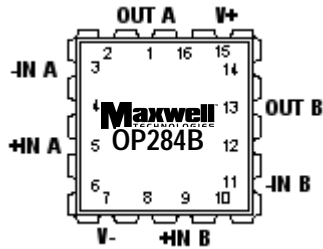
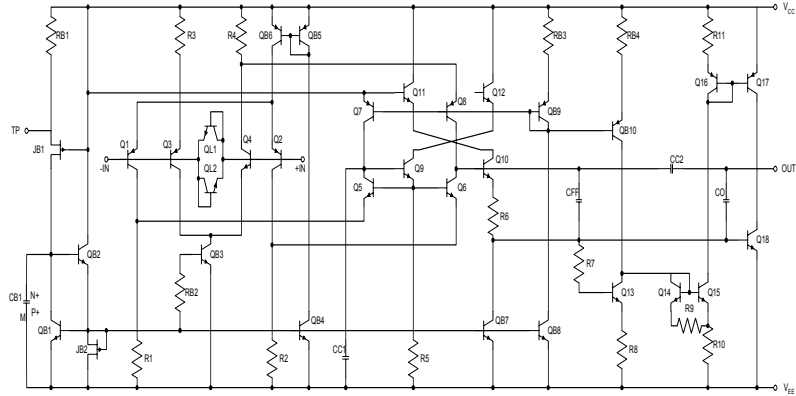


Flat Pack



Leadless Chip Carrier (LCC)



Logic Diagram

### FEATURES:

- RAD-PAK® radiation-hardened against natural space radiation
- Package:
  - 8-pin RAD-PAK® flat pack
  - 16-pin RAD-PAK® Leadless Chip Carrier (LCC) pack
- Single-Supply Operation
- Wide Bandwidth: 4 MHz
- Unity-Gain Stable
- High Slew Rate: 4.0 V/us
- Low Noise: 3.9 nV/(Hz)<sup>1/2</sup>

### DESCRIPTION:

Maxwell Technologies' OP284B is a dual single-supply, 4 MHz bandwidth amplifier featuring rail-to-rail inputs and outputs. Using Maxwell Technologies' radiation-hardened RAD-PAK® technology, it is guaranteed to operate from +3 to +36 (or ±1.5 to ±18) volts and will function with a single supply as low as +1.5 volts.

This amplifier is superb for single supply applications requiring both ac and precision dc performance. The combination of bandwidth, low noise and precision makes the OP284B useful in a wide variety of applications, including filters and instrumentation. Other applications for this amplifier include portable telecom equipment, power supply control and protection, and as an amplifier or buffer for transducers with wide output ranges.

The ability to swing rail-to-rail at both the input and output enables designers to build multi-stage filters in single-supply systems and to maintain high signal-to-noise ratios.

Maxwell Technologies' patented RAD-PAK® packaging technology incorporates radiation shielding in the microcircuit package. It eliminates the need for box shielding while providing the radiation shielding for a space mission. This product is available with screening up to Class S.

TABLE 1. FLAT PACK PINOUT DESCRIPTION

| PIN  | SYMBOL   | DESCRIPTION     |
|------|----------|-----------------|
| 1, 7 | OUT A, B | Outputs         |
| 2, 6 | -IN A, B | Negative Inputs |
| 3, 5 | +IN A, B | Positive Inputs |
| 4    | V-       | Ground          |
| 8    | V+       | Supply Voltage  |

TABLE 2. LEADLESS CHIP CARRIER (LCC) PINOUT DESCRIPTION

| PIN   | SYMBOL   | DESCRIPTION     |
|-------|----------|-----------------|
| 1, 13 | OUT A, B | Outputs         |
| 3, 11 | -IN A, B | Negative Inputs |
| 5, 9  | +IN A, B | Positive Inputs |
| 7     | V-       | Ground          |
| 15    | V+       | Supply Voltage  |

