

High Speed Operational Amplifier

FEATURES

- *Guaranteed* 1.0mV Max. Input Offset Voltage
- *Guaranteed* 100,000 Min. Gain
- *Guaranteed* 50V/ μ s Slew Rate
- *Guaranteed* 20nA Max. Input Offset Current
- 15MHz Bandwidth
- Unity Gain Stable

APPLICATIONS

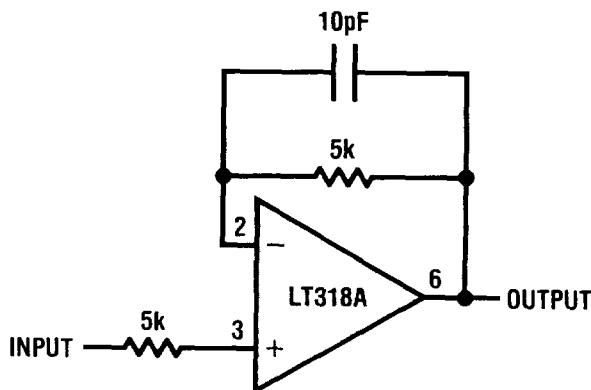
- Wideband Amplifiers
- High Frequency Absolute Value Circuits
- D/A Converter Amplifiers
- Fast Integrators

DESCRIPTION

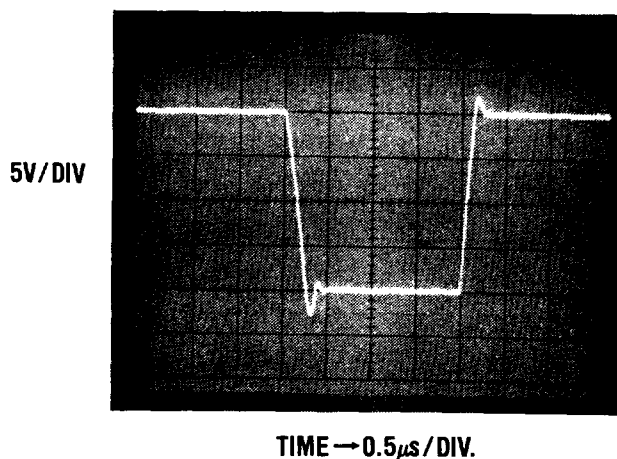
The LT118A is an improved version of the industry standard LM118. The LT118A features lower input offset voltage, lower input offset currents, higher gain and higher common mode and power supply rejection. Because of these enhancements, the LT118A will improve the accuracy of most applications. Unlike many wideband amplifiers, the LT118A is unity gain stable and has a slew rate of 50V/ μ s. When used in inverting amplifier applications, feedforward compensation can be used to achieve slew rates in excess of 150V/ μ s. Linear Technology Corporation's advanced processing techniques make the LT118A an ideal choice for high speed applications.

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Voltage Follower



Voltage Follower Pulse Response



ABSOLUTE MAXIMUM RATINGS

| | |
|---------------------------------------|----------------------------------|
| Supply Voltage | $\pm 20V$ |
| Differential Input Current (Note 1) | $\pm 10mA$ |
| Input Voltage (Note 2) | $\pm 20V$ |
| Output Short Circuit Duration | Indefinite |
| Operating Temperature Range | |
| LT118A/LM118 | $-55^{\circ}C$ to $125^{\circ}C$ |
| LT318A/LM318 | $0^{\circ}C$ to $70^{\circ}C$ |
| Storage Temperature Range | |
| All Devices | $-65^{\circ}C$ to $150^{\circ}C$ |
| Lead Temperature (Soldering, 10 sec.) | $300^{\circ}C$ |

PACKAGE/ORDER INFORMATION

| TOP VIEW | ORDER PART NUMBER |
|---|---|
| <p>METAL CAN H PACKAGE</p> | LT118AH LM118H LT318AH LM318H |
| <p>HERMETIC DIP J8 PACKAGE PLASTIC DIP N8 PACKAGE</p> | LT118AJ8 LM118J8 LT318AJ8 LM318J8 LT318AN8 LM318N8 |

