

OPA343
OPA2343
OPA4343

SINGLE-SUPPLY, RAIL-TO-RAIL OPERATIONAL AMPLIFIERS

MicroAmplifier™ Series

FEATURES

- RAIL-TO-RAIL INPUT
- RAIL-TO-RAIL OUTPUT (within 1mV)
- *Micro*SIZE PACKAGES
- WIDE BANDWIDTH: 5.5MHz
- HIGH SLEW RATE: 6V/μs
- LOW THD+NOISE: 0.0007% (f = 1kHz)
- LOW QUIESCENT CURRENT:
850μA/channel
- SINGLE, DUAL, AND QUAD⁽¹⁾

APPLICATIONS

- DRIVING A/D CONVERTERS
- PCMCIA CARDS
- DATA ACQUISITION
- PROCESS CONTROL
- AUDIO PROCESSING
- COMMUNICATIONS
- ACTIVE FILTERS
- TEST EQUIPMENT

DESCRIPTION

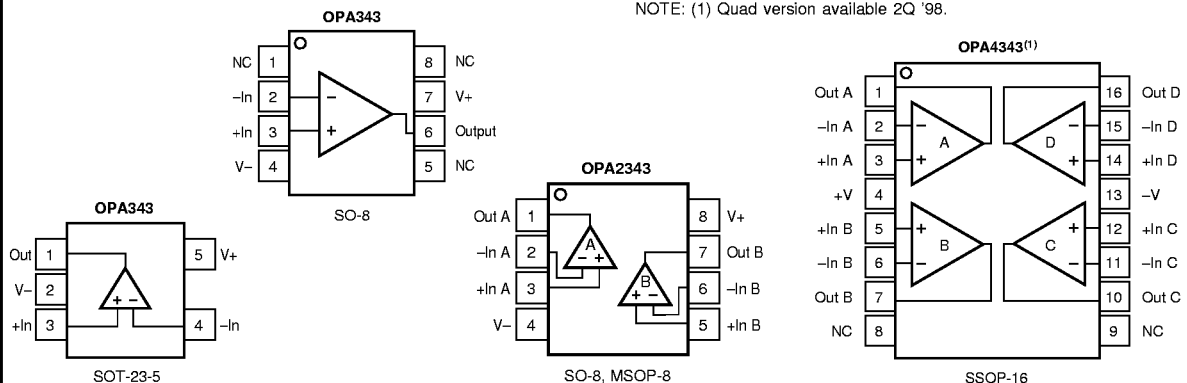
OPA343 series rail-to-rail CMOS operational amplifiers are designed for low cost, miniature applications. They are optimized for low voltage, single supply operation. Rail-to-rail input/output and high speed operation make them ideal for driving sampling analog-to-digital converters. They are also well suited for general purpose and audio applications as well as providing I/V conversion at the output of D/A converters. Single, dual, and quad⁽¹⁾ versions have identical specifications for design flexibility.

The OPA343 series operates on a single supply as low as 2.5V with an input common-mode voltage range that extends 500mV below ground and 500mV above the

positive supply. Output voltage swing is to within 1mV of the supply rails with a 100kΩ load. They offer excellent dynamic response (BW = 5.5MHz, SR = 6V/μs), yet quiescent current is only 850μA. Dual and quad designs feature completely independent circuitry for lowest crosstalk and freedom from interaction.

The single (OPA343) packages are the tiny 5-lead SOT-23-5 surface mount and SO-8 surface mount. The dual (OPA2343) comes in the miniature MSOP-8 surface mount and SO-8 surface mount. The quad (OPA4343) packages are the space-saving SSOP-16 surface mount and SO-14 surface mount. All are specified from -40°C to +85°C and operate from -55°C to +125°C. A SPICE macromodel is available for design analysis.

NOTE: (1) Quad version available 2Q '98.



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 Internet: <http://www.burr-brown.com/> • FAXLine: (800) 548-6133 (US/Canada Only) • Cable: BBRCORP • Telex: 066-6491 • FAX: (520) 689-1510 • Immediate Product Info: (800) 548-6132

SPECIFICATIONS: $V_S = 2.7V$ to $5V$

At $T_A = +25^\circ C$, $R_L = 10k\Omega$ connected to $V_S/2$ and $V_{OUT} = V_S/2$, unless otherwise noted.

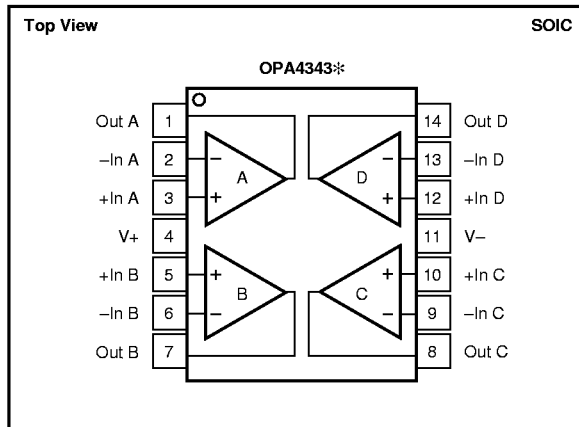
Boldface limits apply over the specified temperature range, $T_A = -40^\circ C$ to $+85^\circ C$. $V_S = 5V$.

