- **Excellent Output Drive Capability**
  **$V_O$ = ±2.5 V Min at $R_L$ = 100 Ω,**
  **$V_{CC\pm}$ = ±5 V**
  **$V_O$ = ±12.5 V Min at $R_L$ = 600 Ω,**
  **$V_{CC\pm}$ = ±15 V**
- **Low Supply Current**
  **280 μA Typ Per Amplifier**
- **High Unity-Gain Bandwidth . . . 2 MHz Typ**
- **High Slew Rate . . . 3.4 V/μs Typ**
- **Macromodels Included**
- **Wide Operating Supply Voltage Range**
  **$V_{CC\pm}$ = ±3.5 V to ±19 V**
- **High Open-Loop Gain . . . 230 V/mV Typ**
- **Low Offset Voltage . . . 1 mV Max**
- **Low Offset Voltage Drift With Time**
  **0.04 μV/mo Typ**
- **Low Input Bias Current . . . 4 pA Typ**

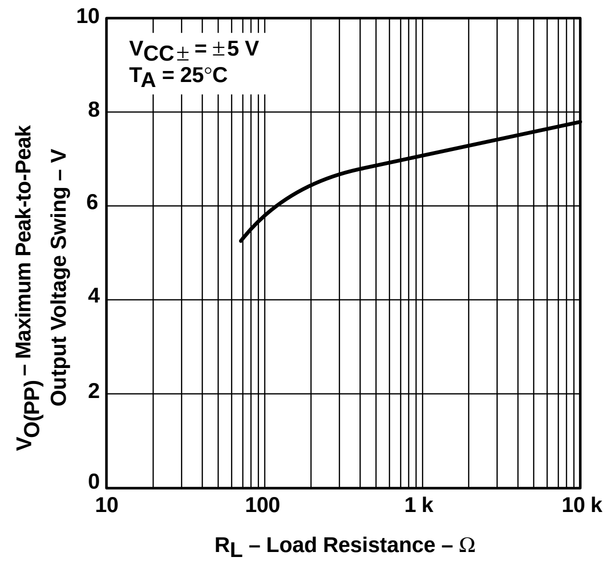
## description

The TLE2062, TLE2062A, TLE2062B, and TLE2062Y are JFET-input, low power, precision dual operational amplifiers manufactured using Texas Instruments Excalibur process. These devices combine outstanding output drive capability with low power consumption, excellent dc precision, and wide bandwidth.

In addition to maintaining the traditional JFET advantages of fast slew rates and low input bias and offset currents, the Excalibur process offers outstanding parametric stability over time and temperature. This results in a precision device remaining precise even with changes in temperature and over years of use.

The TLE2062, TLE2062A, and TLE2062B are ideal choices for any application requiring excellent dc precision, high output drive, wide bandwidth, and low power consumption.

**MAXIMUM PEAK-TO-PEAK OUTPUT VOLTAGE SWING vs LOAD RESISTANCE**




**AVAILABLE OPTIONS**

| $T_A$ | $V_{IO}$max AT 25°C | PACKAGED DEVICES SMALL OUTLINE (D) | CHIP CARRIER (FK) | CERAMIC DIP (JG) | PLASTIC DIP (P) | CHIP FORM (Y) |
|---|---|---|---|---|---|---|
| 0°C to 70°C | 1 mV<br>2 mV<br>4 mV | TLE2062BCD<br>TLE2062ACD<br>TLE2062CD | —<br>—<br>— | —<br>—<br>— | TLE2062BCP<br>TLE2062ACP<br>TLE2062CP | —<br>—<br>TLE2062Y |
| –40°C to 85°C | 1 mV<br>2 mV<br>4 mV | TLE2062BID<br>TLE2062AID<br>TLE2062ID | —<br>—<br>— | —<br>—<br>— | TLE2062BIP<br>TLE2062AIP<br>TLE2062IP | —<br>—<br>— |
| –55°C to 125°C | 1 mV<br>2 mV<br>4 mV | TLE2062BMD<br>TLE2062AMD<br>TLE2062MD | TLE2062BMFK<br>TLE2062AMFK<br>TLE2062MFK | TLE2062BMJG<br>TLE2062AMJG<br>TLE2062BMJG | TLE2062BMP<br>TLE2062AMP<br>TLE2062BMP | —<br>—<br>— |

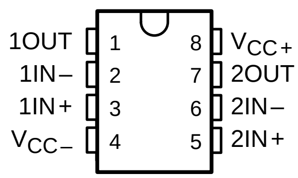
The D packages are available taped and reeled. Add R suffix to device type (e.g., TLE2062ACDR). Chips are tested at 25 °C.

## description (continued)

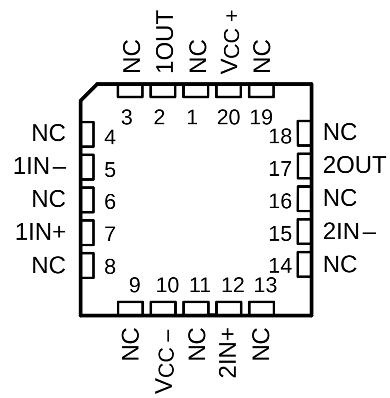
A variety of available package options includes small-outline and chip-carrier versions for high-density system applications.

The C-suffix devices are characterized for operation from 0°C to 70°C. The I-suffix devices are characterized for operation from –40°C to 85°C. The M-suffix devices are characterized for operation over the full military temperature range of –55°C to 125°C.

**D, JG, OR P PACKAGE**
**(TOP VIEW)**

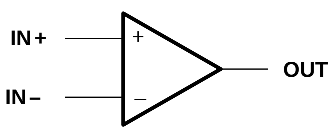



**FK PACKAGE**
**(TOP VIEW)**

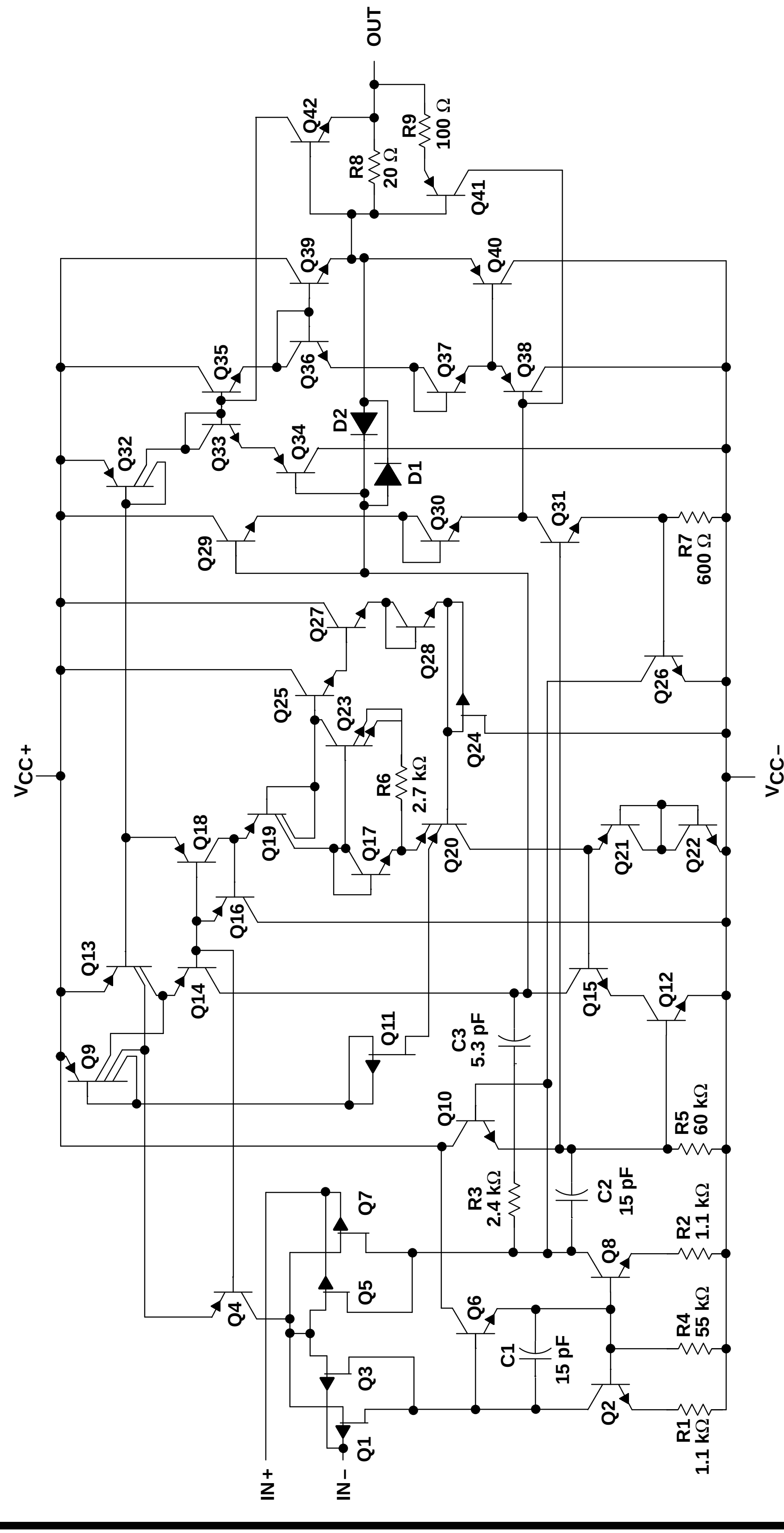



NC – No internal connection

## symbol



## equivalent schematic (each channel)



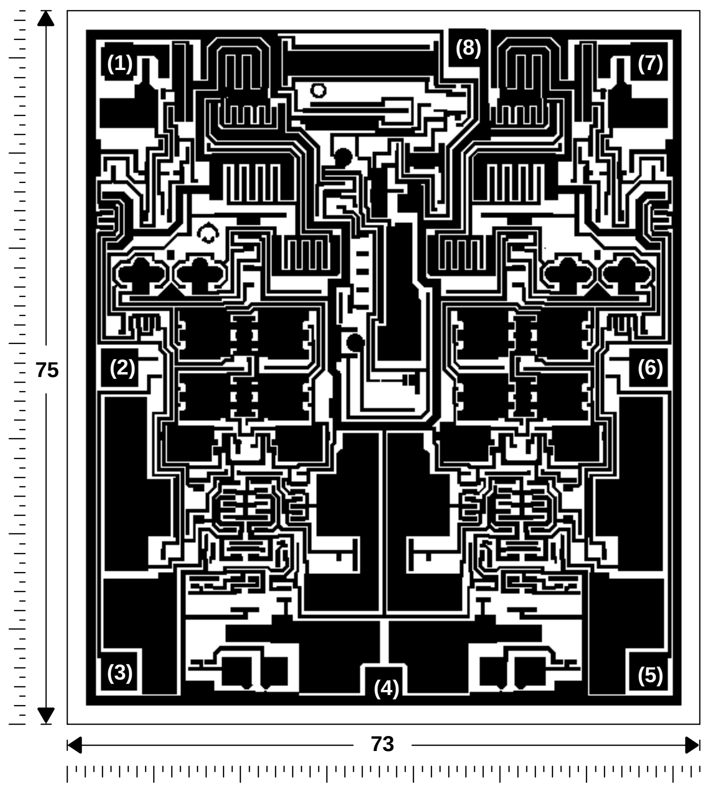

| ACTUAL DEVICE COMPONENT COUNT | |
|---|---|
| Transistors | 42 |
| Resistors | 9 |
| Diodes | 2 |
| Capacitors | 3 |

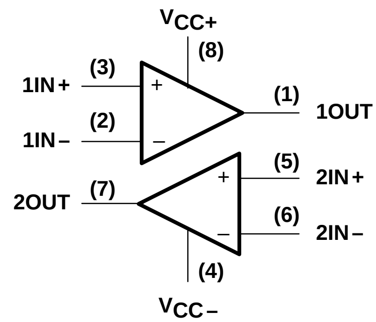
Component values are nominal.

## TLE2062Y chip information

This chip, when properly assembled, displays characteristics similar to the TLE2062. Thermal compression or ultrasonic bonding may be used on the doped-aluminum bonding pads. Chips may be mounted with conductive epoxy or a gold-silicon preform.

BONDING PAD ASSIGNMENTS




CHIP THICKNESS: 15 TYPICAL

BONDING PADS: 4 × 4 MINIMUM

$T_J$max = 150°C

TOLERANCES ARE ±10%.

ALL DIMENSIONS ARE IN MILS.

PIN (4) IS INTERNALLY CONNECTED TO BACKSIDE OF THE CHIP.

## absolute maximum ratings over operating free-air temperature range (unless otherwise noted)†

Supply voltage, $V_{CC+}$ (see Note 1) . . . 19 V
Supply voltage, $V_{CC-}$ . . . –19 V
Differential input voltage, $V_{ID}$ (see Note 2) . . . ±38 V
Input voltage, $V_I$ (any input) . . . $\pm V_{CC}$
Input current, $I_I$ (each input) . . . ±1 mA
Output current, $I_O$ (each output) . . . ±80 mA
Total current into $V_{CC+}$ . . . 80 mA
Total current out of $V_{CC-}$ . . . 80 mA
Duration of short-circuit current at (or below) 25°C (see Note 3) . . . unlimited
Continuous total dissipation . . . See Dissipation Rating Table
Operating free-air temperature range, $T_A$: C suffix . . . 0°C to 70°C
I suffix . . . –40°C to 85°C
M suffix . . . –55°C to 125°C
Storage temperature range . . . –65°C to 150°C
Case temperature for 60 seconds: FK package . . . 260°C
Lead temperature 1,6 mm (1/16 inch) from case for 10 seconds: D or P package . . . 260°C
Lead temperature 1,6 mm (1/16 inch) from case for 60 seconds: JG package . . . 300°C

† Stresses beyond those listed under "absolute maximum ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under "recommended operating conditions" is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

NOTES: 1. All voltage values, except differential voltages, are with respect to the midpoint between $V_{CC+}$ and $V_{CC-}$.
2. Differential voltages are at IN+ with respect to IN–.
3. The output may be shorted to either supply. Temperatures and/or supply voltages must be limited to ensure that the maximum dissipation rate is not exceeded.

