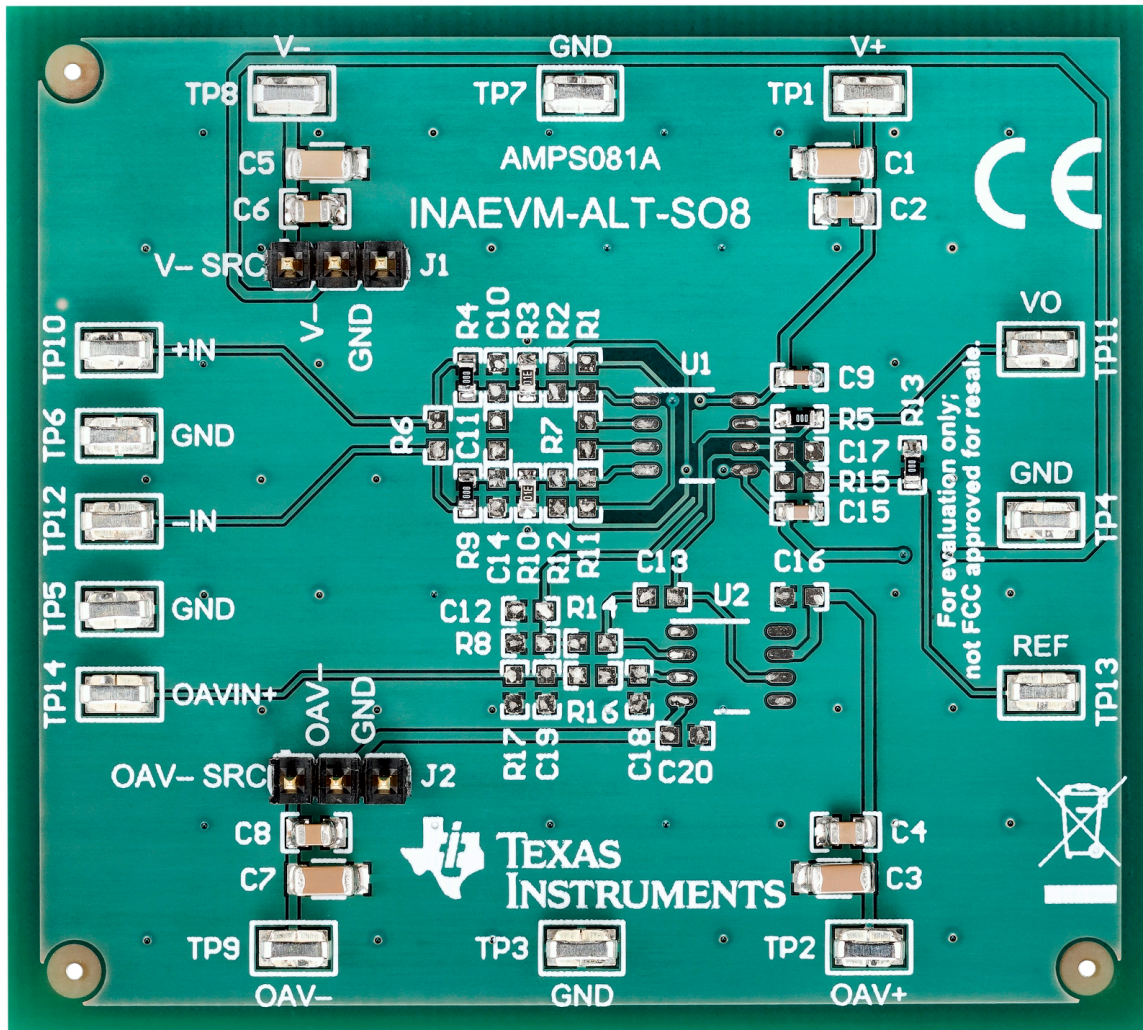




# THE DATASHEET OF INAEVM-ALT-S08



# Universal Instrumentation Amplifier Evaluation Module: Alternate Pinout



This user's guide describes the characteristics, operation, and use of the INAEVM-ALT-SO8, a universal evaluation module (EVM) that is compatible with a variety of instrumentation amplifiers (INAs), specifically those with the resistor gain pins at pins 2 and 3. This EVM is compatible with the SOIC-8 (D) package, 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) layout, and BOM. Throughout this document the terms evaluation board, evaluation module, and EVM are synonymous with the universal INAEVM-ALT-SO8.