ELECTRICAL CHARACTERISTICS (Note 3)

| SYMBOL | PARAMETER | CONDITIONS | LT118A | | | LM118 | | | UNITS |
|----------|------------------------------|---|------------|----------|------------|----------|-----|------------|-------|
| | | | MIN | TYP | MAX | MIN | TYP | MAX | |
| V_{OS} | Input Offset Voltage | | 0.5 | 1 | 1 | 2 | 4 | 6 | mV |
| | | | 1 | 2 | | | | | mV |
| I_{OS} | Input Offset Current | | 6 | 20 | 10 | 6 | 50 | 100 | nA |
| | | | 10 | 30 | | | | | nA |
| I_B | Input Bias Current | | 120 | 250 | 500 | 120 | 250 | 500 | nA |
| | | | | | | | | | nA |
| R_{IN} | Input Resistance | | 1 | 3 | 1 | 3 | | M Ω | |
| A_V | Large Signal Voltage Gain | $V_S = \pm 15V, V_{OUT} = \pm 10V, R_L \geq 2k\Omega$ | 100 | 500 | 100 | 50 | 200 | | V/mV |
| | | | | | | 25 | | | V/mV |
| SR | Slew Rate | $V_S = \pm 15V, A_V = 1$ | 50 | 70 | 50 | 70 | | V/ μs | |
| GBW | Gain Bandwidth Product | $V_S = \pm 15V$ | | 15 | | 15 | | MHz | |
| | Output Voltage Swing | $V_S = \pm 15V, R_L = 2k\Omega$ | ± 12 | ± 13 | ± 12 | ± 13 | | V | |
| | Input Voltage Range | $V_S = \pm 15V$ | ± 11.5 | | ± 11.5 | | | V | |
| I_S | Supply Current | $T_A = 125^{\circ}C$ | 5 | 8 | 5 | 8 | | mA | |
| | | | 4.5 | 7 | 4.5 | 7 | | mA | |
| CMRR | Common Mode Rejection Ratio | | 86 | 100 | 80 | 100 | | dB | |
| PSRR | Power Supply Rejection Ratio | | 86 | 100 | 70 | 80 | | dB | |

ELECTRICAL CHARACTERISTICS (Note 3)

| SYMBOL | PARAMETER | CONDITIONS | LT318A | | | LM318 | | | UNITS |
|----------|------------------------------|---|-----------------|------------|------------|----------|------------|------------|--------------|
| | | | MIN | TYP | MAX | MIN | TYP | MAX | |
| V_{OS} | Input Offset Voltage | | | 0.5 | 1 2 | | 4 | 10 15 | mV mV |
| I_{OS} | Input Offset Current | | | 10 | 20 30 | | 30 | 200 750 | nA nA |
| I_B | Input Bias Current | | | 150 | 250 500 | | 150 | 500 750 | nA nA |
| R_{IN} | Input Resistance | | 0.5 | 3 | | 0.5 | 3 | | M Ω |
| A_V | Large Signal Voltage Gain | $V_S = \pm 15V, V_{OUT} = \pm 10V, R_L \geq 2k\Omega$ | ● 100 100 | 500 | | 25 20 | 200 | | V/mV V/mV |
| SR | Slew Rate | $V_S = \pm 15V, A_V = 1$ | | 50 | 70 | | 50 | 70 | V/ μ s |
| GBW | Gain Bandwidth Product | $V_S = \pm 15V$ | | 15 | | | 15 | | MHz |
| | Output Voltage Swing | $V_S = \pm 15V, R_L = 2k\Omega$ | ● | ± 12 | ± 13 | | ± 12 | ± 13 | V |
| | Input Voltage Range | $V_S = \pm 15V$ | ● | ± 11.5 | | | ± 11.5 | | V |
| I_S | Supply Current | | | 5 | 10 | | 5 | 10 | mA |
| CMRR | Common Mode Rejection Ratio | | ● | 86 | 100 | | 70 | 100 | dB |
| PSRR | Power Supply Rejection Ratio | | ● | 86 | 100 | | 65 | 80 | dB |

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

The shaded electrical specifications indicate those parameters which have been improved or guaranteed test limits provided for the first time.

