

Low Noise, High Speed Precision Operational Amplifiers

FEATURES

- *Guaranteed* $4.5\text{nV}/\sqrt{\text{Hz}}$ 10Hz Noise
- *Guaranteed* $3.8\text{nV}/\sqrt{\text{Hz}}$ 1kHz Noise
- 0.1Hz to 10Hz Noise, 60nVp-p, Typical
- *Guaranteed* 5 Million Min. Voltage Gain, $R_L = 2\text{k}\Omega$
- *Guaranteed* 2 Million Min. Voltage Gain, $R_L = 600\Omega$
- *Guaranteed* 60 μV Max. Offset Voltage
- *Guaranteed* 1.0 $\mu\text{V}/^\circ\text{C}$ Max. Drift with Temperature
- *Guaranteed* 11V/ μsec Min. Slew Rate (LT1037)
- *Guaranteed* 110dB Min. CMRR

APPLICATIONS

- Low Noise Signal Processing
- Microvolt Accuracy Threshold Detection
- Strain Gauge Amplifiers
- Direct Coupled Audio Gain Stages
- Sine Wave Generators
- Tape Head Preamplifiers
- Microwave Preamplifiers

DESCRIPTION

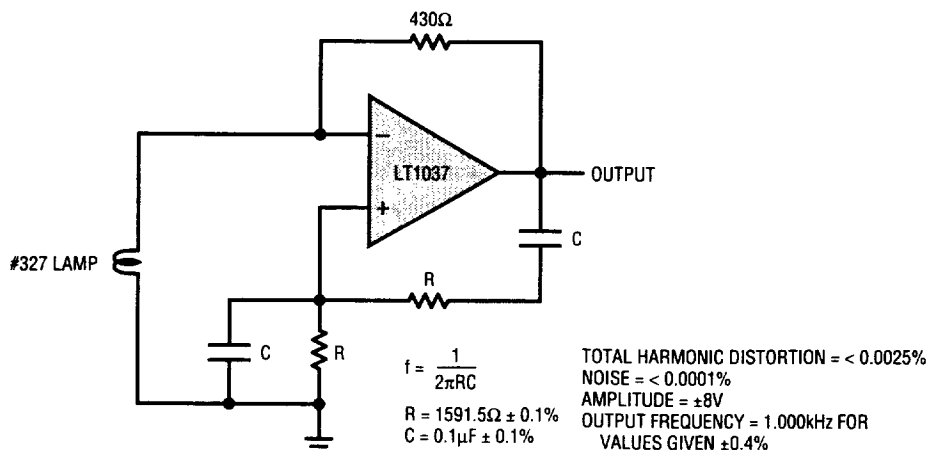
Next to the LT1028, the LT1007/LT1037 series features the lowest noise performance available to date for monolithic operational amplifiers: $2.5\text{nV}/\sqrt{\text{Hz}}$ wideband noise (less than the noise of a 400 Ω resistor), 1/f corner frequency of 2Hz and 60nV peak-to-peak 0.1Hz to 10Hz noise. Low noise is combined with outstanding precision and speed specifications: 20 μV offset voltage, 0.3 $\mu\text{V}/^\circ\text{C}$ drift, 126dB common mode and power supply rejection, and 60MHz gain-bandwidth-product on the decompensated LT1037, which is stable for closed loop gains of 5 or greater.

The voltage gain of the LT1007/LT1037 is an extremely high 20 million driving a 2k Ω load and 12 million driving a 600 Ω load to $\pm 10\text{V}$.

In the design, processing, and testing of the device, particular attention has been paid to the optimization of the entire distribution of several key parameters. Consequently, the specifications have been spectacularly improved compared to competing amplifiers.

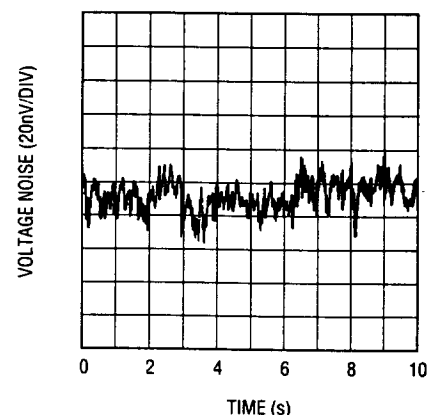
The sine wave generator application shown below utilizes the low noise and low distortion characteristics of the LT1037.

Ultra-Pure 1kHz Sine Wave Generator



LT1007CS8 - TA01

0.1Hz to 10Hz Noise



LT1007CS8 - TA02

ABSOLUTE MAXIMUM RATINGS

| | |
|---|-------------------------|
| Supply Voltage | ±22V |
| Input Voltage | Equal to Supply Voltage |
| Output Short Circuit Duration | Indefinite |
| Differential Input Current (Note 5) | ±25mA |
| Operating Temperature Range | 0°C to 70°C |
| Storage Temperature Range | |
| All Devices | – 65°C to 150°C |
| Lead Temperature (Soldering, 10 sec.) | 300°C |

PACKAGE/ORDER INFORMATION

| | |
|--|------------------------|
| | ORDER PART NUMBER |
| | LT1007CS8 LT1037CS8 |
| | PART MARKING |
| | 1007 1037 |

ELECTRICAL CHARACTERISTICS $V_S = \pm 15V$, $T_A = 25^\circ C$, unless otherwise noted.

