

REF200

DUAL CURRENT SOURCE/CURRENT SINK

FEATURES

- COMPLETELY FLOATING:
No Power Supply or Ground Connections
- HIGH ACCURACY: $100\mu\text{A} \pm 0.5\%$
- LOW TEMPERATURE COEFFICIENT:
 $\pm 25\text{ppm}/^\circ\text{C}$
- WIDE VOLTAGE COMPLIANCE:
2.5V to 40V
- ALSO INCLUDES CURRENT MIRROR

APPLICATIONS

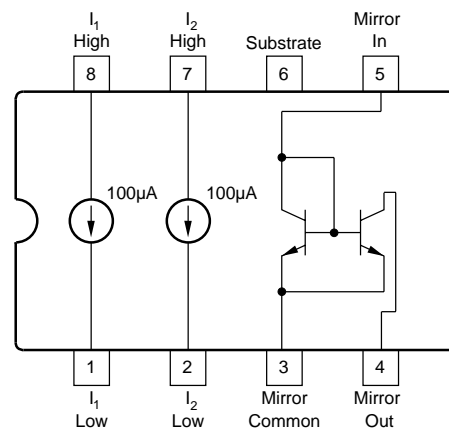
- SENSOR EXCITATION
- BIASING CIRCUITRY
- OFFSETTING CURRENT LOOPS
- LOW VOLTAGE REFERENCES
- CHARGE-PUMP CIRCUITRY
- HYBRID MICROCIRCUITS

DESCRIPTION

The REF200 combines three circuit building-blocks on a single monolithic chip—two $100\mu\text{A}$ current sources and a current mirror. The sections are dielectrically isolated, making them completely independent. Also, since the current sources are two-terminal devices, they can be used equally well as current sinks. The performance of each section is individually measured and laser-trimmed to achieve high accuracy at low cost.

The sections can be pin-strapped for currents of $50\mu\text{A}$, $100\mu\text{A}$, $200\mu\text{A}$, $300\mu\text{A}$ or $400\mu\text{A}$. External circuitry can be used to obtain virtually any current. These and many other circuit techniques are shown in the Applications section of this Data Sheet.

The REF200 is available in plastic 8-pin mini-DIP and SOIC packages.



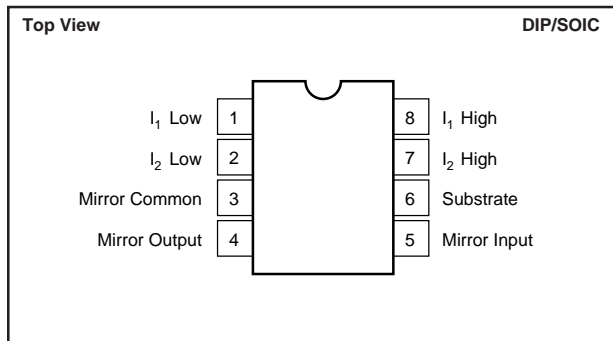
SPECIFICATIONS

ELECTRICAL

At $T_A = +25^\circ\text{C}$, $V_S = 15\text{V}$, unless otherwise noted.

| PARAMETER | CONDITION | REF200AP, AU | | | UNITS |
|---------------------------|---|--------------|------------|---------|------------------------------|
| | | MIN | TYP | MAX | |
| CURRENT SOURCES | | | | | |
| Current Accuracy | | | ± 0.25 | ± 1 | % |
| Current Match | | | ± 0.25 | ± 1 | % |
| Temperature Drift | Specified Temp Range | | 25 | | ppm/ $^\circ\text{C}$ |
| Output Impedance | 2.5V to 40V | 20 | 100 | | $\text{M}\Omega$ |
| | 3.5V to 30V | 200 | 500 | | $\text{M}\Omega$ |
| Noise | BW = 0.1Hz to 10Hz | | 1 | | nAp-p |
| | f = 10kHz | | 20 | | $\text{pA}/\sqrt{\text{Hz}}$ |
| Voltage Compliance (1%) | T_{MIN} to T_{MAX} | | See Curves | | |
| Capacitance | | | 10 | | pF |
| CURRENT MIRROR | | | | | |
| Gain | I = 100 μA Unless Otherwise Noted | 0.995 | 1 | 1.005 | |
| Temperature Drift | | | 25 | | ppm/ $^\circ\text{C}$ |
| Impedance (output) | 2V to 40V | 40 | 100 | | $\text{M}\Omega$ |
| Nonlinearity | I = 0 μA to 250 μA | | 0.05 | | % |
| Input Voltage | | | 1.4 | | V |
| Output Compliance Voltage | | | See Curves | | |
| Frequency Response (-3dB) | Transfer | | 5 | | MHz |
| TEMPERATURE RANGE | | | | | |
| Specification | | -25 | | +85 | $^\circ\text{C}$ |
| Operating | | -40 | | +85 | $^\circ\text{C}$ |
| Storage | | -40 | | +125 | $^\circ\text{C}$ |

PIN CONFIGURATION



ABSOLUTE MAXIMUM RATINGS

| | |
|-----------------------------------|---|
| Applied Voltage | -6V to +40V |
| Reverse Current | -350 μA |
| Voltage Between Any Two Sections | $\pm 80\text{V}$ |
| Operating Temperature | -40 $^\circ\text{C}$ to +85 $^\circ\text{C}$ |
| Storage Temperature | -40 $^\circ\text{C}$ to +125 $^\circ\text{C}$ |
| Lead Temperature (soldering, 10s) | +300 $^\circ\text{C}$ |
| (SOIC 3s) | +260 $^\circ\text{C}$ |

PACKAGE/ORDERING INFORMATION

| PRODUCT | PACKAGE | PACKAGE DRAWING NUMBER ⁽¹⁾ | TEMPERATURE RANGE |
|----------|-------------------|---------------------------------------|--|
| REF200AP | 8-Pin Plastic DIP | 006 | -25 $^\circ\text{C}$ to +85 $^\circ\text{C}$ |
| REF200AU | 8-Pin SOIC | 182 | -25 $^\circ\text{C}$ to +85 $^\circ\text{C}$ |

NOTE: (1) For detailed drawing and dimension table, please see end of data sheet, or Appendix C of Burr-Brown IC Data Book. (2) Grade designation "A" may not be marked. Absence of grade designation indicates A grade.

ELECTROSTATIC DISCHARGE SENSITIVITY

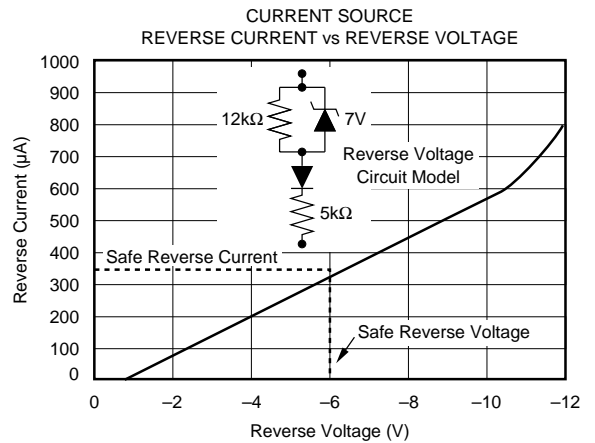
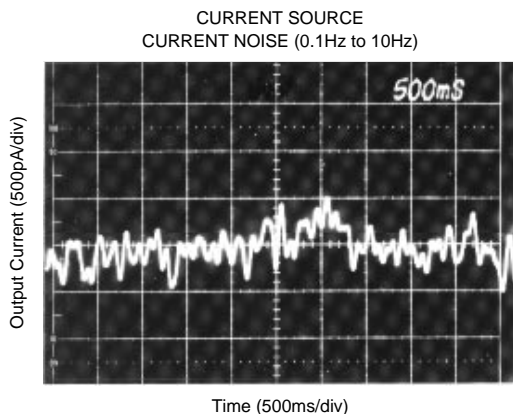
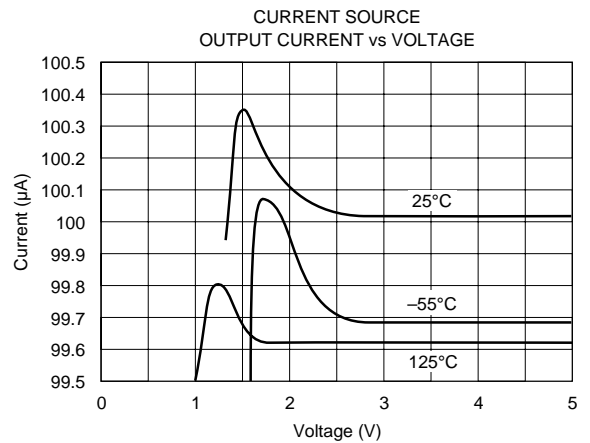
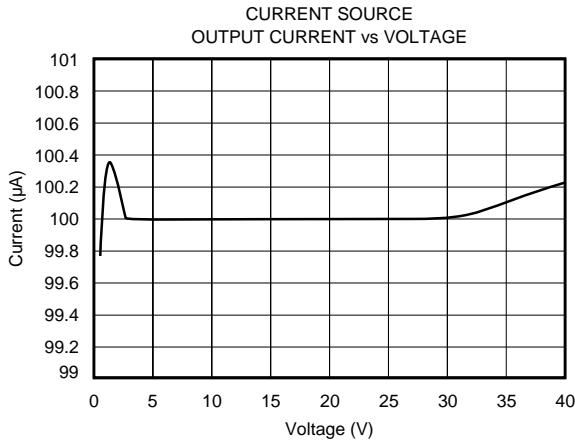
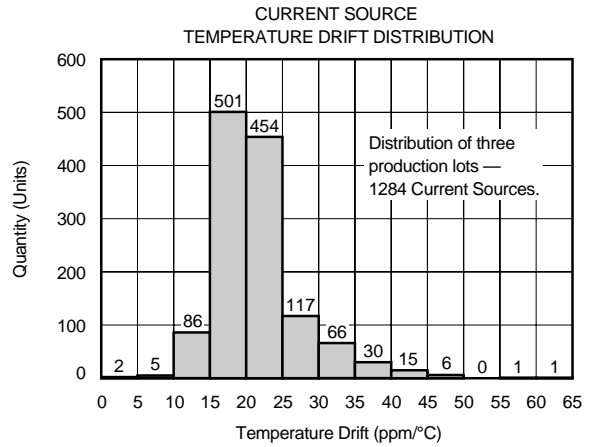
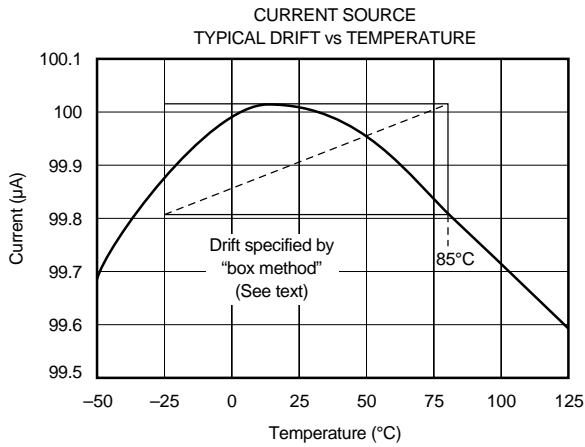
This integrated circuit can be damaged by ESD. Burr-Brown recommends that all integrated circuits be handled with appropriate precautions. Failure to observe proper handling and installation procedures can cause damage.