**DISSIPATION RATING TABLE**

| PACKAGE | $T_A \le 25°C$ POWER RATING | DERATING FACTOR ABOVE $T_A = 25°C$ | $T_A = 70°C$ POWER RATING | $T_A = 85°C$ POWER RATING | $T_A = 125°C$ POWER RATING |
|---|---|---|---|---|---|
| D | 725 mW | 5.8 mW/°C | 464 mW | 377 mW | 145 mW |
| FK | 1375 mW | 11.0 mW/°C | 880 mW | 715 mW | 275 mW |
| JG | 1050 mW | 8.4 mW/°C | 672 mW | 546 mW | 210 mW |
| P | 1000 mW | 8.0 mW/°C | 640 mW | 520 mW | 200 mW |

## recommended operating conditions

| | | C SUFFIX | | I SUFFIX | | M SUFFIX | | UNIT |
|---|---|---|---|---|---|---|---|---|
| | | MIN | MAX | MIN | MAX | MIN | MAX | |
| Supply voltage, $V_{CC\pm}$ | | ±3.5 | ±18 | ±3.5 | ±18 | ±3.5 | ±18 | V |
| Common-mode input voltage, $V_{IC}$ | $V_{CC\pm} = \pm 5$ V | –1.6 | 4 | –1.6 | 4 | –1.6 | 4 | V |
| | $V_{CC\pm} = \pm 15$ V | –11 | 13 | –11 | 13 | –11 | 13 | |
| Operating free-air temperature, $T_A$ | | 0 | 70 | –40 | 85 | –55 | 125 | °C |

## electrical characteristics at specified free-air temperature, $V_{CC\pm} = \pm5$ V (unless otherwise noted)

| PARAMETER | | | TEST CONDITIONS | $T_A$† | TLE2062C TLE2062AC TLE2062BC MIN | TYP | MAX | UNIT |
|---|---|---|---|---|---|---|---|---|
| $V_{IO}$ | Input offset voltage | TLE2062C | $V_{IC} = 0$, $R_S = 50\ \Omega$ | 25°C | | 1 | 5 | mV |
| | | | | Full range | | | 5.9 | |
| | | TLE2062AC | | 25°C | | 0.9 | 4 | |
| | | | | Full range | | | 4.9 | |
| | | TLE2062BC | | 25°C | | 0.7 | 3 | |
| | | | | Full range | | | 3.9 | |
| $\alpha_{VIO}$ | Temperature coefficient of input offset voltage | | | Full range | | 6 | | μV/°C |
| | Input offset voltage long-term drift (see Note 4) | | | 25°C | | 0.04 | | μV/mo |
| $I_{IO}$ | Input offset current | | | 25°C | | 1 | | pA |
| | | | | Full range | | | 0.8 | nA |
| $I_{IB}$ | Input bias current | | | 25°C | | 3 | | pA |
| | | | | Full range | | | 2 | nA |
| $V_{ICR}$ | Common-mode input voltage range | | | 25°C | –1.6 to 4 | –2 to 6 | | V |
| | | | | Full range | –1.6 to 4 | | | V |
| $V_{OM+}$ | Maximum positive peak output voltage swing | | $R_L = 10\ k\Omega$ | 25°C | 3.5 | 3.7 | | V |
| | | | | Full range | 3.3 | | | |
| | | | $R_L = 100\ \Omega$ | 25°C | 2.5 | 3.1 | | |
| | | | | Full range | 2 | | | |
| $V_{OM-}$ | Maximum negative peak output voltage swing | | $R_L = 10\ k\Omega$ | 25°C | –3.7 | –3.9 | | V |
| | | | | Full range | –3.3 | | | |
| | | | $R_L = 100\ \Omega$ | 25°C | –2.5 | –2.7 | | |
| | | | | Full range | –2 | | | |
| $A_{VD}$ | Large-signal differential voltage amplification | | $V_O = \pm2.8$ V, $R_L = 10\ k\Omega$ | 25°C | 15 | 80 | | V/mV |
| | | | | Full range | 2 | | | |
| | | | $V_O = 0$ to 2 V, $R_L = 100\ \Omega$ | 25°C | 0.75 | 45 | | |
| | | | | Full range | 0.5 | | | |
| | | | $V_O = 0$ to –2 V, $R_L = 100\ \Omega$ | 25°C | 0.5 | 3 | | |
| | | | | Full range | 0.25 | | | |
| $r_i$ | Input resistance | | | 25°C | | $10^{12}$ | | Ω |
| $c_i$ | Input capacitance | | | 25°C | | 4 | | pF |
| $z_o$ | Open-loop output impedance | | $I_O = 0$ | 25°C | | 560 | | Ω |
| CMRR | Common-mode rejection ratio | | $V_{IC} = V_{ICR}$min, $R_S = 50\ \Omega$ | 25°C | 65 | 82 | | dB |
| | | | | Full range | 65 | | | |
| $k_{SVR}$ | Supply-voltage rejection ratio ($\Delta V_{CC\pm}/\Delta V_{IO}$) | | $V_{CC\pm} = \pm5$ V to $\pm15$ V, $R_S = 50\ \Omega$ | 25°C | 75 | 93 | | dB |
| | | | | Full range | 75 | | | |

† Full range is 0°C to 70°C.

NOTE 4: Typical values are based on the input offset voltage shift observed through 168 hours of operating life test at $T_A = 150$°C extrapolated to $T_A = 25$°C using the Arrhenius equation and assuming an activation energy of 0.96 eV.

## electrical characteristics at specified free-air temperature, $V_{CC\pm} = \pm 5$ V (unless otherwise noted) (continued)

| PARAMETER | | TEST CONDITIONS | | $T_A$† | TLE2062C TLE2062AC TLE2062BC | | | UNIT |
|---|---|---|---|---|---|---|---|---|
| | | | | | MIN | TYP | MAX | |
| $I_{CC}$ | Supply current | $V_O = 0$, | No load | 25°C | | 560 | 620 | μA |
| | | | | Full range | | | 635 | |
| $\Delta I_{CC}$ | Supply-current change over operating temperature range | | | Full range | | 26 | | μA |

† Full range is 0°C to 70°C.

## operating characteristics at specified free-air temperature, $V_{CC\pm} = \pm 5$ V

| PARAMETER | | TEST CONDITIONS | | $T_A$† | TLE2062C TLE2062AC TLE2062BC | | | UNIT |
|---|---|---|---|---|---|---|---|---|
| | | | | | MIN | TYP | MAX | |
| SR | Slew rate at unity gain (see Figure 1) | $R_L = 10$ kΩ, | $C_L = 100$ pF | 25°C | 2.2 | 3.4 | | V/μs |
| | | | | Full range | 2.1 | | | |
| $V_n$ | Equivalent input noise voltage (see Figure 2) | f = 10 Hz, | $R_S = 20$ Ω | 25°C | | 59 | 100 | nV/√Hz |
| | | f = 1 kHz, | $R_S = 20$ Ω | 25°C | | 43 | 60 | |
| $V_{N(PP)}$ | Peak-to-peak equivalent input noise voltage | f = 0.1 Hz to 10 Hz | | 25°C | | 1.1 | | μV |
| $I_n$ | Equivalent input noise current | f = 1 kHz | | 25°C | | 1 | | fA/√Hz |
| THD | Total harmonic distortion | $V_{O(PP)} = 2$ V, $A_{VD} = 2$, | $R_L = 10$ kΩ, f = 10 kHz | 25°C | | 0.025% | | |
| $B_1$ | Unity-gain bandwidth (see Figure 3) | $R_L = 10$ kΩ, | $C_L = 100$ pF | 25°C | | 1.8 | | MHz |
| | | $R_L = 100$ Ω, | $C_L = 100$ pF | 25°C | | 1.3 | | |
| | Settling time | 0.1% | | 25°C | | 5 | | μs |
| | | 0.01% | | 25°C | | 10 | | |
| $B_{OM}$ | Maximum output-swing bandwidth | $A_{VD} = 1$, | $R_L = 10$ kΩ | 25°C | | 140 | | kHz |
| $\phi_m$ | Phase margin at unity gain (see Figure 3) | $R_L = 10$ kΩ, | $C_L = 100$ pF | 25°C | | 58° | | |
| | | $R_L = 100$ Ω, | $C_L = 100$ pF | 25°C | | 75° | | |

† Full range is 0°C to 70°C.

## electrical characteristics at specified free-air temperature, $V_{CC\pm} = \pm 15$ V (unless otherwise noted)

| PARAMETER | | | TEST CONDITIONS | $T_A$† | TLE2062C, TLE2062AC, TLE2062BC MIN | TYP | MAX | UNIT |
|---|---|---|---|---|---|---|---|---|
| $V_{IO}$ | Input offset voltage | TLE2062C | $V_{IC} = 0$, $R_S = 50\ \Omega$ | 25°C | | 0.9 | 4 | mV |
| | | | | Full range | | | 4.9 | |
| | | TLE2062AC | | 25°C | | 0.8 | 2 | |
| | | | | Full range | | | 2.9 | |
| | | TLE2062BC | | 25°C | | 0.5 | 1 | |
| | | | | Full range | | | 1.9 | |
| $\alpha_{VIO}$ | Temperature coefficient of input offset voltage | | | Full range | | 6 | | μV/°C |
| | Input offset voltage long-term drift (see Note 4) | | | 25°C | | 0.04 | | μV/mo |
| $I_{IO}$ | Input offset current | | | 25°C | | 2 | | pA |
| | | | | Full range | | | 1 | nA |
| $I_{IB}$ | Input bias current | | | 25°C | | 4 | | pA |
| | | | | Full range | | | 3 | nA |
| $V_{ICR}$ | Common-mode input voltage range | | | 25°C | –11 to 13 | –12 to 16 | | V |
| | | | | Full range | –11 to 13 | | | V |
| $V_{OM+}$ | Maximum positive peak output voltage swing | | $R_L = 10\ k\Omega$ | 25°C | 13.2 | 13.7 | | V |
| | | | | Full range | 13 | | | |
| | | | $R_L = 600\ \Omega$ | 25°C | 12.5 | 13.2 | | |
| | | | | Full range | 12 | | | |
| $V_{OM-}$ | Maximum negative peak output voltage swing | | $R_L = 10\ k\Omega$ | 25°C | –13.2 | –13.7 | | V |
| | | | | Full range | –13 | | | |
| | | | $R_L = 600\ \Omega$ | 25°C | –12.5 | –13 | | |
| | | | | Full range | –12 | | | |
| $A_{VD}$ | Large-signal differential voltage amplification | | $V_O = \pm 10$ V, $R_L = 10\ k\Omega$ | 25°C | 30 | 230 | | V/mV |
| | | | | Full range | 20 | | | |
| | | | $V_O = 0$ to 8 V, $R_L = 600\ \Omega$ | 25°C | 25 | 100 | | |
| | | | | Full range | 10 | | | |
| | | | $V_O = 0$ to –8 V, $R_L = 600\ \Omega$ | 25°C | 3 | 25 | | |
| | | | | Full range | 1 | | | |
| $r_i$ | Input resistance | | | 25°C | | $10^{12}$ | | Ω |
| $c_i$ | Input capacitance | | | 25°C | | 4 | | pF |
| $z_o$ | Open-loop output impedance | | $I_O = 0$ | 25°C | | 560 | | Ω |
| CMRR | Common-mode rejection ratio | | $V_{IC} = V_{ICR}$min, $R_S = 50\ \Omega$ | 25°C | 72 | 90 | | dB |
| | | | | Full range | 70 | | | |
| $k_{SVR}$ | Supply-voltage rejection ratio ($\Delta V_{CC\pm}/\Delta V_{IO}$) | | $V_{CC\pm} = \pm 5$ V to $\pm 15$ V, $R_S = 50\ \Omega$ | 25°C | 75 | 93 | | dB |
| | | | | Full range | 75 | | | |

† Full range is 0°C to 70°C.

NOTE 4: Typical values are based on the input offset voltage shift observed through 168 hours of operating life test at $T_A$ = 150°C extrapolated to $T_A$ = 25°C using the Arrhenius equation and assuming an activation energy of 0.96 eV.

## electrical characteristics at specified free-air temperature, $V_{CC\pm} = \pm 15$ V (unless otherwise noted) (continued)

| PARAMETER | | TEST CONDITIONS | $T_A$† | TLE2062C TLE2062AC TLE2062BC | | | UNIT |
|---|---|---|---|---|---|---|---|
| | | | | MIN | TYP | MAX | |
| $I_{CC}$ | Supply current | $V_O = 0$ V, No load | 25°C | | 625 | 690 | μA |
| | | | Full range | | | 715 | |
| $\Delta I_{CC}$ | Supply-current change over operating temperature range | $V_O = 0$ V, No load | Full range | | 36 | | μA |

† Full range is 0°C to 70°C.

## operating characteristics at specified free-air temperature, $V_{CC\pm} = \pm 15$ V

| PARAMETER | | TEST CONDITIONS | | $T_A$† | TLE2062C TLE2062AC TLE2062BC | | | UNIT |
|---|---|---|---|---|---|---|---|---|
| | | | | | MIN | TYP | MAX | |
| SR | Slew rate at unity gain (see Figure 1) | $R_L = 10$ kΩ, | $C_L = 100$ pF | 25°C | 2.6 | 3.4 | | V/μs |
| | | | | Full range | 2.5 | | | |
| $V_n$ | Equivalent input noise voltage (see Figure 2) | f = 10 Hz, | $R_S = 20$ Ω | 25°C | | 70 | 100 | nV/√Hz |
| | | f = 1 kHz, | $R_S = 20$ Ω | 25°C | | 40 | 60 | |
| $V_{N(PP)}$ | Peak-to-peak equivalent input noise voltage | f = 0.1 Hz to 10 Hz | | 25°C | | 1.1 | | μV |
| $I_n$ | Equivalent input noise current | f = 1 kHz | | 25°C | | 1.1 | | fA/√Hz |
| THD | Total harmonic distortion | $V_{O(PP)} = 2$ V, $A_{VD} = 2$, | $R_L = 10$ kΩ, f = 10 kHz | 25°C | | 0.025% | | |
| $B_1$ | Unity-gain bandwidth (see Figure 3) | $R_L = 10$ kΩ, | $C_L = 10\ 0$ pF | 25°C | | 2 | | MHz |
| | | $R_L = 600$ Ω, | $C_L = 100$ pF | 25°C | | 1.5 | | |
| | Settling time | 0.1% | | 25°C | | 5 | | μs |
| | | 0.01% | | 25°C | | 10 | | |
| $B_{OM}$ | Maximum output-swing bandwidth | $A_{VD} = 1$, | $R_L = 10$ kΩ | 25°C | | 40 | | kHz |
| $\phi_m$ | Phase margin at unity gain (see Figure 3) | $R_L = 10$ kΩ, | $C_L = 100$ pF | 25°C | | 60° | | |
| | | $R_L = 600$ Ω, | $C_L = 100$ pF | 25°C | | 70° | | |

† Full range is 0°C to 70°C.

