

## FEATURES

- 400MHz Gain Bandwidth Product
- 2500V/ $\mu$ s Slew Rate
- -85dBc Distortion at 5MHz
- 9mA Supply Current Per Amplifier
- Space Saving SOT-23 and MS8 Packages
- 6nV/ $\sqrt{\text{Hz}}$  Input Noise Voltage
- Unity-Gain Stable
- 1.5mV Maximum Input Offset Voltage
- 8 $\mu$ A Maximum Input Bias Current
- 800nA Maximum Input Offset Current
- 40mA Minimum Output Current,  $V_{OUT} = \pm 3\text{V}$
- $\pm 3.5\text{V}$  Minimum Input CMR,  $V_S = \pm 5\text{V}$
- Specified at  $\pm 5\text{V}$ , Single 5V Supplies
- Operating Temperature Range:  $-40^\circ\text{C}$  to  $85^\circ\text{C}$

## APPLICATIONS

- Wideband Amplifiers
- Buffers
- Active Filters
- Video and RF Amplification
- Communication Receivers
- Cable Drivers
- Data Acquisition Systems

## DESCRIPTION

The LT<sup>®</sup>1818/LT1819 are single/dual wide bandwidth, high slew rate, low noise and distortion operational amplifiers with excellent DC performance. The LT1818/LT1819 have been designed for wider bandwidth and slew rate, much lower input offset voltage and lower noise and distortion than devices with comparable supply current. The circuit topology is a voltage feedback amplifier with the excellent slewing characteristics of a current feedback amplifier.

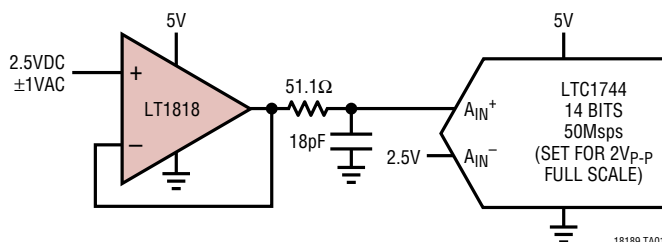
The output drives a 100 $\Omega$  load to  $\pm 3.8\text{V}$  with  $\pm 5\text{V}$  supplies. On a single 5V supply, the output swings from 1V to 4V with a 100 $\Omega$  load connected to 2.5V. The amplifier is unity-gain stable with a 20pF capacitive load without the need for a series resistor. Harmonic distortion is -85dBc up to 5MHz for a 2V<sub>P-P</sub> output at a gain of 2.

The LT1818/LT1819 are manufactured on Linear Technology's advanced low voltage complementary bipolar process. The LT1818 (single op amp) is available in SOT-23 and SO-8 packages; the LT1819 (dual op amp) is available in MSOP-8 and SO-8 packages.

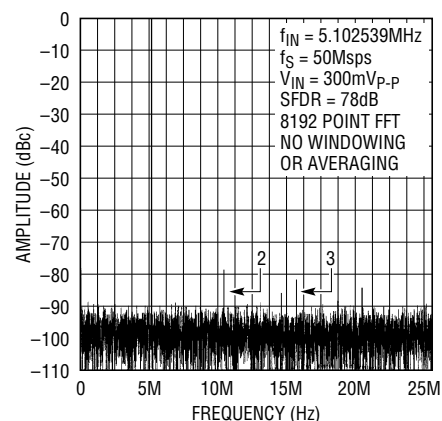
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## TYPICAL APPLICATION

Single Supply Unity-Gain ADC Driver for Oversampling Applications



FFT of Single Supply ADC Driver



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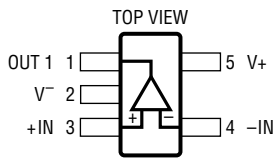
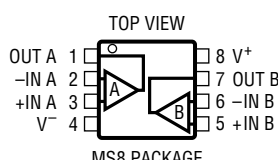
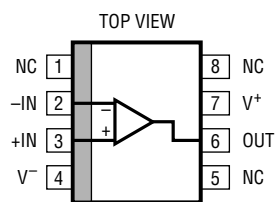
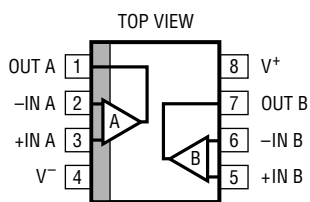
## ABSOLUTE MAXIMUM RATINGS

(Note 1)

Total Supply Voltage ( $V^+$  to  $V^-$ ) ..... 12.6V  
 Differential Input Voltage  
 (Transient Only, Note 2) .....  $\pm 6V$   
 Output Short-Circuit Duration (Note 3) ..... Indefinite  
 Operating Temperature Range (Note 8) ..  $-40^\circ\text{C}$  to  $85^\circ\text{C}$

Specified Temperature Range (Note 9) ...  $-40^\circ\text{C}$  to  $85^\circ\text{C}$   
 Maximum Junction Temperature .....  $150^\circ\text{C}$   
 Storage Temperature Range .....  $-65^\circ\text{C}$  to  $150^\circ\text{C}$   
 Lead Temperature (Soldering, 10 sec) .....  $300^\circ\text{C}$

## PACKAGE/ORDER INFORMATION

|                                                                                                                                                                                                                                       |                        |                                                                                                                                                                                                                                       |                          |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------|
|  <p>S5 PACKAGE<br/>5-LEAD PLASTIC SOT-23<br/><math>T_{JMAX} = 150^\circ\text{C}</math>, <math>\theta_{JA} = 250^\circ\text{C/W}</math> (NOTE 10)</p> | ORDER PART NUMBER      |  <p>MS8 PACKAGE<br/>8-LEAD PLASTIC MSOP<br/><math>T_{JMAX} = 150^\circ\text{C}</math>, <math>\theta_{JA} = 250^\circ\text{C/W}</math> (NOTE 10)</p> | ORDER PART NUMBER        |
|                                                                                                                                                                                                                                       | LT1818CS5<br>LT1818IS5 |                                                                                                                                                                                                                                       | LT1819CMS8<br>LT1819IMS8 |
|                                                                                                                                                                                                                                       | S5 PART* MARKING       |                                                                                                                                                                                                                                       | MS8 PART MARKING         |
|  <p>S8 PACKAGE<br/>8-LEAD PLASTIC SO<br/><math>T_{JMAX} = 150^\circ\text{C}</math>, <math>\theta_{JA} = 150^\circ\text{C/W}</math> (NOTE 10)</p>    | ORDER PART NUMBER      |  <p>S8 PACKAGE<br/>8-LEAD PLASTIC SO<br/><math>T_{JMAX} = 150^\circ\text{C}</math>, <math>\theta_{JA} = 150^\circ\text{C/W}</math> (NOTE 10)</p>   | ORDER PART NUMBER        |
|                                                                                                                                                                                                                                       | LT1818CS8<br>LT1818IS8 |                                                                                                                                                                                                                                       | LT1819CS8<br>LT1819IS8   |
|                                                                                                                                                                                                                                       | S8 PART MARKING        |                                                                                                                                                                                                                                       | S8 PART MARKING          |
|                                                                                                                                                                                                                                       | 1818<br>1818I          |                                                                                                                                                                                                                                       | 1819<br>1819I            |

\*The temperature grade is identified by a label on the shipping container. Consult LTC Marketing for parts specified with wider operating temperature ranges.

## ELECTRICAL CHARACTERISTICS

The ● denotes the specifications which apply over the full operating temperature range, otherwise specifications are at  $T_A = 25^\circ\text{C}$ . (Note 9)  $V_S = \pm 5V$ ,  $V_{CM} = 0V$ , unless otherwise noted.

| SYMBOL                   | PARAMETER                   | CONDITIONS                                               | MIN | TYP | MAX      | UNITS                        |
|--------------------------|-----------------------------|----------------------------------------------------------|-----|-----|----------|------------------------------|
| $V_{OS}$                 | Input Offset Voltage        | (Note 4)                                                 |     | 0.2 | 1.5      | mV                           |
|                          |                             | $T_A = 0^\circ\text{C}$ to $70^\circ\text{C}$            | ●   |     | 2.0      | mV                           |
|                          |                             | $T_A = -40^\circ\text{C}$ to $85^\circ\text{C}$          | ●   |     | 3.0      | mV                           |
| $\Delta V_{OS}/\Delta T$ | Input Offset Voltage Drift  | $T_A = 0^\circ\text{C}$ to $70^\circ\text{C}$ (Note 7)   | ●   | 10  | 15       | $\mu\text{V}/^\circ\text{C}$ |
|                          |                             | $T_A = -40^\circ\text{C}$ to $85^\circ\text{C}$ (Note 7) | ●   | 10  | 30       | $\mu\text{V}/^\circ\text{C}$ |
| $I_{OS}$                 | Input Offset Current        | $T_A = 0^\circ\text{C}$ to $70^\circ\text{C}$            | ●   | 60  | 800      | nA                           |
|                          |                             | $T_A = -40^\circ\text{C}$ to $85^\circ\text{C}$          | ●   |     | 1000     | nA                           |
|                          |                             |                                                          |     |     | 1200     | nA                           |
| $I_B$                    | Input Bias Current          | $T_A = 0^\circ\text{C}$ to $70^\circ\text{C}$            | ●   | -2  | $\pm 8$  | $\mu\text{A}$                |
|                          |                             | $T_A = -40^\circ\text{C}$ to $85^\circ\text{C}$          | ●   |     | $\pm 10$ | $\mu\text{A}$                |
|                          |                             |                                                          | ●   |     | $\pm 12$ | $\mu\text{A}$                |
| $e_n$                    | Input Noise Voltage Density | $f = 10\text{kHz}$                                       |     | 6   |          | $\text{nV}/\sqrt{\text{Hz}}$ |
| $i_n$                    | Input Noise Current Density | $f = 10\text{kHz}$                                       |     | 1.2 |          | $\text{pA}/\sqrt{\text{Hz}}$ |

