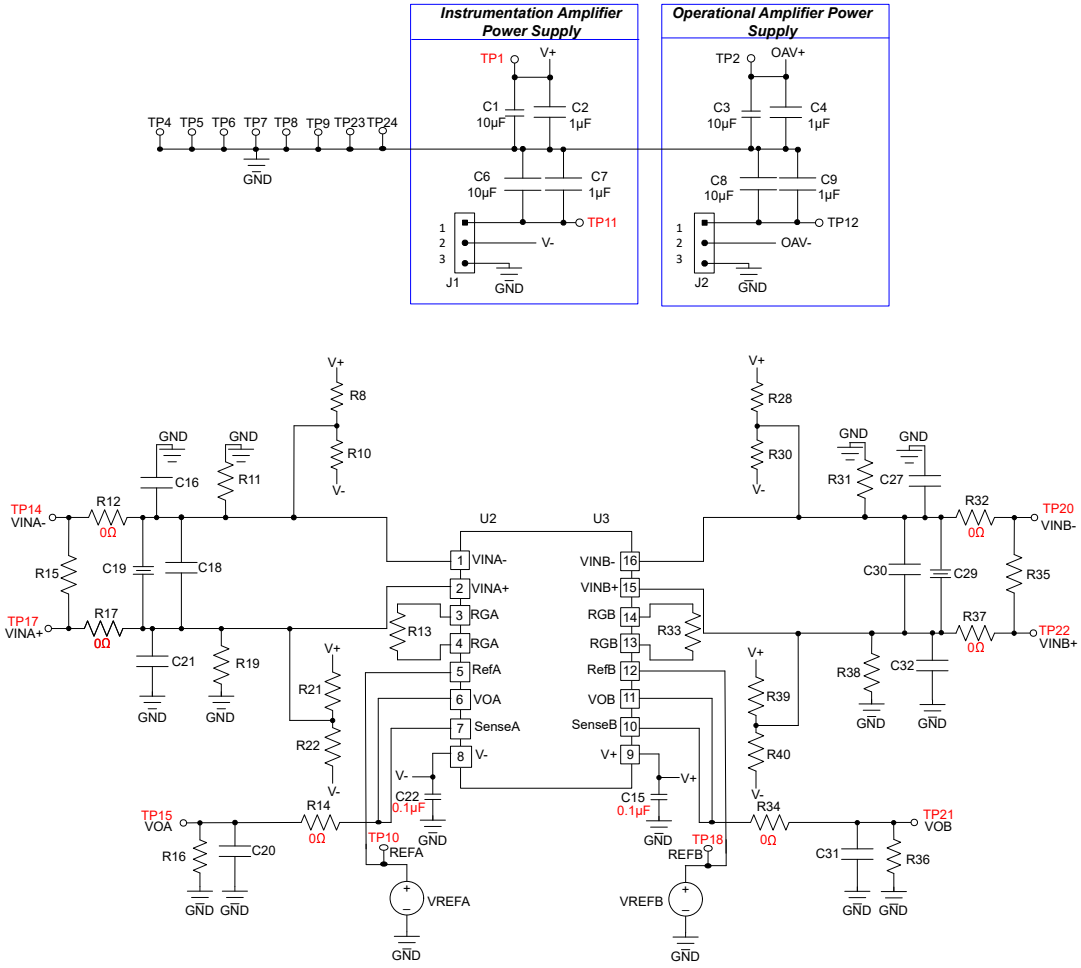

Figure 2-2. Single-Supply Configuration, Direct Reference Connection

1. +VS to test point TP1
2. GND to test point TP11
3. Install jumper shunt to positions 2 and 3 on J1
4. Remove resistor R5 for REFA
   a. Remove resistor R25 for REFB
5. Reference voltage to test point REFA (TP10)
   a. Reference voltage to test point REFB (TP18)
6. Differential input signal connect to test points VinA– (TP14) and VinA+ (TP17) of channel A
   a. Differential input signal connect to test points VinB– (TP20) and VinB+ (TP22) of channel B
7. Observe output at test point VOA (TP15)
   a. Observe output at test point VOB (TP21)

Note

C15 and C22 are prepopulated with 0.1-µF power-supply decoupling capacitors. C22 is not required to be removed for proper single-supply operation. See the respective device data sheet for additional power-supply decoupling information.

2.2.2 Buffered-Reference Voltage Connection

A buffered-reference 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 preserves common-mode rejection. Figure 2-3 shows an example of how to set up the EVM for single-supply operation with a buffered-reference voltage connection. Depending on the application, desirable single-supply buffer operational amplifiers include the OPA2330 and OPA2376. The OPA2202 is a good choice for high-voltage applications.

