



**LM148**  
**LM248**  
**LM348**

## FOUR UA741 QUAD BIPOLAR OPERATIONAL AMPLIFIERS

- LOW SUPPLY CURRENT: 0.53mA/AMPLIFIER
- CLASS AB OUTPUT STAGE: NO CROSS OVER DISTORTION
- PIN COMPATIBLE WITH LM124
- LOW INPUT OFFSET VOLTAGE: 1mV
- LOW INPUT OFFSET CURRENT: 2nA
- LOW INPUT BIAS CURRENT: 30nA
- GAIN BANDWIDTH PRODUCT: 1.3MHz
- HIGH DEGREE OF ISOLATION BETWEEN AMPLIFIERS: 120dB
- OVERLOAD PROTECTION FOR INPUTS AND OUTPUTS

### DESCRIPTION

The LM148 consists of four independent, high gain internally compensated, low power operational amplifiers which have been designed to provide functional characteristics identical to those of the familiar UA741 operational amplifier. In addition the total supply current for all four amplifiers is compatible to the supply current of a single UA741 type op amp. Other features include input offset current and input bias current which are much less than those of a standard UA741. Also, excellent isolation between amplifiers has been achieved by independently biasing each amplifier and using layout techniques which minimize thermal coupling.

The LM148 can be used anywhere multiple UA741 type amplifiers are being used and in applications where amplifier matching or high packing density is required.

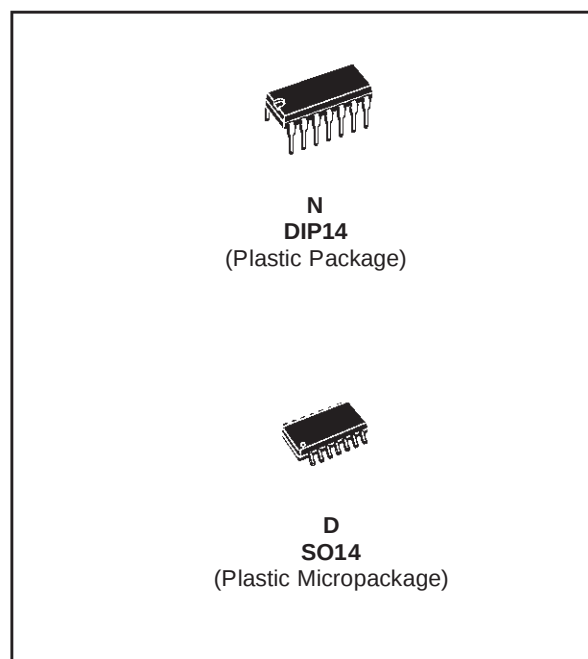
### ORDER CODE

| Part Number | Temperature Range | Package |   |
|-------------|-------------------|---------|---|
|             |                   | N       | D |
| LM148       | -55°C, +125°C     | •       | • |
| LM248       | -40°C, +105°C     | •       | • |
| LM348       | 0°C, +70°C        | •       | • |