TABLE 3. OP284A ABSOLUTE MAXIMUM RATINGS

| PARAMETER                               | SYMBOL        | MIN        | MAX       | UNIT  |
|---|---------------|------------|-----------|-------|
| Supply Voltage                          | $V_{CC}$      | --         | $\pm 18$  | V     |
| Input Voltage                           | $V_I$         | --         | $\pm 18$  | V     |
| Differential Input Voltage <sup>1</sup> | $V_{DIF}$     | --         | $\pm 0.6$ | V     |
| Output Short-Circuit Duration to GND    |               | Indefinite |           |       |
| Storage Temperature Range               | $T_S$         | -65        | +150      | °C    |
| Operating Temperature Range             | $T_A$         | -40        | +125      | °C    |
| Junction Temperature Range              | $T_J$         | -65        | +150      | °C    |
| Package Weight                          |               |            | 0.75      | Grams |
| Thermal Impedance                       | $\Theta_{JC}$ | --         | 6.48      | °C/W  |

- For input voltages greater than 0.6 volts, the input current should be limited to less 5 mA to prevent degradation or destruction of the input devices.

TABLE 4. DELTA LIMITS

| PARAMETER | VARIATION                                |
|-----------|--|
| $I_{CC}$  | $\pm 10\%$ of specified value in Table 5 |

TABLE 5. OP284B ELECTRICAL CHARACTERISTICS

(V<sub>+</sub> = 15V, V<sub>-</sub> = -15V, V<sub>OUT</sub> = 0V, R<sub>S</sub> = 50Ω, R<sub>L</sub> = 100kΩ, V<sub>CM</sub> = 0V, T<sub>A</sub> = -40°C TO +125°C UNLESS OTHERWISE SPECIFIED.)

