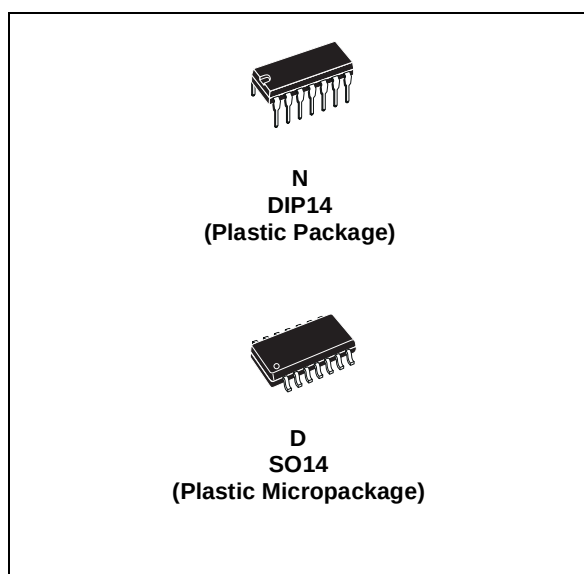




## WIDE BANDWIDTH QUAD J-FET OPERATIONAL AMPLIFIERS

- 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/ $\mu$ s (typ)



### DESCRIPTION

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

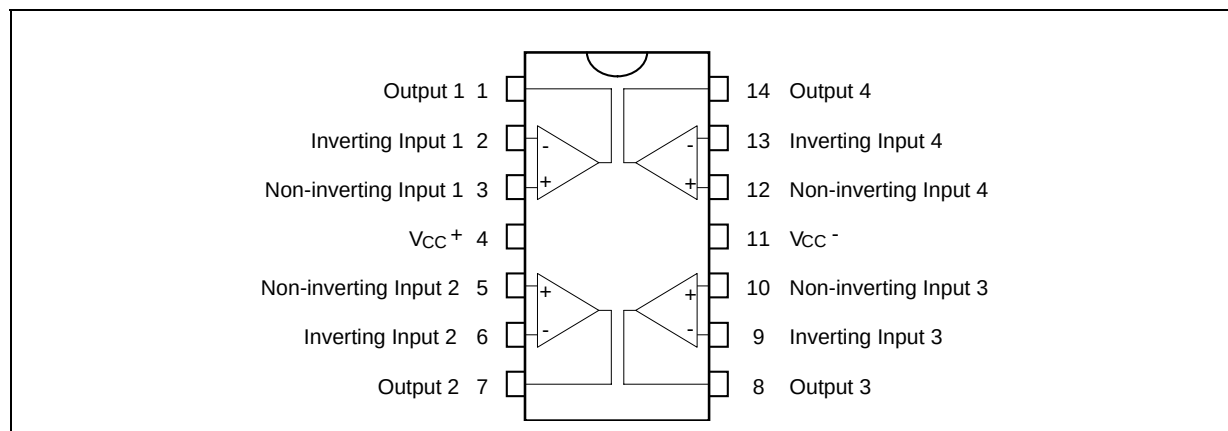
The devices feature high slew rates, low input bias and offset currents, and low offset voltage temperature coefficient.

### ORDER CODE

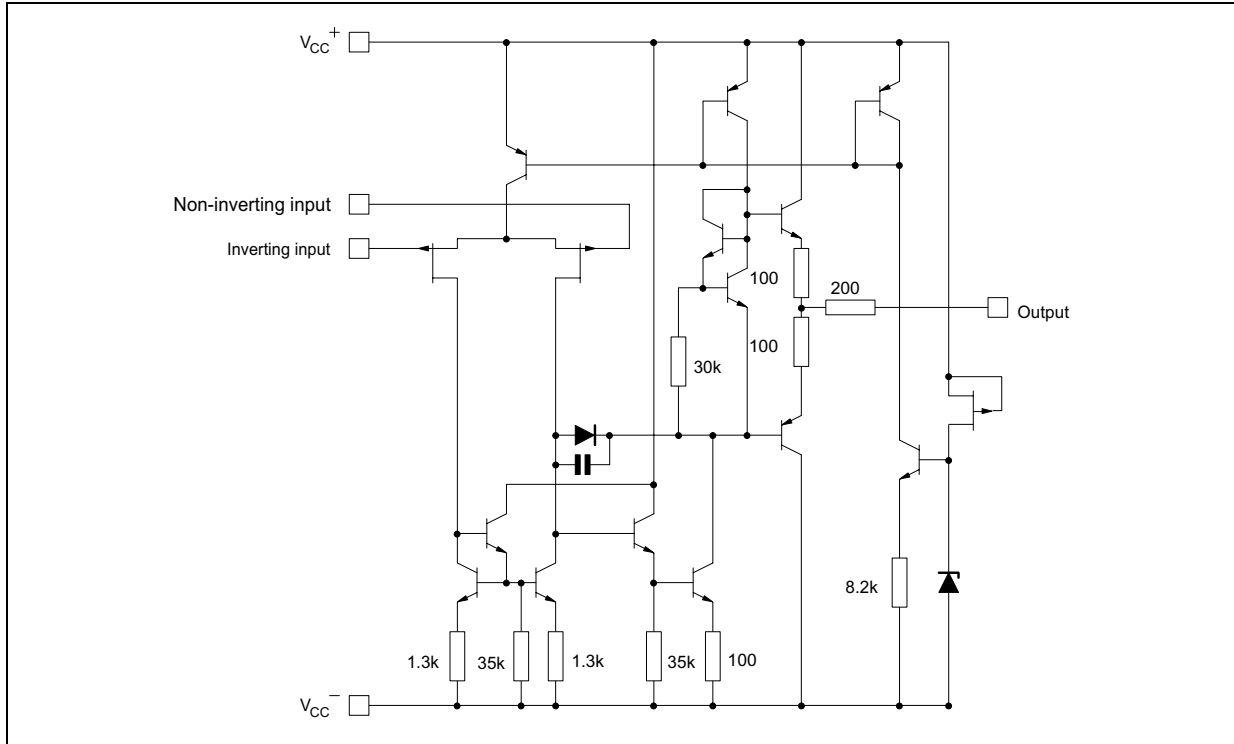
| Part Number       | Temperature Range | Package |   |
|-------------------|-------------------|---------|---|
|                   |                   | N       | D |
| LF147             | -55°C, +125°C     | •       | • |
| LF247             | -40°C, +105°C     | •       | • |
| LF347             | 0°C, +70°C        | •       | • |
| Example : LF347IN |                   |         |   |