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# ELECTRICAL CHARACTERISTICS

The ● denotes the specifications which apply over the full operating temperature range, otherwise specifications are at  $T_A = 25^\circ\text{C}$ . (Note 9)  $V_S = \pm 5\text{V}$ ,  $V_{CM} = 0\text{V}$ , unless otherwise noted.

| SYMBOL        | PARAMETER                                  | CONDITIONS                                                                                                                                                     | MIN                                          | TYP                 | MAX                | UNITS                                                    |
|---------------|--------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------|---------------------|--------------------|----------------------------------------------------------|
| $R_{IN}$      | Input Resistance                           | $V_{CM} = V^- + 1.5\text{V}$ to $V^+ - 1.5\text{V}$<br>Differential                                                                                            | 1.5                                          | 5<br>750            |                    | $\text{M}\Omega$<br>$\text{k}\Omega$                     |
| $C_{IN}$      | Input Capacitance                          |                                                                                                                                                                |                                              | 1.5                 |                    | pF                                                       |
| $V_{CM}$      | Input Voltage Range<br>(Positive/Negative) | Guaranteed by CMRR<br>$T_A = -40^\circ\text{C}$ to $85^\circ\text{C}$                                                                                          | ● $\pm 3.5$<br>● $\pm 3.5$                   | $\pm 4.2$           |                    | V<br>V                                                   |
| CMRR          | Common Mode Rejection Ratio                | $V_{CM} = \pm 3.5\text{V}$<br>$T_A = 0^\circ\text{C}$ to $70^\circ\text{C}$<br>$T_A = -40^\circ\text{C}$ to $85^\circ\text{C}$                                 | ● 75<br>● 73<br>● 72                         | 85                  |                    | dB<br>dB<br>dB                                           |
|               | Minimum Supply Voltage                     | Guaranteed by PSRR<br>$T_A = -40^\circ\text{C}$ to $85^\circ\text{C}$                                                                                          | ●                                            | $\pm 1.25$          | $\pm 2$<br>$\pm 2$ | V<br>V                                                   |
| PSRR          | Power Supply Rejection Ratio               | $V_S = \pm 2\text{V}$ to $\pm 5.5\text{V}$<br>$T_A = 0^\circ\text{C}$ to $70^\circ\text{C}$<br>$T_A = -40^\circ\text{C}$ to $85^\circ\text{C}$                 | ● 78<br>● 76<br>● 75                         | 97                  |                    | dB<br>dB<br>dB                                           |
| $A_{VOL}$     | Large-Signal Voltage Gain                  | $V_{OUT} = \pm 3\text{V}$ , $R_L = 500\Omega$<br>$T_A = 0^\circ\text{C}$ to $70^\circ\text{C}$<br>$T_A = -40^\circ\text{C}$ to $85^\circ\text{C}$              | ● 1.5<br>● 1.0<br>● 0.8                      | 2.5                 |                    | V/mV<br>V/mV<br>V/mV                                     |
|               |                                            | $V_{OUT} = \pm 3\text{V}$ , $R_L = 100\Omega$<br>$T_A = 0^\circ\text{C}$ to $70^\circ\text{C}$<br>$T_A = -40^\circ\text{C}$ to $85^\circ\text{C}$              | ● 1.0<br>● 0.7<br>● 0.6                      | 6                   |                    | V/mV<br>V/mV<br>V/mV                                     |
|               | Channel Separation                         | $V_{OUT} = \pm 3\text{V}$ , LT1819<br>$T_A = 0^\circ\text{C}$ to $70^\circ\text{C}$<br>$T_A = -40^\circ\text{C}$ to $85^\circ\text{C}$                         | ● 82<br>● 81<br>● 80                         | 100                 |                    | dB<br>dB<br>dB                                           |
| $V_{OUT}$     | Output Swing(Positive/Negative)            | $R_L = 500\Omega$ , 30mV Overdrive<br>$T_A = 0^\circ\text{C}$ to $70^\circ\text{C}$<br>$T_A = -40^\circ\text{C}$ to $85^\circ\text{C}$                         | ● $\pm 3.8$<br>● $\pm 3.7$<br>● $\pm 3.6$    | $\pm 4.1$           |                    | V<br>V<br>V                                              |
|               |                                            | $R_L = 100\Omega$ , 30mV Overdrive<br>$T_A = 0^\circ\text{C}$ to $70^\circ\text{C}$<br>$T_A = -40^\circ\text{C}$ to $85^\circ\text{C}$                         | ● $\pm 3.50$<br>● $\pm 3.25$<br>● $\pm 3.15$ | $\pm 3.8$           |                    | V<br>V<br>V                                              |
| $I_{OUT}$     | Output Current                             | $V_{OUT} = \pm 3\text{V}$ , 30mV Overdrive<br>$T_A = 0^\circ\text{C}$ to $70^\circ\text{C}$<br>$T_A = -40^\circ\text{C}$ to $85^\circ\text{C}$                 | ● $\pm 40$<br>● $\pm 35$<br>● $\pm 30$       | $\pm 70$            |                    | mA<br>mA<br>mA                                           |
| $I_{SC}$      | Output Short-Circuit Current               | $V_{OUT} = 0\text{V}$ , 1V Overdrive (Note 3)<br>$T_A = 0^\circ\text{C}$ to $70^\circ\text{C}$<br>$T_A = -40^\circ\text{C}$ to $85^\circ\text{C}$              | ● $\pm 100$<br>● $\pm 90$<br>● $\pm 70$      | $\pm 200$           |                    | mA<br>mA<br>mA                                           |
| SR            | Slew Rate                                  | $A_V = 1$                                                                                                                                                      |                                              | 2500                |                    | V/ $\mu\text{s}$                                         |
|               |                                            | $A_V = -1$ (Note 5)<br>$T_A = 0^\circ\text{C}$ to $70^\circ\text{C}$<br>$T_A = -40^\circ\text{C}$ to $85^\circ\text{C}$                                        | ● 900<br>● 750<br>● 600                      | 1800                |                    | V/ $\mu\text{s}$<br>V/ $\mu\text{s}$<br>V/ $\mu\text{s}$ |
| FPBW          | Full Power Bandwidth                       | $6V_{P-P}$ (Note 6)                                                                                                                                            |                                              | 95                  |                    | MHz                                                      |
| GBW           | Gain Bandwidth Product                     | $f = 4\text{MHz}$ , $R_L = 500\Omega$<br>$T_A = 0^\circ\text{C}$ to $70^\circ\text{C}$<br>$T_A = -40^\circ\text{C}$ to $85^\circ\text{C}$                      | ● 270<br>● 260<br>● 250                      | 400                 |                    | MHz<br>MHz<br>MHz                                        |
| $t_r$ , $t_f$ | Rise Time, Fall Time                       | $A_V = 1$ , 10% to 90%, 0.1V Step                                                                                                                              |                                              | 0.6                 |                    | ns                                                       |
| $t_{PD}$      | Propagation Delay                          | $A_V = 1$ , 50% to 50%, 0.1V Step                                                                                                                              |                                              | 1.0                 |                    | ns                                                       |
| OS            | Overshoot                                  | $A_V = 1$ , 0.1V, $R_L = 100\Omega$                                                                                                                            |                                              | 20                  |                    | %                                                        |
| $t_S$         | Settling Time                              | $A_V = -1$ , 0.1%, 5V                                                                                                                                          |                                              | 10                  |                    | ns                                                       |
| HD            | Harmonic Distortion                        | HD2, $A_V = 2$ , $f = 5\text{MHz}$ , $V_{OUT} = 2V_{P-P}$ , $R_L = 500\Omega$<br>HD3, $A_V = 2$ , $f = 5\text{MHz}$ , $V_{OUT} = 2V_{P-P}$ , $R_L = 500\Omega$ |                                              | -85<br>-89          |                    | dBc<br>dBc                                               |
| dG            | Differential Gain                          | $A_V = 2$ , $R_L = 150\Omega$                                                                                                                                  |                                              | 0.07                |                    | %                                                        |
| dP            | Differential Phase                         | $A_V = 2$ , $R_L = 150\Omega$                                                                                                                                  |                                              | 0.02                |                    | DEG                                                      |
| $I_S$         | Supply Current                             | Per Amplifier<br>$T_A = 0^\circ\text{C}$ to $70^\circ\text{C}$<br>$T_A = -40^\circ\text{C}$ to $85^\circ\text{C}$                                              | ●<br>●                                       | 9<br>10<br>13<br>14 |                    | mA<br>mA<br>mA<br>mA                                     |

# ELECTRICAL CHARACTERISTICS

The ● denotes the specifications which apply over the full operating temperature range, otherwise specifications are at  $T_A = 25^\circ\text{C}$  (Note 9).  $V_S = 5\text{V}$ ,  $0\text{V}$ ;  $V_{CM} = 2.5\text{V}$ ,  $R_L$  to  $2.5\text{V}$  unless otherwise noted.