## electrical characteristics at specified free-air temperature, $V_{CC\pm} = \pm5$ V (unless otherwise noted)

| PARAMETER | | | TEST CONDITIONS | $T_A$† | TLE2062I TLE2062AI TLE2062BI MIN | TYP | MAX | UNIT |
|---|---|---|---|---|---|---|---|---|
| $V_{IO}$ | Input offset voltage | TLE2062I | $V_{IC} = 0$, $R_S = 50\ \Omega$ | 25°C | | 1 | 5 | mV |
| | | | | Full range | | | 6.3 | |
| | | TLE2062AI | | 25°C | | 0.9 | 4 | |
| | | | | Full range | | | 5.3 | |
| | | TLE2062BI | | 25°C | | 0.7 | 3 | |
| | | | | Full range | | | 4.3 | |
| $\alpha_{VIO}$ | Temperature coefficient of input offset voltage | | | Full range | | 6 | | μV/°C |
| | Input offset voltage long-term drift (see Note 4) | | | 25°C | | 0.04 | | μV/mo |
| $I_{IO}$ | Input offset current | | | 25°C | | 1 | | pA |
| | | | | Full range | | | 2 | nA |
| $I_{IB}$ | Input bias current | | | 25°C | | 3 | | pA |
| | | | | Full range | | | 4 | nA |
| $V_{ICR}$ | Common-mode input voltage range | | | 25°C | –1.6 to 4 | –2 to 6 | | V |
| | | | | Full range | –1.6 to 4 | | | V |
| $V_{OM+}$ | Maximum positive peak output voltage swing | | $R_L = 10\ k\Omega$ | 25°C | 3.5 | 3.7 | | V |
| | | | | Full range | 3.1 | | | |
| | | | $R_L = 100\ \Omega$ | 25°C | 2.5 | 3.1 | | |
| | | | | Full range | 2 | | | |
| $V_{OM-}$ | Maximum negative peak output voltage swing | | $R_L = 10\ k\Omega$ | 25°C | –3.7 | –3.9 | | V |
| | | | | Full range | –3.1 | | | |
| | | | $R_L = 100\ \Omega$ | 25°C | –2.5 | –2.7 | | |
| | | | | Full range | –2 | | | |
| $A_{VD}$ | Large-signal differential voltage amplification | | $V_O = \pm 2.8$ V, $R_L = 10\ k\Omega$ | 25°C | 15 | 80 | | V/mV |
| | | | | Full range | 2 | | | |
| | | | $V_O = 0$ to 2 V, $R_L = 100\ \Omega$ | 25°C | 0.75 | 45 | | |
| | | | | Full range | 0.5 | | | |
| | | | $V_O = 0$ to –2 V, $R_L = 100\ \Omega$ | 25°C | 0.5 | 3 | | |
| | | | | Full range | 0.25 | | | |
| $r_i$ | Input resistance | | | 25°C | | $10^{12}$ | | Ω |
| $c_i$ | Input capacitance | | | 25°C | | 4 | | pF |
| $z_o$ | Open-loop output impedance | | $I_O = 0$ | 25°C | | 560 | | Ω |
| CMRR | Common-mode rejection ratio | | $V_{IC} = V_{ICR}$min, $R_S = 50\ \Omega$ | 25°C | 65 | 82 | | dB |
| | | | | Full range | 65 | | | |
| $k_{SVR}$ | Supply-voltage rejection ratio ($\Delta V_{CC\pm}/\Delta V_{IO}$) | | $V_{CC\pm} = \pm 5$ V to $\pm 15$ V, $R_S = 50\ \Omega$ | 25°C | 75 | 93 | | dB |
| | | | | Full range | 65 | | | |

† Full range is –40°C to 85°C.

NOTE 4: Typical values are based on the input offset voltage shift observed through 168 hours of operating life test at $T_A = 150$°C extrapolated to $T_A = 25$°C using the Arrhenius equation and assuming an activation energy of 0.96 eV.

## electrical characteristics at specified free-air temperature, $V_{CC\pm} = \pm5$ V (unless otherwise noted) (continued)

| PARAMETER | | TEST CONDITIONS | | $T_A$† | TLE2062I TLE2062AI TLE2062BI | | | UNIT |
|---|---|---|---|---|---|---|---|---|
| | | | | | MIN | TYP | MAX | |
| $I_{CC}$ | Supply current | $V_O = 0$, | No load | 25°C | | 560 | 620 | μA |
| | | | | Full range | | | 640 | |
| $\Delta I_{CC}$ | Supply-current change over operating temperature range | $V_O = 0$, | No load | Full range | | 54 | | μA |

† Full range is –40°C to 85°C.

## operating characteristics at specified free-air temperature, $V_{CC\pm} = \pm5$ V

| PARAMETER | | TEST CONDITIONS | | $T_A$† | TLE2062I TLE2062AI TLE2062BI | | | UNIT |
|---|---|---|---|---|---|---|---|---|
| | | | | | MIN | TYP | MAX | |
| SR | Slew rate at unity gain (see Figure 1) | $R_L = 10\ k\Omega$, | $C_L = 100$ pF | 25°C | 2.2 | 3.4 | | V/μs |
| | | | | Full range | 1.7 | | | |
| $V_n$ | Equivalent input noise voltage (see Figure 2) | f = 10 Hz, | $R_S = 20\ \Omega$ | 25°C | | 59 | 100 | $nV/\sqrt{Hz}$ |
| | | f = 1 kHz, | $R_S = 20\ \Omega$ | 25°C | | 43 | 60 | |
| $V_{N(PP)}$ | Peak-to-peak equivalent input noise voltage | f = 0.1 Hz to 10 Hz | | 25°C | | 1.1 | | μV |
| $I_n$ | Equivalent input noise current | f = 1 kHz | | 25°C | | 1 | | $fA/\sqrt{Hz}$ |
| THD | Total harmonic distortion | $V_{O(PP)} = 2$ V, $A_{VD} = 2$, | $R_L = 10\ k\Omega$, f = 10 kHz | 25°C | | 0.025% | | |
| $B_1$ | Unity-gain bandwidth (see Figure 3) | $R_L = 10\ k\Omega$, | $C_L = 100$ pF | 25°C | | 1.8 | | MHz |
| | | $R_L = 100\ \Omega$, | $C_L = 100$ pF | 25°C | | 1.3 | | |
| | Settling time | 0.1% | | 25°C | | 5 | | μs |
| | | 0.01% | | 25°C | | 10 | | |
| $B_{OM}$ | Maximum output-swing bandwidth | $A_{VD} = 1$, | $R_L = 10\ k\Omega$ | 25°C | | 140 | | kHz |
| $\phi_m$ | Phase margin at unity gain (see Figure 3) | $R_L = 10\ k\Omega$, | $C_L = 100$ pF | 25°C | | 58° | | |
| | | $R_L = 100\ \Omega$, | $C_L = 100$ pF | 25°C | | 75° | | |

† Full range is –40°C to 85°C.

## electrical characteristics at specified free-air temperature, $V_{CC\pm} = \pm 15$ V (unless otherwise noted)

| PARAMETER | | | TEST CONDITIONS | $T_A$† | TLE2062I, TLE2062AI, TLE2062BI MIN | TYP | MAX | UNIT |
|---|---|---|---|---|---|---|---|---|
| $V_{IO}$ | Input offset voltage | TLE2062I | $V_{IC} = 0$, $R_S = 50\ \Omega$ | 25°C | | 0.9 | 4 | mV |
| | | | | Full range | | | 5.3 | |
| | | TLE2062AI | | 25°C | | 0.8 | 2 | |
| | | | | Full range | | | 3.3 | |
| | | TLE2062BI | | 25°C | | 0.5 | 1 | |
| | | | | Full range | | | 2.3 | |
| $\alpha_{VIO}$ | Temperature coefficient of input offset voltage | | | Full range | | 6 | | μV/°C |
| | Input offset voltage long-term drift (see Note 4) | | | 25°C | | 0.04 | | μV/mo |
| $I_{IO}$ | Input offset current | | | 25°C | | 2 | | pA |
| | | | | Full range | | | 3 | nA |
| $I_{IB}$ | Input bias current | | | 25°C | | 4 | | pA |
| | | | | Full range | | | 5 | nA |
| $V_{ICR}$ | Common-mode input voltage range | | | 25°C | –11 to 13 | –12 to 16 | | V |
| | | | | Full range | –11 to 13 | | | V |
| $V_{OM+}$ | Maximum positive peak output voltage swing | | $R_L = 10\ k\Omega$ | 25°C | 13.2 | 13.7 | | V |
| | | | | Full range | 13 | | | |
| | | | $R_L = 600\ \Omega$ | 25°C | 12.5 | 13.2 | | |
| | | | | Full range | 12 | | | |
| $V_{OM-}$ | Maximum negative peak output voltage swing | | $R_L = 10\ k\Omega$ | 25°C | –13.2 | –13.7 | | V |
| | | | | Full range | –13 | | | |
| | | | $R_L = 600\ \Omega$ | 25°C | –12.5 | –13 | | |
| | | | | Full range | –12 | | | |
| $A_{VD}$ | Large-signal differential voltage amplification | | $V_O = \pm 10$ V, $R_L = 10\ k\Omega$ | 25°C | 30 | 230 | | V/mV |
| | | | | Full range | 20 | | | |
| | | | $V_O = 0$ to 8 V, $R_L = 600\ \Omega$ | 25°C | 25 | 100 | | |
| | | | | Full range | 10 | | | |
| | | | $V_O = 0$ to –8 V, $R_L = 600\ \Omega$ | 25°C | 3 | 25 | | |
| | | | | Full range | 1 | | | |
| $r_i$ | Input resistance | | | 25°C | | $10^{12}$ | | Ω |
| $c_i$ | Input capacitance | | | 25°C | | 4 | | pF |
| $z_o$ | Open-loop output impedance | | $I_O = 0$ | 25°C | | 560 | | Ω |
| CMRR | Common-mode rejection ratio | | $V_{IC} = V_{ICR}$min, $R_S = 50\ \Omega$ | 25°C | 72 | 90 | | dB |
| | | | | Full range | 65 | | | |
| $k_{SVR}$ | Supply-voltage rejection ratio ($\Delta V_{CC\pm}/\Delta V_{IO}$) | | $V_{CC\pm} = \pm 5$ V to $\pm 15$ V, $R_S = 50\ \Omega$ | 25°C | 75 | 93 | | dB |
| | | | | Full range | 65 | | | |

† Full range is –40°C to 85°C.

NOTE 4: Typical values are based on the input offset voltage shift observed through 168 hours of operating life test at $T_A = 150$°C extrapolated to $T_A = 25$°C using the Arrhenius equation and assuming an activation energy of 0.96 eV.

## electrical characteristics at specified free-air temperature, $V_{CC\pm} = \pm 15$ V (unless otherwise noted) (continued)

| PARAMETER | | TEST CONDITIONS | $T_A$† | TLE2062I TLE2062AI TLE2062BI MIN | TYP | MAX | UNIT |
|---|---|---|---|---|---|---|---|
| $I_{CC}$ | Supply current | $V_O = 0$, No load | 25°C | | 625 | 690 | μA |
| | | | Full range | | | 720 | |
| $\Delta I_{CC}$ | Supply-current change over operating temperature range | | Full range | | 74 | | μA |

† Full range is –40°C to 85°C.

## operating characteristics at specified free-air temperature, $V_{CC\pm} = \pm 15$ V

| PARAMETER | | TEST CONDITIONS | | $T_A$† | TLE2062I TLE2062AI TLE2062BI MIN | TYP | MAX | UNIT |
|---|---|---|---|---|---|---|---|---|
| SR | Slew rate at unity gain (see Figure 1) | $R_L = 10$ kΩ, | $C_L = 100$ pF | 25°C | 2.6 | 3.4 | | V/μs |
| | | | | Full range | 2.1 | | | |
| $V_n$ | Equivalent input noise voltage (see Figure 2) | f = 10 Hz, | $R_S = 20$ Ω | 25°C | | 70 | 100 | nV/√Hz |
| | | f = 1 kHz, | $R_S = 20$ Ω | 25°C | | 40 | 60 | |
| $V_{N(PP)}$ | Peak-to-peak equivalent input noise voltage | f = 0.1 Hz to 10 Hz | | 25°C | | 1.1 | | μV |
| $I_n$ | Equivalent input noise current | f = 1 kHz | | 25°C | | 1.1 | | fA/√Hz |
| THD | Total harmonic distortion | $V_{O(PP)} = 2$ V, $A_{VD} = 2$, | $R_L = 10$ kΩ, f = 10 kHz | 25°C | | 0.025% | | |
| $B_1$ | Unity-gain bandwidth (see Figure 3) | $R_L = 10$ kΩ, | $C_L = 100$ pF | 25°C | | 2 | | MHz |
| | | $R_L = 600$ Ω, | $C_L = 100$ pF | 25°C | | 1.5 | | |
| | Settling time | 0.1% | | 25°C | | 5 | | μs |
| | | 0.01% | | 25°C | | 10 | | |
| $B_{OM}$ | Maximum output-swing bandwidth | $A_{VD} = 1$, | $R_L = 10$ kΩ | 25°C | | 40 | | kHz |
| $\phi_m$ | Phase margin at unity gain (see Figure 3) | $R_L = 10$ kΩ, | $C_L = 100$ pF | 25°C | | 60° | | |
| | | $R_L = 600$ Ω, | $C_L = 100$ pF | 25°C | | 70° | | |

† Full range is –40°C to 85°C.

