

# 10MHz, 6V/ $\mu$ s, Quad Rail-to-Rail Input and Output Precision C-Load Op Amp

## DESCRIPTION

The RH1499 is a quad, rail-to-rail input and output precision C-Load™ op amp with a 10MHz gain-bandwidth product and a 6V/ $\mu$ s slew rate.

The RH1499 is designed to maximize input dynamic range by delivering precision performance over the full supply voltage. Using a patented technique, the input stages of the RH1499 are trimmed, one at the negative supply and the other at the positive supply. The resulting guaranteed common mode rejection is much better than other rail-to-rail input op amps. When used as a unity-gain buffer in front of single supply 12-bit A-to-D converters, the RH1499 is guaranteed to add less than 1LSB of error even in single 3V supply systems.

With 110dB of supply rejection, the RH1499 maintains its performance over a supply range of 2.2V to 36V. The inputs can be driven beyond the supplies without damage or phase reversal of the output. These op amps remain stable while driving capacitive loads up to 10,000pF.

The wafer lots are processed to Linear Technology's in-house Class S flow to yield circuits usable in stringent military and space applications.

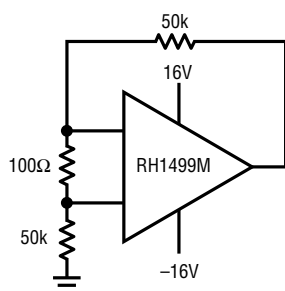
LT, LTC and LT are registered trademarks of Linear Technology Corporation.  
C-Load is a trademark of Linear Technology Corporation.

## ABSOLUTE MAXIMUM RATINGS

(Note 1)

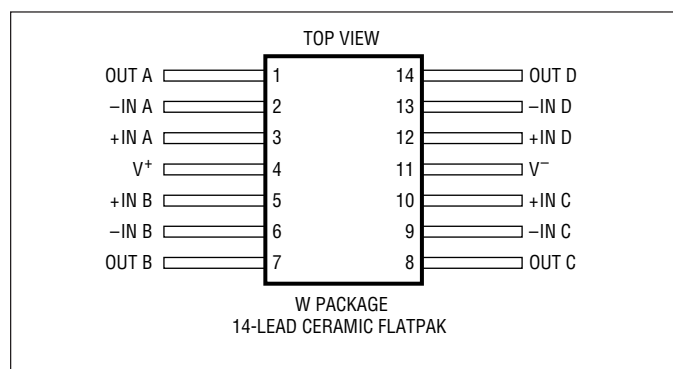
|                                               |                                            |
|-----------------------------------------------|--------------------------------------------|
| Total Supply Voltage ( $V^+$ to $V^-$ ) ..... | 36V                                        |
| Input Current .....                           | $\pm 10\text{mA}$                          |
| Output Short-Circuit Duration (Note 2) .....  | Continuous                                 |
| Operating Temperature Range .....             | $-55^\circ\text{C}$ to $125^\circ\text{C}$ |
| Specified Temperature Range .....             | $-55^\circ\text{C}$ to $125^\circ\text{C}$ |
| Junction Temperature .....                    | $150^\circ\text{C}$                        |
| Storage Temperature Range .....               | $-65^\circ\text{C}$ to $150^\circ\text{C}$ |
| Lead Temperature (Soldering, 10 sec) .....    | $300^\circ\text{C}$                        |

## BURN-IN CIRCUIT



RH1499M BI

## PACKAGE INFORMATION



**TABLE 1: ELECTRICAL CHARACTERISTICS**(Pre-Irradiation)  $V_S = \pm 15V$ ,  $V_{CM} = V_{OUT} = 0V$ , unless otherwise noted.