| SYMBOL                   | PARAMETER                      | CONDITIONS                                                           | MIN | TYP        | MAX      | UNITS                        |
|--------------------------|--------------------------------|----------------------------------------------------------------------|-----|------------|----------|------------------------------|
| $V_{OS}$                 | Input Offset Voltage           | (Note 4)                                                             |     | 0.4        | 2.0      | mV                           |
|                          |                                | $T_A = 0^\circ\text{C to } 70^\circ\text{C}$                         | ●   |            | 2.5      | mV                           |
|                          |                                | $T_A = -40^\circ\text{C to } 85^\circ\text{C}$                       | ●   |            | 3.5      | mV                           |
| $\Delta V_{OS}/\Delta T$ | Input Offset Voltage Drift     | (Note 7)                                                             |     | 10         | 15       | $\mu\text{V}/^\circ\text{C}$ |
|                          |                                | $T_A = 0^\circ\text{C to } 70^\circ\text{C}$                         | ●   | 10         | 30       | $\mu\text{V}/^\circ\text{C}$ |
|                          |                                | $T_A = -40^\circ\text{C to } 85^\circ\text{C}$                       | ●   |            |          |                              |
| $I_{OS}$                 | Input Offset Current           | $T_A = 0^\circ\text{C to } 70^\circ\text{C}$                         | ●   | 60         | 800      | nA                           |
|                          |                                | $T_A = -40^\circ\text{C to } 85^\circ\text{C}$                       | ●   |            | 1000     | nA                           |
|                          |                                |                                                                      |     |            | 1200     | nA                           |
| $I_B$                    | Input Bias Current             | $T_A = 0^\circ\text{C to } 70^\circ\text{C}$                         | ●   | -2.4       | $\pm 8$  | $\mu\text{A}$                |
|                          |                                | $T_A = -40^\circ\text{C to } 85^\circ\text{C}$                       | ●   |            | $\pm 10$ | $\mu\text{A}$                |
|                          |                                |                                                                      |     |            | $\pm 12$ | $\mu\text{A}$                |
| $e_n$                    | Input Noise Voltage Density    | $f = 10\text{kHz}$                                                   |     | 6          |          | $\text{nV}/\sqrt{\text{Hz}}$ |
| $i_n$                    | Input Noise Current Density    | $f = 10\text{kHz}$                                                   |     | 1.4        |          | $\text{pA}/\sqrt{\text{Hz}}$ |
| $R_{IN}$                 | Input Resistance               | $V_{CM} = V^- + 1.5\text{V to } V^+ - 1.5\text{V}$                   |     | 1.5        | 5        | M $\Omega$                   |
|                          |                                | Differential                                                         |     |            | 750      | k $\Omega$                   |
| $C_{IN}$                 | Input Capacitance              |                                                                      |     | 1.5        |          | pF                           |
| $V_{CM}$                 | Input Voltage Range (Positive) | Guaranteed by CMRR<br>$T_A = -40^\circ\text{C to } 85^\circ\text{C}$ | ●   | 3.5        | 4.2      | V                            |
|                          | Input Voltage Range (Negative) | Guaranteed by CMRR<br>$T_A = -40^\circ\text{C to } 85^\circ\text{C}$ | ●   |            | 0.8      | 1.5                          |
| CMRR                     | Common Mode Rejection Ratio    | $V_{CM} = 1.5\text{V to } 3.5\text{V}$                               |     | 73         | 82       | dB                           |
|                          |                                | $T_A = 0^\circ\text{C to } 70^\circ\text{C}$                         | ●   | 71         |          | dB                           |
|                          |                                | $T_A = -40^\circ\text{C to } 85^\circ\text{C}$                       | ●   | 70         |          | dB                           |
|                          | Minimum Supply Voltage         | Guaranteed by PSRR<br>$T_A = -40^\circ\text{C to } 85^\circ\text{C}$ | ●   | $\pm 1.25$ | $\pm 2$  | V                            |
|                          |                                |                                                                      |     |            | $\pm 2$  | V                            |
| PSRR                     | Power Supply Rejection Ratio   | $V_S = 4\text{V to } 11\text{V}$                                     |     | 78         | 97       | dB                           |
|                          |                                | $T_A = 0^\circ\text{C to } 70^\circ\text{C}$                         | ●   | 76         |          | dB                           |
|                          |                                | $T_A = -40^\circ\text{C to } 85^\circ\text{C}$                       | ●   | 75         |          | dB                           |
| $A_{VOL}$                | Large-Signal Voltage Gain      | $V_{OUT} = 1.5\text{V to } 3.5\text{V}$ , $R_L = 500\Omega$          |     | 1.0        | 2        | V/mV                         |
|                          |                                | $T_A = 0^\circ\text{C to } 70^\circ\text{C}$                         | ●   | 0.7        |          | V/mV                         |
|                          |                                | $T_A = -40^\circ\text{C to } 85^\circ\text{C}$                       | ●   | 0.6        |          | V/mV                         |
|                          |                                | $V_{OUT} = 1.5\text{V to } 3.5\text{V}$ , $R_L = 100\Omega$          |     | 0.7        | 4        | V/mV                         |
|                          |                                | $T_A = 0^\circ\text{C to } 70^\circ\text{C}$                         | ●   | 0.5        |          | V/mV                         |
|                          |                                | $T_A = -40^\circ\text{C to } 85^\circ\text{C}$                       | ●   | 0.4        |          | V/mV                         |
|                          | Channel Separation             | $V_{OUT} = 1.5\text{V to } 3.5\text{V}$ , LT1819                     |     | 81         | 100      | dB                           |
|                          |                                | $T_A = 0^\circ\text{C to } 70^\circ\text{C}$                         | ●   | 80         |          | dB                           |
|                          |                                | $T_A = -40^\circ\text{C to } 85^\circ\text{C}$                       | ●   | 79         |          | dB                           |
| $V_{OUT}$                | Output Swing(Positive)         | $R_L = 500\Omega$ , 30mV Overdrive                                   |     | 3.9        | 4.2      | V                            |
|                          |                                | $T_A = 0^\circ\text{C to } 70^\circ\text{C}$                         | ●   | 3.8        |          | V                            |
|                          |                                | $T_A = -40^\circ\text{C to } 85^\circ\text{C}$                       | ●   | 3.7        |          | V                            |
|                          |                                | $R_L = 100\Omega$ , 30mV Overdrive                                   |     | 3.7        | 4        | V                            |
|                          |                                | $T_A = 0^\circ\text{C to } 70^\circ\text{C}$                         | ●   | 3.6        |          | V                            |
|                          |                                | $T_A = -40^\circ\text{C to } 85^\circ\text{C}$                       | ●   | 3.5        |          | V                            |
|                          | Output Swing(Negative)         | $R_L = 500\Omega$ , 30mV Overdrive                                   |     | 0.8        | 1.1      | V                            |
|                          |                                | $T_A = 0^\circ\text{C to } 70^\circ\text{C}$                         | ●   |            | 1.2      | V                            |
|                          |                                | $T_A = -40^\circ\text{C to } 85^\circ\text{C}$                       | ●   |            | 1.3      | V                            |
|                          |                                | $R_L = 100\Omega$ , 30mV Overdrive                                   |     | 1          | 1.3      | V                            |
|                          |                                | $T_A = 0^\circ\text{C to } 70^\circ\text{C}$                         | ●   |            | 1.4      | V                            |
|                          |                                | $T_A = -40^\circ\text{C to } 85^\circ\text{C}$                       | ●   |            | 1.5      | V                            |

# ELECTRICAL CHARACTERISTICS

The ● denotes the specifications which apply over the full operating temperature range, otherwise specifications are at  $T_A = 25^\circ\text{C}$  (Note 9).  $V_S = 5\text{V}$ ,  $0\text{V}$ ;  $V_{CM} = 2.5\text{V}$ ,  $R_L$  to  $2.5\text{V}$  unless otherwise noted.

| SYMBOL        | PARAMETER                    | CONDITIONS                                                                                                                                                     | MIN               | TYP                       | MAX            | UNITS                        |
|---------------|------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|---------------------------|----------------|------------------------------|
| $I_{OUT}$     | Output Current               | $V_{OUT} = 1.5\text{V}$ or $3.5\text{V}$ , 30mV Overdrive<br>$T_A = 0^\circ\text{C}$ to $70^\circ\text{C}$<br>$T_A = -40^\circ\text{C}$ to $85^\circ\text{C}$  | ±30<br>±25<br>±20 | ±50                       |                | mA<br>mA<br>mA               |
| $I_{SC}$      | Output Short-Circuit Current | $V_{OUT} = 2.5\text{V}$ , 1V Overdrive (Note 3)<br>$T_A = 0^\circ\text{C}$ to $70^\circ\text{C}$<br>$T_A = -40^\circ\text{C}$ to $85^\circ\text{C}$            | ±80<br>±70<br>±50 | ±140                      |                | mA<br>mA<br>mA               |
| $SR$          | Slew Rate                    | $A_V = 1$<br>$A_V = -1$ (Note 5)<br>$T_A = 0^\circ\text{C}$ to $70^\circ\text{C}$<br>$T_A = -40^\circ\text{C}$ to $85^\circ\text{C}$                           |                   | 1000<br>450<br>375<br>300 |                | V/μs<br>V/μs<br>V/μs<br>V/μs |
| FPBW          | Full Power Bandwidth         | $2V_{P-P}$ (Note 6)                                                                                                                                            |                   | 125                       |                | MHz                          |
| GBW           | Gain Bandwidth Product       | $f = 4\text{MHz}$ , $R_L = 500\Omega$<br>$T_A = 0^\circ\text{C}$ to $70^\circ\text{C}$<br>$T_A = -40^\circ\text{C}$ to $85^\circ\text{C}$                      | 240<br>230<br>220 | 360                       |                | MHz<br>MHz<br>MHz            |
| $t_r$ , $t_f$ | Rise Time, Fall Time         | $A_V = 1$ , 10% to 90%, 0.1V Step                                                                                                                              |                   | 0.7                       |                | ns                           |
| $t_{PD}$      | Propagation Delay            | $A_V = 1$ , 50% to 50%, 0.1V Step                                                                                                                              |                   | 1.1                       |                | ns                           |
| OS            | Overshoot                    | $A_V = 1$ , 0.1V, $R_L = 100\Omega$                                                                                                                            |                   | 20                        |                | %                            |
| HD            | Harmonic Distortion          | HD2, $A_V = 2$ , $f = 5\text{MHz}$ , $V_{OUT} = 2V_{P-P}$ , $R_L = 500\Omega$<br>HD3, $A_V = 2$ , $f = 5\text{MHz}$ , $V_{OUT} = 2V_{P-P}$ , $R_L = 500\Omega$ |                   | -72<br>-74                |                | dBc<br>dBc                   |
| dG            | Differential Gain            | $A_V = 2$ , $R_L = 150\Omega$                                                                                                                                  |                   | 0.07                      |                | %                            |
| dP            | Differential Phase           | $A_V = 2$ , $R_L = 150\Omega$                                                                                                                                  |                   | 0.07                      |                | DEG                          |
| $I_S$         | Supply Current               | Per Amplifier<br>$T_A = 0^\circ\text{C}$ to $70^\circ\text{C}$<br>$T_A = -40^\circ\text{C}$ to $85^\circ\text{C}$                                              |                   | 8.5                       | 10<br>13<br>14 | mA<br>mA<br>mA               |

**Note 1:** Absolute Maximum Ratings are those values beyond which the life of a device may be impaired.

**Note 2:** Differential inputs of  $\pm 6\text{V}$  are appropriate for transient operation only, such as during slewing. Large sustained differential inputs can cause excessive power dissipation and may damage the part.

