

# JFET Input Operational Amplifiers

These low cost JFET input operational amplifiers combine two state-of-the-art analog technologies on a single monolithic integrated circuit. Each internally compensated operational amplifier has well matched high voltage JFET input devices for low input offset voltage. The JFET technology provides wide bandwidths and fast slew rates with low input bias currents, input offset currents, and supply currents.

These devices are available in single, dual and quad operational amplifiers which are pin-compatible with the industry standard MC1741, MC1458, and the MC3403/LM324 bipolar devices.

- Input Offset Voltage of 5.0 mV Max (LF347B)
- Low Input Bias Current: 50 pA
- Low Input Noise Voltage:  $16 \text{ nV}/\sqrt{\text{Hz}}$
- Wide Gain Bandwidth: 4.0 MHz
- High Slew Rate:  $13\text{V}/\mu\text{s}$
- Low Supply Current: 1.8 mA per Amplifier
- High Input Impedance:  $10^{12} \Omega$
- High Common Mode and Supply Voltage Rejection Ratios: 100 dB

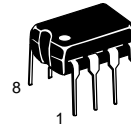
## MAXIMUM RATINGS

| Rating   | Symbol          | Value       | Unit                       |
|--|-----------------|-------------|----------------------------|
| Supply Voltage   | $V_{CC}$        | +18         | V                          |
|  | $V_{EE}$        | -18         | V                          |
| Differential Input Voltage   | $V_{ID}$        | $\pm 30$    | V                          |
| Input Voltage Range (Note 1)   | $V_{IDR}$       | $\pm 15$    | V                          |
| Output Short Circuit Duration (Note 2)   | $t_{SC}$        | Continuous  |                            |
| Power Dissipation at $T_A = +25^\circ\text{C}$<br>Derate above $T_A = +25^\circ\text{C}$ | $P_D$           | 900         | mW                         |
|  | $1/\theta_{JA}$ | 10          | $\text{mW}/^\circ\text{C}$ |
| Operating Ambient Temperature Range  | $T_A$           | 0 to +70    | $^\circ\text{C}$           |
| Operating Junction Temperature Range   | $T_J$           | 115         | $^\circ\text{C}$           |
| Storage Temperature Range  | $T_{stg}$       | -65 to +150 | $^\circ\text{C}$           |

- NOTES:**
1. Unless otherwise specified, the absolute maximum negative input voltage is limited to the negative power supply.
  2. Any amplifier output can be shorted to ground indefinitely. However, if more than one amplifier output is shorted simultaneously, maximum junction temperature rating may be exceeded.

# LF347, B LF351 LF353

## FAMILY OF JFET OPERATIONAL AMPLIFIERS

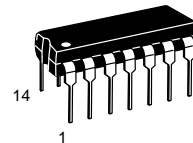
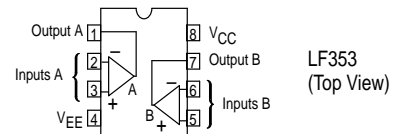
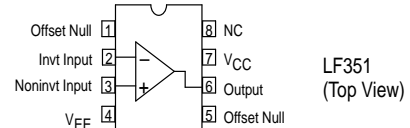


**N SUFFIX**  
PLASTIC PACKAGE  
CASE 626



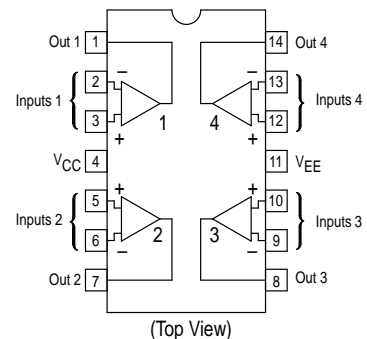
**D SUFFIX**  
PLASTIC PACKAGE  
CASE 751  
(SO-8)

### PIN CONNECTIONS



**N SUFFIX**  
PLASTIC PACKAGE  
CASE 646

### PIN CONNECTIONS



## ORDERING INFORMATION

| Device            | Function         | Operating Temperature Range                   | Package                    |
|-------------------|------------------|---|----------------------------|
| LF351D<br>LF351N  | Single<br>Single | $T_A = 0^\circ \text{ to } +70^\circ\text{C}$ | SO-8<br>Plastic DIP        |
| LF353D<br>LF353N  | Dual<br>Dual     |   | SO-8<br>Plastic DIP        |
| LF347BN<br>LF347N | Quad<br>Quad     |   | Plastic DIP<br>Plastic DIP |

