

## **Not Recommended for New Designs**

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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.

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

## General Description

The MAX478 and MAX479 are dual and quad micro-power, precision op amps available in 8-pin and 14-pin DIP and small-outline packages, respectively. Both devices feature an extremely low, 17μA 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

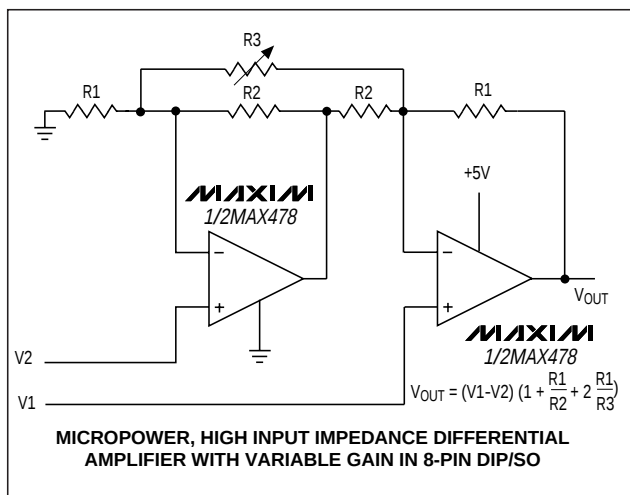
Micropower Sample-and-Hold

Thermocouple Amplifier

Micropower Filters

Single Lithium Cell Powered Systems

## Typical Operating Circuit



## Features

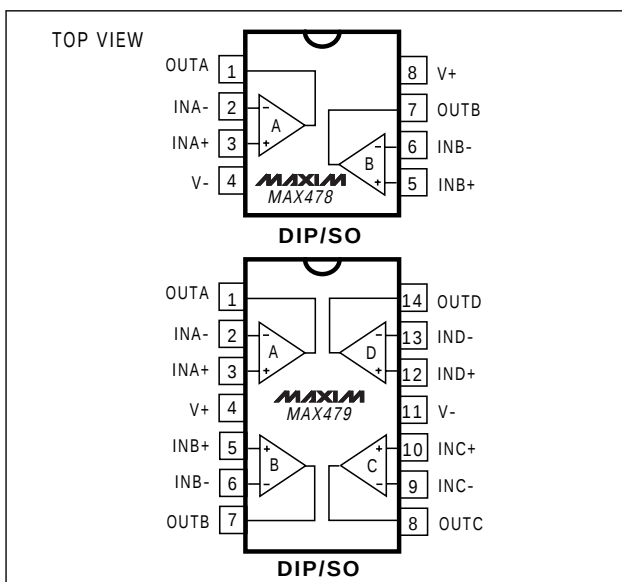
- ♦ 17μA Max Supply Current (MAX478A/MAX479A)
- ♦ 70μV Max Offset Voltage (MAX478A)
- ♦ Single-Supply Operation:  
Input Voltage Range Includes Ground  
Output Swings to Ground While Sinking Current  
No Pull-Down Resistors Required
- ♦ Dual Op Amp in 8-Pin DIP/SO Package (MAX478)  
Quad Op Amp in 14-Pin 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    |
|------------|----------------|----------------|
| MAX478ACPA | 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           |
| MAX479ACPD | 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  $T_A = +25^\circ\text{C}$ , DC parameters only.

## Pin Configurations



## 17 $\mu$ A 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<br>5V Below Negative Supply Voltage |
| Output Short-Circuit Duration .....                    | Continuous                                                           |
| Continuous Power Dissipation (T <sub>A</sub> = +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 ratings only, and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.*