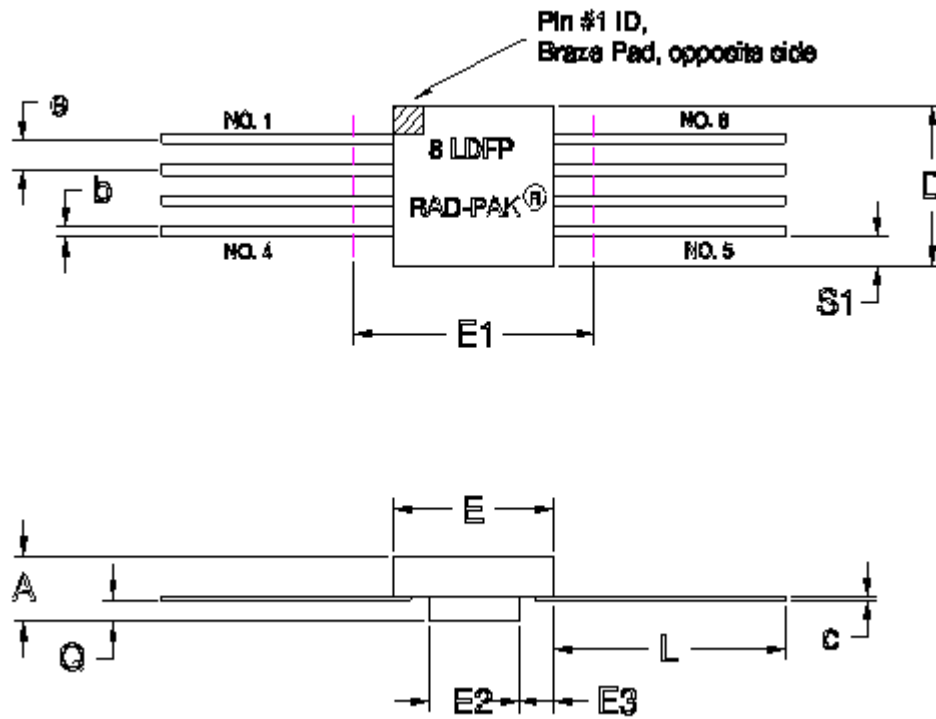
| PARAMETER                                      | SYMBOL             | TEST CONDITIONS   | SUBGROUPS | MIN   | TYP  | MAX  | UNIT                   |
|--|--------------------|---|-----------|-------|------|------|------------------------|
| Input offset voltage                           | V <sub>IO</sub>    | +25°C   | 1         | -175  | --   | 175  | μV                     |
|  |                    | -40 to +125°C   | 2, 3      | -375  | --   | 375  |                        |
| Average offset voltage drift <sup>1</sup>      | V <sub>IO</sub> TC | R <sub>L</sub> = 2kΩ  | 1, 2, 3   | --    | --   | 2    | μV/°C                  |
| Offset voltage match <sup>1</sup>              | ΔV <sub>IO</sub>   | V <sub>IO</sub> (max) - V <sub>IO</sub> (min) , +25°C   | 1         | -     | --   | 100  | μV                     |
|  |                    | V <sub>IO</sub> (max) - V <sub>IO</sub> (min) , -40 to +125°C   | 2, 3      | -     | --   | 200  |                        |
| Input bias current                             | I <sub>B</sub>     | R <sub>S</sub> = 50Ω, +25°C   | 1         | -350  | --   | 350  | nA                     |
|  |                    | R <sub>S</sub> = 50Ω, -40 to +125°C   | 2, 3      | -575  | --   | 575  | nA                     |
| Input offset current                           | I <sub>OS</sub>    | R <sub>S</sub> = 50Ω, +25°C   | 1         | -35   | --   | 35   | nA                     |
|  |                    | R <sub>S</sub> = 50Ω, -40 to +125°C   | 2, 3      | -50   | --   | 50   | nA                     |
| Input bias current drift <sup>1</sup>          | I <sub>IBTC</sub>  | R <sub>S</sub> = 50Ω  | 1, 2, 3   | --    | --   | 200  | pA/°C                  |
| Input voltage range                            | I <sub>VR</sub>    |   | 1, 2, 3   | -15   | --   | 15   | V                      |
| Common mode rejection ratio                    | CMRR               | V <sub>CM</sub> = -14V to +14V  | 4,5,6     | 86    | --   | --   | dB                     |
|  |                    | V <sub>CM</sub> = -15V to +15V, T <sub>A</sub> = 25°C   | 4         | 80    | --   | --   |                        |
| Output current                                 | +I <sub>O</sub>    | V <sub>OUT</sub> = -10V, 1ms pulse, T <sub>A</sub> = 25°C   | 1         | 10    | --   | --   | mA                     |
|  |                    | V <sub>OUT</sub> = -10V, 1ms pulse  | 2, 3      | 5     | --   | --   |                        |
|  | -I <sub>O</sub>    | V <sub>OUT</sub> = +10V, 1ms pulse, T <sub>A</sub> = 25°C   | 1         | --    | --   | -10  | mA                     |
|  |                    | V <sub>OUT</sub> = -10V, 1ms pulse  | 2, 3      | --    | --   | -5   |                        |
| Quiescent power supply current/amplifier       | +I <sub>CC</sub>   | I <sub>OUT</sub> = 0mA V <sub>S</sub> = ±18V, T <sub>A</sub> = 25°C   | 1         | --    | --   | 1.80 | mA                     |
|  |                    | I <sub>OUT</sub> = 0mA V <sub>S</sub> = ±18V  | 2, 3      | --    | --   | 2.25 |                        |
|  | -I <sub>CC</sub>   | I <sub>OUT</sub> = 0mA V <sub>S</sub> = ±18V, T <sub>A</sub> = 25°C   | 1         | -1.80 | --   | --   | mA                     |
|  |                    | I <sub>OUT</sub> = 0mA V <sub>S</sub> = ±18V  | 2, 3      | 2.25  | --   | --   |                        |
| Power supply rejection ratio                   | +PSRR              | V <sub>S</sub> = ±2V to ±18V  | 1, 2, 3   | 90    | --   | --   | dB                     |
|  | -PSRR              | V <sub>S</sub> = ±2V to ±18V  | 1, 2, 3   | 90    | --   | --   |                        |
| Low frequency, peak-to-peak noise <sup>1</sup> | E <sub>np-p</sub>  | 0.1Hz to 10Hz, R <sub>L</sub> = 2kΩ, C <sub>L</sub> = 50pF, T <sub>A</sub> = +25°C                                | 1         | --    | 0.30 | --   | μV <sub>p-p</sub>      |
| Input noise voltage density <sup>1</sup>       | E <sub>n</sub>     | R <sub>S</sub> = 20Ω, f <sub>O</sub> = 1kHz, R <sub>L</sub> = 2kΩ, C <sub>L</sub> = 50pF, T <sub>A</sub> = +25°C  | 1         | --    | 3.9  | --   | nV/(Hz) <sup>1/2</sup> |
| Input noise current density <sup>1</sup>       | I <sub>n</sub>     | R <sub>S</sub> = 20MΩ, f <sub>O</sub> = 1kHz, R <sub>L</sub> = 2kΩ, C <sub>L</sub> = 50pF, T <sub>A</sub> = +25°C | 1         | --    | 0.4  | --   | pA/(Hz) <sup>1/2</sup> |
| Power consumption <sup>1,2</sup>               | P <sub>C</sub>     | +10V, I <sub>OUT</sub> = 0mA, R <sub>L</sub> = 2kΩ  | 1, 2, 3   | --    | --   | 81   | mW                     |
| Large signal voltage gain                      | +A <sub>VOL</sub>  | +10V, R <sub>L</sub> = 2.0kΩ, T <sub>A</sub> = 25°C   | 4         | --    | --   | 150  | V/mV                   |
|  |                    | +10V, R <sub>L</sub> = 2.0kΩ  | 5,6       | --    | --   | 75   |                        |
|  | -A <sub>VOL</sub>  | -10V, R <sub>L</sub> = 2.0kΩ, T <sub>A</sub> = 25°C   | 4         | --    | --   | 150  | V/mV                   |
|  |                    | -10V, R <sub>L</sub> = 2.0kΩ  | 5,6       | --    | --   | 75   |                        |