| SYMBOL    | PARAMETER                                                | CONDITIONS                                                                                     | NOTES | $T_A = 25^\circ C$ |                  |                  | SUB-GROUP | $-55^\circ C \leq T_A \leq 125^\circ C$ |                 |                  | SUB-GROUP | UNITS                |
|-----------|----------------------------------------------------------|------------------------------------------------------------------------------------------------|-------|--------------------|------------------|------------------|-----------|-----------------------------------------|-----------------|------------------|-----------|----------------------|
|           |                                                          |                                                                                                |       | MIN                | TYP              | MAX              |           | MIN                                     | TYP             | MAX              |           |                      |
| $V_{OS}$  | Input Offset Voltage                                     | $V_{CM} = V^+, V^-$<br>$V_{CM} = 14.5V, -14.5V$                                                |       |                    | 200              | 800              | 1         |                                         | 350             | 1100             | 2, 3      | $\mu V$<br>$\mu V$   |
|           | Input Offset Voltage Match (Channel-to-Channel) (Note 3) | $V_{CM} = V^+ \text{ to } V^-$<br>$V_{CM} = 14.5V \text{ to } -14.5V$                          | 3     |                    | 250              | 1400             |           |                                         | 450             | 1800             |           | $\mu V$<br>$\mu V$   |
| $I_B$     | Input Bias Current                                       | $V_{CM} = V^+$<br>$V_{CM} = 14.5V$<br>$V_{CM} = V^-$<br>$V_{CM} = -14.5V$                      |       | 0                  | 250              | 715              | 1         |                                         | 500             | 1200             | 2, 3      | nA<br>nA<br>nA<br>nA |
|           | Input Bias Current Match (Channel-to-Channel) (Note 3)   | $V_{CM} = V^+, V^-$<br>$V_{CM} = 14.5V, -14.5V$                                                | 3     | 0                  | 12               | 120              |           |                                         | 50              | 400              |           | nA<br>nA             |
| $I_{OS}$  | Input Offset Current                                     | $V_{CM} = V^+, V^-$<br>$V_{CM} = 14.5V, -14.5V$                                                |       |                    | 6                | 70               | 1         |                                         | 40              | 300              | 2, 3      | nA<br>nA             |
|           | Input Voltage Range                                      |                                                                                                |       | -15                |                  | 15               |           | -14.5                                   |                 | 14.5             |           | V                    |
|           | Input Noise Voltage                                      | 0.1Hz to 10Hz                                                                                  |       |                    | 400              |                  |           |                                         |                 |                  |           | nV <sub>p-p</sub>    |
| $e_n$     | Input Noise Voltage Density                              | $f = 1kHz$                                                                                     |       |                    | 12               |                  |           |                                         |                 |                  |           | nV/ $\sqrt{Hz}$      |
| $i_n$     | Input Noise Current Density                              | $f = 1kHz$                                                                                     |       |                    | 0.3              |                  |           |                                         |                 |                  |           | pA/ $\sqrt{Hz}$      |
| $A_{VOL}$ | Large-Signal Voltage Gain                                | $V_O = -14.5V \text{ to } 14.5V$ ,<br>$R_1 = 10k$<br>$V_O = -10V \text{ to } 10V$ , $R_1 = 2k$ |       | 1000               | 5200             |                  | 4         | 60                                      | 400             |                  | 5, 6      | V/mV<br>V/mV         |
| $CMRR$    | Common Mode Rejection Ratio                              | $V_{CM} = V^+ \text{ to } V^-$<br>$V_{CM} = 14.5V \text{ to } -14.5V$                          |       | 90                 | 102              |                  | 1         | 86                                      | 102             |                  | 2, 3      | dB<br>dB             |
|           | CMRR Match (Channel-to-Channel) (Note 3)                 | $V_{CM} = V^+ \text{ to } V^-$<br>$V_{CM} = 14.5V \text{ to } -14.5V$                          | 3     | 84                 | 103              |                  |           | 80                                      | 100             |                  |           | dB<br>dB             |
| $PSRR$    | Power Supply Rejection Ratio                             | $V_S = \pm 2V \text{ to } \pm 16V$                                                             |       | 90                 | 110              |                  | 1         | 88                                      | 100             |                  | 2, 3      | dB                   |
|           | PSRR Match (Channel-to-Channel) (Note 3)                 | $V_S = \pm 2V \text{ to } \pm 16V$                                                             | 3     | 83                 | 110              |                  |           | 82                                      | 100             |                  |           | dB                   |
| $V_{OL}$  | Output Voltage Swing (Low) (Note 4)                      | No Load<br>$I_{SINK} = 1mA$<br>$I_{SINK} = 10mA$<br>$I_{SINK} = 5mA$                           | 4     |                    | 18<br>50<br>230  | 30<br>100<br>500 | 4         |                                         | 25<br>70<br>180 | 75<br>150<br>500 | 5, 6      | mV<br>mV<br>mV<br>mV |
| $V_{OH}$  | Output Voltage Swing (High) (Note 4)                     | No Load<br>$I_{SINK} = 1mA$<br>$I_{SINK} = 10mA$<br>$I_{SINK} = 5mA$                           | 4     |                    | 2.5<br>75<br>420 | 10<br>150<br>800 | 4         |                                         | 5<br>100<br>300 | 25<br>250<br>800 | 5, 6      | mV<br>mV<br>mV<br>mV |
| $I_{SC}$  | Short-Circuit Current                                    |                                                                                                |       | $\pm 15$           | $\pm 30$         |                  | 1         | $\pm 7.5$                               | $\pm 12$        |                  | 2, 3      | mA                   |
| $I_S$     | Supply Current per Amp                                   |                                                                                                |       |                    | 1.8              | 2.5              | 1         |                                         | 2.2             | 3                | 2, 3      | mA                   |
| GBW       | Gain-Bandwidth Product                                   | $f = 100kHz$                                                                                   |       | 6.8                | 10.5             |                  |           | 5.8                                     | 8.5             |                  |           | MHz                  |
| SR        | Slew Rate                                                | $A_V = -1$ , $R_L = 2k$ ,<br>$V_O = \pm 10V$ , Measure at<br>$V_O = \pm 5V$                    |       | 3.5                | 6                |                  | 4         | 2.2                                     | 4               |                  | 5, 6      | V/ $\mu s$           |

