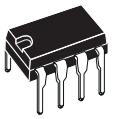
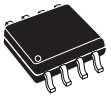
# LF151
# LF251 - LF351

## WIDE BANDWIDTH SINGLE J-FET OPERATIONAL AMPLIFIER

- INTERNALLY ADJUSTABLE INPUT OFFSET VOLTAGE
- LOW POWER CONSUMPTION
- WIDE COMMON-MODE (UP TO $V_{CC}^+$) AND DIFFERENTIAL VOLTAGE RANGE
- LOW INPUT BIAS AND OFFSET CURRENT
- OUTPUT SHORT-CIRCUIT PROTECTION
- HIGH INPUT IMPEDANCE J–FET INPUT STAGE
- INTERNAL FREQUENCY COMPENSATION
- LATCH UP FREE OPERATION
- HIGH SLEW RATE : 16V/µs (typ)



**N**
**DIP8**
(Plastic Package)



**D**
**SO8**
(Plastic Micropackage)

### DESCRIPTION

These circuits are high speed J–FET input single-operational amplifiers incorporating well matched, high voltage J–FET and bipolar transistors in a monolithic integrated circuit.

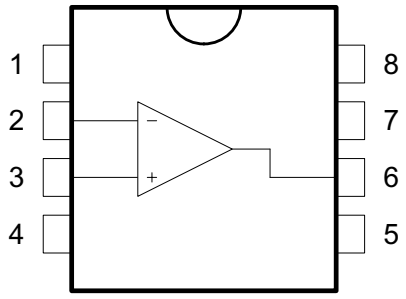
The devices feature high slew rates, low input bias and offset currents, and low offset voltage temperature coefficient.

### ORDER CODE

| Part Number | Temperature Range | Package | |
|---|---|---|---|
| | | N | D |
| LF351 | 0°C, +70°C | • | • |
| LF251 | -40°C, +105°C | • | • |
| LF151 | -55°C, +125°C | • | • |

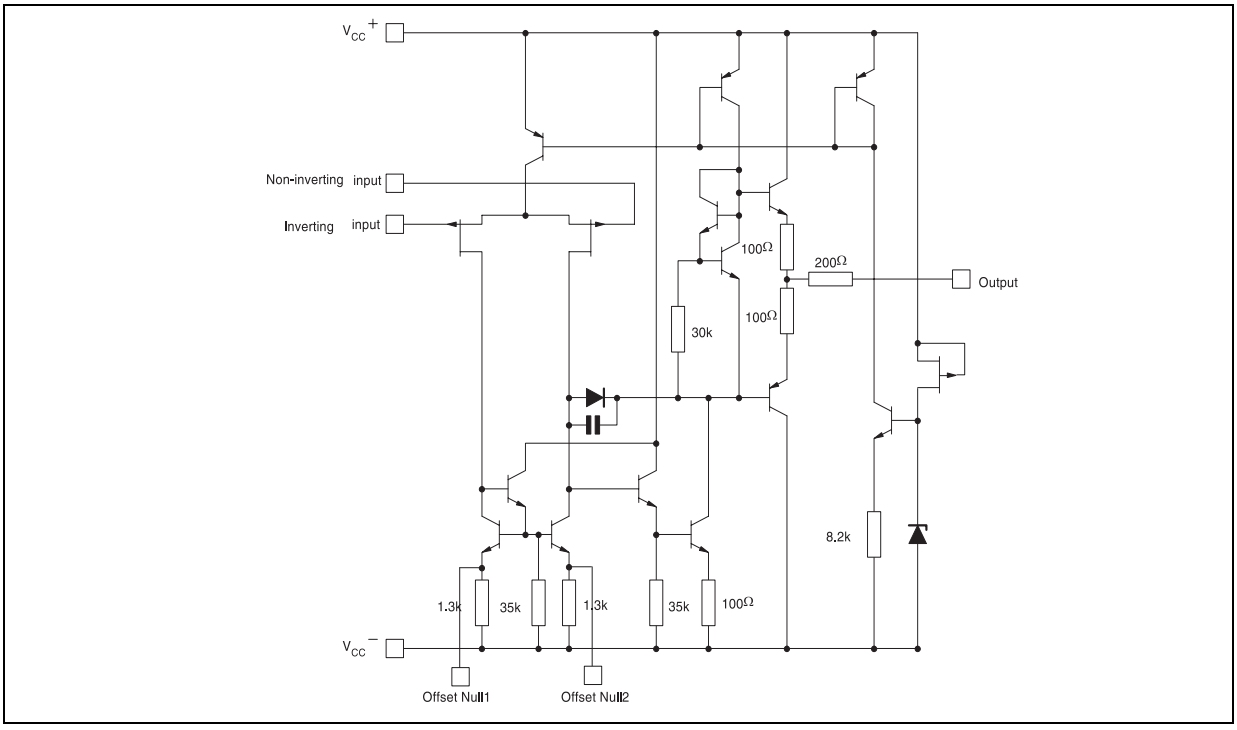
**N =** Dual in Line Package (DIP)
**D =** Small Outline Package (SO) - also available in Tape & Reel (DT)