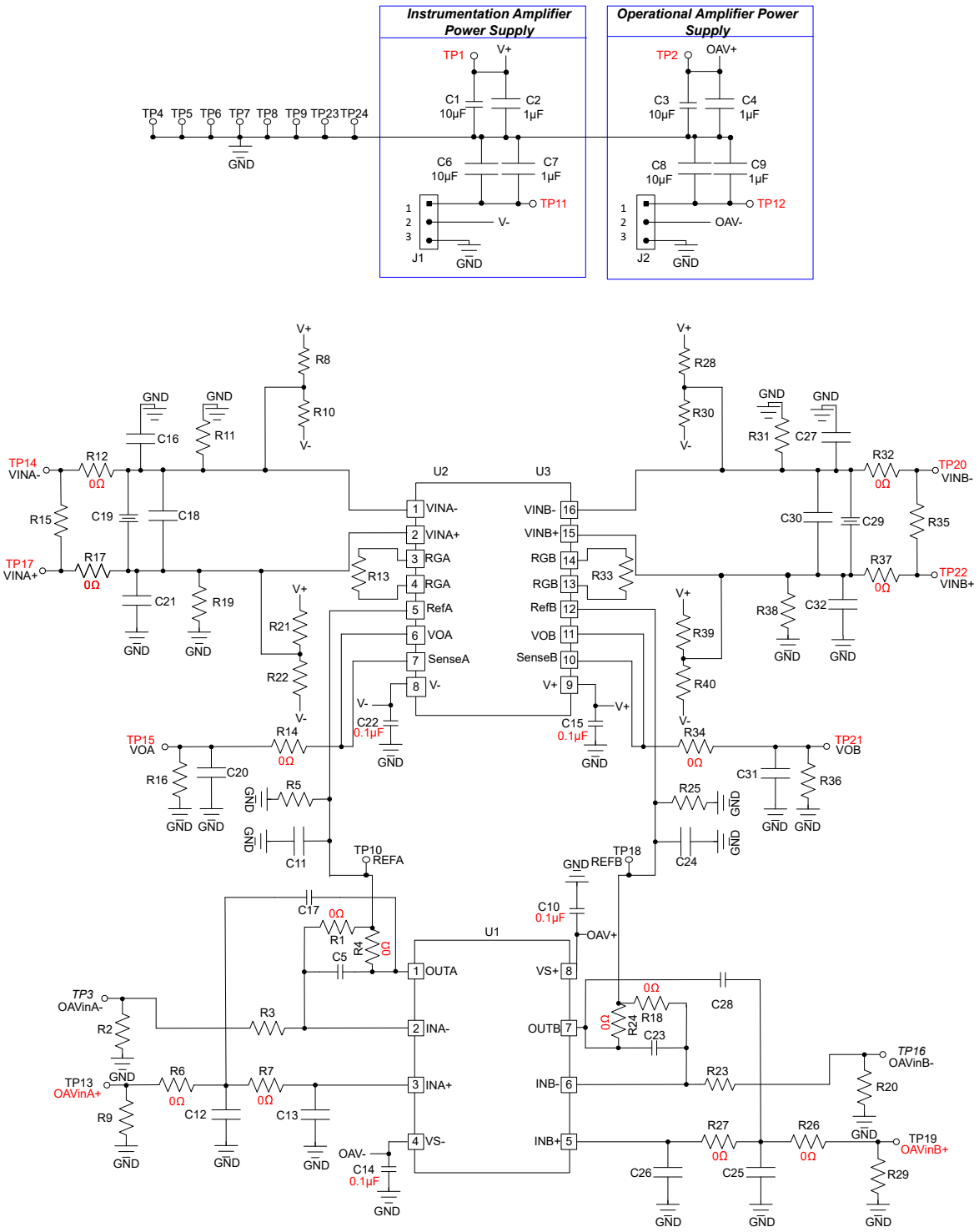

Figure 2-3. Single-Supply Configuration, Buffered Reference Connection

1. +VS to test point TP1
2. GND to test points TP11 AND TP12
3. OAV+ to test point TP2
4. Install jumper shunt on positions 2 and 3 on J1 and J2
5. Remove resistor R5 for REFA
   a. Remove resistor R25 for REFB
6. Populate R1, R4, R6, and R7 with a 0-Ω resistor for channel A
   a. Populate R18, R24, R26, and R27 with a 0-Ω resistor for channel B
7. Reference voltage to test point OAVinA+ (TP13)
   a. Reference voltage to test point OAVinB+ (TP19)
8. Differential input signal connect to test points VinA– (TP14) and VinA+ (TP17) of channel A
   a. Differential input signal connect to test points VinB– (TP20) and VinB+ (TP22) of channel B
9. Observe output at test point VOA (TP15)
   a. Observe output at test point VOB (TP21)

Note

C15 and C22 are prepopulated with 0.1-µF power-supply decoupling capacitors. C22 is not required to be removed for proper single-supply operation. See the respective device data sheet for additional power-supply decoupling information.