**Note 3:** A heat sink may be required to keep the junction temperature below absolute maximum when the output is shorted indefinitely.

**Note 4:** Input offset voltage is pulse tested and is exclusive of warm-up drift.

**Note 5:** With  $\pm 5\text{V}$  supplies, slew rate is tested in a closed-loop gain of  $-1$  by measuring the rise time of the output from  $-2\text{V}$  to  $2\text{V}$  with an output step from  $-3\text{V}$  to  $3\text{V}$ . With single  $5\text{V}$  supplies, slew rate is tested in a closed-loop gain of  $-1$  by measuring the rise time of the output from  $1.5\text{V}$  to  $3.5\text{V}$  with an output step from  $1\text{V}$  to  $4\text{V}$ . Falling edge slew rate is not production tested, but is designed, characterized and expected to be within 10% of the rising edge slew rate.

**Note 6:** Full power bandwidth is calculated from the slew rate:

$$FPBW = SR/2\pi V_P$$

**Note 7:** This parameter is not 100% tested.

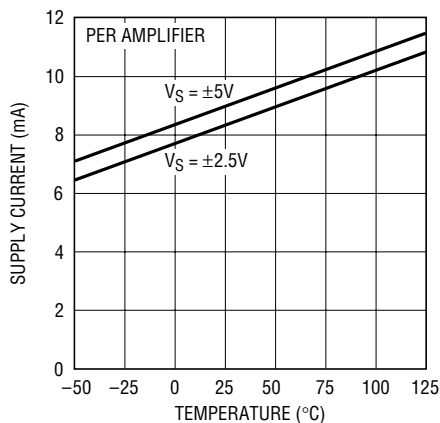
**Note 8:** The LT1818C/LT1818I and LT1819C/LT1819I are guaranteed functional over the operating temperature range of  $-40^\circ\text{C}$  to  $85^\circ\text{C}$ .

**Note 9:** The LT1818C/LT1819C are guaranteed to meet specified performance from  $0^\circ\text{C}$  to  $70^\circ\text{C}$  and is designed, characterized and expected to meet the extended temperature limits, but is not tested at  $-40^\circ\text{C}$  and  $85^\circ\text{C}$ . The LT1818I/LT1819I are guaranteed to meet the extended temperature limits.

**Note 10:** Thermal resistance ( $\theta_{JA}$ ) varies with the amount of PC board metal connected to the package. The specified values are for short traces connected to the leads. If desired, the thermal resistance can be significantly reduced by connecting the  $V^-$  pin to a large metal area.