### PIN CONNECTIONS (top view)

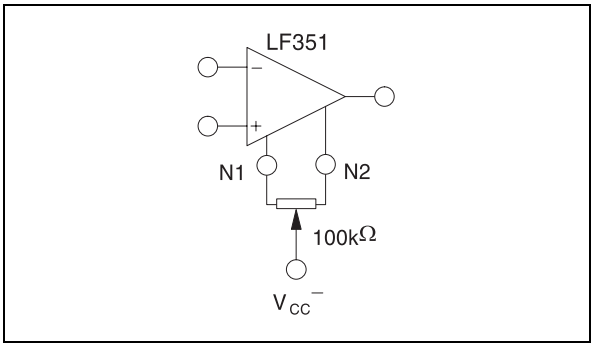



1 - Offset null 1
2 - Inverting input
3 - Non-inverting input
4 - $V_{CC}^-$
5 - Offset null 2
6 - Output
7 - $V_{CC}^+$
8 - N.C.

## SCHEMATIC DIAGRAM




## INPUT OFFSET VOLTAGE NULL CIRCUIT




## ABSOLUTE MAXIMUM RATINGS

| Symbol | Parameter | LF151 | LF251 | LF351 | Unit |
|---|---|---|---|---|---|
| $V_{CC}$ | Supply voltage - note 1) | ±18 | | | V |
| $V_i$ | Input Voltage - note 2) | ±15 | | | V |
| $V_{id}$ | Differential Input Voltage - note 3) | ±30 | | | V |
| $P_{tot}$ | Power Dissipation | 680 | | | mW |
| | Output Short-circuit Duration - note 4) | Infinite | | | |
| $T_{oper}$ | Operating Free-air Temperature Range | -55 to +125 | -40 to +105 | 0 to +70 | °C |
| $T_{stg}$ | Storage Temperature Range | -65 to +150 | | | °C |

1. All voltage values, except differential voltage, are with respect to the zero reference level (ground) of the supply voltages where the zero reference level is the midpoint between $V_{CC}^+$ and $V_{CC}^-$.
2. The magnitude of the input voltage must never exceed the magnitude of the supply voltage or 15 volts, whichever is less.
3. Differential voltages are the non-inverting input terminal with respect to the inverting input terminal.
4. The output may be shorted to ground or to either supply. Temperature and/or supply voltages must be limited to ensure that the dissipation rating is not exceeded

## ELECTRICAL CHARACTERISTICS

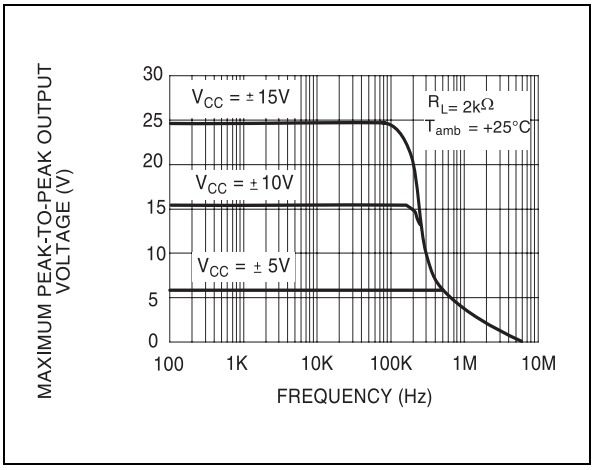
$V_{CC}$ = ±15V, $T_{amb}$ = +25°C (unless otherwise specified)