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## 1 Overview

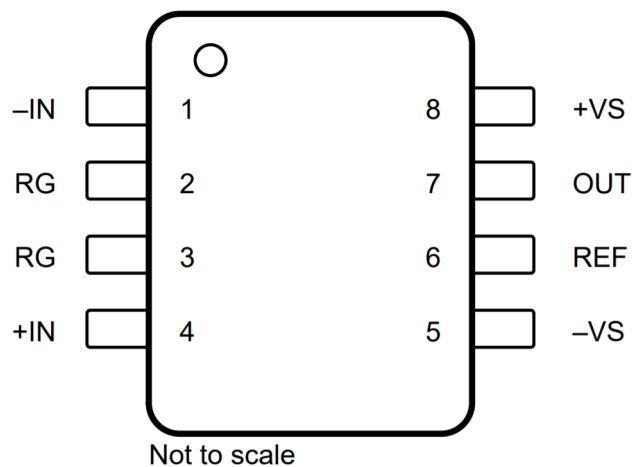
### 1.1 Features

This EVM is intended to provide basic functional evaluation of the instrumentation amplifiers with the pinout shown in [Figure 1](#). The EVM provide the following features:

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

### 1.2 INA Pinout

The INAEVM-ALT-SO8 is evaluates INAs that have the pinout shown in [Figure 1](#), specifically those with the gain resistor pins at positions 2 and 3.

