Ultra-Low Noise, Precision OPERATIONAL AMPLIFIERS

FEATURES

- **LOW NOISE**: 4.5nV/√Hz max at 1kHz
- **LOW OFFSET**: 100µV max
- **LOW DRIFT**: 0.4µV/°C
- **HIGH OPEN-LOOP GAIN**: 117dB min
- **HIGH COMMON-MODE REJECTION**: 100dB min
- **HIGH POWER-SUPPLY REJECTION**: 94dB min
- **FITS OP-07, OP-05, AD510, AND AD517 SOCKETS**

APPLICATIONS

- **PRECISION INSTRUMENTATION**
- **DATA ACQUISITION**
- **TEST EQUIPMENT**
- **PROFESSIONAL AUDIO EQUIPMENT**
- **TRANSDUCER AMPLIFIERS**
- **RADIATION HARD EQUIPMENT**

DESCRIPTION

The OPA27 and OPA37 are ultra-low noise, high-precision monolithic operational amplifiers.

Laser-trimmed thin-film resistors provide excellent long-term voltage offset stability and allow superior voltage offset compared to common zener-zap techniques.

A unique bias current cancellation circuit allows bias and offset current specifications to be met over the full –40°C to +85°C temperature range.

The OPA27 is internally compensated for unity-gain stability. The decompensated OPA37 requires a closed-loop gain ≥ 5.

The Texas Instruments’ OPA27 and OPA37 are improved replacements for the industry-standard OP-27 and OP-37.
ABSOLUTE MAXIMUM RATINGS(1)

Supply Voltage ................................................................. ±22V
Internal Power Dissipation (2) ........................................ 500mW
Input Voltage ................................................................. ±VCC
Output Short-Circuit Duration (3) ..................................... Indefinite
Differential Input Voltage (4) ............................................ ±0.7V
Differential Input Current (4) ............................................ ±25mA
Storage Temperature Range ........................................ -55°C to +125°C
Operating Temperature Range ........................................ -40°C to +85°C
Lead Temperature:
P (soldering, 10s) ......................................................... +300°C
U (soldering, 3s) ......................................................... +260°C

NOTES: (1) Stresses above these ratings may cause permanent damage.
Exposure to absolute maximum conditions for extended periods may degrade
device reliability. (2) Maximum package power dissipation versus ambient
temperature. (2) To common with ±VCC = 15V. (4) 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 ±0.7V, the input current should
be limited to 25mA.

PACKAGE/ORDERING INFORMATION(1)

<table>
<thead>
<tr>
<th>PRODUCT</th>
<th>PACKAGE-LEAD</th>
<th>θJA</th>
<th>PACKAGE DRAWING</th>
<th>PACKAGE MARKING</th>
</tr>
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<tbody>
<tr>
<td>OPA27</td>
<td>DIP-8</td>
<td>100°C/W</td>
<td>P</td>
<td>OPA27GP</td>
</tr>
<tr>
<td>OPA27</td>
<td>SO-8</td>
<td>160°C/W</td>
<td>D</td>
<td>OPA27U</td>
</tr>
<tr>
<td>OPA37</td>
<td>DIP-8</td>
<td>100°C/W</td>
<td>P</td>
<td>OPA37GP</td>
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<tr>
<td>OPA37</td>
<td>SO-8</td>
<td>160°C/W</td>
<td>D</td>
<td>OPA37U</td>
</tr>
</tbody>
</table>

NOTE: (1) For the most current package and ordering information, see the
Package Option Addendum located at the end of this document, or see the TI

ELECTROSTATIC DISCHARGE SENSITIVITY

This integrated circuit can be damaged by ESD. Texas Instruments 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.

PIN CONFIGURATION

Top View

-Offset Trim
+In
-In
-VCC

+VCC

Output

NC = No Connection
ELECTRICAL CHARACTERISTICS

At \( V_{CC} = \pm 15V \) and \( T_A = +25^\circ C \), unless otherwise noted.

