**BURR - BROWN®**
**BB**

# INA105

# Precision Unity Gain
# DIFFERENTIAL AMPLIFIER

## FEATURES

- **CMR 86dB min OVER TEMPERATURE**
- **GAIN ERROR: 0.01% max**
- **NONLINEARITY: 0.001% max**
- **NO EXTERNAL ADJUSTMENTS REQUIRED**
- **EASY TO USE**
- **COMPLETE SOLUTION**
- **HIGHLY VERSATILE**
- **LOW COST**
- **PLASTIC DIP, TO-99 HERMETIC METAL, AND SO-8 SOIC PACKAGES**

## APPLICATIONS

- **DIFFERENTIAL AMPLIFIER**
- **INSTRUMENTATION AMPLIFIER BUILDING BLOCK**
- **UNITY-GAIN INVERTING AMPLIFIER**
- **GAIN-OF-1/2 AMPLIFIER**
- **NONINVERTING GAIN-OF-2 AMPLIFIER**
- **AVERAGE VALUE AMPLIFIER**
- **ABSOLUTE VALUE AMPLIFIER**
- **SUMMING AMPLIFIER**
- **SYNCHRONOUS DEMODULATOR**
- **CURRENT RECEIVER WITH COMPLIANCE TO RAILS**
- **4mA TO 20mA TRANSMITTER**
- **VOLTAGE-CONTROLLED CURRENT SOURCE**
- **ALL-PASS FILTERS**

## DESCRIPTION

The INA105 is a monolithic Gain = 1 differential amplifier consisting of a precision op amp and on-chip metal film resistors. The resistors are laser trimmed for accurate gain and high common-mode rejection. Excellent TCR tracking of the resistors maintains gain accuracy and common-mode rejection over temperature.

The differential amplifier is the foundation of many commonly used circuits. The INA105 provides this precision circuit function without using an expensive precision resistor network. The INA105 is available in 8-pin plastic DIP, SO-8 surface-mount and TO-99 metal packages.
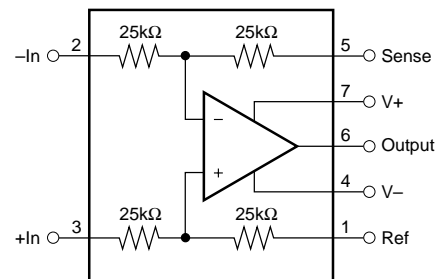
PDS-617G
Printed in U.S.A. August, 1993

SBOS145

# SPECIFICATIONS

## ELECTRICAL

At +25°C, $V_{CC} = \pm15V$, unless otherwise noted.

| PARAMETER | CONDITIONS | INA105AM | | | INA105BM | | | INA105KP, KU | | | UNITS |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | MIN | TYP | MAX | MIN | TYP | MAX | MIN | TYP | MAX | |
| **GAIN** | | | | | | | | | | | |
| Initial[1] | | | 1 | | | * | | | * | | V/V |
| Error | | | 0.005 | 0.01 | | * | * | | 0.01 | 0.025 | % |
| vs Temperature | | | 1 | 5 | | * | * | | * | * | ppm/°C |
| Nonlinearity[2] | | | 0.0002 | 0.001 | | * | * | | * | * | % |
| **OUTPUT** | | | | | | | | | | | |
| Rated Voltage | $I_O$ = +20mA, −5mA | 10 | 12 | | * | * | | * | * | | V |
| Rated Current | $V_O$ = 10V | +20, −5 | | | * | | | * | | | mA |
| Impedance | | | 0.01 | | | * | | | * | | Ω |
| Current Limit | To Common | | +40/−10 | | | * | | | * | | mA |
| Capacitive Load | Stable Operation | | 1000 | | | * | | | * | | pF |
| **INPUT** | | | | | | | | | | | |
| Impedance[3] | Differential | | 50 | | | * | | | * | | kΩ |
| | Common-Mode | | 50 | | | * | | | * | | kΩ |
| Voltage Range[4] | Differential | ±10 | | | * | | | * | | | V |
| | Common-Mode | ±20 | | | * | | | * | | | V |
| Common-Mode Rejection[5] | $T_A$ = $T_{MIN}$ to $T_{MAX}$ | 80 | 90 | | 86 | 100 | | 72 | * | | dB |
| **OFFSET VOLTAGE** | RTO[6], [7] | | | | | | | | | | |
| Initial | | | 50 | 250 | | * | * | | * | 500 | µV |
| vs Temperature | | | 5 | 20 | | 5 | 10 | | * | * | µV/°C |
| vs Supply | ±$V_S$ = 6V to 18V | | 1 | 25 | | * | 15 | | * | * | µV/V |
| vs Time | | | 20 | | | * | | | * | | µV/mo |
| **OUTPUT NOISE VOLTAGE** | RTO[6], [8] | | | | | | | | | | |
| $f_B$ = 0.01Hz to 10Hz | | | 2.4 | | | * | | | * | | µVp-p |
| $f_O$ = 10kHz | | | 60 | | | * | | | * | | nV/√Hz |
| **DYNAMIC RESPONSE** | | | | | | | | | | | |
| Small Signal Bandwidth | −3dB | | 1 | | | * | | | * | | MHz |
| Full Power Bandwidth | $V_O$ = 20Vp-p | 30 | 50 | | * | * | | * | * | | kHz |
| Slew Rate | | 2 | 3 | | * | * | | * | * | | V/µs |
| Settling Time: 0.1% | $V_O$ = 10V Step | | 4 | | | * | | | * | | µs |
| 0.01% | $V_O$ = 10V Step | | 5 | | | * | | | * | | µs |
| 0.01% | $V_{CM}$ = 10V Step, $V_{DIFF}$ = 0V | | 1.5 | | | * | | | * | | µs |
| **POWER SUPPLY** | | | | | | | | | | | |
| Rated | | | ±15 | | | * | | | * | | V |
| Voltage Range | Derated Performance | ±5 | | ±18 | * | | * | * | | * | V |
| Quiescent Current | $V_O$ = 0V | | ±1.5 | ±2 | | * | * | | * | * | mA |
| **TEMPERATURE RANGE** | | | | | | | | | | | |
| Specification | | −40 | | +85 | * | | * | * | | * | °C |
| Operation | | −55 | | +125 | * | | * | −40 | | +85 | °C |
| Storage | | −65 | | +150 | * | | * | −40 | | +125 | °C |

∗ Specification same as for INA105AM.

NOTES: (1) Connected as difference amplifier (see Figure 4). (2) Nonlinearity is the maximum peak deviation from the best-fit straight line as a percent of full-scale peak-to-peak output. (3) 25kΩ resistors are ratio matched but have ±20% absolute value. (4) Maximum input voltage without protection is 10V more than either ±15V supply (±25V). Limit $I_{IN}$ to 1mA. (5) With zero source impedance (see "Maintaining CMR" section). (6) Referred to output in unity-gain difference configuration. Note that this circuit has a gain of 2 for the operational amplifier's offset voltage and noise voltage. (7) Includes effects of amplifier's input bias and offset currents. (8) Includes effects of amplifier's input current noise and thermal noise contribution of resistor network.

## PIN CONFIGURATIONS



**Top View** — TO-99

Tab / No Internal Connection

8

Ref 1
−In 2
3 +In
4 V−
5 Sense
6 Output
7 V+

**INA105AM**
**INA105BM**

Case internally connected to V−. Make no connection.



**Top View** — DIP/SOIC

Ref 1 ● (1)
−In 2
+In 3
V− 4
8 No Internal Connection
7 V+
6 Output
5 Sense

NOTE: (1) Performance grade identifier box for small outline surface mount. Blank indicates K grade. Part is marked INA105U.
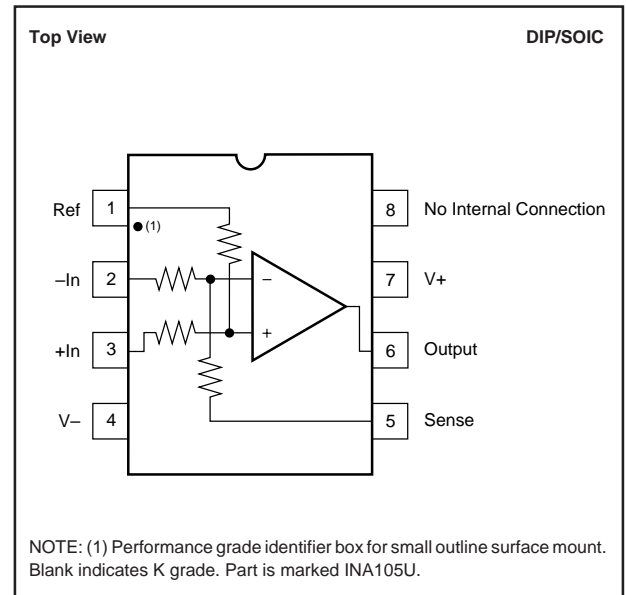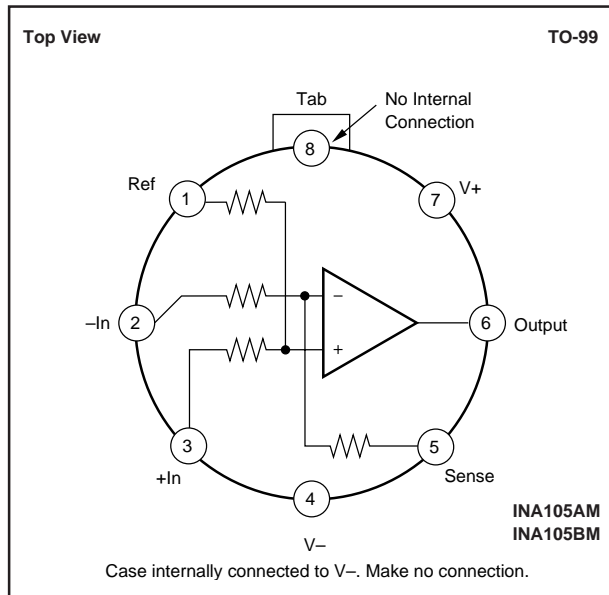
## ABSOLUTE MAXIMUM RATINGS

