## Not Recommended for New Designs

This product was manufactured for Maxim by an outside wafer foundry using a process that is no longer available. It is not recommended for new designs. The data sheet remains available for existing users.

A Maxim replacement or an industry second-source may be available. Please see the QuickView data sheet for this part or contact technical support for assistance.

For further information, contact Maxim's Applications Tech Support.

19-0127; Rev. 1; 11/98

MAXIM

# 17µA Max, Dual/Quad, Single-Supply, Precision Op Amps



## General Description

The MAX478 and MAX479 are dual and quad micropower, precision op amps available in 8-pin and 14-pin DIP and small-outline packages, respectively. Both devices feature an extremely low, 17 µA max supply current per op amp, 70µV max offset voltage, 2.2µV/°C max offset voltage drift (0.5µV/°C typ), and 250pA max input offset current.

The MAX478 and MAX479 operate from a single supply. The input voltage range includes ground, and the output swings to within a few millivolts of ground, which eliminates pull-down resistors and saves power.

Both devices are optimized for single 3V and 5V supply operation, with guaranteed specifications at each supply voltage. Specifications for ±15V operation are also provided.

## Applications

Battery- or Solar-Powered Systems:
- Portable Instrumentation
- Remote Sensor Amplifier
- Satellite Circuitry

Micropower Sample-and-Hold

Thermocouple Amplifier

Micropower Filters

Single Lithium Cell Powered Systems

## Features

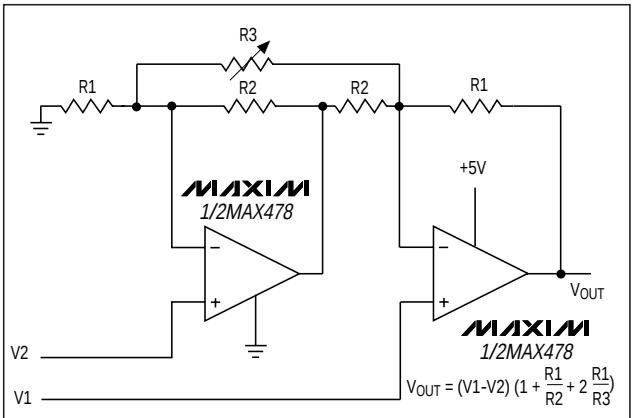
- **17µA Max Supply Current (MAX478A/MAX479A)**
- **70µV Max Offset Voltage (MAX478A)**
- **Single-Supply Operation:**
  **Input Voltage Range Includes Ground**
  **Output Swings to Ground While Sinking Current**
  **No Pull-Down Resistors Required**
- **Dual Op Amp in 8-Pin DIP/SO Package (MAX478)**
  **Quad Op Amp in 14-Pin DIP/SO Package (MAX479)**
- **250pA Max Input Offset Current (MAX478A/MAX479A)**
- **0.5µV/°C Offset-Voltage Drift**
- **Output Sources and Sinks 5mA Load Current**

## Ordering Information

| PART | TEMP. RANGE | PIN-PACKAGE |
|---|---|---|
| **MAX478**ACPA | 0°C to +70°C | 8 Plastic DIP |
| MAX478CPA | 0°C to +70°C | 8 Plastic DIP |
| MAX478CSA | 0°C to +70°C | 8 SO |
| MAX478C/D | 0°C to +70°C | Dice* |
| MAX478EPA | -40°C to +85°C | 8 Plastic DIP |
| MAX478ESA | -40°C to +85°C | 8 SO |
| **MAX479**ACPD | 0°C to +70°C | 14 Plastic DIP |
| MAX479CPD | 0°C to +70°C | 14 Plastic DIP |
| MAX479CSD | 0°C to +70°C | 14 SO |
| MAX479EPD | -40°C to +85°C | 14 Plastic DIP |
| MAX479ESD | -40°C to +85°C | 14 SO |

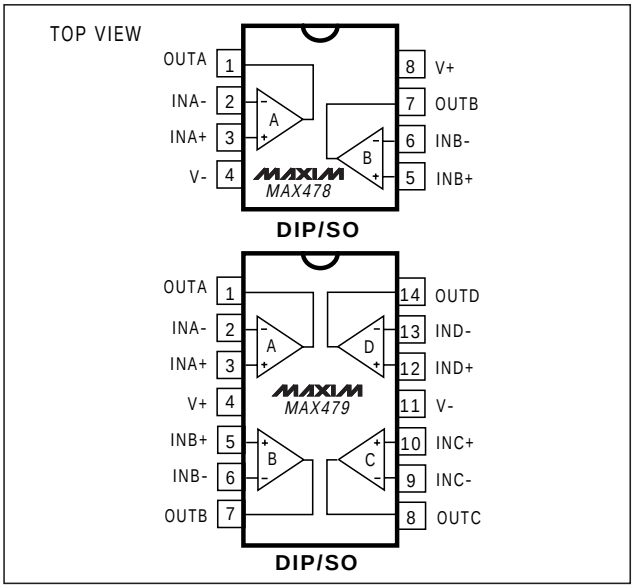
** Dice are specified at $T_A$ = +25°C, DC parameters only.*

## Typical Operating Circuit




**MICROPOWER, HIGH INPUT IMPEDANCE DIFFERENTIAL AMPLIFIER WITH VARIABLE GAIN IN 8-PIN DIP/SO**

## Pin Configurations



# 17µA Max, Dual/Quad, Single-Supply, Precision Op Amps

## ABSOLUTE MAXIMUM RATINGS

Supply Voltage ..... ±22V
Differential Input Voltage ..... ±30V
Input Voltage ..... Equal to Positive Supply Voltage
5V Below Negative Supply Voltage
Output Short-Circuit Duration ..... Continuous
Continuous Power Dissipation ($T_A$ = +70°C):
8-Pin Plastic DIP (derate 9.09mW/°C above +70°C) ..... 727mW
14-Pin Plastic DIP (derate 10.00mW/°C above +70°C) .. 800mW
14-Pin Wide SO (derate 9.52mW/°C above +70°C) ... 762mW