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>CONDITIONS</th>
<th>OPA27</th>
<th>OPA37</th>
<th>MIN</th>
<th>TYP</th>
<th>MAX</th>
<th>UNITS</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>INPUT NOISE</strong> (^{(6)})</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Voltage, ( f_o = 10Hz )</td>
<td></td>
<td></td>
<td></td>
<td>3.8</td>
<td>8.0</td>
<td></td>
<td>nV/\sqrt{Hz}</td>
</tr>
<tr>
<td>( f_o = 30Hz )</td>
<td></td>
<td></td>
<td>3.3</td>
<td>5.6</td>
<td></td>
<td></td>
<td>nV/\sqrt{Hz}</td>
</tr>
<tr>
<td>( f_o = 1kHz )</td>
<td></td>
<td></td>
<td>3.2</td>
<td>4.5</td>
<td></td>
<td></td>
<td>nV/\sqrt{Hz}</td>
</tr>
<tr>
<td>( f_o = 0.1Hz ) to 10Hz</td>
<td></td>
<td></td>
<td>0.09</td>
<td>0.25</td>
<td></td>
<td></td>
<td>\mu V/Hz</td>
</tr>
<tr>
<td>Current, (^{(1)}) ( f_o = 10Hz)</td>
<td></td>
<td></td>
<td>1.7</td>
<td></td>
<td></td>
<td></td>
<td>\mu A/\sqrt{Hz}</td>
</tr>
<tr>
<td>( f_o = 30Hz )</td>
<td></td>
<td></td>
<td>1.0</td>
<td></td>
<td></td>
<td></td>
<td>\mu A/\sqrt{Hz}</td>
</tr>
<tr>
<td>( f_o = 1kHz )</td>
<td></td>
<td>0.4</td>
<td>0.6</td>
<td></td>
<td></td>
<td></td>
<td>\mu A/\sqrt{Hz}</td>
</tr>
</tbody>
</table>

**OFFSET VOLTAGE** \(^{(2)}\)

- Input Offset Voltage
- Average Drift \(^{(3)}\)
- Long Term Stability \(^{(4)}\)
- Supply Rejection

| SUPPLY REJECTION | \( \pm V_{CC} = 4 \) to 18V | 94     | 120   | ±1  | ±20 | \mu V/V |

**BIAS CURRENT**

- Input Bias Current

| BIAS CURRENT | \( \pm 15 \) | \( \pm 80 \) | nA |

**OFFSET CURRENT**

- Input Offset Current

| OFFSET CURRENT | 10 | 75 | nA |

**IMPEEDANCE**

- Common-Mode

| IMPEDANCE | 2 || 2.5 | \Omega || \mu F |

**VOLTAGE RANGE**

- Common-Mode Input Range
- Common-Mode Rejection

| VOLTAGE RANGE | \( \pm 11 \) | \pm 12.3 | V |

**OPEN-LOOP VOLTAGE GAIN, DC**

- \( R_L \geq 2k \Omega \)
- \( R_L \geq 1k \Omega \)

| OPEN-LOOP VOLTAGE GAIN, DC | 117 | 124 | dB |

**FREQUENCY RESPONSE**

- Gain-Bandwidth Product \(^{(5)}\)
- Slew Rate \(^{(5)}\)

<table>
<thead>
<tr>
<th>FREQUENCY RESPONSE</th>
<th>OPA27</th>
<th>OPA37</th>
<th>5 (^{(6)})</th>
<th>45 (^{(6)})</th>
<th>MHz</th>
</tr>
</thead>
</table>

| Slew Rate | \( V_o = \pm 10V, R_L = 2k \Omega \) | \( OPA27, G = +1 \) | 1.7 \(^{(6)}\) | 1.9 | V/\mu s |
|           | \( OPA37, G = +5 \) | 11 \(^{(6)}\) | 11.9 | V/\mu s |
| Settling Time, 0.01% | \( OPA27, G = +1 \) | 25 |   | \mu s |
|           | \( OPA37, G = +5 \) | 25 |   | \mu s |