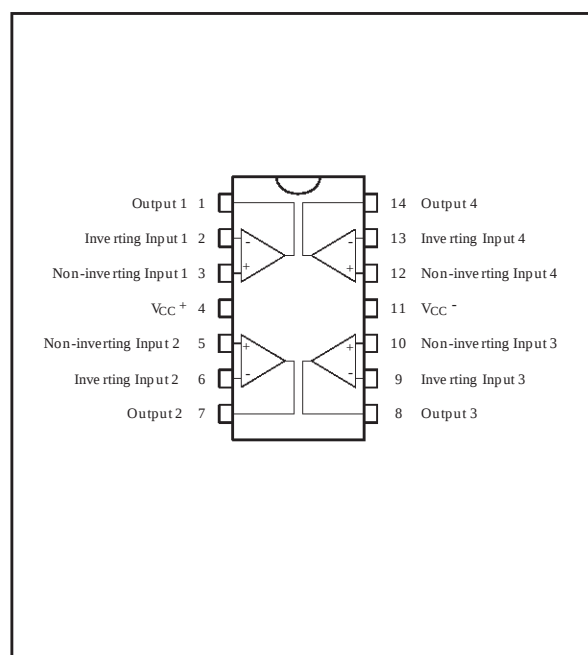
**Example : LM348D**

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

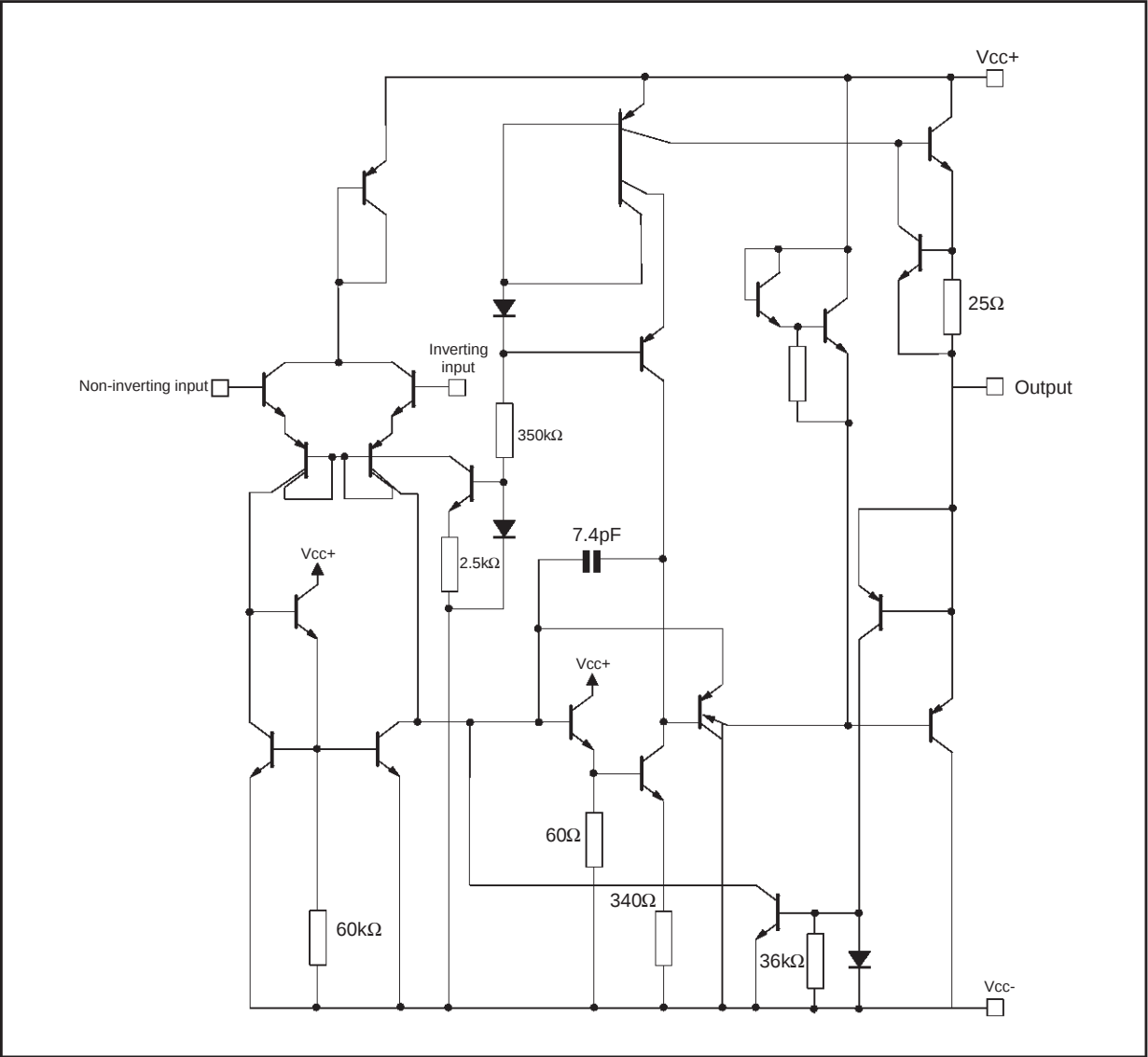
March 2002



### PIN CONNECTIONS (top view)



SCHEMATIC DIAGRAM



ABSOLUTE MAXIMUM RATINGS

| Symbol     | Parameter                                   | LM148       | LM248       | LM348    | Unit |
|------------|---------------------------------------------|-------------|-------------|----------|------|
| $V_{CC}$   | Supply voltage                              | $\pm 22$    |             |          | V    |
| $V_i$      | Input Voltage <sup>1)</sup>                 | $\pm 22$    |             |          | V    |
| $V_{id}$   | Differential Input Voltage                  | $\pm 44$    |             |          | V    |