Operating Temperature Ranges:
MAX47_ACP_/C_ _ ..... 0°C to +70°C
MAX47_E_ _ ..... -40°C to +85°C
Storage Temperature Range ..... -65°C to +150°C
Lead Temperature (soldering, 10sec) ..... +300°C

*Stresses beyond those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress rating s only, and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specificatio ns is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.*

## ELECTRICAL CHARACTERISTICS: 5V

($V_S$ = 5V, 0V, $V_{CM}$ = 0.1V, $V_O$ = 1.4V, $T_A$ = +25°C, unless otherwise noted.)

| PARAMETER | SYMBOL | CONDITIONS | MAX478AC MAX479AC MIN | TYP | MAX | MAX478C/E MAX479C/E MIN | TYP | MAX | UNITS |
|---|---|---|---|---|---|---|---|---|---|
| Input Offset Voltage | $V_{OS}$ | MAX478ACP/CP/EP | | 30 | 70 | | 40 | 120 | µV |
| | | MAX479ACP/CP/EP | | 35 | 100 | | 40 | 150 | |
| | | MAX478CS/ES | | | | | 80 | 180 | |
| | | MAX479CS/ES | | | | | 90 | 250 | |
| Long-Term Input Offset-Voltage Stability | $\frac{\Delta V_{OS}}{\Delta Time}$ | | | 0.5 | | | 0.6 | | µV/Mo. |
| Input Offset Current | $I_{OS}$ | | | 0.05 | 0.25 | | 0.05 | 0.35 | nA |
| Input Bias Current | $I_B$ | | | 3 | 5 | | 3 | 6 | nA |
| Input Noise Voltage | $e_n$ | 0.1Hz to 10Hz (Note 1) | | 0.9 | 2.0 | | 0.9 | | $\mu V_{p-p}$ |
| Input Noise Voltage Density | | $f_O$ = 10Hz (Note 1) | | 50 | 75 | | 50 | | $nV/\sqrt{Hz}$ |
| | | $f_O$ = 1000Hz (Note 1) | | 49 | 65 | | 49 | | |
| Input Noise Current | $i_n$ | 0.1Hz to 10Hz (Note 1) | | 1.5 | 2.5 | | 1.5 | | $pA_{p-p}$ |
| Input Noise Current Density | | $f_O$ = 10Hz (Note 1) | | 0.03 | 0.07 | | 0.03 | | $pA/\sqrt{Hz}$ |
| | | $f_O$ = 1000Hz | | 0.01 | | | 0.01 | | |
| Input Resistance | $R_{IN}$ | Differential mode (Note 1) | 0.8 | 2.0 | | 0.6 | 2.0 | | GΩ |
| | | Common mode | | 12 | | | 12 | | |
| Input Voltage Range | $V_{IN\ (CM)}$ | Upper limit | 3.5 | 3.9 | | 3.5 | 3.9 | | V |
| | | Lower limit | 0 | -0.3 | | 0 | -0.3 | | |
| Common-Mode Rejection Ratio | CMRR | $V_{CM}$ = 0V to 3.5V | 93 | 103 | | 90 | 102 | | dB |
| Power-Supply Rejection Ratio | PSRR | $V_S$ = 2.2V to 12V | 94 | 104 | | 92 | 104 | | dB |
| Large-Signal Voltage Gain | $A_{VOL}$ | $V_O$ = 0.03V to 4V, no load (Note 1) | 140 | 700 | | 110 | 700 | | V/mV |
| | | $V_O$ = 0.03V to 3.5V, $R_L$ = 50kΩ | 80 | 200 | | 70 | 200 | | |

## ELECTRICAL CHARACTERISTICS: 5V (continued)

($V_S$ = 5V, 0V, $V_{CM}$ = 0.1V, $V_O$ = 1.4V, $T_A$ = +25°C, unless otherwise noted.)

| PARAMETER | SYMBOL | CONDITIONS | MAX478AC MAX479AC | | | MAX478C/E MAX479C/E | | | UNITS |
|---|---|---|---|---|---|---|---|---|---|
| | | | MIN | TYP | MAX | MIN | TYP | MAX | |
| Output Voltage Swing | $V_{OUT}$ | Output low, no load | | 6.5 | 9.0 | | 6.5 | 9.0 | mV |
| | | Output low, 2kΩ to GND | | 0.2 | 0.6 | | 0.2 | 0.6 | |
| | | Output low, $I_{SINK}$ = 100µA | | 120 | 160 | | 120 | 160 | |
| | | Output high, no load | 4.2 | 4.4 | | 4.2 | 4.4 | | V |
| | | Output high, 2kΩ to GND | 3.5 | 3.8 | | 3.5 | 3.8 | | |
| Slew Rate | SR | $A_V$ = +1, $C_L$ = 1pF (Note 1) | 0.013 | 0.025 | | 0.013 | 0.025 | | V/µs |
| Gain-Bandwidth Product | GBW | $f_O \le$ 5kHz | | 60 | | | 60 | | kHz |
| Supply Current per Amplifier | $I_S$ | | | 13 | 18 | | 14 | 21 | µA |
| | | $V_S$ = ±1.5V, $V_O$ = 0V | | 12 | 17 | | 13 | 20 | |
| Channel Separation | | $\Delta V_{IN}$ = 3V, $R_L$ = 10kΩ | | 130 | | | 130 | | dB |
| Minimum Supply Voltage | $V_S$ | (Note 2) | | 2.0 | 2.2 | | 2.0 | 2.2 | V |