| Symbol | Parameter | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|
| $V_{io}$ | Input Offset Voltage ($R_S$ = 10kΩ)<br>$T_{amb}$ = +25°C<br>$T_{min} \le T_{amb} \le T_{max}$ | | 3 | 10<br>13 | mV |
| $DV_{io}$ | Input Offset Voltage Drift | | 10 | | µV/°C |
| $I_{io}$ | Input Offset Current- note 1)<br>$T_{amb}$ = +25°C<br>$T_{min} \le T_{amb} \le T_{max}$ | | 5 | 100<br>4 | pA<br>nA |
| $I_{ib}$ | Input Bias Current -note 1<br>$T_{amb}$ = +25°C<br>$T_{min} \le T_{amb} \le T_{max}$ | | 20 | 200<br>20 | nA |
| $A_{vd}$ | Large Signal Voltage Gain ($R_L$ = 2kΩ, $V_o$ = ±10V)<br>$T_{amb}$ = +25°C<br>$T_{min} \le T_{amb} \le T_{max}$ | 50<br>25 | 200 | | V/mV |
| SVR | Supply Voltage Rejection Ratio ($R_S$ = 10kΩ)<br>$T_{amb}$ = +25°C<br>$T_{min} \le T_{amb} \le T_{max}$ | 80<br>80 | 86 | | dB |
| $I_{CC}$ | Supply Current, no load<br>$T_{amb}$ = +25°C<br>$T_{min} \le T_{amb} \le T_{max}$ | | 1.4 | 3.4<br>3.4 | mA |
| $V_{icm}$ | Input Common Mode Voltage Range | ±11 | +15<br>-12 | | V |
| CMR | Common Mode Rejection Ratio ($R_S$ = 10kΩ)<br>$T_{amb}$ = +25°C<br>$T_{min} \le T_{amb} \le T_{max}$ | 70<br>70 | 86 | | dB |
| $I_{OS}$ | Output Short-circuit Current<br>$T_{amb}$ = +25°C<br>$T_{min} \le T_{amb} \le T_{max}$ | 10<br>10 | 40 | 60<br>60 | mA |
| $\pm V_{opp}$ | Output Voltage Swing<br>$T_{amb}$ = +25°C $R_L$ = 2kΩ<br>$R_L$ = 10kΩ<br>$T_{min} \le T_{amb} \le T_{max}$ $R_L$ = 2kΩ<br>$R_L$ = 10kΩ | 10<br>12<br>10<br>12 | 12<br>13.5 | | V |
| SR | Slew Rate<br>$V_i$ = 10V, $R_L$ = 2kΩ, $C_L$ = 100pF, $T_{amb}$ = +25°C, unity gain | 12 | 16 | | V/µs |
| $t_r$ | Rise Time<br>$V_i$ = 20mV, $R_L$ = 2kΩ, $C_L$ = 100pF, $T_{amb}$ = +25°C, unity gain | | 0.1 | | µs |
| $K_{ov}$ | Overshoot<br>$V_i$ = 20mV, $R_L$ = 2kΩ, $C_L$ = 100pF, $T_{amb}$ = +25°C, unity gain | | 10 | | % |
| GBP | Gain Bandwidth Product<br>f = 100kHz, $T_{amb}$ = +25°C, $V_{in}$ = 10mV, $R_L$ = 2kΩ, $C_L$ = 100pF | 2.5 | 4 | | MHz |
| $R_i$ | Input Resistance | | $10^{12}$ | | Ω |
| THD | Total Harmonic Distortion ( f = 1kHz, $A_v$ = 20dB<br>$R_L$ = 2kΩ, $C_L$ = 100pF, $T_{amb}$ = +25°C, $V_o$ = $2V_{pp}$) | | 0.01 | | |
| $e_n$ | Equivalent Input Noise Voltage<br>$R_S$ = 100Ω, f = 1KHz | | 15 | | $\frac{nV}{\sqrt{Hz}}$ |
| ∅m | Phase Margin | | 45 | | Degrees |

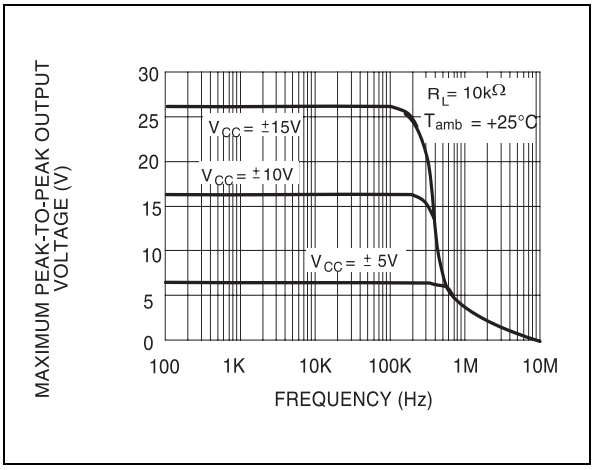
1. The input bias currents are junction leakage currents which approximately double for every 10°C increase in the junction temperature.