| PARAMETER | CONDITION | OPA343NA, UA OPA2343EA, UA | | | UNITS |
|--|--|---|--|---|--|
| | | MIN | TYP ⁽¹⁾ | MAX | |
| OFFSET VOLTAGE Input Offset Voltage vs Temperature vs Power Supply $T_A = -40^\circ C$ to $+85^\circ C$ Channel Separation, dc | $V_S = 5V$ $V_S = 2.7V$ to $5.5V$, $V_{CM} = 0V$ $V_S = 2.7V$ to $5.5V$, $V_{CM} = 0V$ | | ± 2 ± 3 40 0.2 | ± 8 200 200 | mV $\mu V/^\circ C$ $\mu V/V$ $\mu V/V$ |
| INPUT BIAS CURRENT Input Bias Current $T_A = -40^\circ C$ to $+85^\circ C$ Input Offset Current | | | ± 0.2 ± 0.2 | ± 10 ± 10 ± 10 | pA pA pA |
| NOISE Input Voltage Noise, $f = 0.1$ to $50kHz$ Input Voltage Noise Density, $f = 1kHz$ Current Noise Density, $f = 1kHz$ | | | 8 25 3 | | μV_{rms} nV/\sqrt{Hz} fA/\sqrt{Hz} |
| INPUT VOLTAGE RANGE Common-Mode Voltage Range Common-Mode Rejection Ratio | $-0.3V < V_{CM} < (V+) - 1.8V$ $V_S = 5V$, $-0.3V < V_{CM} < 5.3V$ $V_S = 2.7V$, $-0.3V < V_{CM} < 3V$ | -0.3 74 60 54 | 92 75 70 | (V+) +0.3 | V dB dB dB |
| INPUT IMPEDANCE Differential Common-Mode | | | $10^{13} \parallel 3$ $10^{13} \parallel 6$ | | $\Omega \parallel pF$ $\Omega \parallel pF$ |
| OPEN-LOOP GAIN Open-Loop Voltage Gain $T_A = -40^\circ C$ to $+85^\circ C$ $T_A = -40^\circ C$ to $+85^\circ C$ $T_A = -40^\circ C$ to $+85^\circ C$ | $R_L = 100k\Omega$, $5mV < V_O < (V+) - 5mV$ $R_L = 100k\Omega$, $5mV < V_O < (V+) - 5mV$ $R_L = 10k\Omega$, $50mV < V_O < (V+) - 50mV$ $R_L = 10k\Omega$, $50mV < V_O < (V+) - 50mV$ $R_L = 2k\Omega$, $200mV < V_O < (V+) - 200mV$ $R_L = 2k\Omega$, $200mV < V_O < (V+) - 200mV$ | 100 100 100 100 92 92 | 120 117 110 | | dB dB dB dB dB dB |
| FREQUENCY RESPONSE Gain-Bandwidth Product Slew Rate Settling Time, 0.1% 0.01% Overload Recovery Time Total Harmonic Distortion + Noise | GBW SR THD+N $V_S = 5V$, $V_O = 3V_{pp}$, $G = 1$, $f = 1kHz$ | | $G = 1$ 5.5 6 1 1.6 0.2 0.0007 | | MHz V/ μs μs μs μs % |
| OUTPUT Voltage Output Swing from Rail ⁽³⁾ $T_A = -40^\circ C$ to $+85^\circ C$ $T_A = -40^\circ C$ to $+85^\circ C$ $T_A = -40^\circ C$ to $+85^\circ C$ Short-Circuit Current Capacitive Load Drive | $R_L = 100k\Omega$, $A_{OL} \geq 100dB$ $R_L = 100k\Omega$, $A_{OL} \geq 100dB$ $R_L = 10k\Omega$, $A_{OL} \geq 100dB$ $R_L = 10k\Omega$, $A_{OL} \geq 100dB$ $R_L = 2k\Omega$, $A_{OL} \geq 92dB$ $R_L = 2k\Omega$, $A_{OL} \geq 92dB$ | | 1 10 40 ± 50 | 5 5 50 50 200 200 | mV mV mV mV mV mV mA |
| POWER SUPPLY Specified Voltage Range Operating Voltage Range Quiescent Current (per amplifier) $T_A = -40^\circ C$ to $+85^\circ C$ | V_S I_Q $I_O = 0$, $V_S = +5V$ $I_O = 0$, $V_S = +5V$ | 2.7 | 2.5 to 5.5 0.85 | 5 1.25 1.4 | V V mA μA |
| TEMPERATURE RANGE Specified Range Operating Range Storage Range Thermal Resistance SOT-23-5 Surface Mount MSOP-8 Surface Mount SO-8 Surface Mount SSOP-16 Surface Mount SO-14 Surface Mount | θ_{JA} | -40 -55 -55 | | +85 +125 +125 | $^\circ C$ $^\circ C$ $^\circ C$ $^\circ C/W$ $^\circ C/W$ $^\circ C/W$ $^\circ C/W$ $^\circ C/W$ $^\circ C/W$ |

NOTES: (1) $V_S = +5V$. (2) $V_{OUT} = 0.25V$ to $3.25V$. (3) Output voltage swings are measured between the output and power supply rails.



PIN CONFIGURATIONS



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.

ABSOLUTE MAXIMUM RATINGS⁽¹⁾

| | |
|--|--------------------------|
| Supply Voltage | 5.5V |
| Signal Input Terminals, Voltage ⁽²⁾ | (V-) -0.5V to (V+) +0.5V |
| Current ⁽²⁾ | 10mA |
| Output Short-Circuit ⁽³⁾ | Continuous |
| Operating Temperature | -55°C to +125°C |
| Storage Temperature | -55°C to +125°C |
| Junction Temperature | 150°C |
| Lead Temperature (soldering, 10s) | 300°C |

NOTES: (1) Stresses above these ratings may cause permanent damage. Exposure to absolute maximum conditions for extended periods may degrade device reliability. (2) Input terminals are diode-clamped to the power supply rails. Input signals that can swing more than 0.5V beyond the supply rails should be current-limited to 10mA or less. (3) Short-circuit to ground, one amplifier per package.

PACKAGE/ORDERING INFORMATION

| PRODUCT | PACKAGE | PACKAGE DRAWING NUMBER ⁽¹⁾ | SPECIFIED TEMPERATURE RANGE | PACKAGE MARKING | ORDERING NUMBER ⁽²⁾ | TRANSPORT MEDIA |
|---------------------------|-----------------------|---------------------------------------|-----------------------------|-----------------|--------------------------------|----------------------|
| Single OPA343NA | 5-Lead SOT-23-5 | 331 | -40°C to +85°C | B43 | OPA343NA/250 | Tape and Reel |
| " | " | " | " | " | OPA343NA/3K | Tape and Reel |
| OPA343UA | SO-8 Surface-Mount | 182 | -40°C to +85°C | OPA343UA | OPA343UA | Rails ⁽³⁾ |
| Dual OPA2343EA | MSOP-8 Surface-Mount | 337 | -40°C to +85°C | C43 | OPA2343EA/250 | Tape and Reel |
| " | " | " | " | " | OPA2343EA/2K5 | Tape and Reel |
| OPA2343UA | SO-8 Surface-Mount | 182 | -40°C to +85°C | OPA2343UA | OPA2343UA | Rails ⁽³⁾ |
| Quad* OPA4343EA | SSOP-16 Surface-Mount | 322 | -40°C to +85°C | OPA4343EA | OPA4343EA/250 | Tape and Reel |
| " | " | " | " | " | OPA4343EA/2K5 | Tape and Reel |
| OPA4343UA | SO-14 Surface Mount | 235 | -40°C to +85°C | OPA4343UA | OPA4343UA | Rails ⁽³⁾ |

