**850MHz, Output Limiting, Low Distortion Current Feedback Operational Amplifier**

The HFA1130 is a high speed wideband current feedback amplifier featuring programmable output limits. Built with Intersil's proprietary complementary bipolar UHF-1 process, it is the fastest monolithic amplifier available from any semiconductor manufacturer.

This amplifier is the ideal choice for high frequency applications requiring output limiting, especially those needing ultra fast overdrive recovery times. The output limiting function allows the designer to set the maximum positive and negative output levels, thereby protecting later stages from damage or input saturation. The sub-nanosecond overdrive recovery time quickly returns the amplifier to linear operation, following an overdrive condition.

The HFA1130 offers significant performance improvements over the CLC500/501/502.

### Features

- User Programmable Output Voltage Limits
- Low Distortion (30MHz, HD2) . . . . . . . . . . . . . . . . -56dBc
- -3dB Bandwidth . . . . . . . . . . . . . . . . . . . . . . . . 850MHz
- Very Fast Slew Rate . . . . . . . . . . . . . . . . . . . . . 2300V/µs
- Fast Settling Time (0.1%) . . . . . . . . . . . . . . . . . . . 11ns
- Excellent Gain Flatness
  - (100MHz) . . . . . . . . . . . . . . . . . . . . . . . . . . . . 0.14dB
  - (50MHz) . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 0.04dB
  - (30MHz) . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 0.01dB
- High Output Current . . . . . . . . . . . . . . . . . . . . . . . 60mA
- Overdrive Recovery . . . . . . . . . . . . . . . . . . . . . . . <1ns
- Pb-Free Plus Anneal Available (RoHS Compliant)

### Applications

- Residue Amplifier
- Video Switching and Routing
- Pulse and Video Amplifiers
- Wideband Amplifiers
- RF/IF Signal Processing
- Flash A/D Driver
- Medical Imaging Systems
- Related Literature
  - AN9420, Current Feedback Theory
  - AN9202, HFA11XX Evaluation Fixture

### Pinout

```
PART NUMBER (BRAND) | TEMP. RANGE (°C) | PACKAGE | PKG. DWG. # |
---------------------|-----------------|---------|-------------|
HFA1130IB (H1130I)  | -40 to 85       | 8 Ld SOIC | M8.15       |
HFA1130IBZ (Note) (H1130IBZ) | -40 to 85 | 8 Ld SOIC (Pb-free) | M8.15       |
HFA1130IBZ-T (Note) (H1130IBZ) | -40 to 85 | 8 Ld SOIC (Pb-free) | M8.15       |
HFA11XXEVAL         | DIP Evaluation Board for High-Speed Op Amps |
```

NOTE: Intersil Pb-free plus anneal products employ special Pb-free material sets; molding compounds/die attach materials and 100% matte tin plate termination finish, which are RoHS compliant and compatible with both SnPb and Pb-free soldering operations. Intersil Pb-free products are MSL classified at Pb-free peak reflow temperatures that meet or exceed the Pb-free requirements of IPC/JEDEC J STD-020.

### Ordering Information

**Features**

- User Programmable Output Voltage Limits
- Low Distortion (30MHz, HD2) . . . . . . . . . . . . . . . . -56dBc
- -3dB Bandwidth . . . . . . . . . . . . . . . . . . . . . . . . 850MHz
- Very Fast Slew Rate . . . . . . . . . . . . . . . . . . . . . 2300V/µs
- Fast Settling Time (0.1%) . . . . . . . . . . . . . . . . . . . 11ns
- Excellent Gain Flatness
  - (100MHz) . . . . . . . . . . . . . . . . . . . . . . . . . . . . 0.14dB
  - (50MHz) . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 0.04dB
  - (30MHz) . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 0.01dB
- High Output Current . . . . . . . . . . . . . . . . . . . . . . . 60mA
- Overdrive Recovery . . . . . . . . . . . . . . . . . . . . . . . <1ns
- Pb-Free Plus Anneal Available (RoHS Compliant)

### Applications

- Residue Amplifier
- Video Switching and Routing
- Pulse and Video Amplifiers
- Wideband Amplifiers
- RF/IF Signal Processing
- Flash A/D Driver
- Medical Imaging Systems
- Related Literature
  - AN9420, Current Feedback Theory
  - AN9202, HFA11XX Evaluation Fixture