**TABLE 1A: ELECTRICAL CHARACTERISTICS**(Post-Irradiation)  $V_S = \pm 15V$ ,  $V_{CM} = 0V$ ,  $T_A = 25^\circ C$ , unless otherwise noted

| SYMBOL    | PARAMETER                       | CONDITIONS                                                                   | NOTES | 10Krad(Si) |          | 20Krad(Si) |          | 50Krad(Si) |          | 100Krad(Si) |          | 200Krad(Si) |          | UNITS      |
|-----------|---------------------------------|------------------------------------------------------------------------------|-------|------------|----------|------------|----------|------------|----------|-------------|----------|-------------|----------|------------|
|           |                                 |                                                                              |       | MIN        | MAX      | MIN        | MAX      | MIN        | MAX      | MIN         | MAX      | MIN         | MAX      |            |
| $V_{OS}$  | Input Offset Voltage            | $V_{CM} = V^+, V^-$                                                          |       |            | 950      |            | 950      |            | 950      |             | 950      |             | 950      | $\mu V$    |
| $I_B$     | Input Bias Current              | $V_{CM} = V^+, V^-$                                                          |       |            | 765      |            | 815      |            | 865      |             | 915      |             | 965      | nA         |
| $I_{OS}$  | Input Offset Current            | $V_{CM} = V^+, V^-$                                                          |       |            | 100      |            | 100      |            | 100      |             | 100      |             | 100      | nA         |
|           | Input Voltage Range             |                                                                              |       | $V^-$      | $V^+$    | $V^-$      | $V^+$    | $V^-$      | $V^+$    | $V^-$       | $V^+$    | $V^-$       | $V^+$    | V          |
| $A_{VOL}$ | Large-Signal Voltage Gain       | $V_O = -14.5V$ to $14.5V$ ,<br>$R_1 = 10k$                                   |       |            | 500      |            | 500      |            | 500      |             | 500      |             | 500      | V/mV       |
|           |                                 | $V_O = -10V$ to $10V$ ,<br>$R_1 = 2k$                                        |       |            | 250      |            | 250      |            | 250      |             | 250      |             | 250      | V/mV       |
| CMRR      | Common Mode Rejection Ratio     | $V_{CM} = V^+$ to $V^-$                                                      |       |            | 86       |            | 86       |            | 86       |             | 86       |             | 86       | dB         |
|           | CMRR Match (Channel-to-Channel) | $V_{CM} = V^+$ to $V^-$                                                      | 3     |            | 83       |            | 83       |            | 83       |             | 83       |             | 83       | dB         |
| PSRR      | Power Supply Rejection Ratio    | $V_S = \pm 2V$ to $\pm 16V$                                                  |       |            | 90       |            | 90       |            | 90       |             | 90       |             | 90       | dB         |
|           | PSRR Match (Channel-to-Channel) | $V_S = \pm 2V$ to $\pm 16V$                                                  | 3     |            | 83       |            | 83       |            | 83       |             | 83       |             | 83       | dB         |
| $V_{OUT}$ | Output Voltage Swing Low        | No Load                                                                      | 4     |            | 60       |            | 60       |            | 60       |             | 60       |             | 60       | mV         |
|           |                                 | $I_{SINK} = 1mA$                                                             |       |            | 100      |            | 100      |            | 100      |             | 100      |             | 100      | mV         |
|           |                                 | $I_{SINK} = 10mA$                                                            |       |            | 500      |            | 500      |            | 500      |             | 500      |             | 500      | mV         |
|           | Output Voltage Swing High       | No Load                                                                      | 4     |            | 20       |            | 20       |            | 20       |             | 20       |             | 20       | mV         |
|           |                                 | $I_{SINK} = 1mA$                                                             |       |            | 150      |            | 150      |            | 150      |             | 150      |             | 150      | mV         |
|           |                                 | $I_{SINK} = 10mA$                                                            |       |            | 800      |            | 800      |            | 800      |             | 800      |             | 800      | mV         |
| $I_{SC}$  | Short-Circuit Current           |                                                                              |       |            | $\pm 10$ |            | $\pm 10$ |            | $\pm 10$ |             | $\pm 10$ |             | $\pm 10$ | mA         |
| $I_S$     | Supply Current                  |                                                                              |       |            | 2.5      |            | 2.5      |            | 2.5      |             | 2.5      |             | 2.5      | mA         |
| GBW       | Gain-Bandwidth Product          | $f = 100kHz$                                                                 |       |            | 4.5      |            | 4.5      |            | 4.5      |             | 4.5      |             | 4.5      | MHz        |
| SR        | Slew Rate                       | $A_V = -1$ , $R_L = 10k$ ,<br>$V_O = \pm 10V$ , Measure<br>at $V_O = \pm 5V$ |       |            | 3        |            | 3        |            | 3        |             | 3        |             | 3        | V/ $\mu s$ |

**TABLE 2: ELECTRICAL CHARACTERISTICS**(Pre-Irradiation)  $V_S = 3V, 5V$ ;  $V_{CM} = V_{OUT} = \text{half supply}$ , unless otherwise noted.

