

FEATURES

- Handles 10,000pF Capacitive Load
- 450 μ V Max Offset Voltage
- 1200 μ V Max Offset Voltage in S8 Package
- 50pA Bias Current at 70°C
- 13nV/ $\sqrt{\text{Hz}}$ Voltage Noise
- 4V/ μ s Slew Rate
- 4 μ V/°C Drift
- 130dB Channel Separation

APPLICATIONS

- Sample-and-Hold (Drives Large Hold Capacitors)
- A/D and D/A Converters
- Photodiode Amplifiers
- Voltage-to-Frequency Converters

DESCRIPTION

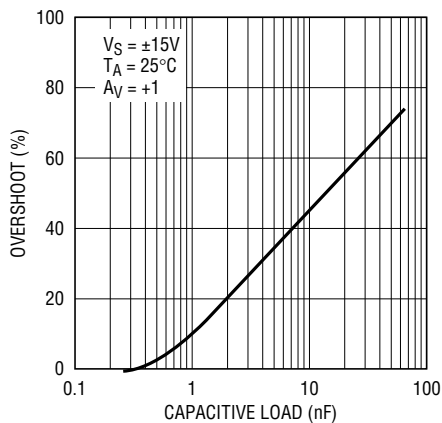
The LT1457 is a dual, JFET input op amp optimized for handling large capacitive loads in combination with precision performance.

Precision specifications include 220 μ V offset voltage in plastic and surface mount packages. At 70°C input bias current is 50pA, input offset current is 20pA. Channel separation is 130dB.

Other dual JFET input op amps from Linear Technology include the LT1057, which is three times faster than the LT1457 but at the expense of significantly lower capacitive load handling capability; and the LT1113 with 4.5nV/ $\sqrt{\text{Hz}}$ voltage noise.

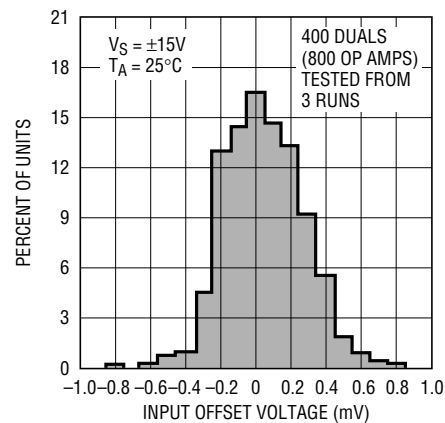
TYPICAL PERFORMANCE CHARACTERISTICS

Capacitive Load Handling



LT1457 • TA01

Input Offset Voltage Distribution
 S8 Package



LT1457 • TA02

ABSOLUTE MAXIMUM RATINGS

| | |
|--|----------------------------------|
| Supply Voltage | $\pm 20V$ |
| Differential Input Voltage | $\pm 40V$ |
| Input Voltage | Equal to Supply Voltages |
| Output Short-Circuit Duration | Indefinite |
| Operating Temperature Range | $-40^{\circ}C$ to $85^{\circ}C$ |
| Storage Temperature Range | $-65^{\circ}C$ to $150^{\circ}C$ |
| Lead Temperature (Soldering, 10 sec) | $300^{\circ}C$ |

PACKAGE/ORDER INFORMATION

| | |
|---|-------------------------|
| <p>N8 PACKAGE 8-LEAD PLASTIC DIP $T_{JMAX} = 115^{\circ}C$, $\theta_{JA} = 130^{\circ}C/W$</p> | ORDER PART NUMBER |
| | LT1457ACN8 LT1457CN8 |
| <p>S8 PACKAGE 8-LEAD PLASTIC SOIC NOTE: THIS PIN CONFIGURATION DIFFERS FROM THE 8-LEAD DIP PIN LOCATIONS. INSTEAD, IT FOLLOWS THE INDUSTRY STANDARD LT1013DS8 SO PACKAGE CONFIGURATION. $T_{JMAX} = 130^{\circ}C$, $\theta_{JA} = 190^{\circ}C/W$</p> | LT1457S8 |
| | S8 PART MARKING |
| | 1457 |

Consult factory for Industrial and Military grade parts.