## MAXIMUM PEAK-TO-PEAK OUTPUT

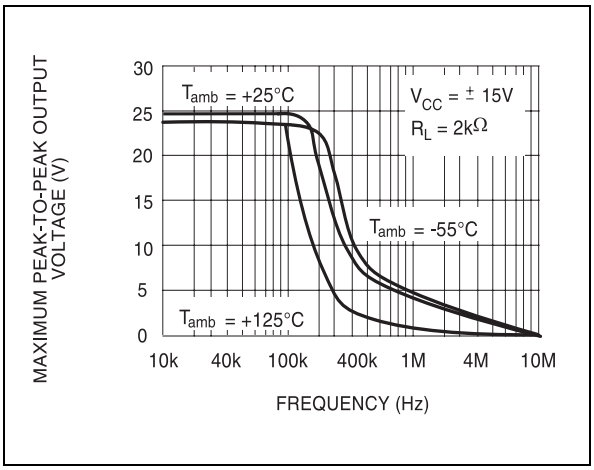
**VOLTAGE versus FREQUENCY**



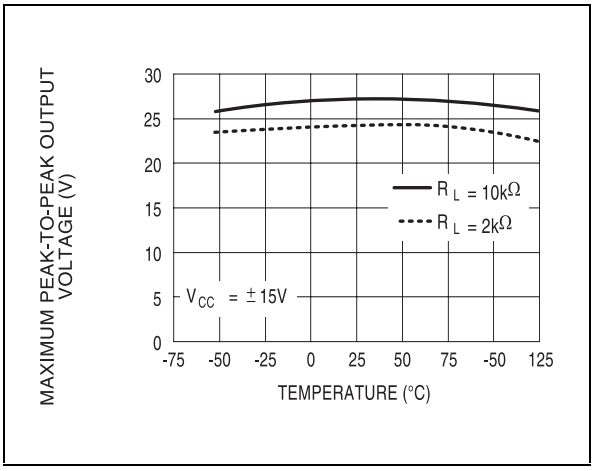

**VOLTAGE versus FREQUENCY**



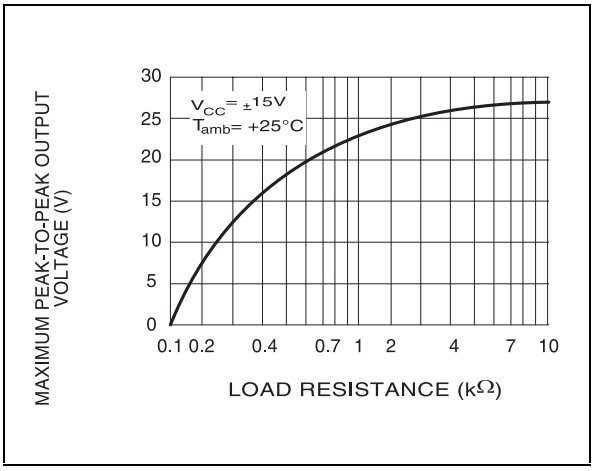

**MAXIMUM PEAK-TO-PEAK OUTPUT VOLTAGE versus FREQUENCY**



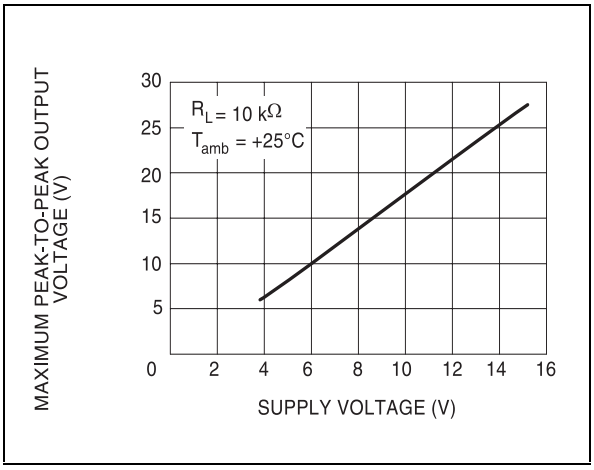

**MAXIMUM PEAK-TO-PEAK OUTPUT VOLTAGE versus FREE AIR TEMP.**




**MAXIMUM PEAK-TO-PEAK OUTPUT VOLTAGE versus LOAD RESISTANCE**



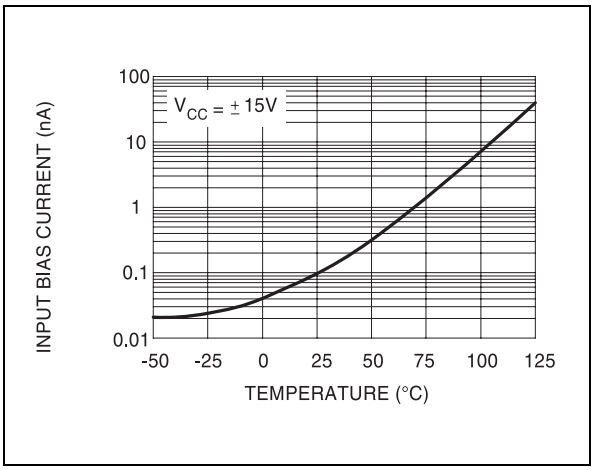