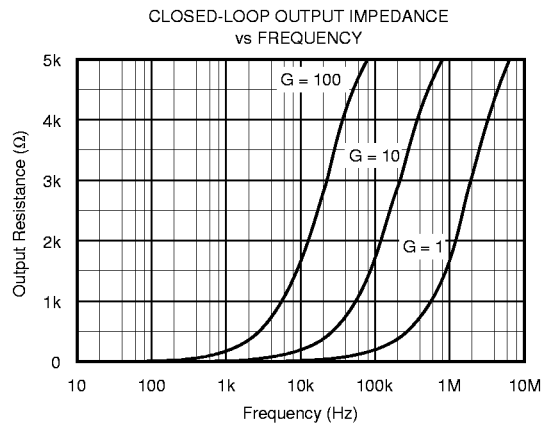
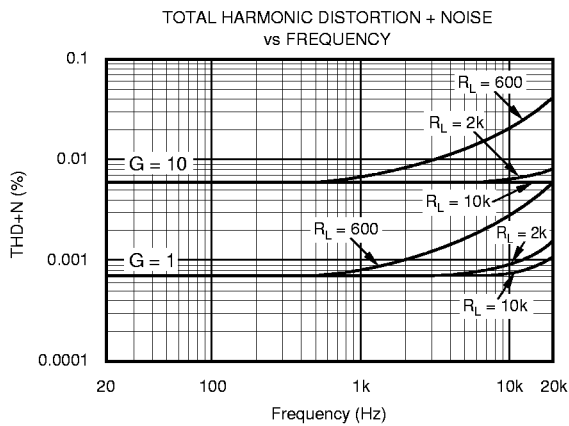
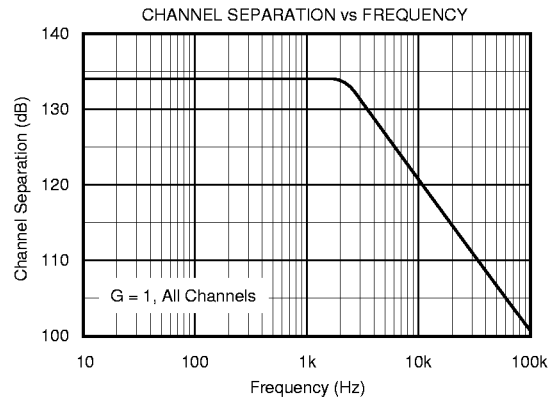
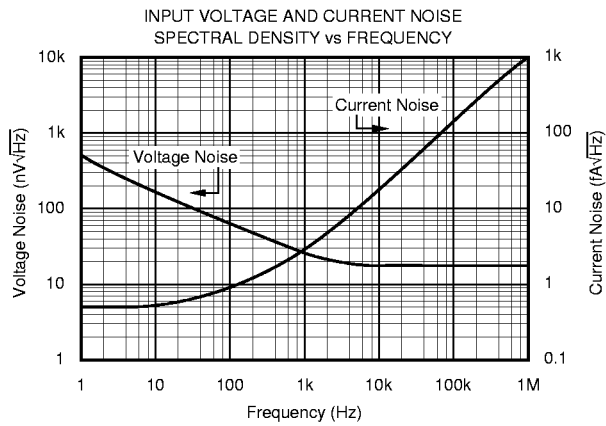
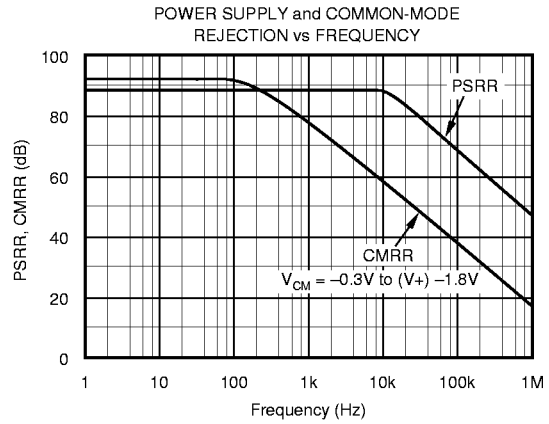
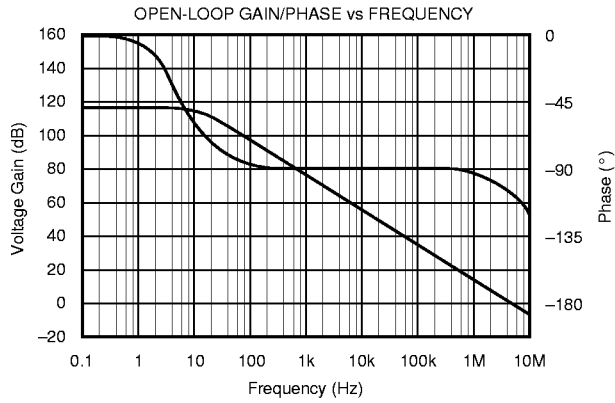
NOTES: (1) For detailed drawing and dimension table, please see end of data sheet, or Appendix C of Burr-Brown IC Data Book. (2) Models with /250, /2K5, and /3K are available only in Tape and Reel in the quantities indicated (e.g., /250 indicates 250 devices per reel). Ordering 2500 pieces of "OPA2343EA/2K5" 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. (3) SO-8 and SO-14 models also available in Tape and Reel.

* Quad version available 2Q '98.

