



INA133 INA2133

For most current data sheet and other product information, visit www.burr-brown.com

High-Speed, Precision DIFFERENCE AMPLIFIERS

FEATURES

- DESIGNED FOR LOW COST
- SINGLE, DUAL VERSIONS
- LOW OFFSET VOLTAGE DRIFT: $\pm 450\mu\text{V}$ max, $\pm 5\mu\text{V}/^\circ\text{C}$ max
- LOW GAIN ERROR: 0.05% max
- WIDE BANDWIDTH: 1.5MHz
- HIGH SLEW RATE: 5V/ μs
- FAST SETTLING TIME: 5.5 μs to 0.01%
- LOW QUIESCENT CURRENT: 950 μA
- WIDE SUPPLY RANGE: $\pm 2.25\text{V}$ to $\pm 18\text{V}$
- SO-8 and SO-14 PACKAGES

DESCRIPTION

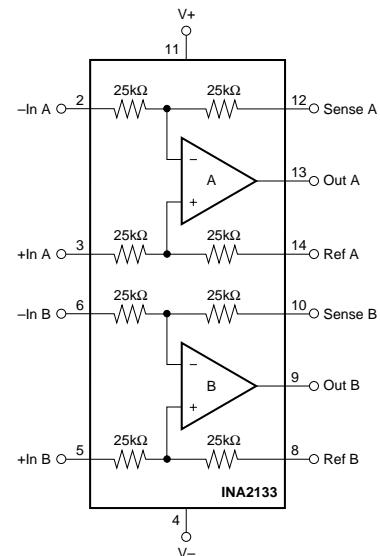
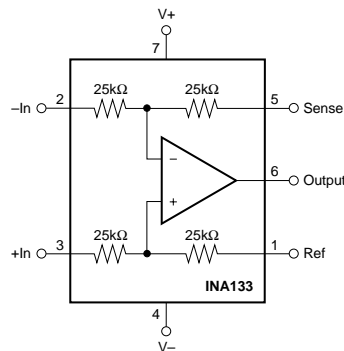
The INA133 and INA2133 are high slew rate, unity-gain difference amplifiers consisting of a precision op amp with a precision resistor network. The on-chip resistors are laser trimmed for accurate gain and high common-mode rejection. Excellent TCR tracking of the resistors maintains gain accuracy and common-mode rejection over temperature. They operate over a wide supply range, $\pm 2.25\text{V}$ to $\pm 18\text{V}$ ($+4.5\text{V}$ to $+36\text{V}$ single supply), and input common-mode voltage range extends beyond the positive and negative supply rails.

APPLICATIONS

- DIFFERENTIAL INPUT AMPLIFIER BUILDING BLOCK
- DIFF IN/DIFF OUT AMPLIFIER
- UNITY-GAIN INVERTING AMPLIFIER
- GAIN = +1/2 OR G = +2 AMPLIFIER
- SUMMING AMPLIFIER
- SYNCHRONOUS DEMODULATOR
- CURRENT/DIFFERENTIAL LINE RECEIVER
- VOLTAGE-CONTROLLED CURRENT SOURCE
- BATTERY POWERED SYSTEMS
- LOW COST AUTOMOTIVE

The differential amplifier is the foundation of many commonly used circuits. The low cost INA133 and INA2133 provide this precision circuit function without using an expensive precision network.

The single version, INA133, package is the SO-8 surface mount. The dual version, INA2133, package is the SO-14 surface mount. Both are specified for operation over the extended industrial temperature range, -40°C to $+85^\circ\text{C}$. Operation is from -55°C to $+125^\circ\text{C}$.



International Airport Industrial Park • Mailing Address: PO Box 11400, Tucson, AZ 85734 • Street Address: 6730 S. Tucson Blvd., Tucson, AZ 85706 • Tel: (520) 746-1111
Twx: 910-952-1111 • Internet: <http://www.burr-brown.com/> • Cable: BBRCORP • Telex: 066-6491 • FAX: (520) 889-1510 • Immediate Product Info: (800) 548-6132

SPECIFICATIONS: $V_S = \pm 15V$

At $T_A = +25^\circ C$, $V_S = \pm 15V$, $R_L = 10k\Omega$ connected to ground, and reference pin connected to ground, unless otherwise noted.

| PARAMETER | CONDITIONS | INA133U INA2133U | | | INA133UA INA2133UA | | | UNITS |
|--|---|----------------------------|---|---------------------------------------|-----------------------|------------------------------------|-------------------------------|--|
| | | MIN | TYP | MAX | MIN | TYP | MAX | |
| OFFSET VOLTAGE⁽¹⁾ Initial ⁽¹⁾ vs Temperature vs Power Supply vs Time Channel Separation (dual) | RTO $V_{CM} = 0V$ $T_A = -40^\circ C$ to $+85^\circ C$ $V_S = \pm 2.25V$ to $\pm 18V$ dc | | ± 150 ± 2 ± 10 0.3 120 | ± 450 ± 5 ± 30 | | * See Typical Curve 900 * | ± 900 ± 50 | μV $\mu V/^\circ C$ $\mu V/V$ $\mu V/\sqrt{m\Omega}$ dB |
| INPUT IMPEDANCE⁽²⁾ Differential Common-Mode | $V_{CM} = 0V$ | | 50 25 | | | * * | | k Ω k Ω |
| INPUT VOLTAGE RANGE Common-Mode Voltage Range Positive Negative Common-Mode Rejection Ratio | $V_O = 0V$ $V_O = 0V$ $V_{CM} = -27V$ to $+27V$, $R_S = 0\Omega$ | 2(V+) -3 2(V-) +3 80 | 2(V+) -2 2(V-) +2 90 | | * * | * * | | V V dB |
| OUTPUT VOLTAGE NOISE⁽³⁾ f = 0.1Hz to 10Hz f = 10Hz f = 100Hz f = 1kHz | RTO | | 2 80 60 57 | | | * * * * | | μV_{p-p} nV/ \sqrt{Hz} nV/ \sqrt{Hz} nV/ \sqrt{Hz} |
| GAIN Initial Error vs Temperature Nonlinearity | $V_O = -14V$ to $+13.5V$ $T_A = -40^\circ C$ to $+85^\circ C$ $V_O = -14V$ to $+13.5V$ | | 1 ± 0.02 ± 1 ± 0.0001 | ± 0.05 ± 10 ± 0.001 | | * * * * | ± 0.1 * ± 0.002 | V/V % ppm/ $^\circ C$ % of FS |
| OUTPUT Voltage Output Positive Negative Positive Negative Current Limit, Continuous-to-Common Capacitive Load (stable operation) | Gain Error < 0.1% $R_L = 10k\Omega$ to Ground $R_L = 10k\Omega$ to Ground $R_L = 100k\Omega$ to Ground $R_L = 100k\Omega$ to Ground | (V+) -1.5 (V-) +1 | (V+) -1.3 (V-) +0.8 (V+) -0.8 (V-) +0.3 -25/+32 1000 | | * * | * * * * * | | V V V V mA pF |
| FREQUENCY RESPONSE Small-Signal Bandwidth Slew Rate Settling Time: 0.1% 0.01% Overload Recovery Time | -3dB 10V Step, $C_L = 100pF$ 10V Step, $C_L = 100pF$ 50% Overdrive | | 1.5 5 4 5.5 4 | | | * * * * * | | MHz V/ μs μs μs μs |
| POWER SUPPLY Rated Voltage Operating Voltage Range Dual Supplies Single Supply Quiescent Current (per amplifier) | $I_O = 0$ | | ± 15 ± 2.25 +4.5 ± 0.95 | ± 18 ± 36 ± 1.2 | | * * * | * * * | V V V mA |
| TEMPERATURE RANGE Specification Operation Storage Thermal Resistance SO-8 Surface Mount SO-14 Surface Mount | θ_{JA} | -40 -55 -55 | | +85 +125 +125 | * * * | | * * * | $^\circ C$ $^\circ C$ $^\circ C$ $^\circ C/W$ $^\circ C/W$ |

* Specifications the same as INA133U, INA2133U.

NOTES: (1) Includes the effects of amplifier's input bias and offset currents. (2) 25k Ω resistors are ratio matched but have $\pm 20\%$ absolute value. (3) Includes effects of amplifier's input current noise and thermal noise contribution of resistor network.