**MAXIMUM PEAK-TO-PEAK OUTPUT VOLTAGE versus SUPLY VOLTAGE**



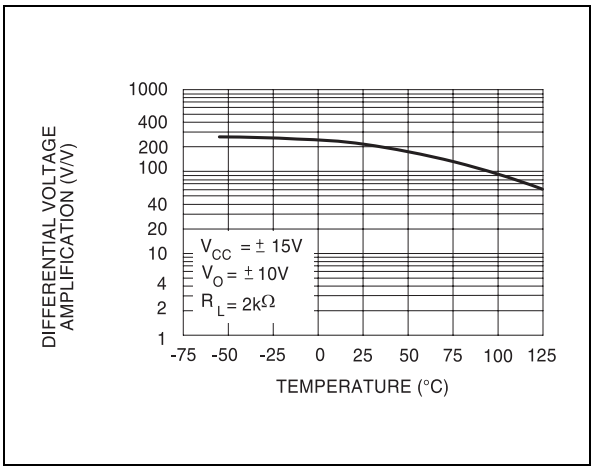

**MAXIMUM PEAK-TO-PEAK OUTPUT**

**INPUT BIAS CURRENT versus FREE AIR**

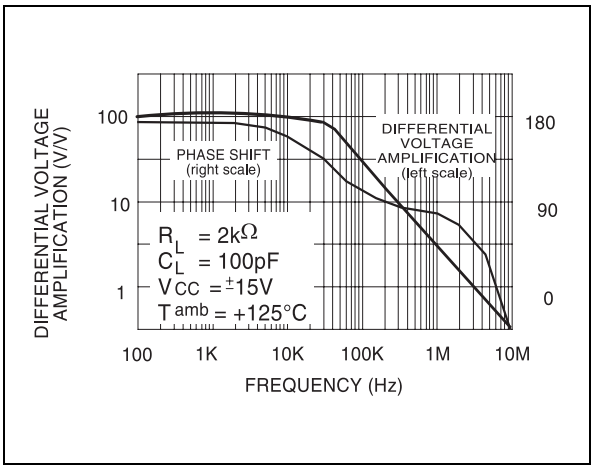
**TEMPERATURE**



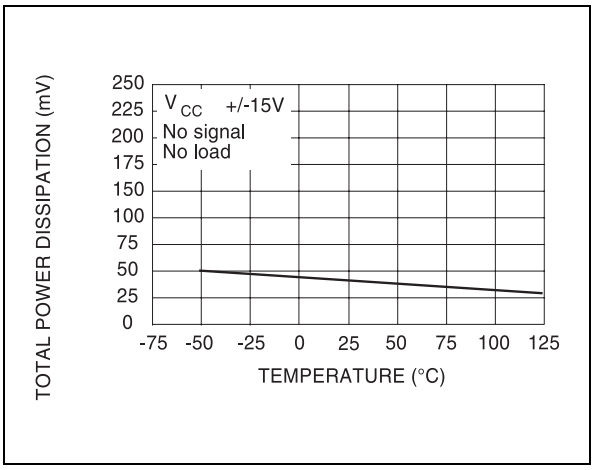

**AMPLIFICATION versus FREE AIR TEMP.**



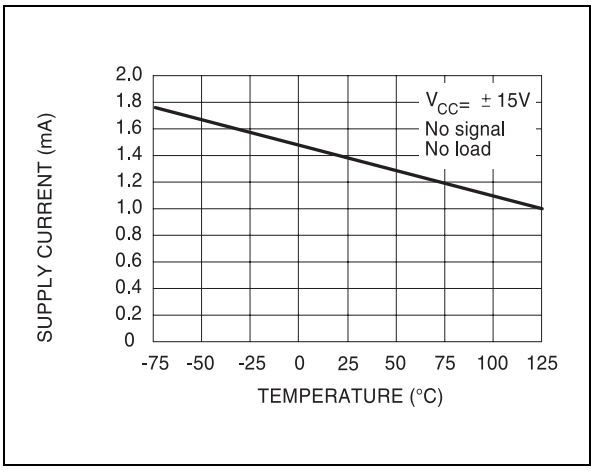

**LARGE SIGNAL DIFFERENTIAL VOLTAGE AMPLIFICATION AND PHASE SHIFT versus FREQUENCY**



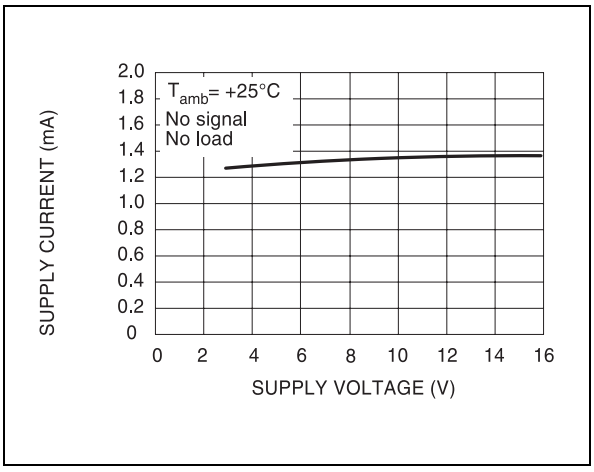