|            | Output Short-circuit Duration <sup>2)</sup> | Infinite    |             |          |      |
| $P_{tot}$  | Power Dissipation                           | 500         |             |          | mW   |
| $T_{oper}$ | 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. For supply voltage less than maximum value, the absolute maximum input voltage is equal to the supply voltage.
2. Any of the amplifier outputs can be shorted to ground indefinitely; however more than one should not be simultaneously shorted as the maximum junction will be exceeded.

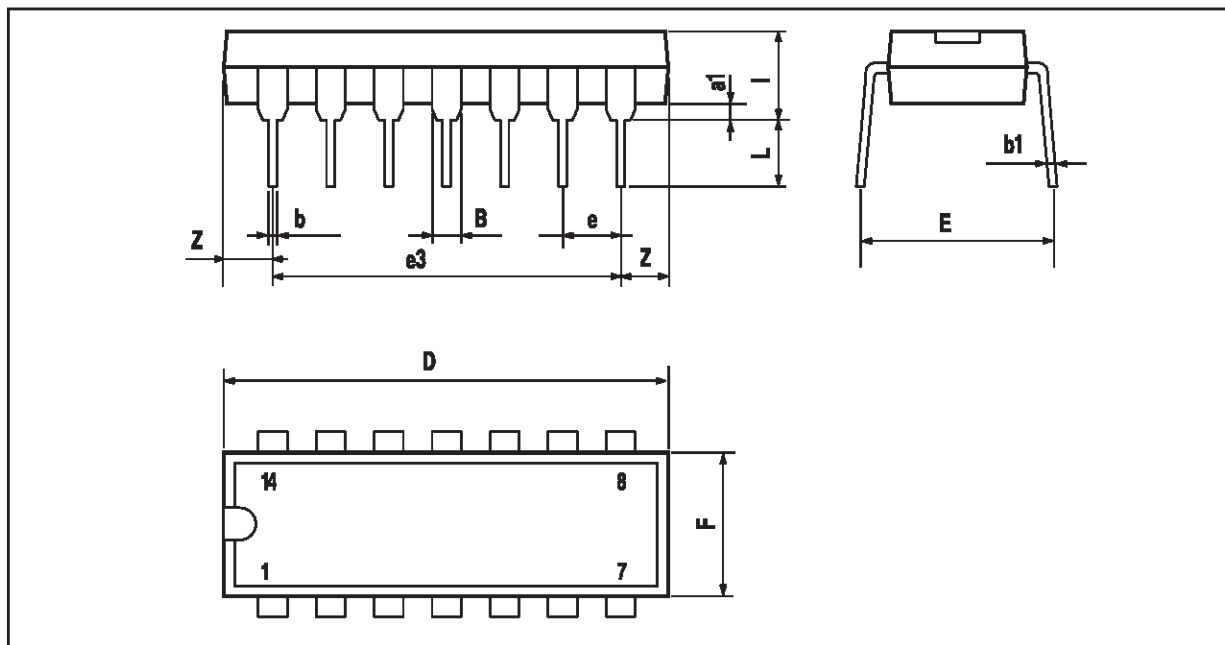
**ELECTRICAL CHARACTERISTICS** $V_{CC} = \pm 15V$ ,  $T_{amb} = 25^{\circ}C$  (unless otherwise specified)