ELECTRICAL CHARACTERISTICS $V_S = \pm 15V$, $T_A = 25^{\circ}C$, $V_{CM} = 0V$ unless otherwise noted. (Note 1)

| SYMBOL | PARAMETER | CONDITIONS | LT1457AC | | | LT1457C/LT1457S8 | | | UNITS |
|-----------|---|---|------------|-----------|----------|------------------|-----------|----------|--------------------|
| | | | MIN | TYP | MAX | MIN | TYP | MAX | |
| V_{OS} | Input Offset Voltage | LT1457AC/C LT1457S8 | | 150 | 450 | | 200 | 800 | μV μV |
| I_{OS} | Input Offset Current | Fully Warmed Up | | 3 | 40 | | 4 | 50 | pA |
| I_B | Input Bias Current | Fully Warmed Up | | ± 5 | ± 50 | | ± 7 | ± 75 | pA |
| | Input Resistance-Differential -Common-Mode | $V_{CM} = -11V$ to $8V$ $V_{CM} = 8V$ to $11V$ | | 10^{12} | | | 10^{12} | | Ω |
| | | | | 10^{12} | | | 10^{12} | | Ω |
| | | | | 10^{11} | | | 10^{11} | | Ω |
| | Input Capacitance | | | 4 | | | 4 | | pF |
| e_n | Input Noise Voltage | 0.1Hz to 10Hz | | 2.0 | | | 2.1 | | μV_{p-p} |
| e_n | Input Noise Voltage Density | $f_0 = 10Hz$ | | 26 | | | 28 | | nV/\sqrt{Hz} |
| | | $f_0 = 1kHz$ (Note 2) | | 13 | 22 | | 14 | 24 | nV/\sqrt{Hz} |
| i_n | Input Noise Current Density | $f_0 = 10Hz, 1kHz$ (Note 3) | | 1.5 | 4 | | 1.8 | 6 | fA/\sqrt{Hz} |
| A_{VOL} | Large-Signal Voltage Gain | $V_O = \pm 10V$, $R_L = 2k$ | 150 | 350 | | 100 | 300 | | V/mV |
| | | $V_O = \pm 10V$, $R_L = 1k$ | 120 | 250 | | 80 | 220 | | V/mV |
| | Input Voltage Range | | ± 10.5 | 14.3 | | ± 10.5 | 14.3 | | V |
| | | | | | -11.5 | | | -11.5 | |
| CMRR | Common-Mode Rejection Ratio | $V_{CM} = \pm 10.5V$ | 86 | 100 | | 82 | 98 | | dB |
| PSRR | Power Supply Rejection Ratio | $V_S = \pm 4.5V$ to $\pm 18V$ | 88 | 103 | | 86 | 102 | | dB |
| V_{OUT} | Output Voltage Swing | $R_L = 2k$ | ± 12 | ± 13 | | ± 12 | ± 13 | | V |
| SR | Slew Rate | | 2 | 4 | | 2 | 4 | | V/ μs |

ELECTRICAL CHARACTERISTICS $V_S = \pm 15V, T_A = 25^\circ C, V_{CM} = 0V$ unless otherwise noted. (Note 1)

| SYMBOL | PARAMETER | CONDITIONS | LT1457AC | | | LT1457C/LT1457S8 | | | UNITS |
|--------|------------------------------|--------------------------------|----------|-----|-----|------------------|-----|-----|-------|
| | | | MIN | TYP | MAX | MIN | TYP | MAX | |
| GBW | Gain-Bandwidth Product | (Note 5) | 1.0 | 1.7 | | 1.0 | 1.7 | | MHz |
| I_S | Supply Current Per Amplifier | | | 1.8 | 3.0 | | 1.8 | 3.0 | mA |
| | Channel Separation | DC to 5kHz, $V_{IN} = \pm 10V$ | | 132 | | | 130 | | dB |

ELECTRICAL CHARACTERISTICS $V_S = \pm 15V, V_{CM} = 0V, 0^\circ C \leq T_A \leq 70^\circ C$, unless otherwise noted.