## ELECTRICAL CHARACTERISTICS: 5V

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

| PARAMETER                                | SYMBOL                                     | CONDITIONS                                            | MAX478AC<br>MAX479AC |      |     | MAX478C/E<br>MAX479C/E |      |                   | UNITS |
|------------------------------------------|--------------------------------------------|-------------------------------------------------------|----------------------|------|-----|------------------------|------|-------------------|-------|
|                                          |                                            |                                                       | MIN                  | TYP  | MAX | MIN                    | TYP  | MAX               |       |
| Input Offset Voltage                     | V <sub>OS</sub>                            | 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 | $\frac{\Delta V_{OS}}{\Delta \text{Time}}$ |                                                       | 0.5                  |      |     | 0.6                    |      | μV/Mo.            |       |
| Input Offset Current                     | I <sub>OS</sub>                            |                                                       | 0.05                 | 0.25 |     | 0.05                   | 0.35 | nA                |       |
| Input Bias Current                       | I <sub>B</sub>                             |                                                       | 3                    | 5    |     | 3                      | 6    | nA                |       |
| Input Noise Voltage                      | e <sub>n</sub>                             | 0.1Hz to 10Hz (Note 1)                                | 0.9                  | 2.0  |     | 0.9                    |      | μV <sub>p-p</sub> |       |
| Input Noise Voltage Density              |                                            | f <sub>0</sub> = 10Hz (Note 1)                        | 50                   | 75   |     | 50                     |      | nV/√Hz            |       |
|                                          |                                            | f <sub>0</sub> = 1000Hz (Note 1)                      | 49                   | 65   |     | 49                     |      |                   |       |
| Input Noise Current                      | i <sub>n</sub>                             | 0.1Hz to 10Hz (Note 1)                                | 1.5                  | 2.5  |     | 1.5                    |      | pA <sub>p-p</sub> |       |
| Input Noise Current Density              |                                            | f <sub>0</sub> = 10Hz (Note 1)                        | 0.03                 | 0.07 |     | 0.03                   |      | pA/√Hz            |       |
|                                          |                                            | f <sub>0</sub> = 1000Hz                               | 0.01                 |      |     | 0.01                   |      |                   |       |
| Input Resistance                         | R <sub>IN</sub>                            | Differential mode (Note 1)                            | 0.8                  | 2.0  |     | 0.6                    | 2.0  | GΩ                |       |
|                                          |                                            | Common mode                                           |                      | 12   |     |                        | 12   |                   |       |
| Input Voltage Range                      | V <sub>IN (CM)</sub>                       | 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 <sub>CM</sub> = 0V to 3.5V                          | 93                   | 103  |     | 90                     | 102  | dB                |       |
| Power-Supply Rejection Ratio             | PSRR                                       | V <sub>S</sub> = 2.2V to 12V                          | 94                   | 104  |     | 92                     | 104  | dB                |       |
| Large-Signal Voltage Gain                | A <sub>VOL</sub>                           | V <sub>O</sub> = 0.03V to 4V, no load (Note 1)        | 140                  | 700  |     | 110                    | 700  | V/mV              |       |
|                                          |                                            | V <sub>O</sub> = 0.03V to 3.5V, R <sub>L</sub> = 50kΩ | 80                   | 200  |     | 70                     | 200  |                   |       |

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

MAX478/MAX479

## ELECTRICAL CHARACTERISTICS: 5V (continued)

(V<sub>S</sub> = 5V, 0V, V<sub>CM</sub> = 0.1V, V<sub>O</sub> = 1.4V, T<sub>A</sub> = +25°C, unless otherwise noted.)

| PARAMETER                    | SYMBOL           | CONDITIONS                                         | MAX478AC<br>MAX479AC |       |     | MAX478C/E<br>MAX479C/E |       |     | UNITS |
|------------------------------|------------------|----------------------------------------------------|----------------------|-------|-----|------------------------|-------|-----|-------|
|                              |                  |                                                    | MIN                  | TYP   | MAX | MIN                    | TYP   | MAX |       |
| Output Voltage Swing         | V <sub>OUT</sub> | 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 <sub>SINK</sub> = 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 <sub>V</sub> = +1, C <sub>L</sub> = 1pF (Note 1) | 0.013                | 0.025 |     | 0.013                  | 0.025 |     | V/μs  |
| Gain-Bandwidth Product       | GBW              | f <sub>O</sub> ≤ 5kHz                              | 60                   |       |     | 60                     |       |     | kHz   |
| Supply Current per Amplifier | I <sub>S</sub>   |                                                    | 13                   | 18    |     | 14                     | 21    |     | μA    |
|                              |                  | V <sub>S</sub> = ±1.5V, V <sub>O</sub> = 0V        | 12                   | 17    |     | 13                     | 20    |     |       |
| Channel Separation           |                  | ΔV <sub>IN</sub> = 3V, R <sub>L</sub> = 10kΩ       | 130                  |       |     | 130                    |       |     | dB    |
| Minimum Supply Voltage       | V <sub>S</sub>   | (Note 2)                                           | 2.0                  | 2.2   |     | 2.0                    | 2.2   |     | V     |

## ELECTRICAL CHARACTERISTICS: 5V

(V<sub>S</sub> = 5V, 0V, V<sub>CM</sub> = 0.1V, V<sub>O</sub> = 1.4V, T<sub>A</sub> = 0°C to +70°C, unless otherwise noted.)