### Pinout

```
HFA1130 (SOIC) TOP VIEW
```

**The Op Amps with Fastest Edges**

![Input 220MHz Signal](image1)

![Output (AV = 2)](image2)

---

**CAUTION:** These devices are sensitive to electrostatic discharge; follow proper IC Handling Procedures.

1-888-INTERSIL or 1-888-468-3774

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Absolute Maximum Ratings  \( T_A = 25°C \)

- Voltage Between V+ and V-: \( 12V \)
- Input Voltage: \( V_{SUPPLY} \)
- Differential Input Voltage: \( 5V \)
- Output Current (50% Duty Cycle): \( 60mA \)

Operating Conditions

Temperature Range: \(-40°C \) to \( 85°C \)

CAUTION: Stresses above those listed in “Absolute Maximum Ratings” may cause permanent damage to the device. This is a stress only rating and operation of the device at these or any other conditions above those indicated in the operational sections of this specification is not implied.

NOTE:
1. \( \theta_{JA} \) is measured with the component mounted on an evaluation PC board in free air.

Thermal Information

- Thermal Resistance (Typical, Note 1):
  - \( \theta_{JA} \) (°C/W): 170 N/A
  - \( \theta_{JC} \) (°C/W): 150°C
- Maximum Junction Temperature (Plastic Package): \( +150°C \)
- Maximum Storage Temperature Range: \(-65°C \) to \( T_A \) to \( +150°C \)
- Maximum Lead Temperature (Soldering 10s): \( -300°C \)
  (SOIC - Lead Tips Only)

Electrical Specifications  \( V_{SUPPLY} = \pm 5V, AV = +1, RF = 510\Omega, RL = 100\Omega \), Unless Otherwise Specified

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>TEST CONDITIONS</th>
<th>TEMPERATURE (°C)</th>
<th>TEST LEVEL</th>
<th>MIN</th>
<th>TYP</th>
<th>MAX</th>
<th>UNITS</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>INPUT CHARACTERISTICS</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Input Offset Voltage (Note 3)</td>
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<td></td>
<td></td>
<td>25</td>
<td>6</td>
<td></td>
<td>mV</td>
</tr>
<tr>
<td>Input Offset Voltage Drift</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>10</td>
<td>mV</td>
</tr>
<tr>
<td>( V_{IO} ) CMRR ( \Delta V_{CM} = \pm 2V )</td>
<td></td>
<td>25</td>
<td></td>
<td>40</td>
<td>46</td>
<td></td>
<td>dB</td>
</tr>
<tr>
<td>( V_{IO} ) CMRR ( \Delta V_{S} = \pm 1.25V )</td>
<td></td>
<td>25</td>
<td></td>
<td>45</td>
<td>50</td>
<td></td>
<td>dB</td>
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<tr>
<td>Non-Inverting Input Bias Current (Note 3)</td>
<td></td>
<td></td>
<td></td>
<td>25</td>
<td>40</td>
<td></td>
<td>µA</td>
</tr>
<tr>
<td>(+IBIAS) Drift</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>65</td>
<td>µA</td>
</tr>
<tr>
<td>(+IBIAS) CMS ( \Delta V_{CM} = \pm 2V )</td>
<td></td>
<td>25</td>
<td></td>
<td>20</td>
<td>40</td>
<td></td>
<td>µA/V</td>
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<tr>
<td>Inverting Input Bias Current (Note 3)</td>
<td></td>
<td></td>
<td></td>
<td>25</td>
<td>12</td>
<td>50</td>
<td>µA</td>
</tr>
<tr>
<td>(-IBIAS) Drift</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>60</td>
<td>µA</td>
</tr>
<tr>
<td>(-IBIAS) CMS ( \Delta V_{CM} = \pm 2V )</td>
<td></td>
<td>25</td>
<td></td>
<td>1</td>
<td>7</td>
<td></td>
<td>µA/V</td>
</tr>
<tr>
<td>(-IBIAS) PSS ( \Delta V_{S} = \pm 1.25V )</td>
<td></td>
<td>25</td>
<td></td>
<td>6</td>
<td>15</td>
<td></td>
<td>µA/V</td>
</tr>
<tr>
<td>Non-Inverting Input Resistance</td>
<td></td>
<td></td>
<td></td>
<td>25</td>
<td>25</td>
<td>50</td>
<td>kΩ</td>
</tr>
<tr>
<td>Inverting Input Resistance</td>
<td></td>
<td></td>
<td></td>
<td>25</td>
<td>20</td>
<td>30</td>
<td>Ω</td>
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<tr>
<td>Input Capacitance (Either Input)</td>
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<td></td>
<td></td>
<td>25</td>
<td>2</td>
<td></td>
<td>pF</td>
</tr>
<tr>
<td>Input Common Mode Range</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Input Noise Voltage (Note 3)</td>
<td></td>
<td>25</td>
<td></td>
<td>2.5</td>
<td>3.0</td>
<td></td>
<td>V</td>
</tr>
<tr>
<td>+Input Noise Current (Note 3)</td>
<td></td>
<td>25</td>
<td></td>
<td>4</td>
<td>-</td>
<td></td>
<td>nV/√Hz</td>
</tr>
<tr>
<td>-Input Noise Current (Note 3)</td>
<td></td>
<td>25</td>
<td></td>
<td>18</td>
<td>-</td>
<td></td>
<td>pA/√Hz</td>
</tr>
</tbody>
</table>

