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Large-Dynamic-Range Amplifiers

- Nine gain settings from 10Ω to 1 GΩ ensure accurate detection from 1 pA to 100 mA.
- The amplifiers operate for eight hours from a set of fully charged NiCd batteries.
- A 3½-digit backlit LCD gives direct readout of photocurrent, range setting, and battery status.

The 13 AMP 003 large-dynamic-range amplifier is a general purpose current amplifier for use with photodiodes and other detectors in applications requiring the transimpedance configuration. The compact unit converts current signals from a detector to a voltage while maintaining a constant zero bias across the detector independent of the signal amplitude.

There are nine gain settings available ranging from 1 GΩ to 10 Ω. This permits accurate detection of signals from as low as 1 pA to 100 mA. The amplifier contains a 3½-digit backlit LCD, providing direct readout of the photocurrent as well as range setting and battery status.

Additional features of the amplifier include offset adjustment to null background readings, a BNC signal monitor for utility purposes, and a rear-panel banana jack connection allowing the amplifier to be connected to earth ground. Rechargeable AA-size nickel-cadmium batteries provide a minimum of eight hours of portable operation. The unit can also be operated from a wall-mounted plug-in power supply which simultaneously charges the internal battery pack.

### SPECIFICATIONS:

**LARGE-DYNAMIC-RANGE AMPLIFIERS**

<table>
<thead>
<tr>
<th>Input/Output:</th>
<th>Accuracy: ±1% all ranges</th>
</tr>
</thead>
<tbody>
<tr>
<td>Input Current Range:</td>
<td>1 pA–100 mA</td>
</tr>
<tr>
<td>Input Connector Type:</td>
<td>BNC</td>
</tr>
<tr>
<td>Range Selection:</td>
<td>9-position switch, 2 nA–100 mA</td>
</tr>
<tr>
<td>Monitor Out:</td>
<td>–2 V to +2 V full scale</td>
</tr>
<tr>
<td>Output Connector Type:</td>
<td>BNC</td>
</tr>
<tr>
<td>Offset Current Range:</td>
<td>–2 mA to +2 mA</td>
</tr>
<tr>
<td>Display:</td>
<td>3½-digit LCD with backlighting</td>
</tr>
</tbody>
</table>

**Power Requirements:**

- Voltage: 115 Vac, 230 Vac, or 8 AA-size nickel-cadmium rechargeable batteries
- Frequency: 50–60 Hz
- Temperature: Operating Temperature: +10°C to +35°C Storage Temperature: –20°C to +55°C
- Dimensions (W × H × D): 133 × 83 × 140 mm (5.25 × 3.25 × 5.5 in.)

### Performance Variation with Range

<table>
<thead>
<tr>
<th>Range</th>
<th>Resolution</th>
<th>Maximum Frequency Response (kHz)</th>
<th>Full Bandwidth Current Noise (A rms)</th>
</tr>
</thead>
<tbody>
<tr>
<td>100 mA</td>
<td>0.1 mA</td>
<td>40.5</td>
<td>900 nA</td>
</tr>
<tr>
<td>20 mA</td>
<td>0.01 mA</td>
<td>40.5</td>
<td>90 nA</td>
</tr>
<tr>
<td>2 mA</td>
<td>0.001 mA</td>
<td>40.5</td>
<td>20 nA</td>
</tr>
<tr>
<td>200 μA</td>
<td>0.1 μA</td>
<td>40.5</td>
<td>2 nA</td>
</tr>
<tr>
<td>20 μA</td>
<td>0.01 μA</td>
<td>40.5</td>
<td>300 pA</td>
</tr>
<tr>
<td>2 μA</td>
<td>0.001 μA</td>
<td>35.0</td>
<td>70 pA</td>
</tr>
<tr>
<td>200 nA</td>
<td>0.1 nA</td>
<td>10.0</td>
<td>20 pA</td>
</tr>
<tr>
<td>20 nA</td>
<td>0.01 nA</td>
<td>1.0</td>
<td>3 pA</td>
</tr>
<tr>
<td>2 nA</td>
<td>0.001 nA</td>
<td>0.1</td>
<td>0.5 pA</td>
</tr>
</tbody>
</table>
**Wide-Bandwidth Amplifier**

- Frequency response: dc to 5 MHz, maximum
- Accurate photocurrent detection from 100 pA to 2 mA
- Variable bias, ±10 V adjustable in 1-V increments
- 3½-digit backlit LCD to display photocurrent and range setting
- Front-panel offset adjustment to null background readings
- BNC signal monitor and switch-selectable 115/230 Vac operation

The 13 AMP 005 wide-bandwidth amplifier is a general-purpose current amplifier used for operating photodiodes in both the photovoltaic and photoconductive modes. The portable unit provides a variable ±10 V biasing adjustment which can be set in 1-V increments.