The information provided herein is believed to be reliable; however, BURR-BROWN assumes no responsibility for inaccuracies or omissions. BURR-BROWN assumes no responsibility for the use of this information, and all use of such information shall be entirely at the user's own risk. Prices and specifications are subject to change without notice. No patent rights or licenses to any of the circuits described herein are implied or granted to any third party. BURR-BROWN does not authorize or warrant any BURR-BROWN product for use in life support devices and/or systems.

SPECIFICATIONS: $V_S = \pm 5V$

At $T_A = +25^\circ C$, $V_S = \pm 5V$, $R_L = 10k\Omega$ connected to ground, and reference pin connected to ground, unless otherwise noted.

| PARAMETER | CONDITIONS | INA133U INA2133U | | | INA133UA INA2133UA | | | UNITS |
|--|---|----------------------------------|--|---------------------------|-----------------------|-----|--------------------------|-----------------------------|
| | | MIN | TYP | MAX | MIN | TYP | MAX | |
| OFFSET VOLTAGE⁽¹⁾ Initial ⁽¹⁾ vs Temperature | RTO $V_{CM} = 0V$ | | ± 300 ± 2 | ± 750 | | * | ± 1500 | μV $\mu V/^\circ C$ |
| INPUT VOLTAGE RANGE Common-Mode Voltage Range Positive Negative Common-Mode Rejection Ratio | $V_O = 0V$ $V_O = 0V$ $V_{CM} = -7V$ to $+7V$, $R_S = 0\Omega$ | $2(V+) - 3$ $2(V-) + 3$ 80 | $2(V+) - 2$ $2(V-) + 2$ 90 | | * | * | | V V dB |
| GAIN Initial Gain Error Nonlinearity | $V_O = -4V$ to $3.5V$ $V_O = -4V$ to $3.5V$ | | 1 ± 0.02 ± 0.0001 | ± 0.05 ± 0.001 | | * | ± 0.1 ± 0.002 | V/V % % of FS |
| OUTPUT Voltage Output Positive Negative Positive Negative | Gain Error < 0.1% $R_L = 10k\Omega$ to Ground $R_L = 10k\Omega$ to Ground $R_L = 100k\Omega$ to Ground $R_L = 100k\Omega$ to Ground | $(V+) - 1.5$ $(V-) + 1$ | $(V+) - 1.3$ $(V-) + 0.8$ $(V+) - 0.8$ $(V-) + 0.3$ | | * | * | | V V V V |
| POWER SUPPLY Rated Voltage Operating Voltage Range Dual Supplies Single Supply Quiescent Current (per amplifier) | $I_O = 0$ | | ± 15 | | | * | | V V V mA |

* Specifications the same as INA133U, INA2133U.

NOTES: (1) Includes the effects of amplifier's input bias and offset currents.

ABSOLUTE MAXIMUM RATINGS⁽¹⁾

| | |
|---|---------------------------------|
| Supply Voltage, $V+$ to $V-$ | 36V |
| Input Voltage Range | $2 \cdot V_S$ |
| Output Short-Circuit (to ground) ⁽²⁾ | Continuous |
| Operating Temperature | $-55^\circ C$ to $+125^\circ C$ |
| Storage Temperature | $-55^\circ C$ to $+125^\circ C$ |
| Junction Temperature | $+150^\circ C$ |
| Lead Temperature (soldering, 10s) | $+300^\circ C$ |

NOTES: (1) Stresses above these ratings may cause permanent damage. Exposure to absolute maximum conditions for extended periods may degrade device reliability. (2) One channel per package.



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.

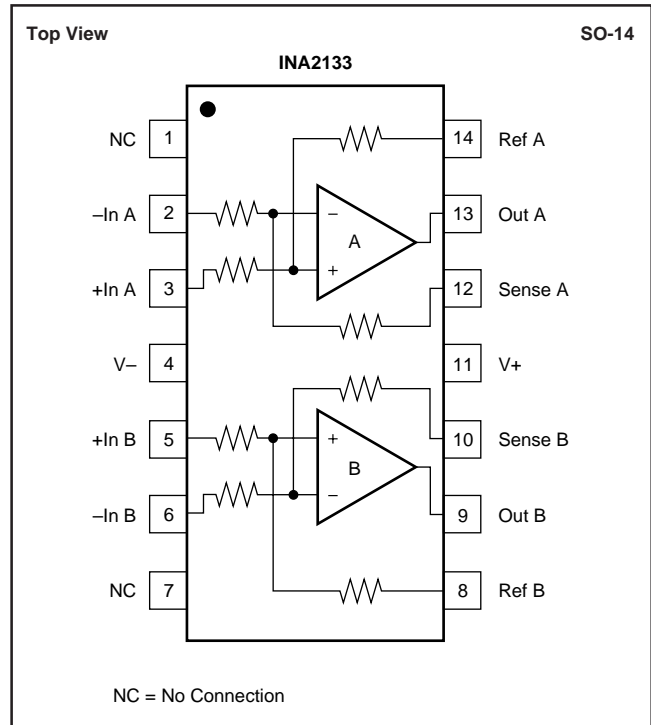
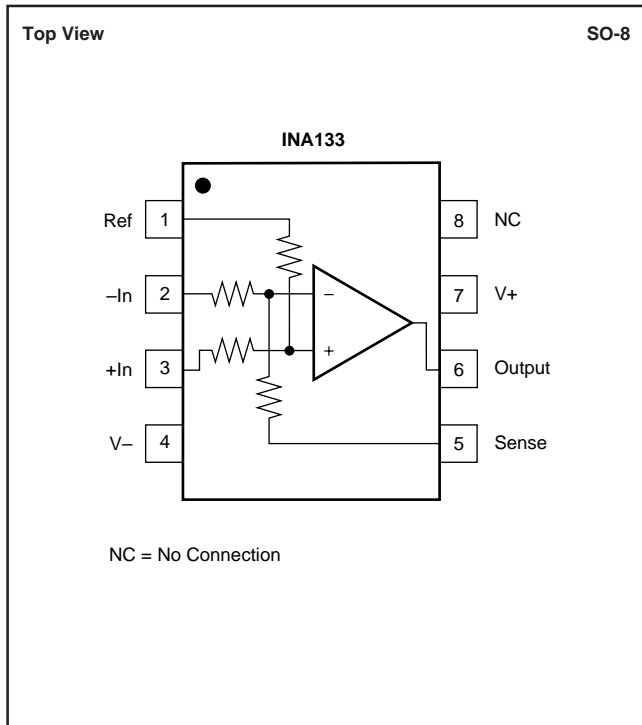
ESD damage can range from subtle performance degradation to complete device failure. Precision integrated circuits may be more susceptible to damage because very small parametric changes could cause the device not to meet its published specifications.

PACKAGE/ORDERING INFORMATION

| PRODUCT | PACKAGE | PACKAGE DRAWING NUMBER ⁽¹⁾ | SPECIFIED TEMPERATURE RANGE | PACKAGE MARKING | ORDERING NUMBER ⁽²⁾ | TRANSPORT MEDIA |
|--------------------------|---------------------|---------------------------------------|--------------------------------|-----------------|--------------------------------|-----------------|
| Single INA133U | SO-8 Surface Mount | 182 | $-40^\circ C$ to $+85^\circ C$ | INA133U | INA133U | Rails |
| " | " | " | " | " | INA133U/2K5 | Tape and Reel |
| INA133UA | SO-8 Surface Mount | 182 | $-40^\circ C$ to $+85^\circ C$ | INA133UA | INA133UA | Rails |
| " | " | " | " | " | INA133UA/2K5 | Tape and Reel |
| Dual INA2133U | SO-14 Surface Mount | 235 | $-40^\circ C$ to $+85^\circ C$ | INA2133U | INA2133U | Rails |
| " | " | " | " | " | INA2133U/2K5 | Tape and Reel |
| INA2133UA | SO-14 Surface Mount | 235 | $-40^\circ C$ to $+85^\circ C$ | INA2133UA | INA2133UA | Rails |
| " | " | " | " | " | INA2133UA/2K5 | Tape and Reel |