| SYMBOL | PARAMETER | CONDITIONS | LT1457AC | | | LT1457C/LT1457S8 | | | UNITS |
|-----------|--|-------------------------------|----------|----------|------------|------------------|----------|------------|------------------|
| | | | MIN | TYP | MAX | MIN | TYP | MAX | |
| V_{OS} | Input Offset Voltage | LT1457AC/C LT1457S8 | ● | 250 | 900 | | 330 | 1500 | μV |
| | | | ● | | | | 400 | 1900 | μV |
| | Average Temperature Coefficient of Input Offset Voltage (Note 4) | | ● | 3 | 10 | | 4 | 16 | $\mu V/^\circ C$ |
| I_{OS} | Input Offset Current | Warmed Up, $T_A = 70^\circ C$ | | 18 | 150 | | 20 | 250 | pA |
| I_B | Input Bias Current | Warmed Up, $T_A = 70^\circ C$ | | ± 50 | ± 250 | | ± 60 | ± 350 | pA |
| A_{VOL} | Large-Signal Voltage Gain | $V_O = \pm 10V, R_L = 2k$ | ● | 70 | 220 | | 50 | 200 | V/mV |
| CMRR | Common-Mode Rejection Ratio | $V_{CM} = \pm 10.4V$ | ● | 85 | 98 | | 80 | 96 | dB |
| PSRR | Power Supply Rejection Ratio | $V_S = \pm 4.5V$ to $\pm 18V$ | ● | 87 | 102 | | 84 | 100 | dB |
| V_{OUT} | Output Voltage Swing | $R_L = 2k$ | ● | ± 12 | ± 12.8 | | ± 12 | ± 12.8 | V |
| I_S | Supply Current Per Amplifier | $T_A = 70^\circ C$ | ● | | 3.2 | | | 3.2 | mA |
| | | | | 1.7 | | | 1.7 | | mA |

ELECTRICAL CHARACTERISTICS $V_S = \pm 15V, V_{CM} = 0V, -40^\circ C \leq T_A \leq 85^\circ C$, unless otherwise noted. (Note 6)

| SYMBOL | PARAMETER | CONDITIONS | LT1457AC | | | LT1457C/LT1457S8 | | | UNITS |
|-----------|---|-------------------------------|----------|-----------|------------|------------------|-----------|------------|------------------|
| | | | MIN | TYP | MAX | MIN | TYP | MAX | |
| V_{OS} | Input Offset Voltage | LT1457AC/C LT1457S8 | ● | 350 | 1100 | | 400 | 1800 | μV |
| | | | ● | | | | 500 | 2300 | μV |
| | Average Temperature Coefficient of Input Offset Voltage | | ● | 3 | 10 | | 4 | 16 | $\mu V/^\circ C$ |
| I_{OS} | Input Offset Current | Warmed Up, $T_A = 85^\circ C$ | | 0.1 | 0.5 | | 0.1 | 0.6 | nA |
| I_B | Input Bias Current | Warmed Up, $T_A = 85^\circ C$ | | ± 0.2 | ± 0.7 | | ± 0.2 | ± 0.9 | nA |
| A_{VOL} | Large-Signal Voltage Gain | $V_O = \pm 10V, R_L = 2k$ | ● | 40 | 120 | | 30 | 110 | V/mV |
| CMRR | Common-Mode Rejection Ratio | $V_{CM} = \pm 10.4V$ | ● | 84 | 97 | | 80 | 95 | dB |
| PSRR | Power Supply Rejection Ratio | $V_S = \pm 5V$ to $\pm 17V$ | ● | 86 | 100 | | 83 | 98 | dB |
| V_{OUT} | Output Voltage Swing | $R_L = 2k$ | ● | ± 12 | ± 12.7 | | ± 12 | ± 12.6 | V |
| I_S | Supply Current Per Amplifier | $T_A = -40^\circ C$ | | | 3.8 | | | 3.8 | mA |
| | | $T_A = 85^\circ C$ | | 1.7 | | | 1.7 | | mA |

The ● denotes the specifications which apply over the full operating temperature range.

Note 1: Typical parameters are defined as the 60% yield of distributions of individual amplifiers; i.e., out of 100 LT1457s (200 op amps) typically 120 will be better than the indicated specification.

Note 2: This parameter is tested on a sample basis only.

Note 3: Current noise is calculated from the formula: $i_n = (2qI_b)^{1/2}$, where $q = 1.6 \times 10^{-19}$ coulomb. The noise of source resistors up to 1G Ω swamps the contribution of current noise.