**RATED OUTPUT**

- Voltage Output
- Output Resistance
- Short Circuit Current

| RATED OUTPUT | \( R_L \geq 2k \Omega \) | \( R_L \geq 600 \Omega \) | 12 | 12.8 | V |

| RATED OUTPUT | \( R_L \geq 2k \Omega \) | \( R_L \geq 600 \Omega \) | 10 | 12.8 | V |

| OUTPUT RESISTANCE | DC, Open Loop | 70 | \Omega |
| Short Circuit Current | \( R_L = 0 \Omega \) | 25 | 50 \(^{(6)}\) | mA |

**POWER SUPPLY**

- Rated Voltage
- Voltage Range
- Rated Current, Quiescent
- Rated Current, Operating

| POWER SUPPLY | \( \pm 4 \) | \pm 22 | VDC |

| POWER SUPPLY | \( \pm 15 \) | +85 | \mu A |
|              | \( \pm 40 \) | +85 | \mu A |

| TEMPERATURE RANGE | Specified | 3.3 | 5.7 | mA |
| Operating | \( \pm 40 \) | +85 | \mu A |

| TEMPERATURE RANGE | Operating | 3.3 | 5.7 | \mu A |

NOTES:
- (1) Measured with industry-standard noise test circuit (Figures 1 and 2). Due to errors introduced by this method, these current noise specifications should be used for comparison purposes only.
- (2) Offsetting and offset voltage specifications are measured with automatic test equipment after approximately 0.5 seconds from power turn-on.
- (3) Unnulled or nulled with 8k\( \Omega \) to 20k\( \Omega \) potentiometer.
- (4) Long-term voltage offset vs time trend line does not include warm-up drift.
- (5) Typical specification only on plastic package units. Slew rate varies on all units due to differing test methods. Minimum specification applies to open-loop test.
- (6) This parameter specified by design.
### Electrical Characteristics (Cont.)

At $V_{CC} = \pm 15\,\text{V}$ and $-40^\circ C \leq T_A \leq +85^\circ C$, unless otherwise noted.

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>CONDITIONS</th>
<th>OPA27</th>
<th>OPA37</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Input Voltage</strong>&lt;sup&gt;(1)&lt;/sup&gt;</td>
<td>$T_{A_{MIN}} \rightarrow T_{A_{MAX}}$</td>
<td>$\pm 48$</td>
<td>$\pm 220$&lt;sup&gt;(3)&lt;/sup&gt;</td>
</tr>
<tr>
<td>Input Offset Voltage</td>
<td>$\pm V_{CC} = 4.5$ to 18V</td>
<td>$\pm 0.4$</td>
<td>$\pm 1.8$&lt;sup&gt;(3)&lt;/sup&gt;</td>
</tr>
<tr>
<td>Average Drift&lt;sup&gt;(2)&lt;/sup&gt;</td>
<td>$\pm V_{CC} = 4.5$ to 18V</td>
<td>$90$&lt;sup&gt;(3)&lt;/sup&gt;</td>
<td>122</td>
</tr>
<tr>
<td>Supply Rejection</td>
<td>$\pm V_{CC} = 4.5$ to 18V</td>
<td>$\pm 0.4$</td>
<td>$\pm 1.8$&lt;sup&gt;(3)&lt;/sup&gt;</td>
</tr>
<tr>
<td><strong>Bias Current</strong></td>
<td></td>
<td>±21</td>
<td>±150&lt;sup&gt;(3)&lt;/sup&gt;</td>
</tr>
<tr>
<td>Input Bias Current</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Offset Current</strong></td>
<td></td>
<td>20</td>
<td>135&lt;sup&gt;(3)&lt;/sup&gt;</td>
</tr>
<tr>
<td>Input Offset Current</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Voltage Range</strong></td>
<td></td>
<td>±10.5&lt;sup&gt;(3)&lt;/sup&gt;</td>
<td>±11.8</td>
</tr>
<tr>
<td>Common-Mode Input Range</td>
<td>$V_N = \pm 11,\text{VDC}$</td>
<td>96&lt;sup&gt;(3)&lt;/sup&gt;</td>
<td>122</td>
</tr>
<tr>
<td>Common-Mode Rejection</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Open-Loop Gain, DC</strong></td>
<td></td>
<td>113&lt;sup&gt;(3)&lt;/sup&gt;</td>
<td>120</td>
</tr>
<tr>
<td>Open-Loop Voltage Gain</td>
<td>$R_L \geq 2,\text{k}\Omega$</td>
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<td></td>
</tr>
<tr>
<td><strong>Rated Output</strong></td>
<td></td>
<td>±11.0&lt;sup&gt;(3)&lt;/sup&gt;</td>
<td>±13.4</td>
</tr>
<tr>
<td>Voltage Output</td>
<td>$R_L = 2,\text{k}\Omega$</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Short Circuit Current</td>
<td>$V_O = 0,\text{VDC}$</td>
<td>25</td>
<td></td>
</tr>
<tr>
<td><strong>Temperature Range</strong></td>
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<td></td>
</tr>
<tr>
<td>Specification</td>
<td></td>
<td>−40</td>
<td>+85</td>
</tr>
</tbody>
</table>