Supply ............................................................................................... ±18V
Input Voltage Range ........................................................................... ±$V_S$
Operating Temperature Range: M ................................. −55°C to +125°C
                                 P, U ................................. −40°C to +85°C
Storage Temperature Range: M ..................................... −65°C to +150°C
                            P, U ................................ −40°C to +125°C
Lead Temperature (soldering, 10s) M, P ....................................... +300°C
Wave Soldering (3s, max) U .......................................................... +260°C
Output Short Circuit to Common ............................................... Continuous

## PACKAGE/ORDERING INFORMATION

| PRODUCT | PACKAGE | PACKAGE DRAWING NUMBER(1) | TEMPERATURE RANGE |
|---------|---------|---------------------------|-------------------|
| INA105AM | TO-99 Metal | 001 | −40°C to +85°C |
| INA105BM | TO-99 Metal | 001 | −40°C to +85°C |
| INA105KP | 8-Pin Plastic DIP | 006 | −40°C to +85°C |
| INA105KU | 8-Pin SOIC | 182 | −40°C to +85°C |

NOTE: (1) For detailed drawing and dimension table, please see end of data sheet, or Appendix C of Burr-Brown IC Data Book.

## ⚠ ELECTROSTATIC DISCHARGE SENSITIVITY

This integrated circuit can be damaged by ESD. Burr-Brown recommends that all integrated circuits be handled with appropriate precautions. Failure to observe proper handling and installation procedures can cause damage.

ESD damage can range from subtle performance degradation to complete device failure. Precision integrated circuits may be more susceptible to damage because very small parametric changes could cause the device not to meet its published specifications.
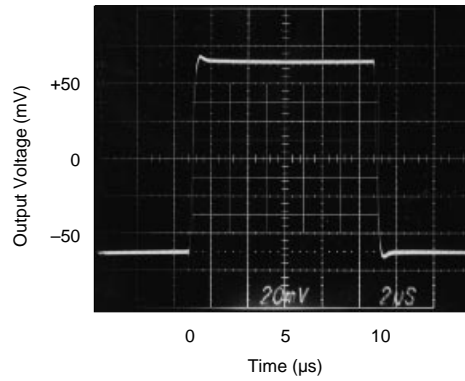
**INA105**

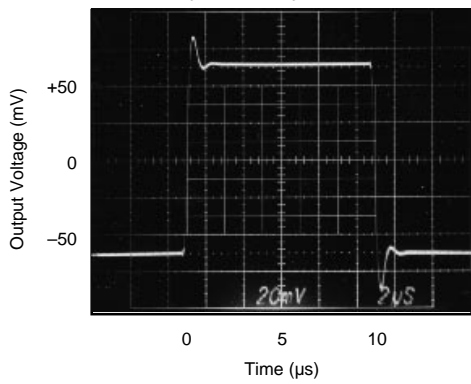# TYPICAL PERFORMANCE CURVES

At $T_A = 25°C$, $V_S = \pm15V$, unless otherwise noted.

STEP RESPONSE
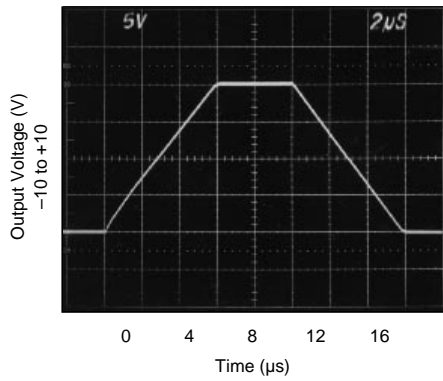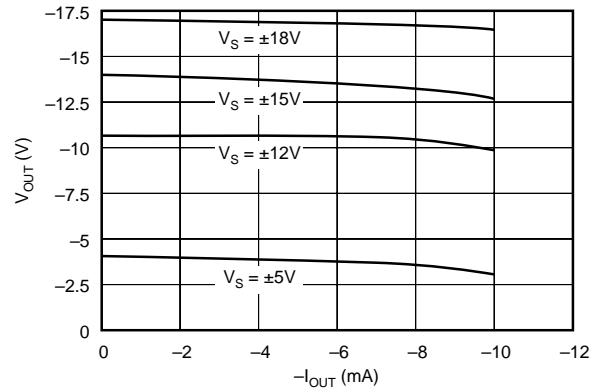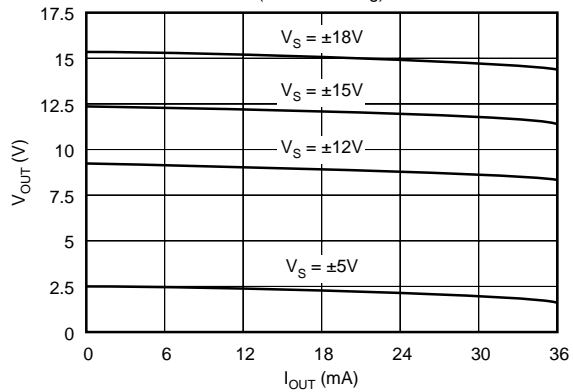


SMALL SIGNAL RESPONSE
(No Load)



SMALL SIGNAL RESPONSE
($R_{LOAD} = \infty\Omega$, $C_{LOAD} = 1000pF$)



MAXIMUM $V_{OUT}$ vs $I_{OUT}$
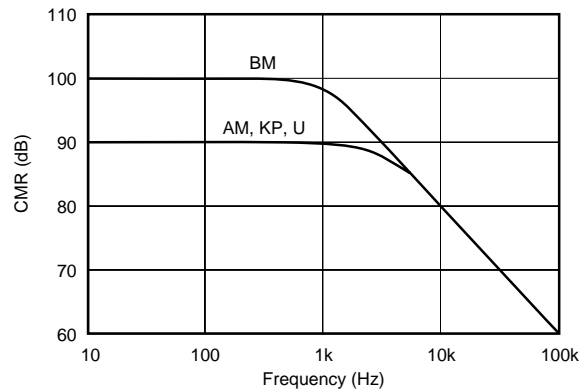(Negative Swing)



MAXIMUM $V_{OUT}$ vs $I_{OUT}$
(Positive Swing)



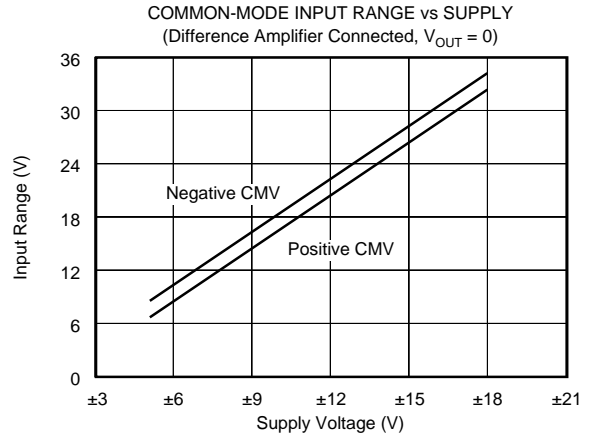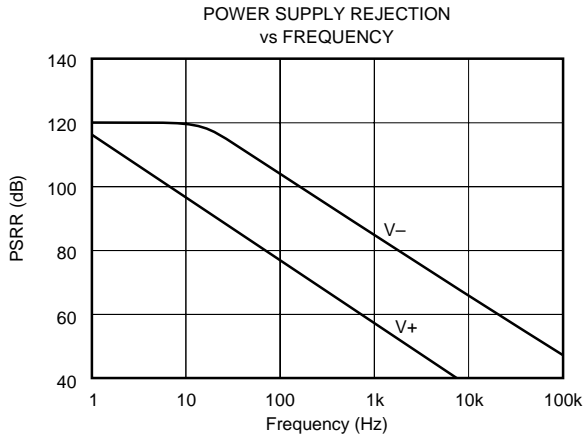CMR vs FREQUENCY

BURR - BROWN®
BB

# TYPICAL PERFORMANCE CURVES (CONT)

At $T_A = 25°C$, $V_S = \pm15V$, unless otherwise noted.

POWER SUPPLY REJECTION
vs FREQUENCY

COMMON-MODE INPUT RANGE vs SUPPLY
(Difference Amplifier Connected, $V_{OUT} = 0$)

## APPLICATION INFORMATION

Figure 1 shows the basic connections required for operation of the INA105. Power supply bypass capacitors should be connected close to the device pins.

The differential input signal is connected to pins 2 and 3 as shown. The source impedances connected to the inputs must be nearly equal to assure good common-mode rejection. A 5Ω mismatch in source impedance will degrade the common-mode rejection of a typical device to approximately 80dB. If the source has a known mismatch in source impedance, an additional resistor in series with one input can be used to preserve good common-mode rejection.

The output is referred to the output reference terminal (pin 1) which is normally grounded. A voltage applied to the Ref terminal will be summed with the output signal. This can be used to null offset voltage as shown in Figure 2. The source impedance of a signal applied to the Ref terminal should be less than 10Ω to maintain good common-mode rejection.