| PARAMETER                    | SYMBOL                           | CONDITIONS                                            | MAX478AC<br>MAX479AC |      |     | MAX478C<br>MAX479C |      |     | UNITS |
|------------------------------|----------------------------------|-------------------------------------------------------|----------------------|------|-----|--------------------|------|-----|-------|
|                              |                                  |                                                       | MIN                  | TYP  | MAX | MIN                | TYP  | MAX |       |
| Input Offset Voltage         | V <sub>OS</sub>                  | 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 <sub>OS</sub>                  |                                                       | 0.06                 | 0.35 |     | 0.06               | 0.50 |     | nA    |
| Input Bias Current           | I <sub>B</sub>                   |                                                       | 3                    | 6    |     | 3                  | 7    |     | nA    |
| Common-Mode Rejection Ratio  | CMRR                             | V <sub>CM</sub> = 0V to 3.4V                          | 90                   | 101  |     | 86                 | 100  |     | dB    |
| Power-Supply Rejection Ratio | PSRR                             | V <sub>S</sub> = 2.5V to 12V                          | 90                   | 102  |     | 88                 | 102  |     | dB    |
| Large-Signal Voltage Gain    | A <sub>VOL</sub>                 | V <sub>O</sub> = 0.05V to 4V, no load (Note 1)        | 105                  | 500  |     | 80                 | 500  |     | V/mV  |
|                              |                                  | V <sub>O</sub> = 0.05V to 3.5V, R <sub>L</sub> = 50kΩ | 55                   | 160  |     | 45                 | 160  |     |       |
| Output Voltage Swing         | V <sub>OUT</sub>                 | Output low, no load                                   | 8                    | 11   |     | 8                  | 11   |     | mV    |
|                              |                                  | Output low, I <sub>SINK</sub> = 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 <sub>S</sub>                   |                                                       | 14                   | 21   |     | 15                 | 24   |     | μA    |

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

## ELECTRICAL CHARACTERISTICS: 5V

(V<sub>S</sub> = 5V, 0V, V<sub>CM</sub> = 0.1V, V<sub>O</sub> = 1.4V, T<sub>A</sub> = -40°C to +85°C, unless otherwise noted.)

| PARAMETER                    | SYMBOL                           | CONDITIONS                                            | MAX478EP<br>MAX479EP |     |     | MAX478ES<br>MAX479ES |     |     | UNITS |
|------------------------------|----------------------------------|-------------------------------------------------------|----------------------|-----|-----|----------------------|-----|-----|-------|
|                              |                                  |                                                       | MIN                  | TYP | MAX | MIN                  | TYP | MAX |       |
| Input Offset Voltage         | V <sub>OS</sub>                  | 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 <sub>OS</sub>                  |                                                       | 0.07                 | 0.7 |     | 0.07                 | 0.7 |     | nA    |
| Input Bias Current           | I <sub>B</sub>                   |                                                       | 4                    | 8   |     | 4                    | 8   |     | nA    |
| Common-Mode Rejection Ratio  | CMRR                             | V <sub>CM</sub> = 0.05V to 3.2V                       | 84                   | 98  |     | 84                   | 98  |     | dB    |
| Power-Supply Rejection Ratio | PSRR                             | V <sub>S</sub> = 3.0V to 12V                          | 86                   | 100 |     | 86                   | 100 |     | dB    |
| Large-Signal Voltage Gain    | A <sub>VOL</sub>                 | V <sub>O</sub> = 0.05V to 4V, no load (Note 1)        | 55                   | 350 |     | 55                   | 350 |     | V/mV  |
|                              |                                  | V <sub>O</sub> = 0.05V to 3.5V, R <sub>L</sub> = 50kΩ | 35                   | 130 |     | 35                   | 130 |     |       |
| Output Voltage Swing         | V <sub>OUT</sub>                 | Output low, no load                                   | 9                    | 13  |     | 9                    | 13  |     | mV    |
|                              |                                  | Output low, I <sub>SINK</sub> = 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 <sub>S</sub>                   |                                                       | 15                   | 27  |     | 15                   | 27  |     | μA    |

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

MAX478/MAX479

## ELECTRICAL CHARACTERISTICS: 3V

(V<sub>S</sub> = 3V, 0V, V<sub>CM</sub> = 0.1V, V<sub>O</sub> = 0.8V, T<sub>A</sub> = +25°C, unless otherwise noted.)

| PARAMETER                    | SYMBOL              | CONDITIONS                                            | MAX478AC<br>MAX479AC |      |     | MAX478C/E<br>MAX479C/E |      |     | UNITS             |
|------------------------------|---------------------|-------------------------------------------------------|----------------------|------|-----|------------------------|------|-----|-------------------|
|                              |                     |                                                       | MIN                  | TYP  | MAX | MIN                    | TYP  | MAX |                   |
| Input Offset Voltage         | V <sub>OS</sub>     | 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 <sub>OS</sub>     |                                                       | 0.05                 |      |     | 0.05                   |      |     | nA                |
| Input Bias Current           | I <sub>B</sub>      |                                                       | 3                    |      |     | 3                      |      |     | nA                |
| Input Noise Voltage          | e <sub>N</sub>      | 0.1Hz to 10Hz                                         | 1.0                  |      |     | 1.0                    |      |     | μV <sub>p-p</sub> |
| Input Voltage Range          | V <sub>IN(CM)</sub> | 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 <sub>CM</sub> = 0V to 1.7V                          | 93                   | 103  |     | 90                     | 102  |     | dB                |
| Power-Supply Rejection Ratio | PSRR                | V <sub>S</sub> = 2.2V to 12V                          | 94                   | 104  |     | 92                     | 104  |     | dB                |
| Large-Signal Voltage Gain    | A <sub>VOL</sub>    | V <sub>O</sub> = 0.03V to 2V, no load (Note 1)        | 100                  | 600  |     | 100                    | 600  |     | V/mV              |
|                              |                     | V <sub>O</sub> = 0.03V to 1.5V, R <sub>L</sub> = 50kΩ | 30                   | 180  |     | 30                     | 180  |     |                   |
| Output Voltage Swing         | V <sub>OUT</sub>    | 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 <sub>O</sub> ≤ 5kHz                                 | 50                   |      |     | 50                     |      |     | kHz               |
| Supply Current per Amplifier | I <sub>S</sub>      |                                                       | 12                   | 17   |     | 13                     | 20   |     | μA                |
| Minimum Supply Voltage       | V <sub>S</sub>      |                                                       | 2.2                  |      |     | 2.2                    |      |     | V                 |
|                              |                     | With 300μV V <sub>OS</sub> degradation                | 1.7                  |      |     | 1.7                    |      |     |                   |