TABLE 5. OP284B ELECTRICAL CHARACTERISTICS

(V+ = 15V, V- = -15V, V<sub>OUT</sub> = 0V, R<sub>S</sub> = 50Ω, R<sub>L</sub> = 100kΩ, V<sub>CM</sub> = 0V, T<sub>A</sub> = -40°C TO +125°C UNLESS OTHERWISE SPECIFIED.)

| PARAMETER                           | SYMBOL             | TEST CONDITIONS   | SUBGROUPS | MIN  | TYP  | MAX   | UNIT    |
|-------------------------------------|--------------------|---|-----------|------|------|-------|---------|
| Output voltage swing                | +V <sub>OUT1</sub> | I <sub>L</sub> =1.0mA   | 4,5,6     | 14.8 | --   | --    | V       |
|                                     | -V <sub>OUT1</sub> | I <sub>L</sub> =1.0mA   | 4,5,6     | --   | --   | -14.8 | V       |
| Gain bandwidth product <sup>1</sup> | GBWP               | V <sub>O</sub> =200mV, R <sub>L</sub> =2.0kΩ,<br>C <sub>L</sub> =50pF, T <sub>A</sub> =+25°C                    | 4         | --   | 4.25 | --    | MHz     |
| Full power bandwidth <sup>1,3</sup> | FPBW               | V <sub>PEAK</sub> =29vp-p, R <sub>L</sub> =2.0kΩ,<br>C <sub>L</sub> =50pF, T <sub>A</sub> =+25°C, 1% distortion | 4         | --   | 35   | --    | kHz     |
| Settling time                       | t <sub>s</sub>     | A <sub>V</sub> =+1.0, C <sub>L</sub> =50pF, R <sub>L</sub> =2.0kΩ<br>To 0.01%, 10V step                         | 9         | --   | --   | 5     | μs      |
| Phase margin                        | F <sub>O</sub>     | A <sub>V</sub> =1.0, C <sub>L</sub> =50pF,<br>R <sub>L</sub> =2.0kΩ, T <sub>A</sub> =+25°C                      | 4         | --   | --   | 50    | Degrees |
| Slew rate                           | +SR                | C <sub>L</sub> =50pF, R <sub>L</sub> =2.0kΩ   | 4,5,6     | 2.4  | 4.0  | --    | V/μs    |
|                                     | -SR                | C <sub>L</sub> =50pF, R <sub>L</sub> =2.0kΩ   | 4,5,6     | 2.4  | 4.0  | --    | V/μs    |