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.

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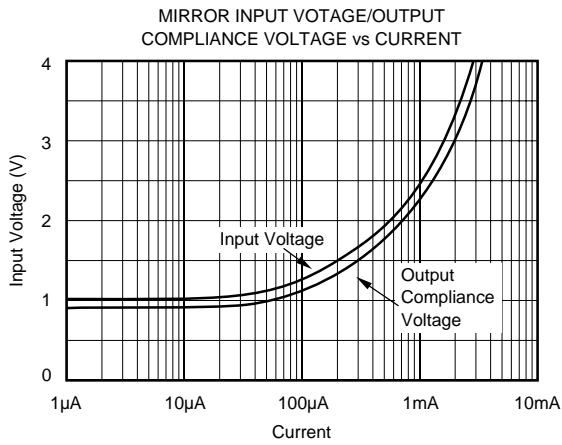
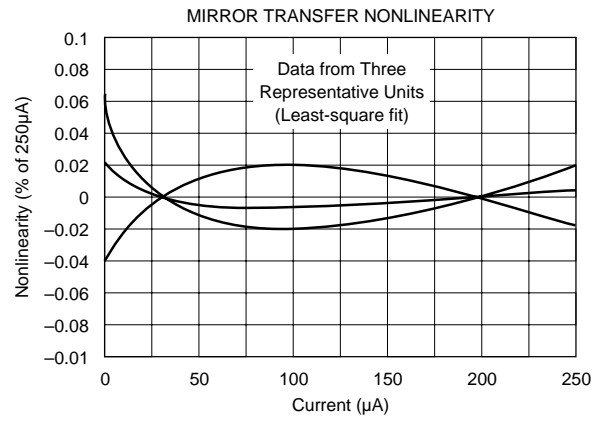
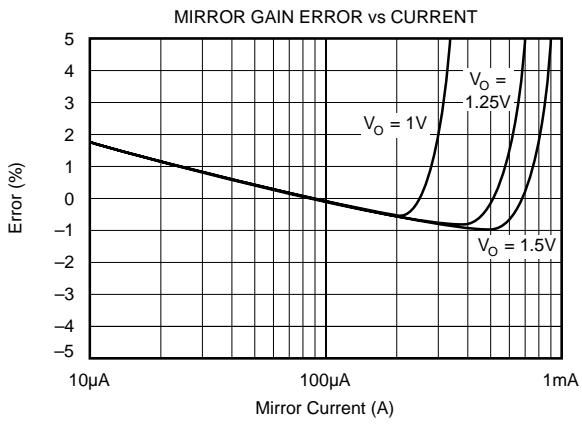
TYPICAL PERFORMANCE CURVES

At $T_A = +25^\circ\text{C}$, $V_S = +15\text{V}$, unless otherwise noted.



TYPICAL PERFORMANCE CURVES (CONT)

At $T_A = +25^\circ\text{C}$, $V_S = +15\text{V}$, unless otherwise noted.



APPLICATIONS INFORMATION

The three circuit sections of the REF200 are electrically isolated from one another using a dielectrically isolated fabrication process. A substrate connection is provided (pin 6), which is isolated from all circuitry. This pin should be connected to a defined circuit potential to assure rated DC performance. The preferred connection is to the most negative constant potential in your system. In most analog systems this would be $-V_s$. For best AC performance, leave pin 6 open and leave unused sections unconnected.

Drift performance is specified by the “box method,” as illustrated in the Current vs Temperature plot of the typical performance curves. The upper and lower current extremes measured over temperature define the top and bottom of the box. The sides are determined by the specified temperature range of the device. The drift of the unit is the slope of the diagonal—typically 25ppm/°C from -25°C to $+85^{\circ}\text{C}$.

If the current sources are subjected to reverse voltage, a protection diode may be required. A reverse voltage circuit model of the REF200 is shown in the Reverse Current vs Reverse Voltage curve. If reverse voltage is limited to less than 6V or reverse current is limited to less than $350\mu\text{A}$, no protection circuitry is required. A parallel diode (Figure 2a) will protect the device by limiting the reverse voltage across the current source to approximately 0.7V. In some applications, a series diode may be preferable (Figure 2b) because it allows no reverse current. This will, however, reduce the compliance voltage range by one diode drop.

Applications for the REF200 are limitless. Application Bulletin AB-165 shows additional REF200 circuits as well as other related current source techniques. A collection of circuits is shown to illustrate some techniques. Also, see AB-165A.

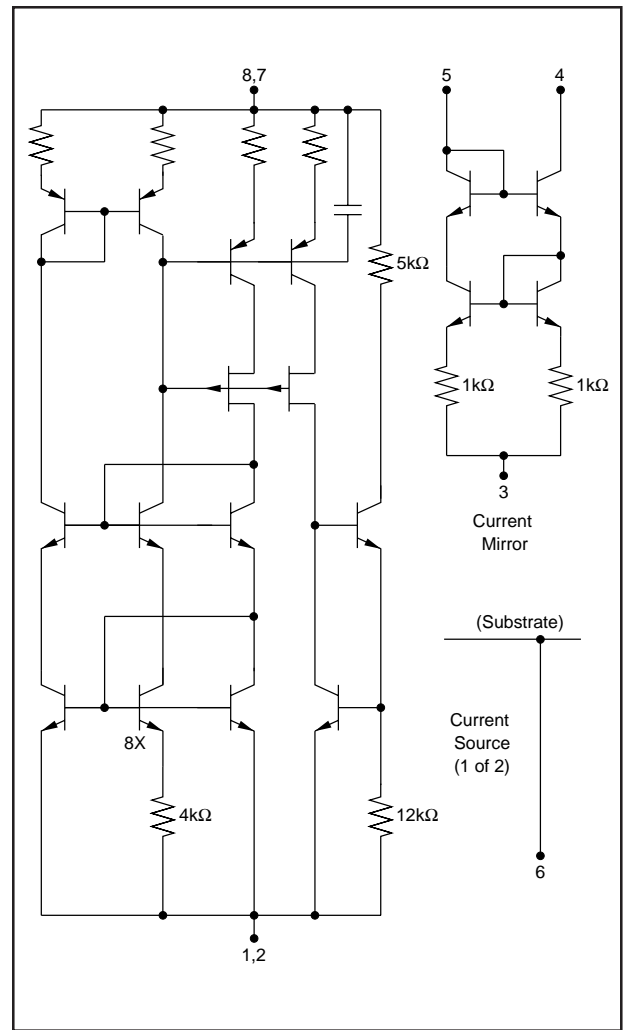


FIGURE 1. Simplified Circuit Diagram.

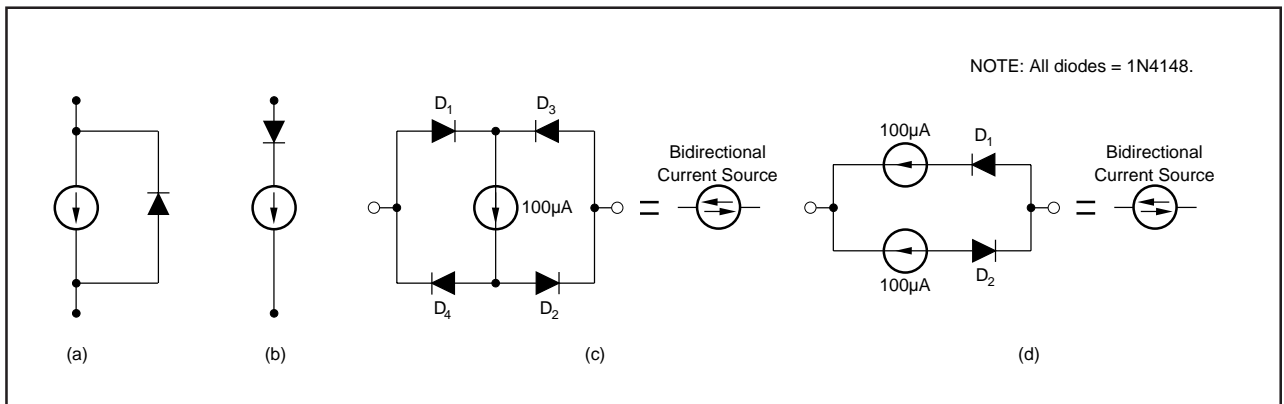


FIGURE 2. Reverse Voltage Protection.