# 17 $\mu$ A Max, Dual/Quad, Single-Supply, Precision Op Amps

## ELECTRICAL CHARACTERISTICS: $\pm 15$ V

( $V_S = \pm 15$ V,  $T_A = +25^\circ\text{C}$ , unless otherwise noted.)

| PARAMETER                    | SYMBOL       | CONDITIONS                                      | MAX478AC<br>MAX479AC |            |     | MAX478C/E<br>MAX479C/E |            |     | UNITS            |
|------------------------------|--------------|-------------------------------------------------|----------------------|------------|-----|------------------------|------------|-----|------------------|
|                              |              |                                                 | MIN                  | TYP        | MAX | MIN                    | TYP        | MAX |                  |
| Input Offset Voltage         | $V_{OS}$     |                                                 | 80                   | 350        |     | 100                    | 480        |     | $\mu\text{V}$    |
| 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         | $V_{CM} = +13.5\text{V}, -15\text{V}$           | 97                   | 106        |     | 94                     | 106        |     | dB               |
| Power-Supply Rejection Ratio | PSRR         | $V_S = 5\text{V}, 0\text{V to } \pm 15\text{V}$ | 96                   | 112        |     | 94                     | 112        |     | dB               |
| Large-Signal Voltage Gain    | $A_{VOL}$    | $V_O = \pm 10\text{V}, R_L = 50\text{k}\Omega$  | 300                  | 1200       |     | 250                    | 1000       |     | V/mV             |
|                              |              | $V_O = \pm 10\text{V}, \text{no load}$          | 600                  | 2500       |     | 400                    | 2500       |     |                  |
| Output Voltage Swing         | $V_{OUT}$    | $R_L = 50\text{k}\Omega$                        | $\pm 13.0$           | $\pm 14.2$ |     | $\pm 13.0$             | $\pm 14.2$ |     | V                |
|                              |              | $R_L = 2\text{k}\Omega$                         | $\pm 11.0$           | $\pm 12.7$ |     | $\pm 11.0$             | $\pm 12.7$ |     |                  |
| Slew Rate                    | SR           | $A_V = +1\text{V}, C_L = 15\text{pF}$           | 0.02                 | 0.04       |     | 0.02                   | 0.04       |     | V/ $\mu\text{s}$ |
| Gain-Bandwidth Product       | GBW          | $f_O \leq 5\text{kHz}$                          | 85                   |            |     | 85                     |            |     | kHz              |
| Supply Current per Amplifier | $I_S$        |                                                 | 16                   | 21         |     | 17                     | 25         |     | $\mu\text{A}$    |

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

## ELECTRICAL CHARACTERISTICS: ±15V

(V<sub>S</sub> = ±15V, T<sub>A</sub> = 0°C to +70°C, unless otherwise noted.)

| PARAMETER                       | SYMBOL                           | CONDITIONS                                   | MAX478AC<br>MAX479AC |       |     | MAX478C<br>MAX479C |       |     | UNITS |
|---------------------------------|----------------------------------|----------------------------------------------|----------------------|-------|-----|--------------------|-------|-----|-------|
|                                 |                                  |                                              | MIN                  | TYP   | MAX | MIN                | TYP   | MAX |       |
| Input Offset Voltage            | V <sub>OS</sub>                  |                                              | 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 <sub>OS</sub>                  |                                              | 0.06                 | 0.35  |     | 0.06               | 0.35  |     | nA    |
| Input Bias Current              | I <sub>B</sub>                   |                                              | 3                    | 6     |     | 3                  | 7     |     | nA    |
| Large-Signal<br>Voltage Gain    | A <sub>VOL</sub>                 | V <sub>O</sub> = ±10V, R <sub>L</sub> = 50kΩ | 200                  | 800   |     | 150                | 750   |     | V/mV  |
| Common-Mode<br>Rejection Ratio  | CMRR                             | V <sub>CM</sub> = +13V, -15V                 | 94                   | 104   |     | 91                 | 104   |     | dB    |
| Power-Supply<br>Rejection Ratio | PSRR                             | V <sub>S</sub> = 5V, 0V to ±15V              | 93                   | 110   |     | 91                 | 110   |     | dB    |
| Output Voltage Swing            | V <sub>OUT</sub>                 | R <sub>L</sub> = 5kΩ                         | ±11.0                | ±13.5 |     | ±11.0              | ±13.5 |     | V     |
| Supply Current per Amplifier    | I <sub>S</sub>                   |                                              | 17                   | 24    |     | 18                 | 28    |     | μA    |