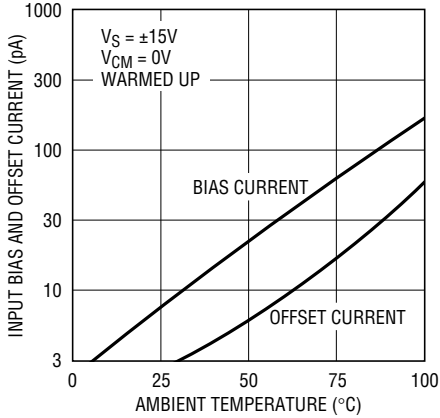
Note 4: This parameter is not 100% tested.

Note 5: Gain-Bandwidth product is not tested. It is guaranteed by design and by inference from the slew rate measurement.

Note 6: The LT1457 is not tested and not quality-assurance-sampled at $-40^\circ C$ and at $85^\circ C$. These specifications are guaranteed by design, correlation, and/or inference from $0^\circ C$, $25^\circ C$, and $70^\circ C$ tests.

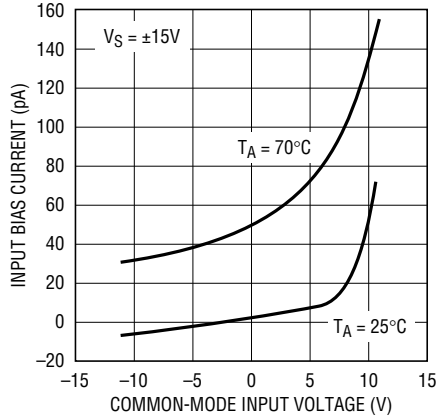
TYPICAL PERFORMANCE CHARACTERISTICS

Input Bias and Offset Current vs Temperature



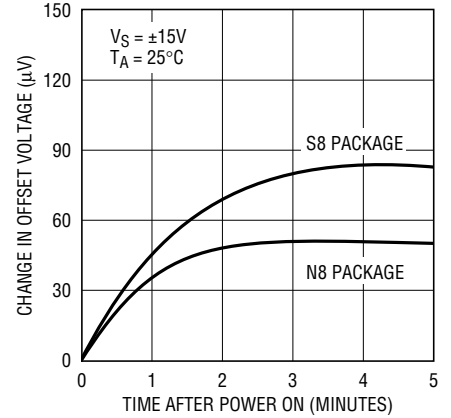
LT1457 • TPC01

Input Bias Current Over the Common-Mode Range