# LF347, B LF351 LF353

## ELECTRICAL CHARACTERISTICS ( $V_{CC} = +15$ V, $V_{EE} = -15$ V, $T_A = 25^\circ\text{C}$ , unless otherwise noted.)

| Characteristic   | Symbol                   | LF347B      |               |              | LF347, LF351, LF353 |                   |                  | Unit                         |
|--|--------------------------|-------------|---------------|--------------|---------------------|-------------------|------------------|------------------------------|
|  |                          | Min         | Typ           | Max          | Min                 | Typ               | Max              |                              |
| Input Offset Voltage ( $R_S \leq 10$ k, $V_{CM} = 0$ )<br>$T_A = +25^\circ\text{C}$<br>$0^\circ\text{C} \leq T_A \leq +70^\circ\text{C}$       | $V_{IO}$                 | –           | 1.0           | 5.0          | –                   | 5.0               | 10               | mV                           |
|  |                          | –           | –             | 8.0          | –                   | –                 | 13               |                              |
| Avg. Temperature Coefficient of Input Offset Voltage<br>$R_S \leq 10$ k, $0^\circ\text{C} \leq T_A \leq +70^\circ\text{C}$                     | $\Delta V_{IO}/\Delta T$ | –           | 10            | –            | –                   | 10                | –                | $\mu\text{V}/^\circ\text{C}$ |
| Input Offset Current ( $V_{CM} = 0$ , Note 3)<br>$T_A = +25^\circ\text{C}$<br>$0^\circ\text{C} \leq T_A \leq +70^\circ\text{C}$                | $I_{IO}$                 | –           | 25            | 100          | –                   | 25                | 100              | pA                           |
|  |                          | –           | –             | 4.0          | –                   | –                 | 4.0              | nA                           |
| Input Bias Current ( $V_{CM} = 0$ , Note 3)<br>$T_A = +25^\circ\text{C}$<br>$0^\circ\text{C} \leq T_A \leq +70^\circ\text{C}$                  | $I_{IB}$                 | –           | 50            | 200          | –                   | 50                | 200              | pA                           |
|  |                          | –           | –             | 8.0          | –                   | –                 | 8.0              | nA                           |
| Input Resistance   | $r_i$                    | –           | $10^{12}$     | –            | –                   | $10^{12}$         | –                | $\Omega$                     |
| Common Mode Input Voltage Range  | $V_{ICR}$                | $\pm 11$    | +15<br>–12    | –            | $\pm 11$            | +15<br>–12        | –                | V                            |
| Large-Signal Voltage Gain ( $V_O = \pm 10$ V, $R_L = 2.0$ k)<br>$T_A = +25^\circ\text{C}$<br>$0^\circ\text{C} \leq T_A \leq +70^\circ\text{C}$ | $A_{VOL}$                | 50<br>25    | 100<br>–      | –<br>–       | 25<br>15            | 100<br>–          | –<br>–           | V/mV                         |
| Output Voltage Swing ( $R_L = 10$ k)   | $V_O$                    | $\pm 12$    | $\pm 14$      | –            | $\pm 12$            | $\pm 14$          | –                | V                            |
| Common Mode Rejection ( $R_S \leq 10$ k)   | CMR                      | 80          | 100           | –            | 70                  | 100               | –                | dB                           |
| Supply Voltage Rejection ( $R_S \leq 10$ k)  | PSRR                     | 80          | 100           | –            | 70                  | 100               | –                | dB                           |
| Supply Current<br>LF347<br>LF351<br>LF353  | $I_D$                    | –<br>–<br>– | 7.2<br>–<br>– | 11<br>–<br>– | –<br>–<br>–         | 7.2<br>1.8<br>3.6 | 11<br>3.4<br>6.5 | mA                           |
| Short Circuit Current  | $I_{SC}$                 | –           | 25            | –            | –                   | 25                | –                | mA                           |
| Slew Rate ( $A_V = +1$ )   | SR                       | –           | 13            | –            | –                   | 13                | –                | V/ $\mu\text{s}$             |
| Gain-Bandwidth Product   | BWp                      | –           | 4.0           | –            | –                   | 4.0               | –                | MHz                          |
| Equivalent Input Noise Voltage<br>( $R_S = 100$ $\Omega$ , $f = 1000$ Hz)  | $e_n$                    | –           | 24            | –            | –                   | 24                | –                | $\text{nV}/\sqrt{\text{Hz}}$ |
| Equivalent Input Noise Current ( $f = 1000$ Hz)  | $i_n$                    | –           | 0.01          | –            | –                   | 0.01              | –                | $\text{pA}/\sqrt{\text{Hz}}$ |
| Channel Separation (LF347, LF353)<br>$1.0$ Hz $\leq f \leq 20$ kHz (Input Referred)  | –                        | –           | –120          | –            | –                   | –120              | –                | dB                           |