MAX478/MAX479

# 17 $\mu$ A Max, Dual/Quad, Single-Supply, Precision Op Amps

## ELECTRICAL CHARACTERISTICS: $\pm 15$ V

( $V_S = \pm 15$ V,  $T_A = -40^\circ\text{C}$  to  $+85^\circ\text{C}$ , unless otherwise noted.)

| PARAMETER                    | SYMBOL                           | CONDITIONS                                          | MAX478EP<br>MAX479EP |            |      | MAX478ES<br>MAX479ES |            |      | UNITS                        |
|------------------------------|----------------------------------|-----------------------------------------------------|----------------------|------------|------|----------------------|------------|------|------------------------------|
|                              |                                  |                                                     | MIN                  | TYP        | MAX  | MIN                  | TYP        | MAX  |                              |
| Input Offset Voltage         | $V_{OS}$                         |                                                     |                      | 130        | 740  |                      | 130        | 740  | $\mu\text{V}$                |
| Input Offset-Voltage Drift   | $\frac{\Delta V_{OS}}{\Delta T}$ | (Note 1)                                            |                      | 0.7        | 4.0  |                      | 0.9        | 5.5  | $\mu\text{V}/^\circ\text{C}$ |
| 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    | $A_{VOL}$                        | $V_O = \pm 10\text{V}$ , $R_L = 50\text{k}\Omega$   | 100                  | 500        |      | 100                  | 500        |      | V/mV                         |
| Common-Mode Rejection Ratio  | CMRR                             | $V_{CM} = +13\text{V}$ , $-14.9\text{V}$            | 88                   | 103        |      | 88                   | 103        |      | dB                           |
| Power-Supply Rejection Ratio | PSRR                             | $V_S = 5\text{V}$ , $0\text{V}$ to $\pm 15\text{V}$ | 88                   | 109        |      | 88                   | 109        |      | dB                           |
| Output Voltage Swing         | $V_{OUT}$                        | $R_L = 5\text{k}\Omega$                             | $\pm 11.0$           | $\pm 13.5$ |      | $\pm 11.0$           | $\pm 13.5$ |      | V                            |
| Supply Current per Amplifier | $I_S$                            |                                                     |                      | 19         | 30   |                      | 19         | 30   | $\mu\text{A}$                |

