

### FEATURES

- 5.5 nV/ $\sqrt{\text{Hz}}$  Maximum noise density
- 0.08 Microvolt peak-to-peak low frequency noise
- 25 Microvolt maximum input offset voltage
- $\pm 40$  nA Maximum input offset current
- 0.6 Microvolt/ $^{\circ}\text{C}$  maximum offset voltage drift

### GENERAL DESCRIPTION

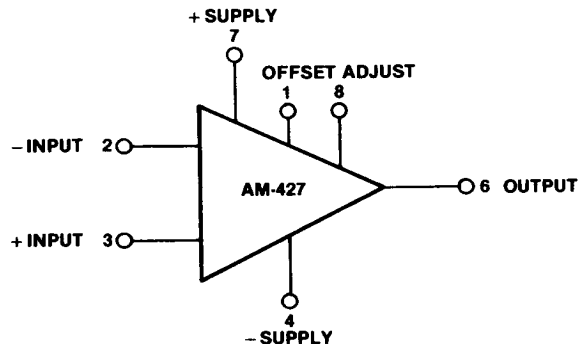
The AM-427 is a low cost monolithic instrumentation grade amplifier that combines ultra-low noise operation with exceptional dc performance. Input noise voltage density is typically 3.5 nV/ $\sqrt{\text{Hz}}$  at 10 Hz while input noise current density is as low as 0.4 pA/ $\sqrt{\text{Hz}}$ .

Other significant features include a maximum input offset voltage of 25 microvolts, eliminating the need for external zeroing in most applications. Maximum input offset voltage drift is only 0.6 microvolt/ $^{\circ}\text{C}$ . The AM-427 is internally compensated to provide a phase margin of  $70^{\circ}$  in the unity gain mode which eliminates peaking and ringing in low gain feedback applications. Output voltage is typically  $\pm 13.5\text{V}$  at  $\pm 6.75$  mA load current with a short circuit protected output.

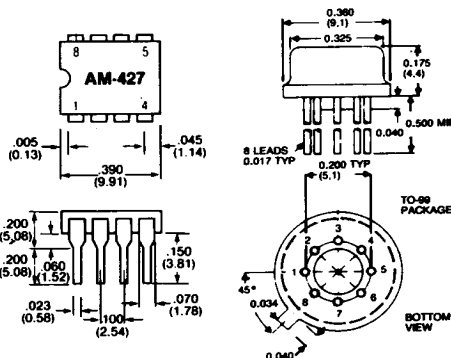
Dynamic characteristics include an 8 MHz gain bandwidth product and 2.8V/microseconds slew rate. Power supply rejection ratio and common mode rejection ratio are both in excess of 120 dB.

The AM-427 is an ideal choice for applications requiring high accuracy, low drift and low noise performance such as the amplification of low level transducer signals.

The AM-427 is available for operation over the industrial  $-25^{\circ}\text{C}$  to  $+85^{\circ}\text{C}$  temperature ranges. Models are packaged in either an 8-pin, hermetically sealed TO-99 case or an 8-pin ceramic DIP.



### MECHANICAL DIMENSIONS INCHES (mm)



### INPUT/OUTPUT CONNECTIONS

| PIN | FUNCTION            |
|-----|---------------------|
| 1   | OFFSET VOLTAGE ADJ. |
| 2   | - INPUT             |
| 3   | + INPUT             |
| 4   | - SUPPLY VOLTAGE    |
| 5   | N.C.                |
| 6   | OUTPUT              |
| 7   | + SUPPLY VOLTAGE    |
| 8   | OFFSET VOLTAGE ADJ. |

| ABSOLUTE MAXIMUM RATINGS   | A MODELS | B MODELS          |
|----------------------------|----------|-------------------|
| Power Supply Voltage       |          | $\pm 22\text{V}$  |
| Input Voltage              |          | $\pm 22\text{V}$  |
| Differential Input Voltage |          | $\pm 0.7\text{V}$ |
| Power Dissipation          |          | 658 mW            |

## FUNCTIONAL SPECIFICATIONS

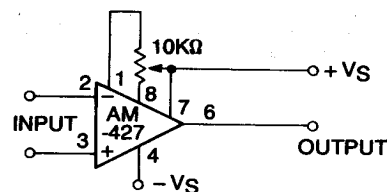
Typical at 25°C,  $\pm 15\text{V}$  dc supplies, unless otherwise noted.