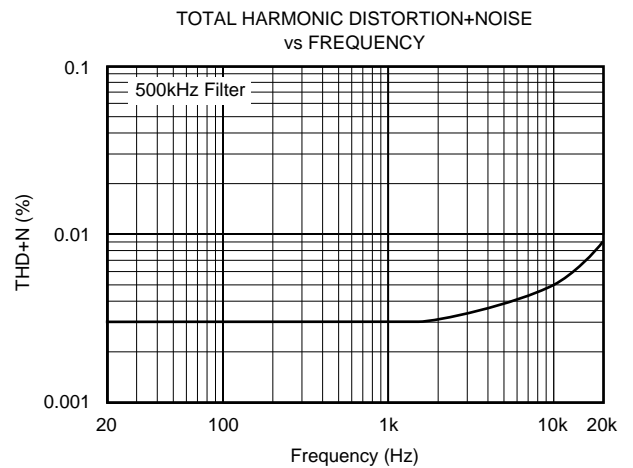
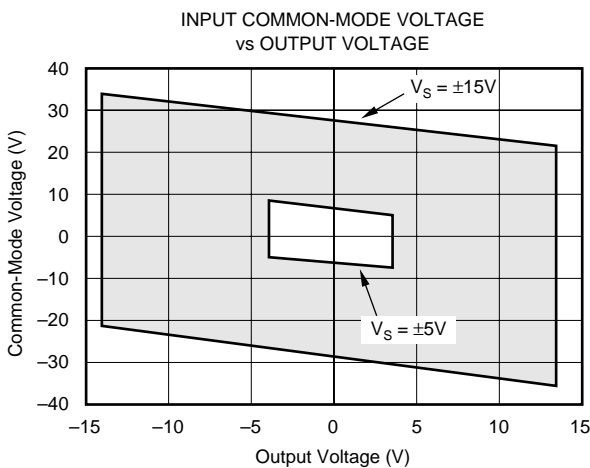
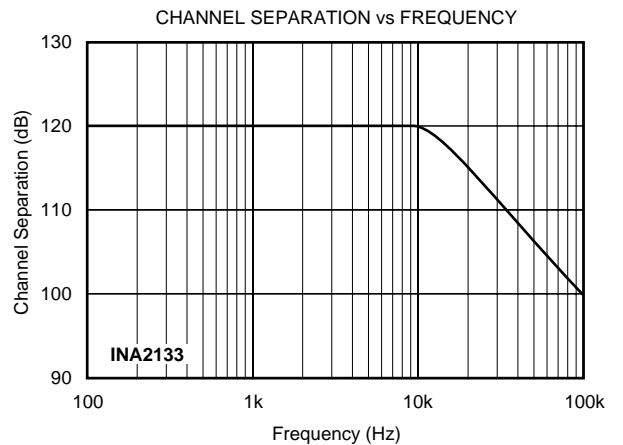
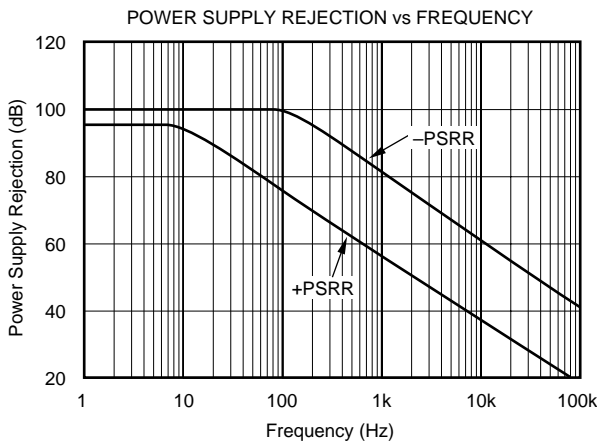
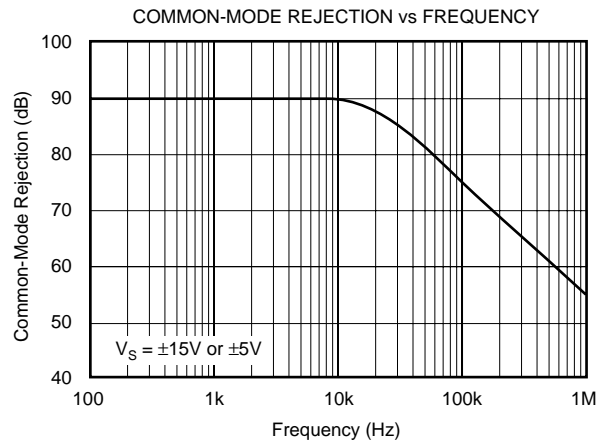
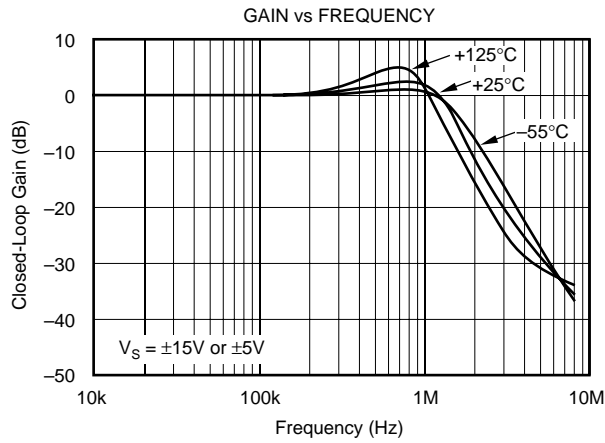
NOTES: (1) For detailed drawing and dimension table, please see end of data sheet, or Appendix C of Burr-Brown IC Data Book. (2) Models with a slash (/) are available only in Tape and Reel in the quantities indicated (e.g., /2K5 indicates 2500 devices per reel). Ordering 2500 pieces of "INA133UA/2K5" will get a single 2500-piece Tape and Reel. For detailed Tape and Reel mechanical information, refer to Appendix B of Burr-Brown IC Data Book.

PIN CONFIGURATIONS



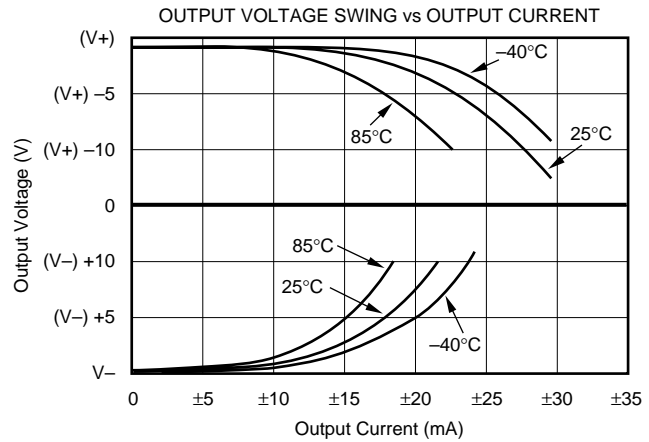
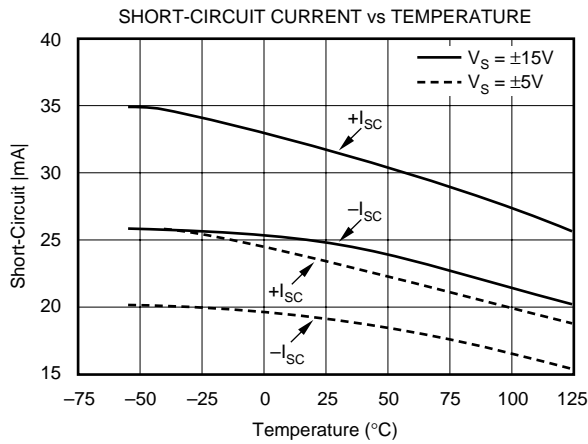
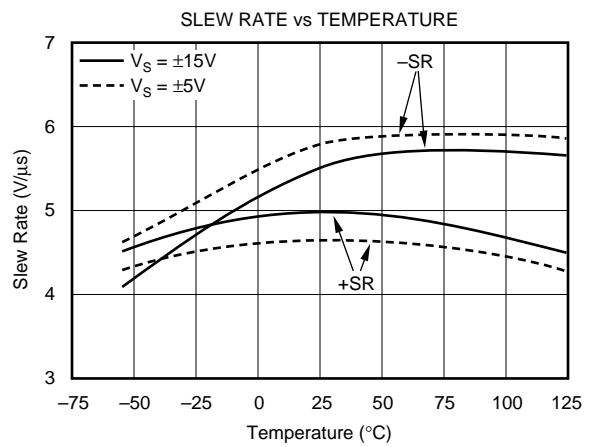
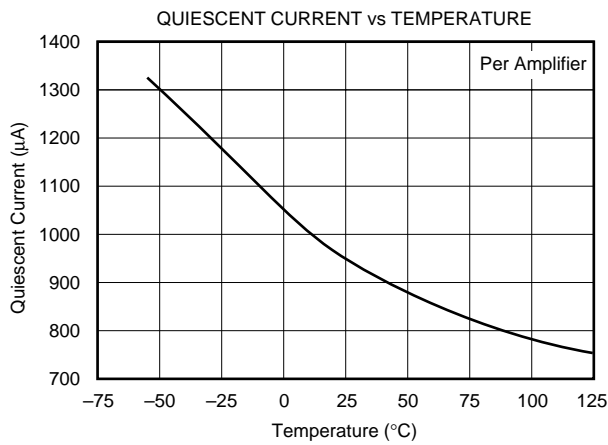
TYPICAL PERFORMANCE CURVES

At $T_A = +25^\circ\text{C}$, $V_S = \pm 15\text{V}$, $R_L = 10\text{k}\Omega$ connected to ground, and reference pin connected to ground, unless otherwise noted.