The transimpedance gain may be varied over five decades from 103 to 107 V/A. This permits accurate detection of photocurrents from as low as 100 pA to 2 mA with ±1% accuracy. The maximum frequency response in the 103 V/A gain setting is dc to 5 MHz. A 3½-digit backlit LCD is provided for directly displaying the photocurrent and range setting. Additional features include a front-panel offset adjustment to null background readings, a BNC signal monitor for utility purposes, and a rear-panel banana jack connection which allows the unit to be connected to ground.

**PRODUCT NUMBER**

Wide-Bandwidth Amplifier 13 AMP 005

**Performance Variation with Range**

<table>
<thead>
<tr>
<th>Range</th>
<th>Resolution</th>
<th>Transimpedance Gain (V/A)</th>
<th>Maximum Frequency Response (kHz)</th>
<th>Full Bandwidth Current Noise (A rms)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 mA</td>
<td>0.001 mA</td>
<td>$10^{1}$</td>
<td>5000</td>
<td>100 nA</td>
</tr>
<tr>
<td>200 µA</td>
<td>0.1 µA</td>
<td>$10^{4}$</td>
<td>1000</td>
<td>12 nA</td>
</tr>
<tr>
<td>20 µA</td>
<td>0.01 µA</td>
<td>$10^{5}$</td>
<td>300</td>
<td>1.5 nA</td>
</tr>
<tr>
<td>2 µA</td>
<td>0.001 µA</td>
<td>$10^{6}$</td>
<td>75</td>
<td>180 pA</td>
</tr>
<tr>
<td>200 nA</td>
<td>0.1 nA</td>
<td>$10^{7}$</td>
<td>15</td>
<td>32 pA</td>
</tr>
</tbody>
</table>
High-Frequency Amplifier

The 13 AMP 007 is a low-noise ac-coupled high-frequency voltage or current amplifier.

- High-frequency response ranges from 4 kHz to >300 MHz.
- The amplifier accepts input currents up to 160 mA and input voltages up to 8 mV.

**SPECIFICATIONS:**

**HIGH-FREQUENCY AMPLIFIER**

- Frequency Response: 4 kHz to >300 MHz (−3dB)
- Maximum Output Voltage: 1 V p-p into 50 Ω
- Input and Output Connector type: BNC
- Input and Output Impedance: 50 Ω
- Transimpedance Mode:
  - Transimpedance Gain: 6250 V/A
  - Maximum Input Current: 160 μA
  - Output Noise: 3.2 mV rms
  - Input-Referred Noise: 24 pA/Hz½
  - Bias Adjustment: −20 V to +20 V
- Voltage Amplification Mode:
  - Voltage Gain: 125
  - Maximum Input Voltage: 8 mV
  - Output Noise: 3.2 mV rms
  - Input Referred Noise: 1.2 nV/Hz½
- Power Requirements:
  - Voltage: 115 Vac ±10% and 230 Vac ±10%
    - rear panel switch selectable
  - Frequency: 50–60 Hz
  - Power: 3 W
- Temperature:
  - Operating Temperature: +10°C to +35°C
  - Storage Temperature: −40°C to +55°C
- Dimensions (W × H × D):
  - 91 × 48.3 × 143 mm (3.6 × 1.9 × 5.6 in.)

**Performance Variation with Detector Type**

<table>
<thead>
<tr>
<th>Rise Time²</th>
<th>NEP²</th>
<th>DETECTOR PRODUCT NUMBER</th>
</tr>
</thead>
<tbody>
<tr>
<td>at − 9 Vdc</td>
<td>at − 9 Vdc</td>
<td>PRODUCT NUMBER</td>
</tr>
<tr>
<td>(nsec)</td>
<td>(nsec)</td>
<td></td>
</tr>
<tr>
<td>1.0</td>
<td>48 × 10⁻¹²</td>
<td>13 DAH 001</td>
</tr>
<tr>
<td>1.25</td>
<td>48 × 10⁻¹²</td>
<td>13 DAH 003</td>
</tr>
<tr>
<td>1.5</td>
<td>48 × 10⁻¹²</td>
<td>13 DAH 005</td>
</tr>
</tbody>
</table>

1 Combined performance for Melles Griot high-speed silicon photodiodes and the 13 AMP 007.
2 Rise-time and noise equivalent power values are for a transimpedance gain of 6250 V/A and a detector responsivity of 0.5 A/W.
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