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

### PIN CONNECTIONS (top view)



**SCHEMATIC DIAGRAM (each amplifier)**



**ABSOLUTE MAXIMUM RATINGS**

| Symbol     | Parameter                                          | LF147       | LF247       | LF347    | Unit |
|------------|----------------------------------------------------|-------------|-------------|----------|------|
| $V_{CC}$   | Supply voltage - note <sup>1)</sup>                | $\pm 18$    |             |          | V    |
| $V_i$      | Input Voltage - note <sup>2)</sup>                 | $\pm 15$    |             |          | V    |
| $V_{id}$   | Differential Input Voltage - note <sup>3)</sup>    | $\pm 30$    |             |          | V    |
| $P_{tot}$  | Power Dissipation                                  | 680         |             |          | mW   |
|            | Output Short-circuit Duration - note <sup>4)</sup> | 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

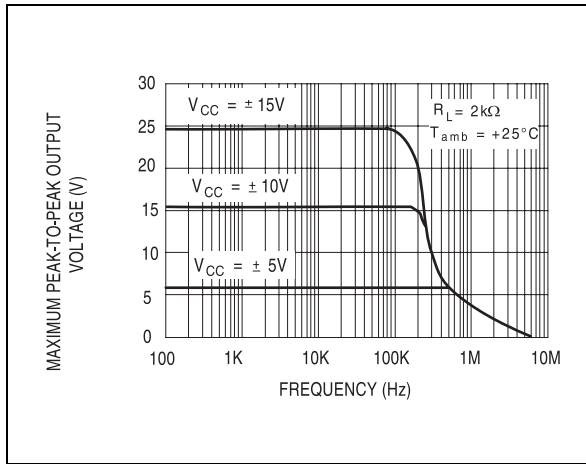
# **ELECTRICAL CHARACTERISTICS**

$V_{CC} = \pm 15V$ ,  $T_{amb} = +25^{\circ}C$  (unless otherwise specified)

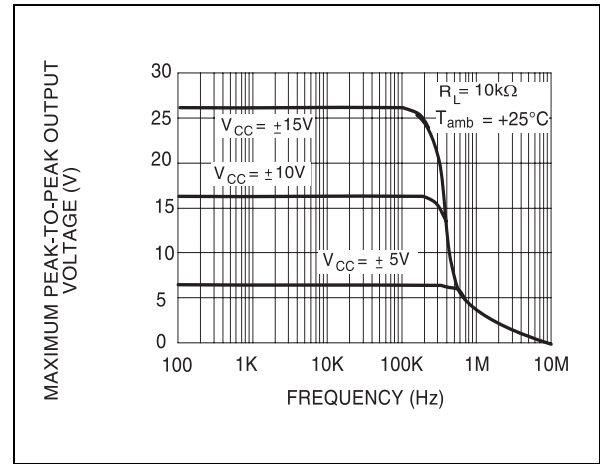
| Symbol          | Parameter                                                                                                                                                                | Min.                 | Typ.       | Max.       | Unit                   |
|-----------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------|------------|------------|------------------------|
| $V_{io}$        | Input Offset Voltage ( $R_S = 10k\Omega$ )<br>$T_{amb} = 25^{\circ}C$<br>$T_{min} \leq T_{amb} \leq T_{max}$                                                             |                      | 3          | 10<br>13   | mV                     |
| $DV_{io}$       | Input Offset Voltage Drift                                                                                                                                               |                      | 10         |            | $\mu V/^{\circ}C$      |
| $I_{io}$        | Input Offset Current - note 1)<br>$T_{amb} = 25^{\circ}C$<br>$T_{min} \leq T_{amb} \leq T_{max}$                                                                         |                      | 5          | 100<br>4   | pA<br>nA               |
| $I_{ib}$        | Input Bias Current - note 1<br>$T_{amb} = 25^{\circ}C$<br>$T_{min} \leq T_{amb} \leq T_{max}$                                                                            |                      | 20         | 200<br>20  | pA<br>nA               |
| $A_{vd}$        | Large Signal Voltage Gain ( $R_L = 2k\Omega$ , $V_O = \pm 10V$ ) ,<br>$T_{amb} = 25^{\circ}C$<br>$T_{min} \leq T_{amb} \leq T_{max}$                                     | 50<br>25             | 200        |            | V/mV                   |
| SVR             | Supply Voltage Rejection Ratio ( $R_S = 10k\Omega$ )<br>$T_{amb} = 25^{\circ}C$<br>$T_{min} \leq T_{amb} \leq T_{max}$                                                   | 80<br>80             | 86         |            | dB                     |
| $I_{CC}$        | Supply Current, Per Amp, no Load<br>$T_{amb} = 25^{\circ}C$<br>$T_{min} \leq T_{amb} \leq T_{max}$                                                                       |                      | 1.4        | 2.7<br>2.7 | mA                     |
| $V_{icm}$       | Input Common Mode Voltage Range                                                                                                                                          | $\pm 11$             | +15<br>-12 |            | V                      |
| CMR             | Common Mode Rejection Ratio ( $R_S = 10k\Omega$ )<br>$T_{amb} = 25^{\circ}C$<br>$T_{min} \leq T_{amb} \leq T_{max}$                                                      | 70<br>70             | 86         |            | dB                     |
| $I_{OS}$        | Output Short-Circuit Current<br>$T_{amb} = 25^{\circ}C$<br>$T_{min} \leq T_{amb} \leq T_{max}$                                                                           | 10<br>10             | 40         | 60<br>60   | mA                     |
| $\pm V_{opp}$   | Output Voltage Swing<br>$T_{amb} = 25^{\circ}C$<br>$T_{min} \leq T_{amb} \leq T_{max}$<br>$R_L = 2k\Omega$<br>$R_L = 10k\Omega$<br>$R_L = 2k\Omega$<br>$R_L = 10k\Omega$ | 10<br>12<br>10<br>12 | 12<br>13.5 |            | V                      |
| SR              | Slew Rate<br>$V_i = 10V$ , $R_L = 2k\Omega$ , $C_L = 100pF$ , $T_{amb} = 25^{\circ}C$ , unity gain                                                                       | 12                   | 16         |            | V/ $\mu s$             |
| $t_r$           | Rise Time<br>$V_i = 20mV$ , $R_L = 2k\Omega$ , $C_L = 100pF$ , $T_{amb} = 25^{\circ}C$ , unity gain                                                                      |                      | 0.1        |            | $\mu s$                |
| $K_{ov}$        | Overshoot<br>$V_i = 20mV$ , $R_L = 2k\Omega$ , $C_L = 100pF$ , $T_{amb} = 25^{\circ}C$ , unity gain                                                                      |                      | 10         |            | %                      |
| GBP             | Gain Bandwidth Product<br>$f = 100kHz$ , $T_{amb} = 25^{\circ}C$ , $V_{in} = 10mV$ , $R_L = 2k\Omega$ , $C_L = 100pF$                                                    | 2.5                  | 4          |            | MHz                    |
| $R_i$           | Input Resistance                                                                                                                                                         |                      | $10^{12}$  |            | $\Omega$               |
| THD             | Total Harmonic Distortion<br>$f = 1kHz$ , $A_v = 20dB$ , $R_L = 2k\Omega$ , $C_L = 100pF$<br>$T_{amb} = 25^{\circ}C$ , $V_O = 2V_{pp}$                                   |                      | 0.01       |            | %                      |
| $e_n$           | Equivalent Input Noise Voltage ( $R_S = 100\Omega$ , $f = 1kHz$ )                                                                                                        |                      | 15         |            | $\frac{nV}{\sqrt{Hz}}$ |
| $\phi_m$        | Phase Margin                                                                                                                                                             |                      | 45         |            | Degrees                |
| $V_{O1}/V_{O2}$ | Channel Separation ( $A_v = 100$ )                                                                                                                                       |                      | 120        |            | dB                     |