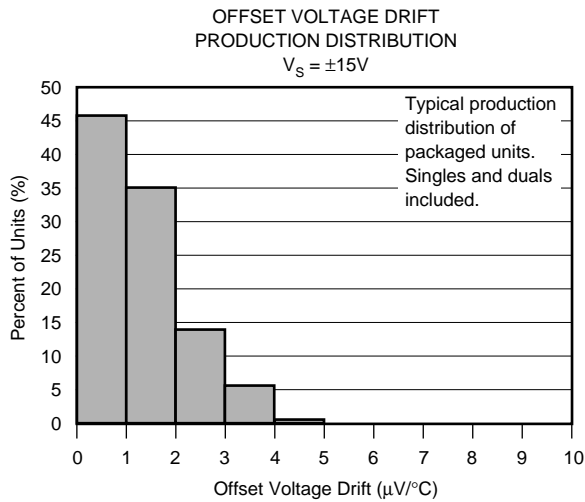
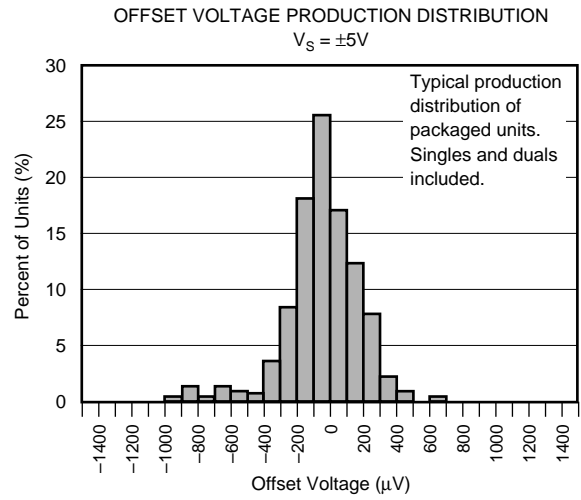
TYPICAL PERFORMANCE CURVES (CONT)

At $T_A = +25^\circ\text{C}$, $V_S = \pm 15\text{V}$, $R_L = 10\text{k}\Omega$ connected to ground, and reference pin connected to ground, unless otherwise noted.



TYPICAL PERFORMANCE CURVES (CONT)

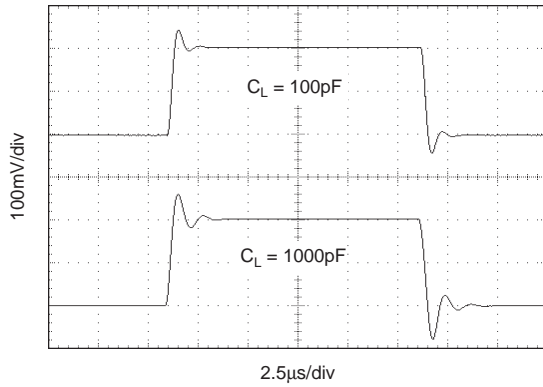
At $T_A = +25^\circ\text{C}$, $V_S = \pm 15\text{V}$, $R_L = 10\text{k}\Omega$ connected to ground, and reference pin connected to ground, unless otherwise noted.



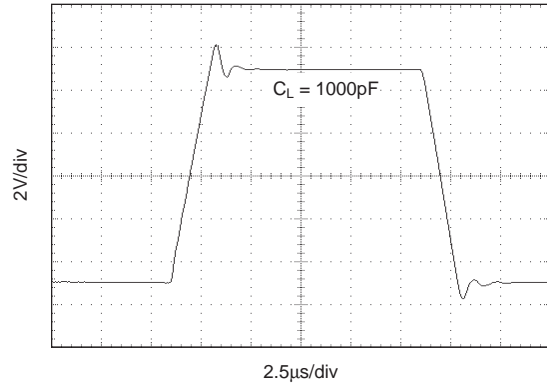
TYPICAL PERFORMANCE CURVES (CONT)

At $T_A = +25^\circ\text{C}$, $V_S = \pm 15\text{V}$, $R_L = 10\text{k}\Omega$ connected to ground, and reference pin connected to ground, unless otherwise noted.

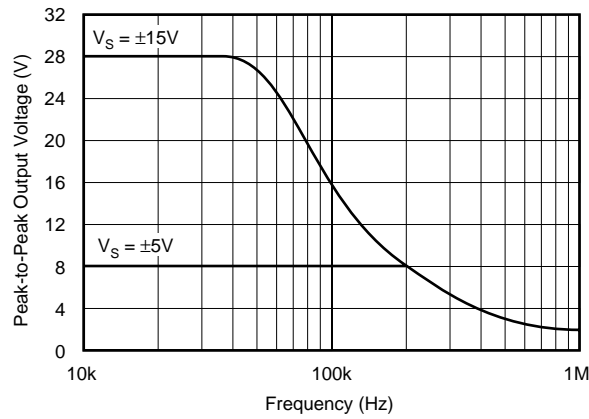
SMALL-SIGNAL STEP RESPONSE



LARGE-SIGNAL STEP RESPONSE



MAXIMUM OUTPUT VOLTAGE vs FREQUENCY



APPLICATIONS INFORMATION

The INA133 and INA2133 are high-speed difference amplifiers suitable for a wide range of general purpose applications. Figure 1 shows the basic connections required for operation of the INA133. Decoupling capacitors are strongly recommended in applications with noisy or high impedance power supplies. The capacitors should be placed close to the device pins as shown in Figure 1. All circuitry is completely independent in the dual version assuring lowest crosstalk and normal behavior when one amplifier is overdriven or short-circuited.

As shown in Figure 1, the differential input signal is connected to pins 2 and 3. 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 (a 10Ω mismatch degrades CMR to 74dB). If the source has a known impedance mismatch, an additional resistor in series with the opposite input can be used to preserve good common-mode rejection.

The INA133's internal resistors are accurately ratio trimmed to match. That is, R_1 is trimmed to match R_2 and R_3 is trimmed to match R_4 . However, the absolute values may not be equal ($R_1 + R_2$ may be slightly different than $R_3 + R_4$). Thus, large series resistors on the input (greater than 250Ω), even if well matched, will degrade common-mode rejection.

Circuit board layout constraints might suggest possible variations in connections of the internal resistors. For instance, it appears that pins 1 and 3 could be interchanged. However, because of the ratio trimming technique used (see paragraph above) CMRR will be degraded. If pins 1 and 3 are inter-

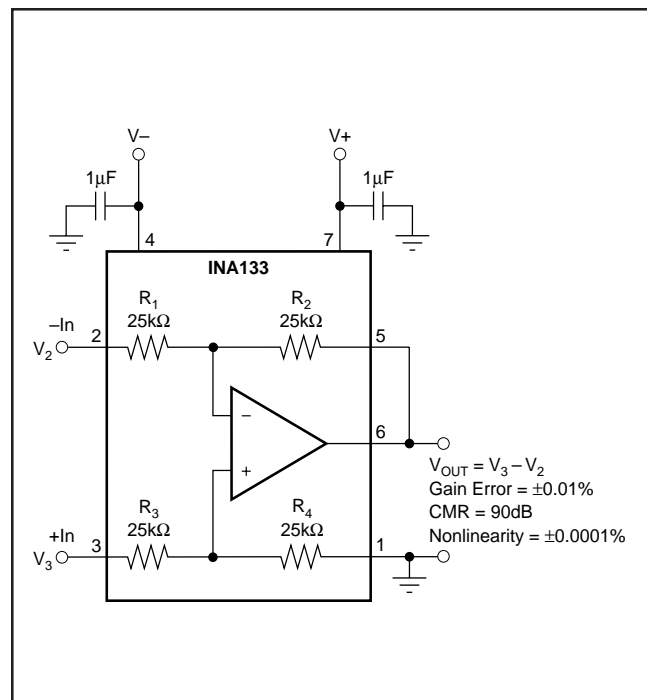


FIGURE 1. Precision Difference Amplifier (Basic Power Supply and Signal Connections).

changed, pins 2 and 5 must also be interchanged to maintain proper ratio matching.