## ELECTRICAL CHARACTERISTICS: 5V

($V_S$ = 5V, 0V, $V_{CM}$ = 0.1V, $V_O$ = 1.4V, $T_A$ = 0°C to +70°C, unless otherwise noted.)

| PARAMETER | SYMBOL | CONDITIONS | MAX478AC MAX479AC | | | MAX478C MAX479C | | | UNITS |
|---|---|---|---|---|---|---|---|---|---|
| | | | MIN | TYP | MAX | MIN | TYP | MAX | |
| Input Offset Voltage | $V_{OS}$ | MAX478ACP/CP | | 50 | 170 | | 65 | 250 | µV |
| | | MAX479ACP/CP | | 60 | 200 | | 70 | 290 | |
| | | MAX478CS | | | | | 120 | 300 | |
| | | MAX479CS | | | | | 130 | 400 | |
| Input Offset Voltage Drift | $\frac{\Delta V_{OS}}{\Delta T}$ | MAX47_ACP/CP (Note 1) | | 0.5 | 2.2 | | 0.6 | 3.0 | µV/°C |
| | | MAX47_CS (Note 1) | | | | | 0.8 | 4.5 | |
| Input Offset Current | $I_{OS}$ | | | 0.06 | 0.35 | | 0.06 | 0.50 | nA |
| Input Bias Current | $I_B$ | | | 3 | 6 | | 3 | 7 | nA |
| Common-Mode Rejection Ratio | CMRR | $V_{CM}$ = 0V to 3.4V | 90 | 101 | | 86 | 100 | | dB |
| Power-Supply Rejection Ratio | PSRR | $V_S$ = 2.5V to 12V | 90 | 102 | | 88 | 102 | | dB |
| Large-Signal Voltage Gain | $A_{VOL}$ | $V_O$ = 0.05V to 4V, no load (Note 1) | 105 | 500 | | 80 | 500 | | V/mV |
| | | $V_O$ = 0.05V to 3.5V, $R_L$ = 50kΩ | 55 | 160 | | 45 | 160 | | |
| Output Voltage Swing | $V_{OUT}$ | Output low, no load | | 8 | 11 | | 8 | 11 | mV |
| | | Output low, $I_{SINK}$ = 100µA | | 140 | 190 | | 140 | 190 | |
| | | Output high, no load | 4.1 | 4.3 | | 4.1 | 4.3 | | V |
| | | Output high, 2kΩ to GND | 3.3 | 3.8 | | 3.3 | 3.8 | | |
| Supply Current per Amplifier | $I_S$ | | | 14 | 21 | | 15 | 24 | µA |

## ELECTRICAL CHARACTERISTICS: 5V

($V_S$ = 5V, 0V, $V_{CM}$ = 0.1V, $V_O$ = 1.4V, $T_A$ = -40°C to +85°C, unless otherwise noted.)

| PARAMETER | SYMBOL | CONDITIONS | MAX478EP MAX479EP | | | MAX478ES MAX479ES | | | UNITS |
|---|---|---|---|---|---|---|---|---|---|
| | | | MIN | TYP | MAX | MIN | TYP | MAX | |
| Input Offset Voltage | $V_{OS}$ | MAX478 | | 80 | 315 | | 150 | 400 | µV |
| | | MAX479 | | 80 | 345 | | 160 | 530 | |
| Input Offset Voltage Drift | $\frac{\Delta V_{OS}}{\Delta T}$ | (Note 1) | | 0.6 | 3.0 | | 0.8 | 4.5 | µV/°C |
| Input Offset Current | $I_{OS}$ | | | 0.07 | 0.7 | | 0.07 | 0.7 | nA |
| Input Bias Current | $I_B$ | | | 4 | 8 | | 4 | 8 | nA |
| Common-Mode Rejection Ratio | CMRR | $V_{CM}$ = 0.05V to 3.2V | 84 | 98 | | 84 | 98 | | dB |
| Power-Supply Rejection Ratio | PSRR | $V_S$ = 3.0V to 12V | 86 | 100 | | 86 | 100 | | dB |
| Large-Signal Voltage Gain | $A_{VOL}$ | $V_O$ = 0.05V to 4V, no load (Note 1) | 55 | 350 | | 55 | 350 | | V/mV |
| | | $V_O$ = 0.05V to 3.5V, $R_L$ = 50kΩ | 35 | 130 | | 35 | 130 | | |
| Output Voltage Swing | $V_{OUT}$ | Output low, no load | | 9 | 13 | | 9 | 13 | mV |
| | | Output low, $I_{SINK}$ = 100µA | | 160 | 220 | | 160 | 220 | |
| | | Output high, no load | 3.9 | 4.2 | | 3.9 | 4.2 | | V |
| | | Output high, 2kΩ to GND | 3.0 | 3.7 | | 3.0 | 3.7 | | |
| Supply Current per Amplifier | $I_S$ | | | 15 | 27 | | 15 | 27 | µA |

## ELECTRICAL CHARACTERISTICS: 3V

($V_S$ = 3V, 0V, $V_{CM}$ = 0.1V, $V_O$ = 0.8V, $T_A$ = +25°C, unless otherwise noted.)