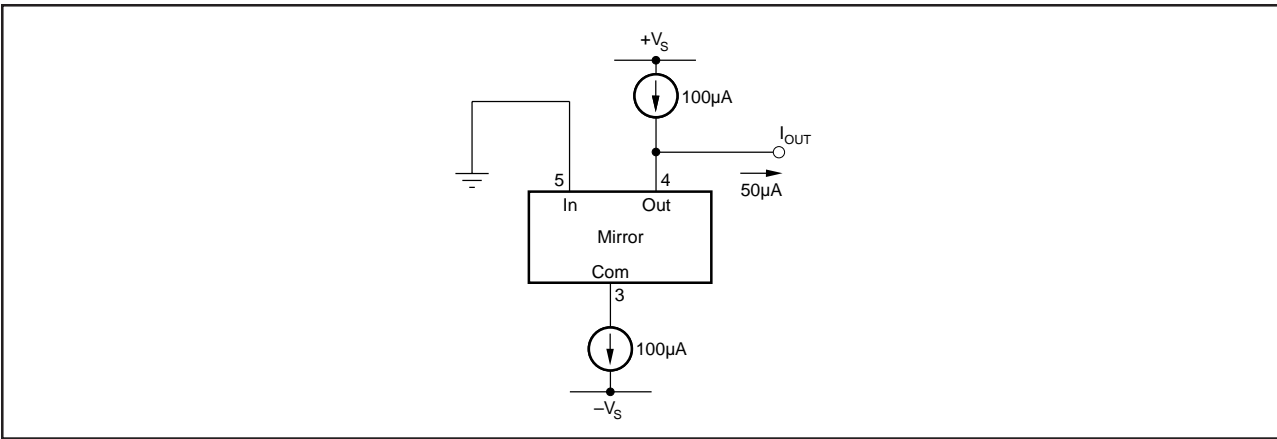


FIGURE 3. 50µA Current Source.

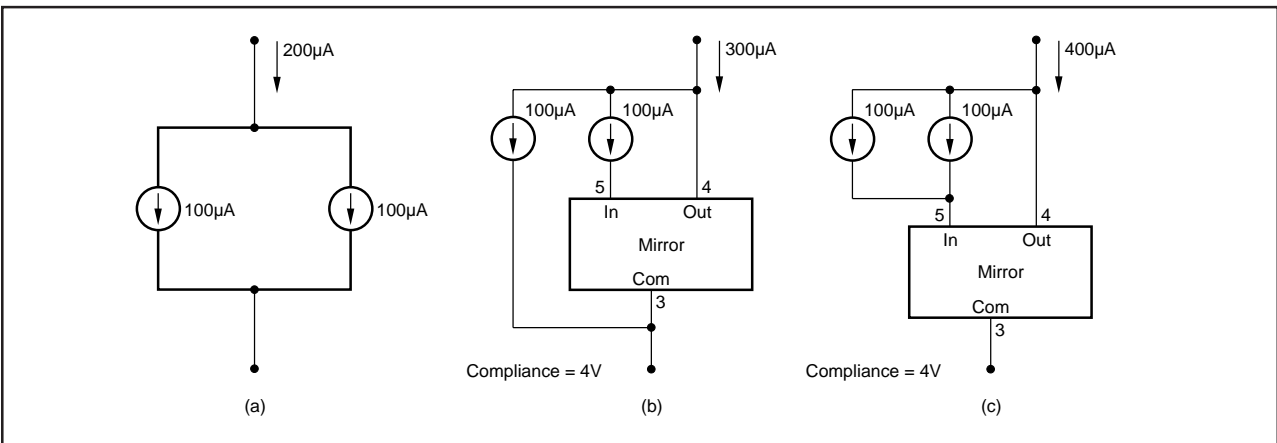


FIGURE 4. 200µA, 300µA, and 400µA Floating Current Sources.

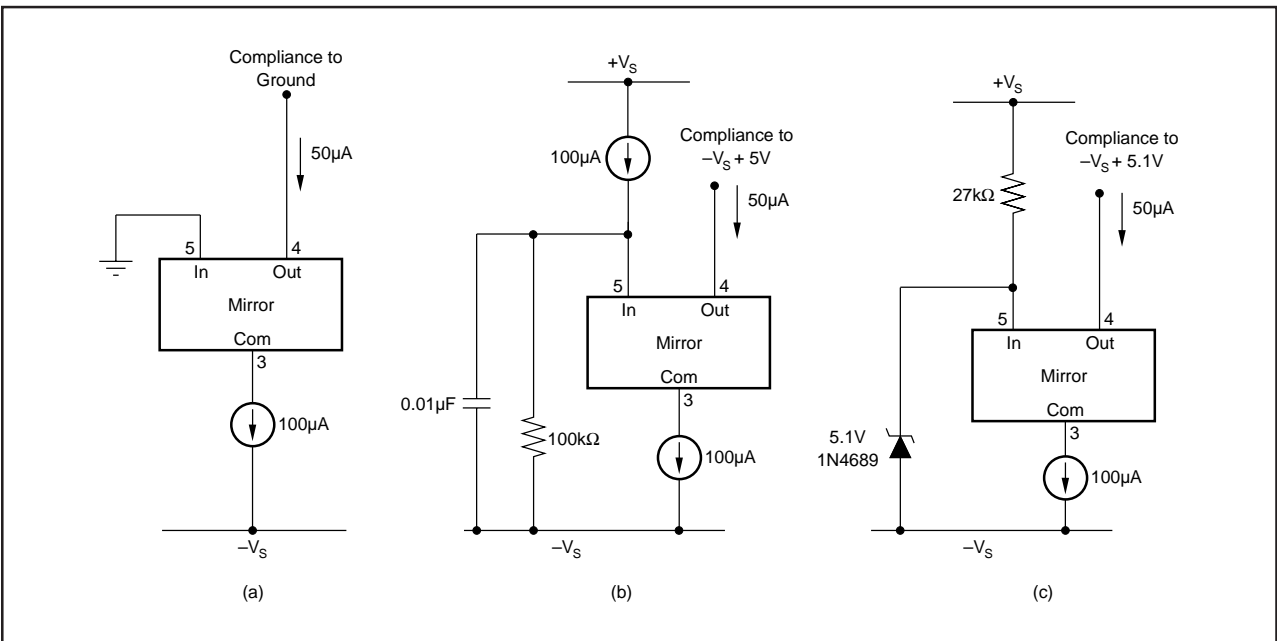


FIGURE 5. 50µA Current Sinks.

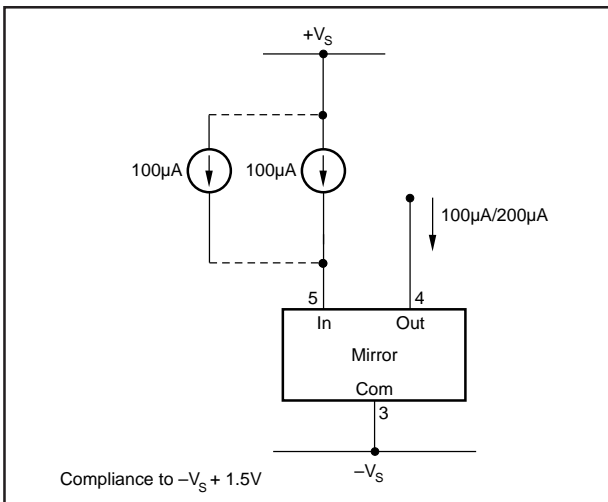


FIGURE 6. Improved Low-Voltage Compliance.

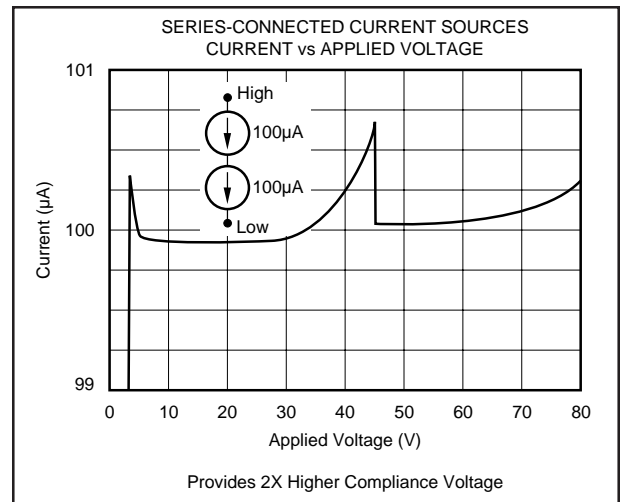


FIGURE 7. 100µA Current Source—80V Compliance.