## electrical characteristics at specified free-air temperature, $V_{CC\pm} = \pm 5$ V

| PARAMETER | | | TEST CONDITIONS | $T_A$† | TLE2062M, TLE2062AM, TLE2062BM MIN | TYP | MAX | UNIT |
|---|---|---|---|---|---|---|---|---|
| $V_{IO}$ | Input offset voltage | TLE2062M | $V_{IC} = 0$, $R_S = 50\ \Omega$ | 25°C | | 1 | 5 | mV |
| | | | | Full range | | | 7 | |
| | | TLE2062AM | | 25°C | | 0.9 | 4 | |
| | | | | Full range | | | 6 | |
| | | TLE2062BM | | 25°C | | 0.7 | 3 | |
| | | | | Full range | | | 5 | |
| $\alpha_{VIO}$ | Temperature coefficient of input offset voltage | | | Full range | | 6 | | μV/°C |
| | Input offset voltage long-term drift (see Note 4) | | | 25°C | | 0.04 | | μV/mo |
| $I_{IO}$ | Input offset current | | | 25°C | | 1 | | pA |
| | | | | Full range | | | 15 | nA |
| $I_{IB}$ | Input bias current | | | 25°C | | 3 | | pA |
| | | | | Full range | | | 30 | nA |
| $V_{ICR}$ | Common-mode input voltage range | | | 25°C | –1.6 to 4 | –2 to 6 | | V |
| | | | | Full range | –1.6 to 4 | | | V |
| $V_{OM+}$ | Maximum positive peak output voltage swing | | $R_L = 10\ k\Omega$ | 25°C | 3.5 | 3.7 | | V |
| | | | | Full range | 3 | | | |
| | | FK and JG packages | $R_L = 600\ \Omega$ | 25°C | 2.5 | 3.6 | | |
| | | | | Full range | 2 | | | |
| | | D and P packages | $R_L = 100\ \Omega$ | 25°C | 2.5 | 3.1 | | |
| | | | | Full range | 2 | | | |
| $V_{OM-}$ | Maximum negative peak output voltage swing | | $R_L = 10\ k\Omega$ | 25°C | –3.5 | –3.9 | | V |
| | | | | Full range | –3 | | | |
| | | FK and JG packages | $R_L = 600\ \Omega$ | 25°C | –2.5 | –3.5 | | |
| | | | | Full range | –2 | | | |
| | | D and P packages | $R_L = 100\ \Omega$ | 25°C | –2.5 | –2.7 | | |
| | | | | Full range | –2 | | | |
| $A_{VD}$ | Large-signal differential voltage amplification | | $V_O = \pm 2.8$ V, $R_L = 10\ k\Omega$ | 25°C | 15 | 80 | | V/mV |
| | | | | Full range | 2 | | | |
| | | FK and JG packages | $V_O = 0$ to 2.5 V, $R_L = 600\ \Omega$ | 25°C | 1 | 65 | | |
| | | | | Full range | 0.5 | | | |
| | | | $V_O = 0$ to –2.5 V, $R_L = 600\ \Omega$ | 25°C | 1 | 16 | | |
| | | | | Full range | 0.5 | | | |
| | | D and P packages | $V_O = 0$ to 2 V, $R_L = 100\ \Omega$ | 25°C | 0.75 | 45 | | |
| | | | | Full range | 0.5 | | | |
| | | | $V_O = 0$ to –2 V, $R_L = 100\ \Omega$ | 25°C | 0.5 | 3 | | |
| | | | | Full range | 0.25 | | | |

† Full range is –55°C to 125°C.

NOTE 4: Typical values are based on the input offset voltage shift observed through 168 hours of operating life test at $T_A = 150$°C extrapolated to $T_A = 25$°C using the Arrhenius equation and assuming an activation energy of 0.96 eV.

## electrical characteristics at specified free-air temperature, $V_{CC\pm} = \pm 5$ V (unless otherwise noted)

| PARAMETER | | TEST CONDITIONS | $T_A$† | TLE2062M TLE2062AM TLE2062BM | | | UNIT |
|---|---|---|---|---|---|---|---|
| | | | | MIN | TYP | MAX | |
| $r_i$ | Input resistance | | 25°C | | $10^{12}$ | | Ω |
| $c_i$ | Input capacitance | | 25°C | | 4 | | pF |
| $z_o$ | Open-loop output impedance | $I_O = 0$ | 25°C | | 560 | | Ω |
| CMRR | Common-mode rejection ratio | $V_{IC} = V_{ICR}$min, $R_S = 50\ \Omega$, | 25°C | 65 | 82 | | dB |
| | | | Full range | 60 | | | |
| $k_{SVR}$ | Supply-voltage rejection ratio ($\Delta V_{CC\pm}/\Delta V_{IO}$) | $V_{CC\pm} = \pm 5$ V to $\pm 15$ V, $R_S = 50\ \Omega$ | 25°C | 75 | 93 | | dB |
| | | | Full range | 65 | | | |
| $I_{CC}$ | Supply current (two amplifiers) | $V_O = 0$, No load | 25°C | | 560 | 620 | μA |
| | | | Full range | | | 650 | |
| $\Delta I_{CC}$ | Supply-current change over operating temperature range (two amplifiers) | | Full range | | 72 | | μA |

† Full range is –55°C to 125°C.

## operating characteristics at specified free-air temperature, $T_A = 25°C$, $V_{CC\pm} = \pm 5$ V

| PARAMETER | | TEST CONDITIONS | | TLE2062M TLE2062AM TLE2062BM | | | UNIT |
|---|---|---|---|---|---|---|---|
| | | | | MIN | TYP | MAX | |
| SR | Slew rate at unity gain (see Figure 1) | $R_L = 10\ k\Omega$, | $C_L = 100$ pF | | 3.4 | | V/μs |
| $V_n$ | Equivalent input noise voltage (see Figure 2) | f = 10 Hz, | $R_S = 20\ \Omega$ | | 59 | | nV/√Hz |
| | | f = 1 kHz, | $R_S = 20\ \Omega$ | | 43 | | |
| $V_{N(PP)}$ | Peak-to-peak equivalent input noise voltage | f = 0.1 Hz to 10 Hz | | | 1.1 | | μV |
| $I_n$ | Equivalent input noise current | f = 1 kHz | | | 1 | | fA/√Hz |
| THD | Total harmonic distortion | $V_{O(PP)} = 2$ V, $A_{VD} = 2$, | $R_L = 10\ k\Omega$, f = 10 kHz | | 0.025% | | |
| $B_1$ | Unity-gain bandwidth (see Figure 3) | $R_L = 10\ k\Omega$, | $C_L = 100$ pF | | 1.8 | | MHz |
| | | $R_L = 600\ \Omega$, | $C_L = 100$ pF | | 1.3 | | |
| | Settling time | 0.1% | | | 5 | | μs |
| | | 0.01% | | | 10 | | |
| $B_{OM}$ | Maximum output-swing bandwidth | $A_{VD} = 1$, | $R_L = 10\ k\Omega$ | | 140 | | kHz |
| $\phi_m$ | Phase margin at unity gain (see Figure 3) | $R_L = 10\ k\Omega$, | $C_L = 100$ pF | | 58° | | |
| | | $R_L = 600\ \Omega$, | $C_L = 100$ pF | | 75° | | |

† Full range is –55°C to 125°C.

## electrical characteristics at specified free-air temperature, $V_{CC\pm} = \pm 15$ V (unless otherwise noted)

| PARAMETER | | | TEST CONDITIONS | $T_A$† | TLE2062M TLE2062AM TLE2062BM MIN | TYP | MAX | UNIT |
|---|---|---|---|---|---|---|---|---|
| $V_{IO}$ | Input offset voltage | TLE2062M | $V_{IC} = 0$, $R_S = 50\ \Omega$ | 25°C | | 0.9 | 4 | mV |
| | | | | Full range | | | 6 | |
| | | TLE2062AM | | 25°C | | 0.8 | 2 | |
| | | | | Full range | | | 4 | |
| | | TLE2062BM | | 25°C | | 0.5 | 1 | |
| | | | | Full range | | | 3 | |
| $\alpha_{VIO}$ | Temperature coefficient of input offset voltage | | | Full range | | 6 | | μV/°C |
| | Input offset voltage long-term drift (see Note 4) | | | 25°C | | 0.04 | | μV/mo |
| $I_{IO}$ | Input offset current | | | 25°C | | 2 | | pA |
| | | | | Full range | | | 20 | nA |
| $I_{IB}$ | Input bias current | | | 25°C | | 4 | | pA |
| | | | | Full range | | | 40 | nA |
| $V_{ICR}$ | Common-mode input voltage range | | | 25°C | –11 to 13 | –12 to 16 | | V |
| | | | | Full range | –11 to 13 | | | V |
| $V_{OM+}$ | Maximum positive peak output voltage swing | | $R_L = 10\ k\Omega$ | 25°C | 13 | 13.7 | | V |
| | | | | Full range | 12.5 | | | |
| | | | $R_L = 600\ \Omega$ | 25°C | 12.5 | 13.2 | | |
| | | | | Full range | 11 | | | |
| $V_{OM-}$ | Maximum negative peak output voltage swing | | $R_L = 10\ k\Omega$ | 25°C | –13 | –13.7 | | V |
| | | | | Full range | –12.5 | | | |
| | | | $R_L = 600\ \Omega$ | 25°C | –12.5 | –13 | | |
| | | | | Full range | –11 | | | |
| $A_{VD}$ | Large-signal differential voltage amplification | | $V_O = \pm 10$ V, $R_L = 10\ k\Omega$ | 25°C | 30 | 230 | | V/mV |
| | | | | Full range | 20 | | | |
| | | | $V_O = 0$ to 8 V, $R_L = 600\ \Omega$ | 25°C | 25 | 100 | | |
| | | | | Full range | 7 | | | |
| | | | $V_O = 0$ to –8 V, $R_L = 600\ \Omega$ | 25°C | 3 | 25 | | |
| | | | | Full range | 1 | | | |
| $r_i$ | Input resistance | | | 25°C | | $10^{12}$ | | Ω |
| $c_i$ | Input capacitance | | | 25°C | | 4 | | pF |
| $z_o$ | Open-loop output impedance | | $I_O = 0$ | 25°C | | 560 | | Ω |
| CMRR | Common-mode rejection ratio | | $V_{IC} = V_{ICR}$min, $R_S = 50\ \Omega$ | 25°C | 72 | 90 | | dB |
| | | | | Full range | 65 | | | |
| $k_{SVR}$ | Supply-voltage rejection ratio ($\Delta V_{CC\pm} / \Delta V_{IO}$) | | $V_{CC\pm} = \pm 5$ V to $\pm 15$ V, $R_S = 50\ \Omega$ | 25°C | 75 | 93 | | dB |
| | | | | Full range | 65 | | | |

† Full range is –55°C to 125°C.

NOTE 4: Typical values are based on the input offset voltage shift observed through 168 hours of operating life test at $T_A = 150$°C extrapolated to $T_A = 25$°C using the Arrhenius equation and assuming an activation energy of 0.96 eV.

## electrical characteristics at specified free-air temperature, $V_{CC\pm} = \pm15$ V (unless otherwise noted)

| PARAMETER | | TEST CONDITIONS | $T_A$† | TLE2062M TLE2062AM TLE2062BM MIN | TYP | MAX | UNIT |
|---|---|---|---|---|---|---|---|
| $I_{CC}$ | Supply current | $V_O = 0$, No load | 25°C | | 625 | 690 | μA |
| | | | Full range | | | 730 | |
| $\Delta I_{CC}$ | Supply-current change over operating temperature range | | Full range | | 97 | | μA |

† Full range is –55°C to 125°C.

## operating characteristics at specified free-air temperature, $V_{CC\pm} = \pm15$ V

| PARAMETER | | TEST CONDITIONS | $T_A$† | TLE2062M TLE2062AM TLE2062BM MIN | TYP | MAX | UNIT |
|---|---|---|---|---|---|---|---|
| SR | Slew rate at unity gain (see Figure 1) | $R_L = 10$ kΩ, $C_L = 100$ pF | 25°C | 2 | 3.4 | | V/μs |
| | | | Full range | 1.8 | | | |
| $V_n$ | Equivalent input noise voltage (see Figure 2) | f = 10 Hz, $R_S = 20$ Ω | 25°C | | 70 | | nV/√Hz |
| | | f = 1 kHz, $R_S = 20$ Ω | 25°C | | 40 | | |
| $V_{N(PP)}$ | Peak-to-peak equivalent input noise voltage | f = 0.1 Hz to 10 Hz | 25°C | | 1.1 | | μV |
| $I_n$ | Equivalent input noise current | f = 1 kHz | 25°C | | 1.1 | | fA/√Hz |
| THD | Total harmonic distortion | $V_{O(PP)} = 2$ V, $R_L = 10$ kΩ, $A_{VD} = 2$, f = 10 kHz | 25°C | | 0.025% | | |
| $B_1$ | Unity-gain bandwidth (see Figure 3) | $R_L = 10$ kΩ, $C_L = 100$ pF | 25°C | | 2 | | MHz |
| | | $R_L = 600$ Ω, $C_L = 100$ pF | 25°C | | 1.5 | | |
| | Settling time | 0.1% | 25°C | | 5 | | μs |
| | | 0.01% | 25°C | | 10 | | |
| $B_{OM}$ | Maximum output-swing bandwidth | $A_{VD} = 1$, $R_L = 10$ kΩ | 25°C | | 40 | | kHz |
| $\phi_m$ | Phase margin at unity gain (see Figure 3) | $R_L = 10$ kΩ, $C_L = 100$ pF | 25°C | | 60° | | |
| | | $R_L = 600$ Ω, $C_L = 100$ pF | 25°C | | 70° | | |

† Full range is –55°C to 125°C.

## electrical characteristics at $V_{CC\pm}$ = ±15 V, $T_A$ = 25°C (unless otherwise noted)

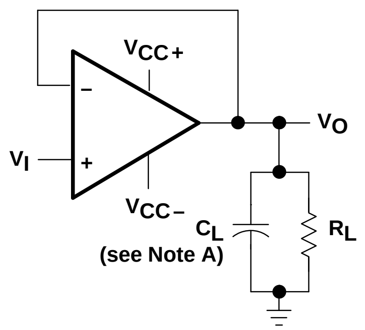
| PARAMETER | | TEST CONDITIONS | | TLE2062Y | | | UNIT |
|---|---|---|---|---|---|---|---|
| | | | | MIN | TYP | MAX | |
| $V_{IO}$ | Input offset voltage | $V_{IC}$ = 0, | $R_S$ = 50 Ω | | 0.9 | 4 | mV |
| $\alpha_{VIO}$ | Input offset voltage long-term drift (see Note 4) | $V_{IC}$ = 0, | $R_S$ = 50 Ω | | 0.04 | | μV/mo |
| $I_{IO}$ | Input offset current | $V_{IC}$ = 0, | $R_S$ = 50 Ω | | 2 | | pA |
| $I_{IB}$ | Input bias current | $V_{IC}$ = 0, | $R_S$ = 50 Ω | | 4 | | pA |
| $V_{ICR}$ | Common-mode input voltage range | | | –11 to 13 | –12 to 16 | | V |
| $V_{OM+}$ | Maximum positive peak output voltage swing | $R_L$ = 10 kΩ | | 13.2 | 13.7 | | V |
| | | $R_L$ = 600 Ω | | 12.5 | 13.2 | | |
| $V_{OM-}$ | Maximum negative peak output voltage swing | $R_L$ = 10 kΩ | | –13.2 | –13.7 | | V |
| | | $R_L$ = 600 Ω | | –12.5 | –13 | | |
| $A_{VD}$ | Large-signal differential voltage amplification | $V_O$ = ±10 V, | $R_L$ = 10 kΩ | 30 | 230 | | V/mV |
| | | $V_O$ = 0 to 8 V, | $R_L$ = 600 Ω | 25 | 100 | | |
| | | $V_O$ = 0 to –8 V, | $R_L$ = 600 Ω | 3 | 25 | | |
| $r_i$ | Input resistance | | | | $10^{12}$ | | Ω |
| $c_i$ | Input capacitance | | | | 4 | | pF |
| $z_o$ | Open-loop output impedance | $I_O$ = 0 | | | 560 | | Ω |
| CMRR | Common-mode rejection ratio | $V_{IC}$ = $V_{ICR}$min, | $R_S$ = 50 Ω | 72 | 90 | | dB |
| $k_{SVR}$ | Supply-voltage rejection ratio ($\Delta V_{CC}/\Delta V_{IO}$) | $V_{CC\pm}$ = ±5 V to ±15 V, $R_S$ = 50 Ω | | 75 | 93 | | dB |
| $I_{CC}$ | Supply current | $V_O$ = 0, | No load | | 625 | 690 | μA |

NOTE 4: Typical values are based on the input offset voltage shift observed through 168 hours of operating life test at $T_A$ = 150°C extrapolated to $T_A$ = 25°C using the Arrhenius equation and assuming an activation energy of 0.96 eV.