| PARAMETER | SYMBOL | CONDITIONS | MAX478AC MAX479AC | | | MAX478C/E MAX479C/E | | | UNITS |
|---|---|---|---|---|---|---|---|---|---|
| | | | MIN | TYP | MAX | MIN | TYP | MAX | |
| Input Offset Voltage | $V_{OS}$ | MAX478ACP/CP/EP | | 30 | 90 | | 40 | 140 | µV |
| | | MAX479ACP/CP/EP | | 35 | 120 | | 40 | 170 | |
| | | MAX478CS/ES | | | | | 80 | 200 | |
| | | MAX479CS/ES | | | | | 90 | 270 | |
| Input Offset Current | $I_{OS}$ | | | 0.05 | | | 0.05 | | nA |
| Input Bias Current | $I_B$ | | | 3 | | | 3 | | nA |
| Input Noise Voltage | $e_N$ | 0.1Hz to 10Hz | | 1.0 | | | 1.0 | | $µV_{p-p}$ |
| Input Voltage Range | $V_{IN\ (CM)}$ | Upper limit | 1.7 | 1.9 | | 1.7 | 1.9 | | V |
| | | Lower limit | 0 | -0.3 | | 0 | -0.3 | | |
| Common-Mode Rejection Ratio | CMRR | $V_{CM}$ = 0V to 1.7V | 93 | 103 | | 90 | 102 | | dB |
| Power-Supply Rejection Ratio | PSRR | $V_S$ = 2.2V to 12V | 94 | 104 | | 92 | 104 | | dB |
| Large-Signal Voltage Gain | $A_{VOL}$ | $V_O$ = 0.03V to 2V, no load (Note 1) | 100 | 600 | | 100 | 600 | | V/mV |
| | | $V_O$ = 0.03V to 1.5V, $R_L$ = 50kΩ | 30 | 180 | | 30 | 180 | | |
| Output Voltage Swing | $V_{OUT}$ | Output low, no load | | 6 | 9 | | 6 | 9 | mV |
| | | Output low, 2kΩ to GND | | 0.2 | 0.6 | | 0.2 | 0.6 | |
| | | Output high, no load | 2.2 | 2.4 | | 2.2 | 2.4 | | V |
| | | Output high, 2kΩ to GND | 1.8 | 2.0 | | 1.8 | 2.0 | | |
| Gain-Bandwidth Product | GBW | $f_O$ ≤ 5kHz | | 50 | | | 50 | | kHz |
| Supply Current per Amplifier | $I_S$ | | | 12 | 17 | | 13 | 20 | µA |
| Minimum Supply Voltage | $V_S$ | | | | 2.2 | | | 2.2 | V |
| | | With 300µV $V_{OS}$ degradation | | 1.7 | | | 1.7 | | |

## ELECTRICAL CHARACTERISTICS: ±15V

($V_S$ = ±15V, $T_A$ = +25°C, unless otherwise noted.)

| PARAMETER | SYMBOL | CONDITIONS | MAX478AC MAX479AC | | | MAX478C/E MAX479C/E | | | UNITS |
|---|---|---|---|---|---|---|---|---|---|
| | | | MIN | TYP | MAX | MIN | TYP | MAX | |
| Input Offset Voltage | $V_{OS}$ | | | 80 | 350 | | 100 | 480 | µV |
| Input Offset Current | $I_{OS}$ | | | 0.05 | 0.25 | | 0.05 | 0.35 | nA |
| Input Bias Current | $I_B$ | | | 3 | 5 | | 3 | 6 | nA |
| Input Voltage Range | $V_{IN\ (CM)}$ | Upper limit | 13.5 | 13.9 | | 13.5 | 13.9 | | V |
| | | Lower limit | -15.0 | -15.3 | | -15.0 | -15.3 | | |
| Common-Mode Rejection Ratio | CMRR | $V_{CM}$ = +13.5V, -15V | 97 | 106 | | 94 | 106 | | dB |
| Power-Supply Rejection Ratio | PSRR | $V_S$ = 5V, 0V to ±15V | 96 | 112 | | 94 | 112 | | dB |
| Large-Signal Voltage Gain | $A_{VOL}$ | $V_O$ = ±10V, $R_L$ = 50kΩ | 300 | 1200 | | 250 | 1000 | | V/mV |
| | | $V_O$ = ±10V, no load | 600 | 2500 | | 400 | 2500 | | |
| Output Voltage Swing | $V_{OUT}$ | $R_L$ = 50kΩ | ±13.0 | ±14.2 | | ±13.0 | ±14.2 | | V |
| | | $R_L$ = 2kΩ | ±11.0 | ±12.7 | | ±11.0 | ±12.7 | | |
| Slew Rate | SR | $A_V$ = +1V, $C_L$ = 15pF | 0.02 | 0.04 | | 0.02 | 0.04 | | V/µs |
| Gain-Bandwidth Product | GBW | $f_O$ ≤ 5kHz | | 85 | | | 85 | | kHz |
| Supply Current per Amplifier | $I_S$ | | | 16 | 21 | | 17 | 25 | µA |

## ELECTRICAL CHARACTERISTICS: ±15V

($V_S$ = ±15V, $T_A$ = 0°C to +70°C, unless otherwise noted.)

| PARAMETER | SYMBOL | CONDITIONS | MAX478AC MAX479AC | | | MAX478C MAX479C | | | UNITS |
|---|---|---|---|---|---|---|---|---|---|
| | | | MIN | TYP | MAX | MIN | TYP | MAX | |
| Input Offset Voltage | $V_{OS}$ | | | 100 | 480 | | 130 | 660 | µV |
| Input Offset-Voltage Drift | $\frac{\Delta V_{OS}}{\Delta T}$ | MAX47_ACP/CP (Note 1) | | 0.6 | 2.8 | | 0.7 | 4.0 | µV/°C |
| | | MAX47_CS (Note 1) | | | | | 0.9 | 5.5 | |
| Input Offset Current | $I_{OS}$ | | | 0.06 | 0.35 | | 0.06 | 0.35 | nA |
| Input Bias Current | $I_B$ | | | 3 | 6 | | 3 | 7 | nA |
| Large-Signal Voltage Gain | $A_{VOL}$ | $V_O$ = ±10V, $R_L$ = 50kΩ | 200 | 800 | | 150 | 750 | | V/mV |
| Common-Mode Rejection Ratio | CMRR | $V_{CM}$ = +13V, -15V | 94 | 104 | | 91 | 104 | | dB |
| Power-Supply Rejection Ratio | PSRR | $V_S$ = 5V, 0V to ±15V | 93 | 110 | | 91 | 110 | | dB |
| Output Voltage Swing | $V_{OUT}$ | $R_L$ = 5kΩ | ±11.0 | ±13.5 | | ±11.0 | ±13.5 | | V |
| Supply Current per Amplifier | $I_S$ | | | 17 | 24 | | 18 | 28 | µA |

## ELECTRICAL CHARACTERISTICS: ±15V

($V_S$ = ±15V, $T_A$ = -40°C to +85°C, unless otherwise noted.)