3 EVM Components

3.1 Power

Power is applied to the INA with test points TP1 and TP11. For the unpopulated operation amplifier used for the reference voltage circuitry (U1), power is applied using test points TP2 and TP12.

3.2 Inputs

Inputs are applied to the INA using test points TP14 and TP17 for channel A, and TP20 and TP22 for channel B. The inputs for the op amp are applied through test points TP3 and TP13 for REFA, and TP16 and TP19 for REFB. To maintain linear operation, the INA must remain within the common mode voltage range with respect to the power supplies and differential inputs. A useful tool to calculate whether the INA is operating within safe limits can be found in the TI's Analog Engineer's Calculator. Click the + symbol next to *Amplifier and Comparators* and then click on *INA VCM v VOUT.*

3.2.1 Input Filtering

Components R12, R17, and C16, C18, C21 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. Make C18 approximately ten times larger than C16 and C21. These calculations presume R12 = R17 and C16 = C21. The correlating resistors and capacitors provide input filtering for channel B.

Common-mode cutoff frequency:

$$f_{c-cm} = \frac{1}{2\pi \times R12 \times C16} \tag{1}$$

Differential-mode cutoff frequency:

$$f_{c-dm} = \frac{1}{2\pi \times (R12+R17) \times (C18+\frac{C16}{2})} \tag{2}$$

3.3 Output

Access the output of the device, with test point TP15 for channel A, and TP21 for channel B.

3.3.1 Output Filtering

Components R14 and C20 provide the ability to apply a single-pole RC output filter. The cutoff frequency of the output filter is calculated as shown in Equation 3. The correlating resistor and capacitor provide output filtering for channel B.

$$f_{c-o} = \frac{1}{2\pi \times R14 \times C20} \tag{3}$$

3.4 Reference

There are multiple methods of applying a reference voltage to the device. A straightforward approach is to apply a voltage to test point TP10 (TP18) with U1 and R5 (R25) not populated. If a buffered voltage is desired, U1 can be populated with an operational amplifier in an appropriate SOIC-8 (D) package and pinout. If the reference voltage is GND, R5 (R25) is populated with a 0-Ω resistor.

Reference voltage circuitry on the board provides numerous options for biasing the corresponding reference pins. The EVM layout allows for many configurations to bias the reference pin, such as:

- Sallen-Key 2nd-order filter
- Buffer configuration
- Inverting and noninverting gain configurations
- 1st-order filtering at the noninverting input and feedback path
- RISO + dual feedback stability compensation scheme

3.5 Miscellaneous

C1, C2, C6, and C7 are the populated bypass capacitors for the device, U2 and U3.

Similarly, C3, C4, C8 and C9 are populated to provide supply bypassing for U1.

C19 and C29 can be used with an X2Y® capacitor.

4 Schematic, PCB Layout, and Bill of Materials

4.1 Schematic

The schematic for the PCB for the INA-DUAL-2AMP-EVM is shown in Figure 4-1.