**TRANSFER CHARACTERISTICS**  \( AV = +2 \), Unless Otherwise Specified

- Open Loop Transimpedance (Note 3)            |                 | 25               |            |     | 300 |      | kΩ    |
### Electrical Specifications

**V\text{SUPPLY} = \pm 5\text{V, A}_V = +1, R_F = 510\Omega, R_L = 100\Omega, Unless Otherwise Specified** (Continued)

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>TEST CONDITIONS</th>
<th>(NOTE 2) TEST LEVEL</th>
<th>TEMP. (°C)</th>
<th>MIN</th>
<th>TYP</th>
<th>MAX</th>
<th>UNITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>-3dB Bandwidth (Note 3)</td>
<td>V\text{OUT} = 0.2V_p-p, A_V = +1</td>
<td>B</td>
<td>25</td>
<td>530</td>
<td>850</td>
<td>-</td>
<td>MHz</td>
</tr>
<tr>
<td>-3dB Bandwidth</td>
<td>V\text{OUT} = 0.2V_p-p, A_V = +2, R_F = 360\Omega</td>
<td>B</td>
<td>25</td>
<td>-</td>
<td>670</td>
<td>-</td>
<td>MHz</td>
</tr>
<tr>
<td>Full Power Bandwidth</td>
<td>4V_p-p, A_V = -1</td>
<td>B</td>
<td>Full</td>
<td>-</td>
<td>300</td>
<td>-</td>
<td>MHz</td>
</tr>
<tr>
<td>Gain Flatness (Note 3)</td>
<td>V\text{OUT} = 0.2V_p-p, A_V = +1</td>
<td>B</td>
<td>25</td>
<td>-</td>
<td>±0.14</td>
<td>-</td>
<td>dB</td>
</tr>
<tr>
<td>Gain Flatness</td>
<td>V\text{OUT} = 500MHz</td>
<td>B</td>
<td>25</td>
<td>-</td>
<td>±0.04</td>
<td>-</td>
<td>dB</td>
</tr>
<tr>
<td>Gain Flatness</td>
<td>V\text{OUT} = 500MHz</td>
<td>B</td>
<td>25</td>
<td>-</td>
<td>±0.01</td>
<td>-</td>
<td>dB</td>
</tr>
<tr>
<td>Linear Phase Deviation (Note 3)</td>
<td>DC to 100MHz</td>
<td>B</td>
<td>25</td>
<td>-</td>
<td>0.6</td>
<td>-</td>
<td>Degrees</td>
</tr>
<tr>
<td>Differential Gain</td>
<td>NTSC, R_L = 75\Omega</td>
<td>B</td>
<td>25</td>
<td>-</td>
<td>0.03</td>
<td>-</td>
<td>%</td>
</tr>
<tr>
<td>Differential Phase</td>
<td>NTSC, R_L = 75\Omega</td>
<td>B</td>
<td>25</td>
<td>-</td>
<td>0.05</td>
<td>-</td>
<td>Degrees</td>
</tr>
<tr>
<td>Minimum Stable Gain</td>
<td>A</td>
<td>Full</td>
<td>1</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>V/V</td>
</tr>
<tr>
<td><strong>OUTPUT CHARACTERISTICS</strong> A_V = +2, Unless Otherwise Specified</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Output Voltage (Note 3)</td>
<td>A_V = -1</td>
<td>A</td>
<td>25</td>
<td>±3.0</td>
<td>±3.3</td>
<td>-</td>
<td>V</td>
</tr>
<tr>
<td>Output Current</td>
<td>R_L = 50\Omega, A_V = -1</td>
<td>A</td>
<td>25, 85</td>
<td>50</td>
<td>60</td>
<td>-</td>
<td>mA</td>
</tr>
<tr>
<td>DC Closed Loop Output Impedance (Note 3)</td>
<td>B</td>
<td>25</td>
<td>-</td>
<td>0.07</td>
<td>-</td>
<td>Ω</td>
<td></td>
</tr>
<tr>
<td>2nd Harmonic Distortion (Note 3)</td>
<td>30MHz, V\text{OUT} = 2V_p-p</td>