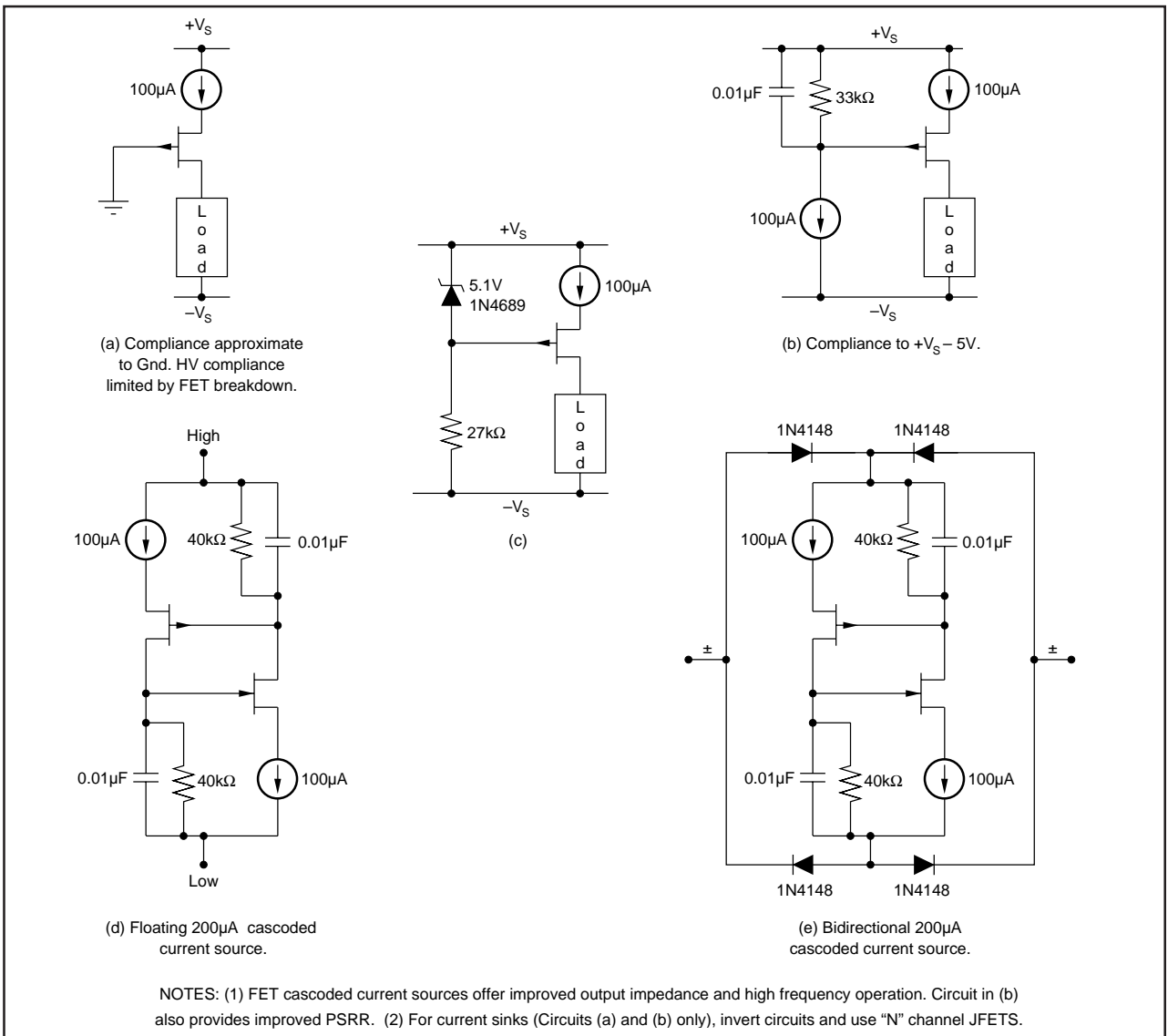


FIGURE 8. FET Cascode Circuits.

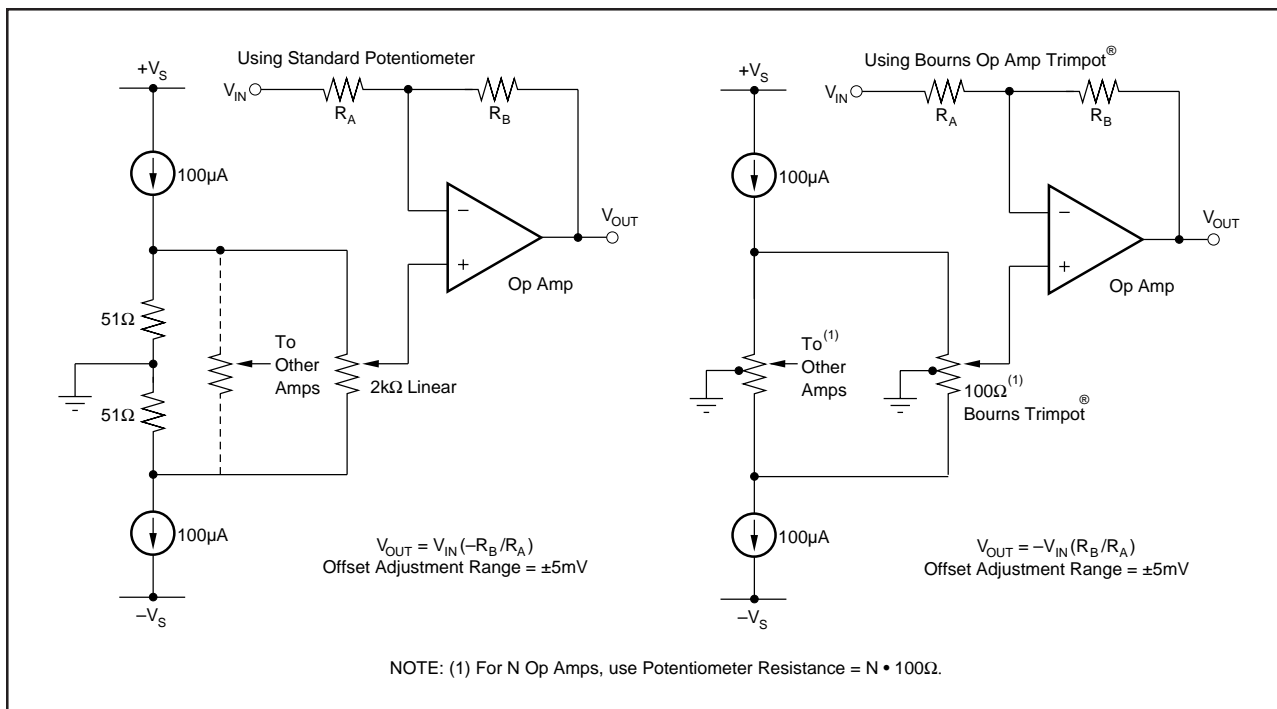


FIGURE 9. Op Amp Offset Adjustment Circuits.

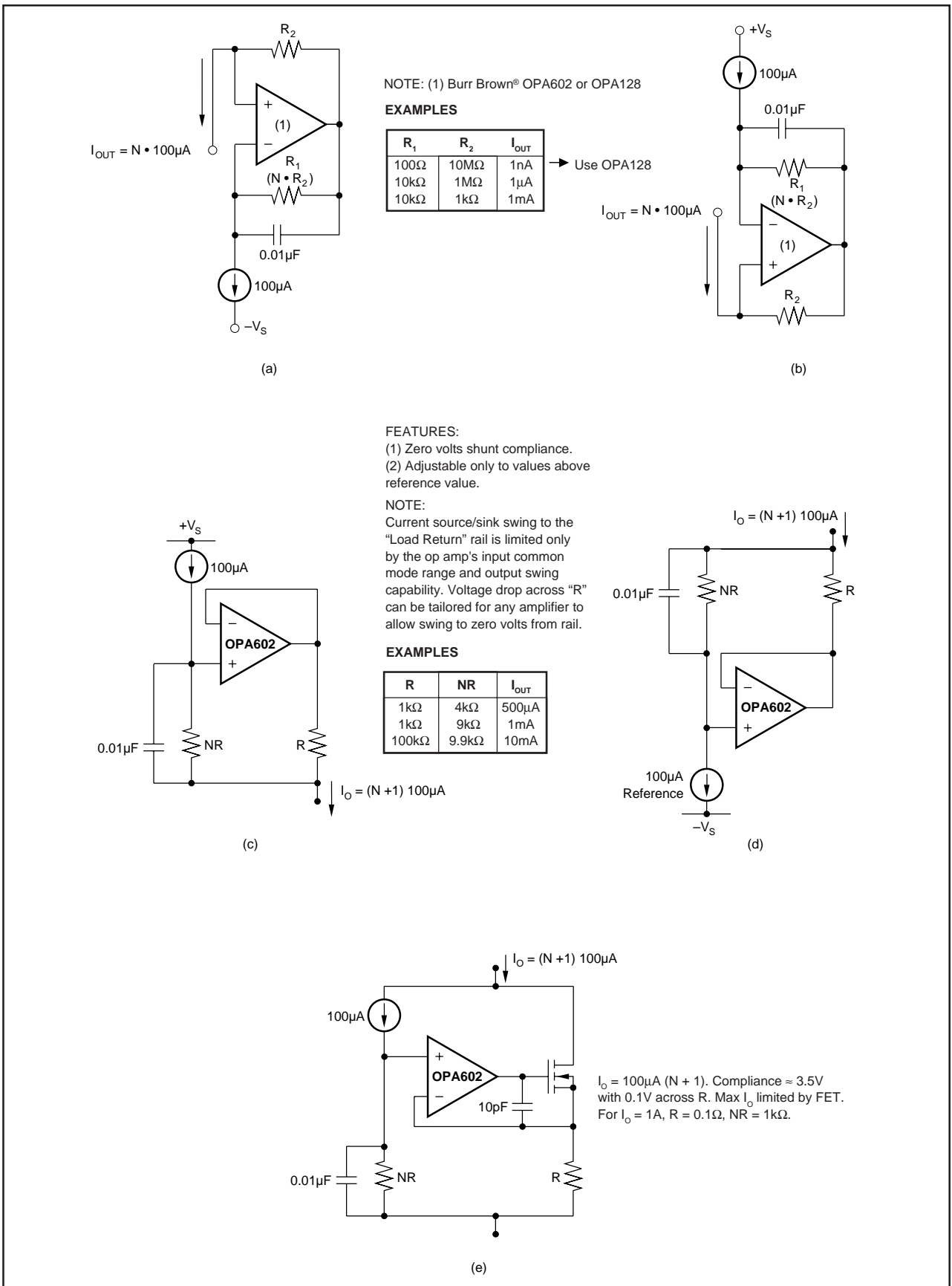


FIGURE 10. Adjustable Current Sources.