OPERATING VOLTAGE

The INA133 and INA2133 operate from single (+4.5V to +36V) or dual ($\pm 2.25V$ to $\pm 18V$) supplies with excellent performance. Specifications are production tested with $\pm 5V$ and $\pm 15V$ supplies. Most behavior remains unchanged throughout the full operating voltage range. Parameters which vary significantly with operating voltage are shown in the Typical Performance Curves.

INPUT VOLTAGE

The INA133 and INA2133 can accurately measure differential signals that are above and below the supply rails. Linear common-mode range extends from $2 \cdot (V+) - 3V$ to $2 \cdot (V-) + 3V$ (nearly twice the supplies). See the typical performance curve, "Input Common-Mode Voltage vs Output Voltage."

OFFSET VOLTAGE TRIM

The INA133 and INA2133 are laser trimmed for low offset voltage and drift. Most applications require no external offset adjustment. Figure 2 shows an optional circuit for trimming the output offset voltage. 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.

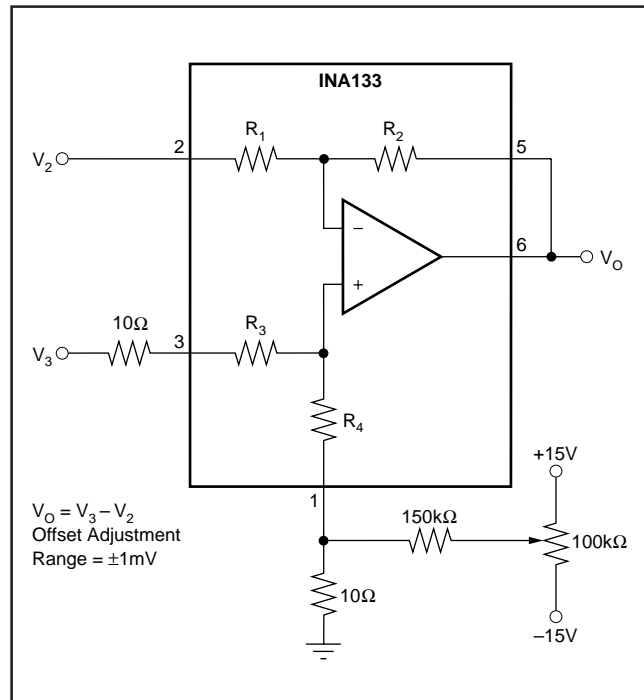


FIGURE 2. Offset Adjustment.

TYPICAL APPLICATIONS



| A ₁ , A ₂ | FEATURE | SIMILAR COMPLETE BURR-BROWN IA |
|---------------------------------|-------------------------------------|--------------------------------|
| OPA2227 | Low Noise | INA103 |
| OPA129 | Ultra Low Bias Current (fA) | INA116 |
| OPA2277 | Low Offset Drift, Low Noise | INA114, INA128 |
| OPA2130 | Low Power, FET-Input (pA) | INA121 |
| OPA2234 | Single Supply, Precision, Low Power | INA122, INA118 |
| OPA2237 | Single Supply, Low Power, MSOP-8 | INA122, INA126 |

FIGURE 3. Precision Instrumentation Amplifier.



FIGURE 4. Current Receiver with Compliance to Rails.

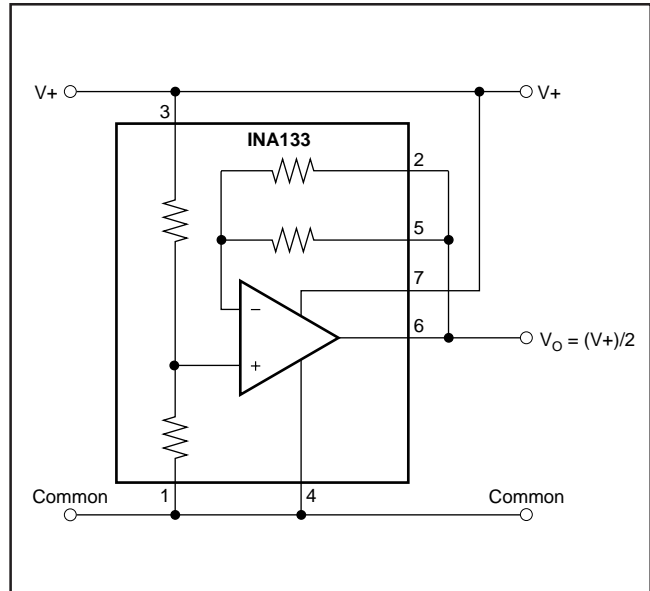


FIGURE 5. Pseudoground Generator.



FIGURE 6. Precision Unity-Gain Inverting Amplifier.



FIGURE 7. Precision Gain = 2 Amplifier.



FIGURE 8. Precision Gain = 1/2 Amplifier.

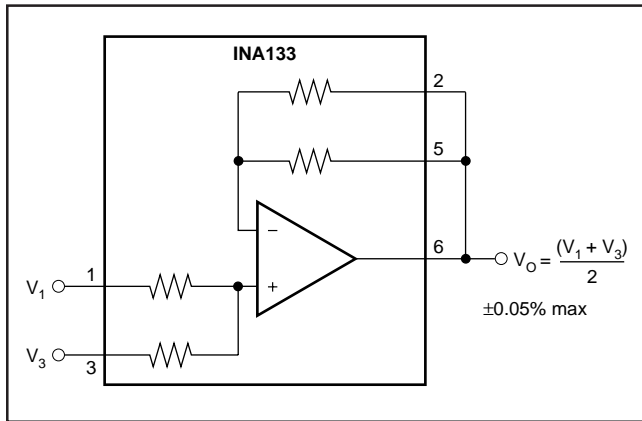


FIGURE 9. Precision Average Value Amplifier.

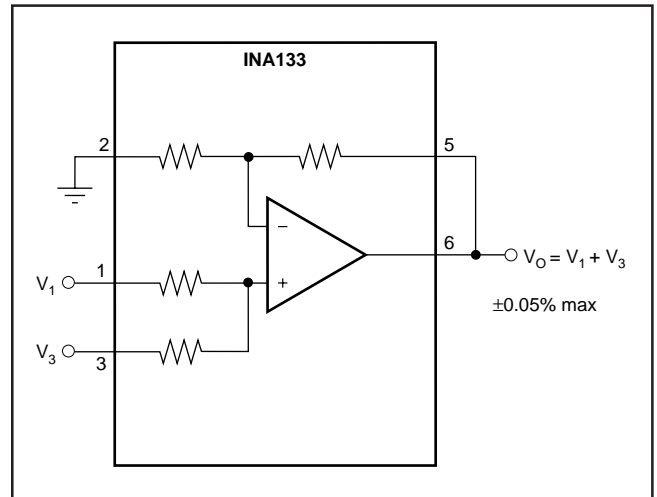


FIGURE 10. Precision Summing Amplifier.

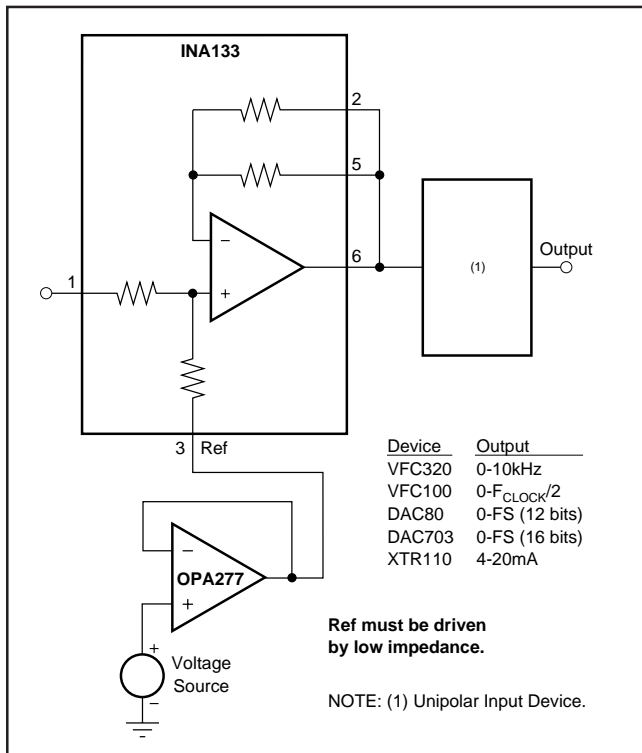


FIGURE 11. Precision Bipolar Offsetting.