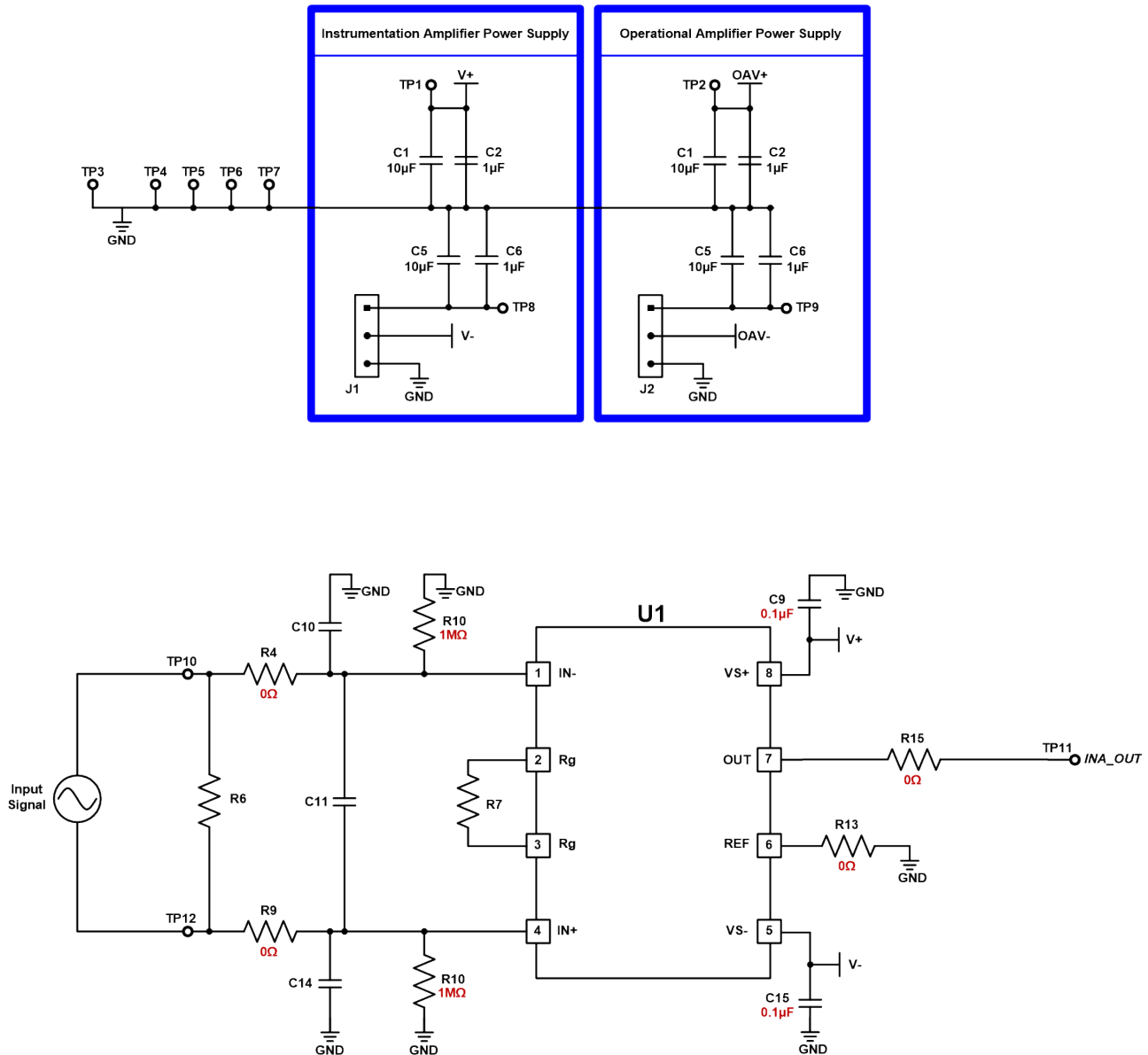


**Figure 1. Universal INAEVM-ALT-SO8 Pinout**

## 2 Quick Start

### 2.1 Dual-Supply Configuration

Figure 2 shows an example of how to set up the EVM for dual-supply operation.



**Figure 2. Dual-Supply Configuration**

1. +VS to test point TP1
2. -VS to test point TP8
3. Install jumper shunt to position 1 and 2 on J1
4. Differential input signal connect to test points TP10 and TP12
5. Observe output at test point TP11

**NOTE:** C9 and C15 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 3 shows an example of how to set up the EVM for single-supply operation with a direct voltage connection to the reference pin.