## operating characteristics at $V_{CC\pm}$ = ±15 V, $T_A$ = 25°C

| PARAMETER | | TEST CONDITIONS | | TLE2062Y | | | UNIT |
|---|---|---|---|---|---|---|---|
| | | | | MIN | TYP | MAX | |
| SR | Slew rate at unity gain | $R_L$ = 10 kΩ, | $C_L$ = 100 pF | 2.6 | 3.4 | 4 | V/μs |
| $V_n$ | Equivalent input noise voltage (see Figure 2) | f = 10 Hz, | $R_S$ = 20 Ω | | 70 | | nV/√Hz |
| | | f = 1 kHz, | $R_S$ = 20 Ω | | 40 | | |
| $V_{N(PP)}$ | Peak-to-peak equivalent input noise voltage | f = 0.1 Hz to 10 Hz | | | 1.1 | | μV |
| $I_n$ | Equivalent input noise current | f = 1 Hz | | | 1.1 | | fA/√Hz |
| THD | Total harmonic distortion | $V_{O(PP)}$ = 2 V, $A_{VD}$ = 2, | $R_L$ = 10 kΩ, f = 10 kHz | | 0.025% | | |
| $B_1$ | Unity-gain bandwidth (see Figure 3) | $R_L$ = 10 kΩ, | $C_L$ = 100 pF | | 2 | | MHz |
| | | $R_L$ = 600 Ω, | $C_L$ = 100 pF | | 1.5 | | |
| | Settling time | 0.1% | | | 5 | | μs |
| | | 0.01% | | | 10 | | |
| $B_{OM}$ | Maximum output-swing bandwidth | $A_{VD}$ = 1, | $R_L$ = 10 kΩ | | 40 | | kHz |
| $\phi_m$ | Phase margin at unity gain (see Figure 3) | $R_L$ = 10 kΩ, | $C_L$ = 100 pF | | 60° | | |
| | | $R_L$ = 600 Ω, | $C_L$ = 100 pF | | 70° | | |

## PARAMETER MEASUREMENT INFORMATION




NOTE A: $C_L$ includes fixture capacitance.

**Figure 1. Slew-Rate Test Circuit**

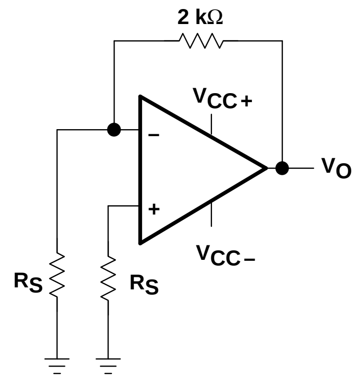
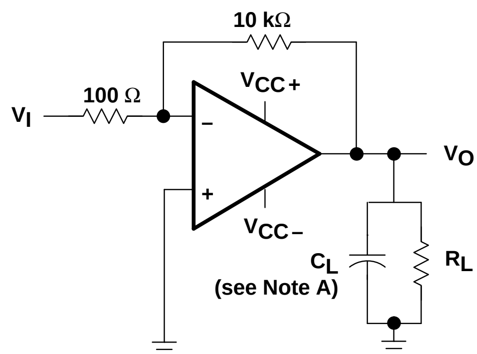



**Figure 2. Noise-Voltage Test Circuit**




NOTE A: $C_L$ includes fixture capacitance.

**Figure 3. Unity-Gain Bandwidth and Phase-Margin Test Circuit**

### typical values

Typical values presented in this data sheet represent the median (50% point) of device parametric performance.

### input bias offset current

At the picoamp bias current level typical of the TLE2062, TLE2062A, and TLE2062B, accurate measurement of the bias current becomes difficult. Not only does this measurement require a picoammeter, but test socket leakages can easily exceed the actual device bias currents. To accurately measure these small currents, Texas Instruments uses a two-step process. The socket leakage is measured using picoammeters with bias voltages applied but with no device in the socket. The device is then inserted into the socket and a second test that measures both the socket leakage and the device input bias current is performed. The two measurements are then subtracted algebraically to determine the bias current of the device.

## TYPICAL CHARACTERISTICS

### Table of Graphs

| | | | FIGURE |
|---|---|---|---|
| $V_{IO}$ | Input offset voltage | Distribution | 4 |
| $I_{IB}$ | Input bias current | vs Common-mode voltage<br>vs Free-air temperature | 5<br>6 |
| $I_{IO}$ | Input offset current | vs Free-air temperature | 6 |
| $V_{ICR}$ | Common-mode input voltage range | vs Free-air temperature | 7 |
| $V_{OM}$ | Maximum peak output voltage swing | vs Output current<br>vs Supply voltage | 8,9<br>10,11,12 |
| $V_{O(PP)}$ | Maximum peak-to-peak output voltage | vs Frequency | 13,14 |
| $A_{VD}$ | Large-signal differential voltage amplification | vs Frequency<br>vs Free-air temperature | 15<br>16 |
| $I_{OS}$ | Short-circuit output current | vs Time<br>vs Free-air temperature | 17<br>18 |
| $z_o$ | Output impedance | vs Frequency | 19 |
| CMRR | Common-mode rejection ratio | vs Frequency | 20 |
| $I_{CC}$ | Supply current | vs Supply voltage<br>vs Free-air temperature | 21<br>22 |
| | Pulse response | Small signal<br>Large signal | 23,24<br>25,26 |
| | Noise voltage (referred to input) | 0.1 to 10 Hz | 27 |
| $V_n$ | Equivalent input noise voltage | vs Frequency | 28 |
| THD | Total harmonic distortion | vs Frequency | 29,30 |
| $B_1$ | Unity-gain bandwidth | vs Supply voltage<br>vs Free-air temperature | 31<br>32 |
| $\phi_m$ | Phase margin | vs Supply voltage<br>vs Load capacitance<br>vs Free-air temperature | 33<br>34<br>35 |
| | Phase shift | vs Frequency | 15 |

## TYPICAL CHARACTERISTICS†

**TLE2062
DISTRIBUTION OF
INPUT OFFSET VOLTAGE**

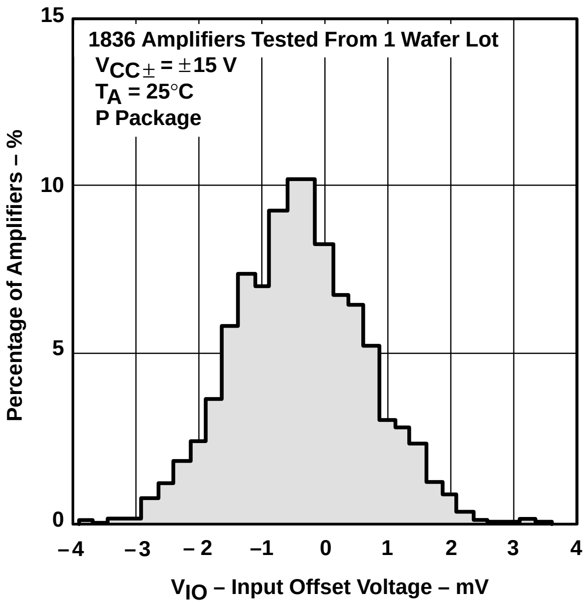



Figure 4

**INPUT BIAS CURRENT
vs
COMMON-MODE INPUT VOLTAGE**

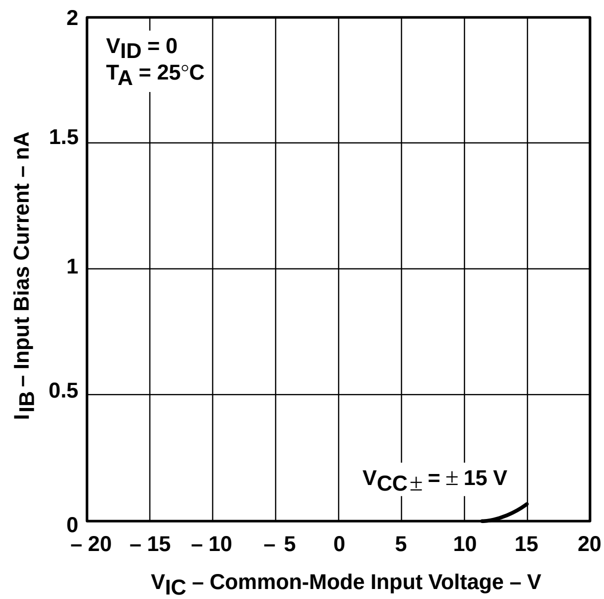



Figure 5

**INPUT BIAS CURRENT
AND INPUT OFFSET CURRENT
vs
FREE-AIR TEMPERATURE**

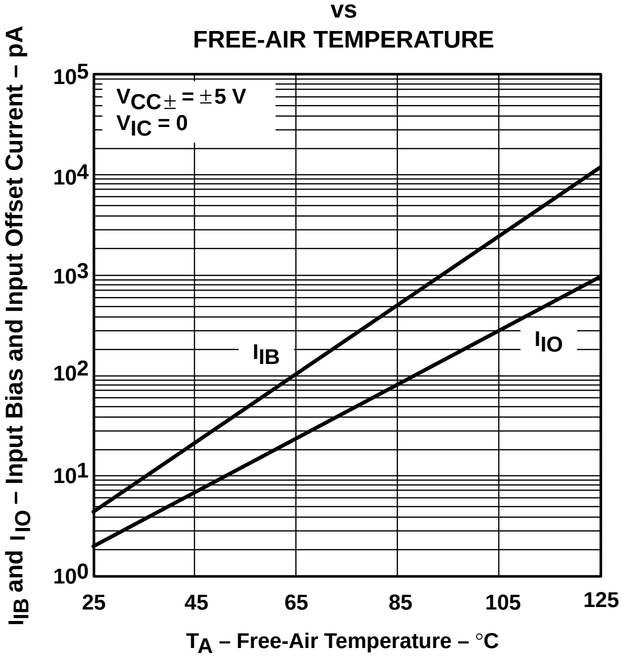



Figure 6

**COMMON-MODE INPUT VOLTAGE
vs
FREE-AIR TEMPERATURE**

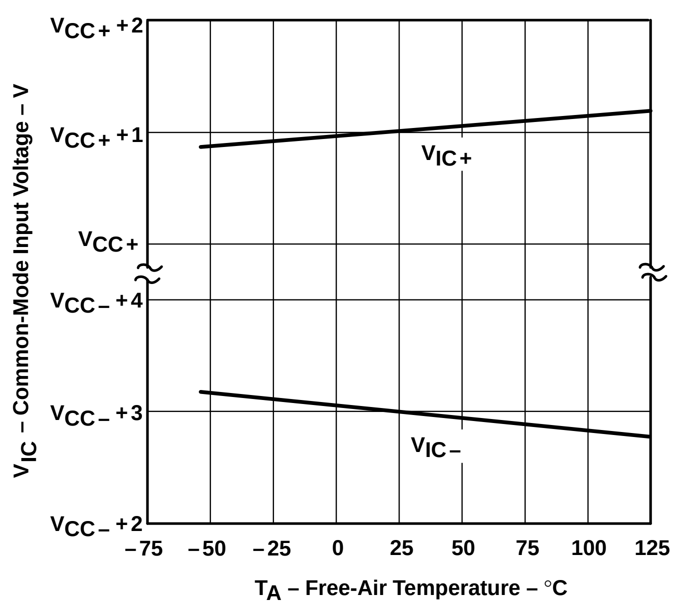



Figure 7

† Data at high and low temperatures are applicable only within the rated operating free-air temperature ranges of the various devices.