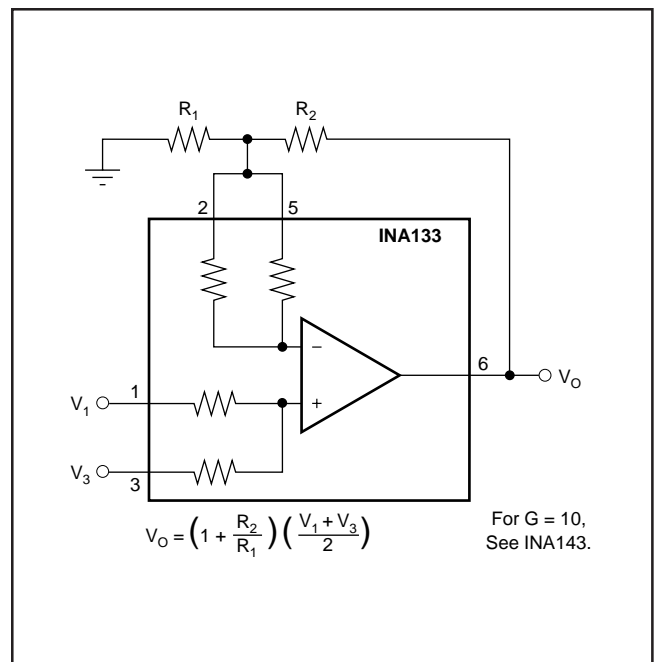


FIGURE 12. Precision Summing Amplifier with Gain.



FIGURE 13. Instrumentation Amplifier Guard Drive Generator.

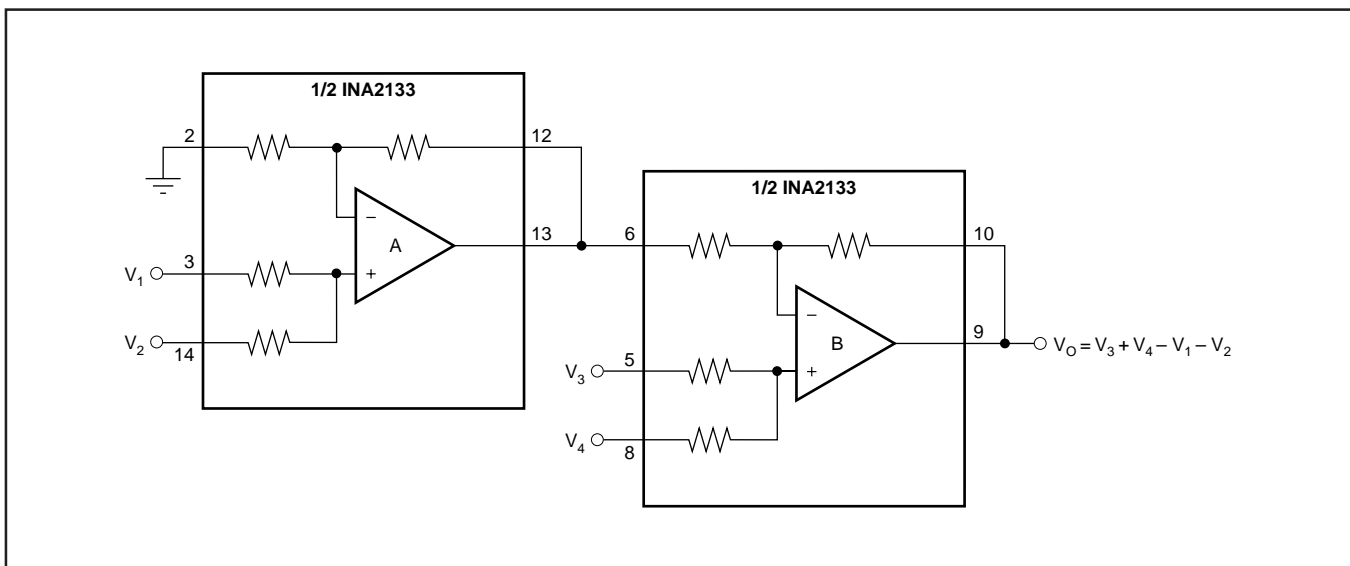


FIGURE 14. Precision Summing Instrumentation Amplifier.



FIGURE 15. Precision Voltage-to-Current Converter with Differential Inputs.



FIGURE 16. Differential Input Voltage-to-Current Converter for Low I_{OUT} .



FIGURE 17. Isolating Current Source.



FIGURE 18. Differential Output Difference Amplifier.



FIGURE 19. Isolating Current Source with Buffering Amplifier for Greater Accuracy.

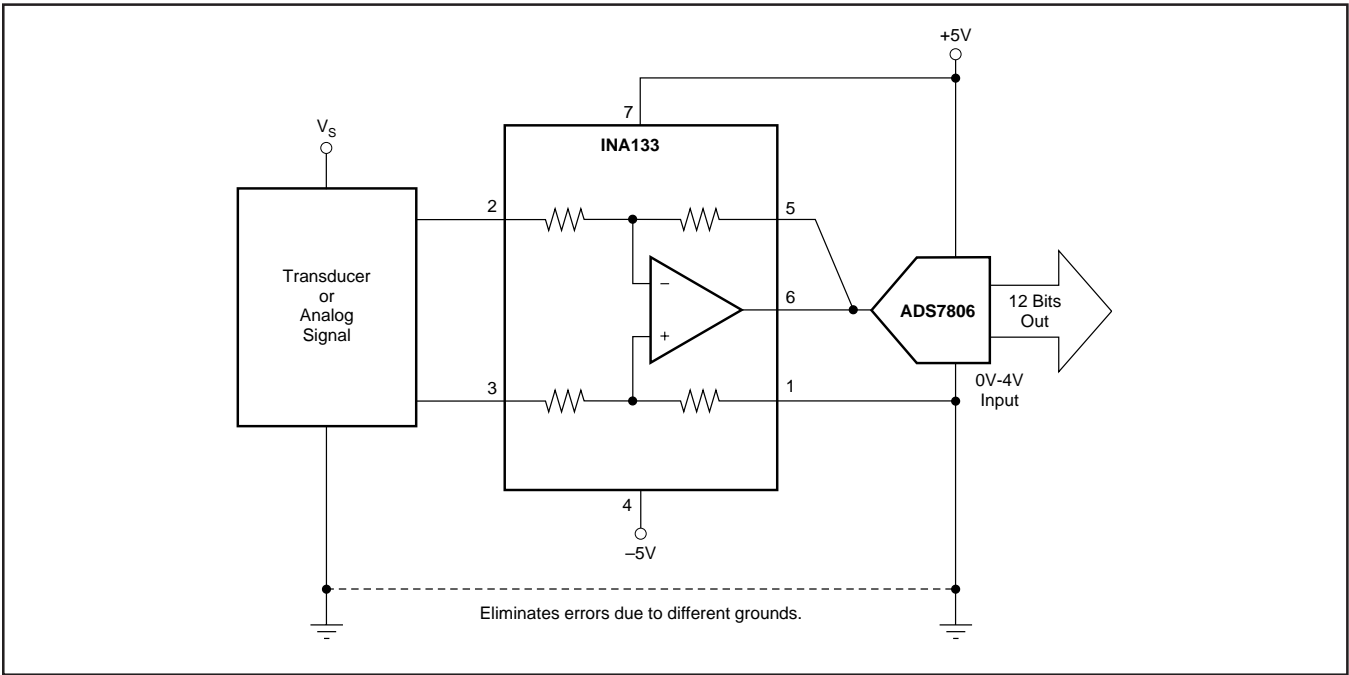


FIGURE 20. Differential Input Data Acquisition.