<td>B</td>
<td>25</td>
<td>-</td>
<td>-56</td>
<td>-</td>
<td>dBc</td>
</tr>
<tr>
<td>3rd Harmonic Distortion (Note 3)</td>
<td>30MHz, V\text{OUT} = 2V_p-p</td>
<td>B</td>
<td>25</td>
<td>-</td>
<td>-80</td>
<td>-</td>
<td>dBc</td>
</tr>
<tr>
<td>3rd Order Intercept (Note 3)</td>
<td>100MHz</td>
<td>B</td>
<td>25</td>
<td>20</td>
<td>30</td>
<td>-</td>
<td>dBm</td>
</tr>
<tr>
<td>1dB Compression</td>
<td>100MHz</td>
<td>B</td>
<td>25</td>
<td>15</td>
<td>20</td>
<td>-</td>
<td>dBm</td>
</tr>
<tr>
<td><strong>TRANSIENT RESPONSE</strong> A_V = +2, Unless Otherwise Specified</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Rise Time</td>
<td>V\text{OUT} = 2.0V Step</td>
<td>B</td>
<td>25</td>
<td>-</td>
<td>900</td>
<td>-</td>
<td>ps</td>
</tr>
<tr>
<td>Overshoot (Note 3)</td>
<td>V\text{OUT} = 2.0V Step</td>
<td>B</td>
<td>25</td>
<td>-</td>
<td>10</td>
<td>-</td>
<td>%</td>
</tr>
<tr>
<td>Slew Rate</td>
<td>A_V = +1, V\text{OUT} = 5V_p-p</td>
<td>B</td>
<td>25</td>
<td>-</td>
<td>1400</td>
<td>-</td>
<td>V/µs</td>
</tr>
<tr>
<td>Slew Rate</td>
<td>A_V = +2, V\text{OUT} = 5V_p-p</td>
<td>B</td>
<td>25</td>
<td>1850</td>
<td>2300</td>
<td>-</td>
<td>V/µs</td>
</tr>
<tr>
<td>0.1% Settling Time (Note 3)</td>
<td>V\text{OUT} = 2V to 0V</td>
<td>B</td>
<td>25</td>
<td>-</td>
<td>11</td>
<td>-</td>
<td>ns</td>
</tr>
<tr>
<td>0.2% Settling Time (Note 3)</td>
<td>V\text{OUT} = 2V to 0V</td>
<td>B</td>
<td>25</td>
<td>-</td>
<td>7</td>
<td>-</td>
<td>ns</td>
</tr>
<tr>
<td><strong>POWER SUPPLY CHARACTERISTICS</strong></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Supply Voltage Range</td>
<td>B</td>
<td>Full</td>
<td>±4.5</td>
<td>-</td>
<td>±5.5</td>
<td>-</td>
<td>V</td>
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<tr>
<td>Supply Current (Note 3)</td>
<td>A</td>
<td>25</td>
<td>-</td>
<td>21</td>
<td>26</td>
<td>mA</td>
<td></td>
</tr>
<tr>
<td>Supply Current (Note 3)</td>
<td>A</td>
<td>Full</td>
<td>-</td>
<td>-</td>
<td>33</td>
<td>mA</td>
<td></td>
</tr>
<tr>
<td><strong>LIMITING CHARACTERISTICS</strong> A_V = +2, V_H = +1V, V_L = -1V, Unless Otherwise Specified</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Clamp Accuracy</td>
<td>V\text{IN} = ±2V, A_V = -1</td>
<td>A</td>
<td>25</td>
<td>-</td>
<td>60</td>
<td>±125</td>
<td>mV</td>
</tr>
<tr>
<td>Clamped Overshoot</td>
<td>V\text{IN} = ±1V, Input \text{t}\text{R}/\text{t}\text{F} = 2ns</td>
<td>B</td>
<td>25</td>
<td>-</td>
<td>4</td>
<td>-</td>
<td>%</td>
</tr>
<tr>
<td>Overdrive Recovery Time</td>
<td>V\text{IN} = ±1V</td>
<td>B</td>
<td>25</td>
<td>-</td>
<td>0.75</td>
<td>1.5</td>
<td>ns</td>
</tr>
</tbody>
</table>
Application Information