1. The input bias currents are junction leakage currents which approximately double for every  $10^{\circ}C$  increase in the junction temperature.

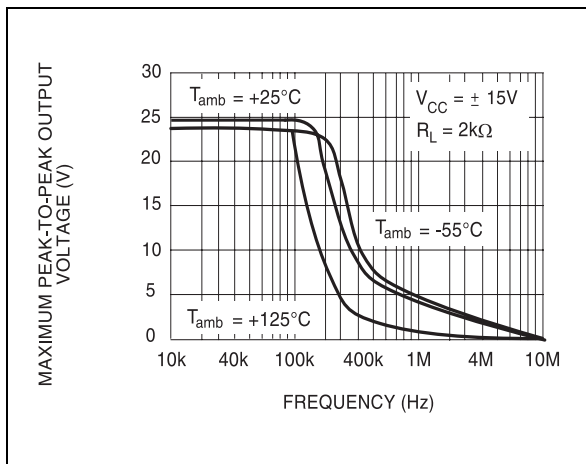
**MAXIMUM PEAK-TO-PEAK OUTPUT  
VOLTAGE versus FREQUENCY**



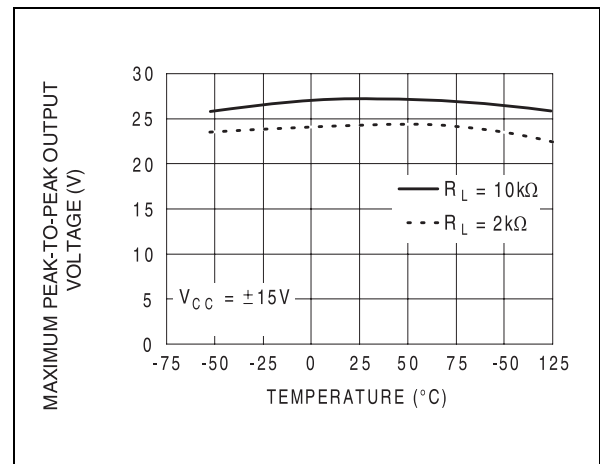
**MAXIMUM PEAK-TO-PEAK OUTPUT  
VOLTAGE versus FREQUENCY**



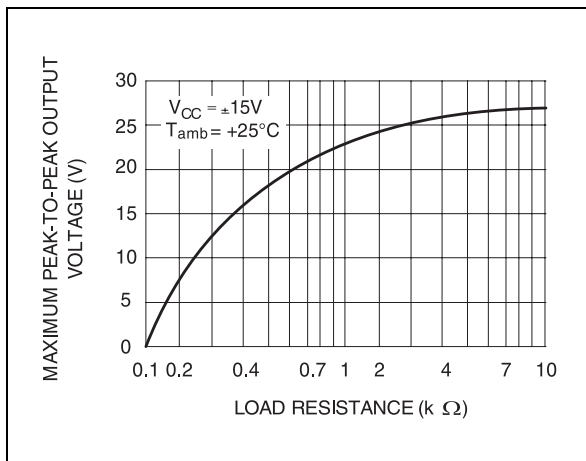
**MAXIMUM PEAK-TO-PEAK OUTPUT  
VOLTAGE versus FREQUENCY**



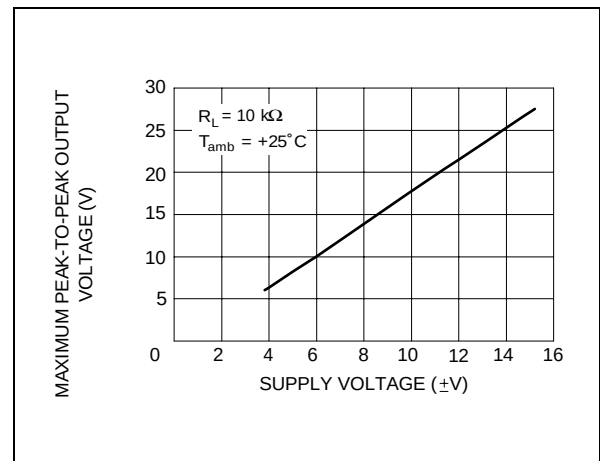
**MAXIMUM PEAK-TO-PEAK OUTPUT  
VOLTAGE versus FREE AIR TEMP.**