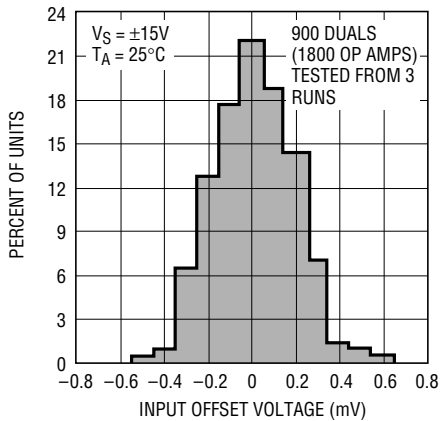
LT1457 • TPC02

Warm-Up Drift



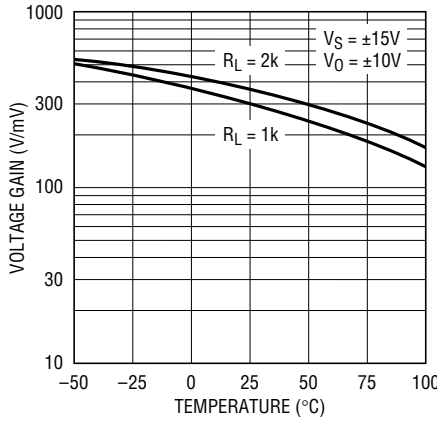
LT1457 • TPC03

Input Offset Voltage Distribution N8 Package



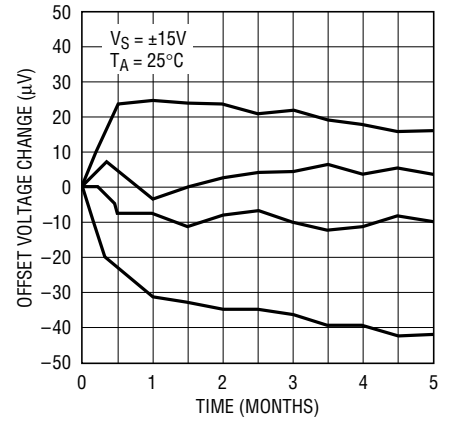
LT1457 • TPC04

Voltage Gain vs Temperature



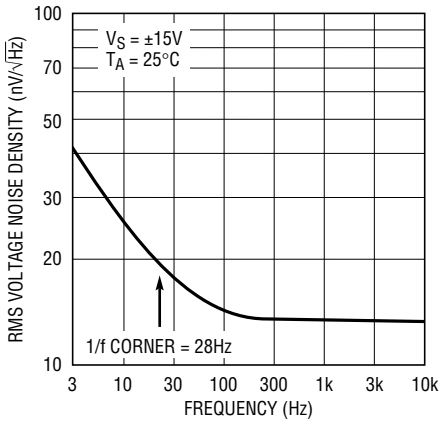
LT1457 • TPC05

Long Term Drift of Representative Units



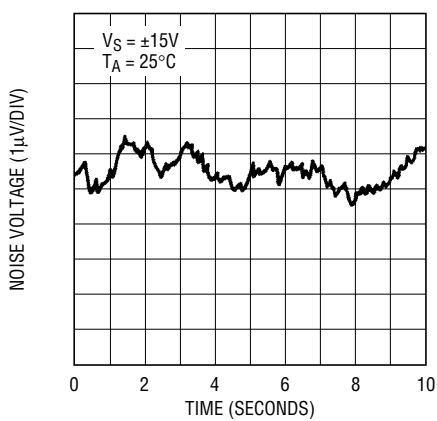
LT1457 • TPC06

Voltage Noise vs Frequency



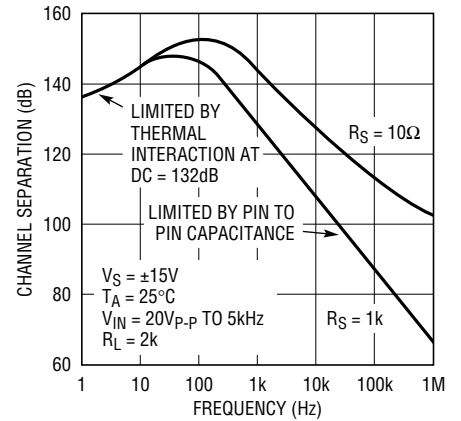
LT1457 • TPC07

0.1Hz to 10Hz Noise



LT1457 • TPC08

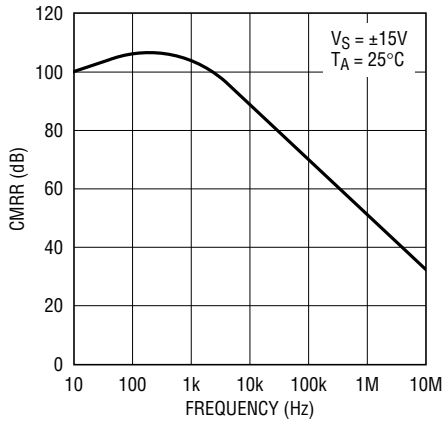
Channel Separation vs Frequency



LT1457 • TPC09