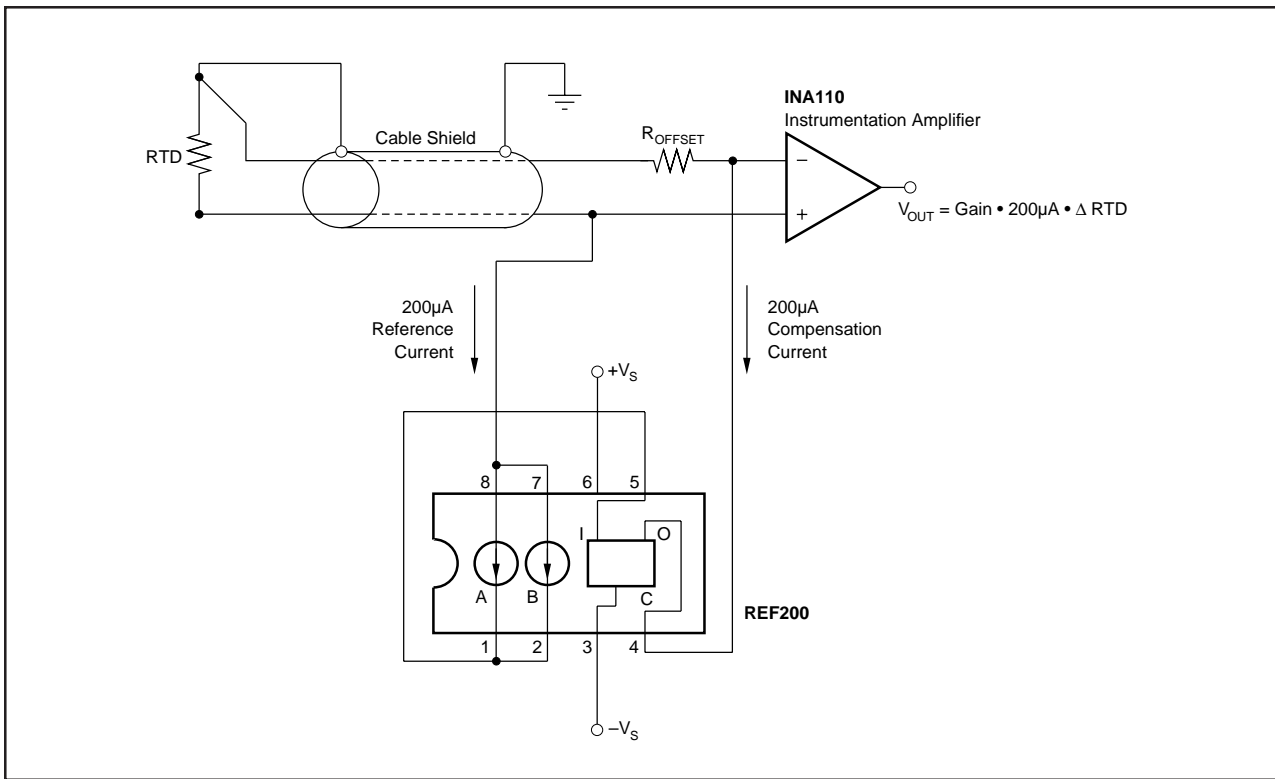


FIGURE 11. RTD Excitation With Three Wire Lead Resistance Compensation.

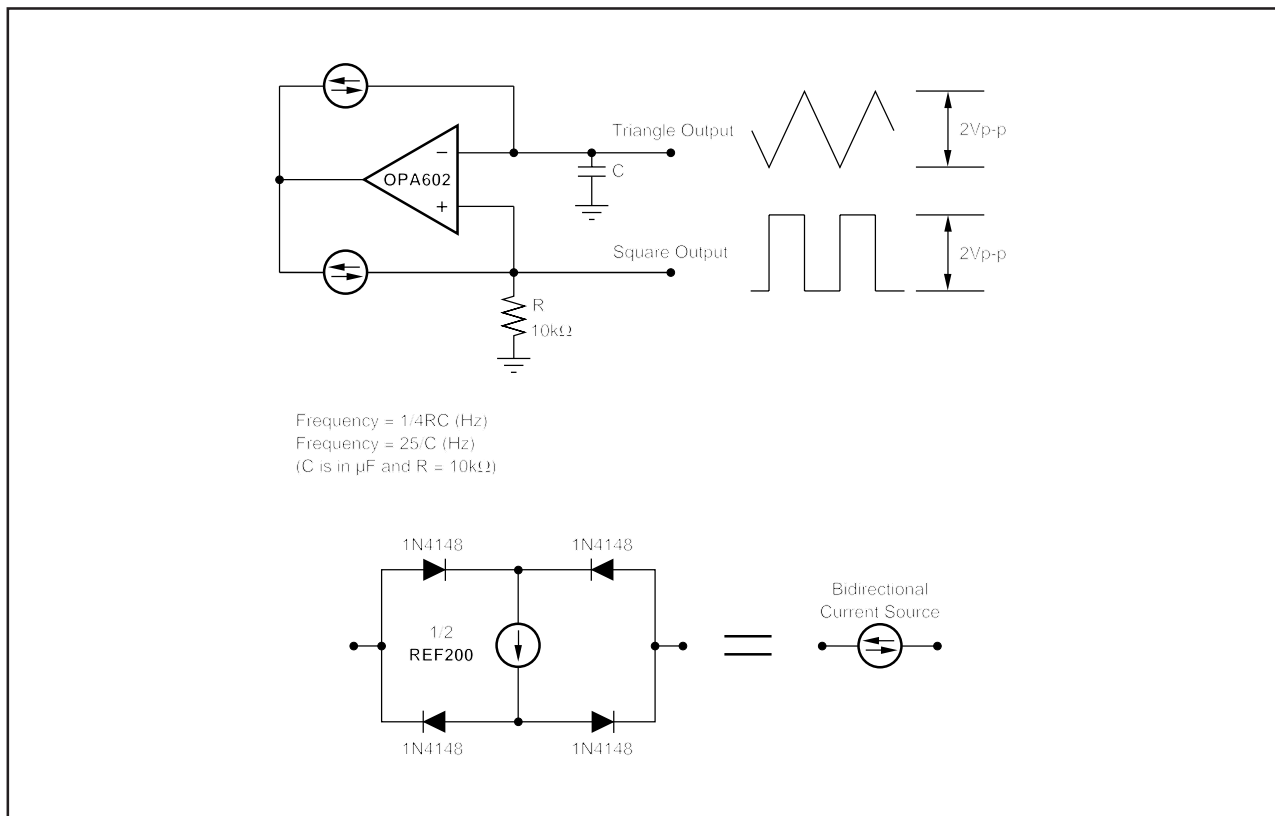


FIGURE 12. Precision Triangle Waveform Generator.

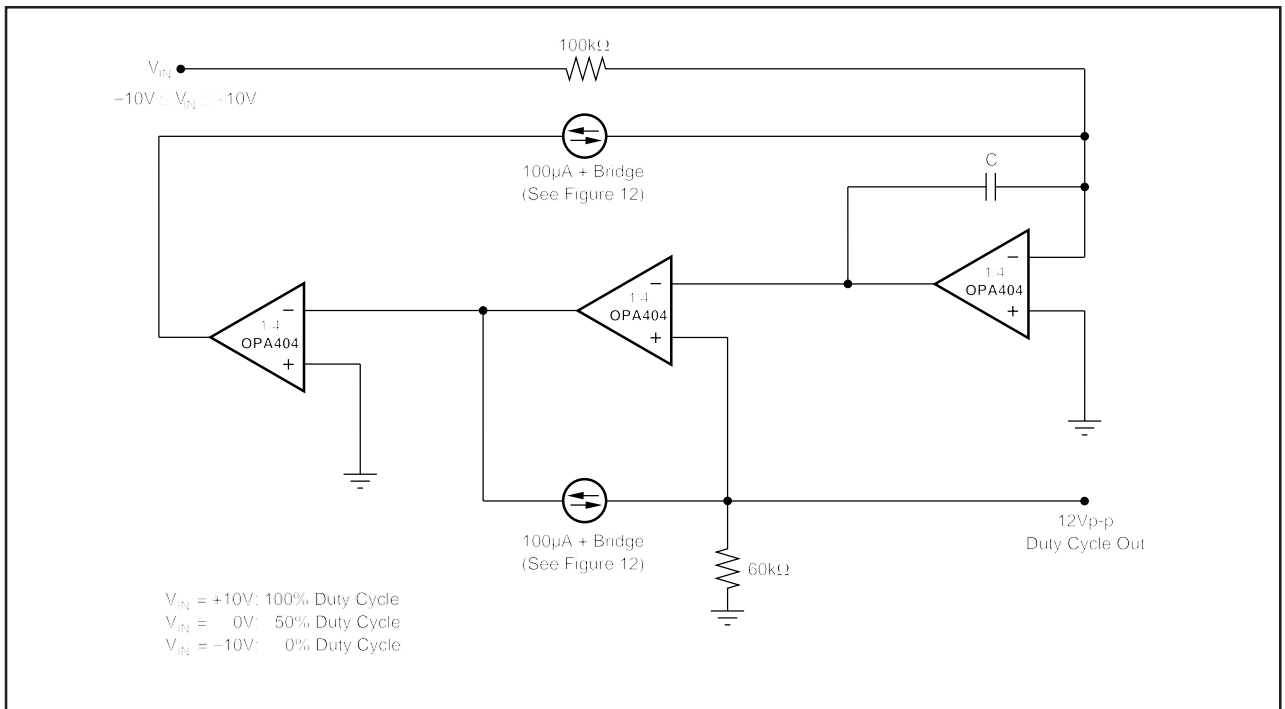


FIGURE 13. Precision Duty-Cycle Modulator.