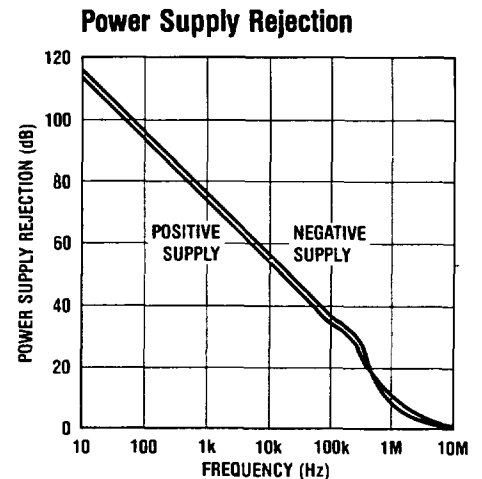
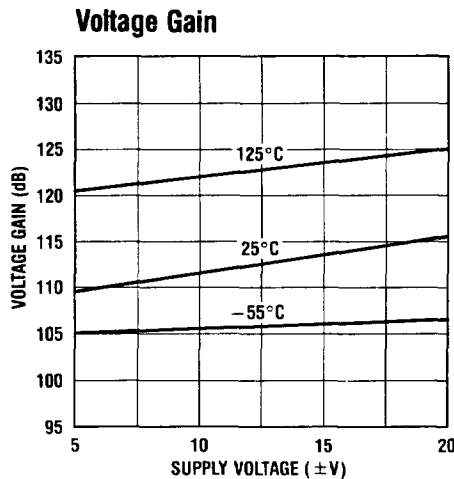
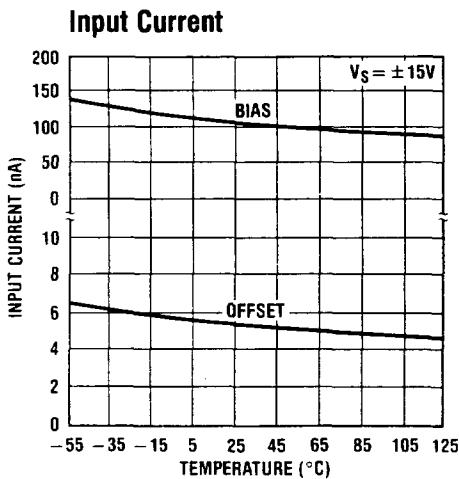
Note 1: The inputs are shunted with back-to-back zeners for overvoltage protection. Excessive current will flow if a differential voltage greater than 5V is applied to the inputs.

Note 2: For supply voltages less than $\pm 15V$, the maximum input voltage is equal to the supply voltage.

Note 3: These specifications apply for $\pm 5V \leq V_S \leq \pm 20V$. The power supplies must be bypassed with a 0.1 μ F or greater disc capacitor within 4 inches of the device.

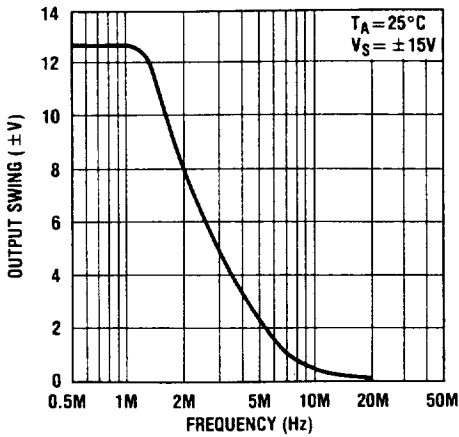
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TYPICAL PERFORMANCE CHARACTERISTICS