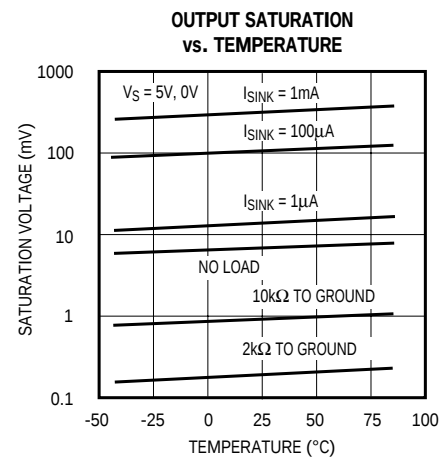
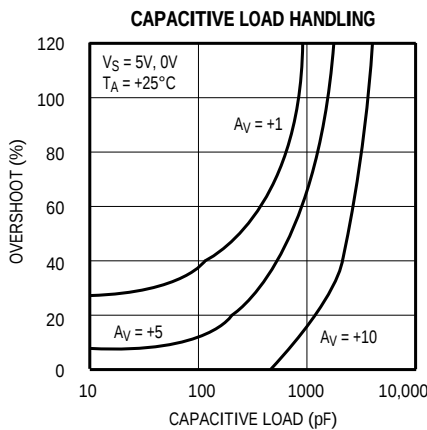
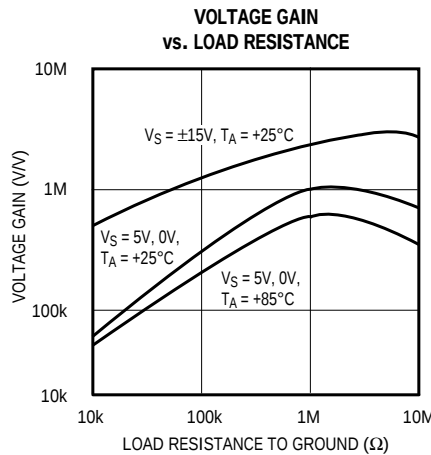
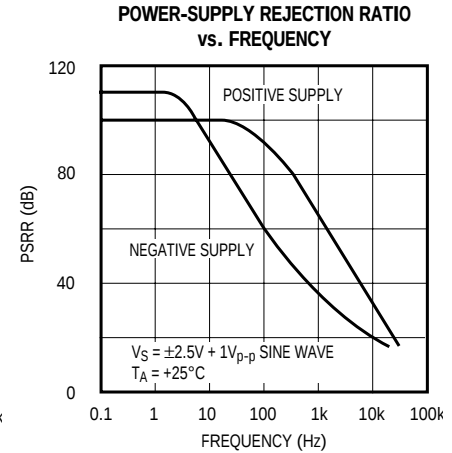
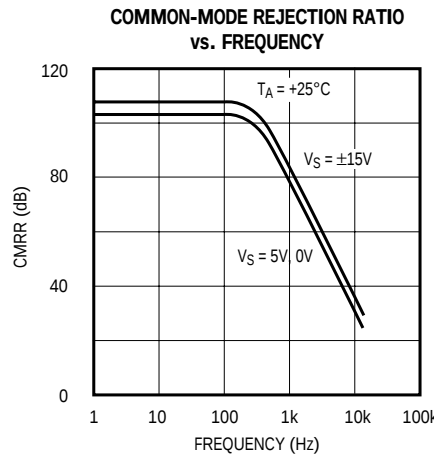
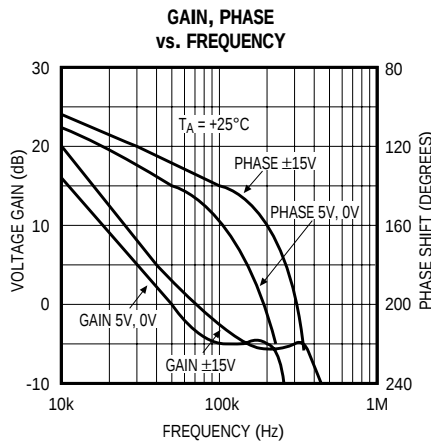
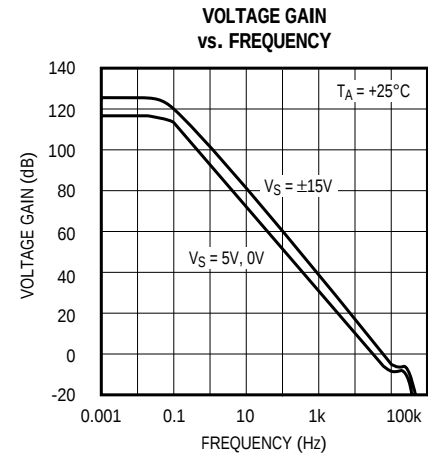
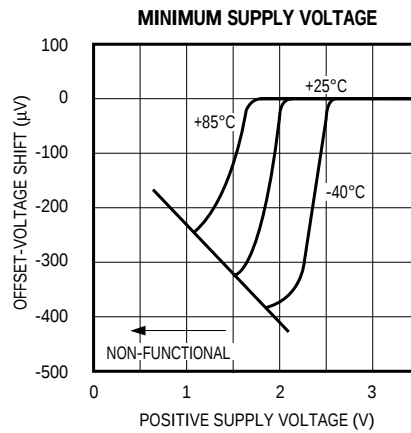
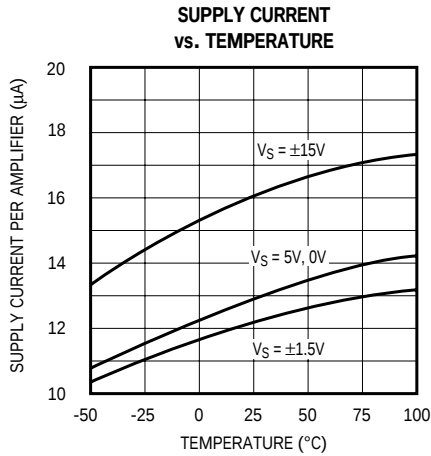
**Note 1:** Guaranteed by design.