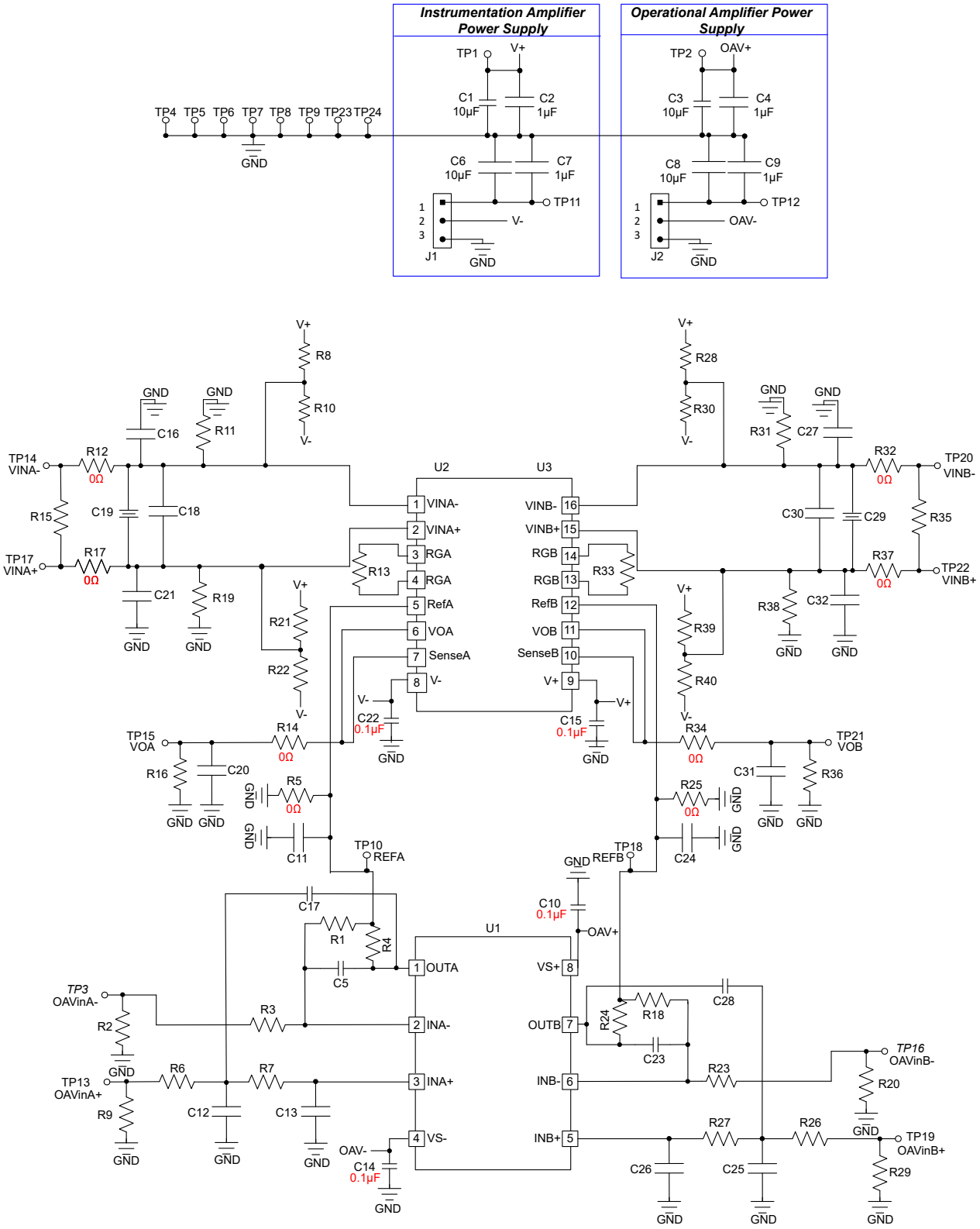

Figure 4-1. INA-DUAL-2AMP-EVM Schematic

4.2 PCB Layout

The component PCB layout for the INA-DUAL-2AMP-EVM is shown in Figure 4-2.

Note

Figure 4-2 is intended to show how the board is laid out; it is not intended to be used for manufacturing PCBs.