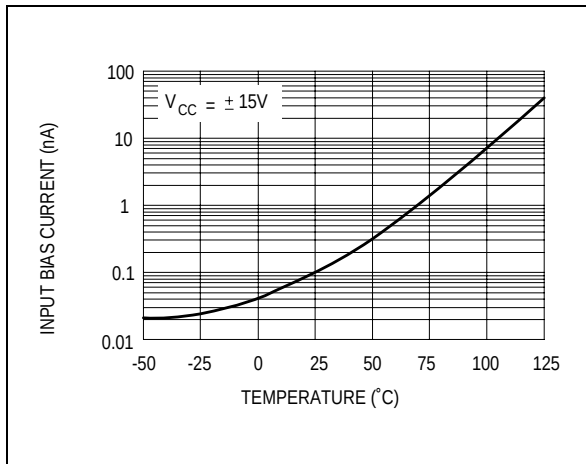
**MAXIMUM PEAK-TO-PEAK OUTPUT  
VOLTAGE versus LOAD RESISTANCE**



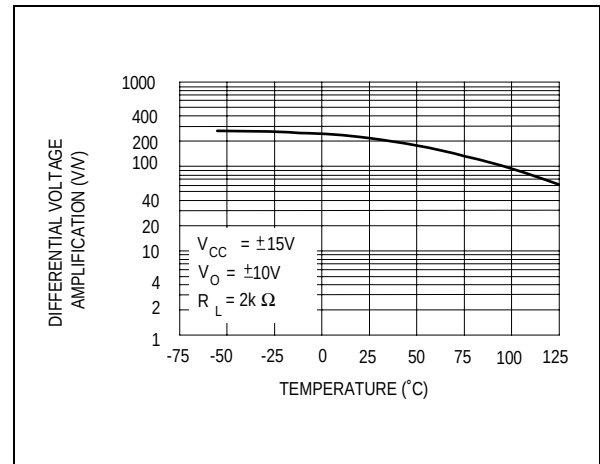
**MAXIMUM PEAK-TO-PEAK OUTPUT  
VOLTAGE versus SUPPLY VOLTAGE**



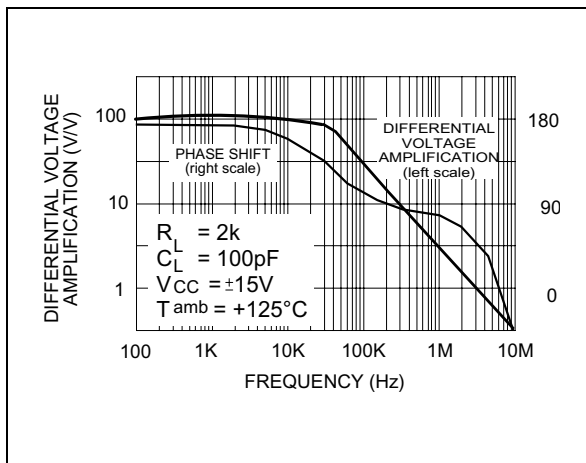
**INPUT BIAS CURRENT versus FREE AIR TEMPERATURE**



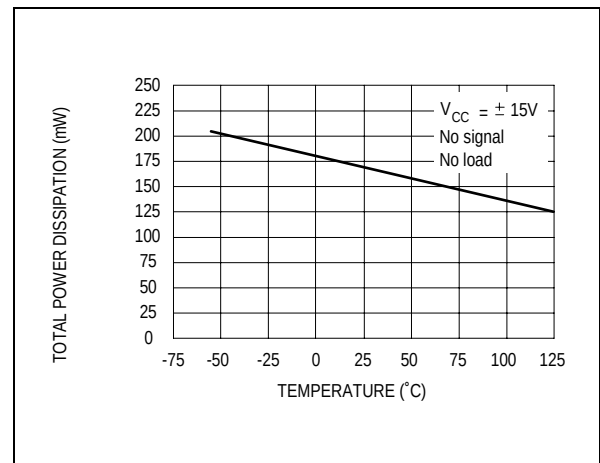
**LARGE SIGNAL DIFFERENTIAL VOLTAGE AMPLIFICATION AND PHASE SHIFT versus FREQUENCY**



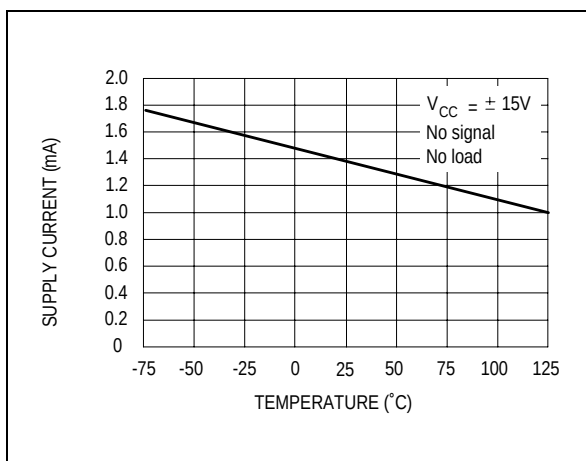
**LARGE SIGNAL DIFFERENTIAL VOLTAGE AMPLIFICATION AND PHASE SHIFT versus FREQUENCY**