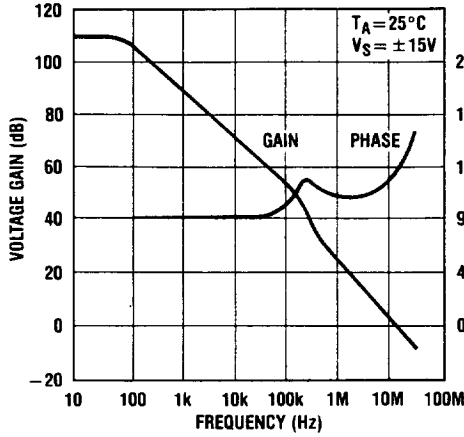


TYPICAL PERFORMANCE CHARACTERISTICS

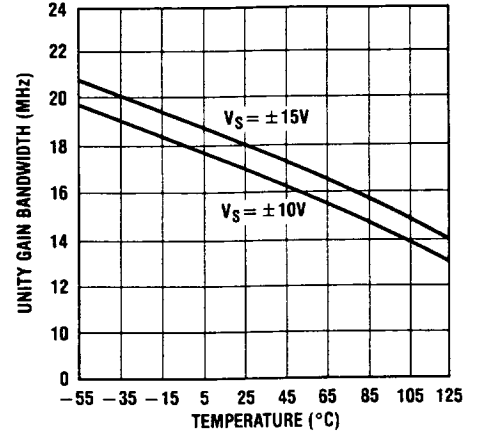
Large Signal Frequency Response



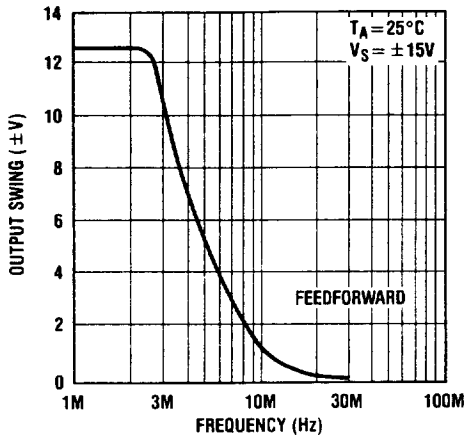
Open Loop Frequency Response



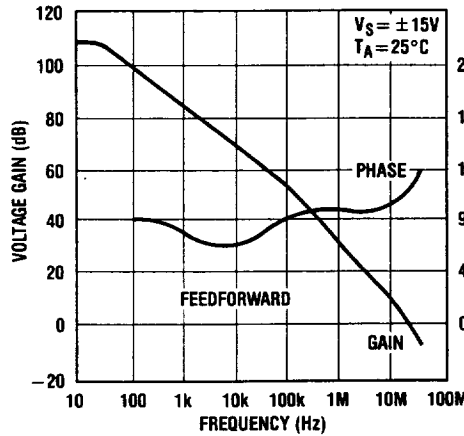
Unity Gain Bandwidth



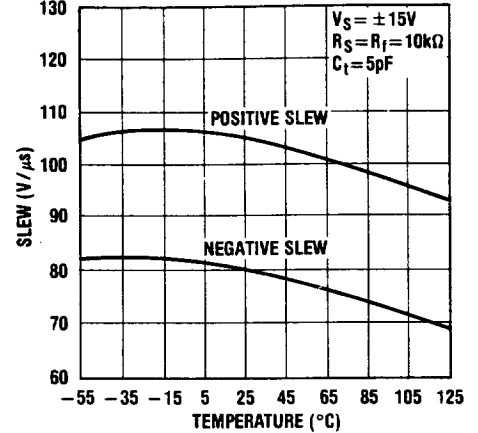
Large Signal Frequency Response



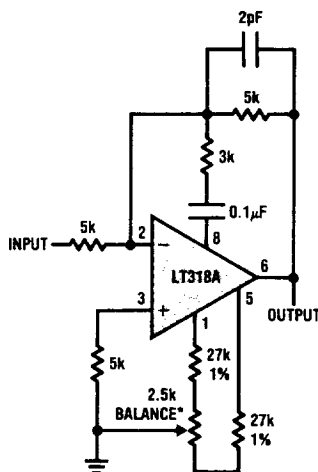
Open Loop Frequency Response



Voltage Follower Slew Rate

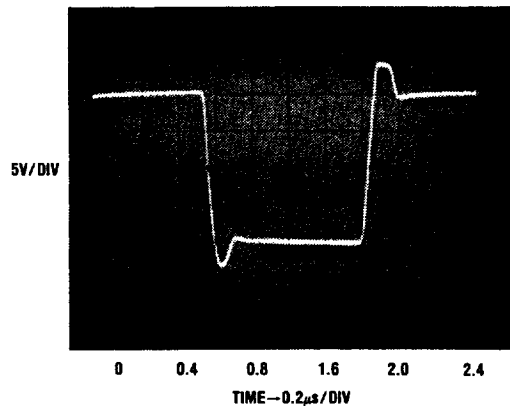


Feedforward Compensation for Slew Rates of $150V/\mu s$



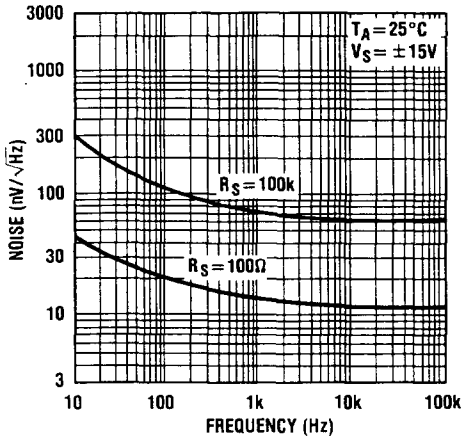
*BALANCE CIRCUIT NECESSARY FOR INCREASED SLEW RATE