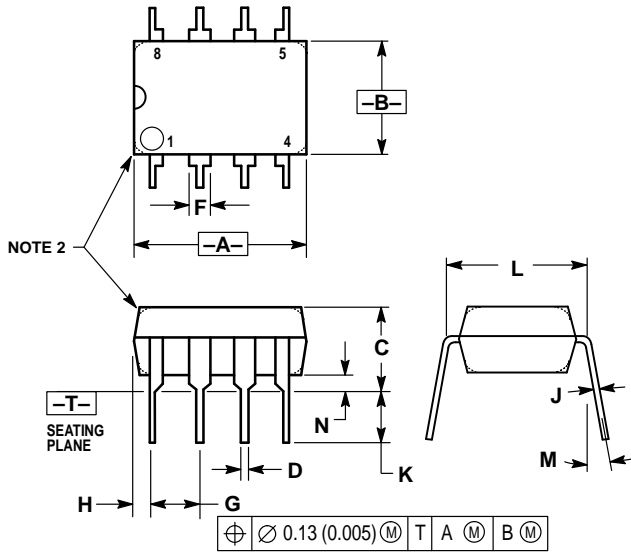
For Typical Characteristic Performance Curves, refer to MC34001, 34002, 34004 data sheet.

**NOTE:** 3. Input bias currents of JFET input op amps approximately double for every  $10^\circ\text{C}$  rise in junction temperature. To maintain junction temperatures as close to ambient as is possible, pulse techniques are utilized during test.

# LF347, B LF351 LF353

## OUTLINE DIMENSIONS

### N SUFFIX PLASTIC PACKAGE CASE 626-05 ISSUE K

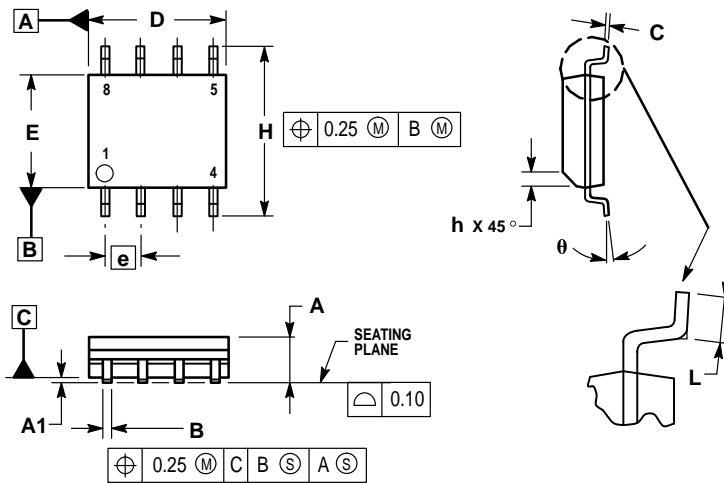


NOTES:

1. DIMENSION L TO CENTER OF LEAD WHEN FORMED PARALLEL.
2. PACKAGE CONTOUR OPTIONAL (ROUND OR SQUARE CORNERS).
3. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.