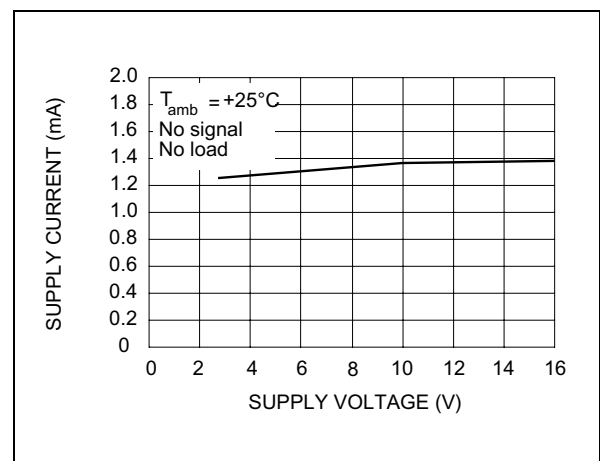
**TOTAL POWER DISSIPATION versus FREE AIR TEMPERATURE**



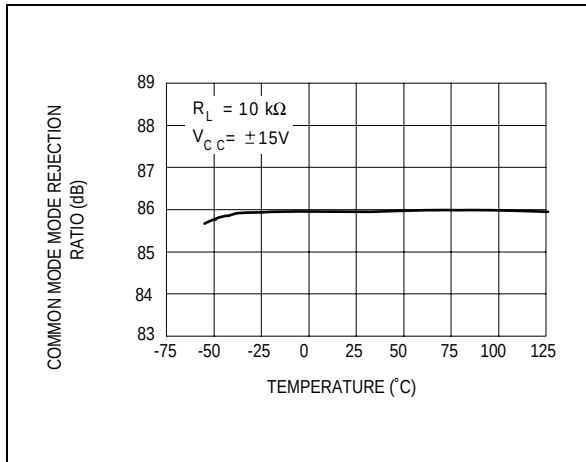
**SUPPLY CURRENT PER AMPLIFIER versus FREE AIR TEMPERATURE**



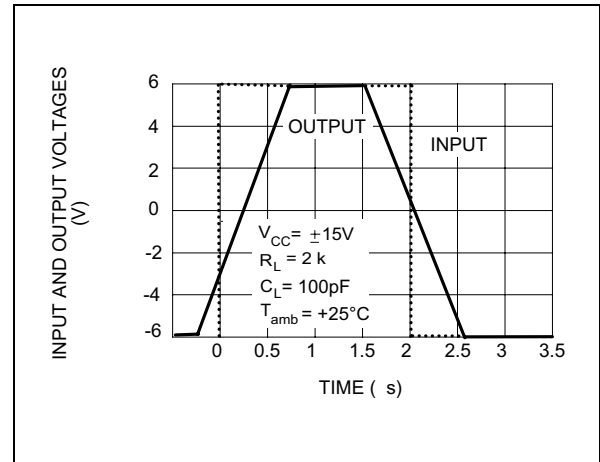
**COMMON MODE REJECTION RATIO versus FREE AIR TEMPERATURE**



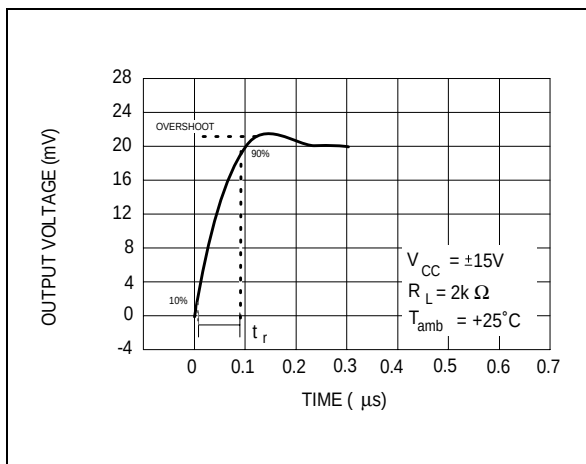
**COMMON MODE REJECTION RATIO versus FREE AIR TEMPERATURE**