**TOTAL POWER DISSIPATION versus FREE AIR TEMPERATURE**




**SUPPLY CURRENT PER AMPLIFIER versus FREE AIR TEMPERATURE**



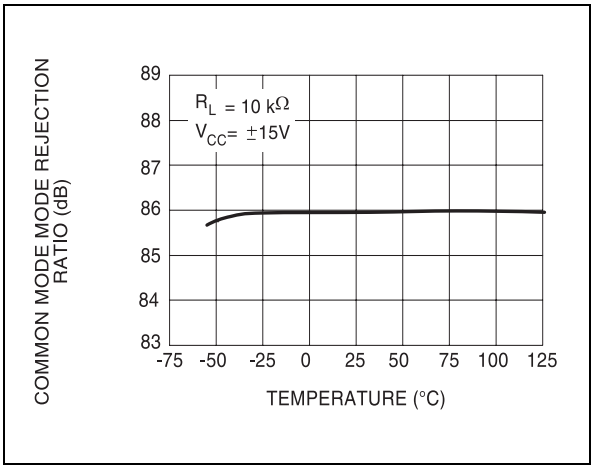

**SUPPLY CURRENT PER AMPLIFIER versus SUPPLY VOLTAGE**



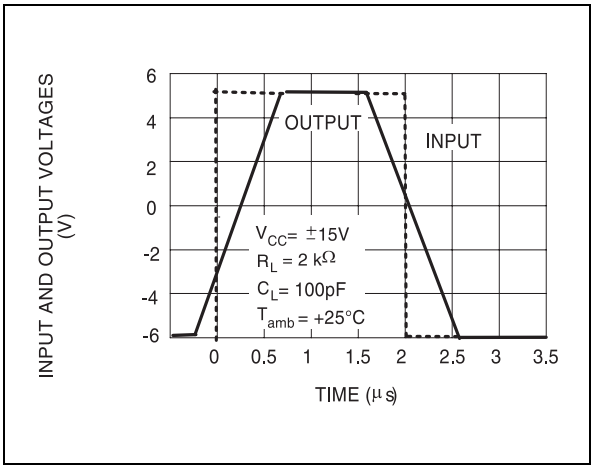

**LARGE SIGNAL DIFFERENTIAL VOLTAGE**

**COMMON MODE REJECTION RATIO versus**

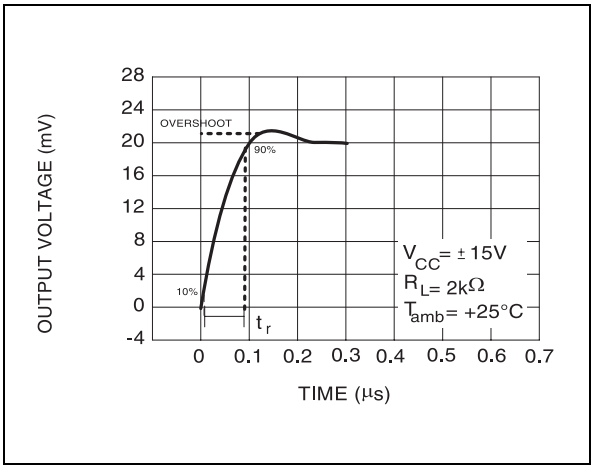
### FREE AIR TEMPERATURE



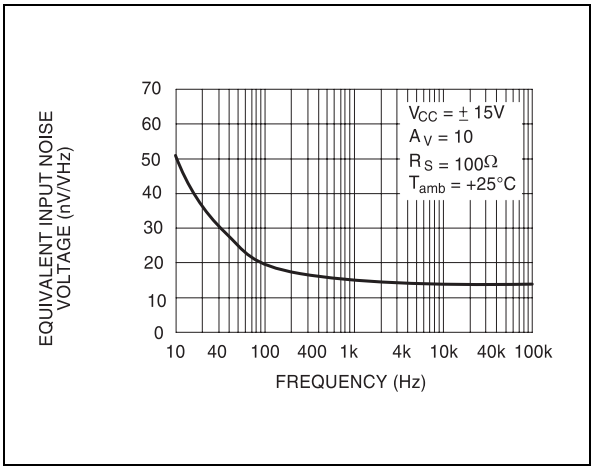