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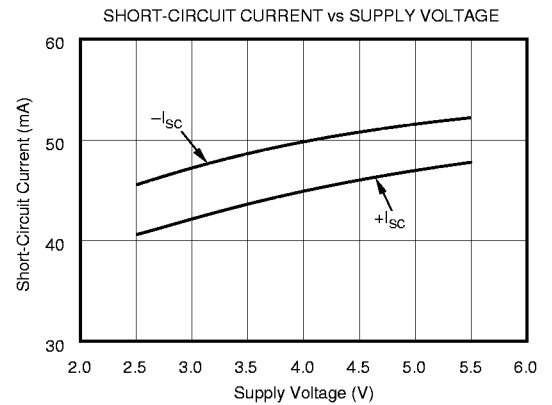
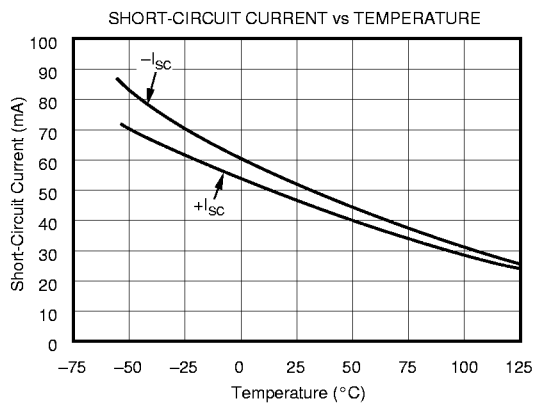
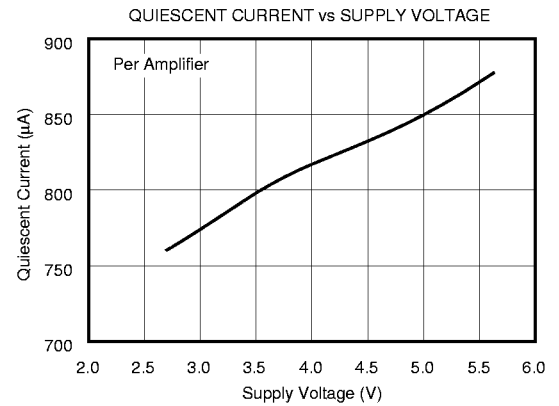
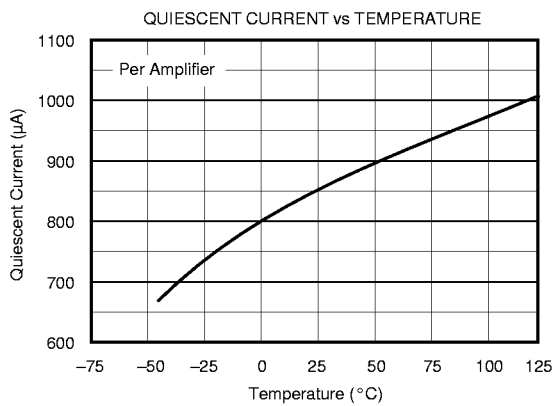
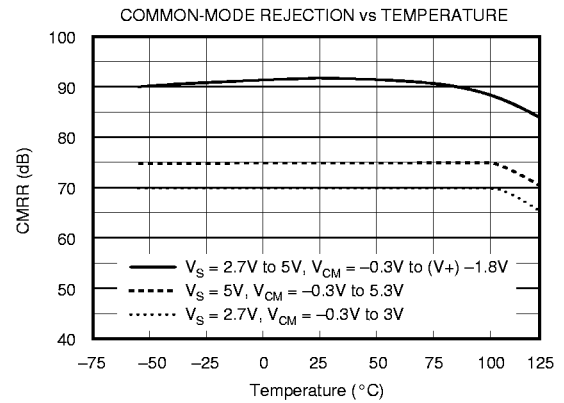
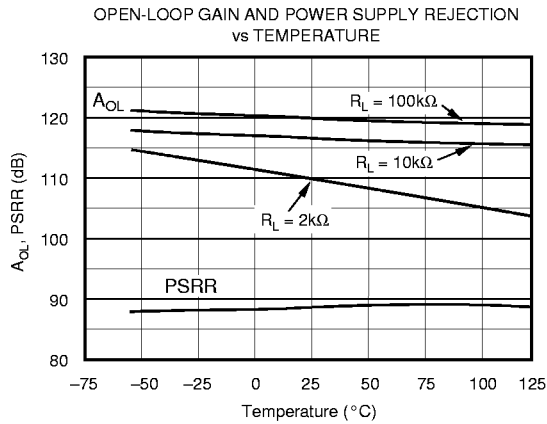
TYPICAL PERFORMANCE CURVES

At $T_A = +25^\circ\text{C}$, $V_S = +5\text{V}$, and $R_L = 10\text{k}\Omega$ connected to $V_S/2$, unless otherwise noted.



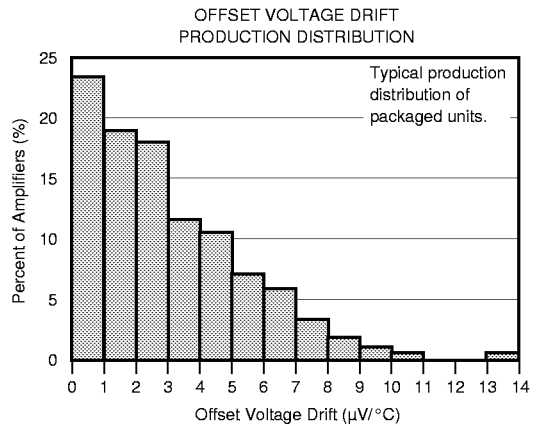
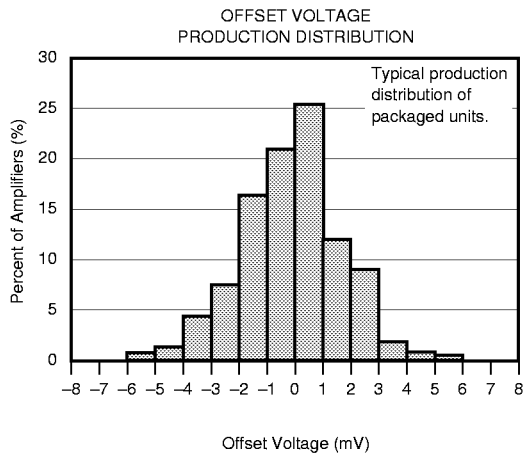
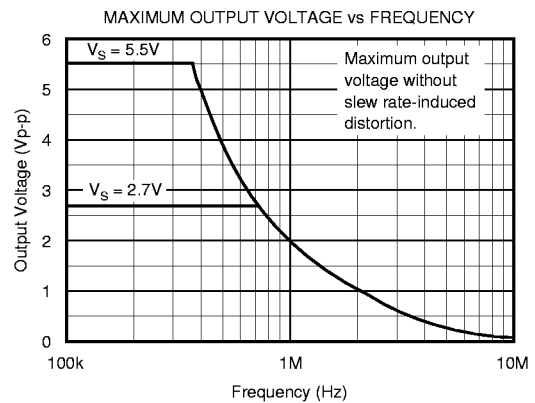
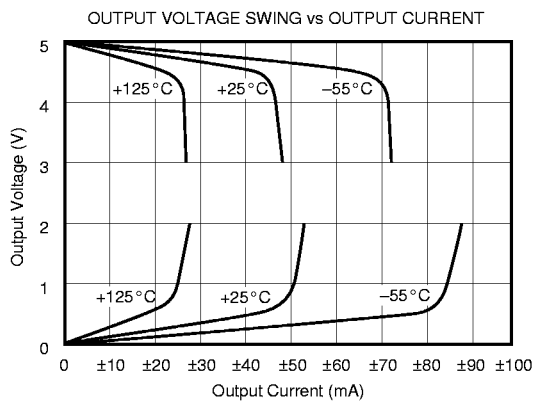
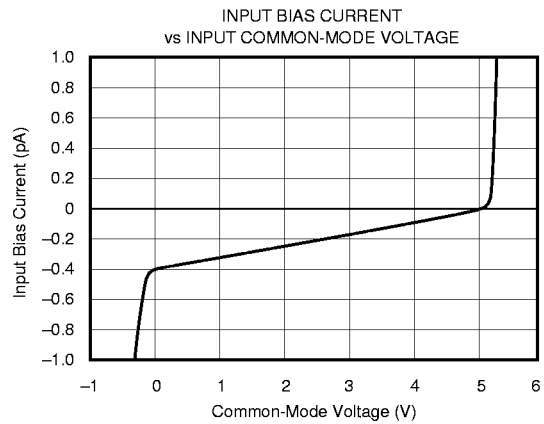
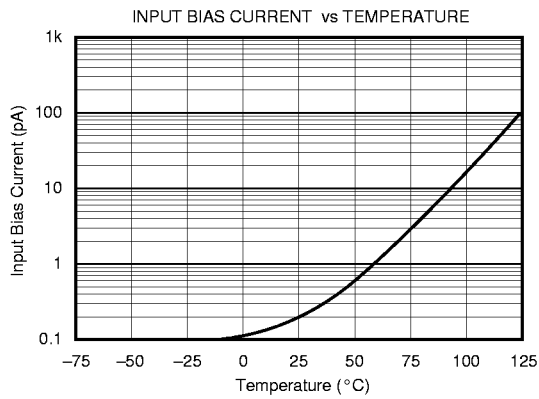
TYPICAL PERFORMANCE CURVES (CONT)