Pulse Response of Feedforward Inverter

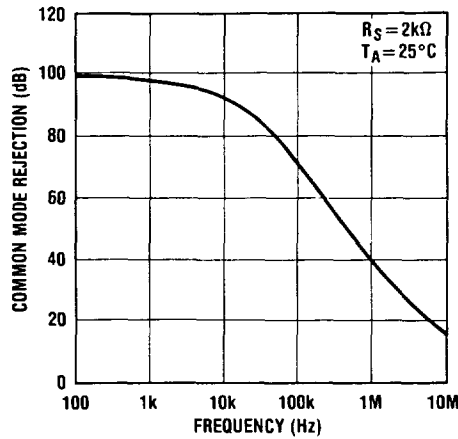


TYPICAL PERFORMANCE CHARACTERISTICS

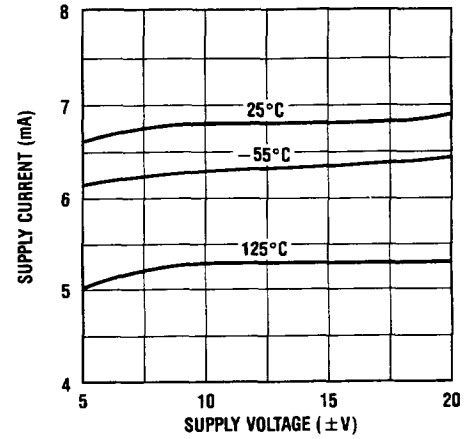
Input Noise Voltage



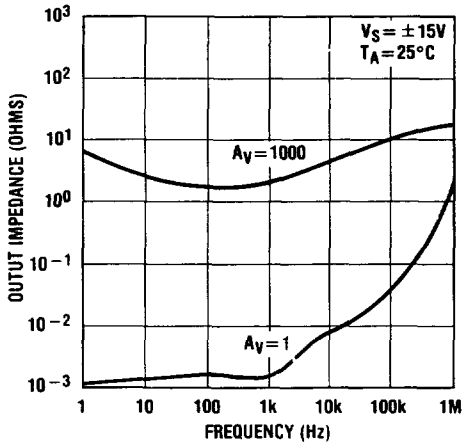
Common Mode Rejection



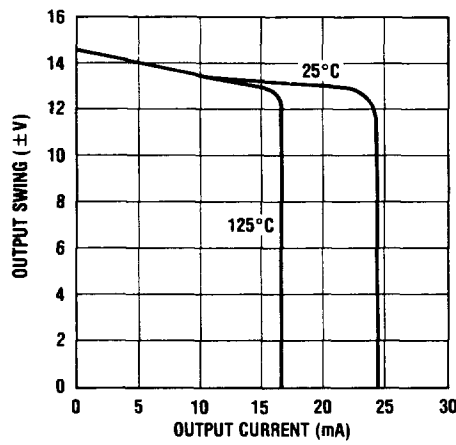
Supply Current



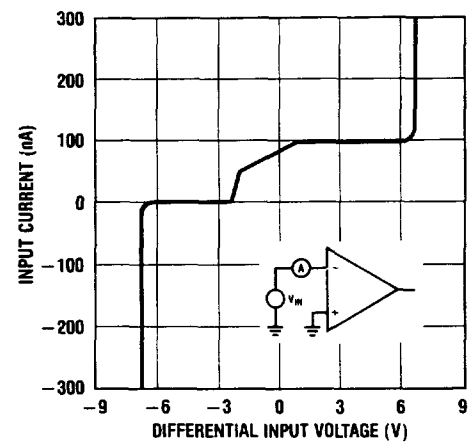
Closed Loop Output Impedance



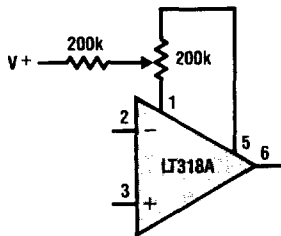
Current Limiting



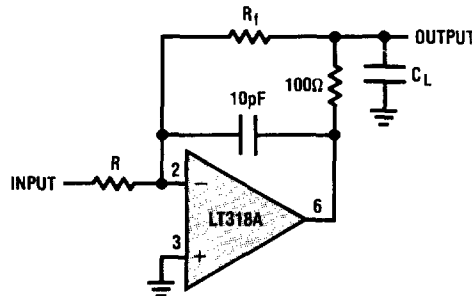
LT118A Input Current



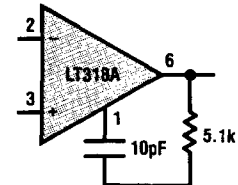
Offset Balancing



Isolating Large Capacitive Loads



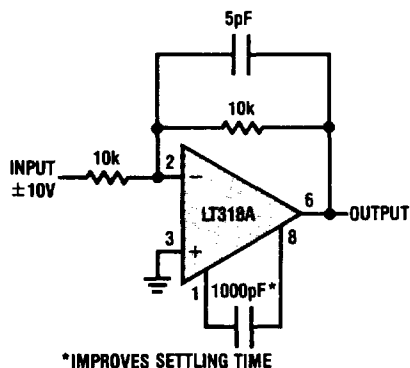
Overcompensation for Increased Stability