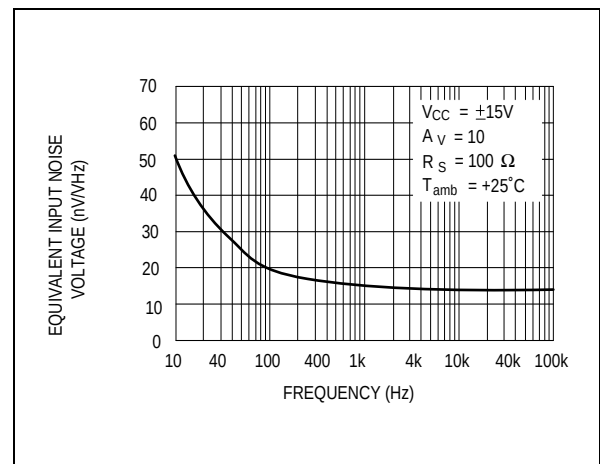
**VOLTAGE FOLLOWER LARGE SIGNAL PULSE RESPONSE**



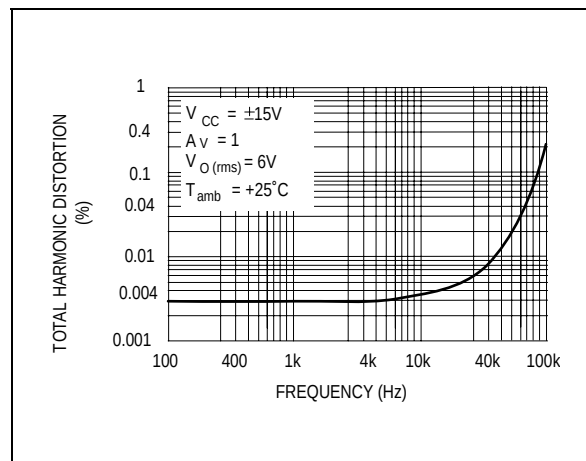
**OUTPUT VOLTAGE versus ELAPSED TIME**



**EQUIVALENT INPUT NOISE VOLTAGE versus FREQUENCY**



**TOTAL HARMONIC DISTORTION versus FREQUENCY**



## PARAMETER MEASUREMENT INFORMATION

**Figure 1 : Voltage Follower**

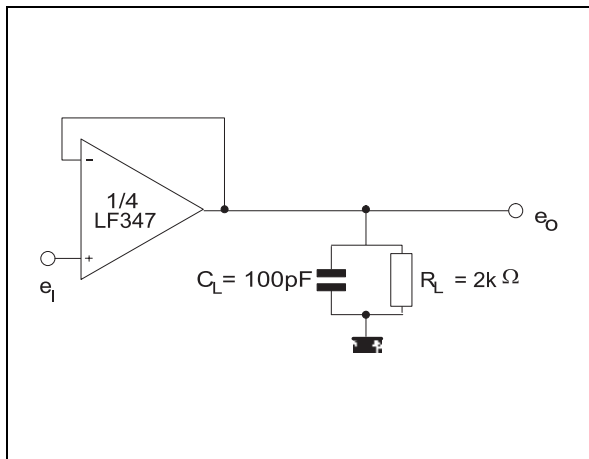
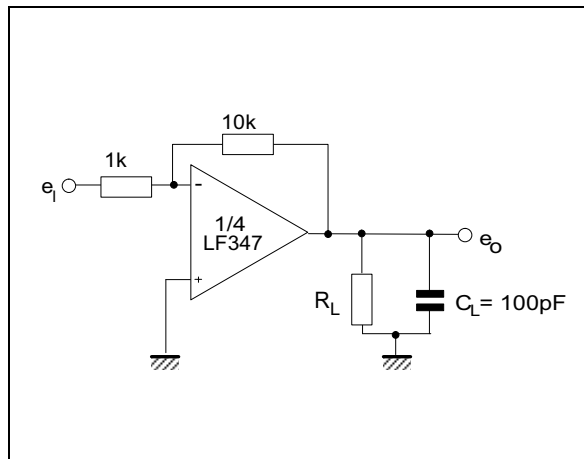
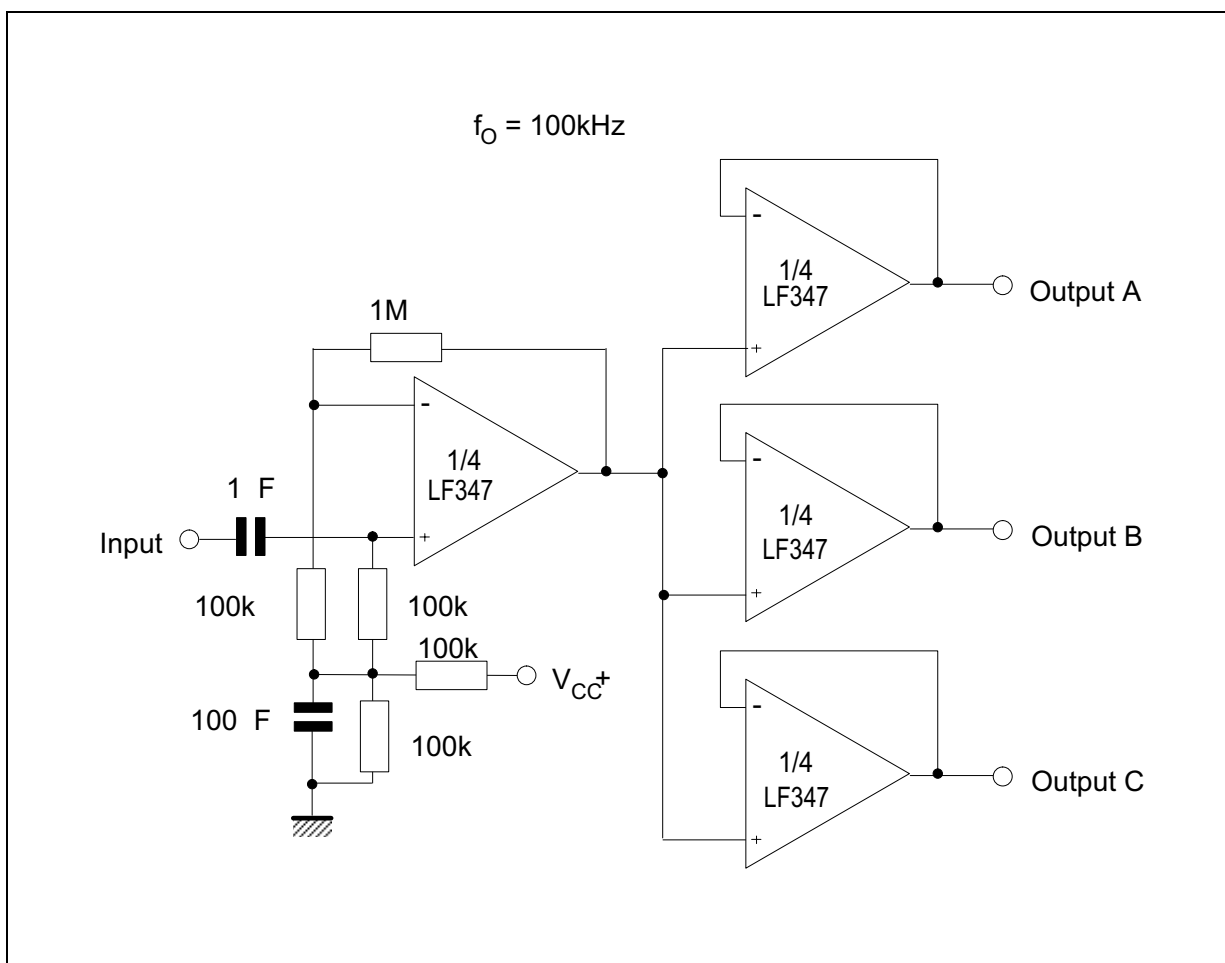