1. Guaranteed by design.
2. Power consumption is based upon quiescent supply current maximum test limit. No load on outputs.
3. Full power bandwidth is based on slew rate measurement using  $F_{PBW} = \text{slew rate} / (2 \cdot V_{PEAK})$ .

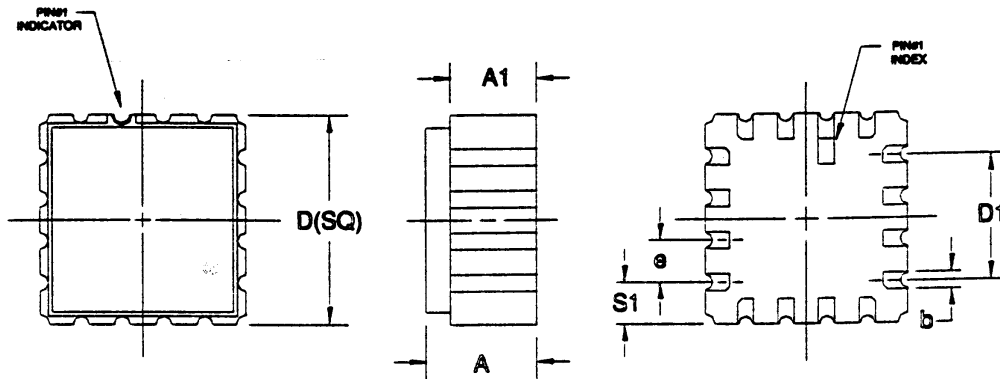


8-PIN RAD-PAK® FLAT PACKAGE

| SYMBOL | DIMENSION |       |       |
|--------|-----------|-------|-------|
|        | MIN       | NOM   | MAX   |
| A      | 0.119     | 0.132 | 0.149 |
| b      | 0.010     | 0.017 | 0.022 |
| c      | 0.004     | 0.005 | 0.009 |
| D      | 0.250     | 0.255 | 0.260 |
| E      | 0.250     | 0.255 | 0.260 |
| E1     | --        | --    | 0.290 |
| E2     | 0.125     | 0.145 | --    |
| E3     | 0.030     | 0.040 | --    |
| e      | 0.050 BSC |       |       |
| L      | 0.338     | 0.348 | 0.358 |
| Q      | 0.021     | 0.025 | 0.045 |
| S1     | 0.005     | 0.019 | --    |
| N      | 8         |       |       |

F8-01

Note: All dimensions in inches



16-PIN RAD-PAK® LCC PACKAGE

| SYMBOL | DIMENSION |       |       |
|--------|-----------|-------|-------|
|        | MIN       | NOM   | MAX   |
| A      | 0.123     | 0.135 | 0.150 |
| b      | 0.018     | 0.020 | 0.025 |
| D      | 0.245     | 0.250 | 0.260 |
| D1     | 0.150 BSC |       |       |
| S1     | 0.050 BSC |       |       |
| e      | 0.050 BSC |       |       |
| A1     | 0.095     | 0.105 | 0.116 |
| N      | 16        |       |       |

LC16-01

Note: All dimensions in inches.

## Important Notice:

These data sheets are created using the chip manufacturer's published specifications. Maxwell Technologies verifies functionality by testing key parameters either by 100% testing, sample testing or characterization.

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# Dual Operational Amplifier

# OP284B

## Product Ordering Options