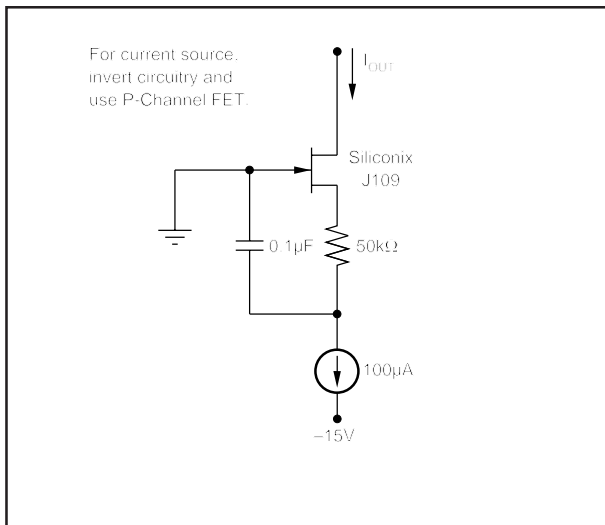


FIGURE 14. Low Noise Current Sink.

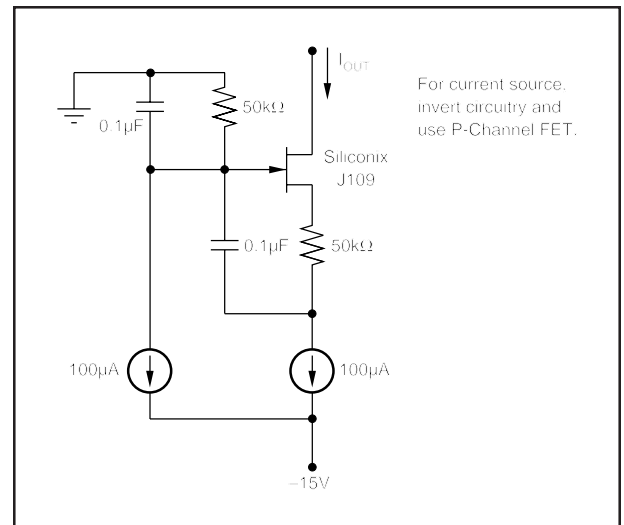


FIGURE 15. Low Noise Current Sink with Compliance Below Ground.

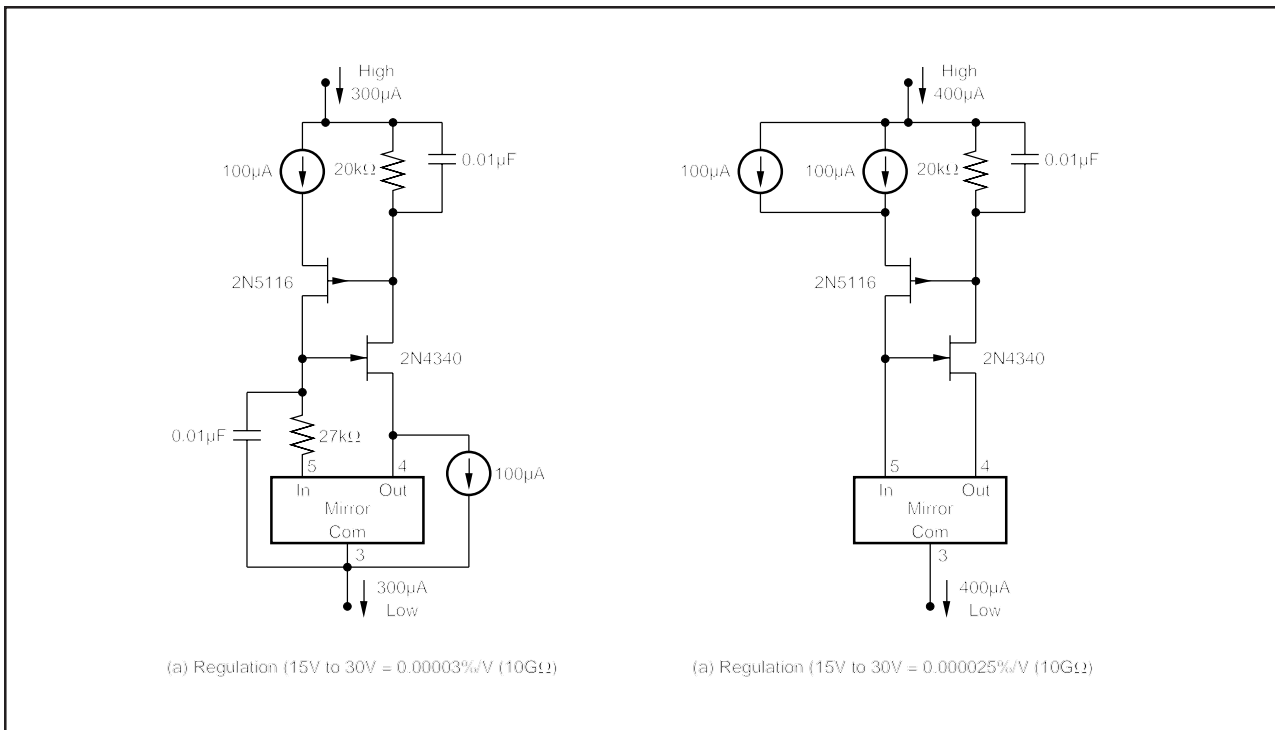


FIGURE 16. Floating 300µA and 400µA Cascoded Current Sources.

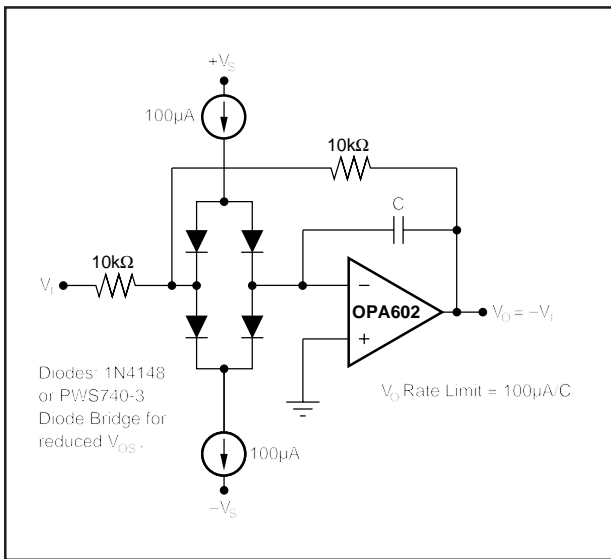


FIGURE 17. Rate Limiter.

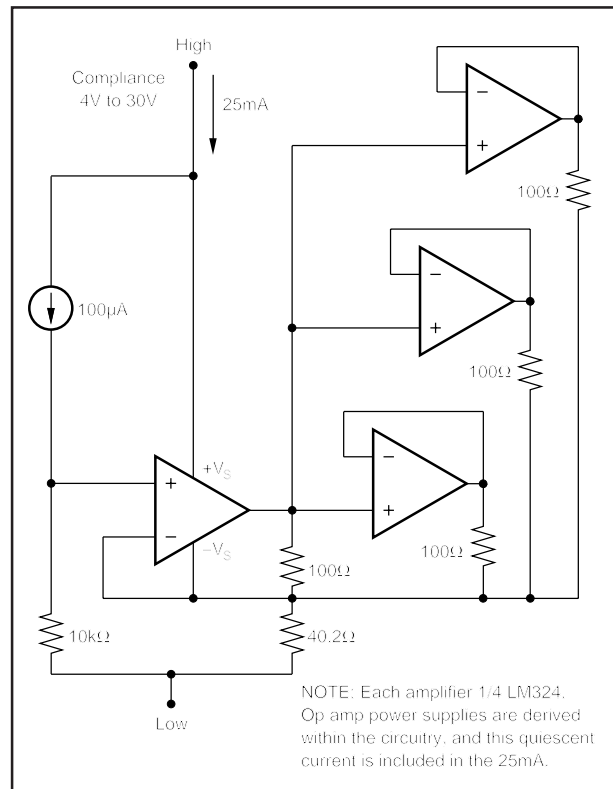


FIGURE 18. 25mA Floating Current Source.