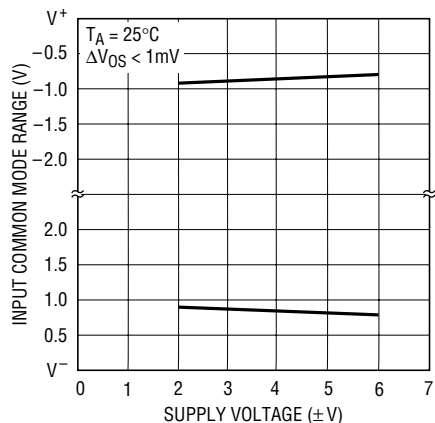
# TYPICAL PERFORMANCE CHARACTERISTICS

## Supply Current vs Temperature



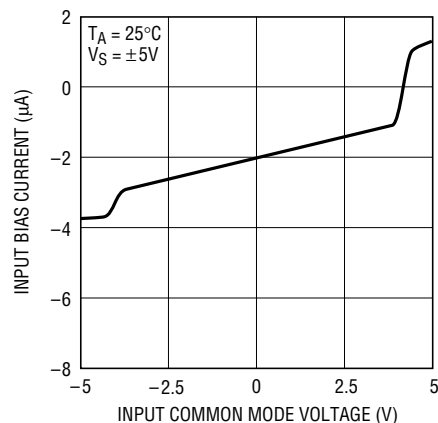
18189 G01

## Input Common Mode Range vs Supply Voltage



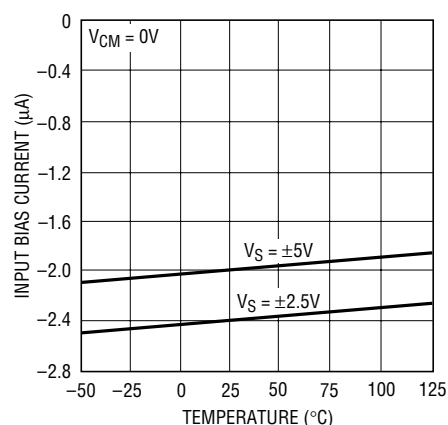
18189 G02

## Input Bias Current vs Common Mode Voltage



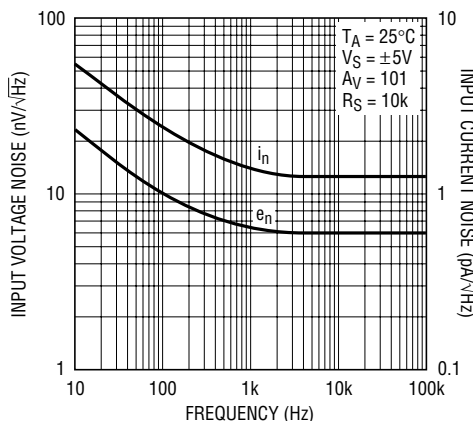
18189 G03

## Input Bias Current vs Temperature



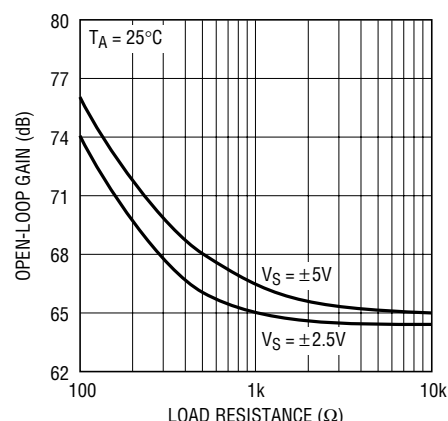
18189 G04

## Input Noise Spectral Density



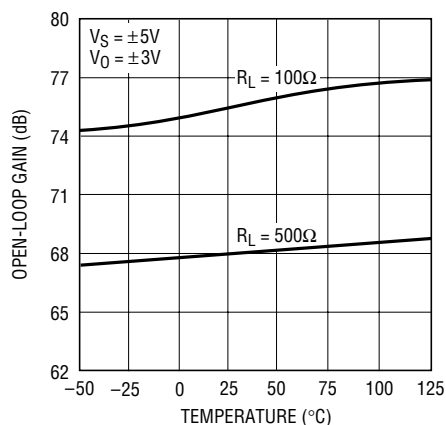
18189 G05

## Open-Loop Gain vs Resistive Load



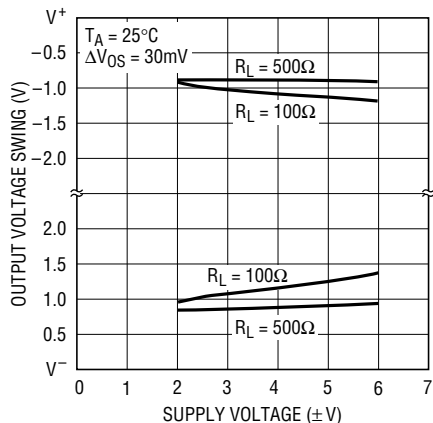
18189 G06

## Open-Loop Gain vs Temperature



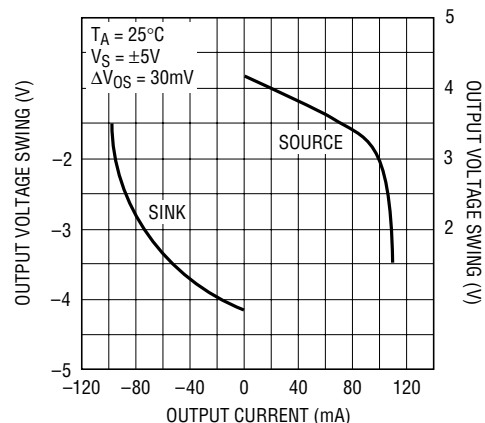
18189 G07

## Output Voltage Swing vs Supply Voltage



18189 G08

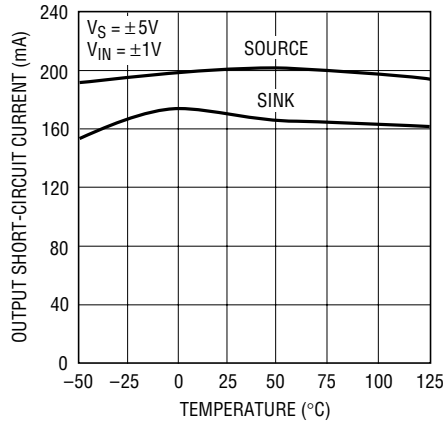
## Output Voltage Swing vs Load Current



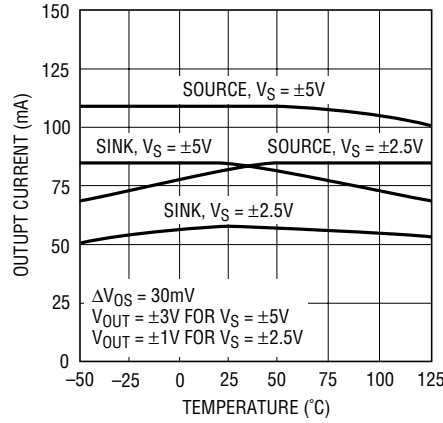
18189 G09

# TYPICAL PERFORMANCE CHARACTERISTICS

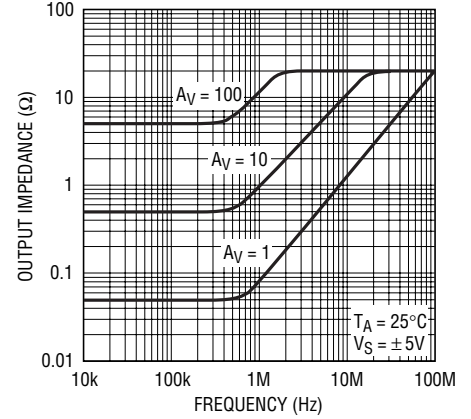
Output Short-Circuit Current vs Temperature



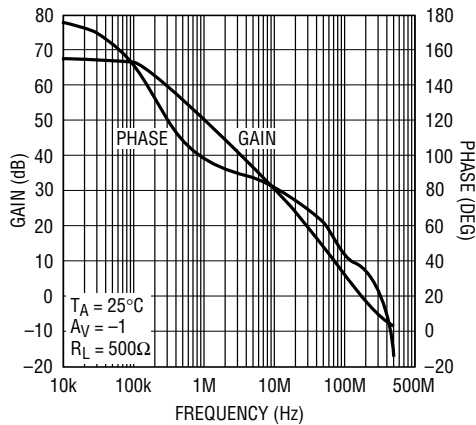
Output Current vs Temperature



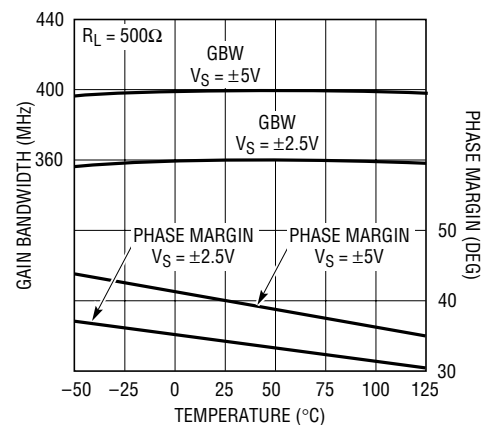
Output Impedance vs Frequency



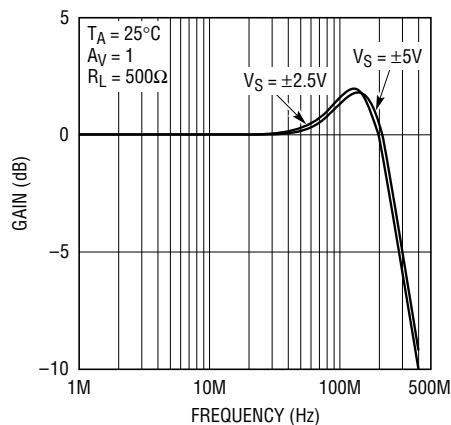
Gain and Phase vs Frequency



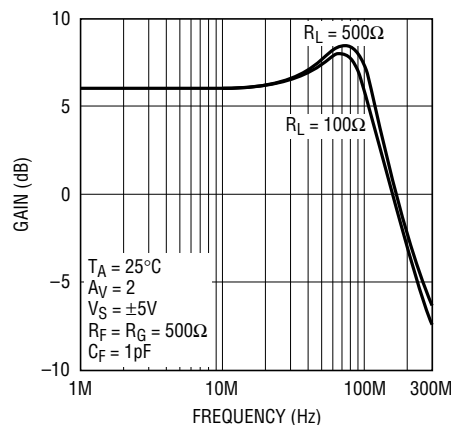
Gain Bandwidth and Phase Margin vs Temperature



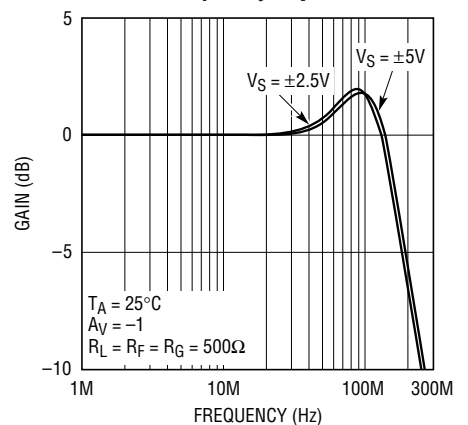
Gain vs Frequency,  $A_V = 1$



Gain vs Frequency,  $A_V = 2$

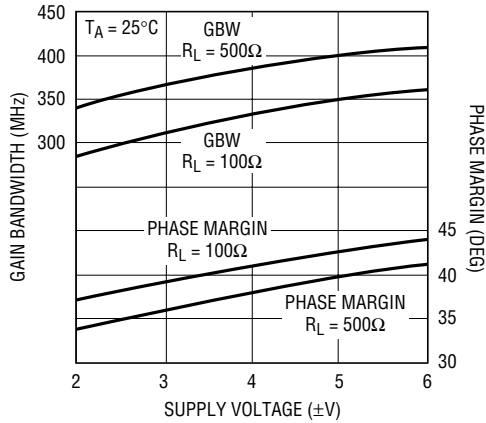


Gain vs Frequency,  $A_V = -1$

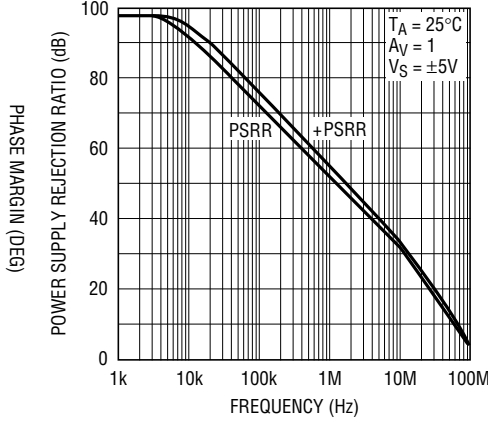


# TYPICAL PERFORMANCE CHARACTERISTICS

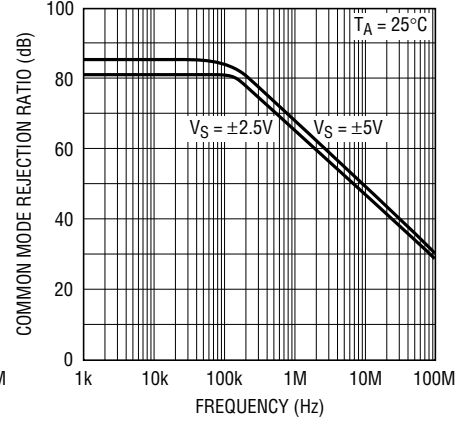
**Gain Bandwidth and Phase Margin vs Supply Voltage**



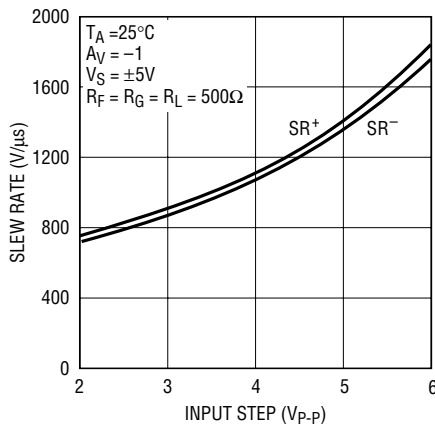
**Power Supply Rejection Ratio vs Frequency**



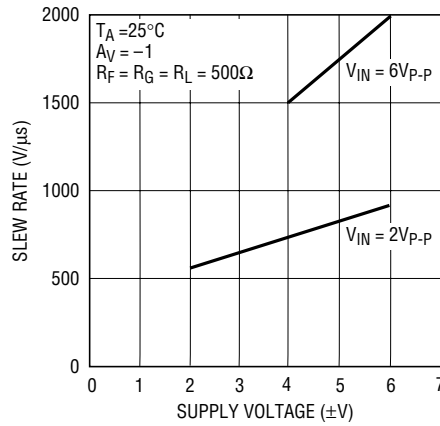
**Common Mode Rejection Ratio vs Frequency**