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| SYMBOL | PARAMETER | CONDITIONS | MIN | LT1007C LT1037C TYP | MAX | UNITS |
|-------------------------------------|--|--|-------|---------------------------|------|----------------|
| V_{OS} | Input Offset Voltage | (Note 1) | | 20 | 60 | μV |
| $\frac{\Delta V_{OS}}{\Delta Time}$ | Long Term Input Offset Voltage Stability | (Notes 2 and 3) | | 0.2 | 1.0 | $\mu V/Mo$ |
| I_{OS} | Input Offset Current | | | 12 | 50 | nA |
| I_B | Input Bias Current | | | ±15 | ±55 | nA |
| e_n | Input Noise Voltage | 0.1Hz to 10Hz (Note 3) | | 0.06 | 0.13 | $\mu Vp-p$ |
| | Input Noise Voltage Density | $f_0 = 10Hz$ (Note 3) | | 2.8 | 4.5 | nV/\sqrt{Hz} |
| | | $f_0 = 1000Hz$ (Note 3) | | 2.5 | 3.8 | nV/\sqrt{Hz} |
| i_n | Input Noise Current Density | $f_0 = 10Hz$ (Note 3) | | 1.5 | 4.0 | pA/\sqrt{Hz} |
| | | $f_0 = 1000Hz$ (Note 3) | | 0.4 | 0.6 | pA/\sqrt{Hz} |
| | Input Resistance—Common Mode | | | 5 | | GΩ |
| | Input Voltage Range | | ±11.0 | ±12.5 | | V |
| CMRR | Common Mode Rejection Ratio | $V_{CM} = \pm 11V$ | 110 | 126 | | dB |
| PSRR | Power Supply Rejection Ratio | $V_S = \pm 4V$ to $\pm 18V$ | 106 | 126 | | dB |
| A_{VOL} | Large Signal Voltage Gain | $R_L \geq 2k\Omega$, $V_O = \pm 12V$ | 5.0 | 20.0 | | $V/\mu V$ |
| | | $R_L \geq 1k\Omega$, $V_O = \pm 10V$ | 3.5 | 16.0 | | $V/\mu V$ |
| | | $R_L \geq 600\Omega$, $V_O = \pm 10V$ | 2.0 | 12.0 | | $V/\mu V$ |
| V_{OUT} | Maximum Output Voltage Swing | $R_L \geq 2k\Omega$ | ±12.5 | ±13.5 | | V |
| | | $R_L \geq 600\Omega$ | ±10.5 | ±12.5 | | V |
| SR | Slew Rate | LT1007 $R_L \geq 2k\Omega$ | 1.7 | 2.5 | | $V/\mu s$ |
| | | LT1037 $A_{VCL} \geq 5$ | 11 | 15 | | $V/\mu s$ |
| GBW | Gain-Bandwidth Product | LT1007 $f_0 = 100kHz$ (Note 4) | 5.0 | 8.0 | | MHz |
| | | LT1037 $f_0 = 10kHz$ (Note 4), ($A_{VCL} \geq 5$) | 45 | 60 | | MHz |
| Z_O | Open Loop Output Resistance | $V_O = 0$, $I_O = 0$ | | 70 | | Ω |
| P_d | Power Dissipation | LT1007 | | 80 | 140 | mW |
| | | LT1037 | | 85 | 140 | mW |

ELECTRICAL CHARACTERISTICS

$V_S = \pm 15V$, $0^\circ C \leq T_A \leq 70^\circ C$, unless otherwise noted.

| SYMBOL | PARAMETER | CONDITIONS | | LT1007C LT1037C | | | UNITS |
|-------------------------------------|------------------------------|---------------------------------------|---|--------------------|------------|----------|------------------|
| | | | | MIN | TYP | MAX | |
| V_{OS} | Input Offset Voltage | (Note 1) | ● | | 35 | 110 | μV |
| $\frac{\Delta V_{OS}}{\Delta Temp}$ | Average Input Offset Drift | (Note 6) | ● | | 0.3 | 1.0 | $\mu V/^\circ C$ |
| I_{OS} | Input Offset Current | | ● | | 15 | 70 | nA |
| I_B | Input Bias Current | | ● | | ± 20 | ± 75 | nA |
| | Input Voltage Range | | ● | ± 10.5 | ± 11.8 | | V |
| CMRR | Common Mode Rejection Ratio | $V_{CM} = \pm 10.5V$ | ● | 106 | 120 | | dB |
| PSRR | Power Supply Rejection Ratio | $V_S = \pm 4.5V$ to $\pm 18V$ | ● | 102 | 120 | | dB |
| A_{VOL} | Large Signal Voltage Gain | $R_L \geq 2k\Omega$, $V_O = \pm 10V$ | ● | 2.5 | 18.0 | | $V/\mu V$ |
| | | $R_L \geq 1k\Omega$, $V_O = \pm 10V$ | ● | 2.0 | 14.0 | | $V/\mu V$ |
| V_{OUT} | Maximum Output Voltage Swing | $R_L \geq 2k\Omega$ | ● | ± 12.0 | ± 13.6 | | V |
| P_d | Power Dissipation | | ● | | 90 | 160 | mW |

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

Note 1: Input Offset Voltage measurements are performed by automatic test equipment approximately 0.5 seconds after application of power.

Note 2: Long Term Input Offset Voltage Stability refers to the average trend line of Offset Voltage vs Time over extended periods after the first 30 days of operation. Excluding the initial hour of operation, changes in V_{OS} during the first 30 days are typically $2.5\mu V$.

Note 3: This parameter is tested on a sample basis only.

Note 4: This parameter is guaranteed by design and is not tested.

Note 5: The inputs are protected by back-to-back diodes. Current limiting resistors are not used in order to achieve low noise. If differential input voltage exceeds $\pm 0.7V$, the input current should be limited to 25mA.

Note 6: The Average Input Offset Drift performance is within the specifications unnullled or when nulled with a pot having a range of $8k\Omega$ to $20k\Omega$.