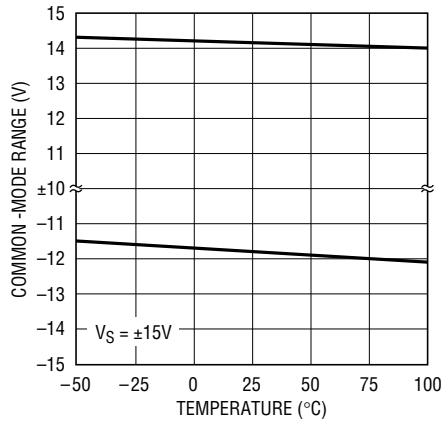
TYPICAL PERFORMANCE CHARACTERISTICS

Common-Mode Rejection Ratio vs Frequency



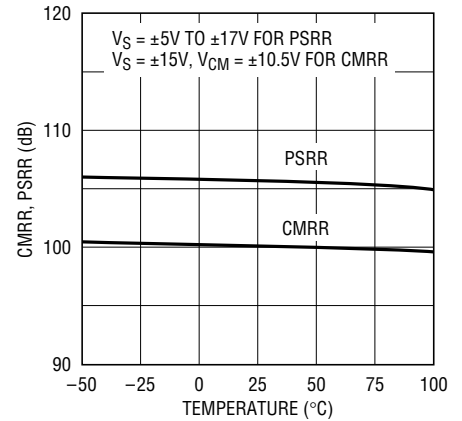
LT1457 • TPC10

Common-Mode Range vs Temperature



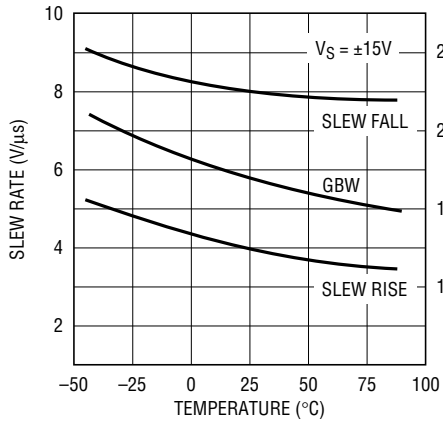
LT1457 • TPC11

Common-Mode and Power Supply Rejections vs Temperature



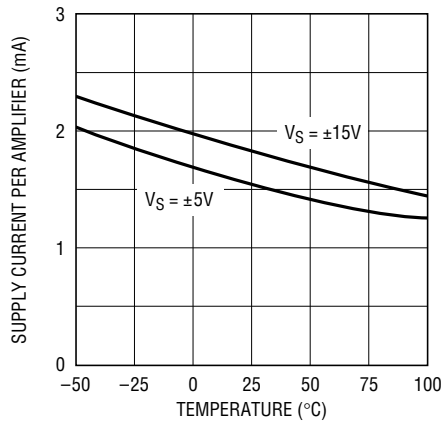
LT1457 • TPC12

Slew Rate, Gain-Bandwidth Product vs Temperature



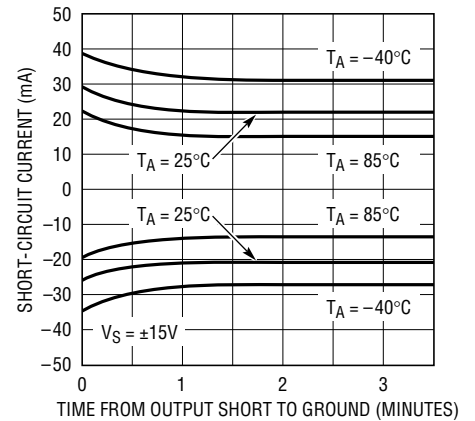
LT1457 • TPC18

Supply Current vs Temperature



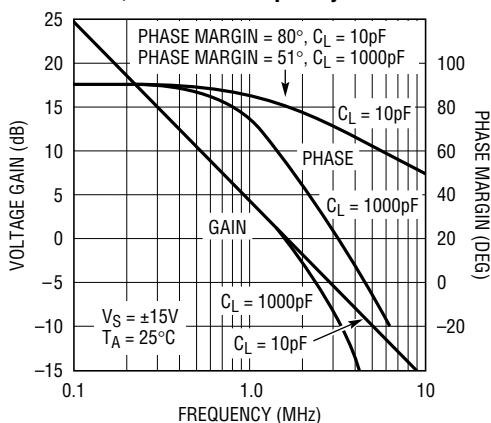
LT1457 • TPC14

Short-Circuit Current vs Time (One Output Shorted to Ground)