| SYMBOL    | PARAMETER                                                | CONDITIONS                                                                                                                                                                       | NOTES | $T_A = 25^\circ\text{C}$ |                  |          | SUB-GROUP | $-55^\circ\text{C} \leq T_A \leq 125^\circ\text{C}$ |                       |              | SUB-GROUP | UNITS                          |
|-----------|----------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|--------------------------|------------------|----------|-----------|-----------------------------------------------------|-----------------------|--------------|-----------|--------------------------------|
|           |                                                          |                                                                                                                                                                                  |       | MIN                      | TYP              | MAX      |           | MIN                                                 | TYP                   | MAX          |           |                                |
| $V_{OS}$  | Input Offset Voltage                                     | $V_{CM} = V^+, V^-$<br>$V_{CM} = V^+ - 0.5V, V^- + 0.5V$                                                                                                                         |       | 150                      | 800              |          | 1         | 300                                                 | 1100                  |              | 2, 3      | $\mu\text{V}$<br>$\mu\text{V}$ |
|           | Input Offset Voltage Match (Channel-to-Channel) (Note 3) | $V_{CM} = V^+ \text{ to } V^-$<br>$V_{CM} = V^+ - 0.5V, V^- + 0.5V$                                                                                                              | 3     | 200                      | 1400             |          |           | 350                                                 | 1800                  |              |           | $\mu\text{V}$<br>$\mu\text{V}$ |
| $I_B$     | Input Bias Current                                       | $V_{CM} = V^+$<br>$V_{CM} = V^+ - 0.5V$<br>$V_{CM} = V^-$<br>$V_{CM} = V^- + 0.5V$                                                                                               |       | 0<br>-650                | 250<br>-250      | 650<br>0 | 1         | 0<br>-1100                                          | 450<br>-450           | 1100<br>0    | 2, 3      | nA<br>nA<br>nA<br>nA           |
|           | Input Bias Current Match (Channel-to-Channel) (Note 3)   | $V_{CM} = V^+, V^-$<br>$V_{CM} = V^+ - 0.5V, V^- + 0.5V$                                                                                                                         | 3     | 0                        | 10               | 100      |           | 0                                                   | 30                    | 400          |           | nA<br>nA                       |
| $I_{OS}$  | Input Offset Current                                     | $V_{CM} = V^+, V^-$<br>$V_{CM} = V^+ - 0.5V, V^- + 0.5V$                                                                                                                         |       | 5                        | 65               |          | 1         | 15                                                  | 300                   |              | 2, 3      | nA<br>nA                       |
|           | Input Voltage Range                                      |                                                                                                                                                                                  |       | $V^-$                    |                  | $V^+$    |           | $V^- + 0.5V$                                        |                       | $V^+ - 0.5V$ |           | V                              |
|           | Input Noise Voltage                                      | 0.1Hz to 10Hz                                                                                                                                                                    |       | 400                      |                  |          |           |                                                     |                       |              |           | nV <sub>p-p</sub>              |
| $e_n$     | Input Noise Voltage Density                              | $f = 1\text{kHz}$                                                                                                                                                                |       | 12                       |                  |          |           |                                                     |                       |              |           | nV/ $\sqrt{\text{Hz}}$         |
| $i_n$     | Input Noise Current Density                              | $f = 1\text{kHz}$                                                                                                                                                                |       | 0.3                      |                  |          |           |                                                     |                       |              |           | pA/ $\sqrt{\text{Hz}}$         |
| $C_{IN}$  | Input Capacitance                                        |                                                                                                                                                                                  |       | 5                        |                  |          |           |                                                     |                       |              |           | pF                             |
| $A_{VOL}$ | Large-Signal Voltage Gain                                | $V_S = 5V, V_O = 75\text{mV to } 4.8V,$<br>$R_L = 10k$<br>$V_S = 3V, V_O = 75\text{mV to } 2.8V,$<br>$R_L = 10k$                                                                 |       | 600<br>500               | 3800<br>2000     |          | 4         | 60<br>25                                            | 210<br>210            |              | 5, 6      | V/mV<br>V/mV                   |
| $CMRR$    | Common Mode Rejection Ratio                              | $V_S = 5V, V_{CM} = V^+ \text{ to } V^-$<br>$V_S = 3V, V_{CM} = V^+ \text{ to } V^-$<br>$V_S = 5V, V_{CM} = 0.5V \text{ to } 4.5V$<br>$V_S = 3V, V_{CM} = 0.5V \text{ to } 2.5V$ |       | 76<br>72                 | 90<br>86         |          | 1         | 68<br>65                                            | 85<br>85              |              | 2, 3      | dB<br>dB<br>dB<br>dB           |
|           | CMRR Match (Channel-to-Channel) (Note 3)                 | $V_S = 5V, V_{CM} = V^+ \text{ to } V^-$<br>$V_S = 3V, V_{CM} = V^+ \text{ to } V^-$<br>$V_S = 5V, V_{CM} = 0.5V \text{ to } 4.5V$<br>$V_S = 3V, V_{CM} = 0.5V \text{ to } 2.5V$ | 3     | 75<br>70                 | 91<br>86         |          | 1         | 66<br>62                                            | 82                    |              | 2, 3      | dB<br>dB<br>dB<br>dB           |
| $PSRR$    | Power Supply Rejection Ratio                             | $V_S = 2.2V \text{ to } 12V,$<br>$V_{CM} = V_O = 0.5V$                                                                                                                           |       | 88                       | 105              |          | 1         | 86                                                  | 104                   |              | 2, 3      | dB                             |
|           | PSRR Match (Channel-to-Channel) (Note 3)                 | $V_S = 2.2V \text{ to } 12V,$<br>$V_{CM} = V_O = 0.5V$                                                                                                                           | 3     | 82                       | 120              |          |           | 80                                                  | 118                   |              |           | dB                             |
| $V_{OL}$  | Output Voltage Swing (Low) (Note 4)                      | No Load<br>$I_{SINK} = 1\text{mA}$<br>$I_{SINK} = 2.5\text{mA}$                                                                                                                  | 4     | 14<br>50<br>90           | 30<br>100<br>200 |          | 4         | 25<br>65<br>110                                     | 75<br>150<br>220      |              | 5, 6      | mV<br>mV<br>mV                 |
| $V_{OH}$  | Output Voltage Swing (High) (Note 4)                     | No Load<br>$I_{SINK} = 1\text{mA}$<br>$I_{SINK} = 2.5\text{mA}$                                                                                                                  | 4     | 2.5<br>70<br>140         | 10<br>150<br>250 |          | 4         | 5<br>100<br>180                                     | 25<br>250<br>300      |              | 5, 6      | mV<br>mV<br>mV                 |
| $I_{SC}$  | Short-Circuit Current                                    | $V_S = 5V$<br>$V_S = 3V$                                                                                                                                                         |       | $\pm 12.5$<br>$\pm 12.0$ | 24<br>19         |          | 1         | $\pm 5$<br>$\pm 5$                                  | $\pm 10$<br>$\pm 9.5$ |              | 2, 3      | mA<br>mA                       |
| $I_S$     | Supply Current per Amp                                   |                                                                                                                                                                                  |       | 1.7                      | 2.2              |          | 1         | 2                                                   | 2.7                   |              | 2, 3      | mA                             |