**Notes:**
1. Offset voltage specification are measured with automatic test equipment after approximately 0.5s from power turn-on.
2. Unnulled or nulled with 8kΩ to 20kΩ potentiometer.
3. This parameter specified by design.
TYPICAL CHARACTERISTICS

At $T_A = +25^\circ C$, $\pm V_{CC} = \pm 15VDC$, unless otherwise noted.

- **Input Offset Voltage Warm-Up Drift**
- **Total Input Voltage Noise Spectral Density vs Source Resistance**
- **Voltage Noise Spectral Density vs Supply Voltage**
- **Voltage Noise Spectral Density vs Temperature**
- **Input Voltage Noise vs Noise Bandwidth (0.1Hz to Indicated Frequency)**
- **Input Current Noise Spectral Density**

**Warning:** This industry-standard equation is inaccurate and these figures should be used for comparison purposes only!

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**Current Noise Test Circuit**

- $I_n = \sqrt{\left(e_{n0}\right)^2 - (130nV)^2}$

- $1M\Omega \times 100$

- $500k\Omega$

- $500k\Omega$

- $100k\Omega$

- $100\Omega$

- $1\Omega$

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**References**

- OPA27, OPA37
- SBOS138C
- www.ti.com
TYPICAL CHARACTERISTICS (Cont.)

At $T_A = +25^\circ$C, $\pm V_{CC} = \pm 15$VDC, unless otherwise noted.

**INPUT VOLTAGE NOISE SPECTRAL DENSITY**

**OPEN-LOOP FREQUENCY RESPONSE**

**BIAS AND OFFSET CURRENT vs TEMPERATURE**

**OPA27 CLOSED-LOOP VOLTAGE GAIN AND PHASE SHIFT vs FREQUENCY (G = 100)**

**OPA37 CLOSED-LOOP VOLTAGE GAIN AND PHASE SHIFT vs FREQUENCY (G = 100)**

**COMMON-MODE REJECTION vs FREQUENCY**
TYPICAL CHARACTERISTICS (Cont.)

At $T_a = +25^\circ C$, $\pm V_{CC} = \pm 15V_{DC}$, unless otherwise noted.

**POWER SUPPLY REJECTION vs FREQUENCY**

**OPEN-LOOP VOLTAGE GAIN vs SUPPLY VOLTAGE**

**OPEN-LOOP VOLTAGE GAIN vs TEMPERATURE**

**SUPPLY CURRENT vs SUPPLY VOLTAGE**

**COMMON-MODE INPUT VOLTAGE RANGE**

**OPA27 SMALL SIGNAL TRANSIENT RESPONSE**

OPA27, OPA37

SB0135C

www.ti.com
TYPICAL PERFORMANCE CURVES (Cont.)

At $T_A = +25^\circ C$, $\pm V_{CC} = \pm 15VDC$, unless otherwise noted.