| INPUT CHARACTERISTICS                                                                       |                                    |                                             |
|---------------------------------------------------------------------------------------------|------------------------------------|---------------------------------------------|
| Input Voltage Range, minimum                                                                |                                    | $\pm 11\text{V}$                            |
| Input Resistance, diff. mode, minimum                                                       | 0.8 M $\Omega$                     | 1.5 M $\Omega$                              |
| Input Offset Voltage, maximum                                                               | 100 $\mu\text{V}$                  | 25 $\mu\text{V}$                            |
| Input Bias Current, maximum                                                                 | $\pm 80\text{ nA}$                 | $\pm 40\text{ nA}$                          |
| Input Offset Current, maximum                                                               | 75 nA                              | 35 nA                                       |
| OUTPUT CHARACTERISTICS                                                                      |                                    |                                             |
| Output Voltage, minimum <sup>1</sup>                                                        |                                    | $\pm 11\text{V}$                            |
| Output Current, S.C. protected, minimum                                                     |                                    | $\pm 18\text{ mA}$                          |
| Output Resistance, open loop <sup>2</sup>                                                   |                                    | 70 $\Omega$                                 |
| PERFORMANCE                                                                                 |                                    |                                             |
| DC Open Loop Gain, minimum <sup>3</sup>                                                     | 116 dB                             | 120 dB                                      |
| Input Offset Voltage Drift, maximum <sup>4</sup>                                            | 1.8 $\mu\text{V}/^\circ\text{C}$   | 0.6 $\mu\text{V}/^\circ\text{C}$            |
| Long Term Stability                                                                         | 2 $\mu\text{V}/\text{mo}$          | 1 $\mu\text{V}/\text{mo}$                   |
| Input Bias Current Drift, maximum                                                           | $\pm 700\text{ pA}/^\circ\text{C}$ | $\pm 200\text{ pA}/^\circ\text{C}$          |
| Input Offset Current Drift maximum                                                          | 600 pA/ $^\circ\text{C}$           | 150 pA/ $^\circ\text{C}$                    |
| Common Mode Rejection Ratio, minimum <sup>5</sup>                                           | 100 dB                             | 114 dB                                      |
| Input Noise Voltage, maximum, 0.1 to 10 Hz                                                  | 0.25 $\mu\text{V}$ peak-to-peak    | 0.18 $\mu\text{V}$ peak-to-peak             |
| Input Noise Voltage Density, maximum, 10 Hz                                                 | 8 nV/ $\sqrt{\text{Hz}}$           | 5.5 nV/ $\sqrt{\text{Hz}}$                  |
| Input Noise Current Density, maximum, 1 kHz                                                 | 0.6 pA/ $\sqrt{\text{Hz}}$         | 0.6 pA/ $\sqrt{\text{Hz}}$                  |
| Power Supply Rejection Ratio, minimum                                                       | 94 dB                              | 100 dB                                      |
| Gain Bandwidth Product, minimum                                                             |                                    | 5.0 MHz                                     |
| Slew Rate, minimum                                                                          |                                    | 1.7V/microsecond                            |
| POWER REQUIREMENTS                                                                          |                                    |                                             |
| Voltage, Rated Performance                                                                  |                                    | $\pm 15\text{V}$ dc                         |
| Quiescent Current, maximum                                                                  | $\pm 5.7\text{ mA}$                | $\pm 4.7\text{ mA}$                         |
| Power Dissipation                                                                           | 170 mW                             | 140 mW                                      |
| PHYSICAL-ENVIRONMENTAL                                                                      |                                    |                                             |
| Operating Temperature Range:                                                                |                                    |                                             |
| AM-427A,B                                                                                   |                                    | $-25^\circ\text{C}$ to $+85^\circ\text{C}$  |
| Storage Temperature Range                                                                   |                                    | $-65^\circ\text{C}$ to $+150^\circ\text{C}$ |
| Package, AM-427-1                                                                           |                                    | 8-Pin Ceramic DIP                           |
| AM-427-2                                                                                    |                                    | 8-Pin Hermetically Sealed TO-99             |
| FOOTNOTES:                                                                                  |                                    |                                             |
| 1. $R_L = 600\Omega$                                                                        |                                    |                                             |
| 2. Output Voltage = 0, output current = 0.                                                  |                                    |                                             |
| 3. $R_L = 2\text{K ohm}$ , $V_{\text{OUTPUT}} = \pm 10\text{V}$ .                           |                                    |                                             |
| 4. Guaranteed untrimmed or when nulled with an 8 k $\Omega$ to 20 k $\Omega$ potentiometer. |                                    |                                             |
| 5. Common mode voltage = $\pm 11\text{V}$ .                                                 |                                    |                                             |
| 6. $V_S = \pm 4\text{V}$ to $\pm 18\text{V}$ .                                              |                                    |                                             |