| DIM | MILLIMETERS |       | INCHES    |       |
|-----|-------------|-------|-----------|-------|
|     | MIN         | MAX   | MIN       | MAX   |
| A   | 9.40        | 10.16 | 0.370     | 0.400 |
| B   | 6.10        | 6.60  | 0.240     | 0.260 |
| C   | 3.94        | 4.45  | 0.155     | 0.175 |
| D   | 0.38        | 0.51  | 0.015     | 0.020 |
| F   | 1.02        | 1.78  | 0.040     | 0.070 |
| G   | 2.54 BSC    |       | 0.100 BSC |       |
| H   | 0.76        | 1.27  | 0.030     | 0.050 |
| J   | 0.20        | 0.30  | 0.008     | 0.012 |
| K   | 2.92        | 3.43  | 0.115     | 0.135 |
| L   | 7.62 BSC    |       | 0.300 BSC |       |
| M   | —           | 10°   | —         | 10°   |
| N   | 0.76        | 1.01  | 0.030     | 0.040 |

### D SUFFIX PLASTIC PACKAGE CASE 751-05 (SO-8) ISSUE R



NOTES:

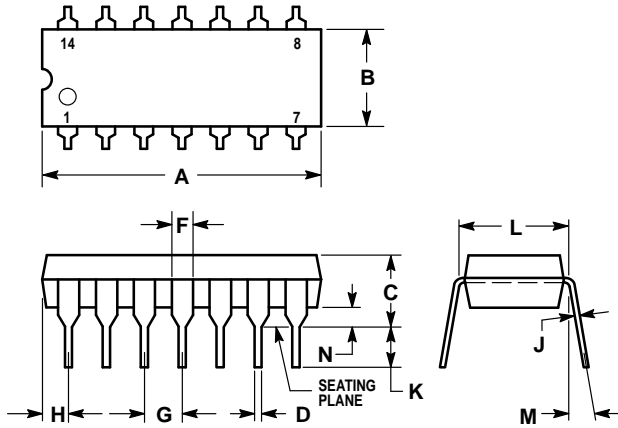
1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
2. DIMENSIONS ARE IN MILLIMETERS.
3. DIMENSION D AND E DO NOT INCLUDE MOLD PROTRUSION.
4. MAXIMUM MOLD PROTRUSION 0.15 PER SIDE.
5. DIMENSION B DOES NOT INCLUDE MOLD PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.127 TOTAL IN EXCESS OF THE B DIMENSION AT MAXIMUM MATERIAL CONDITION.

| DIM      | MILLIMETERS |      |
|----------|-------------|------|
|          | MIN         | MAX  |
| A        | 1.35        | 1.75 |
| A1       | 0.10        | 0.25 |
| B        | 0.35        | 0.49 |
| C        | 0.18        | 0.25 |
| D        | 4.80        | 5.00 |
| E        | 3.80        | 4.00 |
| e        | 1.27 BSC    |      |
| H        | 5.80        | 6.20 |
| h        | 0.25        | 0.50 |
| L        | 0.40        | 1.25 |
| $\theta$ | 0°          | 7°   |

# LF347, B LF351 LF353

## OUTLINE DIMENSIONS


**N SUFFIX**  
**PLASTIC PACKAGE**  
**CASE 646-06**  
**ISSUE L**



**NOTES:**

- LEADS WITHIN 0.13 (0.005) RADIUS OF TRUE POSITION AT SEATING PLANE AT MAXIMUM MATERIAL CONDITION.
- DIMENSION L TO CENTER OF LEADS WHEN FORMED PARALLEL.
- DIMENSION B DOES NOT INCLUDE MOLD FLASH.
- ROUNDED CORNERS OPTIONAL.

| DIM | INCHES    |       | MILLIMETERS |       |
|-----|-----------|-------|-------------|-------|
|     | MIN       | MAX   | MIN         | MAX   |
| A   | 0.715     | 0.770 | 18.16       | 19.56 |
| B   | 0.240     | 0.260 | 6.10        | 6.60  |
| C   | 0.145     | 0.185 | 3.69        | 4.69  |
| D   | 0.015     | 0.021 | 0.38        | 0.53  |
| F   | 0.040     | 0.070 | 1.02        | 1.78  |
| G   | 0.100 BSC |       | 2.54 BSC    |       |
| H   | 0.052     | 0.095 | 1.32        | 2.41  |
| J   | 0.008     | 0.015 | 0.20        | 0.38  |
| K   | 0.115     | 0.135 | 2.92        | 3.43  |
| L   | 0.300 BSC |       | 7.62 BSC    |       |
| M   | 0°        | 10°   | 0°          | 10°   |
| N   | 0.015     | 0.039 | 0.39        | 1.01  |

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LF347/D