## TYPICAL CHARACTERISTICS

**MAXIMUM POSITIVE PEAK OUTPUT VOLTAGE vs OUTPUT CURRENT**

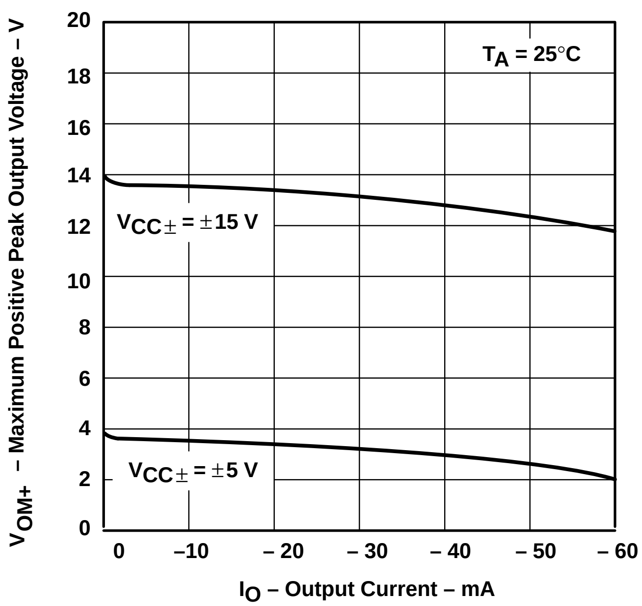



Figure 8

**MAXIMUM NEGATIVE PEAK OUTPUT VOLTAGE vs OUTPUT CURRENT**

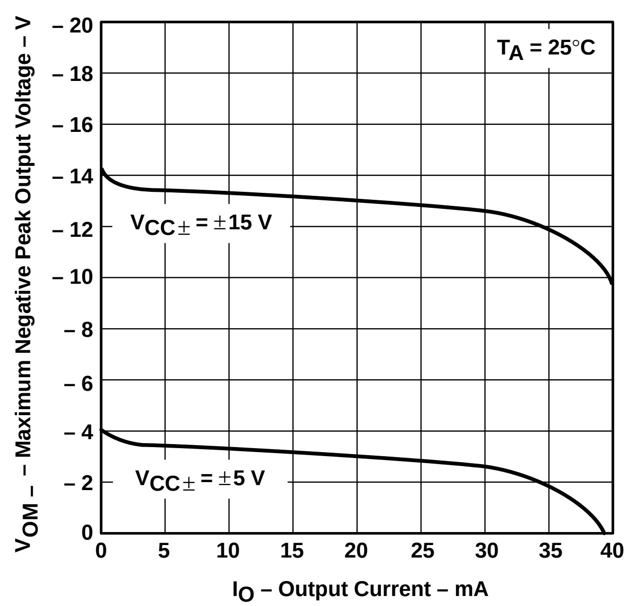



Figure 9

**MAXIMUM PEAK OUTPUT VOLTAGE vs SUPPLY VOLTAGE**

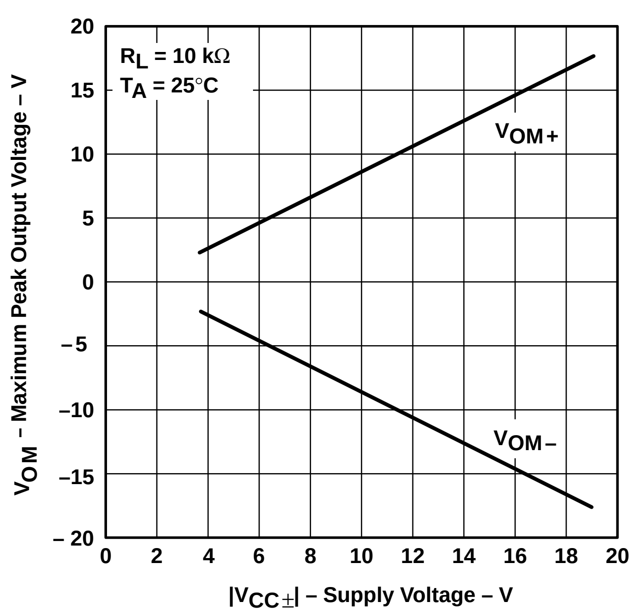



Figure 10

**MAXIMUM PEAK OUTPUT VOLTAGE vs SUPPLY VOLTAGE**

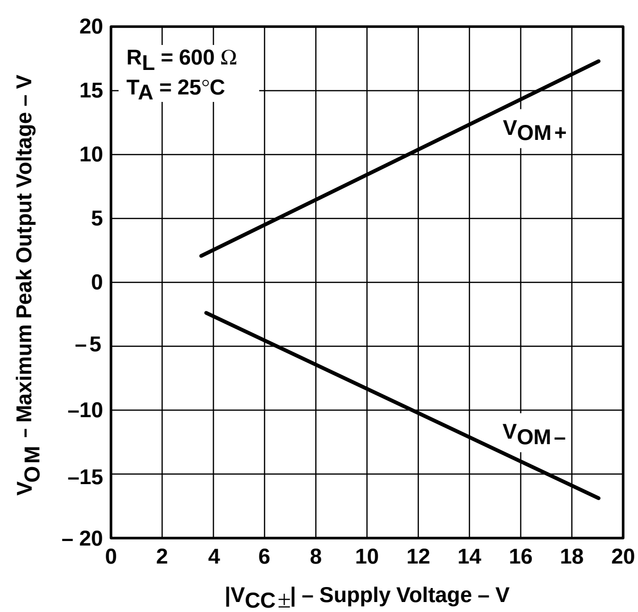



Figure 11

## TYPICAL CHARACTERISTICS

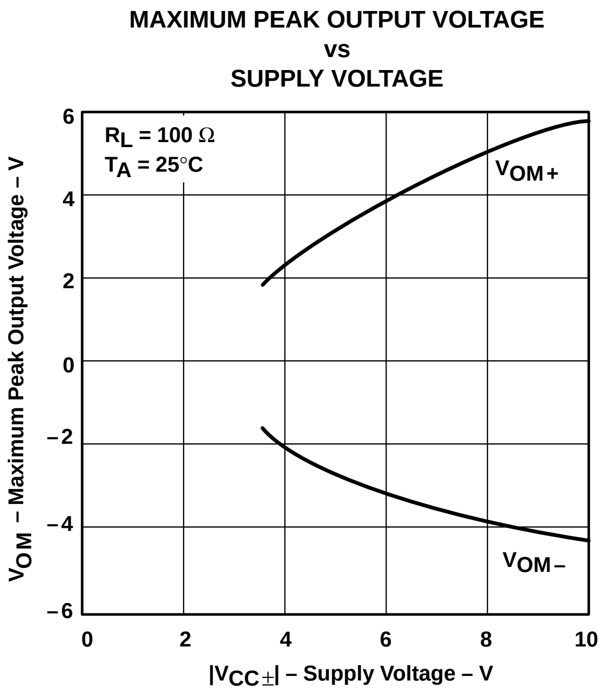



Figure 12

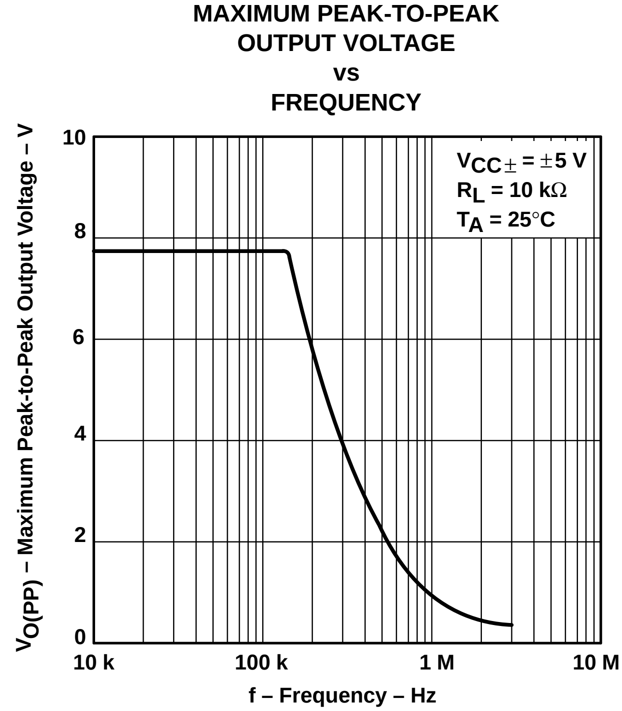



Figure 13

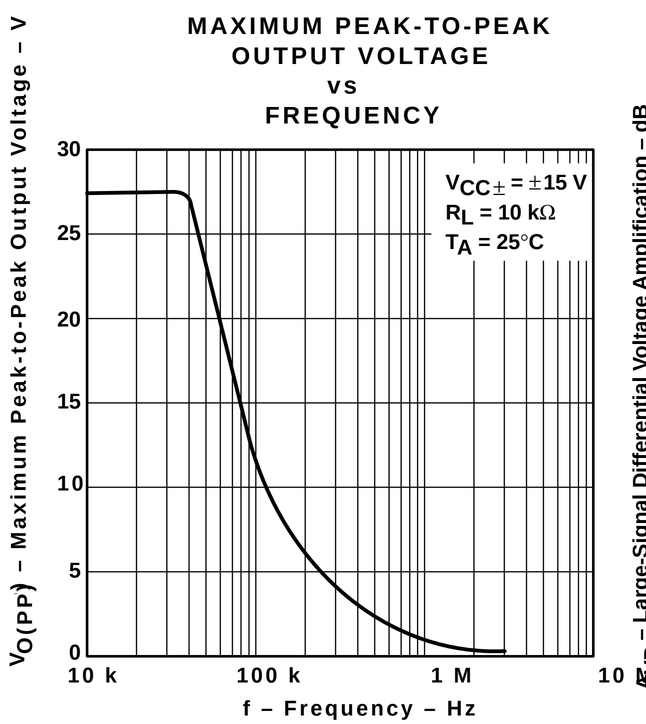



Figure 14

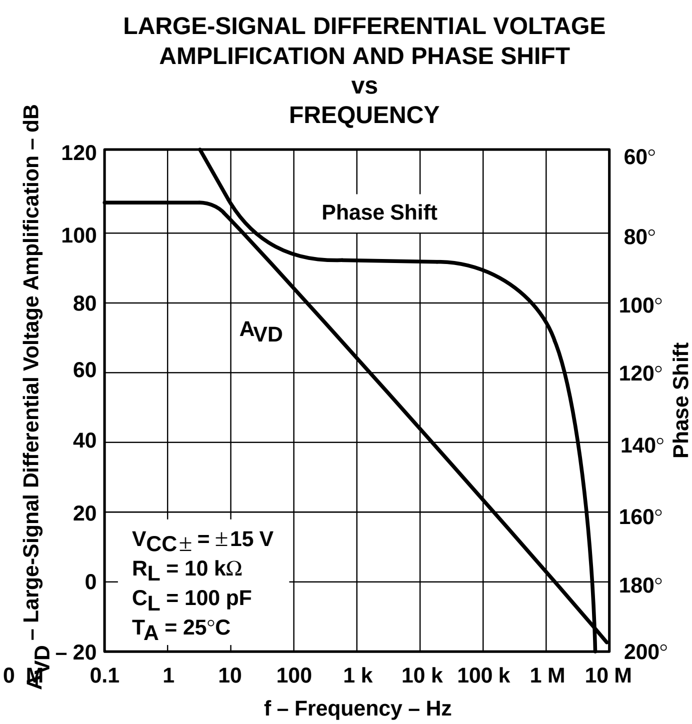



Figure 15

## TYPICAL CHARACTERISTICS

**LARGE-SIGNAL DIFFERENTIAL VOLTAGE AMPLIFICATION vs FREE-AIR TEMPERATURE**

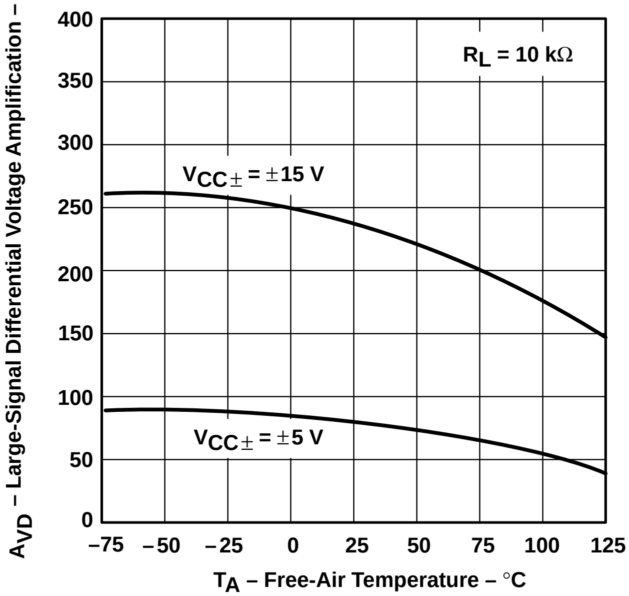



**Figure 16**

**SHORT-CIRCUIT OUTPUT CURRENT vs ELAPSED TIME**

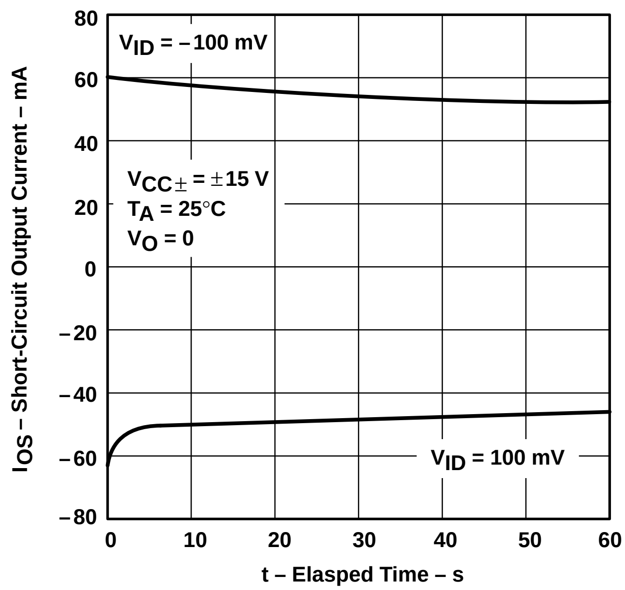



**Figure 17**

**SHORT-CIRCUIT OUTPUT CURRENT vs FREE-AIR TEMPERATURE**

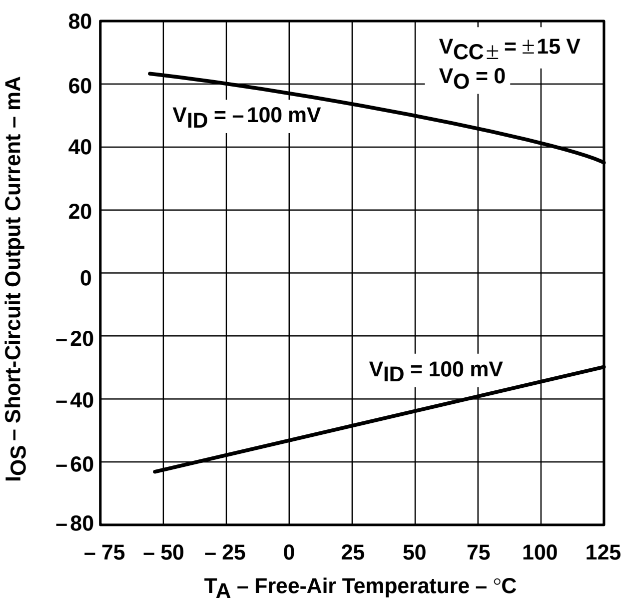



**Figure 18**

**OUTPUT IMPEDANCE vs FREQUENCY**

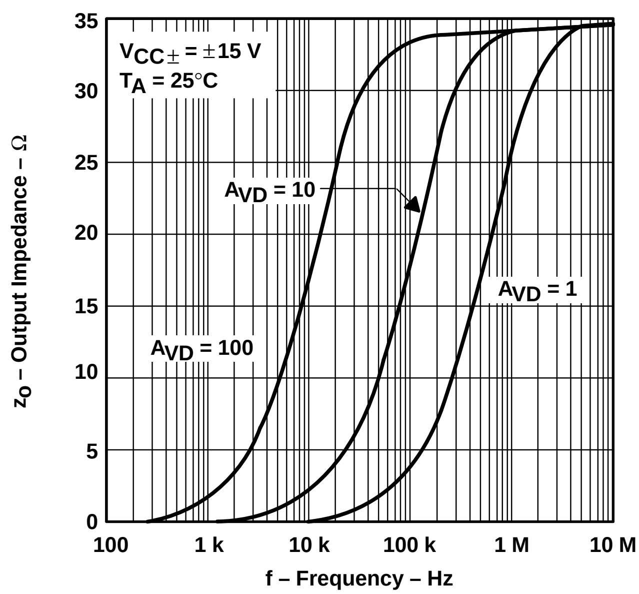



**Figure 19**

## TYPICAL CHARACTERISTICS†

**COMMON-MODE REJECTION RATIO vs FREQUENCY**

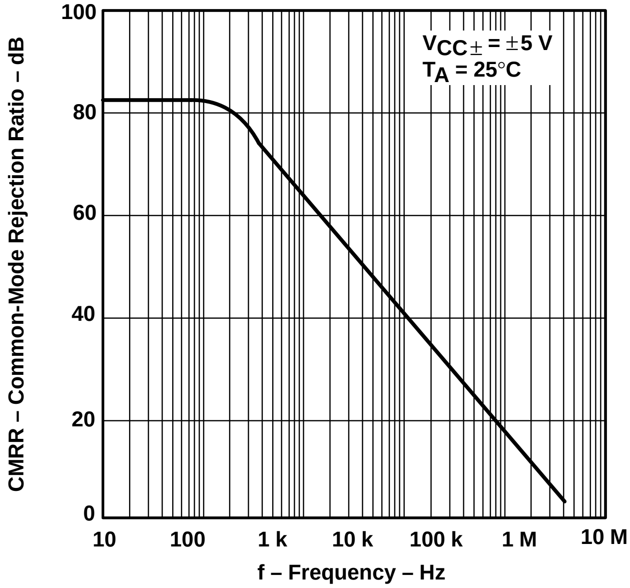



**Figure 20**

**SUPPLY CURRENT vs SUPPLY VOLTAGE**

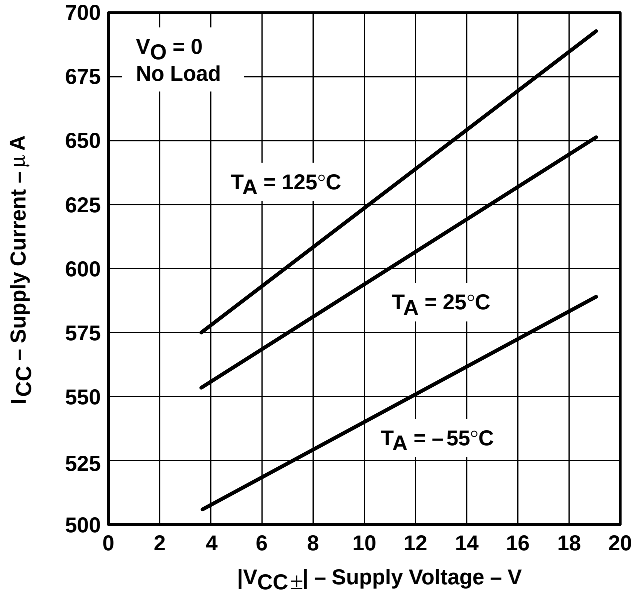



**Figure 21**

**SUPPLY CURRENT vs FREE-AIR TEMPERATURE**

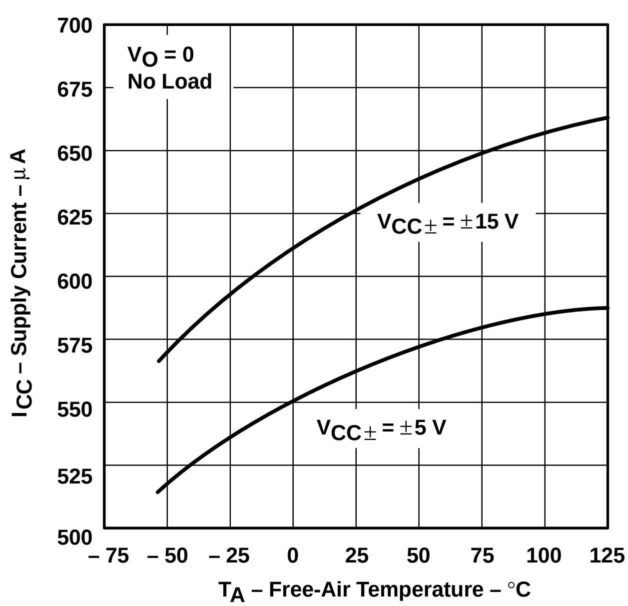



**Figure 22**

**VOLTAGE-FOLLOWER SMALL-SIGNAL PULSE RESPONSE**

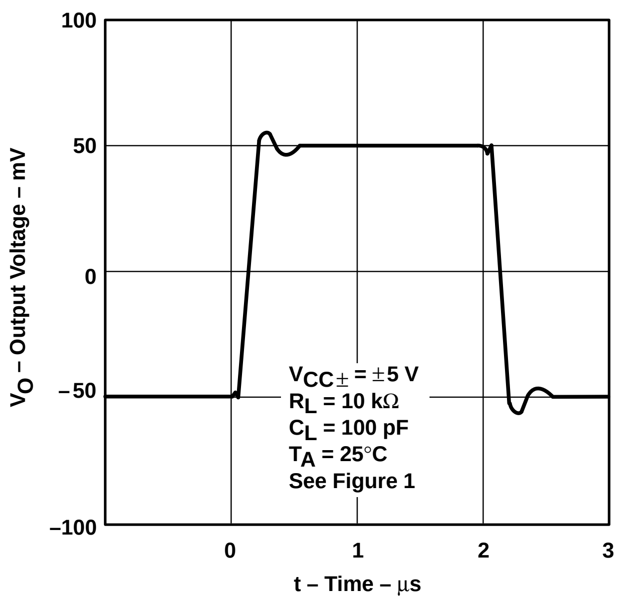



**Figure 23**

† Data at high and low temperatures are applicable only within the rated operating free-air temperature ranges of the various devices.