## TECHNICAL NOTES

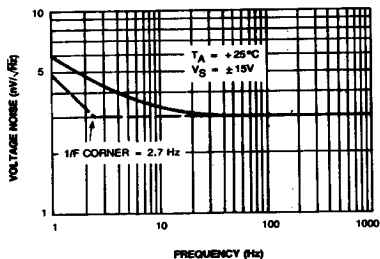
- In order to maintain the specified drift performance, both input pins should be maintained at the same relative temperature. This is to avoid stray thermoelectric voltages which are generated by the dissimilar metals at the contacts of the input terminals.
- To obtain the best possible linearity, circuit design should call for the minimum output current required by the application to assure high gain performance and excellent linearity, the output current range should be held to a maximum of  $\pm 10\text{ mA}$ .
- The AM-427 provides stable operation with load, capacitance of up to 2000 pF and  $\pm 10$  volt swings. Larger capacitances should be decoupled with a 50 $\Omega$  decoupling resistor. To avoid additional phase shifting and phase margin, a 20 pF capacitor should be used in parallel with the feedback resistor when the value of the feedback resistor is greater than 2K ohm.
- If adjustment of offset voltage is required, a 10 k $\Omega$  trimpot can be used without degrading the offset voltage drift specifications. A 1K ohm to 1 M $\Omega$  trimpot can be used, however, a 0.1 to 0.2  $\mu\text{V}/^\circ\text{C}$  degradation may occur. Trimming to a value other than zero will create a drift of (offset voltage/300)  $\mu\text{V}/^\circ\text{C}$ . A 10K ohm offset trimpot will yield an adjustment range of  $\pm 4\text{ mV}$ . A smaller trimpot in conjunction with fixed resistors can be used to obtain a smaller adjustment range with higher sensitivity and resolution.