| Symbol          | Parameter                                                                                                                                                                            | Min.                 | Typ.     | Max.       | Unit                   |
|-----------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------|----------|------------|------------------------|
| $V_{io}$        | Input Offset Voltage ( $R_S \leq 10k\Omega$ )<br>$T_{amb} = 25^{\circ}C$<br>$T_{min} \leq T_{amb} \leq T_{max}$                                                                      |                      | 1        | 5<br>6     | mV                     |
| $I_{io}$        | Input Offset Current<br>$T_{amb} = 25^{\circ}C$<br>$T_{min} \leq T_{amb} \leq T_{max}$                                                                                               |                      | 2        | 25<br>75   | nA                     |
| $I_{ib}$        | Input Bias Current<br>$T_{amb} = 25^{\circ}C$<br>$T_{min} \leq T_{amb} \leq T_{max}$                                                                                                 |                      | 30       | 100<br>300 | nA                     |
| $A_{vd}$        | Large Signal Voltage Gain ( $V_O = \pm 10V$ , $R_L = 2k\Omega$ )<br>$T_{amb} = 25^{\circ}C$<br>$T_{min} \leq T_{amb} \leq T_{max}$                                                   | 50<br>25             | 160      |            | V/mV                   |
| SVR             | Supply Voltage Rejection Ratio ( $R_S \leq 10k\Omega$ )<br>$T_{amb} = 25^{\circ}C$<br>$T_{min} \leq T_{amb} \leq T_{max}$                                                            | 77<br>77             | 100      |            | dB                     |
| $I_{CC}$        | Supply Current, all Amp, no load<br>$T_{amb} = 25^{\circ}C$<br>$T_{min} \leq T_{amb} \leq T_{max}$                                                                                   |                      | 2.1      | 3.6<br>4.8 | mA                     |
| $V_{icm}$       | Input Common Mode Voltage Range<br>$T_{amb} = 25^{\circ}C$<br>$T_{min} \leq T_{amb} \leq T_{max}$                                                                                    | $\pm 12$<br>$\pm 12$ |          |            |                        |
| CMR             | Common Mode Rejection Ratio ( $R_S \leq 10k\Omega$ )<br>$T_{amb} = 25^{\circ}C$<br>$T_{min} \leq T_{amb} \leq T_{max}$                                                               | 70<br>70             | 110      |            | dB                     |
| $I_{os}$        | Output Short-circuit Current<br>$T_{amb} = 25^{\circ}C$                                                                                                                              | 10                   | 25       | 35         | mA                     |
| $\pm V_{opp}$   | Output Voltage Swing<br>$T_{amb} = 25^{\circ}C$<br>$T_{min} \leq T_{amb} \leq T_{max}$<br>$R_L \leq 10k\Omega$<br>$R_L \leq 2k\Omega$<br>$R_L \leq 10k\Omega$<br>$R_L \leq 2k\Omega$ | 12<br>10<br>12<br>10 | 13<br>12 |            | V                      |
| SR              | Slew Rate ( $V_I = \pm 10V$ , $R_L = 10k\Omega$ , $C_L = 100pF$ , unity Gain)                                                                                                        | 0.25                 | 0.5      |            | V/ $\mu s$             |
| $t_r$           | Rsie Time ( $V_I = \pm 10V$ , $R_L = 10k\Omega$ , $C_L = 100pF$ , unity Gain)                                                                                                        |                      | 0.3      |            | $\mu s$                |
| $K_{OV}$        | Overshoot ( $V_I = \pm 10V$ , $R_L = 10k\Omega$ , $C_L = 100pF$ , unity Gain)                                                                                                        |                      | 5        |            | %                      |
| $R_I$           | Input Resistance                                                                                                                                                                     | 0.8                  | 2.5      |            | M $\Omega$             |
| GBP             | Gain Bandwidth Product ( $V_I = 10$ mV, $R_L = 10k\Omega$ , $C_L = 100pF$ , $f = 100kHz$ )                                                                                           | 0.7                  | 1.3      |            | MHz                    |
| THD             | Total Harmonic Distortion ( $f = 1kHz$ , $A_v = 20dB$ , $R_L = 10k\Omega$ , $C_L = 100pF$ , $V_O = 2V_{pp}$ )                                                                        |                      | 0.08     |            | %                      |
| $e_n$           | Equivalent Input Noise Voltage ( $f = 1kHz$ , $R_S = 100\Omega$ )                                                                                                                    |                      | 40       |            | $\frac{nV}{\sqrt{Hz}}$ |
| $V_{O1}/V_{O2}$ | Channel Separation                                                                                                                                                                   |                      | 120      |            | dB                     |