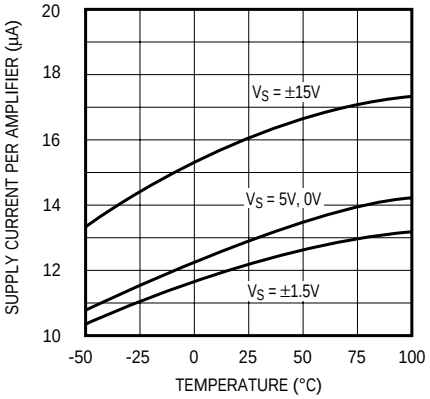
| PARAMETER | SYMBOL | CONDITIONS | MAX478EP MAX479EP | | | MAX478ES MAX479ES | | | UNITS |
|---|---|---|---|---|---|---|---|---|---|
| | | | MIN | TYP | MAX | MIN | TYP | MAX | |
| Input Offset Voltage | $V_{OS}$ | | | 130 | 740 | | 130 | 740 | µV |
| Input Offset-Voltage Drift | $\frac{\Delta V_{OS}}{\Delta T}$ | (Note 1) | | 0.7 | 4.0 | | 0.9 | 5.5 | µV/°C |
| Input Offset Current | $I_{OS}$ | | | 0.07 | 0.70 | | 0.07 | 0.70 | nA |
| Input Bias Current | $I_B$ | | | 4 | 8 | | 4 | 8 | nA |
| Large-Signal Voltage Gain | $A_{VOL}$ | $V_O$ = ±10V, $R_L$ = 50kΩ | 100 | 500 | | 100 | 500 | | V/mV |
| Common-Mode Rejection Ratio | CMRR | $V_{CM}$ = +13V, -14.9V | 88 | 103 | | 88 | 103 | | dB |
| Power-Supply Rejection Ratio | PSRR | $V_S$ = 5V, 0V to ±15V | 88 | 109 | | 88 | 109 | | dB |
| Output Voltage Swing | $V_{OUT}$ | $R_L$ = 5kΩ | ±11.0 | ±13.5 | | ±11.0 | ±13.5 | | V |
| Supply Current per Amplifier | $I_S$ | | | 19 | 30 | | 19 | 30 | µA |

**Note 1:** Guaranteed by design.

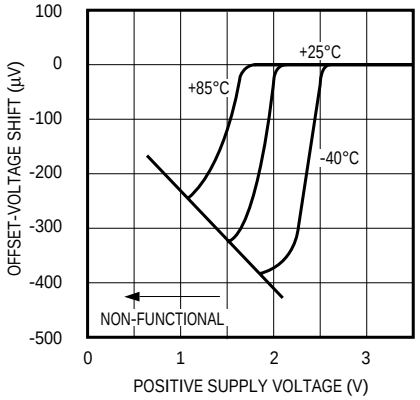
**Note 2:** Power-supply rejection ratio is measured at the minimum supply voltage. The op amps actually work at 1.7V supply, but with additional input offset-voltage skew.