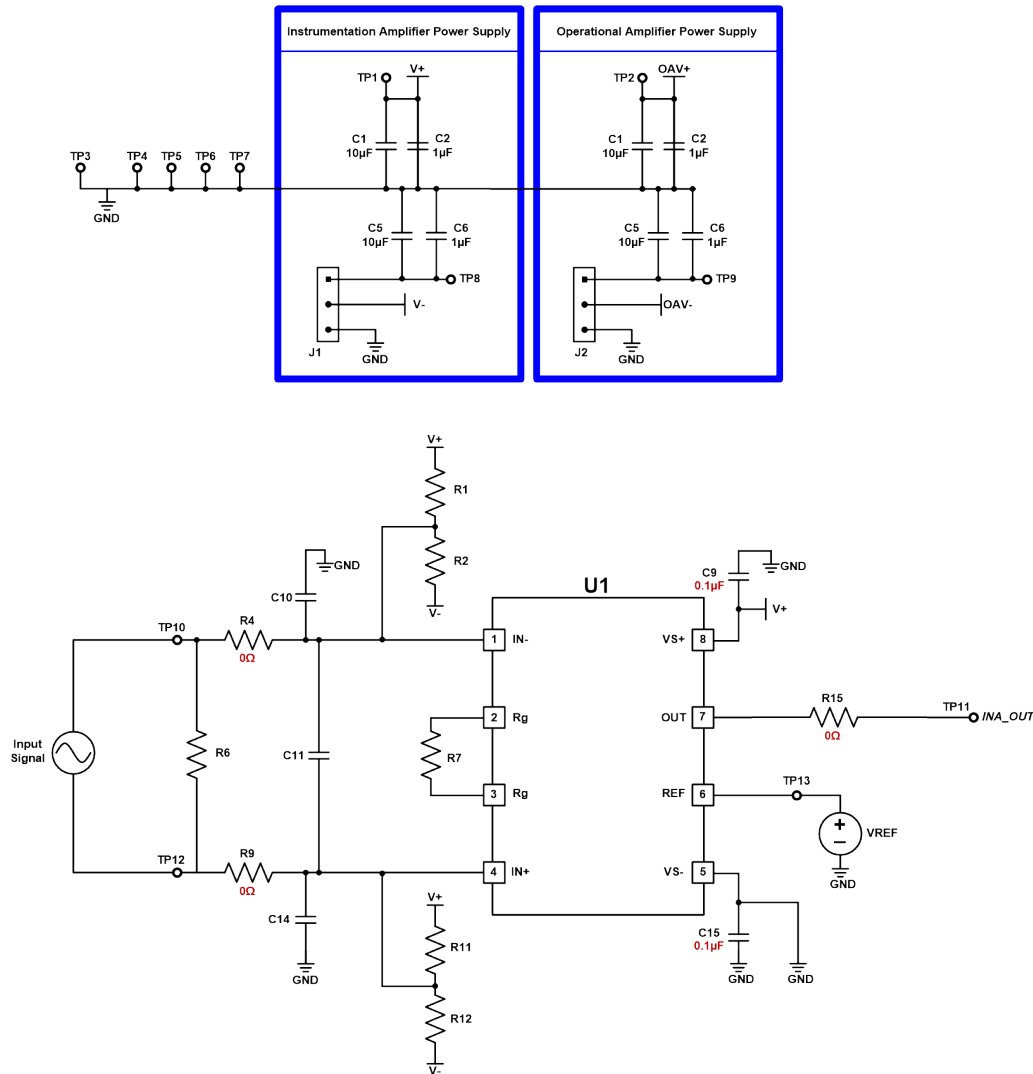


Figure 3. Single-Supply Configuration, Direct Reference Connection

1. +VS to test point TP1
2. GND to test point TP8
3. Install jumper shunt to positions 2 and 3 on J1
4. Remove resistor R13
5. Reference voltage to test point TP13
6. Differential input signal to test points TP10 and TP12
7. Observe output at test point TP11

**NOTE:** C9 and C15 are prepopulated with 0.1-µF power-supply decoupling capacitors. It is not required to remove C15 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 4 shows an example of how to set up the EVM for single-supply operation with a buffered-reference voltage connection.