**Figure 2 : Gain-of-10 Inverting Amplifier**



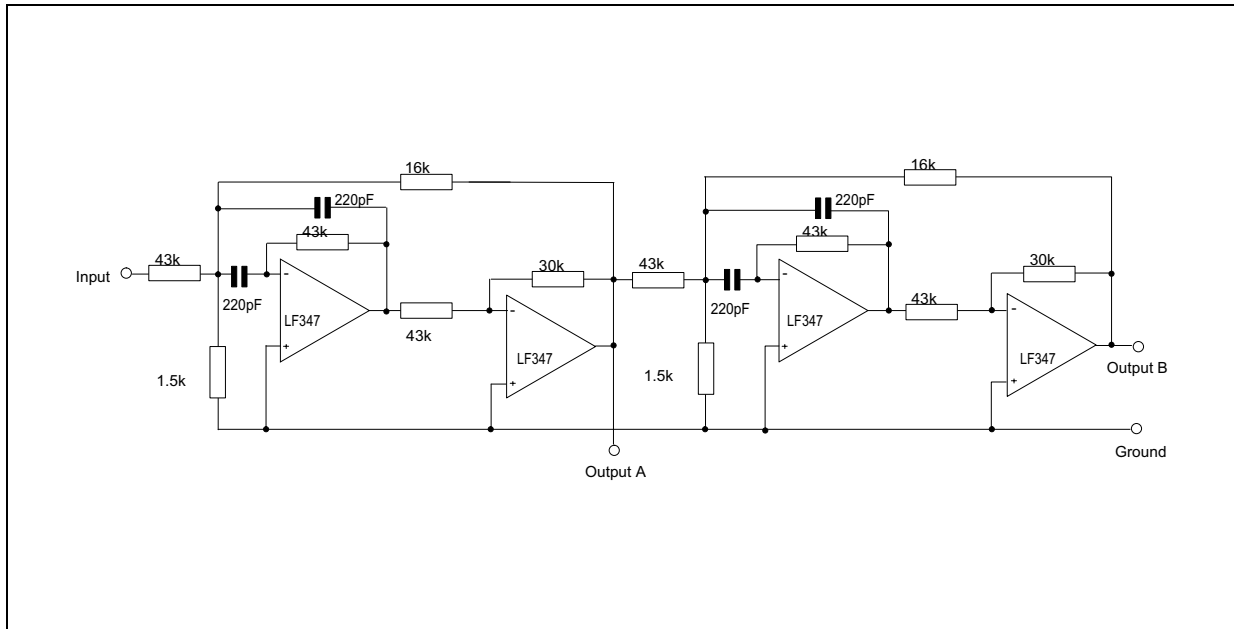
## TYPICAL APPLICATIONS

### AUDIO DISTRIBUTOR AMPLIFIER

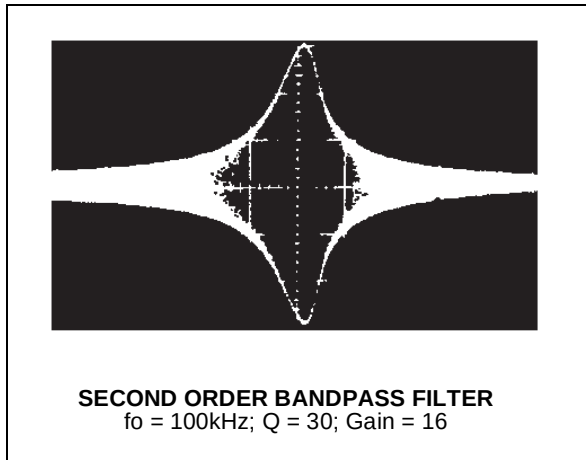


TYPICAL APPLICATIONS (continued)