## Typical Operating Characteristics

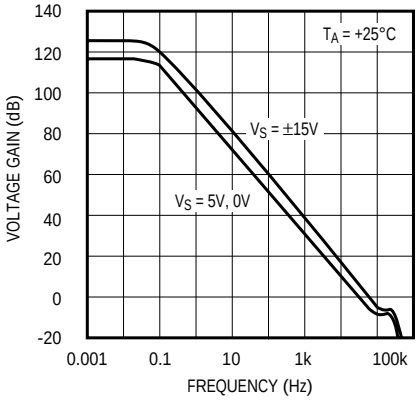
**SUPPLY CURRENT vs. TEMPERATURE**



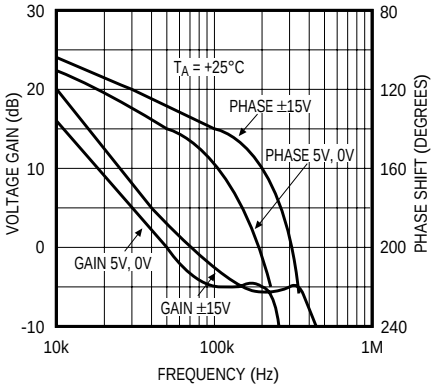

**MINIMUM SUPPLY VOLTAGE**



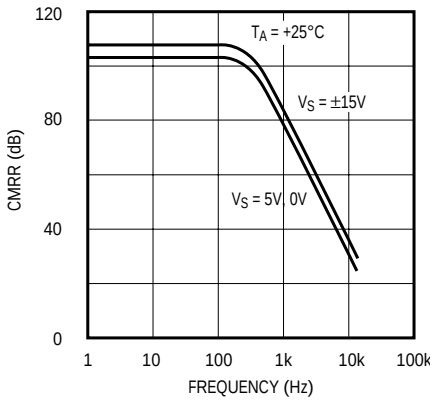

**VOLTAGE GAIN vs. FREQUENCY**



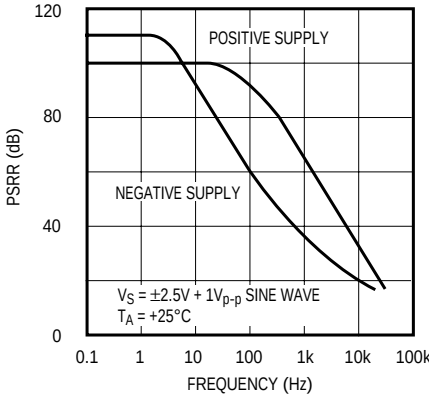

**GAIN, PHASE vs. FREQUENCY**



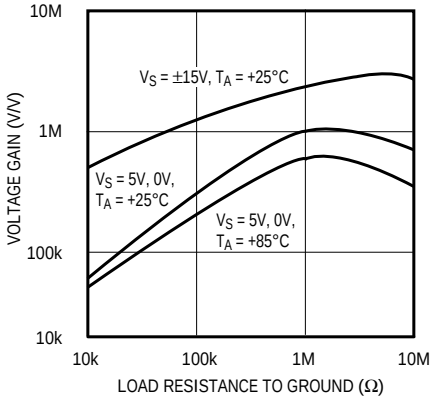

**COMMON-MODE REJECTION RATIO vs. FREQUENCY**



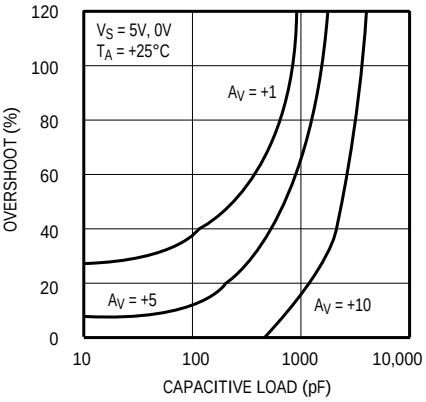

**POWER-SUPPLY REJECTION RATIO vs. FREQUENCY**



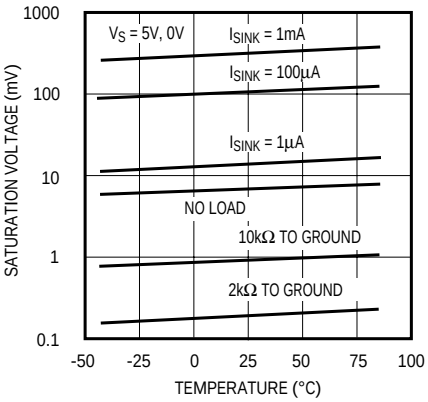

**VOLTAGE GAIN vs. LOAD RESISTANCE**




**CAPACITIVE LOAD HANDLING**



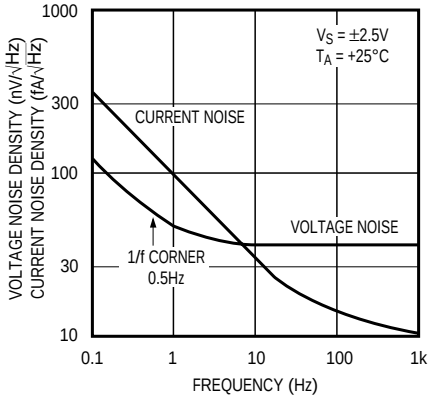

**OUTPUT SATURATION vs. TEMPERATURE**



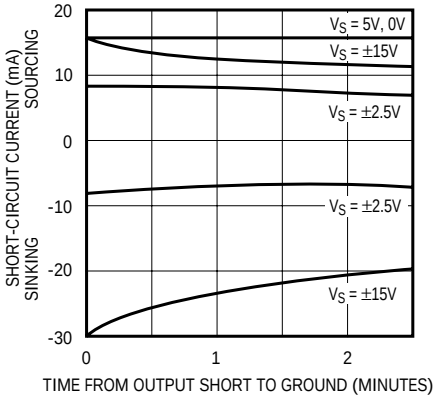
# 17µA Max, Dual/Quad, Single-Supply, Precision Op Amps