## TYPICAL CHARACTERISTICS

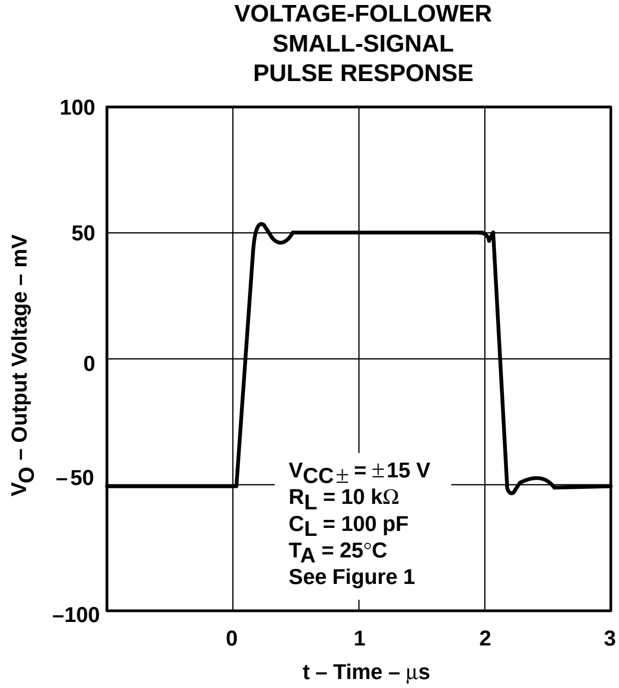



Figure 24

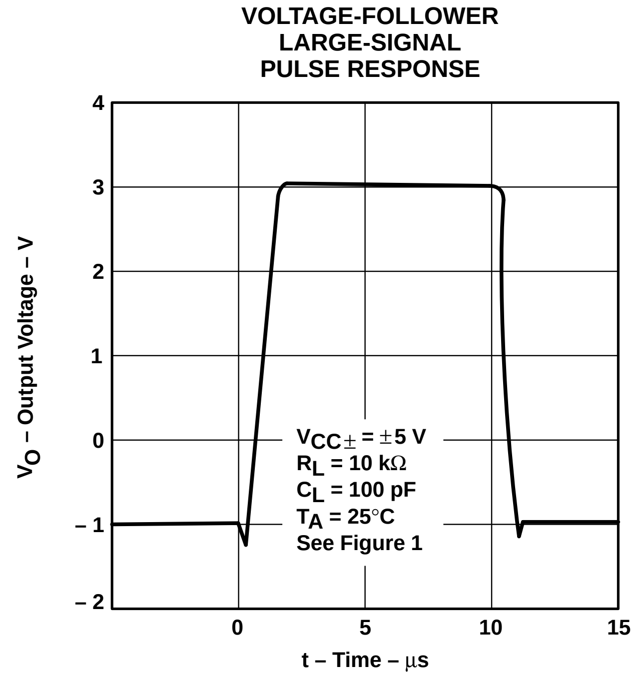



Figure 25

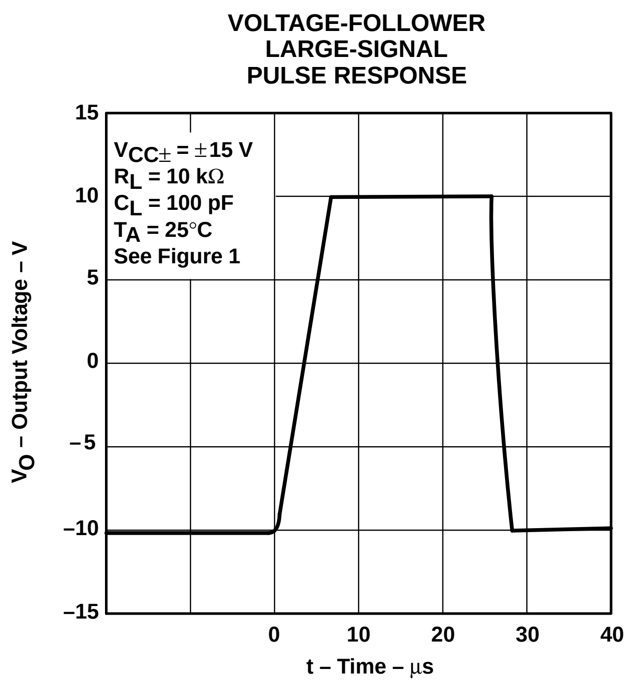



Figure 26

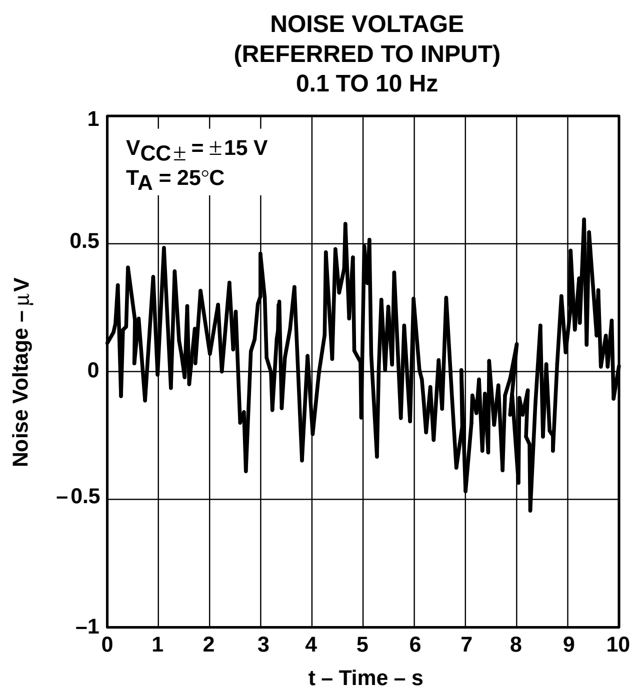



Figure 27

## TYPICAL CHARACTERISTICS

### EQUIVALENT INPUT NOISE VOLTAGE vs FREQUENCY

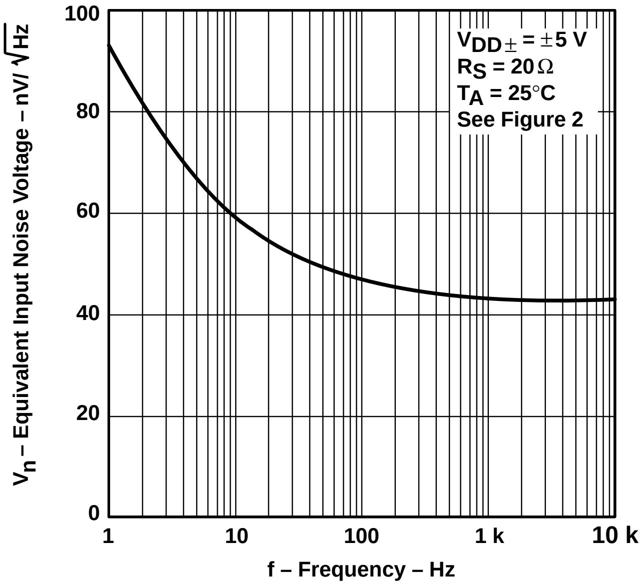



Figure 28

### TOTAL HARMONIC DISTORTION vs FREQUENCY

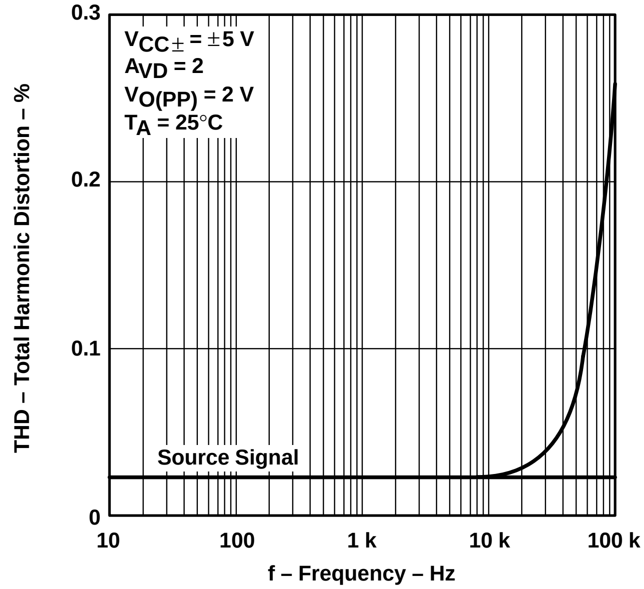



Figure 29

### TOTAL HARMONIC DISTORTION vs FREQUENCY

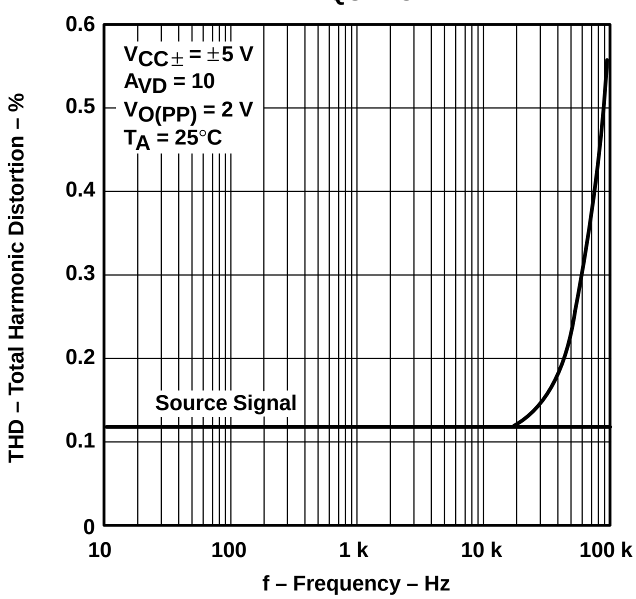



Figure 30

### UNITY-GAIN BANDWIDTH vs SUPPLY VOLTAGE

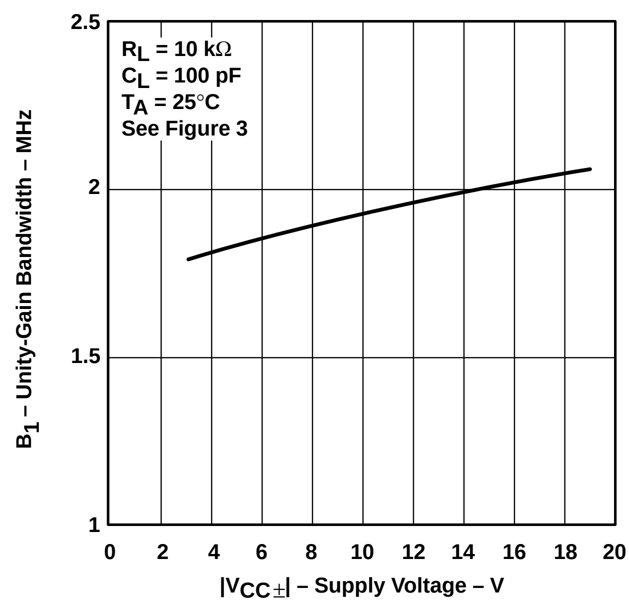



Figure 31

## TYPICAL CHARACTERISTICS†

**UNITY-GAIN BANDWIDTH vs FREE-AIR TEMPERATURE**

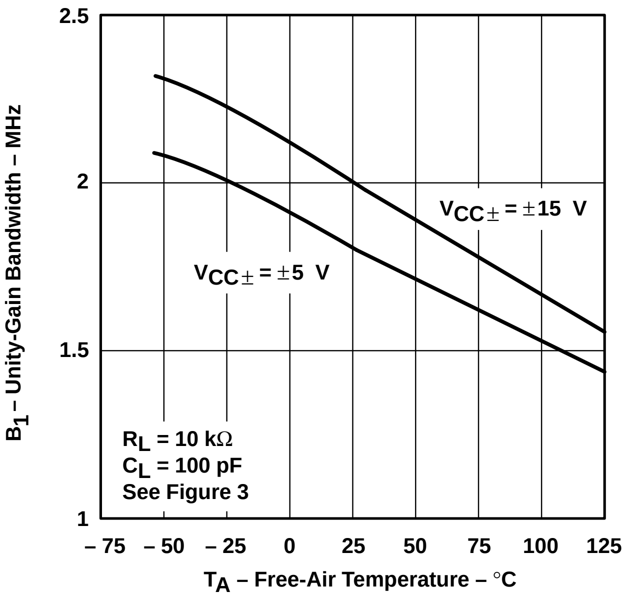



**Figure 32**

**PHASE MARGIN vs SUPPLY VOLTAGE**

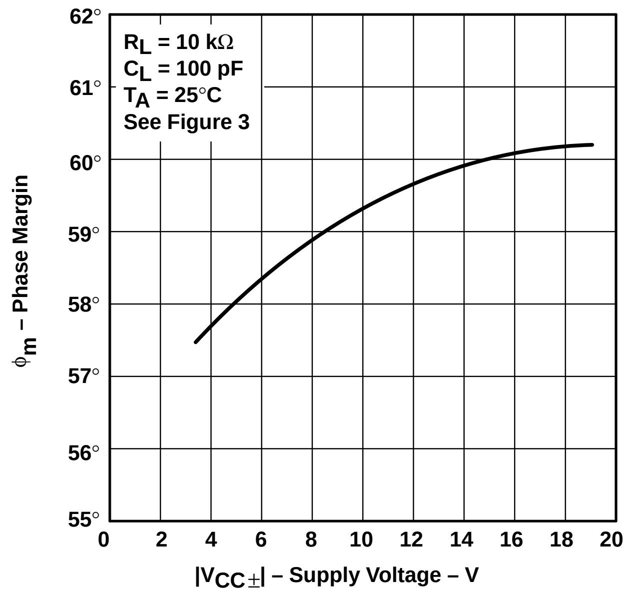



**Figure 33**

**PHASE MARGIN vs LOAD CAPACITANCE**

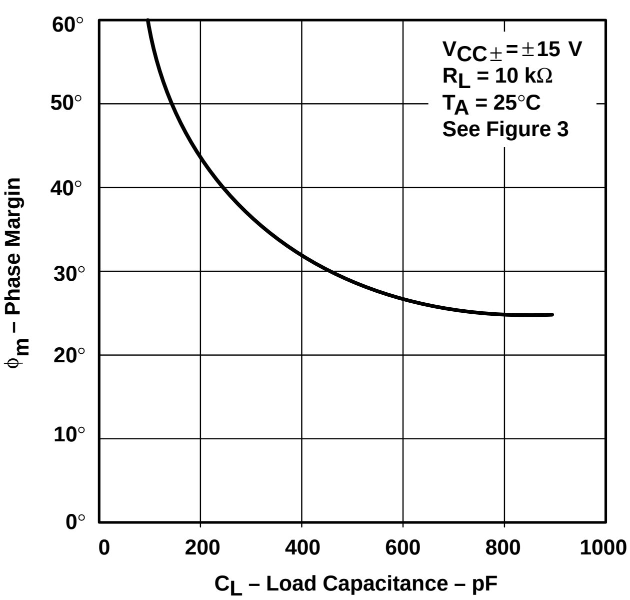



**Figure 34**

**PHASE MARGIN vs FREE-AIR TEMPERATURE**

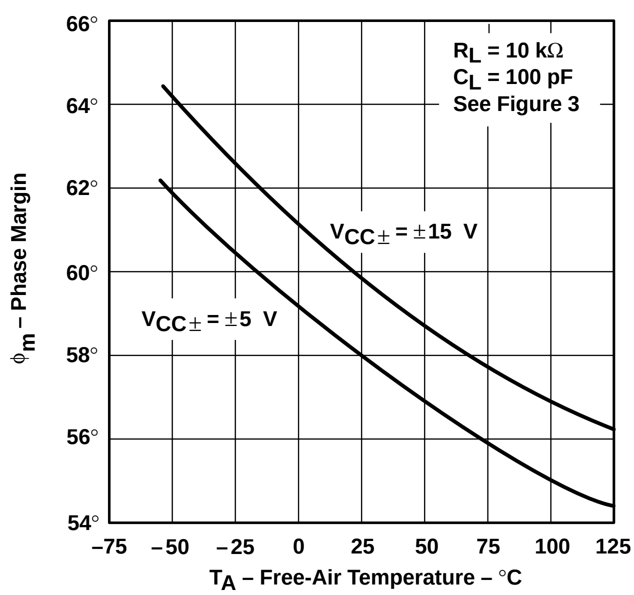



**Figure 35**

† Data at high and low temperatures are applicable only within the rated operating free-air temperature ranges of the various devices.

## APPLICATION INFORMATION

### input characteristics

The TLE2062, TLE2062A, and TLE2062B are specified with a minimum and a maximum input voltage that if exceeded at either input could cause the device to malfunction.

Because of the extremely high input impedance and resulting low bias current requirements, the TLE2062, TLE2062A, and TLE2062B are well suited for low-level signal processing; however, leakage currents on printed-circuit boards and sockets can easily exceed bias current requirements and cause degradation in system performance. It is a good practice to include guard rings around inputs (see Figure 38). These guards should be driven from a low-impedance source at the same voltage level as the common-mode input.