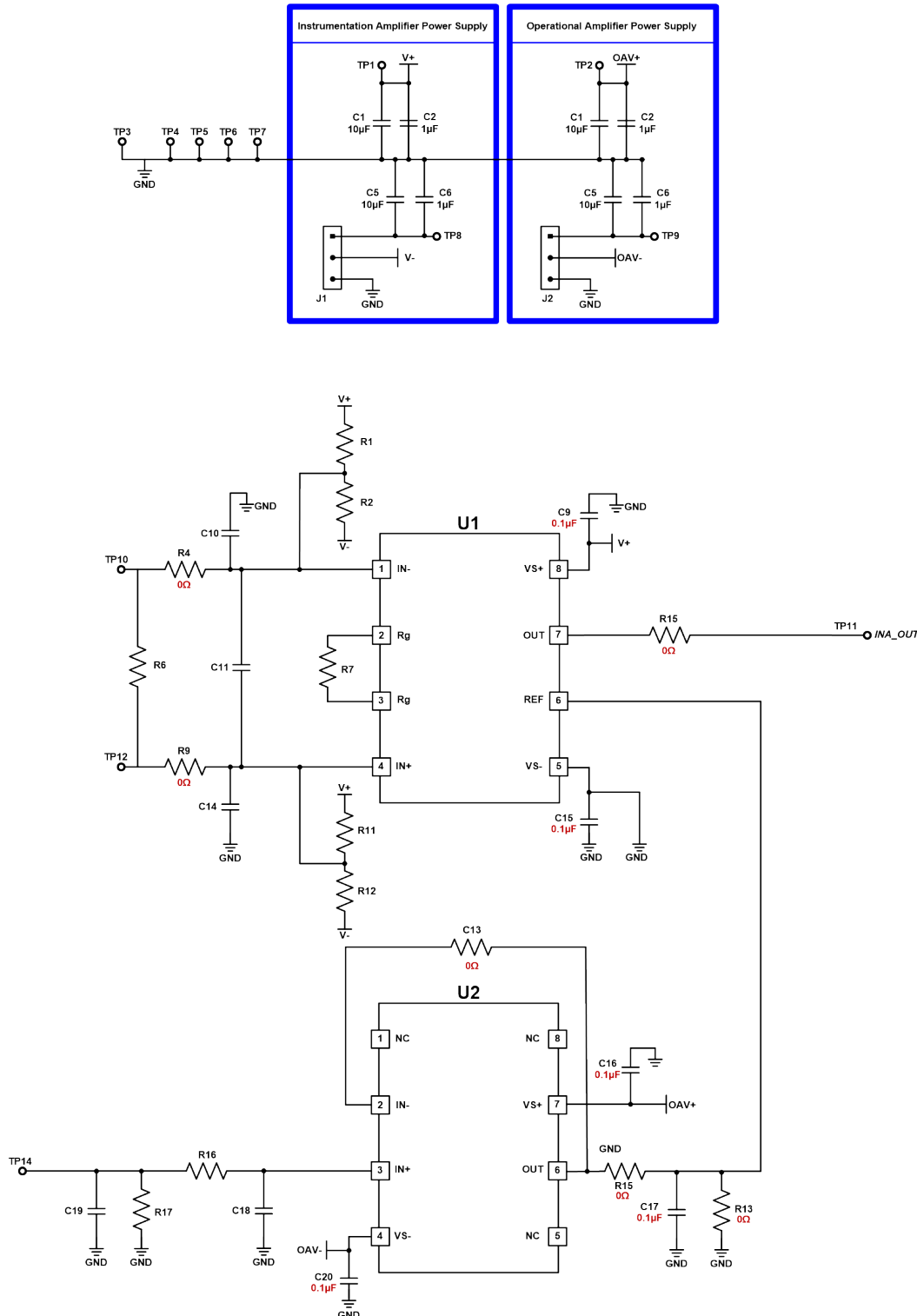


Figure 4. Single-Supply Configuration, Buffered Reference Connection

1. +VS to test point TP1
2. +OAV to test point TP2
3. GND to test points TP8 and TP9
4. Install jumper shunt on positions 2 and 3 on J1 and J2
5. VREF to test point TP14
6. Make sure that resistor R13 is not populated
7. Populate C13 with a 0- $\Omega$  resistor. The capacitor and resistor have the same footprint
8. Differential input signal to test points TP10 and TP12
9. Observe output at test points TP11

---

**NOTE:** C9 and C15 are prepopulated with 0.1- $\mu$ F power-supply decoupling capacitors. It is not required to remove C15 for proper single-supply operation. See the respective device data sheet for additional power-supply decoupling information.

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### 3 EVM Components

#### 3.1 Power

Power is applied to the device with test points TP1 and TP8. For the unpopulated device (U2), power is applied using test points TP2 and TP9.

#### 3.2 Inputs

Inputs are applied to the device using test points TP12 and TP10. The inputs for U2 are applied through test points TP14 and TP11.

##### 3.2.1 Input Filtering

R4, R9, and C10, C11, C14 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 C11 approximately ten times larger than C10 and C14. These calculations presume R4 = R9 and C10 = C14.

Common-mode cutoff frequency:

$$f_{c-cm} = \frac{1}{2\pi \times R4 \times C10} \quad (1)$$

Differential-mode cutoff frequency:

$$f_{c-dm} = \frac{1}{2\pi \times (R4 + R9) \left( C11 + \frac{C10}{2} \right)} \quad (2)$$

#### 3.3 Output

Access the output of the device with test point TP11.

##### 3.3.1 Output Filtering

R5 and C12 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](#).

$$f_{c-o} = \frac{1}{2\pi \times R5 \times C12} \quad (3)$$

#### 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 TP13 with U2 and R13 not populated. If a buffered voltage is desired, U2 can be populated with an operational amplifier in an appropriate SO-8 package and pinout. If the reference voltage is GND, R5 is populated with a 0-Ω resistor.