## Typical Operating Characteristics (continued)

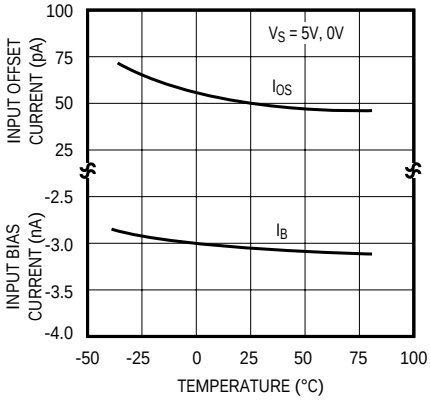
**NOISE SPECTRUM**



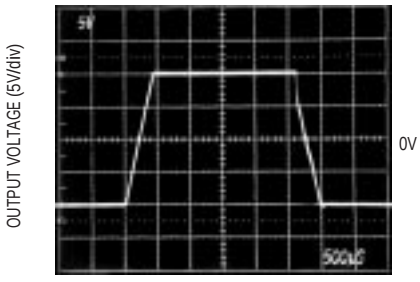

**SHORT-CIRCUIT CURRENT**



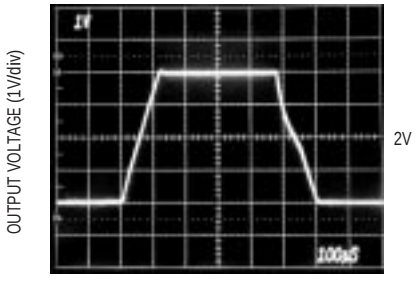

**INPUT BIAS AND OFFSET CURRENT vs. TEMPERATURE**



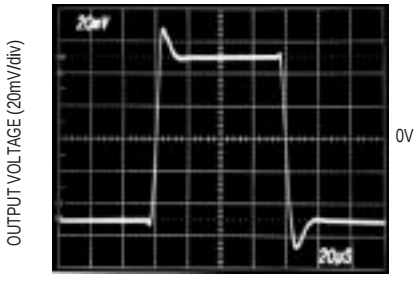

**LARGE-SIGNAL TRANSIENT RESPONSE**
**$V_S$ = ±15V**



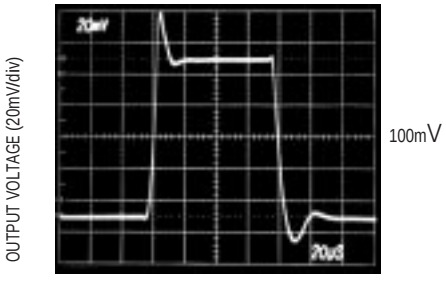

**LARGE-SIGNAL TRANSIENT RESPONSE**
**$V_S$ = 5V, 0V**



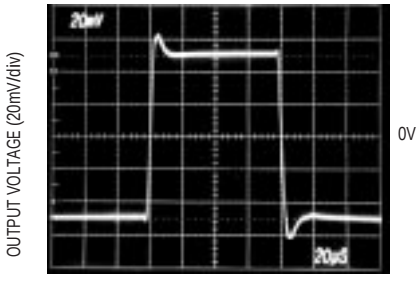

**SMALL-SIGNAL TRANSIENT RESPONSE**
**$V_S$ = ±2.5V**




**SMALL-SIGNAL TRANSIENT RESPONSE**
**$V_S$ = 5V, 0V**

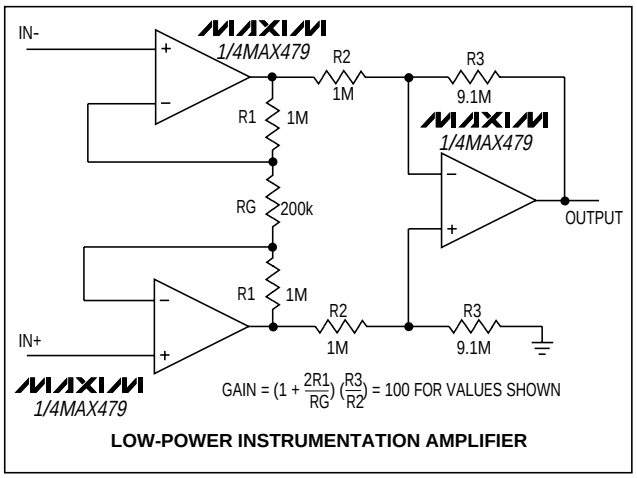



**SMALL-SIGNAL TRANSIENT RESPONSE**
**$V_S$ = ±15V**



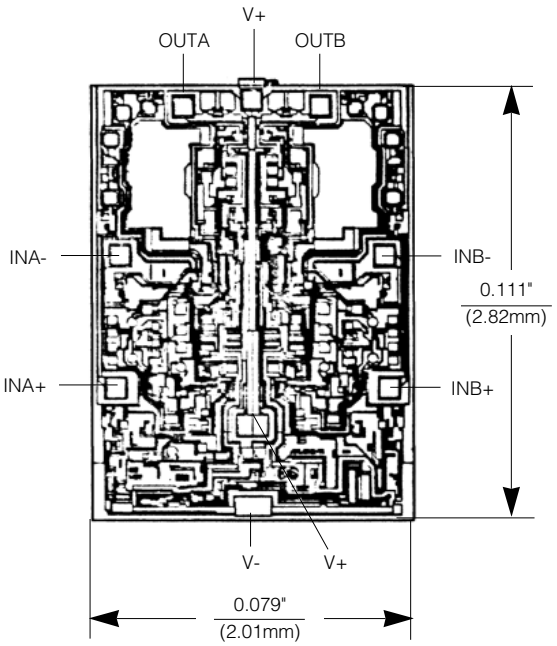
# 17µA Max, Dual/Quad, Single-Supply, Precision Op Amps

## Typical Application Circuit

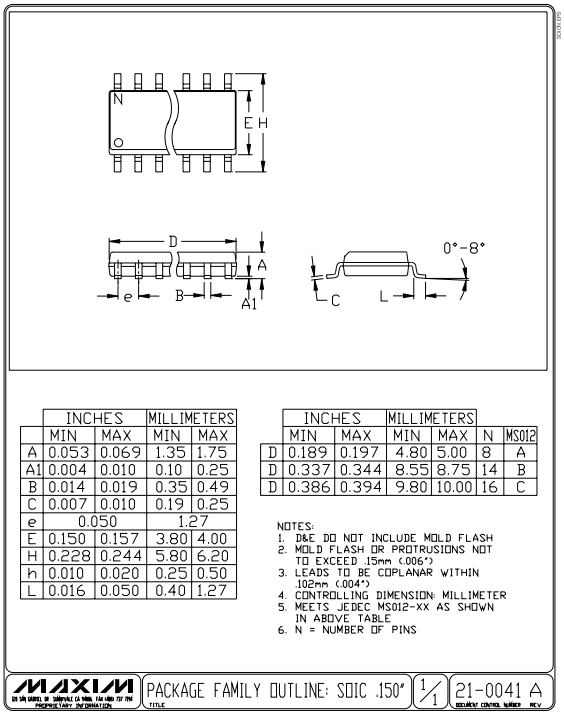



**LOW-POWER INSTRUMENTATION AMPLIFIER**

## Chip Topograqhy




## Package Information




| | INCHES | | MILLIMETERS | |
|---|---|---|---|---|
| | MIN | MAX | MIN | MAX |
| A | 0.053 | 0.069 | 1.35 | 1.75 |
| A1 | 0.004 | 0.010 | 0.10 | 0.25 |
| B | 0.014 | 0.019 | 0.35 | 0.49 |
| C | 0.007 | 0.010 | 0.19 | 0.25 |
| e | 0.050 | | 1.27 | |
| E | 0.150 | 0.157 | 3.80 | 4.00 |
| H | 0.228 | 0.244 | 5.80 | 6.20 |
| h | 0.010 | 0.020 | 0.25 | 0.50 |
| L | 0.016 | 0.050 | 0.40 | 1.27 |