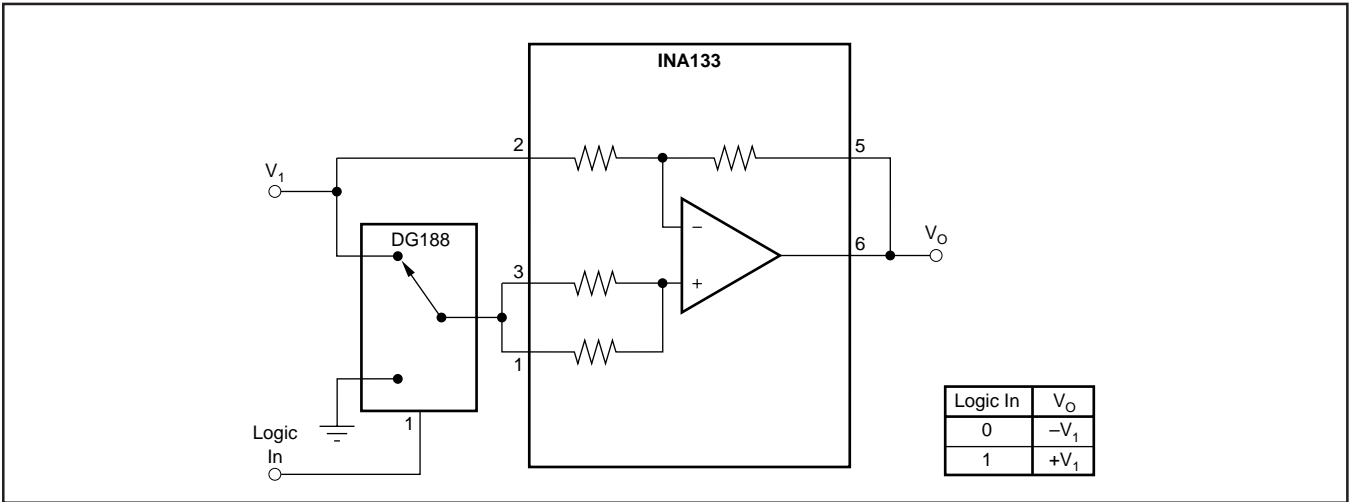


FIGURE 21. Digitally Controlled Gain of ± 1 Amplifier.

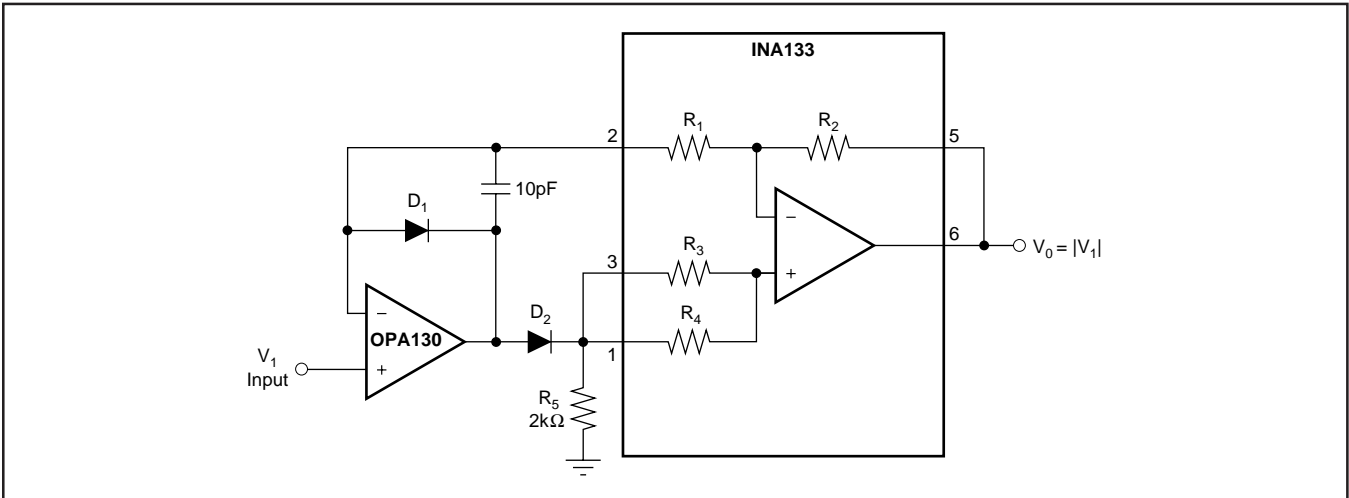


FIGURE 22. Precision Absolute Value Buffer.

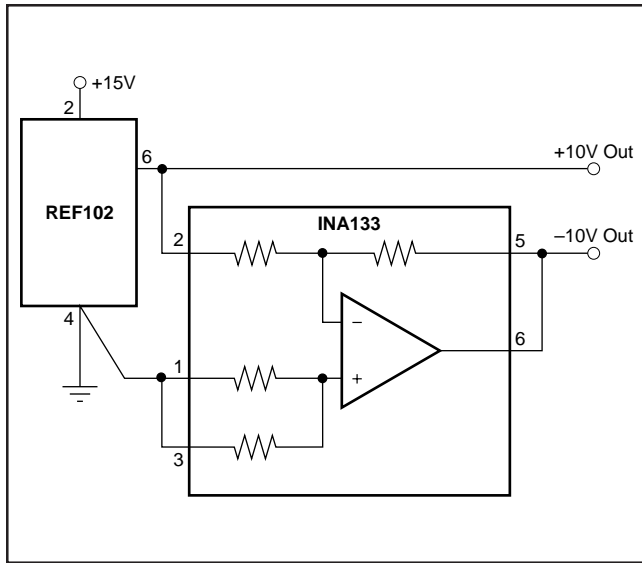


FIGURE 23. ±10V Precision Voltage Reference.

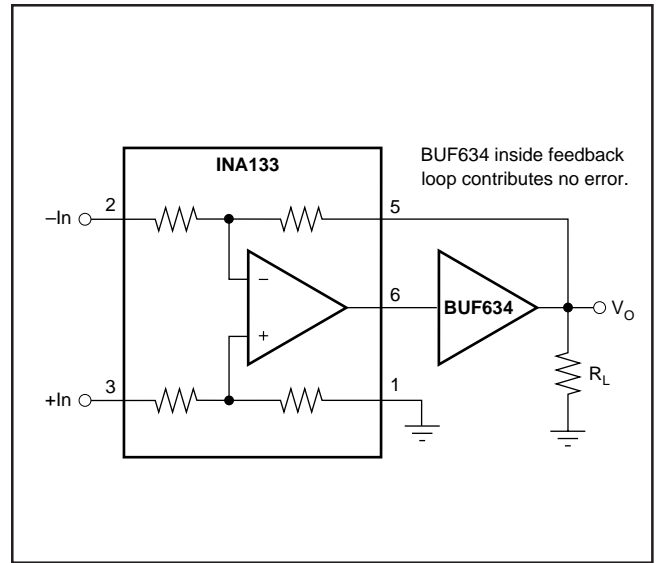


FIGURE 24. High Output Current Precision Difference Amplifier.