At $T_A = +25^\circ\text{C}$, $V_S = +5\text{V}$, and $R_L = 10\text{k}\Omega$ connected to $V_G/2$, unless otherwise noted.



TYPICAL PERFORMANCE CURVES (CONT)

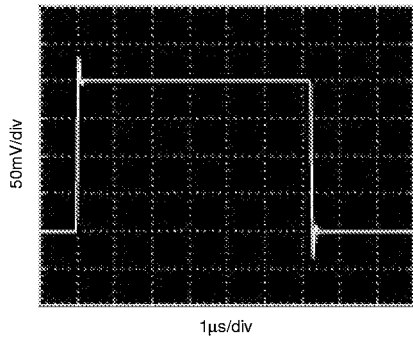
At $T_A = +25^\circ\text{C}$, $V_S = +5\text{V}$, and $R_L = 10\text{k}\Omega$ connected to $V_S/2$, unless otherwise noted.



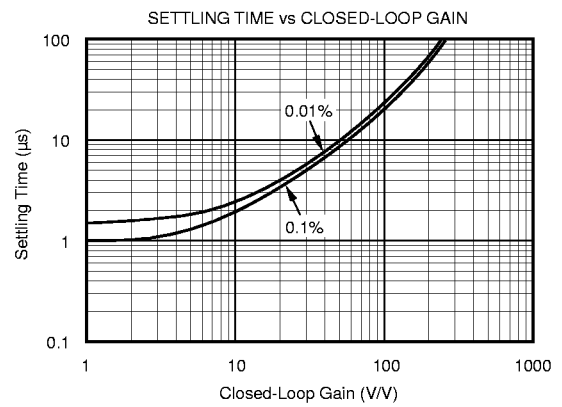
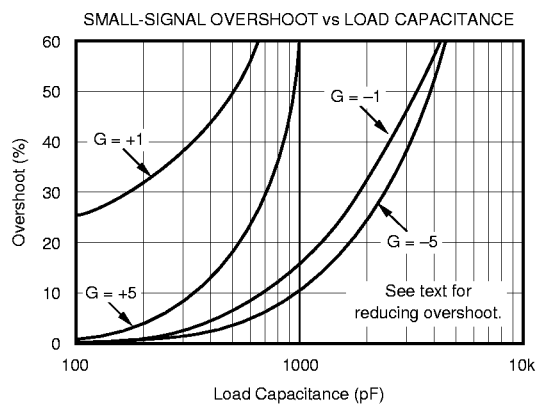
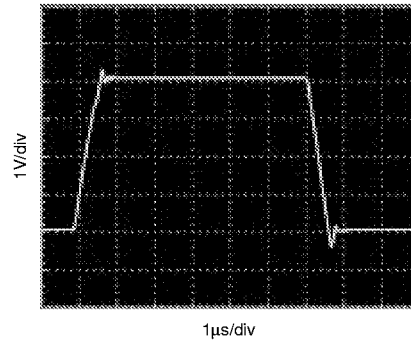
TYPICAL PERFORMANCE CURVES (CONT)

At $T_A = +25^\circ\text{C}$, $V_S = +5\text{V}$, and $R_L = 10\text{k}\Omega$ connected to $V_O/2$, unless otherwise noted.

SMALL-SIGNAL STEP RESPONSE
 $C_L = 100\text{pF}$



LARGE-SIGNAL STEP RESPONSE
 $C_L = 100\text{pF}$



APPLICATIONS INFORMATION

OPA343 series op amps are fabricated on a state-of-the-art 0.6 micron CMOS process. They are unity-gain stable and suitable for a wide range of general purpose applications. Rail-to-rail input/output make them ideal for driving sampling A/D converters. In addition, excellent ac performance makes them well-suited for audio applications. The class AB output stage is capable of driving 600Ω loads connected to any point between V+ and ground.

Rail-to-rail input and output swing significantly increases dynamic range, especially in low supply applications. Figure 1 shows the input and output waveforms for the OPA343 in unity-gain configuration. Operation is from a single +5V supply with a 10kΩ load connected to V_S/2. The input is a 5Vp-p sinusoid. Output voltage is approximately 4.98Vp-p.

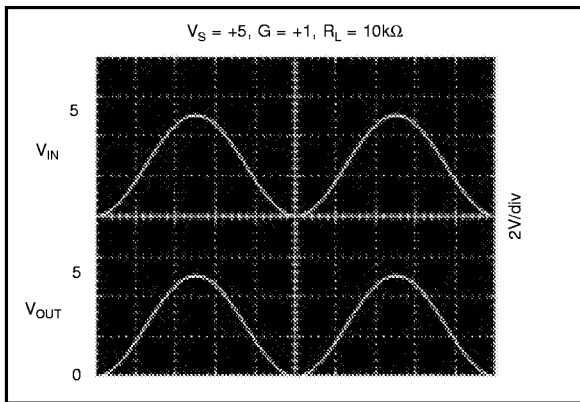


FIGURE 1. Rail-to-Rail Input and Output.