### VOLTAGE FOLLOWER LARGE SIGNAL PULSE RESPONSE



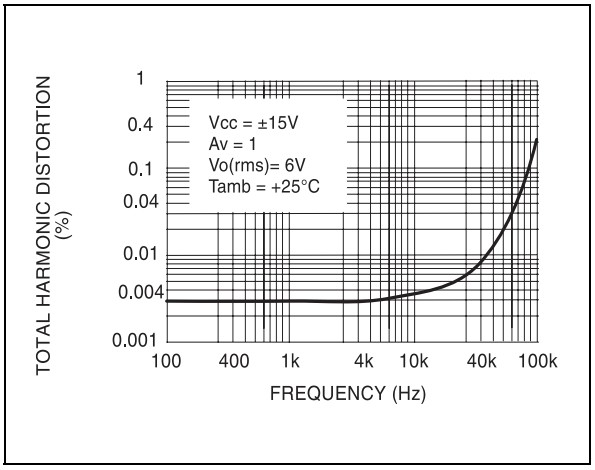

### OUTPUT VOLTAGE versus ELAPSED TIME




### EQUIVALENT INPUT NOISE VOLTAGE versus FREQUENCY




### TOTAL HARMONIC DISTORTION versus FREQUENCY



## PARAMETER MEASUREMENT INFORMATION

**Figure 1 :** Voltage Follower

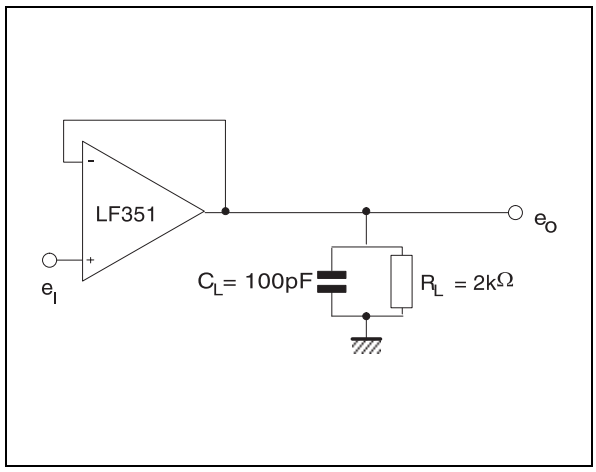
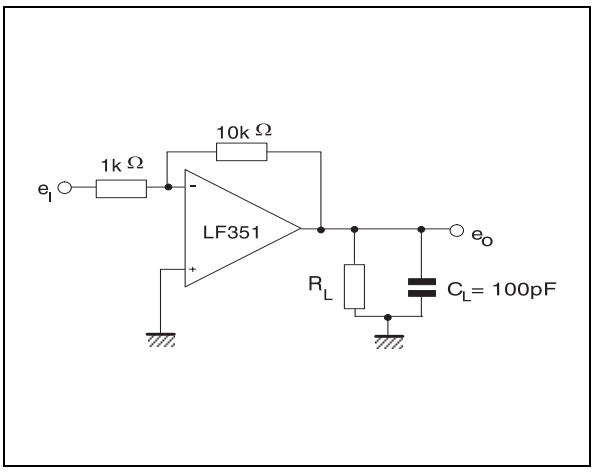
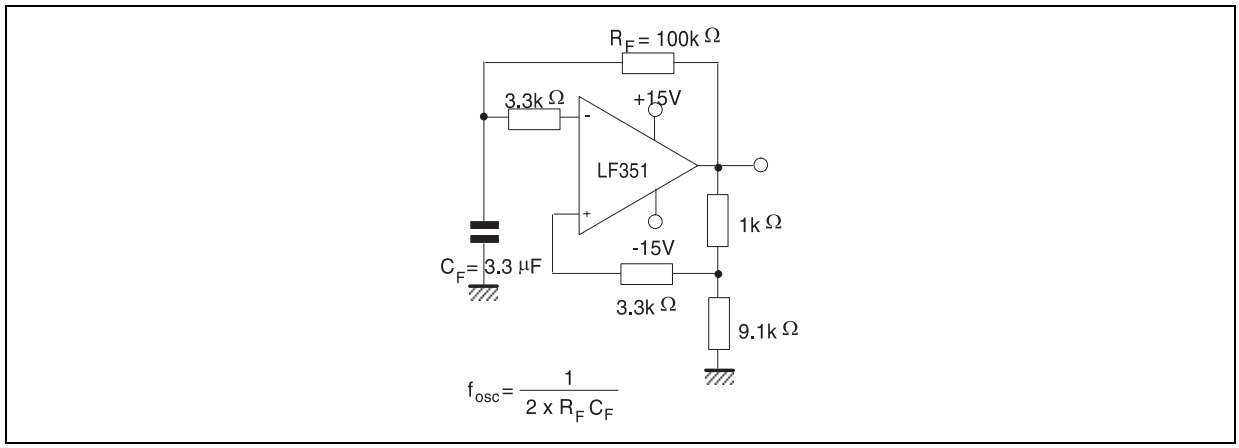