**TABLE 2: ELECTRICAL CHARACTERISTICS**(Pre-Irradiation)  $V_S = 3V, 5V$ ;  $V_{CM} = V_{OUT} = \text{half supply}$ , unless otherwise noted.

| SYMBOL | PARAMETER              | CONDITIONS                                                                        | NOTES | $T_A = 25^\circ\text{C}$ |      |     | SUB-GROUP | $-55^\circ\text{C} \leq T_A \leq 125^\circ\text{C}$ |     |     | SUB-GROUP | UNITS            |
|--------|------------------------|-----------------------------------------------------------------------------------|-------|--------------------------|------|-----|-----------|-----------------------------------------------------|-----|-----|-----------|------------------|
|        |                        |                                                                                   |       | MIN                      | TYP  | MAX |           | MIN                                                 | TYP | MAX |           |                  |
| GBW    | Gain-Bandwidth Product | $V_S = 5V, f = 100\text{kHz}$                                                     |       | 6.8                      | 10.5 |     |           | 5.8                                                 | 8.5 |     |           | MHz              |
| SR     | Slew Rate              | $V_S = \pm 2.5V, A_V = -1, R_L = 2k, V_O = \pm 2V$ ,<br>Measure at $V_O = \pm 1V$ |       | 2.6                      | 4.5  |     | 4         | 2                                                   | 3.6 |     | 5, 6      | V/ $\mu\text{s}$ |

**TABLE 2A: ELECTRICAL CHARACTERISTICS**(Post-Irradiation)  $V_S = 5V, 3V$ ;  $V_{CM} = \text{half supply}$ ,  $T_A = 25^\circ\text{C}$ , unless otherwise noted