Power supply pins should be bypassed with 0.01μF ceramic capacitors.

OPERATING VOLTAGE

OPA343 series op amps are fully specified from +2.7V to +5V. However, supply voltage may range from +2.5V to +5.5V. Parameters are guaranteed over the specified supply range—a unique feature of the OPA343 series. In addition, many specifications apply from -40°C to +85°C. Most behavior remains virtually unchanged throughout the full operating voltage range. Parameters which vary significantly with operating voltages or temperature are shown in the typical performance curves.

RAIL-TO-RAIL INPUT

The input common-mode voltage range of the OPA343 series extends 500mV beyond the supply rails. This is achieved with a complementary input stage—an N-channel input differential pair in parallel with a P-channel differential pair (see Figure 2). The N-channel pair is active for input voltages close to the positive rail, typically (V₊) -1.3V to 500mV above the positive supply. The P-channel pair is on for inputs from 500mV below the negative supply to approximately (V₊) -1.3V.

There is a small transition region, typically (V₊) -1.5V to (V₊) -1.1V, in which both input pairs are on. This 400mV transition region can vary ±300mV with process variation. Thus, the transition region (both stages on) can range from (V₊) -1.8V to (V₊) -1.4V on the low end, up to (V₊) -1.2V to (V₊) -0.8V on the high end. Within the 400mV transition region PSRR, CMRR, offset voltage, offset drift, and THD may be degraded compared to operation outside this region.

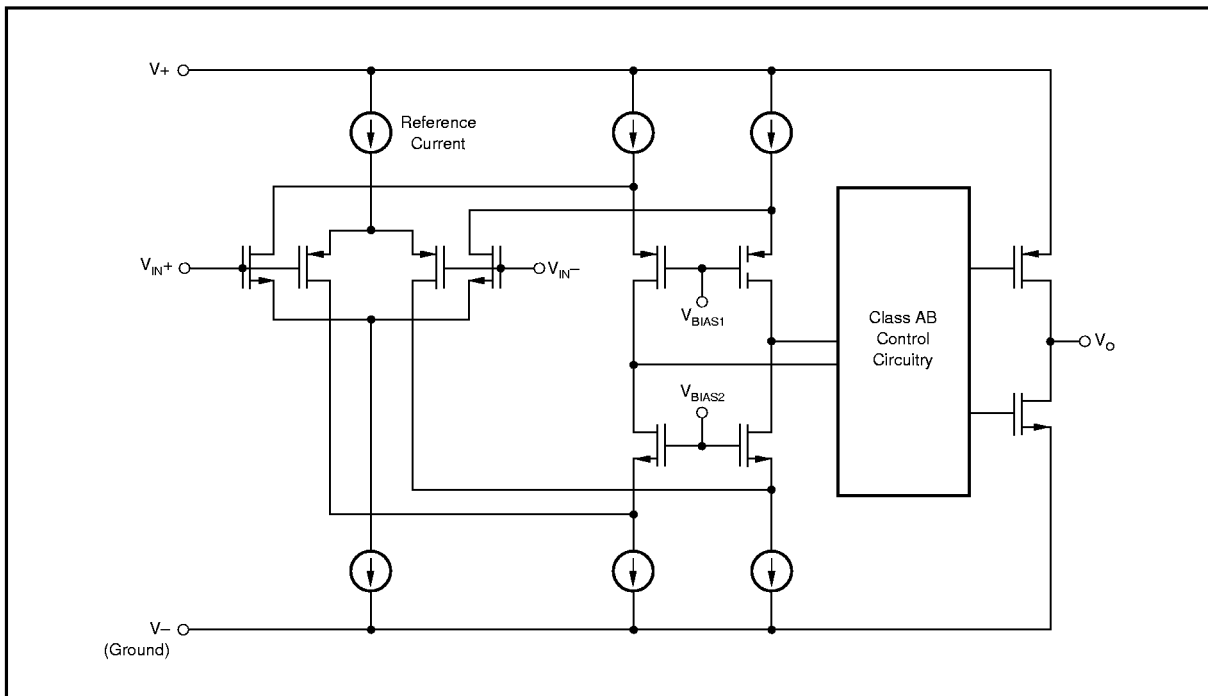


FIGURE 2. Simplified Schematic.

A double-folded cascode adds the signal from the two input pairs and presents a differential signal to the class AB output stage. Normally, input bias current is approximately 200fA, however, input voltages exceeding the power supplies by more than 500mV can cause excessive current to flow in or out of the input pins. Momentary voltages greater than 500mV beyond the power supply can be tolerated if the current on the input pins is limited to 10mA. This is easily accomplished with an input resistor as shown in Figure 3. Many input signals are inherently current-limited to less than 10mA, therefore, a limiting resistor is not required.

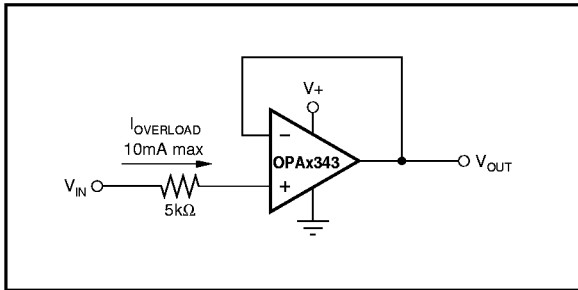


FIGURE 3. Input Current Protection for Voltages Exceeding the Supply Voltage.

RAIL-TO-RAIL OUTPUT

A class AB output stage with common-source transistors is used to achieve rail-to-rail output. For light resistive loads ($>50k\Omega$), the output voltage is typically a few millivolts from the supply rails. With moderate resistive loads ($2k\Omega$ to $50k\Omega$), the output can swing to within a few tens of millivolts from the supply rails and maintain high open-loop gain. See the typical performance curve “Output Voltage Swing vs Output Current.”

CAPACITIVE LOAD AND STABILITY

OPA343 series op amps can drive a wide range of capacitive loads. However, all op amps under certain conditions may become unstable. Op amp configuration, gain, and load

value are just a few of the factors to consider when determining stability. An op amp in unity gain configuration is the most susceptible to the effects of capacitive load. The capacitive load reacts with the op amp’s output resistance, along with any additional load resistance, to create a pole in the small-signal response which degrades the phase margin. In unity gain, OPA343 series op amps perform well, with a pure capacitive load up to approximately 1000pF. Increasing gain enhances the amplifier’s ability to drive more capacitance. See the typical performance curve “Small-Signal Overshoot vs Capacitive Load.”