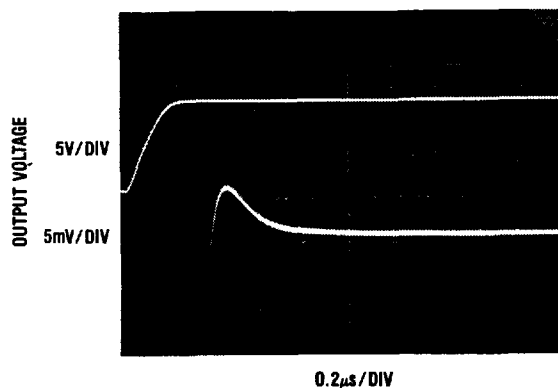
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SETTLING TIME CIRCUITS

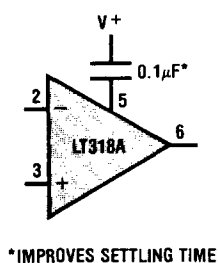
Settling Time Test Circuit



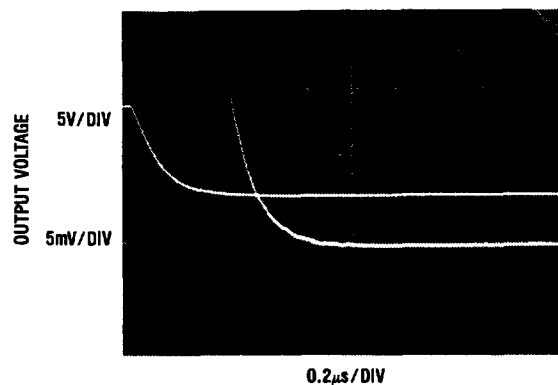
Settling Time



Alternate Compensation for Improved Settling Time



Settling Time



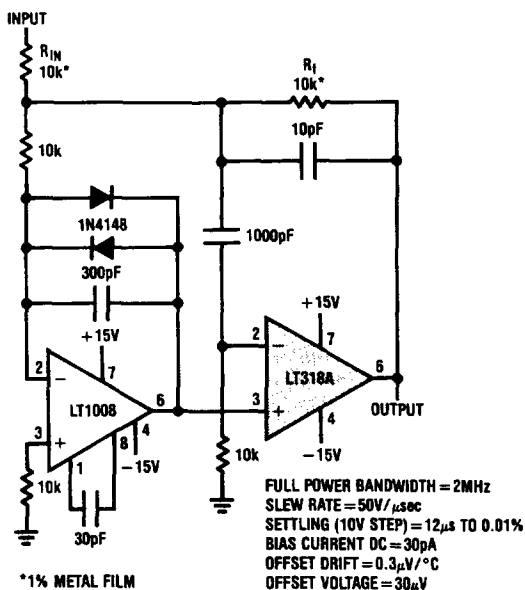
APPLICATIONS INFORMATION

Because of their wider bandwidth, the LT118A and LM118 operational amplifiers require more application care than most general purpose low frequency amplifiers. One of the most critical requirements is that power supplies should be bypassed with a 0.1 μF (or larger) disc ceramic capacitor within an inch of the device. Also, stray capacitance at either the input or output can cause oscillation. While input capacitance can be compensated by placing a capacitor across the feedback resistor, load capacitance must be minimized or isolated as shown. Even the 50pF input capacitance of a 1X scope probe can alter the response of the device.

Settling time, an important parameter in many high speed amplifier applications, is difficult to measure and optimize. Settling time is very "application dependent" and is influenced by external components, layout and the amplifier. In general, the settling time to 0.01% can be minimized by using a circuit similar to that shown. In addition to the compensation network shown, a capacitor is needed across the feedback resistor to minimize ringing.