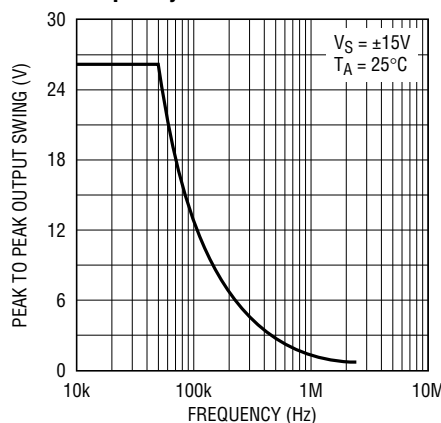
LT1457 • TPC15

Gain, Phase vs Frequency



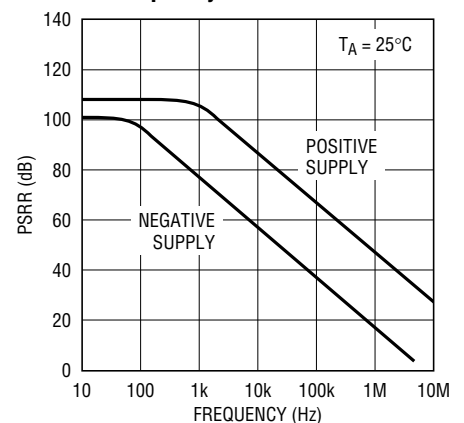
LT1457 • TPC16

Undistorted Output Swing vs Frequency



LT1457 • TPC17

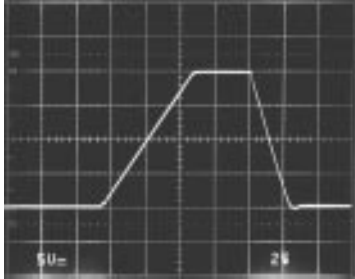
Power Supply Rejection Ratio vs Frequency



LT1457 • TPC13

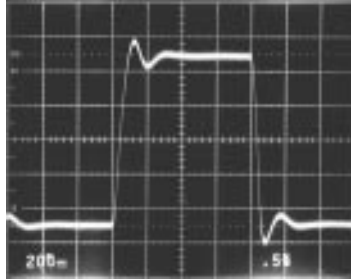
TYPICAL PERFORMANCE CHARACTERISTICS

Large-Signal Response
 $A_V = 1$, $C_L = 100\text{pF}$



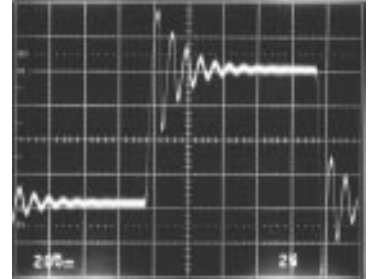
LT1457 TPC19

Small-Signal Response
 $A_V = 1$, $C_L = 1000\text{pF}$



LT1457 TPC20

Small-Signal Response
 $A_V = 1$, $C_L = 10,000\text{pF}$



LT1457 TPC21

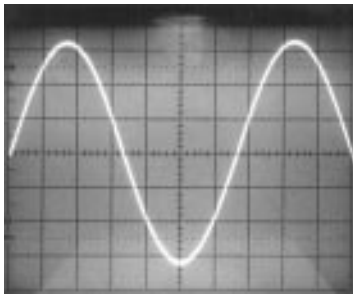
APPLICATIONS INFORMATION

Phase Reversal Protection

Most industry standard JFET input single, dual, and quad op amps (e.g., LF156, LF351, LF353, LF411, LF412, OP-15, OP-16, OP-215, and TL084) exhibit phase reversal at the output when the negative common-mode limit at the input is exceeded (i.e., below -12V with $\pm 15\text{V}$ supplies). The photos show a $\pm 16\text{V}$ sine wave input (A), the response

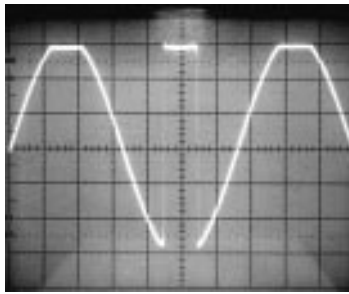
of an LF412A in the unity gain follower mode (B), and the response of the LT1457 (C).

The phase reversal of photo (B) can cause lock-up in servo systems. The LT1457 does not phase-reverse due to a unique phase reversal protection circuit.