Optimum Feedback Resistor (RF)

The enclosed plots of inverting and non-inverting frequency response detail the performance of the HFA1130 in various gains. Although the bandwidth dependency on ACL isn’t as severe as that of a voltage feedback amplifier, there is an appreciable decrease in bandwidth at higher gains. This decrease can be minimized by taking advantage of the current feedback amplifier’s unique relationship between bandwidth and RF. All current feedback amplifiers require a feedback resistor, even for unity gain applications, and the RF, in conjunction with the internal compensation capacitor, sets the dominant pole of the frequency response. Thus, the amplifier’s bandwidth is inversely proportional to RF. The HFA1130 design is optimized for a 510 Ω RF, at a gain of +1.

Decreasing RF in a unity gain application decreases stability, resulting in excessive peaking and overshoot (Note: Capacitive feedback causes the same problems due to the feedback impedance decrease at higher frequencies). At higher gains the amplifier is more stable, so RF can be decreased in a trade-off of stability for bandwidth. The table below lists recommended RF values for various gains, and the expected bandwidth.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Test Conditions</th>
<th>Temp. (°C)</th>
<th>Min</th>
<th>Typ</th>
<th>Max</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Negative Clamp Range</td>
<td>B</td>
<td>25</td>
<td>-5.0 to +2.0</td>
<td>-</td>
<td>V</td>
<td></td>
</tr>
<tr>
<td>Positive Clamp Range</td>
<td>B</td>
<td>25</td>
<td>-2.0 to +5.0</td>
<td>-</td>
<td>V</td>
<td></td>
</tr>
<tr>
<td>Clamp Input Bias Current</td>
<td>A</td>
<td>25</td>
<td>50</td>
<td>200</td>
<td>200</td>
<td>µA</td>
</tr>
<tr>
<td>Clamp Input Bandwidth</td>
<td>VH or VL = 100mVP-P</td>
<td>B</td>
<td>25</td>
<td>500</td>
<td>-</td>
<td>MHz</td>
</tr>
</tbody>
</table>

NOTES:
2. Test Level: A. Production Tested; B. Typical or Guaranteed Limit Based on Characterization; C. Design Typical for Information Only.
3. See Typical Performance Curves for more information.

Clamp Operation

General

The HFA1130 features user programmable output clamps to limit output voltage excursions. Clamping action is obtained by applying voltages to the VH and VL terminals (pins 8 and 5) of the amplifier. VH sets the upper output limit, while VL sets the lower clamp level. If the amplifier tries to drive the output above VH, or below VL, the clamp circuitry limits the output voltage at VH or VL (± the clamp accuracy), respectively. The low input bias currents of the clamp pins allow them to be driven by simple resistive divider circuits, or active elements such as amplifiers or DACs.

Clamp Circuitry

Figure 1 shows a simplified schematic of the HFA1130 input stage, and the high clamp (VH) circuitry. As with all current feedback amplifiers, there is a unity gain buffer (QX1 - QX2) between the positive and negative inputs. This buffer forces -IN to track +IN, and sets up a slewing current of (V-IN - V OUT)/RF. This current is mirrored onto the high impedance node (Z) by QX3-QX4, where it is converted to a voltage and fed to the output via another unity gain buffer. If no clamping is utilized, the high impedance node may swing within the limits defined by QP4 and QN4. Note that when the output reaches its quiescent value, the current flowing through -IN is reduced to only that small current (-IBIAS) required to keep the output at the final voltage.
reaches a voltage equal to QP5’s base + 2VBE (QP5 and QNS). Thus, QP5 clamps node Z whenever Z reaches VH. R1 provides a pull-up network to ensure functionality with the clamp inputs floating. A similar description applies to the symmetrical low clamp circuitry controlled by VL.