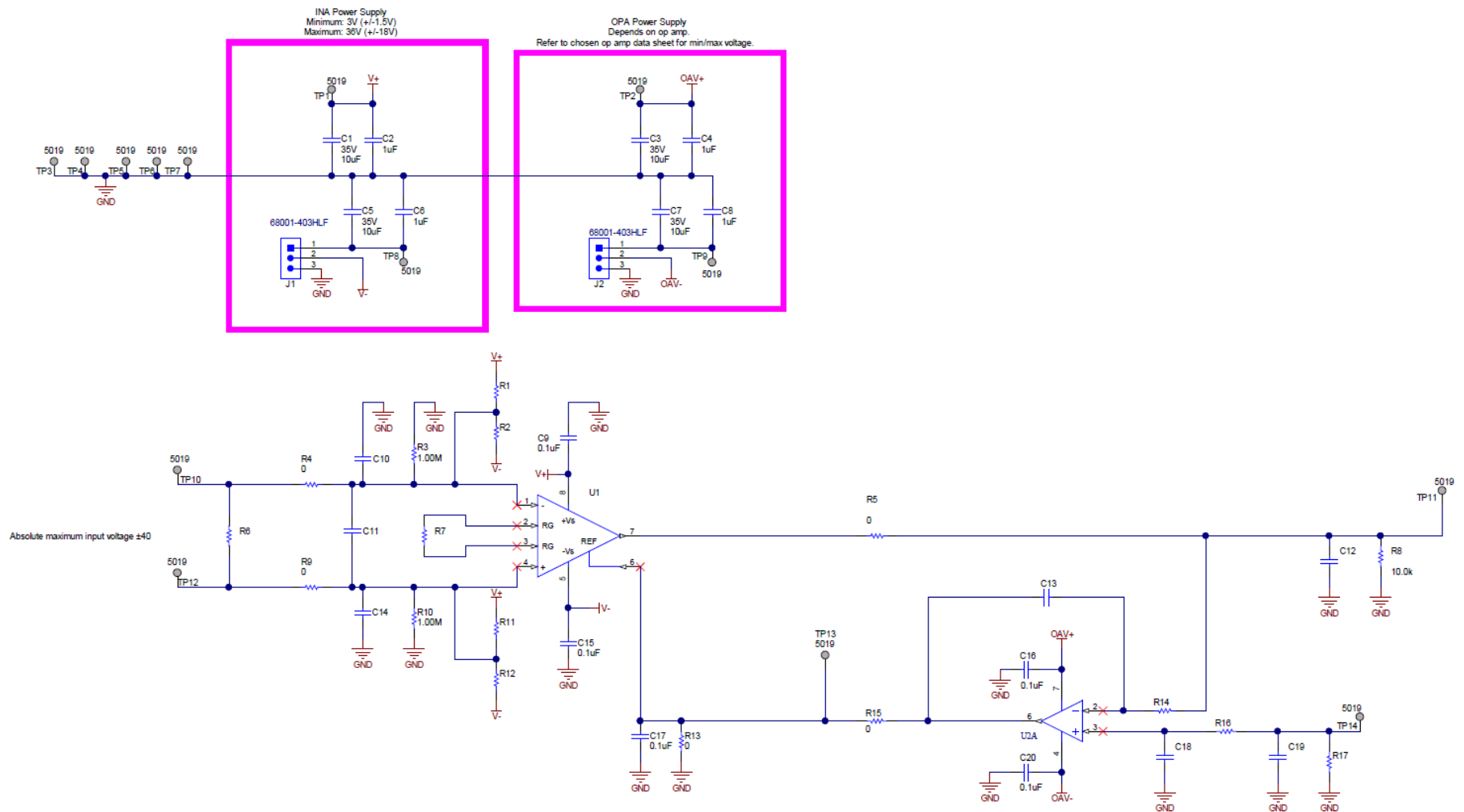
#### 3.5 Miscellaneous

C1, C2, C5, and C6 are the populated bypass capacitors for the device, U1. Similarly, C3, C4, C7 and C8 are populated to provide supply bypassing for U2.

## 4 Schematic, PCB Layout, and Bill of Materials

### 4.1 Schematic

The schematic for the PCB for the SOIC-8 EVM is shown in [Figure 5](#) and [Figure 6](#).