**OPA37 SMALL SIGNAL TRANSIENT RESPONSE**

<table>
<thead>
<tr>
<th>Time ($\mu s$)</th>
<th>Output Voltage (mV)</th>
</tr>
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<tbody>
<tr>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>0.2</td>
<td>+60</td>
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<tr>
<td>0.4</td>
<td>+40</td>
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<tr>
<td>0.6</td>
<td>+20</td>
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<tr>
<td>0.8</td>
<td>0</td>
</tr>
<tr>
<td>1.0</td>
<td>–20</td>
</tr>
<tr>
<td>1.2</td>
<td>–40</td>
</tr>
</tbody>
</table>

$AV = +5$

$CL = 25pF$

**OPA27 LARGE SIGNAL TRANSIENT RESPONSE**

<table>
<thead>
<tr>
<th>Time ($\mu s$)</th>
<th>Output Voltage (V)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>0.2</td>
<td>+6</td>
</tr>
<tr>
<td>0.4</td>
<td>+4</td>
</tr>
<tr>
<td>0.6</td>
<td>+2</td>
</tr>
<tr>
<td>0.8</td>
<td>0</td>
</tr>
<tr>
<td>1.0</td>
<td>–2</td>
</tr>
<tr>
<td>1.2</td>
<td>–4</td>
</tr>
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$AV_{CL} = +1$

**OPA37 LARGE SIGNAL TRANSIENT RESPONSE**

<table>
<thead>
<tr>
<th>Time ($\mu s$)</th>
<th>Output Voltage (V)</th>
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<tr>
<td>0</td>
<td>0</td>
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<tr>
<td>1</td>
<td>+15</td>
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<tr>
<td>2</td>
<td>+10</td>
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<tr>
<td>3</td>
<td>+5</td>
</tr>
<tr>
<td>4</td>
<td>0</td>
</tr>
<tr>
<td>5</td>
<td>–5</td>
</tr>
<tr>
<td>6</td>
<td>–10</td>
</tr>
</tbody>
</table>

$AV = +5$
APPLICATIONS INFORMATION

OFFSET VOLTAGE ADJUSTMENT
The OPA27 and OPA37 offset voltages are laser-trimmed and require no further trim for most applications. Offset voltage drift will not be degraded when the input offset is nulled with a 10kΩ trim potentiometer. Other potentiometer values from 1kΩ to 1MΩ can be used, but $V_{OS}$ drift will be degraded by an additional 0.1µV/°C to 0.2µV/°C. Nulling large system offsets by use of the offset trim adjust will degrade drift performance by approximately 3.3µV/°C per millivolt of offset. Large system offsets can be nulled without drift degradation by input summing.

The conventional offset voltage trim circuit is shown in Figure 3. For trimming very small offsets, the higher resolution circuit shown in Figure 4 is recommended.

The OPA27 and OPA37 can replace 741-type operational amplifiers by removing or modifying the trim circuit.

THERMOELECTRIC POTENTIALS
The OPA27 and OPA37 are laser-trimmed to microvolt-level input offset voltages, and for very-low input offset voltage drift.

Careful layout and circuit design techniques are necessary to prevent offset and drift errors from external thermoelectric potentials. Dissimilar metal junctions can generate small EMFs if care is not taken to eliminate either their sources (lead-to-PC, wiring, etc.) or their temperature difference (see Figure 11).

Short, direct mounting of the OPA27 and OPA37 with close spacing of the input pins is highly recommended. Poor layout can result in circuit drifts and offsets which are an order of magnitude greater than the operational amplifier alone.

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**FIGURE 1.** 0.1Hz to 10Hz Noise Test Circuit.

**FIGURE 2.** Low Frequency Noise.

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NOTE: All capacitor values are for nonpolarized capacitors only.
**NOISE: BIPOLAR VERSUS FET**

Low-noise circuit design requires careful analysis of all noise sources. External noise sources can dominate in many cases, so consider the effect of source resistance on overall operational amplifier noise performance. At low source impedances, the lower voltage noise of a bipolar operational amplifier is superior, but at higher impedances the high current noise of a bipolar amplifier becomes a serious liability. Above about 15kΩ, the OPA111 low-noise FET operational amplifier is recommended for lower total noise than the OPA27, as shown in Figure 5.