When the output is clamped, the negative input continues to source a slewing current (ICLAMP) in an attempt to force the output to the quiescent voltage defined by the input. QP5 must sink this current while clamping, because the -IN current is always mirrored onto the high impedance node. The clamping current is calculated as \((V_{IN} - V_{OUT})/R_F\). As an example, a unity gain circuit with \(V_{IN} = 2V\), \(V_H = 1V\), and \(R_F = 510\Omega\) would have \(I_{CLAMP} = (2-1)/510\Omega = 1.96mA\). Note that ICC will increase by ICLAMP when the output is clamp limited.

**Clamp Accuracy**

The clamped output voltage will not be exactly equal to the voltage applied to VH or VL. Offset errors, mostly due to VBE mismatches, necessitate a clamp accuracy parameter which is found in the device specifications. Clamp accuracy is a function of the clamping conditions. Referring again to Figure 1, it can be seen that one component of clamp accuracy is the VBE mismatch between the QX6 transistors, and the QX5 transistors. If the transistors always ran at the same current level there would be no VBE mismatch, and no contribution to the inaccuracy. The QX6 transistors are biased at a constant current, but as described earlier, the current through QX5 is equivalent to ICLAMP. VBE increases as ICLAMP increases, causing the clamped output voltage to increase as well. ICLAMP is a function of the overdrive level \((V_{IN} - V_{OUTCLAMPED})\) and RF, so clamp accuracy degrades as the overdrive increases, or as RF decreases. As an example, the specified accuracy of \(+60mV\) for a 2X overdrive with \(R_F = 510\Omega\) degrades to \(\pm220mV\) for \(R_F = 240\Omega\) at the same overdrive, or to \(\pm250mV\) for a 3X overdrive with \(R_F = 510\Omega\).

Consideration must also be given to the fact that the clamp voltages have an effect on amplifier linearity. The “Nonlinearity Near Clamp Voltage” curve in the data sheet illustrates the impact of several clamp levels on linearity.

**Clamp Range**

Unlike some competitor devices, both VH and VL have usable ranges that cross 0V. While VH must be more positive than VL, both may be positive or negative, within the range restrictions indicated in the specifications. For example, the HFA1130 could be limited to ECL output levels by setting \(V_H = -0.8V\) and \(V_L = -1.8V\). VH and VL may be connected to the same voltage (GND for instance) but the result won’t be in a DC output voltage from an AC input signal. A 150 - 200mV AC signal will still be present at the output.

**Recovery from Overdrive**

The output voltage remains at the clamp level as long as the overdrive condition remains. When the input voltage drops below the overdrive level \((V_{CLAMP}/AVCL)\) the amplifier will return to linear operation. A time delay, known as the Overdrive Recovery Time, is required for this resumption of linear operation. The plots of “Unclamped Performance” and “Clamped Performance” highlight the HFA1130’s subnanosecond recovery time. The difference between the unclamped and clamped propagation delays is the overdrive recovery time. The appropriate propagation delays are 4.0ns for the unclamped pulse, and 4.8ns for the clamped (2X overdrive) pulse yielding an overdrive recovery time of 800ps. The measurement uses the 90% point of the output transition to ensure that linear operation has resumed. Note: The propagation delay illustrated is dominated by the fixturing. The delta shown is accurate, but the true HFA1130 propagation delay is 500ps.

**Use of Die in Hybrid Applications**

This amplifier is designed with compensation to negate the package parasitics that typically lead to instabilities. As a result, the use of die in hybrid applications results in overcompensated performance due to lower parasitic capacitances. Reducing RF below the recommended values for packaged units will solve the problem. For AV = +2 the recommended starting point is 300\Omega, while unity gain applications should try 400\Omega.

**PC Board Layout**

The frequency performance of this amplifier depends greatly on the amount of care taken in designing the PC board. The use of low inductance components such as chip resistors and chip capacitors is strongly recommended, while a solid ground plane is a must!

Attention should be given to decoupling the power supplies. A large value (10µF) tantalum in parallel with a small value chip (0.1µF) capacitor works well in most cases.

Terminated microstrip signal lines are recommended at the input and output of the device. Output capacitance, such as that resulting from an improperly terminated transmission line will degrade the frequency response of the amplifier and may cause oscillations. In most cases, the oscillation can be avoided by placing a resistor in series with the output.