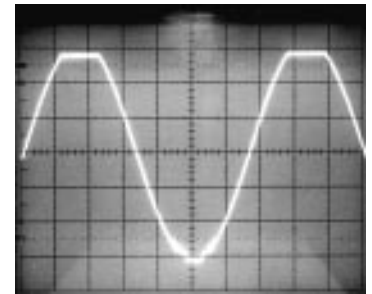
LT1457 AI01

(A) $\pm 16\text{V}$ Sine Wave Input



LT1457 AI02

(B) LF412A Output



LT1457 AI03

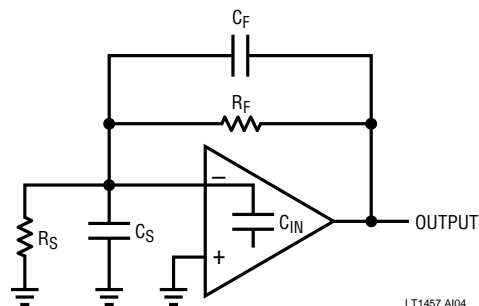
(C) LT1457 Output

All Photos 5V/Div Vertical Scale, 50 μs /Div Horizontal Scale

APPLICATIONS INFORMATION

High Speed Operation

When the feedback around the op amp is resistive (R_F), a pole will be created with R_F , the source resistance and capacitance (R_S, C_S), and the amplifier input capacitance ($C_{IN} \approx 4\text{pF}$). In low closed loop gain configurations and with R_S and R_F in the kilohm range, this pole can create excess phase shift and even oscillation on high speed amplifiers. Because the LT1457's phase margin is very high, this problem is minimal. However, a small capacitor (C_F) in parallel with R_F eliminates this problem. With $R_S(C_S + C_{IN}) = R_F C_F$, the effect of the feedback pole is completely removed.

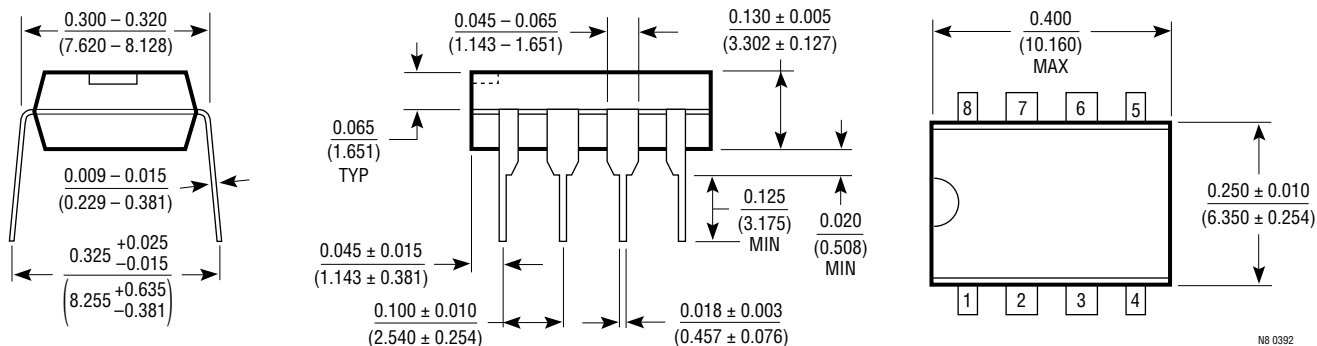


LT1457 A104

PACKAGE DESCRIPTION

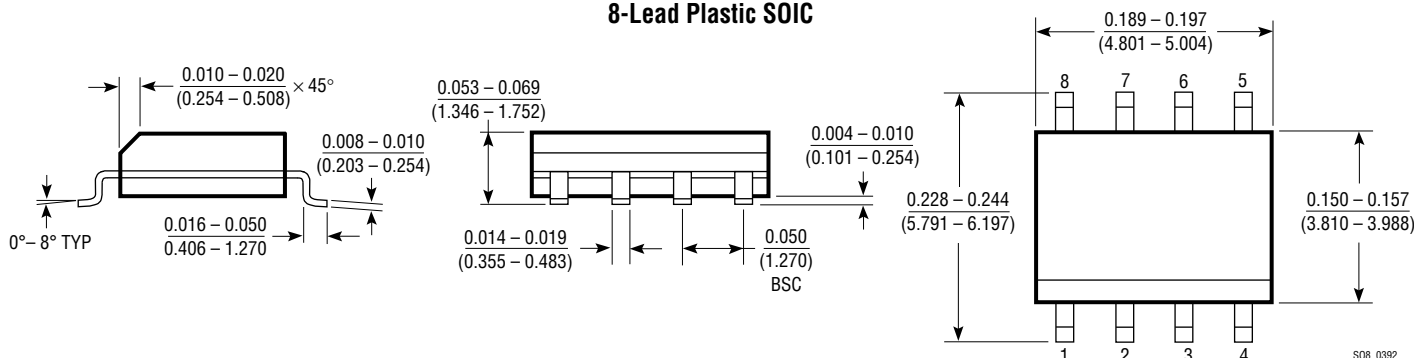
Dimension in inches (millimeters) unless otherwise noted.

N8 Package 8-Lead Plastic DIP



N8 0392

S8 Package 8-Lead Plastic SOIC



S08 0392

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