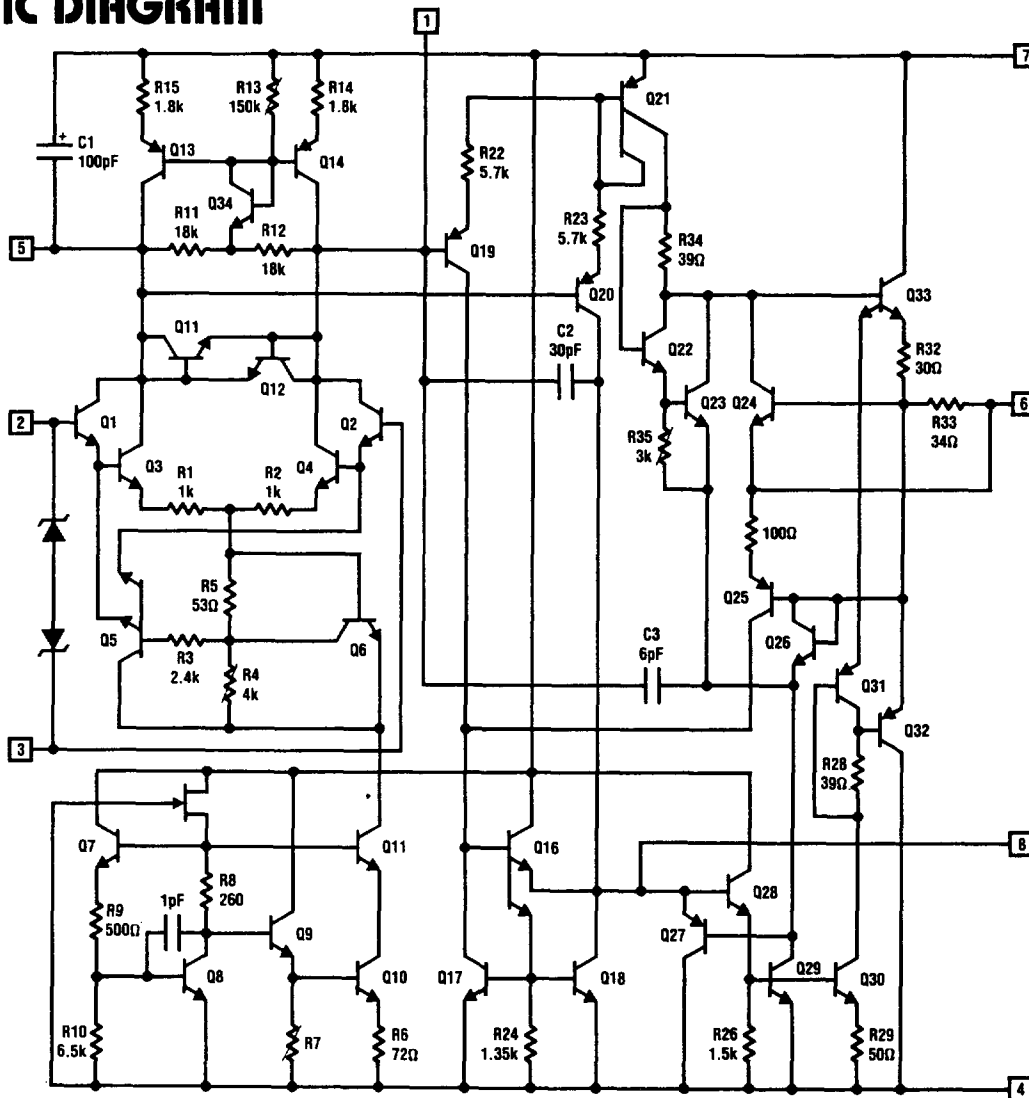
Power supply bypassing can also affect settling time. The amplifier has low power supply rejection ratio at high frequencies, so transients and ringing on the supply leads can appear at the output. Large (22 μF) solid tantalum capacitors are preferred to minimize supply aberrations.

Precision Inverting Amplifier



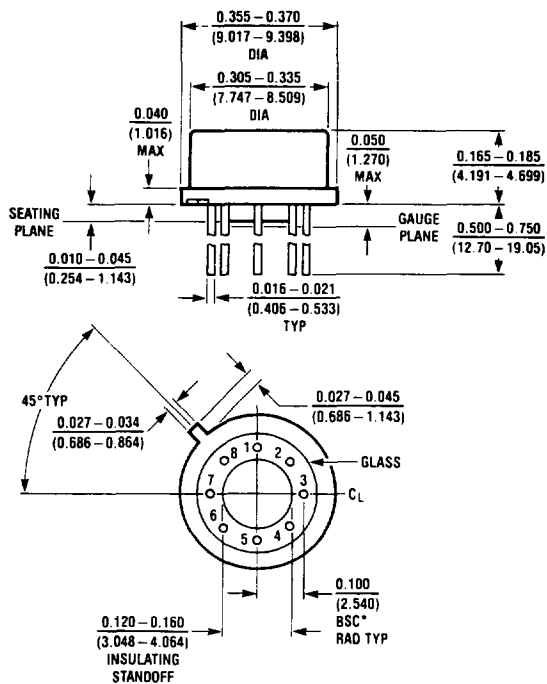
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SCHEMATIC DIAGRAM