## TYPICAL CONNECTION DIAGRAM

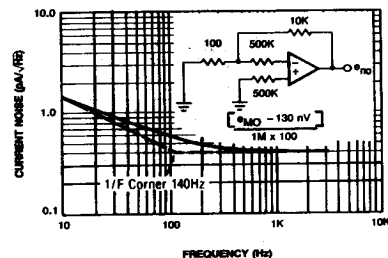


TYPICAL PERFORMANCE

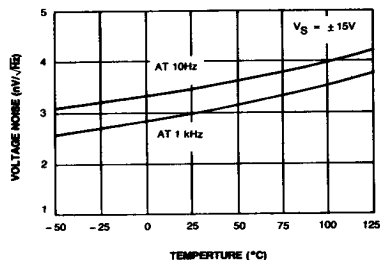
VOLTAGE NOISE VS. FREQUENCY



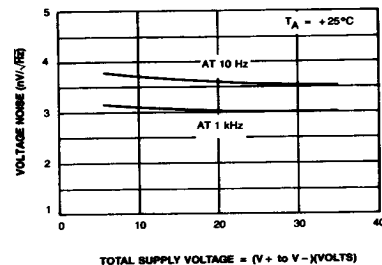
CURRENT NOISE VS. FREQUENCY



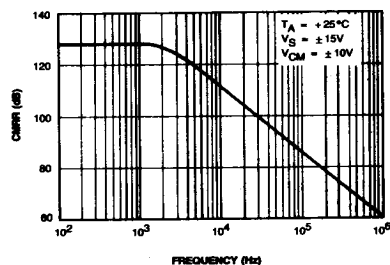
VOLTAGE NOISE VS. TEMPERATURE



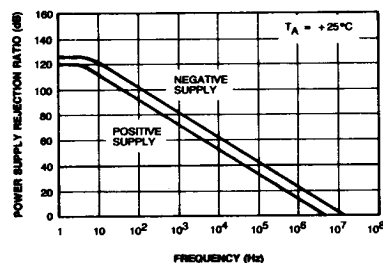
VOLTAGE NOISE VS. SUPPLY VOLTAGE



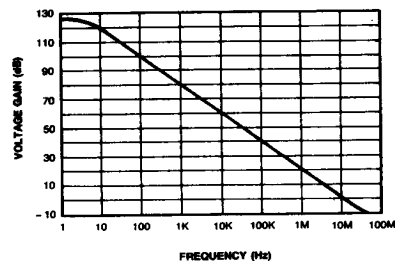
CMRR VS. FREQUENCY



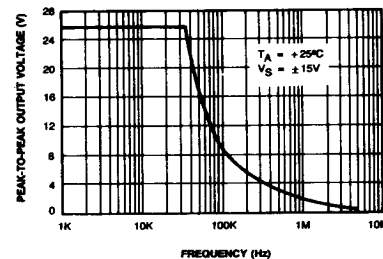
PSRR VS. FREQUENCY



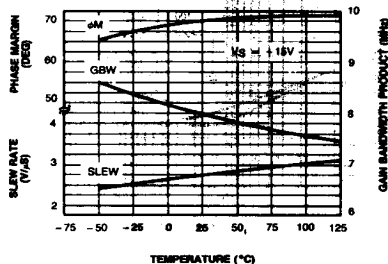
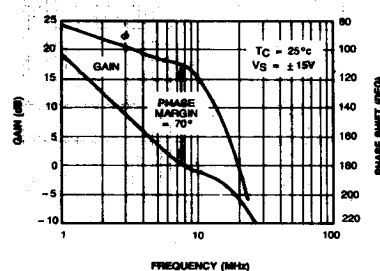
OPEN LOOP GAIN VS. FREQUENCY



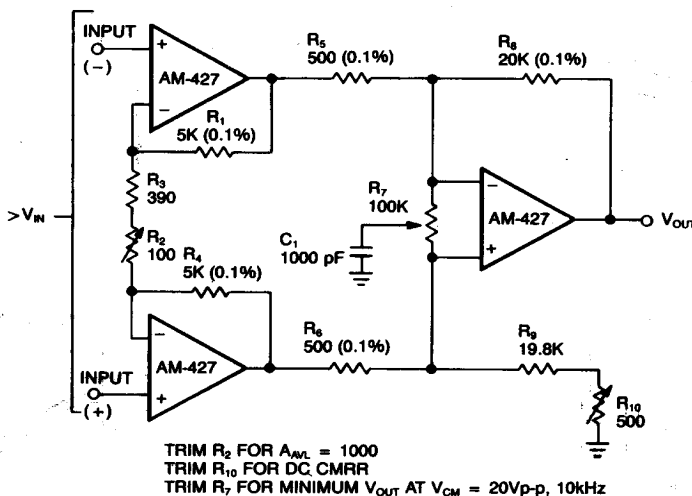
MAXIMUM UNDISTORTED OUTPUT VS. FREQUENCY



## TYPICAL PERFORMANCE AND APPLICATIONS

SLEW RATE, GAIN-BANDWIDTH  
PRODUCT, PHASE MARGIN VS.  
TEMPERATUREGAIN, PHASE SHIFT VS.  
FREQUENCY

## INSTRUMENTATION AMPLIFIER



The AM-427 is particularly useful in instrumentation applications. In a single difference amplifier configuration, the AM-427 exhibits excellent common mode rejection and spot noise voltage so low, it is dominated by the resistor Johnson noise.

The three amplifier configuration shown avoids the low input impedance characteristics of difference amplifiers. Because of the additional amplifiers used, the spectral noise voltage will increase from a typical of 3 nV/√Hz to approximately 4.9 nV/√Hz. The overall gain of the circuit is set at 1000, and with balanced source resistors, a CMRR of 100 dB is achieved.

## ORDERING INFORMATION

## MODEL NO.

AM-427-1A  
 AM-427-1B  
 AM-427-2A  
 AM-427-2B

## PACKAGE

8-Pin Ceramic DIP  
 8-Pin Ceramic DIP  
 8-Pin TO-99  
 8-Pin TO-99