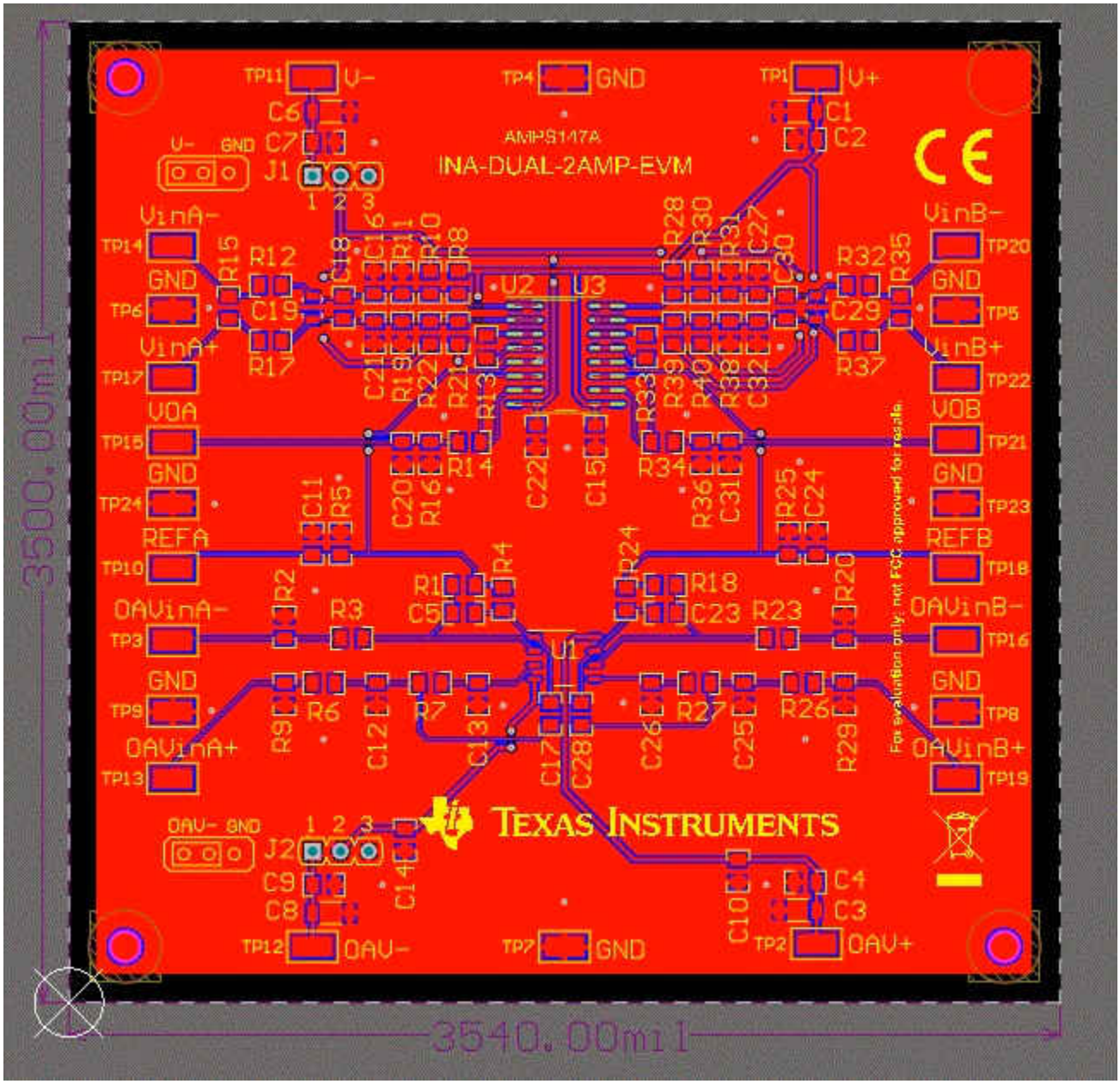

Figure 4-2. INA-DUAL-2AMP-EVM PCB

4.3 Bill of Materials

Table 4-1 provides the parts list for the EVM.

Table 4-1. INA-DUAL-2AMP-EVM Bill of Materials

Designator	Qty	Value	Description	Package Reference	Part Number	Manufacturer
C1, C3, C6, C8	4	10 µF	CAP, CERM, 10 uF, 35 V, +/- 10%, X7R, 1206	1206	C3216X7R1V106K160AC	TDK
C2, C4, C7, C9	4	1 µF	CAP, CERM, 1 uF, 100 V, +/- 10%, X7S, 0805	0805	C2012X7S2A105K125AB	TDK
C10, C14, C15, C22	4	0.1 µF	CAP, CERM, 0.1 uF, 50 V, +/- 10%, X7R, 0805	0805	08055C104KAT2A	AVX
H1, H2, H3, H4	4		Bumpon, Hemisphere, 0.25 X 0.075, Clear	75x250 mil	SJ5382	3M
J1, J2	2		Header, 2.54mm, 3x1, Tin, TH	Header, 2.54mm, 3x1, TH	68001-403HLF	FCI
R5, R12, R14, R17, R25, R32, R34, R37	8	0	RES, 0, 5%, 0.125 W, 0805	0805	RC0805JR-070RL	Yageo America
SH-J1, SH-J2	2	1 x 2	Shunt, 100mil, Gold plated, Black	Shunt	382811-6	AMP
TP1, TP2, TP3, TP4, TP5, TP6, TP7, TP8, TP9, TP10, TP11, TP12, TP13, TP14, TP15, TP16, TP17, TP18, TP19, TP20, TP21, TP22, TP23, TP24	24		Test Point, Miniature, SMT	Test Point, Miniature, SMT	5019	Keystone

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