Do not interchange pins 1 and 3 or pins 2 and 5, even though nominal resistor values are equal. These resistors are laser trimmed for precise resistor ratios to achieve accurate gain and highest CMR. Interchanging these pins would not provide specified performance.
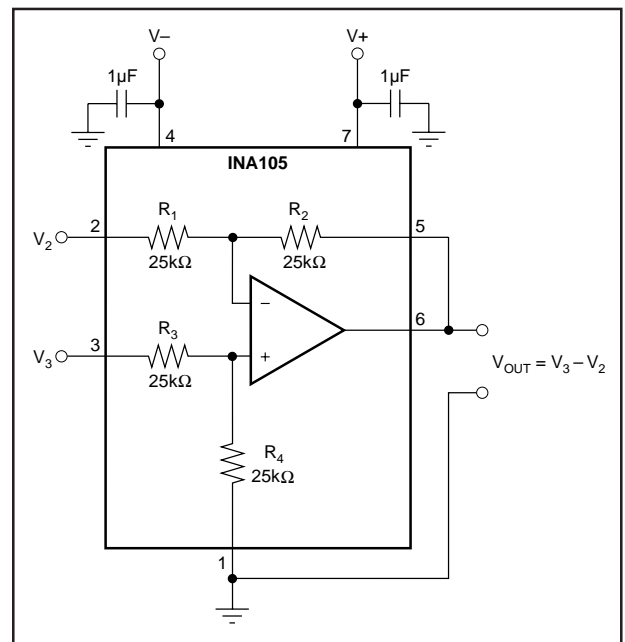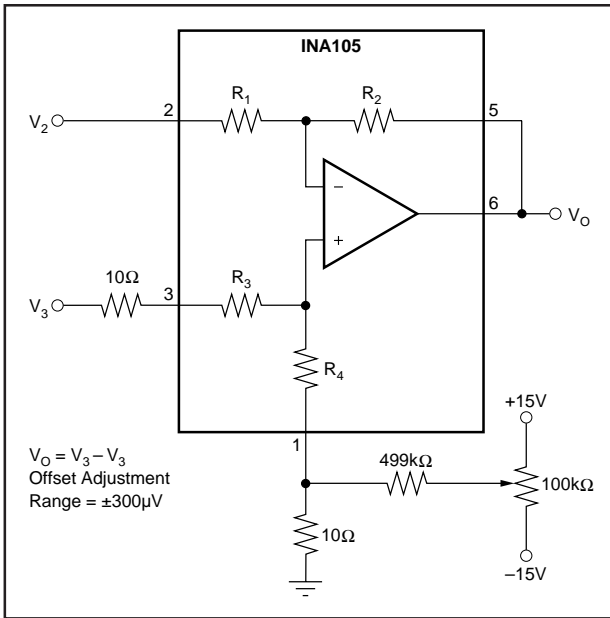
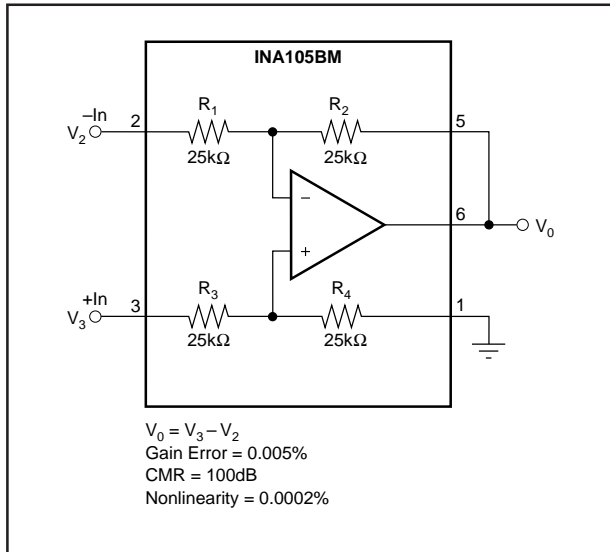FIGURE 1. Basic Power Supply and Signal Connections.

5

FIGURE 2. Offset Adjustment.

$V_O = V_3 - V_3$
Offset Adjustment
Range = ±300µV



FIGURE 3. Precision Difference Amplifier.

$V_0 = V_3 - V_2$
Gain Error = 0.005%
CMR = 100dB
Nonlinearity = 0.0002%



$V_O = (1 + 2R_2/R_1)(V_2 - V_1)$

For low source impedance applications, an input stage using OPA27 op amps will give the best low noise, offset, and temperature drift performance. At source impedances above about 10kΩ, the bias current noise of the OPA27 reacting with the input impedance begins to dominate the noise performance. For these applications, using the OPA111 or dual OPA2111 FET input op amp will provide lower noise performance. For lower cost use the OPA121 plastic. To construct an electrometer use the OPA128.

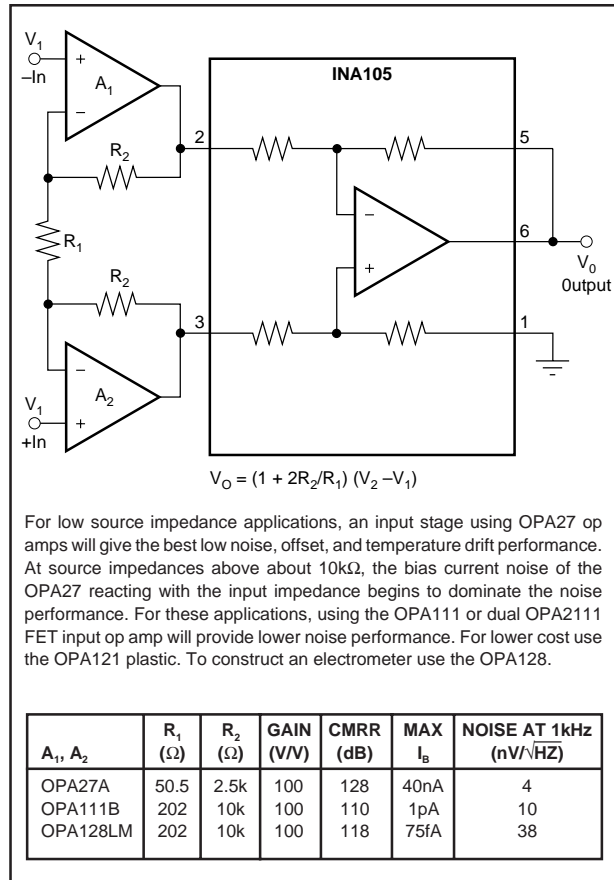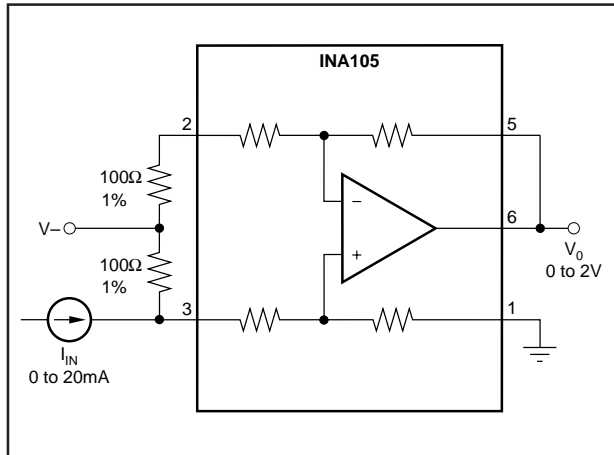| $A_1$, $A_2$ | $R_1$ (Ω) | $R_2$ (Ω) | GAIN (V/V) | CMRR (dB) | MAX $I_B$ | NOISE AT 1kHz (nV/√HZ) |
|---|---|---|---|---|---|---|
| OPA27A | 50.5 | 2.5k | 100 | 128 | 40nA | 4 |
| OPA111B | 202 | 10k | 100 | 110 | 1pA | 10 |
| OPA128LM | 202 | 10k | 100 | 118 | 75fA | 38 |

FIGURE 4. Precision Instrumentation Amplifier.



FIGURE 5. Current Receiver with Compliance to Rails.
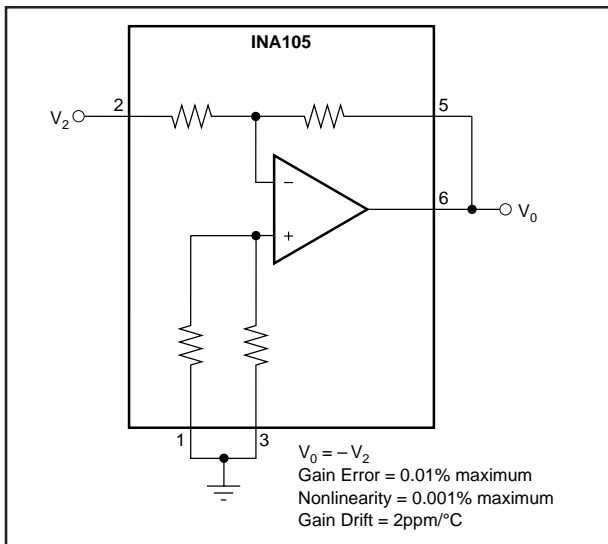
FIGURE 6. Precision Unity-Gain Inverting Amplifier.
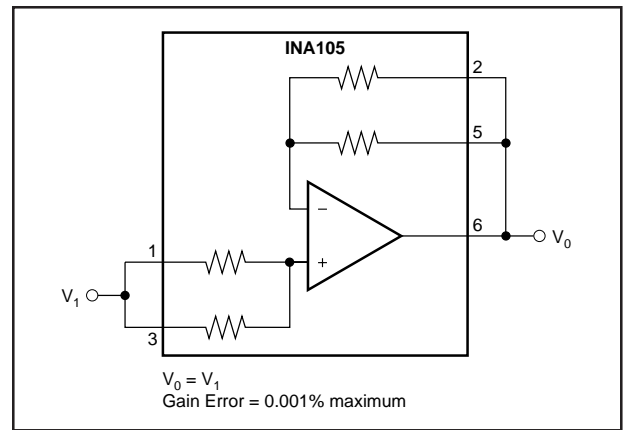
$V_0 = -V_2$
Gain Error = 0.01% maximum
Nonlinearity = 0.001% maximum
Gain Drift = 2ppm/°C



FIGURE 7. ±10V Precision Voltage Reference.