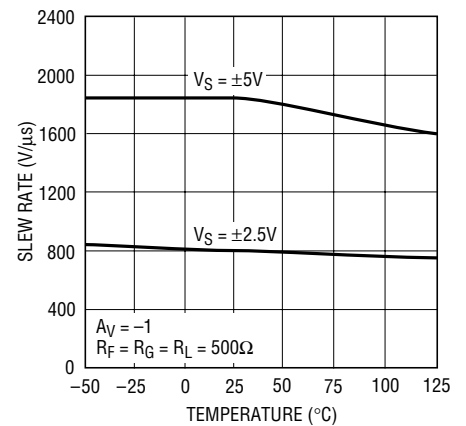
**Slew Rate vs Input Step**



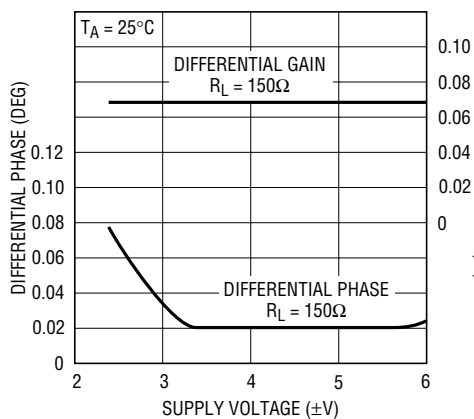
**Slew Rate vs Supply Voltage**



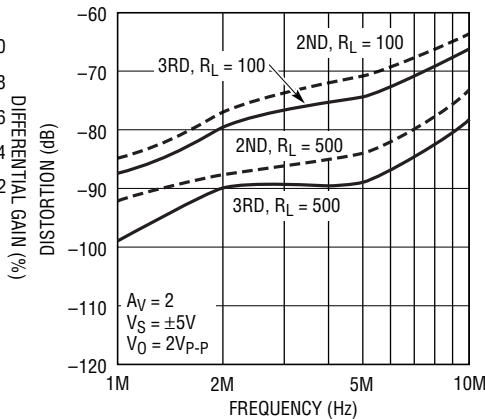
**Slew Rate vs Temperature**



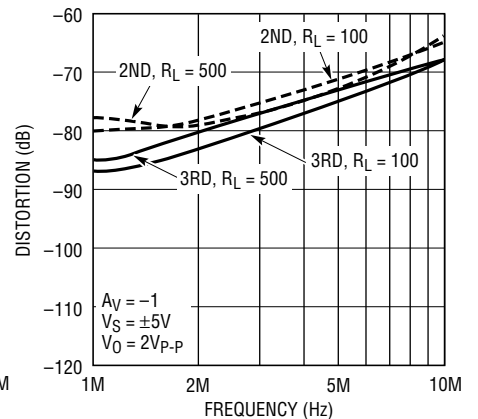
**Differential Gain and Phase vs Supply Voltage**



**Distortion vs Frequency, AV = 2**



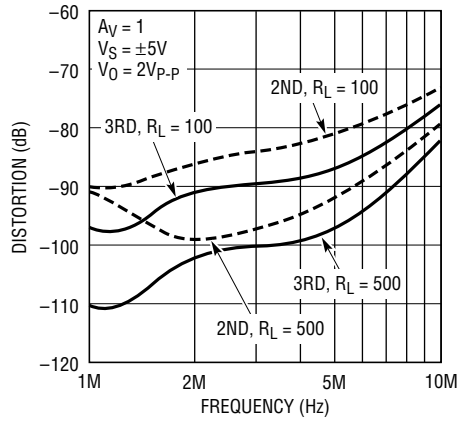
**Distortion vs Frequency, AV = -1**





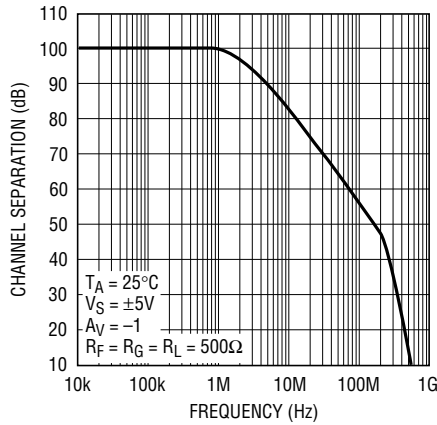
# TYPICAL PERFORMANCE CHARACTERISTICS

**Distortion vs Frequency,  $A_V = 1$**



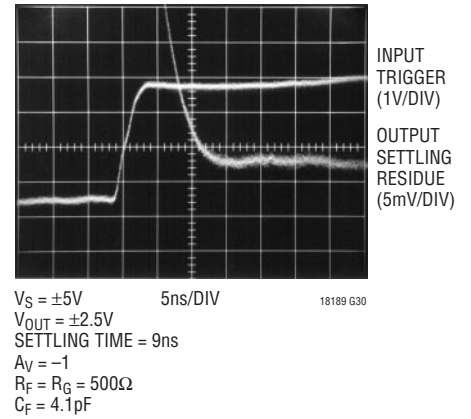
18189 G28

**Channel Separation vs Frequency**



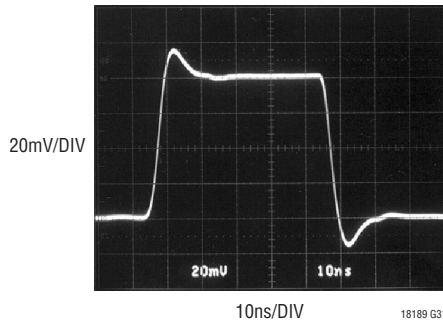
18188 G29

**0.1% Settling Time**



18189 G30

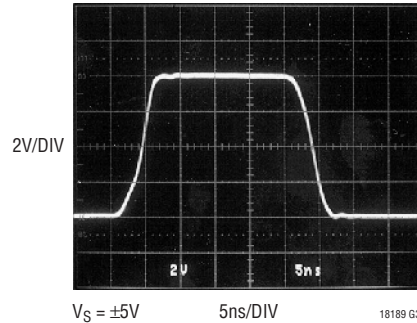
**Small-Signal Transient, 20dB Gain**



10ns/DIV

18189 G31

**Large-Signal Transient,  $A_V = -1$**

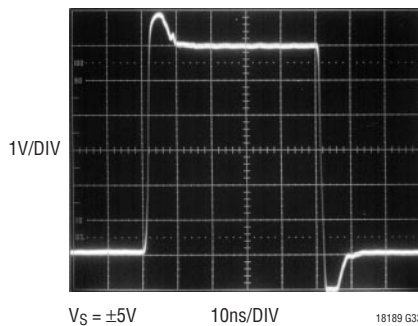


$V_S = \pm 5V$

5ns/DIV

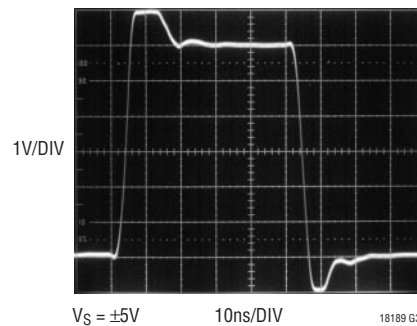
18189 G32

**Large-Signal Transient,  $A_V = 1$**



18189 G33

**Large-Signal Transient,  $A_V = -1$**



18189 G34

## APPLICATIONS INFORMATION

### Layout and Passive Components

As with all high speed amplifiers, the LT1818/LT1819 require some attention to board layout. A ground plane is recommended and trace lengths should be minimized, especially on the negative input lead.

Low ESL/ESR bypass capacitors should be placed directly at the positive and negative supply (0.01μF ceramics are recommended). For high drive current applications, additional 1μF to 10μF tantalums should be added.

The parallel combination of the feedback resistor and gain setting resistor on the inverting input combine with the input capacitance to form a pole that can cause peaking or even oscillations. If feedback resistors greater than 500Ω are used, a parallel capacitor of value

$$C_F > R_G \cdot C_{IN}/R_F$$

should be used to cancel the input pole and optimize dynamic performance (see Figure 1). For applications where the DC noise gain is 1 and a large feedback resistor is used,  $C_F$  should be greater than or equal to  $C_{IN}$ . An example would be an I-to-V converter.

In high closed-loop gain configurations,  $R_F \gg R_G$ , and no  $C_F$  need to be added. To optimize the bandwidth in these applications, a capacitance,  $C_G$ , may be added in parallel with  $R_G$  in order to cancel out any parasitic  $C_F$  capacitance.

### Capacitive Loading

The LT1818/LT1819 are optimized for low distortion and high gain bandwidth applications. The amplifiers can drive a capacitive load of 20pF in a unity-gain configuration and more with higher gain. When driving a larger capacitive

load, a resistor of 10Ω to 50Ω must be connected between the output and the capacitive load to avoid ringing or oscillation (see  $R_S$  in Figure 1). The feedback must still be taken directly from the output so that the series resistor will isolate the capacitive load to ensure stability.

### Input Considerations

The inputs of the LT1818/LT1819 amplifiers are connected to the bases of NPN and PNP bipolar transistors in parallel. The base currents are of opposite polarity and provide first order bias current cancellation. Due to variation in the matching of NPN and PNP beta, the polarity of the input bias current can be positive or negative. The offset current, however, does not depend on beta matching and is tightly controlled. Therefore, the use of balanced source resistance at each input is recommended for applications where DC accuracy must be maximized. For example, with a 100Ω source resistance at each input, the 800nA maximum offset current results in only 80μV of extra offset, while without balance the 8μA maximum input bias current could result in an 0.8mV offset condition.