Care must also be taken to minimize the capacitance to ground seen by the amplifier’s inverting input. The larger this capacitance, the worse the gain peaking, resulting in pulse overshoot and possible instability. To this end, it is recommended that the ground plane be removed under traces connected to pin 2, and connections to pin 2 should be kept as short as possible.

An example of a good high frequency layout is the Evaluation Board shown below.
**Evaluation Board**

An evaluation board is available for the HFA1130, (Part Number HFA11XXEVAL). Please contact your local sales office for information.

Note: The SOIC version may be evaluated in the DIP board by using a SOIC-to-DIP adapter such as Aries Electronics Part Number 08-350000-10.

The layout and schematic of the board are shown here:

![Schematic Diagram](image)

**Typical Performance Curves**  
$V_{SUPPLY} = \pm 5\text{V}, R_F = 510\Omega, T_A = 25^\circ\text{C}, R_L = 100\Omega$, Unless Otherwise Specified

![Small Signal Pulse Response](image)

![Large Signal Pulse Response](image)
Typical Performance Curves  \( V_{\text{SUPPLY}} = \pm 5V, \, R_F = 510\Omega, \, T_A = 25^\circ C, \, R_L = 100\Omega, \) Unless Otherwise Specified  (Continued)

**FIGURE 5. UNCLAMPED PERFORMANCE**

**FIGURE 6. CLAMPED PERFORMANCE**

**FIGURE 7. NON-INVERTING FREQUENCY RESPONSE**

**FIGURE 8. INVERTING FREQUENCY RESPONSE**

**FIGURE 9. FREQUENCY RESPONSE FOR VARIOUS LOAD RESISTORS**

**FIGURE 10. FREQUENCY RESPONSE FOR VARIOUS LOAD RESISTORS**
Typical Performance Curves  $V_{\text{SUPPLY}} = \pm 5\,V$, $R_F = 510\,\Omega$, $T_A = 25^\circ\text{C}$, $R_L = 100\,\Omega$, Unless Otherwise Specified  (Continued)
Typical Performance Curves \( V_{\text{SUPPLY}} = \pm 5\text{V}, R_F = 510\Omega, T_A = 25^\circ\text{C}, R_L = 100\Omega, \) Unless Otherwise Specified (Continued)

![Figure 17. Open Loop Transimpedance](image1.png)

![Figure 18. Settling Response](image2.png)

![Figure 19. Closed Loop Output Resistance](image3.png)

![Figure 20. 3rd Order Intermodulation Intercept](image4.png)

![Figure 21. 2nd Harmonic Distortion vs P_{OUT}](image5.png)

![Figure 22. 3rd Harmonic Distortion vs P_{OUT}](image6.png)
**Typical Performance Curves**  \( V_{\text{SUPPLY}} = \pm 5\, \text{V}, \, R_F = 510\, \Omega, \, T_A = 25^\circ\, \text{C}, \, R_L = 100\, \Omega, \) Unless Otherwise Specified  (Continued)

**Figure 23. OVERSHOOT vs INPUT RISE TIME**

**Figure 24. OVERSHOOT vs INPUT RISE TIME**

**Figure 25. OVERSHOOT vs FEEDBACK RESISTOR**

**Figure 26. SUPPLY CURRENT vs TEMPERATURE**

**Figure 27. SUPPLY CURRENT vs SUPPLY VOLTAGE**

**Figure 28. \( V_{\text{IO}} \) AND BIAS CURRENTS vs TEMPERATURE**
Typical Performance Curves \( V_{\text{SUPPLY}} = \pm 5 \text{V}, R_F = 510 \Omega, T_A = 25^\circ \text{C}, R_L = 100 \Omega \), Unless Otherwise Specified (Continued)
Die Characteristics

DIE DIMENSIONS:
63 mils x 44 mils x 19 mils
1600µm x 1130µm

METALLIZATION:
Type: Metal 1: AlCu(2%)/TiW
Thickness: Metal 1: 8kÅ ±0.4kÅ
Type: Metal 2: AlCu(2%)
Thickness: Metal 2: 16kÅ ±0.8kÅ

PASSIVATION:
Type: Nitride
Thickness: 4kÅ ±0.5kÅ

TRANSISTOR COUNT:
52

SUBSTRATE POTENTIAL (Powered Up):
Floating (Recommend Connection to V-)

Metallization Mask Layout

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