FIGURE 8. ±5V Precision Voltage Reference.



$V_0 = V_1$
Gain Error = 0.001% maximum

FIGURE 9. Precision Unity-Gain Buffer.



FIGURE 10. Pseudoground Generator.



$V_0 = (V_1 + V_3)/2$, ±0.01% maximum
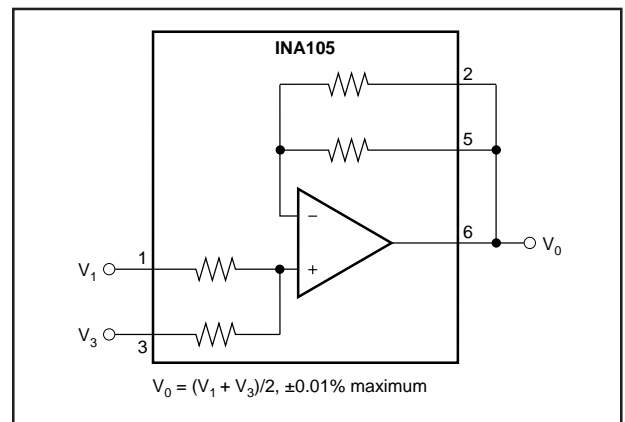
FIGURE 11. Precision Average Value Amplifier.

INA105
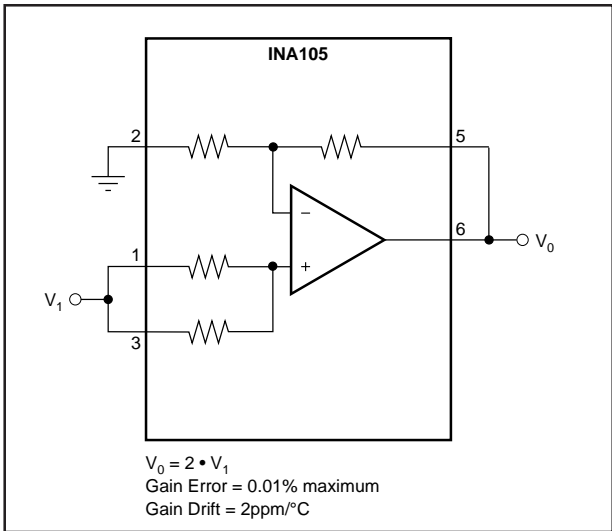
FIGURE 12. Precision (G = 2) Amplifier.

$V_0 = 2 \cdot V_1$
Gain Error = 0.01% maximum
Gain Drift = 2ppm/°C
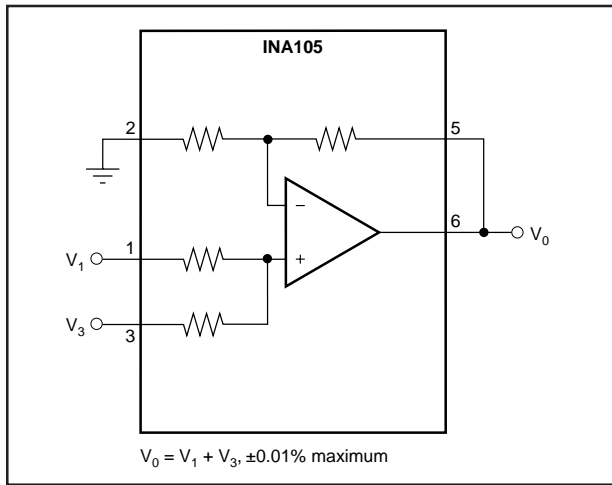


FIGURE 13. Precision Summing Amplifier.

$V_0 = V_1 + V_3$, ±0.01% maximum
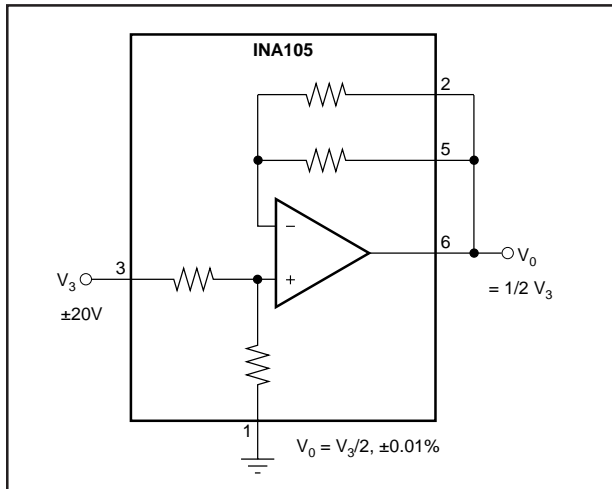


FIGURE 14. Precision Gain = 1/2 Amplifier.

$V_0 = 1/2 V_3$

$V_0 = V_3/2$, ±0.01%
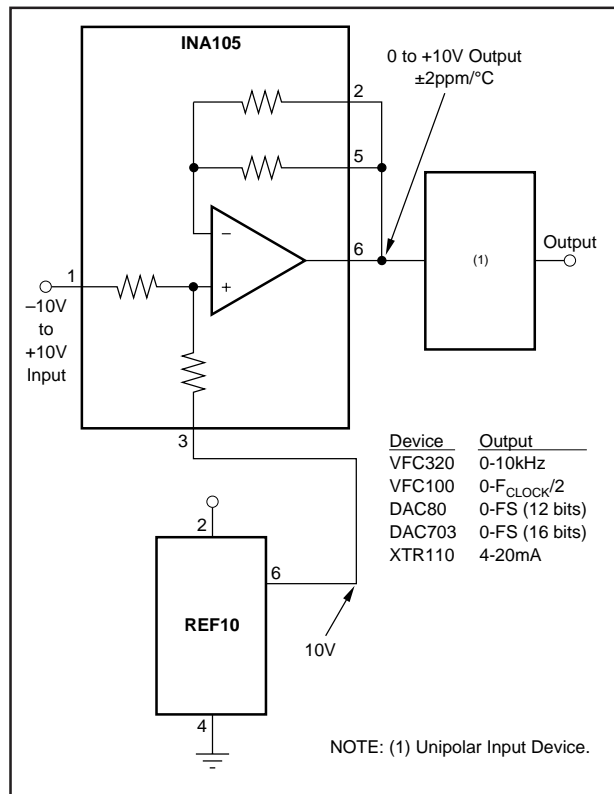


FIGURE 15. Precision Bipolar Offsetting.

0 to +10V Output
±2ppm/°C

| Device | Output |
|--------|--------|
| VFC320 | 0-10kHz |
| VFC100 | 0-$F_{CLOCK}$/2 |
| DAC80 | 0-FS (12 bits) |
| DAC703 | 0-FS (16 bits) |
| XTR110 | 4-20mA |

NOTE: (1) Unipolar Input Device.
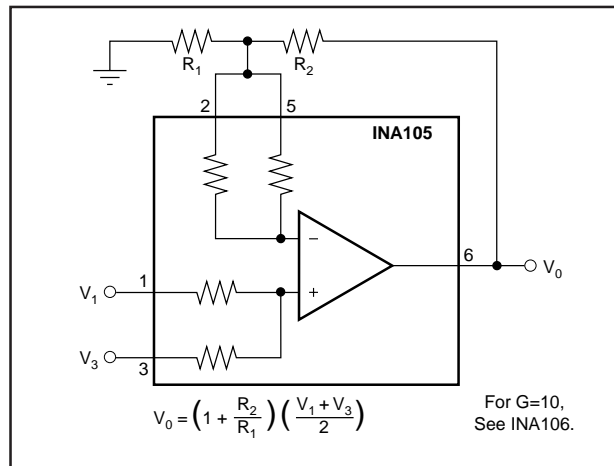


FIGURE 16. Precision Summing Amplifier with Gain.