**Figure 2 :** Gain-of-10 inverting amplifier

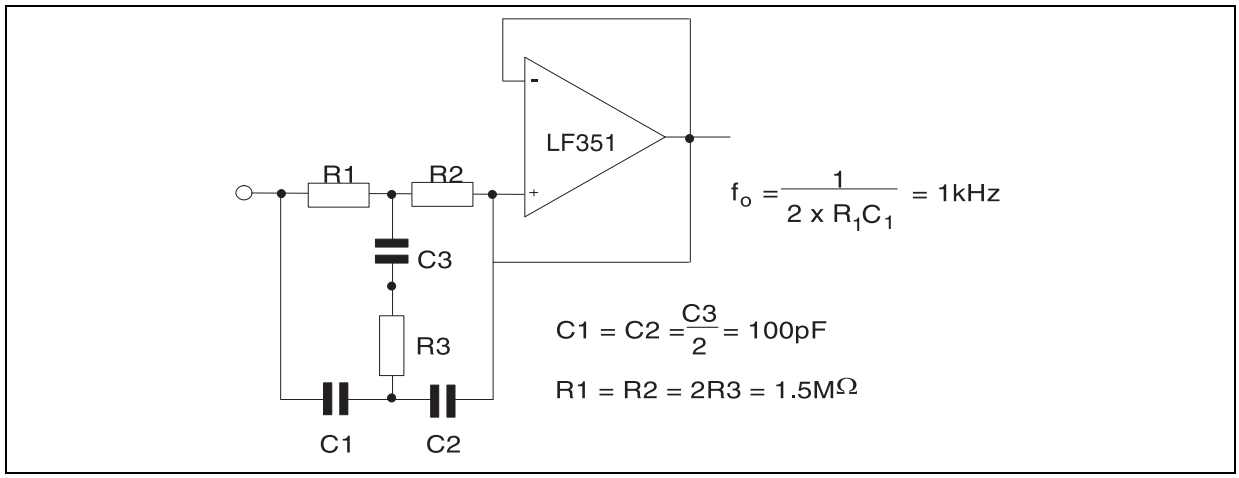



## TYPICAL APPLICATION

(0.5Hz) SQUARE WAVE OSCILLATOR

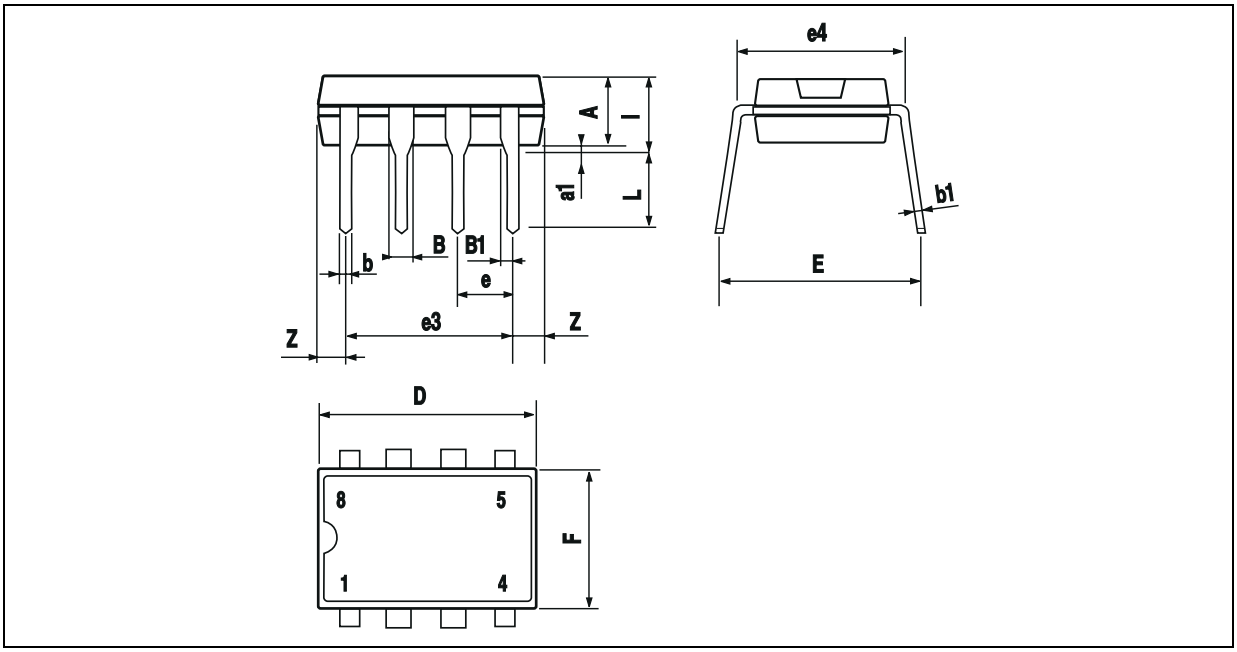



HIGH Q NOTCH FILTER



## PACKAGE MECHANICAL DATA

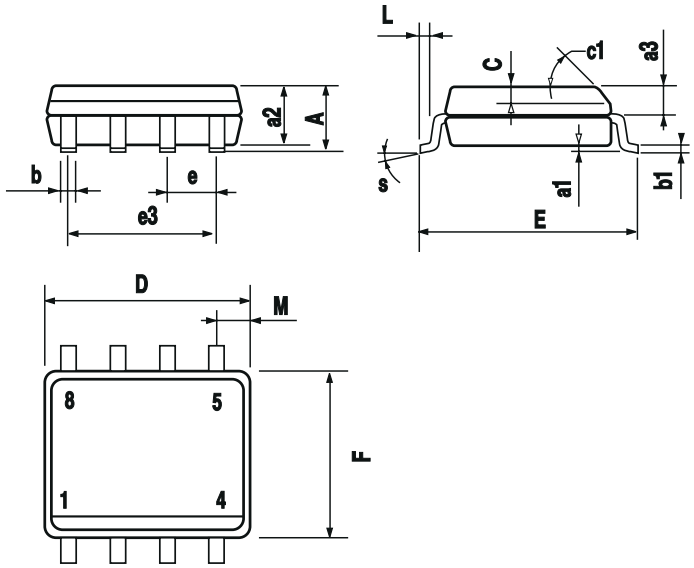
8 PINS - PLASTIC DIP




| Dim. | Millimeters | | | Inches | | |
|---|---|---|---|---|---|---|
| | Min. | Typ. | Max. | Min. | Typ. | Max. |
| A | | 3.32 | | | 0.131 | |
| a1 | 0.51 | | | 0.020 | | |
| B | 1.15 | | 1.65 | 0.045 | | 0.065 |
| b | 0.356 | | 0.55 | 0.014 | | 0.022 |
| b1 | 0.204 | | 0.304 | 0.008 | | 0.012 |
| D | | | 10.92 | | | 0.430 |
| E | 7.95 | | 9.75 | 0.313 | | 0.384 |
| e | | 2.54 | | | 0.100 | |
| e3 | | 7.62 | | | 0.300 | |
| e4 | | 7.62 | | | 0.300 | |
| F | | | 6.6 | | | 0260 |
| i | | | 5.08 | | | 0.200 |
| L | 3.18 | | 3.81 | 0.125 | | 0.150 |
| Z | | | 1.52 | | | 0.060 |

## PACKAGE MECHANICAL DATA

8 PINS - PLASTIC MICROPACKAGE (SO)




| Dim. | Millimeters | | | Inches | | |
|---|---|---|---|---|---|---|
| | Min. | Typ. | Max. | Min. | Typ. | Max. |
| A | | | 1.75 | | | 0.069 |
| a1 | 0.1 | | 0.25 | 0.004 | | 0.010 |
| a2 | | | 1.65 | | | 0.065 |
| a3 | 0.65 | | 0.85 | 0.026 | | 0.033 |
| b | 0.35 | | 0.48 | 0.014 | | 0.019 |
| b1 | 0.19 | | 0.25 | 0.007 | | 0.010 |
| C | 0.25 | | 0.5 | 0.010 | | 0.020 |
| c1 | 45° (typ.) | | | | | |
| D | 4.8 | | 5.0 | 0.189 | | 0.197 |
| E | 5.8 | | 6.2 | 0.228 | | 0.244 |
| e | | 1.27 | | | 0.050 | |
| e3 | | 3.81 | | | 0.150 | |
| F | 3.8 | | 4.0 | 0.150 | | 0.157 |
| L | 0.4 | | 1.27 | 0.016 | | 0.050 |
| M | | | 0.6 | | | 0.024 |
| S | 8° (max.) | | | | | |