PACKAGE DESCRIPTION

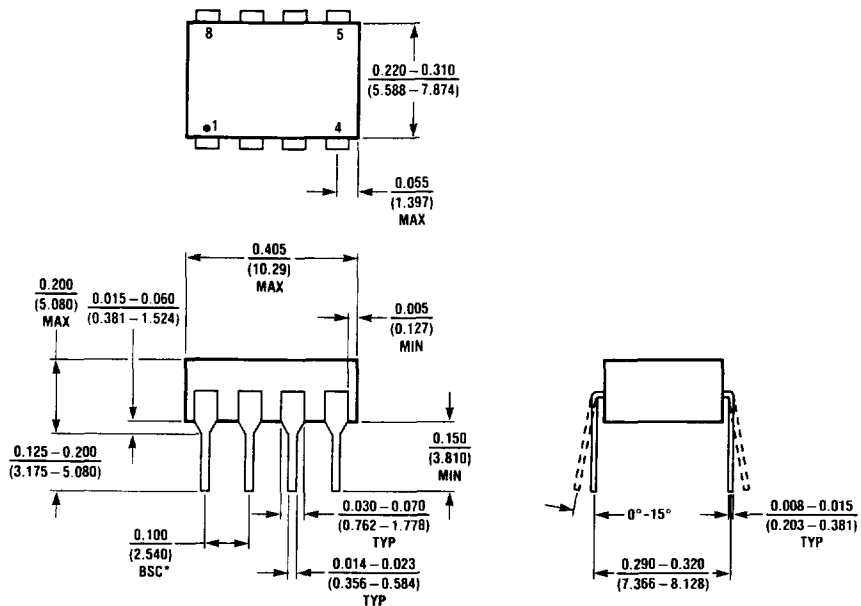
**H Package
Metal Can**



NOTE: DIMENSIONS IN INCHES

| | | |
|------------|---------------|---------------|
| T_{jmax} | θ_{ja} | θ_{jc} |
| 150°C | 150°C/W | 45°C/W |

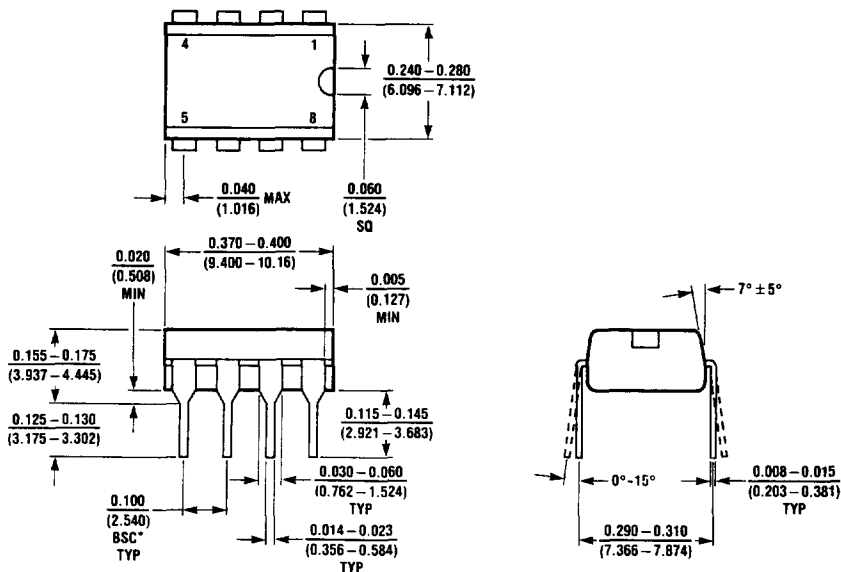
**J8 Package
8 Lead Hermetic DIP**



NOTE: DIMENSIONS IN INCHES UNLESS OTHERWISE NOTED
*LEADS WITHIN 0.007 OF TRUE POSITION (TP) AT GAUGE PLANE

| | |
|------------|---------------|
| T_{jmax} | θ_{ja} |
| 150°C | 100°C/W |

**N8 Package
8 Lead Plastic**



NOTE: DIMENSIONS IN INCHES UNLESS OTHERWISE NOTED
*LEADS WITHIN 0.007 OF TRUE POSITION (TP) AT GAUGE PLANE

| | |
|------------|---------------|
| T_{jmax} | θ_{ja} |
| 100°C | 130°C/W |