$$V_0 = \left(1 + \frac{R_2}{R_1}\right)\left(\frac{V_1 + V_3}{2}\right)$$

For G=10,
See INA106.
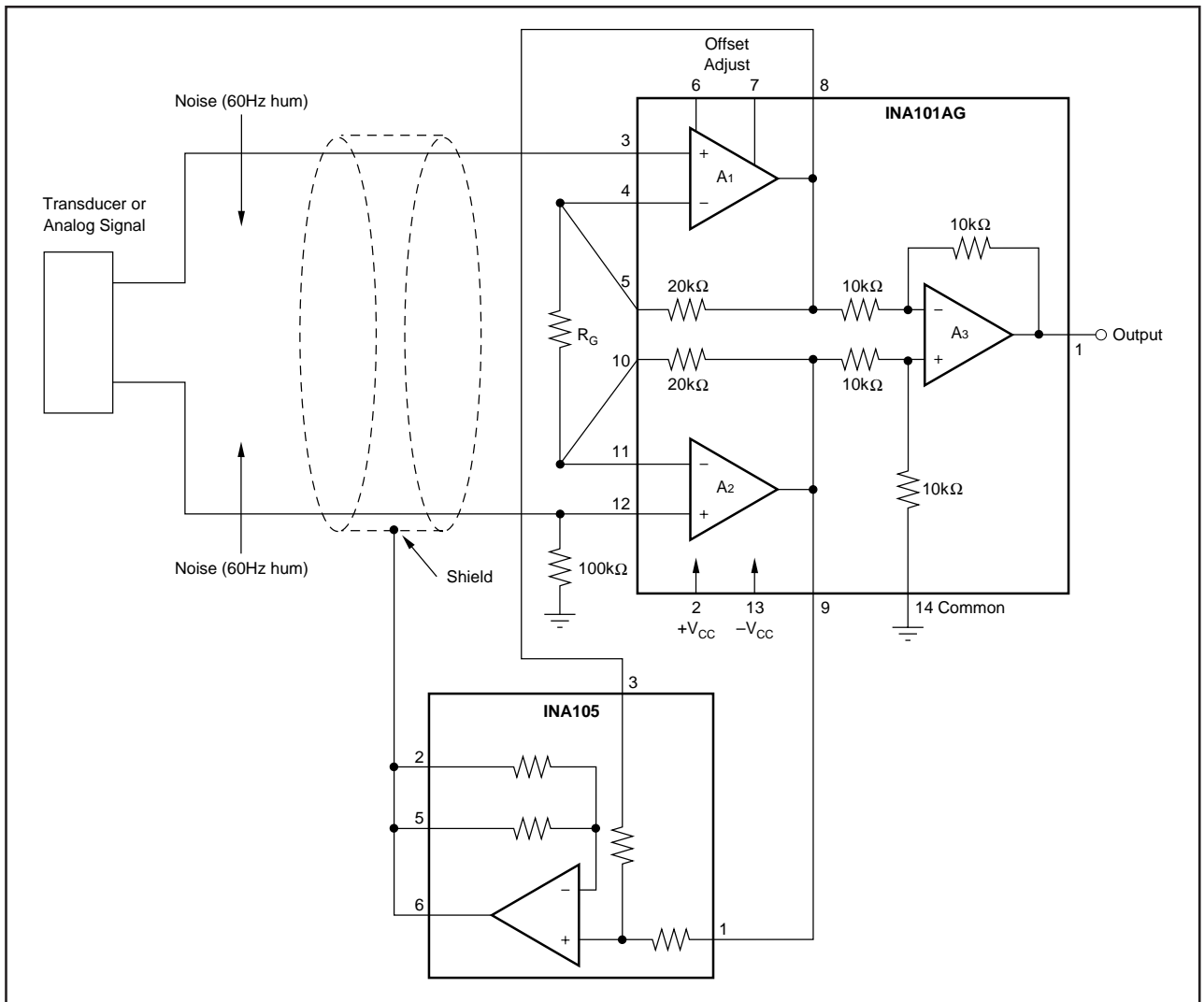
FIGURE 17. Instrumentation Amplifier Guard Drive Generator.



$V_0 = V_3 + V_4 - V_1 - V_2$

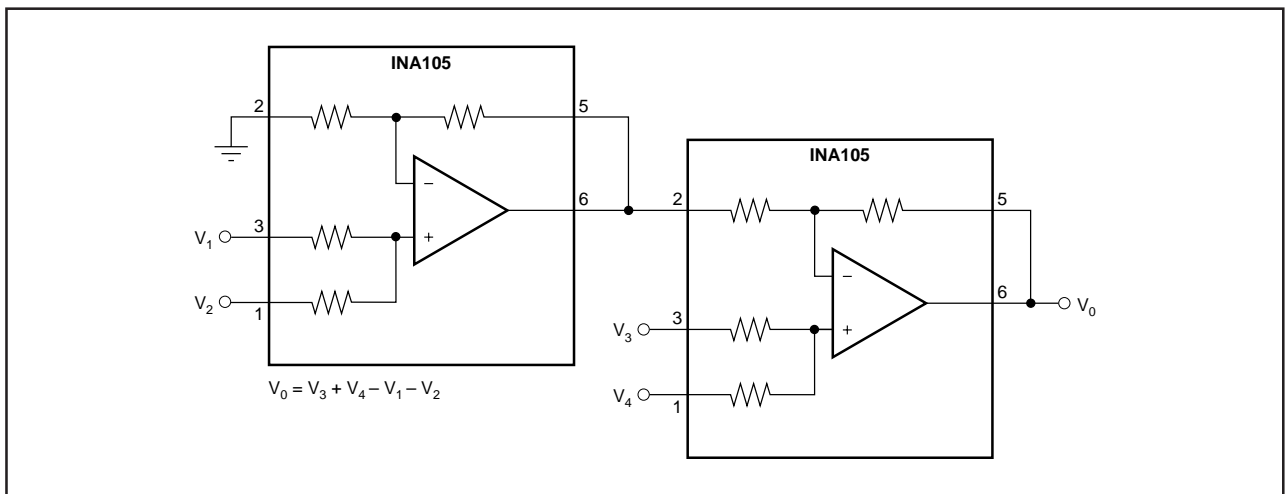FIGURE 18. Precision Summing Instrumentation Amplifier.

INA105
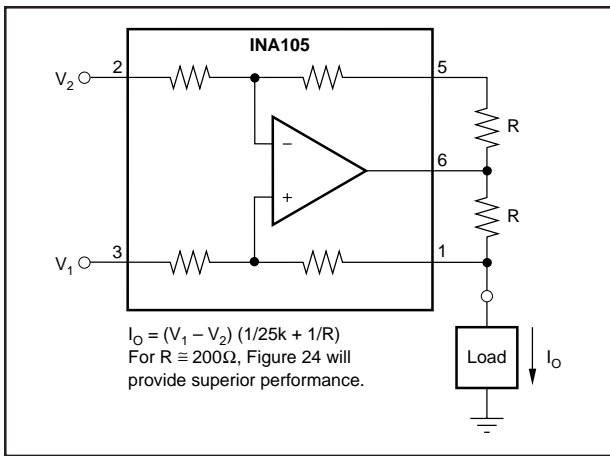
FIGURE 19. Precision Voltage-to-Current Converter with Differential Inputs.

$$I_O = (V_1 - V_2)(1/25k + 1/R)$$
For $R \cong 200\Omega$, Figure 24 will provide superior performance.
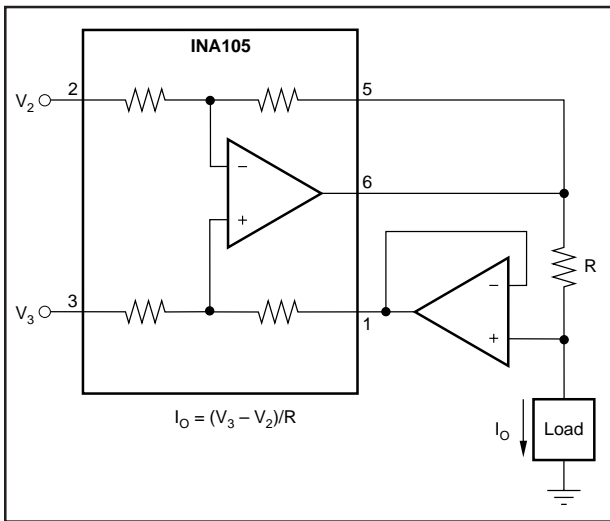


FIGURE 20. Differential Input Voltage-to-Current Converter for Low $I_{OUT}$.

$$I_O = (V_3 - V_2)/R$$
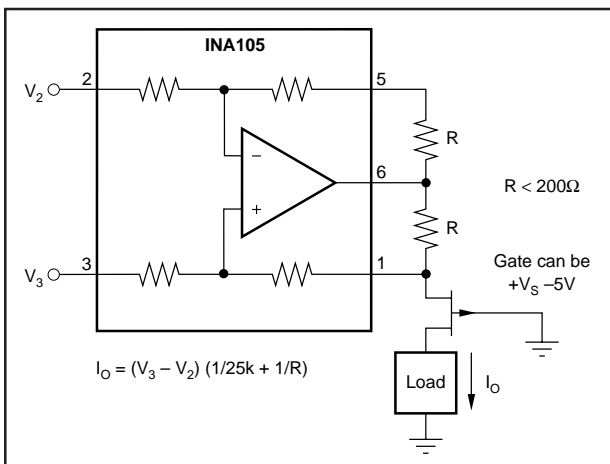


FIGURE 21. Isolating Current Source.