One method of improving capacitive load drive in the unity gain configuration is to insert a 10Ω to 20Ω resistor in series with the output as shown in Figure 4. This significantly reduces ringing with large capacitive loads. However, if there is a resistive load in parallel with the capacitive load, R_S creates a voltage divider. This introduces a dc error at the output and slightly reduces output swing. This error may be insignificant. For instance, with $R_L = 10k\Omega$ and $R_S = 20\Omega$, there is only about a 0.2% error at the output.

DRIVING A/D CONVERTERS

OPA343 series op amps are optimized for driving medium speed (up to 100kHz) sampling A/D converters. However, they also offer excellent performance for higher speed converters. The OPA343 series provides an effective means of buffering the A/D’s input capacitance and resulting charge injection while providing signal gain. For applications requiring high accuracy, the OPA340 series is recommended.

Figures 5 and 6 show the OPA343 driving an ADS7816. The ADS7816 is a 12-bit, micro-power sampling converter in the tiny MSOP-8 package. When used with the miniature package options of the OPA343 series, the combination is ideal for space-limited and low power applications. For further information consult the ADS7816 data sheet.

With the OPA343 in a noninverting configuration, an RC network at the amplifier’s output can be used to filter high frequency noise in the signal (Figure 5). In the inverting configuration, filtering may be accomplished with a capacitor across the feedback resistor (Figure 6).

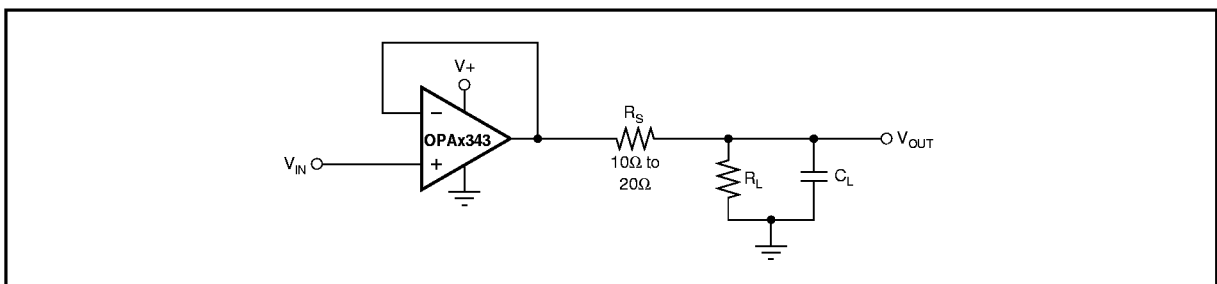


FIGURE 4. Series Resistor in Unity-Gain Configuration Improves Capacitive Load Drive.

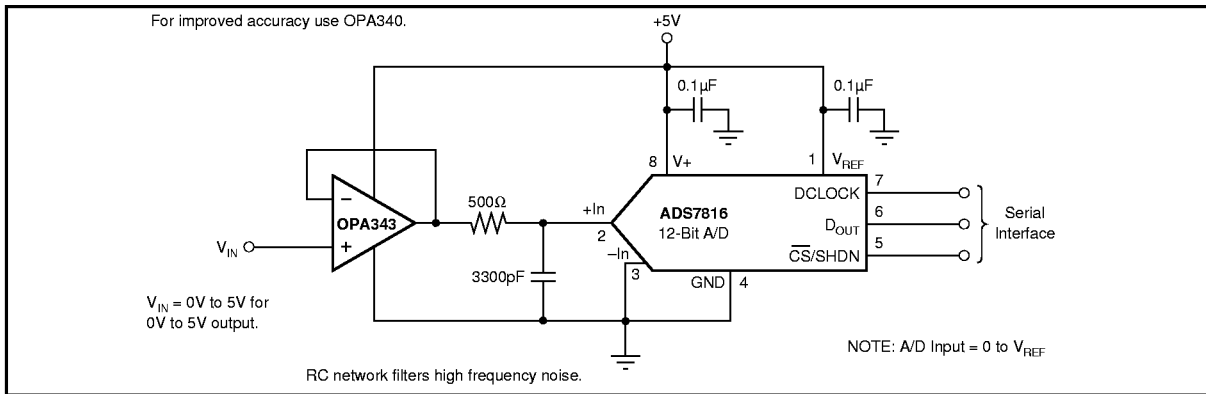


FIGURE 5. OPA343 in Noninverting Configuration Driving ADS7816.

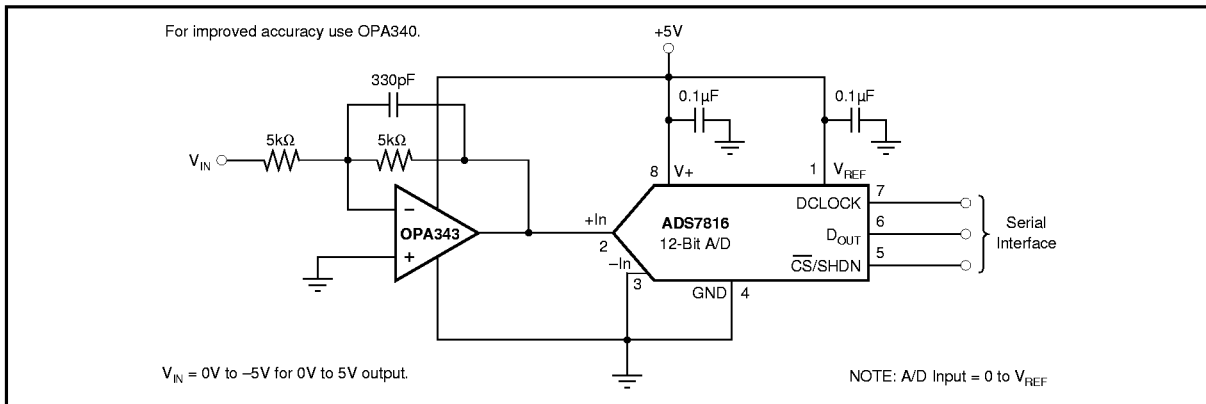


FIGURE 6. OPA343 in Inverting Configuration Driving ADS7816.