| SYMBOL    | PARAMETER                       | CONDITIONS                                                                         | NOTES | 10Krad(Si) |       | 20Krad(Si) |       | 50Krad(Si) |       | 100Krad(Si) |       | 200Krad(Si) |       | UNITS            |
|-----------|---------------------------------|------------------------------------------------------------------------------------|-------|------------|-------|------------|-------|------------|-------|-------------|-------|-------------|-------|------------------|
|           |                                 |                                                                                    |       | MIN        | MAX   | MIN        | MAX   | MIN        | MAX   | MIN         | MAX   | MIN         | MAX   |                  |
| $V_{OS}$  | Input Offset Voltage            | $V_{CM} = V^+, V^-$                                                                |       | 950        |       | 950        |       | 950        |       | 950         |       | 950         |       | $\mu\text{V}$    |
| $I_B$     | Input Bias Current              | $V_{CM} = V^+, V^-$                                                                |       | 700        |       | 750        |       | 809        |       | 850         |       | 900         |       | nA               |
| $I_{OS}$  | Input Offset Current            | $V_{CM} = V^+, V^-$                                                                |       | 65         |       | 65         |       | 65         |       | 65          |       | 65          |       | nA               |
|           | Input Voltage Range             |                                                                                    |       | $V^-$      | $V^+$ | $V^-$      | $V^+$ | $V^-$      | $V^+$ | $V^-$       | $V^+$ | $V^-$       | $V^+$ | V                |
| $A_{VOL}$ | Large-Signal Voltage Gain       | $V_O = 75\text{mV}$ to $V^+ - 0.2V$<br>$R_1 = 10k$                                 |       | 300        |       | 300        |       | 300        |       | 300         |       | 300         |       | V/mV             |
| CMRR      | Common Mode Rejection Ratio     | $V_{CM} = V^+$ to $V^-$                                                            |       | 70         |       | 70         |       | 70         |       | 70          |       | 70          |       | dB               |
|           | CMRR Match (Channel-to-Channel) | $V_{CM} = V^+$ to $V^-$                                                            | 3     | 70         |       | 70         |       | 70         |       | 70          |       | 70          |       | dB               |
| PSRR      | Power Supply Rejection Ratio    | $V_S = 2.2V$ to $12V$ ,<br>$V_{CM} = V_O = 0.5V$                                   |       | 88         |       | 88         |       | 88         |       | 88          |       | 88          |       | dB               |
|           | PSRR Match (Channel-to-Channel) | $V_S = 2.2V$ to $12V$ ,<br>$V_{CM} = V_O = 0.5V$                                   | 3     | 82         |       | 82         |       | 82         |       | 82          |       | 82          |       | dB               |
| $V_{OUT}$ | Output Voltage Swing Low        | No Load                                                                            | 4     | 60         |       | 60         |       | 60         |       | 60          |       | 60          |       | mV               |
|           |                                 | $I_{SINK} = 1\text{mA}$                                                            |       | 100        |       | 100        |       | 100        |       | 100         |       | 100         |       | mV               |
|           |                                 | $I_{SINK} = 2.5\text{mA}$                                                          |       | 200        |       | 200        |       | 200        |       | 200         |       | 200         |       | mV               |
|           | Output Voltage Swing High       | No Load                                                                            | 4     | 20         |       | 20         |       | 20         |       | 20          |       | 20          |       | mV               |
|           |                                 | $I_{SINK} = 1\text{mA}$                                                            |       | 150        |       | 150        |       | 150        |       | 150         |       | 150         |       | mV               |
|           |                                 | $I_{SINK} = 2.5\text{mA}$                                                          |       | 250        |       | 250        |       | 250        |       | 250         |       | 250         |       | mV               |
| $I_{SC}$  | Short-Circuit Current           |                                                                                    |       | $\pm 8$    |       | $\pm 8$    |       | $\pm 8$    |       | $\pm 8$     |       | $\pm 8$     |       | mA               |
| $I_S$     | Supply Current                  |                                                                                    |       | 2.2        |       | 2.2        |       | 2.2        |       | 2.2         |       | 2.2         |       | mA               |
| SR        | Slew Rate                       | $V_S = \pm 2.5V, A_V = -1, R_L = 10k, V_O = \pm 2V$ ,<br>Measure at $V_O = \pm 1V$ |       | 2          |       | 2          |       | 2          |       | 2           |       | 2           |       | V/ $\mu\text{s}$ |

**Note 1:** Absolute Maximum Ratings are those values beyond which the life of a device may be impaired.**Note 2:** A heat sink may be required to keep the junction temperature below this absolute maximum rating when the output is shorted indefinitely.**Note 3:** Matching parameters are the difference between amplifiers A and D and between B and C.**Note 4:** Output voltage swings are measured between the output and power supply rails.

TABLE 2: ELECTRICAL TEST REQUIREMENTS

| MIL-STD-883 TEST REQUIREMENTS                                                   | SUBGROUP     |
|---------------------------------------------------------------------------------|--------------|
| Final Electrical Test Requirements (Method 5004)                                | 1*,2,3,4,5,6 |
| Group A Test Requirements (Method 5005)                                         | 1,2,3,4,5,6  |
| Group B and D for Class S, and<br>End Point Electrical Parameters (Method 5005) | 1,2,3        |

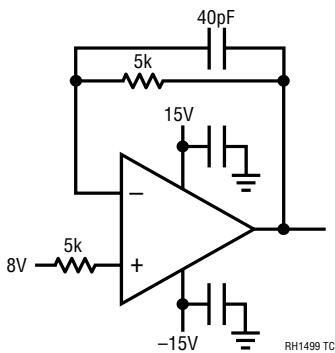
\* PDA applies to subgroup 1. See PDA Test Notes.

PDA Test Notes

The PDA is specified as 5% based on failures from group A, subgroup 1, tests after cooldown as the final electrical test in accordance with method 5004 of MIL-STD-883. The verified failures of group A, subgroup 1, after burn-in divided by the total number of devices submitted for burn-in in that lot shall be used to determine the percent for the lot.

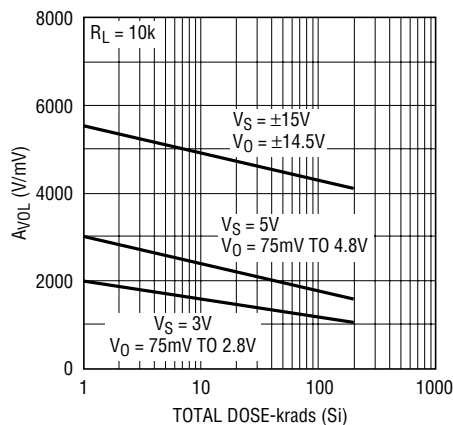
Linear Technology Corporation reserves the right to test to tighter limits than those given.