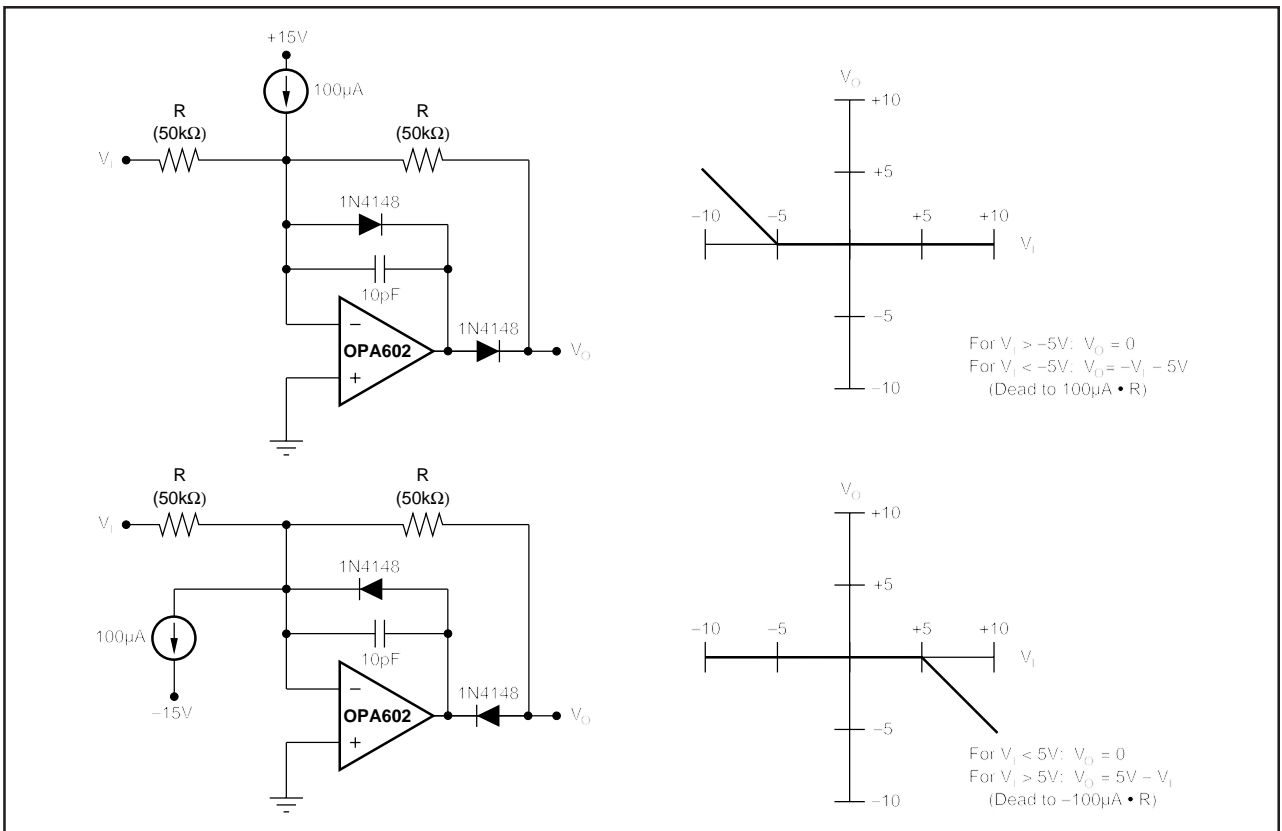


FIGURE 19. Dead-Band Circuit.

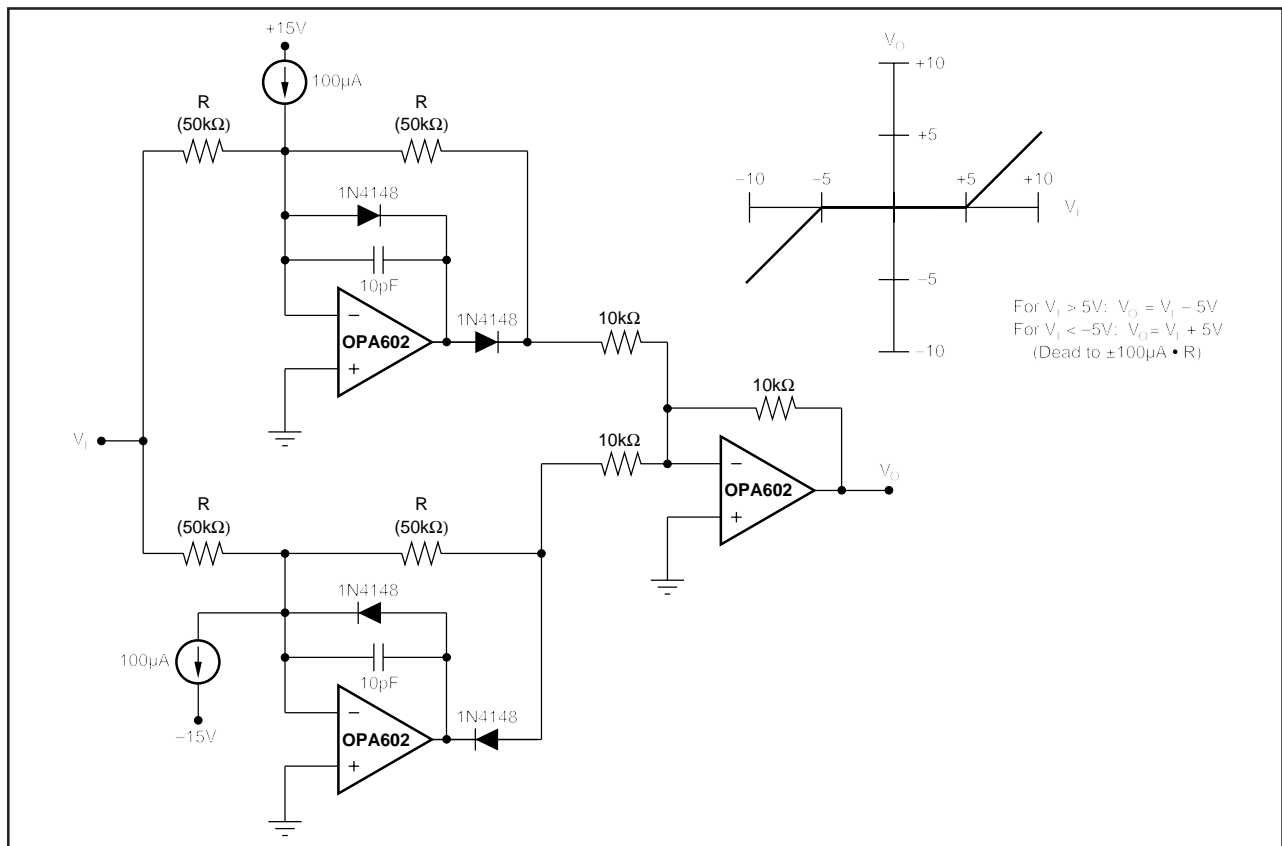


FIGURE 20. Double Dead-Band Circuit.

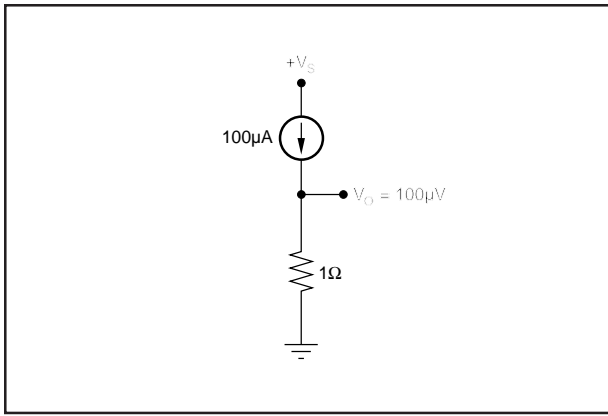


FIGURE 21. Low-Voltage Reference.

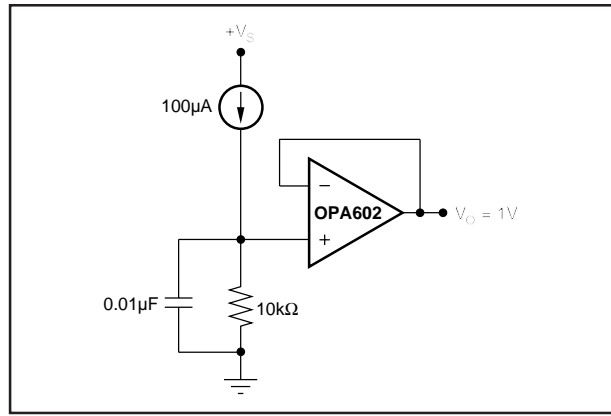


FIGURE 22. Voltage Reference.

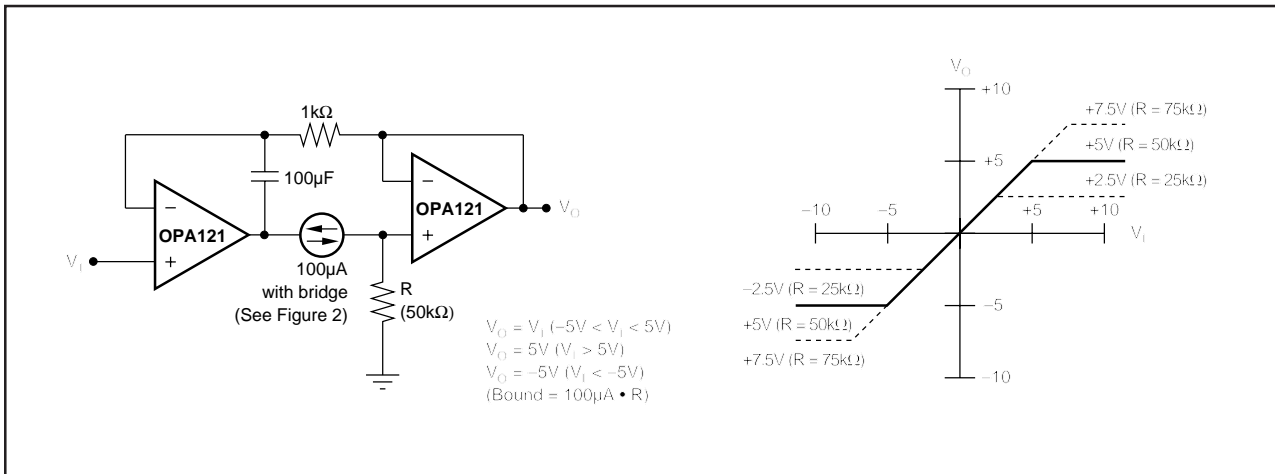


FIGURE 23. Bipolar Limiting Circuit.