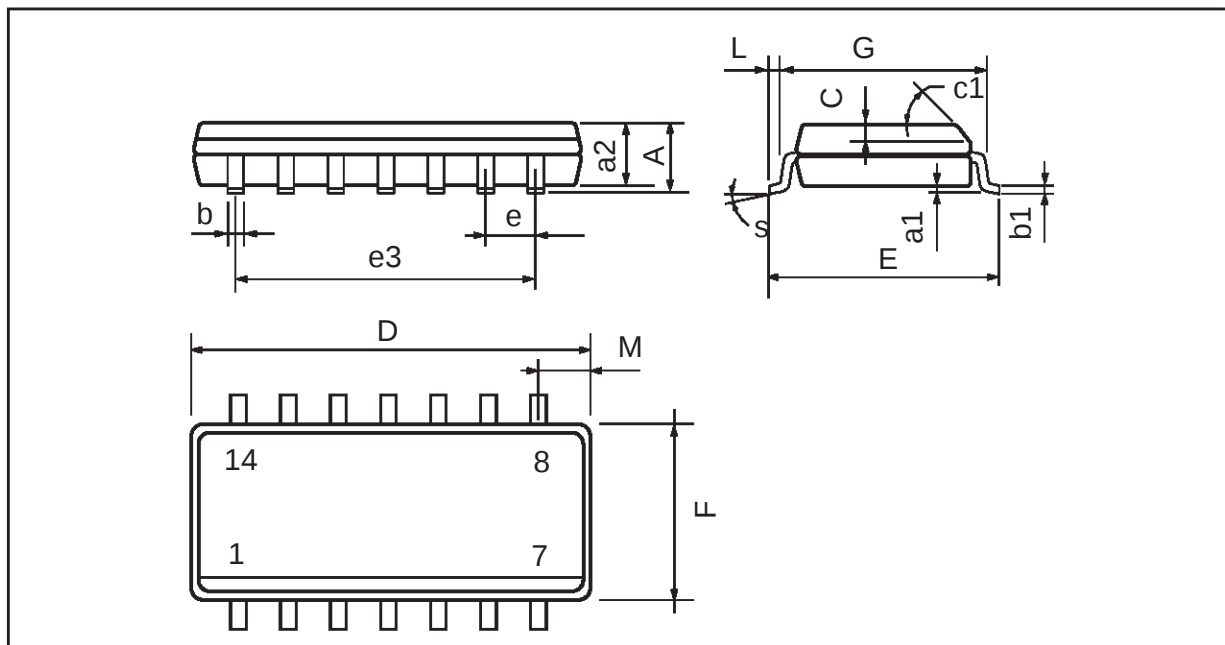
## LM148-LM248-LM348

### PACKAGE MECHANICAL DATA

14 PINS - PLASTIC PACKAGE



| Dimensions | Millimeters |       |      | Inches |       |       |
|------------|-------------|-------|------|--------|-------|-------|
|            | Min.        | Typ.  | Max. | Min.   | Typ.  | Max.  |
| $a_1$      | 0.51        |       |      | 0.020  |       |       |
| $B$        | 1.39        |       | 1.65 | 0.055  |       | 0.065 |
| $b$        |             | 0.5   |      |        | 0.020 |       |
| $b_1$      |             | 0.25  |      |        | 0.010 |       |
| $D$        |             |       | 20   |        |       | 0.787 |
| $E$        |             | 8.5   |      |        | 0.335 |       |
| $e$        |             | 2.54  |      |        | 0.100 |       |
| $e_3$      |             | 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)**

| Dimensions | 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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