**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.

# 17 $\mu$ A Max, Dual/Quad, Single-Supply, Precision Op Amps

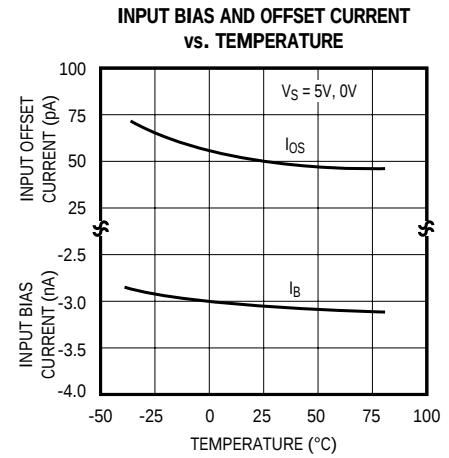
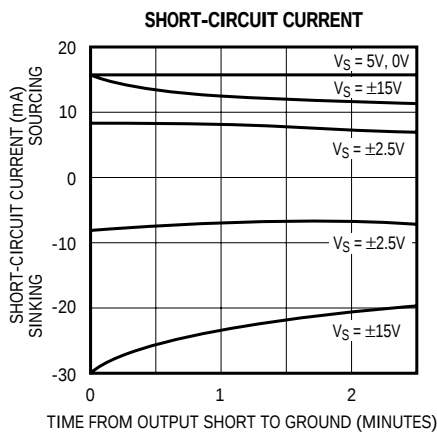
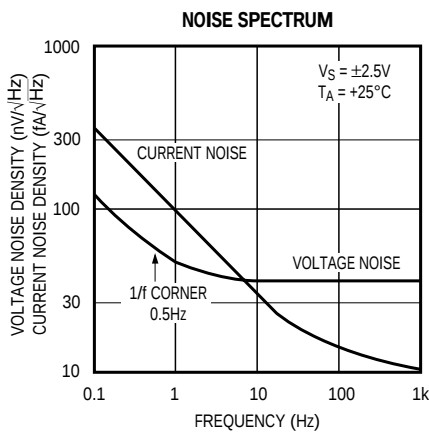
## Typical Operating Characteristics

MAX478/MAX479

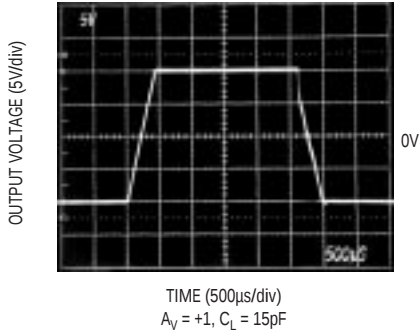


# 17 $\mu$ A Max, Dual/Quad, Single-Supply, Precision Op Amps

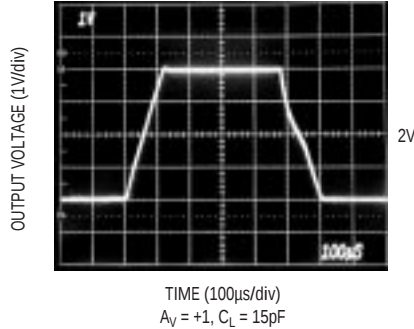
Typical Operating Characteristics (continued)



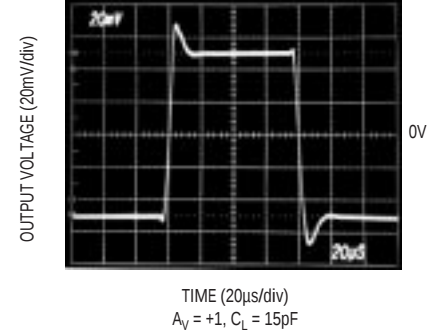
**LARGE-SIGNAL TRANSIENT RESPONSE**  
V<sub>S</sub> =  $\pm 15$ V



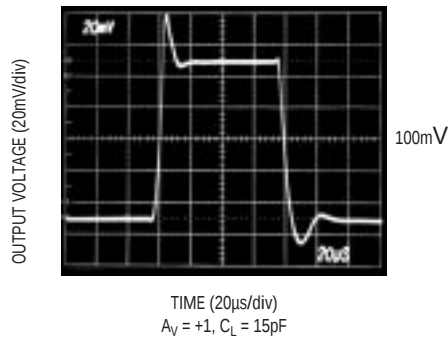
**LARGE-SIGNAL TRANSIENT RESPONSE**  
V<sub>S</sub> = 5V, 0V



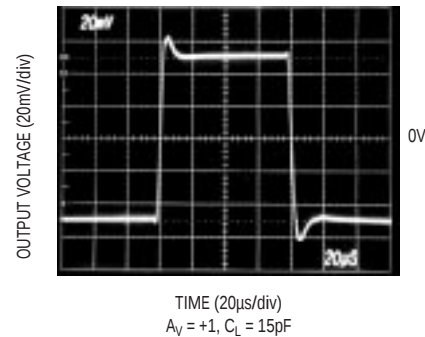
**SMALL-SIGNAL TRANSIENT RESPONSE**  
V<sub>S</sub> =  $\pm 2.5$ V