TOTAL DOSE BIAS CIRCUIT



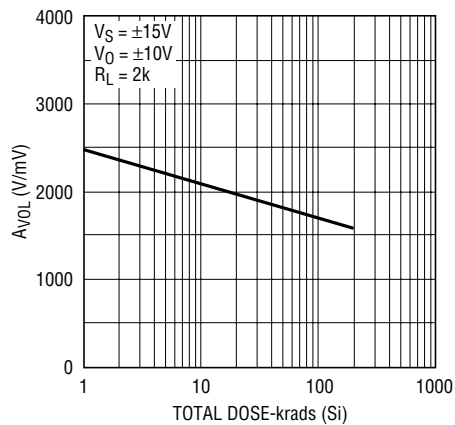
# TYPICAL PERFORMANCE CHARACTERISTICS

## Large Signal Voltage Gain



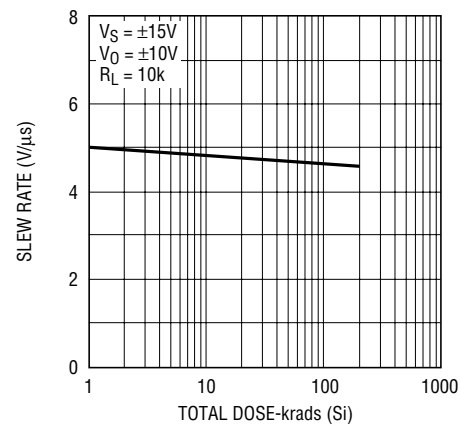
RH1499 G01

## Large Signal Voltage Gain



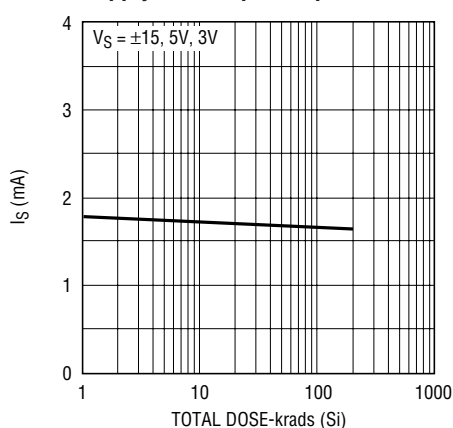
RH1499 G02

## Slew Rate



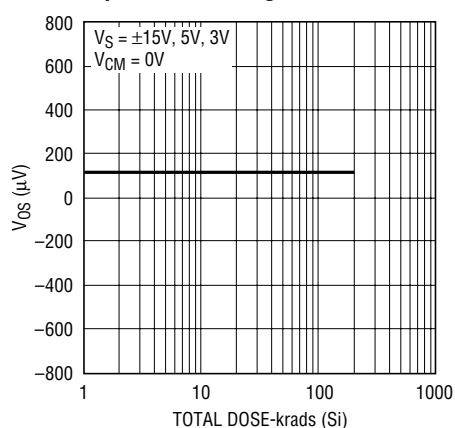
RH1499 G03

## Supply Current per Amp



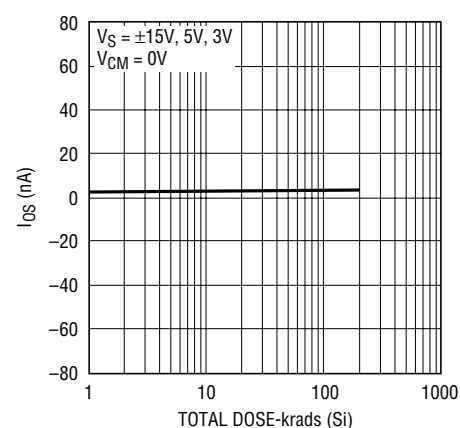
RH1499 G04

## Input Offset Voltage



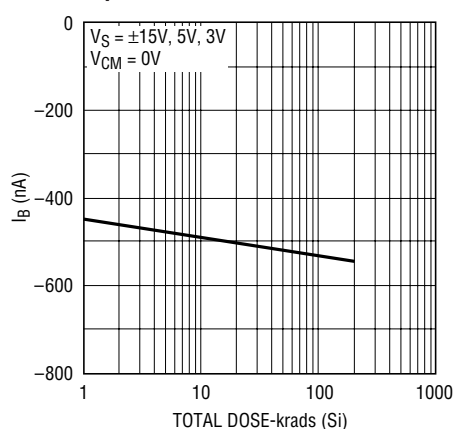
RH1499 G05

## Input Offset Current



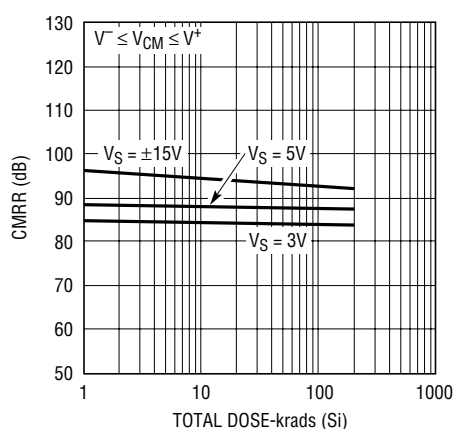
RH1499 G06

## Input Bias Current



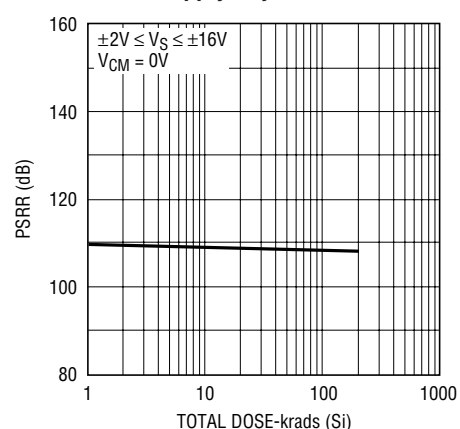
RH1499 G07

## Common Mode Rejection Ratio



RH1499 G08