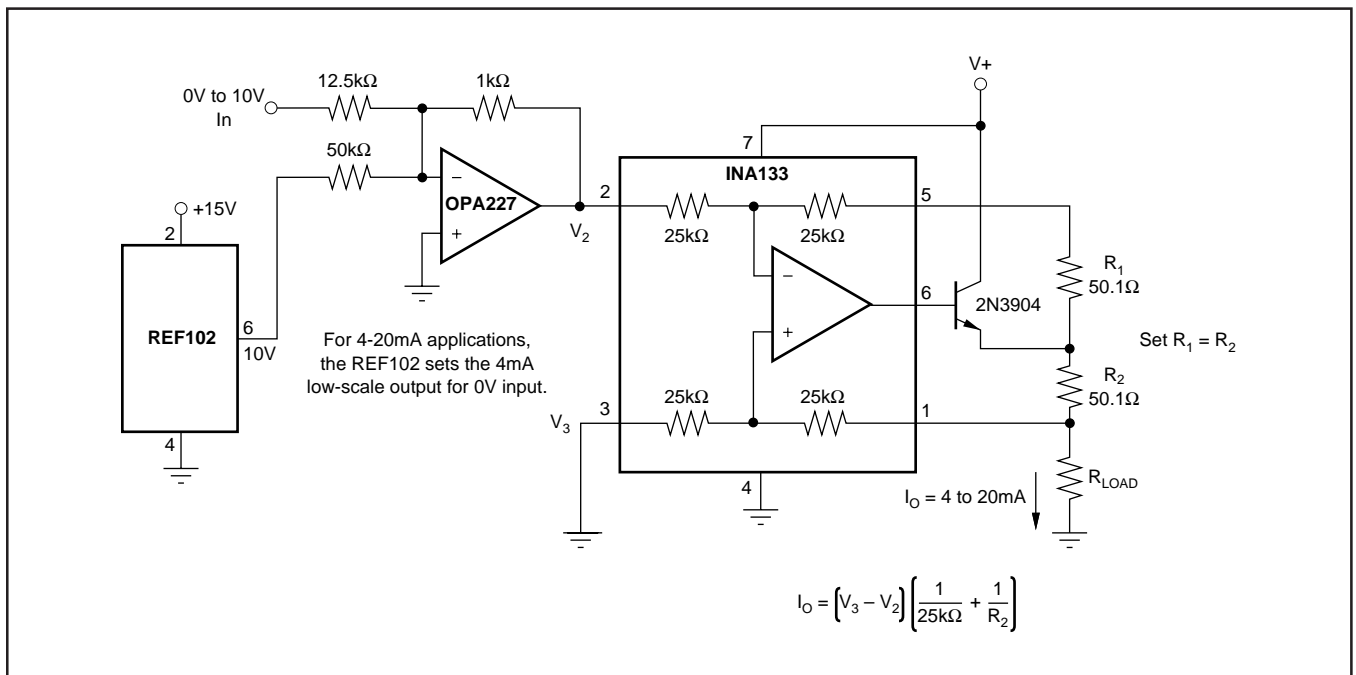


FIGURE 25. Precision Voltage-to-Current Conversion.

PACKAGING INFORMATION

| Orderable Device | Status (1) | Package Type | Package Drawing | Pins | Package Qty | Eco Plan (2) | Lead finish/ Ball material (6) | MSL Peak Temp (3) | Op Temp (°C) | Device Marking (4/5) | Samples |
|------------------|---------------|--------------|-----------------|------|-------------|-----------------|--------------------------------------|----------------------|--------------|-------------------------|-------------------------|
| INA133U | ACTIVE | SOIC | D | 8 | 75 | RoHS & Green | Call TI | Level-3-260C-168 HR | -40 to 85 | INA 133U | Samples |
| INA133U/2K5 | ACTIVE | SOIC | D | 8 | 2500 | RoHS & Green | Call TI | Level-3-260C-168 HR | | INA 133U | Samples |
| INA133UA | ACTIVE | SOIC | D | 8 | 75 | RoHS & Green | Call TI | Level-3-260C-168 HR | | INA 133U A | Samples |
| INA133UA/2K5 | ACTIVE | SOIC | D | 8 | 2500 | RoHS & Green | NIPDAU | Level-3-260C-168 HR | | INA 133U A | Samples |
| INA133UE4 | ACTIVE | SOIC | D | 8 | 75 | RoHS & Green | Call TI | Level-3-260C-168 HR | -40 to 85 | INA 133U | Samples |
| INA2133U | ACTIVE | SOIC | D | 14 | 50 | RoHS & Green | Call TI | Level-3-260C-168 HR | -55 to 125 | INA2133U | Samples |
| INA2133UA | ACTIVE | SOIC | D | 14 | 50 | RoHS & Green | Call TI | Level-3-260C-168 HR | -55 to 125 | INA2133U A | Samples |
| INA2133UE4 | ACTIVE | SOIC | D | 14 | 50 | RoHS & Green | Call TI | Level-3-260C-168 HR | -55 to 125 | INA2133U | 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.

OBSELETE: TI has discontinued the production of the device.

(2) **RoHS:** TI defines "RoHS" to mean semiconductor products that are compliant with the current EU RoHS requirements for all 10 RoHS substances, including the requirement that RoHS substance do not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, "RoHS" products are suitable for use in specified lead-free processes. TI may reference these types of products as "Pb-Free".

RoHS Exempt: TI defines "RoHS Exempt" to mean products that contain lead but are compliant with EU RoHS pursuant to a specific EU RoHS exemption.

Green: TI defines "Green" to mean the content of Chlorine (Cl) and Bromine (Br) based flame retardants meet JS709B low halogen requirements of <=1000ppm threshold. Antimony trioxide based flame retardants must also meet the <=1000ppm threshold requirement.

(3) MSL, Peak Temp. - The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

(4) There may be additional marking, which relates to the logo, the lot trace code information, or the environmental category on the device.

⁽⁵⁾ Multiple Device Markings will be inside parentheses. Only one Device 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 Device Marking for that device.

⁽⁶⁾ Lead finish/Ball material - Orderable Devices may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead finish/Ball material values may wrap to two lines if the finish value exceeds the maximum column width.

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.

TAPE AND REEL INFORMATION

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 |
|--------------|--------------|-----------------|------|------|--------------------|--------------------|---------|---------|---------|---------|--------|---------------|
| INA133U/2K5 | SOIC | D | 8 | 2500 | 330.0 | 12.4 | 6.4 | 5.2 | 2.1 | 8.0 | 12.0 | Q1 |
| INA133UA/2K5 | SOIC | D | 8 | 2500 | 330.0 | 12.4 | 6.4 | 5.2 | 2.1 | 8.0 | 12.0 | Q1 |

TAPE AND REEL BOX DIMENSIONS


*All dimensions are nominal

| Device | Package Type | Package Drawing | Pins | SPQ | Length (mm) | Width (mm) | Height (mm) |
|--------------|--------------|-----------------|------|------|-------------|------------|-------------|
| INA133U/2K5 | SOIC | D | 8 | 2500 | 356.0 | 356.0 | 35.0 |
| INA133UA/2K5 | SOIC | D | 8 | 2500 | 367.0 | 367.0 | 35.0 |

TUBE


*All dimensions are nominal

| Device | Package Name | Package Type | Pins | SPQ | L (mm) | W (mm) | T (μm) | B (mm) |
|------------|--------------|--------------|------|-----|--------|--------|--------|--------|
| INA133U | D | SOIC | 8 | 75 | 506.6 | 8 | 3940 | 4.32 |
| INA133UA | D | SOIC | 8 | 75 | 506.6 | 8 | 3940 | 4.32 |
| INA133UE4 | D | SOIC | 8 | 75 | 506.6 | 8 | 3940 | 4.32 |
| INA2133U | D | SOIC | 14 | 50 | 506.6 | 8 | 3940 | 4.32 |
| INA2133UA | D | SOIC | 14 | 50 | 506.6 | 8 | 3940 | 4.32 |
| INA2133UE4 | D | SOIC | 14 | 50 | 506.6 | 8 | 3940 | 4.32 |

IMPORTANT NOTICE AND DISCLAIMER

TI PROVIDES TECHNICAL AND RELIABILITY DATA (INCLUDING DATA SHEETS), DESIGN RESOURCES (INCLUDING REFERENCE DESIGNS), APPLICATION OR OTHER DESIGN ADVICE, WEB TOOLS, SAFETY INFORMATION, AND OTHER RESOURCES "AS IS" AND WITH ALL FAULTS, AND DISCLAIMS ALL WARRANTIES, EXPRESS AND IMPLIED, INCLUDING WITHOUT LIMITATION ANY IMPLIED WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE OR NON-INFRINGEMENT OF THIRD PARTY INTELLECTUAL PROPERTY RIGHTS.

These resources are intended for skilled developers designing with TI products. You are solely responsible for (1) selecting the appropriate TI products for your application, (2) designing, validating and testing your application, and (3) ensuring your application meets applicable standards, and any other safety, security, regulatory or other requirements.

These resources are subject to change without notice. TI grants you permission to use these resources only for development of an application that uses the TI products described in the resource. Other reproduction and display of these resources is prohibited. No license is granted to any other TI intellectual property right or to any third party intellectual property right. TI disclaims responsibility for, and you will fully indemnify TI and its representatives against, any claims, damages, costs, losses, and liabilities arising out of your use of these resources.

TI's products are provided subject to [TI's Terms of Sale](#) or other applicable terms available either on ti.com or provided in conjunction with such TI products. TI's provision of these resources does not expand or otherwise alter TI's applicable warranties or warranty disclaimers for TI products.

TI objects to and rejects any additional or different terms you may have proposed.

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265
Copyright © 2022, Texas Instruments Incorporated

单击下面可查看定价，库存，交付和生命周期等信息

[>>TI\(德州仪器\)](#)