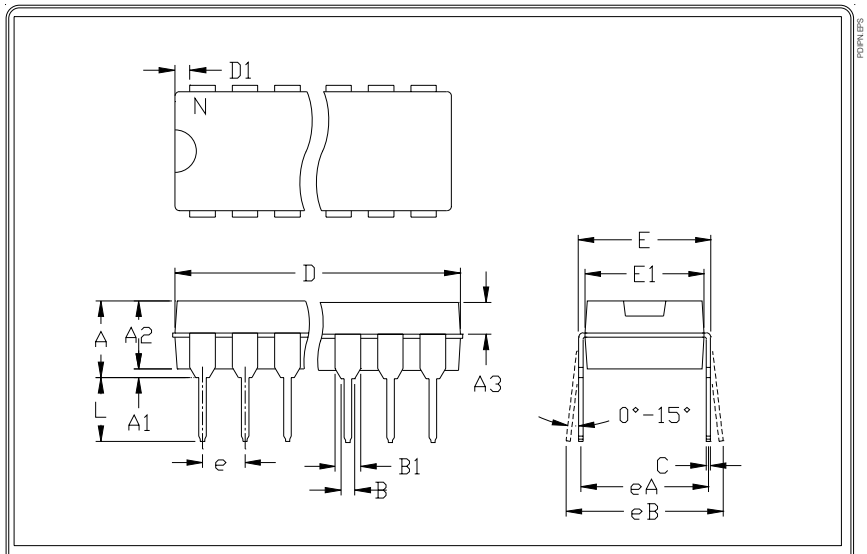
| | INCHES | | MILLIMETERS | | | |
|---|---|---|---|---|---|---|
| | MIN | MAX | MIN | MAX | N | MS012 |
| D | 0.189 | 0.197 | 4.80 | 5.00 | 8 | A |
| D | 0.337 | 0.344 | 8.55 | 8.75 | 14 | B |
| D | 0.386 | 0.394 | 9.80 | 10.00 | 16 | C |

NOTES:
1. D&E DO NOT INCLUDE MOLD FLASH
2. MOLD FLASH OR PROTRUSIONS NOT TO EXCEED .15mm (.006")
3. LEADS TO BE COPLANAR WITHIN .102mm (.004")
4. CONTROLLING DIMENSION: MILLIMETER
5. MEETS JEDEC MS012-XX AS SHOWN IN ABOVE TABLE
6. N = NUMBER OF PINS

PACKAGE FAMILY OUTLINE: SOIC .150" | 1/1 | 21-0041 A

# 17µA Max, Dual/Quad, Single-Supply, Precision Op Amps

## Package Information (continued)




| | INCHES | | MILLIMETERS | |
|---|---|---|---|---|
| | MIN | MAX | MIN | MAX |
| A | --- | 0.200 | --- | 5.08 |
| A1 | 0.015 | --- | 0.38 | --- |
| A2 | 0.125 | 0.175 | 3.18 | 4.45 |
| A3 | 0.055 | 0.080 | 1.40 | 2.03 |
| B | 0.016 | 0.022 | 0.41 | 0.56 |
| B1 | 0.045 | 0.065 | 1.14 | 1.65 |
| C | 0.008 | 0.012 | 0.20 | 0.30 |
| D1 | 0.005 | 0.080 | 0.13 | 2.03 |
| E | 0.300 | 0.325 | 7.62 | 8.26 |
| E1 | 0.240 | 0.310 | 6.10 | 7.87 |
| e | 0.100 | --- | 2.54 | --- |
| eA | 0.300 | --- | 7.62 | --- |
| eB | --- | 0.400 | --- | 10.16 |
| L | 0.115 | 0.150 | 2.92 | 3.81 |

| | INCHES | | MILLIMETERS | | | |
|---|---|---|---|---|---|---|
| | MIN | MAX | MIN | MAX | N | MS001 |
| D | 0.348 | 0.390 | 8.84 | 9.91 | 8 | AB |
| D | 0.735 | 0.765 | 18.67 | 19.43 | 14 | AC |
| D | 0.745 | 0.765 | 18.92 | 19.43 | 16 | AA |
| D | 0.885 | 0.915 | 22.48 | 23.24 | 18 | AD |
| D | 1.015 | 1.045 | 25.78 | 26.54 | 20 | AE |
| D | 1.14 | 1.265 | 28.96 | 32.13 | 24 | AF |
| D | 1.360 | 1.380 | 34.54 | 35.05 | 28 | *5 |

NOTES:
1. D&E DO NOT INCLUDE MOLD FLASH
2. MOLD FLASH OR PROTRUSIONS NOT TO EXCEED .15mm (.006")
3. CONTROLLING DIMENSION: MILLIMETER
4. MEETS JEDEC MS001-XX AS SHOWN IN ABOVE TABLE
5. SIMILIAR TO JEDEC MO-058AB
6. N = NUMBER OF PINS

MAXIM 120 SAN GABRIEL DR SUNNYVALE CA 94086 FAX (408) 737 7194 PROPRIETARY INFORMATION | TITLE: PACKAGE FAMILY OUTLINE: PDIP .300" | 1/1 | DOCUMENT CONTROL NUMBER 21-0043 A REV