The inputs can withstand differential input voltages of up to 6V without damage and without needing clamping or series resistance for protection. This differential input voltage generates a large internal current (up to 50mA), which results in the high slew rate. In normal transient closed-loop operation, this does not increase power dissipation significantly because of the low duty cycle of the transient inputs. Sustained differential inputs, however, will result in excessive power dissipation and therefore **this device should not be used as a comparator.**

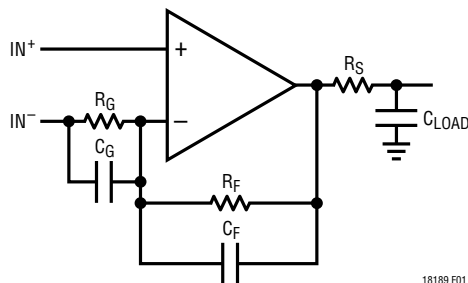


Figure 1

## APPLICATIONS INFORMATION

### Slew Rate

The slew rate of the LT1818/LT1819 is proportional to the differential input voltage. Highest slew rates are therefore seen in the lowest gain configurations. For example, a 6V output step with a gain of 10 has a 0.6V input step, whereas at unity gain there is a 6V input step. The LT1818/LT1819 is tested for slew rate at a gain of  $-1$ . Lower slew rates occur in higher gain configurations, whereas the highest slew rate (2500V/ $\mu$ s) occurs in a noninverting unity-gain configuration.

### Power Dissipation

The LT1818/LT1819 combine high speed and large output drive in small packages. It is possible to exceed the maximum junction temperature specification (150°C) under certain conditions. Maximum junction temperature ( $T_J$ ) is calculated from the ambient temperature ( $T_A$ ), power dissipation per amplifier ( $P_D$ ) and number of amplifiers ( $n$ ) as follows:

$$T_J = T_A + (n \cdot P_D \cdot \theta_{JA})$$

Power dissipation is composed of two parts. The first is due to the quiescent supply current and the second is due to on-chip dissipation caused by the load current. The worst-case load-induced power occurs when the output voltage is at 1/2 of either supply voltage (or the maximum swing if less than 1/2 the supply voltage). Therefore  $P_{D\text{MAX}}$  is:

$$P_{D\text{MAX}} = (V^+ - V^-) \cdot (I_{S\text{MAX}}) + (V^+/2)^2/R_L \text{ or}$$

$$P_{D\text{MAX}} = (V^+ - V^-) \cdot (I_{S\text{MAX}}) + (V^+ - V_{O\text{MAX}}) \cdot (V_{O\text{MAX}}/R_L)$$

Example: LT1819IS8 at 85°C,  $V_S = \pm 5V$ ,  $R_L = 100\Omega$

$$P_{D\text{MAX}} = (10V) \cdot (14mA) + (2.5V)^2/100\Omega = 202.5mW$$

$$T_{J\text{MAX}} = 85^\circ\text{C} + (2 \cdot 202.5mW) \cdot (150^\circ\text{C/W}) = 146^\circ\text{C}$$

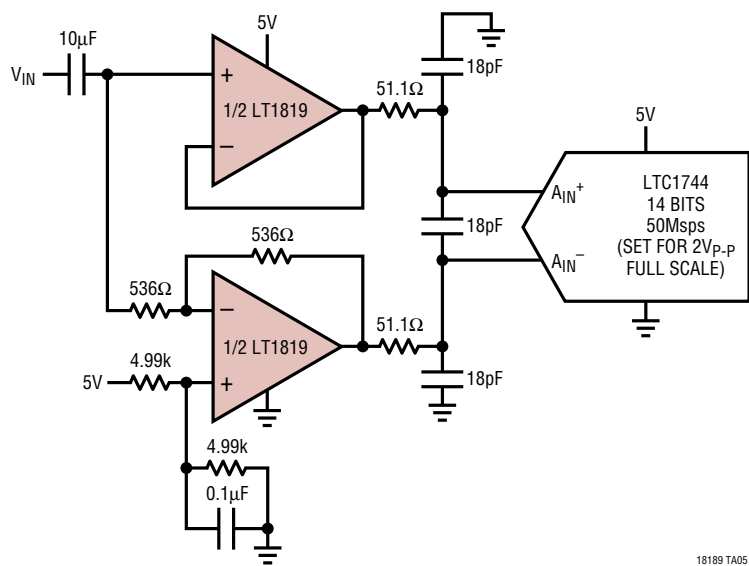
### Circuit Operation

The LT1818/LT1819 circuit topology is a true voltage feedback amplifier that has the slewing behavior of a current feedback amplifier. The operation of the circuit can be understood by referring to the Simplified Schematic. Complementary NPN and PNP emitter followers buffer the inputs and drive an internal resistor. The input voltage appears across the resistor, generating a current that is mirrored into the high impedance node.

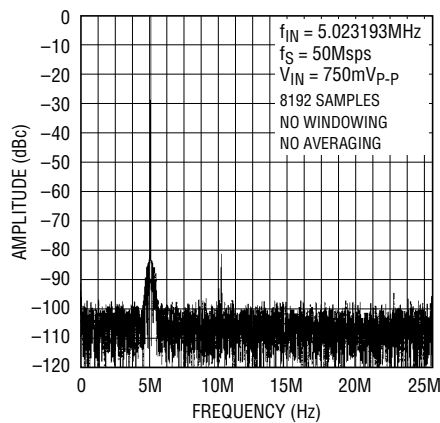
Complementary followers form an output stage that buffer the gain node from the load. The input resistor, input stage transconductance and the capacitor on the high impedance node determine the bandwidth. The slew rate is determined by the current available to charge the gain node capacitance. This current is the differential input voltage divided by  $R_1$ , so the slew rate is proportional to the input step. Highest slew rates are therefore seen in the lowest gain configurations.

TYPICAL APPLICATION

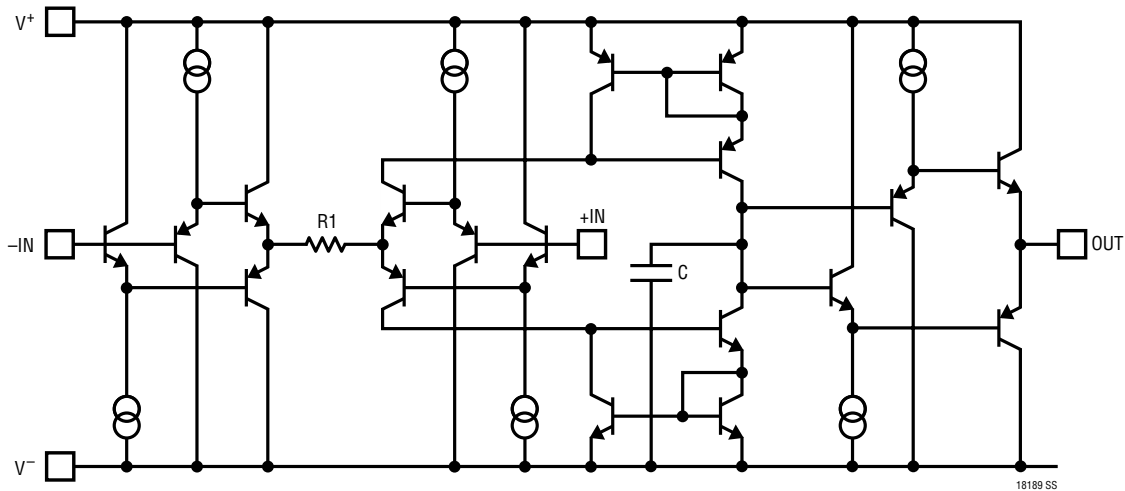
Single Supply Differential ADC Driver



Results Obtained with the Circuit of Figure 2 at 5MHz.  
FFT Shows 81dB Overall Spurious Free Dynamic Range