**Figure 5. Universal INAEVM-ALT-SO8 Schematic (1)**

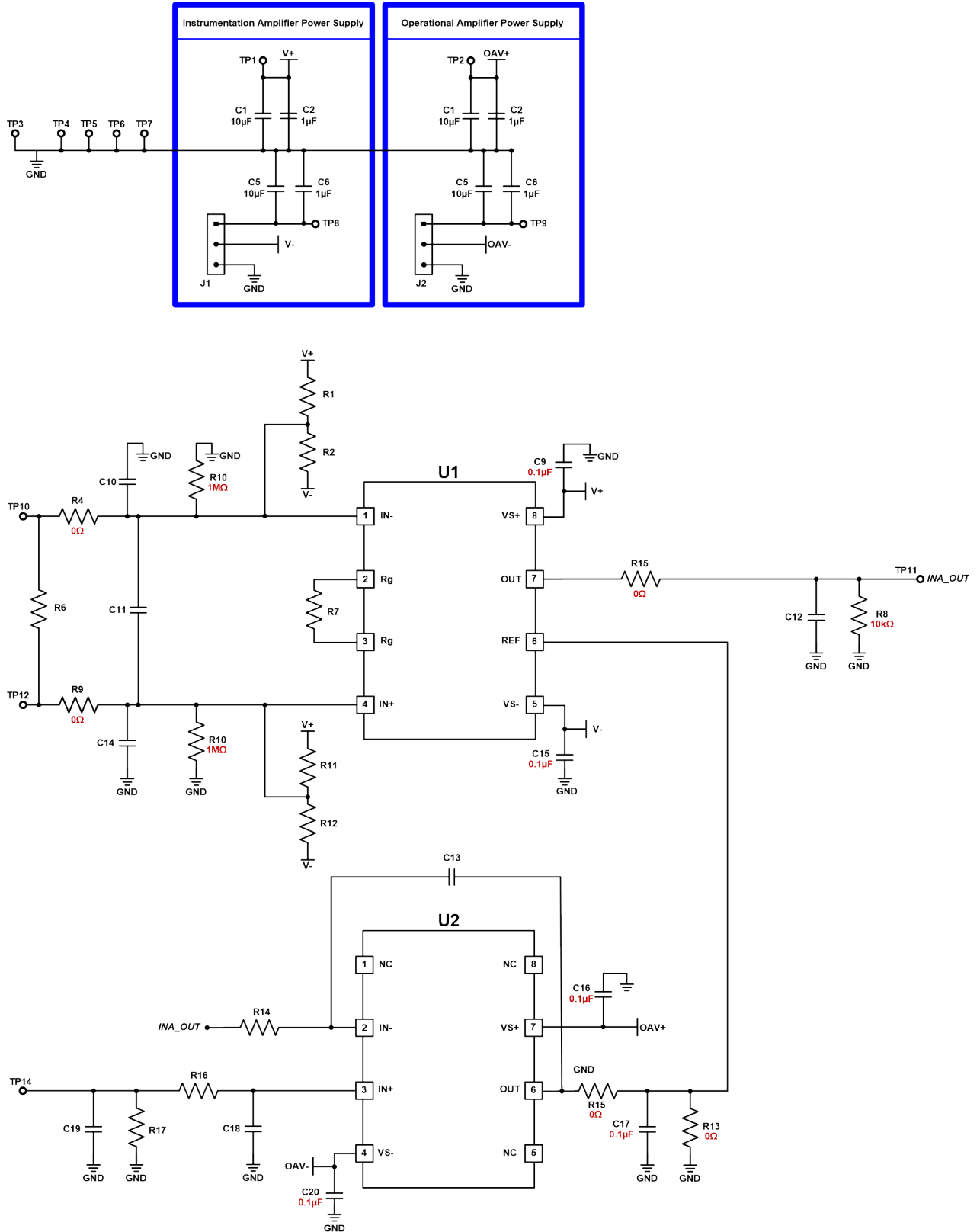


Figure 6. Universal INAEVM-ALT-SO8 Schematic (2)

## 4.2 PCB Layout

The component PCB layout for the SOIC-8 EVM is shown in Figure 7.