$$I_O = (V_3 - V_2)(1/25k + 1/R)$$

$R < 200\Omega$

Gate can be $+V_S -5V$
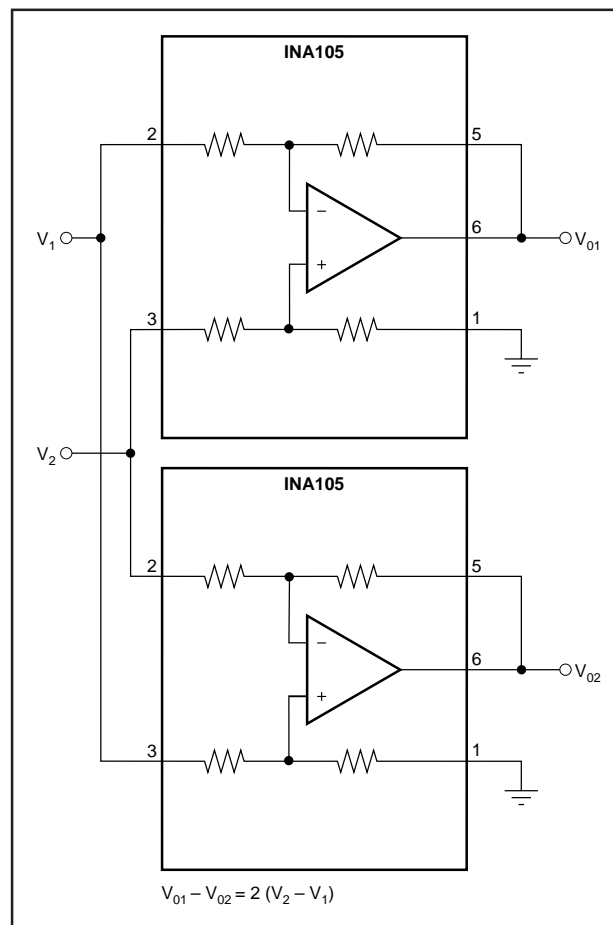


FIGURE 22. Differential Output Difference Amplifier.

$$V_{01} - V_{02} = 2(V_2 - V_1)$$
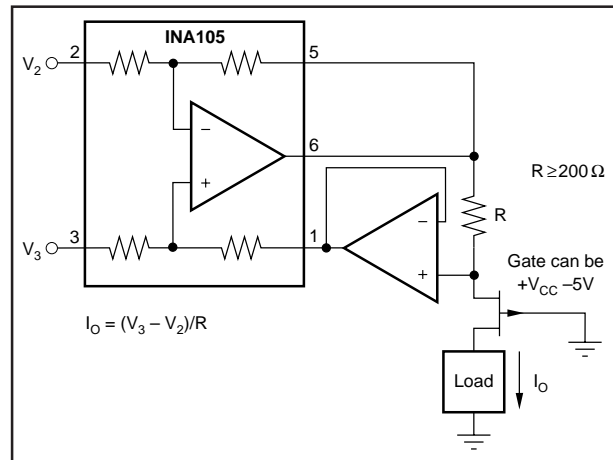


FIGURE 23. Isolating Current Source with Buffering Amplifier for Greater Accuracy.

$$I_O = (V_3 - V_2)/R$$

$R \geq 200\Omega$

Gate can be $+V_{CC} -5V$
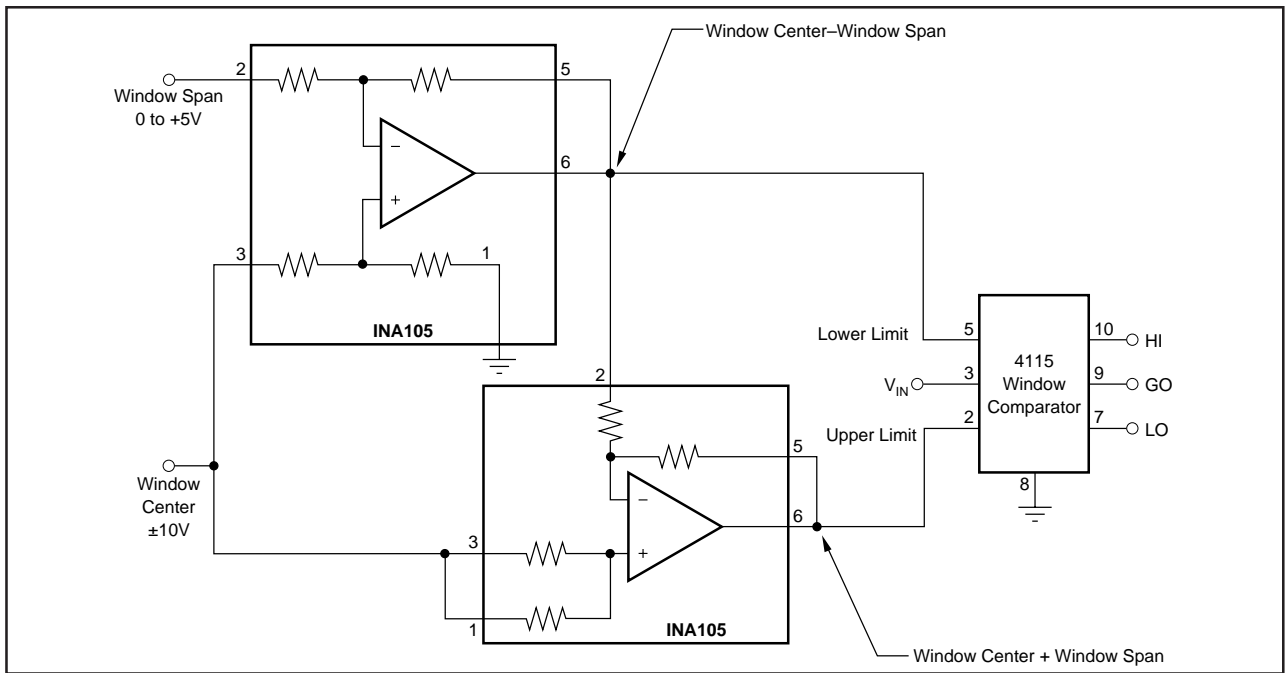
FIGURE 24. Window Comparator with Window Span and Window Center Inputs.



$I_O = (E_2 - E_1)(1 + 2R_2/R_1)(1/25k + 1/R)$
NOTE: (1) See Figure 5 for op amp recommendation.
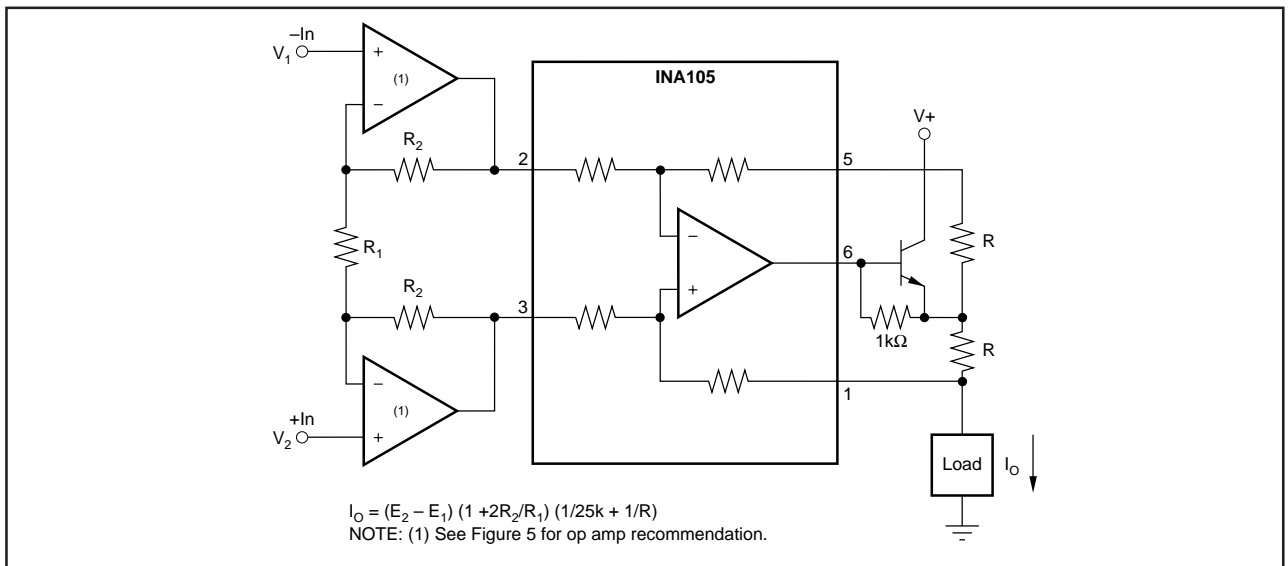
FIGURE 25. Precision Voltage-Controlled Current Source with Buffered Differential Inputs and Gain.



| Logic In | $V_O$ |
|----------|-------|
| 0 | $-V_1$ |
| 1 | $+V_1$ |

FIGURE 26. Digitally Controlled Gain of ±1 Amplifier.

11

INA105

FIGURE 27. Boosting Instrumentation Amplifier Common-Mode Range From ±5 to ±7.5V with 10V Full-Scale Output.



FIGURE 28. Precision Absolute Value Buffer.



FIGURE 29. Precision 4-20mA Current Transmitter.