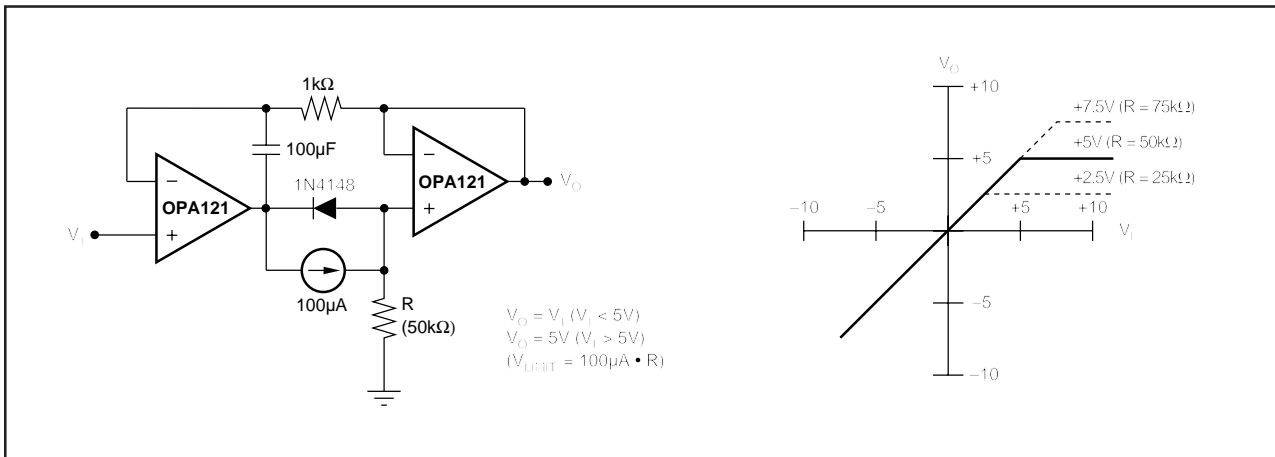


FIGURE 24. Limiting Circuit.

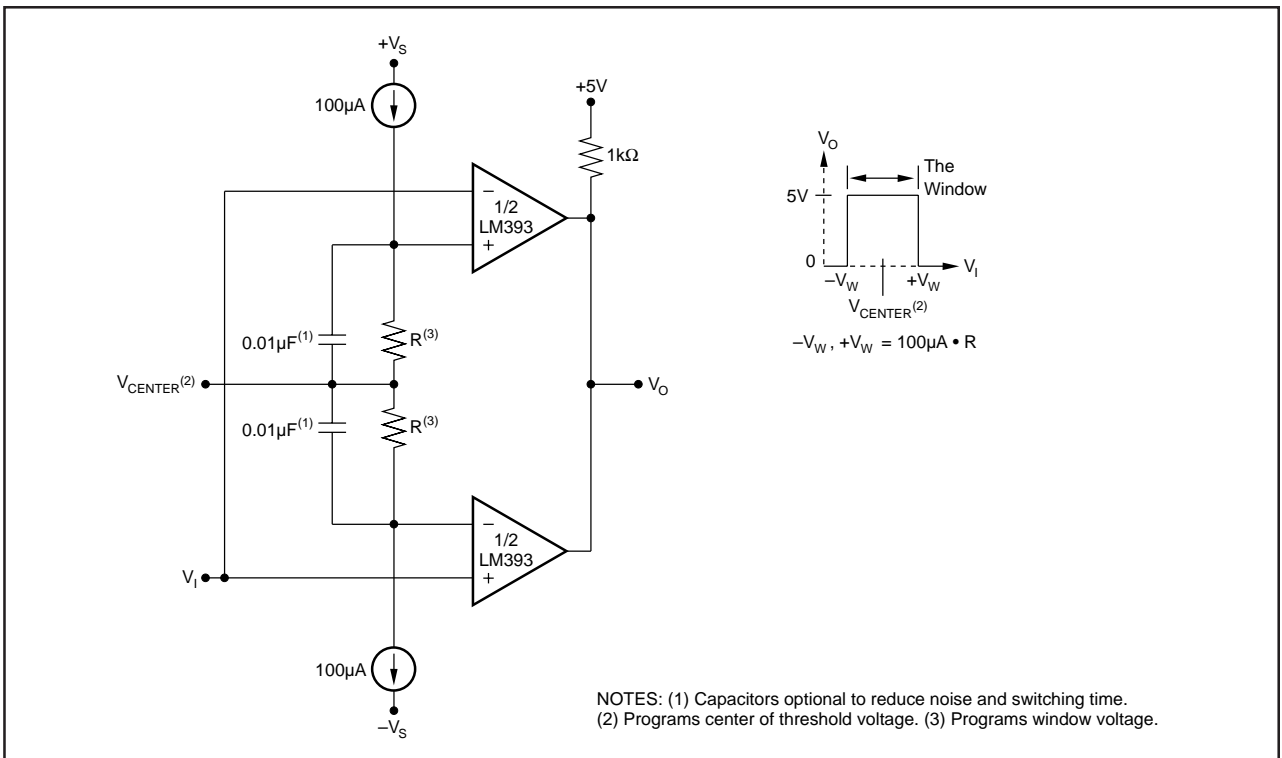


FIGURE 25. Window Comparator.

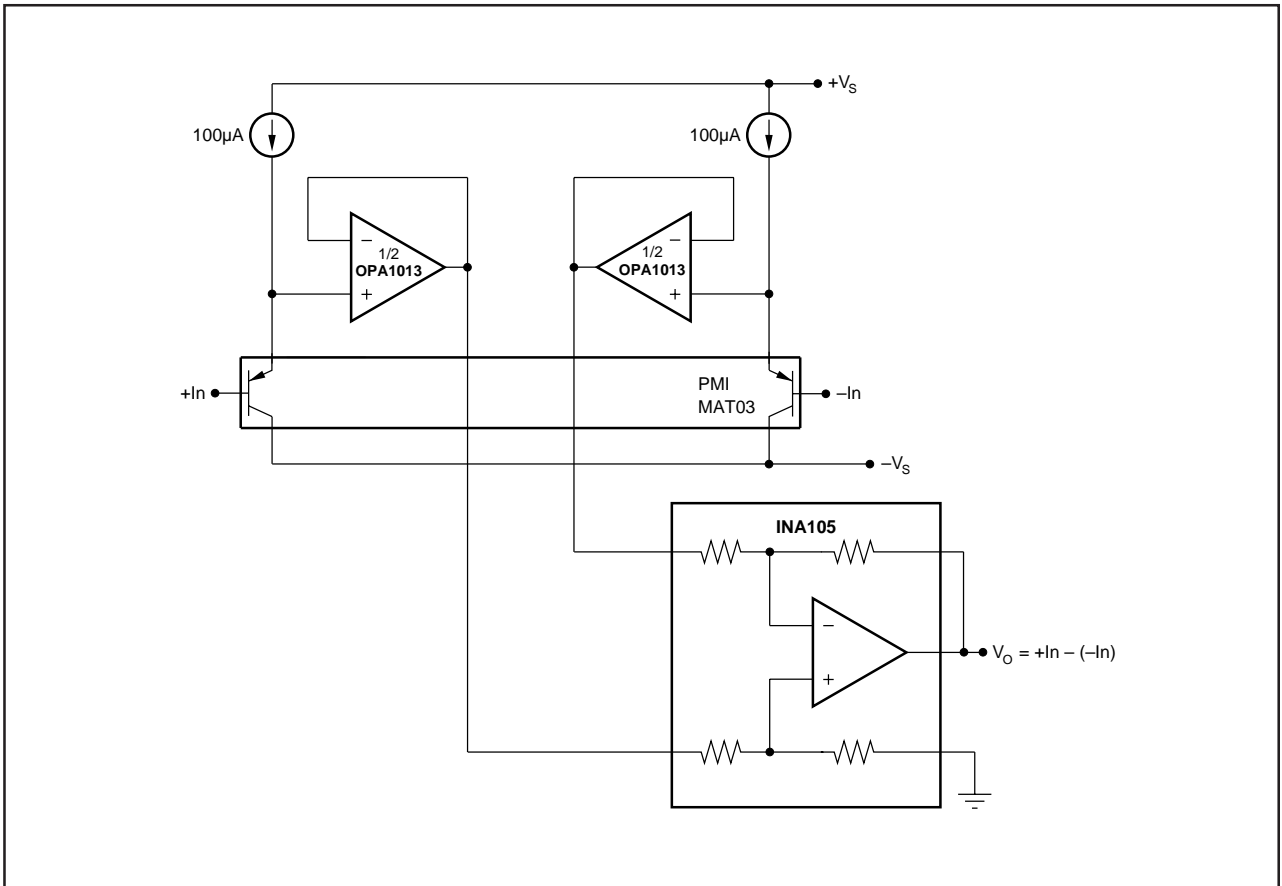


FIGURE 26. Instrumentation Amplifier with Compliance to $-V_S$.

PACKAGING INFORMATION

| Orderable Device | Status ⁽¹⁾ | Package Type | Package Drawing | Pins | Package Qty | Eco Plan ⁽²⁾ | Lead/Ball Finish | MSL Peak Temp ⁽³⁾ |
|------------------|-----------------------|--------------|-----------------|------|-------------|-------------------------|------------------|------------------------------|
| REF200AP | OBSOLETE | PDIP | P | 8 | | TBD | Call TI | Call TI |
| REF200AU | ACTIVE | SOIC | D | 8 | 100 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-3-260C-168 HR |
| REF200AU/2K5 | ACTIVE | SOIC | D | 8 | 2500 | Pb-Free (RoHS) | CU NIPDAU | Level-3-260C-168 HR |
| REF200AU/2K5E4 | ACTIVE | SOIC | D | 8 | 2500 | Pb-Free (RoHS) | CU NIPDAU | Level-3-260C-168 HR |
| REF200AUE4 | ACTIVE | SOIC | D | 8 | 100 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-3-260C-168 HR |
| REF200AUG4 | ACTIVE | SOIC | D | 8 | 100 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-3-260C-168 HR |

⁽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.

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Mailing Address: Texas Instruments
Post Office Box 655303 Dallas, Texas 75265