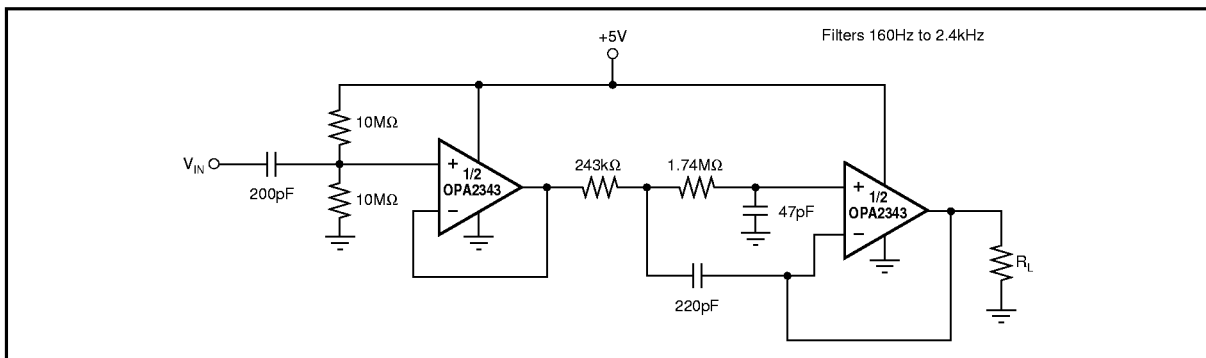


FIGURE 7. Speech Bandpass Filter.

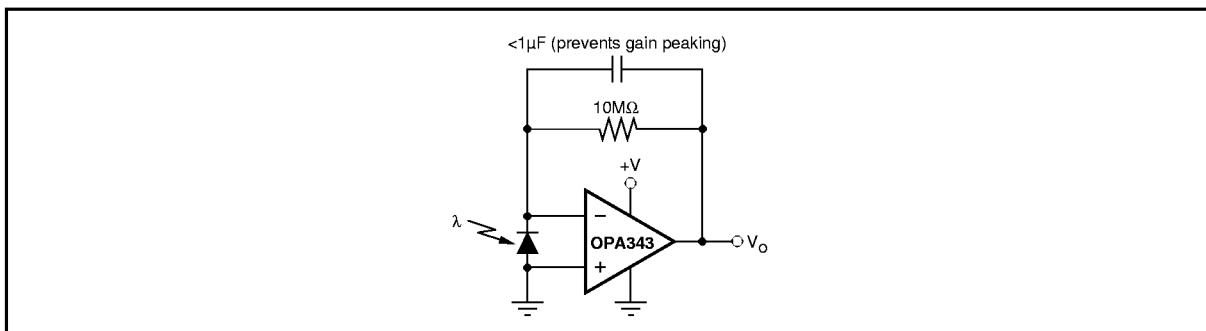
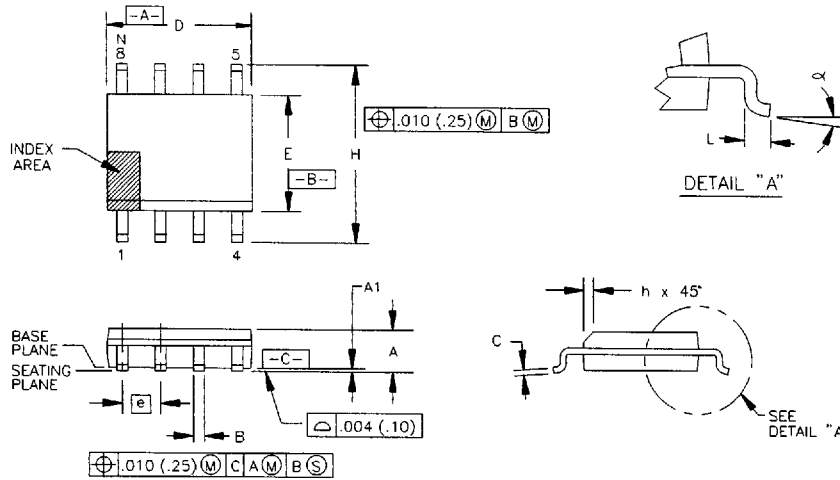


FIGURE 8. Transimpedance Amplifier.

Package Number 182 - 8-Lead SOIC



| DIM | INCHES | | MILLIMETERS | | NOTE |
|----------|--------|-------|-------------|-------|------|
| | MIN. | MAX. | MIN. | MAX. | |
| A | .0532 | .0688 | 1.35 | 1.75 | |
| A1 | .004 | .0098 | 0.10 | 0.23 | |
| B | .013 | .020 | 0.33 | 0.51 | 7 |
| C | .0075 | .0098 | 0.20 | 0.25 | |
| D | .189 | .1968 | 4.80 | 4.98 | 2 |
| E | .1497 | .1574 | 3.80 | 4.00 | 3 |
| e | .050 | BASIC | 1.27 | BASIC | |
| H | .2284 | .244 | 5.80 | 6.20 | |
| h | .0099 | .0196 | 0.25 | 0.50 | 4 |
| L | .016 | .050 | 0.41 | 1.27 | 5 |
| N | 8 | 8 | 8 | 8 | 6 |
| α | 0° | 8° | 0° | 8° | |

NOTES:

1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M-1982.
2. DIMENSION D DOES NOT INCLUDE MOLD FLASH, PROTRUSIONS OR GATE BURRS. MOLD FLASH, PROTRUSIONS AND GATE BURRS SHALL NOT EXCEED .006 IN. (0.15 mm) PER SIDE.
3. DIMENSION E DOES NOT INCLUDE INTER-LEAD FLASH OR PROTRUSIONS. INTER-LEAD FLASH AND PROTRUSIONS SHALL NOT EXCEED .010 IN. (0.25 mm) PER SIDE.
4. THE CHAMFER ON THE BODY IS OPTIONAL. IF IT IS NOT PRESENT,

A VISUAL INDEX FEATURE MUST BE LOCATED WITHIN THE CROSS-HATCHED AREA.

5. L IS THE LENGTH OF TERMINAL FOR SOLDERING TO A SUBSTRATE.
6. N IS THE NUMBER OF TERMINAL POSITIONS.
7. THE LEAD WIDTH B, AS MEASURED .014 IN. (0.36 mm) OR GREATER ABOVE THE SEATING PLANE, SHALL NOT EXCEED A MAXIMUM VALUE OF .024 IN. (0.61 mm).
8. LEAD TO LEAD COPLANARITY SHALL BE LESS THAN .004 IN. (0.10 mm) FROM SEATING PLANE.

PACKAGE NUMBER: ZZ182 REV.: H
JEDEC NUMBER: MS-012-AA



PACKAGE DRAWING

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