**SMALL-SIGNAL TRANSIENT RESPONSE**  
V<sub>S</sub> = 5V, 0V

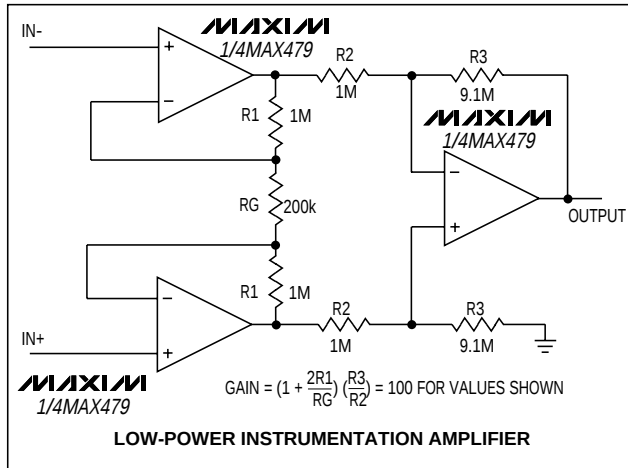


**SMALL-SIGNAL TRANSIENT RESPONSE**  
V<sub>S</sub> =  $\pm 15$ V

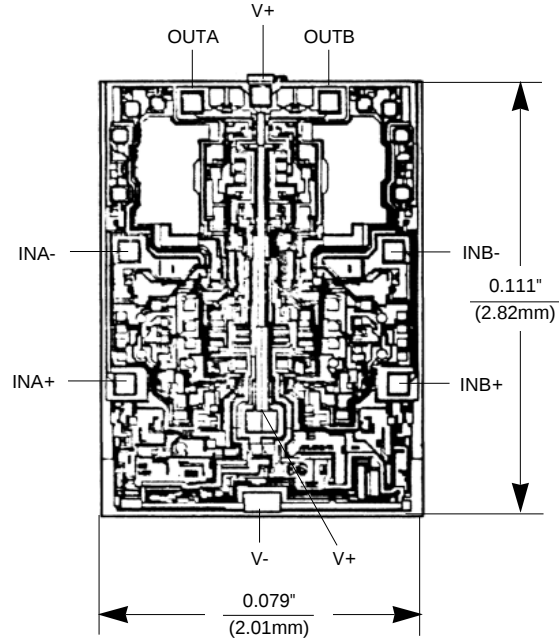


# 17μA Max, Dual/Quad, Single-Supply, Precision Op Amps

Typical Application Circuit

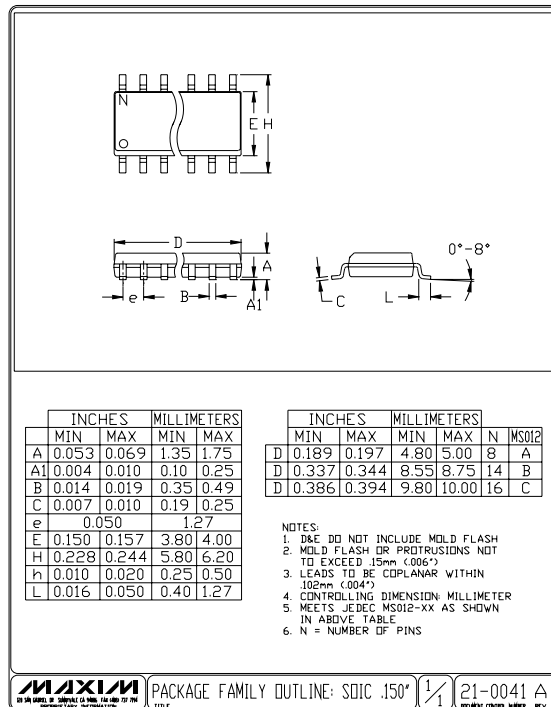


Chip Topography



MAX478/MAX479

Package Information



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

Package Information (continued)

MECHANICAL DRAWING OF THE MAX478/MAX479 PACKAGE. The drawing includes top, side, and end views. Dimensions are labeled as follows: A (total height), A1 (height to base of pins), A2 (height to top of pins), A3 (height to top of package), B (width of pin array), B1 (width of package body), C (width of package body), D (width of package body), D1 (width of package body), E (total width), E1 (width of package body), L (length of package body), e (pitch of pins), eA (width of package body), eB (width of package body), and N (number of pins). The package is shown in a .300" outline.

|    | 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   |
| D | 0.348  | 0.390 | 8.84        | 9.91  |
| D | 0.735  | 0.765 | 18.67       | 19.43 |
| D | 0.745  | 0.765 | 18.92       | 19.43 |
| D | 0.885  | 0.915 | 22.48       | 23.24 |
| D | 1.015  | 1.045 | 25.78       | 26.54 |
| D | 1.14   | 1.265 | 28.96       | 32.13 |
| D | 1.360  | 1.380 | 34.54       | 35.05 |

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. SIMILAR TO JEDEC MO-058AB
6. N = NUMBER OF PINS

MAXIM  
120 SAN GABRIEL DR. SUNNYVALE, CA 94086 FAX (408) 737-7794  
PROPRIETARY INFORMATION

PACKAGE FAMILY OUTLINE: PDIP .300"

1/1

21-0043 A  
DOCUMENT CONTROL NUMBER REV

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