**COMPENSATION**

Although internally compensated for unity-gain stability, the OPA27 may require a small capacitor in parallel with a feedback resistor ($R_F$) which is greater than 2kΩ. This capacitor will compensate the pole generated by $R_F$ and $C_{IN}$ and eliminate peaking or oscillation.

**INPUT PROTECTION**

Back-to-back diodes are used for input protection on the OPA27 and OPA37. Exceeding a few hundred millivolts differential input signal will cause current to flow, and without external current limiting resistors, the input will be destroyed. Accidental static discharge, as well as high current, can damage the amplifier’s input circuit. Although the unit may still be functional, important parameters such as input offset voltage, drift, and noise may be permanently damaged, as will any precision operational amplifier subjected to this abuse.

Transient conditions can cause feedthrough due to the amplifier’s finite slew rate. When using the OPA27 as a unity-gain buffer (follower) a feedback resistor of 1kΩ is recommended, as shown in Figure 6.

**FIGURE 3. Offset Voltage Trim.**

**FIGURE 4. High Resolution Offset Voltage Trim.**

**FIGURE 5. Voltage Noise Spectral Density Versus Source Resistance.**

$$E_O = \sqrt{e_n^2 + (i_n R_s)^2 + 4kT R_s} \quad F_O = 1kHz$$

**FIGURE 6. Pulsed Operation.**

**FIGURE 7. Low-Noise RIAA Preamplifier.**

**FIGURE 8. Unity-Gain Inverting Amplifier.**
FIGURE 9. High Slew Rate Unity-Gain Inverting Amplifier.

FIGURE 10. NAB Tape Head Preamplifier.

FIGURE 11. Low Frequency Noise Comparison.

A. 741 noise with circuit well-shielded from air currents and RFI. (Note scale change.)

B. OP-07AH with circuit well-shielded from air currents and RFI.

C. OPA27AJ with circuit well-shielded from air currents and RFI. (Represents ultimate OPA27 performance potential.)

D. OPA27 with circuit unshielded and exposed to normal lab bench-top air currents. (External thermoelectric potentials far exceed OPA27 noise.)

E. OPA27 with heat sink and shield which protects input leads from air currents. Conditions same as (D).
FIGURE 12. Low Noise Instrumentation Amplifier.

FIGURE 13. Hydrophone Preamplifier.


FIGURE 15. High Performance Synchronous Demodulator.
Gain = –1010V/V
V_{OS} = 2mV
Drift = 0.07µV/°C

\( e_n = 1nV/\sqrt{Hz} \) at 10Hz
0.9nV/\sqrt{Hz} at 100Hz
0.87nV/\sqrt{Hz} at 1kHz

Full Power Bandwidth = 180kHz
Gain Bandwidth = 500MHz
Equivalent Noise Resistance = 50Ω

\[ \text{Signal-to-Noise Ratio} = \sqrt{N} \]

since amplifier noise is uncorrelated.

FIGURE 17. Unity-Gain Buffer.

FIGURE 18. High Slew Rate Unity-Gain Buffer.

FIGURE 19. RF Detector and Video Amplifier.


\[ f_{\text{OUT}} = \text{RPM} \times N \]
Where \( N \) = Number of Gear Teeth
### PACKAGING INFORMATION