**NOTE:** Figure 7 is intended to show how the board is laid out; it is not intended to be used for manufacturing PCBs.

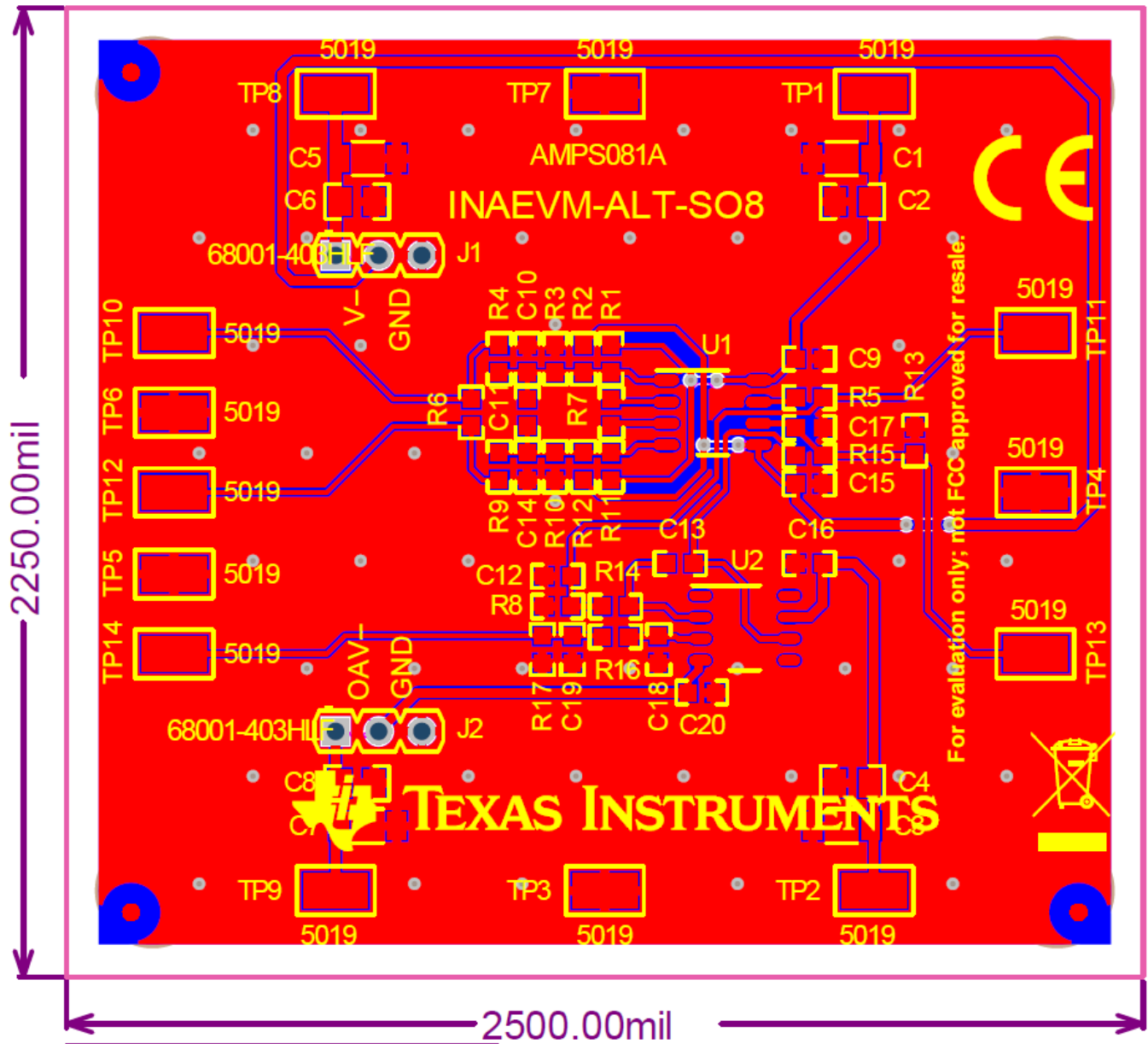


Figure 7. Universal INAEVM-ALT-SO8 PCB

### 4.3 Bill of Materials

Table 1 provides the parts list for the EVM.

**Table 1. Universal INAEVM-ALT-SO8 Bill of Materials**

Designator	Qty	Value	Description	Package Reference	Part Number	Manufacturer
C1, C3, C5, C7	4	10 $\mu$ F	CAP, CERM, 10 uF, 35 V, +/- 10%, X7R, 1206	1206	C3216X7R1V106K160AC	TDK
C2, C4, C6, C8	4	1 $\mu$ F	CAP, CERM, 1 uF, 100 V, +/- 10%, X7S, 0805	0805	C2012X7S2A105K125AB	TDK
C9, C15	2	0.1 $\mu$ F	CAP, CERM, 0.1 uF, 100 V, +/- 10%, X7S, AEC-Q200 Grade 1, 0603	0603	CGA3E3X7S2A104K080AB	TDK
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
R3, R10	2	1.00 M $\Omega$	RES, 1.00 M, 1%, 0.125 W, 0603	0603	MCT06030C1004FP500	Vishay/Beyschlag
R4, R5, R9, R13	4	0	RES, 0, 5%, 0.1 W, 0603	0603	MCT06030C1004FP500	Vishay/Beyschlag
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	14		Test Point, Miniature, SMT	Test Point, Miniature, SMT	5019	Keystone

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##### 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:**

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### Concernant les EVMs avec antennes détachables

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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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8.1 *General Limitations.* IN NO EVENT SHALL TI BE LIABLE FOR ANY SPECIAL, COLLATERAL, INDIRECT, PUNITIVE, INCIDENTAL, CONSEQUENTIAL, OR EXEMPLARY DAMAGES IN CONNECTION WITH OR ARISING OUT OF THESE TERMS OR THE USE OF THE EVMS , REGARDLESS OF WHETHER TI HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES. EXCLUDED DAMAGES INCLUDE, BUT ARE NOT LIMITED TO, COST OF REMOVAL OR REINSTALLATION, ANCILLARY COSTS TO THE PROCUREMENT OF SUBSTITUTE GOODS OR SERVICES, RETESTING, OUTSIDE COMPUTER TIME, LABOR COSTS, LOSS OF GOODWILL, LOSS OF PROFITS, LOSS OF SAVINGS, LOSS OF USE, LOSS OF DATA, OR BUSINESS INTERRUPTION. NO CLAIM, SUIT OR ACTION SHALL BE BROUGHT AGAINST TI MORE THAN TWELVE (12) MONTHS AFTER THE EVENT THAT GAVE RISE TO THE CAUSE OF ACTION HAS OCCURRED.

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9. *Return Policy.* Except as otherwise provided, TI does not offer any refunds, returns, or exchanges. Furthermore, no return of EVM(s) will be accepted if the package has been opened and no return of the EVM(s) will be accepted if they are damaged or otherwise not in a resalable condition. If User feels it has been incorrectly charged for the EVM(s) it ordered or that delivery violates the applicable order, User should contact TI. All refunds will be made in full within thirty (30) working days from the return of the components(s), excluding any postage or packaging costs.

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