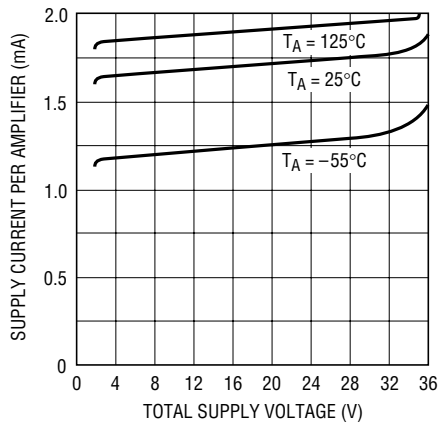
## Power Supply Rejection Ratio



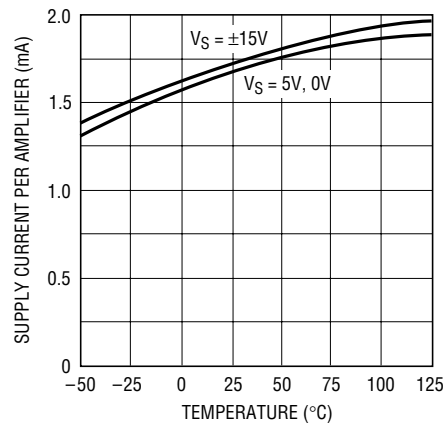
RH1499 G09

# TYPICAL PERFORMANCE CHARACTERISTICS

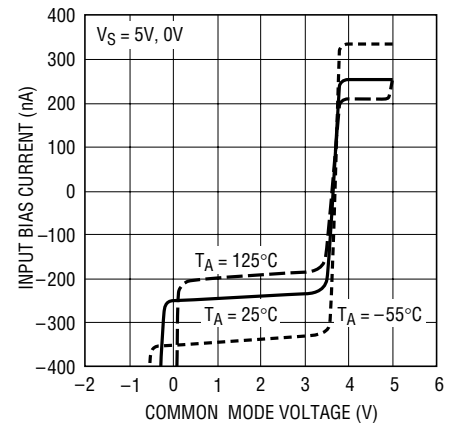
### Supply Current vs Supply Voltage



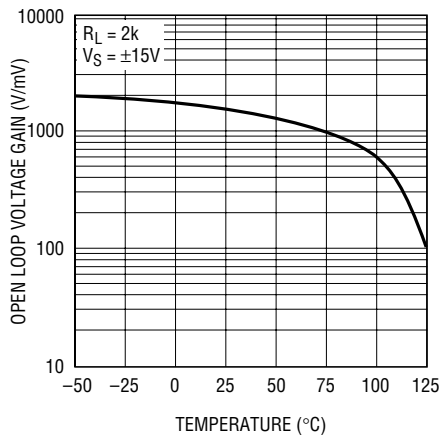
### Supply Current vs Temperature



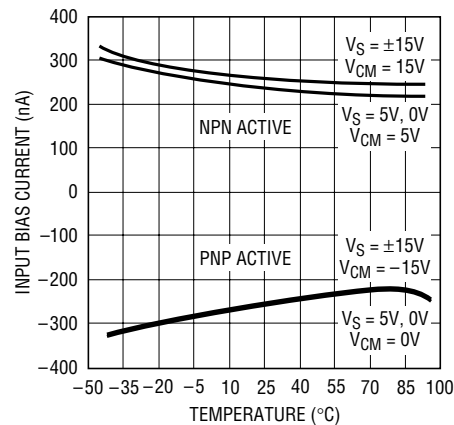
### Input Bias Current vs Common Mode Voltage



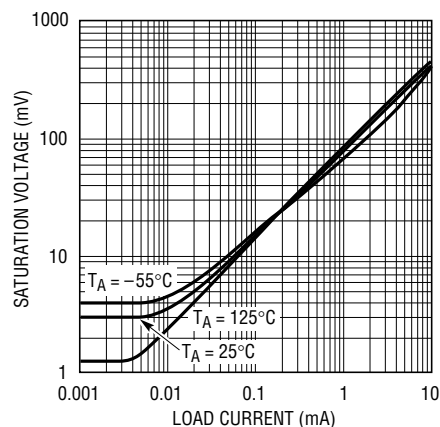
### Open-Loop Voltage Gain vs Temperature



### Input Bias Current vs Temperature



### Output Saturation Voltage vs Load Current (Output High)



### Output Saturation Voltage vs Load Current (Output Low)