## PACKAGING INFORMATION

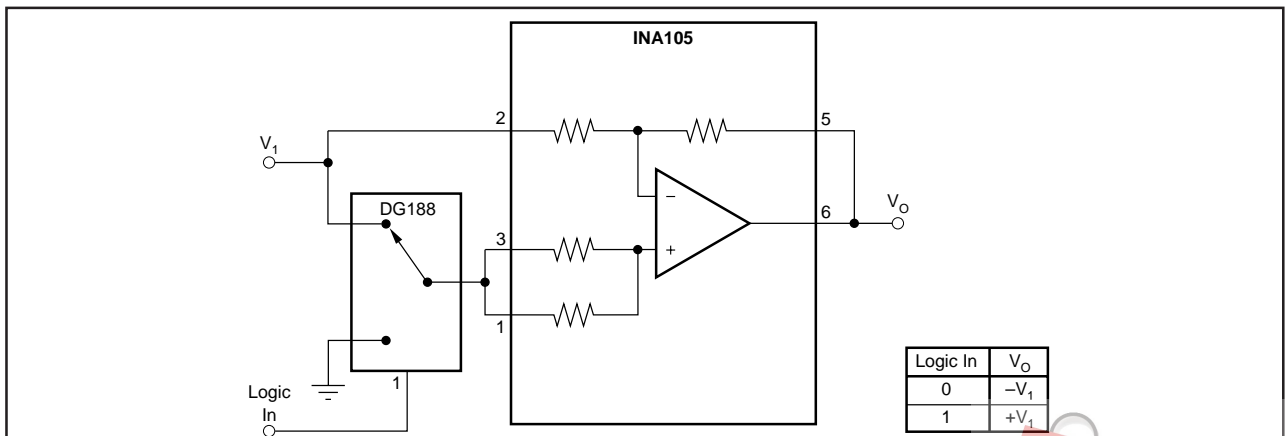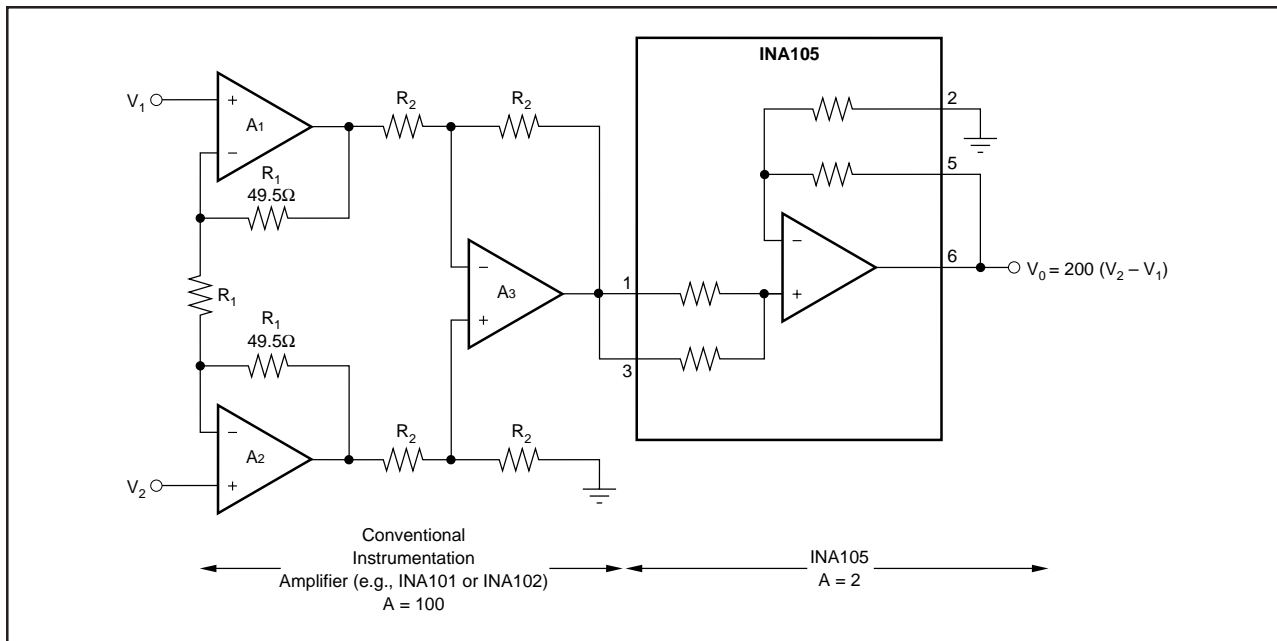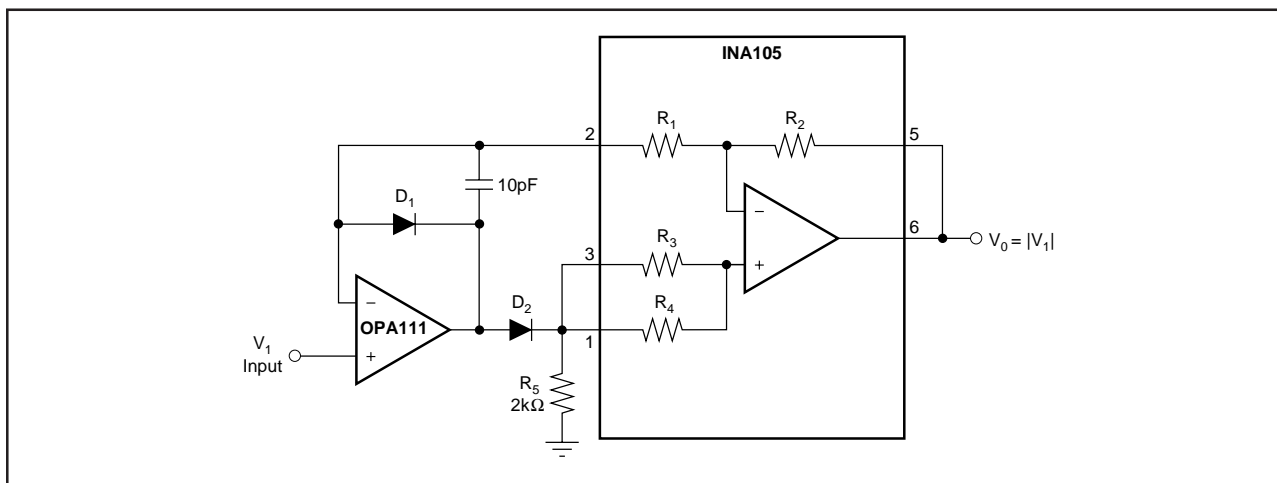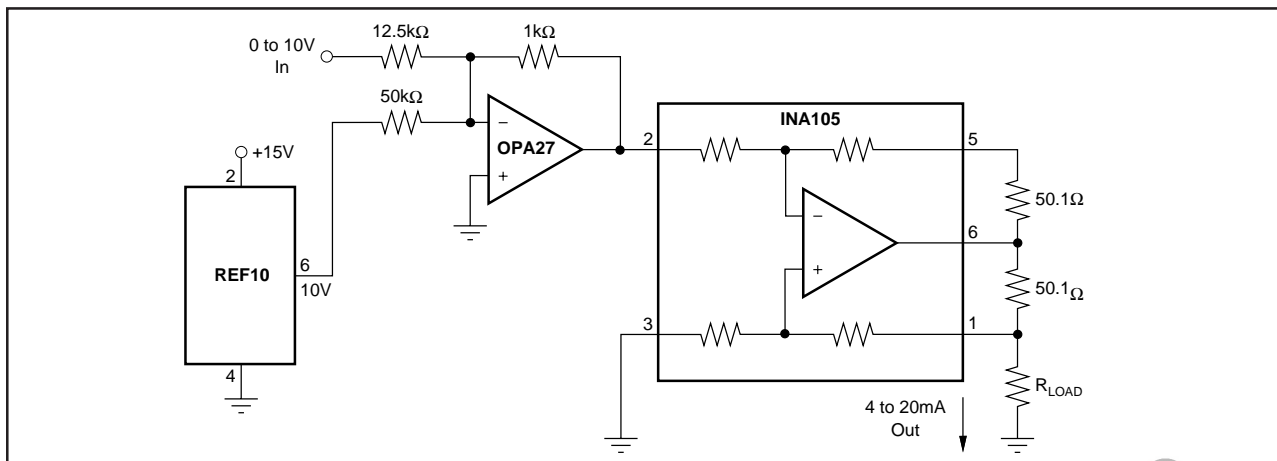| Orderable Device | Status (1) | Package Type | Package Drawing | Pins | Package Qty | Eco Plan (2) | Lead/Ball Finish | MSL Peak Temp (3) | Op Temp (°C) | Top-Side Markings (4) | Samples |
|---|---|---|---|---|---|---|---|---|---|---|---|
| INA105AM | NRND | TO-99 | LMC | 8 | 20 | Green (RoHS & no Sb/Br) | AU | N / A for Pkg Type | | INA105AM | |
| INA105BM | NRND | TO-99 | LMC | 8 | 1 | Green (RoHS & no Sb/Br) | AU | N / A for Pkg Type | | INA105BM | |
| INA105KP | ACTIVE | PDIP | P | 8 | 50 | Green (RoHS & no Sb/Br) | CU NIPDAU | N / A for Pkg Type | | INA105KP | Samples |
| INA105KPG4 | ACTIVE | PDIP | P | 8 | 50 | Green (RoHS & no Sb/Br) | CU NIPDAU | N / A for Pkg Type | | INA105KP | Samples |
| INA105KU | ACTIVE | SOIC | D | 8 | 75 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-3-260C-168 HR | -40 to 85 | INA 105U | Samples |
| INA105KU/2K5 | ACTIVE | SOIC | D | 8 | 2500 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-3-260C-168 HR | -40 to 85 | INA 105U | Samples |
| INA105KU/2K5E4 | ACTIVE | SOIC | D | 8 | 2500 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-3-260C-168 HR | -40 to 85 | INA 105U | Samples |
| INA105KUE4 | ACTIVE | SOIC | D | 8 | 75 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-3-260C-168 HR | -40 to 85 | INA 105U | Samples |

**(1)** The marketing status values are defined as follows:

**ACTIVE:** Product device recommended for new designs.

**LIFEBUY:** TI has announced that the device will be discontinued, and a lifetime-buy period is in effect.

**NRND:** Not recommended for new designs. Device is in production to support existing customers, but TI does not recommend using this part in a new design.

**PREVIEW:** Device has been announced but is not in production. Samples may or may not be available.

**OBSOLETE:** TI has discontinued the production of the device.

**(2)** Eco Plan - The planned eco-friendly classification: Pb-Free (RoHS), Pb-Free (RoHS Exempt), or Green (RoHS & no Sb/Br) - please check http://www.ti.com/productcontent for the latest availability information and additional product content details.