The inputs of any unused amplifiers should be tied to ground to avoid possible oscillation.

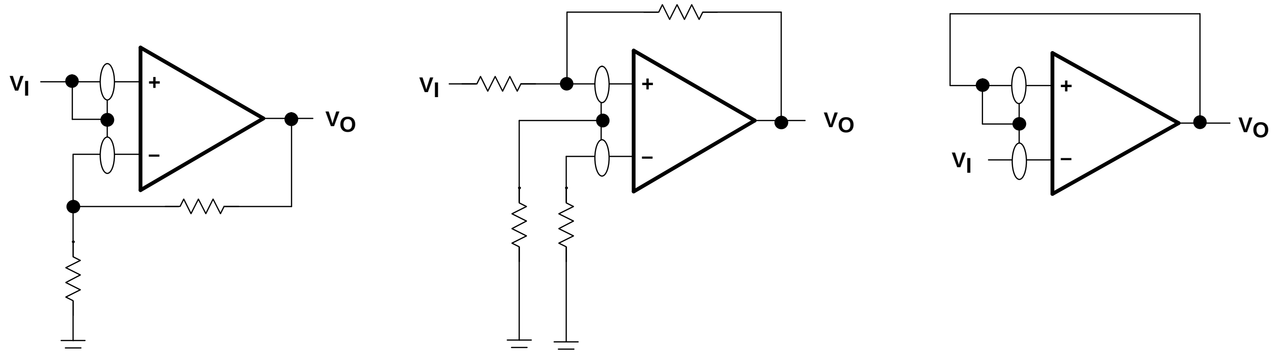



**Figure 36. Use of Guard Rings**

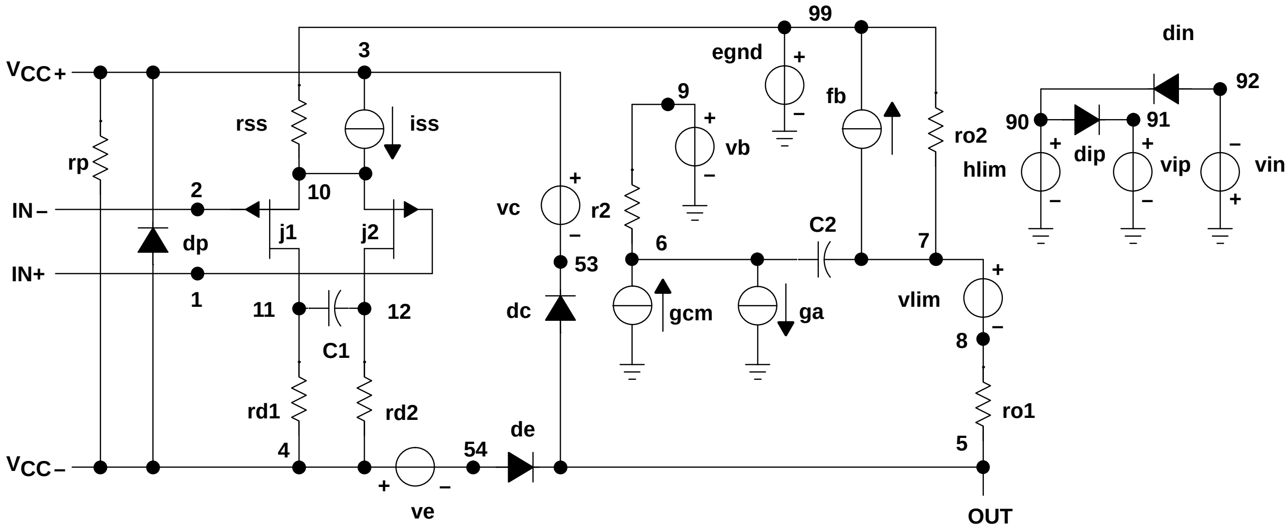
## APPLICATION INFORMATION

### macromodel information

Macromodel information provided was derived using *PSpice*™ *Parts*™ model generation software. The Boyle macromodel (see Note 5) and subcircuit in Figure 37 were generated using the TLE2062 typical electrical and operating characteristics at 25°C. Using this information, output simulations of the following key parameters can be generated to a tolerance of 20% (in most cases):

- Maximum positive output voltage swing
- Maximum negative output voltage swing
- Slew rate
- Quiescent power dissipation
- Input bias current
- Open-loop voltage amplification
- Unity-gain frequency
- Common-mode rejection ratio
- Phase margin
- DC output resistance
- AC output resistance
- Short-circuit output current limit

NOTE 5: G. R. Boyle, B. M. Cohn, D. O. Pederson, and J. E. Solomon, “Macromodeling of Integrated Circuit Operational Amplifiers”, *IEEE Journal of Solid-State Circuits*, SC-9, 353 (1974).




```
.subckt TLE2062 1 2 3 4 5
  c1   11  12 1.457E–12
  c2    6   7 15.00E–12
  dc    5  53 dx
  de   54   5 dx
  dlp  90  91 dx
  dln  92  90 dx
  dp    4   3 dx
  egnd 99   0 poly (2) (3,0) (4,0) 0 .5 .5
  fb    7  99 poly (5) vb vc ve vlp
+  vln 0 4.357E6 –4E6 4E6 4E6 –4E6
  ga    6   0 11 12 188.5E–6
  gcm   0   6 10 99 3.352E–9
  iss   3  10 dc 51.00E–6
  hlim 90   0 vlim 1k
  j1   11   2 10 jx
  j2   12   1 10 jx
  r2    6   9 100.0E3
  rd1   4  11 5.305E3
  rd2   4  12 5.305E3
  r01   8   5 280
  r02   7  99 280
  rp    3   4 113.2E3
  rss  10  99 3.922E6
  vb    9   0 dc 0
  vc    3  53 dc 2
  ve   54   4 dc 2
  vlim  7   8 dc 0
  vlp  91  0  dc 50
  vln   0  92 dc 50
.model dx  D(Is=800.0E–18)
.model jx  PJF(Is=2.000E–12 Beta = 423E–6
+ Vto = –1)
.ends
```

**Figure 37. Boyle Macromodel and Subcircuit**

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## IMPORTANT NOTICE