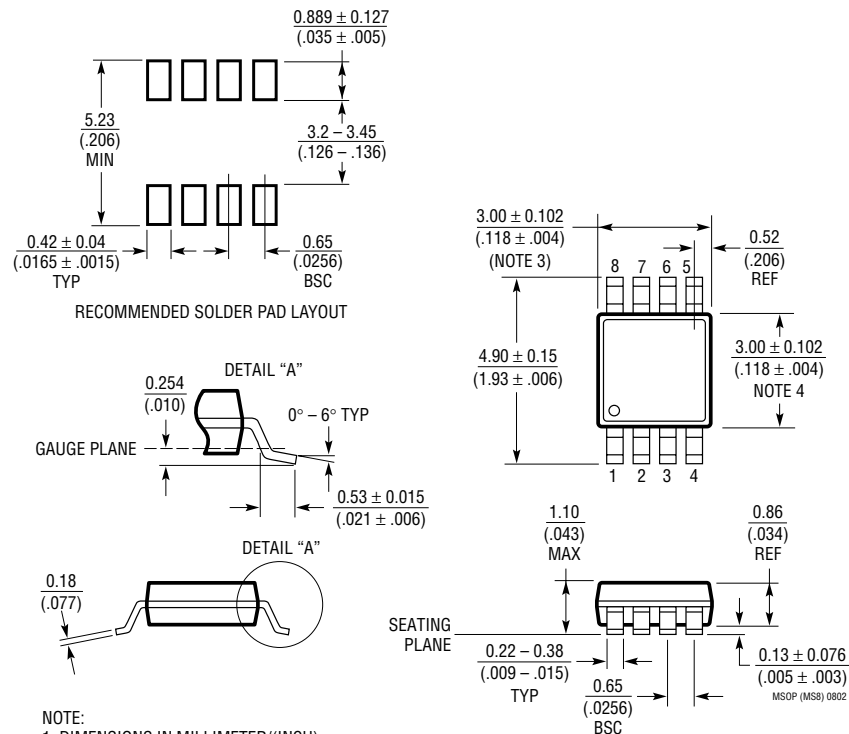


# SIMPLIFIED SCHEMATIC (One Amplifier)



## PACKAGE DESCRIPTION

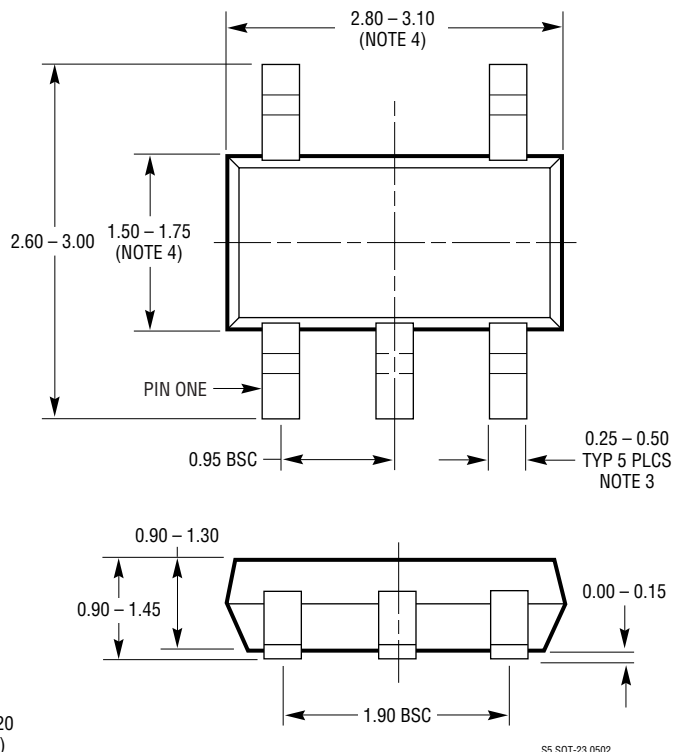
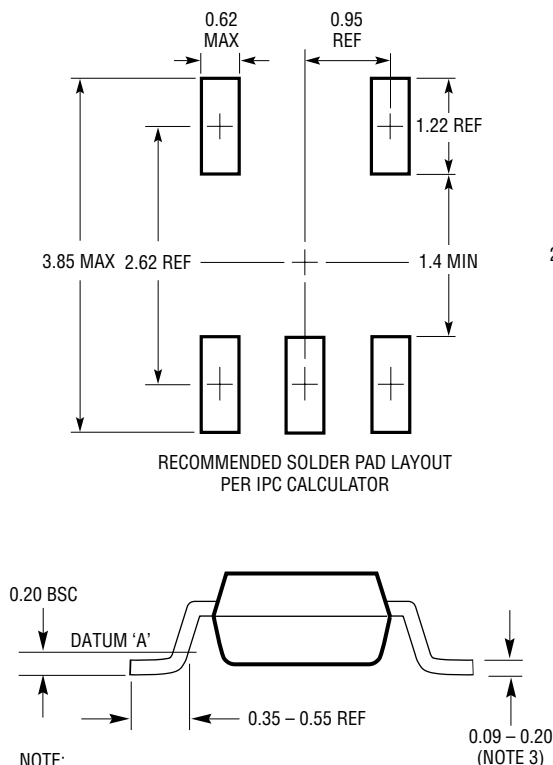
**MS8 Package**  
**8-Lead Plastic MSOP**  
(Reference LTC DWG # 05-08-1660)



- NOTE:
1. DIMENSIONS IN MILLIMETER/(INCH)
  2. DRAWING NOT TO SCALE
  3. DIMENSION DOES NOT INCLUDE MOLD FLASH, PROTRUSIONS OR GATE BURRS.  
MOLD FLASH, PROTRUSIONS OR GATE BURRS SHALL NOT EXCEED 0.152mm (.006") PER SIDE
  4. DIMENSION DOES NOT INCLUDE INTERLEAD FLASH OR PROTRUSIONS.  
INTERLEAD FLASH OR PROTRUSIONS SHALL NOT EXCEED 0.152mm (.006") PER SIDE
  5. LEAD COPLANARITY (BOTTOM OF LEADS AFTER FORMING) SHALL BE 0.102mm (.004") MAX

# PACKAGE DESCRIPTION

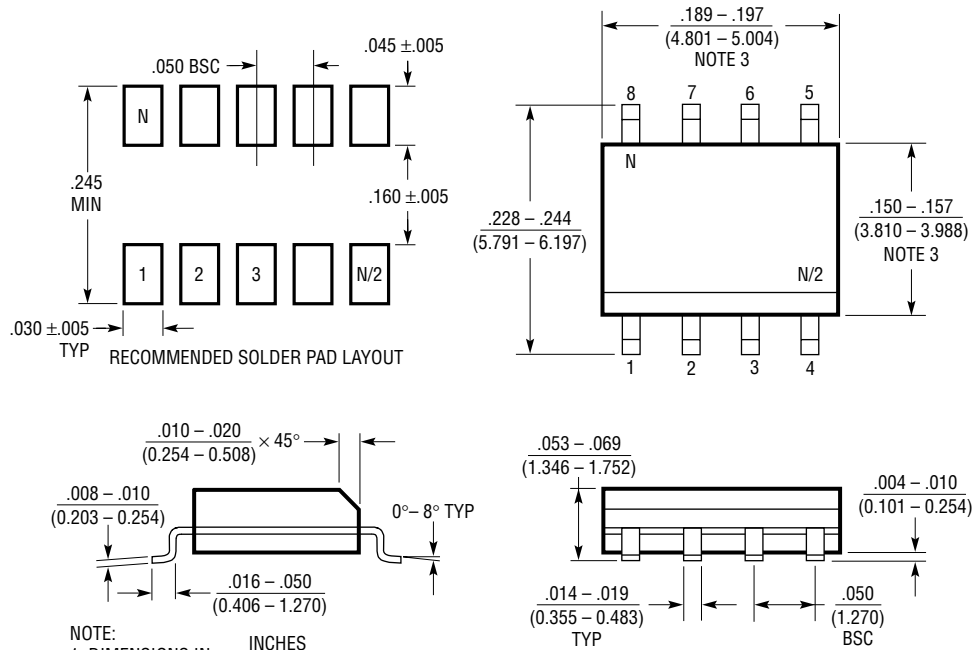
**S5 Package**  
**5-Lead Plastic SOT-23**  
 (Reference LTC DWG # 05-08-1633)



**ATTENTION: ORIGINAL SOT23-5L PACKAGE.**  
 MOST SOT23-5L PRODUCTS CONVERTED TO THIN SOT23  
 PACKAGE, DRAWING # 05-08-1635 AFTER APPROXIMATELY  
 APRIL 2001 SHIP DATE

# PACKAGE DESCRIPTION

## S8 Package 8-Lead Plastic Small Outline (Narrow .150 Inch) (Reference LTC DWG # 05-08-1610)

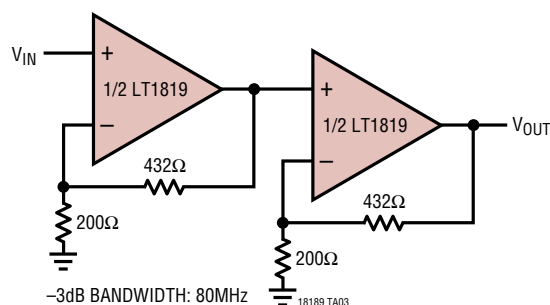


- NOTE:
1. DIMENSIONS IN INCHES (MILLIMETERS)
  2. DRAWING NOT TO SCALE
  3. THESE DIMENSIONS DO NOT INCLUDE MOLD FLASH OR PROTRUSIONS. MOLD FLASH OR PROTRUSIONS SHALL NOT EXCEED .006" (0.15mm)

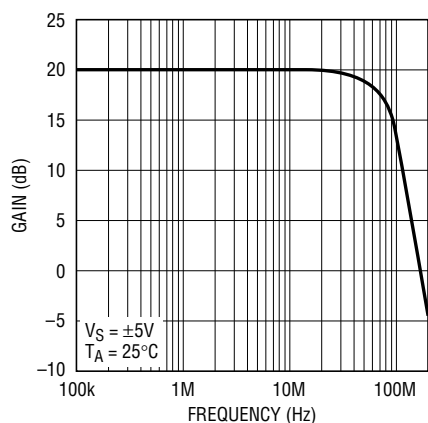
S08 0502

# TYPICAL APPLICATION

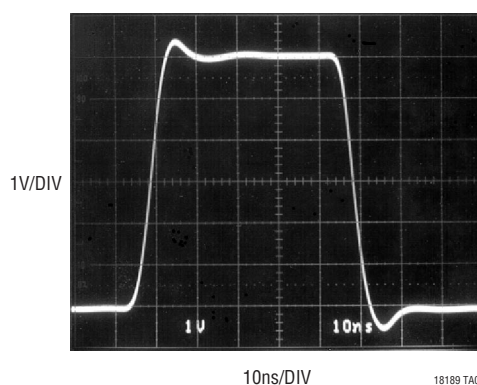
## 80MHz, 20dB Gain Block



## 20dB Gain Block Frequency Response



## Large-Signal Transient Response



# RELATED PARTS

| PART NUMBER          | DESCRIPTION                                          | COMMENTS                       |
|----------------------|------------------------------------------------------|--------------------------------|
| LT1395/LT1396/LT1397 | Single/Dual/Quad 400MHz Current Feedback Amplifiers  | 4.6mA Supply Current           |
| LT1806/LT1807        | Single/Dual 325MHz, 140V/μs Rail-to-Rail I/O Op Amps | Low Noise: 3.5nV/√Hz           |
| LT1809/LT1810        | Single/Dual 180MHz, 350V/μs Rail-to-Rail I/O Op Amps | Low Distortion: –90dBc at 5MHz |
| LT1812/LT1813/LT1814 | Single/Dual/Quad 100MHz, 750V/μs Op Amps             | Low Power: 3.6mA Max at ±5V    |
| LT1815/LT1816/LT1817 | Single/Dual/Quad 220MHz, 1500V/μs Op Amps            | Programmable Supply Current    |
| LT6203/LT6204        | Dual/Quad 100MHz, Rail-to-Rail I/O Op Amps           | 1.9nV/√Hz Noise, 3mA Max       |



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