**TBD:** The Pb-Free/Green conversion plan has not been defined.

**Pb-Free (RoHS):** TI's terms "Lead-Free" or "Pb-Free" mean semiconductor products that are compatible with the current RoHS requirements for all 6 substances, including the requirement that lead not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, TI Pb-Free products are suitable for use in specified lead-free processes.

**Pb-Free (RoHS Exempt):** This component has a RoHS exemption for either 1) lead-based flip-chip solder bumps used between the die and package, or 2) lead-based die adhesive used between the die and leadframe. The component is otherwise considered Pb-Free (RoHS compatible) as defined above.

**Green (RoHS & no Sb/Br):** TI defines "Green" to mean Pb-Free (RoHS compatible), and free of Bromine (Br) and Antimony (Sb) based flame retardants (Br or Sb do not exceed 0.1% by weight in homogeneous material)
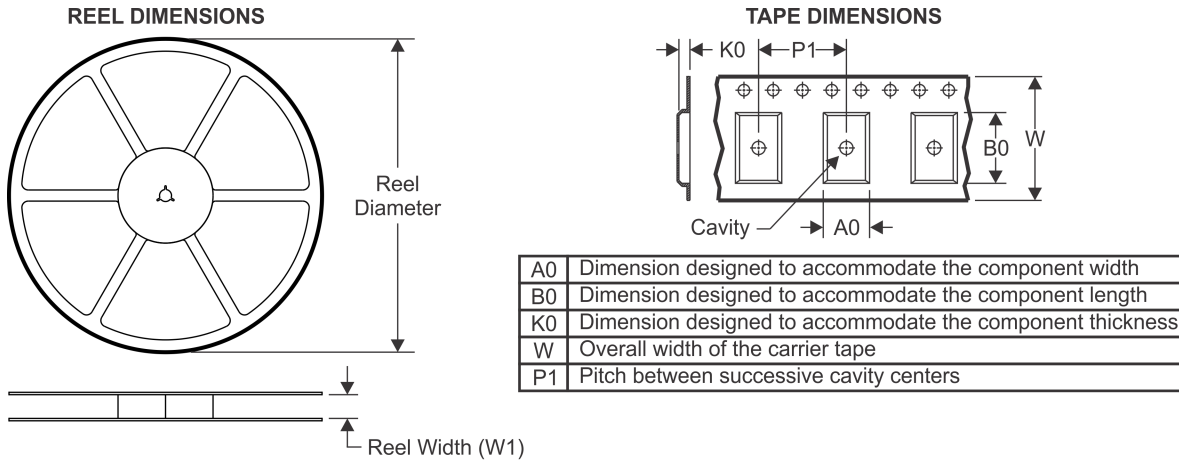
**(3)** MSL, Peak Temp. -- The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

**(4)** Multiple Top-Side Markings will be inside parentheses. Only one Top-Side Marking contained in parentheses and separated by a "~" will appear on a device. If a line is indented then it is a continuation of the previous line and the two combined represent the entire Top-Side Marking for that device.

**Important Information and Disclaimer:**The information provided on this page represents TI's knowledge and belief as of the date that it is provided. TI bases its knowledge and belief on information provided by third parties, and makes no representation or warranty as to the accuracy of such information. Efforts are underway to better integrate information from third parties. TI has taken and continues to take reasonable steps to provide representative and accurate information but may not have conducted destructive testing or chemical analysis on incoming materials and chemicals. TI and TI suppliers consider certain information to be proprietary, and thus CAS numbers and other limited information may not be available for release.

In no event shall TI's liability arising out of such information exceed the total purchase price of the TI part(s) at issue in this document sold by TI to Customer on an annual basis.

# PACKAGE MATERIALS INFORMATION

## TAPE AND REEL INFORMATION

**REEL DIMENSIONS**

**TAPE DIMENSIONS**

| | |
|---|---|
| A0 | Dimension designed to accommodate the component width |
| B0 | Dimension designed to accommodate the component length |
| K0 | Dimension designed to accommodate the component thickness |
| W | Overall width of the carrier tape |
| P1 | Pitch between successive cavity centers |

**QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE**

*All dimensions are nominal

| Device | Package Type | Package Drawing | Pins | SPQ | Reel Diameter (mm) | Reel Width W1 (mm) | A0 (mm) | B0 (mm) | K0 (mm) | P1 (mm) | W (mm) | Pin1 Quadrant |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| INA105KU/2K5 | SOIC | D | 8 | 2500 | 330.0 | 12.4 | 6.4 | 5.2 | 2.1 | 8.0 | 12.0 | Q1 |

![Texas Instruments logo] **PACKAGE MATERIALS INFORMATION**

**TAPE AND REEL BOX DIMENSIONS**



*All dimensions are nominal

| Device | Package Type | Package Drawing | Pins | SPQ | Length (mm) | Width (mm) | Height (mm) |
|---|---|---|---|---|---|---|---|
| INA105KU/2K5 | SOIC | D | 8 | 2500 | 367.0 | 367.0 | 35.0 |

# IMPORTANT NOTICE

Texas Instruments Incorporated and its subsidiaries (TI) reserve the right to make corrections, enhancements, improvements and other changes to its semiconductor products and services per JESD46, latest issue, and to discontinue any product or service per JESD48, latest issue. Buyers should obtain the latest relevant information before placing orders and should verify that such information is current and complete. All semiconductor products (also referred to herein as "components") are sold subject to TI's terms and conditions of sale supplied at the time of order acknowledgment.

TI warrants performance of its components to the specifications applicable at the time of sale, in accordance with the warranty in TI's terms and conditions of sale of semiconductor products. Testing and other quality control techniques are used to the extent TI deems necessary to support this warranty. Except where mandated by applicable law, testing of all parameters of each component is not necessarily performed.

TI assumes no liability for applications assistance or the design of Buyers' products. Buyers are responsible for their products and applications using TI components. To minimize the risks associated with Buyers' products and applications, Buyers should provide adequate design and operating safeguards.

TI does not warrant or represent that any license, either express or implied, is granted under any patent right, copyright, mask work right, or other intellectual property right relating to any combination, machine, or process in which TI components or services are used. Information published by TI regarding third-party products or services does not constitute a license to use such products or services or a warranty or endorsement thereof. Use of such information may require a license from a third party under the patents or other intellectual property of the third party, or a license from TI under the patents or other intellectual property of TI.

Reproduction of significant portions of TI information in TI data books or data sheets is permissible only if reproduction is without alteration and is accompanied by all associated warranties, conditions, limitations, and notices. TI is not responsible or liable for such altered documentation. Information of third parties may be subject to additional restrictions.

Resale of TI components or services with statements different from or beyond the parameters stated by TI for that component or service voids all express and any implied warranties for the associated TI component or service and is an unfair and deceptive business practice. TI is not responsible or liable for any such statements.

Buyer acknowledges and agrees that it is solely responsible for compliance with all legal, regulatory and safety-related requirements concerning its products, and any use of TI components in its applications, notwithstanding any applications-related information or support that may be provided by TI. Buyer represents and agrees that it has all the necessary expertise to create and implement safeguards which anticipate dangerous consequences of failures, monitor failures and their consequences, lessen the likelihood of failures that might cause harm and take appropriate remedial actions. Buyer will fully indemnify TI and its representatives against any damages arising out of the use of any TI components in safety-critical applications.

In some cases, TI components may be promoted specifically to facilitate safety-related applications. With such components, TI's goal is to help enable customers to design and create their own end-product solutions that meet applicable functional safety standards and requirements. Nonetheless, such components are subject to these terms.

No TI components are authorized for use in FDA Class III (or similar life-critical medical equipment) unless authorized officers of the parties have executed a special agreement specifically governing such use.

Only those TI components which TI has specifically designated as military grade or "enhanced plastic" are designed and intended for use in military/aerospace applications or environments. Buyer acknowledges and agrees that any military or aerospace use of TI components which have **not** been so designated is solely at the Buyer's risk, and that Buyer is solely responsible for compliance with all legal and regulatory requirements in connection with such use.

TI has specifically designated certain components as meeting ISO/TS16949 requirements, mainly for automotive use. In any case of use of non-designated products, TI will not be responsible for any failure to meet ISO/TS16949.

| Products | | Applications | |
|---|---|---|---|
| Audio | www.ti.com/audio | Automotive and Transportation | www.ti.com/automotive |
| Amplifiers | amplifier.ti.com | Communications and Telecom | www.ti.com/communications |
| Data Converters | dataconverter.ti.com | Computers and Peripherals | www.ti.com/computers |
| DLP® Products | www.dlp.com | Consumer Electronics | www.ti.com/consumer-apps |
| DSP | dsp.ti.com | Energy and Lighting | www.ti.com/energy |
| Clocks and Timers | www.ti.com/clocks | Industrial | www.ti.com/industrial |
| Interface | interface.ti.com | Medical | www.ti.com/medical |
| Logic | logic.ti.com | Security | www.ti.com/security |
| Power Mgmt | power.ti.com | Space, Avionics and Defense | www.ti.com/space-avionics-defense |
| Microcontrollers | microcontroller.ti.com | Video and Imaging | www.ti.com/video |
| RFID | www.ti-rfid.com | | |
| OMAP Applications Processors | www.ti.com/omap | **TI E2E Community** | e2e.ti.com |
| Wireless Connectivity | www.ti.com/wirelessconnectivity | | |

iCShopping
www.icshop.com.tw