<table>
<thead>
<tr>
<th>Orderable Device</th>
<th>Status</th>
<th>Package Type</th>
<th>Package Drawing</th>
<th>Pins</th>
<th>Package Qty</th>
<th>Eco Plan</th>
<th>Lead/Ball Finish</th>
<th>MSL Peak Temp</th>
<th>Op Temp (°C)</th>
<th>Device Marking</th>
<th>Samples</th>
</tr>
</thead>
<tbody>
<tr>
<td>OPA27GP</td>
<td>ACTIVE</td>
<td>PDIP</td>
<td>P</td>
<td>8</td>
<td>50</td>
<td>Green (RoHS &amp; no Sb/Bi)</td>
<td>CU NIPDAU</td>
<td>N / A for Pkg Type</td>
<td>-40 to 85</td>
<td>OPA27GP</td>
<td>Samples</td>
</tr>
<tr>
<td>OPA27GU</td>
<td>ACTIVE</td>
<td>SOIC</td>
<td>D</td>
<td>8</td>
<td>75</td>
<td>Green (RoHS &amp; no Sb/Bi)</td>
<td>CU NIPDAU-DCC</td>
<td>Level-3-260C-168 HR</td>
<td>-40 to 85</td>
<td>OPA27U</td>
<td>Samples</td>
</tr>
<tr>
<td>OPA27GU/2K5</td>
<td>ACTIVE</td>
<td>SOIC</td>
<td>D</td>
<td>8</td>
<td>2500</td>
<td>Green (RoHS &amp; no Sb/Bi)</td>
<td>CU NIPDAU-DCC</td>
<td>Level-3-260C-168 HR</td>
<td>-40 to 85</td>
<td>OPA27U</td>
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<td>-40 to 85</td>
<td>OPA37GU2</td>
<td>Samples</td>
</tr>
</tbody>
</table>

(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) **RoHS:** TI defines "RoHS" to mean semiconductor products that are compliant with the current EU RoHS requirements for all 10 RoHS substances, including the requirement that RoHS substance do not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, "RoHS" products are suitable for use in specified lead-free processes. TI may reference these types of products as "Pb-Free".

**RoHS Exempt:** TI defines "RoHS Exempt" to mean products that contain lead but are compliant with EU RoHS pursuant to a specific EU RoHS exemption.

**Green:** TI defines "Green" to mean the content of Chlorine (Cl) and Bromine (Br) based flame retardants meet JS709B low halogen requirements of <=1000ppm threshold. Antimony trioxide based flame retardants must also meet the <=1000ppm threshold requirement.
(3) MSL, Peak Temp. - The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

(4) There may be additional marking, which relates to the logo, the lot trace code information, or the environmental category on the device.

(5) Multiple Device Markings will be inside parentheses. Only one Device Marking contained in parentheses and separated by a "~" will appear on a device. If a line is indented then it is a continuation of the previous line and the two combined represent the entire Device Marking for that device.

(6) Lead/Ball Finish - Orderable Devices may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead/Ball Finish values may wrap to two lines if the finish value exceeds the maximum column width.

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TAPE AND REEL INFORMATION

*All dimensions are nominal.

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<th>Package Drawing</th>
<th>Pins</th>
<th>SPQ</th>
<th>Reel Diameter (mm)</th>
<th>Reel Width W1 (mm)</th>
<th>A0 (mm)</th>
<th>B0 (mm)</th>
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<th>P1 (mm)</th>
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**TAPE AND REEL BOX DIMENSIONS**

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*All dimensions are nominal*
NOTES:
A. All linear dimensions are in inches (millimeters).
B. This drawing is subject to change without notice.
⚠️ Body length does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.006 (0.15) each side.
⚠️ Body width does not include interlead flash. Interlead flash shall not exceed 0.017 (0.43) each side.
E. Reference JEDEC MS-012 variation AA.
NOTES:
A. All linear dimensions are in millimeters.
B. This drawing is subject to change without notice.
C. Publication IPC-7351 is recommended for alternate designs.
D. Laser cutting apertures with trapezoidal walls and also rounding corners will offer better paste release. Customers should contact their board assembly site for stencil design recommendations. Refer to IPC-7525 for other stencil recommendations.
E. Customers should contact their board fabrication site for solder mask tolerances between and around signal pads.
MECHANICAL DATA

P (R-PDIP-T8)  PLASTIC DUAL-IN-LINE PACKAGE

NOTES:
A. All linear dimensions are in inches (millimeters).
B. This drawing is subject to change without notice.
C. Falls within JEDEC MS-001 variation BA.

4040082/E  04/2010

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