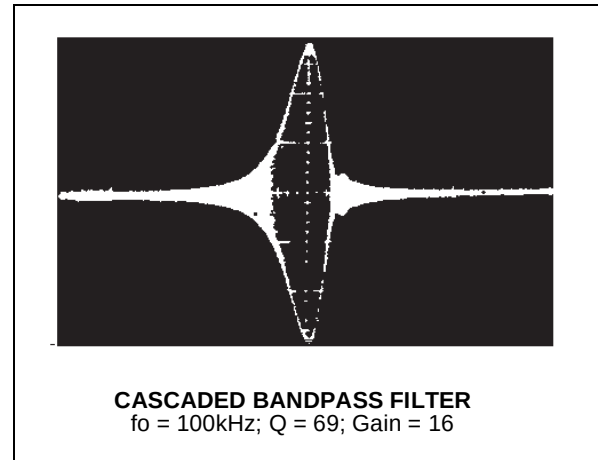
POSITIVE FEEDBACK BANDPASS FILTER



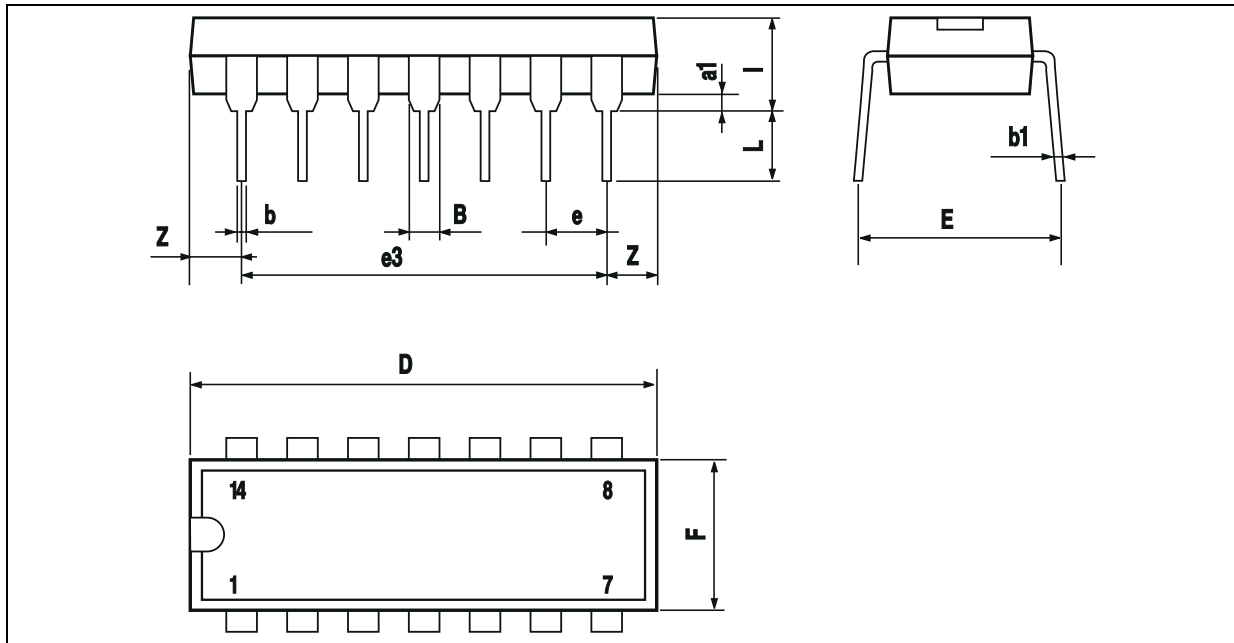
OUTPUT A



OUTPUT B



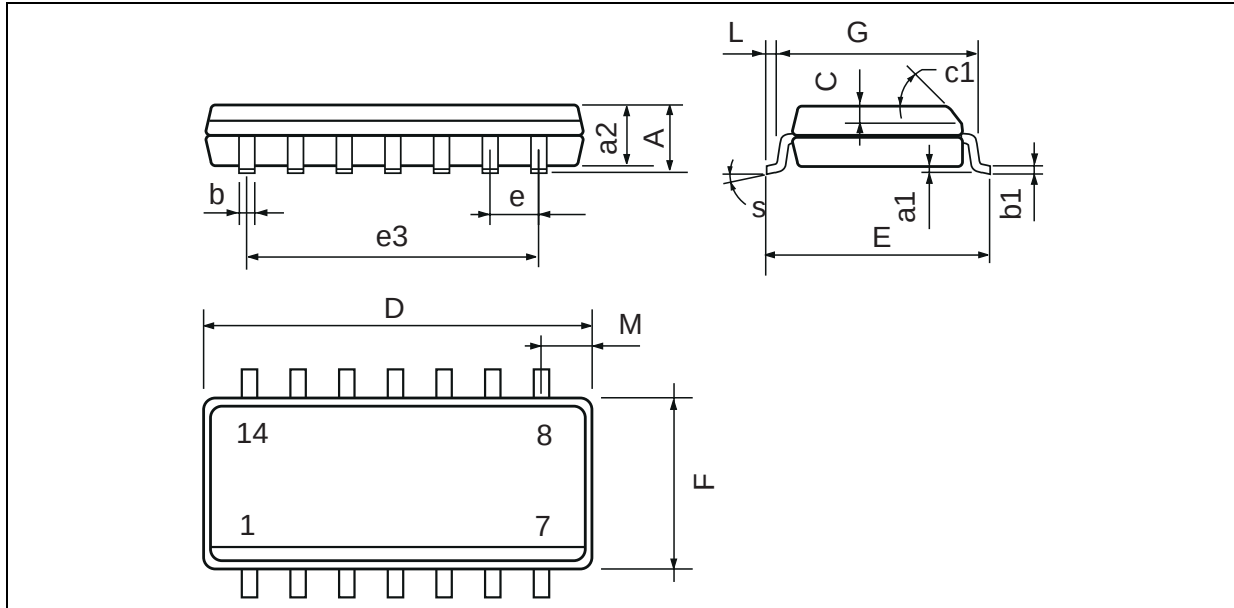
**PACKAGE MECHANICAL DATA**  
14 PINS - PLASTIC DIP



| Dim. | Millimeters |       |      | Inches |       |       |
|------|-------------|-------|------|--------|-------|-------|
|      | Min.        | Typ.  | Max. | Min.   | Typ.  | Max.  |
| a1   | 0.51        |       |      | 0.020  |       |       |
| B    | 1.39        |       | 1.65 | 0.055  |       | 0.065 |
| b    |             | 0.5   |      |        | 0.020 |       |
| b1   |             | 0.25  |      |        | 0.010 |       |
| D    |             |       | 20   |        |       | 0.787 |
| E    |             | 8.5   |      |        | 0.335 |       |
| e    |             | 2.54  |      |        | 0.100 |       |
| e3   |             | 15.24 |      |        | 0.600 |       |
| F    |             |       | 7.1  |        |       | 0.280 |
| i    |             |       | 5.1  |        |       | 0.201 |
| L    |             | 3.3   |      |        | 0.130 |       |
| Z    | 1.27        |       | 2.54 | 0.050  |       | 0.100 |

**PACKAGE MECHANICAL DATA**

**14 PINS - PLASTIC MICROPACKAGE (SO)**



| Dim.  | Millimeters |      |      | Inches |       |       |
|-------|-------------|------|------|--------|-------|-------|
|       | Min.        | Typ. | Max. | Min.   | Typ.  | Max.  |
| A     |             |      | 1.75 |        |       | 0.069 |
| a1    | 0.1         |      | 0.2  | 0.004  |       | 0.008 |
| a2    |             |      | 1.6  |        |       | 0.063 |
| b     | 0.35        |      | 0.46 | 0.014  |       | 0.018 |
| b1    | 0.19        |      | 0.25 | 0.007  |       | 0.010 |
| C     |             | 0.5  |      |        | 0.020 |       |
| c1    | 45° (typ.)  |      |      |        |       |       |
| D (1) | 8.55        |      | 8.75 | 0.336  |       | 0.344 |
| E     | 5.8         |      | 6.2  | 0.228  |       | 0.244 |
| e     |             | 1.27 |      |        | 0.050 |       |
| e3    |             | 7.62 |      |        | 0.300 |       |
| F (1) | 3.8         |      | 4.0  | 0.150  |       | 0.157 |
| G     | 4.6         |      | 5.3  | 0.181  |       | 0.208 |
| L     | 0.5         |      | 1.27 | 0.020  |       | 0.050 |
| M     |             |      | 0.68 |        |       | 0.027 |
| S     | 8° (max.)   |      |      |        |       |       |

Note : (1) D and F do not include mold flash or protrusions - Mold flash or protrusions shall not exceed 0.15mm (.066 inc) ONLY FOR DATA BOOK.

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